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DECEMBER 1962 75c

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the technical journal of the broadcast-communications industry

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EIA BPA

TOTAL PACKAGE CONCEPT ASSURES MAXIMUM STEREO PERFORMANCE

A complete FM stereo broadcast package — specially engineered to deliver the greatest stereo realism possible — is now available from the Gates Radio Company.

This exclusive system features a full power range of stereo transmitters from 10 watts to 20,000 watts, the new Cycloid antenna with one through sixteen bays, a dual peak limiter, stereo Cartritape, the choice of two stereo audio consoles and two professional stereo turntables (12 or 16-inch)—plus other important accessories that add realistic depth and separation to broadcast sound.

All equipment in the package was researched, designed and manufactured after the FCC rules and regulations concerning FM stereo were finalized — yet each product has been extensively field tested.

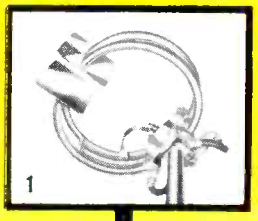
To assure maximum stereo performance, the new FM station will want a fully integrated system designed specifically for stereo—and Gates is the only manufacturer in the broadcast industry to offer such a complete equipment plan. This total package concept solves the broadcaster's problem of purchasing equipment from several different sources — which could result in an incompatible stereo broadcast system.

Many FM stereo stations already on the air may find that they are not getting full stereo performance due to an incomplete system. By reviewing the package diagram on the right, they can determine the equipment needed to assure true stereo transmission. And the monaural station should investigate to see how relatively simple and inexpensive it is to convert to the "wonderful world of stereo" with the complete Gates package.

Full technical information on this special FM stereo package is now available. Write Gates Radio Company, Quincy, Ill., for the FM Stereo Fact File.

(Advertisement)

GATES OFFERS MOST COMPLETE FM STEREO PACKAGE IN INDUSTRY



1 Gates Cycloid FM Antenna — Designed for Stereo

2 Complete Line of FM Stereo Transmitters — from 10 Watts to 20,000 Watts

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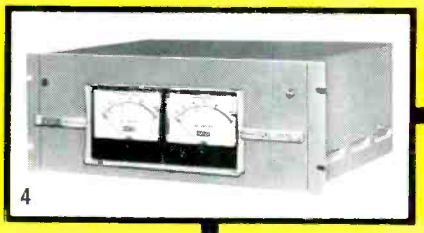
Gates M-6160 Subcarrier Generator 67 KC or 41 KC. Switching Kit Optional

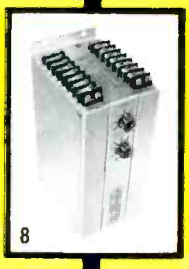


4 Gates M-6144 Stereo Dual Limiter

5 Gates M-6158 Executive transistor console—10-channel stereo

6 Gates M-6188 Stereo Yard

7 Gates Stereo Cartritape II



8 Gates M-6169 Stereo Transistor Preamplifier

9 Gates CB-500 16-inch & CB-77 12-inch, with GE VR-1000 Gray 208S Stereo Cartridge Arm & Rest

Gates is the only manufacturer in the broadcast industry to offer such a complete stereo system. For complete information, write for the FM Stereo Fact File — yours for the asking.

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LETTERS
to the editor

DEAR EDITOR:

I understand that Harold Ennes has written a book on TV systems maintenance. I will appreciate it if you can tell me the name of the publisher, the title of the book, and the price.

C. G. ADAIR

San Antonio, Texas

For the benefit of the hundreds who have written, Harold Ennes is currently authoring a 10-volume "Broadcast Engineering Notebooks" series for Howard W. Sams & Co., Inc. The first volume, "Television Tape Fundamentals," is to be published this month, and is priced at $5.95. Several volumes are planned for TV systems maintenance, later in the series.—Ed.

DEAR EDITOR:

If possible I would like to obtain a reprint of your series, "Audio Studio Maintenance" and "Radio Transmitter Maintenance."

HARRY A. ETKIN

Levittown, Pa.

Sorry, individual reprints of the articles are not available, but we still have most of the back issues, which are available for just 75¢ each. If you can hold off just a bit longer, however, you can obtain a booklet containing all the maintenance series articles with a new or renewal subscription order.—Ed.

DEAR EDITOR:

I enjoyed reading my article on the WINC Satellite in the October issue. However, I have been besieged with calls and letters regarding errors in the circuit diagrams.

