RADIO-ELECTRONIC Engineering SECTION

RADIO & TELEVISION NEWS

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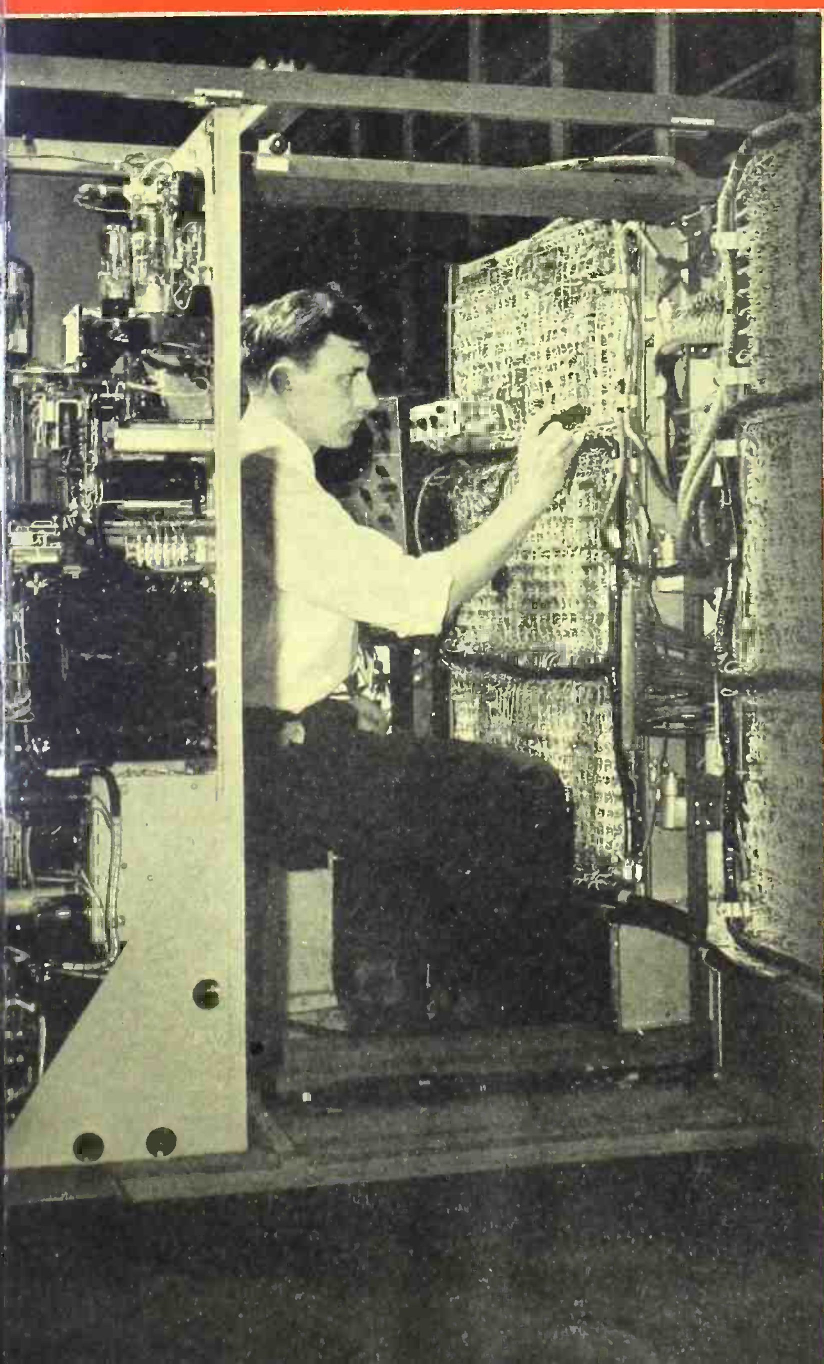


FEBRUARY, 1952

DEPARTMENTS

RADIO-ELECTRONIC ENGINEERING is published each month as a special section in a limited number of copies of RADIO & TELEVISION NEWS, by the Ziff-Davis Publishing Company, 366 Madison Avenue, New York 17, N. Y.

← An International Business Machines Type 604 electronic digital computer is seen here undergoing final tests prior to shipment. On the average, better than two of the 1400-tube mathematical wizards have been produced every working day for the past three years.

Personals

FRANK C. BELDOWSKI, newly appointed plant manager of *Thomas Electronics Inc.*, Passaic, N. J., will be responsible for all TV tube manufacturing, equipment engineering, quality control departments and sub-contracting. With a background of 13 years at *Westinghouse* in the power tube division and association with *Allen B. DuMont Laboratories* since 1945, Mr. Beldowski has had liberal experience in the field of tube development and manufacture.

BRIG. GEN. THOMAS C. RIVES, who retired from the army after 31 years in military service, has been appointed Manager of the *G-E* Advanced Electronics Center at Cornell University, where he will have over-all responsibility for all phases of the Center's operation. He received his M.S. in E.E. from Yale in 1927, and throughout a distinguished army career was bestowed with numerous awards for outstanding work in electronics research and development.

CARL E. SCHOLZ was elected Vice President and Chief Engineer of the *American Cable & Radio Corporation.* A graduate of Stanford University, he has been affiliated with *I.T.&T.* since 1917, serving important executive capacities with *AC&R* companies since 1945. Mr. Scholz became Vice President of *Mackay Radio and Telegraph Company* in 1950, and holds membership in the American Institute of Electrical Engineers and the Institute of Radio Engineers.

HERMON H. SCOTT was presented the John H. Potts Memorial Award at the Audio Engineering Society's annual convention. This award recognized his work in reproduction and measurement of sound. His company, *Hermon Hosmer Scott, Inc.*, manufacturers of high-quality audio amplifiers, dynamic noise suppressors and sound measuring laboratory instruments, also received an award for outstanding product design development.

DR. IRVING WOLFF has been named Director of Research for the *RCA* Laboratories Division of the *Radio Corporation of America.* A specialist in ultra-high radio frequencies, and a pioneer in radar, he joined *RCA* in 1928, devoting research to the audio field, and later shifted his interest to the development of microwave equipment. In 1934, he began basic experiments in radio reflection work, which proved basic to the development of radar.

ROBERT L. WOLFF has been named Director of *Centralab Products Engineering*, according to an announcement by J. F. Harper, *Globe-Union* Vice President. Mr. Wolff, who has been with the company for fourteen years, was formerly Chief Radio-Electrical Engineer. Graduating from the U. of Chicago, he came to *Centralab* with a background of radio manufacturing. His new responsibilities will include ceramics, special products, printed circuits and capacitors.

THE DU-MITTER

Fig. 1. Over-all view of the commercial version of the Du-mitter.

By
S. R. PATREMIO
Special Project Engineer
Allen B. Du Mont Labs., Inc.

The Du-mitter is a complete TV transmitter with five separate composite output signals on Channel 2 or 3.

DURING THE PAST, many occasions arose at the *Du Mont* network requiring the use of a receiver to view a TV program. In many cases, the program being viewed was not actually on the air at the same time, making it impossible to use an off-the-air picture with a standard receiver.

This made it necessary for receivers to be altered to take a video and audio line feed and, in many instances, a switch was required to switch the receiver from line to off-the-air signals.

With all the necessary revisions to the receiver of added lines, distribution amplifiers, etc., the difficulty of installation, cost, performance, and maintenance of such a system became an ever-increasing problem.

The Du-mitter simplifies this problem immensely. A specific example was a recent closed circuit sales meeting of *Schenley Distributors*, connecting 18 cities together. The broadcast originated in the New York Ambassador Theatre from which it was sent out via coaxial cable to 18 other cities. At each city, Du-mitters transformed the line signals to r.f. signals that fed large groups of receivers located in each meeting hall. In this way, a large sales conference was held at one time without the inconvenience of traveling and accommodating such large groups at one meeting.

The increasing problems brought forth the idea of using r.f. for the means of feeding these receivers. Standard receivers could then be used without the problem of making individual modifications and only a single coaxial line was needed to feed the video and audio to the receiver, eliminating need for an audio pair to the receiver. Simplifying the problem further was the elimination of audio and video distribution amplifier equipment.

Many experimental units were developed before coming up with the first Du-mitter design, which consisted of an audio and a video section, the individual transmitter outputs being diplexed into five separate composite r.f. output signals. To minimize transmission line losses, the units were designed for the low channels 2 and 3, with the Du-mitter I being able to cover either channel by retuning. The audio section consisted of a reactance modulator and oscillator operating at one-fourth the operating frequency. Following the oscillator were two doubler stages, the output of the last doubler being used for the final output stage.

The video section consisted of an oscillator driving a push-pull grid-modulated final amplifier output stage. One modulator tube was used to grid-modulate the final stage.

After a considerable amount of experience with the first Du-mitter Model I, it became apparent that the following items required improvement: (1) difficulty of tuning requiring special test equipment, (2) poor stability for operation of intercarrier type receivers, however good on standard type receivers, and (3) lack of built-in metering circuits. With these points in mind, and with further development work, the following improvements were made: (1) video oscillator crystal controlled, (2) front panel meter and switch for metering all circuits, (3) 4.5 mc. discriminator for metering a.f.c. voltage required to control audio oscillator, and (4) automatic frequency control for audio oscillator circuit. With these changes, the stability has been improved to permit satisfactory operation on intercarrier receivers as well as conventional types. The unit is easy to adjust without the use of external special test equipment, is stable in operation, and may be operated unattended for long periods of time.

Figure 5 is a block diagram of the latest Du-mitter circuit. The audio transmitter section consists of three tubes, V_6, V_7 and V_8, audio reactance modulator, oscillator, and first and second doubler, the second doubler being used as the final output.

The video transmitter consists of a crystal oscillator, V_3, driving a push-pull modulated r.f. amplifier V_4 and V_5. The modulator V_1 grid modulates the push-pull r.f. stage. Tube V_{11} mixes part of the second doubler audio output with the unmodulated output of the video crystal oscillator. The difference in frequency of 4.5 mc. is then coupled to the discriminator circuit, including tube V_{12}. The discriminator control voltage is then metered and also used as an a.f.c. voltage to automatically control the frequency of the audio oscillator.

The output of each transmitter is then mixed by a pad isolation network and also is divided into five separate outputs.

The schematic drawing is shown in Fig. 3. The video input requires a minimum of 1 volt peak-to-peak black negative into 75 ohms.

The modulator tube V_1, a 6AH6, is d.c. restored by a 1N34 crystal in its grid circuit. The output of the modulator is d.c. coupled to the grids of the push-pull r.f. stage V_4 and V_5, 6AU6 type tubes. The bias on V_4 and V_5 is dependent on the voltage drop through the modulator plate load. Therefore, the grid return, or restorer return, is fixed to a negative bias potential. This bias is adjustable by control R_{34} to obtain the proper operating point of the push-pull r.f. amplifier. This control is important when changing tubes in the video circuits.

V_3, a 6J6, is the crystal oscillator tube operating in a parallel circuit. The crystal oscillator incorporates an overtone crystal and is very stable and has high

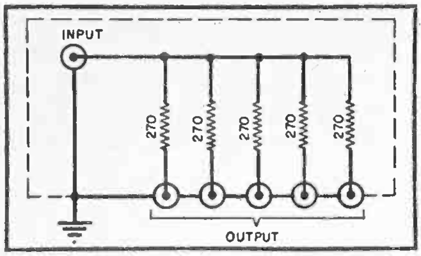


Fig. 2. Standard distribution boxes used to obtain more outputs to feed large groups of receivers. With outputs properly terminated, input impedance will be 72 ohms.

output. The output of the crystal oscillator is loosely coupled to V_4 and V_5, the push-pull r.f. amplifier. The grids and plates of V_4 and V_5 are highly damped to secure a wide bandpass. The over-all bandpass of the video transmitter is better than 5.5 mc.

The transmitter is practically operating double sideband. However, it is still received well on standard receivers because of the lower sideband being cut off in the video i.f. and the carrier being placed at the 50% point on the slope.

V_2 is an 0A2 regulator to fix the voltage at the modulator V_1 and the return of V_4 and V_5 to +150 volts.

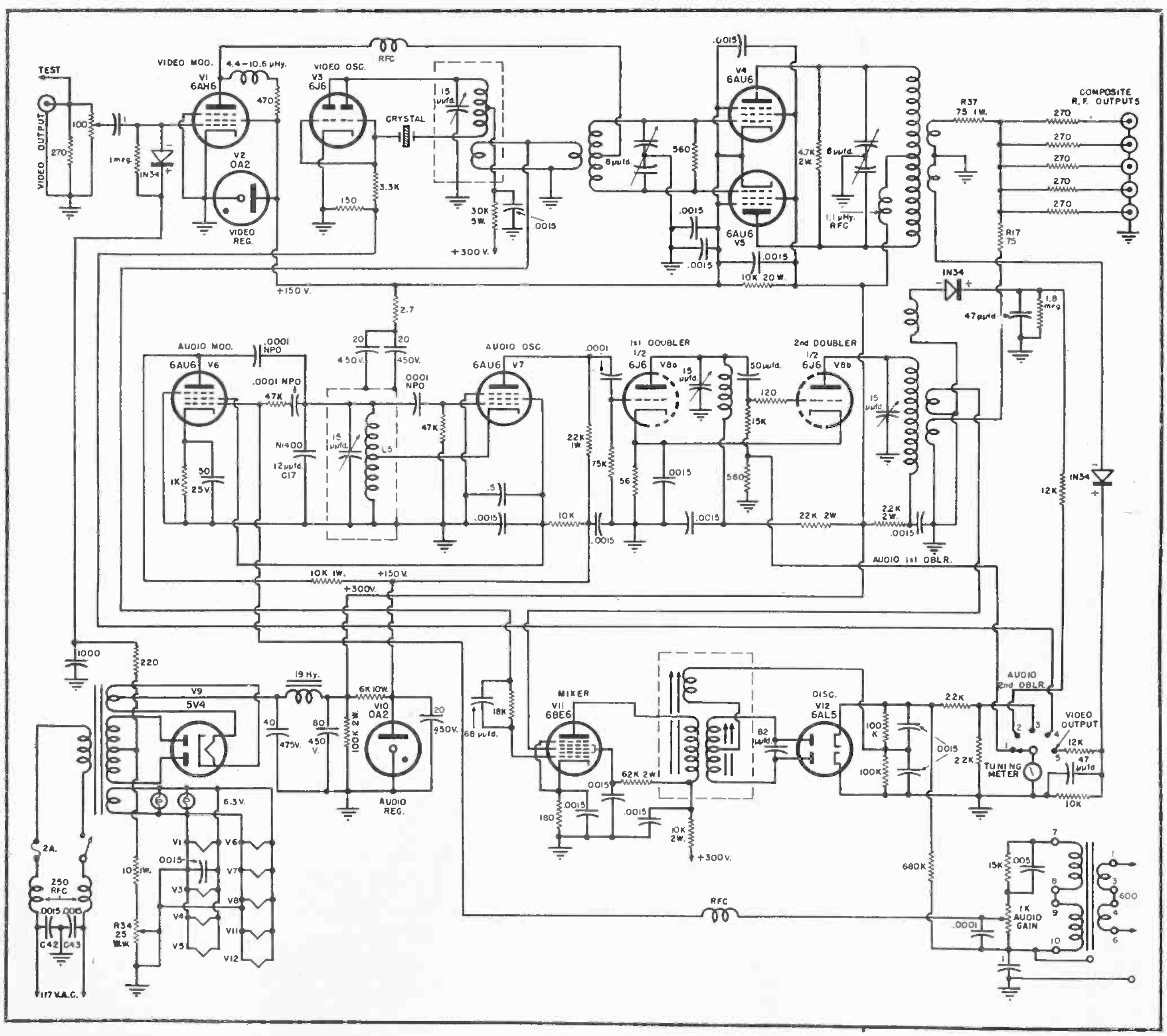
A 1N34 sampling diode is connected to a sampling loop on the plate tank circuit, and is used to determine the video modulation of the carrier by use of an external scope. It is also used to check the linearity of modulation, and the modulation bias control R_{34} is used to correct for nonlinear operation of the final amplifier. A test point on the video input makes it possible to check the percentage of sync to video and compare it with the output sampling diode for correct setting of R_{34}.

The audio transmitter requires a minimum of -20 db into a 500- to 600-ohm balanced or unbalanced line to fully modulate the transmitter (±25 kc.).

Following the input transformer is a preemphasis network and an audio gain control. The audio is fed to V_6, a 6AU6, the reactance tube modulator which, in turn, is coupled to the oscillator tank circuit L_5. The oscillator is an electron-coupled circuit using a pentode V_7, 6AU6, for better isolation of the plate circuit. The components in these two stages are of low loss qualities and carefully assembled. Also, the use of *NPO* (zero temperature coefficient) condensers in the important frequency controlling circuits was needed. In addition to the *NPO* condensers, a negative temperature coefficient condenser C_{17}, N1400, 12 $\mu\mu$fd. was used across the oscillator tank coil for proper frequency stability.

The oscillator operates at one-fourth the frequency of the final output. The oscillator output is resistance-coupled to one-half of V_8 acting as the first doubler and the other half of V_8 as a

Fig. 3. Complete circuit diagram and parts list for the Du-mitter.



second doubler and final output stage. The plate and screen supply voltages for V_6 and V_7 are regulated at +150 volts by V_{10}, an 0A2 voltage regulator tube.

The audio r.f. output and the unmodulated r.f. output of the video crystal oscillator are mixed in V_{11}, a 6BE6 tube. The beat frequency between the two carriers is 4.5 mc. when the audio oscillator is adjusted to the proper frequency. The output of the mixer is then coupled to the 4.5 mc. discriminator circuit incorporating a 6AL5 tube, V_{12}. The voltage developed by this circuit is metered by the tuning meter that can be switched in the circuit. This meter reads the amount of correction voltage required to hold V_7, the audio oscillator, on the correct frequency. The correct voltage is coupled via an *R-C* coupling circuit to the grid return circuit of the reactance tube V_6.

The tuning meter is also used to check the complete tuning of the transmitter by use of a five-position switch that can be switched to any of the stages requiring adjustment.

The power supply is conventional except for the two r.f. chokes Z_{50}, and two condensers C_{42} and C_{43}. This filter was used to prevent any possible radiation through the a.c. power line. The radiation checked at five feet was less than 34 microvolts showing low power line radiation or direct radiation. The power supply makes use of a 5V4G, V_9, rectifier. The slow-heating cathode makes for proper starting of the 0A2 voltage regulator tubes so they do not fire until all the tubes are drawing current.

The separate outputs of the video and audio transmitters are coupled through two 75-ohm resistors to the five isolation resistors that feed each output. This simple resistive circuit offers attenuation of each transmitted signal from getting back into the other output stage in any large quantity to cause cross modulation. The five 270-ohm resistors, when terminated into 72-ohm loads, will terminate the junction of R_{37} and R_{37} into approximately 72 ohms. If any of the five outputs are not in use, they should be terminated by a coax connector containing a 75-ohm terminating resistor.

In the case of a short circuit or an open line, the isolation is sufficient so no reflections are seen on any of the other outputs. Also, the change in level due to such cause is very small, and in the average receiver with a.v.c., no change is noticeable.

