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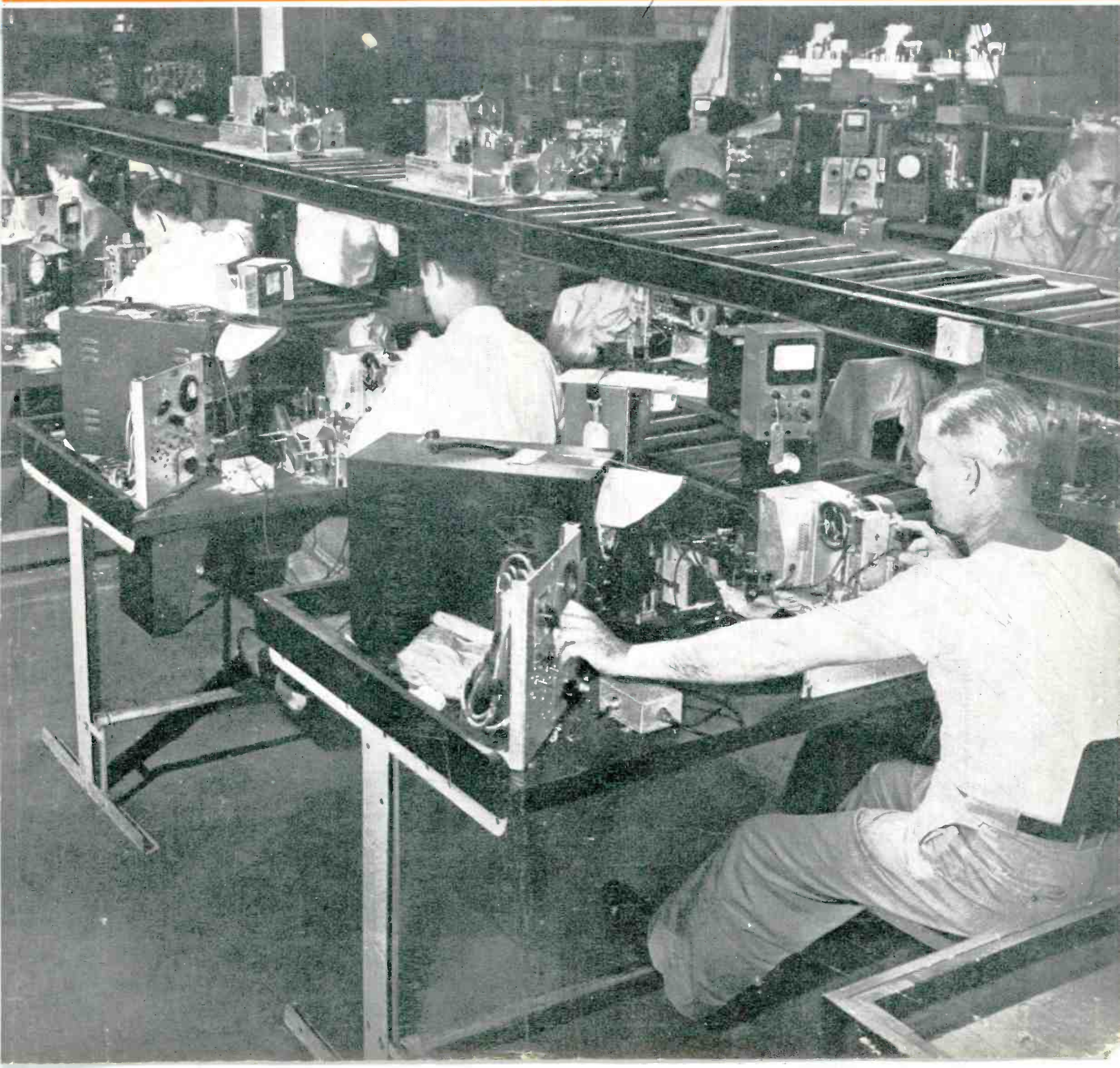
APRIL, 1950



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MONTHLY FEATURES

Cover Illustration

Checking TV-chassis picture-tube circuitry with 'scopes at the Sunbury, Pennsylvania, plant of Westinghouse Electric.

Editor: LEWIS WINNER

ABC

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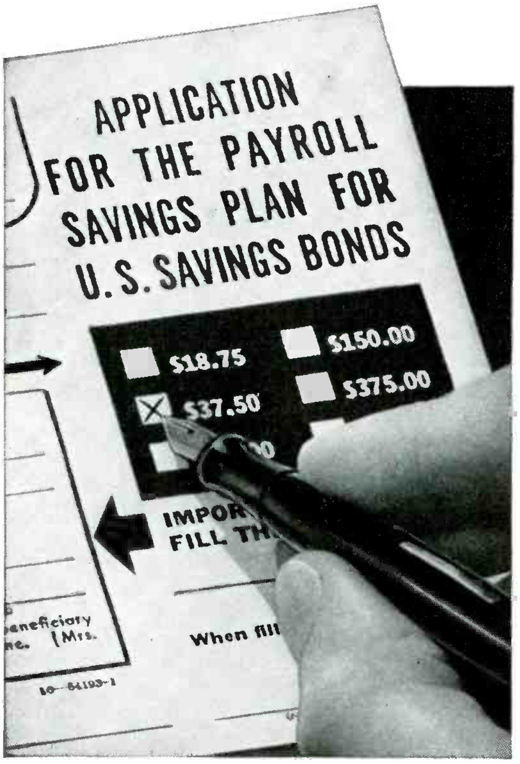

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TELE-VISION ENGINEERING
LEWIS WINNER, Editor

April, 1950

U H F Scores

THE BRIGHT PROSPECTS offered by the ultrahighs, a supposition for quite awhile, now appears to be winning heartening confirmation in the field, as the result of those extensive tests in Bridgeport and between that point and New York.

With *uhf* receivers and converters located at about seventy sites, reception in 38% of the points has been found to be excellent, with 22% reported as good. In a review of these results, in a report-request to the FCC asking for a renewal of the license of KC2XAK, the ultrahigh station in Bridgeport, NBC revealed that 60% of the listeners reported excellent reception at points 10 miles from the station.

The correct antenna was found to be quite a factor at these high frequencies. The tests showed, for instance, that single *fans* and stacked *vees*, as well as stacked *rhombics* and *parabolas* could be used, but stacked *vees* appeared to provide the best results, with single *fans* next in line.

To provide the signals for the tests, a 2000-mc relay link, bridging N. Y. City and Bridgeport, is being used. The transmitter, located in the Empire State Building, feeds a parabolic antenna, on the outside parapet at the 85th floor. Signals are beamed to a parabolic receiving antenna mounted on the 180-foot level of a tower in Bridgeport, 55 miles away. Incidentally, the pictures from the studios are fed directly into the N. Y. relay unit, without going through the vestigial sideband system of WNBT.

As a check on the ultrahigh Bridgeport transmitters, a receiver equipped with a converter has been installed in the RCA Building, 53 miles from the Connecticut point. Thus far, according to NBC, no field-intensity variations of significance have occurred. For receiving at this point, a six-foot parabolic dish with a horizontal dipole was mounted in a plastic radome on the roof of the building, which is about 860′ above sea level. The field intensity at this antenna location was recorded at approximately 2700 microvolts per meter.

Receiving points have also been established at Riverhead, Long Island, and Princeton, New Jersey. The results at both of these points have been very promising, too.

Although these tests have been conducted for only a few months, there appears to be substantial proof that the ultrahighs can provide a reliable limited area service, certainly an ideal prospect for the allocation plan in mind.

Color Gets a Lift

IN ANOTHER STRIKING blueprint-to-life occasion, color TV moved one notch closer to practicality, with a demonstration of that long sought direct view tri-color tube.

Before a meeting of government and industry representatives, RCA unveiled two types of tri-color tubes, a three-gun and a single-gun, which were found to provide effective color reproductions.

The three-gun tube featured an apertured mask, interposed between three guns and a dot-phosphor screen in such a manner that the electrons from any one gun could strike only a single color phosphor, no matter which part of the raster was being scanned. The mask is comprised of a sheet of metal spaced from the phosphor screen and containing 117,000 holes, or one hole for each of the tri-color dot groups. This hole is so registered with its assorted dot group, that the difference in the angle of approach of the three oncoming beams determines the colors. Thus, three-color signals applied to the three guns, produce independent pictures in the three primary colors, the pictures appearing to the eye to be superimposed because of the close spacing of the very small phosphor dots.

The operation of the single-gun tube is analogous to the operation of the three-gun affair, in that the beam from the single gun is magnetically rotated, so that, in effect, it occupies, in time sequence, the three positions of the three guns in the three-gun tube. Accordingly when the beam is in a position corresponding to the green gun of the three-gun tube, it excites only the green phosphor dots, and is at this particular moment modulated only by the green component of the video signal. A short time later, the beam has been rotated to a position corresponding to the red gun of the three-gun tube and modulated by the red component of the video signal to excite red phosphor dots. A third position similarly produces the blue picture.

More details about this intriguing new development, including diagrams of the receiver circuit principles, will appear next month. Watch for these data!

TV Transmitting Haven

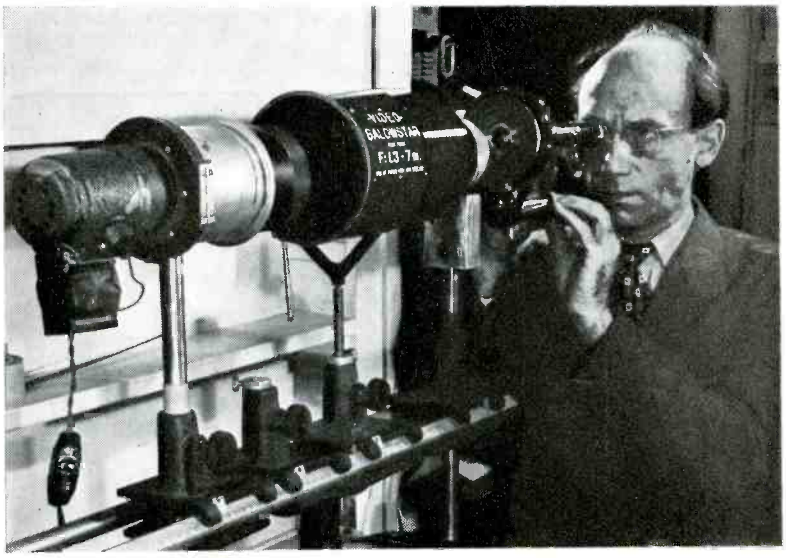
WHAT WILL EVENTUALLY BECOME the capital of *TV Transmittertown*, in New York City, is now being developed at the Empire State Building, on the 83rd and 85th floors.

Originally the sole home of WNBT, these floors are expected to house the transmitters of five of the seven stations in the metropolitan area. According to the antenna blueprints, five bays are expected to be allocated to each station, although it is possible that some may use the same bays, by way of a diplexing system.

The floor plan calls for the allotment of about 3500 square feet for each transmitting setup. Provisions will also be made for standby transmitters, although some operators have stated that they might retain emergency apparatus at their present sites.

With about thirty engineers at home in this transmitting paradise, the site and sound art will certainly reap the benefits of concentrated interest, which should result in better pictures for everyone.—L.W.

Television



Dr. Back checking a video Balowstar in his laboratories.

IN THE TV transmission chain, the pickup medium has always received particularly critical attention, in view of its all-important linkage with the subject matter in the field or in the studio. Specifically, the interest has been focussed on the camera tube and the lens structures which have been found to be key factors.

The lens systems have undergone an intriguing evolution since the early days of the iconoscope. Then and now, studies have revealed that lens requirements must be considered in terms of pickup-tube characteristics.

The Iconoscope

The iconoscope was an electronic marvel in its day, but judged by modern standards it had a relatively low sensitivity to light. Also, it had a relatively large target area; 3¼" x 4½". Those two factors had an important bearing on the types of lenses that could be used. Because the iconoscope was relatively insensitive, high-speed lenses were a *must*, to get as much of the available light as possible to the tube's target. And because a relatively large target area had to be covered, the lenses used had to have a long focal length. As a result, since no special video lenses were available, just about any high-speed photographic lens was used and studios were literally flooded with light to obtain the necessary high level of illumination.

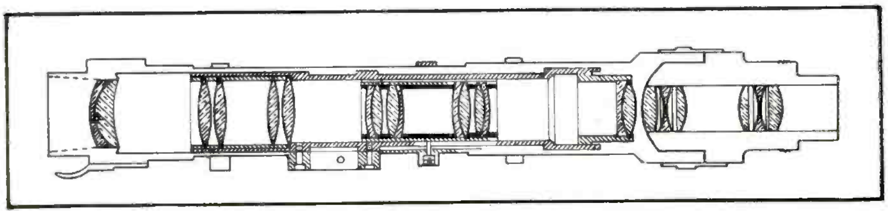
2P23 Image Orthicon

During the war, the 2P23 image orthicon tube made its debut. It marked a definite advance over the iconoscope. It had better sensitivity and a smaller target area (24 by 32 mm), but it, too, presented optical problems. The 2P23 had a high response to infra-red light, and since no lenses fully corrected for infra-red as well as visible light were available, it was practically impossible to obtain sharp images. The visible light formed an image in one plane, the infra-red light an image in another plane, and the best obtainable focus had to be a compromise focus between the two. As a result, fuzzy final images were produced.

The 5655 and 5679 Tubes

Then in rapid succession came the 5655 and 5769 image orthicons. They had better color response, a better signal-to-noise ratio, and, what was equally important from an optical point of view, very little infra-red response. However, their overall sensitivity to visible light still was relatively low. Studios still had to be flooded with bright illumination and high-speed lenses still had to be used wide open. It was impossible to obtain adequate depth of field for good images.

Figure 1
Schematic view of the Zoomar camera lens structure. The movable lens system in the rear position is illustrated.



Small Target Problems

The smaller target of the image orthicon also imposed another important optical problem. Most photographic lenses that were available were designed to cover a larger image area than was necessary for the smaller targets. And, since the total quality provided by a lens is the same regardless

OPTICS

Characteristics of Optical Systems Developed Recently to Provide Normal Long-Distance and Extra Long-Distance Closeups, Pickups in Dimly-Lit Areas and Test Patterns Which Can Be Used to Align Cameras Rapidly.

by FRANK G. BACK, President, Zoomar Corporation

of the image area, the maximum obtainable quality was being wasted; the smaller target was using only a portion of the total lens-image area and therefore was taking advantage of only a portion of the lens' total quality.

5820 Image Orthicon

At this point, in the development of television, two major developments arose, developments which prompted the design and production of special lenses for TV use. In one instance, the popularity of television had begun to spurt, resulting in a demand for better image quality and therefore for better lenses. In addition, there was the introduction of the present-day 5820 image orthicon with its high sensitivity to visible light, practically no infra-red response, a good signal-to-noise ratio, and good resolution. Its higher sensitivity revealed that it would be possible to use slower lenses, which could be stopped down to obtain greater depth of field. Its lack of infra-red response indicated that it would be unnecessary to correct lenses for infra-red. All in all, its overall quality made the use of high-quality lenses not only practical, but desirable.

Lens Design

Much has been learned about TV lens design in the last few years. Great strides have been made in the manufacture of American optical glass and in the basic computations of lens element forms. Years ago, lens computations seldom were carried beyond the third order. Today, they are carried to the seventh order.

Quality Lens Requirements

In constructing a quality lens, it is extremely important to build in high resolution and thorough color correction. High speed, once a particularly vital characteristic, is no longer important except in lenses designed for special on-the-spot pickups, where the level of available illumination is particularly low and nothing can be done about it.

Color Correction

The need for full color correction, both longitudinally and laterally, is obvious. Without full color correction, the various color images will not only focus in different planes (because of the lack of longitudinal correction) but would be of different sizes (because of the lack of lateral correction). The final black-and-white image, without a fully color corrected lens, cannot be pin-point sharp and halo-free.

In evaluating the need for high resolution in a lens, some have ques-

Figure 2
The Zoomar camera in action at a football game being televised by WFIL-TV.

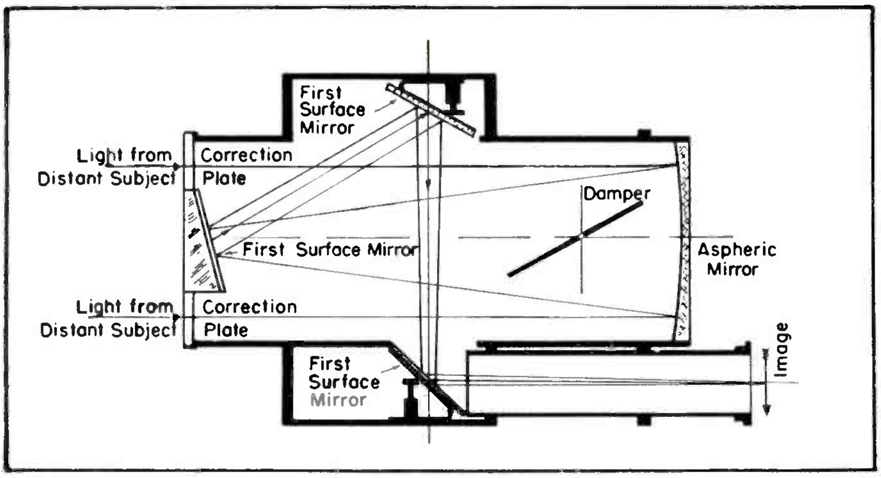


Figure 3
Cross-sectional diagram of the Reflectar system.

tioned the necessity for a lens capable of high resolution, when an image orthicon has a relatively low resolving power, or about 20 lines per millimeter.

Actually, it has been found that a lens should be capable of much greater resolution than the recording medium, whether it be film or an image orthicon, if it is to make the most of the resolving power of that medium.