On page 30, the battery designations are inaccurate. The top terminal which reads +18 V should, of course, read −18V, and the terminal below it should read −6V. In the pickup preamplifiers, the coupling capacitors should be 2 instead of 200 mfd, and the base resistors should be 82K instead of 8200. The resistors shown in the pad on the limiting amplifier diagram on page 32 should be 47 instead of 47K. The negative 18 volts goes only to the program amplifier; all voltages in the preamplifiers should be −6 instead of −18.

PHIL WHITNEY

WINC

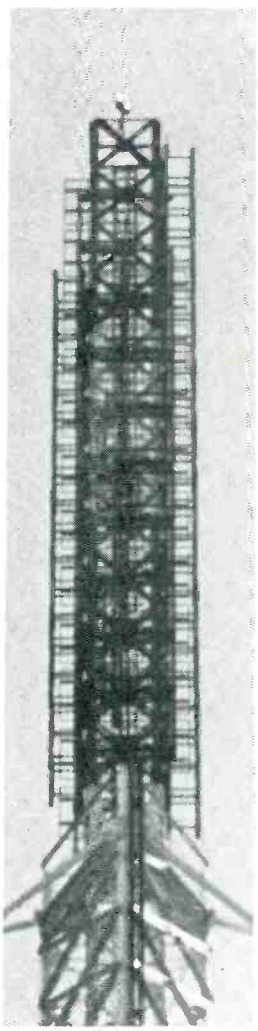
Winchester, Va.

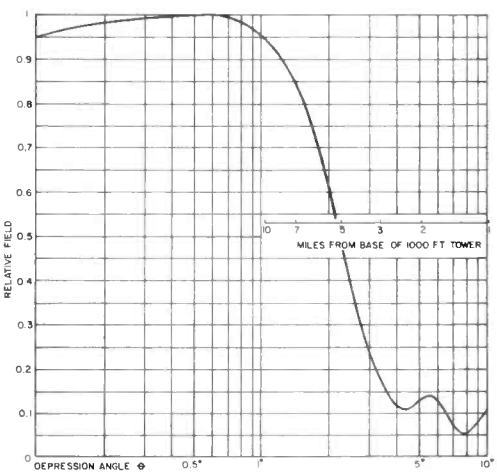
Yipes! Spots on our collective tie. Sorry for the wild schematic, Phil. We held a kangaroo court recently to prevent further such occurrences. Note to readers: Mr. Whitney has also provided us with improvements on his original circuit; the bypass capacitor at the −6 volt tap in the battery divider should be 500 mfd at 25 volts, and the 2N109 input coupling capacitor should be 10 mfd at 15 volts.—Ed.

HIGH BAND TV ANTENNAS

Does your station operate on Channels 7 - 13? Are you interested in improving your signal with a minimum investment? Then it's time you became familiar with our line of CO.EL. High Band Antennas . . . and learned why they are favorites around the world. Here are a few of their features that should be of special interest to both station operators and engineers: VERY LOW VSWR PERMITS TRANSMISSION OF HIGHEST QUALITY SIGNAL — VSWR 1.04 or better guaranteed ☐ AVAILABLE FOR VERY HIGH GAINS — gains up to 23, with circular patterns and null fill available ☐ EXCELLENT VERTICAL PATTERNS — smoothly shaped vertical patterns with null fill and beam tilt eliminate close-in areas of low signal strength ☐ SUITABLE FOR STACKING — CO.EL standard antennas are designed to mount on the face of a tower, thus can be stacked under antenna already in use ☐ AVAILABLE FOR DIRECTIONAL PATTERNS — where increased signal strength in important directions is required, and for "drop-ins." Cost in many instances is lower than that of circular patterns. ☐ NO DE-ICERS REQUIRED — even in heavy icing conditions ☐ FASTER MORE ECONOMICAL INSTALLATION — modular construction permits complete installation and check-out in less than a week ☐ NO GROUND CHECK OR FABRICATION OF TRESTLES FOR TESTING NEEDED ☐ EXPERT CHECKOUT SERVICE — by qualified antenna engineering specialists.

Write for further information on CO.EL. High Band, Low Band and UHF TV Antennas; 10mc Bandwidth FM Antennas; Towers; VSB Filters; Notch Diplexers; Filterplexers, Harmonic Filters; Rigid Transmission Line; and Microwave Parabolic Antennas.





Vertical Pattern of CO. EL. CO-48H Antenna, Channels 7-13. Gain with this vertical pattern varies from 19.7 on Channel 7 to 23.7 on Channel 13.