The Du-mitter output is slightly more than 30,000 microvolts, which most receivers will handle without overload. However, with this high amount of signal, the transmission line and distribution pad losses required to feed many receivers can be tolerated. As much as

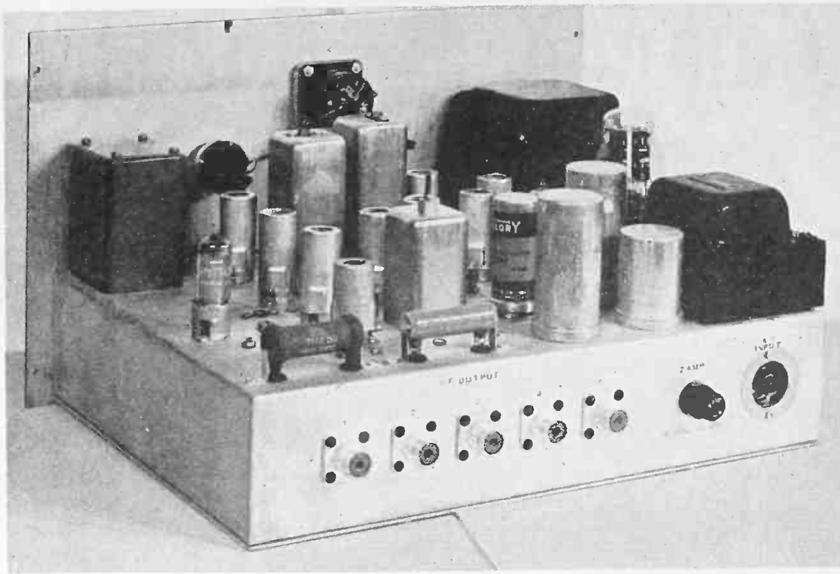


Fig. 4. Top-rear chassis view of the final production model.

30 db attenuation can be tolerated on each output in transmission line losses or pads. Therefore, considerable lengths of line can be used with distribution pads to feed large groups of receivers from one line. As many as 125 receivers could be fed from one Du-mitter, provided transmission line losses are low. Also, 1000 feet of RG59-U cable could be used with a good signal of approximately 1000 microvolts. If longer runs are needed, RG11-U cable can be used, and runs up to 2000 feet can be used with good results. Receivers with 300-ohm balanced inputs can also be used with the Du-mitter if a 300-ohm matching transformer is used at the receiver.

Stability of the Du-mitter has been checked with the idea of maintaining the carriers 4.5 mc. apart. By maintaining the carriers at 4.5 mc. separation, performance of the intercarrier type of receiver is assured. The stability of the Du-mitter from 10 minutes to 2½ hours is within ± 4 kc. However, after approximately thirty minutes, the frequency is held very constant.

During the past year the Du-mitter has been used in many locations and for many uses with very reliable results. The small size combined with ease of installation and operation has made the unit a handy piece of equipment to have around the station.

The Du-mitters have been used for feeding receivers at studios, theaters, offices, clients' booths, closed circuit conferences, closed circuit conventions, and closed circuit sales meetings, with the probability of more uses to come in the future.

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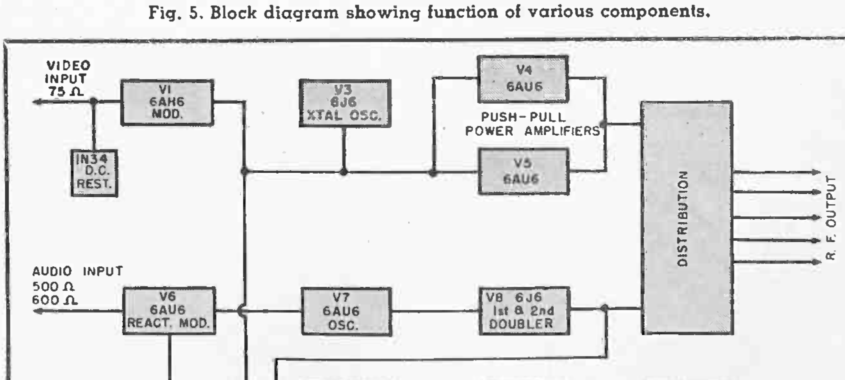
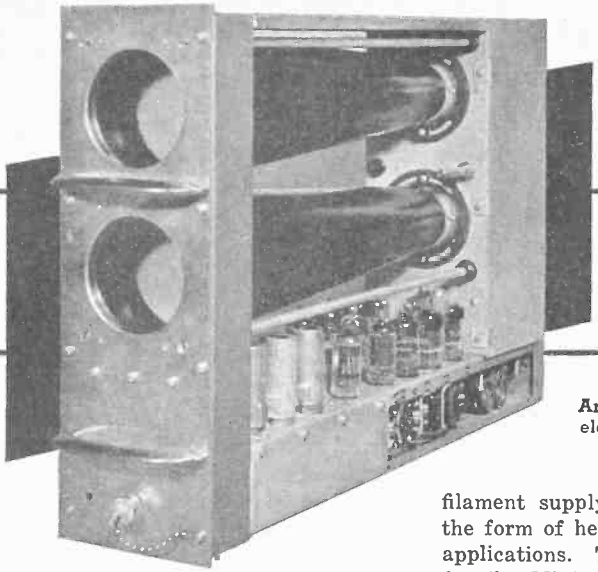
Fig. 5. Block diagram showing function of various components.



Components for COMPUTING MACHINERY



Reliability and consequences of failure are factors which must be considered in determining acceptability of components.

An IBM "pluggable" component consisting of two electrostatic storage tubes and auxiliary apparatus.

By

JOHN D. GOODELL

The Minnesota Electronics Corp.

THE EXTENT to which any component can be considered satisfactorily reliable depends upon the number of similar components required for the proper operation of the equipment in which they are used. Another factor is the importance of continuous operation and the consequences of failure. Until recently, the number of vacuum tubes used in any one device was sufficiently small so that service problems were not particularly serious. Furthermore, the principal applications were in entertainment fields where failure might be annoying but did not generally involve serious economic problems, certainly not matters of life and death. Currently, a single large scale computer uses thousands of tubes, and it is not too uncommon for the average "down" time to be greater than the operating time. Computers and other instruments depending on vacuum tube operation do involve matters of life and death. They function to control aircraft, direct gunfire, detect the presence of enemies, provide vital communication facilities, control degrees of anesthesia, and perform in endless other applications of similar consequence. Tubes have not proven sufficiently reliable and it seems most unlikely that improved designs will be satisfactory.

There are other disadvantages in tubes. Most of them require continuous filament supply. Power dissipation in the form of heat is a problem in many applications. Tubes are mechanically fragile. Miniaturization programs have reduced tube dimensions amazingly but the limit in this direction appears to be closely approached.

It is true that in special cases, and in applications designed to operate tubes within extremely conservative limits, operating life has been extended, but the criterion of conviction with regard to dependability is the willingness to dispense with sockets and solder the tubes into the circuits. There is no evidence of such a trend at the present time. The future of the industry appears to be inevitably tied to germanium, magnetic materials, special dielectrics, non-linear resistances, etc. It behooves the forward-thinking engineer to recognize that this era has seen the rise and will see the decline of the application of vacuum tubes, hence to become familiar with the possibilities of new techniques using essentially passive elements.

The keys to the design of equipment in the field generally included under the term "electronics" are rectifiers, switches, amplifiers and storage elements. All of these functions can be performed with considerable flexibility by suitable tubes and associated circuitry. In a relatively primitive way they can also be demonstrated using a variety of passive elements.

Selenium rectifiers and germanium diodes are familiar as "one-way" elements. Germanium diodes are frequently used as switching components. Magnetic amplifiers, employed in practical applications and development work, promise to broaden the scope rapidly. Any device having a negative resistance characteristic may be used for amplification. Again, crystal diodes may be mentioned as demonstrable. Transistors have received an increasing amount of research and development attention, and recent investigations reveal that their widespread use as amplifiers and switches is imminent. Special dielectric materials such as barium titanate have been studied in connection with amplifier design and the results are very interesting indeed. Magnetic materials are familiar in storage applications such as tape recording. Recent developments demonstrating the multi-stable characteristics of rectangular loop magnetic materials promise their wide application as storage and arithmetic elements in computers.

Dielectric materials have also been used as storage elements and many investigations along these lines are under way. A considerable variety of electrochemical designs have been studied and reported for storage applications, and many inventions of the last century are being revived in the light of new materials, techniques and associated equipment.

This is by no means a complete list of the developments currently described in the literature as being close to fruition. Almost every large organization and most small research and development groups are actively seeking methods of replacing tubes and designing new structures for every electronic application. This is a real frontier, the brink of a major revolution in one of the most important fields of science. It is prompted, to no small degree, by the exacting and important demands of computing machinery and control apparatus.

It is characteristic of the complexity of civilization that a great deal of the effort is disorganized. The duplication of activity is common and intercommunication is inadequate. The largest customer for electronic devices today is the government, and a desirable by-product of the defense effort is the impetus and incentive derived from the widely varied requirements of government organizations. Here, too, is the only real possibility of coordinating and efficiently directing the efforts of widely separated groups of research and development workers. A concerted effort on the part of government representatives to review the field thoroughly and maintain a broad centralized understanding of the activities of all concerned will contribute immeasurably toward the rapid convergence of ideas generated in the entire industry.

To some degree this function is performed by the Computing Machine Laboratory of the Bureau of Standards, by the component groups of the Armed Services and others, but such broad supervision and central clearing house facilities deserve even greater attention than they now enjoy. In cooperation with private industry, this is an important opportunity for the government to perform a fundamental and vital service in facilitating progress, not only for immediate defense efforts but for future improvement and expansion of every aspect of the electronics industry.

The problems of the various fields of development are closely related. It is probably true that any element that can be made into a rectifier can be used for purposes of switching. If it is possible to design a switch using a given basic principle, the same general concept can usually be twisted to produce an amplifier. A switch may be used for purposes of storage. If you have an amplifier it is easy to design an oscillator. The implications of this self-generating chain are obvious. The relationship between various fields is typified by the dependence of the contemporary magnetic amplifier designer on the availability of satisfactory rectifiers. All magnetic material developments are dependent on the ability of the metallurgists and fabricators to keep up with the needs of the equipment engineers.

Computing machinery probably exacts the most rigorous requirements with regard to dependability of any equipment in which electronic components are used. For this reason, magnetic materials are particularly attractive. They are relatively free from effects of physical environment, and their general stability is superior to most of their competitors. Magnetic materials are now available with characteristics that would once have been deemed impossible. Among the most useful and interesting trends is the design of materials with rectangular hysteresis loops and low coercive force.

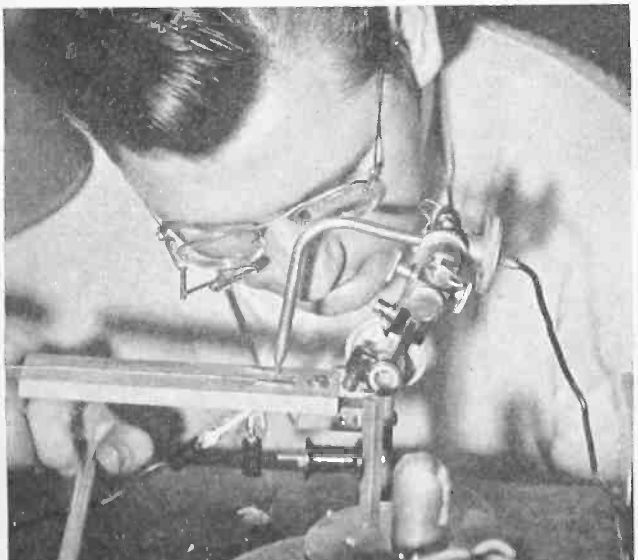
The usefulness of magnetic materials depends on their function as a load, as a means of transferring and transforming energy, their stability in a given state of magnetization, and their ability to quantify. Operating as a load on any circuit, magnetic materials may be used to control the rapidity with which a voltage changes. With materials having essentially rectangular hysteresis loops, the gradual application of magnetizing forces will result in no change in flux, hence no output, until the coercive force has been overcome. At this point, the flux will swing very rapidly toward saturation, producing an output in the form of a steep leading edge. Thus, in a simple application, a sine wave may be used to produce sharp spikes. Certain types of timing circuits may make excellent use of this arrangement.

The G-E Type GL-5844 tube for use in moderately high-speed digital computers.

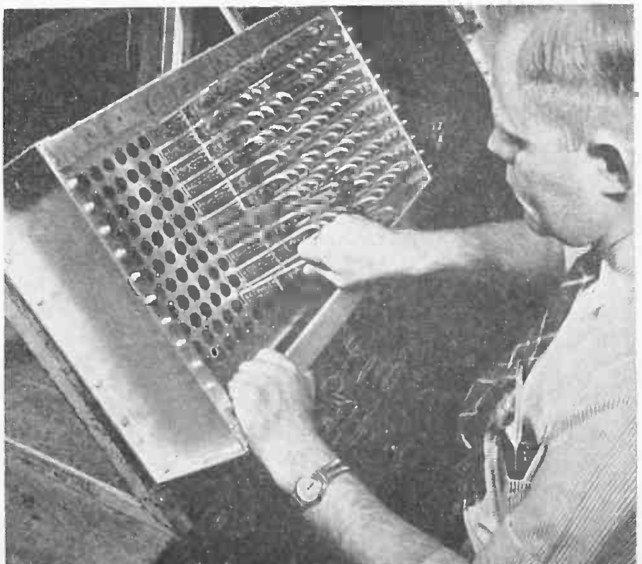
The multi-stable characteristics of these rectangular loop materials were described in a preceding article. They are useful for storage, for counting, for accumulation, for frequency division and various similar functions.

The quantifying characteristic is interesting in many different arrangements. Essentially it means that if a magnetizing force sufficient to drive the material from saturation to saturation is applied, then the volt-second integral of the output is quantified. This means that the applied magnetizing force may be permitted to vary upward from the minimum value required to swing the material from saturation, and the output will be quantified. The shape of the output waveform will vary with the applied magnetizing

Delicate spot-welding operations are required in the fabrication of experimental magnetic memory units.



Pluggable unit "subassemblies," each containing a tube and associated components and circuitry for use in IBM Model 604.



force. As the voltage applied to the magnetizing winding is increased, the voltage of the output pulses will peak at higher values but their time duration will be correspondingly shortened. This principle has been used in the design of various frequency-to-voltage conversion devices, frequency meters, voltage reference sources and a wow meter.

Actually, of course, the saturation curve is asymptotic to some theoretical maximum. Air coupling plays a part in the final analysis and the quantification is not perfect from a theoretical point of view. As a practical matter, the devices mentioned above have been designed with remarkable degrees of accuracy using this principle.

Most of the materials used for these special applications are in the form of tape-wound ribbon toroids. There is no air gap. Such toroids are readily available with materials such as Deltamax and Orthonik in tapes of one mil thickness. Recently such tapes have been rolled down to ⅛ mil in thickness.

Permalloy, Supermalloy, and similar materials of extremely low coercive force, open up the possibilities of applications where the magnetic structure is required to be sensitive to extremely small magnetizing forces.

Most of the published data on these various materials shows the d.c. hysteresis loop characteristic only. In some cases, a 60-cycle loop, and still more rarely, a 400-cycle loop, is shown. In applications where relatively high frequencies are involved, the d.c. or low-frequency loops are not adequate and the performance at high frequencies may be quite different. In general, the effective coercive force increases and the rectangularity suffers at the higher frequencies. However, there are some materials in which the rectangularity actually improves at high frequencies. The phenomena involved are far from fully understood and a great deal of work is yet to be done in connection with such studies.

This does not mean that these materials are not useful at high frequencies. Some of them have been made to operate in the megacycle region. The high frequency limitations may be considered from a variety of viewpoints. Perhaps the simplest viewpoint is to consider the magnetic domains as having physical mass with the associated phenomena involved in abrupt velocity changes.

In the general trend toward increasingly high frequencies, these materials are not only rolled into almost incredibly thin ribbons, but the inside and outside diameters are commonly reduced to very small dimensions. The problem of designing coil winders that will handle these spools in production is considerable, and no entirely satisfactory machine is yet commercially available.

One of the difficulties in dealing with magnetic materials as control and storage devices is the interaction between windings. The application of a magnetizing force to any winding produces a voltage across every other winding. Every winding presents a load to every other winding. To some extent this type of problem can be minimized through the judicious use of associated rectifiers, but the phenomena, in general, appear to follow the fifth law of thermodynamics (which involves the obstinacy of inanimate objects).

The loading effect of various windings may be used to advantage in the adjusting of magnetic cores for purposes of standardizing their characteristics. For example, in the multi-stable applications the storage in a given core can be materially changed by the application of artificial loads. A suitable winding and associated potentiometer make it possible to vary the characteristics of these structures so that widely varying cores may be made to operate with the same maximum storage. A shorted turn will vary the storage in a given element by as much as several thousand pulse units. Effectively, this is a method of selective absorption of the input energy.

The reason for discussing the application of energy to the multi-stable magnetic elements in terms of volt-seconds rather than ampere-turns is that the back emf developed in the energizing winding tends to maintain the current essentially constant during the flux swing, and this terminology can become quite confusing. In all of the multi-stable applications it is extreme-

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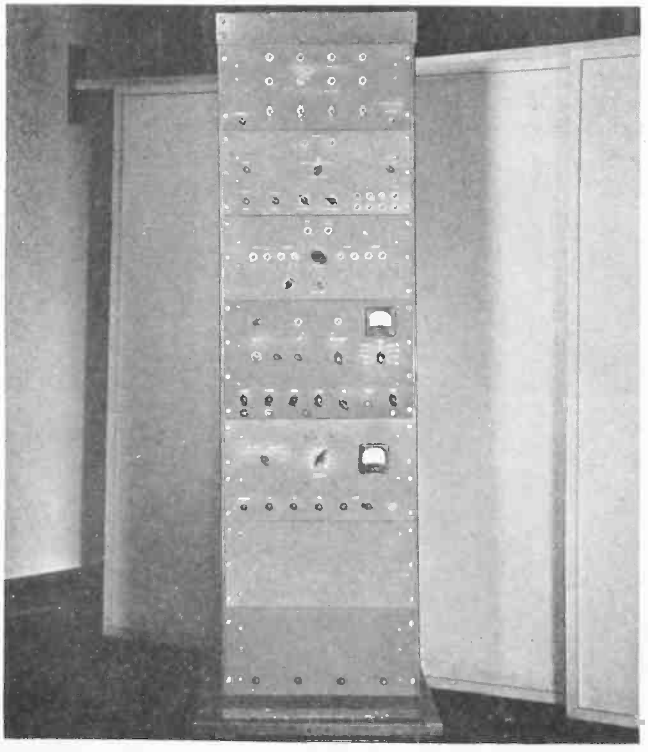
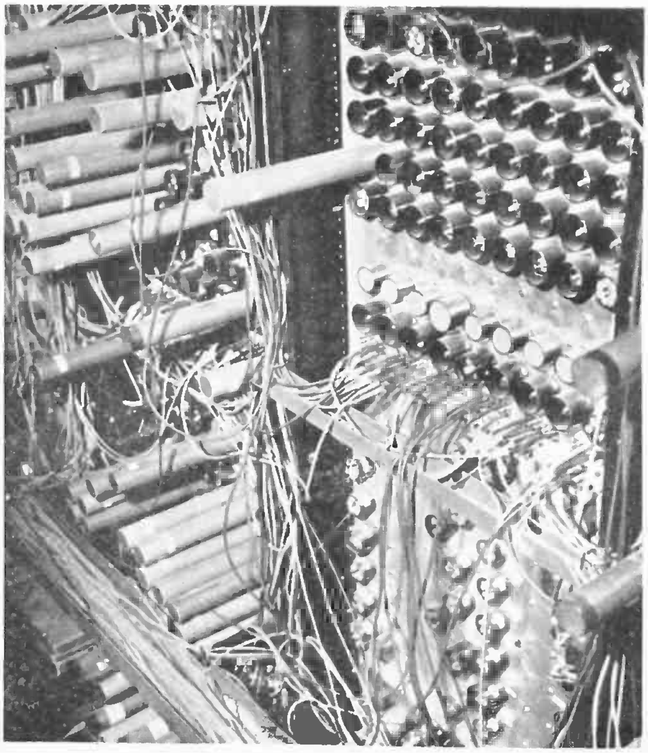
Experimental computing equipment for testing the operation of various magnetic memory devices.



