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Broadcast Engineering

the technical journal of the broadcast-communications industry

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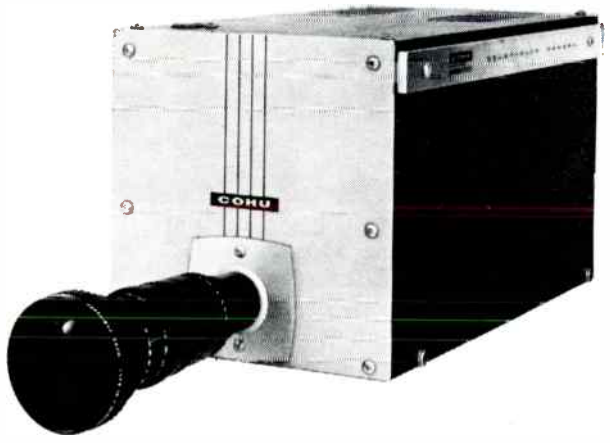

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Circle Item 2 on Tech Data Card

the technical journal of the broadcast-communications industry

Broadcast Engineering

Volume 8, No. 12 December, 1966

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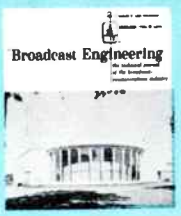

The large, round TV studio is evident in this view of the new WTMJ studio plant. The inside of the building is described beginning on page 14.

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LETTERS to the editor

DEAR EDITOR:

Where are the sounds of radio? Help is needed to track down and preserve for history the radio shows and personalities that made our industry. Strangely, much of radio history is "silent" because of loss or omission of any form of recording of the "golden age" of radio.

A group of audio collectors have banded together to cooperate in tracking down old shows on discs, reference copies, tapes, and even cylinders. These items were made by engineers, amateurs, hobbyists, and others as time and conditions permitted. Thus, the source of old radio shows can be almost anywhere. Your readers may be able to help us by exploring their own attics, basements, shops, and files. We want to dub these recordings on tape which is then given to Broadcast Pioneers, New York, the Library of Congress, Washington, and several universities with audio facilities for preservation.

All work is done gratis in our own individual professional recording studios. We borrow the items (unless the owner wishes to donate them) and will pay postage both ways.

We do not seek historic voices or events only, but copies of the old radio shows from network, syndication, local or regional, soap operas, cliff hangers for kids, comedy bits, whodunits, personalities of all types. They can be in any condition, too.

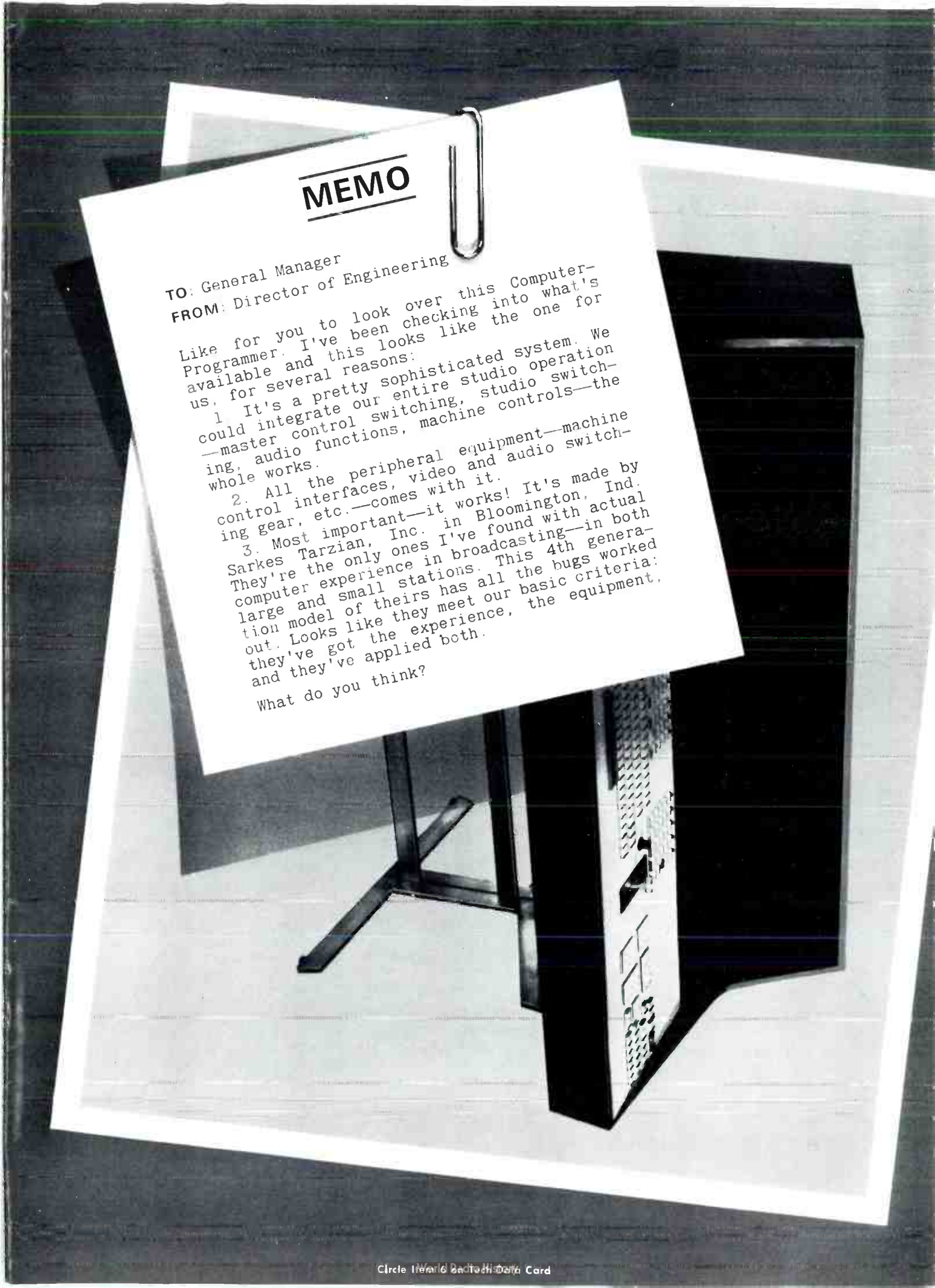
If interested readers will tell us what they have in a letter to S. A. Cisler, Orbit Radio, P.O. Box 1644, Louisville, Ky. 40201, we'll do the rest.

STEPHEN A. CISLER

DEAR READERS:

This year, the BROADCAST ENGINEERING annual index will appear in our January issue instead of in the December issue. By making this change, we will be able to prepare a more complete index for you and to present a full article lineup in December. This change is being made as part of our increasing effort to make BE an even better magazine.

THE EDITOR



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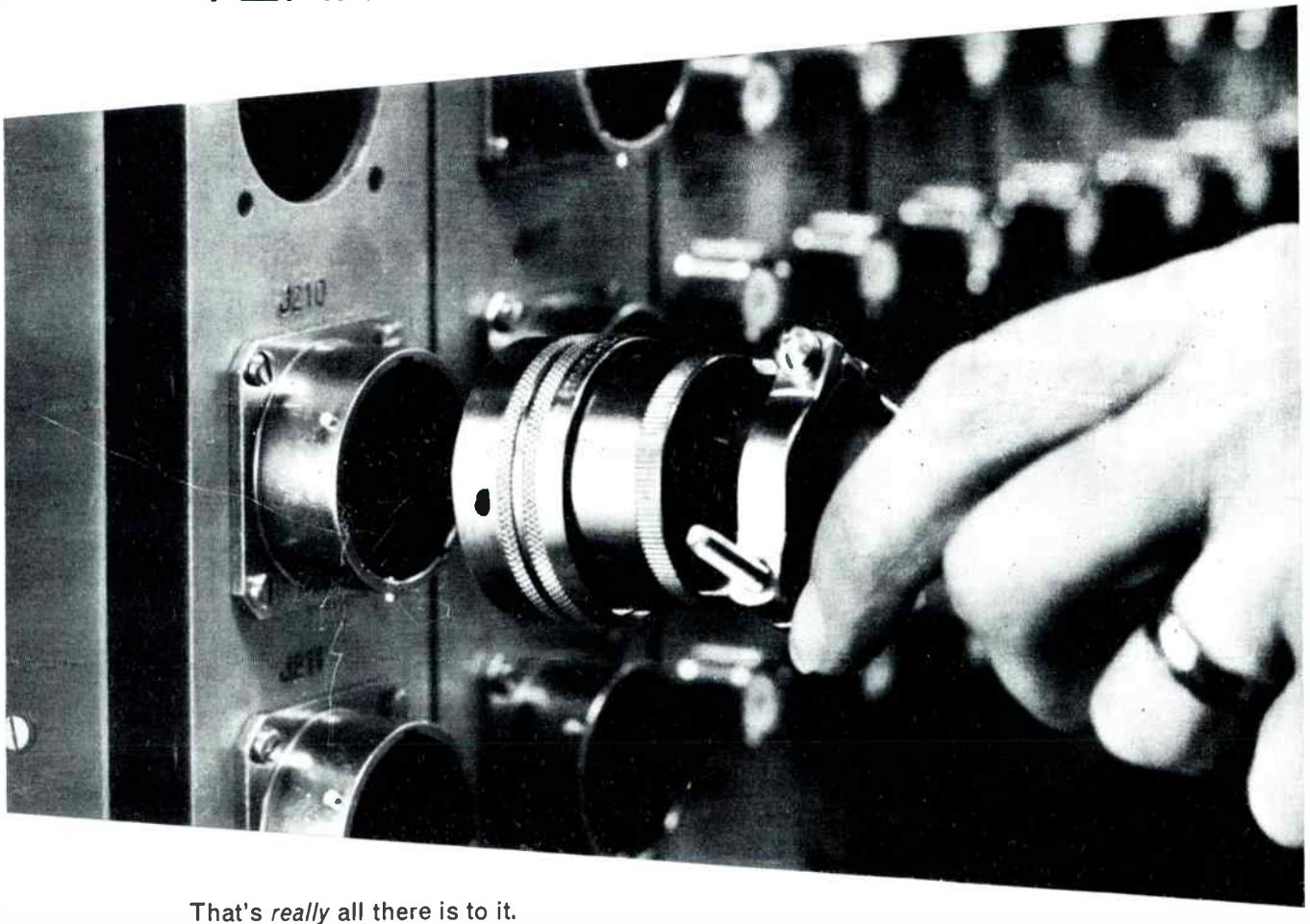

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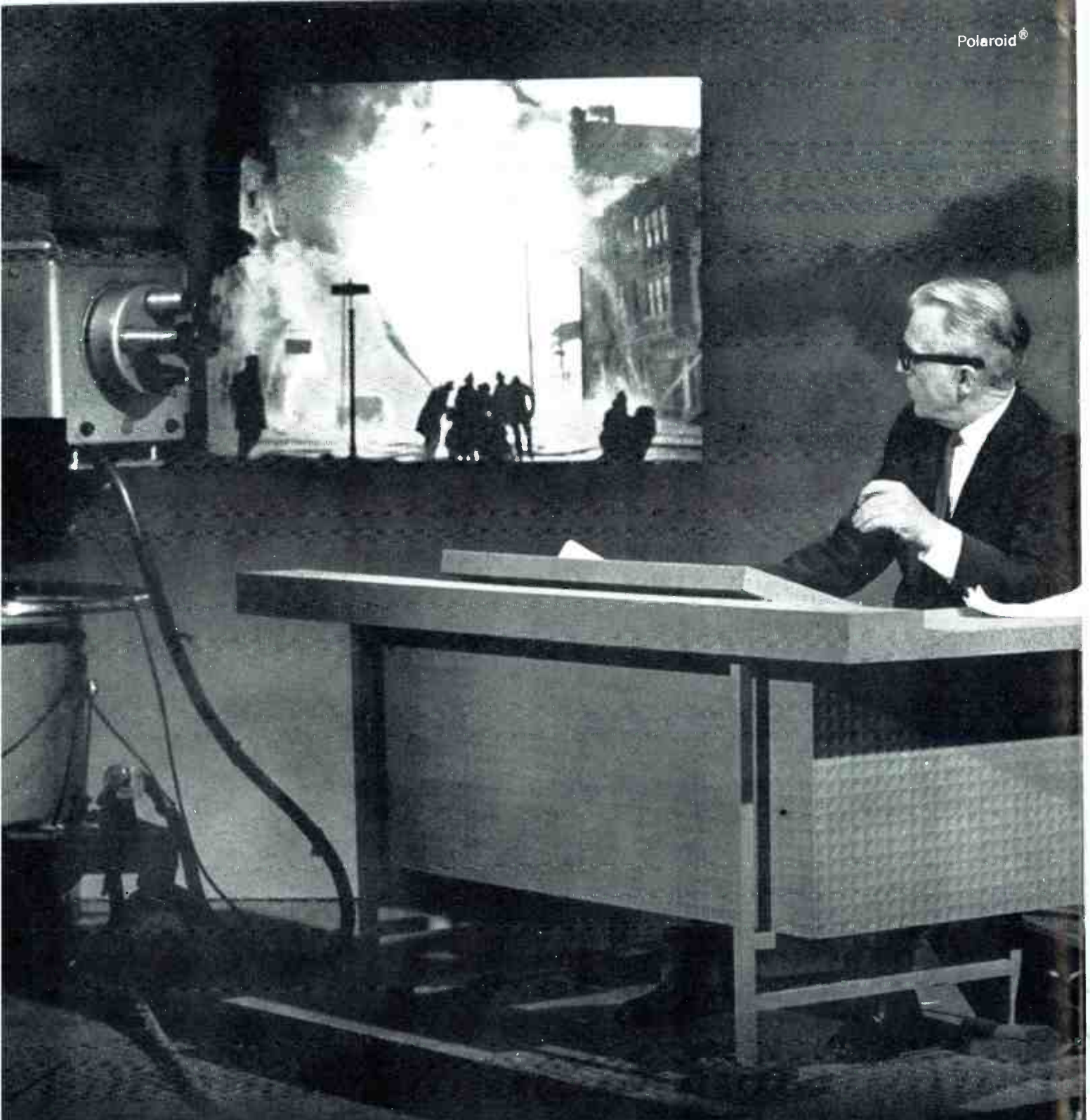

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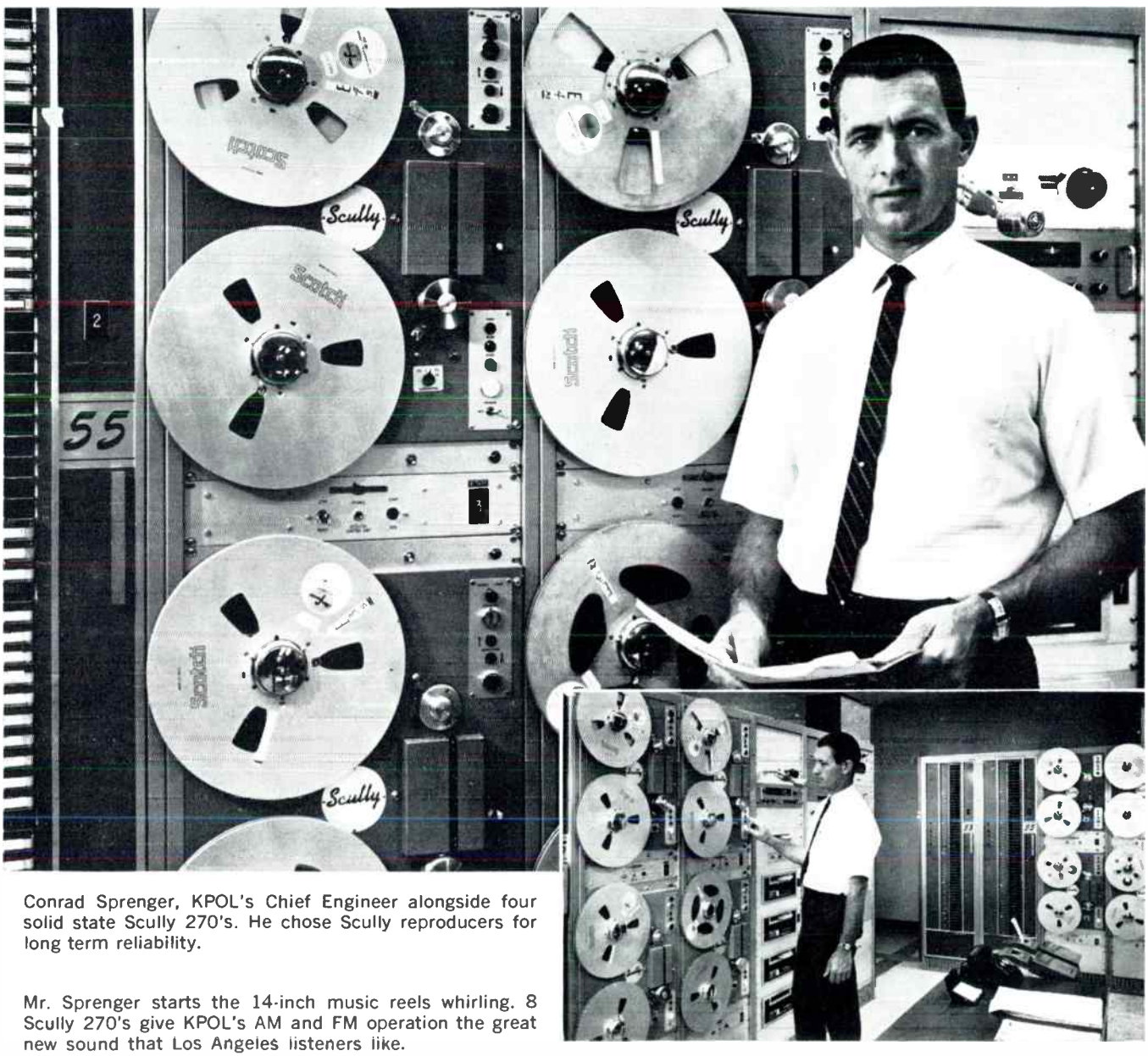

Conrad Sprenger, KPOL's Chief Engineer alongside four solid state Scully 270's. He chose Scully reproducers for long term reliability.

Mr. Sprenger starts the 14-inch music reels whirling. 8 Scully 270's give KPOL's AM and FM operation the great new sound that Los Angeles listeners like.

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Circle Item 10 on Tech Data Card

Is there a swing to Norelco

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Scenes from North American Philips Company, Inc., Studio Equipment Division manufacturing facility, Mt. Vernon, N.Y

3-tube Plumbicon* color cameras?

who build them.

people who are buying them.

Here's a partial list of stations now using the Norelco cameras. Ask them —at our expense—why they chose Norelco cameras. Call or write us. If you're in the market for a new color camera, we'll pay for your trip to one of these stations, subject of course to availability of their technical personnel to show and tell you the reasons for their choice.

STATION	LOCATION
EAST	
WNHC-TV	New Haven, Conn.
WNEW-TV	New York
REEVES SOUND STUDIOS	New York
SPORTS NETWORK	Rutherford, N.J.
SOUTH	
WAGA-TV	Atlanta, Ga.
WJBF-TV	Augusta, Ga.
WCYB-TV	Bristol, Va./Tenn.
WKRG-TV	Mobile, Ala.
WSPA-TV	Spartanburg, S.C.
WBTV (Remote Unit)	Charlotte, N.C.
MIDWEST	
WFIE-TV	Evansville, Ind.
WFRV-TV	Green Bay, Wisc.
WISH-TV	Indianapolis, Ind.
WEST	
KABC-TV	Los Angeles, Cal.
KTTV	Los Angeles, Cal.
KXTV	Sacramento, Cal.

Two major networks and dozens of stations now use Norelco 3-tube color cameras. Over a hundred of these "new generation" cameras are on the air today. And, just to keep up with orders, we've had to triple production personnel and quadruple the number of our factory test stations in less than a year.

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Briefly, that's why they're swinging to the Norelco camera. For technical details, call our sales representative, Visual Electronics. Or call us. Be a swinger.

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THE NEW WTMJ STUDIOS

by Allen B. Smith,
North Central Regional Editor
—Modern design is the key feature of this metropolitan broadcast center.

The most obvious characteristic of the recently dedicated $2.25 million addition to the Milwaukee-based operations of WTMJ is the colonnaded round exterior with its smoke-colored glass facade. The inside of the 32,000-sq. ft. wing, too, is dominated by the circular studio, which is 69 feet in diameter. Programming, production, and operations features in the modern facility, however, all tend to obscure the achievement of a functional and efficient engineering and control center, the highlight of the entire complex.

In planning the expanded broadcast center, all elements of the WTMJ operation were considered, since AM and FM radio as well as TV production and programming originated in the existing studios. While it would have been possible to remodel the older plant to accommodate a much larger studio for color TV without seriously handicapping the radio functions, the management elected to increase the total available building area by nearly 50 percent. This approach will permit additional expansion or modification of the plant without major construction expenditures, regardless of future changes in emphasis given various areas of broadcasting. Television-production and engineering-control functions are brand new, and the AM-FM radio studios—as well as all corporate office areas — have been completely redesigned to make this 80,000-sq ft broadcast complex one of the most versatile and modern centers in the industry.

