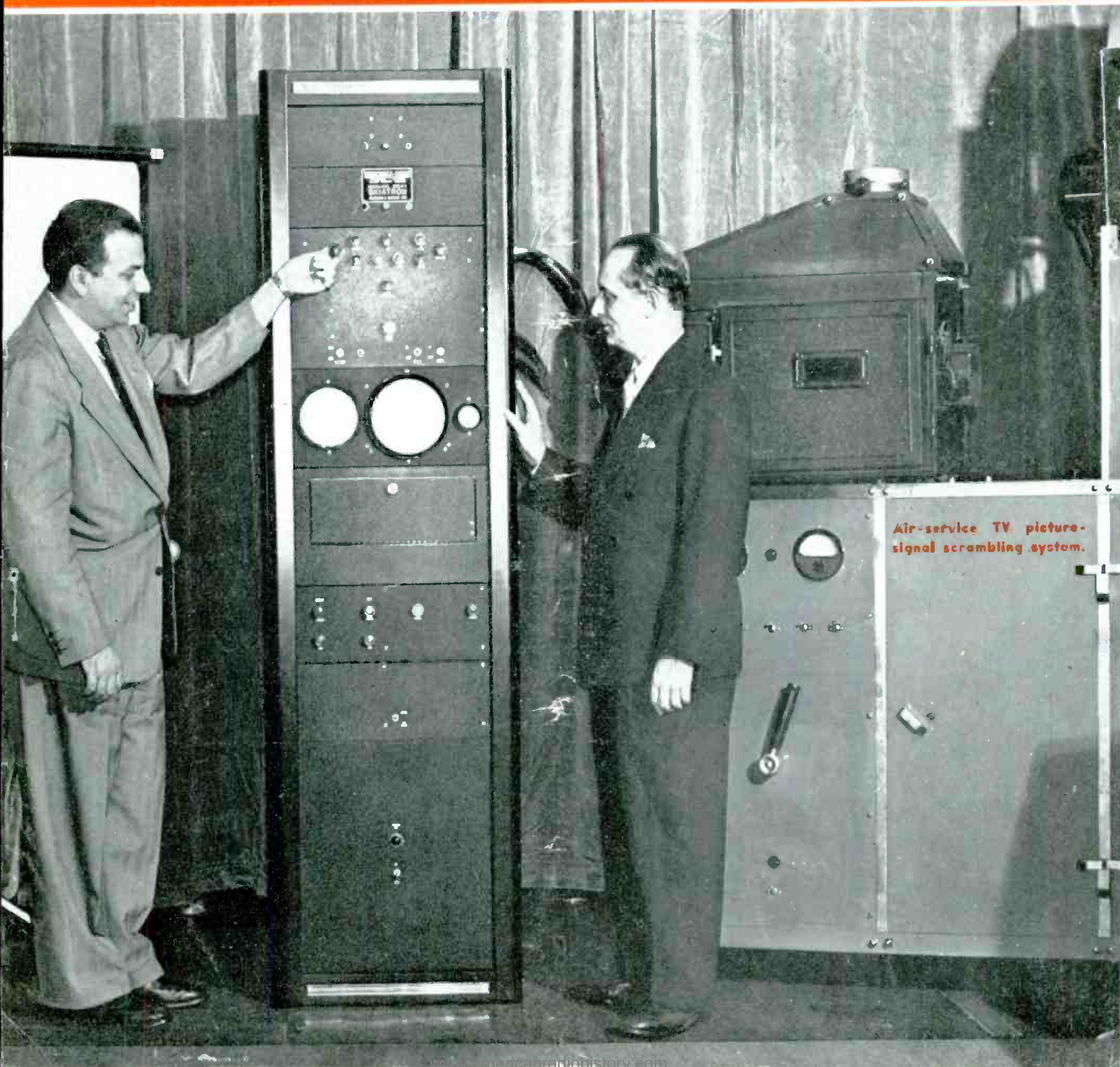
TELE-VISION ENGINEERING

OCTOBER, 1950



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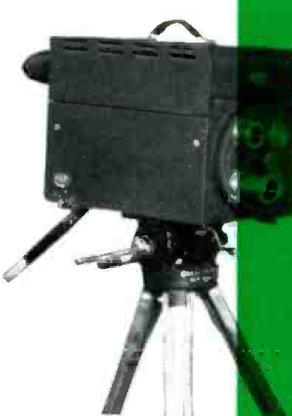

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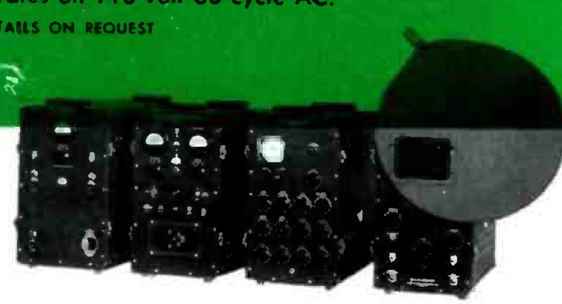

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Research . . . Design . . . Production . . . Instrumentation . . . Operation

VOLUME 1 **OCTOBER, 1950** **NUMBER 10**

MONTHLY FEATURES

Cover Illustration

Adjusting level controls of air-service subscriber-vision coding modulator used to scramble picture content. System is now being tested over WOR-TV during off hours. At controls, Ira Kamen, and looking on, Arthur Levey, president of Skiatron Corp., who produced the equipment. (*See page 6, this issue, for further details.*)

***Editor:* LEWIS WINNER**

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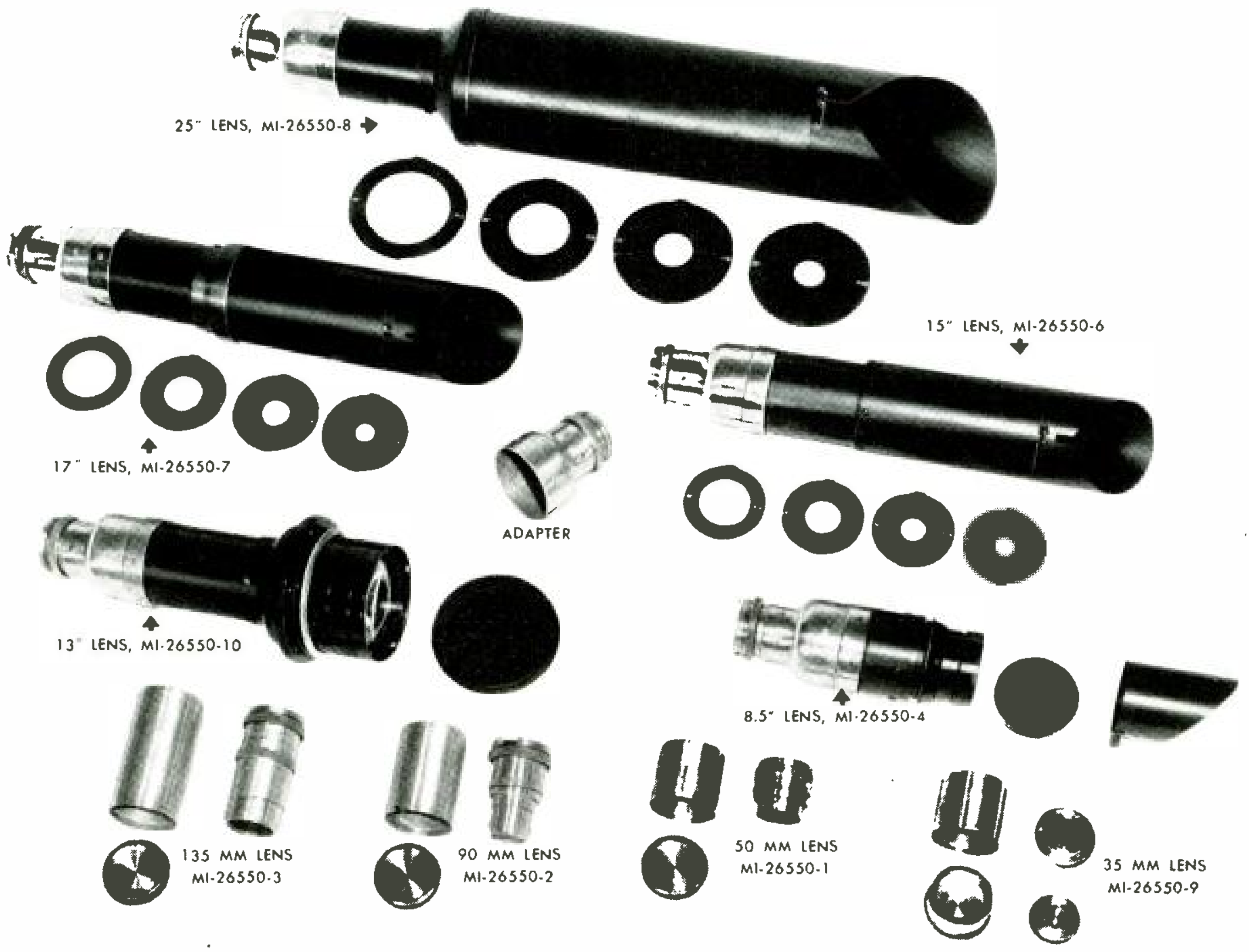

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8½"	studio and field	f/3.9	8°	MI-26550-4
13"	studio and field	f/3.5	5°	MI-26550-10
13"	field	f/5.0	5°	MI-26550-5
15"	field	f/5.0	4.5°	MI-26550-6
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TELE-VISION ENGINEERING
LEWIS WINNER, Editor

October, 1950

Engineering and Program Planning

In the Planning of a Program involving only aural considerations, the engineering attention required is comparatively moderate, with technical assistance normally allotted only to microphone placement and perhaps adjustment of acoustical wings, if such prevail. In the video studio, however, the situation is a taxing one for the engineering and production departments. Referred to as a joint dilemma, the slide-rulers and the grease painters have found it necessary to analyze continually the variety of variables that seem to crop up on every show.

In England, at the BBC studios, the problem has received considerable thought and many interesting answers have been evolved. Discussing these solutions in a paper before the radio section of the BIEE during a visit of the delegates of the television study group of the CCIR, Norman Collins of BBC said that they felt that in TV a single production unit actually exists. It is impossible to note at any stage between the designing of a set, its lighting, the operation of the cameras, and production at the control panel, where art ends and science begins. It was Collins' belief that singleness of control of both program and engineering staffs was desirable., and therefore, the status of the studio operational staff should receive a rather specialized type of recognition, as distinct from the orthodox nod given to standard engineering personnel.

Reviewing the problem of sight and sound studios, the BBC engineer declared that larger and more studios are essential in all TV operations. For the operation in England, it has been found that a 100 x 50 x 25-foot size was the minimum which should be applied for good general purpose studios, and at least three of these are required for minimum practical production work.

Probing the specific requirements of the sound studios used in standard broadcasting and TV, Collins declared that actually there was little comparison between the two. A television studio is useless, he said, unless it has scenery-construction workshops, dressing rooms, wardrobe and makeup rooms all adjoining, with preferably both studios and scenery-construction workshops on the ground floor.

Citing typical studio shortcomings, listed by television producers, the lecturer disclosed that the greatest need was for increased depth of focus without increase in lighting. It was also pointed out that most producers were very concerned with the variations in tone response between camera tubes of the same type. Commenting on studio acoustics, Collins stated that microphones especially adapted for TV were a *must* factor. He placed high on the list of priorities, the need for research into artificial scenic devices and the need for the mechanical development of camera-cranes, dollies and sound booms, the development of which has been carried on quite extensively in this country. Most modern studios here employ highly efficient video, aural and lighting facilities which provide for rapid, smooth equipment shifts, even during complex production operations. And, the move to further streamline these facilities continues at an excellent pace.

Standardization of receiver controls and other elements in the studio were also emphasized by Collins. The move to provide for standardization in this country has gained considerable momentum, thanks to the efforts of the TBA and other interests, and it is expected that a broad, practical plan of standardization may be available soon.

The Second Ad Hoc Report

Once Again, the seventeen members of the energetic Ad Hoc Committee have filed a report on propagation and allocation in the 50-250 mc band, this report covering, in the main, data on methods of evaluating service in the presence of multiple sources of interference. Considered were interference which might result from ignition, diathermy, oscillators of other television receivers, receiver noise and one or more co-channel or adjacent channel stations.

Offering several possible approaches to solutions, one portion of the report declared that the prediction of service to be expected from any station in the presence of a single interfering signal requires the successive evaluation of three factors: the *acceptance ratio* between the desired and undesired signals: *time availability* of the desired-to-undesired signal ratio exceeding the acceptance ratio, and the *probability* with respect to receiving location of receiving a service having a satisfactory time availability. In the opinion of the committee, the minimum acceptable signal-to-interference ratio depends upon the type of service under consideration and upon the character of the interference, which varies widely from individual to individual. In their opinion, it could be concluded that this phase should, in principle, be treated as a population variable.

In a qualitative discussion of the multiple interference problem, the committeemen said that in predicting interference, it must be recognized that the objectionableness of the subjective effect produced on the viewer or listener cannot be simply measured by the number or power or amplitude of interfering signals. For example, interference which produces a beat pattern that is nearly synchronous with the light, field, or frame rate of the desired signal is certainly more objectionable than is non-sync interference with the same energy.

Three members of the committee did not seem to agree with the recommendations offered, declaring that the findings were too complex, too theoretical and impractical for the average engineer who may have to apply the proposed measurements.

However, as one member said, while the new concepts described may not be perfect and may not even stand the test of time, they are based on the best currently available data. Accordingly, therefore, it seems prudent to accept the proposals offered now, so that the freeze might be lifted and video systems expanded for the benefit of the millions anxiously awaiting the service throughout the country.—L. W.

TVE-grams . . .

The Management Front

Hue Dissent: As the wires and airways pulsed with the flaming news that field sequential had won by default and industry, in the main, expressed their violent dissatisfaction over the ruling, the chassis manufacturers learned that two members of the ether jury had dissented and one had done so with a seething contrary opinion, which appeared to express quite vividly how most of the receiver folks felt about the decision. Written by George Sterling, the dissenting report declared that the bracket standards, certainly a new concept in field and line scanning, came as a surprise to industry and was not based on any information which had appeared in the record of the hearings.

Reviewing the bitter correspondence forwarded by industry, the Commissioner declared that manufacturers were simply confused by the bracket-standard comments. Even CBS found it necessary to voice its concern as to the interpretation that might be made of some of the requirements which appeared in the ruling.

Commenting on the serious problems that confronted the plant men, Sterling quoted a letter from Belmont, which stated in part: "We have been unable to find any record in technical literature, nor in our past experience of an attempt to produce a linear sweep for electromagnetic deflection systems covering the wide range of the proposed bracket requirements and at the same time adhering to the proposed requirements of constant picture size and brightness."

Another manufacturer, according to Sterling, declared that the bracket standards covering the full range would require a complete chassis redesign. The Commissioner's views on field testing were particularly significant. He pointed out that the Commission had stressed the need for adequate field testing and yet seemed to be willing to deprive manufacturers of this opportunity. Sterling reported that . . . "manufacturers have a responsibility to the purchasing public, and one of the important criteria of meeting this responsibility is through field testing of products prior to introducing them to the public. The competitive forces in this industry are tremendous and as in all products designed for public acceptance, a manufacturer rises or falls according to the merits of his product. In my opinion, part of a reasonable time table should include the necessity of field testing bracket standards under varying conditions of reception, including temperature, humidity, signal strength, etc."

Pointing out that since neither the Commission nor its staff have the necessary experience in the design and manufacture of TV receivers, Sterling declared that the Commission should take the word of reliable manufacturers, who are willing to cooperate, but unable to meet the Commission's short time table. It was felt that if a reasonable time table had been allowed, the experience of industry could provide wide avenues of improvement.

Citing the mounting problems of production procurement and manpower which industry is beginning to face because of the emergency, Sterling said that this situation should have been considered carefully in weighing industry's response against the decision. According to the Commissioner . . . "The situation on procurement is so acute that manufacturers have been shipping their TV receivers without a full complement of tubes. . . . At least one company has agents in Europe attempting to purchase resistors. . . . This condition, aggravated by others, is bound to have a serious effect on production and will serve only to delay the availability of parts to make not only bracket standards, but also parts with which to build adapters, converters and color receivers."

Declaring that a round-table discussion, perhaps of a two-day duration, would have probably provided the answer to a more realistic time table, Sterling pointed out that such a procedure would have undoubtedly provided a workable plan.

Developmental progress appeared to be seriously disturbed by the Commission's move, in the opinion of Sterling, who bluntly stated that by closing the door at this time, the body has . . . "passed up the opportunity to provide a means of increasing the resolution of color pictures by lowering the field

Below—At the IRE west coast convention audio symposium, left to right: John G. Frayne, chief engineer, Westrix; Bryan Cole, supervisory TV engineer, KFI-TV; and John K. Hilliard, chief engineer, Altec Lansing. Also on panel were Fred G. Albin, supervisor of video recording for ABC; and E. B. Harrison, managing engineer and sales, Peerless Division, Altec Lansing. The symposium led by Hilliard featured discussions of contemporary problems in TV audio. Bryan Cole of KFI-TV revealed that the principal problems were microphone placement, acoustics of sets and studio, reduction of noise in studio, use of smaller rugged microphones, such as the lapel type, and lower noise in microphones and preamps because of distance between microphone and artists.

Below—The IRE west coast convention TV symposium panel, left to right: Robert W. Sanders, Hoffman Radio Corp.; James D. McLean, Philco; FCC Commissioner George Sterling; Cameron G. Pierce, KECA-TV, and Merrill A. Trainer, RCA. During this symposium, it was learned that dot interlace may improve the apparent resolution of the CBS system, present sets might be converted to CBS color for approximately $75.00, and the FCC will propose 150 to 200 kw erp for uhf, instead of adding channels adjacent to present TV bands.

rate without objectionable flicker through the use of long persistence phosphors. . . . The door has also been closed on the opportunity of taking one more look at compatible systems before moving to adopt an incompatible system. with all its attendant problems as they relate to the 10-million receivers that will be in the hands of the public by the end of the year. as well as the manufacturers' problem of production."

Citing that an extension of time would have revealed the availability of improved systems, Sterling declared that such a move would have been in keeping with the Commission's premise that . . . "fundamental research cannot be performed on schedule." Described in his dissenting opinion was the progress which had been achieved by RCA with its tri-color tubes in which the number of dots had been increased from 351,000 to 600,000 with the attendant increase in resolution.

The debate of small picture tubes versus large tubes received a sharp comment from Sterling who stated that he could not agree with the belief that the attractiveness of color would be sufficiently great to cause people to prefer a direct view receiver with a small tube if they could get color, as against a large direct-view receiver limited to black and white. The Commissioner said that . . . "The rapid acceptance by the public of receivers incorporating larger-sized black and white tubes as they moved from 7" to 10" to 12" and then to 16" and 19" clearly indicates the preference of the public for large size pictures, and they will not be satisfied with smaller pictures because they are in color."

One man's poignant opinion and probably a prophetic one!

Materials and Methods

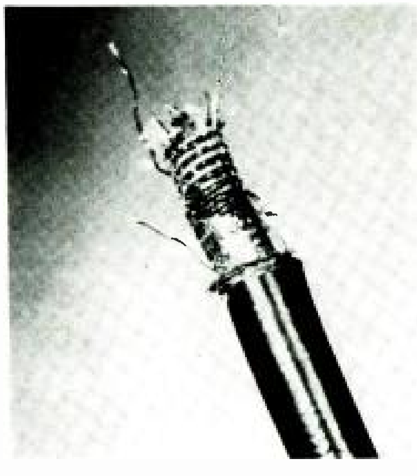
Tantalum Electrolytics: The trend to miniaturized equipment has been highlighted by the development of many unusually compact and yet efficient components. The latest extremely small-sized part to join the miniature parade is the tantalum electrolytic. These unique capacitors are now made in two forms, according to a report in the *Bell Laboratory Record*, one being of the conventional foil construction and the other a sintered type. The foil type is made by winding two paper-separated foil electrodes into a cylindrical unit. Absorbent paper serves essentially to contain the electrolyte and to prevent mechanical abrasion of the film during winding and use. Non-polar designs feature the use of both foils with an outside film. In the standard aluminum-type capacitors, the oxide-forming area of the foil is increased by chemical etching. At present, tantalum capacitors employ foil that is smooth rolled. However, according to the Bell Lab report. tantalum foil is inherently rougher. and therefore, provides 10 to 20 per cent more effective area than smooth aluminum. In addition, the oxide film is 50 per cent higher in dielectric constant and the metal can be used in thinner form. As a result, tantalum foil capacitors are about 30 per cent smaller than the etched-aluminum type. However. the sintered types. for low-voltage ratings, are even smaller.

In sintered construction, the anode is produced by pressing powdered tantalum into a compact shape and then sintering it in a vacuum furnace to weld the powdered articles. This procedure results in a porous mass in which a relatively large surface area is available for oxide film formation. It has been found that the oxide forming area in such a structure is as much as 40 to 50 times that of a solid non-porous body of similar dimensions. Incidentally, the second electrode of this capacitor is usually the container.

The tantalum capacitor has been found to have a better temperature coefficient than aluminum and can be used as low as −60° *C*, whereas the usable range of the aluminum type is normally limited to about −40° *C*. Of course, as in the instance of the aluminum capacitors. the temperature coefficient of capacitance increases with increasing frequency.

Magnetic Ceramics: The increased use of larger and larger picture tubes, particularly those of the rectangular type, has emphasized the need for wider and wider deflection angles. Contributing to deflection control is the yoke and accordingly, many types have been designed to provide a wider angle. In one developmental effort. a yoke featuring a magnetic ceramic has been evolved for 82° deflection. According to Crowley, who have produced the new type yoke, it has been found that deflection angles of 90° or better can be achieved. making it possible to further reduce the lengths of picture tubes.

While externally resembling the grayish hue and surface texture of powdered-iron cores. upon breakage, the magnetic ceramic reveals a glassy composition. which is said to confirm the fact that the core is in the ceramic category and not powdered iron with a resinous binder.



Left: Mounting a polyethylene plastic mounting ring on a 19-inch G.E. chassis to insulate the metal picture tube electrically. On the receding conical body of the tube is a sleeve of the same plastic. completing the insulation. The ring. patented by Anchor Plastics. was developed as a curved extrusion. a process designed to produce a curved shape free of distortion and of the tendency to straighten out again. It is claimed that circular. elliptical and other curved shapes for frames. mounts and the like can be extruded by this process to a maximum diameter of three feet. Right: Flexible electrical conduit. invented by Elliott Solero. of National Electric Products. which consists of an inner woven tubing made of longitudinal Fiberglas yarns. and a spiral wrapping of metal foil. with an outer braided jacket of aluminum wire. Conventional construction makes use of a spiral armor of interlocked aluminum strip over a braided aluminum wire jacket. Patent Office has granted patent number 2,514,905 on the conduit.

TVE-grams . . .

Materials

Deposited Carbon Resistors: The element boron has become a partner of carbon in the resistor family, the new element having been found to provide considerably lower temperature coefficients of resistance. In processing the resistor, boron is pyrolytically deposited in a thin film on a ceramic core.

According to R. O. Grisdale, A. C. Pfister and G. K. Teal, of the Bell Telephone Labs, who presented a paper on this resistor at the NEC meeting, these resistors have been found to provide access to resistance ranges heretofore impossible to attain in film-type units.

The borocarbon film resistors are similar in structure to the pyrolytic carbon resistor which have become widely used. Known as the *cracked carbon resistor* as well as *high-stability carbon-film resistor*, these components are composed of very thin films of microcrystalline carbon formed over the surfaces of ceramic cores. The conducting films of carbon are deposited by the thermal decomposition or pyrolysis of hydrocarbon gases or vapors. Pryolytic carbon films are composed of graphite-like crystallites which are on the average only one ten-millionth of an inch in diameter and half as thick and which are so closely and randomly packed together that all resemblance to graphite is lost. Tests have shown that the pyrolytic carbon is much harder than carborundum and leaves no smear when rubbed on paper as does graphite. However, structural and analytical studies have shown that each crystallite is surrounded by a skin or layer of complex hydrocarbons which separates it from its neighbors. This hydrocarbon skin increases the specific resistance and the temperature coefficient of resistance of pyrolytic carbon relative to graphite which, along certain crystal axes, is a good metallic conductor.

The borocarbon resistors have been produced in values of 500,000 ohms per square, and the possibilities of values in excess of 1,000 megohms per square are now being studied.

Research

Electronic Scanning: It is often desirable to read or observe a number of measuring elements at the same time and still use only one channel to transmit the information to a remote point. Such a procedure requires a scanning device which will successively read the information on the measuring elements at a high rate so that essentially continuous information is obtained from each element. For effective gain results, preamplification is required. However, in arriving at the amount of preamp required, it becomes necessary to consider the noise generated by the scanner as it scans the measuring elements. In reviewing these problems in a paper presented before the recent National Electronics Conference in Chicago, B. R. Shepard, of G. E., declared that the noise generated by the scanner is a broad spectrum consisting of frequency components at the fundamental scan rate and all harmonics of the scan rate. Actually, the portion of this noise spectrum lying within the band transmitting the information is the noise level of the scanner for that particular application. It was shown that the noise performance of the scanning device can be presented on a universal curve which will enable its operation under most practical conditions to be predicted from one set of readings.

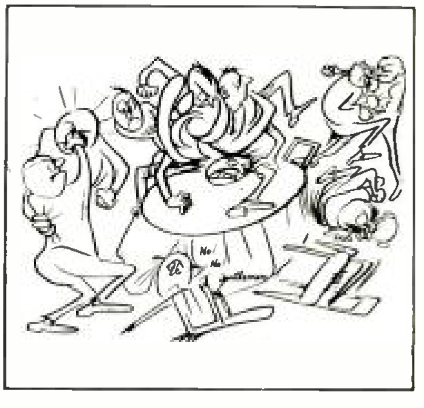
Shepard declared that there are four general methods of improving the noise performance of a scanning device . . . *(1)* Balancing of the input elements to the same *dc* level; *(2)* shaping the scan characteristics so that the transition between elements is as smooth as possible; *(3)* reducing the average *dc* level of the scanner to as low a level as possible, and *(4)* operating the scanner at as low a scanning rate as is practical. All four methods are based on the reduction of the peak level of the noise voltage to a minimum and the reduction, too, of the high-frequency components. At the present time, it is possible to scan at rates on the order of 100,000 elements per second with noise levels in the microvolt region.

Subscriber-Vision: An over-the-air scrambling and unscrambling picture-signal service, involving the use of an electronic decoder and a plastic IBM-type key card, now being tested over the facilities of WOR-TV, is expected to reveal the practicability of such a system, which would provide viewers with special programs at a fee.

Based on a system developed by Adolph Rosenthal, the method features the use of a synchronizing signal separator and amplifier. The time base for the scan of the patterns can be linear or governed by the same time formation at the transmitter and receiver. A difference in the slope of the time characteristics of the two-time bases results in a gradual drift of the starting points of consecutive picture lines, providing a slanting appearance to the vertical edge of the received picture at the side where the line scanning starts. This can be adjusted by operating the tuning control or a frame-time base. Because of irregular timing of the line sync impulses, the length of the scanning lines, both at the transmitter and receiver are different for different lines. To avoid this disadvantage the actual picture area in the transmitter tube is arranged so that the shortest of the scanning lines just completely cover the picture area in the line direction and the excess length of the longer lines follows outside of the picture area.

A cool pleasant way to spend the conference day; aided and abetted by the members of the brawl and confusion club, the boys who have sworn to an allegiance of not budging, regardless, and blocking and sulking at every turn. Unfortunately, these staunch supporters of the my-way-or-else theme are around in handsome numbers. But, there are more members in the harmony club who can arbitrate differences and find that pleasant, mutually satisfactory answer. That dreaded conference really can be the most effective problem solver in the world, and the best way to give yourself and the guy in the next seat a fair shake. Conferees can suddenly find that the exchange of information and experience sets off a sort of chain reaction that builds up a superior group wisdom. Groups can reach their maximum effectiveness when all of the members feel personally responsible for the success of the meeting; and this feeling of personal responsibility starts with the determination to find a common ground, even if it's only the fact that the great majority of us put pants, or panties, on the same way, or one leg at a time. . . .

With apologies to the Bureau of Naval Personnel and their booklet "Conference Sense."



TVE-grams...

The Production Line

Miniaturizing Pentode Amplifiers: With the advent of complex electronic circuitry, the need for smaller components and simplified circuitry layouts has grown. As a result, miniaturization has become quite an active ingredient in planning. In studies of the methods which can be applied to eliminate components, without impairing circuit performance, many novel circuitry arrangements have been probed.

In an approach to the problem at the Naval Ordnance Labs, the feasibility of removing all of the bypass capacitors from a two-stage pentode amplifier were considered. According to William B. Anspacher, of the lab, a solution appeared in the nullification of degeneration by means of a positive feedback path between the two screen grids. Describing this development at the NEC meeting, Anspacher said that the method of attack employed an analysis of the mid-frequency equivalent circuit of the positive feedback amplifier in order to obtain an expression for the feedback resistor required to achieve normal gain. An expression for the feedback resistor was developed and it was found that this expression would not require the determination of any of the usual tube constants, allowing the feedback resistor to be expressed in terms of the various amplification factors obtained by successively removing the screen grid and cathode bypass units.

Transformer Specifications: In a recent evaluation of the engineering specifications for custom-made high-fidelity audio transformers, it was learned that there are five parameters which should be followed in ordering the components. According to E. B. Harrison, of Altec Lansing, who offered the appraisal at the IRE meeting on the Pacific Coast, these requirements are: (*1*) Open circuit inductance at lowest voltage and lowest frequency; (*2*) open circuit inductance at highest voltage and highest frequency; (*3*) insertion loss; (*4*) leakage inductance acceptable at *hf* end of pass band; and (*5*) resonant frequency of transformer at lowest frequency.

Long Talking Range Field Wire: An improved communication wire providing a talking range of approximately 12½ miles and weighing about forty-six pounds per mile is now being used by the Army Signal Corps in Korea. Consist- of two conductors, each individually insulated and jacketed, and twisted together to form a light flexible flat-lying *twisted pair*, the wire can be laid at speeds of up to 120 miles per hour from aircraft. Each conductor is composed of three zinc-coated high-carbon steel strands and four tinned-copper strands all twisted together in a tight, concentric bundle, covered by a tight-fitting cylinder of polyethylene. A thin covering of nylon provides a tight waterproof container for the strands.

On the Bookshelf

Printed Circuits: The fascinating subject of printed circuits has at long last been reviewed, in one of the most comprehensive reports ever prepared, by the Engineering Electronics and Electronic and Ordnance Divisions of the Bureau of Standards.

A 64-page document, the report covers such pertinent topics as general design considerations, constructional methods, characteristics of special components and materials, production equipment, circuitry requirements, test methods and a complete listing of the supply sources for tools, materials and equipment.

Highlights from this extremely informative publication will appear in the November issue of TELEVISION ENGINEERING.

Practical Television Engineering: From the lucid pen of Scott Helt of DuMont has come an unusually complete and useful book on the practical aspects of television engineering.

In over 700 pages, Helt has covered every facet of the art from the fundamentals of picture transmission to television broadcasting techniques.

Students, engineers and those in management will find this text to be an ideal source of helpful information.

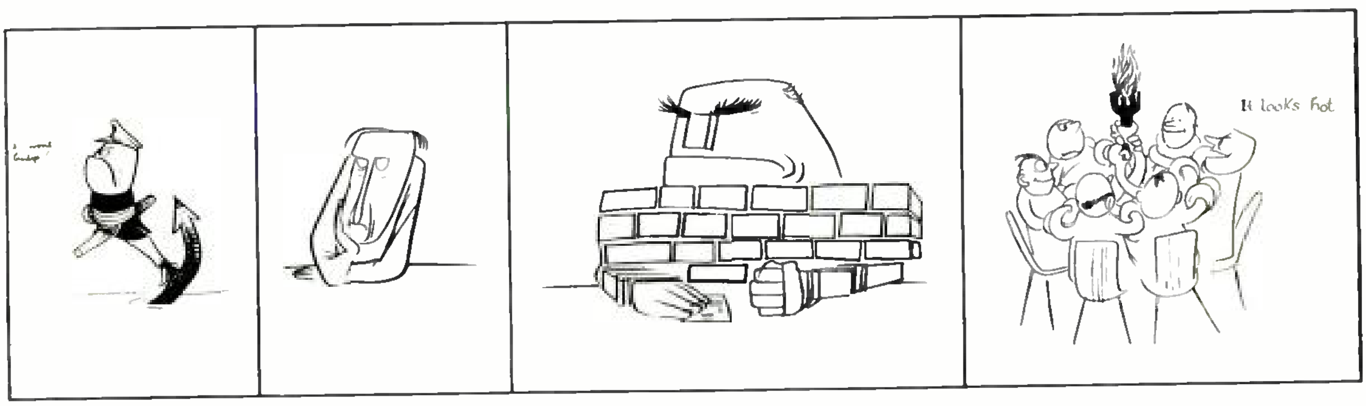
Woods: A complete collection of reports on wood utilization is now available from the Office of Technical Services. Originally prepared under the joint sponsorship of the Office of Naval Research and the National Research Council, the collection includes 24 presentations covering wood research by the armed services, the mechanisms of wood lignification and deterioration, utilization of wood for packaging, etc. Also offered are papers covering fungus and insect problems.

Trends

Oral Strip Tease: To TV has now come a voice that filmland experts declare . . . "Can disarm, bewilder and enchant."

According to a report from Hollywood, Claire Trevor is the sole proprietress of this magnetic property. The sultry blonde, who's quite an attraction on any TV screen, declared that she wasn't so sold on possessing an *oral strip tease* voice, but said she . . . "if that's what they want to call it, it's all right with me."

Gentleman, who is your choice for Miss *OST* on *TV*?—L. W.



TV Frequency-Conversion Problems

by JAMES J. SKILES, Instructor, Electrical Engineering Department,

School of Mines and Metallurgy, University of Missouri

THE FREQUENCY CONVERSION stage of a TV receiver determines to a large extent the quality of the received picture. In superhets, the frequency converter is usually the first or second stage of the receiver, and as a result, the noise introduced in this stage determines to a large extent the minimum signal strength necessary for an acceptable picture. Unfortunately, the converter stage frequently radiates at the oscillator frequency and impairs reception on nearby receivers tuned to different channels.

In the *vhf* band the level of atmospheric noise that enters the receiver with the signal is relatively low, when compared to the noise that originates in the receiver itself. Interference caused by thunderstorms and other forms of atmospheric discharges is almost negligible, as this interference is relegated to the lower frequencies. Thus, it is the internal receiver noise generated in the entrance stages of the receiver that determines the minimum usable signals for satisfactory reception.

The received signal must be strong enough to override the noise introduced by the first stages of the receiver. Since the noise at the grid of the first tube is amplified as much as is the signal present at this point, no subsequent amount of amplification can improve the signal-to-noise ratio. As stage gains of television *rf* amplifiers are usually less than 10, the noise generated in the second stage is also of importance in determining the overall signal-to-noise ratio of the receiver.

It is well at this point to consider the fundamental sources of receiver noise, namely circuit noise and tube noise. These noise sources remain even after careful elimination of all other sources.

Circuit Noise

In '28 there appeared a paper that first focused attention on the fact that a resistor has a potential established across its terminals because of thermal agitation of the electrons in its composition. This voltage has been called *thermal agitation voltage*, or *Johnson Noise*, after an early investigator. This voltage is produced by the random velocities given electrons due to their thermal energy content, and the magnitude is expressed by

$$\bar{e} = \sqrt{4KRT\Delta f}$$

Where: $\bar{e}$ is the root-mean-square thermal agitation voltage
K is Boltzmann's constant (1.37×10^{-23} joules /degree Kelvin)
R is the ohmic resistance
T is the absolute temperature (degrees Kelvin)
Δf is the frequency interval of measurement

The expression for thermal agitation voltage has been experimentally verified. Of course, some restrictions are necessary if the bandwidth becomes infinite. Infinite bandwidth would imply infinite thermal energy content, an impossibility. It is important to notice that the value of the thermal agitation voltage is independent of the mean frequency of measurement, but depends only upon the bandwidth involved. Thermal agitation noise is distributed uniformly throughout the usable radio frequency spectrum.

Thermal Agitation EMFS

One reason why thermal agitation *emfs* are so important at *vhf* is the wide bandwidths of circuits at these frequencies. For example, a bandwidth of 10,000 cycles at 100 mc would imply a circuit Q of around 10,000. This is im-

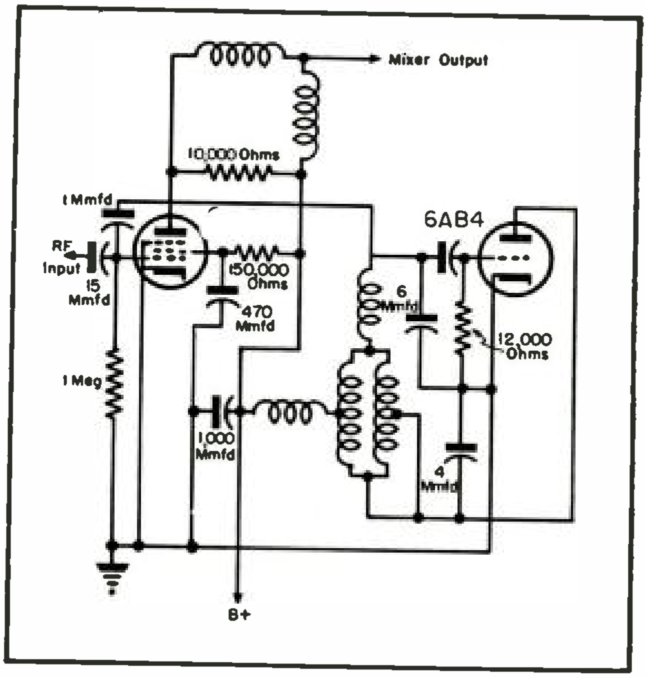


Figure 1
Mixer circuit of the Crosley modey 10-414MU showing the capacitive coupling technique employed in the 6AK5 mixer grid.