Tube-base-mounted germanium diode clusters used as electronic switches in the NBS SEAC computer.



Demountable vacuum system for checking TV tube phosphors and other design features.

TV PICTURE QUALITY

By
WILFRED B. WHALLEY
Physics Laboratories
Sylvania Electric Products Inc.

Optimizing the various TV receiver design factors for the best possible picture.

THE BASIC problem involved in the design and manufacture of TV receivers is—what is required to obtain the best possible picture? The imagination will immediately indicate the wide area of subjects to be covered in a discussion of this subject, extending from physical placement of the tube through component design to system analysis.

Boundary Conditions

In this discussion, we will assume a normally good picture tube and consider some of those numerous external influences which can make or mar its usefulness. Further, we shall also presuppose that the signal radiated from the antenna of the television transmitter fulfills the optimum conditions of good television studio and transmitter engineering standards with, perhaps, the picture information coming from a high quality 35 mm. film and well-designed "flying spot" generator.

The presentation will include (a) a tabulation of the requirements for optimum picture quality, (b) an analysis of the influences upon picture quality from those components directly associated with the picture tube to the more remote circuit design considerations. Later, some methods of testing which make possible further quantitative analyses of component and circuit behaviour will be included.

The requirements for an optimum picture are:

1. Good resolution
2. Steady synchronization
3. Good contrast and gamma
4. Control of the black or background level
5. Low noise and interference content
6. Picture area stability
7. Reasonable brightness.

The order in which the tabulation is arranged is not necessarily the best since, for example, it is difficult to decide whether picture area stability is less important than steady synchronization, for the eye might see just as objectionable variations in position of elements of the picture due to poor area stability as due to poor synchronization. However, placing "resolution" first makes it possible to start the discussion with the components directly associated with the picture tube, such as the focusing unit and the deflection yoke.

Table 1. Factors influencing resolution. See Appendix for analysis methods.

Good Resolution Influenced by	Analysis Methods
1. Focus unit.	P, V
2. Deflection yoke.	P, V
3. Ion trap magnet.	P, V
4. Correct electron gun voltages.	P, V
5. Freedom from stray a.c. magnetic fields.	Q
6. Amplifier bandwidth.	S, G
7. Amplifier phase stability.	O, Q
8. Interfering signals.	V
9. Propagation paths (influence of multipath).	B, V

Table 1 lists some of the influences upon resolution and has symbols referring to analysis methods which will be explained in the Appendix.

Resolution

Focus Unit

The basic function of the focusing unit is to produce a magnetic lens which will cause the electron beam to converge to a minimum diameter at the fluorescent screen and also inject the electron beam, as nearly as possible, at the physical axis of the deflection yoke. It should also be sufficiently shielded so as to be unaffected by fields from the deflection coil, thereby avoiding changes in focus field with beam angle.

To perform the first requirement, it is necessary that the flux be uniform around the periphery of the gap and that it have the desired distribution of field strength along the axis of the tube.[1]

For best results, it is preferable *not* to use the focusing unit for correction of centering of the television picture when the error in centering is caused by incorrect current waveforms and/or by a residual undesired direct current in the deflection yoke. Moving the focus unit to attempt such correction can accentuate neck shadow troubles caused by poor yoke design. It is, of course,

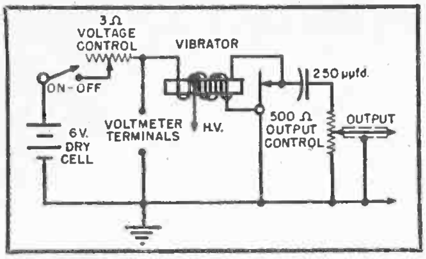


Fig. 1. Pulse noise source unit.

most important to position the focus unit correctly with respect to the end of the electron gun to keep the ripple current in the focus coil below a tolerable value when an electromagnetic type is used, and further to keep undesired a.c. magnetic fields, such as those from the power transformer, at a low level; otherwise, there can be changes in beam diameter with position, on the face of the tube.

Deflection Yoke

The deflection yoke can have a major effect in defocusing the electron beam at the corners of the picture. The distribution of the turns in the windings of the yoke and the contour of the end turns makes the difference between a picture having good resolution at the corners and one having "fuzzy" areas. For optimum results, each design change in a picture tube face radius and cone angle requires a correspondingly selected design and experimentally checked deflection yoke.

Other Considerations

The ion trap magnet should be within a chosen range of flux density and the voltages for the picture tube should be within the rated values. In general, the use of anode voltages near the maximum rating of the picture tube can give smaller beam diameters for a given beam current. It is important to keep the percentage ripple low on all electrode voltages.

Resolution in the picture can be deteriorated by a.c. magnetic fields from power transformers. Any a.c. magnetic field in the neck region of the picture tube affects the path of the electrons and can alternately add to, and subtract from, the strength of the focusing field.

Much data is available on the desired amplitude and phase characteristics of r.f., i.f., and video amplifiers, together with the circuit designs to fulfill these characteristics, so nothing further is added at this time.

Certain types of interference cause a reduction in the effective resolution of the picture. Severe pulse interference can also black out fine detail in areas of the picture.

Multipath interference can cause a severe reduction in resolution, particularly under those conditions where the difference in time between two of the paths is in the order of the time of one small element of the picture.

Incorrectly terminated transmission lines from the antenna to the tuner can also reduce the resolution of the picture, since reflections on a line of a certain physical length can produce cancellation of fine detail. This is one further reason, additional to that of reducing attenuation, for keeping the antenna transmission line as short as is convenient. It is hardly necessary to also point out the importance of the correct design of antenna, and its orientation, for minimizing multipath difficulties.

Synchronization

Experience indicates that steady synchronization is almost as important as good resolution, since unstable pictures are most objectionable to the viewer. Many otherwise well-designed television receivers suffer from poor synchronizing circuits, with the result that they are susceptible to pulse interference and line voltage fluctuations. Table 2 lists the factors influencing synchronization.

Synchronizing Amplifier and Separation Filters

The basic need of a synchronizing amplifier is to separate the synchronizing pulse tips completely from the composite signal, and this must always be done by a circuit which amplifies signals lying above a certain voltage level. This voltage level is somewhat greater than the voltage corresponding to the pedestal or black level of the picture signal.

Also, the synchronizing amplifier should clip or gate the incoming signal so as to hold the noise pulse to an amplitude not exceeding that of the synchronizing pulse. It should also compensate for B supply variations and, of course, provide separation by means of appropriate filters of the horizontal and vertical synchronizing pulses. Separation, to be satisfactory, implies the complete elimination of video or picture information from the synchronizing pulses. Our experiments indicate that the earlier in the sync amplifier circuit this is performed, the better is the operation and the lesser the possibility of amplifying input tuner thermal and fluctuation noise on weak signals. It should not be thought that the number of tubes used in the synchronizing circuit is any criterion of its performance.

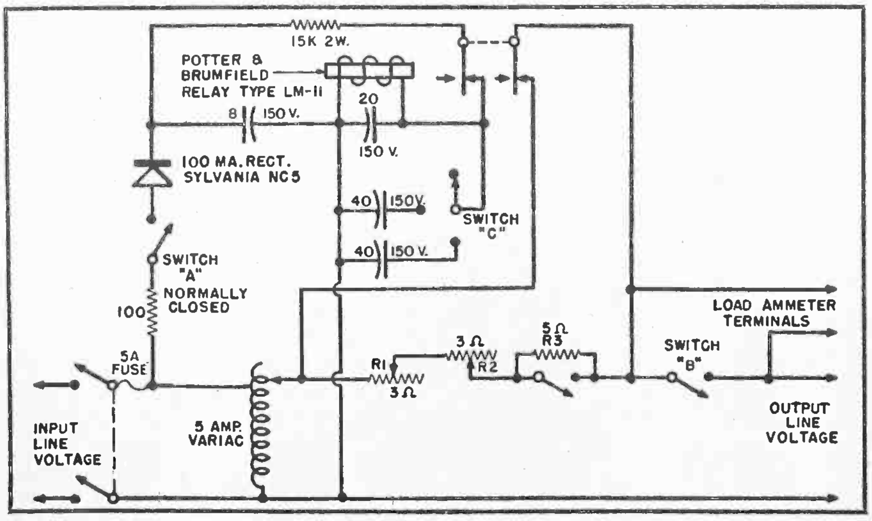
Until recently, there has been some uncertainty as to evaluating the interference immunity of a synchronizing amplifier to interference caused by pulses as from ignition, thermal and fluctuation noise, line voltage fluctuation, radio frequency such as from oscillator radiation, and airplane flutter.

Tests have been devised in our laboratory to give a comparison measurement regarding each of these various forms of interference.

First, suppose that we wish to compare various synchronizing circuits under conditions of pulse interference. To have a true comparison, it is necessary to provide the source of pulse interference *directly* at the antenna terminals, controllable in amplitude, and to avoid injection directly into other parts of the receiver circuits. Fig. 1 shows the arrangement of a simple battery-operated device having a wide range of reproducible pulse amplitudes.

In use, the voltage control is adjusted until the voltmeter indicates 5 volts; this is to provide for aging in the dry cells. The pulse output is set with a calibrated dial on the output control.

Fig. 2. Circuit for determining the effects of voltage fluctuation.



To check for thermal and fluctuation noise, television signals are applied to the receiver through an attenuator and the attenuator adjusted until horizontal scanning shows signs of small area motion in vertical lines of the picture, giving a "shimmering" effect. The amount of attenuation required gives a measure of the effectiveness of different types of synchronizing circuits.

Vertical synchronization is not affected by thermal and fluctuation noise due to the integrating action of the vertical separation filters.

Another unit was constructed to provide controlled line voltage fluctuations at the power input to the receiver, controlled both in amplitude and frequency from 1/3 cycle to 2 cycles. The arrangement of the circuit is shown in Fig. 2. The selenium rectifier, with the electrolytic capacitors, provides control of the switching rate while the resistors R_1, R_2, R_3, make it possible to adjust the percentage change in output a.c. voltage during the switching.

As the percentage change in line voltage increases, a point is reached where one of the circuits loses synchronization, and the relative quality of different sync amplifiers can again be compared on a quantitative basis.

Incidentally, this device is also most useful for area and automatic gain control stability tests of a television receiver, which will be discussed later.

The stability of the synchronizing system under conditions of radio frequency interference is readily checked by inserting a controlled amount of signal from a signal generator while a picture signal of known amplitude is present. It is interesting to observe that, in general, this type of interference causes the least trouble in synchronizing operation, since the horizontal automatic frequency control circuit is very little affected—provided, of course, that the synchronizing amplifier is correctly removing the synchronizing pulses from the picture information portion of the video signal. Finally, it is possible to check the synchronizing amplifier performance under conditions of airplane flutter and other forms of r.f. signal variation by means of what we may call the "signal modulation unit" (Fig. 3).

The television signal from the antenna is simply connected to the television receiver through a plate-coupled pentode which has a chosen modulating signal applied to its cathode. It is also possible to inject a variety of types of signals, including a delayed radio frequency television signal, thereby simulating ghost signals.

Steady Synchronization

Influenced by	Some Analysis Methods
1. Synchronizing amplifier and separation filters.	A, B, F, H, I, N, V
2. Noise pulse reduction through the video amplifier.	N
3. Horizontal automatic frequency control (a.f.c.)	A, B, F, H, I
4. Influence of a.g.c.	A, B, F, H, I
5. Ripple voltage.	N, Q
6. Presence of undesirable a.c. magnetic fields.	Q

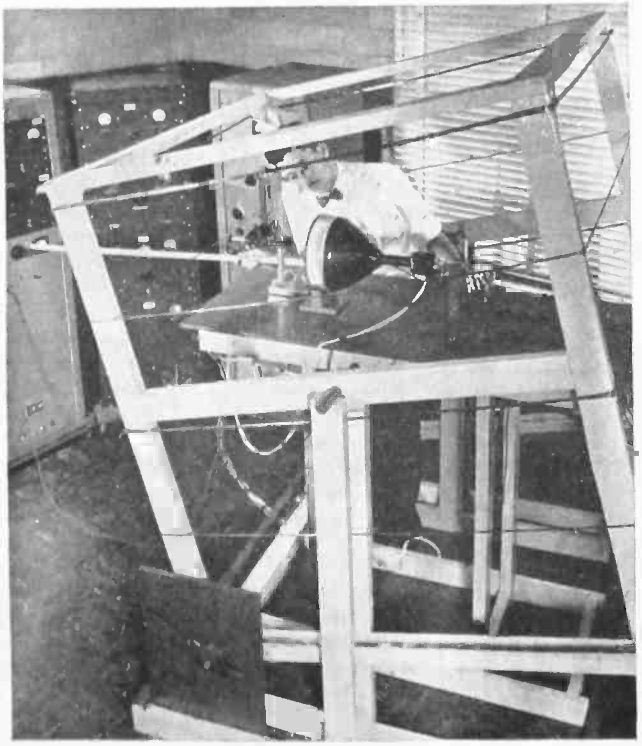
Table 2. Factors influencing synchronization. See Appendix for analysis methods.

Noise Pulse Reduction

In order to reduce interfering noise pulses in the synchronizing signal, as much use should be made of the video amplifier cut-off characteristic as possible. At present, it appears that a video amplifier which is directly coupled to a negatively polarized second detector can best provide reduction in the amplitude of the incoming noise pulses, so that the synchronizing amplifier receives a smaller range of undesired voltages.

Horizontal A.F.C.

Horizontal a.f.c. circuits are used in almost every type of television receiver now manufactured. By using the effect of a large number of incoming synchronizing pulses, we reduce the possibility of displacement of individual lines or "tearing" of the picture due to noise pulses. The a.f.c. circuits of Freedendal,



Aligning beam axially for electron optical experiments.

Checking deflection coils on demountable exhaust system.

Contrast and Gamma Influenced by:	Some Analysis Methods
1. Gain linearity characteristics of video system.	N, V
2. Video amplifier low frequency phase characteristics.	N, V
3. Video amplifier low frequency response.	G
4. Low video frequency response of a.g.c. circuit.	B
5. Ripple voltages.	N, Q
6. Setting of picture tube grid bias.	V

Table 3. Factors influencing contrast and gamma. Analysis methods given in Appendix.

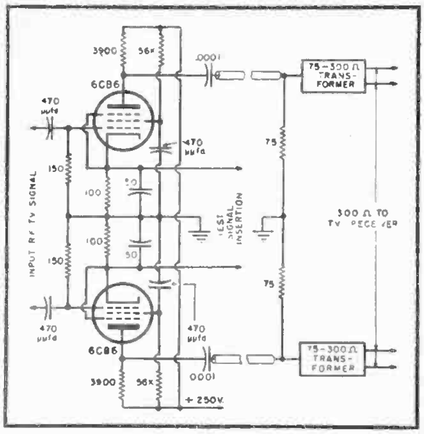


Fig. 3. Modulation unit for artificial flutter and multipath signal simulation.

Schroeder & Torshu of *RCA* are widely used. As in all a.f.c. systems, best operation of the automatic frequency control circuit can only be attained from constant amplitude synchronizing pulses.

Influence of A.G.C.

Further stabilization of synchronization depends upon the performance of the automatic gain control circuit. Good a.g.c. reduces the effect of airplane flutter, line voltage changes, changes in receiver tube gains, and maintains the correct reference pedestal voltage level. All types of horizontal automatic frequency control circuits will give improved synchronizing stability if the synchronizing pulses are held at constant amplitude. The importance of a high quality a.g.c. circuit in this application cannot be minimized. A good circuit will provide compensation for line voltage fluctuations, changes in amplitude of the incoming signal, and will also be unaffected by changes in the scene content of the picture. The "pulse noise source unit," the "line voltage fluctuation unit," and the "signal modulation unit" (Figs. 1, 2, and 3) all provide means of quantitative measurement of automatic gain control circuits. A correctly designed automatic gain control circuit can also tolerate a very high level of interference before the black level and contrast of the picture change.

Ripple and Stray Fields

The importance of low ripple voltages in all of the power supplies and low stray a.c. magnetic fields is so well known that it is not necessary to discuss these in detail.

Contrast and Gamma

Good contrast and gamma have almost as much effect upon picture quality as resolution. Aside from the correct physical placement of the picture tube so that ambient light reflections are minimized, they depend upon the six items listed in Table 3.

Good contrast in the reproduced picture is directly influenced by the linearity of the video amplifier. Tests have indicated that the direct coupled video amplifier, with zero bias operation, provides a definite improvement in the gamma of the picture.

Also, the low frequency amplitude response of direct coupled amplifiers is always superior to that of capacity coupled amplifiers. Hence, there is no low frequency phase shift and negligible possibility of "streaking" or shading of the picture. This also gives increased contrast in both the coarse and fine resolution areas of the picture.

D.c. restorers at the output of an a.c. coupled video amplifier cannot provide as constant a d.c. level control as direct coupling from the video detector, since the restorer depends upon the pulse content of the video signal, whereas a direct coupled video system operates from the rectified envelope of the i.f. signal.

Finally, with all of the other circuits operating correctly, there is the need for adjusting the picture tube bias voltage by what is usually called the brightness control.

Control of Black Level

It is quite objectionable to see the background brightness of a picture varying with the scene, giving such effects as return lines showing when the picture is faded out at the studio, or too dark a background when the scene becomes brighter.

Many types of receivers still suffer from fluctuations in black level. Elimination of the vertical return lines by adding pulses from the vertical deflection amplifier to the cathode or grid of the picture tube is a poor make-shift, since it does not eliminate the horizontal retrace lines under the same adverse conditions.

Automatic *volume* control circuits, that is, circuits which operate on the *average* value of the video signal in the same way as the a.v.c. circuits of a broadcast sound receiver, can cause wide changes in black level at the picture tube as the scene brightness changes. Such circuits also cause the output of the video amplifier to change as a function of pulse interference level, causing fade-out of the picture. It now appears that amplifier direct coupling from the second detector to the picture tube, combined with an a.g.c. amplifier operating on the peaks of the pedestal voltage, is the best method of stabilizing the black level of the picture.