The physical layout of the new studio is shown in Fig. 1, and many advantages of the circular construction are immediately apparent. The entire studio and any of the many sets which ring its perimeter are in full view of the director and production engineer in the Studio Control Center. The engineering supervisor and his assistant in Central Control also can see all studio action. Audio booths are available which provide visual communication with Central Control or Studio Control as is required by specific production schedules.

View of round TV studio shows lighting; kitchen set is in recessed alcove.

Central Control, an area roughly 60 ft x 40 ft, provides space for all rack-mounted equipment, a spacious work area, the main switching and camera-control consoles, and all monitors. Two playback-only tape units are located within easy range of the switching and camera consoles to relieve the load on the engineers responsible for tape and film operation, especially during heavy commercial schedules. A new color-film island with a pair of projectors and a slide drum, a second color-film island, and a black-and-white film island also are in the main control area. To provide for an absolute minimum of video switching, a bank of ten monitors offers continuous and simultaneous presentations from all video sources and intermediate relay points. Both B-W and color units are used in the comprehensive display.

The main switching console is of particular interest, representing as it does a significant development in the primary control function of TV operation. The computer-controlled switcher provides considerable versatility during normal operation in the selection of the desired mode of switching. The operator can choose manual sequencing and select any video or audio function by means of separate push-button controls for each input/output combination. He also may use the memory unit and preprogram as many as 25 individual events with interlocked audio and video. With a combination of real-time references and sensor-input signals, smooth operation is relatively easy to obtain so long as all program elements meet the required close-timing tolerances. An interesting feature of the computer memory unit is that it does not clear itself following each series of

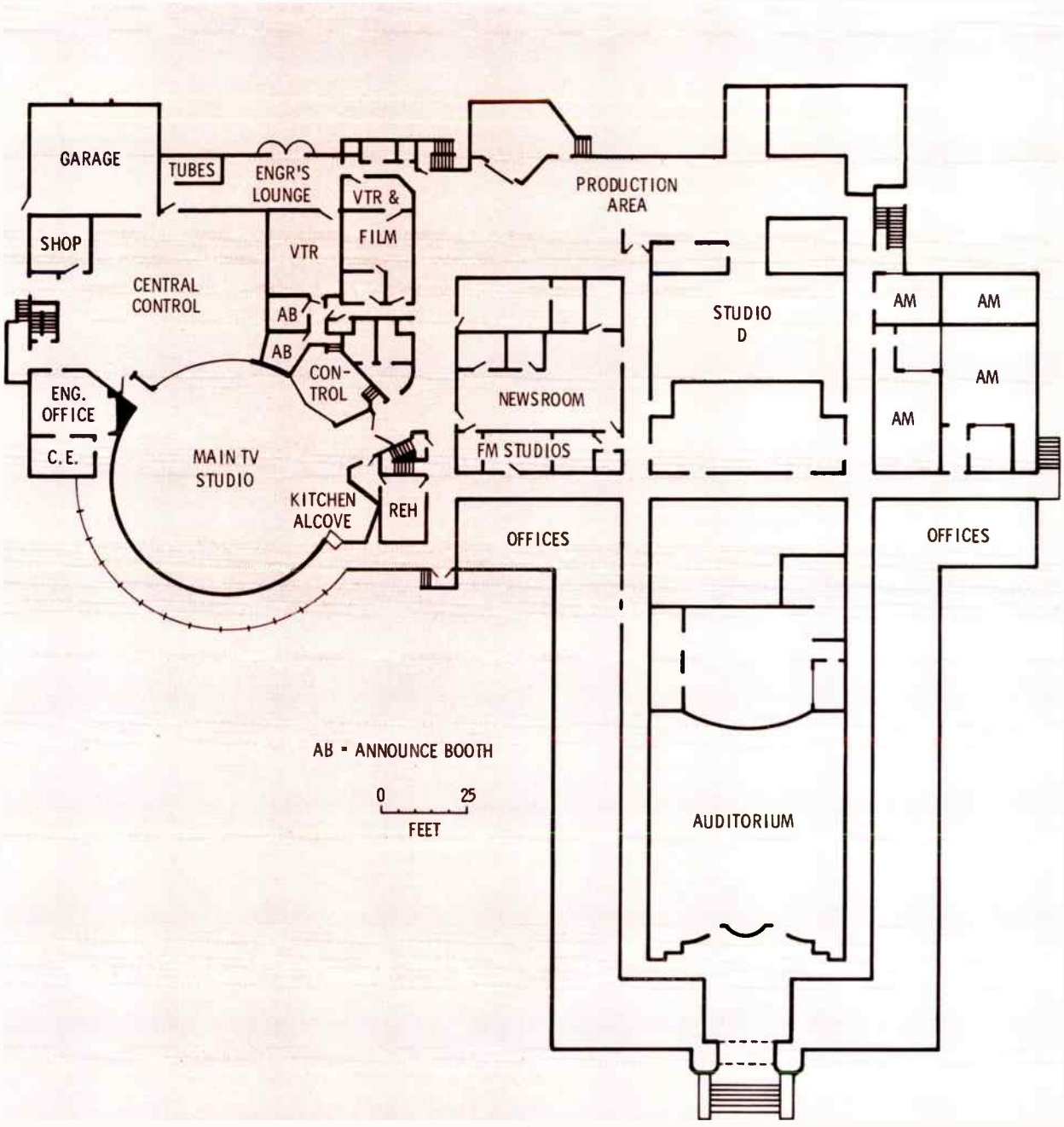


Fig. 1. Addition to WTMJ studio center is built around circular studio, 69 feet in diameter, designed for color programs.

executions; any upcuts, dropouts, or incorrect operations can therefore be traced to equipment malfunction or operator error simply by rechecking the programmed sequence. The control supervisor normally would catch any incipient error on the "next event" preview monitor during the automatic switching cycle, and override any incorrect action manually.

The VTR equipment room is separated from Central Control by a series of patio-style sliding glass doors and has a film-editing bench along the opposite wall. A vidicon film island for slides occupies another small corner. There are four VTR units in this room. Film and tape handling is speeded by using pass-through windows into the file and storage area. Large-screen monitors are used to permit quick evaluation of commercial tapes and programs by sales staffers and clients when other tape facilities are in use. The engineers' lounge and an extensive tube-storage area lie behind the VTR and Central Control areas.

An interesting aspect of the engineering center, one which exemplifies the thoroughness underlying all engineering planning in the new facility, is the use of computer-type rapid-access modular flooring throughout the center. Designed to accommodate equipment installations requiring extensive intra-unit cabling, a computer floor consists of a multi-section grid of cast alloy framing supported above the base flooring of the building on a superstructure capable of carrying the weight of the equipment and occu-

pants in the room. Individual 24-inch square floor sections of cast alloy with epoxy-bonded vinyl tile surfaces fit into the gridded superstructure to form the actual load-bearing floor, leaving an 18-inch subfloor space into which all wires and cables are laid. Entire sections of the floor can be lifted to modify, repair, or remove wiring without disturbing the structural integrity of the installation. Through the use of this relatively simple—although very expensive — concept, cable troughs filled to overflowing with wiring added through years of expansion and modification are eliminated.

In spite of the fact that the circular studio impresses the first-time viewer with a spacious and uncluttered production area, the overhead lighting system is its most obvious characteristic. WTMJ is color oriented; not only has the new studio completely color-balanced fixtures, but 144 separate scoops and spots provide light intensity sufficient for any possible requirement. Maximum capacity is 144,000 watts, with each individual light, selectable banks, or the entire lighting grid capable of being controlled to provide any light level from maximum brilliance to none at all. Control is accomplished through the use of continuously variable SCR dimmers. The entire complement of lights employs quartz-iodine lamps to provide constant light levels regardless of the life of the lamps; color temperature also remains essentially constant at 3200° Kelvin.

Two new live color cameras were purchased to inaugurate operation from the new studios, with the two cameras previously used retained for backup and future use in the as-yet-uncompleted Studio D. This area, used for all studio operations before construction of the addition, is being completely redesigned to duplicate the function and operation of the new main studio to provide two major color-production areas. WTMJ's complement of camera equipment also includes four black-and-white models, for use in the main studios, and four black-and-white units for use in the mobile studio.

Since the production schedule at WTMJ includes the taping in color of several syndicated programs as well as the usual run of commercial spots and local programs, versatility of operation was a prime target. As an example of successful planning, the two announce booths can be used simultaneously—one adjacent to Studio Control to provide audio for live taping in the main studio and the second facing into Central Control for live breaks during normal programming. A camera looks from Central Control through the announce-booth window to obtain live video of the announcer when required for live spots or intros, providing a second "studio" for the price of an announce booth.

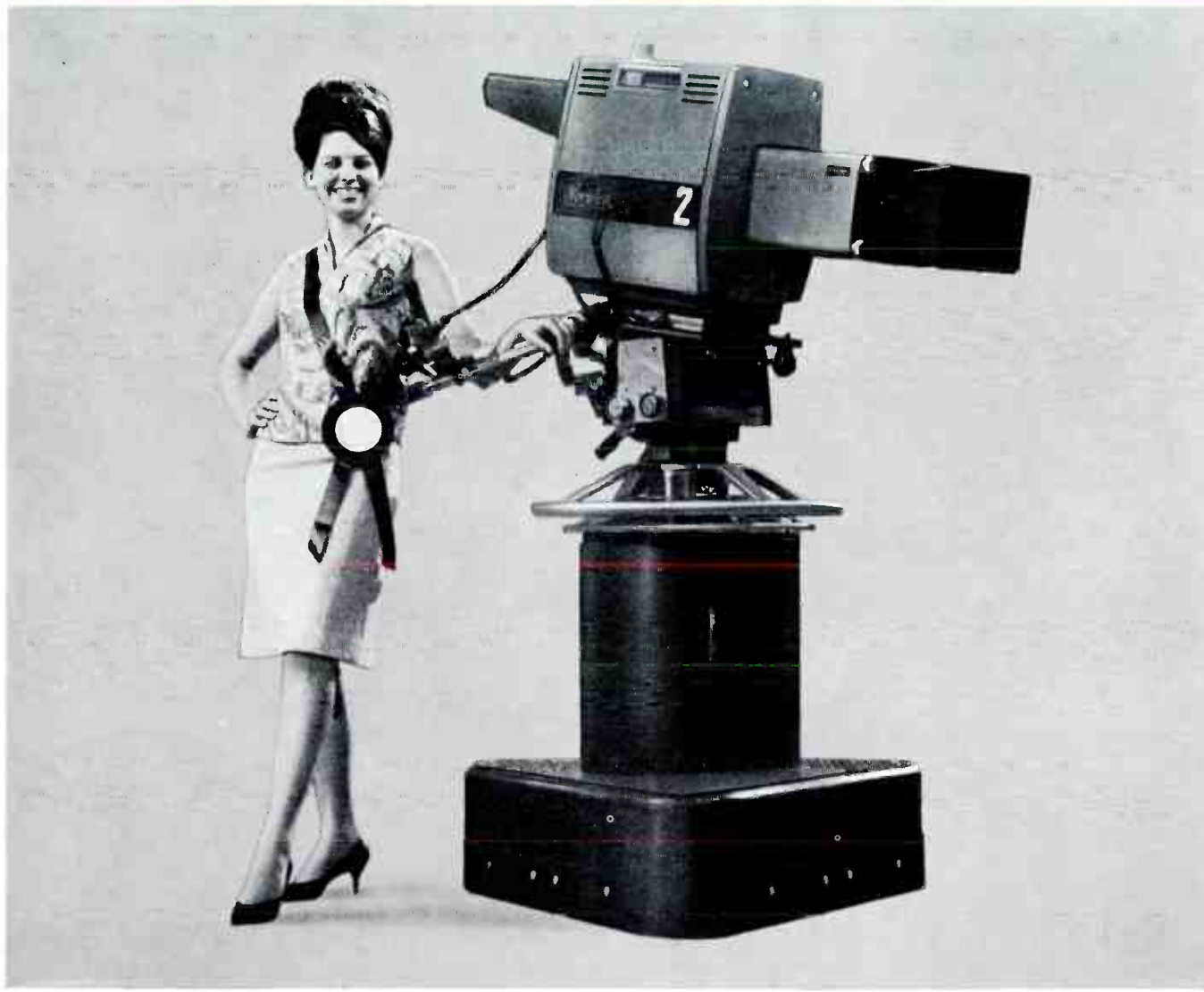
Remaining sections of the new addition include the engineering office, located just off the Central Control and equipment room, and the chief engineer's office. A spacious rehearsal room also is located near the production entrance of the main studio, to provide for preprogram warm-up.

The FM and AM radio facilities, although still located in the older part of the building, also have been extensively remodeled and updated both functionally and decoratively. The spacious auditorium shown in the floor-plan drawing is used only for audience-participation shows on radio; no video equipment is available.

Nearly three years of intensive planning and construction have been expended in creating this interesting and functional broadcasting center for one of the nation's pioneer broadcasting corporations. If competent engineering practices and new techniques in production and programming spell successful broadcast operations, the new combined facilties of WTMJ-TV-AM-FM should point the way for similar complexes throughout the country. ▲

WTMJ-TV central control. Circular studio is beyond windows below row of monitors. Camera looks into announce booth.

The PREFERRED color camera



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FIRST BY ANY STANDARD

2500-MHz ETV SYSTEMS

By John F. X. Browne, Jr.*

Part 4—Further design computations, equipment selection, installation, and measurements are discussed in this concluding part of the series.

In the previous articles of this series, the design criteria and FCC regulations applicable to ITFS systems were discussed. A brief review of the more important of these points includes:

1. Selection of transmitter site and establishment of antenna height.
2. Calculation of proper fresnel zone clearances for receiving paths and determination of receiving antenna heights.
3. Signal-to-noise calculations.
4. Overcoming path obstacles with passive repeaters.
5. Selection of transmitting antenna and determination of the effects of pattern irregularities and beam widths.

Other design aspects not discussed include antenna polarization, multiplexers for multiple-channel operation into a single antenna system, and coverage extension by the use of repeaters.

All of the discussions thus far have been limited to the use of horizontal polarization of the 2500-MHz signals. It should be recognized that vertical polarization is permissible and may be used to advantage in solving coverage problems. Horizontally polarized antennas are generally used for transmitting because of the relative design simplicity in achieving high gain and omni-directivity. Generally speaking, there is no particular advantage in either type of polarization in regard to signal propagation.

However, different polarizations may be used to reduce interference problems between systems operating in close frequency and geographical proximity. This type of problem may be encountered in large urban areas where many users of 2500-MHz systems are anticipated. Take for example two cochannel systems separated by 30 miles. (See Fig. 1.) Assume the following system characteristics.

Operating frequencies: identical
ERP (A and B): 20 dBw
Receiving Dishes (4′): 27-dB gain
No intervening path obstructions
Pattern A omni-directional
Pattern B directional

The signal received at B_R from B can be calculated from the formula

$$P_R = P_{ER} + G_R - L_P \text{ (eq 1)}$$

where,

P_R = Received signal in dB

P_{ER} = Effective radiated power in dBw

G_R = Receiving antenna gain in dB

L_P = Path loss in dB

In the example of Fig. 1

$$P_R = 20 + 27 - 119$$
$$= -72 \text{ dBw}$$

The signal from B received at A_R is negligible because of the antenna pattern at B. However, the signal from A received at B_R is (from eq 1)

$$P_R = 20 + 27 - 136$$
$$= -89 \text{ dBw}$$

and the ratio of desired signal (B) to undesired signal (A) at B_R is

$$-72 \text{ dBw} - (-89 \text{ dBw})$$
$$= 17 \text{ dB}$$

This result indicates that objectionable interference from A will exist at B_R.

The attenuation of a receiving antenna due to cross-polarization

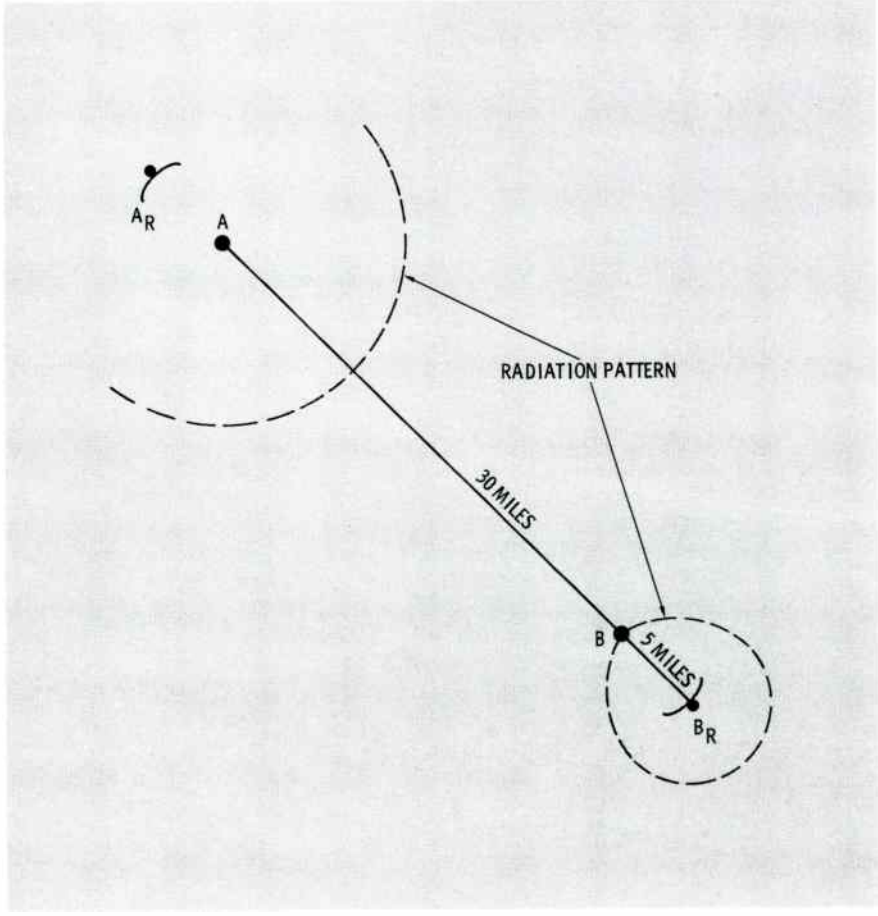


Fig. 1. Cochannel interference may be reduced with different polarization.

*Browne Associates, Telecommunications Consultants, Birmingham, Mich.

is given by the relationship

$$\text{Atten (dB)} = 20 \log \sec A \qquad \text{(eq 2)}$$

where A is the angle formed by the polarization of the E field and the antenna dipole. It would appear that this value should become very large as 90° difference is approached, but as a practical matter the limiting value is about 35 dB.

Thus, in this example, if the signals from A were horizontally polarized and those from B vertically polarized, an additional 35 dB of isolation could be expected under ideal conditions at B_R, or the ratio of desired or undesired would be increased to

$$(35 + 17) \text{ dB} = 52 \text{ dB}$$

which is acceptable.

When this technique is to be used in the design of a system, it would be wise to conduct field measurements with receiving antennas of the type to be employed in the system, in order to determine the exact value of isolation that can be achieved through cross-polarization. This is advisable because the practical maximum value will vary with antenna design and construction.

This discussion leads to another area of concern regarding the use of passive reflectors. A 180° change in polarization occurs upon reflection when the reflecting surface is parallel to the E field. In some cases, the compound angles involved at the reflecting surface in relation to the signal are such that polarization changes other than 180° occur. (A 180° shift does not alter the effective polarization.) If the change in polarization is in excess of approximately 20°, it may be necessary to correct for the change by rotating the antenna feed assembly at the receiving dish.

In a system which requires the use of active repeaters, *i.e.*, retransmission, one of the primary considerations in design is signal- (or carrier-) to-noise ratio at the most distant receiving location. Fig. 2 shows the system in Fig. 1 expanded with the addition of another repeater. In this case, the transmitter frequencies are different, and therefore interference problems are not present. For this discussion, assume the diameter of school receiving dishes will be limited to four feet (to minimize mounting problems); a C/N ratio of 46 dB is desired; and the transmitter ERP is 20 dBw. It is further assumed that calculations have determined the path-clearance requirements are satisfied. Working backward from location C_R, for an ERP of 20 dBw from C in the direction of C_R, it is found that

$$P_R = P_{ER} + (G_R - L_R) - L_P \qquad \text{(eq 3)}$$

where,

G_R = Receiving antenna gain

L_R = Receiving losses

In this case

$$P_R = 20 + (27 - 3) - 121 = -77 \text{ dBw}$$

which corresponds to a C/N ratio of

$$-77 \text{ dBw} - (-125 \text{ dBw}) = 48 \text{ dB}$$

This is 2 dB more than the minimum design value for the system.[1]

The signal from B received at C must now be considered. The system C/N ratio at C_R will be worse than the poorest C/N ratio of the three paths A-B, B-C, C-C_R. Fig. 3 is a curve used for combining carrier-to-noise ratios. From the chart, it can be determined that in order to have a C/N ratio of 46 dB at C_R, the C/N ratio of the signal from B received at C must be greater than 50 dB. This is because a difference of 2 dB between the two C/N ratios would reduce the 48-dB ratio to (48 − 2.25) = 45.75 dB, or less than the minimum required.

