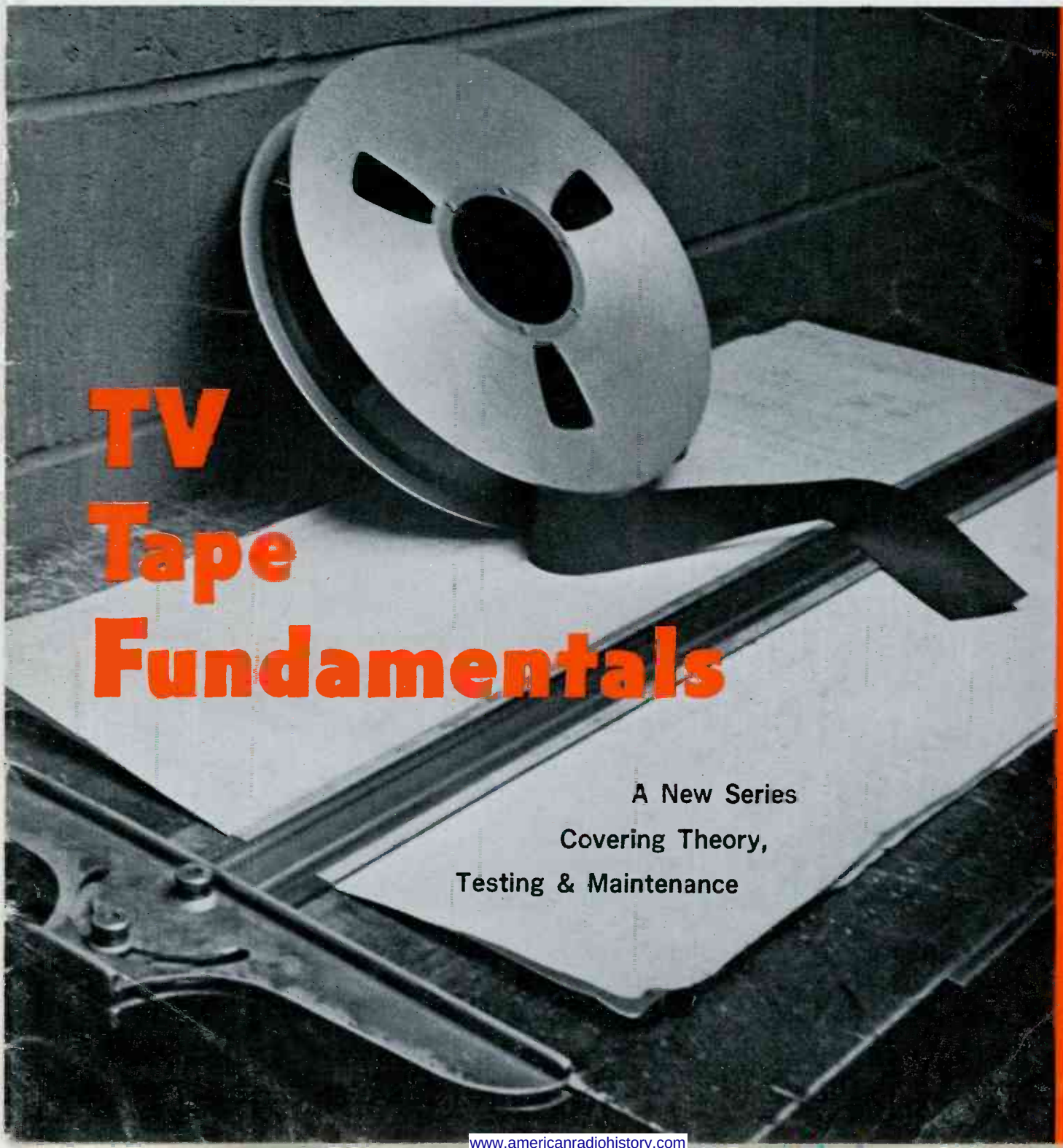
MARCH, 1962

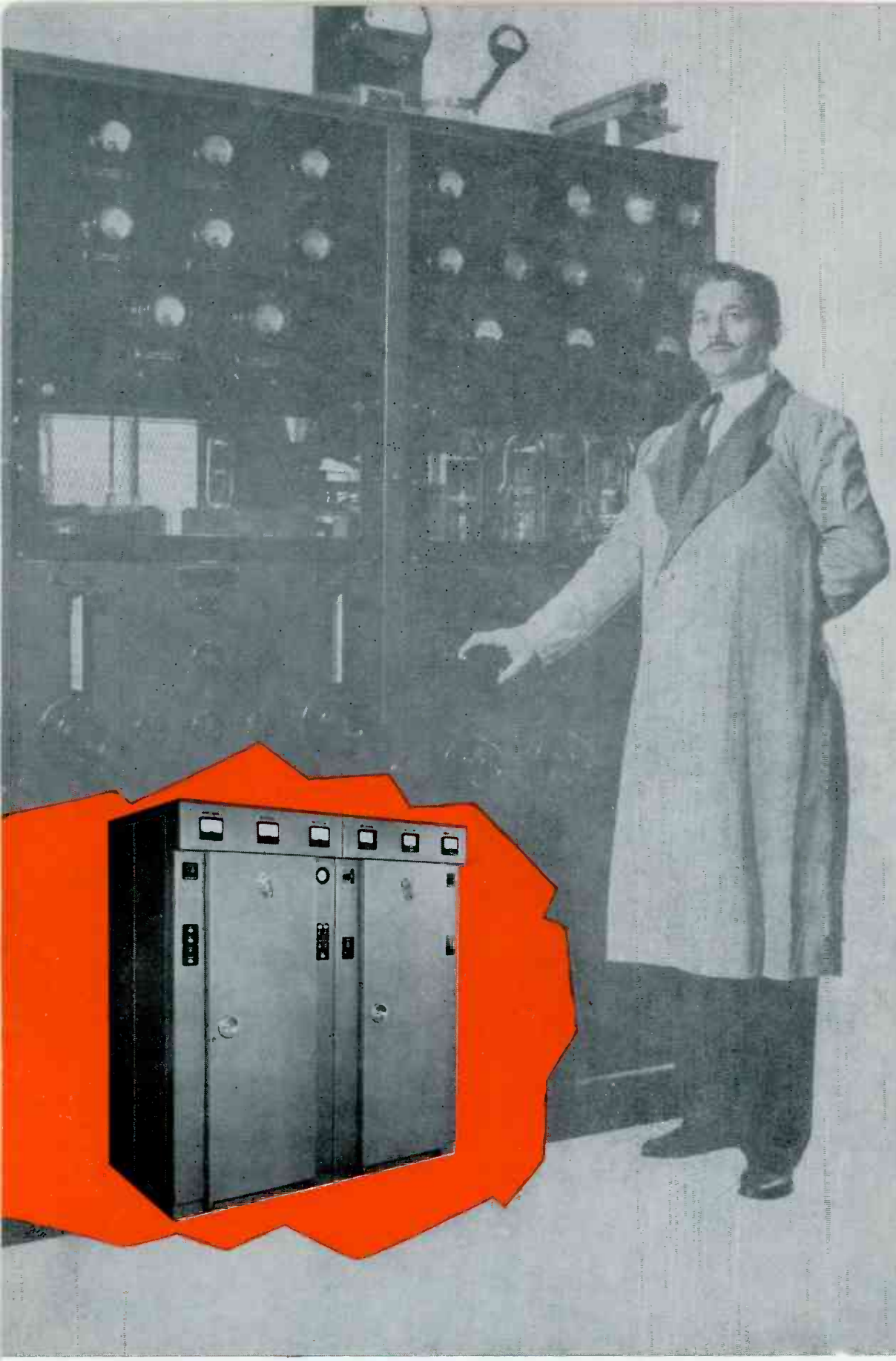
BROADCAST ENGINEERING®

THE TECHNICAL JOURNAL OF THE BROADCAST INDUSTRY



TV Tape Fundamentals

A New Series
Covering Theory,
Testing & Maintenance



5,000 TRANSMITTERS AGO . . .

this fellow had 21 gauges, 12 hand controls, and numerous switches that required constant manipulation and frequent checking just to stay on the air.

TODAY'S LATEST TRANSMITTER

Continental's 315B/316B 5/10 KW AM transmitter features push-button control for unattended operation, instantaneous power cut-back to 1 or 5 KW and tuning that is instant and reliable.

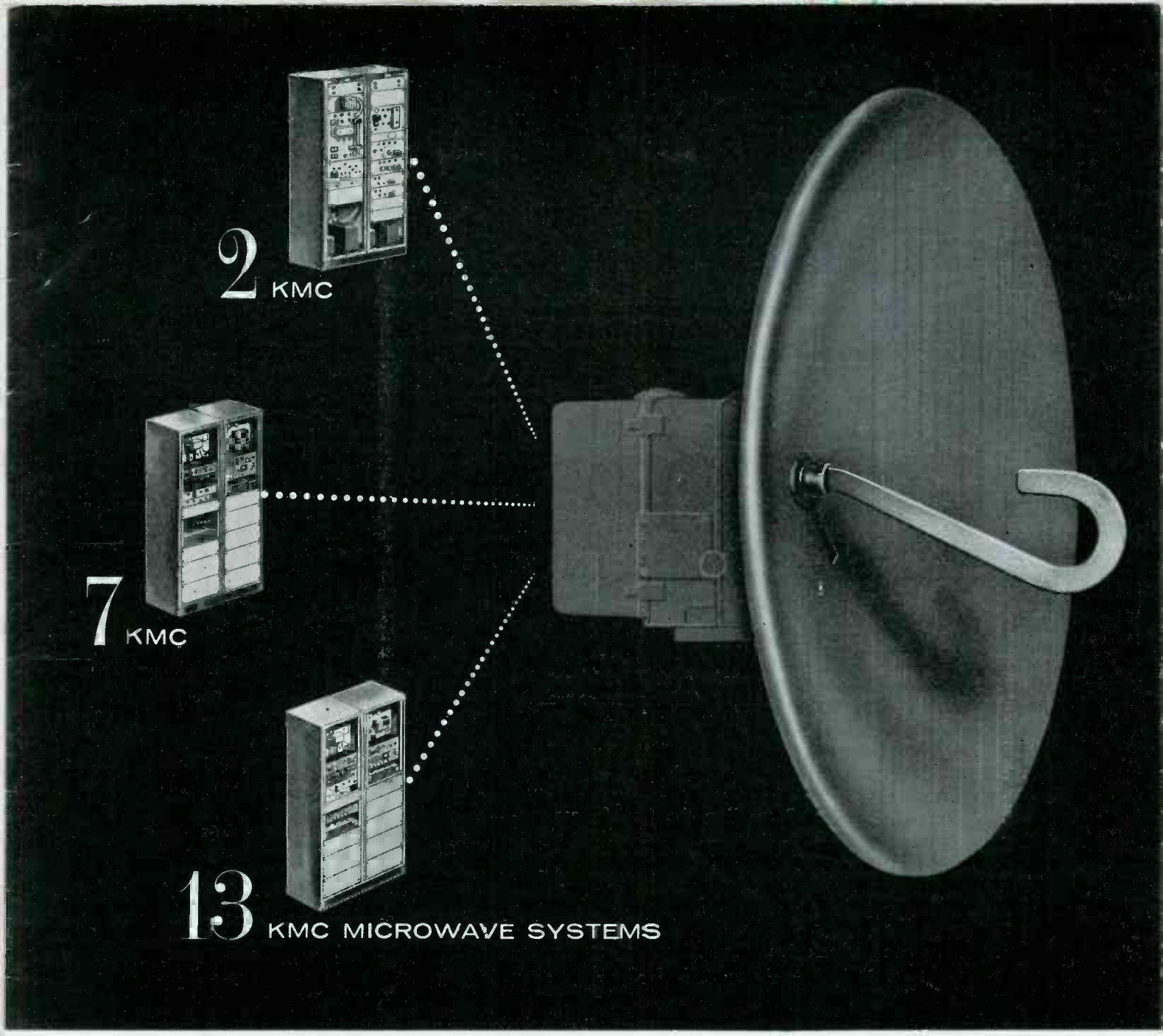
Get the details on tomorrow's transmitter today. It will be operating reliably 5,000 TRANSMITTERS FROM NOW . . .

Continental Electronics

MANUFACTURING COMPANY

Mailing Address: Box 17040, Dallas 17, Texas, 4212 S. Buckner Blvd., EV 1-7161 LTV Subsidiary of Ling-Temco-Vought, Inc.

Designers and Builders of the World's Most Powerful Radio Transmitters



Whatever Frequency You Need... RCA Has the Microwave System to Do the Job

Here's a full line of equipment, excellent for all television microwave applications. Whatever use you have in mind, whatever frequency suits your need, you can get a complete system from RCA. It will be tailored to your own job specifications.

2 KMC-TYPE TVM-22. Offers the very finest specifications available to the microwave user. Gives excellent performance for color signals over long-haul inter-city routes. "Top-of-the-Line" equipment.

7 KMC-TYPE TVM-1B. This 7000 MC equipment is the standard of the industry. Now in use in over 700 installations. For color signals, STL, inter-city routes and remotes. Broadcast and common carrier applications.

13 KMC-TYPE TVM-3A. This new 13,000 MC equipment is fine for intra-city links and for broadcast STL. Also recommended for private business applications.

Rack mounted and portable systems are available. Also reversible, diversity, fault locating and reporting features. RCA has the experience and equipment to give you the greatest assistance and widest choice. Consult your RCA representative. Or write to RCA Broadcast and Television Equipment, Dept. F-367, Building 15-5, Camden, N.J.

WIDEST CHOICE OF EQUIPMENT • THREE FREQUENCY BANDS • COLOR AND MONOCHROME

RCA® The Most Trusted Name in Television

BROADCAST ENGINEERING

THE TECHNICAL JOURNAL OF THE BROADCAST INDUSTRY ®

VOLUME 4 MARCH, 1962 NUMBER 3

Contents

Departments

ROBERT E. HERTEL, Publisher

EDITORIAL

GEO. H. SEFEROVICH, Director
JOHN BATTISON, Consulting Editor
D. F. BOICOURT, Production Editor
DUDLEY ROSE, Presentation Editor

ADVERTISING

E. P. LANGAN, Director
R. J. HANCOCK, Manager
S. F. WILSON, Production Manager

Chicago 1, Illinois
WILLIAM L. MILLER, JR.
E. F. LUKENS
307 N. Michigan Ave.
Telephone FRanklin 2-5944

Cleveland 16, Ohio
DAVID H. HERTEL
3100 Wooster Road
Telephone EDison 1-2370

Omaha 14, Nebraska
BOB HOPKINS
1705 Maenner Drive
Telephone 393-1905

Southwest
C. H. STOCKWELL CO.
4916 W. 64th Street
Mission, Kansas
Telephone RAndolph 2-4417

Los Angeles 57, California
MAURICE A. KIMBALL CO., INC.
2550 Beverly Boulevard
Telephone DUnkirk 8-6178

San Francisco 4, California
MAURICE A. KIMBALL CO., INC.
580 Market Street
Room 400
Telephone EXbrook 2-3365

Paris 5, France
JOHN ASHCRAFT
9 Rue Lagrange
ODeon 20-87.

London W. C. 2, England
JOHN ASHCRAFT
12 Bear Street
Leicester Square
WHitehall 0525

Tokyo, Japan
INTERNATIONAL MEDIA REPRESENTATIVES, LTD.
Shadan Hojin. 14, 2-chome Marunouchi
Telephone 571-4450

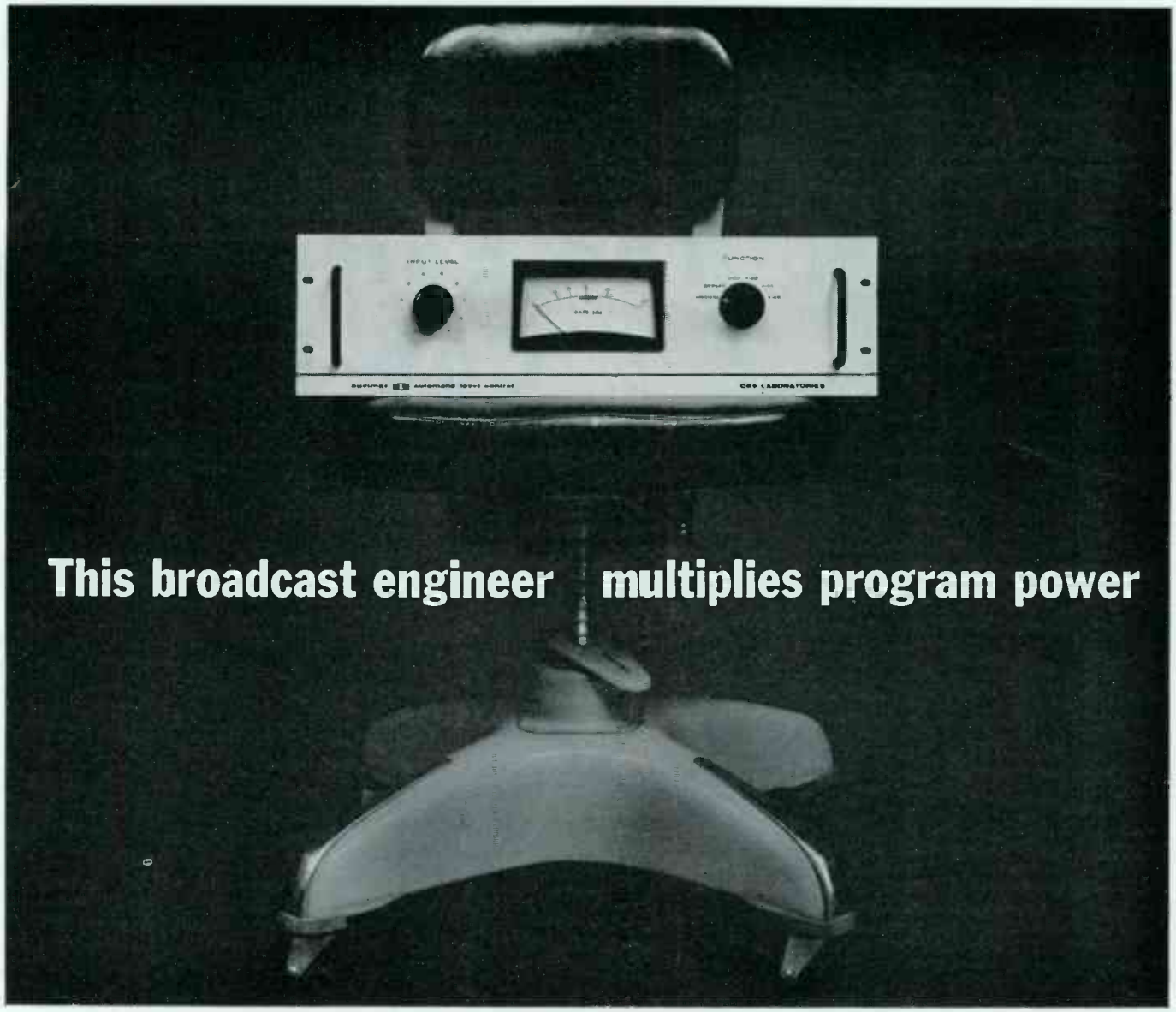
Editorial, Circulation and Advertising headquarters, 1014 Wyandotte St., Kansas City 5, Missouri: Telephone VIctor 2-5955.

