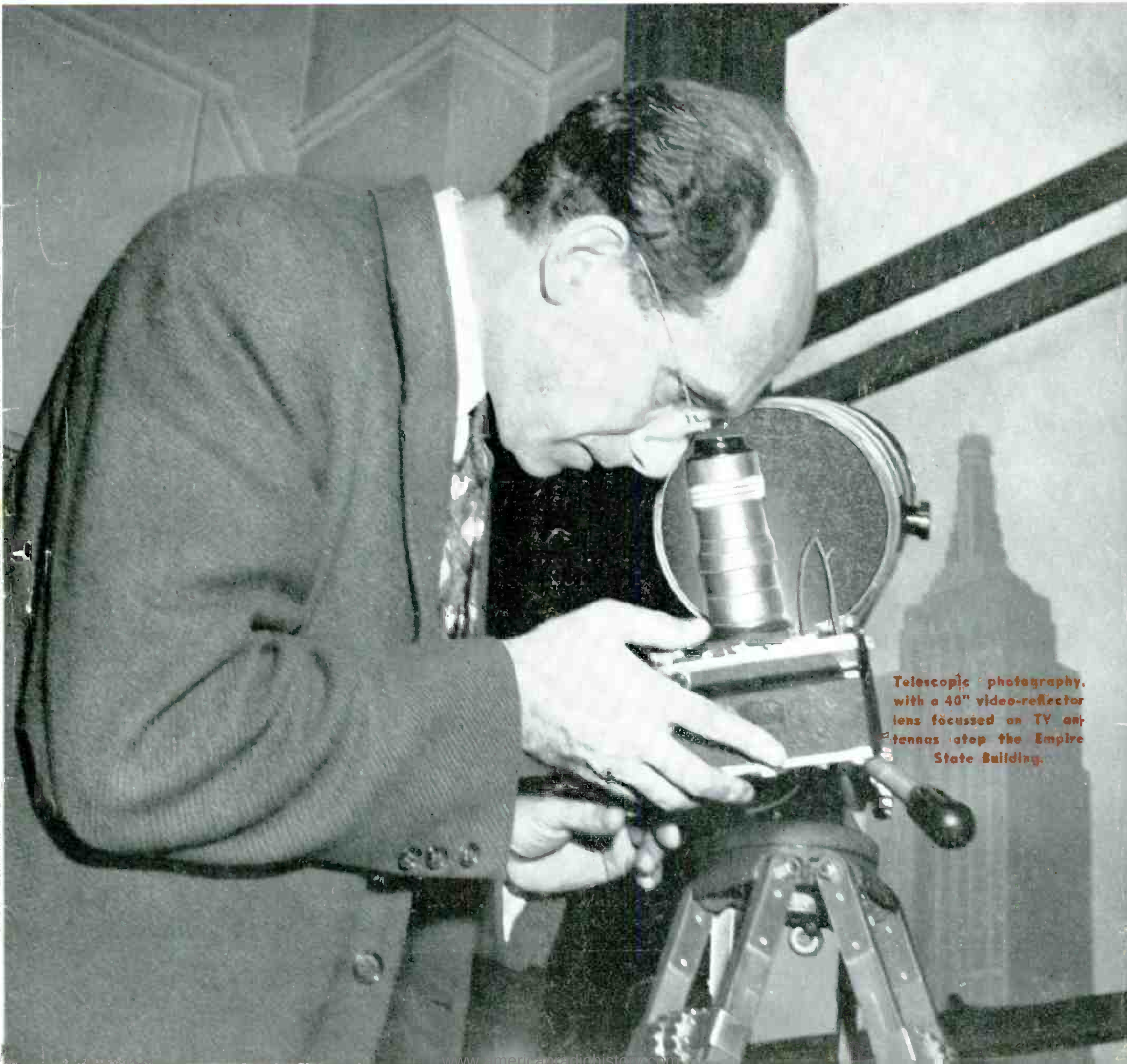
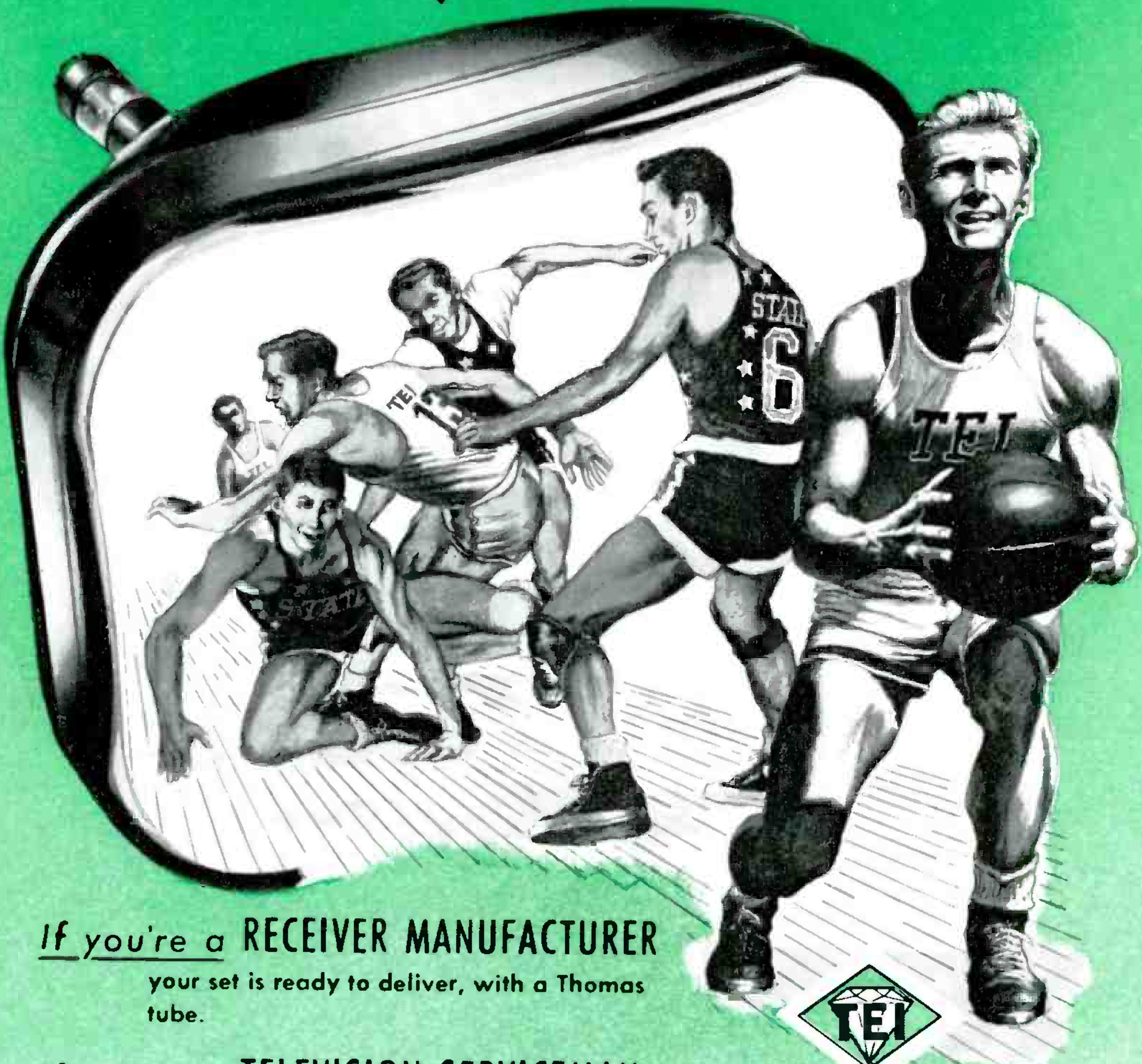
TELEVISION ENGINEERING

NOVEMBER, 1950



Telescopic photography, with a 40" video-reflector lens focussed on TV antennas atop the Empire State Building.

Get set for *ACTION!*



If you're a RECEIVER MANUFACTURER
your set is ready to deliver, with a Thomas tube.

If you're a TELEVISION SERVICEMAN
you're prepared to send those use-worn receivers back into the game fresh and rarin' to go, with a Thomas tube.

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you're stocked to meet servicemen's increasingly heavy demands for the fastest-moving tube in the game, with Thomas tubes.

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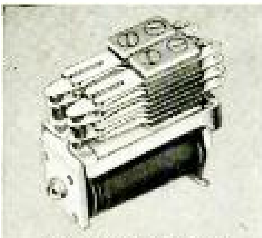
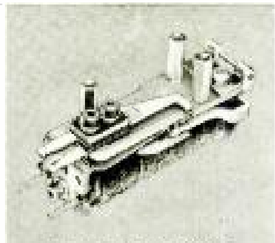
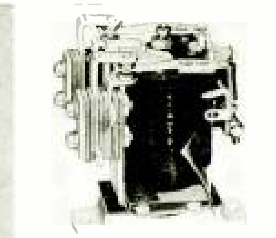

MT—SMALL TELEPHONE


ST—TELEPHONE


LT—LARGE TELEPHONE


LM—PLATE


LS—PLATE

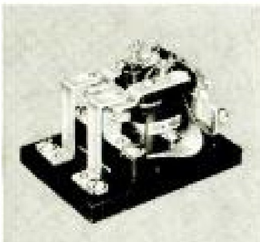

MR—MEDIUM POWER

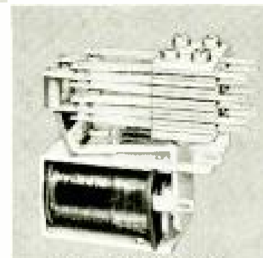

MS—MOTOR START


SM—SUPER MIDGET


LC—PLATE


LP—PLATE


PR—POWER


SU—MULTIPLE LEAF

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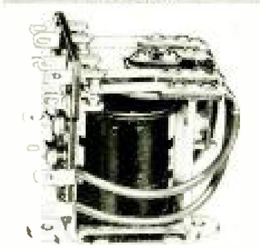
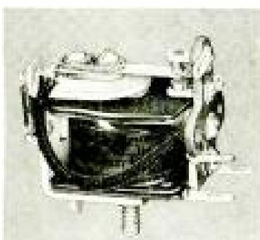
Standard and Special Relays to meet any Specification

P & B Series	Max. Contact Arrangement	Coil Operation	Height	Width	Length
PR	2 form C	AC-DC	2 5/16	2 1/2	3 1/2
LM	2 form C	DC	2 3/8	1 3/8	2 1/4
SU	4 form C	AC-DC	2 3/8	1 7/16	2 1/2
EL	4 form C	AC-DC	2 5/8	1 3/4	3 15/16
LC	1 form C	DC	1 5/16	1 3/8	2 5/16
MR	2 form C	AC-DC	1 5/8	1 1/2	2 15/16
FR	2 form C	AC-DC	1 5/8	1 1/2	2 15/16
LS	1 form C	DC	1 3/8	1 3/8	2 5/8
LP	1 form C	DC	1 5/8	1 1/2	2 5/16
MS	1 form B	AC	1 13/16	2 1/16	2 1/4
KL	4 form C	AC-DC	1 15/16	1 9/16	1 7/8
HG	2 form C	AC-DC	X	2 1/16	2 1/4
SM	1 form C	DC	5/8	Diam.	1 5/16
KR	2 form C	AC-DC	1 1/4	1 3/16	1 11/16
SP	2 form C	AC-DC	1 5/8	1 1/2	2 3/8
ST	12 springs single stack	DC	2 1/16	1 11/32	2 21/32
LT	24 springs Dual Stack	DC	1 15/16	1 7/32	4"
MT	12 springs Dual Stack	AC-DC	1 7/32	11/16	1 1/2
CA	1 Form X SPSTNO-DB	AC-DC	1 1/2	1 3/8	2 9/16
Enclosure for LT only		Dust cover only	4 1/4	1 27/32	2 5/32
Enclosure for MT only		Hermetically Sealed	2 5/32	1	1 11/16
Enclosure for MT or KR		Sealed	2	1 13/32	1 5/8 Octal
Enclosure for MT or KR		Sealed	2	1 13/32	1 5/8 Solder

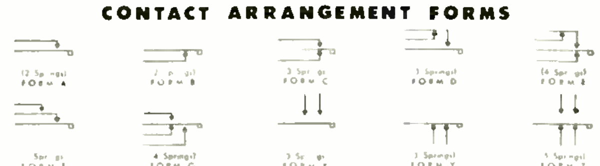

KL—LIGHT DUTY


MT OR KR—HERMETICALLY SEALED OCTAL PLUG


KR—LIGHT DUTY


MT OR KR—HERMETICALLY SEALED SOLDER HEADER

CONTACT ARRANGEMENT FORMS



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HG—MERCURY CONTACT

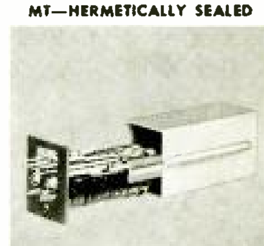

MT—HERMETICALLY SEALED


SP—SHOCK PROOF


FR—PHOTO FLASH


CA—SPACE SAVER


EL—LATCHING


LT—DUST COVER

TELEVISION ENGINEERING

Including Radio Engineering, Communications and Broadcast Engineering. Registered U. S. Patent Office.

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

VOLUME 1 NOVEMBER, 1950 NUMBER 11

MONTHLY FEATURES

Cover Illustration

Focusing *video reflector* for long-range optical pickup. object in this instance being the new TV antenna arrays atop the Empire State Building. At viewing glass is Dr. F. G. Back. inventor of system.
(Courtesy F. G. Back Corp.. and Television Zoomar Corp.)

Editor: LEWIS WINNER

ABC

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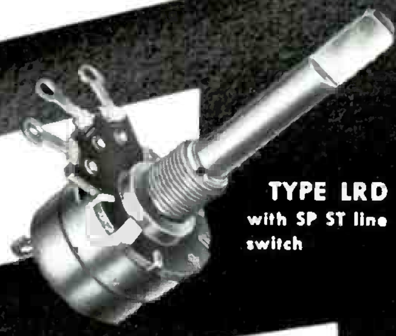
TELEVISION ENGINEERING is indexed in the Engineering Index.

Space and Cost Savers...

TYPE LR
without line switch



TYPE LRD
with SP ST line switch

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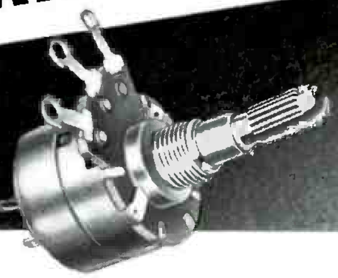
CONSERVATIVELY RATED .5 WATT



TYPE LRA-10
with DP ST line switch

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LR controls are available as concentric shaft duals.

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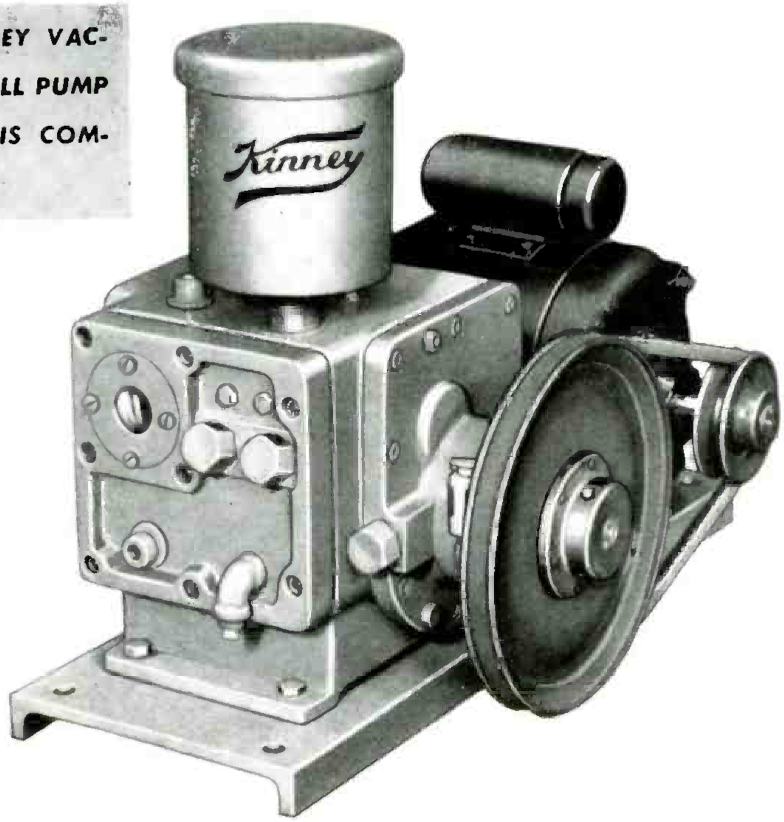

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- ★ — **The same consistent performance and long-lived efficiency that have made Kinney Pumps famous in all phases of low pressure processing.**

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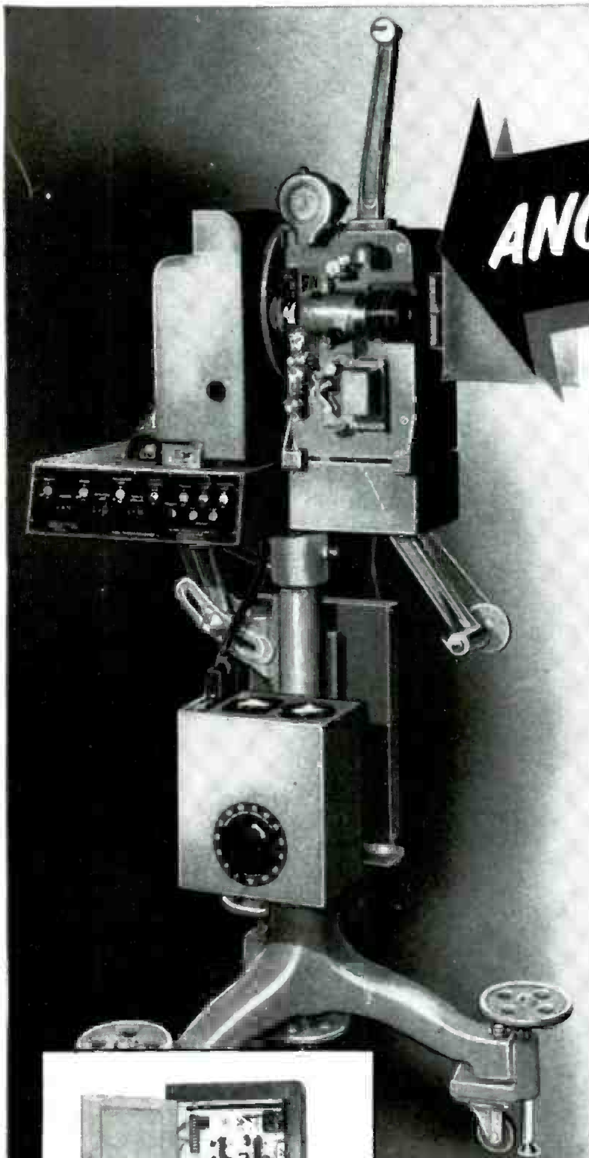
MAKING NEW THINGS POSSIBLE

KINNEY Vacuum Pumps



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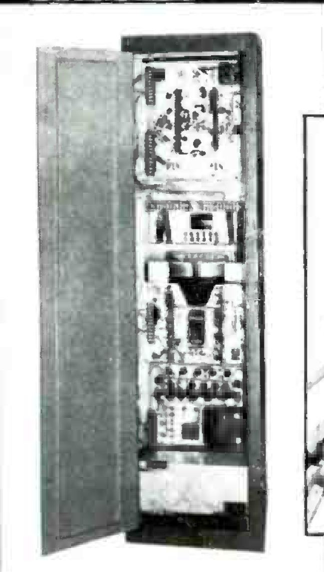
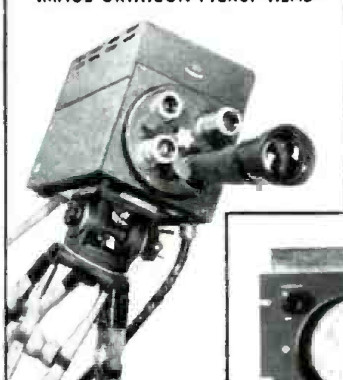
Brings dramatic moving sets and backgrounds into any studio. Eliminates costly and cumbersome sets and backdrops.

For information on the Superspeed Projector or other Du Mont Telecasting Equipment write, phone, or visit.



FLYING SPOT SCANNER

IMAGE ORTHICON PICKUP HEAD



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ALLEN B. DU MONT LABORATORIES, INC., TELEVISION TRANSMITTER DIVISION, CLIFTON, N. J.

TELE-VISION ENGINEERING

LEWIS WINNER, Editor

November, 1950

The Veryhigh-Ultrahigh Snarl

WITH THAT KEY TRIAL of the channels, which should determine our future course in production and transmission, at long last in the testimony stage, the complexities of the entangling issues have been brought into sharp focus. Every factor from station separation to power output appears to have surrounded itself with acute troubles, the most serious of which are in the *uhf* camp. Witness after witness reported to the Commission that those ultrahighs were companions to trouble, at least at present.

Speaking for the Association of Federal Communications Consulting Engineers, Glenn Gillett said that the *uhf* channels will not be developed to the present state of the *vhf* channel, within an appreciable time . . . "because of the lack of equipment and the uncertain factors relative to *uhf* propagation." Accordingly, in the association's opinion, ultrahigh assignments should not be considered on a par with *vhf*, since . . . "*vhf* operation is and will continue to be the backbone of television for many years to come." On the basis of an assortment of available data, the association said that it believed that the *uhf* curves of the Commission reflected a more favorable service condition than would be actually encountered in practice. The rugged terrain of many portions of the country, they felt, would cause the *uhf* signals to fall below 50 per cent of the locations at lesser distances than predicted by the FCC. The problem of oscillator radiation was also cited as a sore spot in the *uhf* picture. It was the group's opinion that the 41-mc *if* now under consideration by the RTMA would result in interference to reception, seven channels separated. If, of course, in the assignments, seven-channel separation in the same service area could be avoided, the problem would disappear. The use of a higher *if*, probably around 111 mc, has been mentioned as another solution to the problem.

In another critical review of *uhf*, B. C. O'Brien of WHEC, said that the experience and propagation measurements of the ultrahigh station in Bridgeport, as well as the earlier surveys of others, have done little to ". . . remove doubts and uncertainty regarding the coverage capabilities of a *uhf* station." O'Brien felt that . . . "more certain than ever that a *uhf* station is going to be severely restricted in coverage as compared to a *vhf* station, at least in anything but prairie country." Discussing the policy of intermixing, O'Brien said that he felt that it would be a grave mistake to allocate *uhf* stations in those areas where a *vhf* audience has already been established.

The co-channel proposals were also subjected to some caustic barbs by the WHEC rep, who declared that the suggested spacing of 220 miles for *vhf* and 200 miles on *uhf* does not make the most efficient use of the *vhf* channels. A rigid adherence to this value, he said, would produce an allocation plan which would not fulfill the FCC priorities, as well as a lower and more flexible separation standard. The proposed *vhf* plan would provide for only 2/3 as many *vhf* stations in the eastern part of the country as a triangular lattice pattern would allow. This is in spite of the fact, he added, that a considerable number of the stations are actually spaced more closely together than 220 miles. Therefore, O'Brien said, it may be suspected that the total area supplied with at least one signal would fall far below the theoretical maximum which could be covered by any triangular lattice pattern, regardless of the station separation used. The unpredictable coverage of *uhf* and the 220-mile pattern inconsistency, in the opinion of O'Brien, indicated that a new plan providing for the efficient use of the *vhf* channels is the answer to the problem. Such a plan might provide for more stations by closer co-channel separation and a more flexible standard for station spacing. In the eastern part of the country where communities are close together, spacing of 100 miles and upward might be considered on the basis of local needs, with no hard and fast minimum set. It was reported that such spacing exists right now, and with benefits of offset carrier, apparently good service is being provided.