Resolving Powers

It can be shown mathematically that the reciprocal of the overall resolving power of an optical-recording system is equal to the sum of the reciprocal of the resolving power of the lens and the reciprocal of the resolving power of the medium; $1/R = 1/r_l + 1/r_m$. Using that formula, it will be found that a lens having a resolving power of 20, used with a TV pickup tube also with a resolving power of 20, provides an overall resolution of only 10. Similarly, a lens with a resolving power of 60, used with an image orthicon with a resolution of 20 only, results in an overall resolving power, for the chain, of 15. We find, therefore, that a TV lens must have high resolution if the final image is to have acceptable resolution, and that resolution must be maintained all along the line both electronically and electrically.

The Zoomar Lens

When the problem of closeups arose, a lens, originally designed for motion-picture work was found to provide an effective answer. In its original design, it provided an optical means by which a cameraman could shift his focus smoothly, continuously, and quickly from an overall view to a sharp closeup. After redesigning, the lens known as the Zoomar, was adapted to TV's peculiar needs.

Another interesting example of TV lens' development is the *Video Reflectar*. With more and more sports and outdoor events being televised, there came a need for a *big* Bertha type of TV lens; a long-focus lens that could bring long-distance closeups to televiewers' screens. Such a lens, built according to the old, conventional theories of design, would have to be at least 40″ long, and, because of the complexity of lens elements would have weighed at least 40 pounds.

Use of Surfaced Reflectors

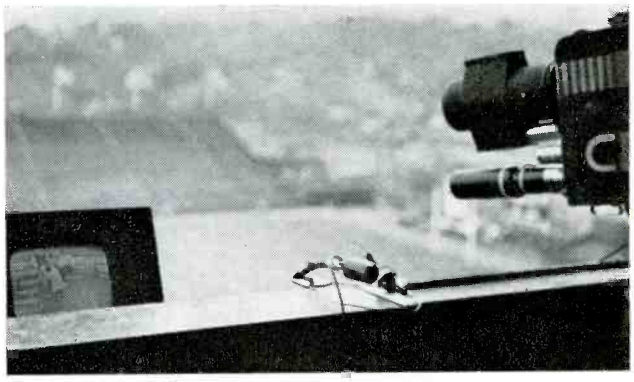
Employing recently developed techniques, it was found possible to build a 40″-focal length system, measuring but 16″ from the mounting to tip and weighing only six pounds. The use of carefully surfaced reflectors, instead of heavy lenses, solved the problem. In operation, light enters the system through a correction plate, is picked up by an aspherical reflector, and then is zig-zagged back and forth by three additional flat reflectors to the target of the camera's image orthicon. Lens control (*F* stop opening) is obtained, not through the use of a conventional iris, but by the adjustment of a rotatable *damper* (not unlike a chimney damper) placed directly in front of the aspherical reflector.

Video Balowstar

In probing another pickup problem, involving transmission of dimly-lighted church services, and theater and opera performances, it was found that a highly-corrected high-speed lens would be required. The answer to this problem appeared in a lens rated at F/1.3, with a focal length of 7 inches. Identified as the *Video Balowstar*, the equipment was found to *see* with no more illumination than that given off by one candle at a distance of one foot. Correction for infra-red illumination, as well as visible illumination, was accomplished through the use of especially designed lens elements which bring the two foci

Figure 4
Typical application of the Reflectar.

Figure 5
A Reflectar image on an off-the-air monitoring receiver.



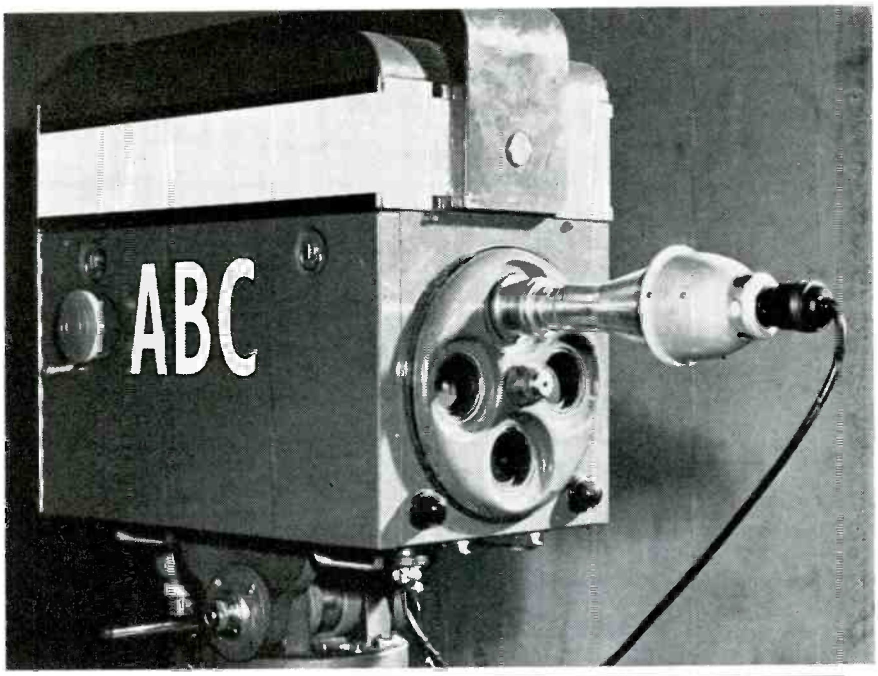


Figure 6
The Video Analyzer on an ABC TV camera.

together to produce a sharp focus, even when infra-red and visible light are mixed.

As was pointed out earlier, we must always remember that the lens is only one part of the optical chain. To get the best quality that a lens has been designed to deliver, the camera and its image orthicon must be well adjusted and matched to the other cameras used on a multi-camera show. Up until fairly recently, there was no accurate way to adjust and balance a camera. Much of it had to be done by *feel* and through the development of a *video sixth sense*. To eliminate the need for this procedure, a device, known as the *Video Analyzer*, was developed.

Contents of Analyzer

This unit consists of an incandescent low-Kelvin rating light source, a specially designed transparent test pattern, and a calibrated correction lens mounted in a metal housing. In use, the analyzer's barrel is mounted on the TV camera's 90-mm lens. A spirit level on the top of the analyzer's housing makes it possible to adjust the built-in test pattern for horizontal alignment. When connected to any 110-volt source, the analyzer's test pattern can be illuminated by pressing a convenient spring-tensioned hand switch.

Camera Checks Possible

Eighteen separate camera checks can be made with the analyzer. It has been found that a cameraman, once he is acquainted with the equipment, can adjust and align a camera in about ten minutes.

The foregoing developments represent just a few examples of the new thinking in television optics. As the needs arise, they will be met by improvements featuring new techniques and new materials. And with each advancement will come a new high in video image quality.

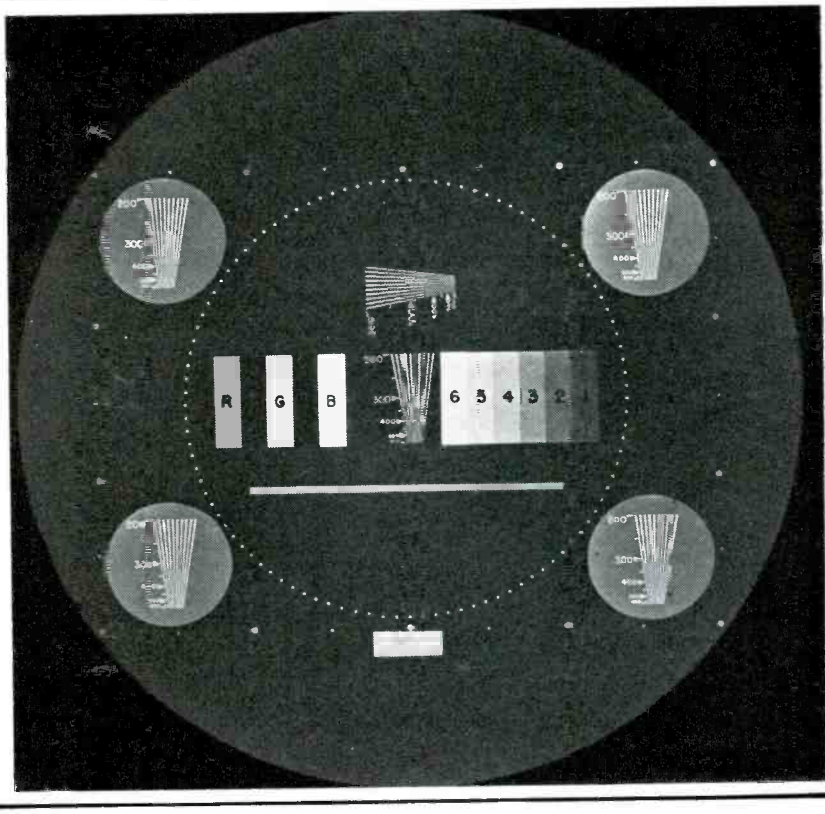


Figure 7 (Right, center)
The Video-Analyzer target.

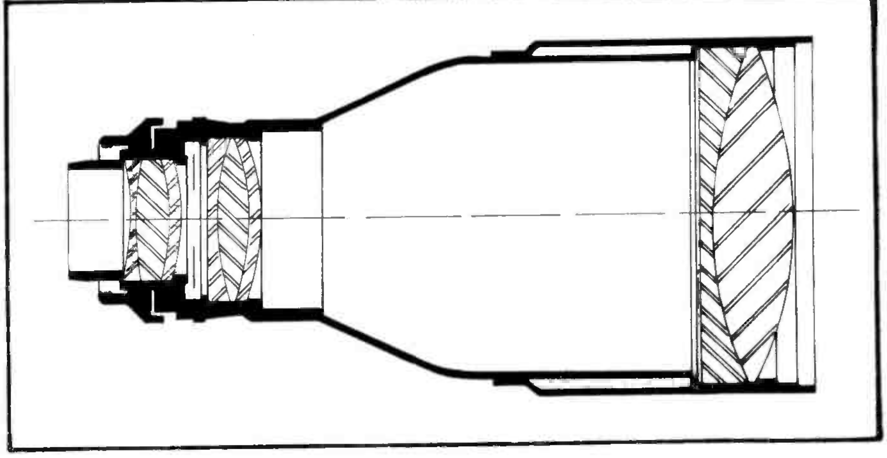


Figure 8
Cross-sectional view of the Balowstar. This unit is now being used for pickups at the Metropolitan Opera and St. Patrick's Cathedral.

The Status of Color TV

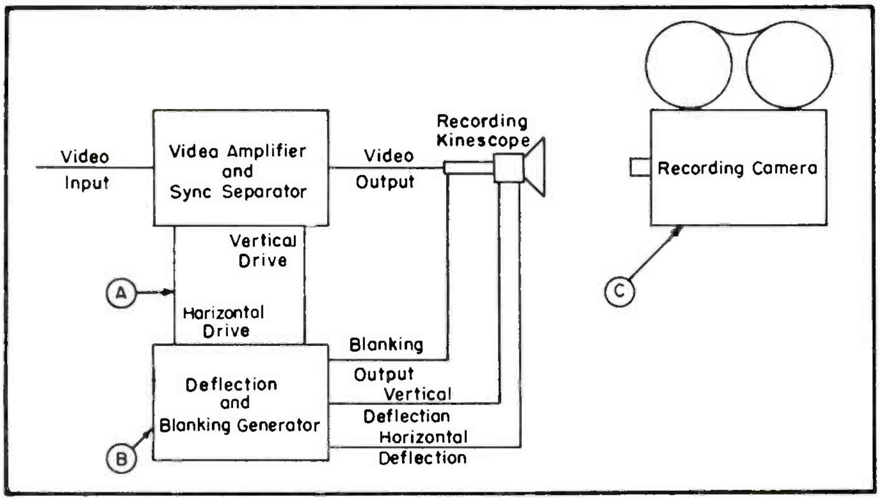


Figure 1
Modifications required for standard TV recording equipment for black and white operation with CBS proposed color standards. Item (A) indicates the wiring removed from a harness to reduce capacity. The changes in the deflection and blanking generator indicated at (B) include a change in the capacitor in the vertical blocking oscillator to increase speed range; a change in the capacitor in the vertical discharge circuit; an additional stage of RC differentiation added to the horizontal drive; a potentiometer added to horizontal blanking to increase the blanking time, and a plate resistor of the blanking amplifier increased to provide a high blanking voltage. In the recording camera (C) the shutter is changed from 72° closed to 120° closed, the camera exposure being unchanged.

THE COLOR TV STORY, which has become encyclopaedic in size and scope, since the days of '44 and '45 when the reds, blues and greens first began to stir up the halls in Washington, during the past few weeks has become heir to another voluminous addition in the form of thousands of pages of new testimony offered at the renewed hearings on color.

Vital data by the three proponents of color systems, RCA, CBS and CTI, as well as by research groups and interested manufacturers and laboratories, have been included in the new chapters of the husky record, information covering not only the results of the hectic comparison tests, but many new developments which were described as bringing color quite close to the standardization stage.

On the new developmental front appeared the report of RCA Lab research head, E. W. Engstrom, who described three innovations which it was felt would play a major role in this new facet of the art. The first of these involved automatic color-receiver sampling synchronization and color phasing. In this method, it was pointed out, a burst approach is featured, a short burst of signal containing sampling frequency and phase information being transmitted during the horizontal blanking period. This information is extracted by the receiver circuits, averaged to remove the effects of noise and interference, and used to lock the frequency and phase of a continuously running receiver sampling oscillator in step with the transmitter sampling oscillator.

Receiver Sampling

High-level receiver sampling was the second new system described.

In this technique, the incoming video signal is first amplified in a single video amplifier channel, and then the sampling is done directly at the picture tube.

The use of this method, affording the elimination of two of the three separate video amplifier channels and a material reduction in the complexity of

Figure 3
A CBS plot illustrating the relationship of the viewing distance and picture height, the total picture lines and the visual acuity in minutes.

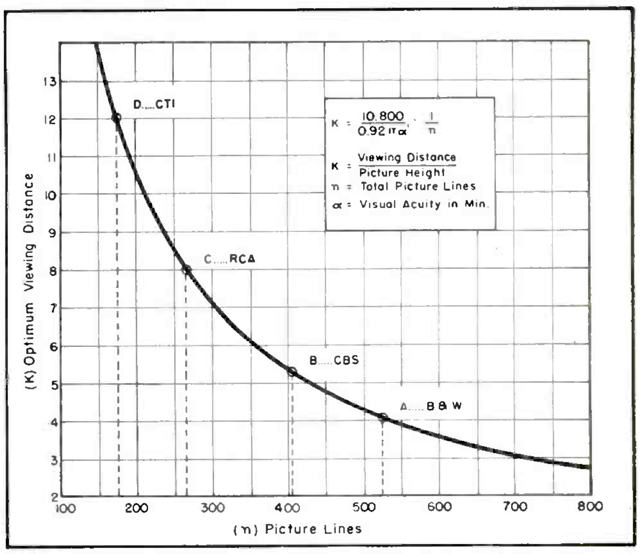
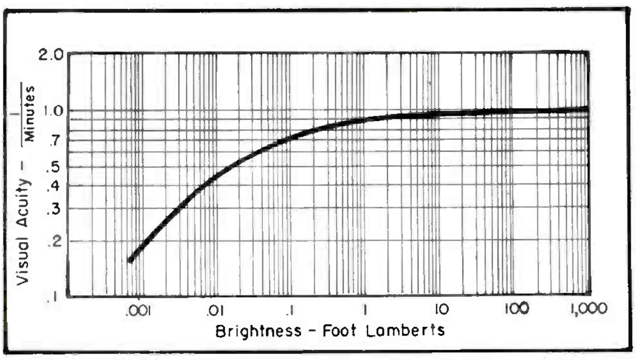


Figure 2
Plot of the visual acuity versus brightness, as prepared by CBS. Shown here is the relationship between per cent contrast and brightness for different target sizes. Assuming that the maximum contrast range of a television picture in coarse detail is of the order of 30:1, for a visual acuity of one minute and a picture brightness of ten foot lamberts, the minimum recognizable contrast step would be about 20%.



As Viewed at the Current FCC Hearings

A Report on the Testimony Offered by Goldmark (CBS), Engstron (RCA) and Jensen.

by DONALD PHILLIPS

the sampling circuits, were described as having resulted in significant reductions in tube complement.

The tubes required for the video amplifier and sampler were said to have been reduced from 40 to 16. It was also stated that the number of tubes required for deflection purposes was reduced from 12 to 9, whereas a conventional black-and-white receiver might require four tubes for this function.

The direct-view tri-color tube[1] was the third significant development analyzed by Engstrom.

Two types were detailed, one featuring a single gun and another a triple gun, both using however a 16-inch face, masked down to about 9″ x 12″.

Then reporting on general problems of transmission and reception, Engstrom stated that many tests and studies had been made on co-channel and adjacent-channel interference for both black-and-white and for the three systems of color television.

The results indicated that the specific character of the video modulation was not of primary significance in determining co-channel requirements. Rather it was the carrier itself which was the determining factor. Tests showed that there were no practical differences between the color systems and black-and-white. As a result of these tests, it was believed that, for the color systems, and for the purposes of allocation, co-channel and adjacent channel requirements would be the same as for black-and-white.

Still to be probed, according to Engstrom, were the color-to-color inter-

[1]Complete details on the tri-color tubes will appear in the May issue.