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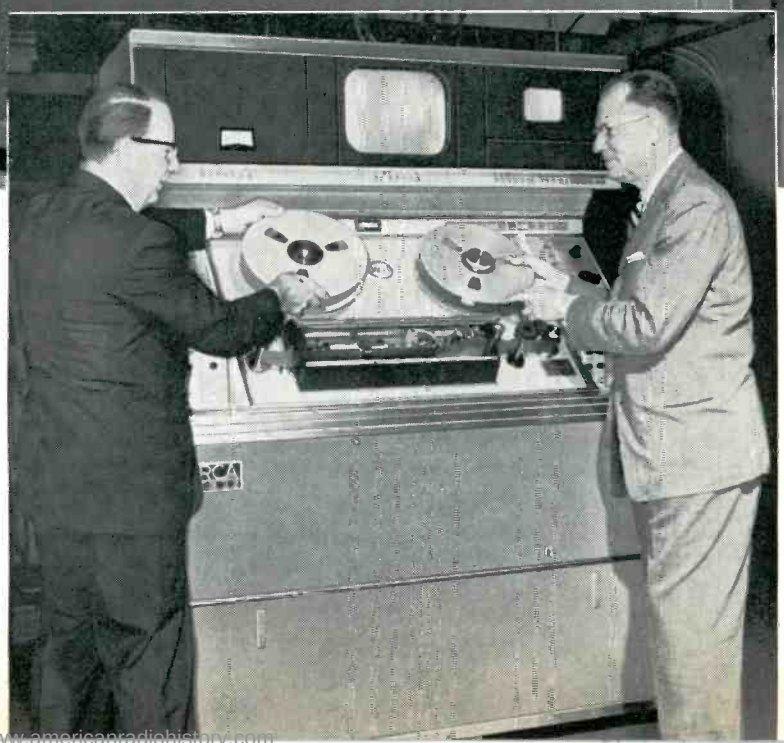

Frank Marx (R), Pres., ABC Engineers, and Charles Colledge, V.P., RCA Broadcast and Communications Division, load up one of ABC's new total solid-state TR-22's.

New All-Transistor RCA TV Tape Recorder

A "new generation" is on its way! Dozens of these fully-transistorized console-model TV tape recorders are coming off production lines in Camden, going to U.S., Canadian, and European users . . . NOW!

The first of these striking new-generation units went to Washington—two for ABC's new facility there, and one for the Navy's Photographic Labs. The fourth and fifth air-jetted to England and France; then units to CFPL in Canada; to WBRE-TV in Wilkes-Barre; to KCRL-TV, Reno, Nevada; to WEAT-TV, West Palm Beach, Florida . . . and so it goes!

Shipments of these compact, solid-state recorders are scheduled well into next year. Camden facilities have been stepped up to a two-shift basis to fill commercial and military orders as fast as possible. Order *now!*

See your RCA Broadcast Representative. Or write RCA Broadcast & Television Equipment, Dept. P-367, Building 15-5, Camden, New Jersey.

RCA **The Most Trusted Name in Television**

MOBILE VIDEOTAPE INSTALLATION —TWW, ENGLAND

*by Jack Alexander**—Local conditions demand compact designs for overseas mobile units. The remote videotape truck described in this article suggests application of similar low-cost remote trucks in the United States.

Fig. 1. The complete TWW remote videotape truck.

Most television remote trucks in the United States are quite large, while in countries such as England, where a smaller scale is the general rule, mobile units are smaller. A good example is a videotape unit built for one of the British commercial operations, TWW, which provides interesting material for consideration by U. S. television engineers.

*TV Consultant. Washington, D. C.