The offset carrier principle came in for a bit of criticism, too. Appearing on behalf of ABC, Frank G. Kear said that it has been found difficult, if not impossible, to maintain proper offset carrier operations over extended periods, in the present state of the art.

Tower heights and corresponding *erps* received an interesting review by Earl Cullum, Jr., who disclosed that for channels 2 to 6, the standard *erp* for metropolitan stations should be 100 kw, with an antenna height, above average terrain, of 1000 feet. For channels 7 to 13, the *erp* should be 300 kw on a 1000-foot antenna height. For the ultrahighs, heights of 1000 feet or more were recommended with *erps* of 100 to 1000 kw.

Probing the amount of time it takes to develop television circulation and its effect on the veryhigh-ultrahigh transition, Walter Evans, of Westinghouse, said that the speed at which such a transfer might occur depends on many factors. First, he declared, there must be designed, manufactured and distributed an acceptable set at a price competitive with present sets, and second, industry must procure the necessary materials, in light of the current world situation. The ingenuity of the American industry will unquestionably solve the first problem, he added, *but* . . . "the answer to the second appears to lie in Moscow and not in Washington."

The road ahead for those channels upstairs appears to be rocky, rough and, according to many, just dangerous. —L. W.

TVE-grams . . .

The Management Front

Television in Industry: TV, which to most has been purely a medium of entertainment, has been considered by many to be just as ideal a medium for other purposes, such as might be, for instance, found in industry. In one effort to probe this possibility, it was noted that TV could be used for accident prevention, the direct reduction of operating expense and the reduction of operation expense by the reduction of capital required to make information available at a remote point.

Nearly all walks of life—manufacturing, surgical, shows, banking, coal, steel, public utilities, nuclear physics, and power plants were found to be fertile fields for sound applications. Reporting on these potentialities, recently, Dr. V. K. Zworykin said that in standard industrial operations, such as coal mining, industrial television may serve as a valuable complement in mechanization, permitting remote control of the digging machines and increased economy in the following of narrow seams. In the automotive industry, he pointed out, performance tests can be facilitated by mounting the TV camera at suitable points on the chassis, indicating the reaction of car components from favorable, but normally inaccessible, points of vantage.

In another report by Du Mont, it was disclosed that color could be introduced effectively in industrial applications. With equipment designed strictly for closed-circuits, it has been found possible to achieve high-resolution, high-fidelity color through the use of a bandwidth 18-mc wide. A fast 180 fields-per-second frame repetition rate is used, providing bright, flickerless images.

The equipment, which incidentally uses the color-wheel technique with 500-line horizontal resolution, can not only be used for pure industrial applications, but research and development, merchandising, and particularly educational work. The latter feature was demonstrated quite effectively recently during a meeting of physicians, when a series of operations were colorcast.

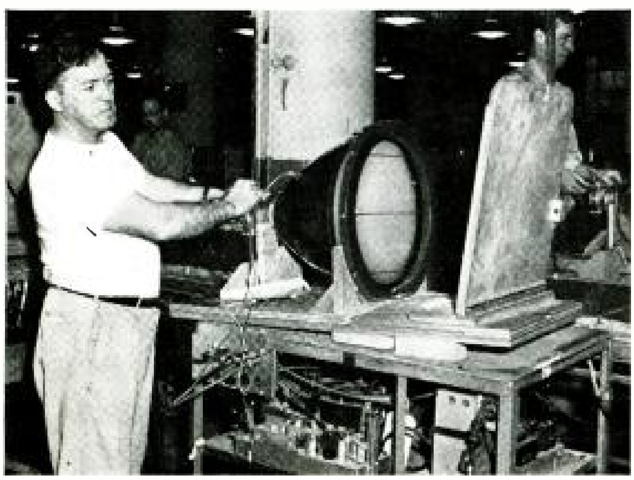
In still another report on industrial TV, the possibilities of third-dimensional TV have been revealed. In a study of this striking application at the Argonne National Lab, it was found that twin lenses, set approximately eyes-width apart, provided pick up of the object at slightly different angles, and the pair of pictures could be handled through the camera in a conventional fashion, transmitted by coax cable and reconstructed in the receiver.

Describing the system recently at the NEC meeting in Chicago, H. R. Johnston, C. A. Hermanson and H. L. Hill of the lab, said that at the receiving end of the stereo-television system, the two images appear side by side on the face of a standard picture tube. Two polarizing filters whose axes of polarization are at right angles to each other are placed immediately in front of the images on the picture tube. An observer wears a pair of polarizing spectacles so oriented that the right eye is permitted to see only the right eye image and the left eye to see only the left eye image. In addition, a pair of glass prisms are placed in front of the eyes to enable the observer to fuse the two pictures into a single three-dimensional image.

Another method featuring the use of two picture tubes was also detailed. In this instance, the tubes are arranged at right angles to each other and a semi-transparent mirror is placed so as to bisect the right angle between them. By means of positioning controls, the right eye picture is placed in the center of one tube and the left eye picture appears in the center of the other tube. With crossed polarizing filters on the tubes and corresponding crossed polarized spectacles, the observer looking into the mirror sees the original object in three dimensions (depth). With the naked eye, the resultant single picture is flat and blurred. With the polarized spectacles, the blurring disappears and the result is a clear picture in which the differences of depth are vivid. This super-position method permits several observers, wearing polarized spectacles, to view the object simultaneously.

The use of two TV camera pickup tubes, arranged side by side in a horizontal direction, is also under study. In this arrangement, the left pickup tube would supply a left eye view to one of the receiving tubes of the dual receiver and the right pickup tube would supply the video signal for the second receiving tube.

Special fixture, with a mirror and TV chassis, used for preliminary alignment and testing of a completed picture tube assembly. (Courtesy Philco)



Checking color content and screen coating of picture tubes to assure good black-and-white reproduction. Operator notes the ratio of green, blue and amber against a standard illuminant. (Courtesy Philco)

Research

Half-Million Pound Sound Test Chamber: In a room, fitted with 256 loudspeakers, mounted close together in a panel of 16 rows of 16 speakers each, the acoustics lab of MIT have devised means of measuring sounds of every conceivable level up to the roar of field artillery. With the aid of this unique setup the lab hopes to find solutions to a variety of sound problems.

The scheme for sound measurement has essentially three parts. A uniform steady sound is pushed toward one side of a wall to be tested. On the other side is a microphone which picks up the sound which gets through the test sample. As the microphone moves, the sound it finds is amplified and recorded on a super-precise electronic mapping device.

This sound-measuring method was first proposed during World War II by Professor L. L. Beranek, now technical director of the lab. The equipment has been built under the direction of Professors Bolt and Beranek, while the electronics equipment is the work of Dr. Jordan J. Baruch.

Electronic oscillators drive the speakers, and they can be *phased* so that they all push in unison, forward and backward simultaneously, or so that some are a bit ahead or behind others.

The array of loudspeakers is brought up close to the panel whose sound-carrying is to be checked, and covered from behind so that the rest of MIT is relatively sheltered from their insistent whine. In front, they create a barrage of sound against the wall section under test. Most conventional walls will be tested without full power, but a full 320 watts may be needed to push the noise through very sound-resistant structures.

The test panel, mounted on a steel frame, is set into one wall of a sound-proof concrete test chamber, whose walls, ceiling, and floor (except for the test panel hole) are foot-thick solid concrete. This whole box sits on its own foundations in the center of the lab.

Inside the test chamber is a tiny microphone which moves systematically across the face of the wall panel; this busy messenger reports on how much sound gets through each component of the panel-window, siding and insulation, studding, or whatever there is and sends the report to a mapping device and automatically puts the information on a map-like plot of the test panel.

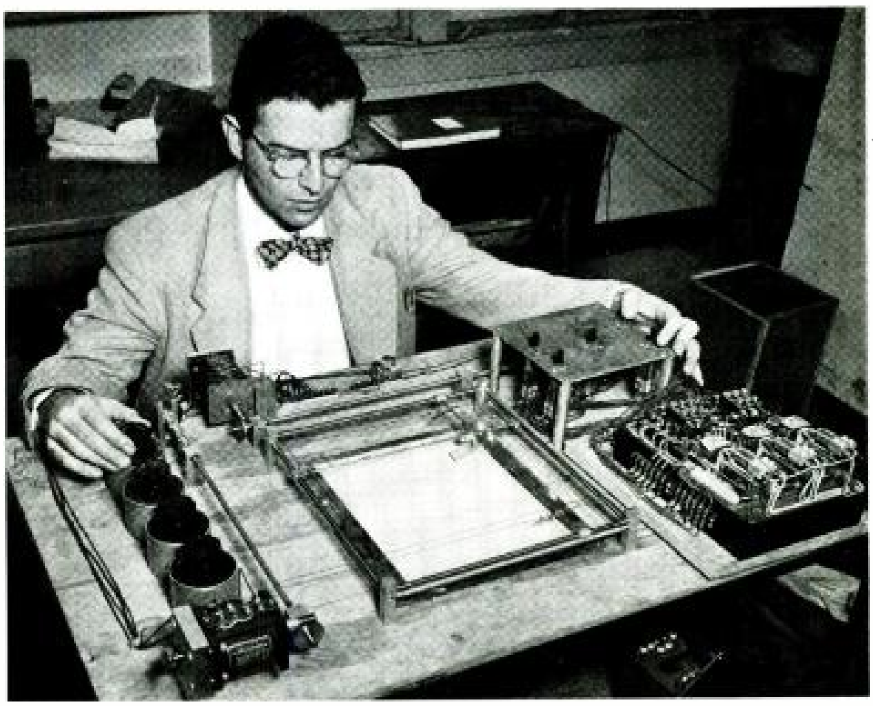
The result is a *contour map* which shows what parts of the panel muffle sounds best, what parts do so less effectively.

The inside of the concrete test room, where the microphone travels its mechanical course, is a cave-like maze of glass fibre wedges coming up from the floor, down from the ceiling and in from the sides. To enter the room one walks on a wire mesh strung taut over the wedges. By absorbing sound which would otherwise bounce around the room, the wedges leave the microphone free to concentrate on the noise that comes through the test panel.

There is also a hole in the ceiling of the test cell through which floor panels can be evaluated.

Interior of new test chamber in the MIT acoustics lab. Left to right, Dr. Richard H. Bolt, director of the lab and Dr. Jordan J. Baruch, designer of the electronic equipment, pointing to extremely sensitive microphone which travels back and forth until it covers the entire area of a sound test section. Analysis is carried out entirely automatically. On the right is Dr. L. L. Beranek, technical director of the lab.

Apparatus which records sound in studies carried out in MIT test chamber. Dr. Baruch, who designed the electronic recording device, is watching the stylus as it draws a sound "contour map" from information transmitted automatically by sensitive microphone moving about in test chamber.



TVE-grams . . .

Equipment Alignment: A technique has been developed by the Naval Research Laboratory which may be employed to indicate, by direct reading or recording, the immediate or long-time frequency variation as related to a standard oscillator to a few parts in 10^9. Although its original purpose was to satisfy this need as applied to primary and secondary standards, the system has been found to be of great value in facilitating investigations in crystal and circuit studies where changes in parameters result in small frequency changes.

This technique can be applied to record any variable which can be converted to frequency change. For example, it could be adapted to measure extremely small temperature variation simply by including a temperature-sensitive element in the frequency-determining circuit such as the crystal in the oscillator producing the frequency of the standard to be measured.

In the field of frequency and time determination, it is often necessary to determine the frequency difference between two *standard* oscillators. This presents a difficult problem since the difference in frequency may be in the order of a few parts in 10^9.

Although various methods have been devised to perform this measurement, they either are not direct methods, or require the offsetting of one of the base frequencies. The technique developed at the laboratory compares the frequency of a base standard with that of a similar standard and records the difference directly in parts in 10^6, 10^7, 10^8, or 10^9 without offsetting either frequency.

In the equipment, designed and constructed at the lab, a standard base frequency of 100 kc is fed into a multiplier-divider system which produces upon separate jacks at its output 4995, 999, 99, and 9 kc. Another 100-kc signal is fed into a harmonic generator which multiplies it to 5 mc. This 5-mc signal is then beat in a mixer section with the 4995 kc obtained from the standard, producing a 5-kc output. This output drives a divider which produces 1 kc, and a decade multiplier which produces 10 kc, 100 kc, and 1 mc.

A switching system and mixer section follows. The switch is so arranged that the 999, 99, and 9 kc derived from the standard can be mixed with 1 mc, 100, and 10 kc, respectively and separately, producing an output in each case of 1 kc. The output of the mixer is then fed into a 1-kc discriminator which produces zero voltage at 1 kc, a plus *dc* voltage when the frequency is higher than 1 kc, and a minus *dc* voltage when the frequency is lower than 1 kc. This voltage drives a one-milliampere zero-center *dc* recording meter calibrated in conjunction with the discriminator, so that a change of 10 cycles will cause the meter to read at the respective ends of the scale.

High Definition Monochrome TV: A new approach towards the achievement of high definition, providing upward of a 50% increase in horizontal detail, has been disclosed by R. B. Dome of G.E. The fundamentally new feature of this system is the unique treatment of small detail in the picture as compared to the larger areas and larger detail of the picture. Observations have been made which show that the eye is not as susceptible to flicker in small areas as it is to flicker in large areas. Based on this premise, a normal video band may be divided into two approximately equal portions. The low frequency portion can thus be transmitted in regular 60-cycle sequence as in present-day monochrome transmissions. But, the upper section of the video band may be utilized on *odd* fields for the transmission of picture detail normally transmitted by present transmitters on both odd and even fields. In this system, the superhigh video band of frequencies, extending beyond the band now capable of being transmitted, is transposed in frequency to fit into the upper section of the band which can be radiated and is transmitted on *even* fields. Thus, if the present band were divided in half, the detail could be extended by a factor of 50%, so that instead of 350 line detail, an effective horizontal resolution of 525 lines could be obtained.

The system can be made compatible by using the principle of frequency-interlace when transmitting the super-high information. The system is inherently compatible for 75% of the information without such treatment because the odd fields are exactly like present monochrome odd fields, and the even fields are like present monochrome even fields for the entire lower section of the frequency band. The only problem remaining is to make the super-high information transmission

Use of sound-level recorder to evaluate the barely perceptible noise made by a kilowatt demand meter in a specially insulated "quiet" room in the new measurements lab of the G.E. Meter and Instrument Divisions at Lynn, Mass. The floor of this room is supported by coil springs, the walls built of layers of insulation material. Access is through three specially constructed doors, each heavily sound-proofed.

New type of "noise meter" recently perfected by Signal Corps Engineering Labs to measure unintentional interference or radiations produced by electric fans, oil burners, automobile ignition systems, refrigerators, etc.

Putting developmental instruments through electrical tests at a harmonic generator, variable frequency, and dc power supply control board in the new lab of the G.E. Meter and Instrument Divisions.

TVE-grams . . .

have a minimum effect on present-day receivers. Since repetitive television information transmitted on alternate fields will largely integrate out, because of the persistence of vision providing the frequencies making up such a signal lie at odd harmonics of half the line frequency, it is proposed to transmit the super-high information in that manner, i.e., by frequency interlace.

Two specific advantages have been claimed for system, which has been submitted to the FCC for study: (*1*) Sampling is not utilized so that no precision gating is required as in dot interlace; (*2*) the texture of the picture is not marred by a fine dot structure.

Materials and Methods

Iron Core Dimensional Specs: A new standard,[1] which defines the terms commonly associated with electronic cores made from iron powder, and specifies the preferred dimensions of standard insert iron cores and threaded iron cores, has been prepared. Specifications include core diameters, lengths, screw inserts, insert size of tuning and insert cores, screw driver slots for inserts, spaded inserts, screw driver slots molded in cores. Thread specifications for standard threaded iron cores are given along with outside diameters and maximum length, diameter tolerance versus permeability, screw driver slots and standard hexagonal holes.

The standard was developed after investigation by the members of the Electronic Core Subcommittee of the Metal Powder Association Standards Committee.

Silicone Rubber: A new silicone rubber compound, developed by the G.E. chemical department, now permits rubber fabricators to mold silicone rubber parts with highly improved mechanical and thermal properties.

Designated as 81223 compound, the rubber permits fabrication of parts without prolonged oven cure. It is said to have excellent molding and extrusion properties after only a five-minute warmup. In view of its hot tear strength, parts with undercuts can easily be removed from molds; and being neutral in color, stock can be colored for product identification purposes for individual fabricators.

Fabricated parts obtained with the rubber compound have been found to have high tensile strength, high elongation, good electrical properties, and be serviceable over a temperature range of 550° F to —85° F.

[1]MPA 11-50-A.

Trends

Unattended Repeaters: A microwave link, comprising two terminal stations and five unattended repeater sites, has been installed by WSM-TV to connect their network program facilities at Louisville, Kentucky, with the station at Nashville, a distance of 163 miles.

To provide sound for the programs, FTL *sound diplexing* is used. This permits the sound and the picture to be picked up and transmitted over the same microwave link.

Intermediate relays are located near Elizabethtown, Smith's Grove, Holtsclaw Hill, Bonnieville, Kentucky and Rockbridge, Tennessee.

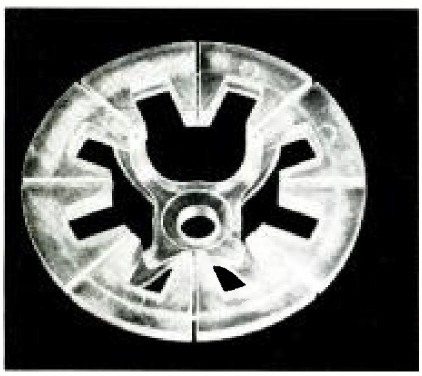
All the equipment in the relay system is ground mounted. The towers at the repeater sites are either one or two hundred feet in height depending on the terrain.

At the base of each tower are two dishes pointed vertically upwards. At the top of each tower are two reflectors inclined at forty-five degree angles. The receiving *fly swatter* transmits the microwave energy downward to the parabolic antenna which is connected by cable to the receiver. A coax cable connects the receiver output to the transmitter and sending antenna which transmits the radiant energy upward to the transmitting reflector. The beam is reflected so as to be transmitted to the next repeater.

This television link equipment, which is turned on and off by time clocks, includes an automatic alarm, by means of which an instantaneous check of the entire system may be obtained.

Unattended repeaters, predicted by many to be the ultimate solution for those long-distance transmitter to studio spans, have become quite an actuality with unlimited application possibilities looming ahead.—L. W.

Kel-F tube base developed for use by Eitel-McCullough. According to M. W. Kellogg Co., manufacturers of the plastic, polymer of trifluorochloroethylene, used in the base, was selected because of its resistance to high temperatures, good mechanical properties, high dielectric strength and ready moldability. The piece, measuring a little more than two inches in diameter and nearly three-quarters of an inch in depth, was injection molded by The American Molding Co., San Francisco.



High-permeability core for deflection of wide-angle, large-screen picture tubes. Made of cold-rolled, grain oriented electrical steel (Hypersil). The core is wound and bonded in circular form from a continuous strip of 5-mil material. It is then cut accurately into two C shaped pieces for ease of assembly around the deflection coils. The extremely thin laminations plus the superior magnetic characteristics of the steel are said to result in excellent linearity and sharper pictures. The cores are rugged and free from magnetic instability due to change in temperature. Core is available in sizes to suit the application. (Courtesy Westinghouse)

Printed corrugated container featuring cardboard "springs" to cushion TV set against jolting made for RCA Victor by the Fibre Board Container Corp., Martinsville, Va., a division of Robert Gair Company, Inc., New York. In packing, set is fastened to a wood skid, covered first with cottony cellulose, then with a moisture resistant paper bag, and finally inserted in the container.

Logic in

The efficient operation of a TV transmitter and studio, as illustrated above (at CBS TV studio) depends on the logical analysis and efficient maintenance of such equipment as that illustrated above at right and below at right. At right, a Dumont dual-film chain control.

TELEVISION has upset the old-line type of thinking—there is no doubt of that. And in the process it has also created a mild paralysis, or befuddled condition, as it were, in the minds of some engineers and technicians. This condition, which may overshadow anything from the choice of test equipment to determining the *fitness* of individuals, has been found to exist during the course of readjustment to changing conditions or new environment, a situation quite prevalent when broadcast engineers or new operators are *broken in* to TV station operation. As a result, snap judgments or distasteful experiences have been found to occur due to misunderstandings between various members of the staff. And, as a rule, these differences are without incident and readjustment follows a smooth, uneventful course. There are instances, however, where opinions or conclusions may be so radically different that a common *meeting of minds* becomes impossible. If these differences are serious enough, they may disrupt group harmony and result in a less-efficient, less-coordinated staff. Individual preferences or opinions, while not so important in AM broadcasting, can play havoc in TV, especially during emergency operation. Lack of cooperation or the failure to adopt a sound, logical procedure for emergencies or special operating conditions can produce disastrous results.

It has been found that all important differences can be adjusted or brought to a common *meeting point*, if only these differences are analyzed and compared *logically*. A *practical* man, for example, need not be a rugged individualist who depends mainly on practical experience, nor should the *theory* man refuse to accept situations which do not appear in the text books. The two can be combined, in fact they *must* be combined if any degree of success is to be achieved. The most valuable man is the one who can draw from both practical experience and theory, and at the same moment keep an open mind for suggestions, improvements, or new developments.

In probing the *meaning* of logic, as it applies to actual maintenance, the term could be defined as . . . "that reasoning power which enables one to ferret out and identify a circuit failure while another man of equal *technical* ability is still looking for clues."

In TV engineering, the use of logic is extremely important. Since a short period off the air is extremely expensive to the station, it is imperative that equipment be repaired and normal operation restored in the shortest possible time.

Logic also covers the ability to determine when and where a certain piece of test equipment should be used. Logic is equally important in determining the correct procedure in maintenance, emergency operations, preparation of schedules, or, for that matter, events which occur in every-day living. In short, *logic* is a short word which covers a lot of territory.

Test Cases

Now that we have a partial definition of logic and a few of its applications, let us apply the term to practical use and see how important it *can* be. The following cases (which, by the way, represent actual incidents), are not presented to cause possible embarrassment to any particular station or individual, but to demonstrate more forcefully the importance of logic in all phases and what can happen when it is not applied. These cases could probably be classified as rare or isolated. Perhaps they are, but more likely they are not. Occurrences of this sort have a habit of slipping through when least expected, especially if the staff has not been well grounded in emergency maintenance or operating procedure.

After studying each case, you might analyze the situation and see what *you* would have done under the same circumstances.

Case 1: The studio sync generator at TV station ——— developed trouble. At the time, only the test pattern was in use, the actual program time being two or three hours away. Although this allowed more time for a study of the trouble and symptoms indicated a major breakdown, no systematic or well-planned maintenance routine was evident. Two engineers were checking the frequency-divider and *afc* circuits with the studio 'scope, while several others, including the supervisor, were studying the schematic. The only explanation of trouble to an arriving engineer was that "*everything* is fouled up!" A point-by-point check of socket or terminal voltages was not being made because the supervisor previously had specified that all troubles *must* be traced with the 'scope (the use of other

TV MAINTENANCE

by JOHN B. LEDBETTER, Engineer, WKRC-TV

Application of Logic at the Transmitter by Personnel Who Can Draw from Practical Experience and Theory and Still Keep an Open Mind for Suggestions, Improvements and New Developments, Found to Be Ideal Means of Minimizing Off-the-Air Periods, Providing for the Use of Correct Procedures in Maintenance, Emergency Operation, Preparation of Schedules, etc. Typical Cases Support Views.

test instruments had been termed *unscientific*). The trouble actually was nothing more than a charred dropping resistor which furnished plate and screen-grid voltages for three separate stages!