BPA

Subscription Price: U. S. $6, one year; Outside U. S. A., $7. Single copies, 75 cents. Adjustments necessitated by subscription termination at single copy price.

Broadcast Engineering is published monthly by Technical Publications, Inc., 1014 Wyandotte St., Kansas City 5, Missouri, U. S. A.

Corporate Personnel: Robert E. Hertel, President; Frank D. Smalley, Executive Vice-President; E. P. Langan, Vice-President; Kenneth Long, Vice-President.



This broadcast engineer multiplies program power

(without degrading signal quality)

CBS Laboratories' new AUDIMAX automatic level control is already helping more than fifty stations multiply their station coverage. Extensive field tests have shown that AUDIMAX increases average modulation by 6 db with a corresponding 300% increase in radiated program power.

AUDIMAX is not just another limiter, compressor or AGC amplifier—it is an electronic device which controls gain as competently as the most alert engineer. No other device acts with such speed and intelligence. While the staff engineer pursues more important duties, AUDIMAX sits in for him, maintaining maximum modulation or recording level. With AUDIMAX there is no need to compromise signal quality for high level of modulation.

This unique sound level control device is available in two models: AUDIMAX I ($495) for broadcasting and recording, and AUDIMAX II ($595) for television, motion picture and video tape production. A special Gated Gain Stabilizer in AUDIMAX II automatically determines whether gain should be turned up during prolonged lapses in the program. This eliminates the need for continuous manual monitoring of TV films and prevents noticeable level changes during pauses in live telecasts. A stereophonic adapter ($150) is also available to enable two AUDIMAX units to adjust gain on both channels simultaneously, thus assuring perfect balance in stereo broadcasts.

For complete information on how AUDIMAX can improve your broadcast efficiency write or call our Audio Products Department.

CBS LABORATORIES
STAMFORD, CONNECTICUT
A DIVISION OF COLUMBIA BROADCASTING SYSTEM, INC.

For export sales, write CBS International, 46 East 52nd St., N.Y. 22, N.Y., Cable address "Columbine".

The Editor's Cue Line

NAB CONVENTION TIME!

BROADCASTER'S HEAVEN . . . is what many people think of the Annual NAB Convention. This year it is being held in Chicago and from all advance reports it promises to be the best ever. Most people who attend these conventions regularly feel that Chicago is the best place from the point of view of convenience, although Los Angeles is a good second.

Apart from the fun and frolics always associated with conventions, but more lacking of later years with the disassociation of the film and program from the convention proper, it always seems that the delegates to this one have a far stronger sense of duty and business than most others that one attends. Maybe it is because of the pressure from "above;" maybe it is just the inherent goodness and dedication to public service that pervades all broadcasters.

This year's meeting will be occupied with discussions of ways of resisting the encroachment of government into broadcasters' affairs in the form of program control by the "lifted eyebrow" and the talks about limiting the number of stations by raising the engineering standards. This is a sneaky way of accomplishing what many people are hesitant of asking for outright—"Let's get Uncle Sam to hold back the competition for us." Once Uncle gets any deeper into the picture the reins will begin to pull tighter, and other, and less welcome, restraints on free broadcasting will emerge. Although this is an engineering magazine we know from letters and reports that management reads it, and, particularly, this editorial page. We think that management should at this time make its voice heard not only in asking for protection but for freedom . . . freedom to program and run their stations as they see fit, based on their knowledge of the needs of the public! This may be the last time that their voices can be heard before more Rules are proposed—this is the place and this is the time!

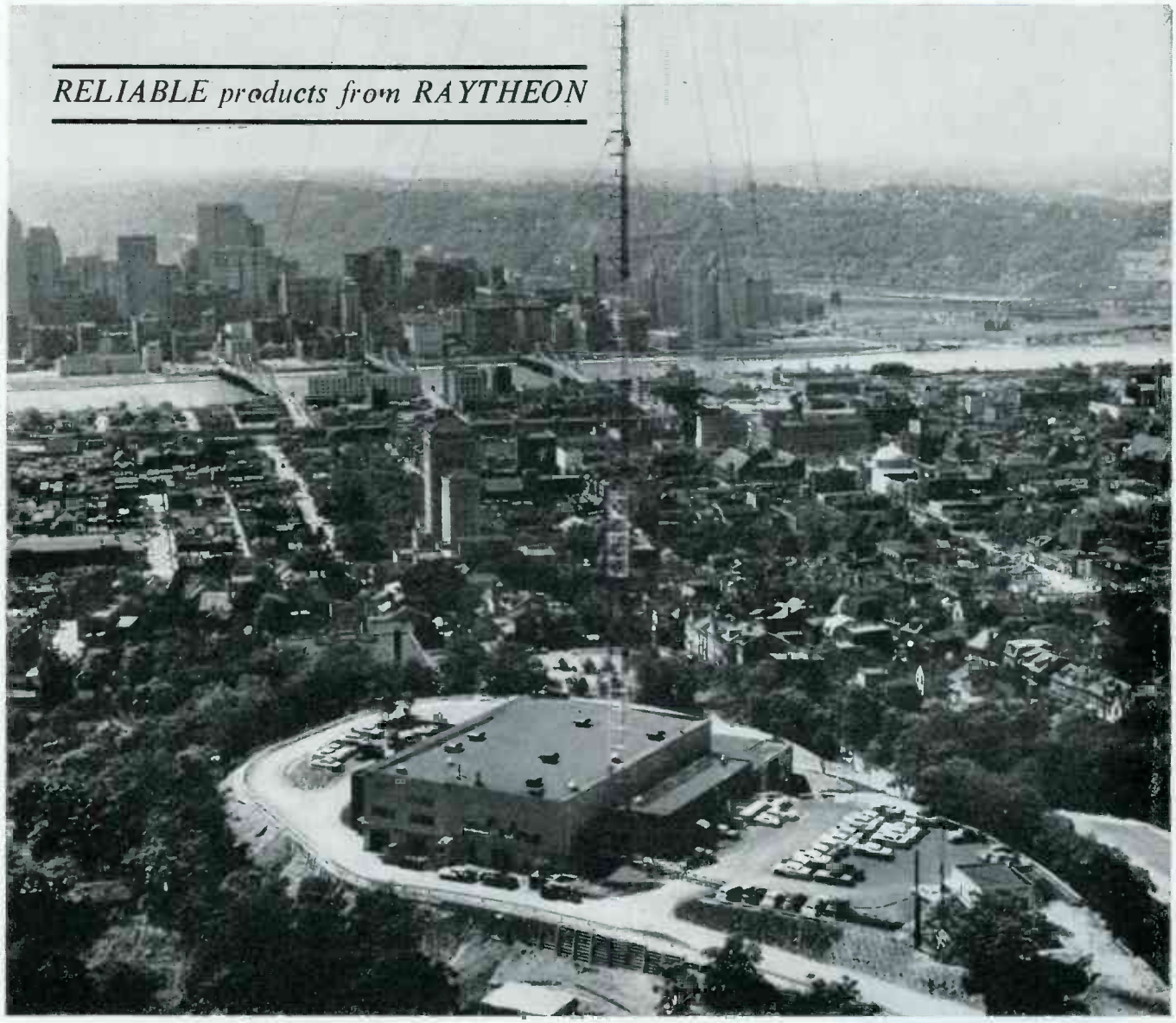
AIEE-IRE Merger . . . this looks like a sure thing now, and may even be concluded by the time this reaches our readers. If so it will mark the end of an era for radio as we broadcasters know it, and the beginning of a combination organization that may not have much sympathy for the old time "straight" radio man. Time will tell, but this writer is not in favor of it . . . nor are quite a number of our readers who have not hesitated to express their views quite strongly.

ONE-SIDED VIEWS . . . editors are not infallible and sometimes their editorials succeed in arousing more interest than they had intended, even to the extent that readers want to "have equal time to answer." In most cases a letter to be run in our "Letters to the Editor" column will take care of this, but sometimes the issues at stake are worthy of more than a letter. For this reason if you differ strongly with our editorials (or even if you agree) and would like to write a rebuttal or push the case further, let us know and if the circumstances warrant it BROADCAST ENGINEERING will carry a guest editorial.

NAB Equipment

This is the time to see what the latest developments are, and how they will affect your operations. With the enlargement of the Hilton Hotel in Chicago there will be even more room for exhibits, and more to see. So far we do not know what will be new and the hit of the show, but no doubt there will be big news from one or more manufacturers by the time this is read. Our thought for this month is . . . have a good time at the NAB Convention, look at all the new equipment, listen to the talks . . . and let your own voices be heard in favor of *what you want,* not what *someone else thinks* is good for you. See you in Chicago!

RELIABLE products from RAYTHEON



Raytheon-Machlett Tube Passes 20,000 Hour Mark for WIIC, Pittsburgh

A Raytheon-Machlett, ML-7007 Ceramic VHF Tetrode passed the 20,000 hour mark at WIIC Channel 11, Pittsburgh, Pa. during December, 1961. Total time for ML-7007 tubes at WIIC's 100 KW Transmitter is now nearing 200,000 hours. Operating parameters, formerly difficult to achieve, are being reached with ease, and maintained over long periods. WIIC's long life records, testimony to the excellence of its operation, are continuing proof of the long range durability and low cost per hour of the Raytheon-Machlett ceramic tube.

The complete line of Raytheon-Machlett tubes is available from your local franchised Raytheon distributor.

RAYTHEON

DISTRIBUTOR PRODUCTS DIVISION

Westwood, Massachusetts

TELEVISION TAPE FUNDAMENTALS

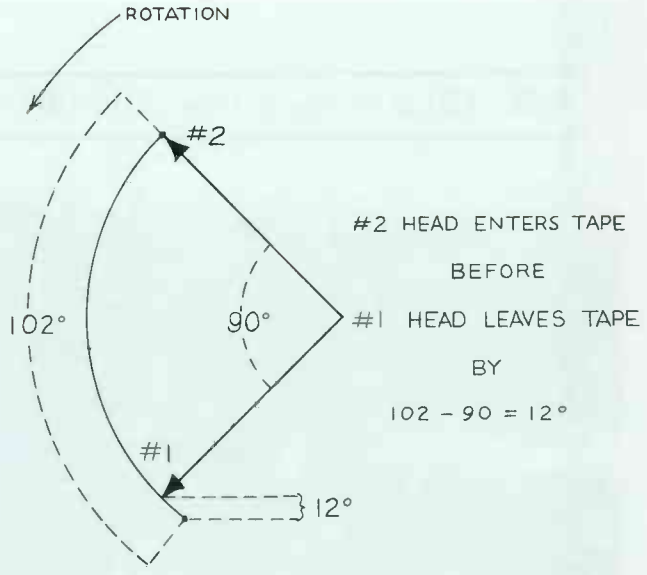


FIG. 8

The Basic Solutions to TV Tape Problems (Part 2)

By Harold E. Ennes, Maintenance Supervisor
WTAE, Pittsburgh, Pa.

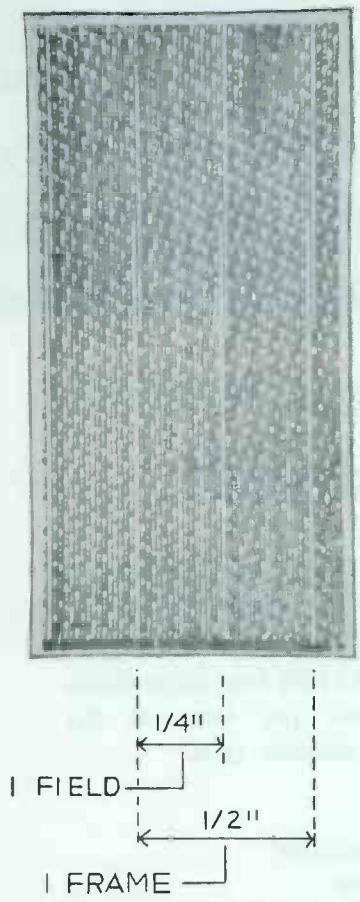


Fig. 9—Photo of "developed" tape. Note: The additional white lines at the bottom (control track) are "edit pulses" which are recorded between the second and third tracks following the head containing vertical sync.

THE HEADWHEEL (or drum) rotates at 240 rps or 4 times the TV field frequency of 60 cps. Thus one revolution (360°) of the wheel lays down 4 tracks (4 heads spaced 90° fed simultaneously) which is equal to one quarter of a field:

1 field = 262.5 lines

0.25 field = 65.264 lines in 4 tracks on the tape.

Then each track contains 0.25 × 65.264 = 16.4 lines.

Note: A TV line is designated as H, where H is the interval from the leading edge of one sync pulse to the leading edge of the next sync pulse. (Standard = 63.5 μs).

Therefore a recorded track = 16.4 H.

The foregoing is the average value of picture lines *used* in reproducing the signal. Actually, each track contains more than this number of lines:

360° = 1/240 sec = 4166.6 μs.

90° = ¼ of 4166.6 = 1041.6 μs = 16.4 H.

Then 1 H in terms of degrees = 90/16.4 = 5.48° = 1 TV line.

and lines/degree = 1/5.48 = 0.182 H/degree.

The control track, cue track, audio track and guard bands leave approximately 102° of the tip pass for picture information.

The heads at 90° apart (at 0.182 H/degree) lay down 90 × 0.182 = 16.4 TV lines which we have already derived above.

But since the heads are spaced 90°, the remaining time that both heads are in contact is 102-90 = 12°, or 0.182 × 12 = 2.2 lines overlap. (See Fig. 8). In recording, the same information is duplicated in this 2.2 lines. During playback, electronic switching is used to disconnect the head nearing the end of a track and to connect the head beginning the next track. This is done during horizontal retrace to avoid visible switching transients.

The 4 heads make 960 sweeps (240 rps × 4) across the tape per second, during which time the tape has traveled 15 inches.

One revolution of the headwheel (4 tracks) is equal to one-quarter of a field, since 240 rps is 4 times the TV field frequency of 60 cps. Therefore there are 240/4 = 60 fields per 15" of tape, or one field = 15/60 = 0.25". Then a frame (2 fields) = 0.5" of tape.

See Table 1 for head timing tabulation.

Note: The tracks on video tape can be made visible by coating with a suspension of carbonyl iron and diluent. (See Fig. 9). Horizontal sync pulses show as white dots between the long white lines of vertical blanking. Fig. 10 shows how the picture raster is made up of consecutive bands of 16-17 lines contained in each head pass across the tape.

The Mechanics of Time-Space Errors

Errors in spacing as a function of time in a video tape reproduction occur as horizontal displacements of vertical lines in the picture. The following illustrations show the space errors resulting in the reproduced picture from time base discontinuities.

Tape Vacuum Guide Too Far From Head (Fig. 11)

(A) Point (Z) represents the center of the drum or headwheel. Assume that the recording was made with the arc x-x representing 16 lines. Arc y-y is the playback position if the guide is too far from the heads, and contains the same 16 lines of information. The pole tip will enter this information late, and leave early compared to the recorded time base.

(B) Space errors resulting from the condition described in (A). Each band of lines representing a head pass across the tape starts late and ends early, thus producing the "skew" effect, sometimes called the "venetian blind" effect.

(C) The appearance of the above time base distortion on a video monitor.

Note: The horizontal position of the vacuum guide (which determines distance of tape from heads) is controlled by a servo amplifier. This servo (in the playback mode) may be placed either in the manual or automatic sense position.

In practice, mechanical adjustments are made on the head assembly with electrical controls centered. After initial mechanical alignment on a given head assembly, only the electrical control need be used to eliminate skew in the manual mode of operation.

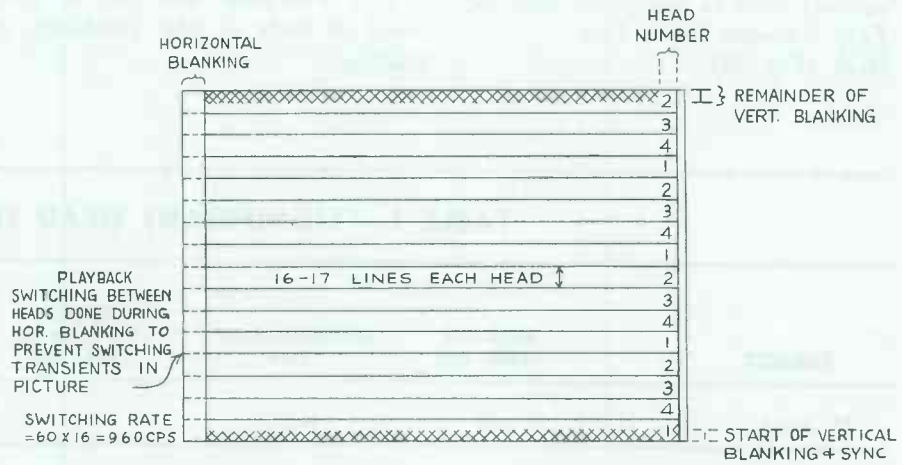


Fig. 10—The raster is made up of 16 bands of 16-17 TV lines (average 16.4) @ 60 cps repetition rate. Playback switching is done at the end of either 16 or 17 lines during horizontal blanking. NOTE: The above sequence assumes head No. 1 is playing-back vertical sync.