Lucid Analysis of Receiver Noise and Converter Circuit Configurations Which Must Be Considered in Achieving Radiation-Free Reception at VHF and UHF. Discussion Discloses Types of Tubes Found Most Effective; Oscillator-System Stabilization Techniques and Their Effect on the Picture and the FM Sound Carrier; Stage Gain Controls, Etc.

possible with available circuit elements. The situation is aggravated by skin effect in conductors at *vhf* which makes the effective resistance much higher than the *dc* resistance. Furthermore, the input resistance of vacuum tubes at *vhf* is quite small; of the order of several thousand ohms. As a result of tube loading, bandwidths at *vhf* are usually of the order of megacycles. In some cases, the circuit loading due to low values of tube input resistance is such that with only slight additional resistive loading the stage grid circuit can be made to match an antenna.

Because the grid-circuit resistance is so low at *vhf*, the thermal-noise voltage is usually less than the noise introduced by the vacuum tubes in the circuits.

Tube Noise

The main sources of vacuum tube noise at *vhf* are:

(*1*) Shot noise
(*2*) Partition noise
(*3*) Induced grid noise

Shot noise is the name that has been given to vacuum-tube noise that is due to the random arrival of electrons at the plate of the tube. Although the individual electrons which make up the plate current arrive at the plate in a random fashion, the multitude of electrons comprising the total current obey definite mathematical probability laws. Shot noise has the same frequency distribution as noise from thermal agitation voltages, and cannot be distinguished from noise produced by thermal agitation in the grid circuit resistance by measurements in the plate circuit of a vacuum tube. Shot noise can be materially reduced by space charge in a tube.

Vacuum tubes with more than one grid have been found to be more noisy than triodes. North[1] has evolved a quantitative theory to explain the increase in tube noise in multi-element tubes. Partition noise has as its origin the random division of space current between the outer electrodes of a multi-grid tube.

At high frequencies there is an additional component of tube noise that is caused by voltages induced in the grid by the fluctuating motion of the electron stream by the grid. This component of noise is not important except at high frequencies where transit time can no longer be neglected.[2]

Converter Circuits

The term converter circuit has unfortunately been used to describe the whole circuit whereby a radio-frequency signal is changed to an intermediate frequency, regardless of whether the operation requires two tubes or one. It is common practice now to designate the single tube which performs this operation the converter tube. Where two tubes are required they are usually designated the mixer and the local oscillator.

In the early days of the superhet receiver the latter system was employed. However, for economic reasons it was desirable to develop single-tube frequency converters, and the forerunner of the modern pentagrid converter emerged. The pentagrid tube may also be used as a mixer with the oscillator voltage furnished by a separate local oscillator.

In the multigrid converter, the oscillator section employs two terminals of the tube in setting up the oscillations, with the frequency determined primarily by the external circuit. The usual choice for the oscillator electrodes are the cathode and a grid, or two grids. The *rf* signal is then injected into a third grid and the *if* output taken from the plate. This type of converter, commonly referred to as electron-coupled, has several bad features

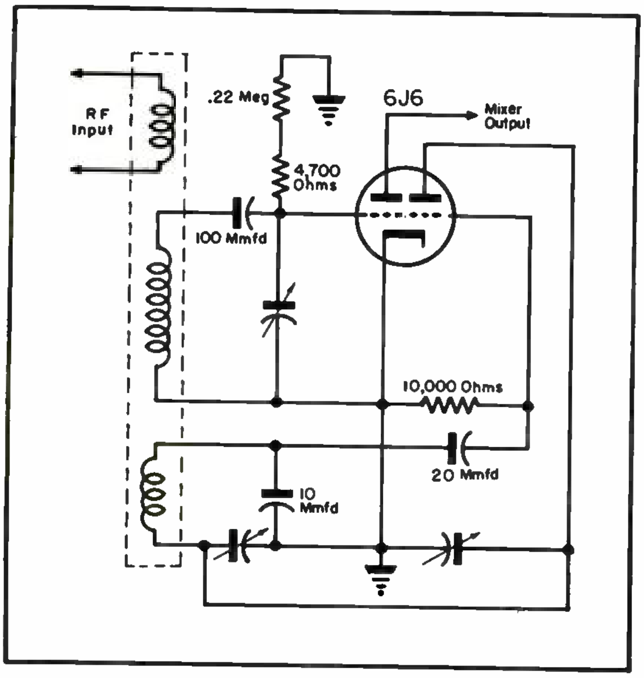


Figure 2
Dual triode mixer circuit of the Craftsmen model RC100 which features inductive coupling to the mixer.

[1]North, D. O., *Fluctuations In Space-Charge-Limited Currents At Moderately High Frequencies, Part Three, Multicollectors.* RCA Review, 5:244; October, 1940.

[2]North, D. O., and Ferris, W. R. *Fluctuations Induced In Vacuum-Tube Grids At Ultra-High-Frequencies,* Proc. IRE, 29:49; February, 1941.

for TV applications. The signal-to-noise ratio is poor, due in part to the conversion transconductance being only about one-fourth that of the same tube used as an amplifier. Furthermore, there is a tendency for the oscillator to try to synchronize with the incoming signal due to the coupling between the input and oscillator sections of the converter tube. Converter tubes have proved unsuitable for operation over the range of frequencies required by television. Proper oscillation is difficult to obtain and the signal-to-noise ratio is too poor for practical TV application.

Pentagrid tubes may also be employed as mixers with the signal and local oscillator voltages injected into different grids. However, this arrangement does not provide the necessary signal-to-noise ratio for television.

When the signal and the local oscillator are both injected into the same grid of a pentagrid converter used as a mixer, considerable improvement in the signal-to-noise ratio is obtained. Commonly, a triode is used as the local oscillator in such an arrangement.

The performance of a pentagrid mixer with both signal and local oscillator injected into the same grid differs little from the triode mixer. The triode mixer is usually somewhat better in respect to signal-to-noise ratio due to lack of partition noise in the triode. The majority of present-day TV receivers use the triode local oscillator-triode mixer arrangement. Commonly both sections of a 6J6 dual triode are used for this purpose.

An example of a pentode mixer with a triode local oscillator appears in Figure 1. In this case both the local oscillator and the *rf* signal are capacitively coupled to the 6AK5 mixer grid.

In Figure 2 is illustrated the use of a 6J6 dual triode in a mixer arrangement where the local oscillator and *rf* signals are inductively coupled to the mixer grid.

Oscillator Stability

The stability of the local oscillator is not critical in TV so far as its influence on the picture. Because of the wide video bandwidth, slight drift in the local oscillator frequency will have only negligible effect on the received picture. Far more serious is the effect on the reception of the FM sound carrier. Frequency modulation signals are much more subject to distortion produced by detuning than is AM. Consequently, oscillator frequency drift materially affects the quality of the sound, in part because of the nature of the FM signal, and in part due to the relatively small FM bandwidth (about 50 kc), when compared to the video bandwidth.

Most of the current receivers use the intercarrier system of sound demodulation. This method has the very desirable feature that demodulation is accomplished independent of the frequency of the local oscillator, and depends only upon the 4.5-mc beat produced by the audio carrier with the video carrier. The difference between the sound and the video carriers is maintained at 4.5 mc at the transmitter, so that the received sound is not affected by local oscillator drift, so long as the drift is not sufficient to appreciably detune the whole receiver. In addition to alleviating to a great extent the effects of oscillator drift, intercarrier sound also reduces overall receiver cost.

Oscillator Radiation

Radiation from the local oscillator of a TV receiver affects nearby receivers in the same manner as does harmonic and spurious radiation from amateur radio stations and diathermy machines. If the oscillator is radiating at a frequency in the pass band of an adjacent receiver tuned to a different channel, then the nearby receiver may be affected in one of two ways. Herold[3] has found that *cw* interference, which produces a beat note of less than 1 mc with a receiver local oscillator, results in interference bars across the picture. Higher frequency beat notes cause loss in picture contrast, and in extreme cases, results in a negative picture with no blanking.

Local-oscillator radiation is particularly exasperating in the urban areas having several stations. Because of the large number of receivers present in limited areas, as in large multi-dwelling apartment houses where TV sets may be separated by only a few feet, oscillator radiation has caused some channels to be virtually useless for reception. Recently station WNAC-TV, Boston, petitioned the FCC to be allowed to change transmission from channel 7 to channel 2 to combat interference from local-oscillator radiation. The FCC refused the request, with the suggestion that more attention be given to suppression of the interference at the source.

It was pointed out in the discussion on frequency converters and mixers that the multigrid mixer circuits have the best signal-to-noise ratio when the *rf* and local oscillator signals are applied to the same grid. Of course, high-frequency triode mixers have a common grid input.

Unfortunately, the advantage of the lower signal-to-noise ratio obtained by the common-grid input is obtained at the expense of a large increase in the coupling between the local oscillator and the *rf* circuits of the receiver. Consequently, a portion of the oscillator energy may find its way into the antenna circuit and be radiated, with the possibility of interference to nearby receivers.

Some idea of the nature of the radiation problem can be found in Herold's work.[4] As a result of his investigation of oscillator radiation, it has been recommended that local oscillator radiation be kept to less than .01 microwatt in order not to interfere with another receiver 50 feet away which is in the 500 microvolt meter region. His measurements on a prewar TV receiver with no *rf* stage showed a radiated power of 1,000 microwatts. Now one can appreciate the problem in apartment houses where receivers may be operating back to back with only a partitioning wall between them.

The addition of a tuned *rf* stage ahead of the converter constitutes probably the best solution to the radiation problem. Because vacuum tubes are essentially unilateral devices (pass current in the forward direction only), this is an effective means of preventing oscillator energy from being transferred to the antenna circuit. However, capacitive coupling through the tube and stray circuit coupling still permits a small portion of the oscillator energy to reach the antenna circuit, but with considerable attenuation.

The *rf* stage not only reduces oscillator radiation but also discriminates against interference at the oscillator, image, and *if* frequencies. The selectivity obtained in the *rf* stage also is effective in reducing adjacent channel interference, as well as cross modulation in the mixer.

Because of the short wavelengths involved at *uhf*, considerable attention must be given to the physical construction and layout of the oscillator circuit to reduce direct radiation. A conductor approaching an eighth wavelength becomes a good radiator, and at 300 mc an eighth wavelength is only about 5 inches. Single and double shielding of the local oscillator and mixer stages has been found effective in reducing this direct radiation.

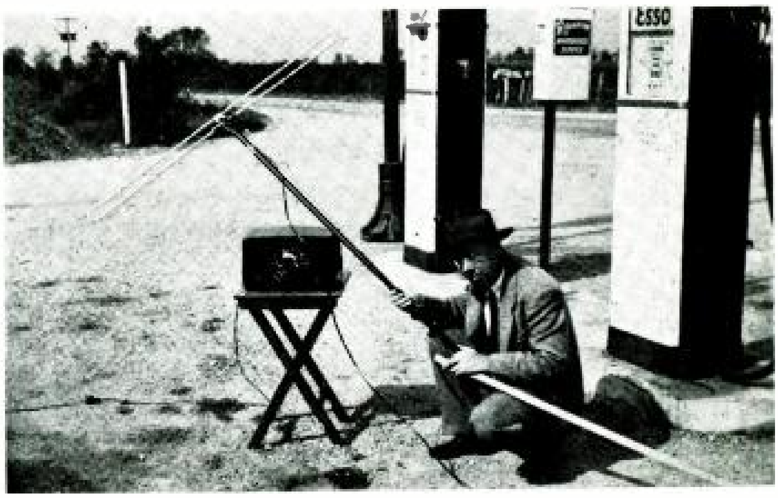
A high *if* frequency also contributes to lessened oscillator radiation. The higher the *if*, the more will be the sepa-

(*Continued on page 25*)

[3] Herold, E. W., *Local Oscillator Radiation And Its Effect On Television Picture Contrast*, RCA Review, 7:32; March, 1946.
[4] Herold, E. W., Op. Cit.

Plotting Aural Coverage By Ear

WIS plant supervisor Joe Davenport connecting section of FM antenna together, prior to making aural tests.



FM Receiver Found to Be Quite Effective in Evaluating Signal Strength and Fidelity

by **HERBERT G. EIDSON, Jr.,** Chief Engineer, WIS and WIS-FM; Technical Director, WIST

In many tests, it has been found that perhaps too much emphasis has been placed on the use of purely engineering methods to determine the performance of a specialized type of equipment.

In an audio amplifier, for example, built to good engineering standards, we find that its features include a frequency response which is flat to within 1 db from 20 to 20,000 cps, and distortion less than 1% at full output. Since the sensitivity of the ear is *not* the same at all frequencies at low volume, the flatness of the amplifier is lost unless the amplitude is held high. To provide a flat response, when listening at low volume, the response would have to be increased on each end as much as 10 db, depending upon the ear and the amount of volume used. Comparing the ear of one of advanced years with that of a young person, with normal hearing, it will be found that the high frequencies must be greatly emphasized to overcome the decreased sensitivity of the ear of the older person, and even then, it will be found quite possible that the highest of the high frequencies will be lost. The overabundance of high frequencies will sound harsh and unnatural to the younger person whose hearing is normal at all frequencies.

Thus we arrive at an inescapable conclusion: In spite of the proper engineering curves which the amplifier produced, the ear appears to provide the final answer. Actually, this fact is far from alarming, for the amplifier certainly was built to satisfy the ear and not test instruments. It is not meant to imply that established unit characteristics do not have their place. They cost certainly do, but it is felt that we are prone to rely, sometimes, too much on them. Why not place more trust in the human ear?

When the question of plotting the coverage of our FM station came up several months ago, it was believed that the proper time had come to test the ear theory, and plot coverage without the use of a field-strength meter. Since there is a definite point where background noise starts to come into audibility when the signal strength gradually decreases, it was felt that this point could be quite easily detected and plotted as the point at which the station coverage ends.

It was realized, of course, that the ear is not very sensitive to small changes of volume, and therefore four ears would be better than two. Thus, it was decided that several hours of listening to weak FM signals would be spent by the two persons. To do the job it would be necessary to memorize that point where good listening could be had, but not with a complete background of silence. It was decided that a small amount of *rush noise* could be tolerated. This decision was made because of the pickup selected; a dipole held at a constant height of only 13 feet. If, at a given location the signal were found to be just less than complete *limiting*, then a slight *rush* would be audible. Raising the antenna from 13 to 20 or 25 feet would provide much more signal strength and thus the rushing background noise would cease and a silent background would prevail. To be conservative in plotting the coverage, a very high pole to hold the FM antenna was not used. A practical compromise was considered to be 13 feet.

To maintain a state of near complete impartiality to our FM coverage it was felt that unusually good receiving equipment should not be used, or it would be reflected as an error in our final plotting. It was desired also to use receiving material that anyone could readily duplicate.

After testing numerous antennas, transmission lines with different surge impedance, and several readily available FM receivers we finally decided on one model* and a single-folded dipole, using 300-ohm transmission line.

A circle of approximately forty miles was drawn on a late highway map with the FM radiating structure at its center. Previous calculations had pointed to a figure of approximately forty miles with our power of 1300 watts** (*erp*) and

(*Continued on page 30*)

*Zenith Symphony model.
**WIS-AM operates with a power of 5 kw when operating directional.

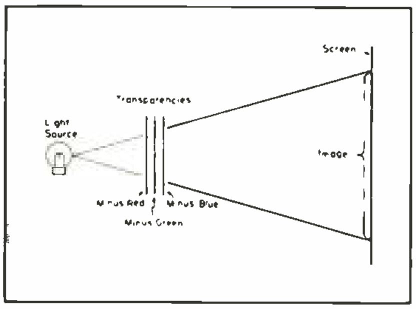


Figure 1
Subtractive system method of operation, with three transparencies on each of which is that portion of the image representing one of the three primary colors.

SUBTRACTIVE Color TV

by IRA KAMEN, TV Consultant

System, With Dark-Trace Type Tubes, Found to Provide Improved Light Efficiency, a Key Factor in Color Operations. Light Source, Independent of Picture Tubes, Affords Light Gain

IN THE THREE COLOR TV systems which have been on trial in Washington for nearly a year, there has been one common denominator of design. All have been of the *additive* type, with images being produced by combining in one manner or another several, usually three, separate images in three different colors, the three images being *added* to produce a final picture with the desired hues.

It has been found that there are several disadvantages in the additive system. Probably the principal one involves light, the efficiency of which appears to suffer. In the case of a three-color picture, for example, only one-third of the incident white light available is used to produce the final picture. While there may still remain sufficient light for home receivers, large-screen color projection systems are at a much greater disadvantage than monochrome projectors, with large or even medium-scale projection becoming perhaps impractical.

In the present types of color systems the only light available is that caused by the fluorescence of the screen material on the face of the picture tube. There is, of course, a practical limit to the amount of light that can be produced in this manner.

Subtractive Color Reception

In an attempt to secure more light efficiency, a subtractive method was probed. It was found possible to employ ths technique in a system[1] which used a light source independent of the picture tubes.

The characteristics of the subtractive system are illustrated in Figure 1. Here we have a group of three transparencies on each of which is that portion of the image representing one of the three primary colors. Each transparency, however, does not have its nominal color, but instead a complementary color. The *—red* slide, for instance, is actually colored bluish-green; the *—green* slide is magenta; and the *—blue* slide is yellow. Actually, of course, only a part of each slide is colored, the remainder being clear.

The light source is a standard projection lamp with a system of lenses (not indicated in the drawing). The function of each slide is to subtract from the white light passing through it, the color to which it is complementary. Where the image is to be white, clear slides are used, and the light is not impeded at all. Where the picture is to be black, all the slides are colored with their deepest intensities. Since the colors on the slides are complementary to red, green and blue, the red, green and blue light is completely subtracted from the light furnished by the lamp and the screen is almost completely black, since it lacks all three primary colors.

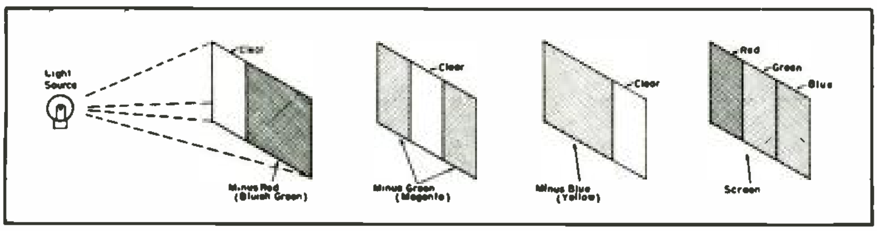
To produce a completely red image, the *—red* slide would be clear, passing all the light; but the *—green* and *—blue* slides would be completely colored, subtracting both green and blue from the white light and leaving only the red. Other colors and combinations of colors are obtained in the same way. In each case, the slide for the desired color is made less opaque, while the greater opacity of the other slides blocks the undesired amounts of the other two colors.

Figure 2 illustrates in detail how an image with red, green, and blue sections would be produced. The left segment is red. The *—red* slide, therefore, blocks no light at all in this section. The following two slides subtract from the white light, in the left section, all of the green and all of the blue. Since none of the red light emitted by the projection lamp has been blocked (actually some has been blocked merely by unavoidable losses), the left section of the screen appears red. Obviously, however, nearly all the red light emitted by the source is used, and efficiency is excellent.

The *—red* slide subtracts all red from the center section and the *—blue* subtracts all the blue. The *—green* slide is clear at the center, however, so that only the green light finds its way to the center section of the screen; but again almost all the incident green light is utilized. The right-hand blue portion of the image is produced similarly. (The system shown in Figure 2 requires, of course, a lens system, which is not shown.)

To utilize such a system for television, three such slides or transparencies

Figure 2
How an image with red, green and blue sections would be reproduced in the subtractive plan.



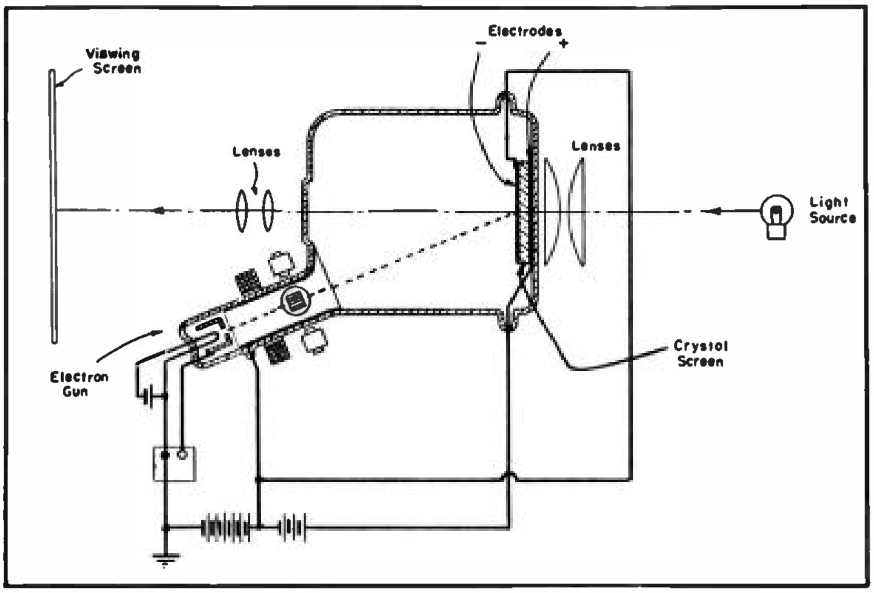


Figure 3
Cross-sectional view of the dark-trace tube.

would be required, each of which would present a continuously changing transparent image of the correct color. The dark-trace tube is effectively such a transparency.

This tube has an envelope somewhat similar in shape to that of an iconoscope. The neck contains an electron gun, together with beam-modulation and deflection elements. It is in the screen where basic picture-tube variations appear. This screen consists of a flat crystal of an alkali halide such as potassium chloride, which is transparent. On each of its faces is a transparent electrode, which may be a thin spattered metallic layer, a fine screen mesh, or some other type of construction. The outer electrode is maintained at a positive potential with respect to the inner one so that an electric field exists between the crystal faces. A light source (projection lamp) and a lens system place the image of the crystal on the viewing screen.

The crystal screen, within the tube, is traversed in the usual manner by the electron beam from the gun, which is intensity-modulated by the picture signals. At each point on the crystal, the electron beam produces a certain degree of opacity, the degree depending directly on the intensity of the beam. A strong beam produces complete opacity and a very weak one produces practically none. As the beam scans the crystal, therefore, during one frame of the transmitted picture, the crystal becomes in effect a lantern slide with opacity points of greater and less density according to the image. The light source projects the whole on the viewing screen as a complete picture.

According to the inventor, the action can be explained by assuming that the electron beam injects into the elemental portion of the crystal, a number of electrons corresponding to the intensity of the beam at each point it strikes. These tend to travel as free electrons toward the positive electrode through the crystal lattice, which is composed of alternate positive alkali ions and negative halogen ions. During the travel, some electrons are captured by the alkali ions, which have a great affinity for electrons. An alkali ion and an electron together form an electrically neutral metallic alkali atom which constitutes an opacity center. The position of each electron given up by the beam is thus made visible.

The crystal screen is held at a certain temperature. Sometime, after the action described, the heat movement of the crystal lattice causes the metallic alkali atom to split again into an ion and an electron. The freed electron continues through the crystal toward the positive electrode, and is again captured by an alkali ion to form another opacity center. It is again liberated by heat, and finally reaches the positive electrode. Thus, the stream of electrons shot into the crystal by the beam and moving toward the positive electrode appears as an opaque deposit, moving through the crystal and disappearing into the positive electrode.

The time required for an electron to pass through the crystal (and thus the duration of the opacity centers) is proportional to the electric field strength and is affected by temperature. By correct choice of these factors, the duration of the opacity centers may be made to correspond to one frame period of television transmission. Since, effectively, storage of the image of one frame is complete until the next frame comes along, the frame repetition rate may be made rather low—17-20 per second—without apparent flicker.

In the subtractive color system three of these tubes are used, each with different spectral transmission properties. The spectral transmission band, or color, of the crystal is determined by the actual material of which it is made and by the temperature at which it is operated.

A three-color subtractive TV receiving system employing three dark-trace tubes is illustrated in Figure 4. The three tubes are placed in line so that the light from the source will pass through them in succession. Each tube is provided with a crystal screen of the appropriate material and with a thermostat to keep the temperature of the crystal at the correct value for the desired color.

As a simple example, the tubes may be used in a sequential-frame color system, where one frame carries the red signal, the second carries the blue, and the third carries the green. The vari-

(*Continued on page* 28)

[1]Skiatron color system (patent No. 2,330,172) invented by Dr. Adolph H. Rosenthal, who conceived the *dark-trace* tube, used in radar.
[2]Substractive color is employed in color photography, where light efficiency is very important.

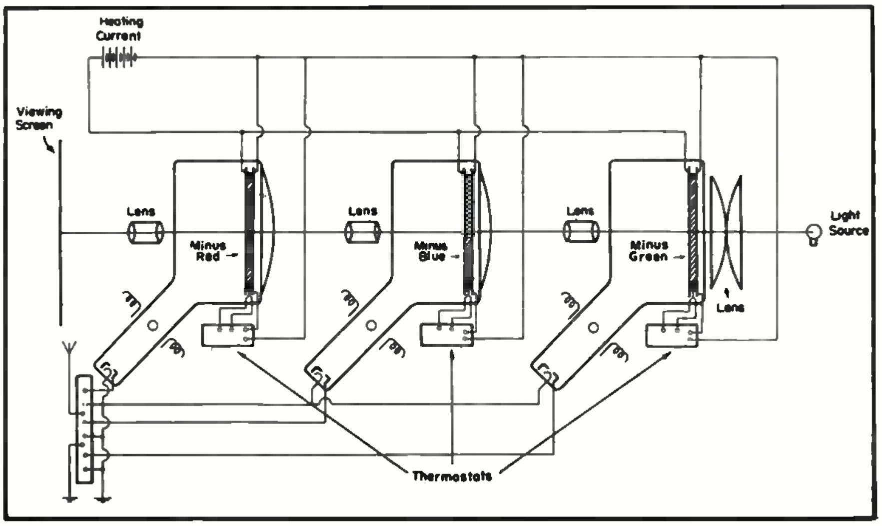


Figure 4
Dark-trace tubes in a color-subtractive setup.

VIDEO Special-Effects System

by **E.M. GORE,** Television Terminal Equipment Engineering
Engineering Products Department, RCA Victor Division, RCA

Effects Method Permits Blanking Out of Any Desired Portion of One Video Signal and Replacing It With Corresponding Portion of a Second Video Signal, According to the Shape of an Optical Mask. TV Camera, Used to Generate Switching Signal Defined by the Mask, Can Be of Flying-Light Spot Type, Where Mask Is Scanned Optically. Conventional TV Camera Can Also Be Used.

SPECIAL EFFECTS, both optical and electrical, play important parts in modern TV productions. It is frequently desirable to combine two or more scenes into a single picture or to remove a portion of one scene to replace it by a portion of another scene. Such effects can be especially satisfying to the sponsor of a program, because it is possible to display a commercial on a portion of the raster without interrupting the show.

In the past, such special effects have been most frequently accomplished with optical techniques. Systems of mirrors and sliding shutters have been used to combine pictures. Background projection has also been found to provide a suitable setting for live shows. The results obtained in the motion picture industry in the form of wipes, fades and dissolves have always been desirable, but most of the motion picture techniques have not been applicable to live television shows, since they have depended upon time-consuming film-splicing operations.

Electrically-accomplished special ef-

[1]RCA TA-10A.

[2]RCA Genlock.

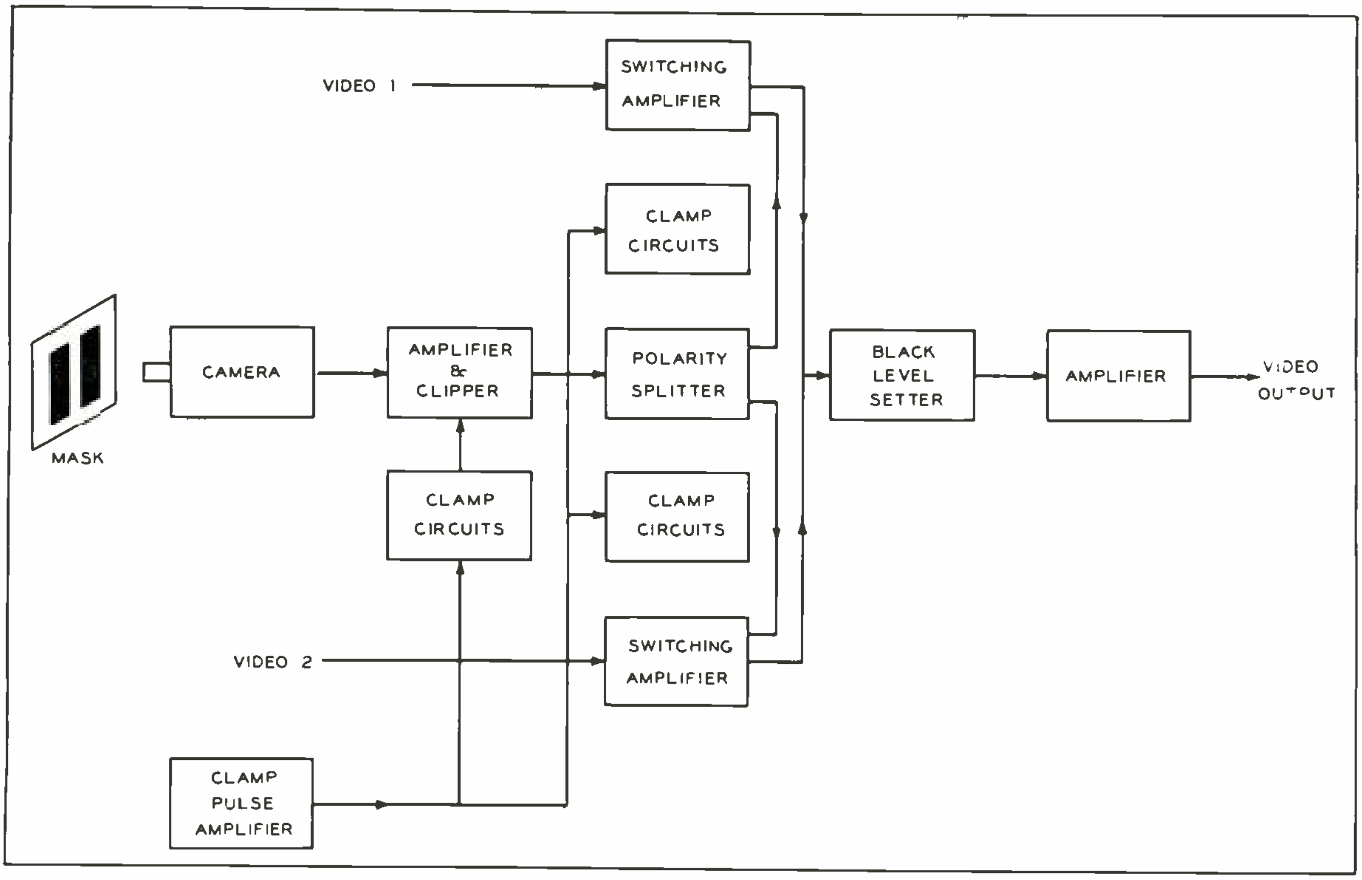


Figure 1
Block diagram of the special effects system.

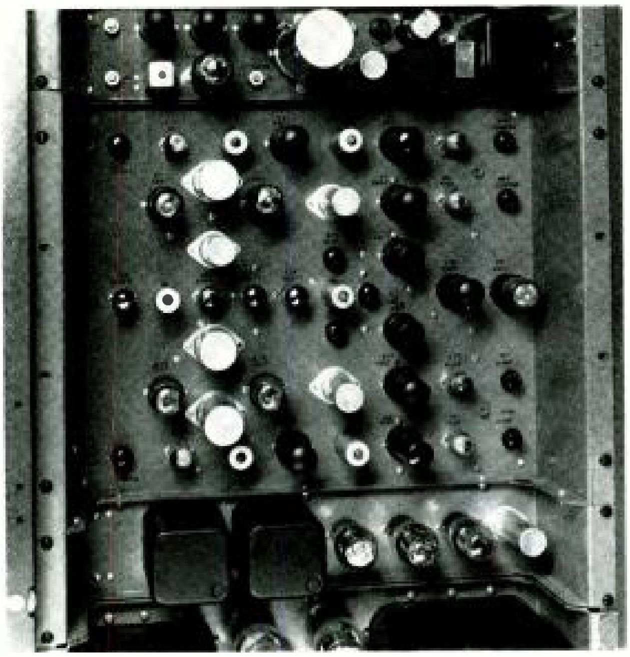


Figure 2
View of developmental model chassis, which provided for the switching of two video signals, which were combined with a mixing amplifier[1], visible at top of chassis.

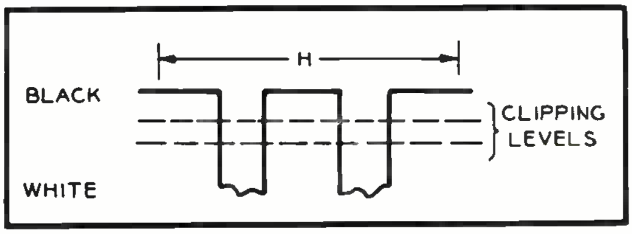


Figure 4
Output signal from the flying spot camera with black positive.

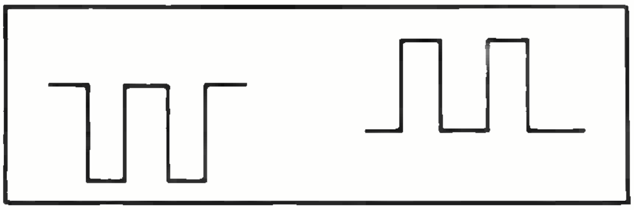


Figure 5
Waveform sketch which illustrates a clamped and clipped signal; clipping levels are adjustable. The clipped signal is fed into the polarity splitter, yielding outputs of opposite polarity.

fects have been found to be particularly desirable because of their increased speed. Fades, dissolves and superpositions are simple examples of electrical TV-program effects now in common use. In some equipment, the fades and dissolves have been accomplished at controlled speeds by means of electrical circuits. Electrical division of the raster into two separate areas by a straight line for displaying two independent video signals has provided another effect, often employed. A major difficulty which has prevented the combination of signals from widely separated cameras, driven by independent synchronizing generators, has been the lack of control of the relative frequency and phase of the synchronizing signals. Partial solution of this problem has recently been achieved through the development of a unit* which uses the sync signal from an incoming remote as a reference standard of comparison for locking-in a local sync generator.

Effects Considerations

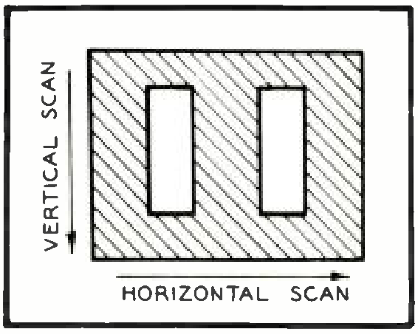
Several possibilities of combining two video signals have been investigated. It has been found desirable to have some means of blanking out one video signal from any one or more areas of a given picture so that video information from another signal can be inserted if desired. It has also been found desirable to separate these areas with a boundary of any desired shape and to be able to move or change the shape of the boundary without interruption of the video signals.

These latter considerations indicate that a purely electrical blanking system is not widely applicable. Even though simple boundaries can quite easily be generated, irregular boundaries of predictable shape require impractical complex circuits. An optical-electrical system has been found to meet the requirements on the boundary shapes, because optical masks can be cut to the desired configuration.

In Figure 1, appears the block diagram of such a system, recently developed. The method was designed to provide blanking out of any desired portion of one video signal and replace it with the corresponding portion of a second video signal, according to the shape of an optical mask. A television camera is used to generate a switching signal defined by the mask. This camera may be of the flying-light spot type where the mask is scanned optically or it may be the conventional television camera where an electron image of the mask is scanned with an electron beam.

The signal from the camera, which is used to generate the switching function, would ideally consist only of two distinct values, one corresponding to white areas and the other to black areas of the mask. Because of the presence of noise, stray light and other factors, the camera output signal has much gray information, even when the camera views areas which are black and white. Therefore, this signal is fed into amplifiers and clippers, the output of which is a squared wave with very fast transitions. The output of the clipper is fed to a polarity splitter to provide two outputs of opposite polarity. These two outputs constitute the switching signals.

Figure 3
Sketch of a simple mask (as used with the flying spot camera).