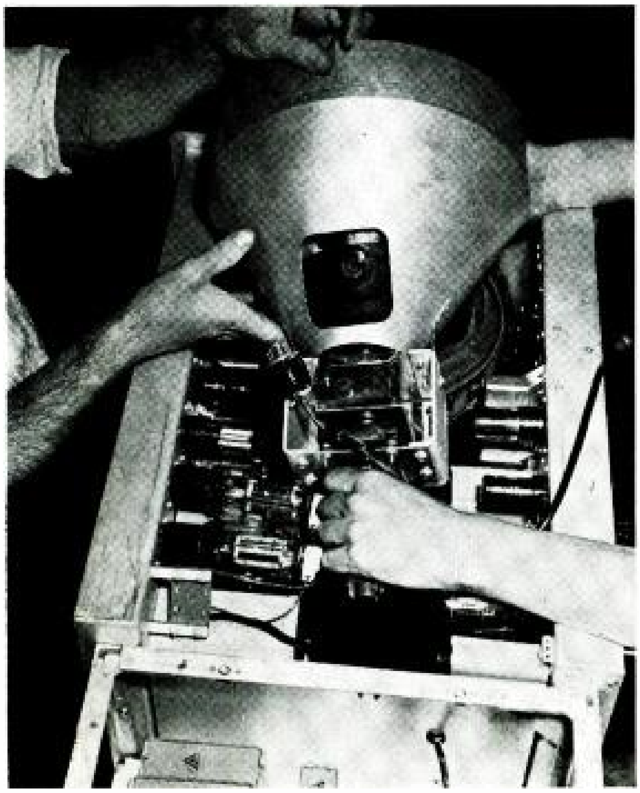
Analysis: A qualifying statement in this case might be that none of the staff, including the supervisor, was very familiar at the time with this particular type of equipment. The fact remains, however, that the application of old-fashioned logic would have done much to rectify the trouble. For instance, the very fact that "everything was fouled up" should have indicated serious trouble in more than one or two stages. This, in turn, should have suggested failure of a common voltage supply circuit or trouble in the power supply, master oscillator, or other stage capable of affecting a number of others. The entire *afc* circuit could have been cleared of suspicion or isolated by throwing the *afc* switch to *off* and noting the effect on the rest of the unit. The power supply, in similar manner, could have been cleared by checking the output voltage, current drain, and regulation on the built-in meters. It will be noted how quickly it was possible to narrow down the field of trouble. Suppose these simple tests cleared the *afc* and power supply circuits from suspicion.

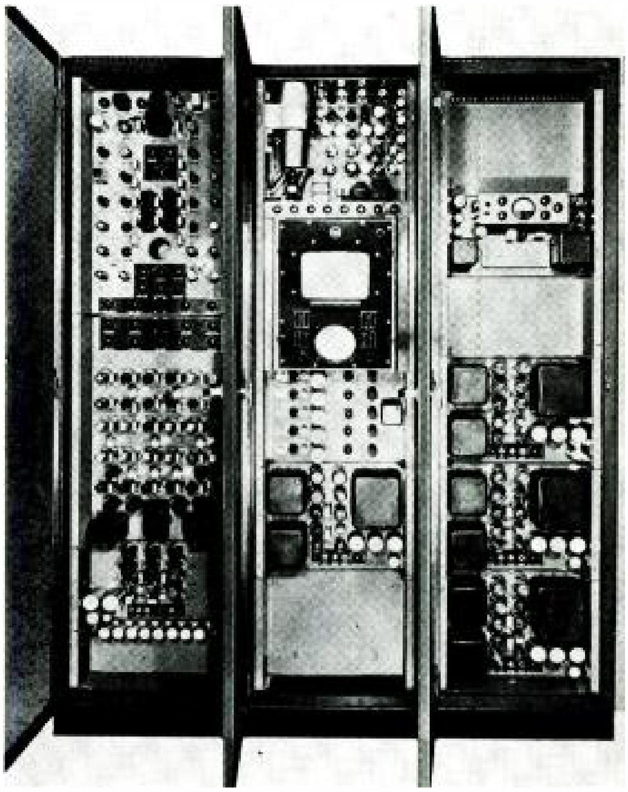
Logical Procedures

The logical procedure now (recalling the statement that everything might be affected) would be to start with the master oscillator, since this stage is common to both the wave-forming and wave-shaping circuits. If we want to be *scientific* we could start by checking for waveforms with the

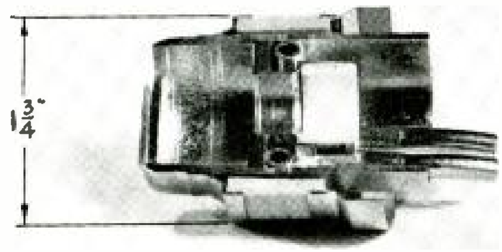
(*Continued on page* 38)

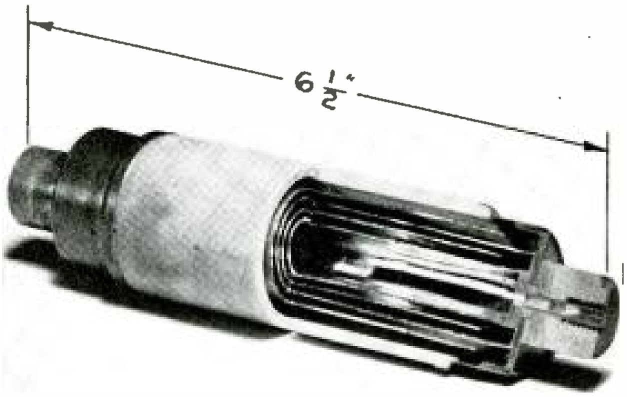
Below, a G.E. chassis and at right, RCA TV racks.





METAL-CERAMIC





A; Above
Portion of an electronic tube showing metal-ceramic seal construction.

B; Right
Ceramic-envelope vacuum capacitor showing construction and brazed seals.

THE INTEREST IN MICROWAVE and other tubes requiring ceramic envelopes has resulted in the evolution of several methods involving the brazing of metals to ceramics. In one approach bonding has been accomplished by the application of extremely finely divided molybdenum and iron powders to a ceramic and heated in moist hydrogen and nitrogen to a high temperature.[1] In another, titanium hydride has been used to produce bonding of certain solders by heating in vacuum.[2] Still another suggests the use of pure titanium and zirconium and its alloys for brazing to ceramics.[3]

The molybdenum-iron process, used in Germany during the war, to produce large quantities of microwave ceramic envelope tubes uses a multi-step hydrogen furnace method wherein the ceramic is metallized prior to brazing. Metallizing is provided by painting a mixture of the finely divided molybdenum and iron powders on the ceramic areas to be brazed, and then sintering and bonding by firing at 1350° *C* in a carefully controlled atmosphere of moist hydrogen and nitrogen. The resultant bonded metal layer is then prepared for brazing by painting on nickel powder and sintering it at 1000° *C*. This process has the advantage of adaptability to well-known hydrogen-furnace brazing equipment and techniques. However, the method does depend to an extent upon the manipulative operator's skill and other difficult-to-control factors, to secure consistent bonding results.

The Titanium-Hydride Process

In the titanium-hydride process, a single-step vacuum method, bonding of the brazing material to the ceramic and brazing together of the metal and ceramic tube parts occur simultaneously. Here, a thin coat of titanium hydride, in liquid suspension, is painted on the areas of the ceramic to be brazed. The ceramic is assembled, with the metal part to which it is to be joined, along with rings or washers of the brazing material. The assembly is then placed in a metal container suitably arranged for evacuation and heating by resistance or induction heating. After evacuation of the container, its temperature is raised until the brazing material is melted. During this heating operation, the titanium hydride loses its hydrogen and leaves pure titanium to alloy with the brazing material. Reaction of the titanium-brazing material alloy with the ceramic forms a strong vacuum-tight bond. This process is a versatile one, being adaptable to the joining together of metals, ceramics, quartz, glass, sapphire and other materials with a variety of solders and brazing mediums.

The Manganese Process

Like the molybdenum-iron process, the manganese process is a multi-step hydrogen-furnace method in which a layer of metal (molybdenum) is bonded to the ceramic previous to brazing. However, the use of manganese has been found to insure reproduceable good bonding with all ceramics and

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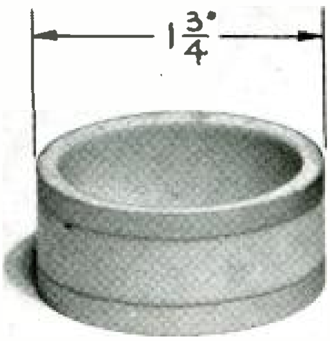
[1] Gross, Malvern J. *New Vacuum Tube Techniques of Telefunken Co., Berlin*, Library of Congress Report PB-17553.

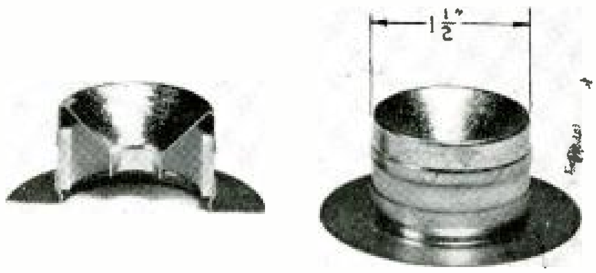
[2] Bondley, R. J. *High Temperature Metal-Ceramic Brazed Seals*, Electronics; July, 1947.

[3] Pearsall, C. S., and Zingeser, P. K., *Metal to Non-Metallic Brazing*, MIT Research Laboratory of Electronics, Technical Report 104; April 5, 1949.



(Left)
Figure 1
Metallized ceramic cylinder before brazing.

Figure 2
A brazed metal-ceramic unit showing junction construction.



Sealing With Manganese

by H. J. NOLTE and R. F. SPURCK, General Electric Co.

Manganese Process, Used in Ceramic-Envelope Tube Production, Permits Bonding of Layer of Metal (Molybdenum) to Ceramic, Previous to Brazing. Approach Insures Reproduceable Good Bonding With All Ceramics and Without the Aid of Finely Divided Powders and Special Protective Atmospheres, and Provides Seals Which Are Mechanically Strong and Can Withstand High Bake-Out and Operation Temperatures.

without the aid of finely divided metal powders and special protective atmospheres.

Preparation of Metallizing Material: For over-all good performance with all ceramics, the metallizing mixture is prepared by ball milling a mixture of five materials for 24 hours . . . 160 grams of molybdenum powder (200 mesh); 40 grams of manganese powder (150 mesh); 100 cc of pyroxylin binder*; 50 cc of amyl acetate; and 50 cc of acetone.

Sufficient amyl acetate-acetone (50%-50%) solution should then be added to the ball milled mixture to give a viscosity reading of 22 seconds with a Zahn viscosimeter. The resultant metal suspension should be suitable for brushing or spraying.

Metallizing the Ceramic: The metallizing mixture can then be applied to the areas to be brazed by brushing or spraying to a thickness of .001" to .002", using suitable masking and rotation means to secure uniform thickness and defined areas. To insure a uniform layer when dry, the coating should be moist a short time after application.

The coated ceramic should now be fired in hydrogen (or other protective atmosphere) for ½ hour at 1350° C. In this, as well as subsequent firing operations, massive or complicated ceramic pieces should be fired in boats or containers lagged with firebrick to prevent shattering due to heat shock. Simple cylinders, in open boats, can be introduced with safety to the high temperature zone of the furnace, if they are given a short pre-heating period (10 minutes) in the furnace entrance. This firing operation forms a strong sintered metallic area securely bonded to the ceramic.

Mechanism of Bonding with Manganese: To bond a metallizing powder to a ceramic, it is necessary to chemically combine them by the formation of eutectics or solid solutions of the metals and ceramic. Because most refractory metals combine indifferently with ceramics, manganese is introduced to the metallizing mixture to stimulate the reaction. This metal is unique in that it reacts very readily with ceramics to provide the means whereby molybdenum powder may combine with ceramics to produce bonding.

Incidentally, manganese is capable of bonding other metal powders than molybdenum to ceramics. For instance, tungsten, iron, nickel and possibly other metals or combinations of them can be substituted for molybdenum. The requisite characteristics of the metallizing metal appear to be an ability to withstand firing temperature and sufficient resistance to alloying with the brazing material, so that its identity as a powder is not lost. Molybdenum is excellent because it not only meets these

*Dupont 5511.

Ceramic	*Type of Body*	*Relative Cost*	*Thermal Expansion*	*Loss Factor at 10,000 Mc±*	*Resistance to Impact*	*Resistance to Thermal Shock*	*Sealing Metal*
Alsimag 243**	Fosterite ($2MgO$-SiO_2)	Low	High	.002	Low (for ½" rod–4.0)	Low	16%Cr–84%Fe
Alsimag 491**	Alumina (Al_2O_3)	High	Medium	.018	High (for ½" rod–7.0)	High	14%Ni–56%Fe
Alumina 2548***	Alumina Al_2O_3)	High	Medium	.010	High	High	44%Ni–56%FE
Zircon Z17A***	Zircon ($Zn\ SiO_4$)	Lowest	Low	.013	Medium High	Medium High	Molybdenum

**American Lava Corp.
***G E.
±Averages from several authorities.

Figure 3
Types of ceramics and sealing metals.

Figure 4
Structure of brazed metal-ceramic junction; 500 magnifications.

requirements, but because its expansion coefficient approaches those of the ceramics.

Manganese Content For Bonding

Good bonding requires that the optimum manganese content of the metallizing mixture should be 20% and firing temperature 1350° *C*. However, good results, particularly with the lower-temperature refractory ceramic bodies, can be had when the manganese content is reduced to 10% or the firing temperature lowered to 1250° *C*. Reduction of the bonding firing temperature minimizes the danger of distortion or sagging of low-fired bodies, such as Alsimag 243 and the zircons.

Preparation of Metallized Ceramic for Brazing: The sintered and bonded molybdenum layer, like ordinary molybdenum or tungsten is not easily wetted by brazing materials; therefore, further treatment of this surface may be necessary before brazing. If silver solder is to be used, the metallized areas should be nickel-plated first, and then copper-plated. Each plating should be applied for 5 minutes at 2 volts. Then, these platings should be sintered in hydrogen for 10 minutes at 1000° *C*. If copper brazing is to be done, the treatment is the same, except that the nickel plating is omitted. The ceramic is now ready for brazing to suitable metal parts.

A ceramic cylinder, with metallized bands, prepared as described and ready for brazing, is shown in Figure 1.

Brazing: Brazing is done in a protective atmosphere in much the same way as ordinary metal-to-metal brazing. Such materials as silver, copper and the silver-copper and gold-copper brazing alloys can be used. Metal caramic fits should be relatively close and the parts clean. Large filets should be avoided to prevent any unequal thermal contraction between the ceramic and brazing medium from cracking the ceramic. This precaution is less important when a very ductile metal such as silver is used.

A finished brazed metal-ceramic unit is shown in Figure 2. The sectional view discloses the relative metal and ceramic thickness and also shows the junction construction for self-alignment.

Lead, tin and other low temperature solders are adaptable, when indicated by economy and use. Again, the technique is the same as for ordinary soft soldering. When lead is used, its extreme ductility permits very loose metal-to- ceramic fits and large filets. In the instances where lead is feasible, a thermal expansion match of metal and ceramic is unnecessary.

A cross-sectional view of a silver solder braze appears in the photomicrograph of Figure 4. The sealing metal is out of the picture at the top. Penetration of the silver solder, into the interstices of the metallized layer, is

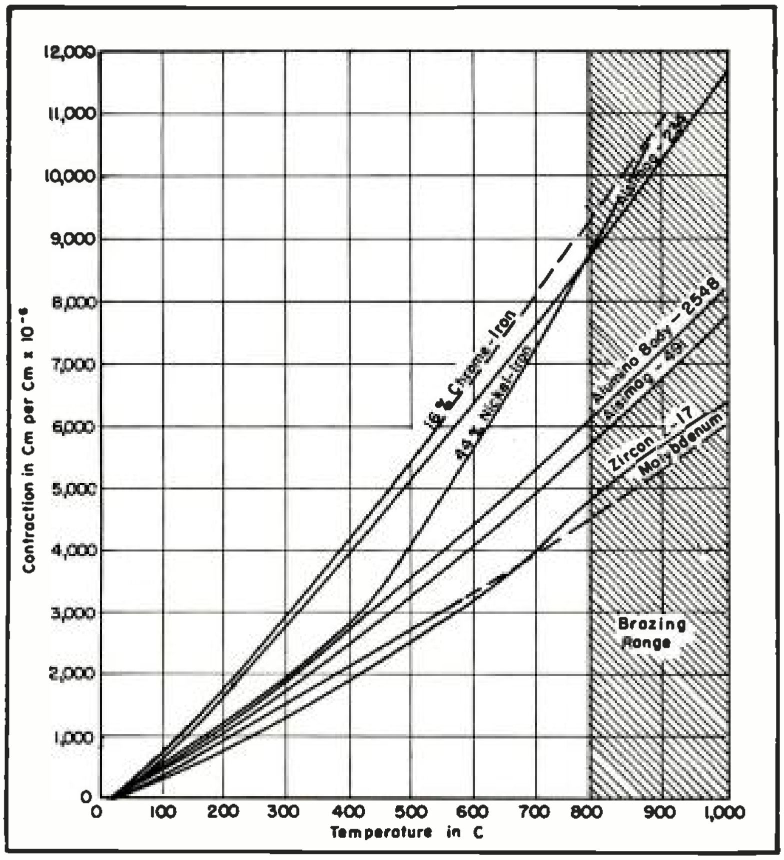


Figure 5
Plot showing linear expansion of ceramics and their sealing metals

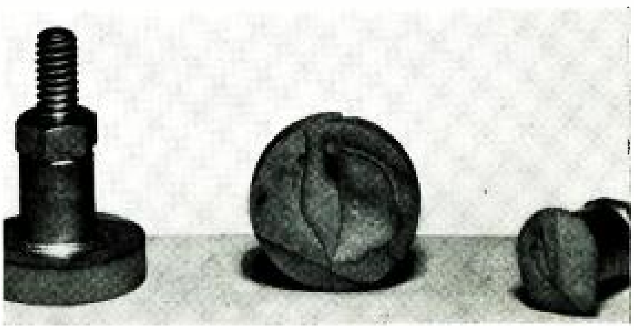


Figure 6
Metal-ceramic butt brazed seal, before and after a tensile test.

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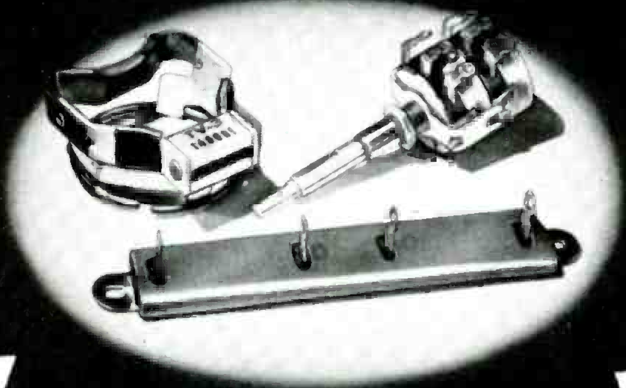

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Figure 7
Butt-brazed metal-ceramic unit showing distortion of thimble after moment test.

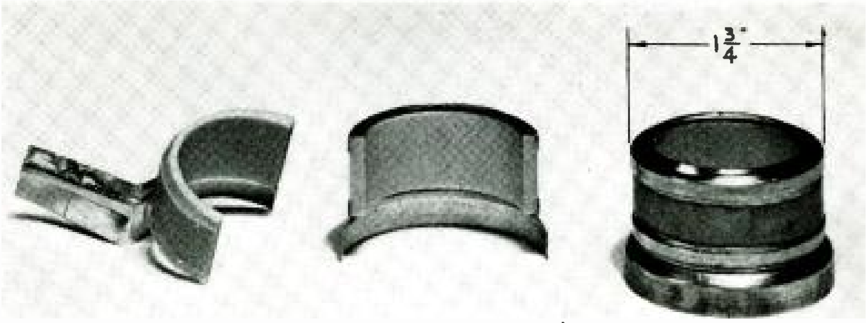

Figure 8
A brazed metal-ceramic unit showing junction construction and stripped-off metal portion.

clearly shown. No evidence of reaction of the metallized layer with the ceramic could be detected with the microscope.

Types of Ceramics and Sealing Metals

Four ceramic bodies, in combination with three sealing metals, have been found to give good results: Alsimag 243 with 16% chrome-iron; Alsimag 491 and Alumina 2548 with 44% nickel-iron and zircon Z17A with molybdenum.

In the Alsimag 243 combination, the ceramic and sealing metal have been found to match in thermal expansion and also be low in cost. The ceramic has the lowest loss factor of any of the bodies, but unfortunately, it is rather poor in its resistance to impact and thermal shock.

In contrast, the ceramics and sealing metal of the 491 and 2548 systems depart widely from one another in thermal expansion. The ceramics, because of machining difficulty, are high in cost. Their redeeming characteristics are, moderately low-loss factors, good resistance to thermal shock and high mechanical strength. The latter feature, with the maleability of the nickel-iron sealing metal, permits successful brazing in spite of the thermal expansion difference of ceramic and sealing metal.

The zircon-molybdenum combination, like the 243, has also been found to have a ceramic and sealing metal match. The ceramic is lowest in cost, has a reasonably low loss factor and is moderately resistant to impact and thermal shock. The difficulty lies in the use of molybdenum as a sealing metal. It is costly, limited in its adaptability to spinning and drawing processes, and cannot be brazed by ordinary means.

Test on Junctions for Vacuum Tightness and Strength

Vacuum and strength tests have been made on the junctions of a large number of metal-ceramic envelopes brazed with the process. Samples of envelopes, exhausted and tested for vacuum over three years ago, still show the original low pressures.

Tensile Stress

Small, half-inch diameter nickel-iron cylinders, with .015" wall thickness, were butt brazed, at their rims, to the flat areas of ceramic discs. These have been found to withstand tensile stress, axial to the cylinder, as great as 400 pounds before destruction. Pulled apart in this way the ceramic will break and portions of it will adhere to the metal part with bond intact. Moment tests of these units, wherein the stress is at right angles to the cylinder axis, show strengths of 100 inch-pounds before breaking. Here, too, portions of the caramic have been found to stick to the metal part. Shown in Figure 7 is a butt-brazed unit which withstood a moment stress in excess of 100 inch-pounds. Cylindrical metal parts brazed to ceramic cylinders, when stripped off, flattened and flexed have been found to show ceramic pieces adhering to them. Figure 8 shows such a stripped-off cylinder, and Figure 9 is a magnified view of the stripped-off metal portion showing adhering ceramic.

Examples of Metal Ceramic Brazing

Various forms of ceramic and metal parts can be joined together with the process. For example, ceramic cylinders in sizes up to 2½" in diameter, such as shown in Figure 10, can be sealed concentrically to metal header members. Other assemblies, utilizing several ceramic cylinders of different diameters, can be brazed together in one operation; (*A*, p. 14). Another complicated structure is the capacitor shown in *B*, p. 14. Here, the two metal-ceramic joints, brazed in one operation, completes the assembly of the tube. Tubes containing these forms of seals will withstand bake-out temperature of 600° *C* and capacitors similar

(*Continued on page* 39)

(Left)

Figure 10
A 2½" diameter ceramic cylinder with brazed-on metal headers.

Figure 9
Magnification of portion of Figure 8 view showing adhesion of ceramic to stripped-off metal.

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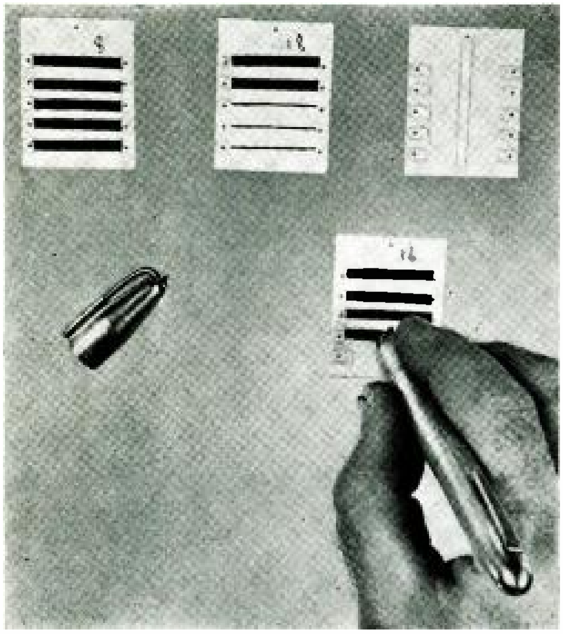
Device for printing resistors by the roller method.