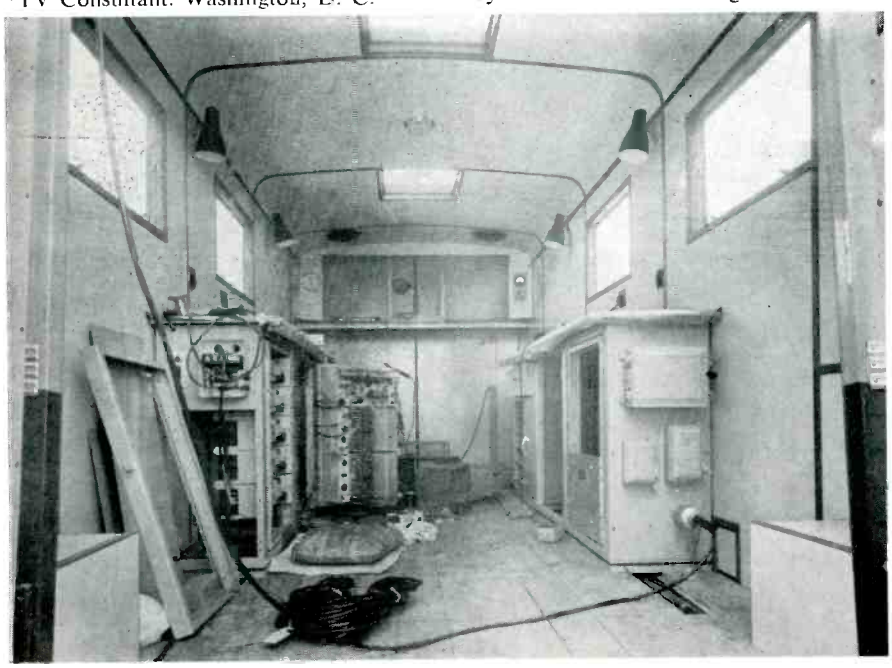

Fig. 2. Interior of truck showing the special Cintel frames during construction.

The remote unit shown in Fig. 1 was built by Rank Cintel of London for use on the narrow roads of England and other European countries. Although small, it provides the facilities required to cope with production and operational emergencies.

Because of the various television standards in Europe—405, 525 (for use with U.S. equipment) 625, and 819 lines—an Ampex Interswitch system was incorporated to provide instantaneous selection of line standards. Alternate provisions were also made for primary power; one is an autotransformer installed to supply 117 volts from the commercial power line. Should there be no primary source available, a small gasoline or diesel generator, towed in a trailer from the hitch at the rear of the truck provides the necessary power.

Design Considerations

Nine criteria were considered in designing the vehicle. These were:

1. Adequate working space.
2. Ample storage facilities for equipment and spares.
3. Elimination of mechanical vibration.
4. Comfortable interior for a relaxed working atmosphere.
5. General ease of operation and setup.
6. Location of individual units for quick maintenance and accessibility.
7. Maximum use of available space.
8. Air conditioning
9. Heating.

For optimum use of the available space, the equipment is mounted on specially designed frameworks, 3″

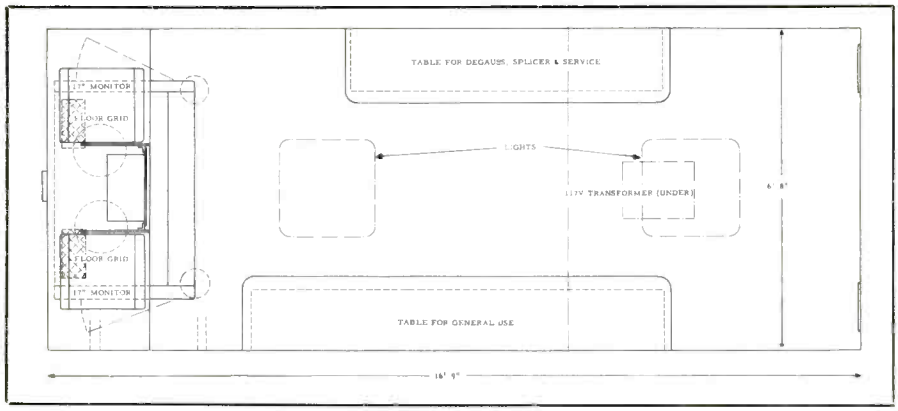

Fig. 3. Floor layout of the TWW mobile unit.

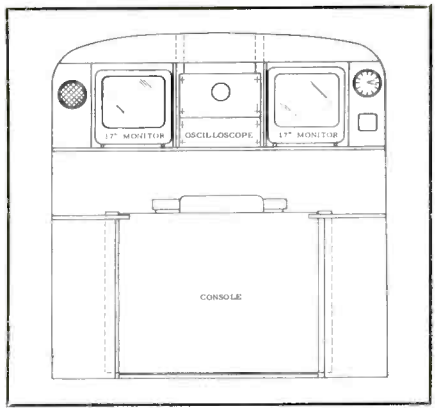

Fig. 4. Layout at the forward end.

high by 15″ deep by 52″ wide. The electronics equipment is affixed to frames which can be swung out for service. These structures, two on one side of the van, and one on the other, can be seen in Fig. 2.

Power Sources

A hinged panel on the right side of the truck swings up to reveal the primary power-input cubicle. A regulator supplies stabilized power with a nominal voltage of 240 volts to all the utility outlets in the truck. A secondary stabilized line feeds the autotransformer beneath the floor at the rear of the truck. From this transformer, 117 volts is distributed to outlets on the maintenance and service benches, and directly to the recorder racks.