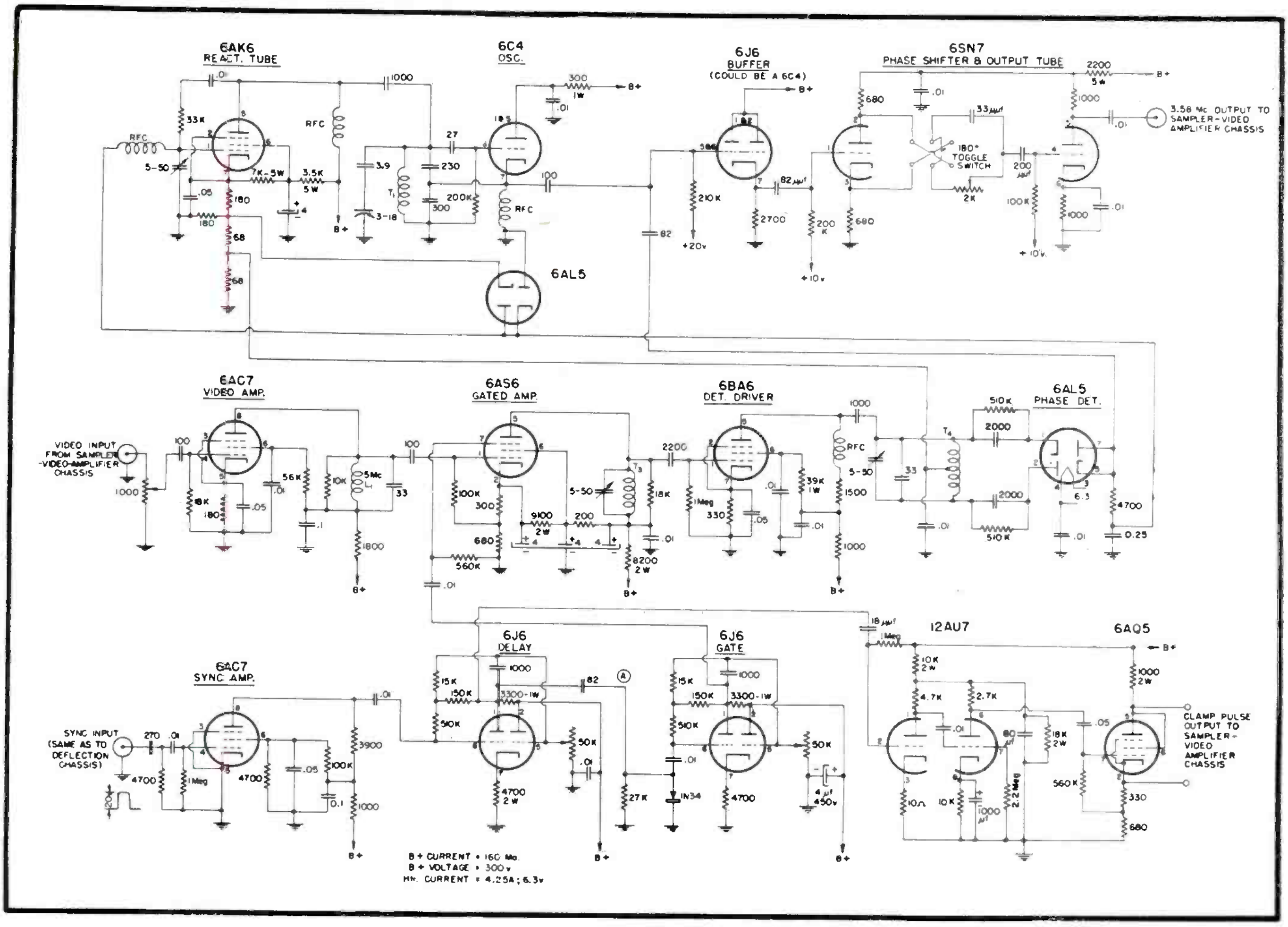


Figure 5
Schematic of RCA burst system color receiver.

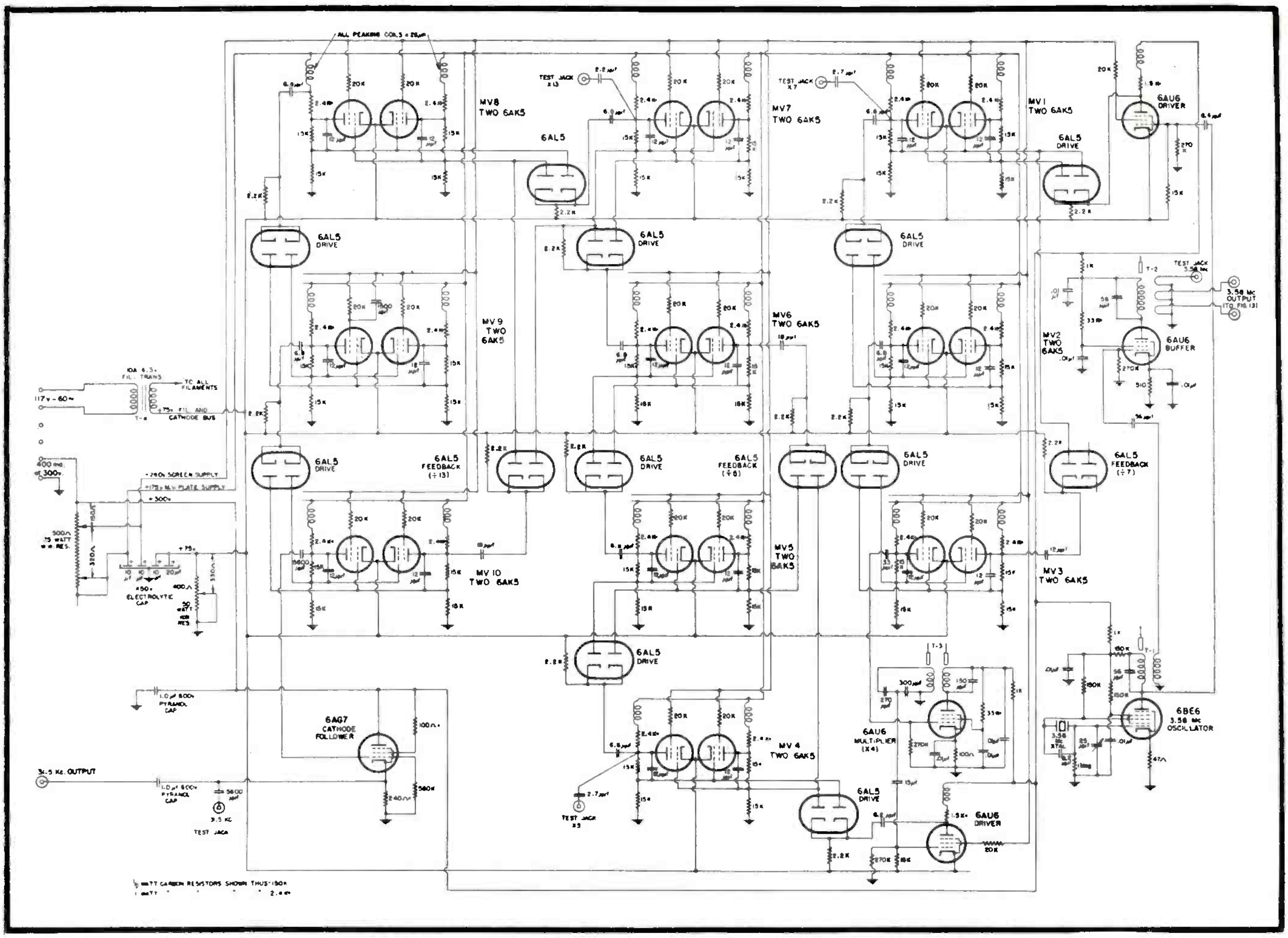


Figure 6
Schematic of RCA transmitter sampling oscillator and frequency divider arrangement.

ference aspects. It was expected that such data would become available shortly. Planned tests will involve quantitative observation in the lab at Princeton and field observations using WNBW, Washington, and WNBT, New York.

Commenting on signal-to-noise ratios required, Engstrom stated that field-test operations indicated that the signal-to-noise ratio required by the RCA color television system was no greater than that necessary for normal black-and-white reception.

Reviewed, too, was the effect of any change of the present 4.5 mc. spacing between picture and sound carriers or type of modulation on system performance. A study of this subject disclosed that the RCA color television system was identical with the black-and-white system insofar as spacing between picture and sound carrier were concerned. Although there is a higher energy content in the spectrum of the video signal around the sampling frequency, no effects on system performance have been observed, it was reported.

Receiving substantial coverage in the Engstrom report was the problem of coax cable routes, which at present do not have a pass band wide enough to accommodate the color signals. To solve the problem an 8-mc band with coax circuit might be provided by the telephone system, the Commission was told. This statement was predicated on a report made by Bell Telephone Labs who were said to have under development a system for use with coaxial cables which would increase the available bandwidth up to about 8 mc. Plans call for the dividing of this band between telephone and television service, allotting to the latter as wide a band as the television industry may require, 4 or 6 or even 8 mc.

Engstrom said that the requirement for the transmission of the signals of the RCA color system is that the pass band must be sufficiently broad to accommodate frequencies up to and including the sampling frequency of approximately 3.6 mc.

Of particular interest, too, during the hearings was the report of CBS colorman Peter Goldmark, who described his work with a 525-line method using the horizontal-interlace principle.

In the CBS method a simple sampling process is carried out at the transmitter where the video response of the camera signal is flat to 8 mc. Because of the horizontal interlace provided by the proper timing of sampling pulses, which have a repetition rate in the neighborhood of 8 million per second, the detail available in the picture was described as essentially doubled even though transmission occurred through a standard 4-mc video transmitter.

Describing the receiver required for 525-line horizontal resolution reproduction, Goldmark said that a sampler unit must be inserted between the second detector and the video amplifier. It was revealed that there are a number of synchronizing means under consideration, none of which represents complicated circuitry in view of the fact that the horizontal interlace sampling does not demand close tolerances, especially since it has nothing to do with color rendition.

After the sampling at the receiver, the sampling pulses themselves are filtered out and straight-forward video amplification takes place.

A highlight presentation of the hearing was a strikingly candid review of

(Continued on page 24)

Accelerated LIFE TESTING OF TUBES*

THE RECENT development of a series of accelerated testing methods has disclosed that substantial tube-testing economies can be effected through the adoption of a speed-up system.

In evolving these tests, it was necessary to set up a definition for tube life. It was found that tube life could be defined by four specifications: a measurement specification in terms of which end of life is determined; specification of standard operating conditions under which a sample of the population is to be tested; sampling specifications to permit sufficiently reliable prediction of population properties from observations of those of the sample; and a convention for assigning a life in terms of these observations. A life test must be considered as a means of tube-life determination, while an accelerated test represents another approach yielding a set of numerical data in a time short, compared with a life test, from which life can be deduced with acceptable accuracy. All accelerated methods considered so far seem to be either a choice of operating conditions causing failure in a relatively short time, a measurement of physical quantities with which later failure can be correlated, or a combination of approaches.

Figure 1

Specifications required to define tube life

1: A measurement specification defining life end-point.

2: Specification of standard operating conditions for the tubes under test.

3: A sampling specification designed to ensure that information concerning life distribution in the parent population can be inferred with sufficient accuracy from observations on the sample.

4: A convention for calculating tube life from numerical measures of observations on the sample tubes.

Life Test: A determination of tube life.

Accelerated Life Test: A set of measurement, testing, and sampling specifications yielding numerical data in a time short compared with a conventional life test and from which life data can be deduced with satisfactory accuracy.

Tube failure eventuates in many forms representing many distinct types of physical phenomena (e.g. mechanical failure, gas, hum, arcs, noise, low g_m or emission, etc.). The relative importance of the various types depends on operating conditions as well as on the specific tube population, and each type is subject to its own (usually unknown) extrapolatory laws. A necessary condition for good correlation with conventional life date therefore seems to be that accelerated testing be multiple, i.e., separate, accelerated, or extrapolated tests for each distinct and important type of failure with correlations attempted between the individual test results and the incidence of the corresponding failure type under normal conditions. The design of individual tests has been found to vary from simple vibration or shock testing for mechanical weakness to the unsolved problem of predicting emission life.

Failure rates (total and individual) were found to depend not only on the external variables of operation (circuit parameters, switching surges, stand-by periods, supply fluctuations, ambient temperature, shock, vibration, humidity, corrosive atmosphere, peak demands, etc.), but also on the internal variables of manufacture (material specifications, design, construction, coating procedures, cleaning and firing schedules, pumping processing and aging procedures, etc.). The spread in internal variables was found to be large, varying from lot to lot, plant to plant, manufacturer to manufacturer. Correlations between accelerated and normal test results will, therefore, be of little value unless one or more of the following conditions hold: (*1*), the accelerated approach provides a sufficiently good representation of a performance test relative to an individual failure type that correlations remain significant; (*2*), the extrapolated approach is made in terms of measurable quantities so intimately related to inherent quality that manufacturing variation is taken into account by measuring these quantities; and (*3*), analysis of failure and design of accelerated procedures does not permit falsification of results by confusion of one type of failure with another (bad heater wire expanding out of the cathode sleeve, or warping excessively and giving rise to apparent insulation or emission failure). Closely related to (*2*) is what one might call extrapolation by specification, with each step in manufacture so closely controlled and the population so uniform that correlations are good. This approach seems too expensive for conventional production type tubes. Step (*3*) should be satisfied if accelerated procedures are properly designed. Step (*2*) may be applicable to some failure types, but in general present knowledge does not permit of extrapolation on other than a statistical performance test basis, which does not satisfy step (*2*). Quality is a complex quantity so that an extrapolatory complex of many components derived from many measurements may be needed to permit predictions of probable future performance.

In work sponsored by the Signal Corps, the main emphasis has been placed on the accelerated approach with attempts to satisfy steps (*1*) and (*3*). Previous work by the industry indicates the feasibility of accelerated tests for heater burn-out, grid emission, and some forms of glass failure. The present work has so far given strong reason for believing that cathode arcing in receiving tubes can be tested for in an accelerated manner with definite indications that many other failure types are amenable to this approach.

Figure 2

Skeleton plan for developing accelerated test methods

1: Selection of reference population.

2: Specification of reference life test.

3: Analysis of failure data into distinct significant types.

4: Investigation of dependance of individual failure types on relevant observables (internal, external).

5: Design of specific accelerated or extrapolated tests for the various failure types.

6: Comparison of deductions from results of (*5*) with (*3*).

7: Repetition of (*4*), (*5*), (*6*), until agreement between (*6*) and (*3*) is satisfactory.

8: Extension to additional populations.

* *From a 1950 IRE National Convention paper by Jerome Rothstein, Signal Corps Engineering Labs.*

TV Transmitter Lower Sideband Measurements

Theoretical and Practical Considerations Involved in the Measurement of Spectral Energy Distribution of Television Signals, Taking into Account the Parameters of Transmitter Adjustment, Receiver Selectivity, Calibration Accuracy and Interpretation of Results. Methods Employed in Making Measurements Include RF Excitation of Input of Modulated Amplifier, Sine-Wave Modulation of Transmitter and Synthetic Video Signal Modulation of the Transmitter.

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THE SYSTEM of TV transmission in current use employs vestigial sideband transmission of the picture signal. In this system, the higher frequency sidebands resulting from amplitude modulation of a *rf* carrier by a video signal are transmitted in their entirety, while only a vestige of the lower frequency sidebands are transmitted, the remainder being attenuated. The required attenuation is generally obtained by means of a suitable filter which is inserted in the output of the visual transmitter, or by the use of low-level modulation followed by a number of linear amplifiers. These amplifiers are tuned in such a manner that the desired sidebands are transmitted and the unwanted sidebands attenuated.[1]

The transmission characteristic of an *ideal* visual transmitter, as defined by the FCC in the *Standards of Good Engineering Practice Concerning Television Broadcast Stations*, is shown in Figure 1. This curve indicates the relative amplitude of the sidebands which appear in the output of the transmitter when the corresponding components of the modulating signal are uniform in amplitude. The higher frequency sidebands between (f_c) and (f_c+ 4) mc, and the lower frequency sidebands between (f_c) and (f_c—0.75) mc are transmitted without attenuation, where (f_c) is the carrier frequency. The transmitter output is reduced to zero at (f_c+ 4.5) mc (sound carrier frequency) and at (f_c—1.25) mc (the lower frequency limit of a TV channel).

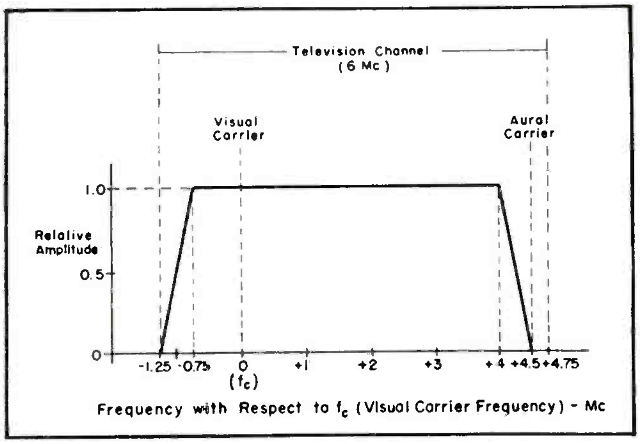
When the output of such an *ideal* transmitter is detected by a receiver which responds equally to both sidebands, the amplitude of the receiver output varies with modulating frequency, as shown in Figure 2. If E is the amplitude of an unattenuated sideband, the receiver output for modulating frequencies between 0 and 0.75 mc is proportional to $2E$, since both sidebands contribute to the receiver output. For modulating frequencies between 1.25 and 4 mc, the receiver output is very nearly proportional to E, since only one sideband is present. The receiver output for modulating frequencies above 1.25 mc is approximately 6 db below its output for modulating frequencies below 0.75 mc. Since such an overall result is not satisfactory, it is necessary to compensate for the reduction of lower sideband energy in the transmitter output by adjustment of the receiver response characteristic. This is accomplished, as shown in Figure 3, where the *ideal* receiver response is complementary to that of the *ideal* transmitter. When these two *ideal* characteristics are combined, the overall performance, shown in Figure 4, is the result.

Such *ideal* characteristics cannot, of course, be obtained in practice for either transmitter or receiver. The specifications that the visual transmitter must meet in regard to sideband amplitude are given by the FCC, in terms of allowable deviations from the *ideal* case. These specifications, as stated in the *Standards of Good Engineering Practice Concerning Television Broadcast Stations*, are:

Section A (*1*) "The overall attenuation characteristics of the (visual) transmitter measured in the antenna transmission line after the vestigial sideband filters (if used) shall not be greater than . . . be-

This paper was prepared while the authors were at Allen B. DuMont Labs, where Hamilton served as head of the TV RF Development Section and Artman was a senior development engineer in the TV RF Development Section.