Noise and Interference

The importance of directive antennas for reducing multiple images in multipath signal areas and of both the antenna gain and directivity for reducing the effect of r.f. amplifier tube fluctua-

(*Continued on page* 29)

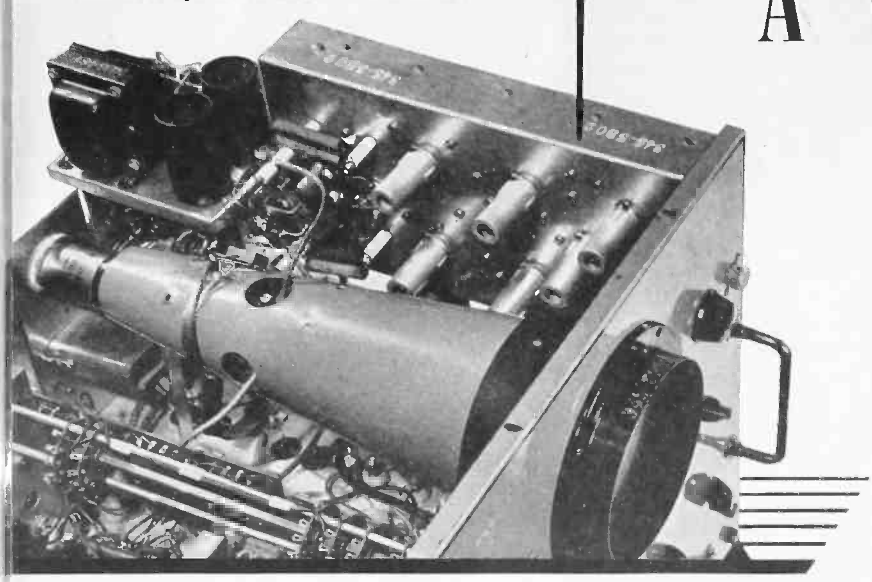
Background Level Influenced by:	Some Analysis Methods
1. D.c. restorers.	A, B, F, I, N, V
2. Direct coupled video amplifiers.	N, V
3. A.g.c. characteristics.	A, B, F, I, V

Table 4. Some factors influencing background level. Analysis methods given in Appendix.

Table 5. Factors influencing noise and interference. Analysis methods given in Appendix.

Noise and Interference Influenced by:	Some Analysis Methods
1. Antenna design and adjustment.	N, V
2. Tuner design.	C, G, S
3. Adjacent channel selectivity of television receiver i.f. amplifiers.	G, S, V
4. Noise pulse characteristics of the video amplifier.	I, N, V
5. Recovery rate of video system from noise pulses.	I, N, V and Calculation

The video amplifier mounted inside the cabinet of a Sylvania Model P5 Synchroscope.



A WIDE-BAND VIDEO AMPLIFIER

By
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and
ROBERT L. MASSARD

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Massachusetts Institute of Technology

Design features of a 5-stage amplifier having linear phase response and a frequency response flat to within ± 1 db from 25 cycles to 20 mc.

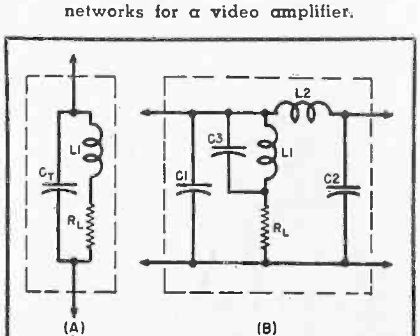
TROUBLE SHOOTING and routine maintenance checks on the MIT digital computer, Whirlwind I, require precise observation of waveforms with a synchroscope. Early in the design and testing of the various computer elements, however, difficulties were encountered from stray capacitance and inductance in the cable connecting the synchroscope to the circuit under test. The video probe described in the January, 1952 issue of RADIO-ELECTRONIC ENGINEERING was constructed to overcome this problem, but reduction of signal amplitude by the probe meant that a video amplifier had to be used. Since high-frequency pulses and low-frequency gates were to be observed and since none of the commercial synchroscopes at the laboratory had amplifiers with sufficiently wide band-pass characteristics, it was necessary to draw up design considerations for a new amplifier.

Performance requirements were outlined before work was started on the design. It was decided that the amplifier must have:

1. A flat frequency response so that a 500-μsec gate with a rise time of 0.2 μsec would be amplified with negligible distortion.
2. A large voltage output (120 to 180 peak-to-peak volts) which would correspond to 2 or 3 inches in scope deflection.
3. Small distortion due to tube non-linearities.
4. Linear phase-shift characteristic (phase shift directly proportional to frequency).
5. A gain of 150 to 250 so that, even with a probe gain of ⅓, 0.2-volt signals could be observed easily with a synchroscope.
6. Low power consumption.
7. Small physical size.
8. Small input capacitance.

The completed design called for five stages, a single-ended input followed by a push-pull phase inverter and three push-pull amplifier sections (see Fig. 3). It was found that power consumption could be cut down by using push-pull rather than single-ended amplifier sections, as the former have the advantage of eliminating even-harmonic distortion. Thus, for the same over-all distortion in the five stages, small tubes driven harder in push-pull in the three amplifier sections, which are concerned with large signals, may be used to better advantage than large tubes in single-ended stages. The push-pull output also tends to eliminate beam astigmatism in the cathode-ray tube to which the amplifier is attached.

Fig. 1. Two standard peaking networks for a video amplifier.



Comparisons of tube types were made by special tests; only pentodes or beam power tubes were considered. A sample tube of a particular type was biased at a given point for Class A operation, and the plate and screen voltages varied until design ratings were reached. (These were 90% of absolute maximum ratings.) A transfer characteristic was plotted with these plate and screen voltages. The tube was then biased at another point, the corresponding plate and screen voltages determined, and another transfer curve obtained. (See Fig. 2A.)

Similarly, for each tube type a set of characteristics was plotted, each curve representing the plate current available for a given grid voltage when plate and screen-grid voltages had each been adjusted for maximum dissipation at the quiescent operating point. The harmonic distortion (mainly second) was then calculated for each curve. When a signal of such size as to drive the grid to zero volts was assumed, one value of transconductance (g_m) for each curve was found from the calculated fundamental output, and a curve could then be plotted of g_m versus quiescent operating points (Fig. 2B). Consequently, the figures-of-merit of tubes could be compared at the same distortion and with the tubes operating at maximum dissipations. The figure-of-merit may be defined as the gain-bandwidth product of a tube: the gain of one stage is $g_m R_L$, and the bandwidth f_2 is $1/2\pi R_L C_T$; thus the product is

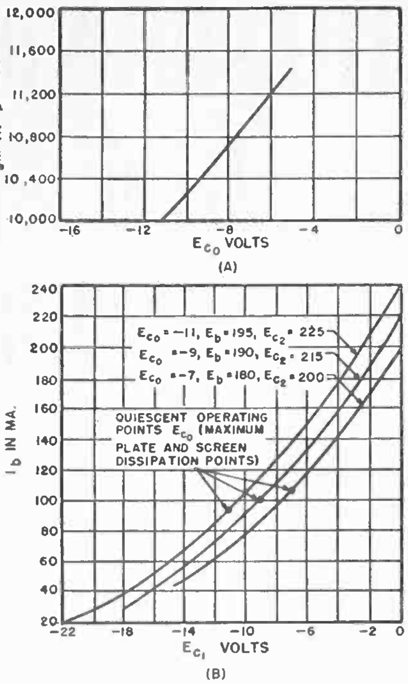


Fig. 2. (A) Average g_m for transfer curves vs. quiescent grid bias. (B) Transfer characteristics having maximum screen and plate dissipations at quiescent grid bias.

$g_m/2\pi\ (C_{IN} + C_{OUT})$. When the capacitances are separated in a four-terminal network, the figure-of-merit is then defined as $g_m/2\pi C_L$. In the above equations, C_{IN} is the total tube input capacitance, C_{OUT} is the total tube output capacitance, and C_L is the larger of C_{IN} and C_{OUT}. One type of each network is illustrated in Fig. 1.

Tube types considered were: 6AC7, 6AG5, 6AG7, 6AH6, 6AJ5, 6AK5, 6AN5, 6AU6, 807, 815, 829-B, 832-A, and 715-C. The 6AH6 was found to have a much higher high-frequency figure-of-merit than the 6AC7; and the 6AN5 was chosen instead of the 6AG7 because it gave the same output current for lower d.c. plate and screen inputs.

In all cases, comparisons between tube types by means of figures-of-merit from either the two-terminal or four-terminal network resulted in the same tubes being selected. Final decisions on tubes were made only after considering the voltage output needed per stage; types selected were 6AH6, 6AN5, and 829-B.

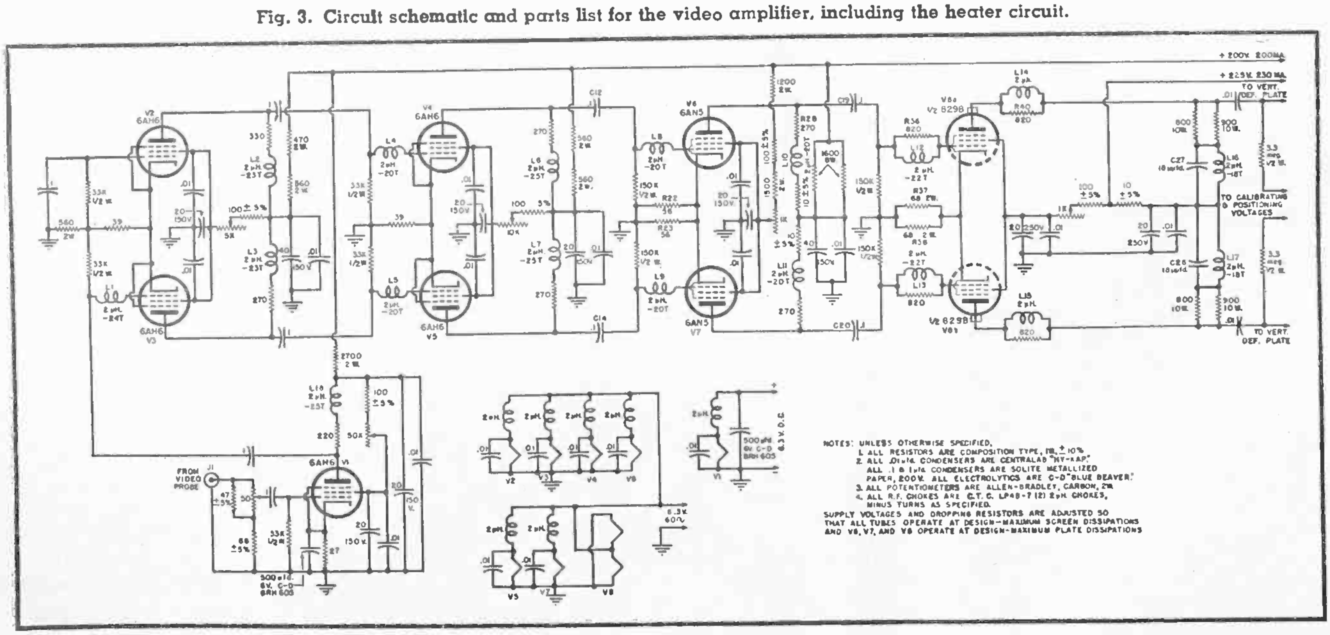
It is well known that the highest over-all gain-bandwidth product for a given set of tubes is obtained when all of the individual-stage bandwidths are the same; however, in the case at hand, signal-voltage level and tube-dissipation considerations modified the picture. It was found that for the same gain, the bandwidth of a particular stage with no peaking might be increased (without over-compensating) by a factor of 1.7 with shunt peaking alone, and by a factor of 2.0 with shunt and series peaking. (The theoretical values, according to F. E. Terman, are 2.0 and 4.0 respectively, provided that the total capacitances are equally divided in the latter case.) Increasing the bandwidth by a certain factor, however, decreases the gain by a much greater factor: (1) the load resistance is decreased; thus the grid bias and drive for each stage must be increased in order to get the same final output voltage. As a result, the tubes are operated at a point of lower g_m than usual. (2) The bandwidth of the output stage, in order to keep the specified output voltage, cannot be increased enough to make the bandwidths of all stages the same; consequently, the bandwidth of the first stages must be increased by a very large factor in order that the over-all bandwidth be as great as needed. Normally the gain would decrease directly as the bandwidth is increased, but due to the complications of large output voltages, a somewhat larger loss in gain must be tolerated for this increased passband.

In order to design an amplifier with a specified over-all bandwidth, we had to assume a somewhat greater bandwidth for the peaked output stage. This assumed bandwidth (f'_2) was equal to the peaking factor (in this case, 1.8) times $1/2R_L C_T$, where R_L is the output load resistor and C_T the total output-stage shunt capacitance. Since C_T was known, R_L could be calculated by finding the unpeaked output-stage bandwidth (f_2) in $f_2 = f'_2/1.8$ and substituting the values in $R_L = 1/2\pi f_2 C_T$. A typical example will illustrate the procedure:

Desired over-all bandwidth = 25 mc.
Assumed peaked output-stage bandwidth (f'_2) = 28 mc.
Total shunt capacitance (C_T) = 22 μμfd.
Unpeaked output-stage bandwidth (f_2) $= f'_2/1.8 = 15.5$ mc.;
$R_L = 1/2\pi f_2 C_T = 465$ ohms.
$f'_2 = 1.8/2\pi R_L C_O = 28$ mc.

To find the maximum output voltage of the amplifier, the desired output voltage for each side of the output stage was used; by assuming a quiescent grid bias, the gain from the corresponding g_m was determined. The maximum output voltage obtainable without driving the grid positive was then calculated from the gain and the quiescent grid bias. If the result did not correspond to the desired output voltage, another quiescent grid bias was assumed and the cycle repeated until the maximum output voltage was that specified. For example, an 80-volt output (peak-to-peak) is desired. Two points from the plot of g_m versus grid bias for max-

Fig. 3. Circuit schematic and parts list for the video amplifier, including the heater circuit.



imum dissipations (see Fig. 2A for a typical plot) for the tube under consideration might be:

−7.5 volts———11,000 μmhos;

−9.0 volts———10,000 μmhos.

It should be noted that the biases considered must be such that, even with maximum input signal, the tube (push-pull or single-ended) operates linearly (as defined in the above discussion on tubes). If we assume the first bias (−7.5), then the peak-to-peak input can be about $2 \times 7 = 14$ volts. The gain $= (g_m R_L) = E_{out}/E_{in} = 80/14 = 5.7$. The g_m required in this case $= 5.7/R_L = 5.7/470 = 12{,}000$ μmhos. However, the given g_m for −7.5 volts bias is 11,000 μmhos; therefore, we assume the second bias (−9.0). Without overdrive, the peak-to-peak input can be $2 \times 8.5 = 17.0$ volts; and, since the gain now is $80/17 = 4.7$, the g_m required is $4.7/470 = 10{,}000$ μmhos, which is that g_m given for −9.0 volts bias. If we then substitute values in $E_{out} = E_{in} \times (g_m R_L)$, we find that E_{out} is equal to the desired peak-to-peak output voltage:

$$E_{out} = (2 \times 8.5) \times (10^4 \times 10^{-6}) \times 470 = 80 \text{ volts.}$$

The best phase-inverting circuit of those investigated was found to be the grounded-grid cathode-coupled type. The only disadvantage is that, since it is basically a cathode-follower circuit, it may oscillate. The advantages are: (1) very nearly equal outputs may be obtained with equal load resistors, and (2) each side has a plate output circuit, and thus both have the same impedance levels and may be peaked to give equal delays.

The actual capacitances in the amplifier were measured by means of a clip-on coil and a grid-dip meter. The series peaking choke (described later) was placed so that the total capacitances to ground from each end of the choke (including hot-tube capacitances) were about equal. From the values of these capacitances and the load resistance of the particular stage under test, the bandwidth and the sizes of the peaking elements were calculated.

The total capacitance for each stage was estimated as: $C_{out} + C_{in} + C_W$; the wiring capacitance C_W was assumed to be between 9 and 10 μμfd., which is possible by careful wiring, mounting, and parts layout. In some cases, the excessive size of load resistors, especially in the output stage, leads to difficulties in mounting and a very detrimental amount of wiring capacitance. Spurious oscillations were suppressed by means of small series resistors or chokes, and/or good bypass condensers. The series peaking chokes themselves were often sufficient. All electrolytic bypass condensers were paralleled by small mica-type capacitors placed as close to the tube sockets as possible;

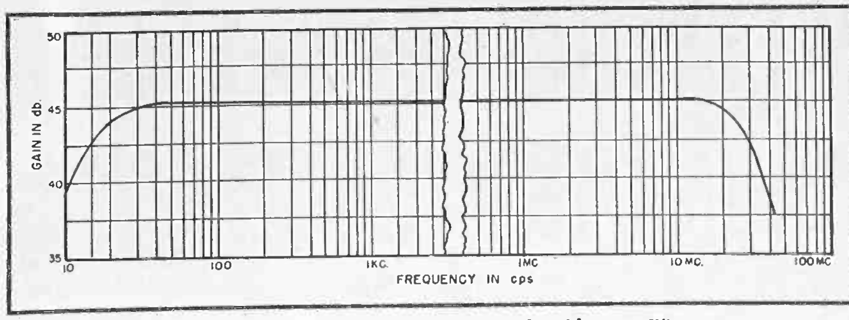


Fig. 4. Over-all frequency response of the video amplifier.

heater wiring included series chokes and shunt condensers, shown separately in Fig. 1. Direct current is used for the heater voltage of V_1 to eliminate excessive hum.

Amplifier Specifications

Circuits (see Fig. 3)
- 1st stage—input amplifier (6AH6)
- 2nd stage—push-pull phase inverter (2-6AH6's)
- 3rd stage—push-pull amplifier (2-6AH6's)
- 4th stage—push-pull driver amplifier (2-6AN5's)
- 5th stage—push-pull final amplifier (829-B)

Frequency response (see Fig. 4)
- ±1 db: 25 cps to 20 mc.
- −3 db points: 17 cps and 28 mc.

Transient and test response
- Amplifier rise time (from 10 to 90%) 0.013 μsec.
- Maximum square-wave droop: 5% in 600 μsec.
- Half-sine-wave pulse 0.07 μsec long decreased in amplitude 5%.

Input (see Fig. 5)
- Input-signal amplitude approximately 0.05 peak-to-peak volt minimum (depending on vertical sensitivity of scope tube); approximately 0.6 peak-to-peak volt maximum (depending on linearity requirements).

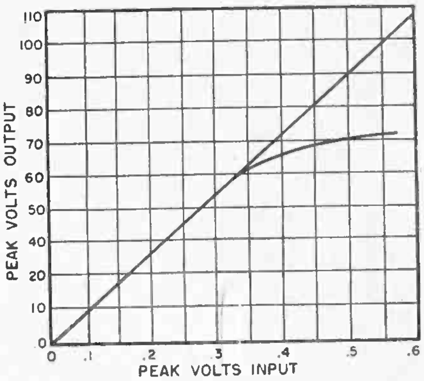
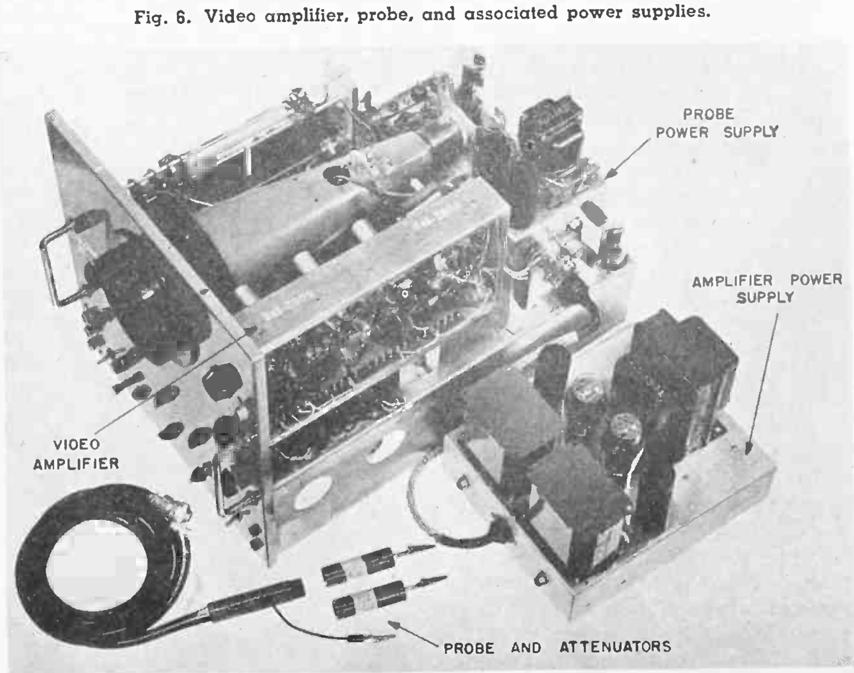


Fig. 5. Linearity curve of amplifier.