Application of resistor tape to a printed-circuit assembly.

PRINTED CIRCUIT

Report on Striking New Concepts Which It Has Been Found Possible to Apply in the Fabrication of Conductors, Resistors and Capacitors, and Tuned Amplifiers, Video Amplifiers, Audio Amplifiers, Detectors, Input and Output Couplers, etc.

PRINTED CIRCUITRY, which has achieved quite a mature status since the days of '44, winning its spurs because of many simplification virtues featuring the use of more compact components which could be operated at higher temperatures than conventional equipment, has now become the subject of an intensive report which will undoubtedly raise the popularity of the art quite a few pegs.

The report, based on a three-year study instituted at the Bureau of Standards, with every facet of the art as a target of analysis, reveals that printed circuitry looms as a process of unusually broad possibilities, particularly adapted to almost any degree of mechanization desired.

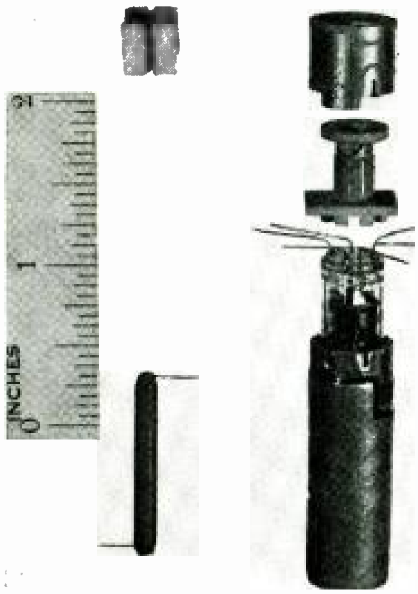
This feature, plus the fact that a *pc* system may be operated independently of component manufacturers or other intermediaries, should be of especial logistical importance during times of national production crisis. For, according to the study, such an integrated system can be based upon strategically noncritical material and may include, if desirable, continuous production in one place from raw material to finished product.

The report discloses that the advantages inherent in printed-circuit production processes are largely based upon the system of metallizing nonconductors to form electrically conducting patterns by the use of screen-process printing and special silver-pigmented paint. Currently, the screen-process seems the best suited of all printing processes for this application. The process combines the outstanding advantages of economy, simplicity, flexibility in application of design, and variability in printing medium and surfaces. Thus, a high degree of mechanization may be accomplished with moderate capitalization, compared to other industrial products of similar complexity, when the duplication of a large number of units is required.

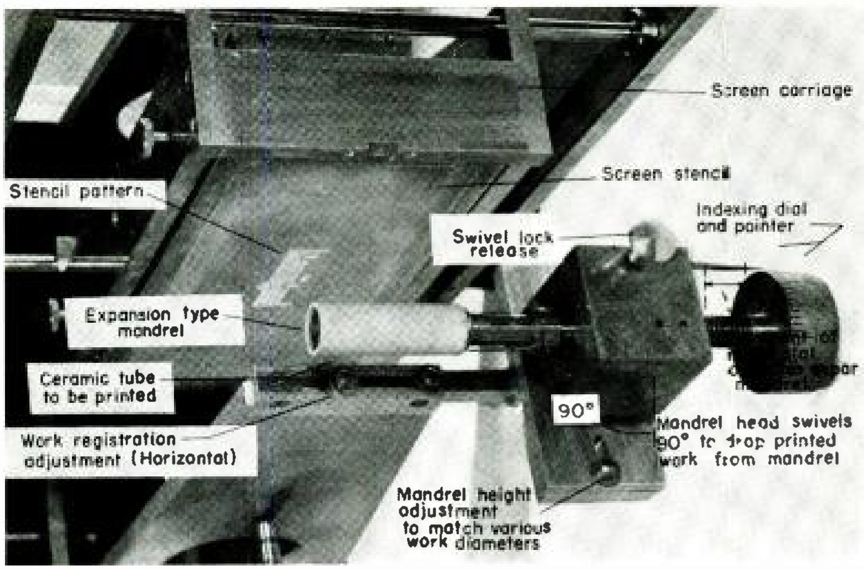
The factors involved in adapting an electronic device to production by this method are indicated principally by the characteristics of the mechanical process and the materials used. The stencil screen process, which was originally designed for printing on plane surfaces, is adaptable to printing on almost any regular surface, including the surfaces of round, elliptical, and conical objects. The screen-printing machine is not greatly complicated by modification for printing on round objects. For example, it is usually possible to use the same flat-screen stencil of the flat-work press on a curved surface by rotating the work form about a suitable axis. However, other factors must be considered such as automatic feeding, conveying and assembling. In general, flat plates lend themselves to simplified handling in these operations, although this may be offset by functional advantages of more complicated work forms in specific instances.

Forming of ceramic bodies can be accomplished by one or a combination of four methods: (1) die pressing, in a hydraulic or automatic mechanical press; (2) extruding, possibly followed by machining operations before firing, such as cutting to length, drilling and tapping or thread cutting; (3) casting, using slips that can be poured into

Printed-circuit components of a single stage 60-mc if amplifier.



Closeup of bottom of screen frame and stencil, showing details of work mandrel.



Production and Assembly Techniques

by RALPH G. PETERS

molds; and (4) grinding to shape after firing.

The first two methods have been found to be the most suitable for large production quantities. The first method is particularly adapted to the large-scale production of flat plates, with any necessary holes and depressions being formed during the pressing operation.

The general effect of the problems connected with the production of ceramic base plates and the printing of conductive patterns, is to favor the use of flat plates because their shape factor provides the highest degree of simplicity. Thin plates printed with electrical conducting elements on the front and back surfaces and interconnected by holes through the plates have found wide acceptance in many applications as printed-circuit base plates. Variations on this basic design to include depressions, cavities, or holes which permit recessing of components, such as vacuum tubes, capacitors, and non-printed resistors, or other components not conforming to monoplanar construction, has proven feasible. The second most geometrical form is the tube or cylindrical construction. If the inside diameter of a tubular printed-circuit base is made sufficiently large to slip over an associated vacuum tube, a very economical ratio of volume to printable surface area may be obtained. The large surface area of the tubular form usually offsets any loss of printable area caused by the difficulty of printing inside the cylinder.

Ceramic Parts

Citing that due to the high temperatures occurring in miniature electronic equipment, the materials suitable as base plates or *chassis* are rather restricted, the BS study declares that metals and ceramics are probably the only choices. Metals are almost entirely eliminated unless they are coated with suitable insulating materials, the best of which are ceramics.

Fired ceramics are extremely hard and brittle. Machining operations are severely limited to those which can be performed in a relatively laborious fashion by high-speed grinders, diamond drills, and saws.

Ceramic materials are available, however, in an unfired state in which they are soft and easily machined by proper methods, and then fired to the ultimate hardness of typical ceramics. Two of these materials, which have proven satisfactory, are unfired or *green* steatite and massive block talc.

Both of these materials can readily be shaped or formed using even the simplest tools. Thus, a hacksaw with a fairly fine blade, or a wood-cutting bandsaw can cut these materials roughly to shape. Holes may be drilled with an ordinary drill press at somewhat higher speeds than for wood or metal. Large surfaces may be finished to close tolerances by using conventional milling cutters in a milling machine, or by means of a metal shaper. At the Bureau some large plates were prepared from block talc by grinding on a toolroom surface grinder. However, the powder was found to contaminate the coolant, caking in the corners of the

Special equipment for printed-circuit fabrication, designed and constructed at the National Bureau of Standards. Equipment at left are flat-bed metallizing presses of hand operated and motor driven automatic type. A metallizing press for cylindrical work is the third item on the table and at extreme right is a continuous furnace.

coolant tank, and becoming difficult to remove.

It was found that both steatite and massive talc change dimensions during firing; steatite shrinking somewhat, while the hydrous-aluminum-silicate form of massive talc expands slightly. The amount of shrinkage or expansion is very definite for a particular lot of material, so that proper allowances may be made during fabrication.

The facilities of the ceramic lab of the Bureau were utilized for firing. A furnace wound with platinum wire was used to obtain the necessary high temperatures. Steatite was fired by raising the temperature of the furnace at a rate of 3° per minute to 1276° *C*, holding at that temperature for one hour, then shutting off the heat and allowing the furnace to cool. Massive talc was similarly treated, except that the final temperature was 1095° *C*. Suppliers of *green* steatite or block talc can fire machined pieces, and the cost may actually be included in the cost of the unfired ceramics.

Conductive Coatings

The conductive coatings used for the printed capacitors, leads and shields are silver paint formulations intended to produce a continuous, firmly adhering, silver film on the ceramic base after firing to the proper maturing temperature. Methods of application of the silver formulations are numerous, limited only by the ingenuity of the fabricator, and the shape and size of the base piece to be coated.

Screen Process Method: This process is based on the use of silk or metal screen on which the pattern to be printed has been prepared as a stencil. The printing apparatus holds the screen and brings together the bottom of the screen and the base to be imprinted.. A rubber squeegee is used to force the silver formulation through the screen openings not blocked by the stencil material onto the base. Screen presses for this type of work have long been used in the printing industry for printing on paper, cloth, plastics, etc. The problem involved in printed-circuitry is to adapt or modify the basic design to the work at hand.

A printing screen suitable for printed-circuit production may be prepared by stretching silk or metal bolting cloth tightly over a suitable frame, and then coating the screen with dichromate-sensitized polyvinyl alcohol. A pattern of the desired circuit can then be placed on the sensitized screen and exposed to ultra-violet light and the protected portions of the polyvinyl alcohol removed by washing. It has been found that 100-200-mesh silk or metal bolting cloth are useful in this process. The coarser meshes in this range may be used to give thicker coats, but the edges may not be as sharp. The finer meshes give thinner coats with sharper, less broken edges.

Ceramic Decalcomanias: An additional method for applying printed-circuit conductive patterns was also studied. The method consists of printing the desired circuit on a decalcomania using suitable firing-type silver formulations. The decal can be applied like an ordinary decal, then fired to remove organic matter and achieve the desired bonding between the silver and ceramic base.

The preparation of conductive-coating delcalcomanias is basically the same as in preparing decalcomanias for the decoration of glass and ceramic ware. The difference in the conductive decalcomania is that it is adapted to printed-electronic circuits and to surfaces encountered in this type of application. The ready-to-use decal consists of multiple layers, or plies, each with a specific function. The base is a special paper stock which acts as a support or carrier for the transfer materials during printing and handling operations. This paper is coated with dextrin which is readily water soluble and forms a parting layer permitting the release of the printed pattern from the paper. A thin lacquer film holds the conductive pattern in proper alignment during the transfer operations from the paper to the work.

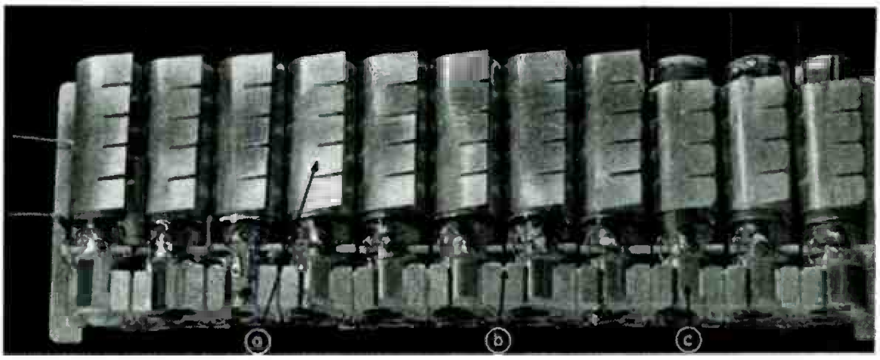
The conductive paint used consists of finely divided silver powder and a small amount of low-melting glass or ceramic-type flux in a paint-type vehicle. The conductive layer of the decal is most frequently applied by the screen-process method which permits the deposition of a thick film of conductive paint in a single operation.

In preparation for use, the decal is soaked in water until the conductive design, supported by the lacquer film, floats free. Excess water is allowed to drain from the film and the film is spread directly on the work surface or rolled on from a resilient surface such as felt, foam rubber or blotting paper; the conductive pattern being faced toward the receiving surface of the work. A soft flexible squeegee or paddle may aid in pressing the decal onto the surface and in the final smoothing operations to remove bubbles and wrinkles. It has been found necessary, at times, to prepare the work surface by a light application of a solvent before the decal is applied. The mild effect of the solvent causes the decal to adhere to the work surface more firmly. After the decal is pressed on, additional solvent solution may be applied on the outside of the pattern to cause the adherence of any defective spots or *bubbles*. The object, with the decal in place, is allowed to dry under a heat lamp for about 15 minutes or in a 100°*C* oven for the same period of time before starting firing operation.

Firing temperatures are dependent upon the type of conductive paint and base material used. Ordinarily, ceramic-base materials are best fired at a maximum temperature in the range from 675° to 730°*C*, heat-resistant glass at approximately 620°*C*, and low-melting glass at approximately 535°*C*. In any case, the parts being fired should be heated slowly from room temperature to the recommended maximum, so that the organic material in the conductive pattern and the lacquer support layer have an opportunity to be driven off without disruptive effects.

A typical firing program would be

based upon two hours in an oxidizing atmosphere as the time required to go from room temperature to maximum and back down to room temperature. The parts being fired do not need to be kept at the maximum temperature for more than 5-10 minutes. The firing operation may have to be modified slightly to allow for the variations and peculiarities of individual types of equipment. If the materials have been handled properly it will be found that the conductive pattern is fired to a silvery color, it will be free of pin holes and bubbles, it will be strongly adherent, it may be soldered to, and it will have the same conductivity as when the conductive coating has been applied by brush or screen process.



Front view of complete assembly of a 60-mc if amplifier. The stage sub-assemblies are held in physical alignment by spring clips shown at (a) and choke-spacer forms (b). The tuning slugs (c) are accessible for alignment after assembly.

Resistive Coating Development

The desired characteristics of a suitable resistor have been found to present a number of difficulties which must be satisfactorily overcome. In addition to stability at temperatures approaching 200°*C*, the resistors must be readily applied and cured and have a reasonable degree of reproducibility. The problems associated with the desired characteristics mentioned have been found to be numerous. Stability for long periods at temperatures of 200°*C* is a formidable requirement, for it must be realized that this temperature is considerably in excess of the decomposition temperatures of practically all presently known organic binders and film-forming materials. The problems associated with deposition of uniform films and reasonable tolerances also offer major difficulties.

Resistor Formulations

The resistor formulations used at the Bureau consisted of carbon black, binder, solvent and sometimes a filler. The silicates were one class of binders which were experimented with for some time. These materials appear to be especially adaptable because they are inorganic, and should theoretically withstand elevated temperatures better than organic binders. One of the simplest and most readily available silicates is sodium silicate. Sodium silicate may be mixed with carbon blacks, and forms films which readily set up or cure. However, these films are extremely hygroscopic and scale off in a few days. Ethyl silicate (tetraethyl orthosilicate) when hydrolyzed, deposits silicic acid which is quite adhesive and possesses the properties needed in a binder. On heating, the silicic acid dehydrates leaving a film of almost pure silica. The hydrolysis of the ethyl silicate was carried out as follows:

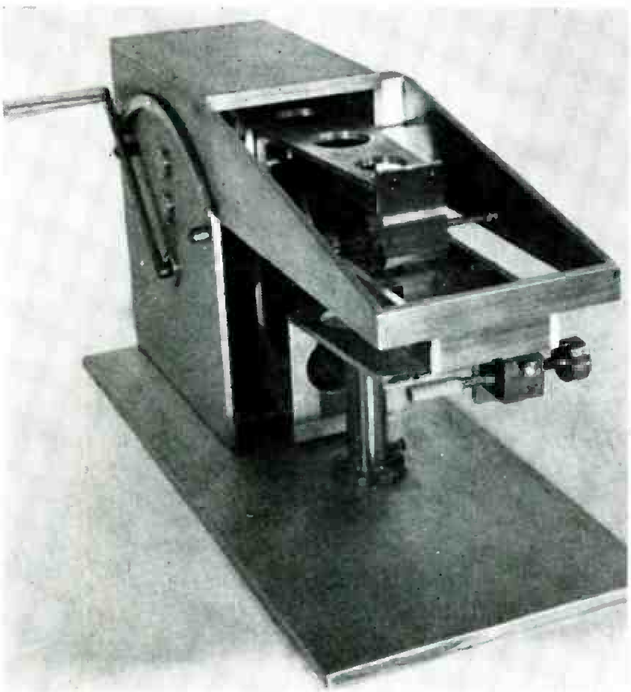
To 100 grams of ethyl silicate 15 cc, of .5 per cent hydrochloric acid was added, and the mixture agitated for three hours.

This mixture was then stored at —10°*C*. This hydrolyzed silicate binder was mixed with carbon black, fillers, and solvents to form appropriate printing formulations.

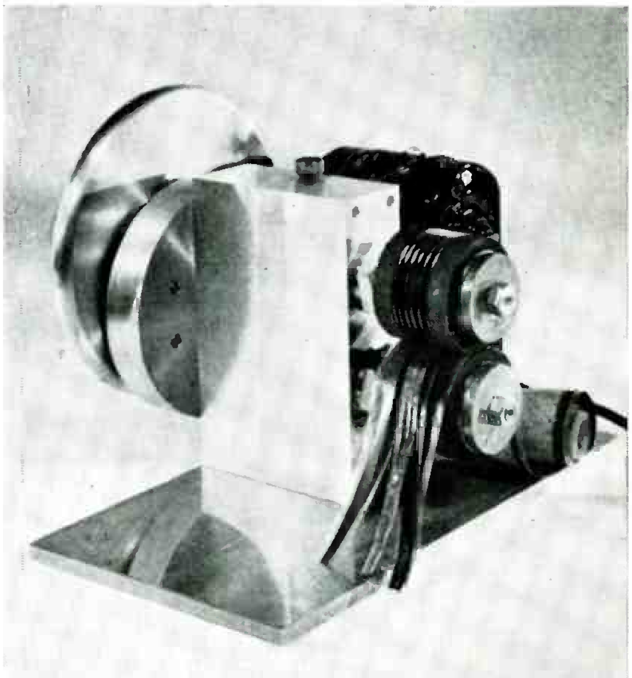
While the results appeared to offer some promise, several difficulties were

(Continued on page 44)

A closeup of the screen printing press for cylindrical shapes. At left is a housing for the operating mechanism which includes a knock-off cam. The squeegee operating arm, and squeegee holder and rubber squeegee are shown at the top of the device. Work mandrel, dial for indexing pattern, screen carriage and work to be printed appear at lower right.



Equipment for slitting resistor tape. Guard and feed guide have been removed from the view to show cutting head.



The Subscriber-Vision System

Figure 1

Front view of rack installed at transmitter to scramble transmissions. Illustration shows operator inserting a code card between photocell and picture tube.

by IRA KAMEN, TV Consultant

Proposed On-the-Air Service Employs Code Cards and Decoder Units at Transmitter and in Receiver

Picture-content scrambling methods, evolved to provide a box-office type of service, which for quite a while were confined to the lab, have now become the object of intensive home-test studies. In one system, being piped over the air by WOR-TV, viewers are now being surveyed on the merits of the method which employs a decoding technique. Employed is an unscrambling device with a receptacle for a decoding card which must be inserted for each event broadcast.

At the transmitter, standard TV synchronizing pulses are fed into a small cathode-ray tube and projected onto a photocell. The output of the photocell circuit is used to supply a final synchronizing pulse to the transmitter. The transmitted pulse is then coded by the insertion of a slide or code card, which has special markings, between the cathode-ray tube and the photocell. The light and dark spaces on the coding card displace horizontal synchronizing pulses so that they do not occur at the same time as the normal uncoded

(*Continued on page 39*)

Above:

Figure 3

Inserting decoding card in decoder.

Below:

Figure 2

Before-and-after scrambling results, photographed during a typical scrambling test. Four images appear in scrambled reproduction.

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TV Systems Engineering For

Planning for Initial Phase of Independent Station Operation to Minimize Costs Found to Revolve About Centralization, With Program and Operational Activities Concentrated in One Location. Specific Factors to Be Considered Include Transmitter-Site Systems Layouts Which Are Closely Related to Program Requirements and Can Influence Operational Costs in a Substantial Way.

Independent television stations, operating in small markets, are today faced with that disturbing situation which was so common in the early days of aural broadcasting: red ink operation before income can defray operating expenses. At present it appears as if the condition may persist for from one to two years. Just how soon it will be possible to pay the operating expenses, amortize equipment and earn a profit will depend greatly on two factors, the engineering layout of the television system and the program requirements. During the initial red-ink phase of operation, however, it has been found that the losses can be minimized by concentrating all program and operating activities in one location to achieve maximum utilization of manpower and better supervision.

The transmitter location is a vital factor in the new-station problem. There should be no compromise on the site. The transmitter should be centrally located, with respect to the densely populated areas, and should have its antenna high above the average terrain. From the standpoint of economy and convenience it is desirable to utilize an office building provided the service area of the station will not be compromised by antenna-height limitations.

If the transmitter is located on a hill or mountain, the location should be selected, with respect to the center of population, and the future possibilities of growth. In instances where such a location is near an ocean, desert, or high mountain range, directional antennas must be considered to provide concentration of the radiation over the populated areas, and thereby extending the useful service area of the station and improving the signal-to-noise ratio in industrial and metropolitan areas.

Irrespective of the transmitter location, it has been proven that considerable savings in manpower can accrue if film, studio, and microwave facilities are provided at the transmitter plant. If the transmitter plant is so remote that it cannot be served by public transportation, it then becomes desirable to have the main studio located downtown and the programs microwaved to the transmitter. However, a small auxilliary studio at the transmitter has been found invaluable for holiday, Saturday, Sunday and late-at-night operation, thereby releasing the large studio crew after they have completed their regular day's work. In small markets it may be desirable to forego the convenience of the downtown studio and operate exclusively from the transmitter, until it is evident that a studio will be adequately utilized. It should be remembered that many AM radio station engineers and managers have built *monuments to broadcasting* with a half dozen studios, with good intentions of producing many live programs back to back, but in practice they are seldom used

(Left)

The KRON-TV control console and transmitter room as viewed through the studio window. All equipment having controls has been located in the control area for convenient operation by one man, during test pattern network or remote studio programs, or two men when film and live studio programs are to be transmitted. The power supplies have been removed from the area to increase rack space for equipment having controls and to reduce heat in the operating area.

(Above)

Transmitter control at KRON-TV, in action. Left to right: Jule Vetter, audio control; Bill Sadler, video control; Marc Spinelli, producer-announcer; Fred Street, cameraman; and Lee Gero, commercial announcer. In this instance, a live program consisting of a one-minute spot, was being offered in conjunction with a one-hour film program.

Economy of Manpower

by R. A. ISBERG, Chief Engineer KRON-TV and President, Isberg Engineering Co.

because of network commitments and transcribed program material.

The proposed program structure and the potential sales requirements represents the second criterion of the television system design. *While program structure dictates the facilities required, the operating costs are greatly influenced by the engineering systems layout.*

Most systems-engineering plans for TV stations, available from TV manufacturers, have been patterned according to network-owned station-operating practice where manpower is normally more readily available than in the smaller independent stations.

In addition, influenced by the usual conservative attitude of engineers in providing a system layout that would satisfy every possible operating condition, the proposed methods have not been too practical for the unaffiliated station. In an effort to solve the problem several stations have followed a different approach by first analyzing the program structure and the requirements of the operating staff. The success of this type of design has been found to be directly reflected in additional number of program hours produced, reduced technical staff and reduced amount of overtime.