[1] G. Edward Hamilton, *TV Transmitter Design*, COMMUNICATIONS; May, June, July, and August, 1948.



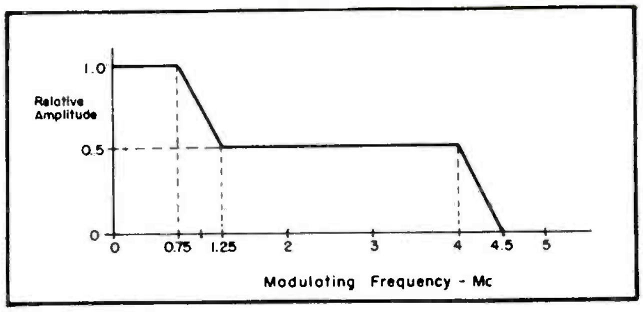


Figure 1 (Left)
Transmission characteristic of an 'ideal' visual transmitter.

Figure 2 (Above)
Result of detection of 'ideal' visual transmitter output by a double-sideband detector.

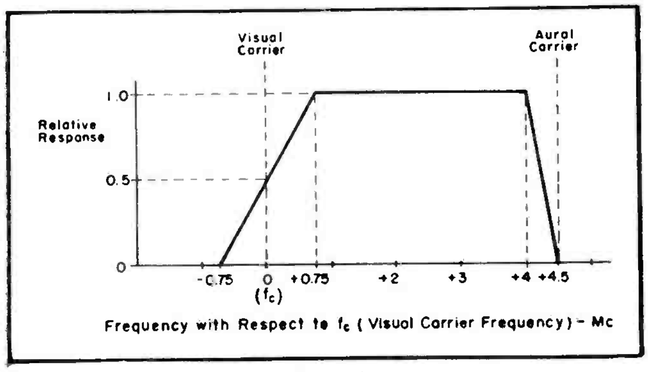


Figure 3
Response characteristic of an 'ideal' visual receiver.

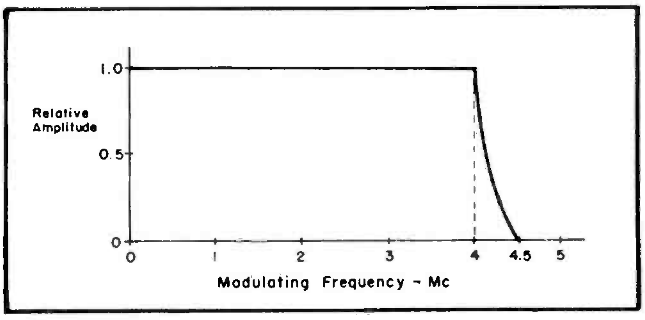


Figure 4
Overall performance of 'ideal' visual transmitter and receiver.

low the ideal demodulated curve." (See Figure 5, curve *A*)[2]

(*2*) "The field strength or voltage of the lower sideband . . . shall not be greater than -20 db for a modulating frequency of 1.25 mc or greater."

Section A (*1*), of the *Standards*, refers to the output of a receiver which responds equally to both sidebands. When the attenuation characteristic of a transmitter is measured, this receiver generally takes the form of a simple untuned diode or crystal detector, lightly coupled into the output transmission line. The amplitude of the detector output for a modulating frequency of 100 kc is designated 0 db, and the amplitudes obtained for other modulating frequences are referred to this value.

The data obtained in this manner are sometimes taken as an indication of the degree of lower sideband attenuation. This, however, may easily lead to erroneous conclusions, since the attenuation characteristic is a function of the amplitudes of both higher and lower frequency sidebands. Furthermore, the value of the characteristic for modulating frequencies between 1.25 and 4 mc will usually be determined chiefly by the amplitude of the higher frequency sidebands. Let us suppose, for example, that the higher frequency sidebands appearing in the output of a visual transmitter were uniform in amplitude between (f_c) and (f_c+ 4) mc, and that the amplitudes of the lower frequency sidebands at (f_c—1.25) mc and below were 20 or more db below this value. The attenuation characteristic would then lie between —5.2 and —6 db for modulating frequencies between 1.25 and 4 mc. When the lower sideband is reduced to zero, the amplitude of the detected signal is one-half of that observed for double sideband transmission, or equivalent to an attenuation of *6 db*. When the lower sideband is reduced 20 db in amplitude, with respect to the upper sideband or 10%, the amplitude of the detected signal is 55% of that observed for both sidebands. This is equivalent to an attenuation of *5.2 db*; (Figure 5, curve *C*). However, if the higher frequency sideband amplitudes were not uniform, but instead varied over a range of several db, the position of the attenuation characteristic for modulating frequencies between 1.25 and 4 mc could lie above —5.2 db, even though the lower frequency sideband attenuation was within the limits specified by the FCC. Conversely, the attenuation characteristic could lie below —5.2 db even though the lower frequency sideband attenuation was not adequate.

Several possibilities of this kind are illustrated by Figure 6. A *rf* sideband amplitude versus frequency curve, which might be obtained from a transmitter employing double coupled circuits, together with a notching circuit, (of suitable characteristics) is shown in (*a*) of this plot, with its corresponding attenuation characteristic. The transmitter is so tuned that its response at (f_c+3 mc) is 1 db higher than that at the carrier frequency. The lower frequency sideband attenuation is adequate, although the attenuation characteristic lies above —5.2 db for modulating frequencies between 2.25 and 3.5 mc. In (*b*) of this plot we see how a similar result might be obtained with a transmitter employing a single tuned circuit. The transmitter is so tuned that the peak of the response curve occurs at (f_c+ 1.5) mc. The attenuation characteristic again lies above —5.2 db for modulating frequencies greater than

[2]Specifications of RMA, which are more rigid than those given by the FCC, are also shown in Figure 5, curve *B*.

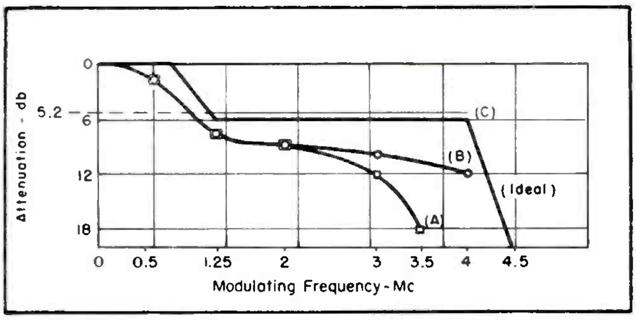


Figure 5

Visual transmitter attenuation characteristics. In (A) appear the limits imposed by FCC specifications. Limits imposed by RMA specifications are shown in (B). The plot in (C) illustrates the position of the characteristic when the higher frequency sideband amplitude is uniform and the lower frequency sideband amplitude is —20 db.

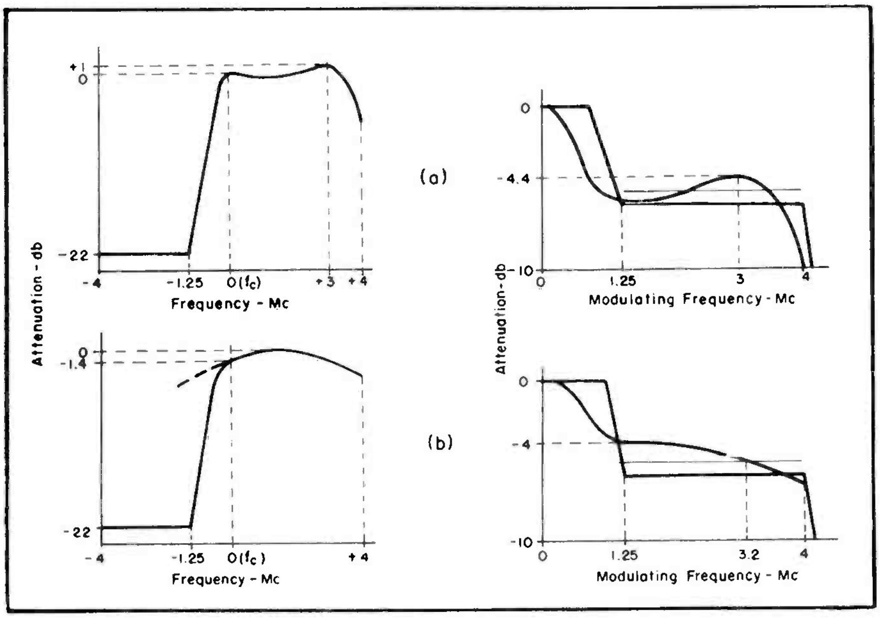
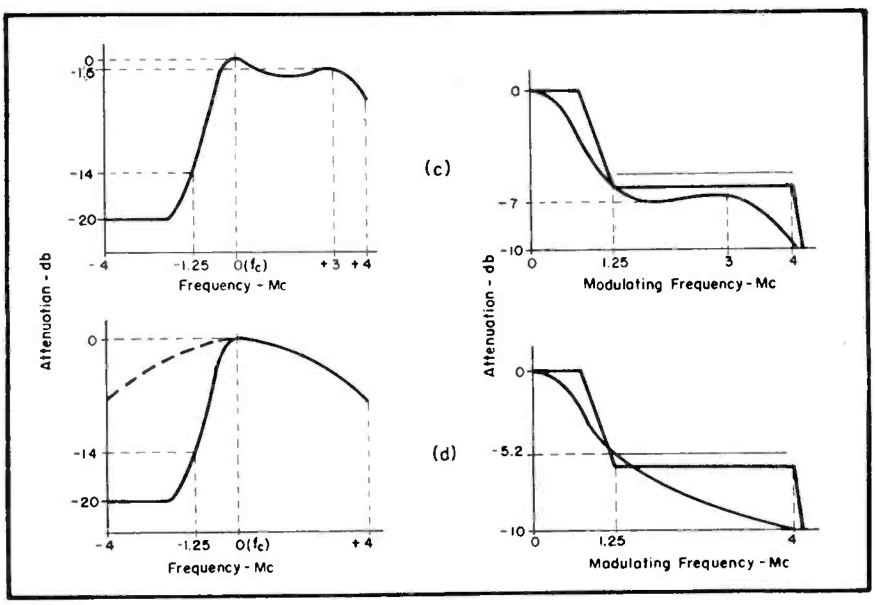


Figure 6 (Above and below)

Example of sideband amplitude versus frequency curves and corresponding attenuation characteristics. In (a) and (b) (top) we have the lower sideband attenuation within FCC standards, but showing attenuation characteristic above —5.2 db. In (c) and (d) appears the lower sideband attenuation not within FCC standards, but showing attenuation characteristic below —5.2 db.



1.25 mc, even though the lower frequency sideband attenuation is within the FCC specifications. The (*c*) and (*d*) curves in Figure 6, illustrate the case where the attenuation characteristic lies below —5.2 db for modulating frequencies between 1.25 and 4 mc, even though the lower frequency sideband attenuation is not sufficient. In (*c*) of the Figure 6 plot, the curve is the result of a transmitter employing double coupled circuits tuned so that its response at the higher frequency peak is slightly lower than that at the carrier frequency. The (*d*) curve shows the same response curve as (*b*) except that the transmitter is so tuned that the peak of the curve lies at the carrier frequency.

Results of the types shown in Figure 6 may be avoided if reasonable care is taken in tuning of the visual transmitter. This may be difficult, however, unless some means of displaying the response of the transmitter in panoramic form is provided for use during the tuning process. It is thus apparent that some means independent of the attenuation measurement is required, so that transmitter compliance with respect to the requirements of Section A (*2*) of the *Standards* may be determined.

There are two methods which may be used for specific measurement of lower (and also higher) frequency sideband amplitudes:

(*1*) *RF excitation of input of modulated amplifier. . . .* The portion of the visual transmitter which determines sideband amplitude is excited by an *rf* signal, and the transmitter output voltage or power is measured for each excitation frequency.

(*2*) *A sine-wave modulation of the transmitter. . . .*The transmitter is modulated with suitable signal information and the amplitude of the resulting sidebands are measured.

In use of the first method, *rf* excitation is supplied to the input of the modulated amplifier stage in the transmitter, since the output circuit of this stage and any tuned amplifiers or filters following, affect sideband amplitude. The amplitude of the excitation must, of course, be the same for all frequencies. The voltage or power output of the transmitter for an excitation frequency of (f_c) or (f_c—100 kc) may be designed as 0 db, and the outputs for other excitation frequencies referred to this value. If the final amplifier stage of the transmitter is modulated and followed by a sideband filter, the excitation is sometimes applied to the input of the filter, although in this case the characteristics of the output circuit of the modulated stage are ignored. The results of such a measurement may be accepted as valid for determination of compliance with Section A (2) of the *FCC Standards*, providing it can be assumed or otherwise determined that the output circuit of the modulated amplifier is not adjusted in such a way, as to make the overall sideband attenuation less than that indicated by a measurement on the filter alone. It would seem preferable that the excitation be applied to the input of the modulated amplifier, regardless of whether or not a sideband filter is used. The results, thus obtained, may vary with different values of the excitation voltage, since the loading effect of an amplifier tube upon its tuned circuits will change with amplitude. To obtain complete data the measurements may be repeated for several values of excitation voltage; the lowest value corresponding to transmission of an all white picture, and the highest value to transmission of an all black picture. It will be noted that this method does not take into consideration the response characteristic of the video amplifier and modulator; in fact, the process of modulation is omitted entirely. For these reasons, the use of the method described may not yield results which are representative of the operation of the transmitter when it is modulated by a picture signal.

The conditions occurring when method (2) is employed duplicate to a greater extent the actual operation of the transmitter. This method is, therefore, preferable to measurement of the transmitter output under conditions of *rf* excitation. The transmitter may be modulated by a sine-wave signal. Its output will then consist of a carrier and two sidebands. The amplitude of either of the sidebands may be measured by means of a device possessing sufficient selectivity to reject the carrier and one sideband when measurement of the other sideband is made. As required by the *Standards* the amplitude of the 100-kc lower frequency sideband shall be measured and designated 0 db, as a basis for comparison. (This specification assumes negligible attenuation of the 100 kc lower frequency sideband. The amplitude of the 100-kc higher frequency sideband may be measured as a check on this assumption.) The modulating signal frequency shall then be varied over the desired range and the voltage of the corresponding sidebands measured. It is apparent that the selectivity of the measuring device must be such that its response is very small at 100 kc off resonance in order that interference from the carrier does not affect the reference measurement.

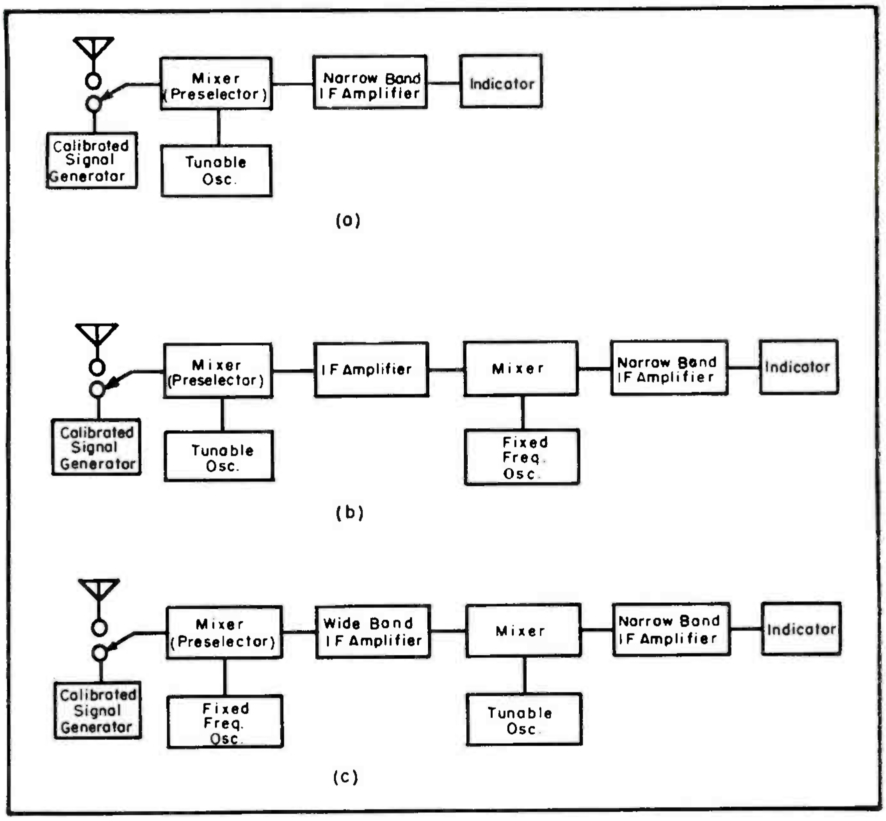


Figure 7

Block diagrams of devices suitable for measurement of sideband amplitude. A single conversion system is shown in (a). Double conversion systems are illustrated in (b) and (c).

Synthetic Video Signal Modulation of Transmitter (Method 2b)

Alternatively, the transmitter may be modulated with a *synthetic* composite video signal composed of synchronizing signals to establish peak output voltage plus a variable frequency sine wave voltage occupying the interval between synchronizing pulses. When such a composite signal is used for modulation, sidebands due to a synchronizing and blanking impulses also appear in the transmitter output. These sidebands may affect the accuracy of measurement of 100 kc sideband, unless the receiving device is sufficiently selective to separate the higher order harmonics (sixth and seventh) from the reference.

Block diagrams of suitable measuring devices are shown in Figure 7. In (*a*) of this illustration appears a setup in which the transmitter output signals are converted to an intermediate frequency by means of an oscillator mixer system. The required selectivity is obtained in the *if* amplifier. It is necessary that the *if* be higher than the highest video modulating frequency which is to be used in the tests. Otherwise, the desired response and other spurious responses will be received simultaneously at some modulation frequency. An *if* of 10 mc or higher is desirable. The selectivity required for use with sine wave modulation has been exceeded with four stages at 10.7 mc, employing double-tuned circuits with coupling far below critical.