Input circuit (see Fig. 3)
- 33,000 ohms shunted by 17-μμfd. 200-volt condenser. Probe cable is terminated by a 25-ohm gain-control potentiometer in series with a 68-ohm resistor.

(*Continued on page* 28)

Fig. 6. Video amplifier, probe, and associated power supplies.



WELDING and SOLDERING ALUMINUM

By
SAMUEL FREEDMAN
Chemalloy Associates Laboratories

Corrosive fluxes and special cleaning are unnecessary when this newly-developed material, called Chemalloy, is used.

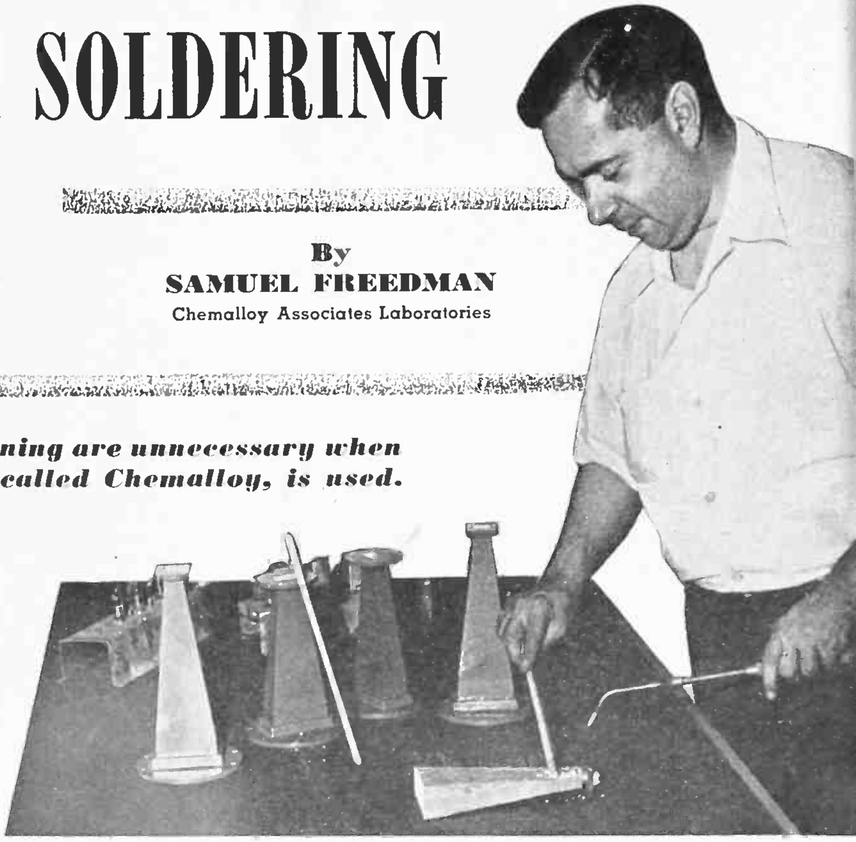


Fig. 1. The author is shown fabricating a wave guide transition by welding together four pieces of aluminum by means of Chemalloy.

ALUMINUM IS one of the most difficult metals to weld and solder, yet its use in many kinds of radio, electronic and nucleonic apparatus keeps increasing. It is used in aviation, guided missiles, walkie-talkie equipment or for hand-carried apparatus, and is heavily used in the radio-electronic art today for such items as cabinets, chassis, panels, frameworks, shields, compartmentation, antennas, wave guide flanges, pressurized housings or where rust cannot be permitted to develop.

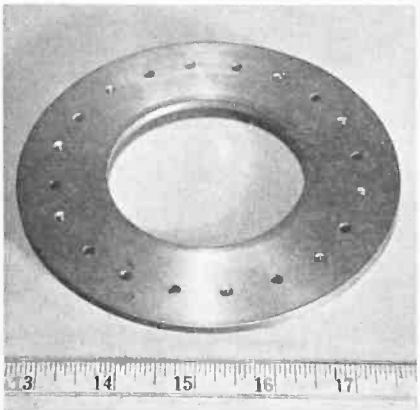
One serious problem in working with aluminum is the fact that it melts at 1217°F. More serious than this is the fact that a surface film or oxide exists on the surface of aluminum when it is exposed to air. It is this surface film that keeps aluminum bright and attractive, as well as free from corrosion. However, no weld or solder will hold if this film is not removed or cracked up so that metal fusion can take place between the parent metal and the welding/soldering metal. This film, or surface oxide, will not disintegrate at welding or soldering temperatures sufficiently below the disintegration temperature of aluminum. It will not melt away or dissolve merely by the application of heat to still intact aluminum.

This has, therefore, necessitated the use of corrosive forms of flux, sufficiently potent to dissolve the surface oxide and expose the bare parent metal, before attempting to weld or solder. However, all aluminum welding fluxes contain chlorides and fluorides. If left on or in the aluminum, these will attack the base metal later when exposed to moisture. Many plants fabricating aluminum wave guides find it very necessary to super-clean the aluminum in advance of welding or soldering. Furthermore, it is necessary to reclean the same aluminum if it is exposed to air more than a few minutes, since the oxides reform quickly and recreate the difficulties all over again. This has been particularly true in fabricating directional couplers out of aluminum wave guide tubing.

The foregoing problems of soldering and welding aluminum have been overcome with the use of a new metal alloy called *Chemalloy*. It permits welding or soldering of aluminum merely by heating the parent metal to about 800°F. or any temperature sufficient to melt the welding rod on contact with the aluminum.

Chemalloy welding metal is produced by combining and making very homogeneous zinc, bronze-copper-brass, aluminum, slag, and several chemicals.

Fig. 2. A machined piece of Chemalloy which has withstood 14 years exposure.



Some versions also contain lead, tin, silver and nickel. The metal has developed unusual properties because of the ability of its discoverers to combine molten metals with wet chemicals free of serious explosive hazards. This is particularly noteworthy since muriatic acid or hydrochloric acid is a principal chemical ingredient in addition to dry chemicals mixed with it.

The process is so effective in removing impurities from the ingredient metals and in causing them to fingerlock or homogenize, that it has also been possible to work with lower grade or scrap metals to assure good availability during periods of critical shortages. The impurities come off readily as surface slag which may be skimmed from the top of the crucible mix.

The metal is so finely grained and of such quality that a solid rod of it can be machined with ease. The metal surface machines down to a brilliant finish as attractive as one that is plated. The metal has also been recently used for dry bearings without lubricants and as a bearing lubricated by water immersion. When exposed to moisture in any form, it recognizes the moisture or liquid as a protective lubricating film, rather than a corroding agent. When it is exposed to salt water or sprays, any superfluous action which forms on the surface after an extended period of time and abuse will be found not

...WITH CONFIDENCE

Sylvania proudly presents 2 Zero Focus Voltage Picture Tubes

Paring anything off television set costs is a tough problem for today's designers. Sure, there are ways . . . and ways, but naturally you have a fine reputation to maintain. You want *confidence* as well as cost cutting.

And, that's just what Sylvania offers you. Now we proudly present 2 Zero Focus Voltage Electrostatic Picture Tubes . . . quality tested to assure finest possible performance, PLUS real design savings.

Types 17RP4 and 21FP4

These new Sylvania tubes are electrostatic focus, magnetic deflection, all-glass direct-view picture tubes.

Outstanding Savings result from the elimination not only of focus coils and fixed magnets, but also potentiometers and condensers to adjust focus voltage.

Special features of these new tubes include: (1) a neutral filter face plate which greatly improves picture contrast; (2) the ion trap gun which focuses at zero voltage; (3) an external conductive coating that acts as a filter condenser.

Critical Materials are Saved, too. The elimination of magnets and other components conserves your allotments of cobalt, nickel, and copper . . . prevents plant tie-ups and costly delays. Complete data sheets for both these tubes are now available. For your free copies address: Sylvania Electric Products Inc., Dept. R-2602, Emporium, Pa.

SYLVANIA

RADIO TUBES; TELEVISION PICTURE TUBES; ELECTRONIC PRODUCTS; ELECTRONIC TEST EQUIPMENT; FLUORESCENT TUBES, FIXTURES, SIGN TUBING, WIRING DEVICES; LIGHT BULBS; PHOTOLAMPS; TELEVISION SETS

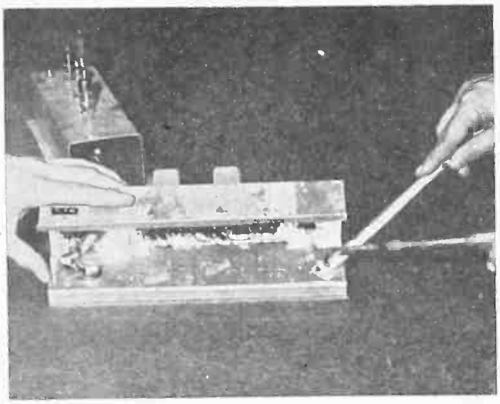


Fig. 3. Attaching Chemalloy solder to aluminum surface of a 452 megacycle fail-safe radio receiver unit. Soft solder can then be applied to Chemalloy.

to have penetrated below the metal surface.

Chemalloy welding rod or solder requires no flux or special cleaning or preparation of metal in advance of welding or soldering. Neither does it require any special treatment or handling afterwards. The difference between welding and soldering is merely that of degree of temperature used.

Chemalloy penetrates through surface films or oxides as if they were absent, and will crawl inside of the softened aluminum or parent metal when temperatures exceeding 1000°F. are used. In addition to aluminum, it will also work with any zinc-base metal, such as material from which automobile radiators, carburetors, fuel pumps, etc., are made. The Chemalloy rod itself should not be heated or melted by the flame directly. It should melt and flow as the result of direct contact with the heated aluminum. It is applied in strokes or by rubbing on the aluminum. This is necessary in order to disturb the surface oxide so that Chemalloy can reach the parent metal.

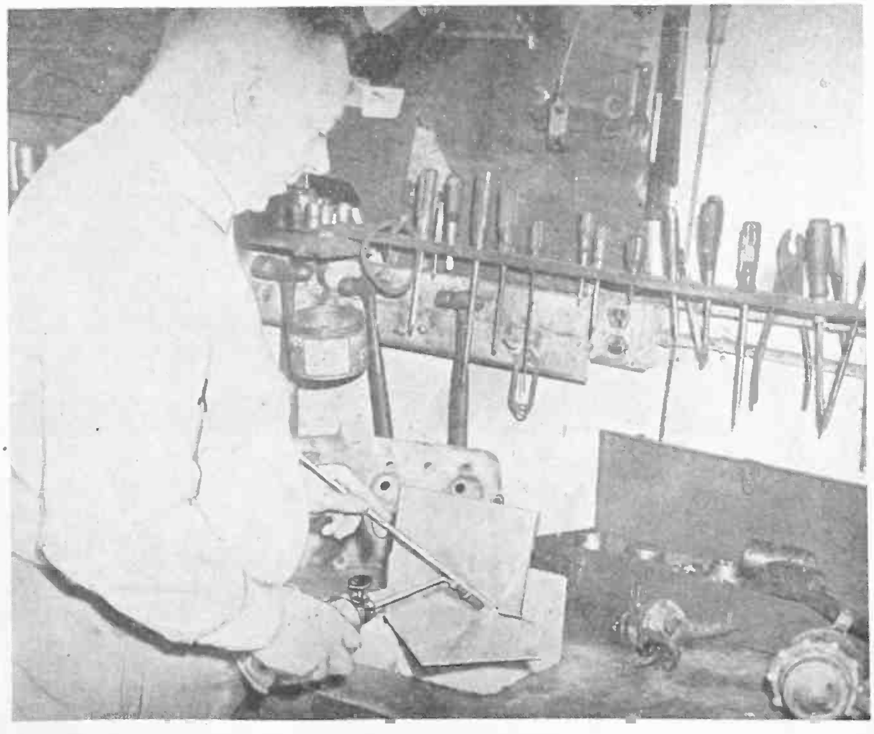
Fig. 4 shows a difficult weld where one sheet of aluminum stands on edge against the full surface of another sheet. Despite such a small bearing surface and the use of a small propane gas torch as illustrated, the weld is sufficiently strong so that the aluminum normally breaks in trying to part it. This is because Chemalloy is stronger than aluminum, having a tensile strength of as much as 40,000 lbs. per-square-inch, or more. This can be varied up or down by ingredients used. The same applies to ductility or brittleness.

Fig. 3 shows Chemalloy being applied to aluminum with a small Prestolite torch. In this illustration, the aluminum is very thin in gauge whereas the Chemalloy rod is a thick size.

The work may be cooled and handled immediately by cooling or quenching in water, although this will tend to darken the weld. The most attractive silvery weld and the greatest strength of weld will exist when it is permitted to cool naturally and gradually instead of abruptly.

Fig. 2 shows this metal made up as a machined ring. This particular piece was produced in 1937 and still remains in good condition except for some darkening of the surface. Several batches were made prewar before it was further improved and commercially made available in January, 1951.

Fig. 4. Welding two sheets of aluminum on edge by means of Chemalloy.



The equipment needed to weld or solder with Chemalloy is merely any source of heat sufficient to develop about 800°F. at the point of weld. A higher temperature short of the disintegration or buckling point of aluminum will assure an even stronger weld and form a blister. The blister means the the welding material has crawled well inside of the aluminum. Such a weld will be stronger than the aluminum.

In a test made at the *Inland Testing Laboratory*, subsidiary of the *Cook Research Laboratories* and *Cook Electric Company* of Chicago, Chemalloy was reported excellent for lap, butt and fillet joints, and for adhesive and tinning qualities. Tests in this report covered four grades of aluminum including 2S, 3S, 24ST and 52S.

Chemalloy cannot be extruded as wire, but has to be manufactured as cast rod. Cast rod is normally superior since it is free of stress or strain in its forming. A common size suffices for most applications since it flows freely.

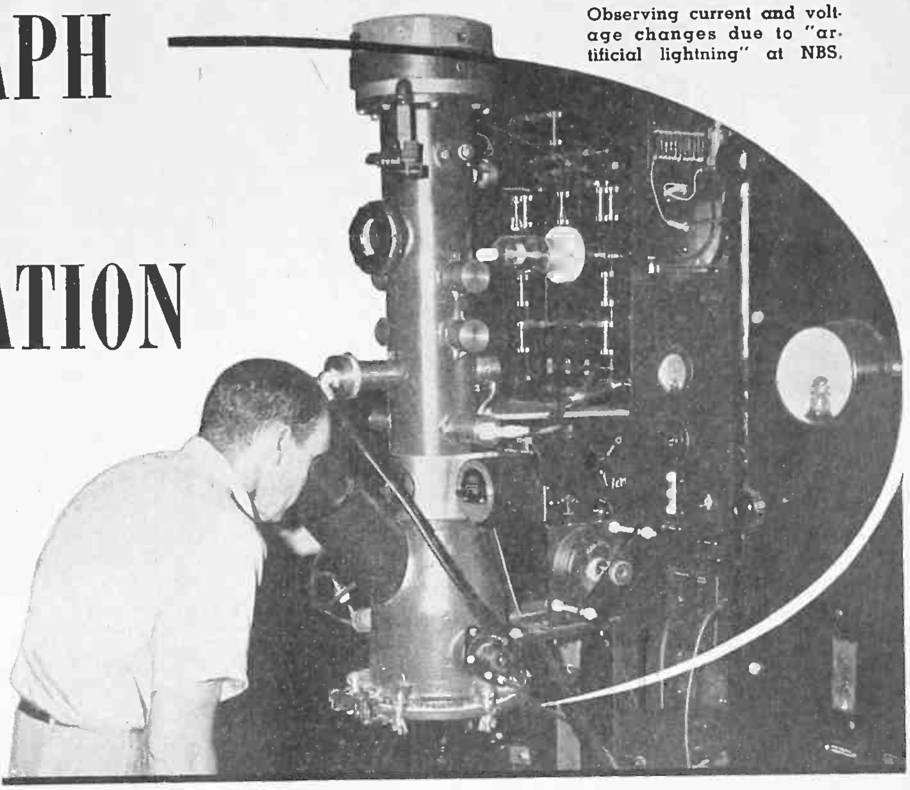
Fig. 1 is an outstanding example of the use of Chemalloy to fabricate an aluminum wave guide transition out of four pieces of aluminum and flange. It has been even simpler to use Chemalloy to solder or weld two wave guide sections in position for fabricating a directional coupler. Such work has previously been unheard of except with professional equipment and high competence in this specialized welding field by the welding person. It has been a task that the average radio-electronic technician or engineer felt incompetent to undertake with previously available materials, techniques and equipment.

Soft solder will adhere to Chemalloy so that wires may be electrically connected to aluminum. In practice, the soft solder can be applied even without a soldering iron since the heat from the Chemalloy weld will last long enough to melt radio solder in contact with the Chemalloy. A wire attached to the solder will then hold with a force greater than the breaking strength of the wire itself.

In conclusion, it now can be said that aluminum welding and/or soldering has been simplified to merely heating the aluminum and rubbing Chemalloy rod on it.

The author wishes to thank *Chemalloy Associates* of Santee, California, for use of illustrations and for permission to photograph previously confidential details of the Chemalloy process and applications. The material itself is available direct from this company.

OSCILLOGRAPH BEAM INTENSIFICATION



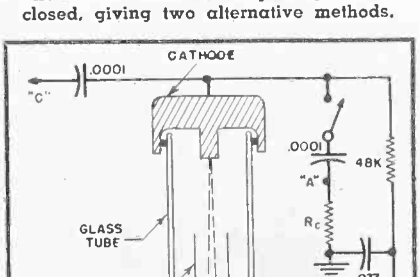
Observing current and voltage changes due to "artificial lightning" at NBS.

Writing speeds as high as 9100 inches per microsecond are possible with new techniques developed at NBS.

A NEW TECHNIQUE developed by J. H. Park of the National Bureau of Standards increases the "writing speed" of a high-voltage oscillograph to three-fourths the velocity of light. High intensification of the electron beam is obtained momentarily by superposing a steeply rising voltage pulse on the steady voltage applied to the discharge tube of the oscillograph.* The resultant increase in the intensity of the trace makes writing speeds up to 9100 inches per microsecond easily visible. These high writing speeds can be used to study rapidly varying electrical surges, such as are caused by lightning discharges, and to learn more about the insulation breakdown the surges produce.