Analyses of the operating functions of personnel assigned to the various positions of the conventional TV plant have revealed that there is a substantial wastage of manpower which can be recovered by combining the duties of engineers as well as program people. For example, a man assigned to transmitter duty ordinarily has few operating duties other than to readjust filament voltages, check percentage of modulation and frequency, and keep the engineering logs. In some stations he also keeps the program log which may become so involved that it will require his continuous attention. In this instance, the man keeping the program log is assigned to transmitter control-room duty while another man is made responsible for the transmitter. By the simple expedient of assigning the responsibility for the program log as a function of the program department (the announcer on duty), technicians can be relieved of a routine bookkeeping chore and are available for operating functions.

Since the transmitter man has relatively little to do, he can easily absorb other duties, such as monitoring audio levels, playing recorded-station identifications, relieving the control-room man, audio switching at times when program sources are being switched, etc.

By relieving the control-room man of the program-log responsibility, the technician can be utilized for additional video requirements, such as film and live camera control operation and the loading of film projection equipment.

Typical Standard Layout

In Figure 2 appears a typical *standard* layout of a TV plant which permits programming at the transmitter with film, studio cameras, and microwave facilities. Depending upon program requirements this plant could require six technicians, and one or more program personnel when film and live programs are being produced. By coordination and planning, the duties of the various men can be combined. Thus, the transmitter man can change slides, load projectors, rewind film, etc., without being away from the transmitter control room for long periods of time. The video-control man could be responsible for the makeup of the film and technical operating sequences. If the live program is simple, such as a newscast, a short commercial demonstration, an interview, or a series of title cards in connection with a film program, one or both live cameras may be in fixed positions, thus eliminating one and possibly two camera men.

Since the audio from film, network or studio has been previously monitored, the sound man's function could be assigned to the transmitter man. However, the layout shown in Figure 2 does not permit such an operation. The arrangement illustrated in Figure 3, representing the systems layout of KRON-TV at San Francisco, provides for such a setup.

All equipment having controls, including the transmitter console, has been located in a *U*-shaped console designed for only two-man operation, when programs originate at the transmitter. If the program originates at the downtown studio or the network only one man is required. Fixed microphones, fixed lighting of a 12' x 19' studio, and fixed-studio cameras are utilized for most of the live shows originating at the transmitter. These shows are usually very simple involving drop cards and demonstrations against back drop sets. When the cameras have to be dollied, panned, or the lens turret changed, a third man is assigned. This studio has been found to be a great asset in that the studio crew need not be scheduled to cover late at night operation, holidays, or *off days*. Should overtime be incurred, to present a live commercial spot late at night or on an *off day*, only one additional man is required to operate the cameras. On several occasions, shows involving more than thirty persons have been very successfully presented from this auxiliary studio.

The left end of the *U*-shaped operating area includes rack-mounted equipment minus the power supplies. A studio type synchronizing generator* is contained in one rack; video equipment including two microwave receivers, two stabilizing amplifiers, a video jack panel and two distribution amplifiers comprise an adjoining rack; and the audio equipment including the limiting amplifier, preemphasis network, magnetic tape recorder, audio jack panel, audio equalizer, and video bar generator is located in a third rack. The transmitter power console is next, the space below the operating shelf being utilized

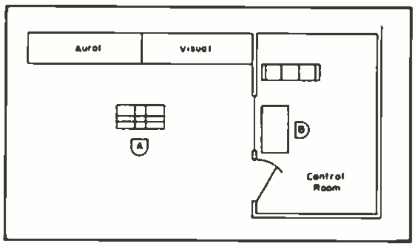
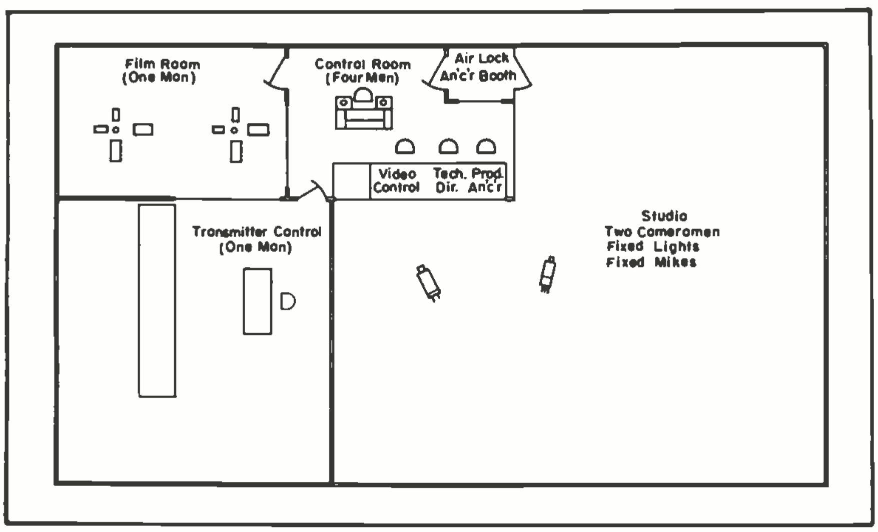


Figure 1
Conventional transmitter control-room arrangement. Technician at (a) is normally responsible for the transmitter and the engineering logs, while man (b) is charged with the control of picture and audio quality and preparation of program logs.

for a studio lighting switch panel so that the technicians can have control of the pre-set lights. Next in line is the *on-the-air picture* and wave-form monitor, and then the transmitter audio video-control panel. Under the operating shelf of this console are the power switches for the video and audio equipment. An intercommunication panel for talking to the film room, studio, office, shop and front door, is located between the transmitter audio video-control panel and the control consoles for the two film cameras. Adjacent to the second film-camera control is a special console containing two variacs for the slide projectors, controls for the two automatic and fixed-slide projectors and an opaque projector, remote controls for two 16-mm film projectors, and a two-mixer audio channel providing a choice of ten audio inputs. This audio console permits one-man operation of video and audio switching since it places faders, selector switches, and remote controls for starting and stopping the turntables and magnetic tape recorders within easy reach of the operator. The video switcher and program monitor is next in line, followed by two

*RCA.

Figure 2
A conventional centralized TV station. In this setup a staff of six men is required for film programing, microwave and network duties. By rearranging the equipment layout and reassigning duties, it has been found that two engineers and one producer-announcer can do the work of six.



field-type camera control units for the studio cameras.

Completing the *U* on the right-hand side is a six-channel audio console containing the equivalent of a relay rack full of audio equipment, all of the plug-in variety, and two turntables with special cueing systems and modification for remote relay control.

The audio system is unique in many ways. It was designed to satisfy the requirements of a one-man video audio operation and still permit separation of the audio control from the video control, when two men must be employed to handle levels, switching and so forth. This is accomplished by providing two separate program channels, one for a two-channel mixer and the other for a six-channel mixer; the outputs of the two channels can be combined to feed the transmitter. This flexibility is also utilized in playing recordings through one channel feeding a speaker in the studio, so that an artist can sing to the accompaniment of the recorded orchestra without danger of acoustic feedback, because his voice is being amplified by the other channel.

The film room at our station was designed to be remotely controlled and is nearly 100% automatic in operation. Automatic slide projectors have been modified for remote control and special cams and reversible motors installed. Thus, it is unnecessary for a man to be in the film room to change slides. Since each automatic projector is associated with one film camera, the video operator can easily preview and shade each slide before *taking it* on the air. The film-room equipment has been laid out for maximum efficiency and continuity of operation. Since duplicate equipment is provided, protection in case of equipment failure is assured.

Use of 95-Minute Film Reels

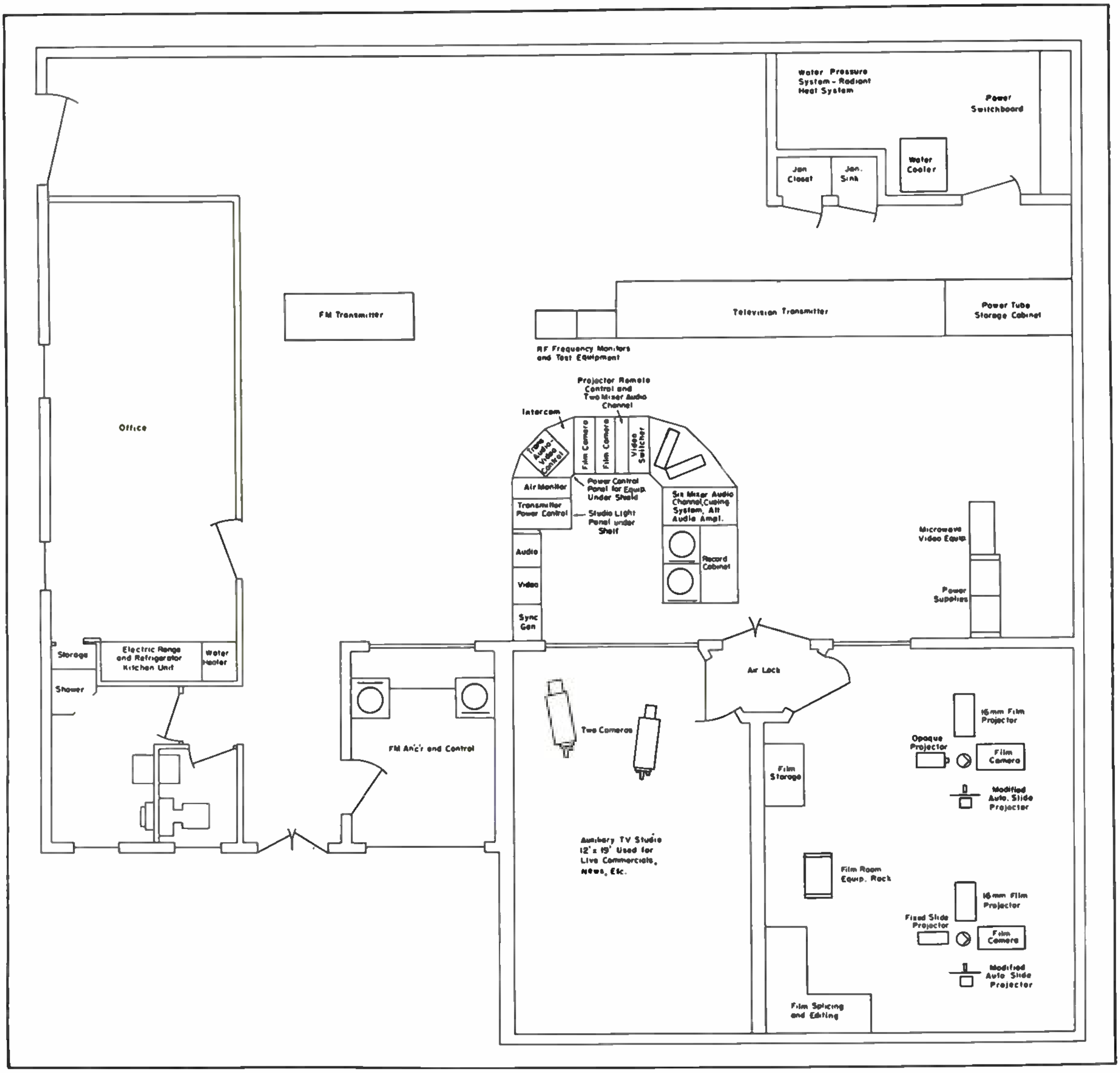
The 16-mm film projectors have been modified by extending the reel arms and by providing specially designed 95-minute film reels.** Thus, a one-hour picture-tube recording or film feature may be spliced to film-station identification, film-spot announcements and another half-hour show, and run continuously on one projector. Film editing and makeup is done by the program department downtown and the film delivered to the technicians at the transmitter by a messenger service. Facilities for the film makeup is included in the transmitter film room and all technicians are familiar with the techniques.

The division of duties at the KRON-TV transmitter is such that the transmitter man is responsible for audio switching, cueing, and playback as well as the engineering logs and relief for

**Goldberg Brothers, Denver, Colorado.

Figure 3

Facilities arrangement at KRON-TV which has been found to be very efficient in manpower requirements. Before the station was constructed, the operating area was mocked up full scale for complete operational analysis.



the video control man. The video control man coordinates the technical switching, shades film, sets up live-camera control, loads film and slides and plans the operating sequence for the following day's program routine sheet. The announcer on duty at the transmitter is responsible for the program production at the transmitter and the program log. If a cameraman is required, he is usually one who completes his day at the transmitter after the downtown studio has shut down.

The downtown studios likewise have a number of manpower-saving innovations. Eleven-foot high doorways connect two studios with the set storage and carpentry shop. Thus, much of the scenery can be readily moved by one man. Fixed lighting has been provided for all fixed sets, and fixed microphones as well as a microphone boom are utilized for audio pickup. The studio crew consists of a technical supervisor who normally operates the video switcher, and two camera controls, an audio man, and two cameramen. The microphone boom and lights are operated by junior technicians who also assist in setting up the studio. Back-to-back programming is smoothly accomplished in the studio with cameras, microphone boom and lights being moved from one end of the studio to the next during a one-minute film spot. The synchronizing generator at the studio is locked in with the synchronizing generator on the mountain, thus facilitating switching and video lap dissolves.

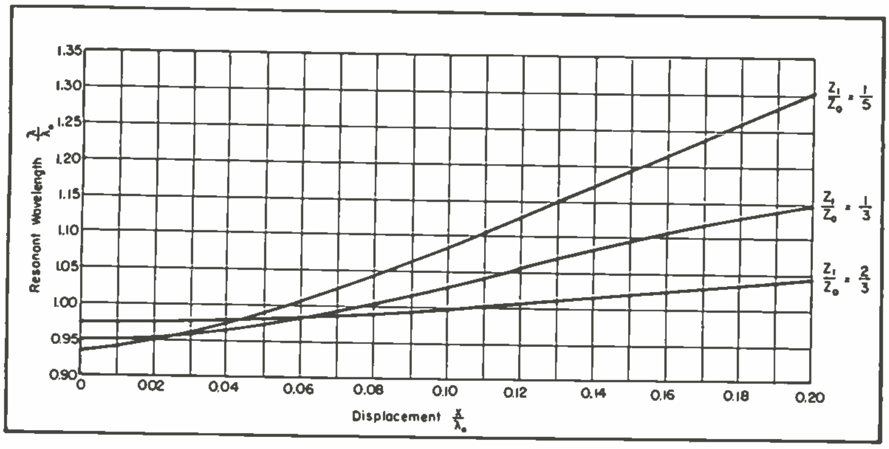
In our studio floor plan, facilities have been provided for audience participation shows, automobile commercials, complete kitchen, and nearly every type of show yet devised.

Through careful attention to scheduling and sales commitments it is possible to operate our station on a six-day week basis producing 12 hours of test patterns, 22 hours of live programs, and 20 hours of film programs, with a technical staff of only eight technicians and two junior technicians. It has been found that technicians need not be

(*Continued on page* 39)

Discontinuity Tuning Charts for Resonant Coax Lines

by J. GREGG STEPHENSON, Receiver Section, Airborne Instruments Laboratory



(Above)

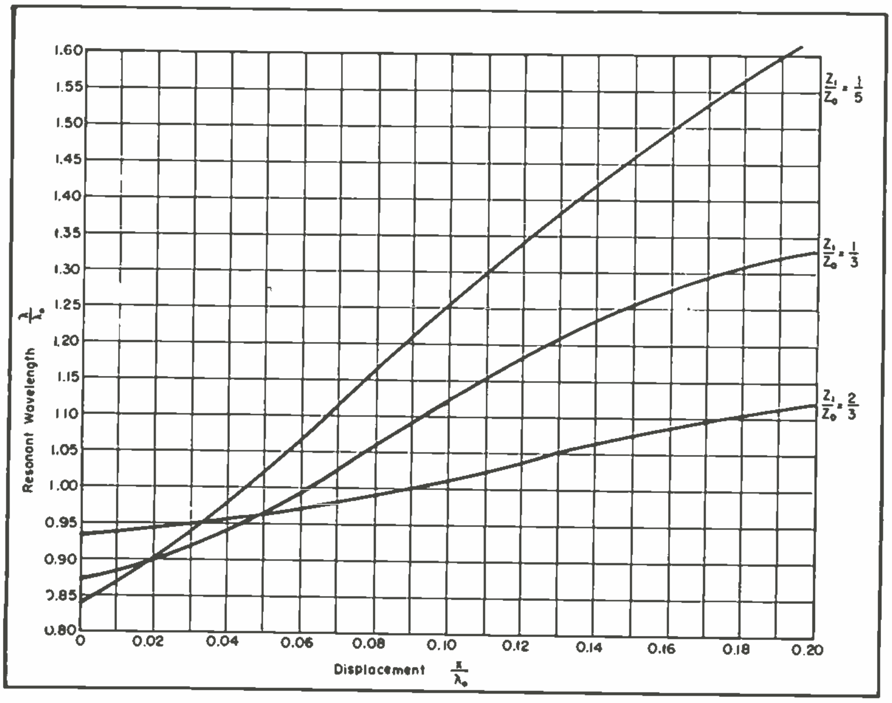
Figure 2

Plot for the $\lambda/4$ mode, and $d/\lambda_0 = .02$.

(Below)

Figure 3

Plot for the $\lambda/4$ mode, and $d/\lambda_0 = .05$.



Discontinuity tuning has been found to offer many advantages when applied to certain applications of coax-line oscillators, amplifiers, and other *hf* resonant circuits. The method is mechanically simple, provides electrical symmetry, and can be constructed without using rubbing or sliding metallic contacts or fingers. In addition, no *dc* connection across the transmission line is necessary, and an approximately constant incremental tuning range, with adjustable center frequency, can be provided. It is also possible to employ a large mechanical translation per megacycle for vernier tuning, or to obtain appreciable tuning ranges with fairly small motions of the tuning discontinuity.

The various parameters of a resonant coaxial line, tuned by a movable sleeve, are defined in Figure 1. Three assumptions about this resonant system have been made: (*1*) negligible transmission line losses, (*2*) terminating capacitance C_0 equals zero, and (*3*) effects of discontinuity capacitance at the corners of the tuning sleeve are negligible. The first two assumptions involve little error in practical cases, but the third assumption does involve a correction for which curves have been prepared.

The movable discontinuity is considered as a line section having a characteristic impedance Z_1 smaller than the characteristic impedance of the main coaxial line Z_0, and length d shorter than the length l_0 of the main line. One end of the main line is short circuited, while the other end is terminated in a small capacitance C_0. The movable discontinuity can be a metallic sleeve that constitutes either an enlargement of the center conductor, as in *a* of Figure 1, or a shrunken section of the outer conductor, as in *b* of Figure 1. In such cases, the tuning sleeve is assumed to have highly conducting surfaces. It is possible to avoid all metallic sliding contacts by inserting a thin cylinder of low dielectric constant, low-loss material between the sleeve and line. The necessary actuating motion for the tuning sleeve can be obtained in various ways. Dielectric or metallic push rods can be used, or the movable sleeve can be driven through slots in inner or outer conductor.

A tuning sleeve made entirely of low-loss dielectric or a sleeve made partly of dielectric and partly of metal may be used. The tuning curves still apply, but an equivalent characteristic impedance Z_1' and an equivalent sleeve length d' must be employed.[3]

Derivation of Charts

Nine charts. Figures 2 through 11, have been derived on a normalized basis, using the undisturbed resonant wavelength of the coaxial cavity, λ_0, as the reference. The curves disclose the variation of λ/λ_0 as a function of x/λ_0, where λ/λ_0 is the normalized resonant wavelength and x/λ_0 is the normalized distance of the beginning of the discontinuity from the short-circuited end of the resonant line. The three most common resonant modes of operation are covered ($l_0 = \lambda/4$, $3\lambda/4$, and $5\lambda/4$). Three values of the normalized length of the discontinuity d/λ_0 have been chosen, ($d/\lambda_0 = 0.02$, 0.05, and 0.08). Finally, three values of the ratio of the characteristic impedance of the discontinuity to that of the main coax line have been selected for the families of curves ($Z_1/Z_0 = 2/3$, 1/3, and 1/5). These values of the parameters embrace most of the range of practical interest for tuning applications. Moreover, it is possible to employ linear interpolation with little error for solutions falling between the curves.

Referring to Figure 1, λ_0 the undisturbed resonant wavelength of the coax line (the wavelength with the sleeve removed) is defined by

$$\lambda_0 = 2\pi v C_0 X_0 = 2\pi v C_0 Z_0 \tan (2\pi l_0/\lambda_0) \qquad (1)$$

Where: λ_0 is the undisturbed resonant wavelength in cm.

C_0 is the terminating capacitance in mmfd.

X_0 is the reactance of C_0 at $\lambda = \lambda_0$ in ohms.

Z_0 is the characteristic impedance of the main coax line in ohms.

v is the velocity of propagation, 3×10^{10} cm/sec.

l_0 is the total length of main resonant line in cm.

The curves presented in the charts are solutions of λ/λ_0 as a function of

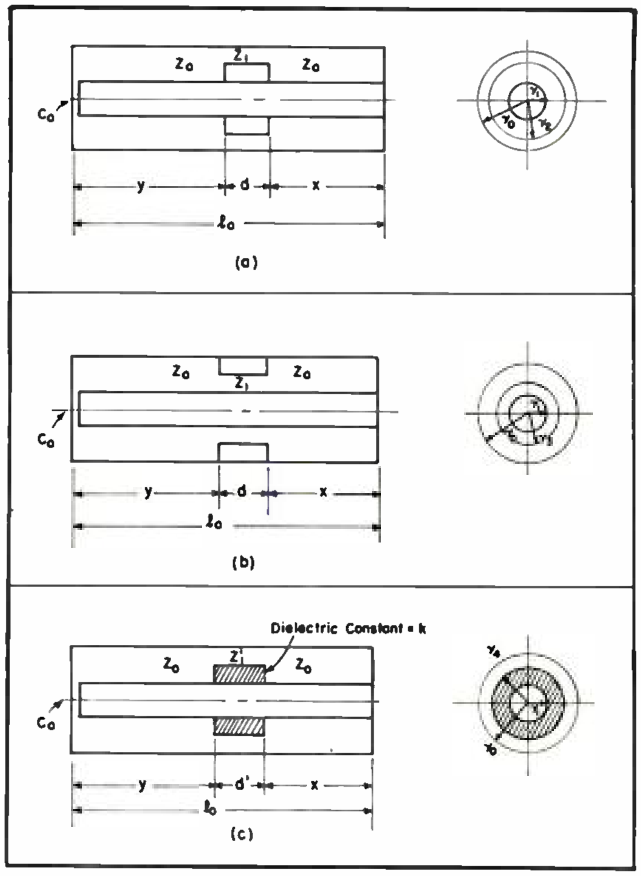


Figure 1

Parameters of a resonant line, tuned by a movable sleeve, are illustrated in these cross-sectional views. In (a) is shown the discontinuity on an inner conductor; (b), discontinuity on outer conductor; (c), dielectric tuning sleeve on inner conductor.

Quantitative Data, Included in Series of Plots, Detail the Tuning Ranges That Are Realizable With Resonant Coax Lines Which Can Be Tuned by a Movable Sleeve That Forms a Line Section Having a Characteristic Impedance Smaller Than That of the Main Coax Line. Curves, Which Permit Prediction of Tuning Behavior Fairly Accurately, Have Been Derived on a Normalized Basis.

x/λ_0 for various fixed values of Z_1/Z_0, d/λ_0, and l_0/λ_0 in the equation

$$\frac{\frac{\lambda_0}{2\pi v C_0 Z_0}\left(\frac{\lambda}{\lambda_0}\right) - \tan 2\pi\left(\frac{y}{\lambda_0}\right)\left(\frac{\lambda_0}{\lambda}\right)}{\frac{\lambda_0}{2\pi v C_0 Z_0}\left(\frac{\lambda}{\lambda_0}\right)\tan 2\pi\left(\frac{y}{\lambda_0}\right)\left(\frac{\lambda_0}{\lambda}\right) + 1} = \left(\frac{Z_1}{Z_0}\right)\frac{\left(\frac{Z_1}{Z_0}\right)\tan 2\pi\left(\frac{d}{\lambda_0}\right)\left(\frac{\lambda_0}{\lambda}\right) + \tan 2\pi\left(\frac{x}{\lambda_0}\right)\left(\frac{\lambda_0}{\lambda}\right)}{\left(\frac{Z_1}{Z_0}\right) - \tan 2\pi\left(\frac{d}{\lambda_0}\right)\left(\frac{\lambda_0}{\lambda}\right)\tan 2\pi\left(\frac{x}{\lambda_0}\right)\left(\frac{\lambda_0}{\lambda}\right)} \qquad (2)$$

where x, y, d, are as defined in Figure 1. The solutions are for $C_0 = 0$, but, as indicated in the examples*, the value of C_0 has been found to have little effect on the curves.