The interior lighting can be powered by either of two systems—the emergency generator, which operates from the truck batteries, and the standard 240-volt system. A number of ventilating fans for the work space are also fed from the standard power line. Skylights, windows, and inlet ducts provide adequate ventilation under most weather conditions. However, air-conditioning and heating units can also be provided if extreme weather conditions prevail.

Physical Layout

The floor layout of the mobile unit is shown in Fig. 3. The Ampex video tape recorder is fitted across the front end of the truck (Fig. 4), more or less centered for maximum stability, freedom from roll, and best weight distribution. The console can be swung forward for maintenance after the floor-mounting bolts are removed.

One 17″ Cintel monitor is positioned at each side of the console with the waveform monitor and switching panel mounted on a standard 19″ rack and centered. Also located on this central panel are the power control panel and clock. A mechanical clock is employed to eliminate timing errors due to power supply problems.

All of the units normally housed in 7′ racks are mounted on double swinging frames along the left side of the interior (Fig. 5). The top of this special rack is covered with Formica to provide a large work space. The bulk tape eraser and splicer are stored in a single frame along the right side of the truck (Fig. 6). The cabinet section of this assembly provides for tape, head, and material storage.

Although the truck may be small by U.S. standards, the interior measures 17′ long by 7′ wide by 7′ high. The floor is flat with no wheel or transmission "humps," and through careful selection of colors and decor, any tendency toward claustrophobia is avoided. Cables are routed through floor ducts which are large enough to permit future alterations. All operating cables are stored in enclosed trunks (which are accessible from the outside) and are connected through a panel behind a hinged door.

The special Dennis Heron chassis which carries the truck body can be supplied with a gasoline or diesel engine to power the complete unit. Considerably smaller than most remote trucks made in the United States, this mobile videotape unit is capable of equal performance quality under a variety of rigorous conditions. ▲

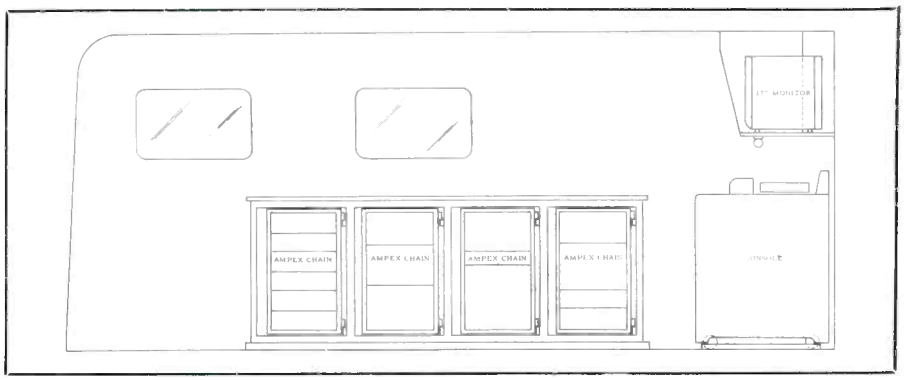

Fig. 5. Equipment layout on left side.

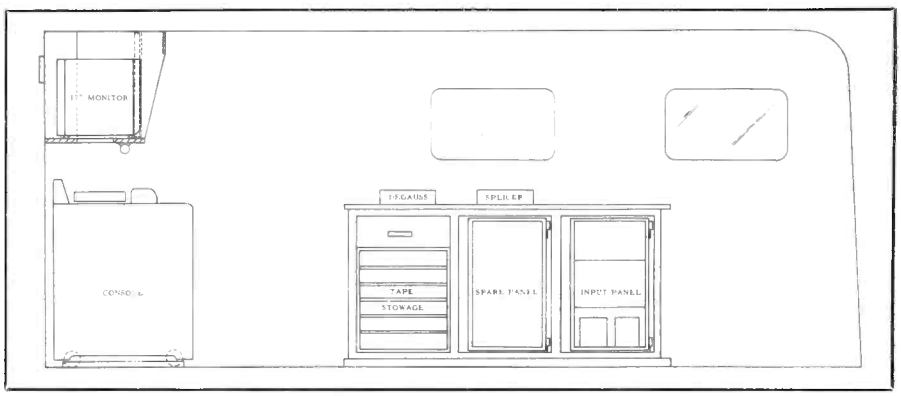

Fig. 6. Equipment layout on right side.