Switching Amplifiers

The switching signals are used to control two switching amplifiers, one for each of the video signals to be switched. These amplifiers are so adjusted that only one of them transmits video information at any one instant. The amplifier which transmits depends on whether black or white areas of the mask are being scanned.

The outputs of the switching amplifiers are combined in a common load resistance and the black level is set by a clipper. The necessary amplifiers are included to provide the correct signal amplitude and polarity into a coaxial cable. This single video output can be fed into a switcher and treated as another signal source.

To maintain the *dc* component of the video and switching signals, several clamp circuits are employed. These permit movement of the mask or change of the mask, while the output signal is being viewed, and allow for a change of

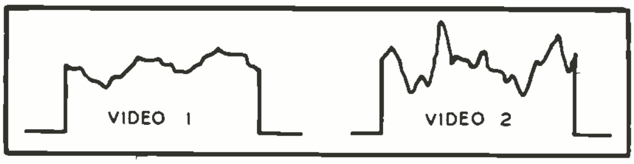


Figure 6
Waveforms illustrating how the two switching signals are clamped during the blanking interval and are mixed with their respective video signals (video signals are also clamped).

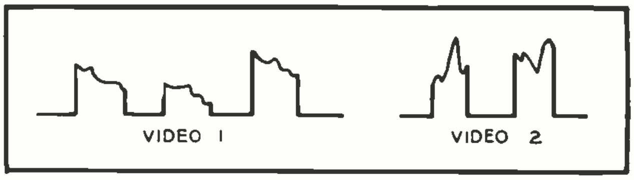


Figure 7
The useful portions of the mixed video signals are those shown in these waveform diagrams.

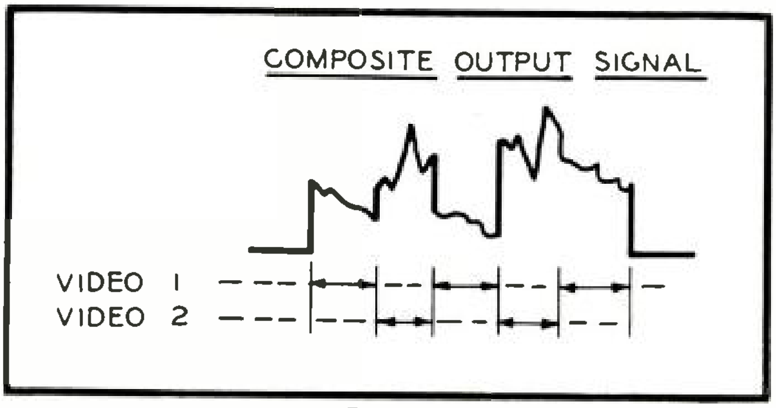


Figure 8
Desired composite signal, resulting from the mixing of two signals in an amplifier. In this case, the video signal 1 is displayed when the flying spot is behind the mask. Video signal 2 is displayed when the phototube is illuminated by the flying spot. (Black level is set to the desired level by means of a clipper.)

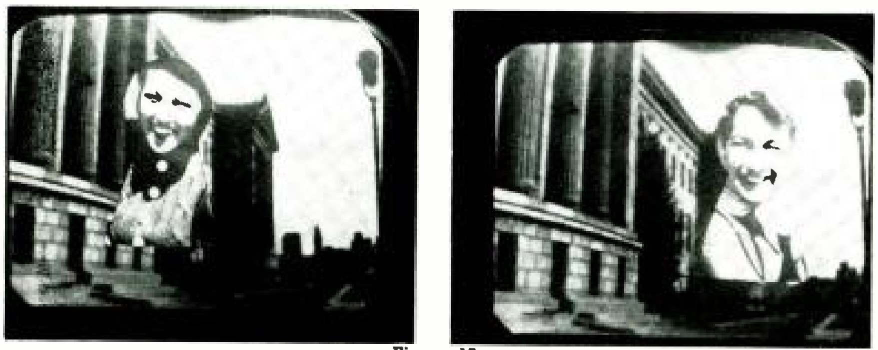


Figure 10
A novel series of effect views which illustrates the replacement of an area of one picture with picture information from the corresponding area of a second signal. A keyhole slot was used as a mask for the special effect.

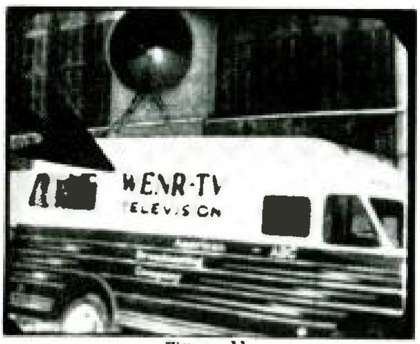


Figure 11
Use of a sharp-pointer effect, pointer having been placed in the focal plane of the flying-spot scanner.

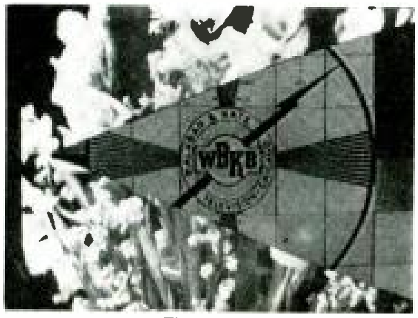


Figure 12
View of scene masked with a pointed wipe, in which the wedged-shaped area of one picture can be moved into, or out, of the area of another picture.

the average level of the video information.

Associated Equipment

Although most of the work on this system has been done using flying-spot cameras to generate the switching signals, studio and film cameras have also been used successfully. The principal requirements of the camera signal are that it be capable of reproducing the edges of the mask to the required degree of accuracy and that a noise-free switching signal can be derived from it by clipping.

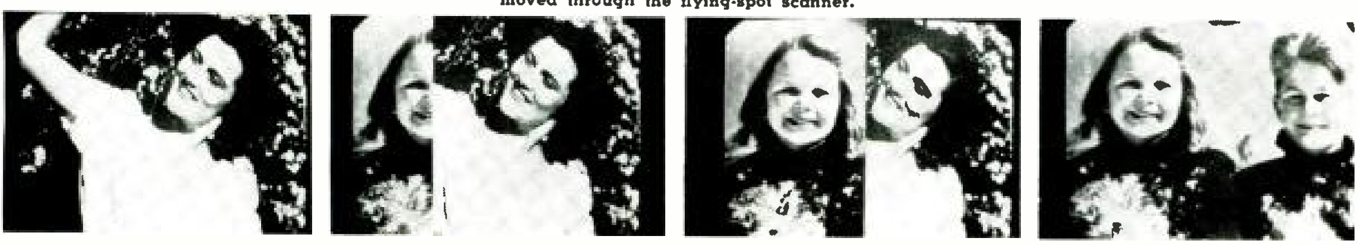
Some form of switching system at the video inputs of the special effects equipment may be desirable so that any two video signals may be introduced. Interchange of the blanked out and the transmitted portions of the two video signals may be accomplished by interchange of the input video lines, although it is also possible to accomplish the same result by reversal of the switching signal polarity.

Masks may be cut out of suitable paper and placed on a contrasting background when using a studio camera or opaque projector for generating the switching signal. For cameras using transparencies, the masks may be cut from opaque paper or cardboard or opaque markings may be made on glass or plastic. A means of providing smooth controllable movement of the masks is desirable when making wipes or other movements of the blanked areas of the raster.

The use of the sync-generator lock-in system* makes possible the combination of remote and of network programs with the local programs. In any case, the video signals and the switching signals used must all be precisely syn-

(*Continued on page* 28)

Figure 9
Series of photos demonstrating a horizontal wipe, where the first picture was progressively replaced by the second picture, as the mask was moved through the flying-spot scanner.



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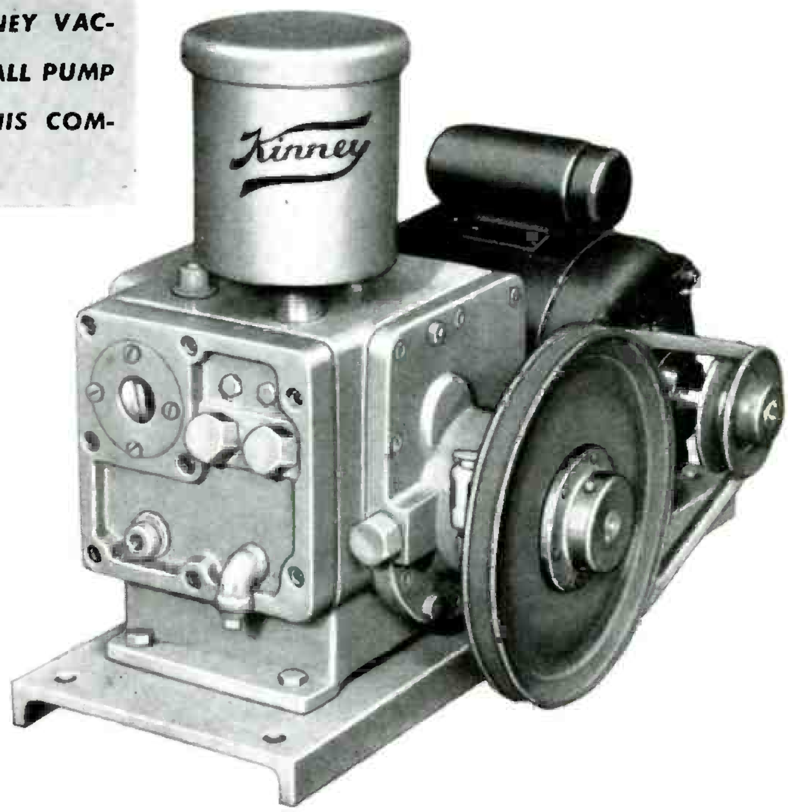

- ★ — Free air displacement of 4.9 cu. ft. per min. (139 liters per min.) . . . operates with 1/3 HP motor.
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MAKING OLD THINGS BETTER
MAKING NEW THINGS POSSIBLE

KINNEY
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Meeting Audio Requirements in

Part II . . . Use of the 'Scope in Checking for Push-Pull Effectiveness, Bias-Modulation Percentage, Noise Levels, Etc.

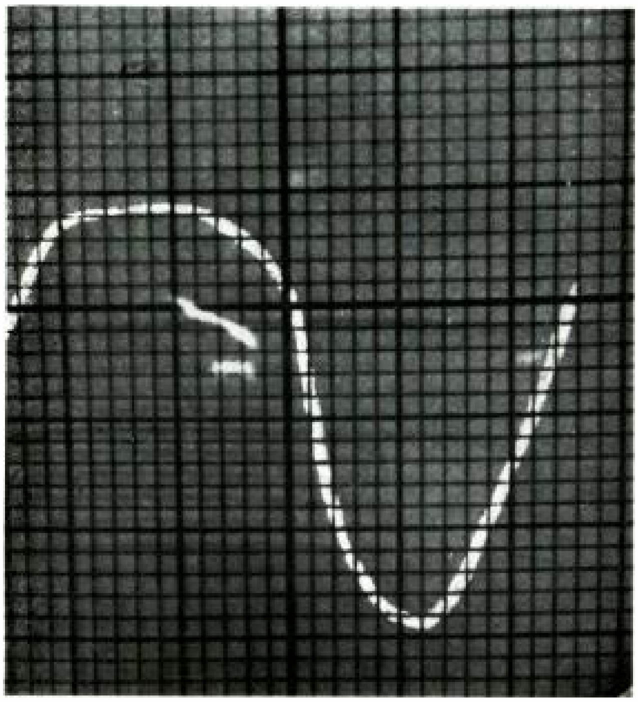
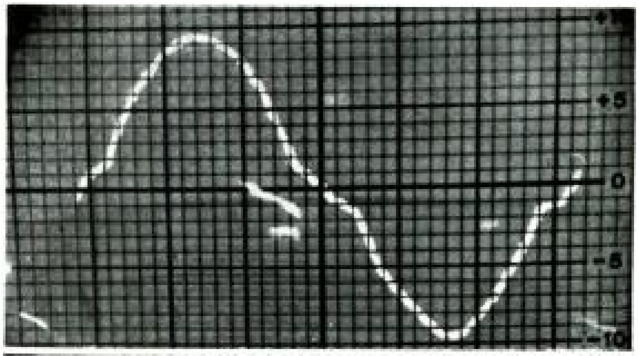


Figure 1
A push-pull amplifier with one side not functioning will result in a pattern of this type. With partial failure, one half of the cycle will not reach the same amplitude as the other.



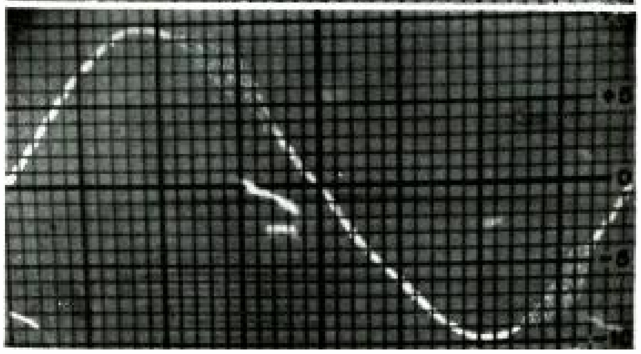


Figure 2 (Above)
A bias kink pattern caused by an over-biased class B stage. Frequently transmitter designer employs a feedback to correct.
Figure 3 (Below)
Pattern showing tendency of feedback to oscillate, revealing blisters on the slope of a 50-cycle modulating tone.

Reviewing the possible sources of trouble in a transmitter's audio system, in the initial installment,[1] it was pointed out that capacitors are usually quite a problem, since there is often no external indication of either a short or open circuit. For instance, a bypass which does not bypass, such as on the screens of a pentode or beam power stage, will introduce considerable distortion, in this case, on the high-frequency end of the spectrum.

In replacing bypass units, fortunately, it is not necessary to be too concerned with the exactness of the values. Where the manufacturer has installed, for example, a .008-mfd unit, one with a value of .01 or .005 mfd might work equally as well. Where it has been found necessary to change the capacity on one side of a push-pull stage, it will be necessary to alter the capacity on the other side. If the capacitor is a part of a special network, such as the feedback, the original capacity value should be maintained, since that value has been selected to provide the maximum performance for that circuit. The use of a multiple structure of capacitors may be found necessary to secure the correct capacity.

Resistors are much easier to check. With voltage readings an open resistor will show up immediately, no voltage appearing at a point where an approximate known voltage should exist. Normally resistors do not short circuit, but the associated wiring might develop a short across a resistor.

Audio transformers are difficult to check unless laboratory equipment is available. Input transformers frequently have the terminals closely spaced. These should be examined closely for possible shorts. The terminal board should be clean. The secondary, at high impedance, may be effected by leakage through an accumulation of dirt. Faults in the driver or modulation transformer often show up as severe frequency discrimination, or as a frequency range of excessive distortion.

In using a 'scope, the signal may appear to have considerable distortion. To be sure, the waveform should be compared to the input signal form. The trace should be a faithful reproduction of the input signal.

Failure of one side of a push-pull amplifier results in a pattern similar to that shown in Figure 1. While one-half the cycle is carried through, only that portion of the other half, allowed by the transformers, is transmitted. Transformers, designed to operate from a

[1] TeleVision Engineering; September, 1950.

Proof-of Performance Tests

by L. B. PETERY, Transmitter Design Engineer, Gates Radio Company

single tube to two tubes in push-pull, have secondaries equally coupled to the primary. Transformers designed to operate between push-pull stages do not have the same coupling from one side the primary to the two sides of the secondary.

Another familiar pattern is the *bias kink*, the result of too high bias on the modulators; Figure 2. Many transmitters depend on feedback to correct this. Tube characteristics reveal a sharp bend near cutoff bias. In general operation the straight portion of the tube characteristic blends with the straight portion of the companion tube. It has been found that cure of *bias kink*, if not obtainable by feedback, is a slight decrease of bias voltage.

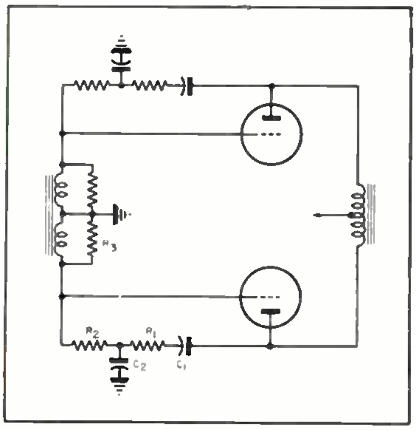
With low-frequency modulation, on the order of 50 cycles, it will be found that as the modulation percentage is raised, the curve will break on the slope. This is due to a tendency of the feedback system to go into oscillation. The effect with a high frequency modulating tone is different, for when the oscillations start, the whole curve will show that the oscillating frequency has been superimposed. By counting the cycles of this superimposed frequency in one cycle of the modulating frequency, the frequency of oscillation of the feedback can be determined. The presence of such oscillations will cause rather rough quality to the bass, and the treble range will be irritating. Reduction of the feedback by some means will serve as the remedy.

Station engineers, perhaps using new and unfamiliar distortion measuring equipment, have often indicated that they have found the distortion in the transmitter quite high. Use of bridging arrangements in the low-level audio stages reveals that the distortion is much higher when the transmitter uses feedback. This condition appears because the feedback introduces distortion supposedly in opposition to that generated in the transmitter, but the measuring equipment does not recognize the source of distortion. The best way to check this point is to disconnect the feedback circuit, and bring the transmitter up to the same percentage of modulation. As a rough approximation, at 90% modulation with a 1,000-cycle tone, distortion should average 1% or under per stage.

Other factors which must be considered are the methods used to pick up the radio frequency for the distortion meter. With transmitter powers up to one kilowatt, a well-insulated pickup coil, on or near the power amplifier tank, will be found to work very well. Transmitter powers above this contain dangerous voltages, and another point of a pickup will be necessary. Several points should be tried. The lead to the pickup loop should be well shielded, so that without the loop connected, no *rf* pickup in the lead will be indicated.

Noise level is almost impossible to measure without equipment designed for making such measurements. However, a brief study of noise sources, and the procedure for isolation, will permit a more rapid reduction of the noise level in his transmitter.

One of the first and most important steps is to determine if the noise is actually in the transmitter. With a reference level obtained, the transmitter can be shut off and the change in noise level noted. With some types of coupling and diode-pickup coupling, hum pickup from the tower lighting circuit might be high. In such a case, it will be necessary to use the type of coupling which would pass the *rf* component only. The diode, itself, has been found to be a noise source to be studied carefully, since the tube can result in noise readings which could be the same whether the transmitter were on or off.



Feedback may be employed around the audio driver stage only as indicated here. Besides reducing distortion, the feedback is used for response control.

Another source which has been found to require investigation is in the audio input line, where hum may be picked up. By disconnecting the audio at the transmitter input, and shorting the input, this possibility might appear.

As most transmitter audio circuits are in push-pull, the filtering of the power supplies are of secondary concern unless the filtering is exceptionally bad. It is not uncommon to find that the ripple of the low power audio supply is 35 or 40 db down, and the carrier noise 60 db down.

The main source of noise in a transmitter has been found to be in the modulators. The magnetic field of the filaments distorts the electron stream to modulate the plate signal. When the noise of each tube is properly phased, a cancellation results with a minimum of noise. In making some of the changes, it will be necessary to recheck the distortion, as cited below, and possibly effect a compromise:

(*1*) A reference noise level should be obtained and the modulator bias adjusted to reduce noise (if transmitter is provided with bias adjustments).

(*2*) A reference noise level should be obtained, modulator tubes changed and interchanged. In addition, new tubes should be tried.

(*3*) After a reference noise level is obtained, filament connections on modulators and power amplifier tubes should be reversed, one at a time, and noise checked.

(*4*) In the final attempt, after a reference noise level has been obtained primary connections should be reversed to modulation transformer and distortion checked.

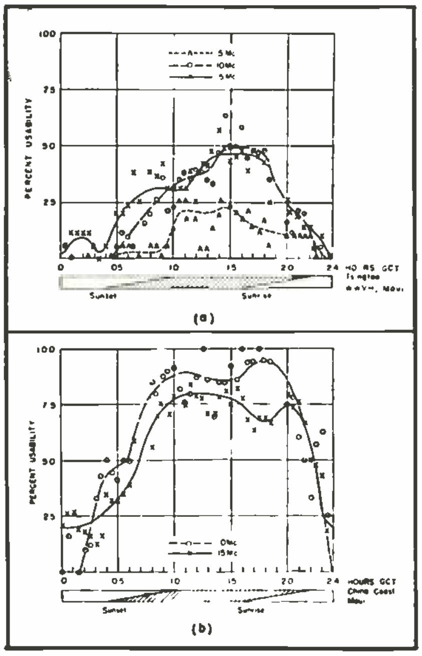
In noise reduction work, the prime consideration is to find the proper phase relation to obtain cancellation. The noise can be definitely isolated to the

(*Continued on page 24*)

Standard-Frequency Station WWVH Coverage

by E. L. HALL

High-Frequency Standards Section, Central Radio Propagation Laboratory
National Bureau of Standards



Figures 6 A and B**
A; reception of WWVH at Tsingtao, China (5,000 miles, 2,840 observations, 20 days). B; reception of WWVH at Shanghai, Hong Kong, Tsingtao and Okinawa (5,000 miles, 1,510 observations, 17 days, 10 and 15 mc).

Part II . . . Report of Observations of Transmissions from 400-Watt Experimental Station WWVH, Maui, T. H., Operating at 5, 10 and 15 Mc.

In our discussion[1] of the CRPL form reports, we revealed that three possibilities of *better*, *worse*, or *about same* were sought in the answers to the question: "Does WWVH make reception at your location. . . ." This question related to satisfactory reception of standard frequencies and time signals. There were over 4000 entries counted over a period from May to August, 1949. These reports came from 21 continental United States localities, 18 in Alaska, 7 in the Pacific area east of the 180th meridian, and 12 in the Pacific area west of the 180th meridian. The data are summarized in Table 3; p. 27.

Referring to the total summary of Table 3 it will be seen that the percentages of *better* and *same* reception are not markedly different, about 53 and 45 per cent, respectively. However, about 51 per cent of the reports on which these figures are based are from the continental United States, which already has fairly adequate standard frequency coverage from station WWV. The contribution of this area, therefore, should not be given much weight in the analysis, except from the interference standpoint, or *worst* reception, which was 2%.

The summary for the 37 localities reporting from Alaska and the Pacific area provided a percentage of 87 and 11 for *better* and *same* reception, respectively, with *worse* reception reported less than 2%. The *worse* re-

(*Continued on page 26*)

[1] TeleVision Engineering: August, 1950.

**March-April, 1949.

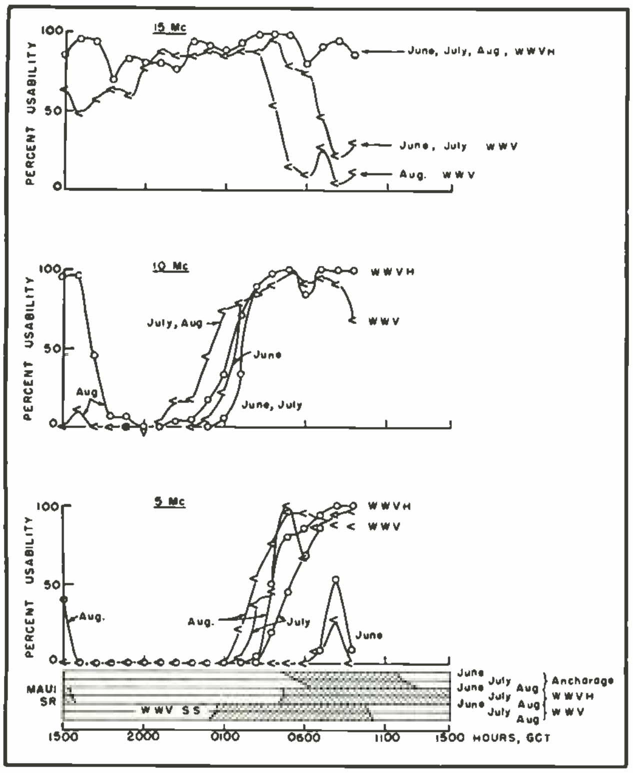
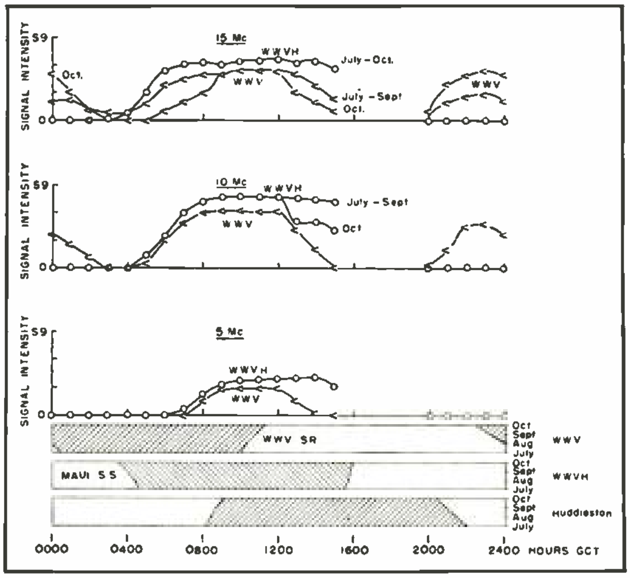


Figure 7 (left)
Reception of WWVH and WWV at Anchorage, Alaska, June, July and August, 1949 (approximate distance from WWVH, 2,800 miles, and from WWV, 3,350 miles).

Figure 8
Reception of WWVH and WWV at Huddleston, South Australia, July 16 to October 15, 1949 (approximate distance to WWVH, 5,600 miles, and to WWV, 10,600 miles).



Bandspreading and Scale Equalization

by C. F. VAN L. WEILAND

Part III . . . Analysis of Circuitry Used to Achieve Completely Equalized Bandspreading

IN REVIEWING the considerations which made it possible to arrive at an equivalent circuit[1] for the *C* scale, it was disclosed that the minimum resistance in this circuit can be increased by the permanently present series resistor, R_e, whereas the parallel combination of the two *A*-scale tuning circuits can be lowered by the parallel resistor, R_s.

The resistors, R_s and R_e for this circuit, were calculated from the equations:

$$R_s = \frac{R_p}{2(S_a - 1)} \times f\left\{\frac{S_a + 1}{2(S_a - f - 1)} + \sqrt{\frac{S_a}{(S_a - f - 1)f} + \frac{S_a + 2}{2(S_a - f - 1)}}\right\} \quad (1c)$$

in which

$$f = 4 \times \frac{1 - 1/S_a}{S_b}$$

$$R_e = \frac{R_p}{2(S_a - 1)}\left\{\frac{4}{S_b S_a} - \frac{R_s}{R_s + \dfrac{R_p}{2(S_a - 1)}}\right\} \quad (2c)$$

The tuning resistance was plotted from the equation

$$R_{e_t} = \frac{R_s}{1 + \dfrac{2R_s}{R_p\left(\sigma + \dfrac{1}{S_a - 1}\right)}} + R_e \quad (3c)$$

In the foregoing equations S_a and S_b were the chosen scale ratios for the *A*

(*Continued on page* 28)

[1] TELEVISION ENGINEERING, August, 1950; Figure 4.

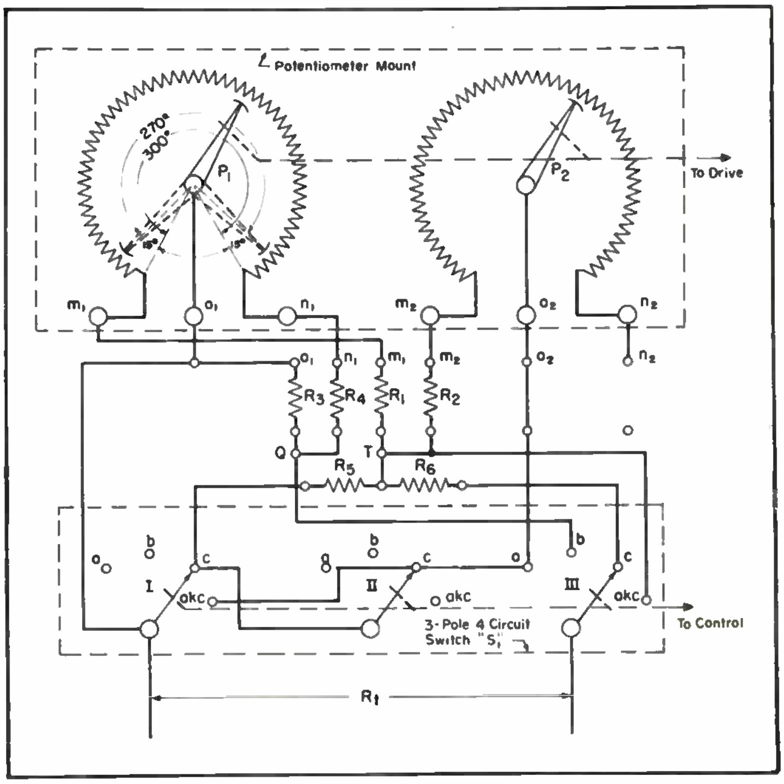


Figure 5 (Above, right)

Circuit of the foundation unit; the bandspread rheostat. Switch position a serves as a series connection for A scales; the position b represents single-pot connection for the B scale; position c, parallel connection for the C scale; and for the aKC position, parallel connection for tuning of the A scale.

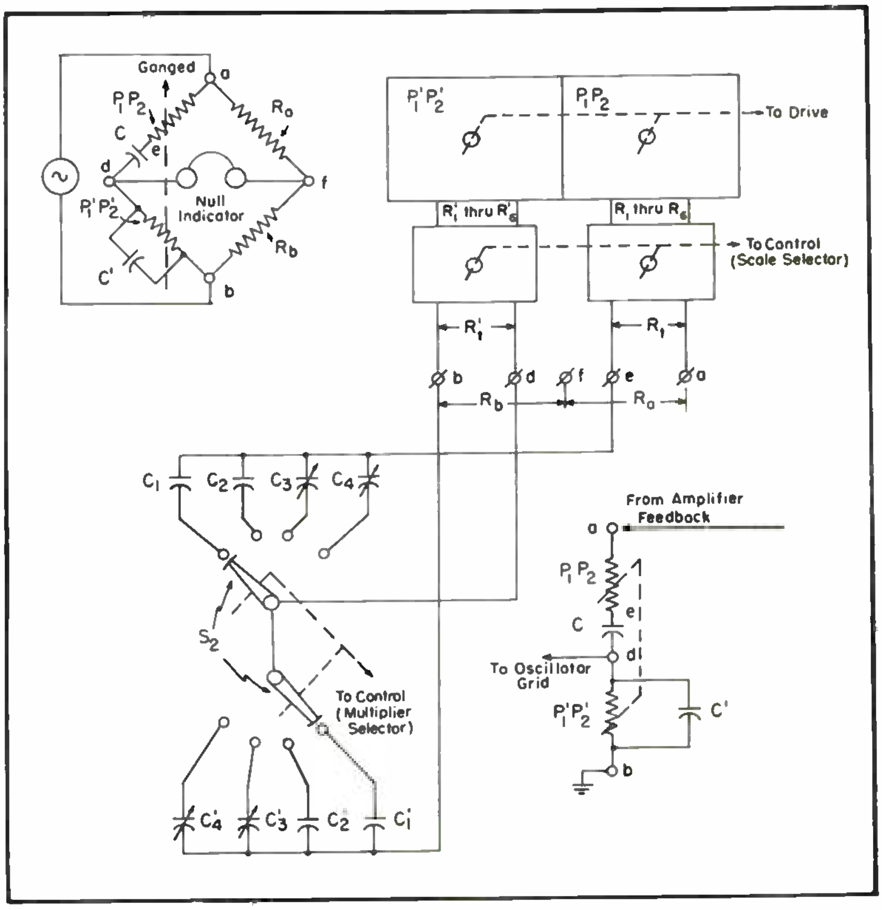


Figure 6 (Right)

Circuits illustrating applications as band-spread frequency tuners. At upper right is the basic circuit for a Wien frequency bridge, and at the lower left is the basic circuit for a Wien-bridge oscillator.

Instrument News

Quantitative 'Scope

A QUANTITATIVE, 10-MC 'scope has been developed. Time calibration is provided for the horizontal sweep of the instrument and regulated voltage calibration for vertical deflection. Both time and voltage calibration are accomplished by substituting a calibrating signal for the input signal.

The Y axis of the instrument, which includes a fixed, signal-delay line, provides a sensitivity of 0.1 volt peak-to-peak per inch. The frequency response is said to be down 3 db at 10 mc with no positive slope in the high-frequency range. Response is said to fall off slowly past the 10-mc point, so that the instrument is usable at frequencies higher than 10 mc.

Both driven and recurrent sweeps are variable continuously from 0.1 second to 5 microseconds. Sweep length may be expanded to the equivalent of 30 inches.

The Y-axis amplifier is said to provide 2.5 inches of undistorted deflection of unidirectional pulses. *Type 303; Allen B. Du Mont Labs., Inc., 1000 Main Ave., Clifton, N. J.*

DuMont 'scope

Frequency Standard Test Set

A FREQUENCY STANDARD AND TEST SET, which consists of a crystal-controlled oscillator, modulator, and a 'scope for observation of Lissajou figures is now available. Special circuits consisting of modulators and filters are used to compare the fixed standard frequencies with a source frequency driving the subcarrier discriminator under test. Accuracy is said to be better than 2 cycles or .1%, whichever is greater. —*Model 1300; Freed Transformer Company, Inc., 1718-36 Weirfield Street, Brooklyn 27, New York.*

Freed frequency standard test set.

12 Channel Television Transmitter

A TELEVISION TRANSMITTER, designed to permit production testing of TV receivers on 12 TV channels has been produced. When modulated by a composite video signal such as produced by a monoscope chain, unit will provide a standard *rf* picture signal suitable for use as a final air check of receivers. The picture signal has an associated FM sound carrier which may be modulated at 400 cps or with music from an external source. This feature is said to be especially valuable to check microphonics and speaker rattle.

Instrument consists of a 12 channel crystal controlled oscillator, frequency multiplier, and amplifier turret which produces the *rf* picture carrier on each TV channel. The *rf* output amplifier is suppressor grid double sideband modulated by means of a video amplifier having adequate frequency response to fully reproduce at least a 375 line signal. The video signal is obtained from an external source, and a continuously variable front panel input control permits varying the percentage of picture modulation.

The FM sound carrier has two components 4.5 mc above and below the picture carrier, and the TV receiver selects the upper sideband while rejecting the lower. Modulation of the sound carrier is accomplished by means of the internal audio oscillator operating at 400 cps or by an external signal such as music. A standard 75 microsecond pre-emphasis network is incorporated, and 40 kc deviation may be obtained. The deviation is continuously variable by means of a panel control.

An electronically regulated power supply assures stable performance regardless of line voltage fluctuations between 105 to 125 volts.—*Type 2111; Tel-Instrument Co., Inc., 50 Paterson Ave., East Rutherford, N. J.*

Tel-Instrument 12-channel TV transmitter.

Electronic Sweep and Marker

AN ALL-ELECTRONIC SWEEP and marker generator has been developed for production alignment of TV tuners and overall alignment of complete receivers. A twelve-position channel switch selects extremely narrow pip-type crystal positioned picture and sound carrier markers, as well as the desired 15-mc wide swept oscillator output. All carriers are oscillator fundamentals. The instrument is said to produce also a true zero amplitude reference baseline on the scope display. Sawtooth sweep is said to eliminate phasing problems. Markers are fed direct to indicator 'scope. Sweep outputs are from maxima of approximately 0.5 volt for 70-ohm unbalanced output and 1.0 volt for 300-ohm balanced output.—*Model RFP; Kay Electric Co., Maple Ave., Pine Brook, N. J.*

Intermodulation Meter

A SELF-CONTAINED INTERMODULATION METER, which consists of two principal sections, a test signal generator and an analyzer, has been produced.

The generator section produces two sinusoidal voltages, one a low frequency and the other a high frequency, which are mixed in a 4/1 voltage ratio and applied to the apparatus under test.

The signal from the equipment being tested is then received by the analyzer section of the instrument to be filtered, amplified, demodulated and metered. The meter is direct-reading in percentage of intermodulation and input volts.

Instrument is useful for evaluating the performance of audio systems, adjustment and maintenance of AM and FM receivers and transmitters, checking linearity of film and disc recordings and reproductions, checking phono pickups and recording styli, adjusting bias in tape recordings, quality control of audio components and equipment, etc.—*Model 31; Measurements Corp., Boonton, N. J.*

Measurements intermodulation meter.

Mixer Crystal Test Set

A PORTABLE SELF-CONTAINED MIXER CRYSTAL test set for measuring conversion loss and noise temperature of silicon crystals has been designed. Instrument is said to be particularly suitable for production testing, incoming inspection, and field tests.

Intended for use at or below 10,000 mc for direct indication and above 10,000 mc for relative indication. *Type 309; Airborne Instruments Lab., 160 Old Country Road, Mineola, N. Y.*

Wide-Band 'Scope

A WIDE-BAND 5" 'SCOPE, with a 10-millivolt sensitivity has been produced. Unit has a 12-mc bandwidth. Deflection plates available on terminal board. Continuously variable calibrator. Sweep magnification five times screen size. *Type T-601-A; TEC, 238 William St., N. Y. 17.*

TEC 'scope.