Assuming a C/N ratio of 53dB is achieved at C, combining 53 dB and 48 dB by use of the chart indicates a correction factor of 1.25 dB; the C/N ratio at CR becomes (48 − 1.25) = 46.75 dB. Now the C/N ratio at B must be such that the correction factor applied to C_R does not exceed 0.75 dB. It can be seen from the chart that a 0.75-dB correction is required when the difference in C/N ratios is about 7 dB. Thus

$$46.75 + 7 = 53.75 \text{ dB}$$

is the minimum C/N ratio at B under these conditions. Obviously there are other combinations of C/N ratios that would achieve the same result at C_R. This will be shown later.

Path B-C can be analyzed using in eq 3 the values found above.

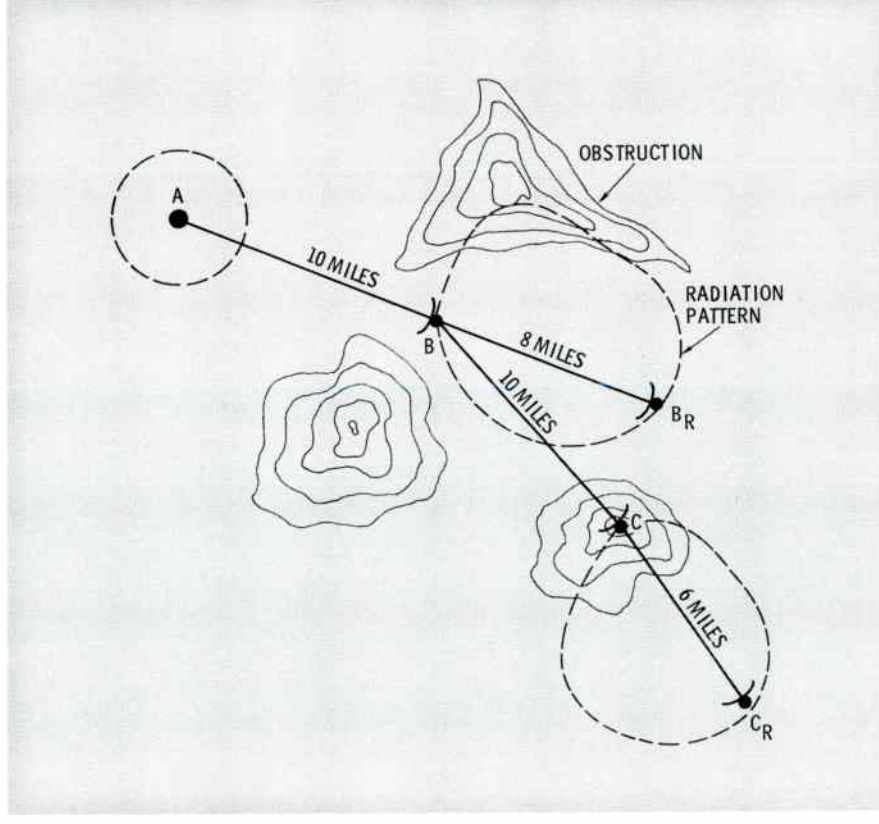


Fig. 2. Additional transmitting repeater to bypass obstruction in signal path.

$$P_R = P_{ER} + (G_R - L_R) - L_P \quad \text{(eq 3)}$$

$$G_R = P_R - P_{ER} + L_R + L_P \quad \text{(eq 4)}$$

In this case

$$G_R = (-125\ \text{dBw} + 53\ \text{dB}) - 20\ \text{dBw} + 2\ \text{dB} + 125\ \text{dB} = 35\ \text{dB}$$

thus, a 10-foot receiving dish is required at C to achieve the 53-dB C/N, and the required C/N at B of 53.75 dB will be achieved only with a dish size of 10 feet. This is recognized as being impractical in most cases, and the system design C/N at C_R will have to be achieved by varying other parameters.

A 4-dB improvement in C/N (52 dB) at C_R can be achieved by increasing the dish size to 6 feet. Reducing the dish size to 8 feet will yield a C/N of 52 dB at C. Combining 52 dB and 52 dB yields a C/N of 49 dB, and from the chart it is seen that a C/N of at least 49 dB will be required at B to have the overall system C/N at least 46 dB at C_R. A C/N of 49 dB can be achieved at B with a 6-foot dish, and the overall system noise is now within the design tolerances using practical components.

Some of these adjustments could have been made by increasing the ERP at one or all of the transmitter sites or by other changes to improve C/N.

As a rule of thumb in initial design considerations, the following technique can be used. In a two-hop system the resulting C/N will be 3 dB worse than a single hop if the CN/ ratios of each hop are equal; in a three-hop system, the overall C/N will be 5 dB worse than a single hop if the C/N ratios of each hop are equal. Thus, if a 46-dB C/N is desired, each hop will have to have a C/N of 49 dB in a two-hop system or 51 dB in a three-hop system.

Note in the previous analysis that the C/N at B of 49 dB requires that each of the receiving sites served by B must have a C/N of at least 40 dB (referenced to B only) in order to have an overall C/N of 46 dB.

In all of these discussions, the term C/N when applied to a multiple-hop system actually refers to (C + N)/N ratio, since the noise picked up in each part of the system is retransmitted to the remainder of the system.

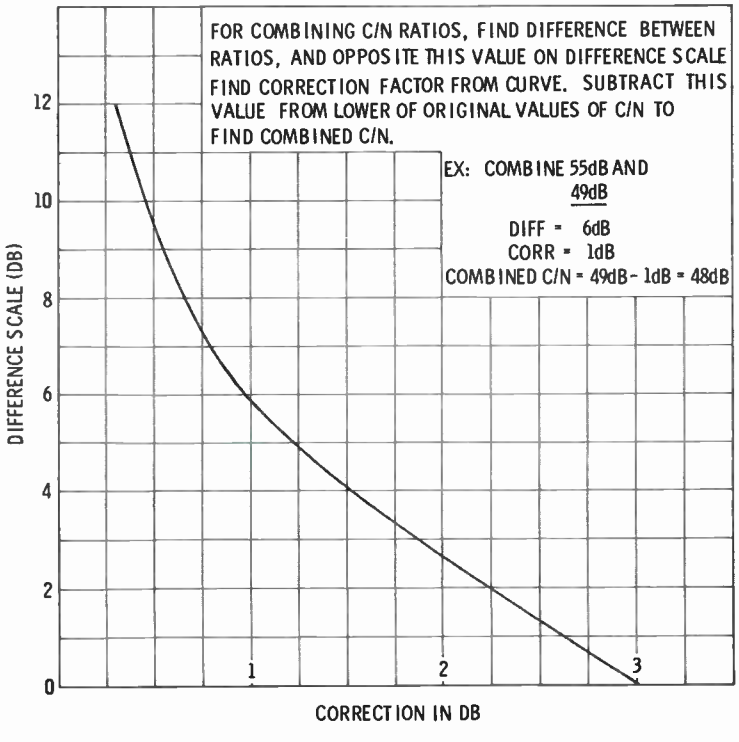


Fig. 3. Curve designed to combine two or more carrier-to-noise (C/N) ratios.

Equipment Selection

The selection of components to construct an ITFS system requires a thorough study of the specifications of available equipment in order to find the items that meet the criteria established during the design stages.

Generally speaking, specifications should be written to cover system performance as well as the performance of individual components. Performance specifications should include:

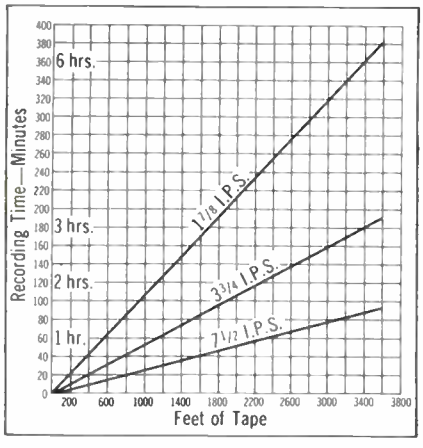
1. Transmitter: Frequency response, noise, linearity, stability, power output, and sideband filtering limits.
2. Antenna system: Gain, bandwidth, VSWR, pattern circularity (or shape), and beamwidth and null-fill/beam-tilt characteristics where applicable.
3. Transmitting/receiving antenna tower and supporting structure: Rigidity, wind loading, deflection limits, painting, and lighting.
4. NTSC color requirements if applicable.
5. System: Noise, frequency response, and differential gain and phase at converter output (or distribution system output) and method of measurement.
6. Minimum acceptable values for converter noise figure and gain.
7. Workmanship requirements.
8. Proof of performance measurements criteria.
9. Requirements for submission of engineering data, design diagrams, and installation diagrams.
10. Reliability and warranty requirements.

The specifications should include information about special control or monitoring features desired, and method of construction, ambient operating conditions, space requirements, etc. A good set of specifications will assure the purchaser of excellent technical performance and will allow the contractor(s) to plan and install equipment with their

Some plain talk from Kodak about tape:

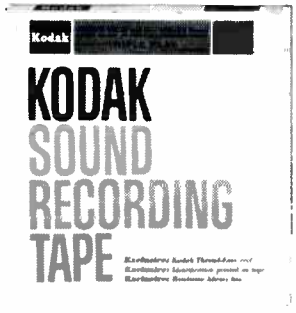
Uninterrupted listening pleasure... and the answer to a searching question

Recording a pop tune or even the whole top ten isn't much of a problem with standard sound tapes. But people always want more—like getting a whole Wagnerian opus on a single reel. Actually, the problem of long playing time involves two variables: how fast you run the tape, and how much tape length you get on a reel. The latter variable is a function of reel size and tape thickness. The following chart will give you an idea of running times with different lengths of tape:



Some like it slow. Taking it slow is the obvious way to get longer playing time. Halve the speed and you double the time it takes for the tape to run. This works very well up to a point. As a matter of fact, it is the historical trend—from 15 ips to 7½ ips to 3¾ ips and so on. But as you cut the speed, and thereby compress the recording, you make the microscopic perfection in the tape more and more important. Furthermore, at slow speeds the increased dependence upon short wavelength information and the concurrently reduced flux-carrying capacity of the tape makes head and equipment design more difficult. But even though improved quality slow-play tape recordings are strongly dependent upon improved equipment, you are still ahead with the built-in quality of KODAK Tapes—high output tape Type 34A, with its output and noise advantages, or low-print tape Type 31A.

Some like it thin. The other avenue is to go to a thinner tape . . . one that packs more length on the reel. This too is an appealing idea—one that explains the proliferation of double and triple play tapes. So what's the catch? Well, for one thing, very thin tapes require careful habits on the part of the home recordist. Your recording/playback heads should be in good shape, as thin tape is more liable to physical distortion and breakage. Make sure that your recording equipment is in top shape so that it produces smooth starts and stops. You can help with a smooth start by turning the reels away from one another (gently, please) so as to take up any slack in the tape which may have occurred during threading. Also, forget the fast-rewind knob—store tapes "as played." Fast rewind can set up a lot of tension and often cause erratic winding. All this can result in "stretched" or "fluted" tapes. In a nutshell, treat thin tapes with loving care. When you record, be careful not to overload on input (if you have a VU meter, keep the needle slightly below the record level you would normally use for regular tape). Last but not least, make sure you get your tape from a reliable maker—like Kodak. It takes a lot of extra care in winding, slitting and over-all handling to come up with a superior triple-play tape like Kodak's famed Type 12P. Because of its highly efficient oxide, Type 12P gives you a signal-to-noise ratio better by close to 6 db compared to the other leading triple-play tape. Add to this the advantage of back printing (so you always know what type of tape you're using—even when it's in the wrong box), and a dynamically balanced reel that reduces the stress and strain on a thin tape, and you can see why KODAK 12P Tape is becoming so popular.



KODAK Tapes—professional types and the long-playing variety—are available at most electronic, camera, and department stores. If you've had trouble finding them at your favorite store, Kodak would like to help. Simply tell us where you'd like to buy KODAK Tape, and we'll see what we can do about having these stores stock it. In the meantime, we'll rush you the names of nearby Kodak dealers where you'll be *sure* to find KODAK Tape; also, a very informative booklet "Some Plain Talk from Kodak about Sound Recording Tape." Just fill out the coupon below.

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responsibilities clearly defined (in a manner that is in accordance with the state-of-the-art capabilities).

The specifications should also include sufficient information about future expansion (more channels or more receiving locations) to preclude the necessity for extensive modifications or replacements at the time of expansion.

Part 1 of this series included a list of equipment manufacturers, and information from them may be obtained by writing to the addresses shown. Most of the equipment available is transistorized except in the high-power or high-frequency stages of the transmitter.

Multiplexing units are used to combine the outputs of two or more transmitters into a common transmission line and antenna. These are passive devices with tuned cavities to provide high isolation between the input ports and have a minimum forward, or insertion, loss looking toward the antenna system. The two prime concerns in system design are the isolation values between ports and the insertion losses. Isolation must be sufficient to prevent interaction between transmitters and resultant crosstalk or cross-modulation problems. Insertion losses must be kept very small, and generally are in the order of less than 1 dB. Depending on the type of construction used, these losses may be different for each input port. If more than two channels are being multiplexed, the losses will not be negligible. Insertion losses experienced in a typical 4-channel system can exceed 2 dB.

VSWR in the antenna system should be kept very low (1.1 — 1.2:1) to prevent reflections in the line (particularly in long lines) and to achieve maximum power transfer into the antenna. Matching devices may be required to achieve these values across the entire bandwidth of the finished system.

Installation and Measurements

The same general rules applying to the installation of broadcast equipment should be used in the construction of 2500-MHz facilities. Workmanship, particularly in the handling of RF components, is extremely important.

The transmitting antenna should be handled carefully during erection to eliminate the possibility of internal damage or misalignment from rough handling. All RF connectors and transmission-line ends or exposed parts should be covered to provide protection from dust and other contamination.

Because of the narrow beamwidths encountered in high-gain antennas, it is essential that the vertical alignment of the antenna be precise, generally within ± 0.1°. This will require a field check with a transit during installation, and the antenna should be sighted from at least three positions. The horizontal alignment of the antenna may be critical if the pattern is not uniformly circular. When it is recalled that C/N computations are compensated with a pattern correction, it is obvious that the antenna must be accurately aligned in the horizontal plane. The effect of the tower on a side-mounted antenna is practically impossible to calculate, and the only practical method of determining the effects is to measure the antenna pattern on a mock-up of the tower section on which it is to be mounted. In regard to pattern measurements, it would be wise to request actual pattern measurements in both planes from the manufacturer so that any deficiencies can be identified prior to erection.

The installation of transmission line or waveguide should be performed according to manufacturer's recommendations. Particular care should be exercised in the type and placement of hangers used in waveguide installations. Permanent damage to waveguide will result if it is not free to move within the limits of expansion and contraction that take place with temperature variations. The top end of the waveguide is normally fixed to the tower with the bottom end free to move both laterally and vertically. The differential movement of the waveguide with respect to the tower is minimized, since the movements are in opposite directions (as tower expands upward waveguide expands downward). Steel has a coefficient of expansion of 6.8, whereas aluminum (of the type used in waveguides) has a coefficient of 12.4. On a 300-foot tower, the differential expansion on a 100° F day when compared to a 50° F day will be in order of — 1.5 inches; *i.e.*, the end of the waveguide will be about 1.5 inches lower on the tower than at 50° F, and obviously must be free to move.

Waveguide pressurization recommendations should be followed carefully. Rigid coaxial lines will take 15-30 psi without damage, but an aluminum waveguide may have a maximum pressurization limit of 5 psi with a recommended steady-state value of less than 1 psi. If bottled nitrogen is used to pressurize the waveguide, an automatic relief valve should be installed to prevent accidental damage caused by inadvertently exceeding the manufacturer's pressure limits.

Waveguide loss should be determined by measurement with a signal generator (or by using the transmitter as a source) and an accurate direct-reading power meter. The measured value should be very close to the theoretical value supplied by the manufacturer. A wide variation is an indication of problems in the system.

VSWR measurements can be made with a signal generator and a slotted line. Ideally, the waveguide should be terminated at the antenna end with a known terminator, and a measurement made on the waveguide or line alone. The measurement should then be repeated with the antenna terminating the line. The two values should be very close and within the range previously specified. Measurements should be taken at 0.5-MHz increments across the entire bandwidth of the system.

Any transitions from waveguide to coaxial line should be factory compensated for minimum VSWR across the operating frequencies. This also applies to flexible sections and elbows. A high VSWR at one elbow or transition could introduce a serious discontinuity which may not show up in the overall VSWR measurements. For this reason it would be advantageous, if the proper equipment is available, to RF-pulse the system. Any serious problems can be detected readily and pinpointed with this technique.

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measuring equipment is not available in the field, all coaxial cables used should be precut with connectors installed at the factory where VSWR and loss measurements can be made. The type "N" connectors normally used at these frequencies can be extremely troublesome, and a pair of these connectors on a short line could exhibit as much as a 2-dB loss if not properly installed. This also applies to the "pigtails" used between receiving antennas and convertor inputs. The use of RG-8 coaxial cable should be kept to a minimum because of high losses in this type of cable at 2500 MHz.

Performance measurements on the transmitter are made with the same type of equipment and techniques used on television broadcast transmitters, and will not be discussed in detail. Some problems may be encountered in finding suitable devices for detecting the transmitter output, if monitoring circuits are not built into the transmitter.

It is recommended that the installation of receiving antennas and convertors be delayed until the transmitter is operational. Wherever possible, a test installation should be made to determine the exact height and position of the tower and receiving antenna. It is possible to optimize the receiving installation by probing vertically and horizontally for the maximum signal, and in some cases an improvement of 3-4 dB has been realized with this technique. This may not be possible where high receiving towers are required, or where the location is determined by other factors.

The erection of the towers should be performed in strict accordance with the manufacturer's recommendations, particularly in regard to guy tensioning. The mounting of the antenna should be extremely rigid to prevent deflection in high winds. Table 1 shows values of antenna movement with respect to the tower and limits of tower twisting for different antenna sizes under maximum wind-load conditions. The figures are from EIA Standard RS-222. These antenna movements would produce a change in signal level on the order of 3 dB in worst-case conditions, but under ordinary high-wind conditions (50 mph or less) the variations would be less than 1.5 dB nominal.

Table 1. Antenna Movement for Maximum Wind Load

Dish Size (Feet)	Movement of Antenna With Respect to Tower (Degrees ±)	Allowable Tower Twist (Degrees ±)
2	0.75	4.5
4	0.5	4.0
6	0.3	3.4
8	0.2	1.9
10	0.2	1.5

To minimize down-lead losses, the convertor should be mounted as close to the antenna as possible. Field installation of connectors is not recommended for the reasons stated earlier. The connector should be weatherproofed after installation to prevent exposure to moisture.

The carrier-to-noise ratio should be measured at all locations, thus insuring that system performance is within the original tolerances. Several initial readings should be compared with the theoretical values, and basic agreement should be found. It may be advantageous to use the same convertor for these measurements so that variations in convertor performance are eliminated from the measurement.

If a field-strength meter is used to make carrier-to-noise measurements, the bandwidth of the unit should be taken into consideration. One popular unit has a bandwidth of 600 kHz. The noise measurement required in this system is that for a 4-MHz bandwidth. A correction factor, therefore, must be applied to the readings obtained with a field-strength meter of limited bandwidth. In this case, a factor of 8-10 dB must be subtracted from the readings obtained to find the actual carrier-to-noise ratio. It would be wise to make a field measurement using a known receiver or demodulator, an oscilloscope, and a wideband VTVM to determine the video signal-to-noise ratio.

$$S/N(dB) = 20\log\frac{\text{peak-to-peak video}}{\text{rms noise}}$$

An S/N ratio in excess of 43 db will provide noise-free pictures, and a correlation between S/N and C/N ratios can be established.

The performance of the distribution system should be checked to make certain it is not contributing objectionable noise, distortion, or interference to the input signals.

Conclusion

The equipment required for studio systems was not covered in detail, but designers are reminded that the FCC specifications for broadcast television apply almost universally to 2500-MHz systems. The performance of sync generators, tape recorders, and audio equipment must be within broadcast tolerances.

FCC Rules and Regulations regarding equipment and program tests should be reviewed thoroughly prior to construction and must be rigidly adhered to, particularly in regard to required notifications and approvals.

This series of articles was intended to provide some of the basic aspects of system-design and installation. It does not cover all aspects nor does it provide answers for special problems that may be encountered. Basic microwave and broadcast engineering techniques and principles apply to installation and design, and most problems can be solved through their proper application and interpretation.

With careful planning, selection of equipment, and installation, a 2500-MHz system can provide reliable signals and overall performance equal to, or better than, that obtained from high-power television broadcast stations. ▲

[1]—125 dBw is the desired threshold signal for the system and was established in Part 2 of this series. See BROADCAST ENGINEERING Oct., 1966, p. 38.

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DC Grid Current	1.8 Amps
Peak RF Grid Voltage	1200 V
Grid Driving Power	2.5 kW
Plate Output Power	292 kW

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Circle Item 14 on Tech Data Card

GROUNDING TOWERS FOR LIGHTNING

*by J. L. Marshall**

Part 2—Considerations for buildings and radial systems are discussed.

Since an elaborate ground system does not render the whole property safe for a high-current lightning stroke, it is necessary to consider the probability of danger. In the first place, it is unlikely that a person would be on the property when a storm was imminent.