In the setup of (*b*), a double conversion system is used. The first *if* amplifier frequency is made sufficiently high to give good image rejection, while the necessary selectivity is obtained in the second and lower frequency *if* amplifier. The first oscillator mixer is tuned.

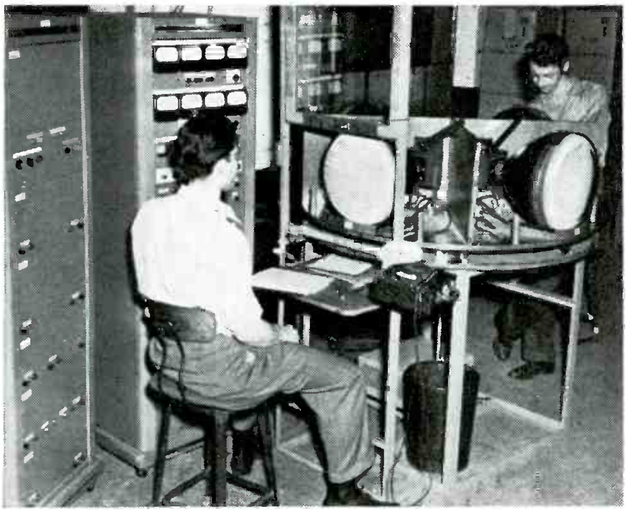
In the system shown in (*c*), the second oscillator mixer is tuned. This requires that the first mixer and *if* amplifier be sufficiently wide band to cover the range desired.

The (*b*) and (*c*) methods offer a convenient means of obtaining good image rejection in the receiver input, as well as the required selectivity. However, large number of spurious responses are possible; therefore, these methods are not recommended.

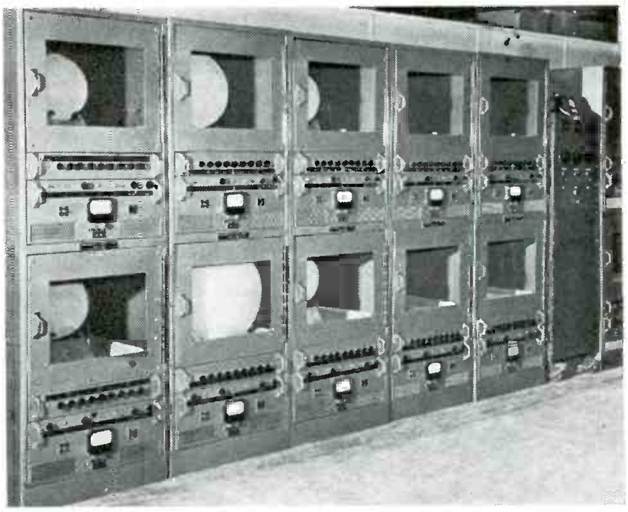
When measurements are to be made *off the air*, the input of the measuring device (receiver) is connected to a suitable antenna, as shown in Figure 7, and tuned to the desired sideband. The calibrated signal generator is then connected to the receiver input in place of

(*Continued on page 25*)

TV Picture Tube



Turntable automatic picture-tube testing equipment.



Picture-tube life-testing equipment.

PICTURE-TUBE designs are presently following trends initiated by: (*1*), the development of metal cone tubes and (*2*), the recent introduction of picture tubes using wide-angle deflection. One type[1], recently announced, includes both of these features. The use of the metal cone in larger tubes has been found to provide such advantages as reduction in weight and cost, and an increase in handling safety. For example, the cost of the glass work alone before fabrication of an all glass type 20BP4 has been found to be in the order of $70.00 to $80.00 per blank. Use of the metal-cone principle and wide-deflection angle has been found to effect a reduction in weight by a factor of three (65 to 28 pounds) and permit a larger useful screen area relative to the maximum tube diameter.

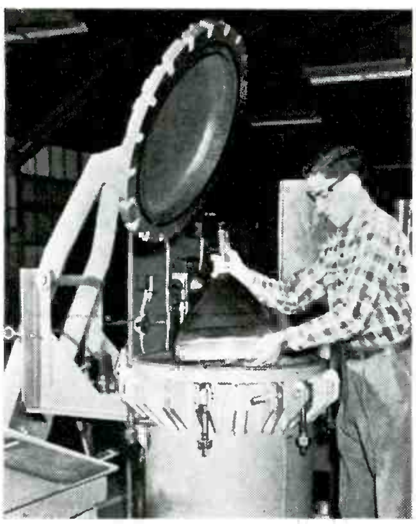
Metal-Cone Tubes

The metal cones for the 19-inch type tubes are spun from flat sheets of a special chrome-iron alloy about ⅛″ thick. The iron is selected to expand and contract with changes in temperature at approximately the same rate as the glass used for the funnel and neck on the small end of the cone. The face plate is a flat piece of glass not unlike window glass, about 5/16″ thickness, cut circular and sagged in a heated mold to the correct curvature. This face plate is then sealed to the large open end of the cone. The expansion rate of the face plate glass is less than

[1]Type 19AP4.

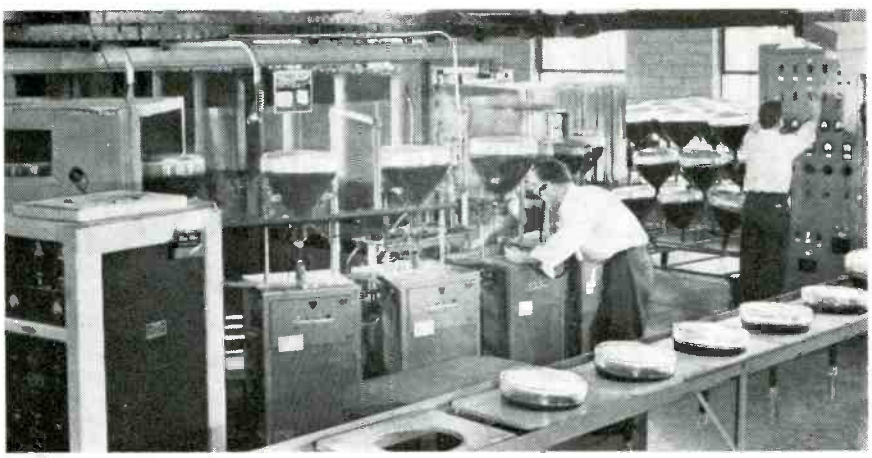
[2]16FP4.

Pressure tank for testing strength of picture-tube bulbs.



(Below)

A railroad exhaust during which a nearly perfect vacuum is obtained.*



Design Trends

Plant and Lab Probe Reveals That Larger Envelope Tubes in Glass and Particularly with Metal Cones with Wide-Angle Deflection Have Begun to Dominate the Picture-Tube Scene.

by **K. A. HOAGLAND**, Tube Engineering Department, Allen B. DuMont Laboratories, Inc.

that of the metal cone; however, this feature permits the use of thin glass for the face. Compressive forces are set up at rim of the cone which act to arch the face plate and brace it against the inward acting pressure of the atmosphere, thus achieving great strength without the use of exceedingly thick glass.

Wide Angle Types

Another recently introduced wide-angle deflection type[2] utilizes a deflection angle of 62° and consequently can be swept with most yokes and circuits designed for 55° operation. An all glass type, this tube features a bent gun and utilizes a new technique of glass-bulb to face-plate sealing which has been found to provide a useful glass area nearly equivalent to that obtainable on metal-cone tubes.

Increased Picture Resolution

An important advantage of wide-angle deflection, other than the advantages previously mentioned, is increased picture resolution. This is achieved, since magnification of the focus coil lens is reduced from what it would be in a type with small deflection angle and consequently longer focus coil to screen distance. Although more scanning current is required in the deflection coils, it has not been necessary to use additional sweep amplifier power, thanks to recent improvements in deflection circuit and component efficiencies.

*Photos taken at new DuMont plant in Allwood, N. J.

Basing and aging processes. On conveyor, at right, bases are cemented to the necks of the tubes. The tubes are aged on the conveyor, at the left, while the tubes are operated at normal potentials.*

Depositing screen material on the face of the tubes. After the screen has been deposited the solution is decanted. The tubes just left of center are being decanted.*

2,000 and 7,000-Mc

TV Microwave Relays

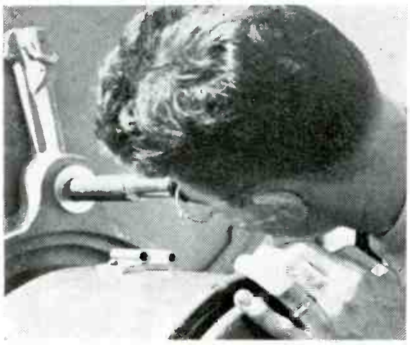


Figure 1
Parapet mounting reflector being positioned by means of telescope. With standard 7,000-mc reflectors, the telescope is jig-mounted to a two-hole bracket on top of the transmitter. In this case the transmitter position was locked before the solid reflector was mounted to the can.

CONTINUING OUR ANALYSIS of the problem of obstructions at 2000 and 7000 mc, let us now consider the case of barriers which might exist at either end of the course. An obstruction at either end is obviously more difficult to diffract around than one somewhere near the middle of the path. In an effort to probe these points, we conducted several tests and broadcast a few programs from sites that were considerably below line-of-sight; a typical course was 5 or 10 miles long, with the receiver as much as 200′ below line-of-sight from the transmitter.

If the initial survey has established the fact that adequate terrain clearance exists along the entire course no equipment tests need be conducted prior to the actual broadcast. However, if a less than line-of-sight course is found, it frequently may be profitable to haul the 2000-mc equipment out for a test transmission, before any decision is reached as to whether or not it is practical to try and do the show.

Operation of 7000-mc Relay

In setting up the 7000-mc apparatus, there is one piece of equipment which demands particular attention, and that is the solid parabolic reflector which offers considerable wind resistance. In high winds, or even in gusty weather, some very great forces may be exerted against the reflector. Unless special precautions are taken, the equipment may blow over, resulting in interruption of the program plus probable damage to the apparatus. We found it necessary to tie the tripods down to wooden *tee's*, which were well weighted with sandbags.

Assuming all units have been installed in their operating positions, and the electrical circuits have been completed (including video coax cable and intercommunication facilities) the transmitter is the next part of the system to consider. After turning it on, it should be allowed to warm up for about 15 minutes. Then, with internal 60 cycle sine-wave modulation applied, the transmitter must be tuned so that the wavemeter absorption notch appears at the top of the 60-cycle pattern on the 'scope connected to the monitor output. With proper adjustment of fre-

Figure 2
Front view of terminal control racks. Left rack contains stabilizing amplifier, order wire panel, test oscillator, etc. Center rack contains audio patching facilities. Right rack contains master monitor, 7,000-mc relay receiver control, video patch panel, etc.

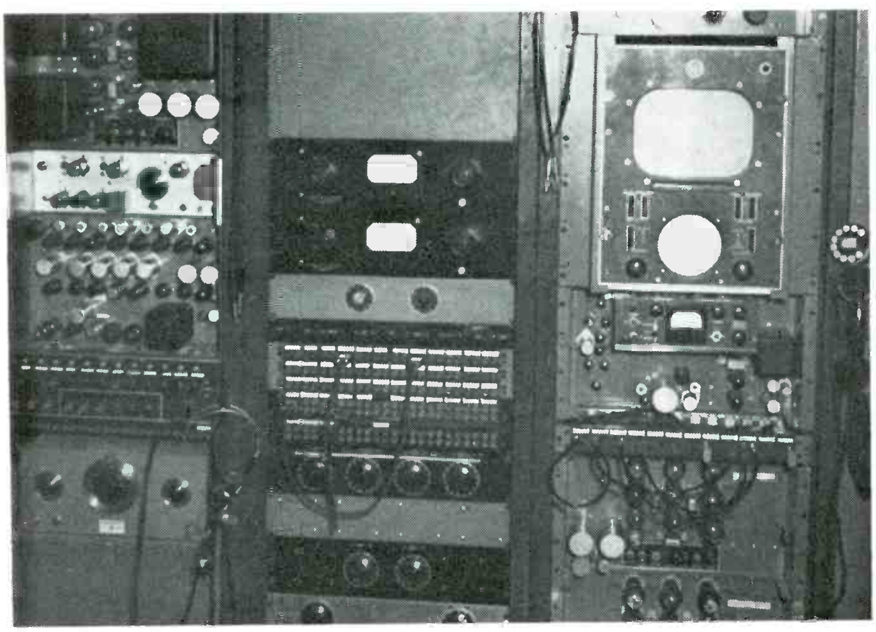
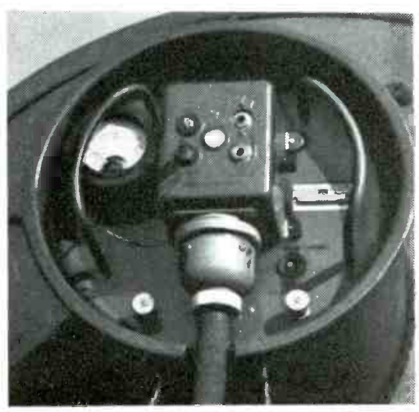


Figure 3
Rear view of 7000-mc relay receiver, showing addition of carrier strength meter.



Part II: Operational Practices. . . . Use of Such Measures as the Telescope, Maps and Compass in Obtaining Correct Antenna Position. . . . Adjustment of Receivers. . . . Cable-Run Controls. . . . Reflection Problems and Solutions. . . . Magnetron Characteristics.

by **EARL D. HILBURN**, Assistant Chief Engineer, WMAL, WMAL-FM, WMAL-TV

quency the notch should stay in view at the wavepeak, as the 60 cycle modulation is slowly reduced to zero.

The receiver should then be turned on and allowed to warm up for a minimum of 15 minutes. With the *afc* switched off, the repeller voltage should be adjusted to find a mode within the range of —70 to —125 volts. The crystal current should be checked and adjusted if necessary and the *if* gain and video gain controls advanced to a point where background noise is perceptible on a monitoring 'scope. After these transmitter and receiver adjustments the antennas can be adjusted.

In the antenna-orientation operation, there is one basic requirement; some small amount of signal must exist through the system. This necessitates having the two antennas adjusted approximately (within 5° or so) in both azimuth and zenith at the start of the procedure. This may be done by map and compass or visually. While not furnished as standard equipment with either of the links discussed, a very helpful accessory is a small telescope, which may be mounted on any of the antennas in such a way that its axis is in alignment with the main lobe of the antenna pattern. Such a telescope is shown in Figure 1. This device makes it possible to orient the antennas quickly. In fact, for many close shots (of a few miles) it is possible to set the antennas with the telescopes alone to a sufficient accuracy. However, generally speaking, it is necessary to maximize the signal at the receiver by adjusting in sequence each of the antennas for strongest signal input to the receiver.

In making the signal adjustments, the operator at the receiver must direct (by private telephone line) the positioning of the transmitting antenna for maximum signal at the receiver. Having adjusted the transmitting antenna in both horizontal and vertical planes, the transmitting antenna should then be left stationary and the receiving antenna carefully adjusted. In the case of a long course resulting in a weak signal, it may be necessary to alternatively readjust each antenna several times to be sure that optimum alignment is achieved. During this entire process, the engineers at the two antennas must take their orders from the operator at the receiver control panel, for he is the sole judge as to whether the signal is increasing or decreasing. When the signal is very weak the best indication of signal strength is the presence of a 60-cycle modulating signal in the receiver output. Extremely weak signals may be detected in this manner as mere ripples in the *grass* on the output waveform monitor. However, any signal of usable proportions will cause

Figure 5

Typical installation of parapet mounting reflector.

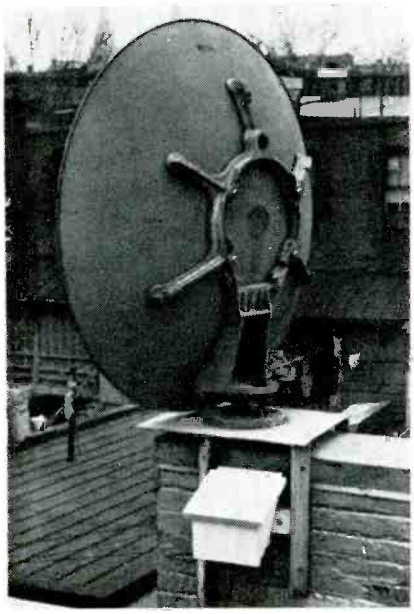


Figure 4

Relay truck loaded for special field test. Four, six and eight-foot reflectors are on roof rack. Equipment for the 2000 and 7000-mc system is in the truck, and a 110-volt gas-engine power plant is in trailer.

TV Microwave Relay

(*Continued from page 19*)

a pronounced deflection of the signal strength meter in the limiter grid circuit.

After adjusting the antennas for maximum signal strength at the receiver, the antennas should be clamped tightly, while the signal strength meter is watched closely to be sure that the reflectors did not shift position while they were being secured. With reasonably close initial alignment at the time of equipment setup, and with careful coordination during the actual orienting procedure, proper adjustment of the two antennas is possible within a matter of a very few minutes.

Another modification which has been found to save orientation time involved the use of a microammeter permanently mounted inside the waterproof cover of the receiver housing. This setup can be plugged into a pin jack which parallels the limiter grid current meter at the receiver control panel. Accordingly, a single operator at the receiving position can cross-connect the telephone line (to the remote location) to the internal intercommunication wiring between the receiver and receiver control units. Thus, with the receiver left in tune, the operator can go up to the antenna and direct the orienting procedure from this position. Under these conditions, the adding of the meter to the receiver proper makes it possible to eliminate an operator in the course of the setup.

Having maximized the carrier strength at the receiver, the demodulated sine wave signal should be observed on a master monitor or a 'scope. The *if* amplifier gain then should be adjusted by watching the peak-to-peak level of the output waveform. It will be noted that this increases, with increasing *if* gain, until the saturation point is reached. At this time the limiter grid-meter reading fails to continue rising and the output signal waveform remains constant or may decrease slightly in amplitude. The *knee* or saturation point should be carefully noted, and the *if* gain set to provide operation just above this point. Limiter action is most effective with this setting.