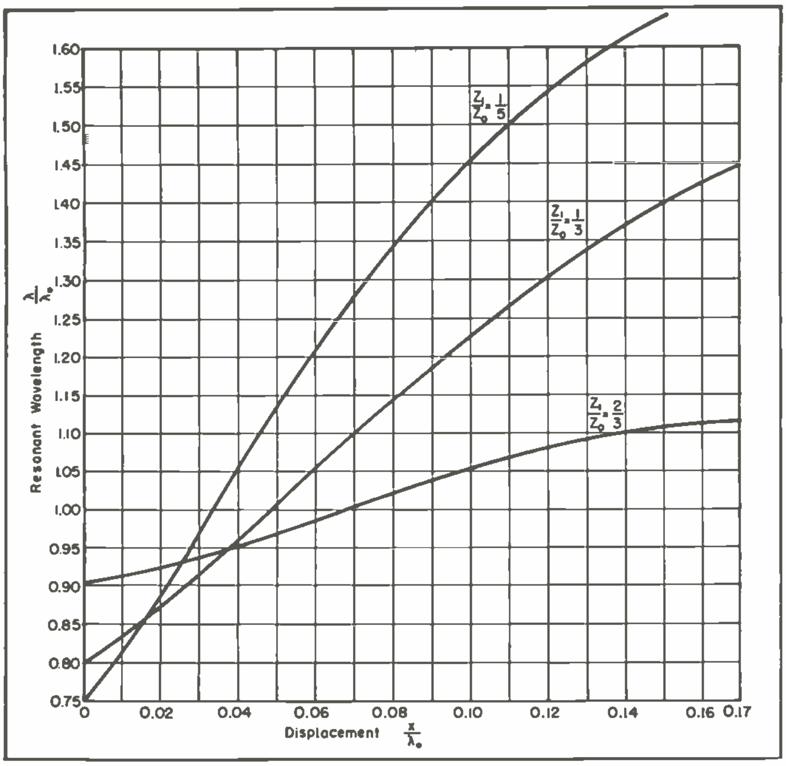
Solution to Equation

This transcendental equation may be solved in various ways, all involving considerable labor and patience for the number of solutions necessary to establish the tuning curves. It was found possible to obtain the solutions most easily by means of the Smith chart,[2] using systematic substitution and interpolation. The curves thus derived are, of course, subject to slight numerical inaccuracies, but the effects of the fundamental assumptions can cause somewhat greater differences between computed and measured values than these inaccuracies. Therefore, slide rule accuracy and the use of the Smith chart seem justifiable.

Effects of Assumptions

Transmission-line losses can be made low enough (by silver plating for example) to be negligible. The effects of capacitance loading at the end of the resonant line are relatively small in curves that are presented in a normalized manner as here. This has been borne out by check substitutions and by measured curves. The principal effect of capacitance loading is to shorten the main coaxial line; that is, to reduce l_0 for a given resonant wavelength λ_0. This means merely that x/λ_0 cannot attain such large values with a finite C_0, as is possible when $C_0 = 0$.

To neglect the discontinuity capacitance at the sharp edges of the tuning



(Left)

Figure 4

Plot for the $\lambda/4$ mode, and $d/\lambda_o = .08$.

sleeve introduces a greater error than neglecting any other single factor. By comparing measured and calculated values at wavelengths from 15 to 60 cm, it has been found that the actual total tuning range of a discontinuity is always somewhat greater than that predicted by the charts. This effect correlates with the magnitude of the total discontinuity capacitance C_d at the sharp edges of the tuning sleeve. Discontinuity capacitance has been defined and calculated by Whinnery and Jamieson.[3] In all cases, the presence of discontinuity capacitance causes a slight increase in the minimum wavelength obtainable λ_{min}/λ_o and a somewhat greater increase in the maximum wavelength λ_{max}/λ_o. Figure 6 represents the average correlation observed between total discontinuity capacitance C_d and the tuning limits λ_{max}/λ_o and λ_{min}/λ_o for various values of d/λ_o and on various resonant modes.

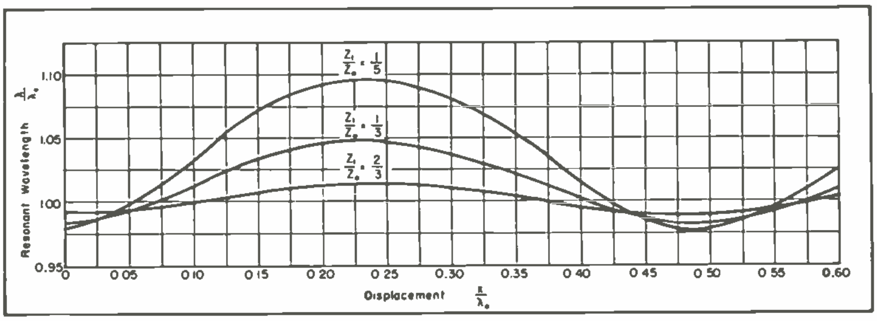
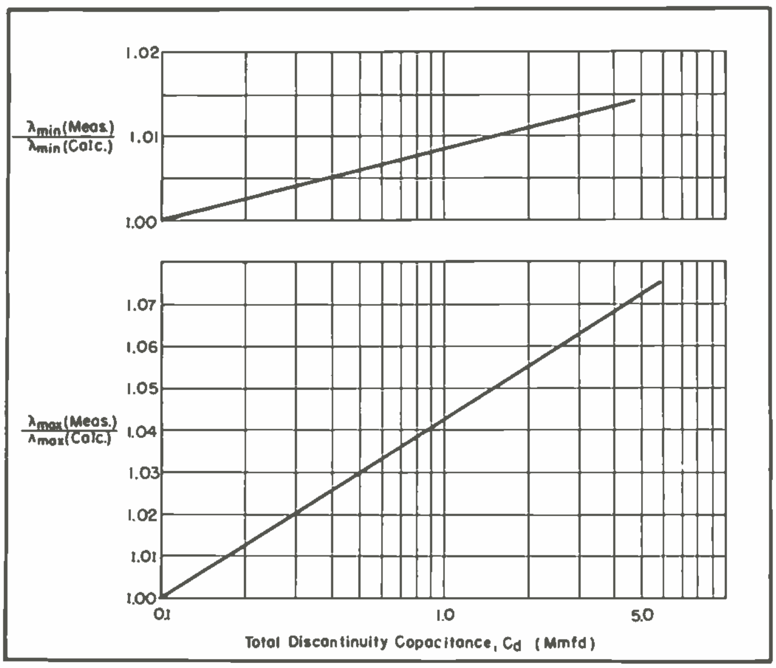


Figure 5 (Above)

Plot for the $3\lambda/4$ mode and $d/\lambda_o = .02$.

Figure 6

Plot showing average correction factors for λ_{min}/λ_o and λ_{max}/λ_o as a function of the total discontinuity capacitance C_d.



Sharp-Edged Tuning Sleeves

In specific cases where a sharp-edged tuning sleeve is employed, the accuracy of prediction of the tuning limits can be improved by using Figure 6. Where incremental tuning is important, corrections for discontinuity capacitance are less significant than for total tuning range. Effects of discontinuity capacitance can be minimized by chamfering the edges of the tuning sleeve.

References

[1]Griemsmann, John W. E., *Handbook of Design Data on Cable Connectors for Microwave Use*, Report No. R-158-47 PIB 107, Microwave Research Institute, Polytechnic Institute of Brooklyn; 1947.

[2]Smith, P. D., *An Improved Transmission Line Calculator*, Electronics; January, 1944.

[3]Whinnery, J. R., and Jamieson, H. W., *Equivalent Circuits for Discontinuities in Transmission Lines*, Proc. IRE; February, 1944.

[*To Be Continued**]

[**A second installment, in which will appear a series of typical examples and appendices detailing the relations between the characteristic impedances and various coax-line and tuning-sleeve radii, will appear in the December issue. Additional charts will also be published within this installment.*]

Instrument News

Phase Meter

A Phase Meter which is said to provide a means for the precise determination of phase relationships throughout the audio spectrum of 30 to 20,000 cps has been produced.

Instrument has a self-calibrating feature which is said to permit operator to check accuracy quickly without recourse to complex calibrating apparatus and techniques.

Measures phase difference in terms of the calibrated phase shift required to establish phase coincidence of the voltages in the measuring circuit. Phase angle is read from two decade dials and a zero-center meter having a full-scale range of plus or minus one degree. Switch-selected controls permit determination of lag or lead and of positive or negative *sense.*—*Model P-1060; The W. L. Maxson Corp., 460 West 34th St., New York 1, New York.*

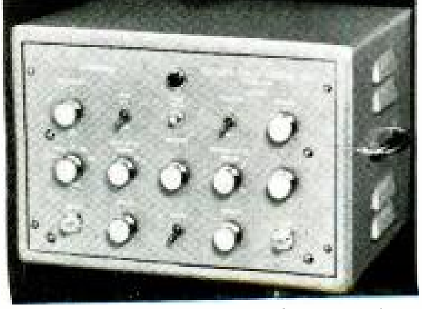
Maxson phasemeter

Double-Pulse Generator

A Double Pulse Generator producing two pulses individually controllable in width, amplitude and time relation to each other, is now in production.

Pulse amplitude is individually adjustable, without cross effect, from 0 to +50 and 0 to —200 volts. Amplitude of both pulses after mixing can be varied by means of a continuous fine control plus a 10:1 step attenuator.

Among the many specific applications for this instrument are testing TV equipment, and checking characteristics of devices such as wide-band amplifiers.—*Model 902; Berkeley Scientific Co., 6th and Nevin Streets, Richmond, Calif.*



Berkeley Scientific double-pulse generator

Two-Signal Audio Generator

A test-signal source for intermodulation distortion measurements has been developed. Generator, designed specifically for supplying the test signals necessary in the various methods of measuring intermodulation distortion is audio systems, can also be used as a general-purpose laboratory beat-frequency oscillator.

Oscillator will supply: *(1)* A single low-distortion sinusoidal voltage adjustable in frequency from 20 cycles to 40 kc in two ranges, 20 c to 20 kc and 20 kc to 40 kc; (2) Two low-distortion sinusoidal voltages, each separately adjustable, one to 20 kc and the other to 10 kc. (Output is useful in testing by the method adopted by the SMPTE); (3) Two low-distortion sinusoidal voltages, with a fixed difference in frequency maintained between the two as the frequency of one voltage is varied. The fixed difference frequency is adjustable up to 10 kc, and the lower of the two frequencies is adjustable up to 20 kc. (Output combination is used in the *CCIF* method of testing.)

The output of the oscillator is continuously adjustable up to 10 milliwatts into 600 ohms with less than 0.25% distortion, and up to 1 watt with less than 0.5% distortion. Output is calibrated both in volts and in db with respect to 1 milliwatt in 600 ohms.—*Type 1303-A; General Radio Co., 275 Massachusetts Ave., Cambridge 39, Mass.*

G-R two-signal audio generator

8-Channel 'Scope

An eight-channel 'scope has been produced.

'Scope consists of eight independent channels, each of which contains a single-gun cathode-ray tube (RMA type 3 JP11) and eight *ac* amplifiers with a deflection sensitivity of 10 mv/in. Frequency response is said to be 20 cps to 25,000 cps ± 2% or 20 to 150,000 cps ± 30%. Also available is a *dc* model eight-channel 'scope with a sensitivity of 2 mv/in.

Signals are displayed on a horizontal axis for photographing on a film strip or drum with vertical travel. Power supply is independent of the indicator unit.—*Models H-81 and H-82; Electronic Tube Corporation, Philadelphia 18, Penna.*

Microwave Signal Sources

Microwave Signal Sources, covering the range of 634 to 11,500 mc, in five units, have been developed.

Employing a reflex klystron system, the signal sources are controlled by one dial and frequency can be read directly from a linear indicator to accuracies of ½%. Reflector voltage is automatically tracked with the cavity tuner. There are said to be no klystron modes to set, no voltage settings to be made.

Non-contacting shorts are used to eliminate noise and reduce mechanical wear. Terminals are provided for applying modulation to either the grid or reflector. The signal sources are supplied complete with tube.

A klystron power unit has also been designed to minimize klystron frequency modulation due to reflector voltage variations.—*Models SSR, SSL, SSS, SSM, and SSX; Polarad Electronics Corp., 100 Metropolitan Ave., Brooklyn 11, N. Y.*

Polarad microwave signal source

Transmission Measuring Set

A transmission measuring set, suitable for rack mounting, which is said to eliminate calculations and intricate setups for checking audio gain or loss, measurement of matching and bridging devices, and mismatch loss and frequency response, has been announced.

Equipment consists of a volume-indicator meter, input and output attenuators, and impedance matching system, and jacks for convenient connection. A meter multiplier, which is geared to the load-impedance shaft, provides an automatic correction for changes in load impedance. Switches facilitate connection of the volume indicator to the input of the attenuator system, or to jacks for external connection. An output impedance switch allows matching to 600, 250, 150, 16, 8, or 4-ohm circuits.

Instrument is said to permit handling of a wide range of load levels with an accuracy of ±.1 db, over the 20 to 20,000 cycle range of the instrument.—*Type BI-11A; Broadcast Equipment Section, RCA Engineering Products Department, Camden 2, N. J.*

RCA transmission measuring set.

TV TUBE Developments

by P. B. LEWIS

Design and Application Characteristics of Miniature Pentode 6CB6 and Its Use in RF Tuners and Video Intermediate-Frequency Amplifiers, Operating in the 40-MC Region.

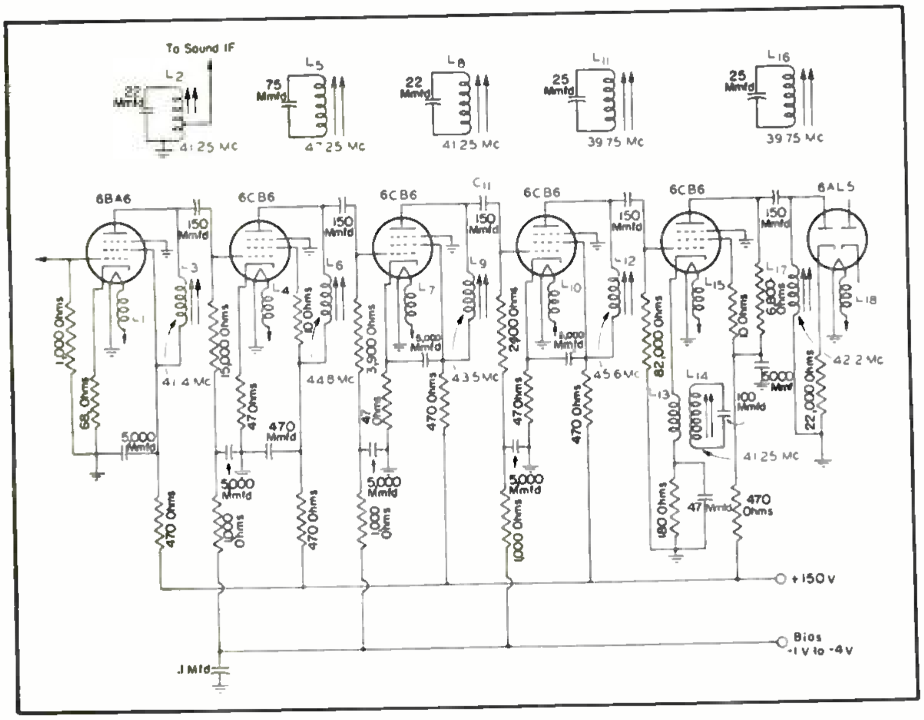


Figure 1

Schematic of 40-mc 4-stage stagger-tuned video if amplifier system. L_1, L_4, L_7, L_{10} and L_{15} and L_{18} are heater chokes, with fifteen turns of No. 22 enameled wire on a 1/4" form. L_2, L_5, L_{11} and L_{16}, contain seven turns of No. 14 wire enameled, wound on a 1/2" diameter form, 5/8" long concentric with and 5/8" from cold end of L_3, L_6, L_{12} and L_{17}, respectively. L_3, L_9 and L_{17} contain eleven turns of No. 30 enameled wire on a 1/4" form. L_6 and L_{12} contain 10 turns of No. 30 enameled wire on a 1/4" form. L_{13} has two turns of No. 22 enameled wire on a 1/4" form. L_{14} has four turns of No. 22 enameled wire, on a 1/4" form, which is 3/8" long, 1/4" from the cold end of L_{13}. L_5 has three turns of No. 14 enameled wire wound on a 1/2" diameter form 1/2" long, concentric with and 5/8" from the cold end of L_6. The 15,000-ohm damping resistor in the 41.4-mc circuit, has a value of 12,000 ohms at 42 mc, while the 82,000-ohm resistor in the 45.6-mc circuit, has a value of 32,000 ohms at 42 mc.

In RF TUNER and video *if* amplifier circuitry, the sharp cutoff miniature pentodes, such as the 6BC6, have been found to be particularly effective. This result has been noted because the tube essentially, an improved 6AG5, features a 20% increase in grid-plate transconductance, and a 30% decrease in grid-plate capacitance. The high transconductance and reduced grid-plate capacitance make it possible to obtain high gain at high frequencies. In addition the tube has a separate grid-No. 3 connection which makes possible the use of an unbypassed cathode resistor to reduce variations in input capacitance and input conductance with changes in bias. When this tube is used as an *rf* amplifier in a television tuner, for example, its lower grid-plate capacitance has been found to reduce oscillator radiation while its separate cathode and grid-No. 3 connections make possible the use of an unbypassed cathode resistor to minimize the detuning effects encountered in sets employing *agc*.

Although there are several other *rf* pentodes having lower grid-plate capacitances than the 6CB6, the reduction in grid-plate capacitance of these types is accomplished by shielding the plate and is, therefore, accompanied by a substantial increase in output capacitance. Because the only capacitance in the tuned circuits of most TV *rf* and *if* amplifiers is that of the tube electrodes and associated wiring, a large increase in output capacitance causes a decrease in plate-circuit impedance and a consequent loss in gain. The maximum grid-plate capacitance of the 6CB6 is 0.020 mmfd, while its output capacitance is 1.9 mmfd.

IF Amplier Design

The main requirements of a suitable television *if* amplifier tube are high transconductance for high gain and low grid-plate capacitance for low feedback. This tube, which has been found to meet these requirements, can be used for the 20-mc *if* band, and also for the RMA-recommended 40-mc band.

In the design of a stagger-tuned *if* amplifier, the values of the damping resistors required to obtain the desired pass band are affected by the input conductance of the tubes used. At high frequencies, the tube input-conductance components due to transit-time effects, tube lead inductance, and feedback through the grid-plate capacitance from the plate circuit are effectively in parallel with the tuned grid circuit. The conductance components due to transit-time effects and tube lead inductances are positive in sign and vary with the square of the frequency. The input-conductance component due to feedback through the grid-plate capacitance, measured at the grid-circuit resonant frequency, may be either positive or negative. It is positive for a tube with the plate circuit tuned to a frequency lower than that of the grid circuit and negative for a tube with the plate circuit tuned to a frequency higher than that of the grid circuit. If the grid-plate capacitance is high, the input conductance will vary rapidly over the band and the grid and plate circuits will not be independently tunable.

Circuit Considerations

A circuit diagram of a 40-mc video *if* amplifier using 6CB6's appears in Figure 1. The diagram includes the plate circuit of a converter stage and a 6AL5 video detector. Each stage is tuned by adjusting its inductance for resonance

*Based on copyrighted data prepared by the RCA Tube Department.

with the tube and circuit capacitance. Because tube capacitance will vary slightly from tube to tube, when tubes are changed retuning is necessary to obtain the same bandpass characteristics.

Screen-Grid Grounding

If the screen grid of an *rf* amplifier tube is at *rf* ground, the effective grid-plate capacitance of the tube will be much higher than the value measured at low frequencies and regeneration may be encountered. At frequencies of 30 mc and higher, however, it becomes quite difficult to ground the screen grid effectively because of the inductance of the screen-grid and bypass-capacitor leads. In many cases, therefore, it may be necessary to adjust the lead inductances so that they are in series resonance with the bypass capacitor in order to ground the screen grid effectively. In the amplifier circuit shown, effective grounding could have been accomplished by selecting a suitable value of screen bypass capacitor and, depending upon its physical construction, by adjusting its lead lengths for series resonance. This method of preventing regeneration, however, was not needed in this amplifier because a 10-ohm unbypassed resistor is used in series with the screen grid in the high-impedance stages and the screen grid is bypassed to the cathode in the low-impedance stages.

Overall Video Gain

The overall video gain of the Figure 1 amplifier circuit can be measured in the following manner. A 43.5-mc unmodulated signal is applied to the control grid of the first *if* stage, an *rms*-reading vacuum-tube voltmeter is connected to the plate of the video detector (across L_5), and a *dc* voltmeter is connected across the 22,000-ohm video detector load. The *ac* voltage at the detector plate and the *dc* voltage across the detector load are measured. Then, the meter across L_5 is removed and the output of the signal generator reduced until the original *dc* voltage across the detector load is obtained. The overall gain is calculated by dividing the voltage measured across L_5 by the output voltage of the signal generator. The overall gain at a fixed bias of one volt was 14,280; an average stage gain of almost 11. Approximately the same gain can be obtained with the 6CB6 in amplifiers operating at lower intermediate frequencies including the 21.25-to-25.75-mc band.

Industry Literature

Feedrail Corp., 125 Barclay St., New York 7, N. Y., has issued a 64-page catalog (No. 25), illustrating and describing prefabricated trolley busway electrical distribution systems. Special sections on planning, layouts, installation and specification appear.

Metalweld, Inc., 26th and Hunting Park Avenue, Philadelphia 29, Pa., has released a 4-page bulletin entitled *Rubber Linings*, describing rubber-lined steel for the transporting, storing and handling of corrosive chemicals.

John F. Rider, Publisher, Inc., 480 Canal Street, New York 13, N. Y., has published a *Receiving Tube Substitution Guide Book* by H. A. Middleton, in which 2,500 radio and television receiving tube types are systematically listed in numerical sequence with accompanying wiring instructions for making the substitutions. Book contains 208 pages and is priced at $2.40.

T. V. Development Corp., 2505 Surf Ave., Brooklyn 24, N. Y., has published a catalog describing filters, knobs, tubular selenium rectifiers, plastic masks, turntables and car antenna conical boosters.

Sylvania Electric Products, Inc., Emporium, Pa., have released tables detailing characteristics of thirty commercially available subminiature electron tubes ranging from 0.200" to 0.383" in diameter. Also provided in the characteristic chart are suggestions for mounting, shielding and application to obtain maximum life for tube types including those rated up to 5,000 hours. Two tables are provided for cross reference between experimental and RTMA type numbers and classification of types with respect to applications.

South Chester Corp., 1418 South Penn Square, Philadelphia 2, Pa., has released a six-page brochure which describes a line of fastening specialties including blind rivets, anchor nuts, screw fasteners, adjustable pawl fasteners, and door retaining springs.

Clarostat Mfg. Co., Inc., Dover, New Hampshire, has published a catalog, No. 50, describing resistors, controls and resistance devices. Various types and sizes of composition-element and wire-wound controls are cataloged, together with *ad-a-switch* and *pick-a-shaft* features. Cataloged resistors include cement-coated power resistors, flexible glass-insulated resistors, plug-in ballasts and voltages dividers, automatic line voltage regulators. Other items are TV beam benders, constant-impedance output attenuators, L-pads, T-pads, and the power resistor decade box.