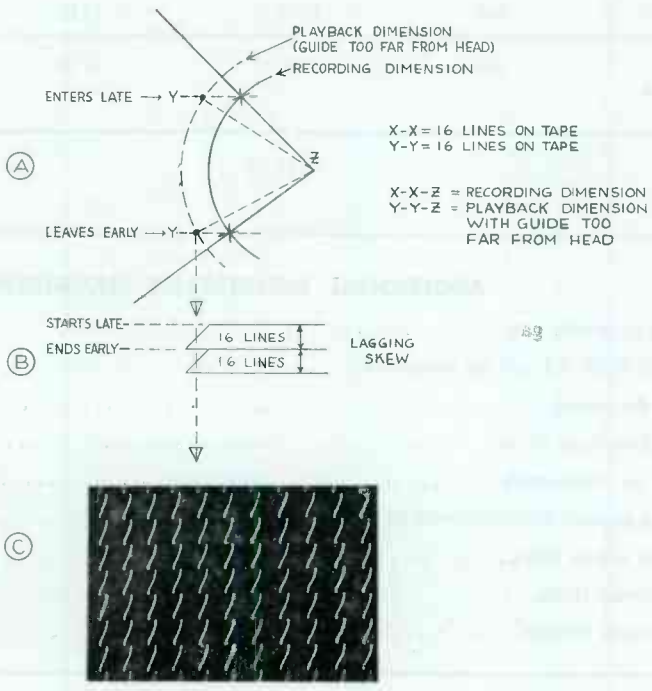


Fig. 11—Space distortion with guide too far from head.

Tape Vacuum Guide Too Close to Head (Fig. 12)

(A) x-x-Z represents the recording dimension with a given number of pulses in the arc x-x.

y-y-Z represents the playback dimension when the guide is too close to the head, with arc y-y containing the same number of pulses as in x-x.

The pole tip now enters early and leaves late compared to the recording time base.

(B) Each band of lines starts early and ends late, producing skew which is opposite to that of Fig. 16.

(C) Shows effect on reproduced vertical lines in the video monitor.

Tape Vacuum Guide Too High (Fig. 13)

Note: Vertical alignment of the guide constitutes a mechanical adjustment only. The correct alignment is that which allows maximum concentricity of the tape with the pole tip circumference. (Same "stretch" of tape at top and bottom of the pole-tip arc.) This is a major problem in the interchangeability and inter-spliceability of tape.

(A) With the guide too high, less stretch occurs at top than at bottom.

(B) Assume the tape was recorded with correct concentricity. The pole-tip enters late and leaves late compared to the recording time base.

(C) The start and end of each band of lines is late, producing a scallop.

(D) Appearance of vertical lines on a video monitor with guide too high.

If a recording is made with the guide positioned as in (A), it will play back on the same head without distortion. But if this tape is played back on a correctly adjusted head assembly, the guide must be mis-adjusted vertically to eliminate scalloping in the picture. A misadjustment as in (A) will produce excessive wear on the bottom half of the tape.

Tape Vacuum Guide Too Low (Fig. 14)

(A) Guide positioned too low causing more stretch at top than at bottom of tape.

(B) Assuming recording was

TABLE I — SIGNIFICANT HEAD TIMING

SUBJECT	RELATIVE FREQ. cps	MICROSECONDS (us)	VERTICAL (V = 1/60 sec 16667 us)	TV LINES (H = 63.5 us)	HEADWHEEL DEGREES (360° = 1/240 sec = 4166.6 us)
TV Field	60	16,667	1	262.5	1440
TV Line	15,750	63.5	1/262.5	1	5.48
One Revolution of Headwheel	240	4166.6	¼	65.624	360
½ Revolution of Headwheel	480	2083.3	⅛	32.8	180
¼ Revolution of Headwheel	960	1041.6	1/16	16.4	90
Playback Switching Rate (Sweeps Across Tape per Sec.	960	1041.6	1/16	16.4	90
1 Degree of Rotation of Headwheel		11.58		0.182	1

ADDITIONAL SIGNIFICANT MEASUREMENTS

Width of video head magnetic gap	0.09 mil
Video Head tip speed (with 3.7 mil tip projection)	1561"/sec
Maximum recorded frequency	7 mc
Minimum wavelength on tape (7 mc)	0.223 mils
Length of 1 TV line on video track	98 mils (approx.)
Head-to-head spacing around circumference of headwheel	1.626" (approx.)
Length of video track across tape	1.82"
Space along tape between fields	0.25"
Space along tape between frames	0.50"

THE TURNER MODEL 58 STUDIO MICROPHONE

FOR BROADCASTING EXCELLENCE OUTSIDE THE STUDIO

Designed for TV and broadcast use, the Model 58 has been specially engineered by Turner to withstand heat, rough handling and humidity. This modestly-priced microphone is rugged enough for use on sports remotes, studio or outside interviews, panel shows — anywhere freedom and mobility are required — and yet it gives the quality performance you expect from stationary studio microphones.

The Model 58 is 4" long, weighs only 3½ ounces. Complete with lavalier; or it can be adapted to a desk or floor stand. Level (RETMA) –149 db. Response 60—13,000 cps. Allows a choice of either hi impedance or 150 ohms selected at the free end of the cable. Model 58A: combination 50 or 200 ohms selected the same way. Net price $34.20. *For complete specifications, write:*

THE TURNER MICROPHONE COMPANY
907 17th Street N.E., Cedar Rapids, Iowa

IN CANADA: Tri-Tel Associates, 81 Shepard Ave. West, Willowdale, Ontario.
EXPORT: Ad Auriema, Inc., 85 Broad St., New York 4, N. Y.

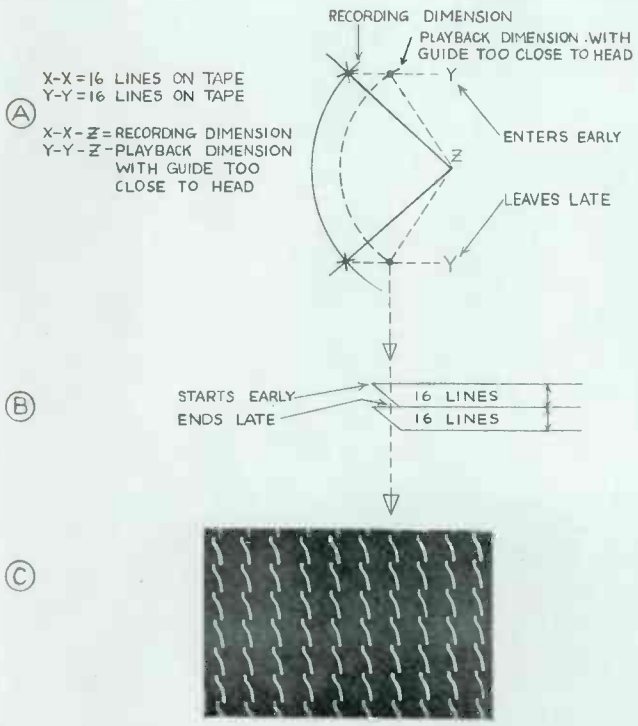


Fig. 12—Space distortion with guide too close to head.

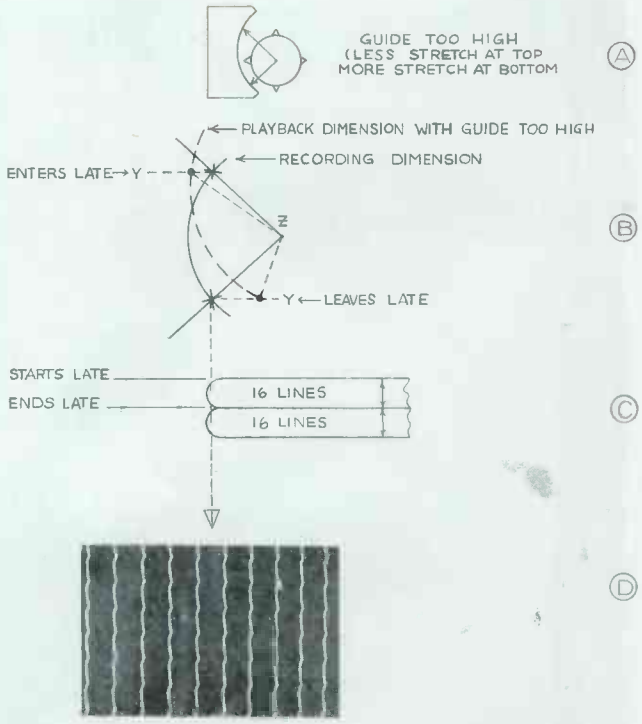


Fig. 13—Space distortion with vacuum guide too high.

made at correct vertical alignment, the pole-tip enters early and leaves early compared to recording time base.

(C) Each band of lines starts and leaves early, producing a scallop which is opposite to that of Fig. 13.

(D) Appearance of vertical lines on a video monitor with tape guide adjusted too low for a properly recorded tape.

Head Quadrature

In the rotary head TV tape system, the ideal head spacing is exactly 90° plus or minus zero seconds of arc. Manufacturing problems understandably place considerable strain on this "perfect" situation.

90° = 90 × 60 = 5400 minutes = 5400 × 60 = 324,000 seconds.

90° = 1041.6 μs (See Table 1).

Then μs per sec of arc = 1041.6/324,000 = 0.00322.

(Continued on page 20)

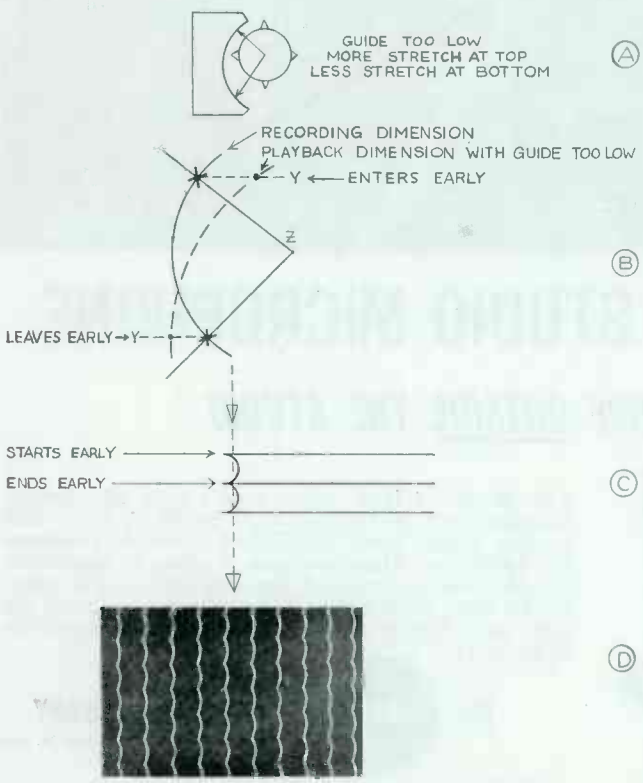


Fig. 14—Space distortion with vacuum guide too low.

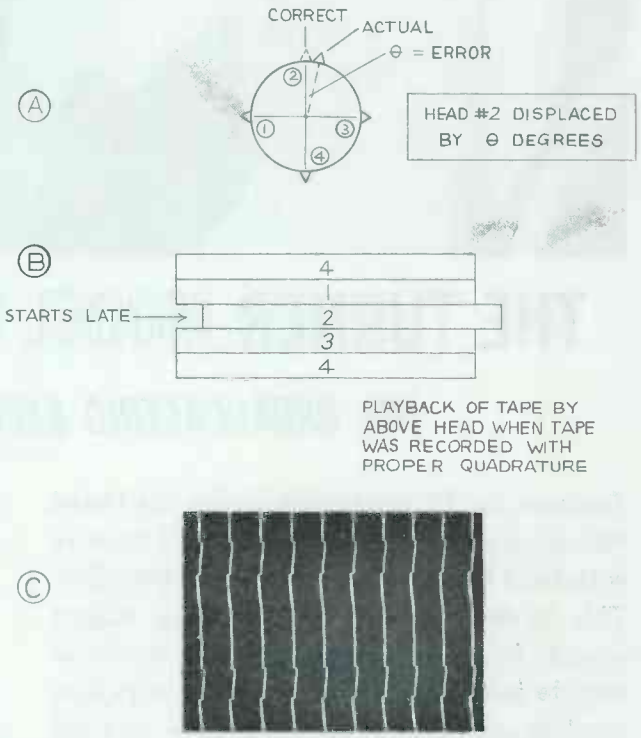
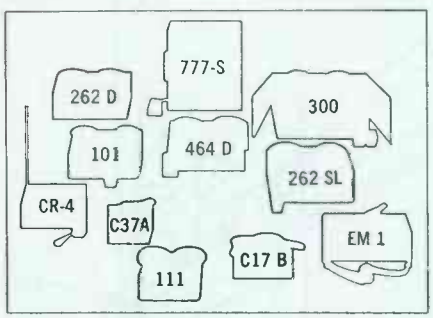


Fig. 15—Space distortion with head quadrature error.

■ **Sony Stereo Tape Deck 262-D**—4 & 2 track stereo recording and playback tape transport to add tape to your existing hi fi system. $89.50. (Also available, not pictured, the new SRA-2 stereo recording amplifier for the 262 D. $89.50.) ■ **Sony Sterecorder 777-S**—All transistorized professional 2 & 4 track stereo recorder featuring the revolutionary Sony Electro Bi Lateral Heads. The world's finest tape recorder. $725. ■ **Sony Sterecorder 300**—A complete professional-quality hi fi stereo tape system with 4 & 2 track recording and playback in one portable unit. $399.50. ■ **Sony Portable 101**—2 speed, dual-track, hi-fidelity recorder with 7" reel capacity. $99.50. ■ **Sony Sterecorder 464-D**—Dual performance 4 track stereo tape deck with built-in recording & playback pre-amps for custom installations and portable use. $199.50. ■ **Sony Wireless Microphone CR-4**—Pocket size mike and transmitter providing complete freedom from entangling microphone cables. $250. ■ **Sony Condenser Microphone C-37 A**—For purity of sound reproduction, the unqualified choice of professional studios throughout the world. $295. ■ **Sony Sound on Sound Recorder 262 SL**—The perfect recorder for language, music and drama students. With 4 track stereo playback. $199.50. ■ **Sony Tapecorder 111**—A popularly priced, high quality bantam recorder for everyday family fun. $79.50. ■ **Sony Condenser Microphone C-17 B**—Miniature size (3¾ "x ⅝" diameter) and exceptional background isolation unidirectional cardiod pattern. $350. ■ **Sony Newscaster Portable EM-1**—A professional on-the-spot battery powered portable recorder with precision spring wind constant speed motor. $495. ***All Sony Sterecorders are Multiplex ready!***



For additional literature and name of nearest franchised dealer write Superscope, Inc., Dept.B, Sun Valley, California

SUPERSCOPE *The Tapeway to Stereo*

PRACTICAL FM ENGINEERING

By Jack Alexander
International Television Consultants, Inc.
Washington, D. C.

In Part Two of this series on practical engineering for FM stations the author discusses antennas and problems involved in mounting them on AM towers, as well as transmission line data and characteristics.

Antennas

No matter how powerful your transmitter, your signal will not accomplish the desired effect unless your transmitter/air medium coupling transformer is effective and efficient. In this we are referring to the antenna which is, after all, only a part of the transformer coupling the transmitter to the receiver. When FM operations started just after WW 2 the generally chosen antenna was a turnstile, or even a simple dipole. With the advent of commercially feasible FM a lot more research went into this subject and many new types of antenna were developed. Today we find that although Turnstiles and Pylon antennas are still used, the trend is toward far cheaper and less complicated radiators. These include simple dipoles, halos and "Vee" types.

The use of simpler antennas has of course made it easier and cheaper to mount them on existing AM towers. The older, heavier and more cumbersome antennas caused such an increase in wind loading that many older towers could not support them. Today a "Vee" type antenna mounted on the side of an AM tower provides an almost circular pattern, and at the same time hardly increases windloading at all.

Figure 1 shows both types of antennas. As will be seen from the illustration of the "Vee" type antenna, the high-voltage points (ends) of the radiating elements are well separated so that no trouble from high-voltage breakdown is to be expected. There is also less chance of heavy ice formation on this type of radiator. The gain of a "Vee" antenna is about 0.9 per element when stacked, and as many as required, within limits, can be stacked to obtain the desired gain.

Feeding this type of antenna is simple. One can use either end feed, or equal feed. In the former all elements are fed equal phase and amplitude; in the latter each element is fed with equal phase by the use of transmission lines of equal length from a central point. Figure 2 illustrates this point.

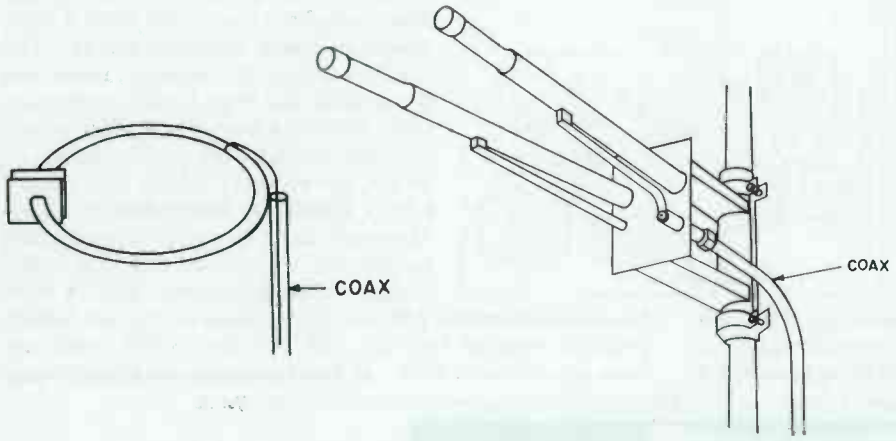


Figure 1—Typical Halo and "Vee" antennas.