Insulation breakdown due to lightning discharge is a frequent cause of power outages and failure of electrical equipment. Thus, for development of insulation designs, as well as for routine tests on high-voltage components, most manufacturers of high-voltage equipment now maintain surge generators which enable them to produce in the laboratory electrical surges having the same voltage and current magnitudes as those occurring on transmission lines as a result of natural lightning. During a thunderstorm, an electrical system may experience surges rising to a million volts or a hundred thousand amperes in less than one millionth of a second. For measurement of such rapid changes in current or voltage when they are artificially produced, special high-voltage cathode-ray oscillographs are used in which a cold-cathode discharge tube is the source of the electron beam. Part of the beam passes through a small hole in the center of the anode of the discharge tube into the main chamber of the oscillograph. Here the electrons pass through a beam trap, focusing coils, deflecting and sweep plates, and finally strike a photographic film or fluorescent screen. A pulse of increasing voltage applied to the sweep plates moves the electron beam horizontally across the film, providing a time axis. The voltage pulse to be studied, after being reduced in magnitude by a suitable divider, is applied to the deflection plates and causes deflection of the beam perpendicular to the time axis. This deflection, in combination with the sweep, leaves a trace on the film which, in effect, is a plot of voltage against time for a particular surge. A corresponding plot of current against time can be obtained by using a shunt in place of the divider. In order to have a readable photographic record of the steeply rising front of the surge, it is necessary to use a very high-intensity electron beam for recording fast phenomena. Several methods have been used to increase the beam intensity, and thus the writing speed, of this type of oscillograph. For example, some workers have used prefocusing coils around the discharge tube, others have reshaped the electrodes or employed different gases in the discharge tube. None of these methods, however, has been entirely successful, and until now the normal writing speed of the instrument has been only about 200 in./μsec.

Circuits used to increase writing speed of high-voltage cold-cathode oscillograph. The switch above "A" may be opened or closed, giving two alternative methods.



As part of a general program of basic instrumentation sponsored at NBS by the Office of Naval Research, the Office of Air Research, and the Atomic Energy Commission, the Bureau undertook to develop a more effective technique for intensifying the beam. The resulting method increases the beam intensity by as much as 50 times the steady value.

In the NBS method, a momentary pulse having a peak value of about 2000 volts is superposed on the steady d.c. voltage of 50 kv. normally applied to the discharge tube. The pulse should be of short duration, down to 5 μsec., and it must produce a sudden increase in the voltage across the tube in 0.5 μsec. or less. This sudden change in

(*Continued on page 26*)

NEW TUBES

PROMOTION CAMPAIGN

The *Radio Corporation of America* Tube Department has started a promotion campaign designed to accentuate the names and services of *RCA* tube distributors in the minds of their broadcast and industrial customers.

A wide variety of utility items is being distributed, consisting of a three-year wall calendar, electric office or studio clock, automatic pencil, wall chart on tube care, the 1952 *RCA* Reference Book, and a tie or money clip fashioned in the form of an *RCA* image orthicon television camera tube.

In addition to these sales aids, *RCA* is making available to its distributors a two-color, business-reply postal card, designed to increase distribution of three *RCA* industrial tube catalogues, and utilize a "Forget-me-not" theme.

THYRATRON TUBE

Developed by the *Sheldon Electric Company*, Irvington, New Jersey, the MT-1530 mercury thyratron tube is capable of handling extremely high d.c. voltages and current. It is a grid control tube, referred to as a "cut-off" or "trigger" tube. Its peak anode voltage is 15,000 v. forward or inverse, and it can be built either as a negative or positive control tube.

Carrying a 1,000 hour guarantee, and capable of withstanding vibrations nor-

mally encountered in industrial and commercial applications, the tube can be moved without fear of damage. It has a completely shielded cathode structure with a grid at the base of the upper half of the mercury-filled tube.

Further information on the MT-1530 may be obtained direct from the *Sheldon Electric Company*, Irvington, New Jersey.

RCA TUBES

Vidicon

This developmental industrial television tube is designed to provide observation in locations which are inaccessible or dangerous to humans. The camera tube utilizes a new light-sensitive material that has a spectral response such that colors of objects televised in black and white are portrayed in approximately their true tonal gradation.

One inch in diameter and six inches long, the Vidicon has a greater life span than its predecessor, wider operating temperature range, and better spectral response. According to Dr. B. H. Vine, *RCA* Tube Department engineer, it is expected to become available sometime this year.

Kinescope

The 17TP4 kinescope is a metal-shell picture tube utilizing a low-voltage electrostatic focus, eliminating the need for a focusing coil or magnet and making possible the attenuation of voltage for the focusing electrode from the d.c. supply of the receiver.

Because of the focusing electrode in

the tube operating at low voltage, the focusing voltage can be obtained from a fixed or adjustable tap on the receiver's low-voltage d.c. supply. The focusing electrode has its own base-pin terminal to permit choice of focusing for best results.

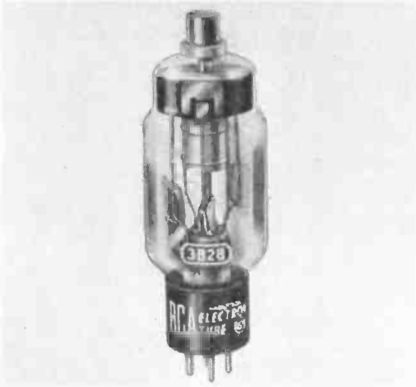
This direct-view kinescope utilizes magnetic deflection and an ion-trap gun which requires an external single-field magnet, and furnishes a picture 14⅝" x 11" with slightly curved sides and rounded corners on a frosted filter-glass faceplate.

Xenon-filled Rectifier

A xenon-filled, half-wave rectifier tube, designed to meet military requirements and capable of performing efficiently under extreme ambient temperatures, has been announced by the *Radio Corporation of America* Tube Department, Harrison, N. J.

The *RCA*-3B28 maintains high efficiency under ambient temperatures ranging from −75° to +90° C. Because of its content of xenon gas, it will function under severe atmospheric heat and cold, and its rugged construction permits use under conditions of severe vibration.

Utilizing a medium-shell, small 4-pin base with bayonet, the 3B28 takes a standard four-contact socket, and has a



maximum diameter of 2$\frac{1}{16}$" with a length of approximately 6". The bulb cap accommodates the anode connection.

Further information on this rectifier and tubes described below may be obtained by writing to the *RCA Victor* Press Division, Camden, N. J.

20-Inch Picture Tube

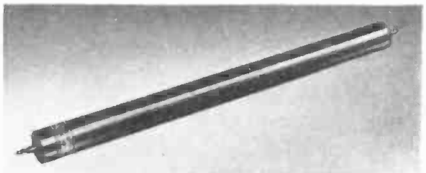
The directly viewed, rectangular, all-glass picture tube 20CP4 announced by *RCA* employs magnetic focus and magnetic deflection, and has an ion-trap gun requiring only a single-field, external magnet. The diagonal deflection angle is 70° and the horizontal deflection angle is 66°.

This tube has a maximum high-voltage rating of 18 kilovolts (design center), and produces 17-¼" x 13-¼" pictures.

GAMMA TUBE

A rugged, stainless steel tube, especially designed for industrial process control procedures using gamma rays, and for cosmic ray counting, has been developed by *Tracerlab, Incorporated*, 130 High Street, Boston, Massachusetts.

Featuring complete absence of any flanges, bases and base pins, wall thick-



ness of approximately 400 mg/cm², starting potential of 870-930 volts, minimum plateau length of 200 volts with a slope of approximately 1% per 100 volts, the TGC-16 Industrial Gamma Tube is filled with helium and has an organic quench and recovery time of approximately 200 microseconds.

It is designed for installations requiring ruggedness and good response over a considerable temperature range and is used for industrial applications such as oil pipe line inspection and liquid level gauges.

NEWS BRIEFS

SOLDERING MINIATURE COMPONENTS

At the *Radio Corporation of America* Engineering Products Dept., Camden, New Jersey, an assembly worker is shown using a magnifying glass for

soldering miniature components on an i.f. assembly of the AN/PRC-10. The completed assembly plugs into the chassis and can easily be replaced for quick servicing.

ANECHOIC LABORATORY

The absence of spurious sounds during acoustic measurements is an utmost necessity in obtaining accurate and reproducible results. Outdoor measurements have become a standard method of overcoming sound reflection and consist of mounting a sound source, usually a loudspeaker angled upward, near the ground. A microphone is located on the axis of the sound source on a boom extending from a tower. Since there is no appreciable reflecting surface, energy which does not strike the microphone is dissipated in the atmosphere.

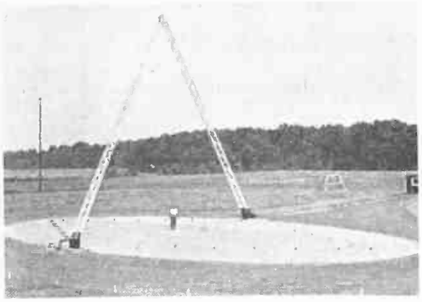
Outdoor reflection conditions can be duplicated indoors in anechoic (echo-

less) rooms by treating the laboratory surfaces with discontinuous sound absorbent materials.

Such a laboratory, known as a "baffle" type, was constructed in the Protective Division of the Army Chemical Center, Maryland. Straight baffles of hair felt of predetermined length are angled from the surfaces of the room to provide greater length of absorbency in a small space. The frequency of sound absorbed is a function of the length of the baffle, so that the room can be "tailor-made" to reduce reflection in the useful spectrum only.

MODEL ANTENNA RANGE

The National Bureau of Standards, Washington 25, D. C., has recently completed a new model antenna range to facilitate the measurement of antenna radiation patterns in the vertical plane. It is composed of an inverted-V-type structure which supports a test or target transmitter more than 50 feet above



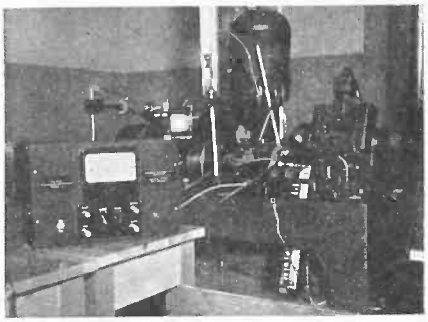
a wire mesh ground plane, in the center of which is placed the model antenna to be tested. The supporting structure can be moved through a 180° arc so that a 180° pattern of the antenna under test may be obtained. The photograph shows the structure raised to the 90° position.

A scaling factor of 60 is used in constructing the antenna models. This permits testing antennas for the 1 to 25 mc. range by building them 1/60 normal size and operating them in the 60/1500 mc. range.

OIL FILM THICKNESS

Mr. M. L. Greenough and associates of the National Bureau of Standards, Washington 25, D. C., have developed a method for measuring clearances between shafts and sleeve-type or journal-type bearings during operation. The heart of the new system is a mutual-inductance type of distance-measuring element; variation of the distance of the rotating shaft from two small fixed coils results in a readily measurable variation of the coupling between the coils.

Two types of probes may be used, one an air-core probe for use at r.f., and the other an iron-core for use at a.f. In each case, the probe consists of a pair of small coils mounted close to each



other and close to, but not touching, the surface of the shaft. A.c. applied to the primary coil induces in the secondary a voltage which is dependent on the mutual coupling between the coils. This coupling is dependent on the proximity of the metal shaft, so the induced voltage will be a measure of the shaft-to-coil distance. The display may be either on an oscilloscope or a meter graduated to read thousandths of an inch.

STRATOSPHERE TEST CHAMBER

A stratosphere test chamber, manufactured by *Tenny Engineering Company*, Newark, N. J., was recently installed at the *Lenkurt Electric Company*, San Carlos, Calif., as part of the latter company's expanding production.

The chamber will be used to test the performance of telephone and telegraph equipment under varying conditions of temperature, altitude and humidity, and is fully automatic in operation. Generating temperatures between −100°F and +200°F, with simulated altitudes as high as 80,000 feet, the Model 18STR-100 can achieve relative humidity conditions as high as 95 per-cent and as low as 10 per-cent.

MULTIPLIER PHOTOTUBE

Distinguished by a head-on photocathode of large diameter, the *RCA*-

5819 Multiplier Phototube is used extensively in scintillation counters for the detection and measurement of nuclear particle radiation.

Dr. Ralph W. Engstrom, of the *RCA Tube Department*, Lancaster, Pa., is shown running design tests on *RCA*-5819 multiplier phototubes.

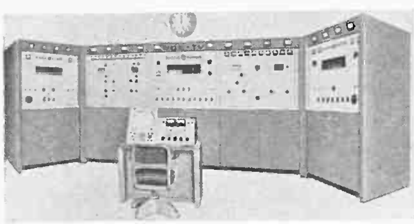
TV INTERFERENCE REDUCER

Reduction of local interference with television pictures, is now possible with a new television circuit, known as "Fringelock," described by Mr. Meyer Marks of the *Zenith Radio Corporation* research department, Chicago, before the 7th Annual National Electronics Conference in Chicago, Illinois.

Requiring a radical change in circuit design, but the addition of surprisingly few small parts and no additional tubes, this new device is so connected as to separate the picture synchronizing pulse from the rest of the television signal picked up by the antenna.

BOOSTER AMPLIFIER

The development of new amplifiers by the *General Electric Company*, Syracuse, N. Y., will enable television stations to boost their power and improve picture and aural signals for televiewers in current weak reception areas, according to F. P. Barnes, *G-E* broadcast equipment sales manager. The new power limits, however, will not be effective by the FCC until after the current freeze on new TV stations is lifted, perhaps sometime early this year.



These amplifiers, designed to operate with all current makes of 5 kw. transmitters whose output signals comply with RTMA standards, incorporate numerous features such as simple r.f. circuits, and control circuit features including arcback indicators, small floor space, and antenna arc-over protection.

A 35 kw. amplifier for low channel transmitters and a 20 kw. amplifier for high channel use will permit stations to easily produce the proposed maximum powers of 100 kw. for low channel and 200 kw. for high channel stations.

MAGNETIC TAPE "MEMORY"

A computer-controlled external auxiliary "memory," using magnetic tape as the recording medium, has recently

(*Continued on page* 31)

NEW PRODUCTS

DESK-TYPE RADIO STATION

A console-type two-way radio station, designed for fixed-station use in any two-way radio communications system operating in the 30-50 mc. frequency

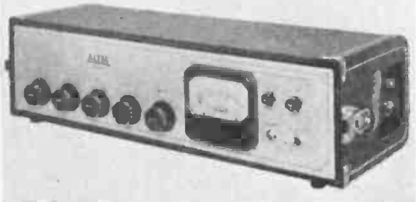
range, has been announced by the Communications Section of the *Radio Corporation of America*, Camden, New Jersey.

The Model CSF-60A provides for remote control, optional two- or three-channel transmitter operation, dual-channel receiver operation, and use of local or remote-type speakers, and it is embodied in a compact cabinet which can be installed at one desk position. The sloping front panel of the desk unit has a built-in direct-reading electric clock with all controls required to operate both the transmitter and the receiver, and it incorporates a suitable antenna, thus constituting a complete radio station.

Further information may be obtained by writing to the *RCA Victor* Press Division, Camden, New Jersey.

PORTABLE MIXER

The 220A portable mixer fulfills all requirements for a high quality broadcast mixer for field use in AM, FM and



TV remote pickups, and is introduced by the *Altec Lansing Corporation.*

Operable from a.c. power or external battery supply, the 220A serves as a portable mixer for public address systems, and incorporates the use of two 1410A dual preamplifiers with individual volume controls for four microphone inputs, a 1440A line amplifier, a master volume control, a 30A power supply and a 4" illuminated VU meter.

The construction of the mixer permits access to the interior without disconnecting cords or wires by removing the front panel.

Additional information may be obtained from *Altec Lansing Corporation*, 9356 Santa Monica Boulevard, Beverly Hills, California.

PORTABLE RADIATION METER

Particularly useful for measuring beta and gamma radiation in laboratories handling levels of radioactivity of the order of millicuries, is the Portable Radiation Survey Meter announced by *Tracerlab, Incorporated*, 130 High Street, Boston, Mass.

Equipped with a new circuit which

makes use of the principle of inverse feedback, it permits stable operation and reduction of the time constant which is 1.5 seconds on all ranges.

The SU-1E Radiation Survey Meter is provided with three ranges of 15, 150 and 1500 mr/hr, giving measurements of relatively high radiation dosage rates. Its small size and gun-shaped construction make it convenient for getting into inaccessible places. The meter is mounted on a sloping panel to permit good visibility of the meter face.

For additional information, write direct to *Tracerlab, Inc.*, Boston, Mass.

QUARTZ ORIENTATION UNIT

The *North American Philips Company* announces an improved Quartz Orientation Unit which will be useful in the field of communications where quartz crystals are used for control of frequency.

The unit, making it possible to hold tolerances in quartz orientation to one minute of arc or better, and incorporating a pre-aligned mica-window x-ray

tube for long life, is available in two types, a single or double unit.

High reproductibility is attained through use of a precision-built rigid gonimeter, a stable power supply and measuring circuits. Angles can be read directly with a high degree of accuracy down to ½ minute of arc.

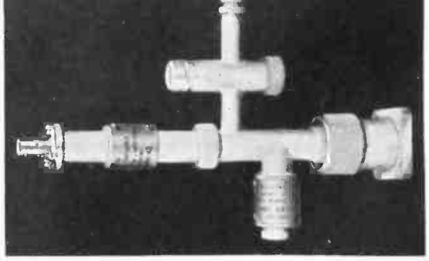
Additional information can be obtained from the Research & Control Instruments Div., *North American Philips Company, Inc.*, 750 South Fulton Avenue, Mount Vernon, N. Y.

CRYSTAL MIXER

Empire Devices, Incorporated has developed a fixed tuned, coaxial crystal mixer, Model CM-107, having an input VSWR better than 2 to 1 for all frequencies within the nominal frequency range.

The Model CM-107 also maintains a local oscillator power requirement of 10 milliwatts, with the oscillator injector being adjustable to accommodate large variations in oscillator power. The local oscillator VSWR is better than 2 to 1, regardless of the injector adjustment.

For further information, write to



Empire Devices, Inc., 38-25 Bell Boulevard, Bayside 61, New York.

FILM BADGE SERVICE

Technical Associates has initiated a Film Badge Service, providing a permanent record of the amount of radiation to which one may be exposed from x-ray equipment, radium, and pile-produced radiosotopes.

The badge is a light weight aluminum shell 1½" x 2" x ¼" having a window

partly covered by a metal filter, so that the type of radiation reaching the two-range film packet inside may be determined. A pin clip for fastening to the clothing, wrist holders, and film rings are available for individual applications.

Further information may be obtained from *Technical Associates*, 140 West Providencia Avenue, Burbank, Calif.

CATHODE FOLLOWERS

Gulton Manufacturing Corporation of Metuchen, New Jersey, announces a new series of cathode followers designed to terminate piezoelectric pickups and other high impedance devices into standard electronic equipment. The Models F403 and F405 are battery powered, and F407 operates on 110 volts, 60 cycles.

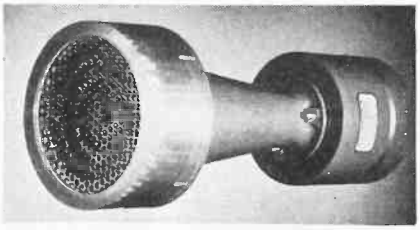
Self-contained in oak carrying cases, they have a high impedance probe with a 9 foot cable. The battery models include a panel meter indicating battery condition.