Canadian Broadcasting Corp., Montreal, Quebec

Secondly, if a person were standing over one of the radial conductors, the danger would be lessened. Thirdly, if the person were taking a step in the circumferential direction rather than a radial direction, he would be on an equipotential line (approximately) and so would be relatively safe. Finally, a maximum-value stroke occurs only once or twice per year in most regions of North American. (See Fig. 1.)

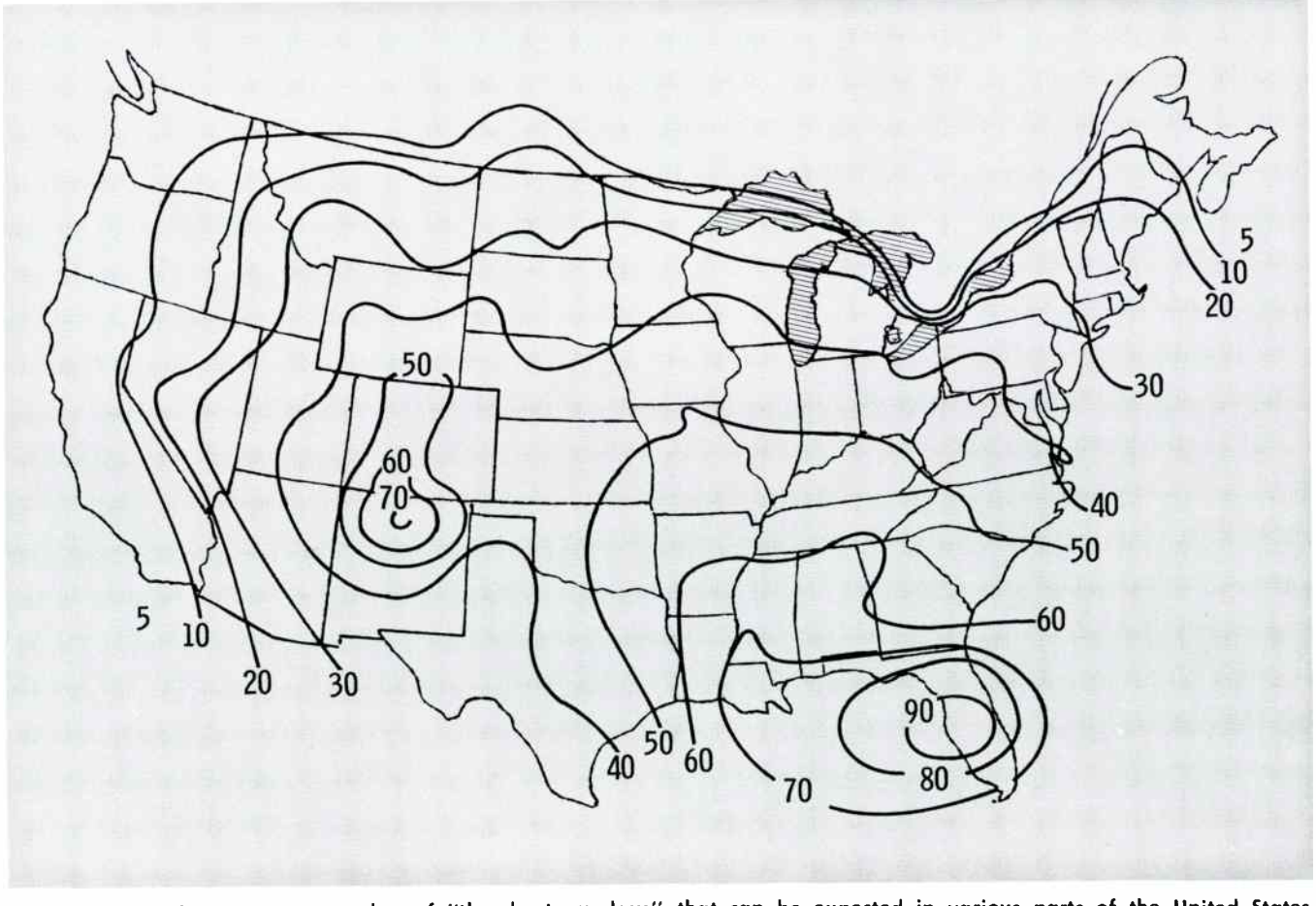

Fig. 1. Curves show average number of "thunderstorm days" that can be expected in various parts of the United States.

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For the case of a guyed tower, 300 feet high, on the same kind of site, grounding conditions are different. The base of the tower is usually much smaller, and the volume of earth associated with the base is small. On the other hand, guy cables are conductors, and each one is anchored in the earth. For a high earth resistivity of 5×10^3 meter ohms, it will be found necessary to create a larger effective base volume, in order to lower the tower base potential for a maximum stroke current of 10^5 amps. A conductor should be carried down from the tower and from each guy to the bottom of each excavation, and a ground rod should be driven below the excavation to a depth of 20 feet (6 meters) from the surface. From this we can assume that the effective base radius is 6 meters. If there are three guy-anchor points, there will be four paths to earth for the lightning current, and the resulting average base potential at each of the foundations will be

$$E = \frac{\rho I}{4\,(2\pi B)} \qquad \text{(eq 9)}$$

$$= \frac{5 \times 10^3 \times 10^5}{4 \times 6.28 \times 6}$$

$$= 3.3 \times 10^6 \text{ volts}$$

From the results derived for a self-supporting tower, it is apparent that a grounding system will be needed for the guyed tower also. Consider ten buried radial copper conductors, centered at the tower, of No. 0 wire, each 150 meters long, extending about 70 meters beyond the guy anchors. The resistance of this part of the system is, from eq 6,

$$R = \frac{5 \times 10^3}{10 \times 3.14 \times 150}\left[\log \frac{300}{(2 \times .00412 \times .305)^{1/2}} - 1 + 9 \log (2 \times 1.707) - \log 10\right]$$

$$= 17 \text{ ohms}$$

In order to make the ground-system resistance at each guy-anchor point approach the value at the base of the tower, it will be necessary to tie each guy-anchor point into the radial ground system with a buried ring conductor, which connects to each guy ground and to the remaining seven buried radials. Now the resistance at the tower base will be somewhat less than 17 ohms, and at the guy-anchor points somewhat greater than 17 ohms. For a practical approximation, the average base resistance of the four grounding points of 17 ohms may be taken. The base voltage (at each foundation) for a maximum stroke current of 10^5 amps would be

$$\frac{10^5}{4} \times 17 = 4.3 \times 10^5 \text{ volts}$$

The equivalent resistivity of the earth as modified by the ground system would be, from eq 8

$$\frac{6.28 \times 6 \times 4.3 \times 10^5}{\frac{1}{4} \times 10^5}$$

$$= 650 \text{ meter ohms}$$

Here, as for the self-supporting tower, ground rods will be needed. A copper ground rod (or tube) of ¾-inch (.019-meter) diameter, inserted 10 meters into the "earth," should be connected to each of the ten buried radials and located along a circle midway between the tower and anchor points, *i.e.*, at a radius of about 40 meters from the tower.

In this example, the resistivity of the rock formation will be predominant in determining the resistance to ground of the rods, because the top layer of soil is relatively thin. The resistance to ground of one rod will, accordingly, be (from eq 7)

$$\frac{5 \times 10^3}{4 \times 3.14 \times 5} \log \frac{2 \times 5}{.0095}$$

$$= 550 \text{ ohms}$$

Ten such rods in parallel will have a resistance of about one-tenth the unit value, or 55 ohms. This is in the same order of magnitude as the radial wire system by itself, and the value of the two systems in parallel is

$$\frac{17 \times 55}{17 + 55} = 13 \text{ ohms}$$

The average potential at each foundation for a maximum stroke current would now be

$$E = \frac{13 \times 10^5}{4}$$

$$= 3.2 \times 10^5 \text{ volts}$$

The average equivalent ground resistivity around each foundation will be, from eq 8

$$\rho = \frac{6.28 \times 6 \times 3.2 \times 10^5}{\frac{1}{4} \times 10^5}$$

$$= 480 \text{ meter ohms}$$

The voltage gradient at the base radius of each foundation would be, from eq 2

$$e = \frac{480 \times \frac{1}{4} \times 10^5}{6.28 \times 36}$$

$$= 5.5 \times 10^4 \text{ v/m}$$

From the previous case it will be recalled that the gradient must be lowered to about 6000 volts per meter to be safe, even with a crushed-stone layer over the surface. This value of gradient would exist at about 20 meters from each foundation, as can be seen from the following:

• *please turn to page 33*

BOOK REVIEW

Electronics: Roy H. Mattson; John Wiley & Sons, Inc., New York, 1966; 620 pages, 6" x 9", cloth, $12.95.

This volume has been designed as a textbook in electronics for the college sophomore level. In it is a general treatment of the principles of electronics with emphasis on semiconductor devices.

The text is organized in three parts, the first of which is concerned with the operating principles of electronic devices and the models that can be used to represent these devices. Substantially, this material explores the physics of materials such as the electrical properties of semiconductors.

The second part is devoted to the study of transducers, systems, and applications. The treatment includes sound, optical, and other related energy-transfer phenomena. The study of transmission systems is related to the functions of their electronic components, and the discussion of applications is about the capabilities of two-terminal devices.

The concluding portion of the work is oriented toward design criteria and includes biasing, linear-network theory, small-signal amplifiers, switching systems, and many other circuits such as DC and power amplifiers.

An unusual feature is a front-of-the-book list of symbols which are uniformly applied to all mathematical formulas, computations, and discussion throughout. "Quantities of Interest" is the title of a table of MKS System values for germanium and silicon. An appendix includes characteristic information for selected semi-conductors.

Each chapter is supplied with questions related to the text, and answers are provided at the end of the book.

The author states that the volume is designed for a three-quarter course, and users should have at least two courses in circuits, including an introduction to Laplace-transform methods of circuit analysis. Some calculus is employed, but a reader could employ the book after completing the freshman-level courses. ▲

December 1966

We interrupt this magazine to bring you...

Late Bulletin from Washington

by Howard T. Head

New Television Program Form Adopted

The Commission has adopted the long-awaited new television program form (March 1966 Bulletin). At the same time, the program logging Rules for television broadcast stations were amended.

The new form requires applicants to state methods used in determining community needs, and to identify various groups and organizations consulted. The applicant must state the needs proposed to be served, and describe by means of illustrative programs the manner in which he proposes to meet these needs.

Statistical information is also required to be submitted for program categories in a composite week, and a description must be furnished of typical programs broadcast during the preceding year to serve public needs and interests. Statistical details concerning proposed programming, as well as past and proposed commercial practices, must also be submitted.

The new form is to be used beginning December 1, 1966, by applicants for new television stations and major changes in existing stations, as well as by assignees and transferees. Renewal applicants and assignors and transferors must use the new form beginning December 1, 1967. The new logging Rules will become effective December 1, 1966.

Plan for Presunrise Operation of Daytime-Only Stations

Most of the details appear to have been worked out in a Commission plan which would permit daytime-only standard broadcast stations operating on the regional channels (Class III) to commence operation at 6:00 a.m. or local sunrise, whichever is earlier (October 1966 Bulletin). Under the plan, all such stations would be permitted to operate between 6:00 a.m. and local sunrise with a minimum power of 500 watts using a nondirectional antenna; earlier plans to restrict such operation to stations in communities having no other radio service seem to have been abandoned.

One of the obstacles to this proposal has been the need for arriving at suitable agreements with other countries whose stations might be affected by presunrise operation. Agreement on this point appears imminent, however, and once the details are worked out with neighboring countries, new Commission Rules are expected to be issued quickly.

FCC to Investigate Bell System CATV Leaseback Tariffs

The Commission has ordered a hearing to determine the lawfulness of tariffs for CATV channel service use filed by the various Bell System operating companies.

At the same time, the Commission suspended the effectiveness of a revised tariff of a West Coast telephone company which would have become effective in October.

The order followed hard on the heels of complaints by the National Community Television Association (NCTA) concerning various aspects of the Bell System leaseback tariffs. As CATV continues to expand, it becomes certain that these controversies will assume increasing importance.

Plans Advance for Channel Sharing Tests

A Government-Industry Working Group, under the leadership of the Commission's Chief Engineer, is making progress in planning field tests of the technical feasibility of the sharing of television broadcast channels by base-station transmitters operating in the land mobile services. These tests are being planned in response to insistent pressures from the land mobile organizations and legislators for more land mobile spectrum space.

Present plans contemplate experimental operation of land mobile base-station transmitters within the limits of Channel 6 (82-88 MHz) in the Los Angeles, California, area. Tests are planned to investigate the severity of interference not only to the adjacent-channel Los Angeles channel-5 television station, but also to a station operating on channel 6 from Tijuana, Mexico.

One unresolved obstacle to the tests may be this country's agreement with Mexico concerning the use of the VHF television band within 250 miles of the International Border. The agreement is silent with respect to the use of channel 6 in the Los Angeles area, but the Commission feels that Mexican concurrence would be required even to permit experimental land-mobile operation.

Licensees Must Inform FCC of Proposed Commercial Practices

The Commission has directed all commercial television and radio (AM and FM) stations to file, prior to January 1, 1967, a statement of their proposed commercial practices. Information which must be reported includes the maximum amount of commercial material normally proposed to be carried in any 60-minute segment, together with a statement as to whether and under what circumstances the limit might be exceeded. If the stated maximum exceeds 18 minutes per hour for radio stations, or 16 minutes per hour for television stations, the licensee must justify the proposed practice to the satisfaction of the Commission.

Short Circuits

A Class III AM station on a regional channel has been authorized 10-kw power -- in Guam, far removed from the continental United States but under FCC jurisdiction. . .The Commission's newly established CATV Task Force (October 1966 Bulletin) is now handling routine matters on a delegated-authority basis. . .The National Association of Broadcasters (NAB) has just concluded its second highly successful Engineering/Management Development seminar for broadcast engineering executives at Purdue University. . .The Commission is expected shortly to authorize remote-control operation of VHF television transmitters. . .Negotiations for a new AM treaty between the United States and Mexico continue to progress -- an informal engineering session is scheduled in Mexico City near the end of the year, with the next formal negotiating session to be held in Mexico City next spring.

Howard T. Head. . . in Washington

BIG PICTURE TK-60 . . . BIG TV FAVORITE!

TK-60 deluxe
4-1/2 inch I.O.
monochrome camera

RCA "Big Picture" TV Camera with 4½ inch image orthicon

. . . TK-60 is symbol of deluxe television

The fact that the TK-60 has attained widespread acceptance in television stations is a tribute to its fine features and superb performance.

This is the camera design that says "television at its best."

BIG PICTURE TUBE

Using a large 4½-inch I.O. tube, the TK-60 produces the ultimate in fine pictures—with greatly improved gray scale and resolution. It's the same "black tube" that's making the big difference in color pictures with the revolutionary new TK-42 color camera.

This is the big 4-1/2 inch I.O. tube for sharper pictures.

BIG BRIGHT VIEWFINDER

The viewfinder features an 8½-inch rectangular kinescope, with maximum useable highlight brightness—at least 150 foot lamberts. Viewfinder can double as a setup monitor. A combined picture from the special effects system—as well as output from the processing amplifier—can be punched up on the viewfinder.

This is the big bright viewfinder for quality control.

BIG PERFORMER

TK-60 cameras do not need to be adjusted from day to day, nor do they need extensive warmup before being used "on air." Pictures "snap in" each time the camera is turned on, and are ready for use in a short time. Once set up, high quality pictures are there to stay.

For further information, write RCA Broadcast and Television Equipment, Building 15-5, Camden, N.J. Or call your RCA Broadcast Representative.

The Most Trusted Name in Television

$$V = \frac{I\rho}{2\pi}\left(\frac{1}{15} - \frac{1}{20}\right)$$

$$= \frac{10^5 \times 480}{8 \times 3.14}\left(\frac{1}{15} - \frac{1}{20}\right)$$

$$= 32{,}000 \text{ volts}$$

The gradient is one fifth of this, or 6400 volts per meter.

It can be concluded that with this rather elaborate ground system, much of the ground surface would be safe under maximum stroke conditions, provided persons restricted themselves to crushed-stone paths or wooden walkways during imminent storm conditions, and stayed about 20 meters from the tower base and anchor points.

As a matter of interest, consider an AM broadcast-station (insulated) tower with 120 radials of No. 10 copper wire, each 150 meters long, buried to a depth of 8 inches (1/5 meter) in low-resistivity soil where $\rho = 10$ meter ohms. By applying eq 6, the resistance of this ground system is found to be a fraction of an ohm. However, based on the investigation of others[1], it would be prudent to regard it as one ohm. Then, for a maximum stroke current of 10^5 amperes (sufficient to jump the lightning ball gap), the base potential will be approximately 10^5 volts. The guy wires cannot be used as parallel paths to ground in this case, because they are insulated. The base potential is also equal to

$$\frac{\rho I}{2\pi B}$$

and in this case it seems reasonable to use the given low value of ρ and derive from this expression the effective radius of the base. Thus

$$\frac{10 \times 10^5}{2\pi B} = 10^5$$

from which

$$B = \frac{10}{2\pi}$$

$$= 1.6 \text{ meters}$$

Then the voltage gradient at the base radius is

$$\frac{10^5}{1.6} = 6 \times 10^4 \text{ volts per meter.}$$

Consider the voltage drop between two points, 3 meters and 8 meters from the tower

$$V = \frac{I\rho}{2\pi}\left(\frac{1}{3} - \frac{1}{8}\right)$$

$$= \frac{10^6}{6.28}(.21)$$

$$= 32{,}000 \text{ volts}$$

and the approximate gradient across these five meters

is 6400 volts per meter. Accordingly, the ground would be "safe" from a distance of eight meters outward, providing the surface were gravelled. To find out where one would be safe without a gravelled surface, assume that grass or other vegetation (when dry) would have an effective resistivity of 100 meter ohms. For this condition the "safe" voltage gradient, from eq 5, would be 200 volts per meter, and this gradient would occur at about 85 meters from the tower, as determined by eq 4. This result indicates that even with a low-resistance ground system, if the surface soil has low resistivity, precautions must be taken.

In the television transmitter building itself, for the earth sample considered, it is necessary, for the safety of personnel, to keep the voltage gradient across the floor area to a minimum. This can be done by bonding the reinforcing steel in all floors if the floors are concrete, or by embedding a conducting wire mesh if the floor composition is nonmetallic. In either case, the conducting grid must be bonded to the general ground system to dissipate the charge.

The question arises as to what happens when lightning strikes a tower mounted on a tall building in a city. First of all, the steel frame and other metallic conductors such as pipes, elevator rails, etc., are equivalent to a massive tower with a very large base. The surge impedance is, consequently, low. Furthermore, the base or foundation is sunk deep into the ground, thus making contact with a large volume of the earth. Then, too, there are large metallic conductors leading away from the base of the building (such as the main water supply, sewer pipes, and electric-cable sheaths). These act as "radial" ground conductors. Also, a city is usually located where there is some top soil, and rarely is set directly on rock. Most frequently, there are paved areas surrounding such buildings. It will be noted that this type of structure provides most of the elements for safety from lightning. The bonded steel framework bypasses the stroke current to ground, thus protecting the occupants. The large volume of the base in contact with the earth lowers the base potential. The large metallic conductors leading away from the base of the building, usually combined with a substantial depth of soil, lower the voltage gradient. The paved areas surrounding the building have a higher resistivity than the underlying soil, and consequently conduct a relatively small current (when dry) through a person's body.

Conclusion

It has been shown how lightning susceptibility in a particular installation can be calculated, and how specific application of known principles can reduce danger zones to reasonably safe areas. Under "maximum stroke" conditions it does not seem feasible to protect personnel on rocky ground immediately surrounding a tower, but the earth can be made safe for lesser strokes. It is imperative, however, that every reasonable step be taken to dissipate the charge from a lightning stroke, and in this way protect human life and equipment. ▲

[1]G.H. Brown, R. F. Lewis, and J. Epstein, "Ground Systems as a Factor in Antenna Efficiency," *Proceedings of the Institute of Radio Engineers,* June 1937.

Ten reasons why Altec shouldn't sell its new condenser microphone systems for $\$198^{00}$...

1. Your choice: AC or DC, Cardioid or Omnidirectional—Order the system you need now and expand by adding the appropriate extra mike or supply at any later time. Get any combination by simply switching microphones and/or power supplies. Model designations: M49—AC/cardioid; M50—DC/cardioid; M51—AC/omnidirectional; M52—DC/omnidirectional.

2. Frequency response from 20 to 20,000 Hz—This is with an essentially flat curve. Output level is—53 dBm re 10 dynes/cm^2, with balanced system output.

3. Extremely small diaphragm—Under 0.5″ in diameter. HF dropoff for sound waves arriving at random, non-perpendicular angles of incidence will occur only at frequencies above 20,000 Hz. All Altec condenser microphones contain diaphragms small enough to insure that HF dropoff does not occur within the usable frequency range.

4. 100% solid-state circuitry—The 195A base utilizes an FET as an emitter follower and also contains a 3-pin XLR-12 connector. No RF or balanced-bridge critical adjustments are used. The FET drops the extremely high impedance of the microphone to an impedance suitable for connection to a shielded 2-conductor standard cable. Power is simplexed over this same cable. The separate power supply provides balanced outputs for standard 150/250-ohm microphone preamp inputs.