PREVENTIVE MAINTENANCE FOR THE STUDIO

*by Jack Walsh** — A schedule you can use as a guide for planning your own efficient and practical preventive maintenance plans.

Asterisk (*) denotes monthly maintenance. One drop of oil in **all** cases. Tube checks are bi-weekly.	Date Initial
Console	
Clean dust from inside of console.	
Replace bulbs if necessary.	
Use toothbrush and carbon tet to clean all pots and switches.	
Check tubes in the following:	
From left to right:	
Preamp No. 1 V201 5979	
V202 5879	
Preamp No. 2 V201 5879	
V202 5879	
Preamp No. 3 V201 5879	
V202 5879	
Preamp No. 4 V201 5879	
V202 5879	
Preamp No. 5 V201 5879	
V202 5879	
Preamp No. 6 V201 5879	
V202 5879	
Booster Amp V201 5879	
V202 5879	
Booster Amp V201 5879	
V202 5879	
Program Amp V301 5879	
V302 5879	
V303 6V6	
V304 6V6	
Limiter Amp V601 6386	
V602 6V6	
V603 6V6	
V604 6AL5	
Cue amp V801 5879	
V802 5879	
Check voltage of power supply (300 VDC)	

Fig. 1. Portion of control-room schedule listing details of console maintenance.

Spotmaster Recorder	
Clean heads with Spotmaster cleaning fluid.	
Clean roller and capstan drive shaft with Spotmaster cleaning fluid.	
Check pressure on capstan pinch roller. See manual.	
*Oil sleeve bearings on the drive motor. One hole in each end of the motor shaft.	
Check tubes: V1 12AU7	
V2 12AX7A	
V3 12AV6	
V4 12AX7A	
Ampex recorder No. 1 (nearest to console)	
Clean heads with head cleaner.	
Clean all metal tape guides with carbon tet.	
Clean capstan with carbon tet.	
Clean rubber idler roller with Spotmaster cleaning fluid.	
*Oil the upper sleeve bearing of the capstan drive motor.	
*Oil the capstan drive motor as per manual. Page 5-8.	
*Oil the capstan idler roller. See manual Page 5-8.	
*Demagnetize heads. See manual.	
*Align heads. See manual.	
Check tubes: 1V1 12AX7	
1V2 12AT7	
2V3 12AX7	
2V4 12AX7	
2V5 12AU7	
1V6 12AU7	
3V7 6X4	

Fig. 2. Studio schedule for tape machines.

Preventive maintenance is a necessity in all broadcast operations, as anyone responsible for equipment operation knows. Attention to a regular maintenance schedule should not be taken lightly, nor can enough be said concerning its importance. The simple procedures involved can often eliminate a problem before it becomes serious, thus preventing a costly loss of air time.

There are too many separate steps in preventive maintenance to memorize them all. It is therefore a good idea to formulate a regular schedule which includes the smallest details (Fig. 1) because they may easily be overlooked. Along with the regular maintenance items on the form, space should be provided for the date, engineer's initials, and for any new practices which may subsequently be adopted. The schedule should include lubrication of motors and other moving parts, voltage checks (generally outlined by the equipment manufacturers), tube checks, as well as demagnetization and alignment checks of tape-recorder heads (Fig. 2). Other essential items are cleaning of all switches and attenuators; special cleaning instructions for tape guides, pressure rollers, etc.; and finally, a complete operational check of all components.

For simplification, the schedule should be arranged in the order maintenance is performed. Our schedule, comprising twelve pages, is divided into three major sections —Control Room, Production Control Room, and News Room. Typical items include consoles, turntables (Fig. 3), tape recorders, and monitor receivers (Fig. 4).

There are five columns to the right of all steps in the form; each represents a week, and a series of

*Chief Engineer. WMAK, Nashville, Tenn.

twelve pages comprise a month's schedule. Such a form may be expanded to cover two, three, or more months, according to the need; however, keep in mind the increasing problem of filing these schedules as they become bulkier!

As for details, notice the reminders for actual checking of each tube, which also serve as a record of tube life. The same plan applies readily to styli. Since there is a variety of lubricants and cleaning solvents available, the type chosen for each should be indicated (Fig. 5).

In some cases there are notes which, with practice, become rather nonessential, but continue to serve as a ready reference when needed. Examples are notes on power-supply voltages, locations of equipment, and lubrication references in instruction manuals.