The halo antenna can be fed in the same way and stacked for desired gain. However, it should be remembered that the halo antenna is very susceptible to arcing-over at the center where the high voltage point is. For this reason it has become more popular for reception than transmission in many cases. It can be seen that this antenna also is more likely to accumulate ice during cold weather at this very sensitive point. The gain of a halo is approximately one, and the wind loading factor is less than the "Vee." Feeding it is accomplished in the same manner, and the general treatment can be the same.

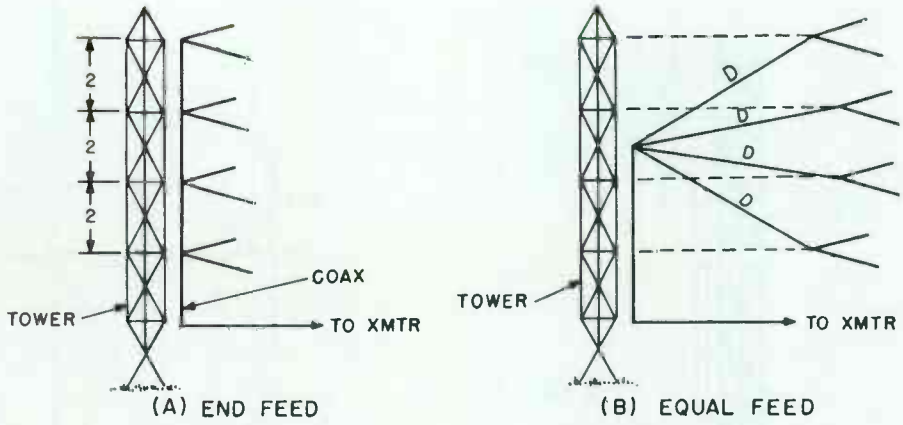


Figure 2—Methods of feeding FM antennas to obtain desired gain.

As the horizontal gain of an antenna is increased, so the vertical directivity increases, and in cases of extremely high gain an actual null is produced over the antenna like a cone of silence over a radio range station. Also, as the gain is increased nulls are produced horizontally. These can result in some unexpected effects in coverage. While the signal will not reduce completely to zero it does go down to a point where reception can become useless by a factor of 20:1. For this reason it is a good idea when planning a new installation to consider this point carefully. A method of approximating the position of these nulls is shown in Figure 3. Of course your manufacturer's sales engineer should be able to inform you on this point so that it will not be necessary to make such an intensive engineering survey. In this connection, be sure to find out what the power handling capability of the antenna is if you intend to put high power into it. It is fatal to put up a high antenna, and then have one or more of the elements burn up as soon as you put full transmitter output into it!

You should also watch the position of your guys if you contemplate putting an FM antenna on the side of a guyed tower. The tendency is to place the "Vee" type of antenna on one side of the top of the tower; this is fine, and produces essentially a circular pattern. However, if the supporting guys run to the top of the tower, as they generally do, there is a strong possibility of two things happening: One is bad distortion of the pattern, and the other is, in extreme cases, burn out of the elements or element. To avoid this a tower can sometimes have the top guys lowered a few feet to allow the top section holding the antenna to be above them, or else the guys should be broken up into very short sections by the use of insulators. Another method of overcoming this problem is to use nylon rope which

GAIN	ANGLE
1	70.0
2	35.0
3	23.3
4	17.5
5	14.0
6	11.7
7	10.0
8	8.75
9	7.78
10	7.00
11	6.36
12	5.84
13	5.38
14	5.00
15	4.66
16	4.37

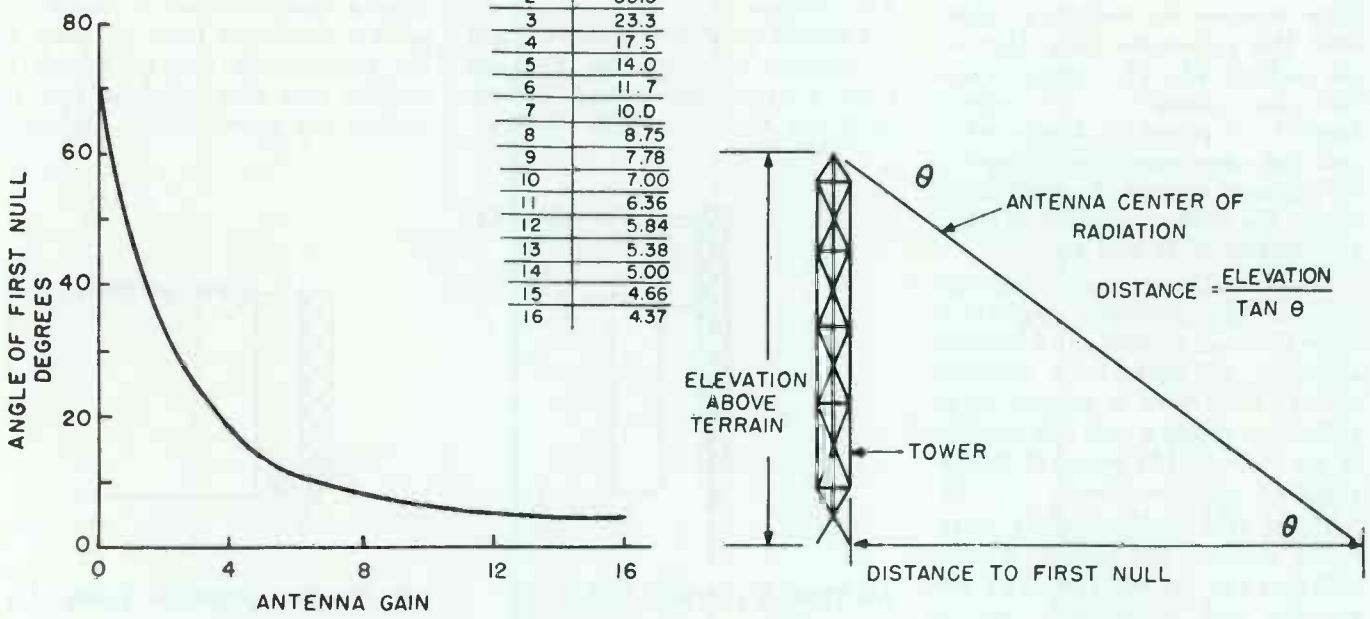


Figure 3—Horizontal null formation in stacked antennas, and method of determination of location for various arrays.

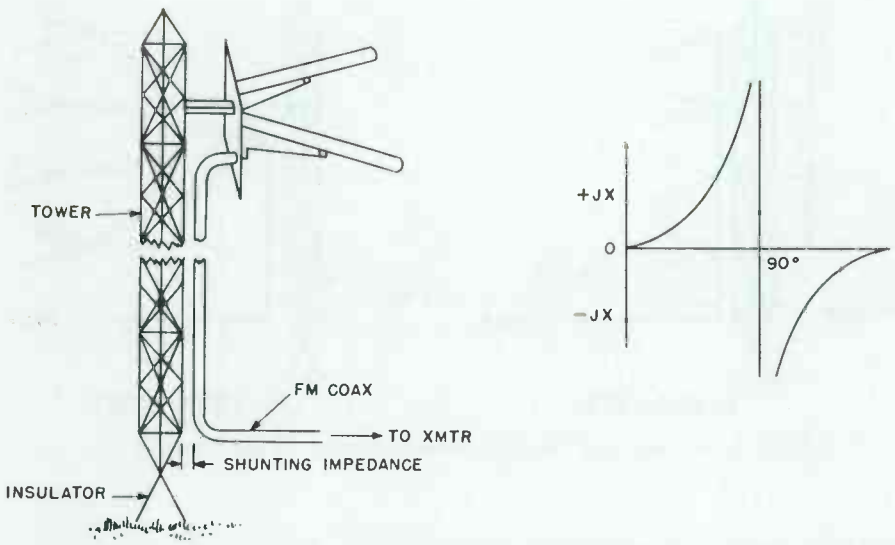


Figure 4—Showing how the shunting impedance is formed by the combination of transmission line and tower; and how the line impedance becomes infinity.

has now reached the stage of acceptance for this type of work.

Mounting FM Antenna On AM Tower

In the case of existing AM operations it is often a very attractive idea to mount a new FM antenna on the AM tower. Provided the tower will support the additional weight of the FM antenna and the extra wind loading will not exceed the rated loading of the tower, this is a practical solution. If the AM station is non-directional there will be no extra work involved except the re-measuring of the antenna resistance after the FM antenna and transmission line are added. Generally this will not result in a very large increase in resistance. However, this is not the point that we are making. The FCC requires that you must change to the indirect method of power measurement if you make any *significant changes* in the antenna system. As readers will recall, the indirect method involves the product of I*p* and E*p*.

Generally the station's chief engineer, or the consulting engineer if there is no competent chief engineer available, will make these measurements. This, then, is all that is involved in adding a new FM antenna to an existing AM tower if the operation is non-directional.

If the AM station uses a directional antenna the picture is quite different and the addition of an FM antenna and transmission line to any one of the directional antenna towers will involve a complete new proof-of-performance! This can run into as much as $10,000 if the pattern is a tight one! Sometimes it is more economical to build a new tower just to support the FM antenna rather than go to the expense and trouble of running a new proof.

Quarter-Wave Transformer

Irrespective of whether the antenna on which the FM antenna is to be mounted is directional or not, the FM transmission line *must* be isolated properly from the AM tower to ensure that no AM-RF gets into the FM system and the AM power is not dissipated in the FM system, or lost through an improper impedance match into the AM antenna.

Figure 4 shows a typical FM/AM installation in which the FM line forms a transformer section between itself and the tower. The combination of line and AM tower forms an open wire transmission line. This in turn represents a reactance across the base of the tower to ground and will of course affect the antenna resistance as well as forming a loss path for the AM *rf*. The value of this reactance depends on the height of the tower electrically.

From standard transmission line theory we know that at a quarter-wave the impedance is infinite. Of course in practice this is very seldom actually the case due to side effects of propagation speed through the dielectric (dielectric effect), extraneous capacities, and physical circuit phenomena. As a result the line will be a little longer or shorter than an exact quarter-wave in most cases. When the line is exactly one quarter-wave, the impedance being infinite has no effect on the AM frequencies, and is in effect that well known phenomena of microwave operation—the metallic insulator.

One of two conditions will be encountered by the engineer in planning an FM installation on an AM tower. The first is the case in which the tower is longer than one quarter-wave. Irrespective of the height of the tower the sheath of the transmission line is always grounded to the tower at the feed point on the antenna. The FM line is then insulated from the tower down to a point approximately one-fifth-wavelength up from the base of the tower at the AM frequency. Due to dielectric effect, and stray capacities, this distance is less than the desired quarter-wave. A small capacitor connected from the base of the transmission line to ground is used to tune this matching stub to exactly one quarter-wave, and thus

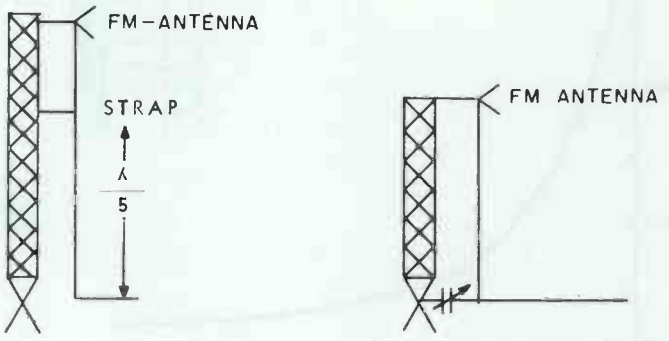


Figure 5—Formation of quarter-wave transformer with varying tower heights.

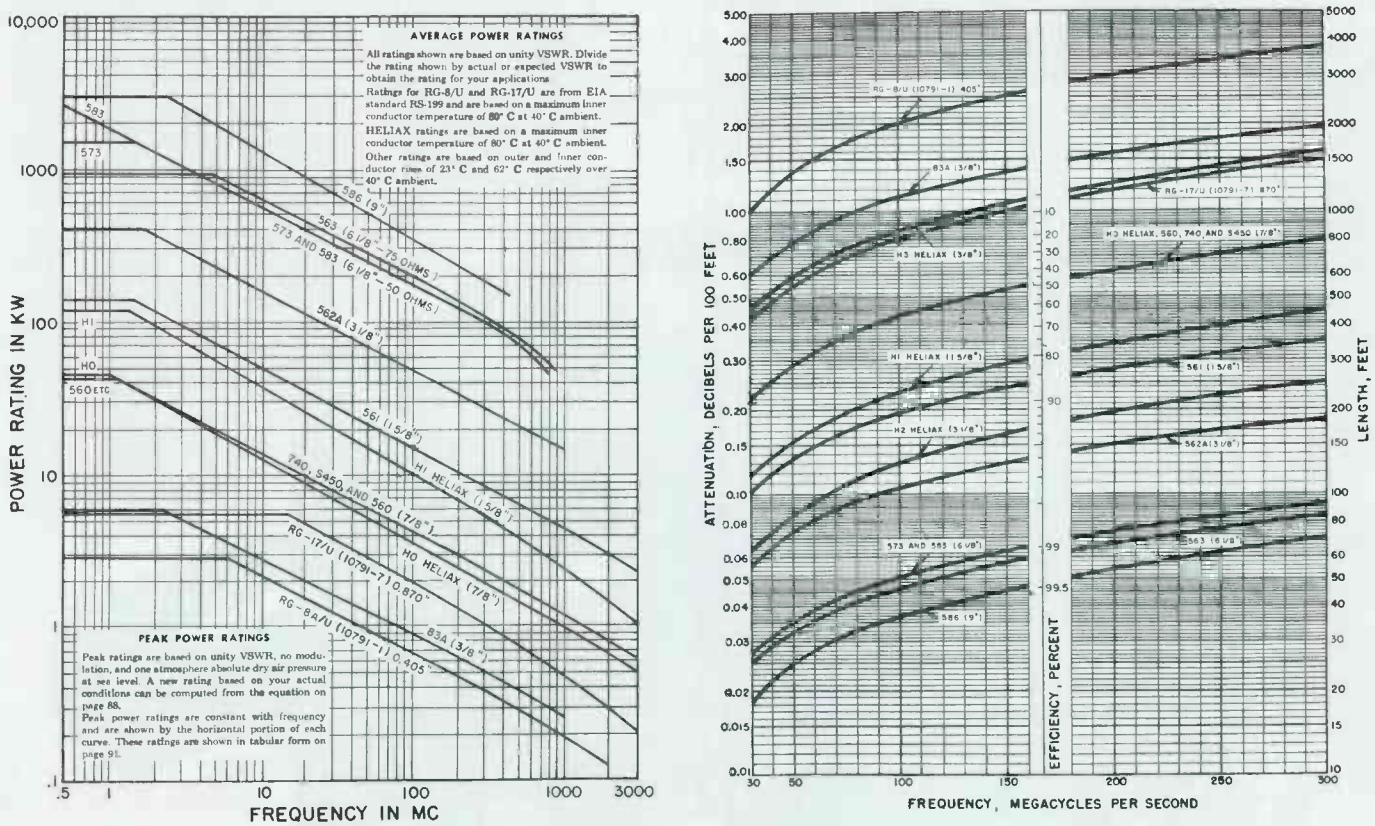


Figure 6—Typical ITA transmission line curves showing attenuation and losses for different size and type transmission lines.

achieve an infinite impedance. See Figure 5.

If the tower is less than a quarter-wave high the transmission line is grounded at the antenna connection as usual, the line insulated as it goes down the tower, and instead of a grounding strap one-fifth-wave up the tower from ground, a small variable capacitor is connected from the line where it leaves the tower, and ground. This capacitor is then adjusted until the desired quarter-wave match is obtained.

If the usual flexible transmission line is used for the FM line no difficulty will be experienced in insulating it from the tower because it has an insulating cover. If rigid copper line is used then the hangers must be insulated to obtain the desired results.

In either case, it is essential that an *rf* bridge and the usual impedance methods be used to ensure that an exact quarter-wave match is obtained. In fact the FCC will not accept a proof, or direct power readings unless this point has been checked first.

Transmission Line

Three types of transmission line are in general use. These are: Rigid "plumbing" using sections generally 20 ft. long, made of copper pipe varying from 1⅝ inches in diameter to 9 inches in diameter; flexible RG Series which comes in diameters of up to 1 inch, and has a solid dielectric with a braided outer cover surrounded by an insulating sheath; and the semi-flexible "Styroflex" (or similar trade names) that has a diameter of up to 6 inches and yet is supplied coiled onto a drum like "flexible" coax and can be handled as such.