5. Small, light power supply—About the size of two back-to-back packs of cigarettes, both the DC and the AC supplies provide ruggedness for long-term heavy duty combined with small size and light weight for new ease in handling. Finish is hard chrome.

6. Long-life DC battery operation—Two mercury batteries provide 2500 operational hours, up to a year in normal use. A convenient meter on the supply shows battery condition. Battery drain is prevented when system is not in use by unplugging the 195A base or by operating a recessed switch on the supply housing.

7. Many accessories are standard—With each system a wind/pop screen; microphone holder; and a 25-foot, 2-wire, shielded cable are provided at no additional cost. Connectors and mounting hardware are attached.

8. High-temperature ambient permissible—The systems will operate in an ambient up to 55° maximum (131°F).

9. Exclusive Altec exchange policy—After expiration of the normal full year guarantee, Altec will accept an inoperative microphone in exchange for a comparable new unit at a fraction of original cost. This policy is unique in the industry.

10. Microphone is unusually small and light—This feature—microphone and base are 3½″ L x ¾″ Diam.; weight 2.2 oz.—designed as a means of eliminating the cumbersome size, bulky shape, and heavy weight of older style microphones.

***** Extra High Sensitivity Models: Extremely high sensitivity (45 dBm re 10 dynes/cm^2) with unusually high signal-to-noise ratio. Designed specifically for use where microphone must be placed at some distance from performers (such as suspended over stage, orchestra pit, or audience, or in footlights). Identical to M51 and M52 systems in other respects, the M251 is for AC operation; M252 for DC. Both are omnidirectional. Price per system: $216.

And one reason why it can.

How Altec can offer you these superb systems at only $198 per—Part of the reason is that they're entirely American-made at our Anaheim plant. No import duties or importer profits to pay. Another part is that we know how to build studio mikes. We should—we've been doing it for nearly 30 years! (For example, remember the 21B and M-11?)

Send your inquiry today for complete technical information. We'll include a recent article on the values of big vs. little condenser microphones written by Alex Badmaieff, our chief engineer of transducers. Also our colorful new 1967 Stereo Components Catalog, just in case you're interested.

ALTEC LANSING

A Division of LTV Ling Altec, Inc., Anaheim, California

Circle Item 21 on Tech Data Card

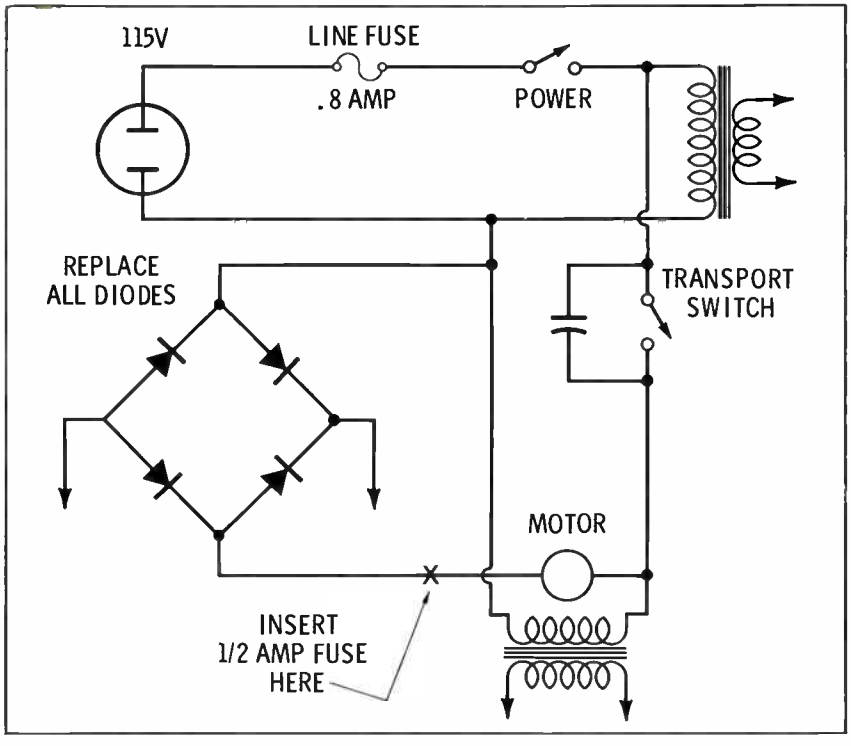
ENGINEERS' EXCHANGE

Voltage-Surge Protection for Cartridge Machines

by J. R. McDonald, Jr.,
Chief Engineer, KCFI,
Waterloo-Cedar Falls, Iowa

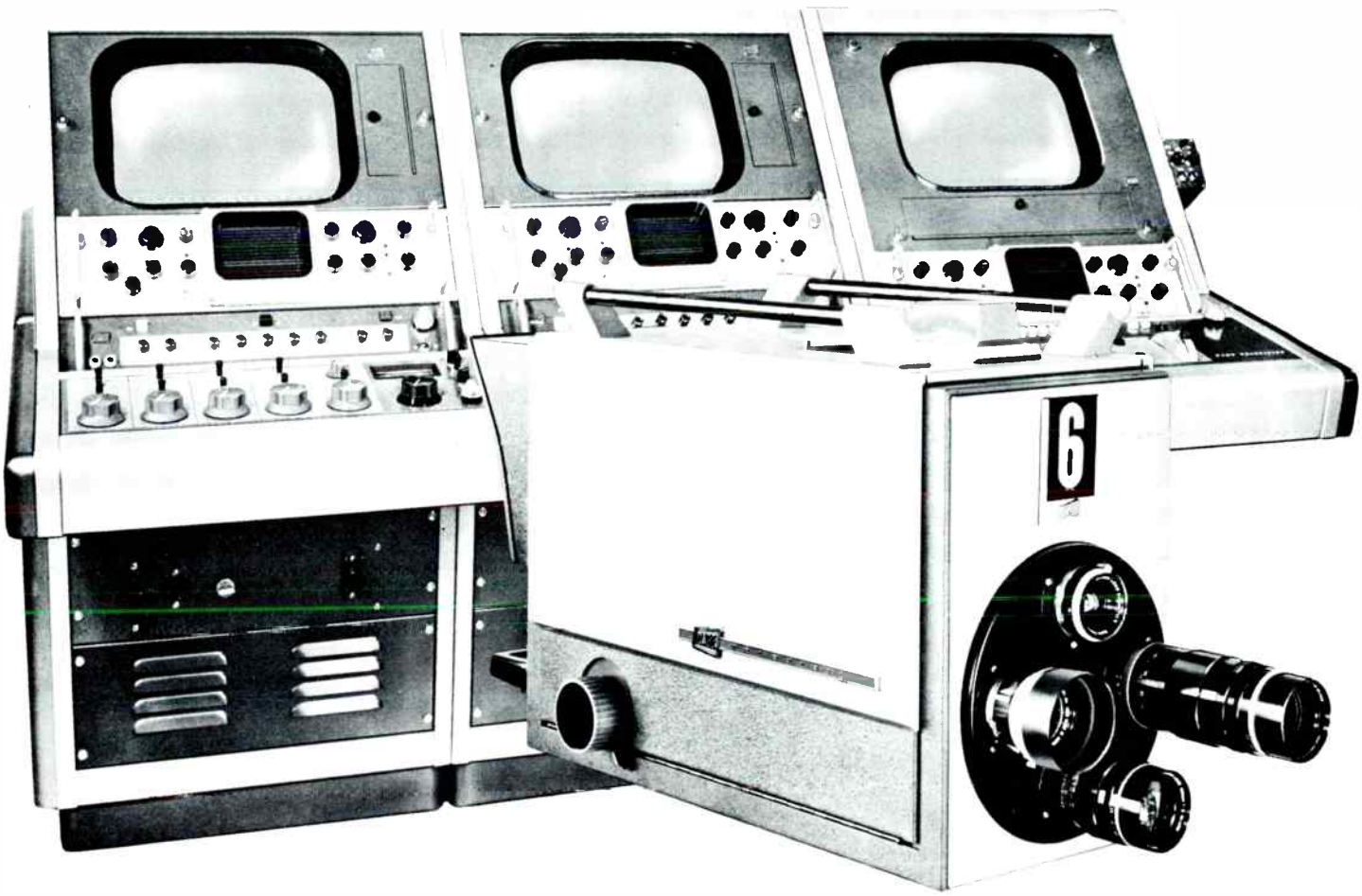
A voltage surge caused by a freak bolt of lightning uncovered a weakness in our cartridge players. Both failed when a bolt of lightning struck the local power station. The trouble was discovered in two of the four silicon diodes in a full-wave bridge (see schematic). They had developed short circuits, causing the fuses to blow. The problem was the same in both machines.

In order to prevent future voltage-surge failures, we replaced all the diodes with units rated at 600 PIV, 100 ma, substantially higher than the originals. In view of the fact that diodes are the only parts



RAYTHEON

THE BEST VALUE IN STUDIO EQUIPMENT



Whatever your requirements—commercial or educational broadcasting, CATV, closed circuit television, or 2500 mHz ITV, Raytheon offers the best value in television studio equipment. Whether you need a single component or a complete studio, Raytheon's years of experience in building television equipment for the broadcast industry, schools and the military, assures you of the ultimate in quality and years of satisfactory service.

Raytheon's experienced television consultants are at your service... why not discuss your needs with one of them today? There's no obligation, of course.

RAYTHEON TELEVISION SYSTEMS

RAYTHEON

DAGE-BELL CORPORATION

A SUBSIDIARY OF RAYTHEON COMPANY

455 Sheridan Avenue, Michigan City, Indiana 46360

Circle Item 56 on Tech Data Card

SOMETHING SPECIAL IN

COLOR VIDEO

THE BBRC MARK VII: AN ADVANCED DEVELOPMENT IN COLOR SPECIAL EFFECTS GENERATORS

The Mark VII, designed for the most critical studio and van applications, assures low maintenance and trouble-free operation.

The Mark VII is capable of color inserts (color matting). The output video of the Mark VII is the combination of background video and artificially generated color inserts. Any color within the range of the NTSC spectrum may be generated by the settings of the manual controls. The basic system can handle a variety of monochrome or color signals of either composite or noncomposite format at the inputs.

A non-additive mixing technique, insensitive to variations in video brightness levels, is incorporated for a new effect with lap-dissolves. The Mark VII systems consist entirely of transistorized plug-in modules, expandable on a building block basis to allow for a variety of pattern cards. Control panels can be selected for present needs or future requirements.

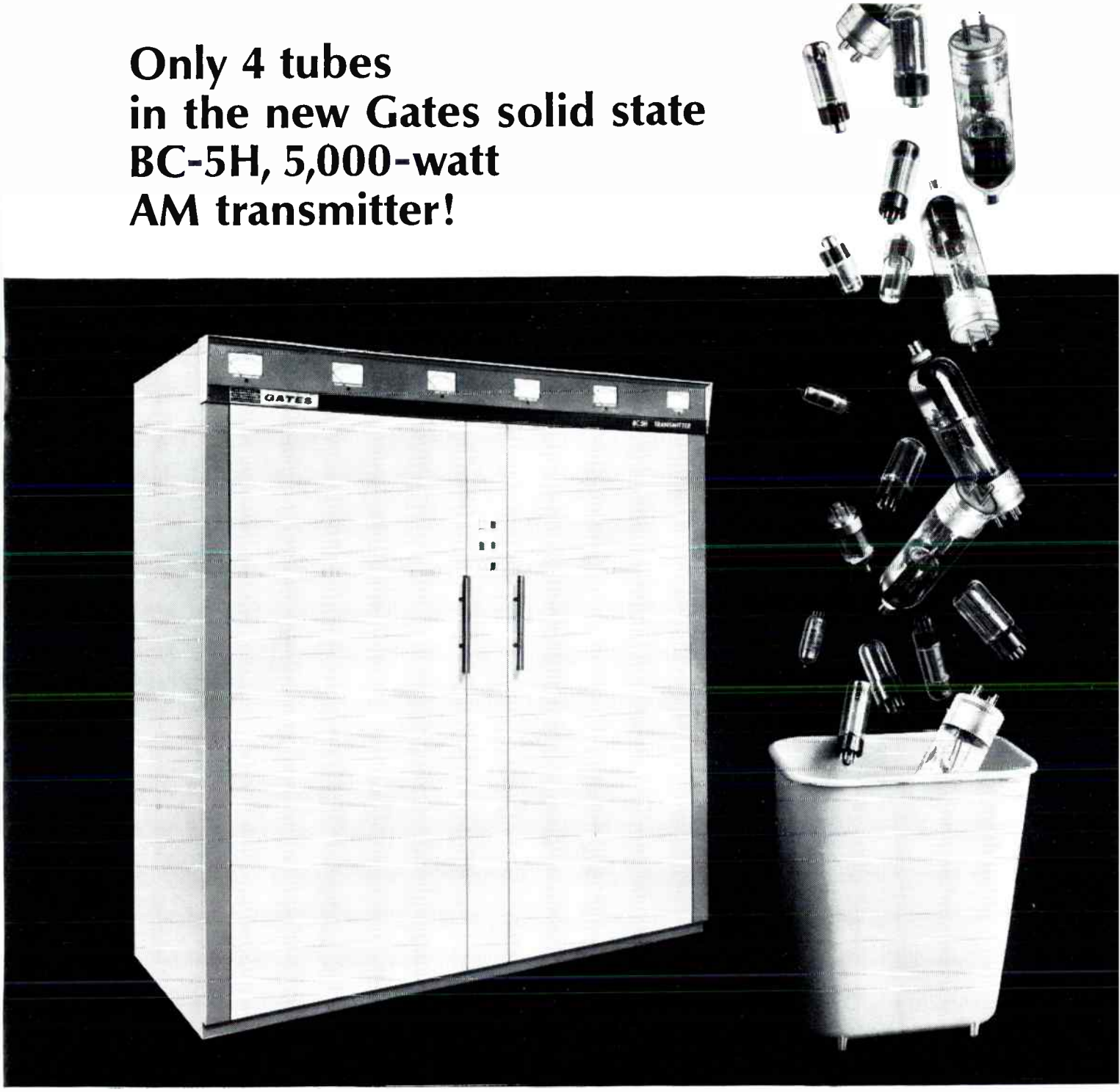
Priced from $1810.00. For immediate information call your local distributor, or write to BBRC Video Marketing.

BALL BROTHERS RESEARCH CORPORATION • BOULDER, COLORADO 80301 • TEL: 303/442-2965 • TWX: 303/443-6290

BBRC

Circle Item 55 on Tech Data Card

Only 4 tubes in the new Gates solid state BC-5H, 5,000-watt AM transmitter!



We threw all those tubes out in designing this new transmitter.
That leaves just 4. And these tubes cost less to buy and less to operate.
Besides that, everything's new in the over-all design:
Like the ceramic-type 3CX2500F3 triodes
in the power amplifier and modulator.
Like the use of transistors in all circuits except the RF driver,
power amplifier and modulator.
And silicon diodes in all power supplies.
And with capability for easy conversion to 10 KW.
And two instantaneously switchable transistorized oscillators.
And a handsome new cabinet.
But enough. Write for the whole story. It's packed with power.

HARRIS INTERTYPE CORPORATION

GATES

GATES RADIO COMPANY
QUINCY, ILLINOIS 62301, U.S.A.
A subsidiary of Harris-Intertype Corporation

Circle Item 23 on Tech Data Card

likely to suffer from moderate voltage surges, the replacements used will be adequate to prevent future cartridge-machine failures. If additional protection is desired, a ½-amp fuse may be inserted in the circuit at the point indicated on the schematic. The replacements have kept the machines on the air admirably in spite of several power surges due to lightning.

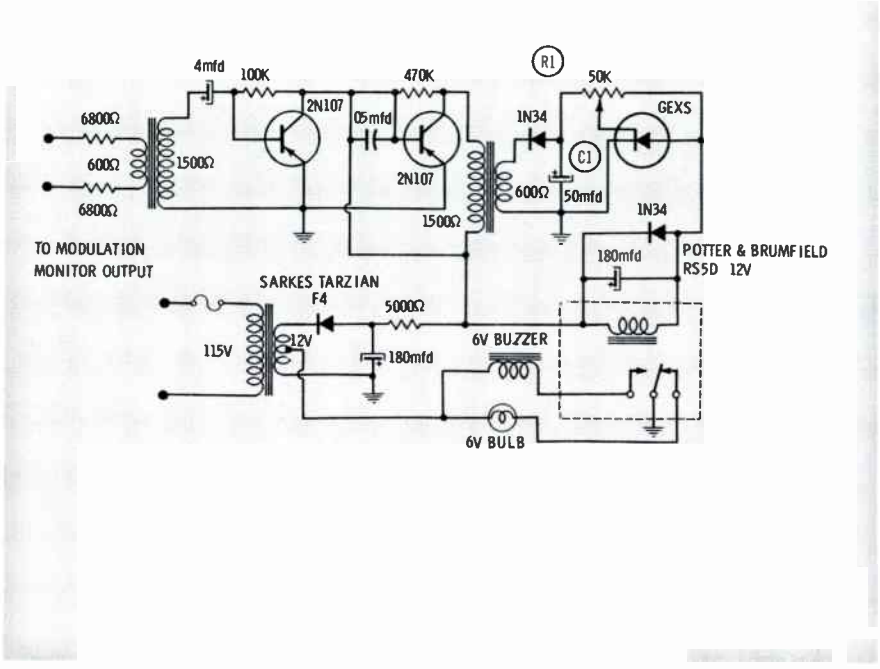
Audio Dropout Alarm

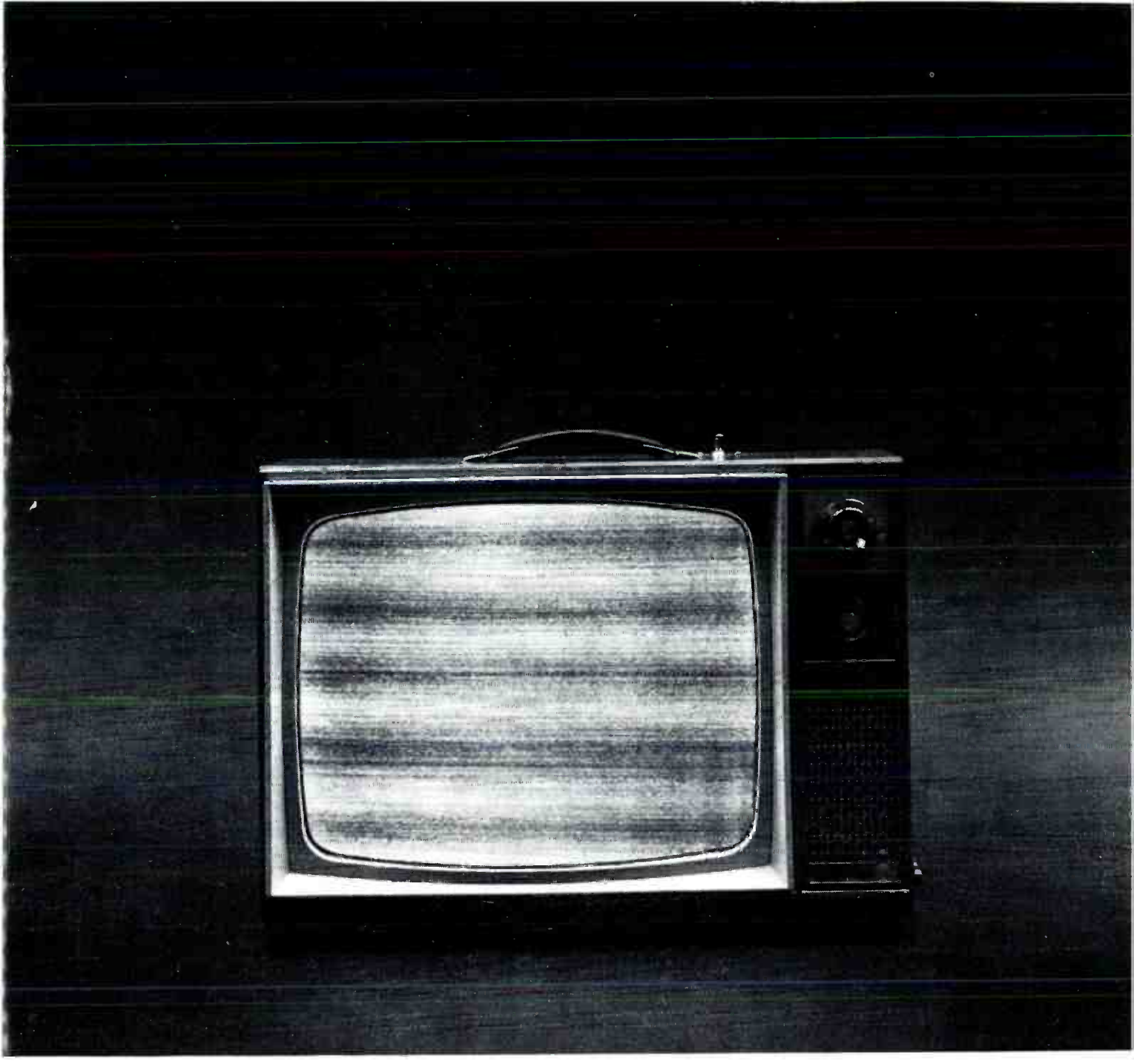
by Marshall Royalty
WKLO, Louisville, Kentucky

We have developed a simple circuit which sounds a buzzer when audio or carrier drops out. The unit receives signal from the station modulator monitor and is particularly useful when we are listening to the console output or a sound source other than off-the-air.