VETERAN WIRELESS OPERATORS ASSOCIATION NEWS

L. E. FELTON, now a technical writer with FTR, and operator of amateur station W2BS, reports that he spent his early days with the Bull Line, Portland Trawling Co., Pocahontas, Moore and McCormick and the NYS Empire State. He also handled the key at WNY, WSH and the Meehan Stock Exchange circuit at 66 Broad St., between '29 and '32. During the next four years he was with the American District Telephone Co., in '36 joining Eastern Airlines. In '40, he became affiliated with CAA, and in '42 left to join the Airadio engineering department. Between '43 and '46, LEF was a project engineer at the United Cinephone-Ripley Corp., and in '46 he became a group leader at the Lavoie Labs. He went over to FTR in '47 and is still with the company. . . . Eugene J. Krusel, Downers Grove, Ill., has notified ye secretary that he has located an old friend and shipmate, Fred J. Gommo. Krusel's career has been quite interesting. In '13, he received his ham ticket and the call 9VQ. In '17, R. H. G. Mathews, of ARRL fame, then with the U. S. Navy, sealed up EJK's radio shack. But soon after the war he was assigned a new call, W9EO, which was kept active until '26, when the commercial operating ranks of RCA were invaded. In '28 he quit brass pounding and went over to WEBC as chief operator. Later, in '29, he joined WCFL, Chicago. Today, he is the station's supervisor, in charge of the 50-kw transmitting plant, located in Downers Grove, about 23 miles from the Loop. . . . D. S. Little is now with American Airlines, working at La Guardia and living in Port Washington, L. I. . . . James Marcroft can now be found at Press Wireless, Hicksville, L. I. He was formerly with Globe Wireless. . . . Max F. Ortelt, who during the war worked at Millis, Mass., with the FCC Radio Intelligence Division, has been with TRT at WBF for several years. . . . H. A. Robinson has written from Pakistan stating that he is with RCA

VWOA veteran, Captain Fred Muller, USNR, during a visit to St. Petersburg, Florida.

International . . . Senior member Chester R. Underhill, has turned the clock back to tell us that he remembers having worked such stations as UC, UG and UF. The year '12, when he was around 13 years old, was his first in radio. He started as a ham using the call 2RM and in '14 the *white* ticket was issued to him. Shortly thereafter he received the coveted *pink* ticket. He started commercial work as a second op aboard the SS El Cid, whose calls were KKT. During World War I he saw service in the U. S. Navy at NAM, NAJ, NAH. From '20 to '23 he punched the key at such coastal stations as WCG, WNY and WLC, and on July 4, 1923, the thrilling assignment as sixth operator of the SS Leviathan was received, to serve under ENP who was chief. This was the maiden voyage of the Levi under the American flag. After that there were trips aboard several ships of the banana navy. Service with RCA as field engineer followed until '36. Various assignments aboard ship and ashore followed until '48, when he became associated with the Pennsylvania State College as an administrative assistant and senior engineer, where he is at this writing. . . . Old Timer G. V. Willets reports that he has moved to his new home in Villa Grande, California . . . Seems as if many of us are either getting older or else the warm climate has become extremely attractive. We find that E. N. Pickerill, who recently retired, is now in San Francisco, while Charlie G. Cooke and Roscoe Kent have both moved to St. Petersburg, Fla. . . . F. K. Bridgman, who lives and works in Chicago, is with the Illinois Bell Telephone Co. as a special contract supervisor on radio-TV. . . . E. N. Price is with Mackay Radio, serving as vice president and general manager. . . . From Santurce, Puerto Rico, Fred Boyd has written to say that he is employed by the CAA. For diversion he serves as Post Commander of the Carribbean Post 700 of the VFW. . . . Congratulations to Doc Lee de Forrest for his fine book, *The Father of Radio*. We understand that Doc is retiring from public activities and will devote his full time to lab work. . . . Al Koehler called ye secretary recently to say he has been away on another trip around the world aboard an Isthmian ship, stopping at such ports as Surabaya, Indonesia. . . . Art Ridley, Winthrop, Mass., is quite active with his ham station W1DJ on phone and *cw*. . . . George W. Sharpe wrote recently apologizing for being so late in sending in his dues, a small matter that all members will have to be told about very soon. George is another real *old timer*, who started with the Independent Wireless Telegraph Co., in the mid-twenties. Ye secretary also served with this company and aboard the Rockaway Park in the early '20s. For many years George was in the servicing and installation business. In '34 he joined WPRO where he remained for 14 years. He is now chief engineer of WPBJ-FM, which he built and placed on the air. . . . Commander D. McWhorter, USN (Ret.), reports that he is enjoying his well earned days of retirement in the beautiful town of Hamburg, N. Y.

Proof-of-Performance

(*Continued from page 19*)

modulators by disconnecting the modulator plate supply. The noise of the power amplifier, by itself, will generally be between 60 and 70 db down. The modulators should be reconnected (taking the precaution to discharge the filters) and the feedback loop disconnected, if this comes from the modulator plates. A reference noise level should be obtained at this point. Then the plate supply should be disconnected from the audio driver and a noise level obtained. If this is approximately the same as the previous reading, it can be assumed that the noise generation is in the modulators.

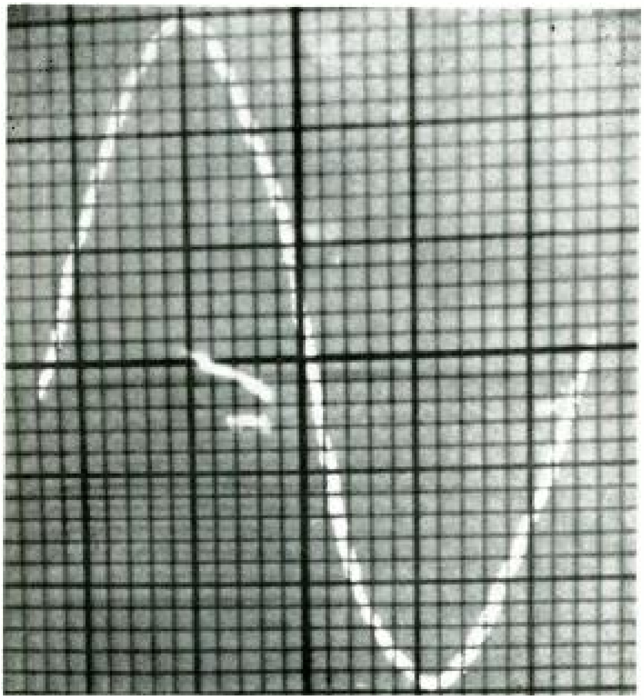
Audio frequency response can be measured if an audio oscillator is available. The oscillator should feed into the transmitter so as to utilize the input level meter. The gain at 1,000 cycles should be brought up to a given percentage of modulation, and the input level noted. By bringing the input level up to the same value for different frequencies, the db above or below the 1,000-cycle point can be read directly on the modulation monitor. As a check, a 'scope can be used to obtain 100% modulation on each frequency. Then the input can be reduced to 1 db and the response read on the input level meter. A falling-off of response will show up as a higher input level and in the opposite way for a rising response.

The falling-off of response of the high frequencies has been found to be due, in the main, to shunting capacities in the audio system, and in the power amplifier to the shunting effect of the plate blocking and bypass filters. Falling-off response on the low frequencies may be due to too low-value audio coupling capacitors in a resistance-coupled amplifier, or failure of transformers to pass low frequencies.

Feedback is variously employed to reduce distortion and noise, and to also

(*Continued on page 26*)

Typical 'scope trace which must be compared with input signal form before judgment of distortion is made. Trace should be a faithful reproduction of the oscillator output.



Frequency Conversion

(*Continued from page* 10)

ration between the frequency of the local oscillator and the frequency of the incoming signal. As a result, the impedance of the tuned *rf* circuits ahead of the mixer will be predominately reactive at the oscillator, image and *if* frequencies. Consequently, interfering image and *if* signals will be greatly attenuated before reaching the mixer grid. In the same fashion, oscillator frequency currents will be attenuated before reaching the antenna.

One line of improvement lies in the development of multigrid mixers and converters for TV applications which can compete favorably with common grid mixers from the standpoint of signal-to-noise ratio. At the 1950 IRE conference Vernon Aske* presented a paper describing a pentode mixer circuit which resulted in a conversion transconductance that was double of that considered feasible previously. In the operation of the circuit, the oscillator voltage is applied to the suppressor grid and serves to partition the space current between the plate and the screen. As the alternating components of the plate and the screen are out of phase, they can be used as a pushpull source. The conversion gain of the circuit is doubled and the signal-to-noise ratio is improved considerable. We may look for continued exploitation of this circuit in the future.

Conclusion

The TV receiver industry today is fiercely competitive. Many of the receivers produced have inadequate sensitivity for use in the fringe areas. Careful attention to the design of the *rf* amplifier and converter can improve receiver sensitivity, and at the same time reduce oscillator radiation, but at the expense of slightly higher receiver cost. The additional cost is a negligible factor, when the improved quality of TV reception is considered.

The problems of oscillator radiation have been recognized by most manufacturers and future receivers will be much less troublesome in this respect. However, there will continue to be a need for a method of eliminating the oscillator radiation interference from receivers now in the hands of the public.

Considerable impetus will be given to the development of improved TV frequency converters should the proposed *uhf* television band become a reality.

*Sylvania Electric.

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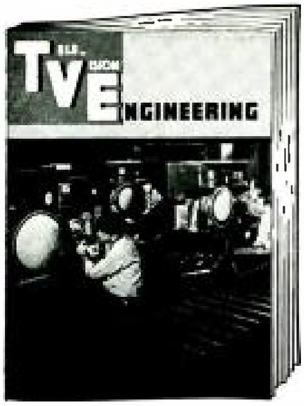

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Proof-of-Performance

(*Continued from page* 24)

correct frequency response. In the case of *overall* feedback, the proper ratio of capacity, the proper ratio of capacity and resistance in all branches of the feedback ladder will give uniform feedback at all frequencies. The reactance of any capacitor at any specified frequency should be the same ratio to the shunting resistor, as the reactance of any other capacitor in the system to its shunting resistor. If the capacity of the capacitors on the ground end of the feedback ladder is increased above this value, more of the high-frequency signals will be bypassed, than the middle and low frequencies, resulting in less high-frequency feedback, with a resultant increase of high frequency response.

The feedback circuit, which appeared in last month's discussion, utilizes this non-linear feedback for frequency correction. The transformer secondary presents an increasing reactance to the higher frequencies resulting in higher feedback with loss of highs. However, the capacitor at C_2, between the resistors R_1 and R_2, bypasses some of the high-frequency feedback to the extent that the transmitter response is flat. The extreme low-frequency response reveals a rising characteristic, as the series capacitor, C_1, begins to show an appreciable reactance. This causes the low-frequency feedback voltage to decrease, the falling off being more rapid than the natural falling off in the audio. The net result is a slight overall rise in response.

WWVH Coverage

(*Continued from page* 20)

ception in the total summary was 2%, and for the continental Unitedl States it was 2.5%.

It appears from these data that WWVH has improved reception of standard frequencies and time signals for Alaska and the Pacific areas by 87 per cent, but causes some confusion or interference in the United States of 2.5 per cent.

WWVH and WWV Reception Reports

Data were received from the Radio Propagation Field station at Anchorage, Alaska for the months of June, and August 1949, showing the per cent of time that the signals from WWVH and WWV were at a useful intensity. The observations were made hourly from 1500 or 1700 to 0900 *GCT* at 5, 10, and 15 mc and varied from 18 to 31 observations per month for each hour. The stations were at the following approximate distances from Anchorage: WWVH 2800 miles, WWV 3400 miles. The data appear in the curves of Figure 7 where the approximate times of sunrise and sunset and hours of darkness are indicated for Anchorage, WWVH and WWV.

Number of Reception Observations

Reviewing Figure 7, which covers reception on 5 mc, it is well known that this frequency best covers distances of a few thousand miles during the hours of darkness over all or a large part of the transmission path. The curves show an advance in time of reception with the month for both WWVH and WWV. The hours when 5 mc may be received 50 per cent of the time with usable intensity increase from June to August. WWV appears to be stronger for one more hour before sunset than WWVH. While data are not given for the period from 0900 to 1500 *GCT* (0000 to 0600 hours local time), it would appear from the curves that WWVH might have been heard most of this time during August.

The curves for 10 mc show an extension in the number of hours during which the two stations are receivable. WWV may be received stronger an hour or two before WWVH, but the curves indicate that WWVH may be received satisfactorily in August after WWV is no longer heard.

The curves for 15 mc show a still further increase in the number of hours during which the two stations are receivable. Reception from WWVH is seen to be much superior to that from WWV, showing 70 per cent or greater for the 18-hour period during the three months considered. WWV shows 50% or greater usability for about 16 hours in June and July and for 13 hours in August.

A set of reports from the Navy presented reception data on both WWVH and WWV as observed at Imperial Beach, California. These data, while somewhat limited, gave a good idea of the relative reception of the two stations during part of the March-April, 1949, period.

Data on 5 and 10 mc were not submitted beyond 1500 *GCT*. If *S2* is taken as the minimum usable signal the curves indicate that WWVH is usable on 5 mc only after sunset at WWVH or for about 10 of the 14 hours shown. WWV should be usable for the 14 hours shown. The same statements may be made with respect to the 10-mc transmissions. WWVH appears to be usable on 15 mc for all but two hours preceding sunset at Imperial Beach. WWV is usable throughout the 24 hours.

Imperial Beach, California is about midway between the two transmitting stations. WWV is seen to give a stronger signal at each frequency. The curves represent averages for a given period but it is quite possible that at specific times WWVH may be stronger than WWV.

It is hoped that the analysis herein presented may be of value in the perfecting of accurate world-wide standard frequency and time signal transmissions.

Acknowledgments

Experimental data from so many places and for such a period of time could not have been obtained without the cooperation of the Government agencies mentioned and the operating personnel and individuals who made observations on these transmissions, whose contributions are gratefully acknowledged.

Reception	5 mc	10 mc	15 mc	Total No. Observations	%
10 Localities in U. S., east of Rocky Mountains					
Better	2	29	50	81	6.8
Worse	10	20	17	47	4.0
Same	272	416	373	1061	89.2
				1189	
11 Localities in U. S., west of Rocky Mountains					
Better	90	118	113	321	37.8
Worse	0	4	0	4	0.5
Same	135	173	216	524	61.7
				849	
18 Localities in Alaska					
Better	158	218	380	756	80.7
Worse	3	5	15	23	2.4
Same	28	74	56	158	16.9
				937	
7 Localities in Pacific east of 180					
Better	63	56	38	157	73.0
Worse	1	5	3	9	4.2
Same	11	14	24	49	22.8
				215	
12 Localities in Pacific west of 180°					
Better	92	211	512	815	98.8
Worse	0	0	0	0	0
Same	2	3	5	10	1.2
				825	
Total Summary, 58 Localities Reporting					
Better	405	632	1093	2130	53.1
Worse	14	34	35	83	2.0
Same	448	680	674	1802	44.9
				4015	
Summary for Alaska and Pacific areas, 37 Localities					
Better	313	485	930	1728	87.4
Worse	4	10	18	32	1.6
Same	41	91	85	217	11.0
				1977	

Table 3

Bandspreading

(*Continued from page* 21)

and *B* scales. The resistors and divisions for these scales were calculated, as cited earlier, from the equations *1a* to *3a and 1b* to *3b*.[1]

A diagram for one resistance tuning circuit for completely equalized bandspreading appears in Figure 5. The six deck-10 position switch has been replaced by a separate *scale selector switch*, S_1, which is shown as a three pole-four position switch. Two of these switches are required for the two circuits of an *rc* tuner.

The fourth switch position on S_1 will be found necessary only when a parallel connection of the *kc* multiplier is used for the *A* scale. The switch pole, II in Figure 5, was included to prevent the paralleling of the resistors R_6 plus R_2 to the connecting points *T* and O_2, which would upset the tuning circuit of P_2, with the switch S_1 in the *a* position. It will be noted that without tuning capacitors, this circuit actually represents the diagram of a bandspread rheostat and can be used as such. It forms the basic or foundation unit for such applications as shown in the composite diagram of Figure 6. This diagram also shows the *multiplier selector switch*, S_2. For sustained oscillations it will be found advisable to use *shorting* type switches for both S_1 and S_2.

By making the *A* scale read sufficiently high, 50 or higher, bandspreading over two scales, namely the *A* and *C* scales may be accomplished. From the foregoing analysis we find that for two-scale bandspreading two terminal tuning elements may take the place of the three-terminal potentiometers. This includes capacitor tuning. The same principles as explained earlier will apply, except, of course, in the instance of capacitor tuning the overall capacity is increased with a parallel capacitor replacing the series resistor, R_6, and a series capacitor is substituted for R_5.

In this discussion the underlying principles of the system have been explained on the basis of circuit elements and parts that are easily available. No attempt has been made to describe the wide range of types to which this principle can be applied in actual production. Due to the breakdown of the scales, as described, it will also be possible to cover the supersonic range more effectively and with greater accuracy than with instruments not employing bandspreading.

In a subsequent paper, scheduled for an early issue of TELEVISION ENGINEERING, will appear an analysis of the various possibilities of bandspreading with fully automatic scale and multiplier selection and sweeping.

Color TV

(*Continued from page* 13)

ous color frames are channeled to the approximate tubes, the red to the —*red* tube, etc. Modulation is negative. Each screen remains opaque to light of its color until its color is desired. The beam intensity is then inversely proportional to the desired strength of color.

There are several advantages to this approach. In a sequential-frame color system, the frame repetition rate for each color is only one-third of the total, which, in a non-storage reception system may give rise to color flicker if the total frame rate is kept down to narrow the band. In the subtractive system, however, low frame rates are of no importance, since the screens may be adjusted to store the image of each frame completely, until the next scans take place. The eye is not, therefore, required to hold an image: *the tube does it*. In addition, the subtractive method makes greater use of the available incident light. And, the available light is not related to what may be obtainable on the face of a picture tube, but is supplied by a projection lamp which may be made as powerful as the requirements dictate.

It has also been found that the subtractive method may be used with almost any system of transmission, although probably its potentialities are realized most fully with frame sequential transmission systems. Where a single tube with a mechanical color wheel is used, as in the CBS system, adoption to the method requires only a series of blanking pulses to blank the beam of each tube for two-thirds of the total time; this can, of course, be synchronized by the pulses normally used to synchronize the color wheel motor. In other systems employing either three separate tubes, or a tricolor tube with separate electron guns, color-separate signals are available for the three dark-trace tubes.

Video Special Effects

(*Continued from page* 16)

chronized at both field and line rates.

Credits

Credit for assistance and advice during the development of this equipment is due H. N. Kozanowski, J. D. Spradlin, J. H. Roe and to other engineers in the TV terminal equipment engineering section.

TV Broadcast Equipment

Electronic Pointer

An electronic method for pointing out a person or item in a TV picture has been developed.

The device enables a narrator or commentator to insert a black and white pointer about 30 lines high and seven lines wide at any point in the TV picture.

Consists of a rack mounted chassis and a control unit, which may be located anywhere a picture is available to the operator. The pointer is controlled by a device similar to the control stick of an airplane. A toggle switch selects either a black or white pointer.—*Type TV-34-A; G.E. Commercial Equipment Division.*

G. E. electronic pointer.

TV Monitor

An off-the-line TV monitor has been developed for viewing programs in control rooms, film rooms, clients' and announcers' booths and executives' offices.

Monitor has a 12½" picture tube and audio channel and speaker which may be used for either cueing or monitoring. The overall dimensions are 16"x18"x21".—*Type MTV-12; Raytheon Manufacturing Co., Waltham 54, Mass.*

Raytheon TV monitor.

Utility Cabinets

A line of small utility cabinets with built-in, welded chassis has been announced. Made of steel in black ripple finish and available in six sizes ranging from 4"x 2"x 4" to 6"x 6"x 6".—*Insuline Corporation of America, 3602 35th Ave., Long Island City, N. Y.*

Ribbon-Pressure Microphone

A 15-ounce ribbon-pressure microphone, designed especially for television, is now available.

Mike features a slimline design. Has an output of 110 microvolts per dyne per square centimeter for an output impedance in accordance with RMA standards of 30, 150, and 250 ohms. Mike is non-directional and said to provide uniform frequency response between 50 and 15,000 cps. Effective output level at 1,000 cycles is said to be —50 dbm. Special transformer design is said to provide a hum pickup level of —125 dbm.

Microphone includes a ⅞" diameter horn for increasing the response in the high-frequency regions. This is coupled to a cylindrical tube, which in turn is coupled to the front of the ribbon by means of a round-to-rectangular connector of constant cross-section. The back of the ribbon is coupled to the damped folded pipe or labyrinth by means of a rectangular-to-round connector. The ribbon impedance, which is said to be practically a pure resistance of .25 ohm, is stepped up to a standard line impedance. Alnico V magnets and the transformer are located in the 7" long barrel section, which has a diameter of 1¼". A plug connection leads to a 30' cable. Can be attached to any standard microphone stand. Overall length of the microphone is 12" and the greatest diameter is 1¼".—*Type BK-4A (The Starmaker); RCA Engineering Products Department.*

RCA ribbon-pressure mike.

TV Stabilizing Amplifier

A stabilizing amplifier which provides automatic correction of the sync and blanking portion of a TV signal has been announced.

Amplifier features adjustable sync percentage. Can remove noise and hum from the video signal, combine sync and video or separate sync and video and automatically clip black and white spikes.

Unit is said to be capable of increasing the picture signal by up to 20 db. Can also control the height of the sync pulse. Provisions have been made in the amplifier for a clipfade (reduction of the signal output, starting with the white region).—*TV-16-B; G.E. Commercial Equipment Division.*

Production Aids

Self-Bonding Tape

A self-bonding tape that is said to shape itself to any surface contour, and offer a watertight seal, has been announced.

Tape has a polyethelyne base. Seals against moisture, ozone and corona can be effected by stripping lines and then making a good electrical splice. Other applications include holding the ion trap magnet to the picture tube; dressing the high voltage leads in the receiver and binding the frayed wire on picture tube leads to the high voltage end.—*Bi-Seal; Bishop Manufacturing Co., 254 W. 31st St., N. Y. 1, N. Y.*

Dumore Automatic Drill Head

An automatic drill head for drilling diameters from .0135" to .1800" in ferrous or non-ferrous metals, plastic, wood, etc., is now available.

Head has a double-end armature shaft with a No. 0 Jacobs chuck on one end and a rotary vane compressor on the other end, the entire assembly operating as a unit. Motor supplies the power for drilling, while self-contained air compressor advances drill at pre-determined speed and pressure.

The speed of a universal motor is controlled by the load of the rotary vane compressor which acts as a speed governor. Thus, the head can operate at work speeds varying from 2,500 to 7,500 rpm, depending on the pressure exerted on the drill by adjusting the air pressure and feed regulator. Pressure and feed vary according to drill size. Setting the externally positioned air intake valve controls the rate of drill advancement to the work. Depth of stroke, which ranges from 1/32" to 1⅛", is selected by adjustable stop nuts in head, and can be controlled to within .004".

For drilling holes greater than 5 drill diameters in depth, or where chip clogging is apt to occur, unit can be operated manually. When set for manual operation, release of actuating or foot switch allows spring to retract drill, thus clearing chips. Switch must then be reactuated to resume drilling operation.—*The Dumore Co., Racine, Wisc.*

Dumore automatic drill head.

Aural Coverage

(Continued from page 11)

our physical antenna height of 370 feet. It was felt that if approximately twelve radials were plotted, with at least two points falling near the periphery of our coverage on each radial, then a reasonably accurate contour could be drawn after analysis of the signal strength at these points was made.

Moving away from the FM radiator, stops were made at gasoline filling stations in rural or near-town sections, beginning at approximately twenty-five miles from the transmitter. A 100-foot extension cord was used to supply the 115 volts *ac* to the receiver.

The folded dipole was carefully set up and rotated for maximum signal, taking care to keep the antenna as far from overhead wires as possible. After careful listening for a few minutes, a note was made as to the listenability of signal, bearing in mind that music averages about 12 db greater *ear* volume, than does male speech due to the preemphasis of 75 microseconds at the input of the FM transmitter, and in addition, music occupies more space or area *under the curve* than does speech, the latter being composed mainly of low volume with numerous severe peaks.

One of four columns was set up to denote quality of received signal at each stop:

	Much noise: Not listenable	*Some noise: Barely listenable*	*Edge of limiting: Good listening*	*Limiting: Excellent*
Point 1.				
Point 2.				
Point 3.				
Point 4.				
Point 5.				
Point 6.				

After obtaining an average of three readings on each radial run, ranging from twenty-five to sixty-five miles, it was felt that the coverage contour could be plotted. By checking the measured contour with that of the calculated one, it was possible to make an interesting comparison. It was found that the measured contour followed closely the predicted radiation pattern that we had received for the type of transmitting antenna used at our plant. Numerous inquiries in different town near Columbia revealed that our actual coverage was very close to that which had been measured, *without the use of an electrical meter*.

Personals

Henry C. Roemer, vice president and comptroller and member of the board of directors of I. T. & T., has been elected executive vice president of Federal Telephone and Radio Corp.

E. Arthur Hungerford, Jr., has joined the sales staff of General Precision Laboratory, Pleasantville, New York, and will handle sales work on the video recorders, television film projectors and other electronic units for telecasting now being manufactured by GPL.

E. A. Hungerford, Jr.

Charles Schrader

Charles Schrader has been appointed director of purchases of Potter & Brumfield, Princeton, Ind.

Mario A. Gardner has been elected vice president in charge of purchases of Air King Products Company, Inc., Brooklyn, New York.

Walter R. Jones, associate professor of electrical engineering at Cornell University, has been retained as a member of the editorial staff of Howard W. Sams & Co., Inc., Indianapolis, Ind.

Peter L. Jensen, president of Jensen Industries, Inc., 329 S. Wood St., Chicago 12, received the Order of Knight of the Flag from King Frederick on his recent trip to Denmark. He was recognized for his contributions to the field of radio.

W. D. Loughlin has been elected chairman of the board of directors of Boonton Radio Corp. Dr. G. A. Downsbrough is now president, and Dr. D. M. Hill, vice president in charge of research and development.

George P. Fryling, chairman of the board of the Erie Resistor Corp., died recently.

J. B. Shimer has been named factories manager of the industrial and electronic division plants of the American Structural Products Co., subsidiary of Owens-Illinois Glass Co., Toledo, Ohio.

Bernard Decoufle is now cabinet production manager of the Starrett Television Corp., 601 W. 26th St., New York 1, N. Y.

John Rhoades has been named chief engineer of the special apparatus division of the Hoffman Radio Corp., Los Angeles.

Dr. R. G. E. Hutter, head of the electronics research section of the Physics Laboratory at Sylvania Electric, has been appointed adjunct professor at the Brooklyn Polytechnic Institute, where he will conduct classes in electron tube theory and electron optics.

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TeleVision Engineering

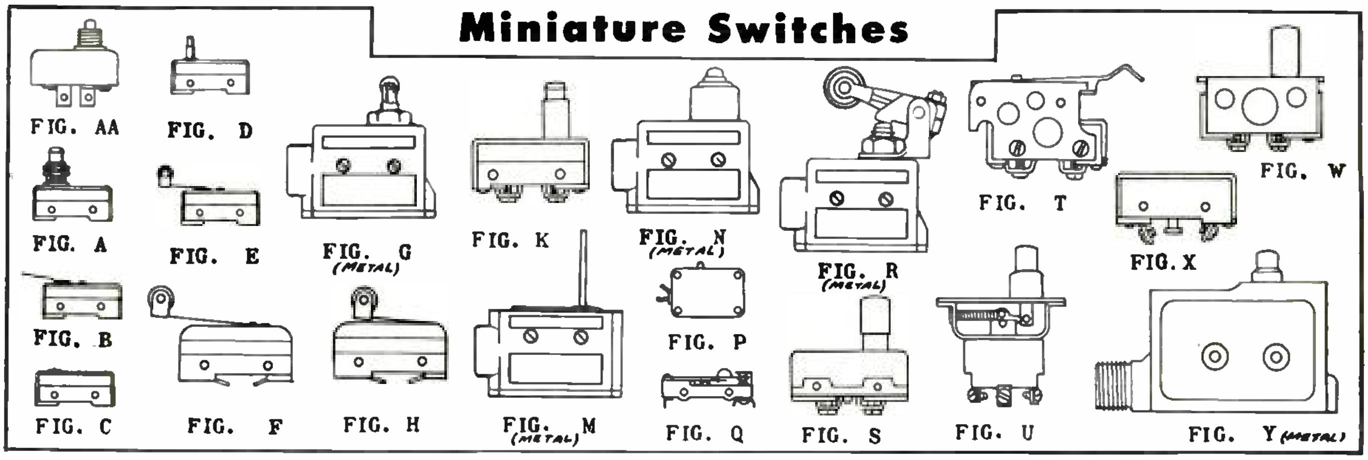
OCTOBER, 1950

Briefly Speaking . . .

THAT DEEP, DEEP FREEZE on TV, celebrated the beginning of its third frigid year a few weeks ago, with the prospect of a thaw, still quite a moot item, although several members of the Commission have indicated on many occasions that the early months of '51 should definitely see the end of the ice clamp. When the freeze was imposed in '48 there were 37 TV stations on the air and 86 authorized. Today, there are 105 on the air with four more being built and 354 applications in the till. . . . The Kansas City section of the IRE have announced plans for its second annual regional conference at the President Hotel in Kansas City on November 3rd and 4th. According to J. H. Van Horn, chairman of the conference committee, the general theme of the session will be *uhf-application and techniques*. . . . Army and naval training centers will soon receive TV sets providing 30" by 40" pictures supplied by Trad Television Corp. . . . Over 8,000 attended the Pacific Electronic Exhibit at Long Beach, California, which featured exhibits by 105 manufacturers. . . . A 5-kw RCA transmitter is now being installed in the WPIX quarters atop the Empire State Building. WPIX is scheduled to go on the air from this new site shortly after the first of the year. . . . Sugar Loaf mountain in Rio de Janeiro, Brazil, is now the home of a 150-foot TV antenna which will radiate signals from a G. E. transmitter, the installation of which is now being completed. . . . Television Equipment Corp. built the CBS color equipment for exhibition by Remington Rand at the National Business Show in Grand Central Palace. . . . Germanium products will soon be processed by G.E. at the Clyde, New York plant, formerly used for the assembly of table model receivers. T. E. Jamro has been appointed manager of the Clyde plant. According to Doc Baker, G.. vice prexy, over one-million G.E. diodes were used in G.E. receivers in '50 and in '51 nearly three million will probably be used in home sets, and about two million for industrial and military projects. . . . The assets of U. S. Devices Corp., manufacturers of antenna rotators, have been purchased by Cornell-Dubilier. . . . A new plant, which will specialize in the production of plastics and plastic metal components, is now being constructed in Warren, Pa., for the parts division of Sylvania Electric. About 30,000 square feet of production space will be available at the new plant. L. R. Wanner, formerly of Hugh H. Eby, Inc., will be manager of the new plant. . . . An additional plant in Los Angeles is now being completed by Haydu Brothers for the manufacture of picture tubes and other accessories. . . . The office, laboratory and rehearsal hall of Telefex, a rear screen projection service, is now located at 5746 Sunset Boulevard, Hollywood 28, Calif. . . . RCA will soon begin the manufacture of miniature tubes in their new plant in Cincinnati, Ohio. The new facilities, on property of about seventeen acres with buildings of approximately 180,00 square feet of floor space, was formerly occupied by the Rich Ladder and Manufacturing Co. . . . Dr. V. K. Zworykin, director of electronic research and vice president of RCA Labs, will receive the 1951 Medal of Honor from the IRE, during their national convention, March 19-22, at the Waldorf-Astoria Hotel in New York City.

SAVE on Miniature and Toggle Switches at WELLS

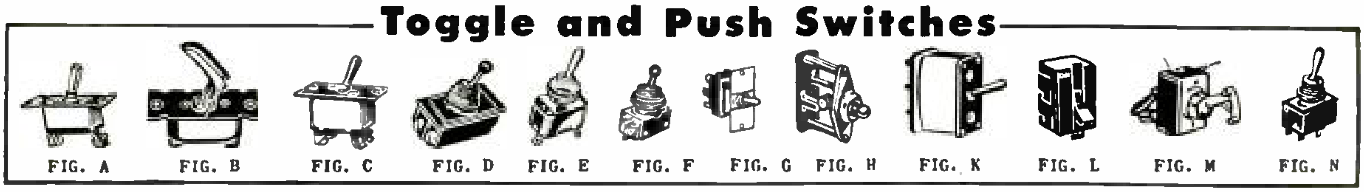
Miniature Switches



STOCK NUMBER	MANUFACTURER	MFR. TYPE NO.	CONTACTS	ILLUSTRATION	PRICE EACH
305-10	Microswitch	WP3M5	N.C.	FIG. AA	$0.40
305-160	Microswitch	WP-5M3	N.C.	FIG. AA	.40
307-210	Microswitch	YP3A	N.O.	FIG. AA	.50
303-67	Microswitch	YZ7RA6	N.O.	FIG. A	.71
PH-100	Acro	R0182T	N.O.	FIG. A	.71
301-46	MU-Switch	MLB-321	SPDT	FIB. B	.85
301-93	Microswitch	YZ-2YLTC1	SPDT	FIG. B	1.01
301-30	MU-Switch	R02M	SPDT	FIG. B	.95
301-78	MU-Switch	Green Dot	SPDT	FIG. B	.75
303-79	Microswitch	BZ-RL32	SPDT	FIG. B	.75
303-85	MU-Switch	MLB329	SPDT	FIG. B	.67
305-154	Acro	XD4-5L	SPDT	FIG. B	.78
311-130	Acro	— —	SPDT	FIG. B	.70
PH-101	Microswitch	BRL18	SPDT	FIG. B	.78
PH-102	Microswitch	YZRL812	N.O.	FIG. B	.65
PH-104	Microswitch	YZ3RLTC2	N.O.	FIG. B	.64
PH-105	Microswitch	YZR31	N.O.	FIG. C	.53
PH-106	Microswitch	R-R36	N.C.	FIG. C	.50
PH-107	Microswitch	BR-26	N.C.	FIG. C	.53
PH-108	Microswitch	WZ-2RT	N.C.	FIG. C	.50
305-161	Microswitch	YZ3R3	N.O.	FIG. C	.71
311-115	Microswitch	WZR31	N.C.	FIG. C	.71
311-123	Microswitch	WZ-7R	N.C.	FIG. C	.60
311-126	Acro	HRRC7.1A	N.C.	FIG. C	.50
311-125	Acro	HRR07.1A	N.D.	FIG. C	.53
311-121	Microswitch	WZ7RTC	N.C.	FIG. C	.50
311-128B	Microswitch	YZ	N.O.	FIG. C	.53
370-6	Microswitch	X757	N.C.	FIG. C	.45
PH-119	Microswitch	WZR-8X	N.C.	FIG. C	.45
PH-109	Microswitch	RRS13	N.C.	FIG. D	.45
PH-110	Microswitch	BRS36	SPDT	FIG. D	.53

STOCK NUMBER	MANUFACTURER	MFR. TYPE NO.	CONTACTS	ILLUSTRATION	PRICE EACH
PH-111	Microswitch	GRS	N.O.	FIG. D	$0.49
311-116	Microswitch	SW-186	N.C.	FIG. D	.63
303-49	Microswitch	YZ2YST	SPDT	FIG. D	.68
309-93	Microswitch	BRS36	SPDT	FIG. D	.68
370-17	MU-Switch	QRS	SPDT	FIG. D	.75
PH-112	MU-Switch	MBW	SPDT	FIG. E	.72
311-25	MU-Switch	CUN24155	N.C.	FIG. E	.85
370-10	Acro	R02M12T	N.O.	FIG. E	.70
303-32	Microswitch	YZ-3RW2T	N.O.	FIG. F	.65
306-10	Microswitch	BZE-2RQ9TM1	SPDT	FIG. G	2.48
PH-123	Microswitch	YZ7RQ9T6	N.O.	FIG. G	.75
309-101	Microswitch	BZ-2FW221	SPDT	FIG. H	.95
PH-113	Microswitch	RZBQT	SPDT	FIG. K	.58
L306-1010	Acro	R07-8586	N.O.	FIG. K	.55
370-18	Acro	HR071P2TSF1	N.O.	FIG. K	.60
370-19	Microswitch	YZRQ41	N.O.	FIG. K	.65
370-8	Microswitch	RN-11-H03	SPDT	FIG. M	1.50
309-157	MU-Switch	— —	N.C.	FIG. N	1.15
370-15	MU-Switch	AHB203	SPDT	FIG. N	1.25
370-7	Microswitch	WZE-7RQTN	N.C.	FIG. N	1.35
305-11	Acro	2M031A	N.O.	FIG. P	.37
305-50	Microswitch	Open Type	SPDT	FIG. Q	.35
303-84	Acro	HR07-4PST	N.O.	FIG. S	.50
303-83	Microswitch	YZ-RQ4	N.O.	FIG. S	.50
PH-114	Microswitch	WZR-31	N.C.	FIG. T	.65
PH-115	Cutler Hammer	8905K564	DPDT	FIG. U	.65
PH-116	Microswitch	WZRQ41	N.O.	FIG. W	.60
PH-118	Microswitch	BZRQ41	SPDT	FIG. W	.60
311-128A	Microswitch	YZ-RTX1	N.O.	FIG. X	.90
PH-117	MU-Switch	Z	N.C.	FIG. Y	1.35

Toggle and Push Switches



STOCK NUMBER	FIG.	CONTACT ARRANGEMENT	MANUFACTURER & NUMBER	PRICE EACH
PH-500	A	SPDT	B1B	$0.35
PH-501	A	SPDT	AN3022-3B	$.35
PH-503	A	SPDT CENTER OFF MOM EACH SIDE	B11	.32
PH-505A	A	SPDT MOMENTARY	B21	.30
PH-505	A	SPST	AN-3022-2B	.30
PH-506	A	SPDT CENTER OFF	AN-3022-1	.35
PH-507	A	SPDT CENTER OFF MOM EACH SIDE	AN-3022-7B	.32
PH-508	A	SPST MOMENTARY	AN-3022-8	.28
PH-513	A	SPDT CENTER OFF	CH AN-3022-1B	.38
PH-514	A	SPST	CH B-5 A	.35
PH-516	A	SPST	B5	.35
LT-104	A	SPDT 1 SIDE MOMENTARY	CH 8905K568	.35
309-168	A	SPST	168553	.30
370-1	A	SPST MOMENTARY	CH AN-3022-8B	.25
370-4	A	SPDT CENTER OFF	CH B-9A	.35
370-14	A	SPDT CENTER OFF 1 SIDE MOM.	CH B-7A	.30
370-25	A	SPST MOMENTARY	CH B-6B	.25
305-171	A	SPDT CENTER OFF MOM 1 SIDE	8209K5	.32
309-169	B	SPST MOMENTARY	CH B-19	.35
PH-509	C	DPST	AN-3023-2B	.45
PH-510	C	DPDT MOMENTARY	CH 8715K2	.50
PH-511	C	DPDT MOMENTARY	CH 8715K3	.50
PH-512	C	DPST CENTER OFF	CH 8720K1	.55
PH-515	C	DPDT CENTER OFF	C-9A-8700K2	.55
PH-517	C	DPDT	C-5A-8701K2	.55
303-63	C	DPST	CH AN-3023-2	.45

Distributors: Our standard distributor arrangement applies on these items.