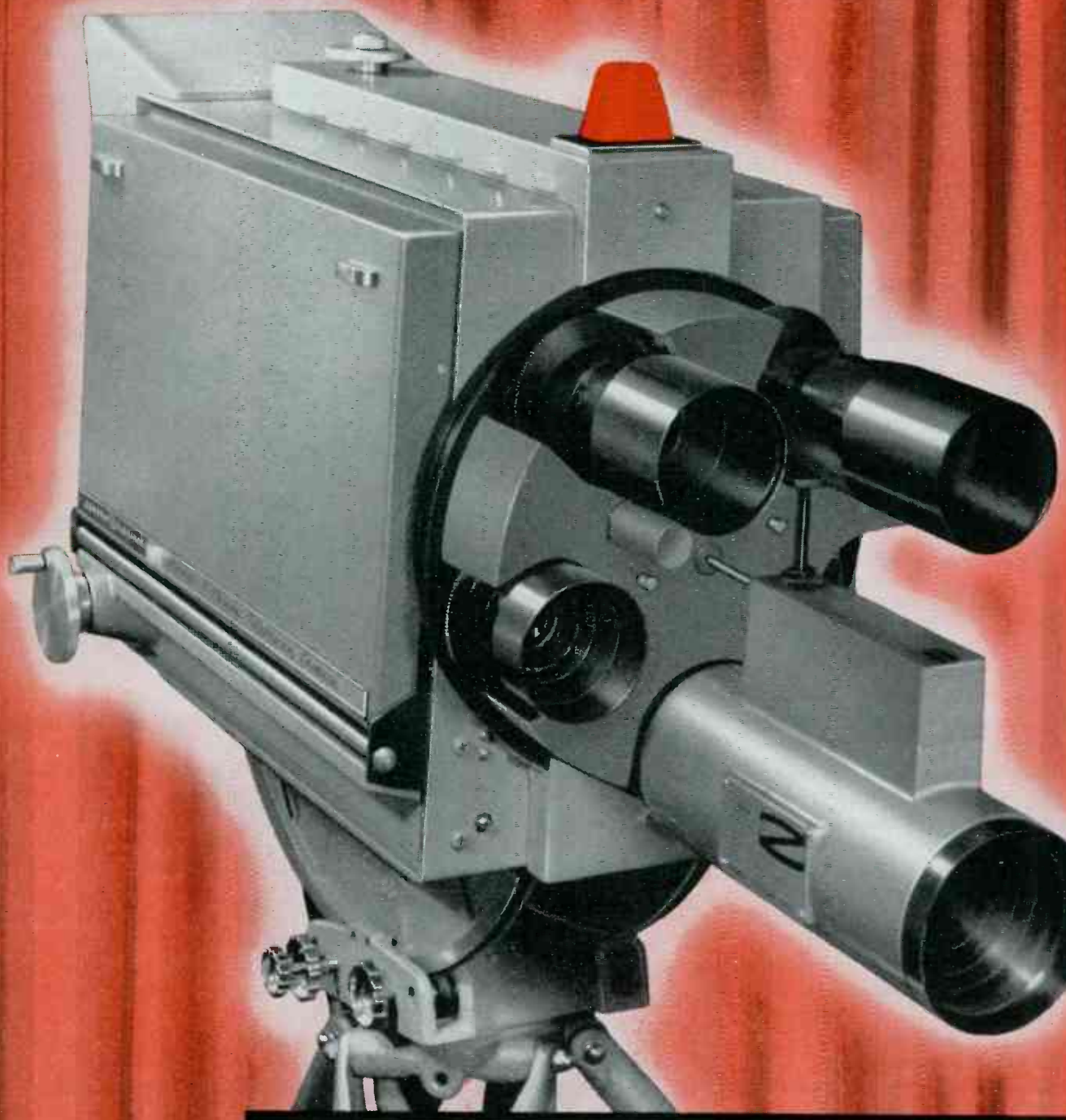
It is surprising the small size lines that can be used to feed FM antennas with high gain characteristics, provided the run is short. For example, ⅞-inch line will handle up to 1 kw, but 3⅛-inch line must be used above 110 kw. The determining factor in the choice of line size is current handling capacity and heat generation, rather than voltage breakdown. Some of the older supply lines, and even some of the more modern ones, are defective in that the center conductor is not spaced exactly in the center of the outer conductor and because of the varying impedances thus produced hot spots are generated along the line that have no connection with nodes or antinodes or current, and producing local heating. This point should be watched, and any time when installing a new FM line the installation engineer should run his hand along the line wherever possible to check for local hot spots that may indicate uneven spacing of the center conductor, or standing waves, or just plain overheating due to overloading the line.

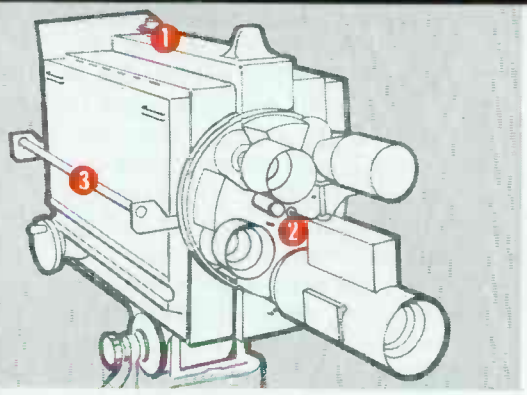
Wherever possible it is best to use flexible line to reduce installation costs and to facilitate handling. The rigid line requires very cumbersome couplings and right angle connectors to avoid any discontinuities of impedance due to variation in conductor spacing. Also the open inner conductor line generally requires to be gassed to keep it dry.

Figure 6 (taken by courtesy from ITA data) shows the attenuation and power handling capabilities of various lines.

The final and third part of this series will deal with the highly important items of studio equipment, and the FCC's proof of performance requirements for studio equipment.

PIONEERS IN TELEVISION PROGRESS





EASE OF OPERATION—Top-mounted control knob **(1)** facilitates changing of the neutral density filter disk and lens cap. Center-shaft zoom lens control **(2)** permits rotating the five-lens turret with zoom lens installed. Handle positioned **(3)** for ease in handling camera.

CONVENIENCE—Viewfinder operating controls, zoom lens handle, and lens selection handle are located for maximum convenience. Other camera controls are fully protected behind swing-down door.

NEW GENERAL ELECTRIC CAMERA CONVERTS FROM 3" TO 4½" I.O.

PE-20-A/B CHANNEL INCREASES FLEXIBILITY; BRINGS GREATER PICTURE STABILITY AND EASIER OPERATION TO LIVE TELECASTING

Now General Electric offers an advanced studio camera channel that can utilize either a 3-inch or 4½-inch image orthicon through a relatively simple and inexpensive conversion process. This design provides either the operational economy of a 3-inch I.O. camera or the optimum video quality of a 4½-inch I.O. camera in one channel.

Designated the type PE-20-A (3") and the type PE-20-B (4½"), the new General Electric camera channel also provides operational control of the image orthicon at the console as well as at the camera. After initial line-up at the camera, any touch-up required, such as target, and all electronic focus control adjustments, can be performed at the console. This dual control feature allows for operational flexibility using standard camera cable.

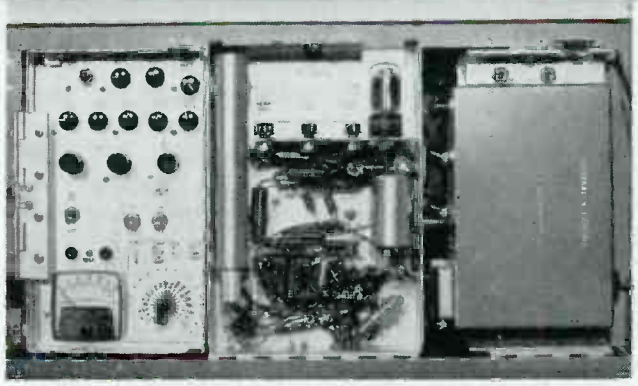
Other features of the PE-20-A/B include:

- *Stability*—Transistorized circuitry and regulated voltages assure maximum stability and reliability.
- *Self contained meter*—Built-in, switchable meter provides monitoring of all important camera voltages including H & V sweep.
- *Electronic lens cap*—New electronic lens cap can be operated at either camera or console without need of delegation switches.
- *Built-in I.O. Guard*—Self contained I.O. Guard assures prolonged I.O. tube life.
- *Improved turret design*—Center shaft zoom lens control permits rotation of 5-lens turret with zoom lens installed and with remote iris control operating.
- *Ease of maintenance*—Plug in circuits mounted on swing out chassis allow quick accessibility for ease in servicing.
- *Improved 8-inch Viewfinder*—Integrated viewfinder with 8" rectangular tube provides sharper, brighter picture. Switchable input permits either preamp output or camera channel output to appear on viewfinder.
- *Retractable handles*—Handles swing out for ease in handling camera.

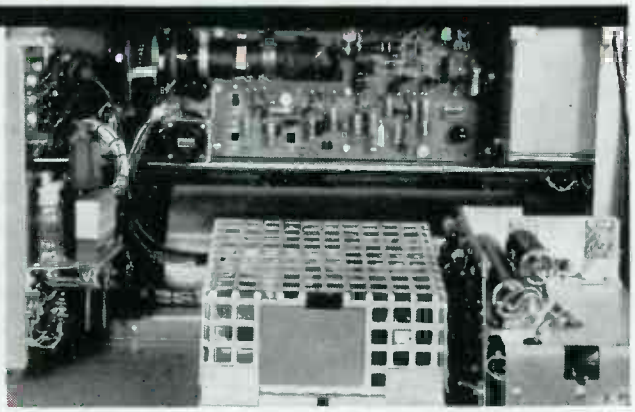
FOR MORE INFORMATION on the new PE-20-A/B Camera Channel, contact your nearest G-E Broadcast Equipment Representative; or write to Section 551-01, General Electric Co., Schenectady, N. Y. In Canada, contact Canadian General Electric Co., Ltd., Broadcast Equipment Sales, 830 Lansdowne Ave., Toronto, Ontario. Elsewhere: International General Electric Co., Inc., 150 East 42nd St., New York 17, N. Y.

Progress Is Our Most Important Product

GENERAL ELECTRIC



COMPACT DESIGN—Right side of camera with swing-out chassis in closed position shows (l to r) built-in switchable voltmeter, vertical sweep chassis with corona regulator and built-in I.O. Guard.



ACCESSIBILITY—Swing-out chassis, shown in open position provide maximum accessibility for ease of maintenance. Behind the center chassis is the transistorized viewfinder video circuitry.

AN APPROACH TO CLEANER SOUND— THROUGH THE ELIMINATION OF SIGNAL CONTAMINATION

By G. Jennings III
Chief Engineer
WHYL/WHYL-FM
Carlisle, Pa.

In the past 10 or 15 years there has been a tremendous boom in the building of radio stations. A high percentage of these recent additions to the industry have had to get on the air with a minimum cash layout. In many cases, to reduce the number of building structures required, the studio and transmitter have been combined into one installation. While it was almost always necessary to call in a consulting engineer to handle the adjustment of the radio frequency end of the operations, the station audio gear was installed in many cases by well meaning, but inexperienced, local radio-TV repairmen who were available for slightly less than a full time experienced broadcast engineer.

This brings about some interesting problems: The station owners have spent a large sum of cash to insure that their signal is capable of penetrating every nook and cranny in the area; and then are confounded when that signal *does* penetrate their audio gear which is located in the center of their blanket area! To add further to the complexity of the problems, perhaps an FM facility is added. They might have installed two remote broadcast pickup two-way rigs, and also monitor the local police and fire control frequencies. The end result is that the spectrum in the immediate area of the station is jammed to the hilt with many harmonics from all these transmitters, and receiver local oscillators. In addition, the advent of extensive fluorescent lighting, the use of mercury vapor rectifiers, and various switching circuits all add their share of clicks, buzzes, squawks and rattles to the already high interference level in the locality. When we add to this various blower motors, heater motors, and other electrically operated gear; and combine all these with their associated interferences, we are pretty well saturated. Now, imagine what happens when all these signals are intermixed and intermodulated in the various non-linear detectors, and remote metering diode circuits that are so common today.

Unfortunately, there is, to date, no simple method of correcting all these difficulties. They *can be* corrected, but it is a long arduous task, which requires minute attention to detail. The answers lie, not so much in bypassing every impedance, but rather in developing a long term plan, philosophy—if you prefer—of attack.

Exploring the Problems

There comes a time in the life of every station when an accounting must be taken. It may be when the equipment no longer passes proof of performance. It may be when a new station moves into the area, sounding like a "million bucks." It may be when the FM beer jingles get into the AM morning devotional program as background music. It may even be when an inspector arrives on the scene . . . !

Basically the problem reduces to one thing—energy is getting into a circuit where it isn't wanted. Call it crosstalk, RF interference, hash, or anything, it is still signal contamination. Since all problems must be attacked from one angle or another let's look into this problem from the signal contamination point of view.

The technical end of a broadcast plant is a custom-made installation. The interconnections are peculiar to the station. The purpose of all this interconnecting wiring is threefold. The first and obvious purpose is to pass electrical energy from one point to another. The second, and often overlooked, purpose is to prevent that signal from escaping from the path provided. The third, and just as frequently overlooked, is to prevent energy from outside the path getting in and contaminating the energy within. If a wiring system can accomplish these three requirements, our problems quickly reduce to pickup within the separate chassis.

There are three general methods used to provide this energy isolation: *Grounding; Shielding;* and *Filtration.* Since both shielding and filtration depend on grounding for their effectiveness, it might be wise

to explore the subject of grounding first.

Grounding: A ground is a curiously elusive thing. What constitutes a ground for 60-cycle power line frequencies may be poor in the upper audio range. A good ground at broadcast band frequencies might be worse than none at all for the FM bands. The whole problem of grounding comes about due to three characteristics of conductors: Inductance, Resistance, and Capacitance. Consider Figure 1.

It looks like a diagram of the distributed characteristics of a transmission line. At just *what* frequency is the rack grounded? Who knows? This depends on the length of the ground wire, and the size of the conductor. Most engineers swear by some volume, or other, on studio wiring. In the first place, there are too few of them on the market, and far too few have been written recently.

Looking through a book a short time back the author came across the famous line that has set the pattern for many a station across the country. ". . . and the console should be grounded to the nearest cold water pipe with a piece of number 12 wire." Let's face it. This number 12 wire served yeoman duty when the transmitter was out on the south edge of town, and the station operated "with studios and offices in the heart of downtown somewhere or other." The only interference they had to contend with then was a neon sign on the front of the store across the street. Try an RF bridge on a 20-foot piece of number 12 wire sometime. Trying to use this wire as an audio ground in the blanket area of an AM transmitter (not to mention FM) is like grounding the console through an RF choke. What good are all the shields and filters in the catalogue if they all return to a point that is floating about 25 volts RF above ground?

What makes a good ground? For one thing, there never is a perfect ground. This is purely a figment of someone's imagination, and refers to an arbitrary reference voltage assumed to be that of the earth. We must settle for second best in this department, and even this is none too good. The best ground one is likely to find is the radial system at the tower(s) base. The shield of the coax is *not* sufficient to connect this back to the transmitter! ! !

It is far from sufficient to ground the console and mike preamps. The only ways known to get rid of inductive reactance are (1) Tune it out—but this is effective at only one frequency; (2) parallel conductors to the point where the reactance is small enough to be useable. Perhaps the best answer to date is the old standby that consultants have been using for years for grounding antenna tuners and tower RF gear—COPPER STRAP! ! ! The wider the better! Four inches should be the absolute minimum for runs longer than 20 feet or so, and the wider the better. Having come up with the best connection to the earth that is readily available, we must now connect the various items of equipment to it by the shortest possible routes. We start at the tower and work back toward the microphones. It would be better if we could do it the other way, but the ground is out at the tower base. Check it off as you go — some may already have been completed. The consultant just might have been in on the installation from the beginning.

(1) The first step is to acquire a good supply of copper strap, four or six inches wide, a propane or butane torch, a good supply of silver solder, and a batch of cadmium plated nuts and bolts with heavy cadmium plated flat and lock washers. You may also require a supply of copper screen mesh, an electric drill with a couple of rotary files, and a roll or two of the heavy braided cable used for automobile battery ground cables.

(2) The manufacturers of antenna tuning boxes usually provide either a copper strap on which are mounted the components, or a highly conductive surface area on which the ground connections are intended to go. If it hasn't been done, bolt a short length of copper strap from the junction of the radial or ground screen system to the tuner box. Silver solder both ends. Ensure that any grounds from the isolation lighting coils are well grounded, too — with more strap. Look around the area. The rule is: if it isn't specifically supposed to be insulated—*ground it! ! !* Since most antenna tuners are low pass or harmonic rejection, filters, you have helped them do their job by providing a short non-reactive ground return path.

(3) A length of copper strap should next be run from the same radial or ground screen junction back to the transmitter building by the shortest possible path; it should be bolted, and silver soldered at all junctions, and buried a foot or so under ground all the way back. We now have a reasonably good ground appearing at the transmitter site.

(4) This copper strap is grounded to the transmitter. This is done by running the strap up into the transmitter proper — right up into the final amplifier tuning compartment. As in the tuner, the manufacturer will have provided either a copper strap or a specially conductive panel. The copper strap is bolted, and silvered soldered to this point. The strap should be formed up the side of the transmitter wall, and bolted fast at several points along the way to reduce the contact resistance. If the transmitter consists of more than one rack, or panel, each section should be firmly grounded to its neighbor. This is mostly a design problem, but specific situations may require additional steps. In any event, keeping the panel bolts tight and all

(Continued on page 24)

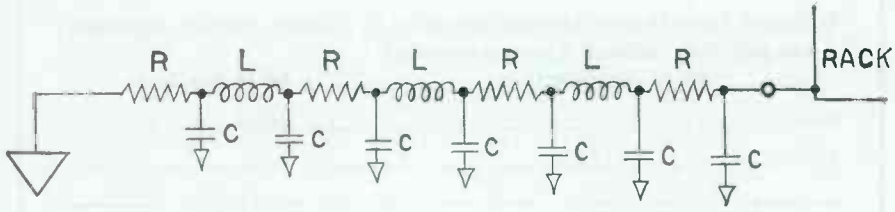


Fig. 1—A line with appreciable impedance will look like this.

TV Tape Fundamentals

(Continued from page 10)

If a head is off quadrature by just 30 sec of arc, then: 30 × 0.00322 = 0.0966 μs or close to 0.1 μs.

If a recording is made with +30 sec of quadrature error and played back on a different head with —30 sec error, the accumulated error is 60 sec (1 minute) which equals approximately 0.2 μs error in quadrature. This is a quite noticeable displacement of a complete band of lines. In practice, this error must be held under approximately plus or minus 0.02 μs to be invisible on vertical picture lines.