Completely transistorized, the "dropout" alarm is very small and can be mounted on an existing rack panel without crowding other units.

The time delay can be varied somewhat by adjusting the gate control (R1), by increasing the value of C1, or by increasing the signal level fed to the unit.





This kind of programming costs you money

You're in business for one reason: to make a profit.

Anything that takes away from your profit-making is your enemy. That's why you're way ahead when you choose Lenkurt microwave transmission equipment for your CATV or ETV system.

For instance, there's our 76 TV microwave relay system that has become the standard of the industry, due to its outstanding performance, ease-of-maintenance, and economical operation. 76 TV is designed to handle monochrome or color transmission and lets you insert and drop programs with ease at intermediate locations.

There is also Lenkurt's 75A, the ideal backbone microwave relay system. Because of its non-demodulating heterodyne repeaters, 75A delivers clear, sharp monochrome and color TV pictures regardless of distance, terrain, or weather.

Lenkurt microwave systems have proved themselves in virtually every situation. From high on Freel Peak in Nevada where 76 TV brings in a sharp high-resolution picture (even when snow levels reach 20 feet), to an ETV closed-circuit system at the University of Kansas Medical Center. And our 75A has been transmitting high quality pictures for a number of CATV networks in New York and Pennsylvania.

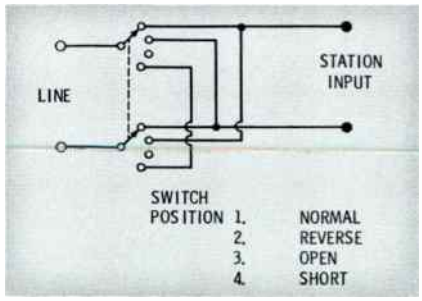
And remember, when you buy Lenkurt equipment, you are buying more than hardware; you are purchasing Lenkurt's heritage and reputation for quality and continuity.

It all comes down to this: when you're thinking about microwave transmission equipment, for any application, think of Lenkurt. We'll show you how to improve your picture – both TV and profit. Write or call Lenkurt Electric Co., Inc., San Carlos, California. Other offices in Atlanta, Chicago, Dallas, and New York City.

LENKURT ELECTRIC

SUBSIDIARY OF
GENERAL TELEPHONE & ELECTRONICS GT&E

Circle Item 25 on Tech Data Card

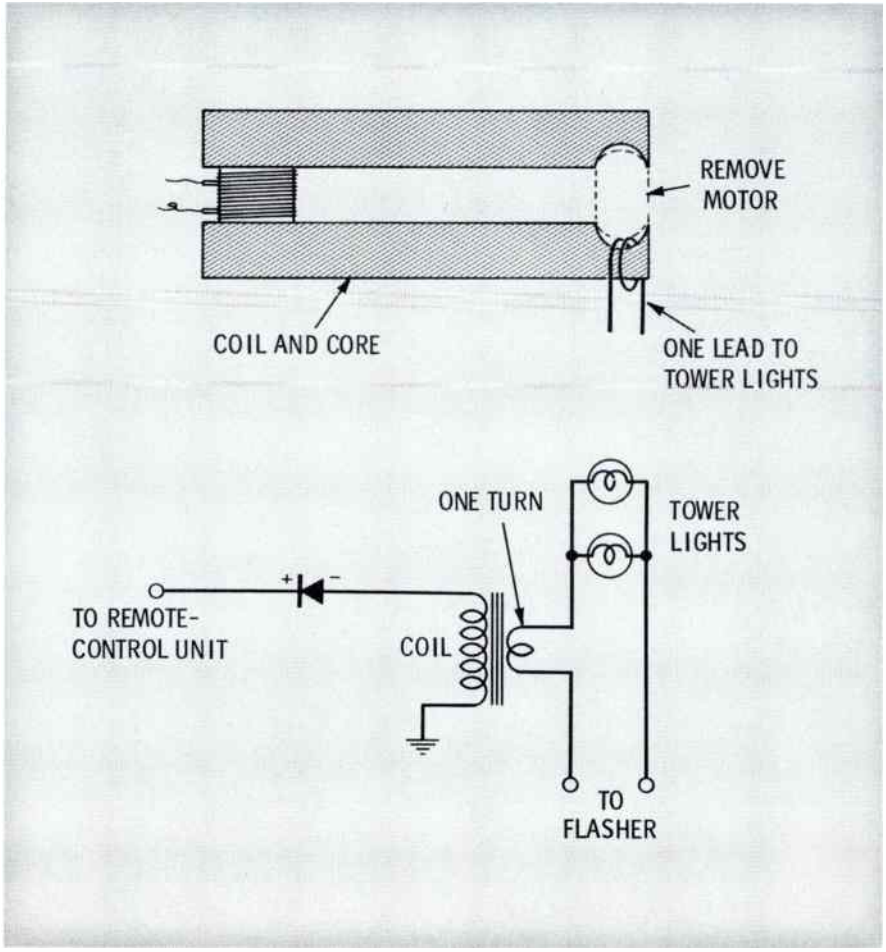


Line Checker

by Henly McElveen, Jr.
Chief Engineer WJOT
Lake City, S. C.

A convenient means for checking telephone or remote line status can be achieved with this simple switch arrangement. Four positions provide for normal operation, reversing, open circuit, and short circuit. This eliminates time-consuming and often inconvenient jumpering for open-circuit checks, disconnecting for short-circuit indications, and reversing for polarity changes. One convenient application of the OPEN position is the protection of station equipment during electrical storms when the circuit is not in use.

Editor's note: The addition of a fifth position to supply tone (from a specially constructed oscillator) would simplify and speed up most telco-line checks.



Tower Light Monitor For Remote Reading

by John W. Molnar
Chief Engineer WDFM
University Park, Pa.

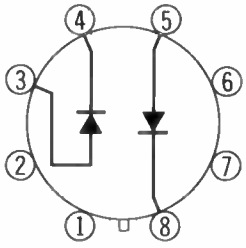
Here is a suggestion for stations required to monitor tower lights through the remote-control unit.

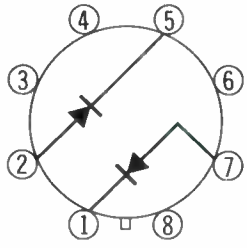
Used electric clocks can be acquired at nominal cost from repair and junk shops. These clocks often employ a small, sealed motor which is driven from a small coil with a U-shaped core passing through it. The core and coil can be used as the current transformer that samples tower light current.

With the motor removed from the core, loop a single turn from one side of the tower-light feed around the core. Place a general-purpose diode in series with the coil, attach the positive coil lead to any unused remote-control position, and ground the other lead to the remote chassis. For remote-control units with provision for tower-light monitoring, omit the diode.

Diodes Replace 6H6 and 6AL5

by John Gaboury
Chief Engineer, KVOY
Yuma, Arizona





Both the 6H6 and the 6AL5 can be replaced with solid-state diodes. This step eliminates two vacuum-tube types from inventory requirements, and in some cases improves equipment performance.

Although the diodes can be wired directly into the circuits, mounting the diodes on the tube socket lugs requires less modification and permits replacement of the vacuum tubes, if desired.

1N2070 diodes were employed in our modifications because there was a large stock of them on hand. We were able, therefore, to select matched units for installation. This particular diode compares favorably in performance with both the 6H6 and the 6AL5, but requires a minimum signal of one volt in order to work. It would not be satisfactory for low-level circuits, but review of tube and semiconductor manuals will show which diodes will perform satisfactorily.

Certain precautions should be observed:

1. Use a heat sink when soldering the diode leads.
2. Disconnect filament leads to the socket.
3. Beware of "cheapie" surplus diodes. Some are unmarked zeners and will create havoc in compressor circuits. ▲

NEWS OF THE INDUSTRY

INTERNATIONAL

TV Transmitters For Viet Nam

Seven television transmitters for sending programs to U. S. troops at key bases throughout Viet Nam are being built by the **Gates Radio Company** under a $350,000 contract awarded by the Department of the Army. The transmitters are for use by the Armed Forces Radio and Television Services, which operates an extensive network of radio and television stations at U. S. military bases overseas.

The kilowatt VHF TV transmitters are standard models especially engineered for van installation to produce 4,000 watts of visual power and 400 watts of aural power. They are being shipped to the Sacramento Army Depot in California, where they will be van-mounted with studio and control switching gear to form a television studio-on-wheels. This mobility, according to an AFRTS spokesman, will enable the units to be moved easily as troop concentrations change.

The only television programming now available to U. S. troops in Viet Nam, on a regular basis, is in Saigon, where telecasts originate in the air from a roving U. S. Navy aircraft. Plans are underway, according to AFRTS, for a fixed transmitter site in Saigon.

NATIONAL

Integrated Circuits in Broadcast Equipment

A new module for high-band color TV tape recorders marks the first use of integrated circuits in **Radio Corporation of America** broadcast equipment. The module, a velocity error corrector, has been designed to improve color program playback quality by compensating for defects caused by mechanical tolerances inherent in the TV tape system. Integrated circuits are employed in about half the module's circuitry, the maximum amount that can be used to advantage, according to the company. This results in a module about one-fourth the size of a comparable one using transistors and other discrete components. The integrated circuits, which are about the size of a dime, are intended to provide a degree of reliability beyond the level established by solid-state components.

The module plugs into the TR-70 high-band color TV tape system and also may be used on RCA color TV tape recorders TR-22, TR-3, and TR-4 after they have been modified for high-band operation.

Large HF Antenna Array For Ionoshere Study

A contract has been awarded to **American Electronic Laboratories, Inc.**, by The Pennsylvania State Uni-

versity for the design, fabrication and installation of a large HF antenna array. Scheduled to occupy an area near University Park, Pennsylvania, the array will be used by Penn State's Ionosphere Research Laboratory in studying and exploring space.

The antenna array will be used in conjunction with a "disturbing" transmitter which will broadcast a powerful signal into the ionosphere in order to heat a portion of the ionosphere and disturb it artificially. During the experiments, researchers will be able to study the electron densities of the D-region with a "wanted" radio signal used to probe the artificially disturbed ionosphere.

Consisting of a number of crossed dipoles that can provide different polarizations, the array will operate at 4.5 MHz. It will have a gain of 14 dB and will be capable of handling power levels up to 500 kw. Completion of the antenna installation is scheduled for this month.

Move to New and Larger Facilities

The second move in a year to expanded facilities has been completed by **Ward Electronic Industries.** The firm's new plant is a modern 18,000-sq ft, air-conditioned building located in Clark, N. J. The building is equipped with test facilities for audio and video equipment, including a large environmental test chamber.

Ward has also announced that its broadcast division is starting to manufacture a complete line of solid-state video switching systems, with or without associated memory-control circuits.

Study Shows Most CATV's Carry Distant Signals

According to a study conducted by NCTA, over 90% of the Nation's CATV systems receive at least one distant signal (imported from beyond the transmitting station's predicted grade B contour). The number receiving only local signals (grade B or better) is quite small—under 8%. About one quarter of the systems receive only distant signals, while 67% get a mixture of both local and distant service.

The data indicate that of the 1650 operating systems:

1. 14 systems (.9%) serving 8493 homes (28,026 people) receive only the stations located in the same community as the system.

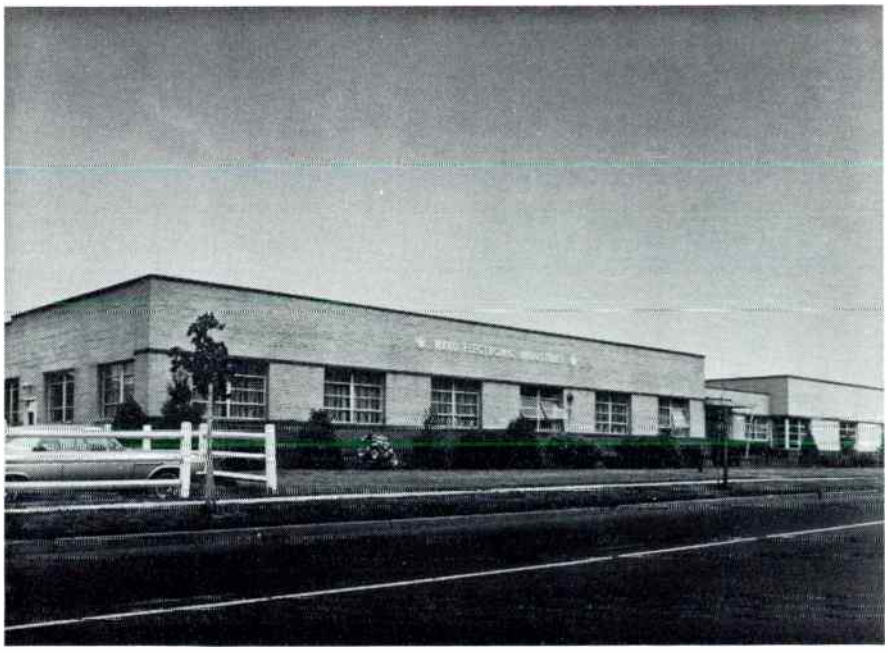
2. 23 systems (1%) serving 21,675 homes (71,528 people) receive only sginals from stations within whose predicted grade A contour the systems are located.

3. 41 systems (2%) serving 28,281 homes (93,327 people) receive only signals of predicted grade B intensity.

4. 74 systems (4%) serving 123,188 homes (406,520 people) receive a combination of predicted grade A and grade B signals.

5. 405 systems (25%) serving 539,203 homes (1,779,370 people) receive no signals of grade A or B intensity (although 81 of these are within the predicted A or B contour of one or more stations).

6. 1111 systems (67%) serving 1,789,147 homes (5,924,185 people) receive an assortment of signals including at least one station of less than grade B predicted intensity and at



least one station of predicted grade B or greater intensity.

The above figures do not include master antenna systems used to serve apartment and hotel installations. According to the survey, a total of 8,302,956 people and 2,509,987 homes are served.

The study was conducted in response to a request by Senator Quentin Burdick (D-N.D.), acting chairman of the copyright sub-committee drafting legislation covering the CATV industry.

ORGANIZATIONS

SMPTE

At the 100th Technical Conference in Los Angeles, President Ethan M. Stifle announced the results of the recently concluded elections for National Office and Governorship. Those elected will serve two-year terms, 1967 and 1968. Newly elected officers are:

President—G. Carleton Hunt, De-Luxe Laboratories, Inc.

Executive Vice-President — Deane R. White, E. I. du Pont de Nemours & Company, Inc.

Editorial Vice-President — Rodger J. Ross, Canadian Broadcasting Corp.

Conference Vice-President—E. B. McGreal, Producers Service Co.

Secretary—H. Theodore Harding, E. I. du Pont de Nemours & Company, Inc.

The Board of Governors at its meeting October 2, 1966 appointed William T. Wintringham to fill Dr. White's unexpired term of office as engineering vice-president, Dr. White having been elected to the 1967-68 office of executive vice-president.

Illuminating Engineering Society

A technical forum has been scheduled by the Theatre, Television, and Film Lighting Committee of the Illuminating Engineering Society. Entitled "How to Designate Gray Scale Equivalents for Colors used in Color Television," the forum will be held in New York City at the United Engineering Center from 2 to 4 p.m., on March 16. 1967. The forum will be a panel presentation on various methods used to establish the colors for a television set. The function which lighting plays in obtaining or changing these colors will be reviewed. The session will end with an open discussion to insure that all phases of this and related subjects are covered.

The Committee has also scheduled its third annual symposium for May 14-16, 1967 at the Hollywood Roosevelt Hotel in Hollywood, California. Through technical papers, discussions, and a progress report, all aspects of these industries will be covered. Special emphasis will be placed, however, on the motion picture industry.

NAEB

The National Association of Educational Broadcasters held its 42nd annual convention at the Muehlebach Hotel, Kansas City, October 23 through 26. Theme for the meeting was "Changing Patterns of Education. Technology and Legislation."

General sessions were held on each of these topics, with members of the Federal Communciations Commission, officials from the U. S. Office of Education, leading educators, and broadcasters on hand to share ideas with the educational broadcasters. Special interest sessions were designed to focus on the effect of change in educational broadcasting.

About 1200 educational broadcasters attended the four days of lectures, discussions, and panel meetings. In addition, there were three days of screenings of television programs provided by educational stations and production centers.

New broadcast production transmission equipment was displayed in more than 100 booths.

PROPERTY TRANSACTIONS

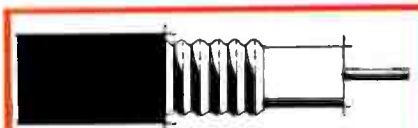
The **Telex Corporation** has completed its acquisition of the assets and certain liabilities of **Viking of Minneapolis, Inc.,** and **Viking Tool & Die Company.** The Viking companies, with manufacturing facilities totaling 80,000 square feet in Bloomington and Savage, Minn., and approximately 200 employees, will be operated under their own names as divisions of the Telex Corporation.

Ansel Kleiman, president of Telex Acoustics Division and also responsible for the Magnecord tape recorder

Deliver outstanding performance with Superior "Coppergard" coaxial cable

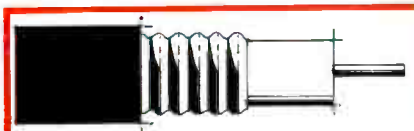
Flawless performance in the studio deserves top quality reproduction on the subscriber's home screen. Superior coaxial cable with "Coppergard" delivers the signal you want. That's because it's quality controlled from raw material through every phase in the manufacturing process. For long-term transmission stability . . . for sharp, clear pictures without interference . . . and for full spectrum capability you can rely upon Superior Cable—Cell-O-Air® for aerial plant and "Solid-D" for buried plant . . . both with "Coppergard."

Every reel is 100% sweep tested and backed with a 5-year guarantee.



Aerial Plant

Superior Cell-O-Air® Coaxial Cable
expanded polyethylene dielectric



Buried Plant

Superior "Solid-D" Coaxial Cable
solid natural polyethylene dielectric

For detailed information and prices, write

SUPERIOR CABLE

SUPERIOR CABLE CORPORATION / HICKORY, NORTH CAROLINA 28601

20275

Circle Item 33 on Tech Data Card

line, will manage the Viking divisions. Viking, Magnecord, and Acoustics will comprise a newly organized Telex Professional Audio Products Group headed by Kleiman.

General Electric Cablevision Corp. has purchased four community antenna television (CATV) systems from **National General Corp.**

The systems are **Alpena Cable TV,** Alpena, Mich.; **Biloxi TV Cable System,** Biloxi, Miss.; **Hattiesburg Video,** Hattiesburg, Miss.; and **National CATV Systems,** Logan, West Va.

G-E Cablevision also operates a system in Watertown, New York, is constructing three systems in California, and holds 15 franchises in other communities.

G-E Cablevision, a wholly-owned subsidiary of the **General Electric Company,** plans to continue seeking new franchises in unserved communities as well as opportunities to invest in existing systems.

PERSONALITIES

A. B. Covey has been appointed assistant to the president of **C-COR Electronics.** In his new position, Mr. Covey will coordinate and direct all sales and engineering activities with the telephone industry for C-COR.

Mr. Covey was associated with the American Telephone and Telegraph Company for 35 years in engineering positions. His most recent business experience includes service as assistant to the president of Ameco, Inc., and as consultant to the president of Stromberg-Carlson Corp. In addition, he had eight years of engineering experience with Southwestern Bell Telephone Company.

A graduate of the University of Kansas with a B.S. in electrical engineering, Mr. Covey was a physics instructor at Kansas for a year before joining the Bell System.

He is a senior member of the IEEE, past chairman of the Kansas City Section of the AIEE, past chairman of the Broadcast Group of IEEE, and a member of Tau Beta Pi and Sigma Tau fraternities.

Three executives of **Ameco, Inc.** have assumed new duties.

R. Bruce Walters becomes director of contracting in addition to his duties as president of Remcor, printed-circuit-board subsidiary. Walters, 30, is a native of Phoenix, schooled at Arizona State University and Grand Canyon College. He joined the Ameco production line in 1956 and worked his way to head of the department.

Ray M. Wood has been named director of manufacturing. He moves up from director of quality assurance, a post to which he brought 12 years of experience in January of this year.

Replacing Mr. Wood as director of quality assurance is **Douglas B. Campbell,** formerly manager of the department's engineering section.

Mathew S. Ceterski has been appointed district sales representative in New York City, and **Harry J. Craig** has been appointed headquarters sales engineer for **General Electric Visual Communications Products.**

Mr. Ceterski will join Lewis F. Page, district sales maanger, and Vincent P. Marlin, sales representative, in

Mr. Ceterski

covering the greater New York area for General Electric television and radio broadcast and CCTV equipment.

Mr. Craig

Mr. Craig succeeds Ceterski in VCP headquarters sales, concentrating on television and radio broadcast equipment.

Mr. Ceterski was a headquarters sales engineer for the past year, following service the previous year as a project engineer on television transmitters. He joined General Electric in 1955 in broadcast equipment engineering and for the next five years served as a design engineer. From 1960 to 1965 he was assigned as a project manager for the company's line of high-power short-wave radio transmitters. Mr. Ceterski has studied electrical engineering at both Balboa College, Panama Canal Zone, and Syracuse University.