Before proceeding with other receiver adjustments the receiver tuning should be checked for normal *afc* action. With proper tuning, the signal strength meter should not shift position appreciably, nor should there be any change in output signal waveform when the *afc* switch is thrown between *off* and *on* positions. Adjusted in this manner, the *afc* system may be expected to keep the receiver in tune for frequency shifts, at the transmitter, of about 20 mc, assuming there is no interruption of the carrier. If the input signal to the receiver is interrupted, the *afc* system may be expected to lock-in automatically when the transmitter oscillator is within ±10 mc of the normal receiver frequency.

With the *afc* locked-in and proper limiting action, the receiver operator must then instruct the transmitter personnel in setting deviation. It is necessary to adjust the 60-cycle modulation until the point of maximum receiver video output, without waveform distortion (flattening of the peaks), is determined. This peak-to-peak level should be marked by the receiver operator with a grease-pencil on the face of the waveform monitor or 'scope. Then, without adjusting the receiver in any way, the transmitter operator should switch from 60-cycle to picture signal and adjust the picture modulation for a peak-to-peak level out of the receiver of about 60% of the maximum point established with the sine wave. Setting normal deviation in this manner is most essential. Some small fluctuation in video levels is inevitable in normal programming (due to difference in picture content and human error in operating the video controls). Unless a reasonable margin of safety on deviation is established in the manner just described, signal peaks will be compressed resulting in disagreeable *blooming* of the whites. In cases of extreme over-deviation the whites may actually reverse, due to frequency excursion, beyond one of the peaks of the discriminator, actually working down the back-slope of the detection characteristic. Having adjusted for normal deviation in this manner, the video gain control should be set to provide normal output signal level.

Normally, after the foregoing steps have been followed, program operation can proceed. However, there may be special circumstances which may call for further adjustments on the system, after everything has been set for normal picture signal. If exceedingly long cable runs are involved, it may be necessary to adjust the matching controls in either or both units. Normally these are set to 75 ohms and need no adjustment from one setup to the next. However, if a video line of more than 200′ in length is used to bring the signal from the cameras to the transmitter control input, close-spaced reflections may appear in the picture or may cause distortion of the synchronizing waveform. These are due to transmission line reflections and can be minimized by a critical adjustment of the terminating controls. In these cases the operator at the receiver can direct the transmitter control operator to vary the matching adjustment for best signal out of the receiver. Similarly, a long run of cable between the transmitter and the transmitter control unit may necessitate readjusting the termination on the transmitter end to minimize any tendency for reflections on that video cable.

One other condition may cause reflection in the picture; multi-path transmission. Although such difficulties are rarely, if ever, encountered on microwave courses of a half-mile or more, on very short courses, the signal strength from the many minor lobes in the antenna pattern may be frequently high enough to cause trouble when reflected from the ground and from nearby buildings. To solve the problem, in most instances, the transmitting antenna should be tilted upward, deliberately shooting the main beam on a course above the receiving dish. Due to the high field intensity the signal strength will not be reduced to an unusably low amount at the receiver, and it will be found possible to direct the minor lobe energy up away from the ground and hence reduce the reflections from this source.

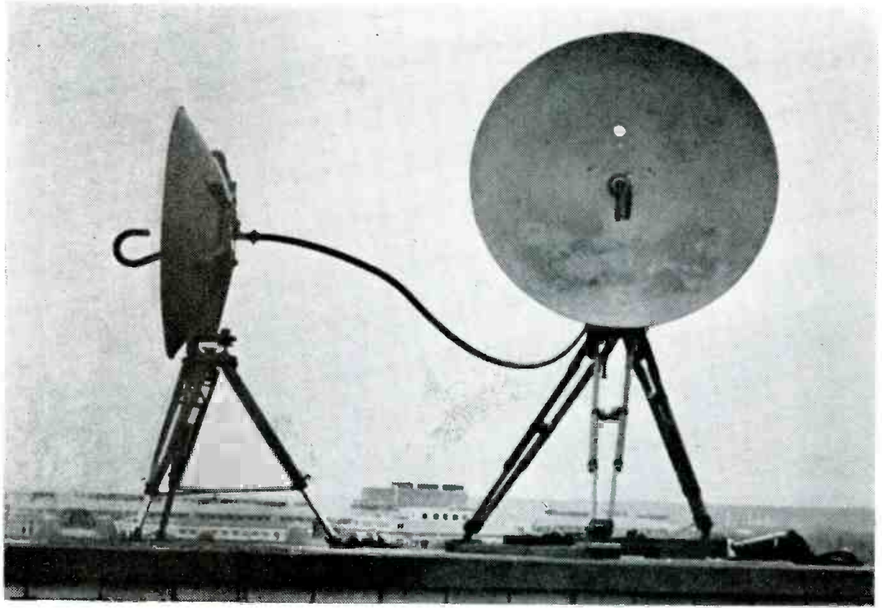


Figure 6

WMAL-TV beam-bender setup with two 7000-mc antenna systems coupled together with waveguide.

Also, tilting up with the main beam will help to reduce the amount of direct beam energy striking the building or tower supporting the receiver. In some short-course multi-path problems, a reflection is obtained when the main beam strikes the structure supporting the receiver and bounces back to other buildings, where it is re-directed back to the receiver.

When the broadcast begins the transmitter personnel should keep their meter selector switch in the repeller voltage position, and a 'scope should be kept on the monitor output. This enables the operator to note any change in klystron operation and at the same time maintain a check that the system is actually emitting a modulated signal.

Receiver personnel should keep their test meter on the carrier strength position. Any reduction in current indicates loss of signal due to antenna misalignment, or equipment difficulties. It is not advisable to check repeller voltage during program transmission inasmuch as the switching process produces a momentary shift in klyston frequency, resulting in a surge in the picture signal. Also, *afc* should not be released during program as the transmitter and receiver idling frequencies may not be the same due to different rates of drift.

Operation of 2000-mc Relay

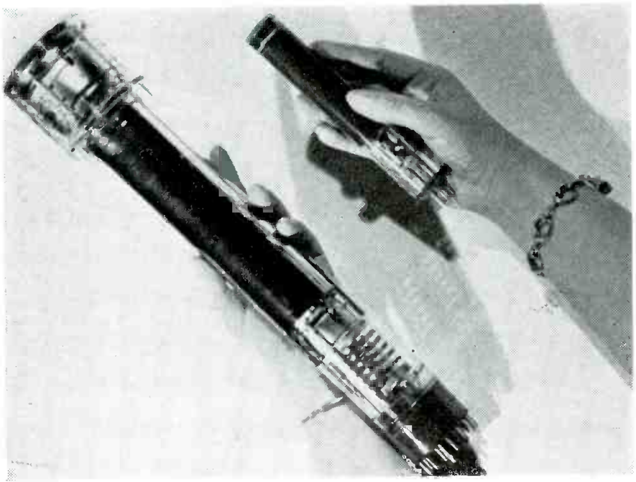
The setup of the 2000-mc equipment is somewhat different from the more portable 7000-mc relay. It has been found that operation of the equipment from a small panel truck serves as an effective means of solving the problem. This is convenient, as it does not require taking the main mobile unit out on surveys, special equipment tests, etc. However, since the equipment is mounted in racks it may be transferred to the main mobile unit or set up at some fixed location removed from the rest of the operation.

Assuming that the transmitting equipment is set up and all cabling has been completed, we are ready for the first operational step, turning on of the primary power switch. This applies tube heaters and starts a five-minute time delay in the high voltage supply. Operating personnel must check the heater and halo-heater *dc* voltages applied to the magnetron. Earlier equipment did not have meters for this purpose and in these instances it is well to consider mounting a set of meters on a suitable insulated panel (with a glass or clear-plastic cover to protect the operating personnel), since these voltages are critical and must be monitored at each set up.

As an aid to keeping these constant, we added a 2-kw autotransformer to the input line. This was tapped in 5-volt steps, allowing the voltage at the transmitter to be set to the proper limits, without too much consideration for the prevailing line voltage. A further refinement would be the use of a saturable-reactor type of primary voltage stabilizer.

[*To Be Concluded in May Issue*]

TV CAMERA



The small-size Vidicon* pick-up tube, developed for use in industrial television systems, and the image orthicon, the pick-up tube generally used in commercial telecasting. (Courtesy RCA)

In our probe of camera tubes, the types which could be strictly classified in that category were detailed. There is another unit, which is often included in the pickup family, although it is actually a static-image tube which produces stationary patterns. This is the monoscope, normally used in the transmission of test patterns.

The *monoscope* produces its picture from a variation in the secondary emission qualities of its fixed target. This plate is a flat section of aluminum approximately .004" thick which contains a pattern printed with ink. During the manufacturing process, the tube is heated and the ink is converted into carbon. In operation, an electron gun scans the target, which is made up of the carbon image and the aluminum plate where the image is not printed. Since the aluminum releases more than twice as many secondary electrons than the carbon, a variation in the secondary emission electron flow to the collector anode is used for the signal. There is no photoelectric effect in this tube, which depends purely upon the secondary emission qualities of the carbon and aluminum. The output signal from the monoscope is larger than that obtained with the conventional camera tube.

Since these tubes are relatively inexpensive, as compared to the more complex camera tubes and no outside lighting source is needed, they serve a very useful function in the complete television system. A strong signal output, several times larger than the conventional iconoscope, can be obtained. The greatest single advantage which results through the use of a monoscope pattern is that the pattern is fixed and invariable which is an extremely important feature in testing television receivers.

Flying Spot Scanners

Station call letters and test patterns may be transmitted by means of the *monoscope* or the studio cameras. To permit the transmission of such material in a novel fashion, a *flying-spot* type of tube[1] has been designed.

Originally some method of scanning an object by means of a moving light spot was used to provide the signal to be televised. This new flying-spot tube is not in any sense a camera tube, but rather a light source used for scanning transparent or opaque material. The phosphor screen has a metallized back to increase the light output and is designed to produce a small intense visible source which has a very strong output near the ultra-violet end of the spectrum. The purpose of producing light of this frequency is to allow this tube to be used in a system operating as a video-signal-generator, in which the picture may be changed at will. The picture to be televised may be motion picture film, a transparent slide or any small opaque object.

In one signal-generator arrangement are included: (*1*), Flying spot tube with its power supplies, deflection yoke and scanning system which are used to provide a small, intense, rapidly moving beam; (*2*), an optical lens which is used to project the flying spot on the object to be televised; and (*3*), a collector for the transmitted or reflected light from the televised object.

If a transparent object is used, the flying spot of light is transmitted through the object to a multiplier phototube which converts the light into video signals. In accordance with the normal photoelectric effect, the basis of all television cameras, the output signal is proportional to the amount of light transmitted to the photo-cell. A standard 525-line interlaced scanning pattern is used in accordance with present-day practice. An amplifier is needed so that the small signal output may be built up until it is applied to the transmitter.

If an opaque object is used as the scene to be televised, energy is reflected to the photo cell which then acts in exactly the same way. In this manner there is a wide choice of material which can be transmitted. Any suitable printed copy or photograph can be transmitted by this equipment which does away with the uneconomical use of studio cameras. There is a possibility of producing unusual effects by having a slide as the object to be televised and simultaneously modulating the scanning beam by a second signal.

In another recently-developed *flying-spot scanner*[2] setup are included a scanner, and picture and waveform monitor, as well as an optical bench unit, in which appears the lens system, flying-

*TeleVision Engineering, March, 1950.

Tube Design

Part IV. . . . Design and Application of the Monoscope and Flying-Spot Scanners in TV Broadcasting and Receiver-Plant Control.

by ALLAN LYTEL, Temple University Technical Institute

spot tube,[3] pickup phototubes and picture material mounting.

The flying-spot tube, a 4″ crt, operates at 25 kv, utilizing magnetic deflection and focus and a zinc-oxide phosphor. A pair of f/2.5 projection lenses focus the image of the tube's master on the picture material. The light which is reflected from the white and gray portions of the picture is picked up by two multiplier phototubes[4] and converted into a video voltage.

The video signal produced by the phototube at any instant of time is proportional to the light reflected from the picture slide, and has a maximum level of about ½ volt. Equalization for the phosphor decay is provided by two *RC* networks in the flying-spot scanner video amplifier. The output of the scanner unit is a composite video signal less the synchronizing signals.

The resolution of this model is 550 lines at the center and better than 400 lines at the corner as measured on a standard RMA test pattern.

The picture and waveform monitor is used to check scanner operation, setting the black level and aligning both units. A 10-inch picture tube and 3-inch waveform tube are provided, with their focus intensity and calibration controls.

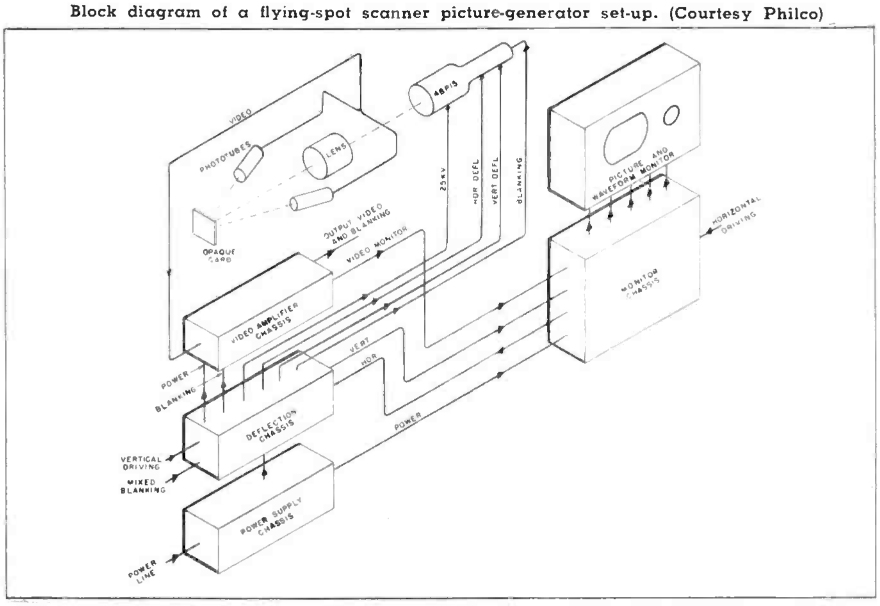
The monitor unit requires either composite video, including blanking and sync, or video and blanking alone. For the latter combination, horizontal and vertical driving pulses must also be provided. When monitoring the scanner unit performance, the same horizontal and vertical driving pulses are supplied to both the monitor and flying-spot tube deflection circuits.

The 4-inch *crt* has a short-persistence phosphor and sharp focusing characteristic. The tube is mounted in a half-gimbal, with the planes of rotation passing through the center of the tube face. Axial focus, vertical tilt and horizontal tilt-locating adjustments are provided. The normal alignment procedure consists of adjusting the axial focus control to focus the center of the picture in the picture monitor. The vertical and horizontal tilt controls are then adjusted to bring the edges of the picture into focus. Because of the gimbal mounting, these adjustments do not affect the focus at the center of the picture.

The scanner unit is designed for opaque picture material, such as photos, photostats or original art work, mounted on 3¾″ x 4″ aluminum slides. Transparent slides may also be used by substituting a refractive than a reflective phototube assembly.

The equipment can be used in the factory, studio or for closed-circuit TV work.

In the plant, the system can be used to provide test signals for checking the quality of receiver performance. Messages and continuous inspection records can be inserted in the scanner and flashed from the control point to selected test positions on production lines.



Block diagram of a flying-spot scanner picture-generator set-up. (Courtesy Philco)

[1]RCA 5WP15.
[2]Philco FSS-2. [3]4PB15. [4]5819.

The Status of Color TV

(*Continued from page* 10)

the merits of each of the systems by Axel Jensen, who offered a report in which was detailed the maximum theoretical performance of which each system is capable.

Discussing the differences between the systems, Jensen declared that the main difference between the setups was that of repetition rate of the color information.

In the CBS system, it was shown that the color is changed at field rate; in the next, the CTI system, the color is changed at line rate; and in the third, the RCA system, the color is changed at dot rate. Analyzing the term *dot*, Jensen said that in what one may call a pure dot sequential system, the dot rate should presumably be equal to that of the Nyquist interval, and the dot repetition rate should therefore presumably be 8 mc. In the RCA system the use of mixed highs is involved, whereby the top half of the band is sent as black and white, and only the lower half of the band is sent with color information. In such a system, we were told, the dot rate should presumably be about 4 mc.; the actual dot rate used by the RCA, as cited earlier, is approximately 3.6 mc.

Commenting on the CBS technique, Jensen declared that it appeared that the decision to use 405 lines vertically was made in order to effect a more equal distribution of vertical and horizontal resolution. Explaining this point, he described how a complete single color frame takes 1/72 second and one single color line is completed in 1/72 x 405 seconds or 34.3 microseconds; a single line in a standard black and white picture is completed in 63.5 microseconds. Since both pictures are going to be transmitted in the same video bandwidth, Jensen stated, the horizontal resolution in the two will therefore bear the same relation as the number of microseconds mentioned above. In other words, he said, the Columbia color system will have a horizontal resolution of 34.3/63.5 or about 55 per cent of black and white. Accordingly, declared Jensen, the Columbia system color pictures, when transmitted in the 4-mc video channel, will have a blurring due to motion 25 percent higher than black and white, and it will have a vertical resolution which is 80 per cent of black and white, and a horizontal resolution which is 55 percent of black and white.

Analyzing the RCA approach to the problem, Jensen cited the tests of '47 which demonstrated that the eye was not able to distinguish individual colors in the finest details of a picture. The eye can distinguish between different shades of brightness; but in a more or less monochromatic fashion. It was therefore decided to divide the frequency band of the individual color channels into two parts: a low band from 0 to 2 mc, and a high band from 2 to 4 mc; the 2 to 4 mc components of the three-color channels thus could be combined directly at the transmitter and reproduced as a panchromatic black and white 2 to 4 mc component, furnishing the fine detail at the receiving end.