Technology Instrument Corp., 1058 Main Street, Waltham, Mass., have released a 6-page leaflet entitled *Determination of the Q of Coils by Means of a Z-angle Meter and the Series Resonance Method.*

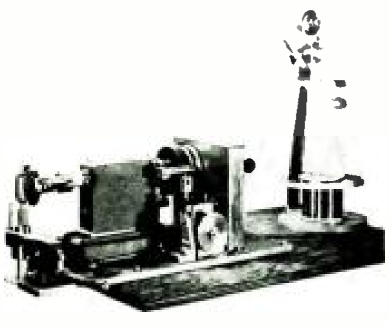
Polarad Electronics Corp., 100 Metropolitan Avenue, Brooklyn 11, N. Y., has issued a 14-page catalog describing television cameras, synchronizing generators, monitors, TV amplifiers and TV power supplies designed for broadcast operation.

Production Aids

Small Armature Winder

An armature winder designed to wind small armatures and featuring a stationary armature has been announced. Wire is fed through a hollow spindle to a revolving arm which winds wire in the armature slots, permitting armature to remain stationary.

The machine operates at high speed, winding 1,000 turns per minute on either straight or skewed armatures. Very tight armatures can be wound because of the uniform tension with which the wire is automatically guided and laid in the slots. Amount of tension is limited solely by the strength of the wire. Control over number of turns is attained by automatically winding a predetermined number of turns. Armature is also automatically indexed. Carballoy wire guides are used. Machine and table occupy 20"x30".—*Model 36; George Stevens Manufacturing Co., Chicago, Ill.*



Stevens armature winder

Demagnetizer

An improved design of demagnetizing coil has been developed for the demagnetizing of materials and stabilizing of magnetic flux.

Device can be used to eliminate undesirable magnetic flux from tools, drills, punches, small arms, and any machined parts that may have become magnetized.

The demagnetizer is also useful in equalizing and stabilizing magnetic flux in permanent-magnet assemblies that are used in electrical instruments and control devices. In general, permanent magnets are magnetized to a flux density higher than that required in the finished product.

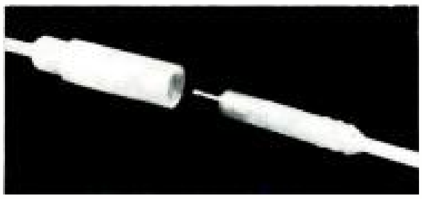
Demagnetizer consists of an air-core coil built in a frame which can be mounted on any table or bench. The coil is rated at 115 volts, 60 cycles, and is equipped with switch, pilot lamp, and a flexible lead fitted with a standard plug. Has a rectangular opening 4½"x8½" to accommodate stock up to 8" wide. The coil axis being horizontal, mass production demagnetizing may be accomplished by passing a non-metallic conveyor belt through the instrument parallel to the coil axis. In this manner parts can be demagnetized continuously. Pieces of considerable length can be demagnetized, or several small pieces can be demagnetized simultaneously, provided they are not in a metal container and are not in sufficient contact to cause shielding of any of the pieces.—*Special Products Division, G. E., Schenectady, N. Y.*

High Voltage Disconnect

A high-voltage disconnect, with leads and body injection molded as one unit of low-loss polyethylene, has been produced.

Has a long protective sleeve on the female, which it is said can be handled safely when *hot*. With a stubby pin on long male stud, contact is made with female in last ¼", after sleeve and stud are sealed. When mated, sleeve and stud fit tightly to form protective seal against dust and moisture. *Click-action* of female clip and male pin is said to allow operator to feel when contact is made and at the same time provides retention force to prevent disconnection due to shaking or other rough handling.

Designed for operation at 15,000 volts *dc*; actual flashover occurs about 31,000 volts *ac* peak. Connection clip, of tin plated brass, will operate at 15 amps.—*Alden Products Co., 117 North Main, Brockton, Mass.*



Alden hv disconnect

HF Insulating Laminate

A paper-base phenolic laminate, for use in high-frequency insulating applications, has been announced.

Laminate is said to have a resistance of 1,000,000 megohms after humidity conditioning (1/16" sheet).—*Insurok, Grade T-812; The Richardson Co., 2793 Lake St., Melrose Park, Ill.*

Colored Wire Markers

Colored wire markers made of silicone treated cotton cloth which has a pressure sensitive adhesive backing are now available. Markers are said to stick permanently to wire without moistening. Markers come in 14 standard NEMA colors.—*W. H. Brady Co., 16 E. Spring St., Chippewa Falls, Wis.*

Induction Heating Generator

Induction heating generators, in 5, 10, 20 and 40 kw sizes, have been designed.

The 40-kw generator is a three-phase 220-volt 400-425 kc unit. Can generate continuously in excess of 1,100 *btu* per minute into ferrous metal parts.

The 20-kw generator is also a three-phase 220-volt unit, with an output of 545 *btu* per minute. Frequency: 375-400 kc.

The 10-kw generator is a single phase, 220-volt unit with an output of 268 *btu* per minute. Frequency: 375-400 kc.

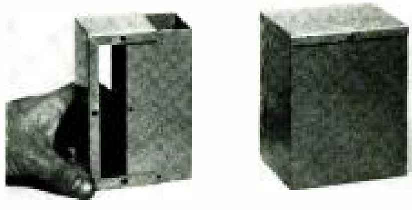
The 5-kw generator is a single-phase 220-volt unit with an output of 131 *btu* per minute. Frequency is 450 kc.

The 10, 20 and 40-kw units are all water-cooled. The same water which cools the generator also cools the work coils. The 5-kw oscillator section is forced-air cooled while the work coils are water-cooled.

Generators are metal enclosed.—*HB-40, HB-20, HB-10, HB-5; Haydu Brothers Laboratory, RF Heating Division, Plainfield, N. J.*

Flexi-Mount Aluminum Cases

A series of two-piece aluminum cases, particularly designed for equipment requiring complete shielding, has been announced. Available in thirteen sizes from 2¾" x 2⅛" x 1⅝" to 17" x 5" x 4", in either natural aluminum or gray hammertone finish. Interlocking sections of the cases are said to be accurately formed for snug fit. They are fastened together by self-tapping screws.—*Flexi-Mount; Insuline Corporation of America, 3602 35th Ave., L. I. C. 1, N. Y.*



Insuline two-piece aluminum cases

Short-Run Stampings

Short-run stampings of phenolic resins, vulcanized fibres, plastics, insulation paper (fish paper) and other non-metallic materials are now available.

Stampings for electronic frames, insulators, spacers, panels, etc., or gaskets, spacers or cams can be made to specifications in dimensions up to 9"x12"x⅛" thick.—*Federal Tool and Manufacturing Co., Dept. C, 3600 Alabama Avenue, St. Louis Park, Minneapolis, Minn.*

Rivet Gun

A rivet gun using Du Pont explosive rivets for high speed operation has been announced.

Only a single touch of the gun (less than 2 seconds) is said to be necessary before the rivet is set. The tips are made of nichrome steel welded to a bronze base. The handle consists of two-piece molded phenolic in which is located an off-on switch.—*Ripley Co., Inc., Middletown, Conn.*

Oilproof Enamel

An oilproof enamel that is said to air dry for handling in a half-hour, and dry hard in eight hours has been produced. Drying can be accelerated by a low-temperature bake.

Enamel, supplied at consistency for brush application, is said to exhibit long shelf life and bond well to insulating materials and metals, such as bus bars, commutator connections, stator ends, field coils and similar irregularly-shaped windings. Said to dry to form a film with a dielectric strength of 800 volts per mil.—*No. 32 Red Oilproof Enamel; Irvington Varnish and Insulator Co., 6 Argyle Terrace, Irvington 11, N. J.*

Pressure-Sensitive Tape Rolls

A line of pressure-sensitive tape imprinted on paper, cellophane, acetate film or cloth stock has been developed.

Tape roll is available in widths from ¼" to 3" and lengths from 648" to 2,592" imprinted with message.—*Westline Division, Western Lithograph Co., 600 East Second St., Los Angeles, Calif.*

TV Maintenance

(*Continued from page* 13)

'scope, but, while this is being connected or is warming up, would it not be practical or logical to check the socket voltages with a 20,000-ohms-per-volt meter or a *vtvm*? Manufacturers list all terminal and socket voltages for this purpose. (In this particular case, a brief *visual* analysis would have shown the charred resistor). Suppose the socket voltages would have been normal—*then* what? Would it have been *unscientific* to test the tubes? Past experience has shown that it would have been prudent to check tubes even earlier. It is well known that from 80 to 90 per cent of all troubles *are* due to tube failures.

The use of logic in the foregoing case could have reduced the off-the-air time from hours to minutes. In a number of similar cases, the same pattern was noted; the lack of a logical or concrete method of carrying out regular or emergency maintenance operations. This usually indicates either the total absence of a workable maintenance schedule, or abnormal laxity in carrying it out, if it *does* exist.

Case 2: For several years an FM engineer was having trouble with the transmitter. The main circuit-breaker, a 3-shot cycling affair, operated through all three cycles and shut off the transmitter. Pushing the plate overload re-set button would restore normal operation momentarily, but the circuit breaker would immediately remove the high voltage again. The engineer, noting that voltages and currents appeared normal during the short *on* periods, decided to hold the circuit breaker in manually for a moment and see if voltages remained normal. They did. But the circuit breaker's holding coil began overheating. As a *practical* solution, the holding coil was disconnected and the circuit breaker jammed shut with an insulated screwdriver handle. This restored manual operation for the rest of the broadcast day, and the trouble was located and permanently repaired after sign-off. In a discussion at the time, the argument was raised that the transmitter should have been shut down until the trouble was *scientifically* corrected. The writer disagreed. Do you?

Analysis: Since all voltages and currents appeared normal during the short *on* periods, it would appear that the trouble could be in the control circuit alone (in this case the circuit breaker control), not in the transmitter. Since the station depends on broadcast operation for its revenue, the main idea is to keep the transmitter on the air with a minimum of lost time. This should be done if humanly possible, whether the transmitter is kept on with shoe string, baling wire or a broom handle. (The author once was guilty of tying a defective circuit breaker together with a handkerchief. This may have been *unscientific*, but the transmitter remained in operation, nevertheless). Of course, such operations are not recommended, *unless* the trouble is apparent and logic indicates that such an operation is practical (and safe).

Some engineers, in fact, too many, have developed the habit of making dangerous adjustments in high-power stages while the transmitter is *on*. It is hoped that these boys are still around to read this article. Plain logic will dictate that *no* adjustment is *that* important!

Case 3: Television station ——— employed a maintenance engineer, a *practical* man who believed in analyzing circuit operations thoroughly before making changes or major adjustments. Although his methods had produced results where several field engineers had failed, he was given other duties, with the explanation that: "A TV maintenance engineer must be able to 'jump right into things', put his finger on the trouble without a moment's hesitation. The 'slow, plodding' type of engineer has no place in TV maintenance."

Case 3 Analysis

Analysis: Speed and accuracy *are* definite requirements, especially in emergency maintenance. But few, very few engineers have the uncanny ability to locate trouble without a *moment's hesitation* unless a certain equipment defect has made that particular function automatic or instantly recognizable. It is much better to analyze the situation logically or *scientifically* for a moment or two, rather than proceed merely for the sake of producing motion. In the foregoing case, the maintenance engineer already had proved the effectiveness of logical or practical analysis by his ability to *think through*, where others had failed. (The same engineer, incidentally, once corrected a circuit difficulty in 30 minutes, where a field engineer with a 'scope had not located the trouble in over 8 *hours!*). Efficiency of this sort does not seem in keeping with the statement that the engineer was slow or "plodding." Here was a case, evidently, where personal opinion superseded logic.

Some supervisors, station engineers and field engineers have voiced the opinion that a tube tester has no practical place in TV servicing or maintenance, explaining that tubes which check good are not necessarily so, and that substitution is the only way to check. This line of *reasoning* is very difficult to understand. Tubes used in television circuits are basically no different than their predecessors. Tubes still are subject to shorts, intermittents, interelement shorts, noise, microphonics, leakage, low emission, poor mu, gassiness, unbalance, etc. True, there are some types which will not convey their true under-load condition in the tube tester, but these are relatively few. (The same argument was familiar in the *old days* when tubes like the 6A7, 75, etc., had to be tested). A good mutual-conductance tube tester is invaluable in the station and deserves to be used more often.

The foregoing should serve to demonstrate the effectiveness of employing sound, hard logic. Of course, the application of so valuable an aid must be accompanied by knowledge of equipment circuitry and operation in order to be effective. The engineer, to appreciate logic at its best, must also be capable of combining practical experience and theory with current operating practice. If he can do this, he will have overcome one of the greatest obstructions to progress and improvement.

TV Systems

(*Continued from page 29*)

stratified as to duties. Although some men are more proficient as cameramen, audio men, maintenance men, etc., they are all shifted in assignments to familiarize them with the entire plant. All available time is utilized for maintenance and new construction. Men having broadcast experience and who have studied TV engineering, and who have built amateur TV stations are excellent material as television operators.

During the construction of the station, technicians were hired and given responsibilities for the installation or construction of the various portions of the station. Overall planning of the philosophy of operation were the projects of Charles Thieriot, and Harold See, manager and director of TV at KRON-TV, respectively. The writer, as chief engineer, planned and coordinated the construction of the station with the assistance of Edward Price, Jule Vetter, William Nielsen, William Sadler, Fred Street, Rodger Woodruff, Donald Anderson, Harold Simpson and James Von Striver.

The soundness of the philosophy of operation and the desire on the part of both the management and the personnel to modify initial plans or procedures, to permit smooth operation under good working conditions, has resulted in a very successful first year of operation.

Metal-Ceramic

(*Continued from page 18*)

to the one shown have operated continuously at 400° C.

Conclusions

Actual production of a large number of junctions in vacuum-tested envelopes has proven the practicability of the process. Seals made by the method have been found to be mechanically strong, withstand high bake-out and operation temperatures, and be vacuum tight over a period of several years.

The process has manufacturing feasibility, since it employs commonly used brazing equipment and well-known, easy to control, techniques. The method is suitable to high-temperature brazing and low-temperature soldering applications and contains no outstanding shape and size factor limitations.

Subscriber-Vision

(*Continued from page 24*)

pulses. The usual desired effect of scrambling makes it necessary to stretch every fourth vertical synchronizing pulse.

The receiving decoding card is identical with the card inserted into the transmitter coding rack and can be easily removed and changed as required. The decoder unit has the effect of displacing the scrambled sync pulses in the opposite direction, so that the images are in step and a single steady picture may be viewed.

In modifying a TV chassis for use with the decoder the sync separator tube is removed and an adapter plug from the decoder unit is placed in the sync tube socket.

In proposed plans for decoder-card distribution, chain, drug and department stores are being considered as purchase points.

SUBTRACTIVE COLOR TV

The Rosenthal patent on the subtractive color TV system described in the October issue of Television Engineering has been assigned to the Skiatron Electronic and Television Corp., New York City.

Quality Control in Tube and

Highlights of Wright and Falk Papers on the Control of Averages in Tube Manufacture and Quality-Control Indicators Presented at the IRE-RTMA Fall Meeting in Syracuse, N. Y.

QUALITY CONTROL, which has become one of the most essential factors in modern plant operations, providing an accurate means for the evaluation of production proficiency and the minimization of material and manpower waste, served as a featured symposium topic during one of the sessions[1] at the recent annual IRE-RMTA meetings in Syracuse.

In one of the papers, involving the control of averages in tube manufacture, A. K. Wright, chief engineer of Tung-Sol Lamp Works, disclosed that the tube industry has had the benefit of some forms of control since the earliest days. Then, employing a base tube for which limits had been set, readings within specific above and below factors served to select the *good* tubes, and all others were simply classified as *bad*.

The virtues of *statistical sampling*, now a standard procedure were unknown then and crude sampling schemes were used for less important or less variable characteristics.

The application of *statistical sampling* has been a great step in improving the control of outgoing quality and reducing testing costs. However, declared Doc Wright, such schemes as now applied still place the emphasis on individual tube limits applied to individual tubes, even though these data are used to control large lots. Accordingly, while this method has served the industry well for many years and undoubtedly will continue to be used, it is open to criticism on at least two counts.

In evaluating these points, it was shown that when one sets a given limit for a characteristic, he is forced to say that tubes within this limit are *good*, and outside it are *bad*. This is basically an absurd statement, according to Wright. For, if the top plate current limit is say 20, the tube reading 19.9 is not *good*, nor is the tube reading 20.1 necessarily bad; that is unusable. Actually, reported Wright, the true answer is that the two tubes in question are of the same quality and that that quality is poor.

Revealing that it is impossible, in most cases, to defend such limits, the often-asked question was then posed: If a plant man asks that since tubes reading 20 are acceptable, why not 20.5? In Wright's opinion, the only answer is that a stand has to be taken somewhere. This, he said, is certainly a weak answer, and it is weak because the basic ideas of a sharp demarcation between *good* and *bad* is truly illogical in the first place.

The second criticism of this system, declared Wright, is that it does not concern itself with the average value of the product. This was brought home forcibly to us during World War II when we were supplying tubes for radar amplifiers having eight or ten stages using the same tube type. If the average *gm* of the type in question was down only a few percent, the overall gain of the amplifier, being the product of the gains of the several stages, was down to the extent that it was unusable. Thus, continued Wright, we were faced with the situation that every individual tube passed specifications, yet the lot of tubes as a whole was unusable.

These and other considerations indicated that it would be very much worth while to establish some sort of control on the average value of the tube. It was felt that if the averages were closely controlled there would be fewer *borderline* tubes (and less shrinkage) and that there would be assurance of a satisfactory product in equipments using many tubes of the same type.

In the first approach to the solution of the problem, Wright said that the control-chart technique was tried.

Samples of ten were measured and averaged. These averages were plotted and compared with modified limits. It was found necessary to discontinue this procedure, because it involved considerable clerical help to keep the charts up; and it did not do the job of controlling averages sufficiently well. Explaining this, Wright said that if the dispersion of the product was small,

[1]Sponsored by the IRE Professional Group on Quality Control.

Figure 1

Computation of the control limits of the gm of a 6AK5.

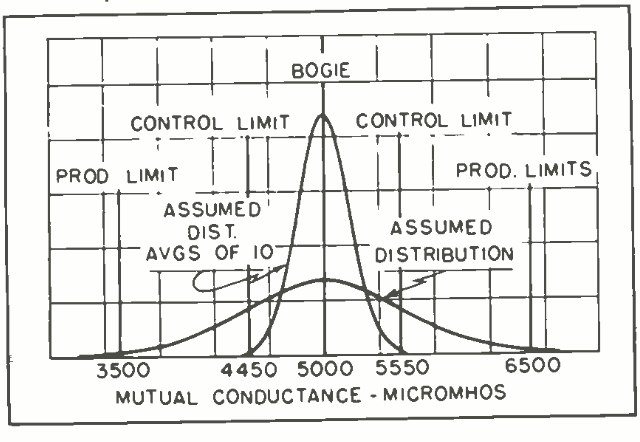
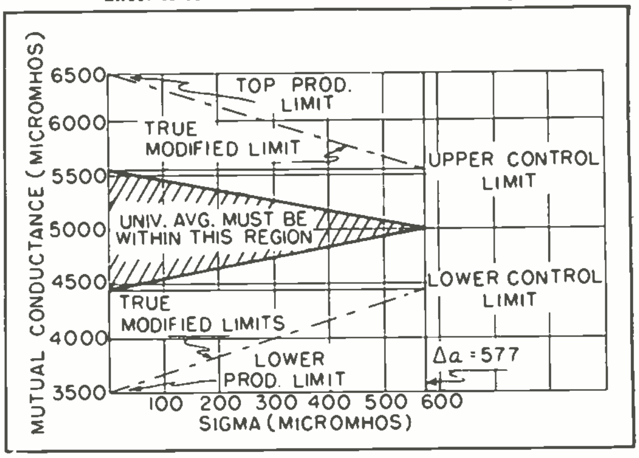


Figure 2

Effect of control limits on the universe average.



Component or Accessory Manufacture

by E. M. JEFFERY

the modified limits were so wide that we were not satisfied with the degree of control.

After considering several other ideas, Wright pointed out that it was decided to use arbitrary *fixed* limits for averages. The limits chosen were arbitrary, but they were computed in such a way that they provided a significance which could be thoroughly understood throughout the factory.

Detailing the system's operation, Wright declared that the characteristics were first divided into two groups, the first corresponding roughly to the group listed as *production tests* in the JAN specifications (*power output* and mutual conductance are typical examples) and the second group corresponding roughly to the *design tests* of the JAN specifications, in which capacitances and μ are typical examples.

It was decided that for the first group, not more than 1% defectives would be permissible in the final product. A limit of 5% was selected for the second class.

In a *production*-test example, Wright said the limits for averages can be computed by first assuming that the product average is exacly on bogie and that the dispersion is such that exactly 1% of the tubes are out of limits. The standard deviation of this assumed product is then computed. If A is the top limit and B is the bottom limit, the value of σ is

$$\sigma a = \frac{A - B}{5.2} \qquad (1)$$

since 99% of the product is within the range of $\pm 2.6\sigma$. If a characteristic is of the second class, the denominator of (*1*) becomes *4*.

From this assumed value of sigma, it is possible to compute modified limits for averages of ten tubes; these are called control limits. Samples of ten tubes are measured regularly, and averages are expected to fall within these *control limits*.

In Figure 1 appears the assumed distribution, the resulting assumed distribution for averages of ten, and the control limits for the *gm* of the type 6AK5. In this case, the bogie value is 5000 μmhos. The top production limit is 6500 μmhos, and the lower production limit is 3500 μmhos. Applying (*1*),

$$\sigma a = \frac{6500 - 3500}{5.2} = 577 \ \mu\text{mhos} \qquad (2)$$

Calculation of the modified limits for averages of ten, using $\sigma a = 577$ μmhos results in *control limits* of 4450 and 5550 μmhos. It is expected that the average of the *gm* of any group of ten 6AK5s, selected at random, will come within these limits.

Analyzing the use of the *universe average*, Wright declared that if the actual σ is equal to σa, the *universe average* must be exactly bogie. In addition, if the actual σ of the product were zero, the *universe average* could be anything within the *control limits*.

Figure 2 illustrates how widely this *universe average* may vary as a function of the actual σ of the product. The boundary lines of the shaded area within which the *universe average* must be are straight lines from the *control limits* at $\sigma = 0$ to bogie at $\sigma = \sigma a = 577$. Values of σ higher than σa were not considered, since such values indicate such a great dispersion in the product that the *control limits* could not be met regardless of the average.

Figure 2 also illustrates two important characteristics of this scheme. First, if the σ of the product is nearly σa, the *universe* must remain very close to bogie. If the σ of the product were very small, the *universe average* could fluctuate considerably. In no case, however, could the average fluctuate widely.

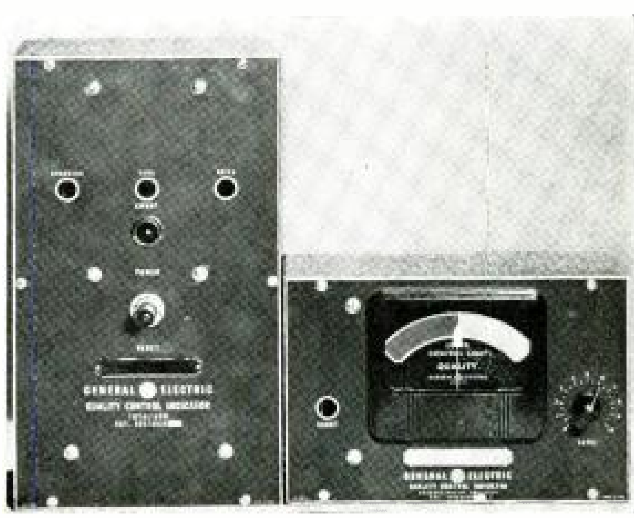
(*Continued on page* 42)

Figure 4

Typical quality control system installation, as described by Falk.