The Mechanics of Head Quadrature (Fig. 15)

(A) Head No. 2 lags the correct position by xx degrees.

(B) Assuming playback of a tape which was recorded with correct quadrature, the band of lines from head 2 is displaced to the right, since this head enters the recorded information late in time.

Now assume that a recording is made with the error of (A), and is played back on a correct quadrature head. Head 2 is now advanced in time relative to the recorded information. This deletes a portion of the duplicated overlap interval (Fig. 8) and starts the lines of head 2 slightly early, displacing the band of lines to the left.

The "reading" of quadrature error is complicated by certain misleading factors such as possible overmodulation, overcompensation of high frequency response, gap tilt, and monitor "horizontal flywheel," discussed in the Maintenance Section of this notebook. A continual check against quadrature "standards" is the obligation of all concerned with the use of video tape if true interchangeability and interspliceability is to be achieved.

(C) Shows appearance of vertical lines on a video monitor when quadrature error exists.

Note: Automatic means have recently been developed to remove time error distortions. (See L. W. Weiland, "Time Base Compensation in Wideband Magnetic Recording," Nov. 1961 B/E.)

at Standard Electronics

ONLY THE BEST is good enough!

Take the Amperex 5924A for example. For the past eleven years, we at Standard Electronics have used these tubes in all of our TV and FM transmitters and amplifiers.
We like them.

Over the years, they have proven themselves to be an excellent performer — a fit companion to the built-in quality of our product — and one we are proud to associate with.

Every component in our broadcast equipment is either manufactured by us, under the most exacting quality-control conditions possible, or supplied by reputable, nationally known American manufacturers — a double assurance that Standard Electronics equipment will meet your highest expectations of performance.

NEW NEW NEW NEW 20 KW FM **Transmitter Type 2012.** Here is a sparkling example of beautifully engineered equipment — equipment that provides the kind of signal your hyper-sensitive FM listener wants to hear! Now — with the advent of Stereo FM, signal quality has become even more important — more critical. Stereo receiver sales are setting unprecedented records — the listeners are eager to tune in the station that provides the clearest, most pleasurable signal.

QUALITY YOU CAN SEE — AND TOUCH — made obvious by superior components skillfully integrated with unsurpassed design and construction — yours to have **only** with Standard Electronics FM and TV transmitters and amplifiers.

standard electronics

PRODUCT LINE BY REEVES INSTRUMENT CORP.
*SUBSIDIARY/*DYNAMICS CORPORATION OF AMERICA
FARMINGDALE, NEW JERSEY

AN AUTOMATIC TAPE CUER

Automation removes tedious cueing!

By Frank Smith and Gary Wittie
Staff Engineers
KMID-TV, Midland, Texas

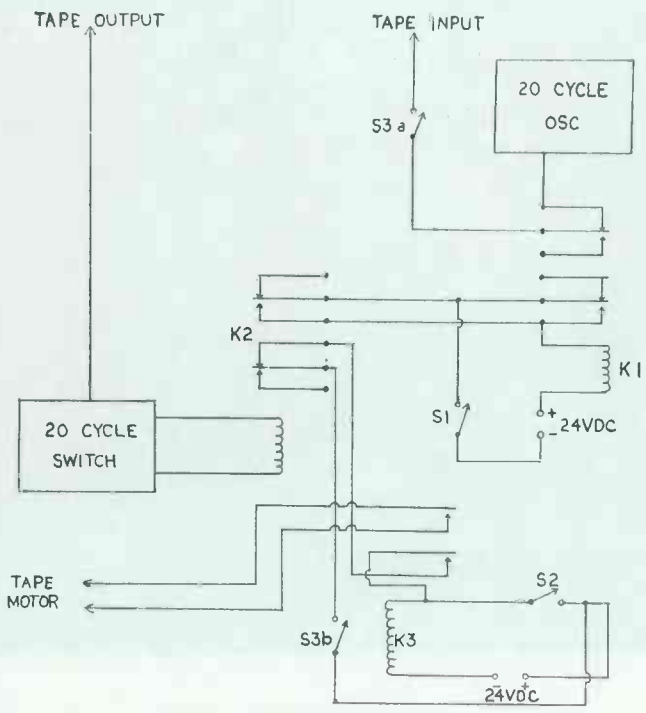


Fig. 1—Relay wiring.

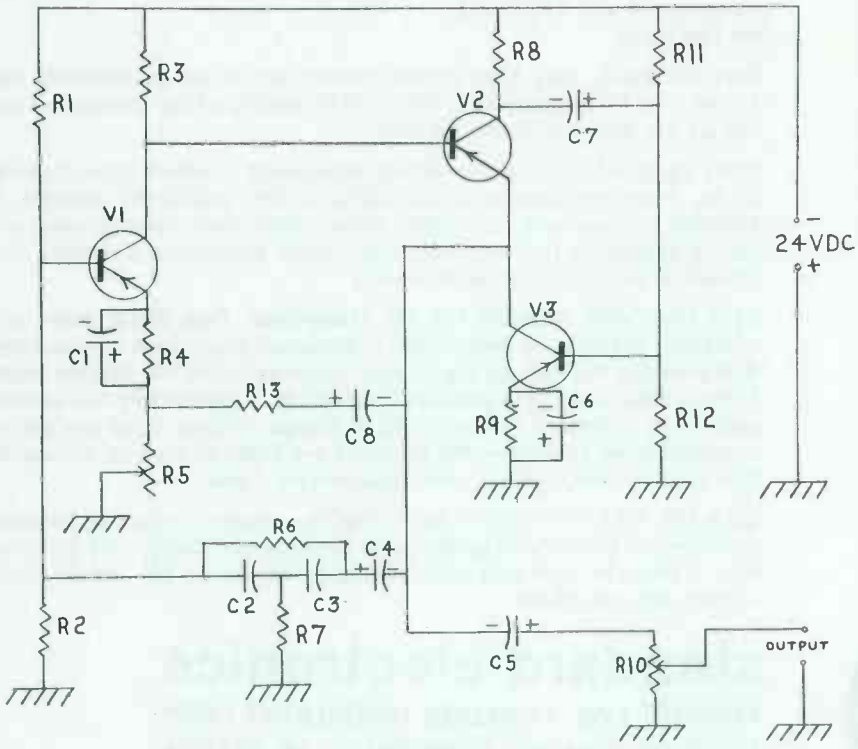


Fig. 2—20 cycle oscillator using three transistors.

HERE, at Channel 2, the audio for the day run is recorded on tape the night before it is to be used. All AB spots or promos are recorded in sequence and the day engineer then cues the tape machine as it is needed. However, cuing the tape machine all day while doing net cutouts is very tedious and quite subject to human error.

We solved this problem with an automatic tape cuer using a subaudible cuing tone. It is inexpensive, easy to build and once adjusted and installed, can be forgotten. It will work, however, only with machines that have separate record and playback amplifiers.

No originality is claimed for the oscillator (Figure 2) which was taken from the *Handbook of Industrial Electronic Control Circuits*. The 20-cycle switch is simply a diode rectifier and dc amplifier with a sensitive relay in the collector circuit. The filter utilizes a variable inductor so that it may be tuned to the oscillator for best results. Circuit details are shown in Figure 3.

S1, the announce booth tape start switch (Figure 1), is one section of a double pole single throw telephone type switch. The other section is connected in parallel with the contacts on K3 which start the tape machine. S2 is a spare set of contacts on the console tape key. S3, a double pole single throw toggle, is an "auto-manual" switch which completely removes the cuer from the circuit when in the "manual" position.

The record sequence is as follows: the announcer closes S1 and the tape machine starts. The 20

cycles from the oscillator is applied to the record amplifier, passes through the record and playback heads to the playback amplifier, then to the 20-cycle switch, where the contacts on the plate circuit relay are used to close K2. When K2 closes it applies power to, and latches K1. This removes the 20 cycles from the tape which in turn releases K2. This will apply exactly the right amount of cue tone to the tape. The announcer is now ready to record. In actual practice, this sequence takes only about ½ second so the announcer should begin to read almost immediately upon closing the switch if a tight cue is desired. The announcer must repeat the above sequence, *i.e.*, open and then close S1, before every break. He should wait four or five seconds after finishing the spot before stopping the machine.

Playback and automatic cue are obtained by closing S2. This applies power to, and latches, K3, which starts the tape machine. After the spot is finished, S2 is opened. This will not stop the tape machine, but prevents any unwanted audio or tape noise from reaching the air. Having S2 closed during the spot also prevents high amplitude voice peaks (which occasionally get through the filter) from stopping the machine. When the previously recorded cue tone reaches the playback head, K2 closes momentarily, this opens K3 and stops the machine. The tape is now cued for the next spot.

The cue tone was fed into the record amplifier "behind" the gain control, and was taken from the playback amplifier "in front of" the gain control. This assures a constant amplitude of the cue tone when the record or playback levels are varied. The tone was fed into the recorder at a level of plus 2 DB. This will probably vary from machine to machine and experimentation will give best results. The station's 24-volt supply can be used, or, if desired, a small supply can be built on the chassis with the oscillator and switch.

PARTS LIST

20 Cycle Oscillator:

C1—500uf, 25V
C2— 2uf, 50V
C3— 2uf, 50V
C4— 25uf, 50V
C5— 25uf, 50V
C6—500uf, 25V
C7—100uf, 50V
C8—100uf, 50V

All Resistors ½w

R1—330K
R2— 47K
R3— 10K
R4— 4.7K
R5—500 ohms
R6— 10K
R7— 1.8K
R8—330 ohms
R9— 1K
R10— 50K
R11—220K
R12—100K
R13—270 ohms
V1, V2, V3—2N104

20 Cycle Switch:

C1— 4uf, 50V
C2— 2uf, 50V
C3— 10uf, 50V
C4— 10uf, 50V
C5— 20uf, 50V
R1—100 ohms ½w
R2— 2K
R3— 1.5meg, ½w
R4— 10K, ½w
R5—470 ohms
CR1—1N34
K1—ADVANCE SV1C20, OOOD
L1—UTC VIC—18

Miscellaneous:

S1, S2, S3, see text
K1, K2, K3, DPDT (Guardian Series 200 or equivalent)

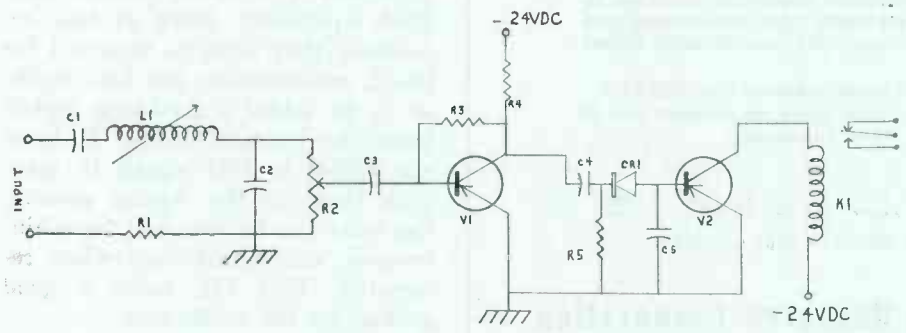


Fig. 3—Transistorized 20 cps switch.

Cleaner Sound

(Continued from page 19)

mechanical devices bolted solidly will help.

The transmitter and main RF path are now reasonably well grounded. At this point, the transmitter may not load up like it used to. *Fine!* This means some reactance in the ground path has been eliminated.

(5) If an FM transmitter is at the same location, the same techniques are used to ground the frame of this transmitter, as well as any other transmitting equipment in the area—26 Mc, 153 mc gear, etc. Again, the rule: If it isn't specifically supposed to be insulated — *ground it! ! ! !*

(6) Almost every station will have at least one equipment rack. This too must be firmly grounded. A good method here is to run a strip of copper strap about 2 inches wide up each rack on the inside, and use battery cable to ground each chassis in the rack to the strap. An area about four inches square is scraped free of paint near the bottom of the rack, and another run of 4-inch copper strap is run, (again by the shortest path), to the main station ground coming from the tower.

(7) The next step in the grounding process is grounding the console(s) with (more) copper strapping. While under the console table, run more strapping from the piece grounding the console over to the turntable frames, motors, the turntable preamps, if under there, and any other pieces of gear, such as tape recorders on the console, telephone "beeper" amplifiers, cartridge recorders, and any auxiliary amplifiers in or on the console table. With equipment (such as tape recorders) that must be removed for bench maintenance, the best method is to solder a foot-long pigtail from the recorder frame. If holes are drilled in this pigtail to mate with those in the regular ground, the bolts can be removed for maintenance, and retightened when reinstated. This will make a good ground for the audio gear.

(8) The only other system that should be considered for grounding

is the power line. Most power companies use a distribution system that has at least one wire at ground potential. It is either the middle neutral on a 220-volt system, the low side of a 110-volt system, or the ground leg of a three-phase, four-wire, 230-volt setup. The power company should be consulted for details in this respect. The ground wire on the incoming power line should also be grounded to the station ground with more strap. A word of caution, at this point: Since power lines are subject to lightning surges, considerable care should be taken to insure that the path from the power company gear to the station ground ties is *outside the building* at the point where the copper strap enters the ground. If much of the above ground portion of the ground strap is involved, the common impedance effect will cause flashbacks in the transmitter and outages, not to mention the shock hazard. (Editor's Note: Extreme caution should be used when employing power line grounds).

Summary

So far all major pieces of gear and most of the minor units have been grounded. The biggest single problem in obtaining a good ground system is that the gear is spatially distributed. Any conductor has reactance, and resistance. To make sure that all equipment is as near the same potential as possible for all expected frequencies this resistance and reactance must be reduced to the smallest practical degree. This, then, is the reason for the wide, low reactance copper strap. By burying the strap from the transmitter, there is more contact between the strap and earth. The silver solder is needed because of a characteristic of conductors. It is very difficult to get two pieces of metal into close contact. There are always small imperfections on which the two pieces of metal will bear, and form high spots. By silver soldering, we fill in the low areas, and insure a highly intimate contact. By reducing the contact and conductor resistance, and reactance, we obtain as good a ground system as the state of the art allows. In the next article, we discuss one of the two remaining methods of attack: Shielding.

FCC NOTES

1961 AND THE FCC

Year-end Statement by Newton N. Minow, Chairman, Federal Communications Commission

At the end of 1961, there were some 65 different kinds of radio services operating more than 2.7 million transmitters in the United States. There were so many developments that space permits noting only some major highlights.

SPACE COMMUNICATION

In March of 1961, the Commission instituted an inquiry into a potential system of communication via space satellites. Thereafter, it called upon U. S. international communication common carriers to speed plans for a possible joint venture, but reserved decision on whether other companies should participate in the U. S. portion of such a venture. It proposed a plan for international frequency allocations to space communication, and granted experimental authorizations to several applicants, with a view to stimulating development of U. S. space communication technology.

The carriers' proposed joint venture, submitted in an Ad Hoc Committee report, was under Commission study at the year's end.

NATIONAL DEFENSE

Besides administering the CONELRAD system to alert and control all radio operation in time of war, the FCC has established FM defense networks, and both systems additionally serve the public by warning of weather and other emergency conditions. The FCC is also concerned with the establishment and maintenance of standby and backup wire and radio circuits which would insure continuity of communication in event of an enemy attack. In these matters the Commission cooperates with military and civil defense authorities and is assisted by its own regional, state and local industry advisory committees.

BROADCASTING

As in 1960, the Commission was active in the field of broadcast programming. It proposed extensive revisions *in the nature* of the programming information which it requires applicants for broadcasting licenses to submit. After full hearing, it denied a permit for an FM station to an applicant who had no knowledge of, and had made no effort to ascertain, the programming needs of his community. And it put all broadcasting licensees on notice that they are expected substantially to carry out the program proposals on the basis of which their licenses are granted, or present adequate justification for departure from those proposals.

A total of 20 short-term licenses was issued in 1961 where the Commission was unable to find that the past operation of the station merited a full three-year license. Additionally, an Examiner's Initial Decision recommending that a radio station license not be renewed on the ground that the licensee was "woefully inadequate" in discharging his broadcast responsibilities regarding "indecent and obscene" programming, abuses with respect to the total amount of time devoted to advertising continuity as well as the frequency of regular program interruptions for advertising messages, was pending review by the full Commission at the end of the year.

Under recent Congressional authority, the Commission now requires applicants for new stations, renewals, sale and major changes (also when set for hearing) to advertise that fact locally. Congress also enabled the Commission to fine stations for violations not warranting revocation proceedings.