A simple code is used in marking the columns to denote the operation performed. A check mark indicates the item was inspected and found in proper order. An **R** denotes the replacement of a tube, stylus, etc., and an **X** signifies that the operation was postponed or was not scheduled to be done at that time. The mark **O** means that repairs were made and a description of the work performed is noted on the back of the form. Thus, there will always be a mark beside every item in the schedule, explaining what has or has not been done.

An asterisk (*) before any item in the schedule denotes a monthly check or lubrication—otherwise the function is performed weekly. A regularly scheduled proof - of - performance, included with preventive maintenance, should be run more often than the F.C.C. requires. Such tests of the various components will often indicate troubles which do not ordinarily appear as a result of tube and voltage checks.

While the specific schedule set up for this station may not serve directly for other broadcast stations, because of the great many special considerations which do not always apply, it can certainly serve as a general outline of preventive maintenance procedures you can use.

A Preventive Maintenance Schedule can be too brief, and thus defeat the purpose — any detail which would help keep the station on the air should be added. ▲

		Date / Initial
Turntable No. 2 (16")		
Remove platter, clean motor, casting, etc.		
*Oil points as shown in the instruction manual. (10 points)		
Clean with carbon tet:	motor pulley	
	drive surface of platter	
Clean the idler wheel with Spotmaster cleaning fluid.		
*Oil motor.		
Check tubes in TT preamp:	V1 EF86	
	V2 EF86	
	V3 12AU7	
	V4 6X4	
Replace styli when needed.	Date	
Turntable No. 3 (16")		
Remove platter, clean motor, casting, etc.		
*Oil points as shown in the instruction manual. (10 points)		
Clean with carbon tet:	motor pulley	
	drive surface of platter	
Clean the idler wheel with Spotmaster cleaning fluid.		
*Oil motor.		
Check tubes in TT preamp:	V1 EF86	
	V2 EF86	
	V3 12AU7	
	V4 6X4	
Replace styli when needed.	Date	

Fig. 3. Turntable maintenance schedule.

		Date / Initial
Monitor Receiver No. 1		
Check tubes:	V1 6BJ6	
	V2 6U8	
	V3 6BJ6	
	V4 6BJ6	
	V5 6AL5	
	V6 12AX7	
	V7 6AK6	
	V8 6X4	
Monitor Receiver No. 2		
Check tubes:	V1 6BJ6	
	V2 6U8	
	V3 6BJ6	
	V4 6BJ6	
	V5 6AL5	
	V6 12AX7	
	V7 6AK6	
	V8 6X4	

Fig 4. Schedule for news-room monitor receivers.

	Date / Initial
Magnecorder PT6-AH	
*Oil front and rear of drive motor.	
*Oil front and rear of rewind motor.	
*Oil felt washers on the take-up clutch assembly.	
*Oil felt washers on the rewind clutch assembly.	
*Disassemble guide rollers and clean all parts with carbon tet.	
*Oil the felt wick and reassemble.	
Clean the capstan with carbon tet.	
Clean the rubber pressure roller with Spotmaster cleaning fluid.	
*Clean and oil the pressure roller shaft.	
CAUTION: DO NOT USE CARBON TET ON ANY BEARING SURFACES.	
*Oil felt wicks on front and rear of the capstan shaft.	
*Clean the rubber covered idlers in rear with Spotmaster cleaning fluid.	
*Clean the rubber covered drive pucks with Spotmaster cleaning fluid.	

Fig. 5. Portion of schedule specifying cleaning and lubrication preparations.

INSTALLING DIRECTIONAL ANTENNA SYSTEMS

*by John H. Mullaney, Peter V. Gureckis, John R. McKenna** — Valuable pointers for all engineers concerned with locating antenna systems

Planning a broadcast antenna system and surveying for the location of towers present several critical problems. Improper handling can result in the need for one or more towers to be dismantled and moved to a correct location. Not only does this cause serious delays and financial difficulties for a station owner, but it might prompt him to take legal action against the surveyor or civil engineer who did the work.

This article is not meant to be a complete treatise on the subject of antenna surveying, but rather a guide for making recommendations to the surveyor or civil engineer.

Ordinarily, when a broadcaster selects an antenna site, his consulting radio engineer furnishes a United States Geological Quadrangular Sheet. If this type of map is not available for the area under consideration, a county or other map on which lines of latitude and longitude are indicated should be obtained. The owner marks the site on the map if there is no doubt as to its exact location. If there is some question, a civil engineer must visit the site and accurately mark the location.