Mr. Craig joined General Electric in 1957 following nine years in transmitter and field engineering assignments with Standard Electronics. From then until his new assignment, he has been a member of the headquarters service engineering staff for General Electric broadcast products, specializing in transmitter installations and service. He studied electrical engineering at Newark College of Engineering. ▲

C-12A CONTEMPORARY IN USE —FOR THE MODERN STUDIO

The Norelco C-12A is the *only* studio condenser microphone system designed to keep abreast of the many recent developments in the professional recording industry.

Recent progressive strides have been made in recording facilities, such as sophisticated mixing consoles, high performance recorders, as well as acoustically engineered and functional studios. Obviously, yesterday's microphone standards are no longer suited to compliment the total effectiveness which can be obtained with newer facilities.

The Norelco C-12A has been designed to meet every modern challenge. It represents a new standard—surpassing today's and bettering tomorrow's needs. Born of years of quality design and applications experience, the C-12A deserves your serious consideration for new construction or studios wishing to *keep ahead.*

For individual C-12A specifications in a 14 page brochure, write today!

Power supply and pattern selector for directional characteristics in a single 4 pound unit suitable for portable or rack mounting. Measures 6½ x 3 inches.

Norelco® PROFESSIONAL SOUND PRODUCTS

NORTH AMERICAN PHILIPS COMPANY, INC.
Professional Products Division, 100 East 42nd St., New York, N.Y. 10017

5-68

Circle Item 37 on Tech Data Card

Announcing...

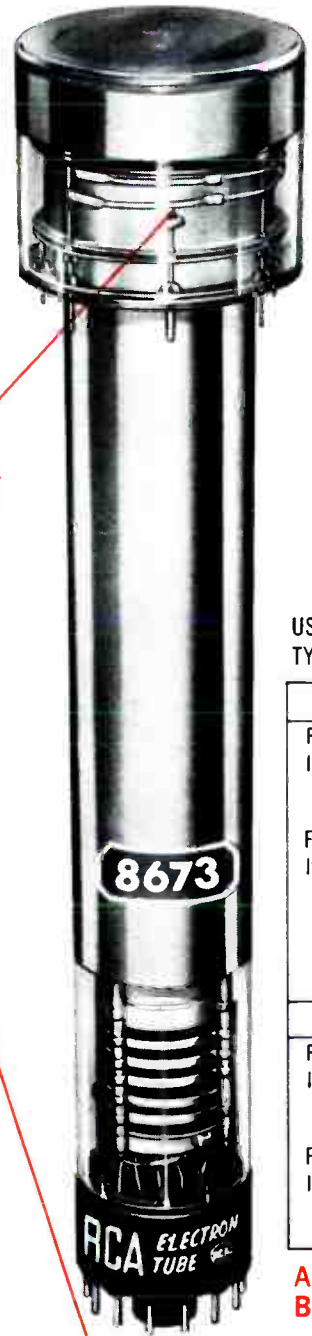
for color and black and white, the new family of RCA image orthicons with a *big difference here* that *shows up big here*

Now RCA brings you the "BIALKALI PHOTOCATHODE" in the new RCA-8673 and -8674 Image Orthicons. This major engineering innovation has greatly improved compatibility with its non-stick target, maintaining resolution and sensitivity over an extended tube lifetime and improving performance of *existing* color or black-and-white cameras. A simple change in a resistor chain provides proper voltages for a trio of these new Bialkali Photocathode Tubes. Wide-range, the 8673 and 8674 fit spectral requirements of all three channels... eliminating the need for another tube type for the blue channel.

Another big difference: the re-designed image section provides reduced distortion and freedom from "ghosts." These new tubes are available singly or as matched sets—a trio of 8673/S or 8674/S types for color service... types 8673 and 8674 for black and white. Main construction difference is in the target-to-mesh spacing. The closer-spaced 8673 enhances S/N ratio for quality performance under sufficient illumination. The 8674 has greater sensitivity under limited illumination. For complete information about the new RCA Bialkali Photocathode Image Orthicons, ask your RCA Broadcast Tube Distributor.

RCA Electronic Components and Devices, Harrison, N.J.

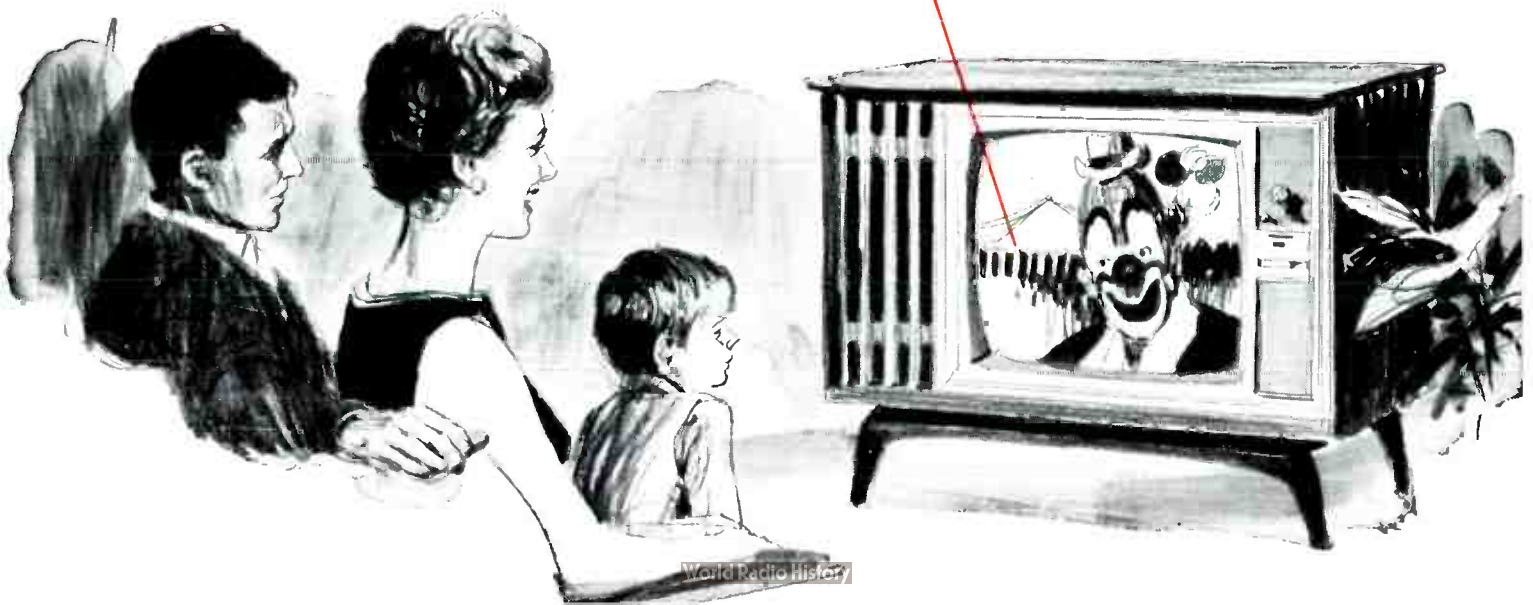
RCA The Most Trusted Name in Electronics



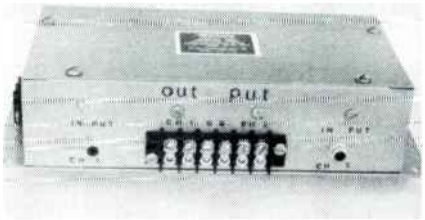
USE THIS CHART TO SELECT REPLACEMENT TYPES FOR THE TUBES YOU ARE NOW USING

UNDER SUFFICIENT LIGHTING LEVELS	
For color pick-up,	
If you're now using...	You can replace with:
4513/S 7513/S	8673/S
For black & white pick-up,	
If you're now using...	You can replace with:
4513 7513 7513/L 8093A 8093A/L	8673
UNDER LIMITED LIGHTING LEVELS	
For color pick-up,	
If you're now using...	You can replace with:
4415S 4416S	8674S
For black & white pick-up,	
If you're now using...	You can replace with:
7293A 7293A/L	8674

AVAILABLE FROM YOUR RCA BROADCAST TUBE DISTRIBUTOR



NEW PRODUCTS



Solid-State Preamps

(55)

Solid-state phonograph preamplifiers for broadcast use are being manufactured by **Russco Electronics.** Specifications for the units, available in stereo and mono models, are as follows: inpedance — 46,000Ω; output impedance — 600Ω; output level — adjustable from —10 to —20 dBm; distortion — less than 0.1%. Prices start at $48.

Portable Mixing Tank

(56)

Portable mixing tanks made by **Houston Fearless** are available in 25- and 30-gallon capacities to meet the needs of users of small processors. Mixing is accomplished with the motor-driven pump concealed under the skirt, which is also used for solution transfer. No separate mixing motor is required.

The tank body and other metal parts are made of Type 316 stainless steel. Piping and valves are rigid polyvinyl chloride. Hoses are neoprene rubber. The motor is mounted under the skirt for protection from drip and splash, and the switch box is completely enclosed. Tubular handles also act as guards to protect the transfer valve and switch box from accidents. Four casters allow the tank to be moved into working position; a caster brake holds it firmly in place. A dip stick shows the volume of solution in the tank.

To mix solutions, the required quantity of water is run into the tank, the three-way valve is set to recirculate, and the pump is turned on. The recirculation mode swirls the solution around in the tanks as the chemicals are added, producing a turbulation pattern for mixing. A diffusion and anti-vortexing plate surrounding the tank outlet aids the turbulation and reduces the tendency for undissolved solids to be drawn through the pump. Aerial oxidation is minimized. When the solution is ready, the gooseneck of the transfer hose is hung over the edge of the processor tank, and the three-way valve is set to transfer. In this mode, the solution is pumped rapidly from the mixing tank to the processor or replenisher tank, freeing the mixing tank for preparation of the next solution.

6:1 F/2.2 Zoom Lens

(57)

A new zoom lens, Model 6 x 12.5B, covers the focal lengths 12.5-75 mm,

widely used with 16-mm motion picture cameras. The lens is manufactured by P. Angenieux and is distributed in the U. S. by **Zoomar International, Inc.**

Two models of the 6 x 12.5B are available, with and without viewfinder. With viewfinder, the lens weighs 1 lb. 12 oz.; without viewfinder, 1 lb. 3 oz.

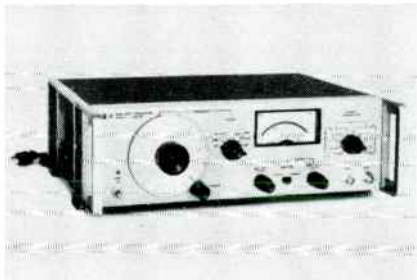
Tape Recorder for Acoustical Measurements

(58)

General Radio Co. is introducing its first tape recorder, a two-channel instrument designed specifically for acoustical measurement. It has been designed to make on-site recordings of noise signals and later play back the tape for extensive study and analysis in the laboratory. The recorder can also be used as a source of prerecorded test signals, with one channel used to apply such signals to the system under study and the other channel used to record the system output.

Specified frequency response at a tape speed of 7½ ips, and with constant-current characteristic, is ± 3 dB from 15 Hz to 16 kHz. At 15 ips, response is ± 2 dB from 50 Hz to 15 kHz. NAB and standard sound-level meter weighting characteristics are also available. Input-level range, with a General Radio ceramic microphone, is from 34 to 140 dB.

The Type 1525-A Data Recorder is priced at $1995.



Test Oscillator

(59)

The Model 652A test oscillator has been developed by **Hewlett-Packard** to provide frequency-response measurements with 0.25% resolution over the range 10 Hz to 10 MHz.

Equipped with a times-20 expanded-scale output meter for maximum output-voltage resolution, the Model 652A may be adjusted to match the amplitude of a precision reference signal. Then the output monitor shows actual output to the attenuator over the whole frequency range, with ±0.25% accuracy. For fast reading, the uppermost scale is an expanded range, centered on zero, calibrated ±2%.

The HP Model 652A Test Oscillator uses the same resistance-capacitance all-solid-state circuit as the HP Model 651B and has the same specified amplitude stability (typically 10 parts per million per minute, in ordinary environments). One output delivers up to 200 mw (3.16 v) into 50 ohms; another delivers up to 16 mw (3.16 v) into 600 ohms. A decade output attenuator is included.

Unit price is $725.

Professional Video Tape Recorder

(60)

Concord Electronics Corp. has announced pricing and marketing plans for its VTR-600 professional video tape recording system.

The new video recorder will retail for $1150. The complete system—recorder, camera, and monitor—is priced at $1609.50. As equipment designed for professional and audio-visual communication rather than "home video recording," the VTR-600 is sold through the company's Industrial Products Division.

The recorder uses a helical-scan recording system with dual rotating heads, and ½-inch tape at a speed of twelve inches per second.

For institutional and commercial communications purposes features include provisions for still-frame monitoring and for audio dubbing when users wish to add narrative explanation or other sound to prerecorded tapes.

The VTR-600 is supplied with a VU meter for audio signal, a digital tape counter, and a pushbutton head-cleaning system that contributes to long head life. All basic circuitry is grouped into replaceable plug-in modules.

The MR-600 monitor may be placed at a distance from the recorder. It is a separate, solid-state unit containing a nine-inch picture tube, built-in UHF and VHF antennas, an RF head, and sensitive RF circuitry. Priced at $160, the MR-600 may also be used for TV broadcast reception.

The Concord MTC-12 camera, priced at $299.50, completes the system. It may also be used for closed-circuit television. The MTC-12 is an all-solid-state, electronically-automated, high-sensitivity camera with simultaneous RF and video output. Since the unit adjusts automatically to changing light conditions or line voltage, no operator is required.

With an optional RF converter, the VTR-600 may be connected to large standard TV sets.

A number of other optional accessories are available. They include a viewfinder and several special lenses for the camera, video tape on five-inch and seven-inch reels, extension cables, an inverter for use in aircraft and motor vehicles, and a film-to-tape converter for direct recording from motion-picture film.

One unusual accessory is the Concord WX-850 wireless microphone system. It consists of a cordless, cigarette-pack-size microphone together with a portable, solid-state FM amplifier that may be operated either from built-in batteries or an AC source.

All-Solid-State MATV Amplifier

(61)

The availability of the new "Gibraltar" Model 3660 solid-state MATV system amplifier has been announced by **Jerrold Electronics Corp.** A minimum of 40 dB gain with flat response across the full VHF band is specified.

The new amplifier is a large-system version of Jerrold's Gibraltar Model 3440. The new unit can handle over 100 outlets and can be used for 12-channel operation. Flat response across both TV and FM bands provides for color-TV and FM performance. Solid-state circuitry serves to insure high reliability.

Brief specifications are: Gain—40 dB; Output Capability — +50 dBmv per channel for 7-channel operation; Gain Control—10 dB; Impedance—75 ohms; Noise Figure—9 dB; Flatness—1.5 dB P/V.

FET Broadcast Monitor Tuner

(62)

This solid-state FM stereo tuner, from **H. H. Scott, Inc.,** features a silver-plated front end with three field effect transistors. The Model 312C includes the following engineering features: All-silicon IF section for stability, selectivity, and wide bandwidth; a front-panel meter switch which allows the tuner meter circuit to be used for signal strength, zero-center tuning, or multipath indication; "Comparatron" circuit for silent, automatic stereo switching, which is not affected by momentary changes in signal strength; Interstation Muting Control for quiet between FM stations; front-panel output for direct tape recording without the use of a separate amplifier; wide-band FM detector circuit for minimal distortion; and oscilloscope output for multi-path-distortion correction.

Specifications include: usable sensitivity of 1.7 μv; cross-modulation rejection, 90 dB; selectivity, 45 dB; and stereo separation, 40 dB. The price is $294.95.

Phase-Shift Distribution Amplifier

(63)

A 3.58-MHz Color Subcarrier Phase Shifter Distribution Amplifier, Model 3248A1, has been added to the line of color broadcast equipment offered by the **Telemet Co.** Its purpose is to equalize phase shifts that occur in long cable runs or studio distribution systems.

The Model 3248A1 is capable of shifting the phase of a 3.58-MHz color subcarrier signal 360° in 30° steps. A fine phase control provides for incremental adjustment. The unit is completely solid state, containing its own power supply. Four isolated outputs at 2 volts P-P are provided for distribution of the phase-corrected signal. Nineteen-inch rack frames are available for mounting one to four units.

Automatic Bulk Erasers for Tape

(65)

A line of portable and conveyor-belt magnetic-tape bulk erasers is being marketed by **Ferranti Electric, Inc.** The three FerrantiWeircliffe portable models are designed to erase saturated tapes at the rate of 100 to 250 reels per hour, with recorded data erased to better than 80 dB below saturation recording level. Models 6, 7, and 8 are static instruments without electrical moving parts and are

free from the need for adjustments or service.

The three portable models are housed in mohagany cases impregnated with clear Melamine® to withstand hard wear. Model 8 handles reels up to 14½ inches in diameter and accommodates tapes ¼ inch to 2 inches wide. Model 7 is suitable for continuous tape cartridges of a size not exceeding 8 inches square with maximum tape width of 1 inch for broadcasting studios. Model 6 handles reels up to 8¼ inches in diameter and accommodates ¼- to 1-inch tape width.

The conveyor-belt bulk erasers are capable of handling 1000 reels of magnetic tape per hour under continuous operating conditions. The Model 14 bulk erase system was specifically designed for tape or film manufacturers or other firms processing large quantities of magnetic tapes. It handles reels up to 14½ inches in diameter and tape widths up to 2 inches, and the unit can be adapted to process the six sound strips on 70 mm Todd-AO film. Model 14A is available to handle audio tapes in ¼-inch and ½-inch tape widths and 16mm film. Both models are designed to erase tapes to better than 85 dB below saturated signal of any frequency.

The units do not require rotation of the reels, and a light indicates completion of erasure. Prices of the portable units range from $340 to $550.

Cartridge Recorder/Reproducer

(66)

High-speed forward, editing reversibility, and flexible control of cuing and erasing are features of the **KRS** SB1 1-STACT® Broadcaster, a new continuous-loop magnetic tape reproducer. The equipment is designed to permit program material of all types to be recorded, edited, erased, cued-up in cartridges, and aired directly.

Specifications of the unit include: frequency response, 30-15,000 Hz at 7½ ips; flutter and wow, 0.18%; signal to noise ratio, 50 dB; tape start and stop time, 50 msec. Simplified controls facilitate the production makeup of cartridges. Push buttons provide control of START, STOP/ REVERSE, FAST FORWARD, EJECT, RECORD and CUING functions. Toggle switches permit selective track erasure of program or cues. Stop cues may be recorded and sensed at 150 Hz, 1000 Hz, and 8 kHz. The unit may be equipped with a fast-forward stop cue tone and sensor.

The unit accepts one KRS STAC-Tape® reversible continuous-loop tape cartridge, with playing times from 10 seconds to 30 minutes at 7½ ips. Tape speeds of 7½ and 3¾ ips are standard; 1⅞, 15, and 30 ips are available.

Space for four magnetic heads is provided, permitting use of erase heads, record heads, and reproduce heads. Addition of a second reproduce head permits use of the unit for program-delay applications.

Electronics are completely solid-state on separate miniature epoxy-glass etched circuit boards. Connections are plug-in for easy removal and maintenance. Play and cue amplifiers are interchangeable.

Dimensions are 17 in. x 6⅝ in. x 15 in. The machine is available rack mounted for 19 in. x 7 in. x 15 in. panel space. Price range is $650—$895.

Sign And Lettering System

(67)

A lettering system for vehicles, signs, and other applications is offered by **W. H. Brady Co.** With the system it is possible to make a 10-letter sign in about 60 seconds. The self-aligning numbers and letters stick to any clean, dry surface—including glass, metal, and curved surfaces — with finger pressure. No moistening, glue, or tools are needed.

Made of heavy-duty vinyl, the letters are available in white, yellow, red, and black, and in 1-, 2-, 3-, 4-, and 6-in sizes. They are supplied on individual cards with an interlocking

feature to facilitate alignment and spacing.

Letters and numbers are furnished in kits containing a "sign painter's assortment" of 533 characters or in refill packs of 10 identical letters or numbers. Refill kits can be ordered independently. Spaces and punctuation marks are also included.

Gold-Plated Microphones

(68)

Two special-purpose dynamic microphones—custom finished in gold plate for use in conjunction with religious services—are available from **Altec Lansing,** a division of **LTV Ling Altec, Inc.** The new microphones, 681A Gold Omnidirectional and 683B Gold Cardioid, have been finished in 22-carat gold to better suit the use of the microphone on the lecturn or pulpit to the decors of both traditional and modern church interiors. A baked clear-lacquer coating has been provided for protection against scratching, scraping, or other accidental damage.

The microphones are available for immediate delivery at industrial net prices of $58.50 for the 681A and $84.00 for the 683B.

Aluminum-Sheathed Cable for CATV

(69)

A line of 75-ohm, aluminum-sheathed coaxial cable for Community Antenna Television (CATV) applications is now available from **ITT Wire and Cable Division**.

A special manufacturing process enables ITT to supply cable lengths up to a mile. This feature enables the system installer to make fewer splices, resulting in improved system performance and reduced maintenance.

The new cable is also available with a polyethylene jacket for use underground or in corrosive atmospheres, and with a steel messenger for overhead suspension. It can be supplied in 0.412-, 0.5-, or 0.75-inch diameters.