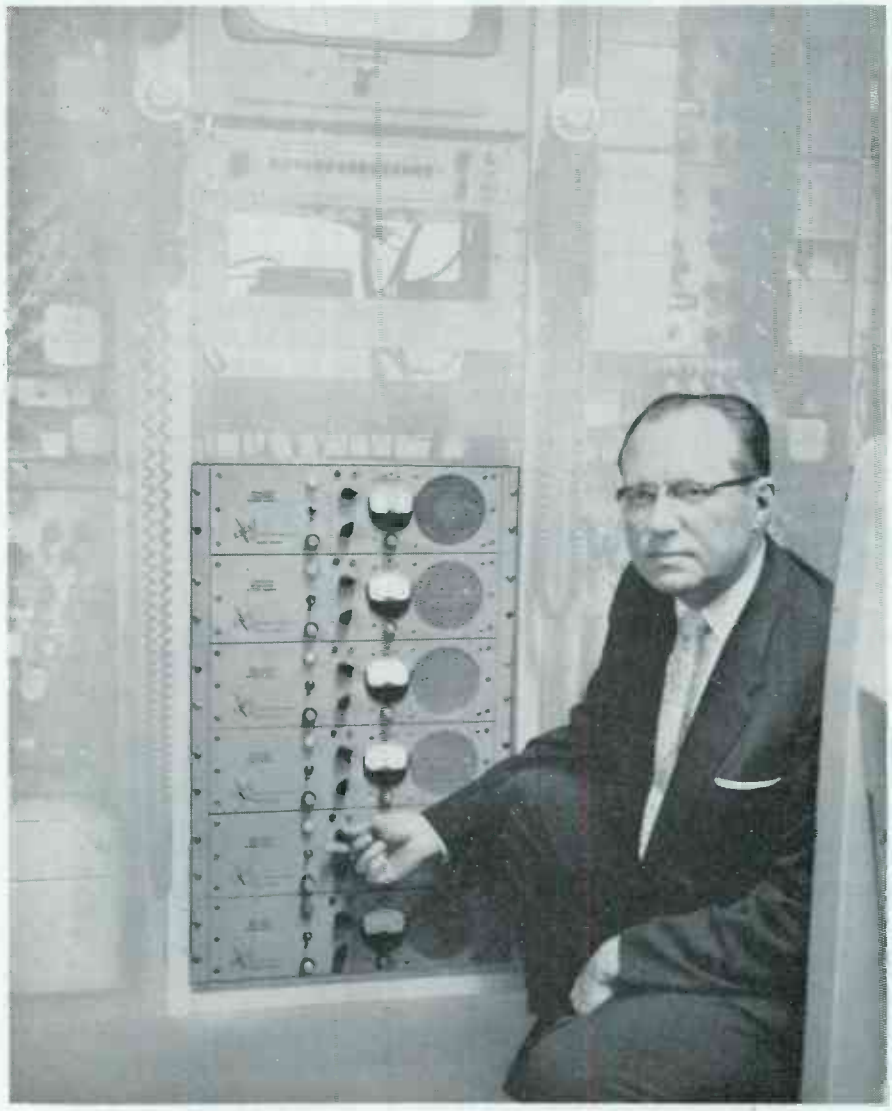
TV Operation—The Commission has taken actions to promote the use of UHF to extend and augment competitive TV service not possible with the limited number of VHF channels. These include proposals to relax certain UHF technical requirements, make certain areas either UHF or VHF, test UHF for large metropolitan area coverage, and has recommended legislation to require TV sets also to receive UHF broadcast. Meanwhile, added TV translator and repeater stations are bringing outside programs to small, remote communities unable to support regular TV stations.

The first (and only) subscription TV grantee (experimental, in Hartford) plans to start operation in 1962.

Educational TV is advancing at an accelerated pace. Several states have or propose ETV networks, the capital city's first video educational outlet is in operation, and the Commission has increased the channels reserved for education to more than 270. Tests of airborne transmission by Purdue University indicate the feasibility of giving wide-area school coverage by this means.

FM Operation—Mounting interest in

the ultimate *in* reliability



Frank Marx, Vice President, ABC-TV Network, is shown with the six Power Sources transistorized power supplies used to power two video tape recorders.

- **SELF VENTILATED**
- **INCREASED STABILITY**
- **LOWER COST**
- **LESS SPACE REQUIRED**

Each unit is self-ventilated, placing a lighter load on existing air conditioning systems. Advanced transistorized circuitry provides increased stability compared to previous tube supplies. Six supplies replace thirteen at a savings in cost.

In pointing out his new units, Mr. Marx noted "We at ABC-TV are primarily interested in reliability, stability of performance, space, and work load on our air conditioning. Power Sources units have exceeded our requirements in all respects."

For complete information on how Power Sources can save you space and investment without sacrificing reliability, call or write

POWER SOURCES INC.

Northwest Industrial Park
Burlington, Massachusetts

A Subsidiary of Technical Operations, Incorporated

and competition for FM broadcast facilities made it necessary for the Commission to revamp the rules for that service and, meanwhile, adopt an interim procedure for processing FM applications. Over 300 commercial FM stations obtain additional revenue by furnishing background music and other subsidiary services. All FM stations have the green light to engage in stereophonic broadcasting if they so desire. Only three states have no FM stations as yet.

Low power and other economies of educational FM operation are attracting additional stations in that category.

AM Operation—The continued squeezing in of new AM facilities is accompanied by mounting competition and added interference which demonstrate the acute congestion in that band.

The long-pending clear channel proceeding was concluded when the Commission opened the way for assigning one additional secondary station on each of 13 of the 25 clear channels to benefit certain unserved or underserved areas.

Entry into force of the North American Regional Broadcasting Agreement and a separate pact with Mexico will further the coordinated use of FM frequencies by the member countries.

SAFETY AND SPECIAL

About 140,000 additional stations in the safety and special services, representing the use of many times that number of transmitters, is further evidence of the value of radio for a myriad of uses by air, water and ground transportation; police and fire protection; and as an aid to industry, business and individuals.

The fastest growing and now largest service in this group benefits private citizens and "wee" enterprises by providing short-range radio to meet their particular conveniences.

Safety and special radio usage now actually extends "from the cradle to the grave" since it is employed to speed expectant mothers to hospitals and for expediting various services for infants and, ultimately, for directing funeral processions at large cemeteries.

COMMON CARRIERS

Telephone—Because calls on 75 million telephones are approaching 300 million daily, the Commission is currently concerned with interstate rates in view of the Bell System's earnings, also with domestic telephone service in general.

Meanwhile, the telephone system continues to expand, with work progressing on a new coast-to-coast relay system and new ocean telephone cables projected or under construction to connect the United States with England, Japan and Bermuda. The Commission has asked AT&T for a cost study of the level of earnings of its mounting overseas communication services.

FIELD ENGINEERING AND MONITORING

The Commission's engineering field force inspects, observes, enforces and advises licensees and others in the technical aspects of radio operation. In addition, field engineers give radio operator examinations, resolve major interference cases, and process antenna proposals in the interest of air safety. (Among the more than 100 TV towers over a thousand feet high now authorized, one at Columbus, Ga., will be the world's tallest man-made structure—1,749 feet.) This field staff is located at 18 monitoring stations, 24 district offices and 7 suboffices. The monitoring network is also invaluable for obtaining bearings on ships and planes in distress.

The field staff is kept so busy with interference complaints that it must curtail some of its periodic inspection of stations. Causes of disruption to radio communication range from illegal operation (often by juveniles) to technical violations by authorized stations, some in foreign countries. The interference

The only electronics home study program that guarantees*...

A Commercial FCC License ...Or Your Money Back!

No other electronics home study program can equal that offered by Cleveland Institute. And that's why we make this exclusive guarantee:

***Completion of our Master Course prepares you for a First-Class Commercial Radio Telephone License with a Radar Endorsement. If you fail the FCC examination for this license after successfully completing the Master Course, you will receive a full refund of all tuition payments. This guarantee is valid for the entire duration of your enrollment period.**

This Course Is Designed Specifically For Men With Previous Electronics Training or Experience and Provides...

- Advanced electronic theory and math. (You will receive a special 10" Electronic Slide Rule and complete instructions).
- Special training in the practical application of electronics skill in such advanced fields as Computers . . . Servo-Mechanisms . . . Magnetic Amplifiers . . . AC Circuit Analysis . . . Pulse Circuitry . . . Color TV . . . Radar . . . Advanced Measuring Techniques . . . Industrial Electronics . . . Instrumentation . . . Automation . . . Radio Telemetry . . . Semiconductors.

Get This Handy Pocket Electronics Data Guide Free...

Conversion factors, formulas, tables and color codes at your fingertips. Yours without obligation, simply for responding NOW to this opportunity to improve your future.

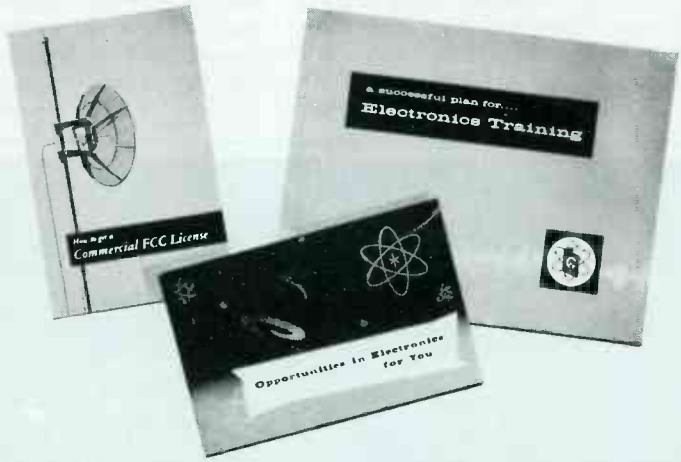
Send This Coupon Today →

Cleveland Institute of Electronics

1776 E. 17 St., Desk BE-3, Cleveland 14, O.

Accredited by the Accrediting Commission of the National Home Study Council
(An Accrediting Commission Approved by the U. S. Office of Education).

Three Free Booklets Tell How CIE Training Opens The Door To Unlimited Opportunities



More Reasons How CIE Will Help You Get Ahead in Electronics

Job Service . . . every month, for three years, CIE will supply you with a listing of hundreds of job opportunities. High paying, interesting jobs . . . with top companies throughout the world. See how CIE training opens a whole new world in electronics opportunity.

Electron Bulletin . . . every month, every student receives a free copy of this informative bulletin. Keeps you up to date on what's going on in electronics.

I want to know more about your electronics home study training program. Please send me your free booklets described above plus your handy pocket Electronics Data Guide. I understand there is no obligation. I have had training or experience in electronics as indicated.

Mail Coupon To

Cleveland Institute of Electronics
1776 E. 17th St., Desk BE-3, Cleveland 14, Ohio

- ☐ Military
- ☐ Radio-TV Servicing
- ☐ Manufacturing
- ☐ Communications
- ☐ Amateur Radio
- ☐ Broadcasting
- ☐ Home Experimenting
- ☐ Other

I'm now working in _____

I want to know about the following area of electronics _____

(please print)

Name _____ Age _____

Address _____

City _____ Zone _____ State _____

BE-3

problem is intensified by the increasing number of electronic devices used for noncommunication purposes. The Commission is assisted by nearly 700 cooperating interference committees which handle routine interference cases at the local level.

RESEARCH AND LABORATORY

In its efforts to aid UHF TV operation, the Commission is studying UHF and VHF propagation and TV channel allocations in the light of technical developments. A particular project involves transmissions over Channel 31 from its own temporary antenna atop the Empire State Building, New York City, to test metropolitan area UHF coverage and reception in comparison with VHF service. Programs are being sent over an experimental station operated for the FCC by the City of New York, which had its formal opening in November.

To prevent interference before it starts, certain equipment is approved by the Commission prior to its manufacture. Some of these items are tested at the FCC laboratory at Laurel, Md.

FREQUENCY ALLOCATION

In September the Senate ratified the 1959 Geneva radio regulations. This is the first revision of the global agreement on radio usage since 1947 and reflects important intervening developments. The Commission instituted rule changes to conform domestic operation with the updated pact.

Other U. S. frequency allocation changes were made to accommodate, insofar as possible, the unceasing demand for radio space. Chiefly affected was microwave, which has become the workhorse of many services.

LEGISLATION

The most important legislation affecting Commission organization and practice since 1952 became law in August. Sponsored by the FCC, it is designed to expedite and improve Commission functioning. It does so by delegating more authority to the Commissioners as panels and individuals, also to the staff, and removes certain procedural restrictions. This will give the Commissioners more time to consider policy and other major matters.

Other legislation sought by the Commission would give it authority to exercise a certain degree of regulation over broadcast networks, also CATV systems; to prescribe minimum performance capabilities for TV receivers, and require that they be equipped to receive UHF as well as VHF stations; to permit fines for violators in the nonbroadcast services; to invoke summary judgment procedure in appropriate cases; to repeal the present prohibition on considering public interest in acting on broadcast station sales; to require the marking of abandoned radio towers for air safety; and to remove the present ban on the Commission from reopening the record to hear new evidence or consider new parties, once a case has been reversed and remanded on appeal.

STATISTICS

More than 3.3 million radio authorizations of all kinds were on the Commission's active records at the year end, or nearly 400,000 more than a year ago. This total included over 865,000 radio station authorizations, an increase of 142,000; 2.3 million commercial radio operator permits, a gain of nearly 235,000; and over 225,000 amateur operator permits, or an additional 12,500.

Following is a comparison (mostly in round figures) of radio station authorizations at the close of calendar years 1960 and 1961:

Stations	1960	1961
Broadcast:		
AM	3,700	3,800
FM commercial	1,000	1,100
FM educational	191	200
TV commercial	634	655
TV educational	66	70
TV translators	335	1,200
TV repeaters	908	1,100
TV boosters	1	1
International	4	4
Auxiliary, etc.	6,000	6,600
Total broadcast	12,839	14,800 (approx.)
Safety and Special:		
Marine	103,400	117,000
Aviation	86,800	99,300
Industry-business	71,000	84,400
Public safety	35,000	36,400

Land transportation	11,800	12,500
Citizens	167,000	250,000
Amateur	217,700	231,100
Miscellaneous	11,800	13,500
Total safety & special	704,500	844,200
Common Carrier	4,600	5,300
Experimental	695	800
Total stations	722,634	865,100

These stations collectively now use well over 2.7 million fixed, mobile and portable transmitters, which is 200,000 more than the 1960 figure.

DENIES PETITION FOR AM SINGLE SIDEBAND USE

By Memorandum Opinion and Order, the Commission has denied a Dec. 31, 1959, petition by Kahn Research Laboratories, Inc., to permit AM stations to operate with a "compatible single sideband system of modulation," and terminated its inquiry as to whether rulemaking would be warranted by the Kahn proposal (Docket 13596, RM-156).

The Commission concluded that the proponents have not made a sufficient showing, it does not appear that there is a sufficient interest on the part of the broadcasters or the public, and the Commission's greatest concern with the proposed system is the possibility of its causing interference to other stations and, further, such modulation does not conform to the North American Regional Broadcasting Agreement definition of that term.

Commissioner Cross dissented.

TECHNICAL FM AND TV RULE CHANGES

By Report and Order, the Commission finalized, with modifications, rulemaking in Docket 13766 and amended the FM and TV standards in Part 3 of the rules in keeping with acceptable engineering practice and procedures. The amendments (1) clarify the specifications for frequency response in vicinity of the color pass band; (2) permit FM and TV stations to determine operating power of aural transmitters by direct measurement or by the presently prescribed indirect method; (3) relax requirements relating to operation with

reduced power to the extent that the Commission need only be notified if the required minimum operating schedule cannot be maintained with authorized power and provided the period of reduced power operation is not over 10 days; and (4) modify wording in Sect. 3.689 (a) (1) by abolishing reference to "standard black television picture" and substituting language specifying form and amplitude of modulating signal when determining operating power of visual transmitter.

A tubeless electron tube (right), for spacecraft and satellites, that operates without the familiar glass envelope of conventional "radio" tubes, has been announced by International Telephone & Telegraph Corp. The tube was developed by the ITT Industrial Laboratories, Fort Wayne, Ind. Conventional electron tubes use envelopes or tubes of glass, metal, ceramic or other materials to keep out air that would interfere with the tube's operation. ITT's tubeless tube is designed for use in outer space where there is no air. Hence there is no need for a glass envelope and its elimination permits a wider range of sensitivity. The ITT tube is known technically as a windowless multiplier phototube. It generates an electrical signal when light shines on it. A conventional multiplier phototube is shown at left.

TELEMET now manufactures Telechrome Video Equipment

THE TELECHROME LINE OF TEST equipment, special effects generators, wave form correctors and other video equipment is now manufactured and serviced only by the Telemet Corporation, a Giannini Scientific Company. An expanded sales organization, new product development program and improved manufacturing facilities have been established to provide the industry with the highest quality Telechrome video equipment. A new trademark now backs up your guarantee that Telechrome equipment offers better performance and the best in design, manufacture, sales and service. Telemet will continue to offer and will expand the Telechrome line of equipment to meet your immediate and future needs.

Dr. Gabriel M. Giannini, president of Giannini Scientific Corporation is a pioneer in the field of communication and the holder of more than 30 patents. He is the founder of a number of nationally recognized technical companies and has personally taken over the management of Telemet Corporation and the supervision of its Telechrome product line and sales policies to serve the television broadcast industry.

In addition to the Telemet Corporation, the Giannini Scientific Corporation owns other individually managed subsidiaries including: Flight Research Inc., Hammarlund Manufacturing Co., Micro Balancing Inc., Plasmadyne Corporation, Wiley Electronics and Giannini Research Laboratory. The technical talents of these combined companies are available to help make Telemet products the finest available in the broadcast industry.

TELEMET
CORPORATION

Eastern Sales: 185 Dixon Ave., Amityville, N.Y.
Western Sales: 38-41 S. Main St., Santa Ana, Cal.

Industry News

Audio Devices Enlarges Manufacturing Facilities

Audio Devices, Inc., New York, has enlarged its manufacturing facilities in Stamford, Conn., with the addition of a new research and engineering building and pilot plant. Part of an overall expansion plan, the new 20,000 sq. ft. building is being used for the development and pilot production of higher density, long-wearing tapes for computers still in the design stage, and other new magnetic tape products.

On a site adjacent to the new engineering building, the company is constructing an additional manufacturing plant to meet the increased demands for computer and other specialized magnetic tapes.