STOCK NUMBER	FIG.	CONTACT ARRANGEMENT	MANUFACTURER & NUMBER	PRICE EACH
305-174	C	DPDT CENTER OFF MOM 1 SIDE	AN-3023-5	$0.50
305-177	C	DPDT CENTER OFF MOM EACH SIDE	C-3	.50
305-176	C	DPDT CENTER OFF MOM EACH SIDE	AN-3023-7	.50
305-173	C	DPDT	8710K3	.55
305-175	C	DPDT CENTER OFF MOM EACH SIDE	3712K3	.50
305-179	C	DPDT CENTER OFF MOM EACH SIDE	8732-K2	.50
309-163	C	DPDT CENTER OFF MOMENTARY	CH C-11	.55
309-162	C	DPST	CH C-1	.45
309-164	C	DPST MOMENTARY	CH 8711K3	.40
370-31	C	DPDT	CH C-1B	.55
305-87	D	1 SIDE DPST MOM 1 SIDE SPST	AH & H	.95
LT-100	F	SPST	CH	.22
LT-101	F	SPST MOMENTARY	AH & H w/LEADS	.20
301-51	G	4PDT MOMENTARY	CH 8905K12	.75
305-140	H	DT NO MAKE EACH SIDE	OPEN FRAME	.25
309-161	K	SPST	CH 8781K3	1.95
305-76	L	DPST	AH & H OPEN FRAME	.75
301-12	M	DPST	AH & H SPECIAL FOR HANDY	.40
LT-107	N	DPST	AH & H TALKIE	.25

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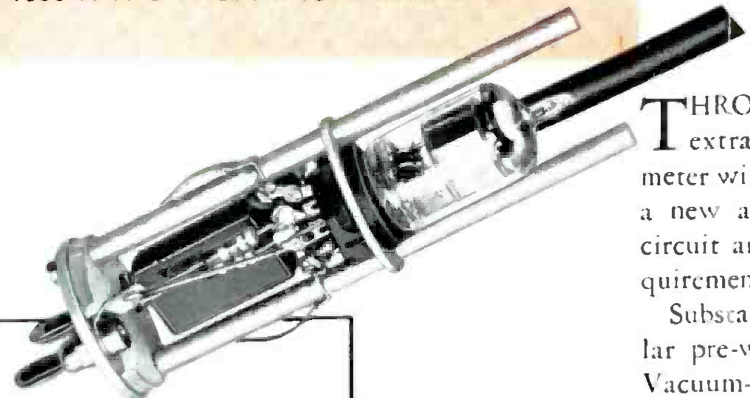

Probe with completely shielded case removed. Twin diode tube in the probe has an inactive section connected to the grid of one triode in the V-2 amplifier while the active section is connected to the grid of the other triode, both sections of the amplifier being used in a balanced circuit. The balanced amplifier insures very little zero shift when the line voltage varies.

THROUGH the elimination of many unnecessary frills and extra circuit refinements which would be necessary in a meter with ohmeter and d-c circuits and scales, G-R announces a new a-c vacuum-tube voltmeter with a straightforward circuit and with accuracies sufficient for most laboratory requirements, at a very moderate price.

Substantially duplicating the performance of the very popular pre-war Type 726-A instrument, the new Type 1803-A Vacuum-Tube Voltmeter sells for less than its predecessor and is improved over the older model in that it is smaller, lighter, has a probe which is smaller and completely shielded, a single zero adjustment for all ranges and a power supply not limited to operation at a single frequency.

The probe plugs into clips on the side of the cabinet, in which position the auxiliary test leads and terminals supplied with the instrument can be attached conveniently to the input connections.

This instrument should find wide application in many laboratories operating on a modest budget. Its accuracy is sufficient for the majority of laboratory measurements.

WRITE FOR COMPLETE DATA

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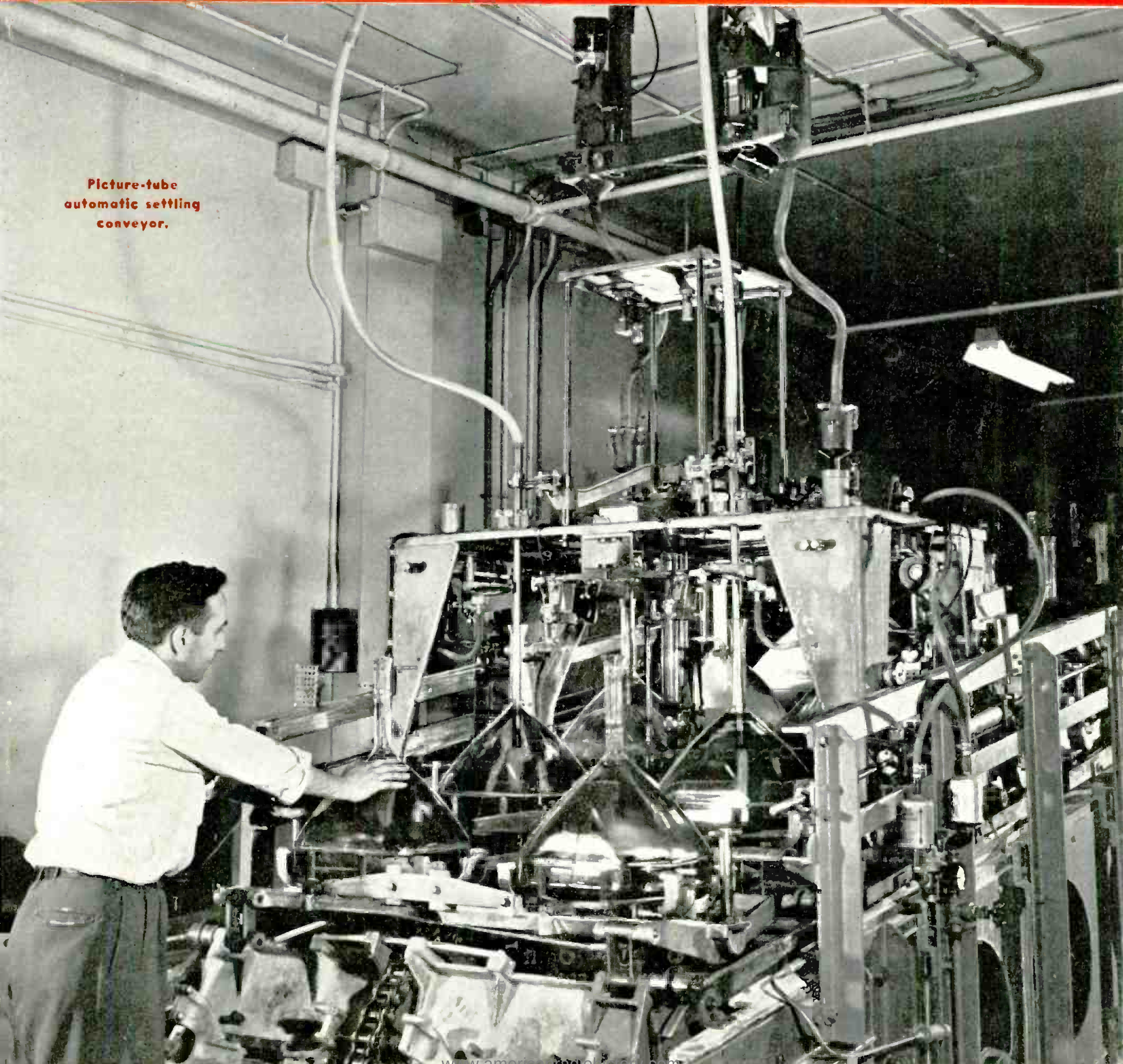
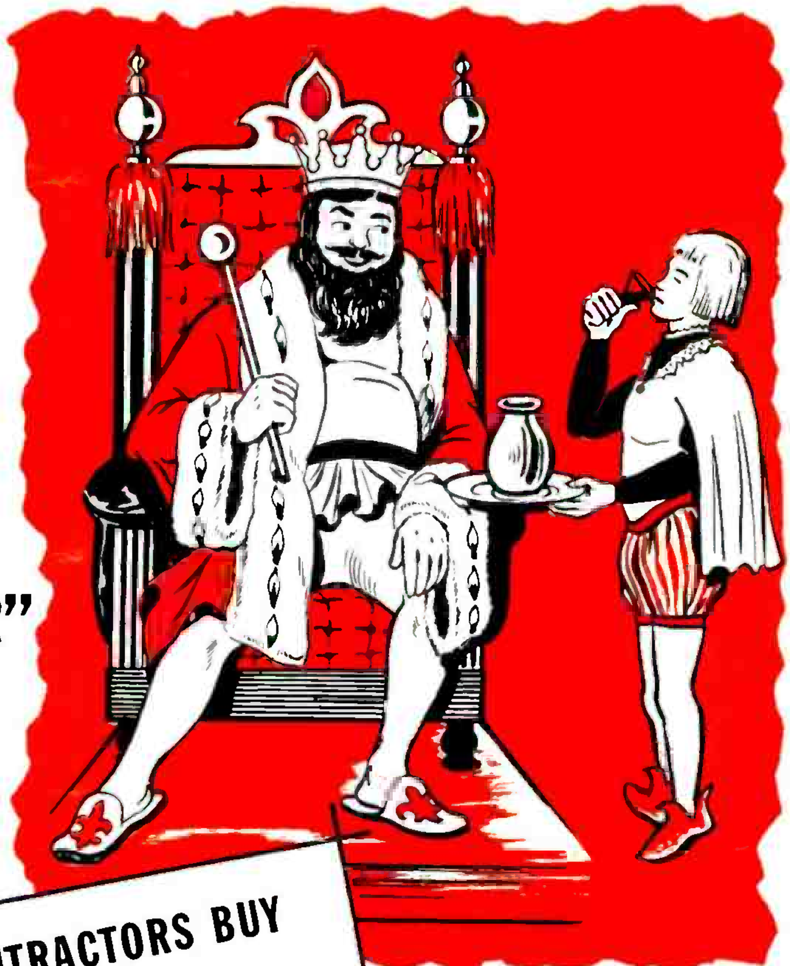
TELE-VISION ENGINEERING

AUGUST, 1951



Picture-tube automatic settling conveyor.

FIT FOR A KING *after* THE "ROYAL TASTER"



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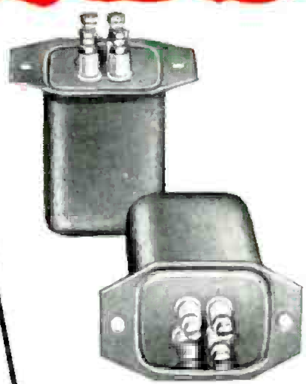
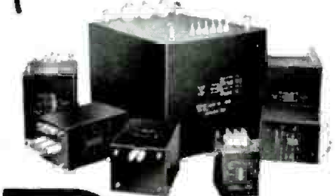


VERTICAL BLOCKING OSCILLATING TRANSFORMER HERMETICALLY SEALED BUILT TO MIL-T-27



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VOLUME 2 **AUGUST, 1951** **NUMBER 8**

MONTHLY FEATURES

Cover Illustration

Automatic settling conveyor which dispenses and settles uniform TV picture-tube screens.

(Courtesy Hytron)

Editor: LEWIS WINNER

ABC

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TELE-VISION ENGINEERING
LEWIS WINNER, Editor

August, 1951

Boosted ERP's Liven TV Scene—As wires sped around the country to dozens of stations with the good news that powers can now be upped to their capacities, and the *erp*'s roared to levels that doubled, and in some instances tripled coverage, broadcasters, setmakers, sponsors and practically everyone involved in the business began to beam. The expanded trading areas were envisoned as a blessing by makers and sellers of not only transmitters and receivers, but antennas and the host of accessories that might be necessary to provide pictures to those in the primary and secondary fringe sites, who have been waiting so long for the occasion.

The stepped-up audience possibilities intrigued time buyers, prompting reams of enthusiastic predictions on the tremendous possibilities now on the scene and in store for the future, as new stations come on the air.

The break in the ice jam routed much of the gloom which had been hovering over industry since the early part of the year. The telephone company's announcement that the long-promised Atlantic-to-Pacific video line would become an eventuality before world-series time, was also noted as quite a boon.

All that is necessary now to cause the bells to ring wildly is that news flash, which FCC's headman promised Congress would be aired soon—news declaring *finis* to the freeze. We're waiting, Mr. Commissioner.

South-of-the-Border TV Stepping Along—In Mexico, Cuba, Uruguay and Brazil, TV activity is rapidly becoming an item of major import. With six stations now in operation, and eighteen scheduled for installation soon, a market for nearly two-million receivers, and millions of dollars worth of accessories in the transmitting, as well as the listening field, lies ahead. In Cuba, present plans call for the spending of nearly two-million dollars for stations and equipment, which will include a chain of microwave retransmission points in outlying provinces. In Uruguay, over $100,000 has been set aside for a TV station, and probes to survey the potentialities of additional telecasting.

Reports from other Latin American countries indicate corresponding interest in the possibilities of sight and sound.

A Wise Appointment—Haraden Pratt, who has been serving industry in a sterling fashion for nearly four decades, now has a new job, one of the most important ever assigned: Telecommunications Advisor to the President.

It will be his responsibility to formulate national policy on frequency allocations here and abroad, not only insofar as government is concerned, but industry, too. His complete familiarity with frequency applications throughout the spectrum should enable him to judge everybody's needs wisely, and proffer decisions which will be equitable.

The Pacific Coast Meeting—A host of extremely interesting papers on broadcast-TV services have been scheduled for the annual western IRE convention, convening at the Civic Auditorium in San Francisco on Wednesday, August 22. The session, presided over by Al Isberg of KRON-TV, will feature talks on microwave relays, klystrons and color TV. In addition, there'll be held the first western meeting of the IRE Professional Group on Broadcast Transmission Systems.

Here is an event that merits an enthusiastic reception.

TV at the Radio Fall Meeting—The annual IRE-RTMA meeting, usually held at Syracuse, and this year scheduled for Toronto, has on the program a variety of excellent talks on TV receiver and component design.

At the three-day gathering, beginning on October 29 and ending on the 31st, papers presented will cover noise in TV receivers, suppression of local oscillator radiation, miniature triodes for *uhf* TV tuners, converters, phase linearity, pencil triodes, and color TV. Among those who will present the talks are: S. J. H. Carew, Stromberg-Carlson; John Van Duyne, DuMont; K. E. Loofbourrow and C. M. Morris, RCA; H. R. Hesse, DuMont; Herbert Kiehne and Stanley Mazur, Emerson; and John W. Busby, RCA.

The First UHF Symposium—At Franklin Institute in Philadelphia, on September 17, a historic episode in TV progress will be staged, as eight leading ultrahigh specialists gather to report on the state of the art. Sponsored by the IRE Professional Group on Broadcast Transmission Systems, of which ye editor is chairman, there'll be talks on 850-mc transmission, 700-mc installations, impedance and frequency measurements at the ultrahighs, side-fire helix *uhf* transmitting antennas, receiver design, transmission-line problems and field-strength analyzers, by Dr. George H. Brown, RCA; William Sayer, Jr. and Elliot Mehrbach, DuMont; R. A. Soderman and F. D. Lewis, General Radio; L. O. Krause, G.E.; W. B. Whalley, Sylvania; Raymond Guy, NBC; J. M. De Bell, Jr., DuMont; and Frederick W. Smith, NBC.

The program will begin at 10 a.m. and run until 6 p.m.

It'll be quite a day. Circle that date, *September* 17, on your calendar now. Hope we'll be seeing you!—L. W.

A Progress Report

TV . . . Now . . . and This Fall and Winter: Beset by a chain of stubborn obstacles, stemming from, in the main, mismoves in the nation's capital, TV production, particularly on the chassis front, during the past months, has been quite a gloomy item. With production down to around 20,000 units a week, from a high of 218,000 set in October, '50, and inventory figures even more startling, up from around 50,000 sets in November to a total of over 700,000 a few weeks ago, the scene has been a distressing one.

Although four factors have been commonly cited as the reasons for the decline, namely, the freeze, color, material scarcities and regulation W, the latter has been noted as the real culprit. Describing the ravages this ruling had cast on industry, RTMA prexy Glen McDaniel pointed out, during a recent address before the Electric League in California, that up to 50,000 had been released from production lines, because of lack of sales, caused by the W ruling.

Declaring that the ruling was not necessary to divert materials and manpower, McDaniel said that the NPA and other organizations have been set up to do that job directly and are doing it well. A recent survey was noted as showing that less than half of the plant capacity of the industry had been employed in June in civilian work, with defense work taking a small fraction of the remaining half. "Nothing could be more plain than that," declared McDaniel, "that there is no justification for regulation W on the ground of defense production needs, either now or at any time in the past."

Fortunately, Congressional committees became cognizant of the damage wrought by the ruling and have provided a relaxation, reducing down payments to 15 per cent, a move, McDaniel felt will recapture the fading market, and strive to empty those bulging warehouses this fall and winter.

Commenting on possible troubles from material shortages, the association's headman said that, thus far, they have not delayed deliveries of either military or civilian electronic goods. As far as television sets are concerned, McDaniel declared, RTMA's industry-wide program for the conservation of critical materials through the exchange of information gives great promise of *more television sets* with fewer pounds of critical material and without loss of quality.

It was pointed out that some shortages may be expected to pinch civilian production in the fourth quarter, but it is very difficult to learn the facts and make predictions with any accuracy. Industry feels that it can do its part in the mobilization effort, said McDaniel, and still have enough materials for a healthy and active civilian production.

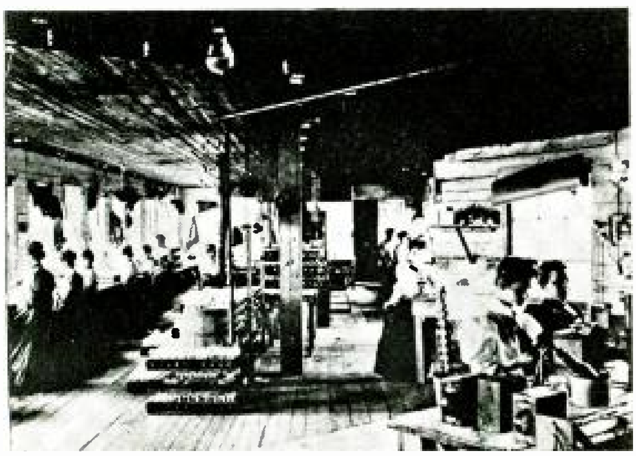
Reviewing the steps FCC has taken to shorten the television allocation hearings by dispensing with oral testimony, RTMA's prexy pointed out that while this is a commendable move which will greatly hasten the lifting of the freeze, the lifting will not come before the end of the year and new stations will not be on the air until a year from now or more. However, he said, the Commission's action in opening the question of increased power for existing stations is an encouraging step, and one that may help set sales relatively soon.

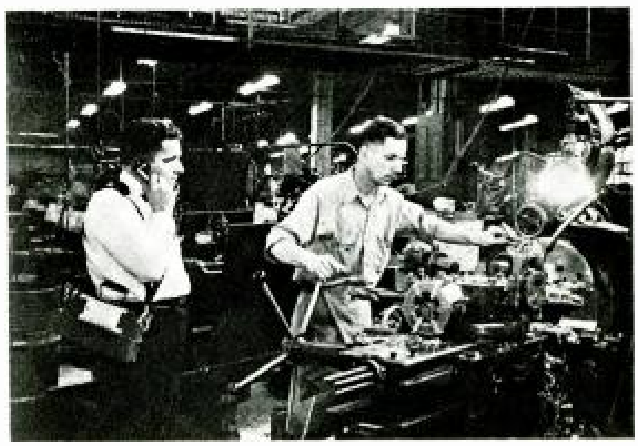
Detailing the effect of color on future production, McDaniel noted that the development of color television will be slow. Manufacturers will make sets and converters of the mechanical type, and there will also be adapters for those who want to receive the color telecasts in black and white, the Californians were told. The limited colorcasting schedule will naturally reduce the potential audience, it was pointed out.

"Meanwhile," declared McDaniel, "the efforts of industry to devise a system of color television which it considers better than the one adopted by the FCC are proceeding. When the tests are completed there will no doubt be applications to the FCC for authority to operate an improved system."

Surveying the striking progress that TV has made and will make on a continuing basis, the RTMA spokesman noted that any industry which can jump from a production of several thousand units to many millions in four years can't help but succeed in a bustling way. Quoting the rising values of television stations as another example of industry expansion, McDaniel said that transmitting setups today are truly priceless. "A television station that sold for $375,000 two years ago sold a one-quarter stock interest in the station, recently, for the same price," he declared. And it won't be long before even that price will be considered low, quite low for so powerful a medium, it was pointed out.

Below: Production line in 1901: At the small plant of Sylvania, in Middleton, Mass., where women performed most of the operations. Sole output was refilled lamps. Burned-out bulbs, which arrived in barrels, were cleaned, sorted, given a new filament, resealed after the air was exhausted, and packed for shipping. Sylvania, now celebrating its golden anniversary, operates plants in 20 communities in six states, and employs more than 22,000. Products now made include incandescent and fluorescent lamps, receiving tubes, picture tubes, photoflash tubes, industrial electronic tubes, receivers, lighting fixtures, tungsten parts, chemicals for radio and TV, metal parts and stampings, wire and plastic parts. Right: Modern production line at the Weatherhead Co., in Cleveland, where handie-talkies are used to report to production control center, in this instance, on the status of the parts being machined. By this means the company is able to maintain a continuous inventory of orders in production. (Courtesy Motorola)





Production Pools

Small-Plant Grouping Plan Revived: During World War II, many small manufacturing plants organized and operated production pools to facilitate the solicitation of subcontracts and thus increase war production. The move proved so successful that the DPA has returned the plan for the current defense drive. Noting that under favorable, individual circumstances, the use of these pools has been and can be helpful, and in such cases will be encouraged, DPA has declared that a new pooling section of the NPA, in Washington, on behalf of DPA, has been set up to assist those interested in production pools. According to J. C. Pritchard, DPA deputy administrator for small business, a production pool is desirable if it serves to increase the capacity to produce defense goods and services by broadening the production base; obtains a more desirable distribution of defense production without hurting existing capacity; accelerates the rate of defense production by reducing the backlog of unfilled orders of procurement agencies and prime contractors; prevents capacity from being lost during partial mobilization; relieves the load on businesses able to produce other items of greater scarcity; produces a product or service which can pass necessary tests and can be delivered on schedule; and decentralizes defense production.

Production pools have been found to aid small manufacturers in securing contracts, as a member of a pool, for items not otherwise available, by pooling skilled labor, finance, machines and plants, since the pool has available to it the best management experience to be found in any one of the individual member firms. Such a pool would have more highly trained and experienced managerial, engineering and accounting supervision. By combining complementary facilities, the pool can deal more effectively with Government procurement officers and prime contractors than can its members individually, and at a fraction of the cost of time and effort.

There are several important organizational problems. There has been, in the past, a tendency toward attempting too loose an organization, rather than one which is too centralized. The type of small plants entering the pool is also of basic importance. Any pool made up exclusively of foundries or wood-working or machine shops with the same kind of facilities would certainly be at a disadvantage, when compared with another pool whose individual plant facilities complement each other. A complementary group might include a foundry, machine shop, sheet metal working shop, welding shop, and plating and finishing shop.

The collaborative organization into a common unit of separate business enterprises might be viewed as a combination of conspiracy in restraint of trade or commerce or an attempt to monopolize trade or commerce in violation of the Federal antitrust laws and the Federal Trade Commission Act. According to DPA, if the administrator considers the voluntary program justified, under which a particular production pool will be formed, he will consult with the Attorney General and the FTC chairman. If and when the pool requests are approved by the Attorney General, the administrator has the authority to approve the voluntary program, make his finding that it is in the public interest as contributing to the national defense, and note that the companies who have agreed to pool their efforts will not be subject to monopoly prosecution.

Procurement

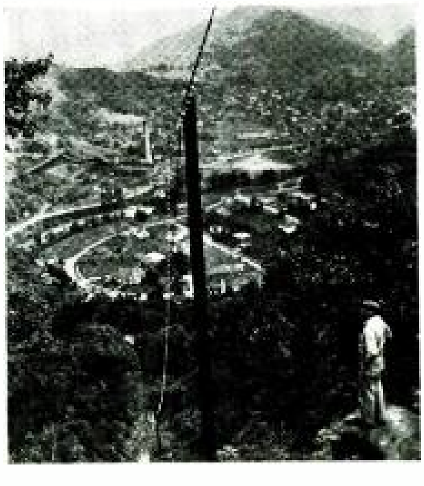
Small-Business Assistance: More than 200 full-time small business specialists have been appointed by the Army throughout the country to aid small-business firms interested in learning how they may participate in the current military procurement program.

Named as small business specialists, for the Signal Corps, are: District of Columbia—Jean P. Jaquette, Room 2C 263, Pentagon; Illinois—George Boyajean, 226 West Jackson Boulevard, Chicago; New Jersey—John B. Cannon, Ft. Monmouth; New York—Randolph C. Bradshaw, 180 Varick St., N. Y. C.; Pennsylvania—Maj. Ed. E. Regan, 2800 South 20th St., Philadelphia.

Below: Sixty-five-foot tower with three yagis, cut for channels 4, 5 and 7, on mountain peak 1000' above Hazard, Ky. Installed to pick up programs from Huntington, West Virginia and Cincinnati, Ohio, 90 and 150 airline miles away. Right, below: View of poles on which have been mounted about 3000' of open-wire leadin, feeding signals to amplifiers. At bottom of hill amplified signals are fed to coax cable mounted on poles of the local electric light company. From these poles, smaller coax cable, strung into each home, feeds sets. Amplifiers have been placed along the system at intervals to compensate for line losses in signal strength. Junction boxes, which can be mounted on any pole, permit four homes to be connected into the system from a single pole. At present, about 600 feet of the heavy cable has been strung on power company poles, and about twenty receivers have been installed. (Courtesy G.E.)

Below:

A 40' helical antenna designed by G.E. to boost erp of uhf transmitters by 20. Antenna is now being used at Electronics Park, in Syracuse, N. Y., with low (100-watt) and high-power (5-kw) experimental transmitters.



Color Television

Colorimetry: The recent surge of interest in the reds, greens and blues has prompted the initiation of many intriguing studies on not only new methods which will provide improved transmission and reception, but on those principles which other industries allied in the color world have found to be really basic in the art. In this category, the science of colorimetry has loomed as perhaps the most important of the essentials which must be carefully evaluated. During meetings of many of panels of the NTSC, the term has served as the basis of series of discussions on techniques, standards, etc.

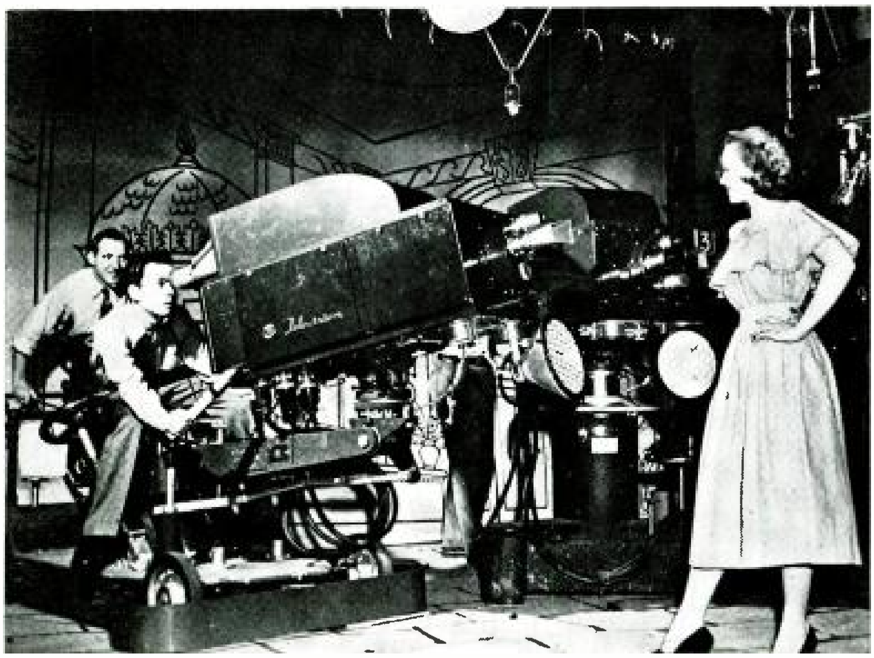
The significance of colorimetry in setting standards has been also explored during quite a few lectures. One of the most revealing reviews of the subject was offered by Frank Bingley during the recent annual IRE meeting in New York. Describing signal packaging, for instance, he noted that such an approach revolves about the manner in which colorimetric information is placed together for shipment over the ether. In his opinion, packaging must be such as to protect the information from significant damage in shipment, but yet, be no more robust than necessary.

Analyzing the system which would be involved, he said that the brightness information, *Y*, is transmitted directly over the normal picture carrier, using present black and white television standards so as to render the system compatible. The balance of the information is placed upon a subcarrier, or a color carrier, it was then pointed out, with the quantities *Z-Y* and *X-Y* used to amplitude modulate two color carrier vectors which are in quadrature. The resultant color carrier, which is then both phase and amplitude modulated, he said, is mixed with the normal *Y* brightness signal, and the complete signal transmitted on the normal picture carrier; the color carrier frequency is chosen to have minimum visibility. The fact that since both *X-Y* and *Z-Y* vanish for white input pictures (there is no color carrier on white) was cited as being particularly important, since it improves compatibility by insuring that a color carrier is present only when necessary to transmit color. Therefore, it was noted, colors near white have only small carrier amplitudes.

Projection-TV Room Fire Prevention

Safety Requirements: The equipment necessary in TV station projection rooms has been found ot create possible hazards of the same type inherent in the projection rooms of motion picture theatres. With the present use of 35-mm film and projectors equipped with the *synchro-lite*, instead of the conventional carbon arc lamps, hazards affecting the safety of the operating personnel appear to be continuously present. Describing this problem at the recent SMPTE meeting in N. Y., Samuel R. Todd of the Chicago Board of Examiners declared that the gas discharge gap lamp in the light source employs potentials up to 5000 volts across its terminals, a high voltage which could be a trouble source when nitrate base film is used, unless safety regulations of the type employed in projection rooms of motion picture theatres are adopted.

The panic that may be created by the sudden explosion due to the ignition of perhaps a thousand or more feet of nitrate film or the uncomfortable situation incident to one of the operating personnel lying prone from the effects of an electric shock are, it was pointed out, possible situations requiring very special consideration from those individuals charged with the responsibility for formulating safety rules and regulations for TV station projection rooms. Todd said that the safety requirements for projection rooms in TV stations should include as a minimum: (*a*) standard fireproof construction of the projection room; (*b*) the proper floor dimensions to provide good operating conditions; (*c*) approved storage facilities for the film; (*d*) an approved rewinding device for 35-mm film; (*e*) installation of approved, self-closing, automatically-controlled, fire shutters for the port holes; (*f*) proper projection room ventilation, including both natural gravity and forced draft methods, and (*g*) provision of adequate means for instant exit for the operating personnel through openings equipped with fireproof self-closing doors opening outward.



Above: Colorcast pickup on compatible system cameras, at the Palisades Amusement Park pool, across the Hudson River from N. Y. City, during the recent RCA tests. Left: Compatible color TV in action in the studios, during the recent field tests.

Microwave Instruments

Magnetic Attenuator: Recent studies in the use of attenuators at microwave frequencies for adjusting power levels, isolating monitoring equipment, or padding oscillators from variations in the load, have indicated that the operation usually becomes complicated because of control inaccuracies and mechanical inflexibility.

In conventional microwave attenuators, the energy is usually dissipated in an element made of resistive film on glass or bakelite, powdered carbon, or polyiron materials having characteristics that vary with length, composition, and the operating frequency. The dissipative element must often be carefully machined to close tolerances and is usually very fragile. Additional difficulties arise when variable attenuation is required in a transmission line circuit. Complex mechanisms which are necessary to insure a high degree of precision and fineness of control, have been found to result usually in bulky, hard-to-handle controls at substantial increased costs.

In an effort to find an instrument which would avoid many of these disadvantages, Frank Reggia of NBS discovered that a magnetic attenuator, composed of a slug of some highly permeable and resistive ferromagnetic material placed within the field of an electromagnet, was very effective. The significant feature of the device was found to be a change in the loss properties of the dissipative material when it is subjected to a magnetic field. Because the magnetic field is produced by an electromagnet, its magnitude can be changed simply and precisely by varying the current in the field coils. Consequently, the permeability and loss characteristics of the dissipative material can be controlled, and a variable attenuator results. In addition, the control characteristics are linear over a substantial range. An NBS investigation of materials such as polyiron and ferrites (with electrical resistivities from 10^2 to 10^7 ohms cm) indicated that the loss characteristics not only depend upon the composition and length of the material, but increase with increasing frequency.

The size of a magnetic attenuator for $^3\!/_8$″ coax transmission lines was 1″ x 4″ x 2″, and the dissipative material, a cylinder of polyiron, about ½″ long and $^3\!/_8$″ in diameter. In fabricating the model, a recessed conductor hole for the center conductor was drilled into the cylinder, ceramic insulators placed at the extremities, the whole assembly encased in a metal sheath, and connector pins fastened to the ends of the center conductor. Standard male and female type N coaxial connectors completed the assembly.

The electromagnet requires a *dc* power source of 0 to 250 volts, with a maximum of 30 milliamperes current to produce a magnetic field of 1500 gauss in the air gap. Small changes in the magnetic field can be obtained by controlling the field current with a multi-turn potentiometer.

An experimental model of the magnetic attenuator which uses polyiron as the dissipative element was operated at frequencies from 1000 to 3000 mc. Variations in the losses of the polyiron were produced which were large enough to reduce the attenuation 60 per cent, change the power by a ratio greater than 60:1, with a voltage-standing-wave ratio always less than 1.5.

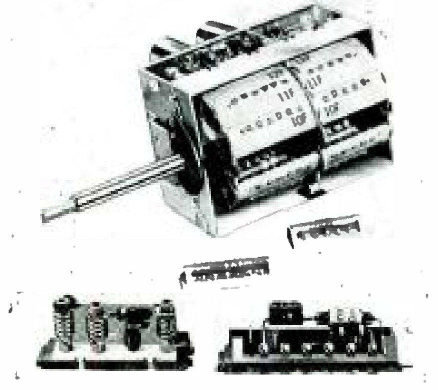
More recently, a study was made at NBS of an attenuator that employs a slug of Ferramic B ½″ long and $^3\!/_8$″ in diameter as the dissipative medium. The dependence of the losses in the material on frequency was strikingly demonstrated by this experiment. At 2200 mc the attenuation was reduced from 17 db to less than ½ db, and less than 45 milliamperes of current were required to maintain the magnetic field. At a frequency of 2600 mc, changes in attenuation greater than 20 db were obtained with the same electromagnet currents.