With this technique as a basis of reasoning, it was felt that the remaining 0 to 2 mc components could be sampled at intervals of ¼ microsecond and they could be sent in the order of red, green, blue in the first frame; green, blue, red in the second frame, and blue, red, green in the third frame, and thus complete a color picture in 1/10 of a second.

Actually, Jensen said, RCA has chosen to complete a picture in 1/15 of a second: The 2 to 4 mc components are sent as mixed highs; the 0 to 2 components of the three color signals are sampled at $\frac{1}{4}$ microsecond intervals (actually 3.6 mc) and transmitted as four 1/60 second fields. In each successive field the individual color dots are $\frac{1}{4}$ microsecond apart, but the third field is staggered one-half a dot with respect to the first field, and the fourth field is staggered one-half of a dot with respect to the second field.

When all four fields are correctly superimposed, it was shown we have in each line the color sequence green. blue, red, at $\frac{1}{8}$ microsecond intervals. Individual color dots in each line are repeated at $\frac{3}{8}$ microsecond intervals. Taking this as a Nyquist interval, we were told, this represents color information corresponding to a bandwidth of 8/3 x 2 or 1.33 mc.

Accordingly, indicated Jensen, it would seem that from 0 to 1.33 mc the color information is presented correctly at the receiving end, and from 1.33 to 2 mc the picture is presented as predominantly black and white. The color information at the receiving end is not correct, he said, and from 2 to 4 mc the received picture is predominantly black and white.

In his conclusion. Jensen declared that with 10 complete frames per second it should be possible to obtain horizontal color detail equal to that of black and white; with 15 frames per second the horizontal color detail should be at least two-thirds that of black and white, for a pure dot sequential system. And introducing the principle of mixed highs, he said, probably increases this horizontal definition to somewhere between two thirds and one times that of black and white.

SOUND-PROOF NEWS ROOM

Sound-proofed open-door phone booth in use as a broadcast studio in the newspaper offices of the Sharon Herald, Sharon, Pa., who operate WPIC. Compact studio is a Scout Model Acousti-Booth, developed by the Burgess-Manning Co.

Lower Sideband Measurements

(*Continued from page* 15)

the antenna and adjusted to obtain the same output. The amplitude of the signal may then be read directly from the signal generator. It is imporant that the antenna used be flat for all frequencies at which measurements are to be made, and that the transmission line between the antenna and receiver be well terminated at the receiving end. If the receiver-input impedance is not definitely known to be constant and of the proper value, an attenuating pad may be used at the receiver input. Line termination may be checked by measuring a sideband with a given length line. and then repeating the measurement several times with short lengths added to the line. The results must be identical in all cases. It is also possible that the reflected signals at the antenna may affect the measurements; thus, before a complete set of data are obtained at any one location, tests should be made to determine the propagation characteristics with respect to multi-path phenomena.

Measurements may also be made with the transmitter operating into a dummy load, although this method does not take into account the antenna characteristics. In this case, the receiver may be coupled to the output transmission line by means of a small loop or probe. The coupling should be made very small so that the transmitter output will be unaffected. The precautions previously outlined, as to the termination of the transmission line to the receiver, should also be observed. In this case, direct pickup of energy by the receiver may cause difficulty, and must be checked by operation with the input transmission line disconnected. If the receiver response is observed under this condition, more adequate shielding is required.

[*To Be Continued*]

AT IRE CONVENTION

Donald B. Sinclair, chief engineer of General Radio Company, demonstrating a reversible motor control system to FCC Commissioner Frieda Hennock, during her tour of the IRE convention at the Grand Central Palace.

TV Parts and Accessory Review

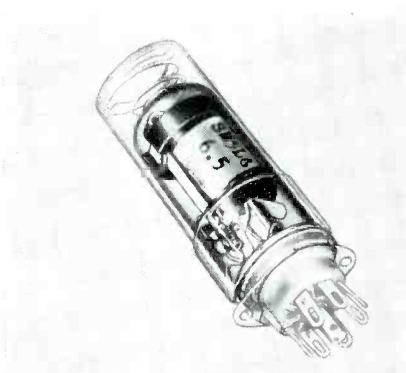
Flat Metal Encased Wire-Wound Resistors

A FLAT, METAL-ENCASED, wire-wound power resistor has been designed. Resistor is space wound, has mica rather than phenolic insulation, and is encased in aluminum for mounting flat against a metal chassis to assure maximum heat dissipation. At 175° C continuous operating temperature these units are said to be conservatively rated for 7½ watts in still air and 15 watts when mounted on a metal chassis.—*Type 265A; Shallcross Manufacturing Co., Collingdale, Penna.*

Shallcross flat wire-wound resistor.

SPDT Plug-In Midget Relay

A SPDT PLUG-IN super midget relay requiring ⅞" chassis space and permitting use with a miniature socket and shield with inner spring has been developed. Relays may be mounted in any position without danger of working out of the socket. They are available with coil power ratings up to 1.75 watts and with dc windings from 0.155 to 8000 ohms. Minimum adjustment to pull in on 3 milliamperes at 75 milliwatts. Hermetically sealed in miniature tube glass envelopes with standard 7-pin bases. Available also in open construction type with single-screw mounting. — *SM model series, G version; Potter & Brumfield, Princeton, Indiana. For further details, write to Ralph Brengle, general sales manager and ask for bulletin 102.*

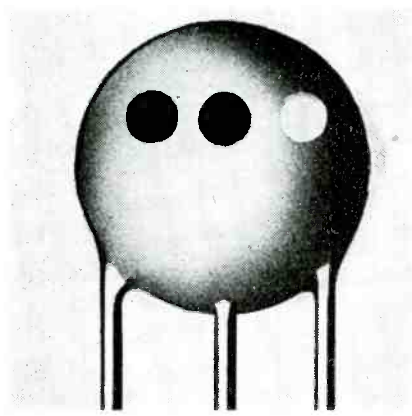


Potter and Brumfield plug-in relay.

Ceramic Capacitors

CERAMIC DISC CAPACITORS in dual 1000, 1500, 4000 and 5000 *mmfd* values are now available. These are in addition to a line of single 1000, 1500, 5000 and 10,000 *mmfd* types, announced previously.

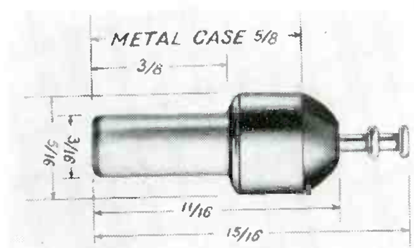
Duals measure ½" in diameter; single values are ¼" to 9/16" in diameter.—*Type Discap; Radio Materials Corp., 1708 W. Belmont Ave., Chicago 13, Ill.*



RMC dual disc ceramic capacitor.

Metal-Clad Standoff Capacitor

A METAL-CLAD STANDOFF CAPACITOR, with a capacity of 1500 *mmfd* ± 500 *mmfd*, with a solid axial terminal, has been designed. Features a ceramic tube enclosed in a cadmium plated metal case with a specially developed end seal which is said to provide protection against humidity and temperature changes.—*MCS type; Electrical Reactance Corporation, Franklinville, N. Y.*



ERC metal-clad standoff capacitor.

Receiving Tube Sockets

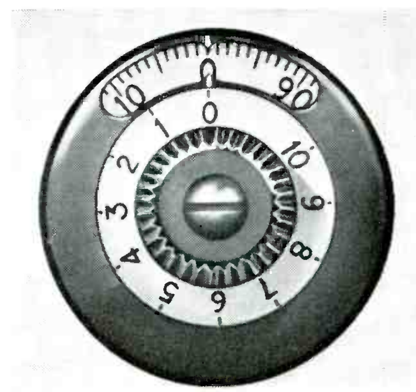
RECEIVING TUBE SOCKETS conforming to the standards of RMA and the Underwriter's Labs for a wide range of miniature and GT type tube circuit applications have been announced.

Socket types supplied include T5½, T6½ and octal with 7, 8 and 9 cadmium plated brass contacts; general purpose or low loss shielded or unshielded phenolic bases; with or without center shield, and with or without ground lugs on cadmium plated or hot tin finish saddle, for top or bottom chassis mounting.—*Parts Division, Sylvania Electric Products, Inc.*

Ten Turn-Counting Dial

A TEN TURN-COUNTING dial designed primarily for use with *Micropot* ten-turn potentiometers, and applicable to any multi-turn device of ten turns or less is now available. It is composed of two concentrically mounted dials, one for counting increments of each turn and the other for counting turns up to ten. The incremental dial has 100 equal divisions and is attached rigidly to the shaft, so there is no backlash. Thus the contact position is said to be indicated to an indexed accuracy of 1 part in 1000.

The dial is delivered completely assembled with turn-counting and incremental dials synchronized ready to place on the shaft. Requires 1¾" diameter of panel space.—*Microdial; Gibbs Division, The George W. Borg Corp., Delavan, Wisc.*

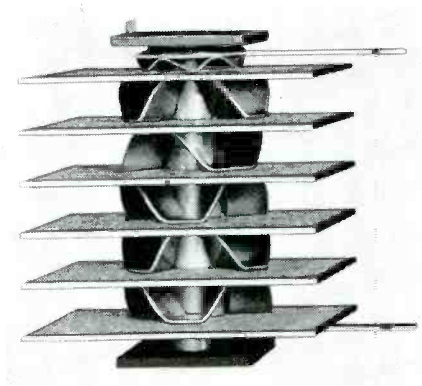


Microdial ten turn-counting dial.

Selenium Rectifiers

A LINE OF CENTRE-KOOLED selenium rectifiers has been announced. Center-cooling feature is provided by a special spacer between the cells which is said to insure lower over-all operating temperatures by allowing air to reach the portions of the cells in which the current density is the greatest. Other features are: constant assembly pressure under all operating conditions, universal locating lug and a constantly high-resistance path to ground under all atmospheric conditions.

Sixteen models are available ranging from units rated at 65 milliamperes at 130 volts to units capable of handling 450 milliamperes at 130 volts.—*Sarkes Tarzian, Inc., Bloomington, Indiana.*

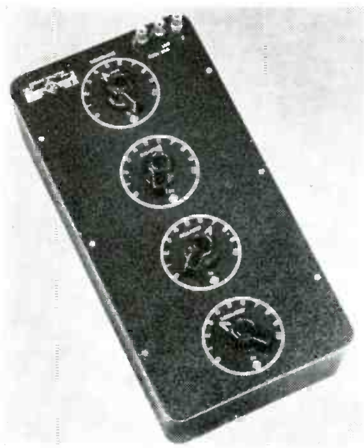


Tarzian selenium rectifiers.

Instrument News

Decade Inductors

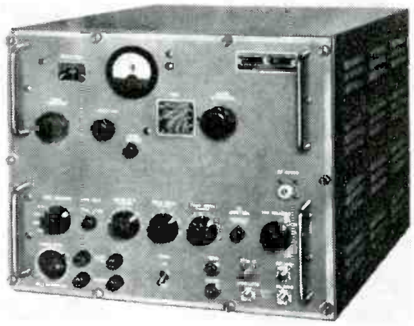
SINGLE-DECADE UNITS for building into other equipment and in three- and four-decade cabinet assemblies for laboratory use have been developed. Inductors are said to provide precise decade steps of inductance from one millihenry to one henry per step. Cores are molybdenum permalloy dust toroids with precisely adjusted, banked windings. Temperature coefficient of inductance is -24 parts per million per degree *C* over the normal range of room temperatures, and maximum storage factor, *Q*, is between 200 and 330. Accuracies range from 2% for the one-millihenry steps to 0.25% for the one-henry steps.—*Type 1490; General Radio Co., 275 Massachusetts Ave., Cambridge 39, Mass.*



G-R decade inductor.

Broadband Microwave Signal Generators

BROADBAND SIGNAL GENERATORS covering in two units the frequency range from 3,650 to 10,900 mc are now available. Each of these units employs a tunable coaxial cavity oscillator incorporating a Raytheon type 5721 klystron. The resonant frequency of the oscillator is controlled by a front panel dial engraved to read directly in frequency. Provision is made for *cw*, FM and pulse operation as well as for external modulation.—*Types 902 and 903; Polytechnic Research and Development Company, Inc., 202 Tillary St., Brooklyn 1, New York.*



Polytechnic microwave signal generator.

Generator and Bridge for Tests Between 10 and 500 Mc

A VHF SIGNAL GENERATOR with a master oscillator power amplifier circuit, has been developed to provide a directly calibrated output from 0.1 microvolt to 1.0 volt for measuring gain, selectivity, sensitivity or image rejection of receivers, *if* amplifiers, broad band amplifiers or other *vhf* equipment. The 1-volt output (into a 50-ohm load) is said to be useful over the entire frequency range for driving bridges, slotted lines, antennas, filter networks, etc. The output circuit is directly calibrated in volts and dbm.

Frequencies from 10 to 500 mc are covered in five bands, calibrated directly in mc on a drum-type dial having an effective scale length of 90". Has a single-dial, ball-bearing frequency control. The instrument also offers microsecond pulses, wide modulation capabilities, small residual FM, and has *cw*, AM or pulsed output.

Also available is a bridge which provides direct readings in the 50 to 500 mc band. It operates on a new principle suggested by John Byrne of Airborne Instrument Laboratories, and determines impedance by sampling the magnetic and electric fields of a transmission line.

Instrument offers direct impedance readings from 2 to 2,000 ohms. Its primary frequency range is 50 to 500 mc, but it is useful at frequencies up to 1,000 mc and down to 5 mc.—*Model 608A vhf signal generator and 803A vhf bridge; Hewlett-Packard Co., 395 Page Mill Road, Palo Alto, Calif.*

H-P vhf signal generator (above).

Sweep Signal Generator

A SWEEP SIGNAL generator has been designed for servicing FM and television receivers.

Instrument incorporates electronically controlled sweep circuits. Has an FM sweep range from 0 to 600 kc; television sweep, 0 to 15 mc. Fundamental output frequencies range from 2 to 230, in four bands.

Output is at least 100 millivolts on all bands controlled by an attenuator. Double shielding is used to prevent signal leakage and good frequency stability is said to be assured by a voltage regulated power supply. Wide-range phasing control permits adequate adjustment for single 'scope response curve. Voltage for driving or synchronizing horizontal 'scope deflection is provided. — *Radio Tube Division, Sylvania Electric Products, Inc., 500 Fifth Ave., New York 18, N. Y.*

Crystal Calibrator

A CRYSTAL CALIBRATOR has been designed for the frequency calibration of signal generators, transmitters, receivers, grid-dip meters and other equipment in the range of 250 kc to 1000 mc. The frequency accuracy is said to be ±0.001%.

Unit, a dual-purpose calibrator, provides a test signal of crystal-controlled frequency, and has a self-contained receiver with a sensitivity of 2 microwatts.

A new circuit arrangement utilizes the cross-modulation products of three separate oscillators operating at the fundamental frequencies of .25, 1.0 and 10 mc. This system is said to extend the usable range of harmonic frequencies far beyond that of previously available equipment.

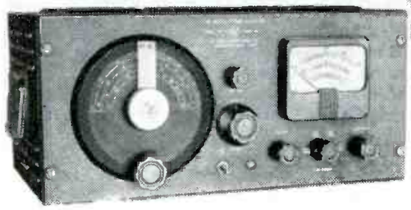
Dimensions: 6" wide, 8" high, 5" deep.—*Model 111; Measurements Corp., Boonton, N. J.*

Measurements crystal calibrator.

Modulation Monitor

AN INSTRUMENT FOR MEASURING the frequency departure of FM emergency services transmitters under modulation has been announced. Designed to cover continuously 30 to 50 mc, 72 to 76 mc, and 152 to 162 mc in four bands, making it possible for the one instrument to be used in checking transmitters on widely separated frequencies or on different bands.

Coarse and fine tuning controls permit precise adjustment to the carrier frequency. Either upward or downward swing can be measured up to 20 kc with an accuracy of better than one kilocycle on 4" meter. This meter is also used as a tuning indicator. An audio output is provided so that the instrument may be used as an aural monitor or a visual monitor when used in conjunction with 'scope. The sensitivity of the instrument is said to make possible measurements with less than 1 millivolt present on the antenna terminals.—*Model MD-25; Browning Laboratories, Inc., Winchester, Mass.*



Browning modulation monitor.

Production Aids

Rubber Anode Connectors

ANODE CONNECTORS can now be processed by injection molding, the manufacturer claiming that the process enables them to hold closer dimensions, tolerances and greater uniformity in production than has previously been possible. A special television rubber compound has been developed to provide heat resistance, corona resistance and high dielectric. Special aging chemicals are said to afford good flexibility after prolonged use.—*Minnesota Rubber and Gasket Co., 3630-T Wooddale Ave., Minneapolis 16, Minn.*

Injection molded rubber anode connectors.

Test Clip

A TEST CLIP for testing assembly line products and for experimental apparatus in labs has been produced. Can be permanently mounted on the panel of any test equipment or, for one-time applications, can be mounted temporarily.

Said to require no additional operation, such as opening or closing jaws. Leads are slipped in or out of clamp type jaws. Spring action holds wire until the operator pulls out the lead.

Tension of the spring action is adjusted by tightening a hex nut that mounts the clip to the panel. Two hex nuts are included with each clip for mounting purposes and wire attachment.—*Grayhill, 4524 W. Madison St., Chicago 24, Ill.*

Aluminum Electrode

ALUMINUM ELECTRODES which are claimed to have the highest tensile strength of any aluminum electrode ever made, 34,000 psi, have been produced.

Material is said to *handle* almost as easily as a mild steel electrode. Weld puddle is visible at all times, because there is said to be no blinding smoke to screen the work.

Rod is said to deposit metal rapidly and smoothly, with good color match and corrosion resistance. It is available in 1/8-inch and 3/16-inch sizes.—*Eutectrode 2101: Eutectic Welding Alloys Corp., 40 Worth St., New York 13, N. Y.*

Flexible Shaft Machine

FLEXIBLE SHAFT MACHINES which can be hung up on the bench or mounted under the bench have been announced. Flexible shaft runs in a metal casing reinforced with oil-resistant neoprene.