Three Stations Install 5 KW FM Transmitters

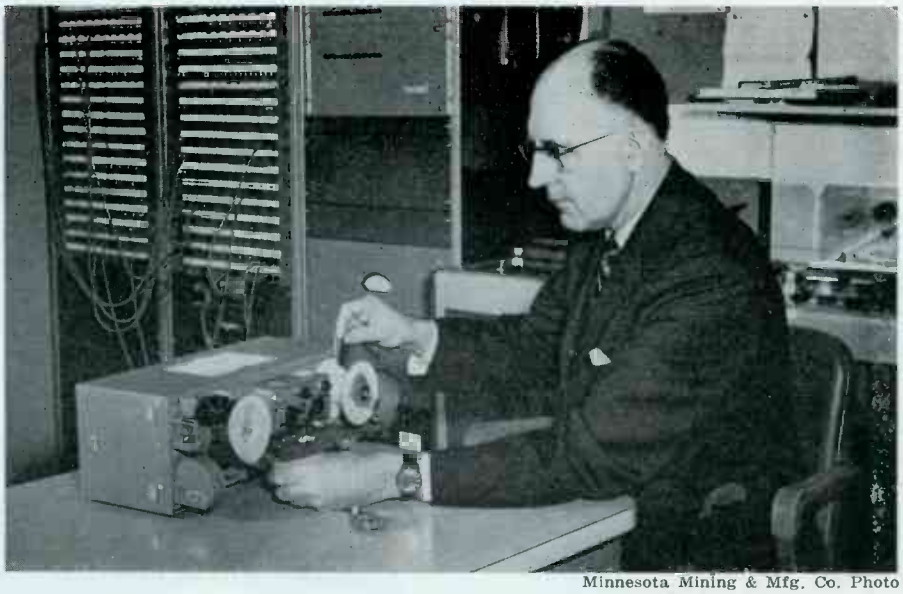
Standard Electronics, Div. Reeves Instrument Corp., Farmingdale, N. J., has announced the sale and installation of three 5 KW FM transmitters to stations WGPR, Detroit, Mich.; KUDE, Ocean Side, Calif.; and KORK, Las Vegas, Nev.

Heeding the listener demands for stereo FM reception, stations WGPR and KUDE also had the model 935 standard electronics stereo generator installed.

Leroy Kilpatrick to Represent Visual

The appointment of Leroy E. Kilpatrick to the technical sales staff of Visual Electronics Corp., New York, N. Y., has been announced by James Tharpe, president of the firm. Kilpatrick will supervise Visual's broadcast account-servicing in the states of Arkansas, Kentucky, Missouri (excepting St. Louis) and Tennessee.

Long an executive in the broadcast field, Kilpatrick joins Visual with a sound management and engineering background, Tharpe pointed out. As vice-president and operations manager for WSAZ, Inc., Kilpatrick designed and supervised construction of their television outlet—WSAZ-TV; their new radio studios; and planned and built one of the first and longest privately owned microwave relay systems in the country.



Minnesota Mining & Mfg. Co. Photo

CBS records all radio shows and the audible portions of telecasts on a compact recorder-reproducer to provide greater control over programming. Davidson M. Vorhes, vice-president of operations for CBS radio, is shown above placing tape on a monitor.

Year's Programs Recorded by CBS Radio and TV Stations

IMPROVED control over Columbia Broadcasting System radio and television programming has been achieved by a magnetic tape monitor, according to Davidson M. Vorhes, New York City, vice-president of operations for CBS radio.

The programs of CBS-owned radio and TV stations have been recorded for a year by compact recorders-reproducers which can record continuously for 24 hours without a tape change. Monitors are used for recording both radio broadcasts and the audio portions of telecasts.

Vorhes foresees that the monitor will become a standard piece of equipment in all stations should the Federal Communications Commission adopt proposals that it accept tapes as an official record of broadcast operations.

Substitution of a taped record for the detailed written log would provide not only an accurate account of a station's operation, Vorhes says, but would reduce logging costs to a minimum. Naturally, written records would be required; but they could be simplified if a tape record could supplement the information on the log. The reduction of network programming and the increase in extemporaneous speaking on radio stations makes the need for accurate records of the actual programming vital, Vorhes said.

"Since the CBS stations are quality stations, the maintenance of quality also requires very close liaison between the station managements and the New York headquarters, and between the stations themselves. The magnetic tape monitor is the only tool by which programming can be checked frequently," Vorhes said. The recorder also makes it possible to reconstruct technical failures.

Whenever management desires to monitor a program or check out a questionable statement by a speak-

er, it can refer to the tape of the program.

The FCC itself, he said, could use the same system to secure data for inspection of license renewal applications. Detailed logs requested at random at a time of renewal could easily be verified from the tapes the FCC had made in advance.

The recorder-reproducer can be fed either from the broadcast line or from a receiver. A footage counter permits easy location of any portion of the 24-hour-long tape for playback. Two extra recorders are on hand for playback or replacement.

The CBS installations use 300-foot-long, two-inch wide "Scotch" brand magnetic tapes. A 24-hour-long recording can be stored on a 300-foot reel because the recorder has an extremely slow tape speed of only 2½ inches per minute.

Newly Revised American Standard Developed by IRE

Testing of monochrome television receivers for audio-video performance moved another step closer to engineering perfection this fall, thanks to a newly revised American Standard developed by the Institute of Radio Engineers. Approved by the American Standards Assn., "American Standard Methods of Testing Monochrome Television Broadcast Receivers, C16.13-1961" not only incorporates the latest principles of electricity and electronics, but assigns specific channels for testing frequencies in the VHF and UHF bands.

Noting that measurement of performance characteristics is not always executed on all UHF and VHF channels, the standard specifies Channels 4 and 10 as standard test frequencies for VHF, and Channels 18, 48 and 79 for UHF. Replacing a standard approved in 1949, the standard also specifies requirements and characteristics of test apparatus, picture quality, picture sensitivity, picture interference, video electrical fidelity, stability, sensitivity, audio interference and fidelity and radiated and conducted emissions.

The standard was processed by the 17-member C16 sectional committee operating under the procedures of the ASA. Dr. Ernst Weber of the Polytechnic Institute of Brooklyn is committee chairman.

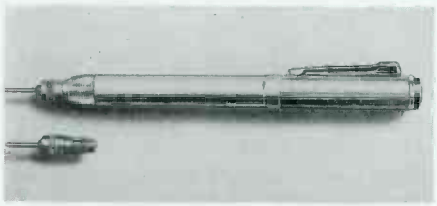
Product News

TRANSISTORIZED POWER CONVERTER

Terado Corp., 1057½ Raymond Ave., St. Paul 8, Minn., has announced the new super-powered transistorized power converter, Continental No. 50-191, designed to change 12-volt battery current to regular 110 volts, 60 cycles, ac.

The unit has a capacity of 275 watts continuous; intermittent, 300 watts. The manufacturer states that the 60-cycle frequency is maintained within one cycle plus or minus, regardless of changing input or load.

The new model is recommended for operation of tape recorders, television sets, sound cameras, amplifiers, etc., and will also operate hand power tools, vacuum cleaners, ac-dc motors, universal type up to ¼-hp. It may be used for mobile truck displays of office equipment, service trucks, etc., and comes complete with remote control cables and battery leads.



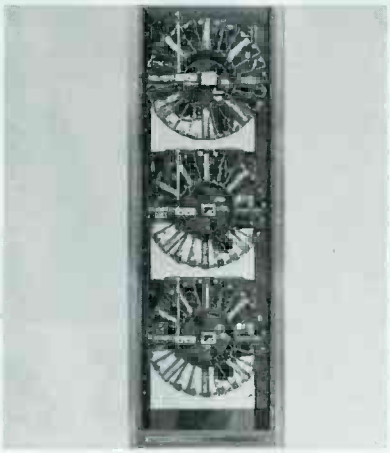
NEW SIGNAL GENERATOR

A pen-size, self-contained signal generator that covers the audio, IF, RF spectrum, has been developed by Don Bosco Electronics, Inc., subsidiary of Howell Electric Motors Co., Inc., Littell Rd., Hanover, N. J. The precision instrument, called the Mosquito, is designed for electronic engineers and technicians concerned with circuit tracing.

The unit is supplied with two interchangeable probes and utilizes a transistor oscillator powered by a single 1.5 volt pen light cell. The manufacturer states that it can be coupled into magnetic pick-ups and circuits without leads, and oscillates at approximately 1,000 cycles per second, with a wave form containing many harmonics. Frequency is 1 KC with harmonics to 30 MC.

The Mosquito contains all solid state components, weighs 1 oz., and measures 5⅝ inches long by ½-inch in diameter. Output voltage is approximately 50 volts peak-to-peak open circuit, with impedance at 10 K megohm capacitive. Input dc is 600 volts maximum from output tip to case ground. The unit uses one 1.5 V conventional battery (Eveready #912 or any A.A.A. size equivalent).

Applications include radio (AF, IF and RF section of vacuum tubes, transistors and auto radios); television (AF, RF section); tape recorders; movie projectors (sound); telephone circuits; etc.



AUTOMATIC PROGRAMMING UNIT

A new concept in automatic programming of radio stations with tape cartridges has been developed by MaCarTa, Inc., 820 Hubbell Bldg., Des Moines 9, Iowa. Called the Carousel, the equipment is designed to allow advanced programming spots, station breaks or musical selections in groups of 24. The standard three-unit rack thus provides 72 separate messages which may be used back-to-back (or triple) practically instantaneously.

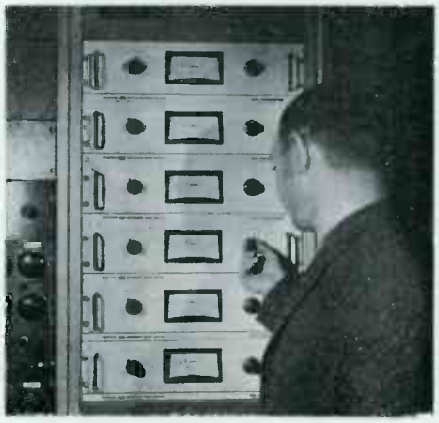
According to the manufacturer, the equipment is compatible with automatic tape cartridge playback equipment now being used having 1,000-cycle cue tone and with double cue machines having a 3,000-cycle trip tone.

TRANSISTORIZED STEREO FM HI-FI TUNER

An ultra-compact stereo FM tuner featuring advanced transistor-nuvistor design for both FM stereo and regular FM broadcast reception is being offered by Allied Radio Corp., 100 N. Western Ave., Chicago 80, Ill.

Intended for addition to existing stereo-hi-fi systems, the Knight KN-250M is not much larger than the average book. Its compact 2⅝ by 9¾ by 8-inch dimensions and light weight are made possible by use of four thimble-size nuvistor tubes, and by eight tiny transistors.

The circuitry design is said to enable more sensitive, stable and heat-free operation with exceptional reception in weak signal areas. Additional features include a quality signal-strength meter to show when stations are tuned on center channel for best broadcast reception, and a special automatic frequency control circuit to prevent drift.



AUTOMATIC LEVEL CONTROL

Audimax, an automatic level control device designed to maximize audio coverage, has been introduced by CBS Laboratories, Div. Columbia Broadcasting System, Inc., High Ridge Road, Stamford, Conn., and is said to incorporate the most recent advances of solid state and computer technology.

The unit is offered in two models. Audimax I employs a new platform concept.

According to the manufacturer, if the range of input levels shifts to a new region, the gain platform is automatically readjusted to a new value providing the maximum desired level. Audimax I is intended especially for broadcasting, recording and background music systems. Audimax II additionally incorporates a gated gain stabilizer which is said to maintain a constant gain that bridges the program lapses when the input level drops below preset values. The model is intended for FM broadcasting, television, motion pictures and public address systems. An Audimax stereophonic adapter is also offered to provide for precise stereophonic coupling of the two units.

Specifications include standard 19-inch rack mounting; input and output impedances for 150 or 600 ohms line operation; frequency response—flat within 1 db from 50 to 15,000 cps; harmonic distortion—below one per cent from 50 cps to 15,000 cps at +21 dbm output; control characteristic ±db of gain control.

NEW MULTIPLEX ADAPTER

A new multiplex adapter, model PX 60, designed to match performance specifications of Bogen and other high fidelity FM tuners and receivers, is being offered by Bogen-Presto Div., Siegler Corp., Paramus, N. J.

According to the manufacturer, the new unit will not draw power from the FM tuner or alter tuner characteristics. It employs four tubes and a germanium diode, forming eight tube functions, and is said to provide full frequency performance even in fringe areas with a plus or minus 3 db deviation from 50 to 15,000 cps.

All necessary filtering is built in to suppress interference from commercial multiplex signals. Distortion is less than one per cent, and hum level is —60 db. Patch cord connections are provided for installation of the adapter without tools or wiring. Front panel controls include an adapter in-out switch for desired switching which may not be incorporated in the tuner, and a stereo separation control to compensate for differences between transmitting stations or reception conditions.

UPCOMING PROFESSIONAL MEETINGS

BROADCAST ENGINEERING will be glad to publish all notices of technical meetings if sent to the editor at least six weeks ahead of time.

March 26-29: Annual National IRE Convention.

April 1-4: National Assn. of Broadcasters National Convention, Chicago.

April 29-May 4: SMPTE Semi-Annual Convention, Los Angeles.

March 20-25: High Fidelity Music Show, Los Angeles, Calif.

April 11-13: Southwestern IRE Conference and Show, SWIRECO, Houston, Texas.

April 23-May 5: 2nd International Television Symposium and Exhibition, Montreux, Switzerland.

May 1-3: Cleveland Electronics Conference, Cleveland, Ohio.

May 21-24: Electronic Parts Distributors Show, Chicago, Ill.

May 24-26: IRE Seventh Region Conference, Seattle, Wash.

Sept. 19-20: Eleventh Annual Industrial Electronics Symposium, Chicago, Ill.

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

Transmission line, styroflex, heliax, rigid with hardware and fittings. New at surplus prices. Write for stock list. Sierra Western Electric Cable Co., 1401 Middle Harbor Road, Oakland 20, California. 6-61 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 A. M. monitor service. Nationwide unsolicited testimonials praise our products and fast service. Eidson Electronic Company, Box 31, Temple, Texas. 9-61 tf

Magnecords—Several different professional models. Newly reconditioned. Send for list. Audio Specialties, Dept. B, P. O. Box 12203, San Antonio 12, Texas. 2-62 2t

One used model 518-DL, 10,000 watt FM broadcast transmitter including: 1,000 watt driver, interconnecting wiring; complete remote control system; frequency and modulation monitor. Immediate delivery, Capitol Broadcasting Company, Inc., Virgil D. Duncan, Chief Engineer, 2619 Western Blvd., Raleigh, North Carolina. Telephone 919 828-2511. 3-62 4t

10 CM. WEATHER RADAR SYSTEM Raytheon, 275 KW peak output S band. Rotating yoke P.P.I. Weather Band 4, 20 and 80 mile range. Price $975 complete. Has picked up clouds at 50 miles. Weight 488 lbs. Radio Research Instrument Co., 550 Fifth Avenue, New York, N. Y. 3-62 1t

Two used model 450 Ampex tape playback units 3¾ ips half track both direction at $400 each. Two late model 450 Ampex tape units as above, $600 each. One changeover panel silence sensing for item one, $50. Five Magnecorder playback units 3¾ ips half track fast rewind, $125 each. Twenty-five slightly used Browning multiplex tuner receivers $75 each. Several used Harkins and Hershfield multiplex receivers, POR. Several used Seeburg Automatic record players 78 rpm and 45 rpm models with 100 record capacity, POR. Capitol Broadcasting Company, Inc., Woody Hayes Music Division, Woody Hayes Manager, 3207 Clark Avenue, Raleigh, North Carolina. Telephone 919, 834-8474. 3-62 4t

POSITION WANTED

First class phone, now chief engineer seeking permanent position in New Jersey, engineering only, AM FM station. Broadcast Engineering, Dept. BE 7, Kansas City 5, Mo. 2-62 2t

BUY, SELL OR TRADE

Will buy or trade used tape and disc recording equipment — Ampex, Concertone, Magnecord, Presto, etc. Audio equipment for sale. Boynton Studio, 10 BE Pennsylvania, Tuckahoe, N. Y. 10-61 6t

MISCELLANEOUS

Train now in New York City for FCC first phone license. Proven methods, proven results. Day and evening classes. Placement assistance. Announcer Training Studios, 25 W. 43 New York—OX 5-9245. 2-62 3t

Advertisers' Index

Professional Services

Planning STL or Intercity Relay? Send for Raytheon's Free Planning Kit!

Raytheon's Microwave System Planning Kit helps you engineer initial requirements, carry out preliminary terrain and tower surveys. It also explains topographic maps, path clearance pitfalls, profile plotting, FAA and FCC regulations.

In designing this Planning Kit for TV Station Chief Engineers, Raytheon experts drew on their extensive experience in servicing over 1000 microwave installations throughout the world.

Raytheon KTR — for Intercity Relay network pick-up — is available in both 1/10-Watt and 1-Watt systems to meet individual needs. These systems have proven their reliability, operating unattended over extended periods. Initial cost is low, and long-term financing is provided.

The world's largest manufacturer of microwave tubes and equipment, Raytheon also offers TV Stations complete, no-obligation System Engineering Service.

RAYTHEON

RAYTHEON COMPANY

EQUIPMENT DIVISION

Mail Today for Free Planning Kit

Raytheon Company, Dept. B-3
Lexington 73, Massachusetts
Attention: Mr. M. B. Curran

Please send free Microwave System Planning Kit

☐ Planning a system. ☐ For reference only.
☐ Have Engineer call.

Name .....

Title .....

Company .....

Address .....

City & State .....

WGAL-TV DEPENDS EXCLUSIVELY ON RCA IMAGE ORTHICONS

"We have never used anything but RCA Camera Tubes," says Jacob Mathiot, Chief Engineer, WGAL-TV, *Lancaster, Pennsylvania.*

From 12 years of telecasting experience, WGAL-TV pays tribute to RCA camera tube quality. They know, for example, about top performance and long life in RCA Image Orthicons. It's no wonder that RCA-4401's were selected when the studio began color programming in Sept. 1960.

The initial tube complement, two sets of three RCA-4401's, is still in each camera. With more than 555 hours already logged, these Image Orthicons are contributing to WGAL-TV's (and RCA's) reputation for dependability—even when operating at light levels well below that required of other Image Orthicon types.

WGAL-TV originates 10 hours a week of local color programming. This gives the Pennsylvania Dutch country more than the national weekly average of color television. As Mr. Mathiot attests, WGAL-TV relies exclusively on RCA Camera Tubes.

Take your cue from WGAL-TV. Investigate the performance characteristics of RCA Image Orthicons with MICRO-MESH and SUPER-DYNODE design. Your RCA Industrial Tube Distributor is ready to help you. Call him today.

RCA Electron Tube Division, Harrison, N.J.

RCA®

The Most Trusted Name in Television