Figure 5

Closeup of quality control indicator totalizer and characteristic analyzer.



Quality Control

(Continued from page 41)

as it could using the usual modified limit scheme. Thus, we were told, these *control limits* do truly limit the average and yet in addition provide a motive for decreasing the dispersion.

The *control* limits are computed once when the limit sheets are first published and they do not change unless there is a limit change.

No charts are maintained. Instead the averages are posted in tabular form and those out of *control limits* are circled in red. This table reveals quite clearly where there might be any troublesome spots. Knowing the background of the *control limits*, one can determine whether a specific trouble is caused by an off-center average, too much dispersion, or both. In fact, said Wright, it has been felt that for this purpose this sort of tabulation is nearly as effective as a *control chart*.

The decision as to what to do when the product was out of *control limits* was a difficult one, cited Wright, who added that they did not want to stop production or shipment, but they did want corrective action to take place quickly. At Tung-Sol, the departments involved in any corrective action are the *factory engineering department* which has control over factory processes, the *design department* which has control of the tube designs, and the *commercial engineering department* which has control of the limits. Wright pointed that the first approach was to have meetings of these department heads for the purpose of analyzing the reasons for the various tubes being out of control and instituting appropriate corrective measures.

It was soon found that this system was not effective. The department heads are all very busy men, and it was difficult to arrange meetings on a regular basis. Secondly, no automatic priority was given to this work, and it very often became lost in the shuffle!

This experience revealed that unless this work was given specific priority, it would not get done. Therefore, the original committee was reorganized, consisting of a member from the *factory engineering section*, one from the *design section*, and one from the *commercial engineering section*, none of whom were department heads. This committee was instructed to meet weekly and issue a report detailing the characteristics which were out of *control limits*, the reason, and whose job it is to fix it. First priority was given to these jobs by these men and their supervisors were instructed that they must not upset this arrangement. Wright reported that this scheme has produced action which has been prompt and completely free of any confusion. As a result, out of the thousands of possibilities only a very few characteristics are now found to be out of control.

This system, in operation at the Tung-Sol plant for over two years, has slowly but surely sold itself to all branches of the company. According to Wright, the factory organization is now using similar methods in the control of many of their own operations. This is a section where the greatest improvement is sought, since the final product can be made more uniform only by improving the quality of the parts from which it is made.

Quality Control Indicator

In another quality-control discussion at the symposium, C. J. Falk of the G. E. general engineering and consulting laboratory described an electric computer, which can monitor statistical control charts.

Describing the problem which led to the development of the instrument, Falk

STATEMENT OF THE OWNERSHIP, MANAGEMENT, CIRCULATION, ETC., REQUIRED BY THE ACTS OF CONGRESS OF AUGUST 24, 1912, AND MARCH 3, 1933, OF TELEVISION ENGINEERING.

Published monthly at New York, N. Y., for October 1, 1950.

State of New York } ss:
County of New York }

Before me, a notary, in and for the State and county aforesaid, personally appeared B. S. Davis, who, having been duly sworn according to law, deposes and says that he is the Business Manager of TELEVISION ENGINEERING, and that the following is, to the best of his knowledge and belief, a true statement of the ownership, management, etc., of the aforesaid publication for the date shown in the above caption, required by the Act of August 24, 1912, as amended by the Act of August 1933, embodied in section 537, Postal Laws and Regulations, to wit: 1. That the names and addresses of the publisher, editor, managing editor, and business manager are: Publisher, Bryan Davis Publishing Co., Inc., 52 Vanderbilt Avenue, New York 17, N. Y.; Editor, Lewis Winner, New York, N. Y.; Managing Editor, None; Business Manager, B. S. Davis, Ghent, N. Y.; 2. That the owners are: Bryan Davis Publishing Co., Inc., 52 Vanderbilt Avenue, New York 17, N. Y.; B. S. Davis, Ghent, N. Y.; J. C. Munn, Cleveland, Ohio; A. B. Goodenough, Port Chester, N. Y.; F. S. Weil, Great Neck, N. Y.; F. Walen, Teaneck, N. J.; G. Weil, Great Neck, N. Y.; L. Winner, New York, N. Y. 3. That the known bondholders, mortgagees, and other security holders owning or holding 1 per cent or more of total amount of bonds, mortgages, or other securities are: None. 4. That the two paragraphs next above, giving the names of the owners, stockholders and security holders, if any, contain not only the list of stockholders and security holders as they appear upon the books of the company, but also, in cases where the stockholder or security holder appears upon the books of the company as trustee or in any other fiduciary relation, the name of the person or corporation for whom such trustee is acting is given; also that the said two paragraphs contain statements embracing affiant's full knowledge and belief as to the circumstances and conditions under which stockholders and security holders who do not appear upon the books of the company as trustees, hold stock, and securities in a capacity other than that of a bona fide owner; and this affiant has no reason to believe that any other person, association, or corporation has any interest direct or indirect in the said stock, bonds, or other securities than as so stated by him.

(Signed) B. S. DAVIS, Business Manager.

Sworn to and subscribed before me, this 6th day of September, 1950.

(Seal) NATHAN JELLING,
Notary Public.

Commission expires March, 1952.

pointed out that the quality control engineers, who were using statistical control charts and their *upper control limits* discovered that maximum benefits were not being derived from them. These difficulties appeared to be due to several factors. Since several hours were normally needed to collect and analyze production data quite a staff was required to do this job. In addition, a number of rejects could build up before it was found necessary that corrective action should be initiated. Although quite often production difficulties correct themselves before they are found out, these difficulties always reoccur if steps are not taken to permanently correct the situation. These engineers felt that a solution could be found in an automatic computer which would not only continuously keep or monitor control charts, but analyze rejects every time one occurred, and give a warning when the *upper control limit* was exceeded.

The computer, designed to solve the problem, compares the total count and the count of rejects according to a built-in mathematical formula, the result being indicated on a *quality meter*.

Basically, the computer employs a bridge circuit. A *dc* voltage is applied across two slide-wire potentiometers. One pot advances as the total units produced are registered in the equipment while the second pot advances as rejects are registered. To start operation, both potentiometers are at the zero position. A meter is connected between the sliders of the potentiometers, and this indicates the relative positions of the sliders. When the voltage at the slider of the second pot is above or below that at the first slider, the meter needle will deflect to the right or left of its zero center, giving a quantitative comparison between the total count and the number of units rejected.

A Two-Unit System

Two units are actually employed in the system: A *totalizer* which incorporates a *dc* power supply and a linear slide-wire potentiometer, and a *characteristic analyzer* which includes a quality meter, reject level selector, and a pot. The latter is a non-linear unit that consists of a telephone stepping switch and resistors which bridge its contacts, having such values as to make the computer follow a curve of the *upper control limit*.

The *totalizer* counts total production and this count can be observed through holes in the front of the *totalizer* panel in units, tens and hundreds of units produced.

The *characteristic analyzer* counts the number of units rejected at an inspection point indicating abnormal production difficulties on its *quality meter*. Whenever the needle of the *quality meter* moves into a red portion of the scale, it is time for the factory personnel to move and find out what new trouble has arisen in production.

Level Selector

The level at which the *characteristic analyzer* operates is controlled by a level selector knob and the level is continuously variable. Card holders on the front of these units are provided for identification purposes. At the end of a day's run, the total counts are observed and recorded. Then the entire equipment can be reset.

Falk said that as few as one or as many as ten *characteristic analyzers* can be used with one *totalizer*.

In one plant twenty *characteristic analyzers* were installed to monitor twenty different inspection characteristics on two product lines.

Printed Circuits

(Continued from page 23)

encountered causing abandonment of this material as a binder. Some of the difficulties were: (1) The hydrolyzed silicate acted differently depending on whether it was freshly prepared, or had aged for some time; (2) formulations could not be stored for more than a matter of hours, or at most, one or two days; (3) crazing of the finished resistors often occurred. It seemed difficult to control this crazing.

A justifiable criticism of printed circuitry and a great deterrent to its development has been the problem of control of resistance value characteristic of printed-resistor manufacture by the foregoing methods outlined. The production of individual resistors to close tolerance is difficult and the reduced probability of producing a number of resistors on the same base to reasonable tolerances greatly affects the yield of acceptable assemblies.

The yield of such assemblies, without resorting to special methods, is proportional to the yield rate of an individual resistor raised to a power equal to the number of resistors per assembly.

Depending on the values of resistors desired, the operations of laying down the resistors may become quite complicated. Only in rare instances are the resistance values so close together as to permit printing all values in a single operation using one resistance paint formulation. Instead, several printing operations must be made, using either different formulations to print each resistor or closely related group of resistors, or using the same formulation and printing successive layers in each operation to obtain the desired resistance values.

Among the production *tricks* which have been resorted to, to increase overall yield, have been the formulation of inks and adjustment of the screens or other printing means in such a way that should the resistance be off tolerance, it is always low in value; by abrasive means the resistance value can then be raised as needed to make an entire assembly meet tolerances. Where the nature of the composition of the resistor and its cure permits, more resistance ink may be added by hand to reduce the value of the resistor. By careful engineering, circuitry may be designed so that, for example, only a ratio between the values of two resistors is important; if both resistors are outside of tolerance, but as long as they are both high or both low, the ratio may still be acceptable. Circuitry may be so engineered that only one or at the most two, out of five or six resistors need be kept to close tolerances, thereby increasing over-all yield. These methods are all used, but they serve only to emphasize the importance of this problem and to indicate the deficiencies of the system.

The most promising method developed so far may be considered a compromise between the manufacture of resistors as a separate component and existing methods of printing resistors.

In this method flexible heat-resistant tape base is coated with the resistance-paint formulation. Asbestos paper and woven glass-fiber tapes were found to be among the suitable tapes for this purpose. The tape preferred for economical reasons, as well as numerous other production reasons, is an asbestos paper tape known as Quinterra* tape. The coated tape is processed, then coated with a protective covering of polyethylene film, so that it may be handled and stored in an uncured or *green* condition.

Individual resistors can be stamped or cut from this tape, the protective plastic layer removed and the resistors pressed face down into place in the circuitry like a piece of adhesive tape, in intimate contact with printed silvered electrodes, then cured according to the appropriate schedule for the formulation. The resistors are not cured until they are in place in the circuitry; they are adhesive, the uncured tape being sufficiently tacky to adhere of itself, making an intermediate adhesive layer unnecessary. The resistance film is protected from abrasion and electrical shorts by the layer of heat-resistant tape which is on top in the finished resistor. The fact that the heat-resistant tape forms a protective coating over the resistor makes it possible to add a moisture-resistant film to improve humidity characteristics with negligible effect on the resistance value. This tape surface has also been found ideal for coding or otherwise identifying the resistor as to batch number, resistance value, or any other desired marking.

Tests performed on resistor units so far developed indicate satisfactory operation in 200° C ambients. More complete tests, including life tests, are in progress. Resistor values greater than one-half megohm have not as yet been produced. Contrary to the experience of others in this field, the attainment of low values has not given much difficulty. Fifty-ohm resistors are readily producible and even lower values may be obtained by slightly modifying production procedures.

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*Johns-Manville Sales Corp., N. Y. City.

VETERAN WIRELESS OPERATORS ASSOCIATION NEWS

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Personals

THE ANNUAL FALL GET-TOGETHER limelighting *rhf*. featured talks by a member of industry and the police department. Acting Captain M. J. McDonough of the N. Y. Police Department described the police communications setup. He revealed that radio was first employed in '32 with a 1-way AM system. In '46 the application of FM was inaugurated. Today there are 1,023 radio units, 700 of which are 2-way type operating in the 155-mc band. The system covers an area of over 500 square miles of water and 323 square miles of land, divided into 87 precincts and 337 radio sectors. In use now are 497 2-way patrol cars, 12 police boats, 6 planes and other miscellaneous vehicles. There are two basic stations with an output of 250 watts, while the car transmitters are rated at 30 watts. The department has two transmitters at each location for emergency use, with facilities for providing emergency power, should regular power fail. McDonough told the VWOAers that in '49, 3,883 prisoners were apprehended through the use of radio, and the property recovered during that year reached a total value of $2,962,424. In addition to the *rhf* system, there is also the radio telegraph operation, using station WPY to communicate with ships at sea, which was installed in '16. . . . The second speaker, Major John E. Ganley, service engineer of the N. Y. Telephone Co., who was connected with Air Force Intelligence during World War II, demonstrated the properties of microwaves such are used in TV-relay and other services using frequencies around 10,000 mc. In his demonstration he showed how these frequencies could be guided in their direction by the use of pipes or hollow rectangular tubes and reflectors, how they would pass through material such as marble 2" thick, but be blocked by thin metal tinfoil, and how the waves could be received only by antennas of the same polarization as the transmitting antenna. . . . Among those at the meeting were Arthur E. Ridley from Boston, Leroy Bremmer from California and Texas, Capt. Fred Muller from Florida. Also around were several pre-VWOAers, Harry Sadenwater, E. J. Quimby and Fred Klingenschmidt. Ridley, who is with WU in Boston, came to New York just to attend the meeting. AER has held a license since '01. Bremmer reported that he is now with the United Nations as a TV engineer. . . . Also in attendance were: H. Harney, Sam Schneider, George F. Duvall, Ray Morehouse, Donald McNicol, H. Q. Horneij, John Lohman, Fred McDermott, C. B. Middleton, Jack Hogan, G. W. Johnstone, Joe Savick, E. B. Wood (a new member), R. K. Davis, G. N. Mathers, C. I. Elliott, C. R. Shanholster, H. B. Kock, A. J. La Grow, L. J. Zegouros, E. P. Nelson, Henry Hayden, A. G. Cooley, Otis Fitchett, L. A. Gagne (also a new member), Ken Richardson, Ed Dros, H. E. Ballentine, Vic Vallandre, Frank Orth, Gus Erickson, R. L. Fischer, A. C. Tamburino, H. T. Williams, W. J. Gullule, J. Lohman, E. C. Cochrane, E. H. Price, Nick Esposito (the third new member at the affair), and Herb Muller, FM's son.

At the recent VWOA fall meeting in New York City, left to right: Leroy Bremmer, William C. Simon, John E. Ganly, William J. McGonigle, Captain M. McDonough, Haraden Pratt, C. D. Guthrie and Fred Muller.

TV Parts & Accessory Review

Miniature 10-Turn Pot

A 10-TURN POT with a wire wound resistance element 18" long, contained in a ¾" diameter case, has been announced.

Two turns of the shaft are said to provide a resolution more than 12 times that of a conventional potentiometer of equivalent diameter.

Available from stock and also in special resistance values from 100 to 50,000 ohms with accuracies of ± .5 per cent and also ± .1 per cent. The power rating is 2 watts and net weight is less than an ounce.

Double shaft extensions may be provided, as may welded tap connections at almost any points on the coils.—*Model AJ; Helipot Corp., S. Pasadena, Calif. (Bulletin 108 contains complete details.)*

Inorganic Green-Cement-Coating Resistors

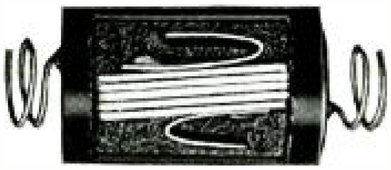
A NEW TYPE OF ORGANIC GREEN CEMENT coating which it is said will not blister, crack or peal as a result of heat is now being applied to resistors. Resistors are available in either fixed or variable types with choice of various terminal ends such as lug, wire, or combinations. Ratings range from 5 to 200 watts, with a choice of resistances: *Greenohm resistors; Clarostate Manufacturing Co., Inc., Dover, N.H.*

Schmidt Optical Barrel

A SCHMIDT OPTICAL BARREL has been produced for the projection of television or 'scope images on screens up to 6'x8'. Images may be varied in size by means of a control on the barrel. For smaller images, the optical system is available with a different lens. Dimensions: 17" high, 13" diameter.—*Spellman Television Corp., 3029 Webster Ave., Bronx 67, New York.*

Selenium Rectifier

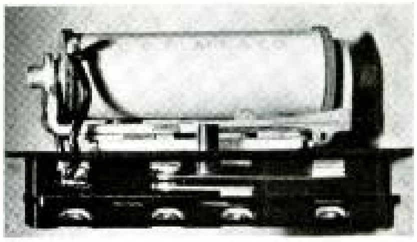
SELENIUM RECTIFIERS which resemble paper capacitors in appearance and do not require mounting holes for installation have been announced. Rectifiers are said to be completely sealed and yet run adequately cool up to their rated capacities. Available are 40, 65 and 100 ma models.—*Plasticel; Precision Rectifier Corp., 131 Boerum St., Brooklyn, N. Y.*



Precision Rectifier 100-ma selenium rectifier (actual size).

Power Relay

A DC POWER RELAY that will operate directly in the plate circuit of any triode, including miniatures, is now available. With proper coil, pickup current can be as low as 3 ma. and dropout current as high as 40 per cent of pickup current. Operate time can be as fast as 30 milliseconds. Contacts conservatively rated at 10 amperes, 230 volts, *ac*, proved by ½ million operations at 30 amperes inrush, 10 amperes break. Contacts said to be heavily insulated. ⅜" creepage, or more, over exposed areas. Numbered screw terminals recessed in molded terminal block.—*Type CP; C. P. Clare and Co., 4719 W. Sunnyside Ave., Chicago, Ill.*



C. P. Clare dc relay.

Personals

Charles M. Odorizzi has become operating vice president of the RCA Victor Division. Odorizzi has served, since July, 1949, as vice president in charge of service for the RCA Victor Division. In his new post he will continue as chairman of the board of the RCA Service Company.

Charles M. Odorizzi

Kenneth Fox

Kenneth Fox, formerly a vacuum metallurgist with National Research Corp., has joined the Kinney Manufacturing Co., Boston, Mass., as sales application engineer.

Frank Freimann has been elected president of The Magnavox Company. *Richard A. O'Connor*, formerly president, has been made chairman of the board.

R. P. Clausen, formerly assistant chief engineer, has become chief engineer of the radio tube division of Sylvania Electric Products, Inc. Clausen succeeds M. A. Acheson, who has been transferred to the staff of E. Finley Carter, vice president in charge of engineering at New York.

Hulbert C. Tittle, formerly engineering service manager, has been appointed assistant chief engineer for the radio and television division of Sylvania Electric Products, Inc.

Charles W. Creaser is now special products sales manager of Workshop Associates, Inc., and *Kenneth S. Brock* has become commercial sales manager.

Wickham Harter has been appointed CRL sales manager of mechanical-electronic products, embracing the sales activities of the variable resistor and switch divisions. Harter will also give executive supervision to distributor, export and CRL advertising departments. *Robert A. Mueller*, who has been sales assistant to Harter, has been appointed distributor sales manager. *Douglas Thatcher* has been appointed sales manager of ceramic-electronic products, including the sales division for ceramic capacitors, printed circuits and steatite.

James H. Sweeney has been appointed sales manager for germanium diodes and quartz crystals in the G.E. commercial equipment division.

James M. Toney, former advertising manager of the RCA Victor Home Instruments Department, has been appointed director of public relations of the RCA Victor Division. *Thomas J. Bernard* will continue as assistant director of public relations.

Toney succeeds John K. West, who is now with NBC as vice president in charge of the western division.

Walter A. Buck has been elected to the board of directors of RCA. Admiral Buck, who is vice president and general manager of the RCA Victor Division, succeeds Edward J. Nally, who retired because of age.

James F. Brehm is now president of Frederick Hart & Co., Inc., Poughkeepsie, N. Y.

M. S. Klinedinst has been appointed manager of the industrial equipment sales section of the RCA Engineering Products Department. Klinedinst succeeds P. B. Reed, who was recently named vice president in charge of the government service division of the RCA Service Company.

Charles H. Cox, Jr., is now purchasing agent of Synthane Corp., Oaks, Pa.

At Chicago IRE Meeting

John Nelson, center, sales manager of transmitting and industrial tubes for the G. E. tube divisions, discussing a G. E. ceramic tube with Kipling Adams, left, of General Radio, chairman of the Chicago IRE chapter, and Ernest B. Schwerin, right, of Bendix Aviation, Kansas City, Mo., at the recent Sixth Annual Electronics Conference and Exhibition in Chicago.

Briefly Speaking . . .

THEATRE TV no longer appears to be confined to the laboratory. Recent demonstrations have revealed that large-screen projection techniques have reached an extremely practical stage. In one recent test, the possibilities of full-screen projection, using 16-mm film processed 60 seconds after picture tube pickup, was shown. In this system, developed by the General Precision Laboratory and presented before the Chicago session of the Theater Equipment and Supply Manufacturers Convention, three units were used: video recorder, rapid-film processor and a projector. Camera featured a shutter which allows one complete scanning of the TV screen to be recorded on each frame of the film, while the processor develops, washes and fixes the film, and then dries it with infra-red rays, waxes it, and feeds it to the projector, all within one minute. . . . Sonotone Corp., Elmsford, N. Y., have opened a new receiving tube plant with 20,000 square feet of floor space in which miniature tubes for radio and TV sets will be made. . . . *Constant-voltage transformers* are now being built into TV receivers, according to a report from Sola Electric Company in Chicago. . . . Ampex Electric Corp., San Carlos, Calif., recently received an award from the 12th Annual Electrical Manufacturing Products Design Competition for their magnetic tape recorder. . . . The Wincharger Corp., Sioux City, Iowa, recently celebrated its 15th anniversary. During a ten-day celebration period, about 3,000 visitors were conducted through the plant. . . . Dr. V. K. Zworykin, vice president and technical consultant of the RCA Laboratories Division, is now on a seven-week tour of South America, during which he will discuss the development and potentialities of TV. Among the countries Dr. Zworykin will visit are Brazil, Argentina, Peru, Ecuador, Colombia and Venezuela. . . . Raytheon has opened a new pilot plant in Quincy, Mass., in which will be manufactured, at the present time, subminiature and miniature tubes for the military. It is expected that at sometime in the future, tubes for commercial applications will be made here, too. . . . Cornish Wire Co., Inc., have moved to new offices at 50 Church St., New York 7, N. Y. . . . Trad Television Corp., recently acquired control of the Wil-Ray Products Company, Marlboro, N. J., a cabinet manufacturer. . . . Radio Receptor Co., Inc., 84 North 9th St., Brooklyn 11, N. Y., has purchased an additional plant with 90,000 square feet of factory space at Wythe Avenue and North 3rd St., Brooklyn.

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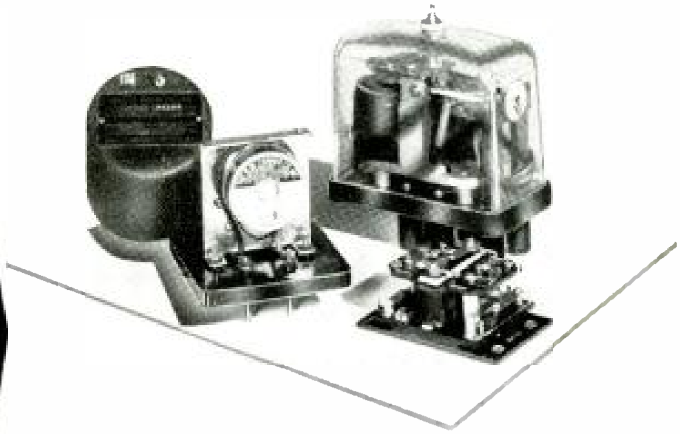

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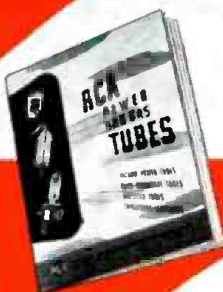

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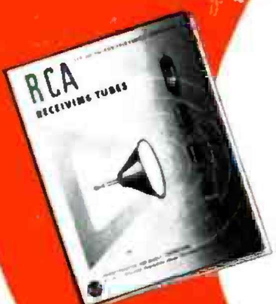

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