Each length is guaranteed to deliver a minimum of 26 dB structural return loss across all channels from 2 through 13. A verified test report is supplied with each reel.

Remote Antenna Positioner

(70)

An antenna positioner for remote TV broadcast applications is being offered by the **Andrew Corp.** Type 30802 is an electro-manually operated positioner designed for use with a standard RF head and parabolic antenna commonly used by TV stations to pick up microwave relay signals. Locating and receiving microwave signals from outlying locations are facilitated by operating the positioner with a remote control unit in the studio, where azimuth and elevation positions are shown on two indicators. Control cable assemblies up to 1000 feet long can be provided for this application.

The positioner can be tower or rooftop mounted, and is rated for 125-mph survival windload and 45-mph operational windload using a 4-foot reflector. The positioner is a dual-axis type which provides 400° travel in aximuth and plus or minus 15° in elevation. Vertical load capability is 600 pounds. The positioner is supplied with mounting brackets and counterweights to accommodate RF equipment and 2-, 4-, and 6-foot dishes.

Modifications of this standard unit can be provided to meet other speed, travel, and performance requirements.

Solvent for Cleaning Contacts
(71)

"Contact Re-Nu," a product of **Miller-Stephenson Chemical Co.,** employs DuPont's "Freon TF" with other fluorocarbons to restore electrical continuity to dirty contacts. The orifice of the aerosol can is designed to deliver a heavy flushing spray to quickly remove dirt, grease, and carbon deposits. As the solvent is nonconductive and nonflammable, the spray can be applied while equipment is operating. It is nontoxic, harmless to insulation or coatings, and leaves no residue.

Helical-Scan Video Tape Line
(72)

Immediate availability of a new helical-scan video-tape line has been announced by the **Magnetic Products Division** of **3M Company.**

The new tapes are designed for all "home," industrial, and educational video recorders employing the helical-scan recording process. These tapes— "Scotch" Brand, No. 350 and No. 351—offer low abrasive qualities, low tape noise, minimum dropout activity, and high-conductivity coating for effective heat dissipation for longer tape life and minimum static build-up. ▲

ENGINEERS' TECH DATA

ANTENNAS, TRANSMISSION LINES, & TOWERS

80. ALFORD — New Bulletin No. 609 illustrates and gives application specifications for 7- and 14-mm instruments and components with GPC precision connectors.
81. ELECTRONIC LIGHTS — Literature describes obstruction lighting systems for tall towers.
82. FORT WORTH TOWER — Information covers fabrication and installation of towers, passive reflectors, equipment buildings, and accessories for TV, AM, FM, CATV, and microwave.
83. GATES RADIO — Catalog supplies data on AM antenna coupling and phasing equipment, and a booklet, "Power Dividers for Directional Antenna System," by R. S. Bush explains what they are and how they work.
84. SPACE DIVERSITY — Material is about tropo-scatter antenna systems with respect to engineering services and construction.

AUDIO & RECORDING EQUIPMENT

85. ALTEC LANSING — Section from the Engineered Sound and Communications Products catalog features audio controls, and a preview sheet about the 250T3 control console includes a block diagram.
86. ATLAS SOUND — Catalog 566-67 exhibits complete equipment line including PA loudspeakers, microphone stands, and accessories.
87. AUDIO DEVICES — Flier is concerned with tape cartridges.
88. HARVEY RADIO — General catalog has professional audio section. Subsidiary Federal Fabricators provides a brochure describing electronic assembling service.
89. MARANTZ — Descriptive sheet covers the Model 15 stereo amplifier with per-channel outputs of 70 watts at 4 ohms, 60 watts at 8 ohms, and 40 watts at 16 ohms.
90. QUAM-NICHOLS—General Catalog 66 lists public-address, replacement speakers.
91. SCULLY — Specification sheet tells about the Model 270 long-play, solid-state tape reproducer with automatic reversing and 14-in reel capacity.
92. SONY — Illustrated catalog shows line of stereophonic and monophonic tape recorders, microphones, accessories, and recording tape.
93. UNIVERSITY — Commercial Sound Products Catalog 67 has 32 pages of the complete line of PA speakers, microphones, and accessories.
94. VIKING OF MINNEAPOLIS — The new Series 235 tape-duplicating system is the subject of a 4-page brochure.

CATV EQUIPMENT

95. AMECO — A brochure describes the selection of pole-line hardware available from the manufacturer.

COMPONENTS & MATERIALS

96. GRAYHILL — A 52-page engineering catalog, G-304, presents a selection of miniature push-button and rotary switches, binding posts, test jacks, sockets, and module cases. Also included is technical reference data.
97. E. F. JOHNSON — Prepared for engineers, a 26-page catalog describes the standard line of electronic components.
98. SWITCHCRAFT — New Product Bulletin 164 is about a new, multicircuit lever switch with positive-detent guide and spring-loaded lifter to prevent accidental actuator bypass of switch positions.
99. ZERO — A 16-page two-color catalog, S-66, gives specifications and drawings of a line of vertical and slope-front electronic enclosures including options and accessories.

MICROWAVE EQUIPMENT

100. BIRD — Available is a new, four-page short-form catalog covering the company's entire line of dry and oil-cooled terminations in the power range of 5 to 600 watts.
101. LENKURT — Type 75A heterodyne microwave radio repeater system, designed for long-haul video networks, and type 76 microwave radio system, designed for color television transmission, are discussed in literature.
102. MICROLAB/FXR — New 148-page Master Catalog 17 shows microwave products including attenuators, power dividers, frequency meters, mixers, tuners, and preselector filters.

MISCELLANEOUS

103. INDUSTRIAL ACOUSTICS — Illustrated manual is for "do-it-yourself" approach to use of Moduline system of designing and a preview sheet about the 250T3 control console inneered and acoustically rated modular noise-control panels.
104. TEXWIPE — "FREON" TF solvent cleaner for tape heads, and Texwipe, a disposable 100% cellulose cloth designed for cleaning areas where noncontamination is essential, are subject of literature.

MOBILE RADIO & COMMUNICATIONS

105. MOSLEY ELECTRONICS — 1967 catalog lists line of Citizens-band antennas.
106. MOTOROLA — A new brochure, "Motrac: The 2-Way Radio Proved by Experienced Buyers," is offered.

POWER DEVICES

107. HEVI-DUTY — Bulletin 7-22 supplies data on line-voltage regulator using saturable-core reactor.
108. McCULLOCH MITE-E-LITE — Booklet is about portable electric-power generators which have fixed coils and moving barium-ferrite permanent magnets.

REFERENCE MATERIALS & SCHOOLS

109. AMP INC. — Pocket-sized manual lists approximately 1,000 alphabetically arranged conversion factors.
110. CLEVELAND INSTITUTE OF ELECTRONICS — New pocket-size plastic "Electronics Data Guide" includes formulas and tables for: frequency vs wavelength, dB, length of antennas, and color code.
111. GPL DIV., GENERAL PRECISION — "A View of Educational Television" is the title of a 32-page booklet which contains statements about ETV by leading educators, ETV methods and techniques, "How to Get Started in ETV," and six typical ETV systems.
112. HAYDEN BOOKS — New 64-page catalog lists Hayden and Rider technical books for engineers, technicians, and management.
113. INTERNATIONAL ELECTRONIC RESEARCH CORP. — A technical report, "Introduction to Telemetry," designated IERC No. 032066, includes definitions of technical terms, history and applications, telemetry techniques, and equipment requirements.

STUDIO & CAMERA EQUIPMENT

114. CLEVELAND ELECTRONICS — A 52-page quick-reference step-down diecut catalog covers complete information on vidicon, Plumbicon®, and image-orthicon deflection components.

TELEVISION EQUIPMENT

115. AMERICAN PAMCOR — Audio-video switching systems, preset programmers, solderless terminals, RF connectors, and CATV connectors are subject of material offered.
116. APPLIED ELECTRO MECHANICS — Data sheets are on distribution and switching equipment, including video DA's LAP amplifiers, pulse-group amplifiers, subcarrier amplifiers, and pulse DA's.
117 COLORADO VIDEO — Specification sheet describes the CVI Model 603 Data Insertion Generator.
118. INTERNATIONAL NUCLEAR — Information is about the Model TVM2 transistorized modulator for conversion of color TV receiver to color monitor.
119. MARCONI INSTRUMENTS — Technical data is in regard to the Eddystone Model 990S VHF/UHF transistorized com munications receiver.
120. TROMPETER — Catalog T-6 covers patching and switching components, and Temporary Bulletin M3 provides information about video and data switching systems.
121. VITAL — Data sheets give specifications of Model VI-500 stabilizing amplifier, Model VI-10A video distribution amplifier, and Model VI-20 pulse-distribution amplifier.

TEST EQUIPMENT & INSTRUMENTS

122. SECO — New line folder describes fifteen items of test equipment.
123. SENCORE — Specification sheets are offered for Transistor Tester TR139, Field Strength Meter FS134, and VTVM/VOM Service Master SM112B. Also offered is a four-color full-line catalog.

TRANSMITTERS & ASSOCIATED EQUIPMENT

124. BAUER — Information sheet illustrates and describes product line.

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Broadcast Engineering

1966 ANNUAL INDEX

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AMPEX HEAD ASSEMBLY RECONDITIONING SERVICE for all Ampex professional model recorders. This professional service features precision relapping of all heads for maximum head life. Your assembly is thoroughly cleaned and guides are replaced as required. Price includes optical and electrical inspection and complete testing on Ampex equipment in our plant. Full track or half track assemblies . . . $35.00. One to two day service. "Loaner" assemblies available if necessary. LIPPS, INC., 1630 Euclid Street, Santa Monica, California 90404. (213) EX 3-0449. tf

VIDEO TAPE RECORDER
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Precision relapping of all heads and supporting posts, including cleaning and testing. Ampex head assembly with "cue" tracks, $75.00 complete. RCA units also relapped. One to two day service. LIPPS, INC., 1630 Euclid St., Santa Monica, Calif. 90404. (213) EX 3-0449. tf

Classified

Advertising rates in the Classified Section are ten cents per word. Minimum charge is $2.00. Blind box number is 50 cents extra. Check or money order must be enclosed with ad.

The classified columns are not open to the advertising of any broadcast equipment or supplies regularly produced by manufacturers unless the equipment is used and no longer owned by the manufacturer. Display advertising must be purchased in such cases.

EQUIPMENT FOR SALE

CO-AXIAL CABLE Heliax, Styroflex, Spiroline, etc. Also rigid and RG types in stock. New material. Write for list. Sierra-Western Electric Co., Willow and 24th Streets, Oakland, Calif. Phone 415 832-3527 5-66-tf

Television / Radio / communications gear of any type available. From a tower to a tube. Microwave, transmitters, cameras, studio equipment, mikes, etc. Advise your needs—offers. Electrofind Co., 440 Columbus Ave., NYC. 212-EN-25680. 8-64 tf

NEW QRK TURNTABLES, all models available, will take any equipment in trade, regardless age or condition. Audiovox, 4310 S.W. 75 Ave., Miami, Florida. 9-66-4t

SPOTMASTERS, completely reconditioned and guaranteed including new hysteresis synchronous motors and Nortronics heads. Model 500 record/playback $350, Model 505 playbacks $250. 30 day money-back guarantee. Terms: Check with order or C.O.D., F.O.B. Washington D. C. Broadcast Products Co., 18804 Woodway Dr., Derwood, Maryland. (301) 942-1224 12-1t

FOR SALE. RCA type 5C, 5 kilowatt transmitter. Water cooled. $1,000 FOB Farmington, Conn. For details, contact Greg Fortune, Radio Park. WRCH, Farmington, Connecticut. 12-1t

AMPEX PR-10-2 7.5/15 w/case. Late model slightly used, perfect condition. 650. Brant Jackson Box 1132. Kokomo, Indiana. 12-1t

McMartin SCA Receivers — Rebuilt 1966 — like new. Send for listing: WWJC, Inc., Duluth, Minn. 55808 12-1t

FOR SALE: Magnecord S36-BX. Good condition/used little. $140 net. We pay transportation. John Young, 702 Currey Road, Nashville, Tennessee. 12-1t

AMPEX 1260—2 speed, 4 track stereo, new play head, portable, excellent—$295.
CROWN 822—2 track stereo, 4 speed, 10-1/2 inch reels, solid state, 12 inputs (2 low impedance microphone). Used 25 hours—Cost $1670, sell for $995. Dept. 166, Broadcast Engineering. 12-1t

Audio Equipment bought, sold, traded. Ampex, Fairchild, Crown, McIntosh, Viking. **F. T. C. Brewer Company, 2400 West Hayes Street, Pensacola, Florida.** 3-64-tf

COMMERCIAL CRYSTALS and new or replacement crystals for RCA, Gates, W. E., Bliley, and J-K holders; regrinding, repair, etc. BC-604 crystals; also service on AM monitors and H-P 335B FM monitors. Nationwide unsolicited testimonials praise our products and fast service. Eidson Electronic Company, Box 96, Temple, Texas. 5-64 tf

OBSOLETE TUBES—80% discount — 6SD7, 7E6, 19V8, 1616, DF91, 6C8, 6J7, 6L7, 12K8, 14H7, 14R7. Large variety of other obsolete numbers. List free. H. Goldman, 28 Joseph, Bethpage, N.Y. 11714 10-66-6t

Trimm 504 Audio Patch cords $4.00. Audio jack panels for 19" racks, 10 pair $8.95. Repeat coils 500-500 ohm flat to 20kc $4.00—Relay racks and equipment cabinets. Write for list. Gulf Electro Sales, Inc., 7031 Burkett, Houston, Texas. 4-66-tf

"AUDIO EQUIPMENT — Whatever your needs, check us first. New and used. Ampex, Altec, AKG, EV, Fairchild, Neumann, Langevin, Rek-O-Kut, Uher, Viking. Send for equipment list." Audio Distributors, Inc., 2342 S. Division Ave., Grand Rapids, Michigan 49507 6-66-6t

G. E. Phono cartridges for broadcast use. Prompt service. Send for price list. Ridge Audio Co., 91 E. Lake Rd., Skaneateles, N.Y. 13152 9-66-1t

Everything in used broadcast equipment. Write for complete listings. Broadcast Equipment and Supply Co., Box 3141, Bristol, Tennessee. 11-64-tf

FREQUENCY MONITOR SERVICE for A.M. monitors including G.R., RCA, Gates, Doolittle, W. E., etc. Frequency change and other services. Reasonable prices, prompt service. Call or write before shipping. Eidson Electronic Co., Temple, Texas. 9-66-tf

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We need used 250, 500, 5K & 10K Watts AM Transmitters. No Junk. Guarantee Radio Supply Co. 1314 Iturbide St., Laredo, Texas 78040. 3-66-tf

Wanted: Field Strength Meter Nems-Clarke AM broadcast band only. Low Power Broadcast Equipment Co., 248 Swedesford Road, Malvern, Penna. 19155 12-1t

WANTED: Copy of "Color Television, Manual for Technical Training" by RCA, 1959. Charles Newman, Box 3605, Altus AFB, Oklahoma, 73521. 12-1t

EMPLOYMENT

FREE PLACEMENT for TV and Radio Chief Engineers and both studio and transmitter engineers. All fees paid by the station. Send resume to: Nationwide Broadcast Personnel Consultants, 645 North Michigan Avenue, Chicago, Illinois or call: 312-337-7075. 9-66-1t

Job Headquarters for all Radio and Television Engineers. Immediate openings exist in 9 western states and elsewhere for qualified engineer and technical personnel. All categories from trainees to experienced transmitter maintenance, chief, assistant chief, live color video maintenance and technical operations. Send us your complete resume now. The AMPS Agency, 3974 Wilshire Blvd., Los Angeles, California 90005. Telephone DU 8-3116.
By Broadcasters — For Broadcasters 11-tf

First Class License, graduate of two year approved technical school (or equivalent) for chief engineer of new 2500 mHz ITFS. Reply to Mr. L. McConnell, Asst. Supt., Alpena Public Schools, Alpena, Mich. 12-1t

"Experienced television broadcast engineer. Replies confidential. Send resume and phone number to Bob Anderson, KIMA-TV, Box 702, Yakima, Washington." 12-1t

Need Engineer with First Class License—transmitter and maintenance duties—no announcing—will train if necessary. Contact: R. J. Bitner, Chief Engineer, KRVN AM/FM, Lexington, Nebraska 68850. Phone 308-324-3271.

We need an announcer Engineer with first phone who has general knowledge of Medium Market Radio including Sales, Programming and Station Management. Dept. 165, Broadcast Engineering. 12-1t

WTOC-AM-FM-TV, Savannah, Georgia, has opening for first class engineer with experience. Reply by letter to Chief Engineer, WTOC, P. O. Box 858, Savannah, Georgia 31402. 12-1t

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Project Engineers, all levels for challenging assignments in the design of audio, video & control facilities for color TV studios. BSEE and minimum of 2 years experience, preferably in broadcasting, required.

Location: CBS Headquarters Building, midtown Manhattan

Please send resume and salary requirments, to:

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Personnel Dept.

COLUMBIA BROADCASTING SYSTEM, INC.
51 W 52 St., N.Y., N.Y. 10019

WANTED: Technicians for RCA closed circuit television—systems planning — color television — video tape — TV cameras — maintenance — sales engineers etc. RCA representative, 143-08 94th Avenue, Jamaica, New York, 212-297-3336 9-66-tf

Prominent Hollywood independent film and general recording facility seeks crackerjack engineer; small secured stock investment buys 10% interest for right man. Box 38027 Hollywood, California, 90038. 11-66-2t

POSITION WANTED

Chief Rigger, Supervisor or Assistant Rigger. Now employed as Chief rigger at a large government radio station wants position with profit making organization. 37 years with R.C.A.-N.B.C. My separation from R.C.A.-N.B.C. took place when government took over station. Would relocate. Prefer foreign duty. Speak French, little Spanish. Dept. 164, Broadcast Engineering. 12-1t

Looking for a good video stabilizing amplifier?

International Nuclear's TVA1 is certainly one of the best on the market today. The TVA1 with its associated series of plug-in units offers high level performance and versatility for studio or transmitter use. It removes all low frequency disturbances such as hum, bounce and tilt by sync-tip clamping. This back porch level is precisely stabilized without affecting color signals in any way. Sync is stretched after back porch stabilization and then clipped accurately to desired level. This level may be set by means of a front panel control which can be extended to a remote location. Stripped sync is provided at one 75 ohm internally terminated output connector, at a 4 volt level. The TVA1 chassis contains a plug-in compartment which accepts up to 4 plug-in units. Among these plug-in units is the TVA1-E, providing a stripped color video channel, and the TVA1-D which provides the means of adjusting peak-white clipping, white stretch and differential phase. Other plug-in units are listed below.

PRICES F.O.B. NASHVILLE, TENNESSEE

Model TVA1 Stabilizing Amplifier (less plug-ins) . . . $1,380.00
Model TVA1-A, Manually Operated Input Amplifier Unit . . . $310.00
Model TVA1-B, Input Amplifier Unit, with Remote Master Gain and Chroma Panel . . . $425.00
Model TVA1-C Monitor Amplifier Unit . . . $265.00
Model TVA1-D White Stretch and Clip Unit . . . $240.00
Model TVA1-E Stripped Video Unit . . . $450.00
Model TVA1-S Remote Sync Level Control Panel . . . $25.00

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Circle Item 53 on Tech Data Card

You have only one opportunity to plug in an RCA solid-state rectifier

RCA solid-state rectifiers are made to last! Plug in one RCA rectifier unit as a direct replacement for one of your mercury vapor or gas rectifiers and it could very well last the lifetime of your equipment. RCA plug-in rectifier units CR273/8008, CR274/872A, and CR275/866A/3B28 are available only through your RCA Industrial Distributor. The three types he stocks, and can deliver off-the-shelf to you, are of the same high quality as those which have racked up 13,338 trouble-free hours in the visual driver of the transmitter at WBRE-TV Wilkes Barre, Pennsylvania. In fact, the high efficiency and performance of the units at WBRE-TV have remained the same as they were on the first day of installation. Realistically, you have everything to gain when you replace with RCA plug-in rectifiers. You get all of the advantages of RCA solid-state: ruggedness, high-reliability, plus economy. Maintenance and replacement costs are practically non-existent. And costly loss of revenue in off-the-air time, because of rectifier failure, becomes a thing of the past. The time to go to RCA solid-state rectifiers is now—and the price is right! Ask your RCA Industrial Distributor for his latest price and off-the-shelf delivery of these units. Call him.

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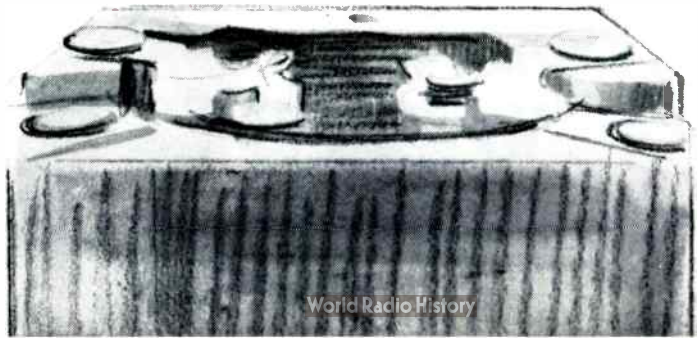

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