Magnetic-Material Standardization

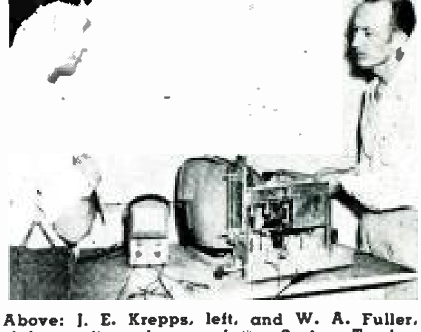
New Core Specs: In an effort to standardize the variety of core materials used in coils, transformers, etc., there has been prepared a chart listing 25 basic materials and their commercial identities, as supplied by eight manufacturers: Empire Coil Co., Inc.[1]; Magnetic Core Corp.[2]; National Moldite Co.[3]; Powdered Metal Products Corp.[4]; Pyoferric Co.[5]; Radio Cores, Inc.[6]; Spear Resistor Corp.[7]; Stackpole Carbon Co.[8] Materials itemized include carbonyl *C, E, HP, L, SF, TH*; IRN-*2-3-6-8-9-16-31*; Plast-Sponge *C3H-BG30, C1C-A30, C3H-A30*; Plast-Coriron *K1J-A33*; Plast-Iron *A3G-G10, A3G-A10, A2B-A10*; Plast-Iron Flakes *M17K-A16*; Magna-Tite *A, C, H*, and Magnetites.

The data sheet, prepared by the Metal Powder Association, states that cores made from basic raw materials by different core manufacturers are not necessarily interchangeable. It is suggested, therefore, that to obtain identical characteristics a mutual agreement on standards will be required. The designations offered are basic and may be modified by the manufacturer to indicate variations in the formula, such as type and amount of insulation and binder.

[1]85 *Beechwood Ave., New Rochelle, N. Y.* [2]142 *S. Highland, Ossining, N. Y.* [3]1410 *Chestnut Ave., Hillside, N. J.* [4]9335 *W. Belmont, Franklin Park, Ill.* [5] 621 *E. 216th St., New York 67, N. Y.* [6]9540-50 *Tully Ave., Oak Lawn, Ill.* [7,8] *St. Marys, Pa.*



Left: Turrett-type tuner (Standard Coil) which can be adapted for ultrahigh pickup, through removal of two vhf channel coils (shown at right of tuner) and replacement by uhf channel coils shown below in separate illustration. In adapting sets equipped with these tuners an unused channel is selected, and with a screwdriver, the small clips that hold the two channel strips in place are released. Then the uhf strips can be inserted in place of the vhf strips. According to Standard, there are approximately four and one-half million owners of TV sets equipped with these tuners, or about 40% of the TV sets made to date.



Above: J. E. Krepps, left, and W. A. Fuller, right, staff engineers of the Sarkes Tarzian engineering research and development laboratories, testing a receiver with a uhf tuner mounted on a currently-produced chassis.

Printed-Circuitry

Circuit Printers for Flat and Cylindrical Surfaces: Two semi-automatic machines for printing circuits, one for flat surfaces and the other for cylindrical surfaces, have been developed by Robert L. Henry and associates of the Bureau of Standards.

The printer for flat plates is motor-driven and more fully automatic than the printer for cylindrical surfaces. In the flat plate printer, a turntable accepts the unprinted plate at a loading position, carries it to a printing position, then carries the printed plate to an unloading position, where it is automatically flipped into a chute.

In regular operation, three plates are processed simultaneously: while the first plate is unloaded, the second is printed, and the third is loaded. The turntable stops while these operations are performed, then advances the plates one-third of a revolution, stops again, and so forth. The usual production rate, about 1,000 plates per hour, can be increased to 1,500 per hour without loss of printing quality but at the expense of excessive wear and tear on the machine.

As the turntable advances the plates from position to position, they rest on rectangular platens about 3″ by 4″ in size. These flat platens are normally flush with the turntable. However, when a plate-carrying platen reaches the printing position, the platen rises and presses the plate against the underside of the printing screen, which occupies a fixed horizontal position. While the plate is held against the screen, a rubber squeegee is automatically moved over the top surface of the printing screen, forcing conducting paint through the screen onto the plate in the desired pattern. The platen is then lowered to its flush-with-the-turntable position and is advanced by the turntable another third of a revolution to the unloading position. Here the platen is tilted, and the printed plate slides into the discharge chute.

The flat-surface printer is at present loaded by hand, one plate at a time, as the turnable moves the three platens past the loading position. Otherwise the process, including the flipping of the printed plates into the discharge chute, is entirely automatic. The loading of the unprinted plates, and also the carrying away of the printed plates, could be done automatically by conveyors.

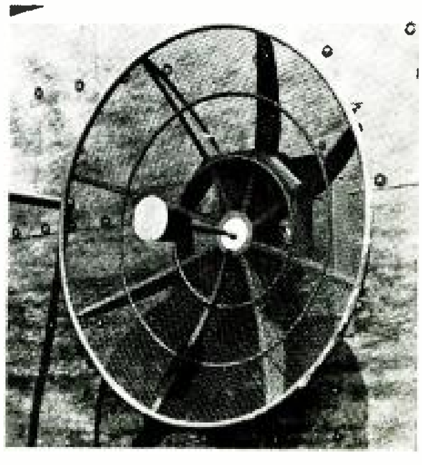
The NBS cylindrical-surface printer was developed for the printing of cylindrical ceramic forms less than .5″ in diameter.

The cylindrical-surface printer is loaded manually by slipping the cylinder to be printed over a mandrel. A single stroke of hand-operated control lever then puts the machine through the entire printing cycle and operates a release mechanism which drops off the printed cylinder.

This printer differs from a conventional printer in that the squeegee remains stationary. As the control lever is brought forward, the mandrel, bearing the cylinder to be printed, rises to meet the stenciled screen. Simultaneously the squeegee, which is directly above the mandrel, drops to press against the top surface of the screen. The screen, which remains flat and horizontal at all times, then starts to move (forward on one stroke, backward on the next) over the cylinder, and the cylinder rotates in response to the horizontal motion of the screen pressing against it. While the cylinder rolls against the screen, the squeegee forces conducting paint onto the cylinder through the pervious pattern of the screen. When the cylinder has made one complete revolution, both cylinder and squeegee are moved away from the screen. As the control lever is moved back to its starting position, the mandrel carrying the cylinder is rotated from a horizontal to a downward position, a release mechanism on the mandrel is actuated, and the printed cylinder drops off.

With hand loading of the cylindrical surface printer, an operator can print 1,500 cylinders in an 8-hour day. The addition of an automatic feed mechanism and electric drive, it is said, should increase the production rate to a probable 500 or 1,000 cylinders per hour.

Left: In-line exhaust machine at the G. E. Electronics Park picture-tube plant which is capable of taking both round and rectangular tubes up to 24 inches in size. Each buggy has an oil diffusion pump which creates a vacuum. As the tubes move through a tunnel, they go through a bake-out process, which consists of heating each tube, to a temperature of 400°C, at which time the pump draws out the gases and other impurities. Below: Microwave-link antenna at Deer Island installation, used to transmit radar information from island to receiving station at Commonwealth Pier, South Boston, which served as a harbor radar centre for a recent test and demonstration by Raytheon and Port of Boston Authority.



TVE-grams . . . Personals

New Posts: Gordon Groth, formerly president of the Electra Manufacturing Co., Kansas City, Mo., has been appointed executive vice president of the Erie Resistor Corp. . . . *W. C. Phillips* has joined the electronic parts division of the Allen B. DuMont Labs as assistant sales manager. . . . *Carl E. Smith*, formerly supervisor of equipment sales service for the Sylvania radio tube division, has been named supervisor of factory sales service. . . . *Dr. C. J. Breitwieser*, formerly chief of electronics and head of the engineering laboratories at Consolidated Vultee Aircraft, has been named executive assistant to Dr. . R. Hensel, vice president in charge of engineering at P. R. Mallory & Co. . . . *William A. Sredenschek* has been appointed manager of materials and purchasing for G.E., headquartering in Schenectady. . . . *Ray Simpson*, chairman of the board of the Simpson Electric Co., has been named chairman of the subpanel on indicating instruments, a part of the Panel on Components of the Research and Development Board. . . . *P. M. Pritchard*, formerly director of sales for Victor Electric Products Inc., has been appointed general sales manager for the parts division of Sylvania Electric. He will headquarter in Warren, Pa. . . . *Walter Lukas* has been promoted to the post of chief television engineer at Emerson Radio. *Francis J. Burger* and *L. G. Zucker* have been named chief radio engineer, and chief mechanical engineer, respectively. . . . *Earl H. Kirk*, formerly manager for Van Sickle Radio Supply Co., has been named assistant sales manager for the Regency division of Industrial Development Engineering Associates. . . . *Karel Van Gessel* has been appointed coordinator of foreign manufacturing affiliates at Sylvania Electric. . . . *Frederick W. Timmons, Jr.*, has been appointed regional sales manager for the cathode-ray tube division, at DuMont, headquartering at Allwood, N. J. . . . *Bernard Grae* has been named product design manager of CBS-Columbia, Inc. . . . *A. D. Plamondon, Jr.*, president of Indiana Steel Products Co., has been named chairman of the RTMA small business survey committee established to draft a program for association assistance to small manufacturers in both military and commercial fields. Other members are: *G. O. Benson*, Premax Products Division; *G. R. Haase*, Dukane Manufacturing Co.; *Otto H. Hoffman*, General Magnetic Corp.; *Matt Little*, Quam-Nichols Co.; and *Richard W. Mitchell*, I.D.E.A., Inc. . . . *Tyler Nourse*, has been named assistant to Peter H. Cousins, RTMA director of information. *Ralph M. Haarlander* has been promoted to assistant secretary of RTMA aiding the RTMA transmitter division, parts and the amplifier and sound equipment divisions. . . . *Dr. Louis T. Rader* has been appointed manager of engineering of G.E.'s control divisions at Schenectary. *Harry L. Palmer* has been named assistant to the manager of engineering of the division, and *Benjamin Cooper* has been appointed division engineer of the electronics and regulator engineering division. . . . *Edward M. Tuft*, formerly director of personnel at RCA, has been appointed vice president in charge of organization development of the RCA Victor division. *Albert F. Watters*, formerly assistant director of personnel, has taken over Tuft's former post. . . . In the Telechron department of G.E., *Donald E. Perry* has been named industrial sales manager; *Joseph Dunn*, clock sales manager; and *Edwin C. Pease*, merchandising manager for both clocks and industrial products. . . . *John H. Cashman*, president of the The Radio Craftsmen, Inc., has been elected chairman of the Association of Electronic Parts and Equipment Manufacturers. Others elected were: *Francis F. Florshein*, president of Columbia Wire and Supply Co., vice chairman; *Helen Staniland Quam*, Quam-Nichols Co., treasurer; and *Kenneth C. Prince*, executive secretary. . . . *J. J. Kahn*, president of Standard Transformer Corp., has been named chairman of the RTMA promotion committee. Other members named were: *Max F. Balcom*, chairman of the board, Sylvania Electric; *Paul V. Galvin*, president of Motorola; and *Leslie F. Muter*, president, The Muter Co. . . . *H. N. Henrye Saller*, John E. Fast and Co., has been reappointed chairman of the RTMA credit committee. *D. F. Reed*, Raytheon, has become eastern vice chairman and *A. D. Sigler*, Crucible Steel Co. of America, western vice chairman of the committee. . . . *Malcolm V. Fields* is now head of the special products division of The LaPointe Plascomold Corp., Windsor Locks, Conn. . . . *H. B. Nelson, Jr.* has become assistant to the sales manager of replacement tubes for the G.E. tube divisions. . . . *Henry Onorati* has joined the Crosley Division, Avco Manufacturing Corporation, as director of electronics advertising. Onorati was formerly assistant advertising manager and national promotion manager of RCA Victor Records. . . . *Ray F. Sparrow* has been elected executive vice president of P. R. Mallory & Co., Inc., Indianapolis, Inc. . . . *Harold C. Buell*, Mallory sales manager since '45, has been promoted to vice president in charge of sales to succeed Sparrow. . . . *Dr. Henry M. O'Bryan*, assistant executive secretary of the Research and Development Board in Washington since '47, has been appointed manager of the physics labs of Sylvania at Bayside, N. Y. . . . *Donald B. Sinclair* of General Radio has been nominated for the presidency of the IRE for '52. . . . *Dr. W. R. G. Baker* has been reappointed head of the RTMA television committee. Membership of the committee now includes *Benjamin Abrams*, Emerson Radio; *Robert S. Alexander*, Wells-Gardner; *Max F. Balcom*, Sylvania; *W. J. Barkley*, Collins Radio; *H. C. Bonfig*, Zenith; *John W. Craig*, Crosley; *Allen B. DuMont*, DuMont Labs; *J. B. Elliott*, RCA; *E. K. Foster*, Bendix; *Paul V. Galvin*, Motorola; *W. J. Halligan*, Hallicrafters; *L. F. Hardy*, Philco; and *W. A. MacDonald*, Hazeltine. . . . *Irwin D. Bereskin* has been appointed head of the governmental department of Columbia Wire and Supply Co. Bereskin will handle and facilitate all governmental orders, both prime and subcontracts.

Ray Simpson

Frederick Timmons, Jr.

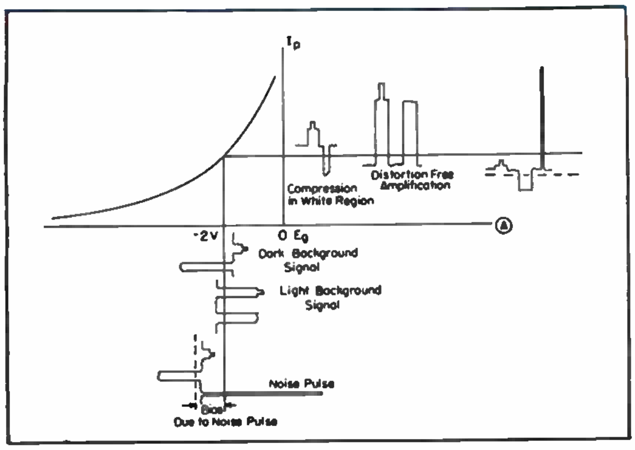
E. M. Tuft

Albert F. Watters

Ray F. Sparrow

HIGHLIGHT CONTROLS

Recently Completed Probe on High-Frequency Boosting Reveals That Circuitry Featuring Capacity Coupling and Cathode Bias Permits Amplification to Take Place With a Relative Expansion of Light Areas of Picture and Some Compression in Dark Areas if Input Signal Is Nominal. Emphasis of Light Regions, Where Detail Is Most Apparent, Found to Result in Improved Sharpness, Lacking in Pictures Amplified With Compression in White Regions.



Operational characteristic plot for circuit shown in Figure 1.

Figure 1

Typical video amplifier circuit, which it has been found has several deficiencies: severe compression of total signal due to operation on non-linear part of characteristic and noise pulse present at plate of tube, interfering with sync.

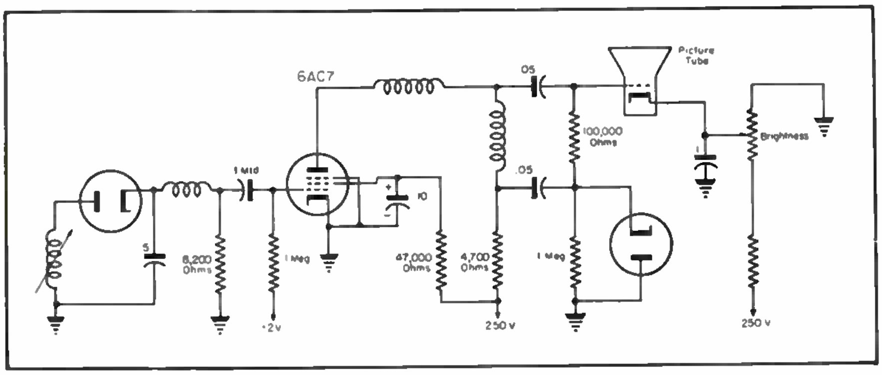
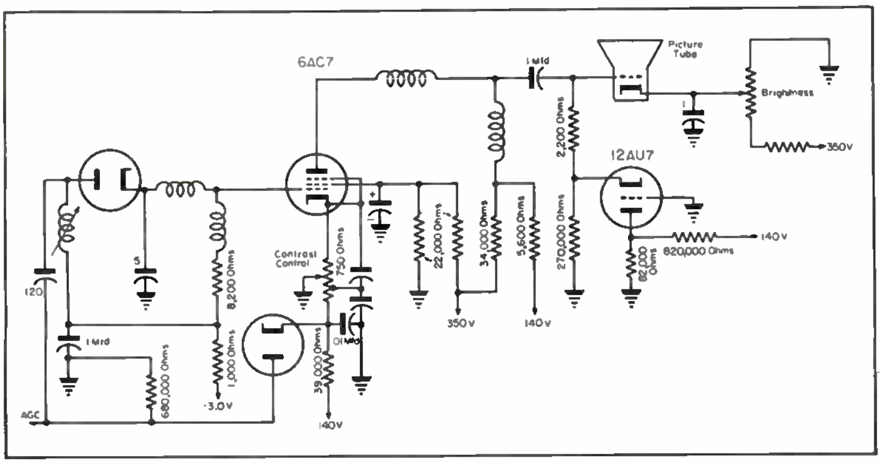


Figure 2 (below)

Another type of video amplifier, whose efficiency is slightly better than the system shown in Figure 1. By tolerating slight shift in the operating part of the transfer characteristic used by different average brightness signals, it is possible to operate the screen from a higher voltage source through a bleeder, as illustrated in this circuit, thus utilizing the full gain and output capability of the tube.



IN THE DESIGN OF A VIDEO amplifier many factors must be taken into consideration to provide a satisfactory picture from the composite video signal impressed on the video amplifier grid.

Some attention must be given to: The frequency and phase characteristic of the amplifier; transmission of the *dc* component of the picture; noise-limiting properties, which should be good to assist the sync separator system; utilization of the non-linear portion of the tube characteristic to the best advantage; interaction between the brightness and contrast controls which should be at a minimum; suitable range of contrast levels to satisfy all viewer preferences; sufficient maximum output to overdrive the picture tube without undesirable signal amplitude distortion; sound output, which should be free of sync buzz at all signal levels and contrast control settings, if the 4.5-mc sound signal is amplified by the video amplifier; introduction of a minimum of sync signal clipping or compression at all contrast control positions and signal levels to maintain stable horizontal hold and good vertical interlace; and adequate gain to drive the picture tube with the minimum useable output signal from the video detector.

Since it is sometimes not practical to satisfy all of these requirements completely, the designer may sacrifice performance of one characteristic to emphasize another. Many operating characteristics are the result of field experience and customer preference. For instance, field experience has shown that it is desirable to reduce the interaction, and limit the range of such controls, as contrast and brightness, to such an extent that the viewer is always able to find his way back to a normal picture after having tried all other set-

In Video Amplifiers

by **RALPH H. COOK**, *Engineer in Charge of Radio and Television Development*
Scott Radio Laboratories, Inc.

tings of the controls. This signifies that the picture must not disappear, bloom excessively, curve, twist, or fall out of vertical or horizontal hold with any combination of positions of the brightness and contrast controls.

However, the engineer must also consider those viewers whose interests lie in determining the so called *reserve of power* of the receiver. If, by the manipulation of the contrast and brightness controls, it is possible to produce excessive blooming, darken and distort the picture beyond viewability, the receiver can be classified as one having the necessary *reserve of power.*

The trend of design seems to be in the direction of chasses with fewer operating controls, using circuits of greater stability, which permit the brightness, vertical and horizontal hold controls to be classed as service items.

It is usually possible to achieve all the requirements of good video amplification, using only one high transconductance pentode, or a dual triode, although compensation problems and fewer components may favor the pentode.

The gain of the pentode is a function of the transconductance and the plate load resistor. However, the operating transconductance has been found to be usually somewhat lower than the values found in the handbooks, when the tube is used in a video amplifier circuit.

For a given bandwidth, the video plate load resistor is a function of the tube and circuit capacitances. Therefore, a tube of low input and output capacity, used in a circuit that has little stray capacity to ground, would permit the use of a higher value plate load resistor for greater gain and output.

The maximum output voltage of a video amplifier is a function of the *dc* plate current and the plate load resistor, which might indicate a high I_p and high R_L. However, circuit capacitance, the maximum needed drive for picture tubes, drain on power supply, and cost of tubes limit the output of a video amplifier to a practical value. Accordingly, a video amplifier should possess a high transconductance, low input and output capacities, and a reasonably high *dc* plate current. If one were to disregard the input capacity of the tube, since it would influence only the previous stage gain, it may be stated that the gain is a function of g_m/C_{out}, while the maximum output voltage is given by I_p/C_{out}.

Since the input capacity of a triode is given by $C_{in} = C_{gk} + C_{gp}\ (1+A)$ where A is the stage gain, compensation becomes a problem when the triode has an appreciable stage gain. For a 6SN7GT with a stage gain of 6 x, the input capacity becomes $C_{in} = 3.0 + 4\ (1 + 6) = 31$ mmfd, which is a relatively high-input capacity, compared to 6-11 mmfd for a pentode amplifier.

When degeneration is introduced in the cathode of a pentode video amplifier, with the use of an unbypassed contrast control, the C_{gk} component of the input capacity of the pentode is reduced by the factor $1 + g_m R_k$. Since the major component of the input capacity of a pentode is the C_{gk}, the total input capacity can be considered reduced by this factor. For a 6AC7 with 160 ohms of unbypassed cathode resistance, the input capacity becomes

$$C_{eff} = \frac{C_{in}}{1 + g_m R_k} = \frac{11}{1 + (.009)\ 160} = 4.52 \text{ mmfd.}$$

The use of a bypassed fixed resistor plus an unbypassed control in the cathode of the video amplifier offers a satisfactory method of tube bias and a means to vary the gain of the tube for a contrast control. Using other methods of bias such as signal grid current bias or *dc* coupling to the video detector, the maximum output of the stage has been found to be limited by the safe dissipation rating of the tube under no signal conditions. Also, using this type of bias, the transconductance of the tube is not constant since the operating bias is a function of the signal amplitude.

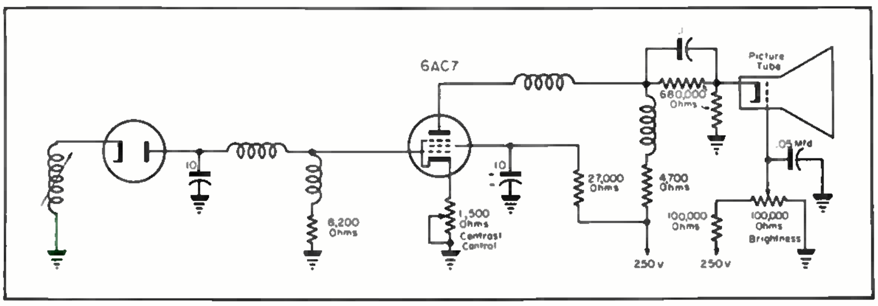
In Fig. 1 appears the circuit of a typical video amplifier which has been found to have several major deficiencies.

Since the input grid signal is capacity coupled and is sync-positive, there appears a high-intensity peak-noise pulse in a positive direction, extending beyond the static grid bias and causing the signal grid to be driven positive with respect to the cathode, thereby drawing grid current. Thus, the grid bias will shift to a greater negative value, and will be maintained at this value a considerable period of time, due to the large grid time constant necessary to maintain low frequency response.

When the operating bias is shifted to a greater negative value, the input signal operates over a very non-linear portion of the transfer characteristic, and compression of the light parts of the video signal is noted. Unfortunately, the noise pulse is amplified in a linear fashion and is allowed to pass on to interfere with synchronization.

It has also been found that this circuit will not amplify, in a linear fashion, signals of equal amplitude, but those that differ in average brightness when the input signal is of such amplitude so as to produce a maximum contrast picture. From the plot, it will be noted signals with a dark background suffer signal compression of the white parts of the picture. Since the majority of the information occurs in the light parts of the picture, this compression of the whites causes a loss of information and the whites assume a

Figure 3
A third type of video amplifier in which the polarity of the grid input signal has been reversed.



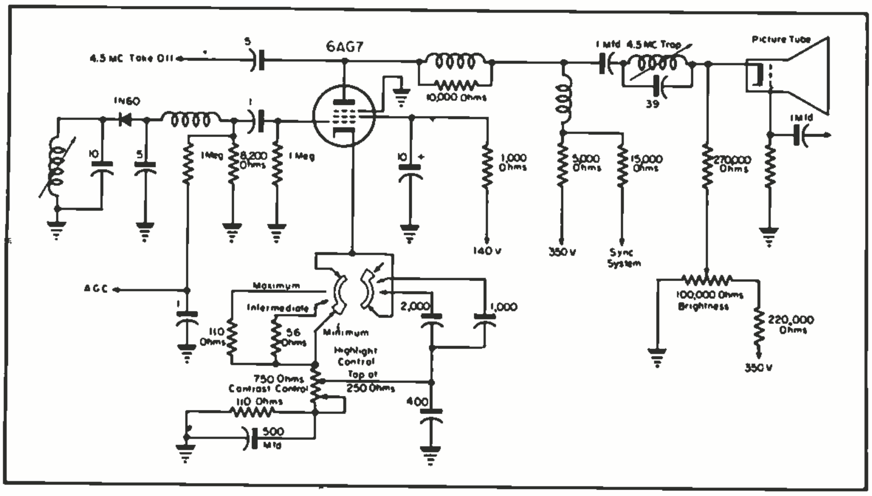


Figure 4

Video amplifier featuring the highlight control, which is shown here in minimum boost position.

pasty appearance. The circuit, however, does provide amplification of light background signals in a linear fashion.

This amplitude distortion of the signal, with different background brightness, is caused by the grid-capacity coupling. The grid capacitor prevents the *dc* voltage change, that takes place with background change, from being applied to the grid of the amplifier tube. Since the reference axis of a dark or light background picture differs so greatly, amplification on different portions of the characteristic curve will occur. For an average background picture of average amplitude, this amplifier will still give some compression of signal in the white regions of the picture.

Fig. 2 illustrates another video amplifier circuit with several modifications.. In the Fig. 1 amplifier grid bias has been found to shift with a noise impulse to such an extent that more noise is amplified. By removing the grid-coupling capacitor, and providing some static bias from a low-impedance source, which will not take a charge in the presence of noise pulses, the noise immunity of the amplifier can be greatly increased. Using a somewhat lower plate voltage also makes it possible to use plate-current saturation for noise clipping, since the dynamic operating bias of the tube is not shifted by impulse noise.

If a low impedance screen source is used, the same part of the tube characteristic is utilized by all types of picture background signals, so that the non-linear amplitude distortion and compression is, to some extent, eliminated.

The screen potential must necessarily be lower than could be tolerated under normal conditions in order not to exceed tube ratings when the input signal is high enough to overcome the static grid bias. Thus, the maximum gain and output of the amplifier would be reduced. However, by tolerating a slight shift in the operating part of the transfer characteristic used by different average brightness signals, one can operate the screen from a higher voltage source through a resistor bleeder, as shown in Fig. 2, thereby utilizing the full gain and output capability of the tube.

However, this circuit will still produce some compression of the light parts of the picture, due to the normal curvature of the tube characteristic. Also, since the gain of the tube is dependent on input signal level, there results a bias that opposes the static grid bias. Therefore, the gain of the tube varies in a manner that is the reverse of what is desired; that is, on strong signals the grid bias approaches zero which increases the amplifier gain, while on weak inputs the static bias is only slightly modified and the amplifier gain is lowered.

With strong inputs and contrast control at maximum setting, the sync portion of the signal is compressed or eliminated by plate current saturation or grid current of the tube. This usually produces curvature of the vertical lines in a picture when the horizontal *afc* circuit is presented a deformed sync pulse, or when the same pulses are absent. Also, intercarrier sync buzz becomes annoying when this sync signal clipping occurs, if the 4.5-mc signal is taken from the plate of the video amplifier.

Still another video-amp system is illustrated in Fig. 3. In this circuit the polarity of the grid input signal has been reversed, making the input signal sync-negative, and impressing a sync-positive signal on the cathode of the picture tube.

At maximum-contrast control position, the only tube bias is provided by the input signal which may be low enough at times, so that the tube is operating close to zero bias. To keep the tube ratings within limits, under this condition, it is necessary to limit the screen potential either by a low source voltage or through a high value of screen resistance. This reduced screen voltage limits the maximum output of the tube under large input signal levels. However, this circuit provides maximum amplification and output voltage capabilities at low input signals and reduced gain at the higher input signal levels which is desirable.

This circuit also amplifies both dark and light background signals over approximately the same portion of the tube characteristic due to direct coupling in the grid circuit, and, therefore, distortion-free amplification of both dark and light background signals is obtained. A slight sacrifice in this property has been accepted, to increase the gain and maximum output of the tube, by not operating the screen from as stiff a source as could be arranged by a bleeder-resistor divider.

It has been found that good noise limiting properties can be obtained by using a sync-negative input signal, since the noise pulses extend beyond signal grid cut-off.

Direct transmission of the *dc* component is provided by direct coupling of the grid and plate circuits. The average *dc* level is divided in the plate

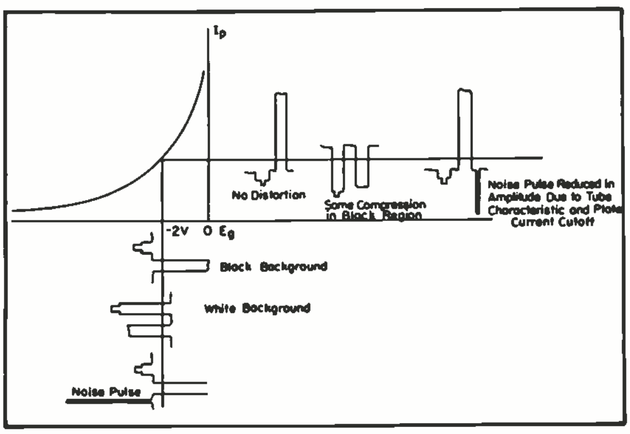


Figure 5
Operational characteristic of highlight control circuit.

circuit of the amplifier to reduce the interaction of the brightness and contrast controls with no apparent degradation of the *dc* level of the picture. Throughout the range of the contrast control it is not necessary to adjust the brightness control to obtain proper background lighting.

This divider has also been found to permit the use of a higher value of video amplifier plate voltage for greater output, without the necessity of providing a separate ungrounded filament winding for the picture tube. The use of a plate voltage of 200-300, directly coupled to the picture tube cathode, would exceed the maximum voltage rating between the cathode and filament of the picture tube, if the conventional grounded filament winding was used to supply filament voltage to the picture tube. However, since the divider is bypassed for the *ac* component of the video signal, it has no effect on the remainder of the signal.

Since this circuit produces a slight expansion of the light parts of the video signal, and a slight compression in the dark region, it is to be favored over those circuits using a sync-positive signal to the grid of the tube. Some compression which does appear in the black regions of the tube does not have any ill effect on viewing.

In Fig. 4 appears a video amplifier circuit that was found to be best suited for the operational characteristics in mind. Provided is a sync-negative input video signal to afford a degree of pulse-noise limiting by plate current cutoff. Since the screen is operated from a relatively low impedance source, the tube cutoff characteristic, although sufficiently remote to handle any amplitude of input signal present in very strong signal areas, was found to be sharp enough to limit impulse noise to a very satisfactory degree.

It has been found that capacity coupling on the grid circuit will introduce some linear amplitude distortion when compared to direct coupling, since signals of equal amplitudes but varying shades of background illumination will be amplified on different portions of the tube characteristic curve. In the case of a dark background signal, the amplification will be linear and no compression will be present. While a white background picture will show some compression in the black region, there'll be no degradation of the picture unless the compression is severe enough to eliminate or radically deform the sync signals.

With this circuit, amplification will take place with a relative expansion of the light areas of the picture and some compression in the dark areas if the input signal is of a nominal value. This

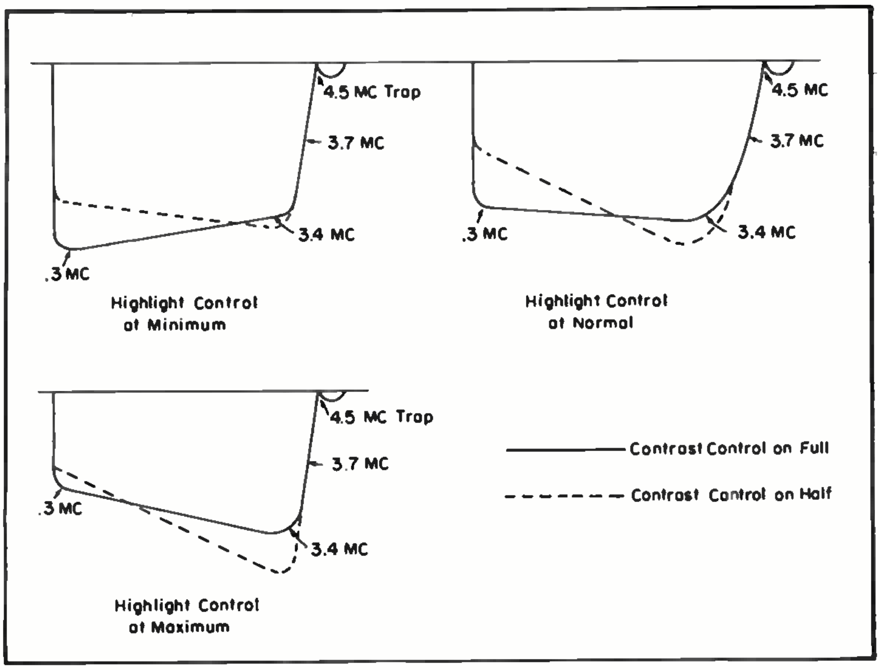


Figure 6
Sweep-frequency response curves for the highlight-control video amplifier.

emphasis of the light regions of the picture, where detail is most apparent, has been found to result in added sparkle and sharpness over a picture that has been amplified with compression in the white region of the picture.

Using capacity coupling and cathode bias it was found possible to operate the tube at such screen and plate potentials as to make available maximum gain and p-p output voltage from the tube without exceeding tube ratings at any input signal level or contrast control position.

The interaction between brightness and contrast controls has been reduced to a minimum, thereby eliminating the necessity for readjustment of the brightness control each time the contrast control setting is appreciably changed. It has been found that once the background brightness has been set it will remain constant throughout the range of the contrast control, or over a wide range of input signal levels.

Using a sync-position signal, capacity coupled from the plate of the amplifier tube to the cathode of the picture tube to provide both the *ac* video signal and the partially restored *dc* for background lighting, was found to result in an independence of operations of the contrast and brightness controls.

The normally used *dc*-restorer diode was eliminated, after sufficient viewing tests by different observers over a wide range of program material resulted in no observable difference in background conditions of the picture, in sets using a conventional *dc* restorer as against the circuit described.

It was also found desirable to allow the picture tube to remain illuminated, in the absence of signal from a transmitter, or when switching between channels, to permit the operator to note when the set was operating without a signal input.

In the Fig. 4 circuit, the grid and cathode of the picture tube operate as the *dc* restorer diode on the opposite half, from the reference axis, of the video signal than is normally used with a diode *dc* restorer.

By feeding a negative pulse of vertical peaking signal to the grid of the picture tube, through a low resistance to ground, it is possible to blank out the vertical retrace lines that are apparent at low contrast levels or theoretically improper settings of the brightness control.

This feature has been found to permit the user to choose from a wider variety of contrast and brightness control settings, than would be possible if the visible retrace lines were limiting the choice of background and contrast range settings.

To handle large p-p input signals without amplitude distortion which became apparent using a 6AC7 in the circuit, it was found desirable to utilize the capabilities of a 6AG7.

At maximum contrast control settings and input signal levels of 6 or more volts p-p, tubes of the 6AC7 class showed complete stripping of the sync signal, which resulted in vertical line curvature or *S* distortion from the horizontal *afc* system, and excessive sync buzz from the intercarrier sound system.

Although the *70* v p-p maximum output obtained with the 6AC7 produced what appeared to be an over-contrasted picture, this was actually found to be

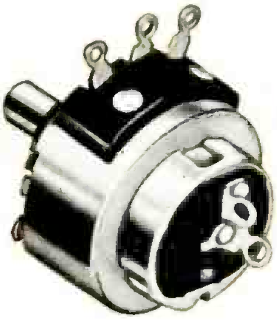
(*Continued on page 21*)

APPLICATIONS

VARIABLE RESISTORS (COMPOSITION and WIRE WOUND)

MEETS ALL JAN-R-19 SPECIFICATIONS

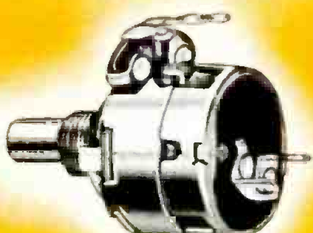

JAN Type RA 20A
2 Watt (CTS Type 252)


JAN Type RA 20B
2 Watt (CTS Type GC-252)

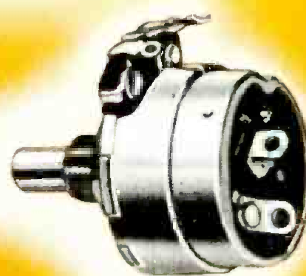

JAN Type RA 25A or 30A
3 or 4 Watt (CTS Type 25)


JAN Type RA 25B or 30B
3 or 4 Watt (CTS Type GC 25)

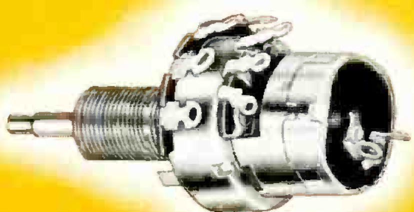

JAN-R-94, Type RV-3A
CTS Type 35, 1⅛" Diameter,
Composition


JAN-R-94, Type RV-2B
CTS Type GC 45 with Switch.