A choice of five handpiece types is afforded, pencil-size or larger, all with a quick-detachable feature, permitting the use of different types on the same machine. Motors are rated 1/15 *hp.*—*Series 900; Foredom Electric Co., 27 Park Place, N. Y. City.*

Power Screw Driver

A POWER SCREW DRIVER has been produced for high-speed mass production lines. Features hopper feeding, driving speed of more than one screw a second in the smaller sizes, uniform tightening torque and a minimum of *down time* for conversion or adjustment.

Practically all types and styles of screws in sizes ranging from No. 1 x 1/8" to 1/4" x 3/4", are accommodated by the hopper and driving spindle of the driver. Installation of the unit consists of plugging into a 110-volt outlet and connecting to a compressed air supply line.

Operation of the driver involves placement of screws in the hopper, locating the part to be fastened beneath the driving spindle and lightly pressing air pedal to drive the screw. Hopper feed positions each screw properly for traveling down the track to the bit where the screw is held in place until one or two threads are engaged. As the desired torque is reached the clutch disengages automatically. When the operator releases the foot pedal the spindle returns for another screw.

Breaking or scarring of work is said to be eliminated because the automatic clutch prevents over-tightening of the screw. Another feature is said to be the mechanism which enables the operator to release a jam caused by a wrong-sized screw without delay or damage to the machines.—*Shakeproof Inc., Division of Illinois Tool Works, 2501 N. Keeler Ave., Chicago 39, Ill.*

Shakeproof power screw driver.

15 Contact Connector

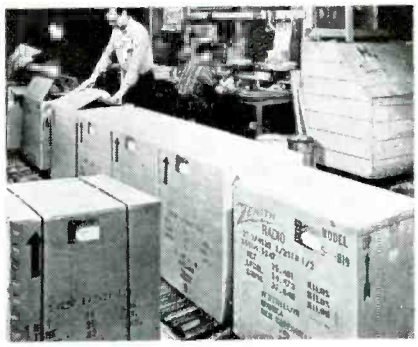
A MINIATURE 15 CONTACT connector is now being marketed. Over-all dimensions of connector, which may be procured with or without shell mounting, are 3/4"x1 1/2"; the shell is 1 5/8" high.

Connectors are molded of high grade mineral filled dielectric. Female contacts are of beryllium silver plated; male contacts are of silver plated brass. Cables up to 9/16" can be accommodated by the mounting shell.—*American Phenolic Corp., Chicago 50, Illinois.*

Reinforced Fibre Tape Strap

A GUMMED paper tape featuring reinforcing fibres which run the long way of the tape, sandwiched between two layers of Kraft paper, affording a tensile strength of 180 pounds for each inch of width is now available. Made in widths from 1/2" to 4".

Tape is said to be so strong that it need be used only at the points where special reinforcement is needed. It has been found possible to seal containers with three short strips, top and bottom.—*Tape-Strap; Mid-States Gummed Paper Co., 2515 S. Damen Ave., Chicago 8, Ill.*



Sealing Zenith Radio export cartons with Tape-Strap. Operation is said to take one minute in comparison to four minutes required to seal and strap with metal.

Electrical Cable Reels

A PORTABLE REEL for the handling and transporting of heavy electrical cables has been designed.

Available with a 2-wheel hand truck, consisting of a handlebar and separate axle with two rubber-tired wheels. Can be used without the hand truck; twin handles of combination handle and cord guide are said to make two-man carrying of heavy cable a simple operation.

Feature of reel frame is welded tubular steel construction with supports as sled runners to facilitate moving the reel in and out of trucks, tool rooms and about the job location.

Reel is rated at 75 amps at 220 volts and is designed for use with any phase current. A collector ring permits winding or unwinding of cable without interrupting service. Rings are of heavy beryllium copper with double constant contact brushes seated in a phenolic casting and housed in metal. The reel comes with either 3 or 4 collector-rings as standard.

Capacity of the reel is governed by the size cable used. Examples of capacity are: 300' of 3/4" diameter No. 12, four conductor cable, or 3,200' of two conductor shielded microphone lead cord.—*Model 3000 Powereel; Dept. A108, Industrial Electrical Works, Omaha, Nebraska.*

Polyethylene Extrusions

PRODUCTION OF POLYETHYLENE FILM, sheeting and seamless flat tubing has been announced.

Films and tubing are said to permit application as protective sheeting, electrical insulations, etc.—*Ivithene; Fibron Division, Irvington Varnish and Insulator Co., Irvington 11, N. J.*

Veteran Wireless Operators Association News

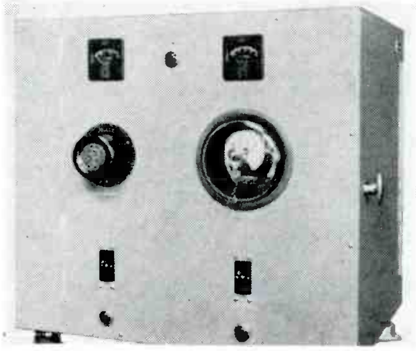
Personals

FROM VWOA OLDTIMER, Pierre Boucheron, has come an extremely interesting memo, commenting on the value of the news provided in these columns, particularly for those somewhat removed from the centers of activities, and reviewing, too, some of his experiences during the past forty-odd years in the wireless business. PB revealed that he was one of the first hams in New York City, along with Armstrong, Eltz, Hudson and Vermilyea, way back in '08. Four years were spent in the amateur field and in 1912, our good friend, who is now with WGL, Fort Wayne, Indiana, as general manager, secured a Certificate of Skill (No. 150) from the Department of Commerce. In August of that year, he went to sea as a wireless operator on the SS Camaguey of the old Ward Line, under the one time United Wireless Telegraph Company setup. For five years, PB sailed the seven seas until World War I in 1917, when he enlisted in the U. S. Naval Reserve Force as an Electrician, Second Class (Radio). He remained in the Naval Reserve between the two wars and when World War II broke, he was called back to active duty. Last year, he retired his commission as a Captain in the USNR. It was certainly good to hear from PB, who is, by the way, a life member of the association, and we hope that he will be reporting to us again in the not-too-distant future. . . . From E. C. Page, another VWOA oldtimer, has also come quite a review of his activities in the art, which began in the days of '15, when he started pounding brass as an amateur. After three years of this activity he set up operation of experimental station 9XBF and in '21 conducted early experiments with 1000-w radiotelephone transmitters on 100 meters. Between '20 and '21, Page served as a commercial radio op for the American Marconi Co. and RCA during the summers on the Great Lakes. In '21, he became a laboratory assistant to Dr. Ray Hall, who was engaged in the development of high-speed radiotelephone recording devices. In '22, ECP joined the test laboratories of Schweitzer and Conrad as an assistant engineer. In 1923, Page had two jobs, one as the manager of the radio service department of Westinghouse in Denver, Colorado, and the other as a radio operator at KFAF. Subsequently, he became manager of the wholesale radio department of the Central Electric Company, who were G.E. distributors in Chicago. In the year '24, Page decided to become a bit of an adventurer and became the chief radio operator on the yacht *Big Bill*, which sailed to the South Seas. The conducting of shortwave experiments, under the direction of the ARRL and Zenith Radio were his pet projects. Shortly thereafter, Page became chief operator of WTAS in Elgin, Illinois. For one year, he also served as chief engineer of WBBM, and in 1925 became involved in the design, construction, and installation of broadcasting equipment. During a period of three years, the transmitters of WSBT, WJJD and WJBT, in Chicago, were all designed and built under his direction. Transmitters in Laramie, Wyoming (KFBU), and in St. Louis, Missouri (KFEQ), also were built under his jurisdiction. In 1928, Page joined the firm of E. A. Beans, during which he supervised the building of stations in Chicago, Fort Wayne, South Bend and Shenandoah, Iowa. The year 1932 saw Page in business for himself, taking over the E. A. Bean organization and founding his company, E. C. Page Engineers. In 1937, he formed a partnership with George C. Davis, who was at that time a hearing engineer of the FCC. In February of '42, he received his commission as Captain in the Signal Corps, and for three years was actively engaged in a variety of operations throughout the world, including a mission with British Field Marshal Alexander, serving as *Staff Officer Wireless*, and was responsible for all the radio plans in the operation known as *Husky*, employed during the Sicilian Invasion. After leaving the service in '45, he became vice president in charge of engineering of the Mutual Broadcasting System. Two years later, he resigned and returned to private practice in the partnership E. C. Page Consulting Engineers, which, we are happy to report, has had significant success.

SUPER-POWER BEAM TRIODE

Dr. L. P. Garner, head of the RCA Lancaster tube plant's advance development section, directing the lowering of the anode-envelope assembly of the 5831 which has a 500 kilowatt output, due largely to the arrangement of electron optical systems which constitute the heart of the new tube. This design in effect concentrates 48 separate triodes in relatively small space.

FIELD POWER CONTROL UNIT



A power control unit designed for mobile television pickup equipment, which provides power consumption readings and permits regulation of both input and output voltages from a central point in the mobile unit. It is said to be capable of operating from any two-wire system providing input voltages between 100 and 120 volts, or between 200 and 220 volts, 60 cycles at 5 kva. Unit is shock-mounted and designed for mounting in the television truck.

(Courtesy RCA)

TV Broadcast Equipment

Projection Equipment

A SUPERSPEED TYPE PROJECTOR, which features an extremely fast pulldown mechanism, is now available. Projector has an intermittent sprocket which pulls down in approximately 2,000 microseconds, thus effectively reversing the present light-duty cycle and allowing pulldown during the blanking period of the tube.

Projector can be used as a direct projector for an image orthicon camera pickup, providing a film chain, which it is claimed, is free from the spurious signal and shading problems inherent in present iconoscope pickup chains.

Projector can also be used as a background projector for studio production. Moving scenery can be projected upon a translucent screen behind the actors.

Projector is available in two models: a universal model, mounted on a movable pedestal, equipped with a 100-watt lamp for direct projection to image orthicon equipment, and a 1,000-watt lamp for rear-screen projection; heavy-duty model pedestal-mounted and equipped with an arc light and 1,000-watt projection lamp for rear-screen projection up to 12' x 15'.—*DuMont-Holmes Superspeed; TV Transmitter Division, Allen B. DuMont Labs, 1008 Main Ave., Clifton, N. J.*

Plastic Tape Reels

PLASTIC REELS for tape recording machines have been produced.

Reels, which are said to be moisture-proof, are obtainable in 5" and 7" diameters for 1/4" tape.—*Amerline, Inc., 1753 N. Honore St., Chicago 22.*

Field TV Camera Chain

A LIGHTWEIGHT field television camera chain, which incorporates a 5820-image orthicon, is now available. Has an electronic view finder unit which plugs in and clamps to the camera unit. All units are packaged in suitcase type containers of approximately the same size.—*Type CV-2; Polarad Electronics Corp., 100 Metropolitan Ave., Brooklyn 11, N. Y.*

Polarad Electronics field TV camera chain.

Personals

Lynn C. Holmes, who has been senior electrical engineer in the Stromberg-Carlson research laboratory since he joined the company in 1943, has been made associate director of research and will share with director Benjamin Olney the guidance of the firm's research activities.

Roy D. Haworth, Jr., is now manager of product development of the Carbide Alloys Division of Allegheny Ludlum Steel Corp.

Haworth was formerly employed by Armour Research Foundation in Chicago as supervisor of abrasion research.

Roger Bowen, formerly with the U. S. Signal Corps., has become chief engineer of Cannon Electric Development Company, Los Angeles, Calif. *D. Frank Jackson*, who has been acting chief engineer since the death of Edward Neifing in 1947, will continue in the engineering department as chief assistant to Bowen.

Roger Bowen

Dr. Antonio R. Rodriguez has become head of the ceramic laboratory of the Electrical Reactance Corp., Franklinville, N. Y.

Dr. Rodriguez was formerly research engineer for the American Lava Corp.

James L. Fouch has been named manager of the Cinema Engineering Co., Burbank, Calif.

J. L. Fouch

D. Y. Robinson is now a rep in New York for the Webster Electric Company's sound division, at 347 Madison Avenue, New York City.

C. A. Lauder has been named plant manager of the Toledo Dorr-Westwood unit of Kimble Glass Division, Owens-Illinois Glass Co., Toledo, Ohio.

Ernest Kohler, formerly with Raytheon, has joined the engineering staff of the Oak Manufacturing Co., Chicago, Ill.

Walter E. Poor, chairman of the board of Sylvania Electric Products, Inc., died recently.

At the time of his death, Mr. Poor was a director of the Sound-Scriber Corp., New Haven, and member of the Committee on Corporations of the Development Fund of MIT.

Industry Literature

Soldering Specialties, Summit, N. J., have published a 4-page bulletin, *How To Speed Up Soldered Assemblies With Solder Pre-Forms*. Arranged to tell the what, how, and when of the uses of pre-formed solder shapes. Has a special illustrated chart which shows applications in diverse fields and instances.

Cinema Engineering Co., Burbank, Cal., has issued a 36-page catalog, 11AX, covering precision wire-wound resistors and resistive devices for sound equipment. Charts, tables, photographs and schematic drawings are featured.

The Insulation Manufacturers Corp., 565 W. Washington Boulevard, Chicago, Ill., have prepared a 128-page catalog, describing tapes, tubings, sleevings, varnished cloths, mica, papers, plastics, cordage, etc.

The Chemical Manufacturing Division of The M. W. Kellogg Company, P. O. Box 469, Jersey City, N. J., have released a technical bulletin, 1-12-49, describing the physical and mechanical properties of KEL-F, fluorocarbon-type thermoplastic. Data include information on physical properties and water vapor transmission rate of KEL-F film, as well as tables concerning some of the characteristics of the material when plasticized with low molecular KEL-F.

The Barry Corp., 179-5 Sidney St., Cambridge. 39, Mass., have issued catalog 502, which illustrates and describes unit-type air-damped *Barry-Mounts* and mounting bases used to protect electronic equipment against shock and vibration encountered in aircraft applications. Listings include unit mounts and bases conforming to U. S. Government specifications. Presented are photos and dimensioned drawings, plus tables of available load ratings.

Electro-Voice, Inc., Buchanan, Mich., have released a bulletin, No. 86, illustrating and describing the E-V 335 blast filter designed for use with E-V models 630, 635 and 605 dynamic microphones.

Ward Products Corp., 1523 E. 45 St., Cleveland 3, Ohio., have published a 16-page booklet, *The Story of the Magic Wand*, covering *antenna development, theory of propagation and transmission, basic antennas, parasitic arrays, all-channel antennas, high-gain broad-band antennas, indoor antennas, unidirectional all-channel antennas, matching and balancing, transmission lines, and conical antennas*

The General Radio Co., 275 Massachusetts Avenue, Cambridge 39, Mass., have released a circular describing *Variac* voltage controls.

The Hewlett-Packard Co., 395 Page Mill Road, Palo Alto, Calif., have released the seventh issue of the *HP Journal* in which appears a description of a 10-500 mc AM signal generator.

The Ward Leonard Electric Co., Mt. Vernon, N. Y., have released an assortment of bulletins covering ribbon resistors, multipole midget relays, speed regulators, *ac* manual starters, and *ac* magnetic starters.

ADVERTISERS IN THIS ISSUE

TeleVision Engineering

APRIL, 1950

Briefly Speaking . . .

TV was quite a featured item at the 1950 conference of the NAB at the Hotel Stevens in Chicago. With exhibit after exhibit displaying a variety of TV developments, the large exhibition was truly a television showplace. On view were such advancements as a flying-spot scanner for reproducing 2" square slides. Also on exhibit was a device called a *Genlock*, designed to permit stations to switch, lap dissolve and superimpose remote programs with studio programs without phase adjustment problems. . . . TV's sensational expansion received an intriguing commentary from Dr. W. R. G. Baker, during the recent visit of the International Radio Consultative Committee. Reporting to the forty-odd representatives from fifteen nations, Doc Baker said: "The growth of the television industry from infancy to a billion-dollar business in a period of four years has been the most rapid of any industry in our recent history. This industry has grown far more rapidly than the automobile and refrigerator industries. Even radio, which exhibited a phenomenal growth curve in its early years, took about twice as long to reach comparable volume." . . . Television was also a major subject at the seventh annual conference of the U.S.A. RMA and the Canadian RMA held in Quebec. Chairman Max F. Balcom of the RMA television committee and RMA's prexy, R. C. Cosgrove presented a comprehensive report on the color television hearings in Washington. . . . Several unusually interesting and informative reports on components and equipment have been prepared by the National Bureau of Standards. In one report appears an analysis of a recording microwave refractometer, an instrument which measures and records small differences in frequency between two resonant cavities. Developed by George Birnbaum, the instrument can be adjusted over a wide band of microwave frequencies for measurement of dielectric constants of lossless gases and changes in the dielectric constant of such gases and very low-loss liquids and solids. Another report describes a method of improving the performance of certain types of thickness-shear quartz plates by coating their surfaces with an inert material. In a third report appears a review of an instrument which provides an instantaneous visual display of tube's characteristics. Developed by Milton L. Kuder of the Bureau, the device, actually a curve generator, plots directly on a screen of a 'scope the family of plate current versus plate voltage curves for any receiving tube. . . . The U. S. Army Signal Corps has announced the development of a milli-microsecond pulse generator. . . . The 1950 convention of the Armed Forces Communications Association will be held in part at Fort Monmouth, New Jersey, and in the Hotel Commodore, New York City. The New York City dates are May 12 and 13. . . . Charles Singer, assistant chief engineer of WOR, presented a talk on the construction problems encountered during the building of WOR-TV before a joint meeting of the AIEE and IRE in N. Y. City. . . . Eight popular models of Government-surplus FM receivers and transmitters are described in a manual issued by the Office of Technical Services of the U. S. Department of Commerce. . . . The Workshop Associates, Inc. have moved into a new building located on Crescent Road, Needham Heights, Mass.