Designed for operating convenience and portability, all three models feature high gain, high input impedance, low input capacitance, wide frequency response, low noise level and high overload capabilities.

Complete information on all models will be supplied by *Gulton Manufacturing Corporation*, Metuchen, New Jersey.

ACOUSTICAL LENS

James B. Lansing Sound, Inc. has announced production of a high frequency speaker Model 175-DLH with an acoustical lens which distributes the sound uniformly over a wide angle.



This new lens is not sensitive to frequency since the bandwidth of the lens is wider than the audio spectrum with which it is used.

Additional information may be obtained from *James B. Lansing Sound, Incorporated*, 2439 Fletcher Drive, Los Angeles 26, California.

L. F. OSCILLATOR

The production of a new ultra-low frequency oscillator, Model 400-A, has

been announced by the *Krohn-Hite Instrument Company*.

The Model 400-A provides both sine and square wave voltages at any frequency between 0.009 and 1100 cps, with an *RC* bridge sine wave oscillator circuit employed with special circuitry to eliminate tuning and switching transients.

The oscillator is especially useful for design and test of servomechanisms,

(*Continued on page* 31)

NEW LITERATURE

RADIOACTIVE FISSION SURVEY

The Stanford Research Institute has published a techno-economic report presenting the survey findings of industrial uses of radioactive fission products which was conducted for the United States Atomic Energy Commission.

…communications system operating in the 30-50 mc. frequen…

the approximate state of tech… development of selected large-scale potential industrial uses, the fission products required, the maximum value-in-use or competitive price, the size of the market and the nature of the competition.

Although it is primarily an economic study, many scientists and engineers contributed to the report.

Copies may be obtained for $1.50 from Project 361, Stanford Research Institute, Stanford, California.

STATION EQUIPMENT

This attractively illustrated brochure is based on field observations and installation experience in choosing and arranging station equipment. Entitled "Station Planning," it deals with basic initial equipment as well as future expansion, and is written in an easy-to-follow manner for both the technician and the station management.

The booklet, plus answers to problems on improving present facilities, is available upon request from the *Allen B. DuMont Laboratories, Inc.*, Television Transmitter Division, 1000 Main Avenue, Clifton, New Jersey.

TESTING AND MEASURING EQUIPMENT

Used primarily as a reference to the apparatus available for the complex measurements to be made in industry, this new 80-page catalogue contains more than 150 photographs and diagrams and describes the uses, features, specifications and prices of more than 130 *General Electric* testing and measuring equipments. It also contains publication references to *General Electric* bulletins that describe each device in more detail.

The 1952 catalogue (GEC-1016) is available without charge from the *General Electric Company*, Schenectady 5, New York.

FERROXCUBE FERRITES

A new 12-page engineering bulletin, entitled "Introduction to the Application of 'Ferroxcube'," gives basic data on the use of ferromagnetic ferrites as magnetic cores in electronic and electrical circuits. It is of particular interest to designers of …oils and r.f. inductors. Among the … …ects discussed are the effects of c… …er, eddy current, hysteresis, and …idual losses in magnetic materials … they pertain to inductor …

…5100 bulletin is available withou… …arge from the Advertising Department, *Ferroxcube Corporation of America*, Saugerties, New York.

TIC LABORATORY REPORT

The *Technology Instrument Corporation*, 531 Main Street, Acton, Massachusetts, has issued a Laboratory Report No. 4, which contains three feature articles, and is available upon request.

The first is entitled "Phase Measurements in Lattice Networks," which discusses phase angles of voltages without common ground measured with Type 320-A Phase Meters; the second, "Production Testing of Dissipated Electrolytic Capacitors," relates how loss in electrolytic capacitors can be measured with a Type 320-A phase meter independent of absolute capacitance; and the third is entitled "Adaptation of 320-A Phase Meter in Servo System for Dynamic Balancing."

Each of these articles is illustrated and diagrammed for quick and easy comprehension.

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4 CHANNEL CARRIER

A descriptive folder, Form 32E-P covers a new *Lenkurt* carrier system capable of superimposing up to four high-quality voice channels and four dial- or ringdown-signaling channels on an open-wire line. This new Type 32E-P System operates in the carrier frequency range from 3.3 to 35 kc., which is shown in detail in the frequency-allocation chart included.

Other information shows how the new equipment coordinates with Type C WE systems and provides the additional advantages of a fourth channel and dialing operation. Further data covers application, physical description, terminals, repeaters, signaling facilities, accessories and operating performance characteristics.

Copies of the folder are available without charge from the *Lenkurt Electric Company*, County Road, San Carlos, California.

Oscillograph Beam

(*Continued from page* 19)

voltage, even though it is only 2% of the steady voltage across the discharge tube, momentarily disrupts equilibrium conditions in the tube, producing a greatly intensified electron beam for about 2 μsec. The increased beam current lasts for such a short time that it does not appreciably increase the heat developed in the discharge tube or "burning" at the cathode. However, its duration is such that by careful synchronization with the start of the sweep, it can be used to obtain the greatly intensified beam for total sweep times of 1 μsec or less as desired.

Two principal methods for applying the pulse have been developed and used by NBS. In one method a current pulse is passed through a resistor placed between the anode and the ground return lead. This causes a similar voltage pulse across the discharge tube, which results in a sharp increase in the intensity of the electron beam. In the other method, the cathode is connected to one terminal of a small high-voltage capacitor, and the other terminal is connected to ground through a resistor. By means of the steady direct-current voltage on the cathode, this capacitor is charged to 50 kv., and when a current pulse is passed through the resistor, the cathode voltage is immediately changed by the drop through the resistor. This produces a very rapid change in the intensity of the beam.

A method of synchronizing the start of beam intensification with the start of the sweep has been devised by NBS and used successfully with sweep speeds up to 60 in./μsec. These fast sweeps were used to obtain records of the voltage oscillations occurring when the deflecting plates were short-circuited after being charged to a high voltage. Although this procedure deflected the electron beam from the top to the bottom of the film record in about the shortest time possible, a readable trace was still recorded on the film, and this trace was found to correspond to a "writing speed" of 9,100 in./μsec (three-fourths the velocity of light).

Writing speeds greater than the speed of light could probably be obtained by the NBS technique if the deflecting system of the oscillograph were designed with this objective in mind. Since the current in the discharge tube is maintained at a low steady value except for the very short time required to obtain the record, the problems of beam adjustment and life of cathode become of minor importance.

**For further details, see "A fifty-fold momentary beam intensification for a high-voltage cold-cathode oscillograph," by John H. Park, J. Research NBS 47, 87, (1951) RP 2231.*

TECHNICAL BOOKS

"BROADCAST OPERATOR'S HANDBOOK" by Harold E. Ennes. Published by *John F. Rider Publishers, Inc.*, 480 Canal St., New York 13, New York. 440 pages. $5.40.

The technical aspects of putting programs on the air are covered in this book, which is in its second revised and enlarged edition. It contains a total of six parts.

The first four parts cover operating practices in the control room, at the master control, outside the studio, and at the transmitter. The fifth and sixth parts consist of the technical data necessary for the maintenance and proper operation of station equipment.

Methods of setting up routines for meeting emergencies in the studio control room are discussed in one of the new chapters of this edition. Studio equipment maintenance procedures, and additional material for transmitter maintenance, FM broadcasting in all of its various phases, broadcasting facilities, microphone techniques, and magnetic-tape recording, are among the many associated topics discussed in detail and brought up to date.

The book endeavors to furnish the industry and all of its interested newcomers with all the necessary information, breaking the gap in literature that exists between the field of radio engineering and design, and practical operation of the products thereof.

"TELEVISION EQUIPMENT THEORY AND OPERATION" by *Broadcast Equipment Section, Engineering Products Department, RCA*. Available from *RCA*, Dept. RE, Camden, N. J. 444 pages. $8.00.

This fully illustrated manual for television technical training programs has been prepared through the combined efforts of various *RCA* engineering department personnel and particularly for broadcast station personnel concerned with the operation, maintenance, design or planning of equipment for television stations.

In its sixth edition, the book contains information which is divided into four specific classes of television equipment: Transmitters, Antennas, Video and Audio. At the end of each section are data and specifications for a number of the newest TV equipment items, besides information on all other TV equipment. Theory and operation of each class of equipment are discussed, as are practical television station equipment layouts.

Components

(*Continued from page* 8)

ly important that the applied storage pulses be suitably quantified. In order to avoid the effects of varying supply voltages and similar problems, it is desirable to use a passive element for this purpose. From the foregoing, it will be clear that a magnetic core is a desirable and relatively simple method of accomplishing the required quantifying of the pulses. This means that the only requirement for the input circuitry is that the applied pulse be of greater magnitude than the specified minimum saturation swing of the quantifying core.

It was mentioned above that all of the windings on a given core have an interaction effect that often produces difficulties in particular design problems. This may be turned to desirable account by recognizing that most of the desired functions may be accomplished with a single winding and suitable coupling arrangements outside the core structure. For example, in the multistable devices there is no need of a secondary winding for observing the output. The change that takes place at the time of transition from dynamic flux change to saturation appears across the input winding as well as the secondary. The obvious deduction is that the secondary winding can be dispensed with and the output taken directly from the primary. In some applications it is desirable to produce saturation of the core back to the zero sense with a single relatively large pulse. This too, may be applied to the primary winding. It is true that the *IR* drop across the primary mitigates against observation of the transition and this limitation is avoided by using a secondary winding. In very high storage applications this might have importance but, in current practice, it is of little or no consequence. In many instances an initial design will be thought out in terms of several windings with various individual purposes but, in the end product, a single winding may often be used to perform all of the desired operations.

Many apparently anomalous results may be obtained whenever there are capacitors associated with the circuitry intimately connected with the magnetic core. Such capacitances charge up during a storage cycle and discharge subsequently in such a manner as to change the effect of the originally applied forces. All of the associated input and output impedances must be carefully selected to produce the desired end results, and a lack of adequate attention to such details will result in considerable confusion.

It is undoubtedly true that in certain applications vacuum tubes will always be superior to any other device. The advent of a new method does not inevitably mean the complete discarding of an existing system. The rapid growth of magnetic tape recording was believed by many to presage the final curtain for disc recording but this has proven to be erroneous. New methods, new materials, and new ideas often mean only the replacement of previous methods in applications to which the old systems are not particularly well suited. Such is probably the case with the current trend toward the elimination of vacuum tubes. It will result, rather, in the minimizing of vacuum tubes in circuits where superior stability and comparable performance may be obtained with other elements.

Video Amplifier

(*Continued from page* 15)

Output (see graph shown in Fig. 5)
Output voltage 120 to 143 peak-to-peak volts.

Construction (see Fig. 6)
Chassis 5 x 6 x 14 inches (with tubes), mounted vertically inside synchroscope cabinet so that one end is flush to synchroscope panel and wiring is accessible for testing.

Power supply (see Figs. 6 and 7)
Constructed on separate chassis and not mounted inside synchroscope cabinet. Connected to amplifier by power cable.

Voltages	*Currents*
+225	230 ma.
+200	200 ma.
6.3 a.c.	6 amp.
6.3 d.c.	450 ma.

Controls

Amplifier: input jack and gain control located on synchroscope panel.

Power supply: on-off switch mounted inside synchroscope. If this switch is left on, a.c. power may be controlled by the synchroscope on-off switch.

Lining Up the Amplifier

General Considerations

The transient-response method is by far the quickest and most effective for lining up this particular amplifier since both amplitude and phase characteristics may be taken care of at the same time, and the effect of peaking-element changes may be immediately observed. In this case, the method consisted of applying a 2-μsec gate pulse with an approximate rise time of 0.002 μsec to the input of the circuit under test, observing and interpreting the output waveform on the synchroscope in which the amplifier was to be used, and making whatever adjustments in peaking that were necessary. A gas-tube-type pulse generator produced pulses which had the proper rise time for the test. The value of this rise time was determined from the following conditions. If the rise time of the signal t_S is much shorter than that of the amplifier t_A, the effects of changes in peaking may be easily measured. On the other hand, if t_S is longer than, or even the same as t_A, the total rise time t being observed in the output will only be relative as far as the amplifier is concerned, and the effects of changes in peaking cannot be detected easily. For example, in Fig. 8 the effects of different amounts of peaking may be clearly observed in the three output waveforms when $t_S = 0$, and $t = t_A$. In practice, in order that t be only 1% greater than t_A, t_S must be approximately one-eighth of t_A. This means that if we wish t_A to be 0.013 μsec, t_S must be approximately 0.002 μsec to secure optimum peaking results. The equation for obtaining t for amplifiers having a transient response with 3% or less overshoot is:

$$t = \sqrt{t_S^2 + t_A^2}$$

Peaking Elements

The peaking elements for each stage are a series choke and a shunt choke. In Fig. 3, the series chokes are L_1, L_4, L_5, L_8, L_9, L_{12}, L_{13}, L_{14}, and L_{15}; the shunt chokes are L_2, L_3, L_6, L_7, L_{10}, L_{11}, L_{16}, L_{17}, and L_{18}. Each is a 2-μhy. hand-wound type, with a specified number of turns removed, depending on the calculated values of L_1 and L_2. Once the series chokes were set at their calculated value by means of a Q meter, they were mounted on the chassis so that they divided properly the two shunt capacitances of each stage ($C_{out} + C_{in} + C_W$, as described above). The average number of turns removed to obtain this value is given in the schematic, Fig. 3; however, these figures may vary slightly if the physical placement of components varies with different construction. The shunt chokes were made large purposely (6 to 8 turns more than the figures given for them in Fig. 3) before being mounted so that the stage would not be under-compensated and they could be cut down a little at a time. Again, the average number of turns which was removed to bring them to their calculated values is noted in Fig. 3.

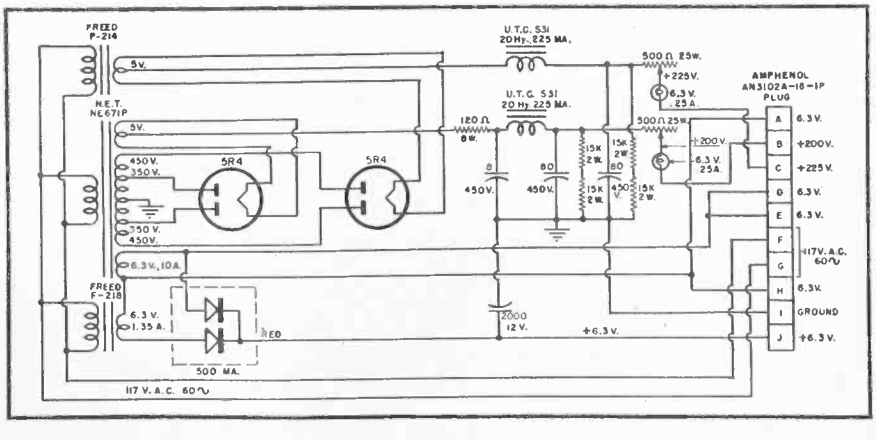
Lining-Up Process

The lining-up process begins with the last stage and ends with the first; one side of a push-pull stage is lined up and then the other. Before the 2-μsec gate pulse is fed to one side of V_8, the coupling condenser C_{19} (see Fig. 3) is disconnected from the plate load resistor R_{28}, and the cathode resistors R_{37} and R_{38} are bypassed with a 0.1-μfd. paper condenser to isolate one push-pull side from the other. The signal is then adjusted by means of a 100-ohm attenuator, and is fed into the grid side of L_{12} at pin 2 of V_8 in order to avoid undesirable ringing. The series choke L_{14} is already at its calculated value, and may be disregarded for the present. The shunt choke L_{16} is cut down a turn at a time and the output waveform observed for proper compensation. If the stage is still over-compensated when L_{16} reaches its calculated value, (approximately minus 18 turns), L_{14} and L_{16} may be reduced alternately, a turn at a time, until there is no overshoot. The resistance R_{40} is shunted across L_{14} to cut down its peaking effect; the small capacitance C_{27} increases the rise time.

After one side of the output is lined up, the other side is handled in the same manner. The coupling condensers C_{19} and C_{20} are then connected back to the plate load resistors, C_{12} and C_{14} disconnected, R_{22} and R_{23} bypassed, and the driver stage (V_6, V_7) lined up. Thus the process continues step by step back to the input. Each stage which is lined up is used with the one under test so that the cumulative effects of peaking may be observed. The only differences in the peaking-element circuits of each stage are (1) the series chokes of the output and driver are shunted by the resistors R_{40} and R_{36} respectively, (2) the shunt chokes L_{16} and L_{17} in the output are padded by the capacitors C_{27}, C_{28}.

There is some leeway in alignment; *i.e.*, if one stage is slightly over-compensated, the one before or after it may be compensated as necessary to insure the proper over-all compensation. It must be noted, however, that all the stages do not have the same upper half-power points either before or after

Fig. 7. Schematic of the power supply for the video amplifier.



compensation; moreover, the last stage is the limiting stage on bandwidth, and the preceding stages must have much greater bandwidths in order to make the over-all bandwidth as wide as possible. Unfortunately, it is not as easy to under-compensate one stage in order to take care of over-compensation in another stage when differences in bandwidth exist as it would be if the bandwidths of individual stages were the same.

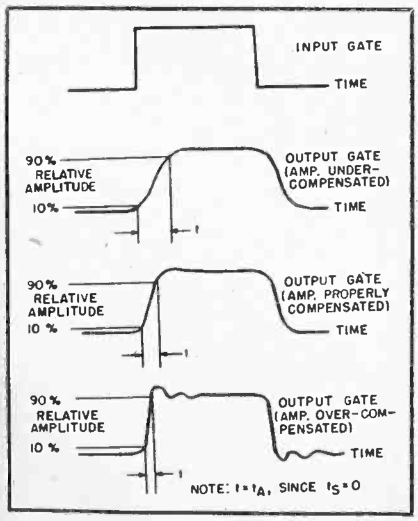
Final Test

A final test to see if the amplifier is lined up correctly is to put two relatively narrow pulses with very short rise times through the amplifier, one pulse following the other by a delay of 1 μsec or more. The pulses should have exactly the same amplitude, but be of different lengths; *i.e.*, 0.07 and 0.15 μsec. If either pulse is lengthened or if there is more than 5% difference in relative amplitudes, the amplifier is under-compensated. This may be caused by insufficient peaking in one stage or a combination of stages, or by the amplifier as a whole. An over-compensated amplifier will narrow the pulses slightly and give them overshoot, the amount of overshoot depending on the amount of over-compensation.

Lining Up Replicas

For the purpose of lining up replicas, it is usually not necessary to follow the above procedure to the letter. The only variables are the individual tube capacitances, and it is possible to have an averaging effect such that the over-all response will be satisfactory, even though the peaking of a stage is effectively modified when tubes are changed. If the amplifier is over-peaked, L_1, L_{10}, and L_{11} (see Fig. 3), or any combination of these three chokes, may be shorted out to give the desired results.

Fig. 8. Gate-pulse waveforms with different amounts of peaking.



If the over-all response is under-peaked, it is best to find which particular stage or stages are under-peaked and compensate accordingly. Once the amplifier is properly lined up, replacing tubes or components does not have a very great effect on over-all gain or bandwidth, provided the tubes are always adjusted to maximum dissipations and the tube capacitances do not vary too much. There is obviously no way to get around large capacitance variations between tubes except to realign the amplifier.