JAN-R-94, Type RV-2A
CTS Type 45, 15/16" Diameter
Composition


JAN-R-94, Type RV-3B
CTS Type GC 35 with Switch


Type 85 NEW High Voltage
Electro-Static Focusing


Type G-C-35-45 Concentric
Shaft Tandem


Type JJ-033 Microphone Jack


Type JJ-034 Phone Jack

ILLUSTRATIONS ARE ACTUAL SIZE

Precision Mass Production of Variable Resistors

FOUNDED 1896

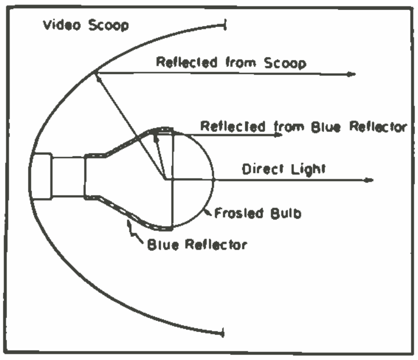


Figure 1
The TV blue lamp in a video scoop.

Blue TV Lamp Design Report

by R. D. CHIPP, *Director of Engineering*
DuMont Television Network, Allen B. DuMont Laboratories, Inc.

Since the early days of TV considerable experimental and development work has been done with various types of light sources for studio use. Concurrently, pickup tube developments have allowed a decrease in the quantity of light required, and more attention has been given to the *quality* of light.

Types of Light Sources

Types of light sources used have included incandescent, fluorescent, and mercury vapor, in various combinations. Each source has been found to have certain advantages and disadvantages in terms of initial cost, maintenance cost, efficiency, spectral characteristics, ability to dim and focus, physical size and flexibility, etc.

Incandescent lamps, for instance, have been found to be flexible, compact, easy to maintain, dimmable and controllable. However, they have been also found to be generally deficient in not only energy at the blue end of the spectrum, but highlight efficiency. Fluorescent light sources, on the other hand, can provide more energy at the blue end of the spectrum, have a high color temperature, and relatively highlight efficiency. The principal disadvantages of the fluorescent lights lie in their large size, lack of flexibility and control. Although mercury vapor sources have the advantage of highlight efficiency, they have not as yet found widespread use due to their spectral and control characteristics.

In view of these many variables, the selection of studio light sources has been a complex problem frequently solved by the heuristic method.

Problems Surveyed

Early in '49 it was considered desirable to attempt the development[1] of a new light source which would combine a maximum number of the good features, be available in different sizes for different applications, and have long life. It was determined to use an incandescent filament as the basic source, and work toward low cost, long life, high color temperature, even spectral characteristic, flexibility, and ease of control. The study resulted in

[1]*Development undertaken by Luxor Lighting Products, under the supervision of chief engineer Herbert Anderson, working with the DuMont general engineering department.*

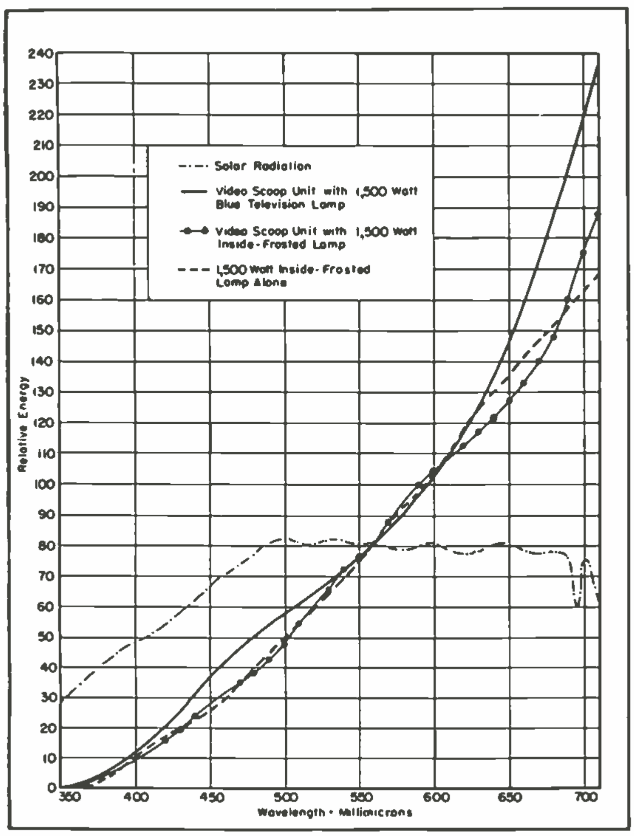
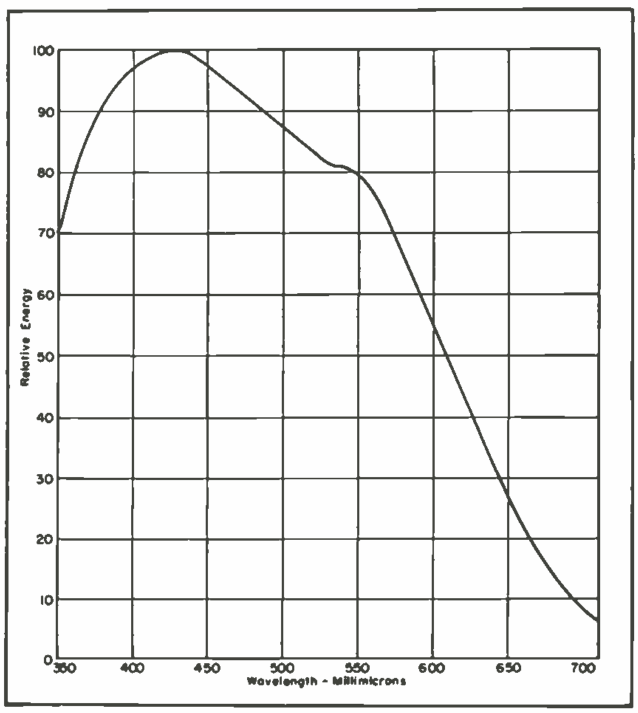


Figure 2
Spectral characteristics of solar radiation and TV light sources.

Figure 3
Spectral characteristics of 5820 image orthicon.



Recently Processed Light, with Improved Spectral Characteristics, Features Blue Ceramic Reflector, One-Third of Light Being Emitted Directly from Filament Through Frosted Portion of Bulb, With No Color Correction, Providing High Content of Red; Some of Balance of Light from Filament is Reflected by Translucent Blue Reflector So as to Provide Mixture of Colors From Red to Blue

Rodney Chipp and Robert Bigwood, chief facilities engineer of the DuMont network, viewing the blue lamp's coating.

the evolution of a blue TV lamp, representing a good compromise between the foregoing conflicting desires.

The unusual manner in which color correction was obtained in the light is illustrated in Fig. 1. With a specially processed blue ceramic reflector, it was found possible to secure emission of approximately one-third of the light directly from the filament through a frosted portion of the bulb with no color correction, thereby providing a high content of red. It was also found that some of the balance of the light from the filament was reflected by the translucent blue reflector in such a way as to provide a mixture of colors from red through the entire spectrum to blue. The last portion of light, from the filament, passing entirely through the translucent reflector, was found to have a high content of blue. When the lamp is used in a reflector fixture, these additional blue rays add to the total light output of the lamp. In Fig. 2 are a curve representing the spectral energy of solar radiation, and three curves representing the spectral characteristics of a standard 1500-watt inside frosted lamp, the same lamp used in a scoop or *videolite*, and a 1500-watt *blue lamp* used in a *videolite* fixture. It will be noted that there is an increase in energy between 450 and 500 millimicrons. The color temperature of the 1500-watt inside frosted lamp was measured as 2840° kelvin, whereas the color temperature of the *blue lamp* was measured as 3000° kelvin, with both lamps mounted in the same type of fixture.

Inasmuch as the 5820 image orthicon is widely used as a camera tube, tests were made with these pickup tubes and the *blue lamp*. Fig. 3 illustrates the spectral characteristic of a typical 5820, and Fig. 4 shows the relative photographic effectiveness of solar radiation, a 1500-watt incandescent lamp in a *videolite*, and a 1500-watt *blue lamp* in a *videolite*. The response in the blue region is quite revealing.

Long life is a prime requirement in any light source used for television, in view of the high maintenance costs in-

(*Continued on page* 29)

(Above)
John Colgan, chief electrician at the Adelphi theatre, used for DuMont telecasts, checking blue TV lamp.

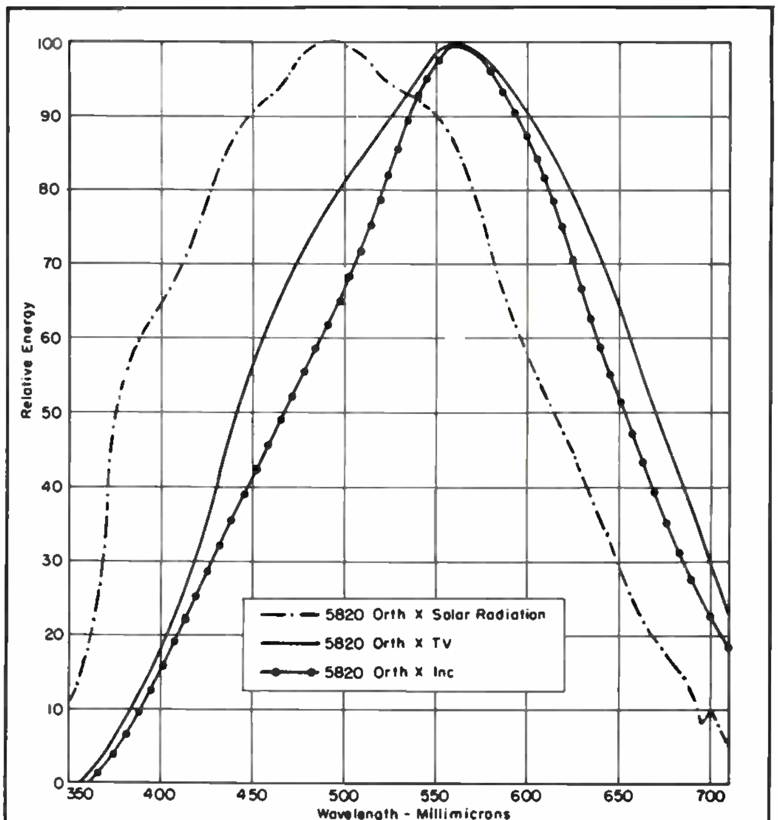


Figure 4
Relative response of 5820 with various light sources.

Liquid

Resins, which have always been popular on the production line, during the past few years have become an even greater favorite not only in the plant but on the engineering and development front, serving to solve those tricky problems of potting, filling, encasing or encapsulation of coils, capacitors, transformers, and printed circuits. In addition, the compounds have also been found to be the key, in many instances, to speedier production with a minimum amount of equipment. The use of resins, which can be cured rapidly at elevated temperatures has contributed substantially to these step-up schedules.

Elevated-temperature cures, of course, can only be used if there are inherent characteristics in the resins which permit this approach. One type resin[1], a light-colored liquid solution of unsaturated polyester in monomeric styrene, was found to be ideal for the process because heat is liberated during polymerization; an exothermic reaction. The amount of heat liberated is constant in any one resin and is determined by the chemical composition of that resin (degree of unsaturation and type of vinyl monomer). However, the rate at which the heat is liberated is directly proportional to the cure temperature and type and amount of catalyst used. Moreover, the resins shrink due to polymerization and thermal contraction. Under adverse conditions, the result of the foregoing factors is a highly stressed product which, in turn, usually results in cracks and crazes.

Certain applications are more adaptable to elevated temperature work than others. This does not mean, however, that all applications cannot utilize some form of heat to realize some benefits from this technique. Keeping in mind the generalization that the curing time is inversely proportional to the curing temperature, the maximum temperature possible for any one application will be dependent upon: mass of resin; type of resin; amount and type of fillers, if any; size and type of confining and heating medium; and type and amount of catalyst.

Mass of resin: Generally speaking, the temperature should be lowered as

[1]Paraplex P series: Rohm and Haas.
*Paraplex P-13.
**Paraplex P-43, P-43-HV.

Resin Curing in Component Manufacture

by RALPH G. PETERS

Review of Elevated-Temperature Cure Techniques Which Have Been Found to Expedite Production of Parts.

the mass of the resin increases.

Type of resin: Since one resin* is less reactive than others**, it can be cured at higher temperatures.

Amount and type of fillers: Since fillers do not enter into the co-polymerization reaction; they reduce the concentration of active ingredients and consequently reduce the severity of the exotherm. Therefore, higher temperatures can be used with higher filler concentrations.

Size and Type of Confining and Heating Medium: The heat transfer efficiency of the confining medium must be considered here. Higher temperatures can be used when metal molds are involved, because metal readily dissipates the exothermic heat. Consequently, lower tempertaures should be used when resins are cured in wood, plaster, cellophane, in hot air, etc.

Type and Amount of Catalyst: The more reactive catalyst such as benzoyl peroxide, require lower temperatures. However, optimum production conditions can be obtained with the most active catalysts and the highest temperatures.

In laminating and molding, elevated temperatures between 220° *F* and 280° *F* have been found to be best. The catalyst most generally used is benzoyl peroxide. Casting and potting are more easily accomplished at lower temperatures using less reactive catalytic systems.

Cures at Room Temperature

In certain applications, where the mass of the resin is large, it may be desirable to minimize the development of exothermic heat (and resultant cracks and high stress concentration) by initiating polymerization at lower temperatures than are required by use of catalyst alone. In other cases, it may be impractical to introduce extraneous heat. For this type of work

(*Continued on page 27*)

PROPERTY	A	B
Mechanical Tests:		
Flexural Strength		
Ultimate, PSI	17,500	-
Mod. of Elast., PSI	533,000	6,400
Tensile Strength		
Ultimate, PSI	9,000	1,600
Compression Strength		
Ultimate, PSI	21,300	-
Hardness		
Rockwell	110-120	-
Barcol	45-50	-
Shore A Durometer	-	80-85
Elongation		
Percent	Less Than 5%	220
Electrical Tests:		
Dielectric Constant 60 CPS	3.3	4.2
10^3	3.2	4.2
10^6	3.2	4.0
10^7	3.2	3.7
3×10^7	3.1	3.4
10^{10}	2.6	-
Power Factor 60 CPS	0.006	.005
10^3	0.006	.011
10^6	0.017	.052
10^7	0.022	.080
3×10^7	0.034	.105
10^{10}	0.043	-
Loss Factor 60 CPS	0.020	.021
10^3	0.019	.046
10^6	0.054	.208
10^7	0.070	.296
3×10^7	0.105	.357
10^{10}	0.112	-
Water Resistance (% Wt. Absorbed, 24 Hrs.):		
25°C	0.3	0.6
100°C	3.0	2.0
Miscellaneous Properties:		
Shrinkage During Cure (Volume Percent)	7.0	9.0
Specific Gravity	1.235	1.122
Ref. Index	1.5564	1.5378
Thermal Expansion (Cm/Cm/°C)	8.2-10.2 $\times 10^{-5}$	-
Thermal Conductivity, BTU/Sq. Ft./ Hr. for Temp. Gradiant of 1°F/Inch Thickness	1.25	1.12

Figure 1

Chart of physical properties of cured, unfilled resins: A representing Paraplex P-43, a light-colored viscous fluid which cures to a transparent thermoset rigid product; and B representing Paraplex P-13, an amber fluid which cures to a thermoset composition whose flexibility is similar to that of plasticized polyvinyl chloride.

Automatic Synchronizing

Equipment, Providing Establishment of Timing Relationships and Proper Output Signals to Convey Timing Information to Allied Apparatus, Features Use of Binary-Scaler Counters to Supply 525-1 and 2-1 Divisions and Also to Provide Gates for Sync Signal Generation.

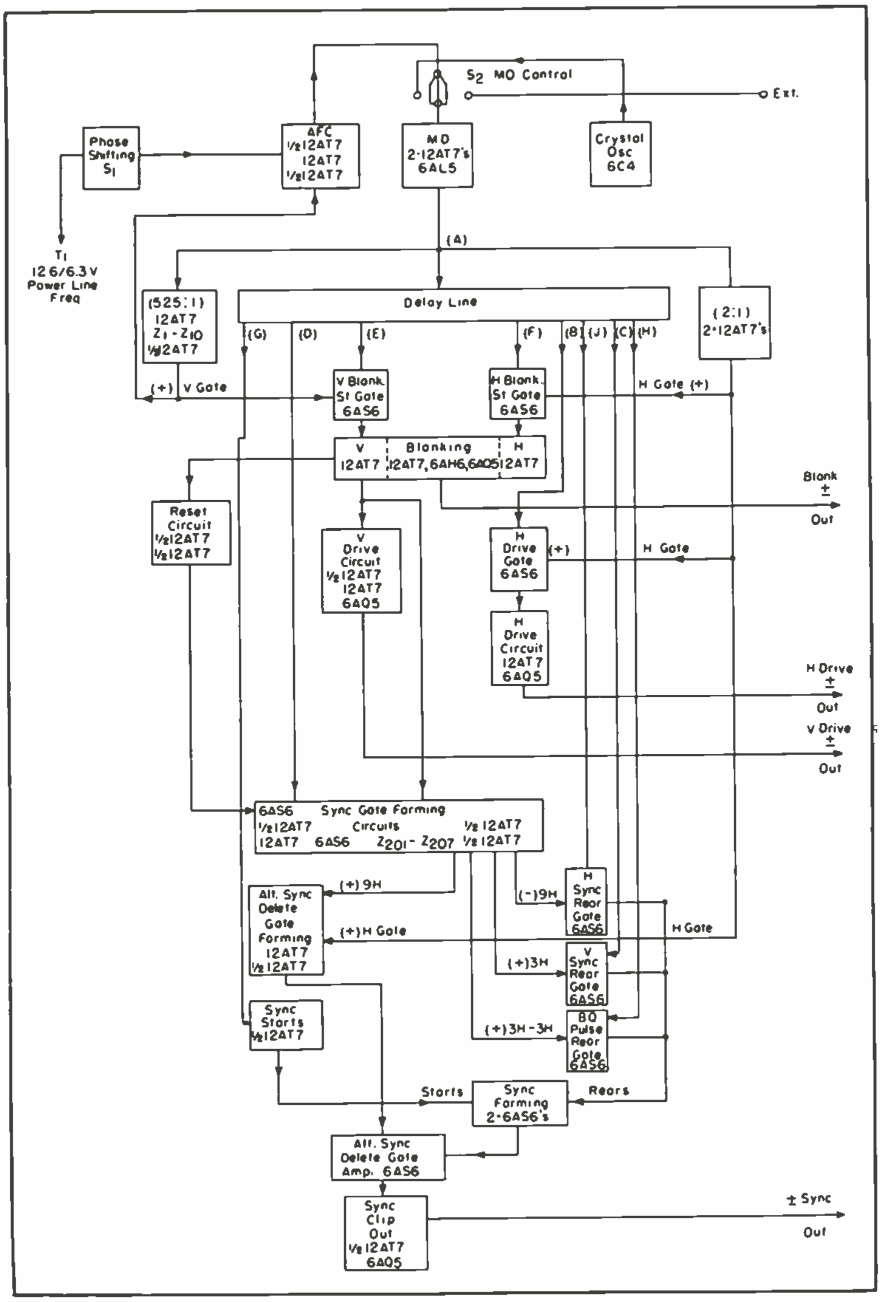


Figure 1

Simplified block diagram of synchronizing generator.

With the expansion and growing complexity of studio facilities, the reliability of the sync generator has become increasingly important.

The increased use of back-porch clamps and sync-locking units, which are very critical of the exact composition of the sync signal, has also accented this factor, it being imperative that there be no deviation from the specified form or number of pulses during normal operation.

Heretofore, it has been considered desirable to lock, in both phase and frequency, the nominal 60-cycle output of the sync generator to that of the main power system of the community being served by the transmitter. This rendered the effect of hum or ripple in the received picture much less objectionable by making the resulting hum pattern stationary. With the growth and utilization of network facilities, where the transmitter and receiver may be on separate power systems, the effectiveness of power line synchronization had been found to be largely nullified. As a consequence, it has been necessary to design receivers so that they are much less susceptible to hum.

Built-in highly stable crystal oscillators, which may be used as a timing reference, in lieu of the power system, have been found to aid system stability. In localities where the power system has insufficient frequency stability or wherever portable power generators might be used, such as in remote locations or during emergencies, this approach has been found to be ideal.

The expansion of network facilities has also increased the desirability of locking the synchronizing generator to a remote, incoming sync signal.

In developing a sync generator which would meet the foregoing specs and produce correctly timed and formed signals during operation, barring a failure of a tube or component, the electrical functions of a sync generator were probed. It was found that these functions could be divided into two parts:

Generator for TV

by CALVIN ELLIS, *Broadcast Engineering Section*
Commercial Equipment Division, General Electric Company

one, the establishment of the timing relationships; and *two*, the provision of the proper output signals to convey the timing information to the various associated apparatus.

The timing relationships can be obtained in a sync generator by having a master oscillator usually operated at 31.5 kc, which is twice the horizontal scanning frequency. This is divided by 525 to 60 cycles, the field repetition rate. Additionally, the 31.5-kc frequency is divided by two to 15.75 kc, the horizontal frequency. This even and odd division results in 262½ lines per field. An interlaced pattern is a natural consequence of this half-line displacement in each field. These divisions can be seen in the simplified block diagram of Fig. 1.

Surveying means of providing system reliability, it was found that this characteristic could be obtained by having the timing relationships and the formation of sync signal determined by electrical counting circuits which are independent of normal variations in resistance, capacitance, and tube characteristics. Counters of *binary scaler* design, similar to the Eccles-Jordan triggered type, were selected, and used for the 525-to-1 division, the 2-to-1 division and for providing gates for the synchronizing signal generation.

The circuit of a binary scaler unit appears in Fig. 2. It will be noted that this is a heavily biased relaxation oscillator consisting of two triode sections direct-coupled to each other. The circuits have two stable conditions of equilibrium wherein one triode section is cut off and the other is conducting. These conditions abruptly reverse upon the application of a suitable trigger.

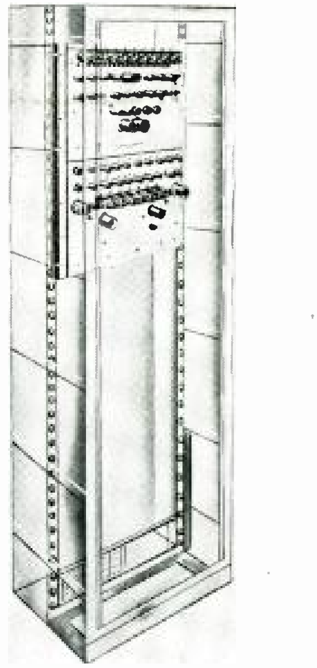
The trigger input to the binary scaler is connected to an internal network which differentiates an applied pulse, attenuating the positive pip and leaving only the negative pip to be applied to both triode sections. Thus when a positive pulse is applied to a binary scaler, only the negative-going trailing edge triggers the scaler.

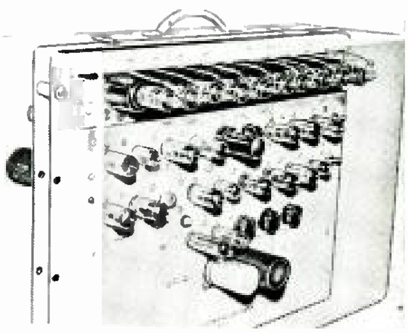
The shift from one stable condition to the other is accomplished in the following manner: The negative triggering pip is applied to both sections by means of the input network. It has no effect on the grid of the cut-off tube, but on the conducting tube it causes the current to decrease, thus causing the plate voltage to rise. The rise is coupled to the grid of the tube which was not conducting, causing current to begin flowing, thus lowering its plate voltage. The voltage drop is transferred to the grid of the opposite section where it reinforces the action initiated by the trigger pip. This is an accumulative action, and results in the tube which was conducting to become cut off, and the tube which was cut off to become conducting. Another trigger pip will reverse this action, returning the scaler to the initial set of conditions which existed before the application of the first of the two triggers. The binary scaler has then gone through *one* complete cycle of operation upon the application of *two* triggers, thereby yielding a division of two.

The output of each scaler is a square wave having one negative and one positive going edge or slope per cycle. However, only the negative going edge will trigger a directly connected succeeding binary scaler. Therefore, when one binary scaler output is connected directly to the input of a second scaler, the second scaler is triggered once for each cycle of operation of the first scaler. These *binary scalers* can be cascaded directly without the necessity of intermediate buffers or amplifiers. So connected and unmodified they will yield total divisions which are integral powers of two. For example, five cascaded scalers will yield a total count or division of $(2)^5$ or 32.

In the sync generator application it was necessary to obtain a division of 525. It was found that odd numbers could be obtained from a binary scaler chain by the application of feedback loops.

For instance, if three cascaded binary scalers were connected, as shown in Fig. 3, they would normally yield a total count or division of $(2)^3$ or 8. If a feedback circuit with a slight amount of delay were used to connect the output of the last or third scaler to the input of the first scaler, the first scaler would receive an additional trigger al-





Synchronizing generator mounted in rack for studio application. Generator is constructed on two separate chassis, each 14" in height and designed to fit a standard 19" rack. Entire generator (both units), with all tubes and components, weighs 23 pounds. Each unit contains 27 tubes; a total of 54 tubes in the entire system. The circuits necessary for the establishments of the timing relationships are located on one chassis; the timer unit. The circuits necessary for the formation of the synchronizing signal and driving pulses are located on the other chassis; the shaper unit. Below: Generator in portable carrying case. The binary counters used in the main count down, (525-to-1) and in the synchronizing signal formation chain are of the individual plug-in type. Ten of these units may be seen in the recessed sub-assembly, the top of the timer unit. Each binary counter circuit is contained in a sealed unit which plugs into an octal socket.

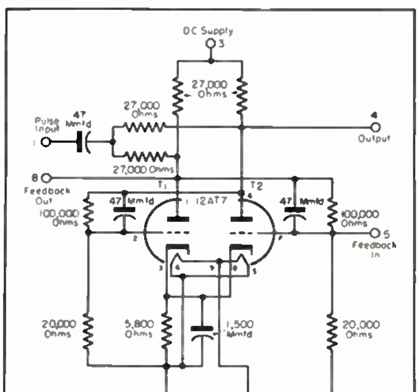


Figure 2
Circuit of plug-in binary scaler unit.

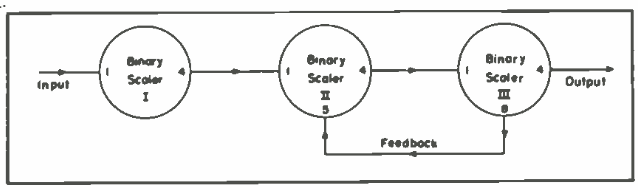


Figure 3
Binary-scaler arrangement to yield a 7-to-1 count-down ratio.

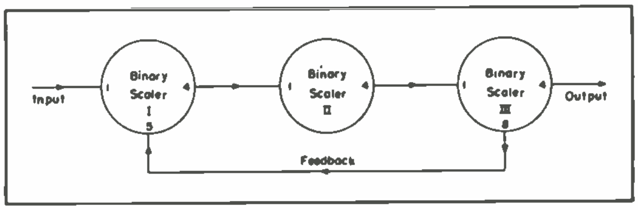


Figure 4
Binary-scaler arrangement to yield a 6-to-1 count-down ratio.

most immediately after the eighth input pulse. As a result of this extra trigger from the output, the system would then require only *seven* more regular input pulses to recycle the last scaler. Hence, the count of the system has been reduced from *8-to-1* to *7-to-1*. The disadvantage of this particular connection is that for the first cycle of the system, the count is *8*-to-*1* and *7*-to-*1*, thereafter. However, this can be circumvented by taking the feed back from the other plate of the last scaler. The pulse at this plate is of opposite polarity, or displaced 180°, from that appearing at the normal output plate. This plate will privide a negative trigger at the *4*th, *12*th, *20*th, etc., input pulse of an unmodified *8*-to-*1* system, instead of at the 8th, *16*th, *24*th, etc. Since this feedback trigger now occurs immediately after the *4*th input pulse, only three more pulses are required for the total count. Thus, a *7*-to-*1* divider has been obtained, which is correct for the first cycle and all succeeding cycles.

Now let us consider the three cascaded binary scalers as before, but with the correctly phased feedback trigger fed to the second scaler intead of to the first one, as shown in Fig. 4. The second scaler will be additionally triggered by a feedback trigger from the third scaler immediately after the fourth input pulse to the first binary as before. Now, however, the triggering of the second scaler is the equivalent of *two* initial input pulses. This means that only two more input pulses are necessary to recycle the system. This totals six, so that total division is now *6*-to-*1*.

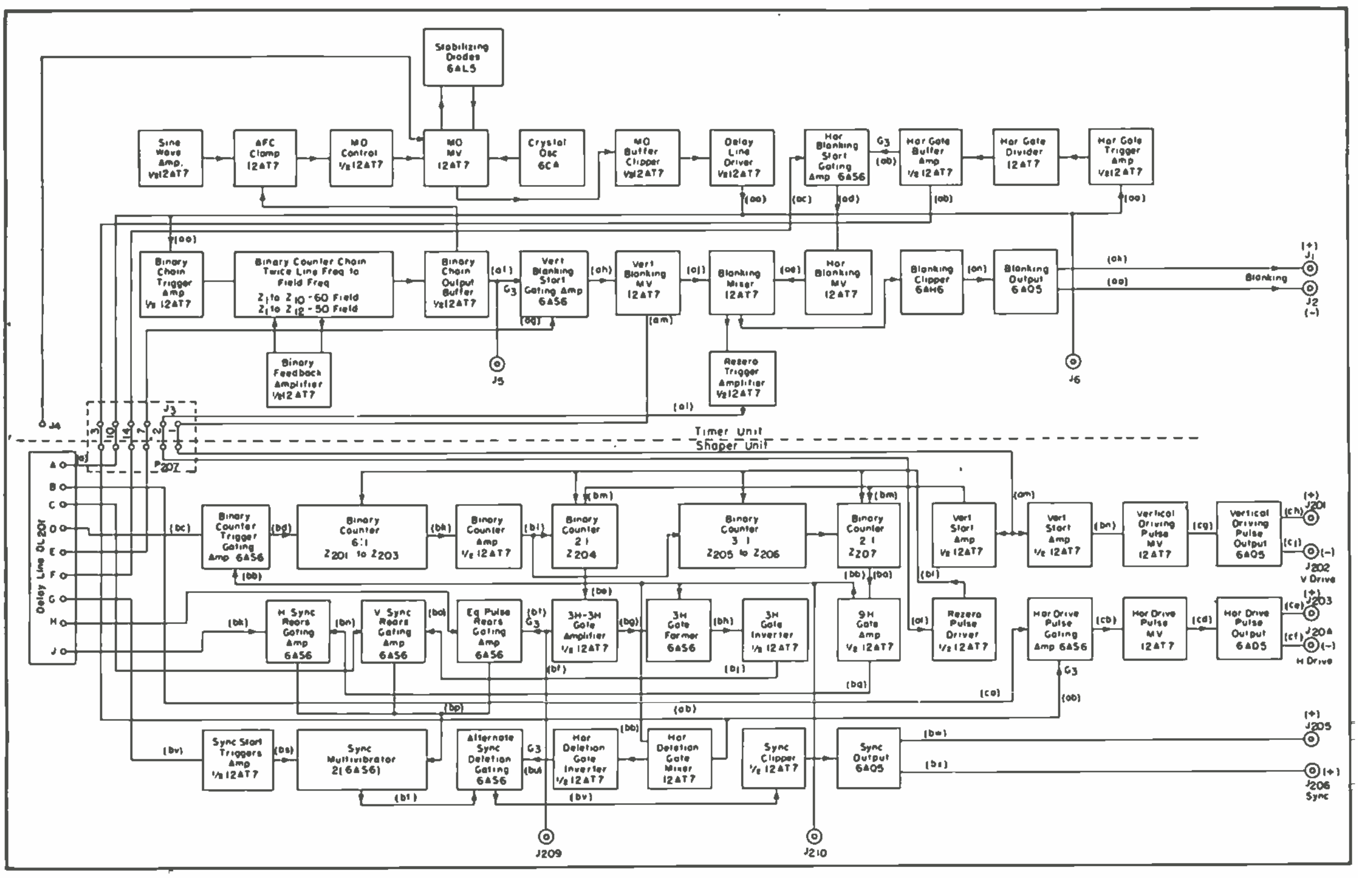
These two examples are governed by the following rule: Let n designate the number of the binary scaler in the chain from which the feedback originates, and p designate the number (from the first scaler) to which the feedback trigger is applied. The total division to the nth scaler is now $2^n—2^p$ instead of 2^n; in other words, the feedback reduces the total count by 2^p. In the first example, n was *3*, and p was *0*, since the feedback trigger was applied to the first scaler, so that $(2)^3—(2)^0$ *equals 8—1* or seven. In the second example, n was *3*, and p was *1*; thus $(2)^3—(2)^1$ equals *8 — 2*, or six.

A total of four separate feedback circuits were incorporated in the sync generator to reduce the count of the ten binary scalers from $(2)^{10}$, or 1024, to 525.

All of the pulses in the sync signal are generated by one multivibrator. However, the synchronizing signal must contain pulses of different widths, namely the equalizing pulses, vertical sync pulses, and horizontal sinc pulses. Hence, the multivibrator must be con-

(Continued on page 25)

Figure 5
Detailed block diagram of synchronizing generator showing the function of each tube.



TV Broadcast Equipment

Image Orthicon Camera Chain

An Image Orthicon Camera Chain consisting of a pickup head and electronic view finder; image orthicon control and monitor; pickup auxiliary; mixer amplifier; low-voltage supply; synchronizing generator; and distribution amplifier and low-voltage supply, has been developed.

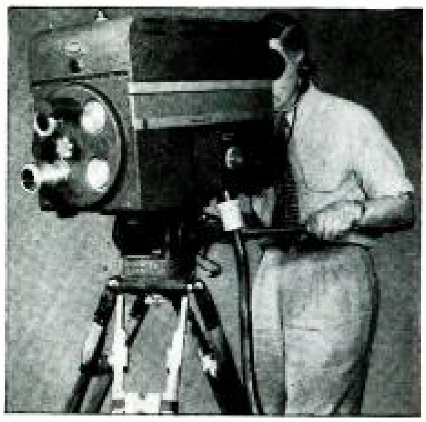
Camera setup features use of two cue lights, one above the lens turret and the other on top. Pickup tube can be rotated with respect to scanning, permitting pickup tubes to be matched in scanning position for interchangeability.

Intermediate amplifier has two separate standard RTMA video outputs at 1.4 p-p *v* 75-ohm source.

Pickup auxiliary features a focus current switch with *on-the-air* and *rehearsal* positions, which is said to extend sweeps slightly during rehearsals to prevent burning of image orthicon tube with a normal raster.

Minimum black level setup in mixer amplifier may be pre-set. Outputs are 2 separate standard RTMA video outputs at 1.4 p-p *v* 75-ohm source impedance. Unit may be used to feed directly into a telephone feed line with equalizers at receiving end.

A time-totalizer meter for recording the number of hours tubes have been operating, is provided in the low-voltage supply. A selenium rectifier power-supply powers telephone circuit for operational use. Switch with *private* and *common* positions enables control operator to speak to and hear his camera man alone, or to speak to and hear every one on the circuit.—*Model TA-124-E; Television Transmitter Division, Allen B. Du Mont Labs, Inc.,* 1000 *Main Ave., Clifton, N. J.*



Du Mont Image Orthicon Camera Chain

Theatre TV System

A Theatre TV System that features a mirror design for balanced light distribution over the entire screen, has been produced. Illumination at the corners of the screen, is said to be 80% of that in the center. Projection tube has a suspension mounting to facilitate cleaning. Optical barrel features a re-circulation system for cooling. An 80-kv power supply, utilizing flexible *hv* cable, is also provided.

System has a receiver for off-the-air reception, accommodates inputs from microwave or coax feeds, may be operated over a range from 32′ and an 10′ x 8′ picture up to 80′ and a picture approximately 25′ x 19′.—*Simplex Theatre TV System; General Precision Laboratory, Inc.,* 63 *Bedford Rd., Pleasantville, N. Y.*

10-kw VHF TV Transmitters

High-Level Modulated, air-cooled VHF transmitters providing a nominal peak visual power output of 10 kw, measured at the output of the sideband filter, and a nominal peak aural power output of 5 kw have been announced.

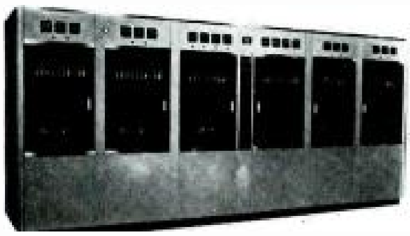
Transmitters employ only air-cooled tetrodes in the final amplifiers of both aural and visual units, with grid modulation. Other design features include single-ended *rf* circuits, built-in control of white saturation, high speed *ac* and *dc* overload protection.