TV Picture

(*Continued from page* 12)

tion noise and interference in weak signal areas is so well known as to make it unnecessary to dwell upon it.

Tuners with lower noise factors are now being produced and, by having higher image rejection, they also reduce

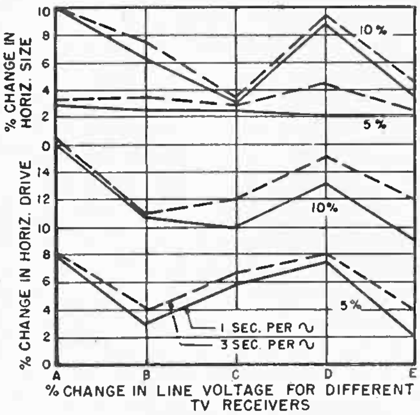


Fig. 4. Per-cent change in picture and sawtooth vs. per-cent change in line voltage for different TV receivers.

both the noise and undesired signal power passed on to the picture tube.

The need for further reduction in adjacent channel interference and noise power by designing i.f. amplifiers with steep sided frequency response curves should be stressed.

Previously, it was noted that to improve synchronizing stability the video amplifier should be designed to limit noise pulse amplitude; here it is recommended in order to reduce the *visible* effect of noise.

A direct coupled type of video amplifier tends also to reduce greatly the "white trail" after "black" noise pulses due to the very fast recovery time. The recovery time from pulse overload corresponds to the inverse of the bandwidth of the amplifier, and not to the time constant of a grid resistor-grid condenser combination as in pulse-overloaded capacity-coupled video amplifiers.

Picture Area Stability

Again, a television receiver designed with all of the previous items carefully considered may still have objectionable

Picture Area Stability Influenced by:	Some Analysis Methods
1. Yoke design (coupling of V to H).	N, V
2. Stability of sawtooth B supply voltages.	B, F, I, N
3. Linearity of deflection.	J, N, P, V
4. Self-regulation of scanning amplitude with respect to high voltage with line voltage fluctuation.	F, V
5. Picture tube bias.	V

Table 6. Factors influencing picture stability. Analysis methods given in Appendix.

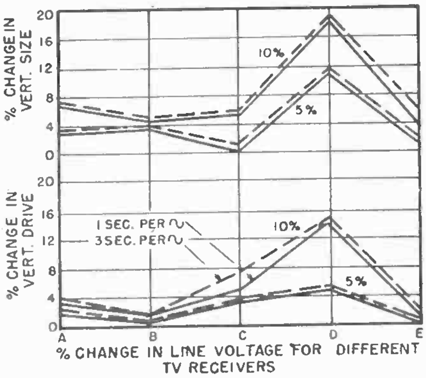


Fig. 5. Per-cent change in picture and sawtooth vs. per-cent change in line voltage for different TV receivers.

changes in size or area of the picture with changes in line voltage or brightness of the scene. The picture may also have a "pincushion" or "barrel" shape due to incorrect yoke design.

Interaction between the vertical and horizontal windings of the yoke can also cause undesirable changes in shape of the picture and "ripple" effects.

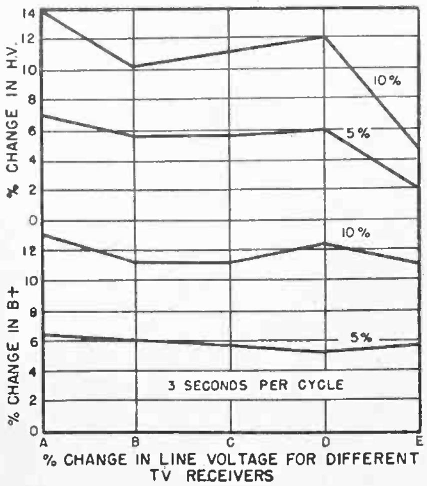
The smaller the percentage change of picture width and height for changes in line voltage, the better the design of the deflection and a.g.c. circuits. As has been pointed out in the literature, the use of the boost voltage of the horizontal deflection circuit can give sawtooth voltages which, with the pulse type of high voltage supply, provide an extremely high degree of picture-size-regulation with line voltage change.

It is hardly necessary to point out the disadvantage, on this basis, of radio frequency and other types of high voltage power supplies which, by being independent of the deflection system, cannot provide correct compensation for changes in line voltage.

Regulation of the high voltage power supply should be sufficiently good to give little change in shape and size of the picture with normal changes in scene brightness.

Figs. 4, 5 & 6 illustrate measurements of variations as a function of 5% and 10% "line voltage fluctuations." As you might expect, the slower rate of fluctuation (3 seconds per cycle) shows the greater change in all of the quantities measured.

Fig. 6. Per-cent change in high voltage and B+ vs. per-cent change in line voltage for different TV receivers.



Brightness

The seventh basic requirement of a good picture, reasonable brightness, can be taken care of by the fairly obvious items, the correct choice of voltages for the picture tube, and the correct positioning of the ion trap magnet.

As you will have seen in the various tables, symbols have been listed to indicate some methods of analysis. The Appendix shows the meanings of these symbols. Those items which are marked with an asterisk may provide some novelty. Methods B, I and F have been explained with the diagrams shown in the earlier part of the paper, while analysis method Q provides a critical test of ripple voltages and stray magnetic fields.

In conclusion, it is hoped that this discussion of the many items influencing the performance of picture tubes and the mention of the new methods of analysis will aid in improving television quality.

The author wishes to express his appreciation to Messrs. C. Masucci, R. Peltz, M. Altman and R. Zitta of our laboratory, for their assistance in the preparation of this paper.

Appendix

Some Analysis Methods

A—Attenuator Connected between Antenna and Receiver (Accentuate Thermal Noise)

*B—Signal Modulation Unit (Artificial "Flutter" and Multipath Signal Simulation)

C—Measurement of Noise Factor by Noise Diode—Oscilloscope—V.T.V.M. Method

D—Measurement with High Resistance Voltmeter

E—Measurement with Calibrated Photocell and Meter

*F—Line Voltage Fluctuation Unit

G—Frequency Gain Curve by R.F. Signal Generator and V.T.V.M.

H—R. F. Generator Coupled to Tuner

*I—Pulse Noise Source Unit

J—Dot and Bar Signal

N—Measurement with Oscilloscope

O—Analysis of G Curve or Measurement of Phase Shift Using Oscilloscope and R. F. Signal Generator

P—Analysis of High Resolution Test Pattern Signal from Wide Band Master Video Signal Generator Applied Directly to Grid or Cathode of Picture Tube

*Q—Observation of Test Pattern When A. C. Line Supply One or More Cycles Different from the Field Frequency

S—Measurement by Sweep R. F. Generator and Calibrated Oscilloscope

V—Visual Check of Picture

REFERENCE

1. *Hadfield, D., Electronic Engineering, April, 1950.*

CALENDAR of Coming Events

JAN. 30—IAS-ION-IRE-RTCA Conference on Air Traffic Control, Astor Hotel, New York.

MAR. 3-6—IRE National Convention, Waldorf-Astoria Hotel and Grand Central Palace, New York, N.Y.

MARCH 22-APRIL 6 — International Trade Fair, Navy Pier, Chicago, Ill.

WEEK OF MARCH 30—Sixth Annual NARTB Broadcast Engineering Conference, Stevens Hotel, Chicago, Ill.

APRIL 15-17—AIEE South West District Meeting, Jefferson Hotel, St. Louis, Mo.

MAY 5-7—RTMA, AIEE and IRE sponsored government—industry conference on quality Electronic Components, Washington, D. C.

MAY 7-9—IRE National Conference on Airborne Electronics, Hotel Biltmore, Dayton, Ohio.

MAY 16-17—Fourth Southwestern IRE Conference and Radio Engineering Show, Rice Hotel, Houston, Texas.

The Du-mitter

(*Continued from page 5*)

This project was conducted by the General Engineering Department of the *DuMont Television Network* under the direction of Mr. Rodney D. Chipp, Director of Engineering. The author thanks Mr. Chipp and others from the WABD Transmitter Staff, Research, and Transmitter Manufacturing Divisions for their contributions in making possible the development, construction, and tests of the Du-mitters.

News Briefs

(*Continued from page 23*)

been developed by James L. Pike of the National Bureau of Standards' computer laboratory.

In the new system, the magnetic tape rests lightly on two smooth-surfaced rollers that rotate continuously but in opposite directions. Between these two rollers the tape passes through magnetic heads for recording, pickup, and erasing. When either of two control solenoids is energized, a low-inertia rubber-covered roller presses the tape against one of the smooth rollers. This quickly starts the tape moving in the desired direction, with tape inertia kept low by letting each end fall in loose folds into a tank or bin consisting of two plates of glass spaced slightly wider than the tape.

The unit, combining high-speed starting, stopping, and reversing with notable mechanical simplicity, is now in routine operation with SEAC.

MICROWAVE SUPPRESSION

A method of alleviating service interruptions resulting from ground-reflection effects has been devised by the National Bureau of Standards, Washington 25, D. C., through application of optical methods and theories to microwave techniques.

In this NBS method, reflected-wave suppression is achieved by setting a small screen of the proper size on the ground at the "reflection point" in the path. The reflected wave at the receiver is then substantially diminished to an extent depending on the smoothness of the ground plane. The screen is designed to block only a small part of the reradiation from the ground to the receiver, while the remainder of the reflected radiation adds up to zero at the receiver.

This technique is based on the optical principle that the wave field transmitted from a point source to a point receiver under free-space conditions becomes zero if half of the first Fresnel zone is blocked, so that the remaining diffracted contribution of the zone is halved in amplitude and unchanged in phase. The reduced contribution of the first zone is then cancelled by radiation from unblocked zones.

ARMOUR STAFF PROMOTIONS

Following a reorganization of the department, five staff members have been named as section supervisors in the electrical engineering research department at the Armour Research Foundation of Illinois Institute of Technology.

Mr. Alfred J. Hoehn, previously an instructor in electrical engineering at the University of Minnesota, will supervise communications; Mr. Edward A. Roberts, former naval radar officer, is in charge of instrumentation; Clifford C. Peterson, an army major in the last war, will oversee materials and measurements; Frederick G. Rest, who in 1946 joined the Foundation as an assistant physicist, will be in charge of recording and computer applications; and George F. Warnke, IIT graduate, will supervise servomechanisms.

All five have worked on both industrial and government research at the Foundation and have published articles in their fields of specialization.

New Products

(*Continued from page 25*)

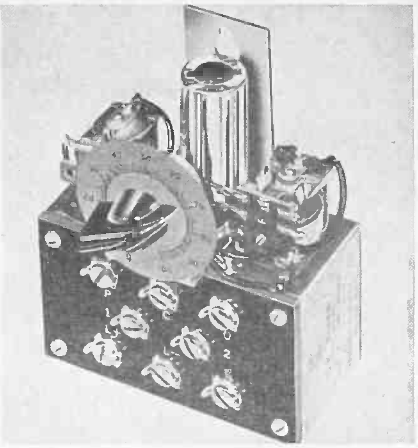
geophysical and seismological instruments and feedback amplifiers, for vibration checks and medical research, and in conjunction with tuning and production controls.

A descriptive pamphlet is available on request by writing to *Krohn-Hite Instrument Company*, 580 Massachusetts Avenue, Cambridge 39, Massachusetts.

ELECTRONIC TIMER

The Type CK Electronic Timer, Models C & D, manufactured by *Farmer Electric Company*, can be started by either a momentary or a sustained contact. The momentary-contact starting is obtained without sacrificing any of the other desirable features that result from the use of the cold-cathode trigger tube.

The timer, having a separate set of single-pole, single-throw, normally open contacts that close at the start and reopen at the end of the time cycle, has four time ranges: 1.5, 3, 6 or 12 seconds, and operates directly from 105-125 volts, 60 cycles. It requires no filament current and can be re-cycled with



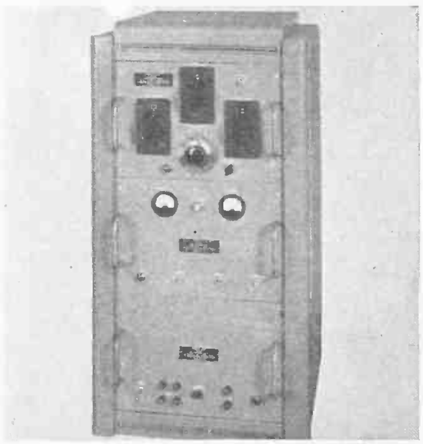
no delay for re-charging a timing capacitor.

A data sheet giving dimensions, recommended circuits, and application notes may be obtained from *Farmer Electric Company*, 21 Mossfield Road, Waban 68, Massachusetts.

FREQUENCY MARKER

Polarad Electronics Corporation announces its precision Frequency Marker, Model FM-1, which produces calibration signals at precisely determined intervals of 1 mc. within the frequency range of 950 to 2040 mc.

The FM-1 provides means for selecting particular frequency markers and



rejecting all others, and determines frequency to an accuracy of one part in one hundred million. An interpolation oscillator produces a comparison signal by which the frequency of an unknown signal is determined to within ± 10 kc. Markers are available at 10 mc. or 1 mc. intervals throughout the entire frequency range.

For further information write to *Polarad Electronics Corporation*, 100 Metropolitan Avenue, Brooklyn, N. Y.

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13, 15	Mass. Institute of Technology
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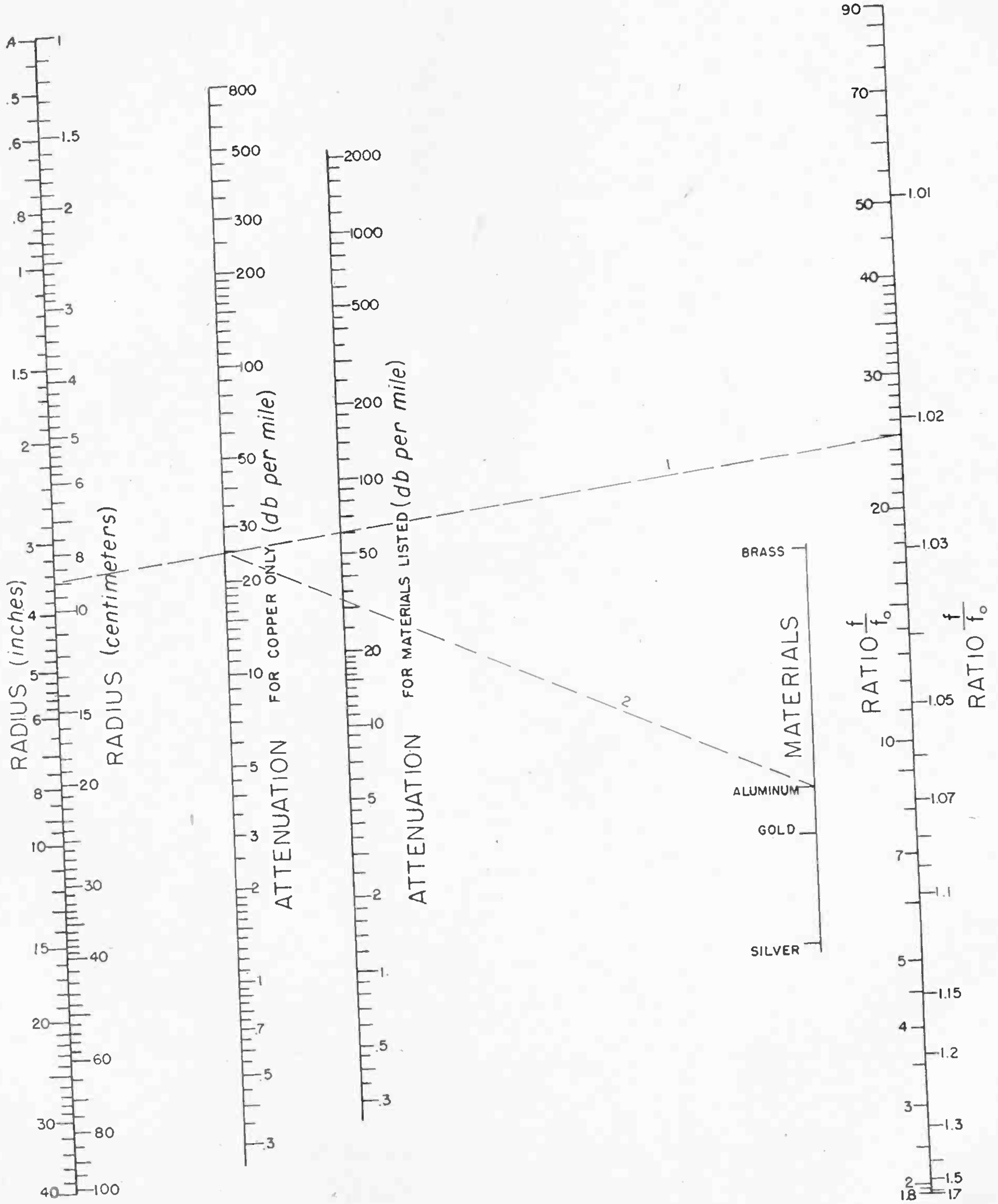
CIRCULAR WAVE GUIDE ATTENUATION

A nomograph for determining the attenuation of the $TM_{1,2}$ (E_1) mode in a circular air-dielectric wave guide.



Courtesy of Federal Telephone and Radio Corporation.

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The torrent of briefs snarled plans made by many, particularly those at the Commission, who expected the hearings to begin earlier and end around August. FCC Headman Wayne Coy had told a group of newspaper men during a Washington meeting that this . . . "hearing may take as much as two months. That would bring us up to the forepart of August. The Commission may need August and September to study the record and render a final decision on its allocation master plan. Thereafter, it will allow a reasonable time, perhaps as much as two months, for the filing of new applications and the amending of old ones. That would bring us up to the first of December when the Commission could begin granting new construction permits or ordering hearings for contested applications."

With the hearings now set to begin just a few weeks before the Commission had felt they might end, and with about triple the amount of testimony to study, it appears as if several and perhaps even more months will have to be added to Coy's timetable for the processing of permits for new stations. The general consensus is that the spring of '52 might see the beginning of a flow of station approvals. Whether the towers will go up and buildings will be constructed immediately or in the future, will depend on the needs of the military and the success of the CMP plan in allocating material for defense and the civilian front. According to Coy, TV transmitters do not . . . "require a large amount of materials and there is considerable optimism in the trade that a reasonable amount of such materials may be made available during '52." The outlook for '53, opined Coy, appears bright. Citing Charles Wilson's favorable report to the President, Coy said that . . . "within the present framework of defense planning, the radio manufacturing industry has a reasonable expectation that there will be a continued, though somewhat curtailed, flow of materials."

COLOR TV, still a subject of sharp debate everywhere and destined to be a controversial topic for a long time, in spite of the decision of the jurists in Washington, had been adopted prior to the final decision by some members of the Commission, particularly its chief, Wayne Coy, as a favorite speech item. In an address before the National Newspaper Promotion Association in Washington, commenting on the fact that it had been suggested that he touch on the subject of color, he said: "Confidentially, I would have touched on it even without a suggestion. I am a color enthusiast. And I know that most of you, too, are becoming increasingly color-minded."

Describing the Commission's new interest in color, Coy declared that they have found that . . . "color opens up whole new fields for effective broadcasting."

(*Continued on page* 120)