Doors on cabinet are constructed of interlocking, extruded aluminum slats. Guided by small rubber caster assemblies riding top and bottom tracks, they can be rolled from front or back into the sides of the cabinets. The visual section of the transmitter consists of a crystal oscillator followed by *rf* amplifiers and a grid-modulated power amplifier. High-level grid-modulation of the final amplifier allows the operation of all driver stages as narow-band, class *C* amplifiers. Vestigial sideband filter is adjusted at the factory.

Amplifier and modulator circuits incorporate the latest design. Clamp circuit *dc* restoration is employed at the grid of the video modulator stage.

Built-in reflectometers continually measure the standing-wave ratio in the transmitter output and indicate transmission line reflections. Interlocked with the plate power supply, they automatically shut down the transmitter if the standing-wave ratio exceeds a preset value. Provision is made for continuous monitoring at various points in the system when desired.

Transmitters are 192″ long, 84″ high, and 32½″ deep overall.—*Model TT-10AL (channel 2 to 6) and Model TT-10AH (channel 7 to 3); RCA Engineering Products Department.*



RCA 10-kw vhf transmitter

Video Line Pad

A Video Line Pad for connecting one- or two-line amplifier outputs, line input and monitor input, has been produced.

Network is designed to feed from a 73-ohm source to a 73-ohm line with zero loss, and at the same time provide a branch circuit containing 14-db of isolation, for the connection of a high-impedance monitor. Pad is said to provide direct monitoring of the outgoing signal between the output of the line amplifier and the line without disturbing the transmission characteristics. Screw driver controls are provided for compensating for the shunt capacities encountered in the monitor input cables, for bandwidth adjustments and amplitude calibration.—*V-109; Daven Co.,* 191 *Central Ave., Newark* 4, *N. J.*

TV Parts

Coil Form Kit

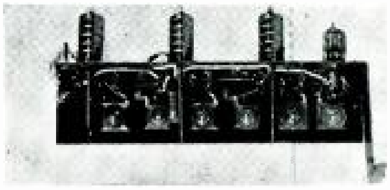
A Coil Form Kit containing samples of ceramic coil forms is now available.

Box contains three each of five different ceramic coil forms, with a different powdered iron slug; high, medium, and low frequency. Extra slugs of silver-plated brass for each coil form are provided as alternates to the iron slugs. Forms vary in diameters from 3/16″ to ½″ and in over-all mounted heights from 19/32″ to 1 11/16″, and are made of grade L-5 silicone impregnated ceramic, meeting specifications JAN-1-10. Also provided is a chart which identifies slug types by color code and part number, and states approximate frequency ranges and permeabilities.—*Information available from Cambridge Thermionic Corp.,* 442 *Concord Ave., Cambridge* 38, *Mass.*

Cambridge Thermionic Coil-Form Kit

IF Amplifier With Die-Stamped Coils

A TV IF Amplifier with die-stamped coils, operating in the range of 41.25 to 45.75 mc has been produced. Available with a stamped tuner as a prealigned assembly.—*Franklin Airloop Corp.,* 43-20 34*th St., Long Island City, N. Y.*



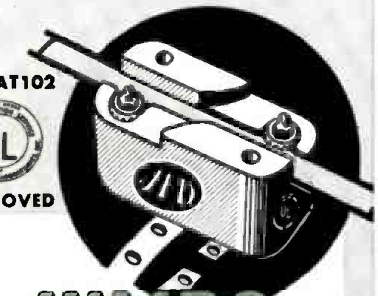
Franklin IF Amplifier

Cosine Yokes

Cosine Yokes with distributed windings for edge-to-edge picture focus, and ferrite cores permitting use with picture tubes up to and including 24″ where they require 70° deflection, have been produced. One model has high horizontal and low vertical inductance for use with air-core fly-back in direct-drive systems. Equipped with network and leads.—*MDF-70, MDF-30; Merit Transformer Corp.,* 4427 *N. Clark St., Chicago, Ill.*

High-Temperature Selenium Rectifiers

Selenium Rectifiers capable of operating without derating in ambient temperatures of 90° C have been developed. Rectifiers are said to be guaranteed for a minimum of 1000 hours of continuous operation.—*Sarkes Tarzian, Inc., Rectifier division,* 415 *N. College Ave., Bloomington, Ind.*



Highlight Controls

(*Continued from page* 13)

the result of severe compression in the black region of the signal and overall distortion of the signal.

With the 6AG7 a maximum output of 150 *v* p-p without amplitude distortion or sync compression was obtained. Throughout the range of input signal encountered in the field and at any contrast control setting, it has been found possible to overdrive the picture tube without the non-linear amplitude distortion and sync buzz that is usually the result of high p-p output levels.

Experience has shown that a sharper, more detailed picture results if the overall frequency response of the video amplifier is not flat or slightly sloping down to the high frequencies, but is made to rise in amplitude with frequency. Since there are no set rules regarding the amount of boost of the high frequencies that is needed to produce a sharper picture than is obtained from a flat frequency response amplifier, it remains a matter of personal viewer judgment as to the needed high frequency boost that produces the picture which might be considered best.

The use of an upward sloping frequency characteristic has been found to produce a transient that sets up a following white line on the dark picture elements which makes them appear to stand out in a well defined manner from the surrounding picture detail.

The amount of high-frequency boost that could be considered excessive is dependent on a number of factors, which include the viewer's personal reaction as to when the amount of rise is great enough to make the picture appear artificial or to have present some characteristic that was not present in the transmitted image.

This reaction of the viewer to the presence of an additional phenomenon in the picture that was not originally present, varies with the person and his viewing distance to the screen.

A larger amount of high frequency boost is desirable when the viewing distance is increased, since it makes the pictorial detail stand out, and much detail that is apparently missing at distance viewing can become readily visible with such boost.

The highlight control, itself, consists of a switch which provides three positions of video-amplifier frequency response to produce the proper *picture highlighting* or high-frequency boost for any type of picture material, viewing distance, signal level or personal preference of the viewer.

By using a contrast control that varies the gain of the output tube by changing the cathode degeneration it is possible to switch in bypass capacitors and resistors to obtain the necessary high-frequency boost.

Although sweep frequency response curves were used in determining the initial circuit parameters affecting the frequency response, the final values of these parameters were arrived at by actually viewing the resultant picture produced by each type of response curve.

Since the amount of high-frequency boost is determined by the partial bypassing of cathode resistance, one can readily change the shape of the curve by switching into the cathode of the amplifier different values of resistors and bypass capacitors.

In the minimum position of the highlight control, the amplifier reaches its maximum gain and has the lowest high-frequency boost. Since low level fringe area signals are accompanied by a high noise level from the input circuits of the receiver, it is desirable to have maximum gain with a minimum of high frequency boost to reduce the amount of *snow* in the picture and prevent sync instability.

The normal position of the highlight control provides an intermediate amount of high-frequency boost that will sharpen and outline the smaller detailed areas of a stronger signal picture.

A degenerative cathode resistor also allows the video amplifier tube a greater input signal handling capacity which eases the burden of the *agc* circuit to hold the input signal level at a constant value.

When the maximum position of the highlight control is used, the circuit has a maximum of high-frequency boost, which can be used to best advantage on strong signal pictures of poor quality such as some coax transmissions, movies, and television transcriptions.

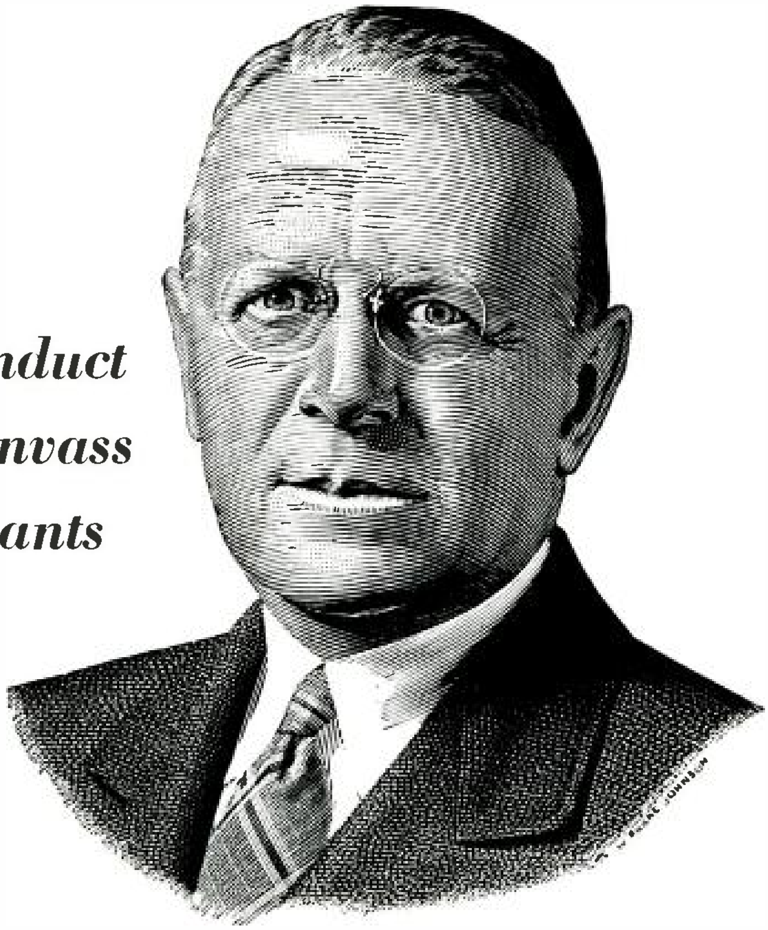
Sync Generator

(*Continued from page* 22)

trolled in its start and stop operation in the precise timing sequence corresponding to the RTMA synchronizing signal. It was found possible to accomplish this through the use of a time delay line, driven by triggers from the master oscillator. Taps on the delay line were included to provide precise timing intervals corresponding to the widths of the sync pulses to be generated. From these taps are obtained triggers which control the start and stop instants of the multivibrator. It will be apparent that the widths of the various sync pulses are determined entirely by the permanent characteristics of the delay line.

[*To Be Concluded in September*]

. . . *"It was easy to conduct a person-to-person canvass at all company plants and offices"*



ROY A. HUNT
President, Aluminum Company of America

"Our employees like the Payroll Savings Plan for U. S. Savings Bonds. It was easy, therefore, to conduct a person-to-person canvass at all company plants and offices.

"I believe every company which promotes the systematic investment in U. S. Savings Bonds in this way provides a highly desirable service for its employees and at the same time gives practical support to an important national effort."

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- Phone, wire or write to Savings Bond Division, U. S. Treasury Department, Suite 700, Washington Building, Washington, D. C.
- Your State Director, U.S. Treasury Department, will contact you or the executive you designate to conduct the canvass and tell you exactly how to proceed. He will furnish posters, pay envelope stuffers, application blanks and other aids.
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TELEVISION ENGINEERING

Resin Curing

(*Continued from page 19*)

it is recommend that *accelerators* which serve to activate the standard catalysts at lower temperatures be used.

There are two types of accelerators which have found most useful in this type of work:

Nuodex cobalt naphthenate, which is useful primarily in initiating gelation and in propagating complete cure at no greater than room temperature. Depending upon the concentration used, complete cure may take two days to two weeks to develop. This accelerator can be used with hydroperoxide type catalysts[1]. *Nuodex cobalt should never be mixed with the peroxide as this combination is explosively reactive.* The best means of introduction is to mix the *nuodex* into the resin first, a mixture which is stable for a period of several months. Hydroperoxide catalyst can then be added when ready for use. Bench lives (time at room temperature to gelation) can be obtained as short as 30 minutes by use of a very active hydroperoxide[2]. This can be varied up to 6 to 8 hours without losing the characteristic of complete cure at room tempertaure. Usual concentrations for use range from .1% *nuodex* (.006% metal) to 2% *nuodex* (.12% metal).

Decreasing the concentration of accelerator has been found to lengthen the bench life, whereas increasing the concentration shortens the bench life. It is generally inadvisable to use more than 2 *nuodex* concentration, because further reduction in bench life is not possible. Bench life has been found to be affected by ultraviolet light; uncontrolled batch-to-batch variation in resin, catalyst and accelerator due to impurities, particularly metallic; age of the resin, and temperature; 85°*F* instead of 75°*F* has been found to affect seriously the results.

A disadvantage of *nuodex cobalt* as an accelerator is that it colors the resin a purple red. Consequently, it cannot be used where light, clear color is desired. If pigments or colors are used, this coloration is negligible.

Accelerator B[3], the second room-temperature type cure (organic solution), has been designed for use with hydroperoxide to give rapid gelation and initation of cure at room temperature without color. It is generally more active than *nuodex colbalt*, but it does not propogate polymerization at room temperature, and it requires heat to complete the cure. This heat may, and often does, come from the exothermic heat of reaction if the mass of resin is sufficiently large to generate it. With smaller masses which do not exotherm, it is necessary to post-heat the resin to complete the cure.

Concentrations most often used vary from 1/8% to 2%, with the higher proportions leading to shorter bench lives. Bench life in this instance, has also been found to be shortened by such factors as ultraviolet light, batch-to-batch variation, age of resin, and temperatures.

There are several ways to evalaute the state of cure of a resin. Usually, rather complete state of cure is desired, so that optimum physical properties may be obtained. In the case of the rigid resins, evaluation of state of cure is determined by hardness (Barcol or Rockwell). The evaluation of state of cure of flexible resins is more difficult, although determination of *Shore A* hardness, specific gravity, or solvent resistance may be helpful.

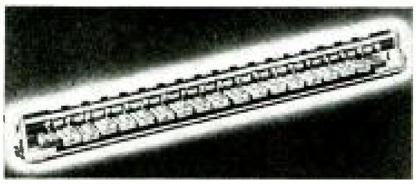
[1]Uniperox 60 (R. T. Collier Corp., Los Angeles); Lupersol DDM (Novadel-Agene Corp., Lucidol Div., Buffalo, N. Y.).

[2]Lupersol DDM. [3]Rohm and Haas.

Instrument News

Delay Lines

Delay lines that are equipped with eighteen taps for the selection of delay intervals ranging from .05 to .9 microsecond, have been introduced. They are said to have a characteristic impedance of 680 ohms and a bandwidth of 4.3 mc. Overall dimensions are 9¾" long, ⅞" wide and 1¼" high.—*1447-A; Tel-Instrument Co., Inc., 52 Paterson Ave., East Rutherford, N. J.*



VHF Frequency Meter

A VHF frequency meter that is said to provide a direct method of measuring or generating a frequency from 20 to 480 mc, has been announced.

Unit is said to be accurate over the frequency range within ±.0005% with a temperature variation of 32° F to 158° F. Features provision to modulate carrier frequency at a minimum of 30% at 1000 cycles.—*FM-1; Gertsch Products, Inc., 11846-48 Mississippi Ave., Los Angeles 25, Calif.*

Ultralow Frequency Bandpass Filter

A Frequency Band Pass Filter with both the high and low cutoff frequencies independently adjustable from 0.02 to 2000 cps, has been produced. Gain is unity in the pass band and drops to a rate of 24 db/octave outside the pass band.

No peaks greater than 1 db in the gain vs frequency plot are said to be produced. —*Krohn-Hite Instrument Co., 580 Massachusetts Ave., Cambridge, Mass.*

Pulse Generator and Calibrator

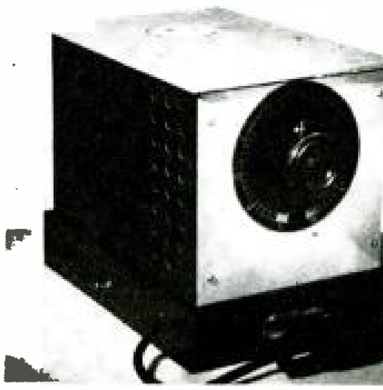
A Pulse Generator and Calibrator that produces two rectangular pulses of short duration whose amplitudes and polarities can be independently controlled, has been introduced.

External sync input has a positive polarity, an amplitude of 10 volts and a repetition frequency of from 50 to 500 pulses per second. Internal sync output has a positive polarity, amplitude of 50 *v* open circuit, repetition frequency of from 50 to 500 pulses per second, and a duration of 1 microsecond. Calibrator output is available in amplitudes of .1, .3, 1, 3, 10, 30 and 100 volts, with a 60 cps square waveform.—*PC-100; Department TE, Teletronics Laboratory, Inc., 352 Maple Ave., Westbury, L. I., N. Y.*

Production

Solder Pot

A Solder Pot, the crucible of which will not crack when the heat is turned off, has been announced. Brazes formvar or enamel insulated wires without pre-stripping or pre-cleaning. Manufacturer claims that there is no need to keep the temperature on low heat during non-use hours. Unit is self-contained with a rheostat, manual control, for maintaining temperature levels. Fused with a 5-amp fuse and equipped with a 66-inch rubber-covered connecting cord. Size is 12¾" deep by 10⅝" high by 8½" wide.—*Tartak-Stolle Electronics, Inc., 3970 South Grand Ave., Los Angeles, Calif.*



Plastic Film Veneer

FILM-LIKE SHEETS (32" x 48") with wood-grain finishes, have been developed. Material can be applied to a smooth surface, either flat or rounded.

Patterns include blonde, medium and dark shades of oak, walnut, mahogany and prima vera. In addition, one leather and two marble reproductions are available.—*Transveneer Plastic Film Veneer; Di-Noc Co., 33 Public Square, Cleveland 13, Ohio.*

Adhesive Backed Felt Tapes and Sheets

REINFORCED FELT TAPE with pressure-sensitive adhesive back has been announced. Product does not require a paper or other separation material between layers. Available in rolls from ¼" to 66" wide and in the following thicknesses: 1/64", 1/32", 1/16" (100' long); ⅛" (50' long); ¼" (25' long). Also available as a cut gasket, diecut to specifications.—*Kling-Felt; Products Research Co., 5426 San Fernando Rd., Glendale 3, Calif.* Address inquiries to J. N. Schien.

Blue TV Lamp

(*Continued from page 17*)

volved in frequent lamp changes. In addition to long life it is essential that the light output remain high during this period of burning. Accordingly, a study of this characteristic was made, and the results plotted, in an average lumen maintenance curve; Fig. 5.

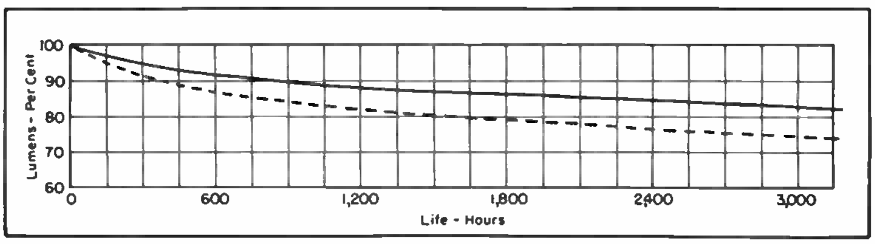
Although it has been found that the initial cost of these bulbs is greater than that of standard incandescent lamps, the long-life feature has resulted in a cost reduction. For example, on the basis of completely lamping a small studio with standard incandescent lamps, an operating cost, including maintenance, of $1.81 per million lumen hours has been estimated. The cost of completely lamping the same studio with the *blue lamps* has been found to be $1.57 per million lumen hours.

Lamp's Features

Compared with certain types of available light sources, the *blue lamp* offers long life with attendant cost reduction; improved spectral characteristic for use with camera tubes; good color temperature from standpoint of the psychological effect on talent, etc.; flexibility of control, and ease of handling and stocking.

It is believed that still further improvements are possible, and development work is continuing.

Figure 5
Lumen maintenance plot. Solid line represents results from 500-TV lamp, and dashed lines show results from 1500-watt lamp.



Industry Literature

Eitel-McCullough, Inc., San Bruno, Calif., has released a 4-page booklet describing a schedule of maximum salvage values allowed for the return of certain used Eimac tubes. A total of 50 tubes are listed.

Cornell-Dubilier Electric Corp., South Plainfield, N. J., has compiled a manual, *TV Replacement Guide TVR-7*, listing over 400 TV twist-prong electrolytic capacitors. Guide lists alphabetically the names of 68 set manufacturers, set model numbers and chassis numbers, recommended C-D twist-prong electrolytic replacements, physical and electrical characteristics and a cross index of former electrolytics and present equivalent part numbers. Priced at $.50.

The Thomas & Betts Co., Inc., 82 Butler St., Elizabeth, N. J., has issued a data sheet, *S4*, detailing technical information on self-insulated *Sta-Kon* terminals with insulation grip.

John Wiley & Sons, Inc., 440 Fourth Ave., New York 16, N. Y., has published a 344-page book, *Linear Computations*, by Paul S. Dwyer, math professor at University of Michigan. Described in terms of elementary algebra are the theorems and methods involved in solving simultaneous linear equations. Included is material on determinants and matrices. Priced at $6.50.

Sylvania Electric Products, Inc., Emporium, Pa., has published the eighth edition of the Sylvania *Technical Manual* in a snap-open, loose-leaf format. Manual contains technical data on more than 500 receiving-type tubes, standard TV picture tubes, and general information on vacuum tube operation. An 84-page engineering data section includes text on fundamental electrical laws, properties of vacuum tubes, definitions of radio terms, general tube and circuit information, tube dimensions, use of curves, resistance coupled amplifier data, information on obsolete tube types, tube base diagrams, and data on panel lamps, ballast tubes and plugin resistors. Priced at $2.00.

Engineering Products Department, Radio Corp. of America, Camden, N. J., has published a 16-page brochure, *2J8024*, describing magnetic tape recording equipment for professional broadcast use. Detailed are a magnetic tape recorder, custom-built recording and editing equipment in rack or console combinations, and accessories including remote control units, metering panels and vacuum equipment for holding tape in place during cutting and splicing operations.

Hewlett-Packard Co., 395 Page Mill Rd., Palo Alto, Calif., has released an issue of *hp Journal* which describes a new low-frequency function generator, model *202A*, that is said to provide frequencies as low as 1 cycle per 100 seconds and sine, square and triangular wave outputs.

General Radio Co., Cambridge, Mass., has published an issue of *The Experimenter*, which describes decade resistors and a multirange filter for audio and ultrasonic amplifiers.

Magnecord, Inc., 360 North Michigan, Chicago, Ill., has released a catalog detailing a line of magnetic tape recording equipment for professional use. Described are conversion and adaption equipment, and accessories such as special switches, spooling mechanisms and adapter panels.

Elliott Manufacturing Co., 350 State St., Binghamton, N. Y., has released an 8-page circular, *207*, describing flexible shafting for power transmission. Included is a table illustrating dynamic torque with varying radius of bends.

Cannon Electric Development Co., 3209 Humboldt St., Los Angeles 31, Calif., has published an 8-page condensed catalog, *RJC-4*, describing plugs, receptacles and accessories for use with microphones, radios, tape recorders, amplifiers and television cameras.

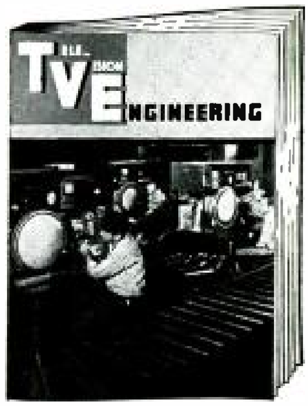
Allen B. DuMont Labs, Inc., 750 Bloomfield Ave., Clifton, N. J., have released a 28-page stockholders' annual report for 1950 with the financial statement for the year. Included is a review of the company's activities during the past ten years.

Federal Tool Equipment Co., 532 Mulberry Street, Newark 5, N. J., has published an eight-page bulletin, *No. 253*, on the *tweezer-weld bench-head* line for small parts welding. The line is said to feature single pair electrodes, double pair electrodes, two welds simultaneously and bench heads with automatic wire feed and cut off arrangements.

VWOA News

OLD, OLD TIMER JOHN B. GAMBLING, whose morning broadcasts over WOR, during the past two-decades, have been welcomed into millions of homes, has become a VWOA'er. Way back in '13 John began pounding brass as a member of the British School of Telegraphy in London. In July '14, he received his radio operators license. Ten days after the outbreak of World War I, he enlisted in the British Navy as a radio operator. He served on several ships of the British Navy, including three years on a converted fishing trawler minesweeping in the North Sea. On several occasions, in '16, he was mentioned in dispatches for meritorious service. In early '19 he was released from the British Navy, but after a few weeks ashore, he decided to return to sea again and joined the British Merchant Marine where he remained until in '20, when he decided to do a bit of seagoing with the U.S. Merchant Marine, an assignment which lasted five years. During three years of this period he sailed aboard the SS Creole. In February, '25, John quit the oceans, married, and set sights for a land job. The search ended quickly, thanks to his friend Jack Poppele, who asked him to join WOR as a radio operator. After operating awhile he transferred to WOR's engineering department and then to announcing. And since that moment, 26-years ago, John has been running WOR's 7.15 to 8 AM daily program. When World War II broke out, John again offered his services to his country, but he could not meet the medical requirements of the Navy. So, he turned over to the Coast Guard, his 40-foot cruiser for the duration. . . Another new member in our fold is Jesse W. Holland, whose key days began in the U.S. Navy in April, '17. Until October, '19, he served as radio operator, and from Jan., '21 until Aug., '23 he was with RCA Communications at New York. He has served with the FCC and is currently working with the *Voice of America*. . . W. H. Medd, U.S.N. (Ret.), has told ye secretary that his career in radio began 50 years ago, when he studied visual signals and electricity, while in Europe on board the USS Chicago, at the time Marconi made his transatlantic record. He completed courses of the Navy Wireless and Electrical school in '03-'04 and was assigned to Highlands, Navasink, as electrician, second class under Jack Scanlon, chief of the station. "During a cruise to South America, while serving as apprentice, second class aboard the USS Dixie," he said, "de Forest conducted his first sailing reports of the Lipton Sailing Races from the Highlands of Navasink."

Group Subscription Plan



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Briefly Speaking . . .

TV CENTERS IN NEW YORK CITY, in the dream stage for years, are rapidly skipping off the drawing board into the land of reality. On the west side of the city, *WOR-TV* is constructing a streamlined building which will centralize all of the studio, film and remote operations. On the east side, on the site of the old Central Opera House building, *DuMont* has broken ground for a 7-story building which will provide five studios for live telecasts, and two for the coordination of film and remote programs. In addition, there'll be facilities for the engineering and programming staffs. . . . *G.E.* has made an agreement with *20th Century Fox Film Corp.* to develop color studio equipment to be used with the Swiss Eidophor projection system for theater television. . . . *Thomas Scott* is now representing *The Workshop Associates*, division of the *Gabriel Co.*, in Michigan. . . . *Radion Corp.* has appointed the *George E. Anderson Co.*, 1901 Griffin St., Dallas, Texas, as rep for Texas, Arkansas and Louisiana. . . . *Jerome T. Keeney* has retired recently from *Simpson Electric* after 35 years as a sales engineer of testing equipment and panel instruments. . . . *William Dubilier*, technical director and founder of *Cornell-Dubilier Electric Corp.*, South Plainfield, N. J., sailed recently for a stay of more than three months in Europe, covering England, Austria, Germany and France in connection with C-D business. . . . *David C. Prince*, a vice president of *G.E.* on the president's staff, and formerly head of the general engineering and consulting laboratory, has retired after 32 years of service. . . . *Edwin I. Guthman and Co., Inc.*, have recently opened a 55,000 square foot plant, the former home of Howard Radio Co., in Attica, Indiana, which will duplicate the Chicago plant operation. . . . *G.E.* will construct a 20,000 square foot manufacturing building on a two-acre site along New Jersey Route 29, Springfield, N. J., for *Precision Laboratories, Inc.*, now located in Irvington, N. J.; Precision is a manufacturing unit of the G.E. components division. . . . *Westrex Corp.*, and *Reeves Soundcraft Corp.*, have completed negotiations under which Westrex will distribute on a world-wide basis the complete line of Reeves Soundcraft magnetic recording films, including not only standard 35-, 17½- and 16-mm magnetic coated films, but *Magna-strip*, a narrow strip of magnetic material coated on clear motion picture film base. . . . *Hytron Radio and Electronics Co.* is now a division of *CBS*. . . The third edition of Kaufman's *Radio Operator's License Q&A Manual* is now available, according to John F Rider Publisher, Inc., 480 Canal St., New York 13. . . . *LaPointe Plascomold Corp.* has purchased *The Sculli Machine Co.*, East Hartford, Conn., manufacturer of aircraft parts. . . . *International Resistance Co.*, Philadelphia, Pa., has purchased the *Hardy Instrument Co.* Further operations will continue under the IRC name, and will be transferred to the specialty division at 401 N. Broad St., Philadelphia, Pa. . . . *General Radio Co.* has begun construction of a plant in Concord, Mass., a three-story brick-faced building of 72,000 square feet, providing facilities for about 200 employees.

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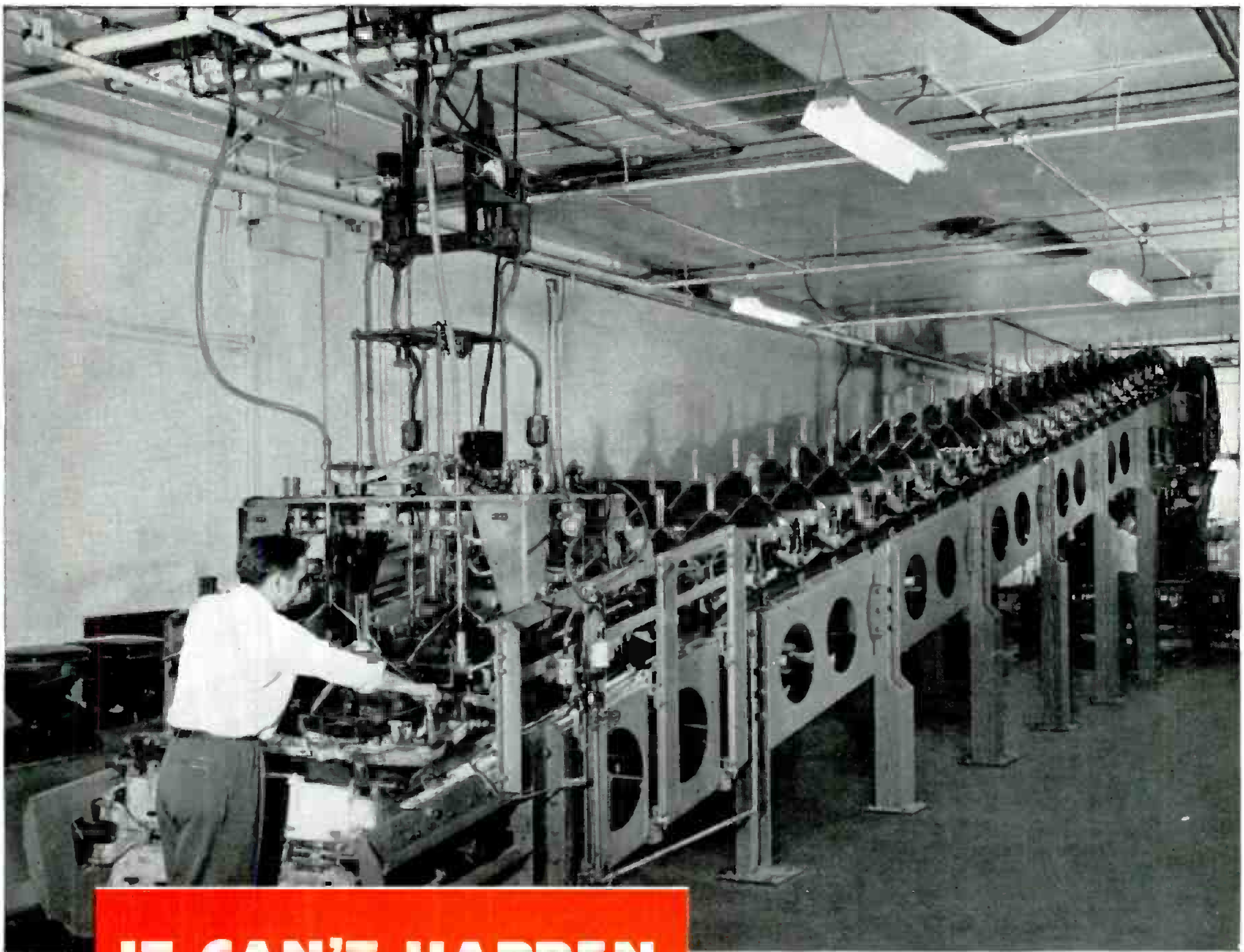
AUGUST, 1951



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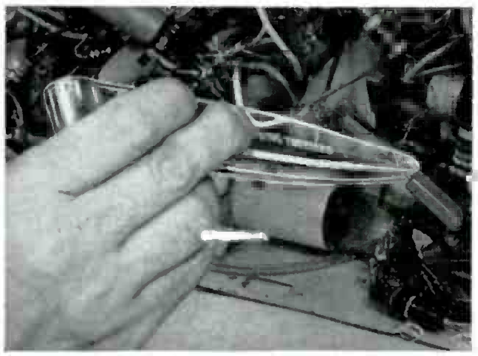

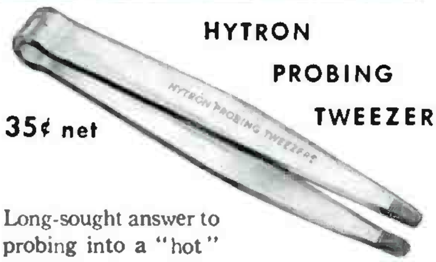

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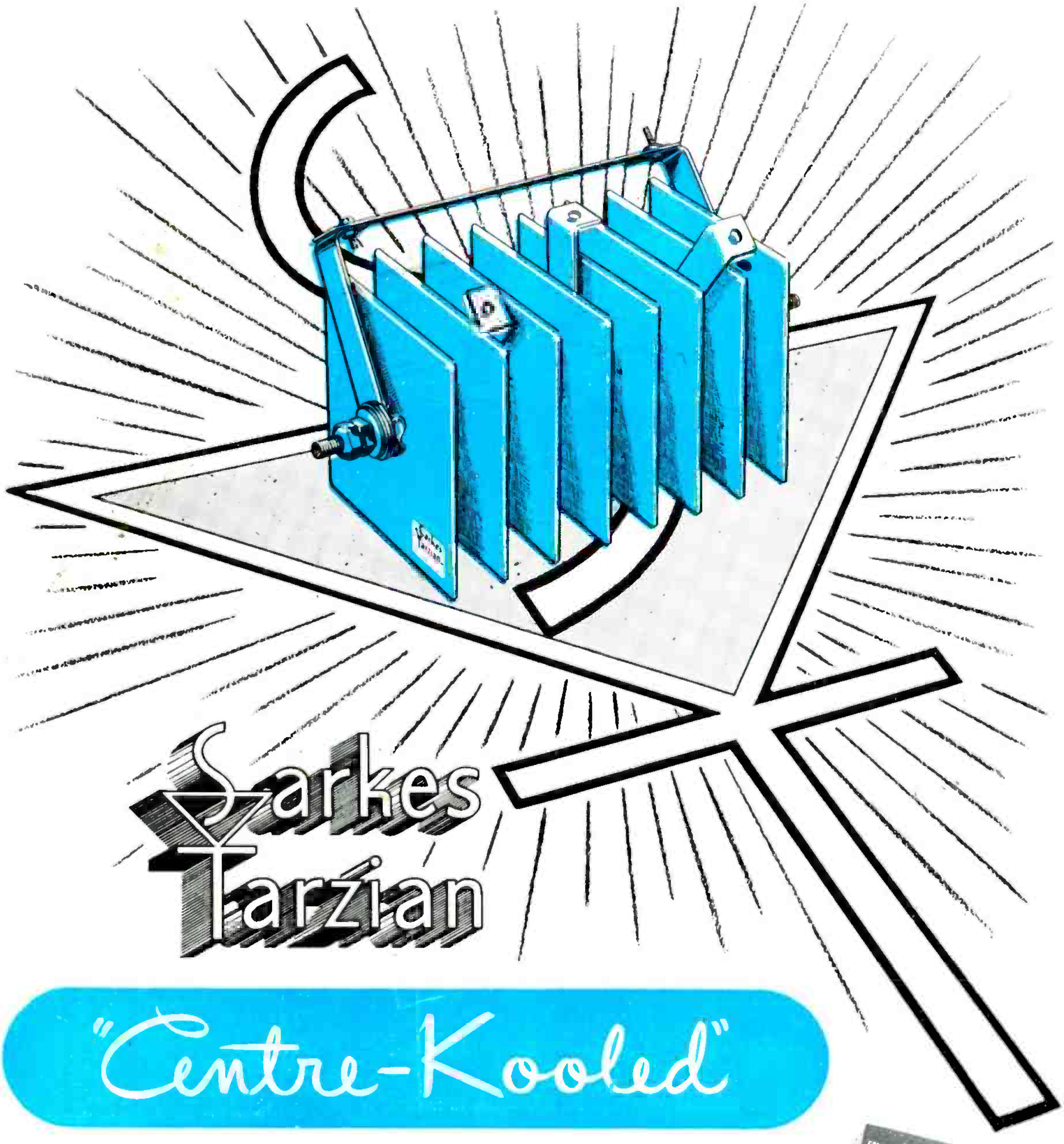

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