In cases where the services of a civil engineer or surveyor are not employed, the geographic coordinates of the site are determined from the map and by computation, relying upon the accuracy of the site-location data furnished by the applicant. For the purpose of an application, this method is satisfactory; however, for determining the exact latitude and longitude in regard to the center-line of an array and in relation to True North, it is not. A surveyor or civil engineer must, in this case, recheck geographic coordinates to insure accuracy.

Most surveyors do not give bearings in relation to True North, but instead use Magnetic North as their base. Consequently, it is possible to obtain plats which, if not corrected, will result in incorrect layout of the towers with reference to True North. Inasmuch as directional antenna systems must be precisely laid out, not only with regard to spacing, but also in relation to True North, an error in these parameters could make it impossible for a station to build the array proposed in the application.

Bearing and Azimuth

The relation of an antenna site to True North is expressed as a **bearing** or **azimuth.** The meaning of the word bearing can cause confusion between surveyors and radio engineers. To a surveyor, it means the direction expressed as a horizontal angle from a point. The bearing can lie in any of the four quadrants of a circle with an axis oriented to either True North or Magnetic North. Bearings are expressed in terms of their applicable quadrant. For example: the bearing N-50°-E means the direction 50° east of the north reference; while the bearing S-10°-W means the direction (rotating clockwise from the north reference) 180° or due south of the north reference, plus another 10° of rotation to the west. To most radio engineers, the word bearing indicates a True direction (e.g., N-10°-E would indicate 10° east of north).

One way to determine if a plat is based on True or Magnetic bearings is to note the arrow used for depicting north. A half arrow refers to Magnetic North, whereas a full arrow refers to True North.

An azimuth, on the other hand, is a horizontal angle measured clockwise from a reference meridian. Unless the reference meridian is expressed as True North, the surveyor will assume Magnetic bearings.

Multi-Tower Arrays

In addition to the normal care required in specifying geographic coordinates for single transmitting antennas, further caution is necessary with multi-tower arrays. When these directional systems are involved, conditions change and the overall situation becomes somewhat more involved.

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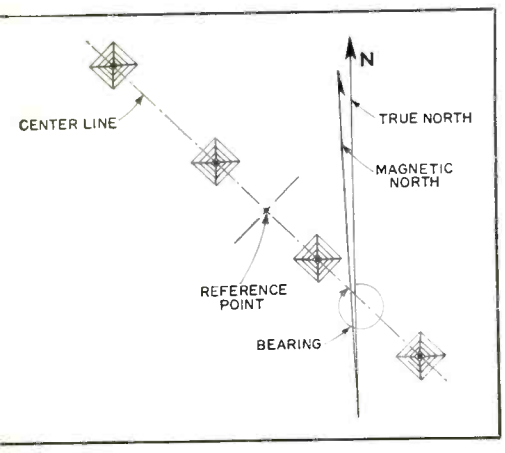

Fig. 1. In-Line array.

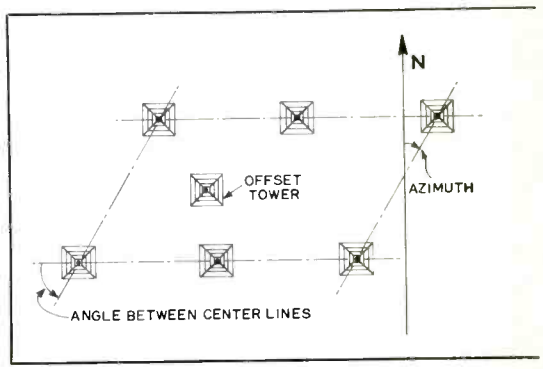

Fig. 2. Parallelogram array.

Two important considerations in planning directional antenna systems are **spacing** and **center lines.** The spacing of an array is the linear distance between the center of each radio tower and a given reference point or reference tower. Spacing varies from layout to layout, and exceptions to spacing rules exist for each configuration.

The center line of an array is the azimuthal orientation of two or more towers to a reference point or reference tower. This orientation is expressed as a bearing in relation to true north. As with spacing, center line rules vary, and the conditions for each configuration must be taken into account.

Ordinarily, if the array is in-line, a point midway between the end towers is used for computing the geographic coordinates. In the case of parallelogram or dog-leg configurations, the center of the array is used for determining the coordinates.

In installations where a different number of towers is used for a day or nighttime pattern, the reference would not necessarily be the center. But for purposes of providing location information to the FCC or the FAA, it is sufficient to use the same geographic coordinates for both arrays. It is not reliable, however, for the civil engineer or surveyor to use the same coordinates for both arrays in establishing orientation, particularly if they have different center lines. When this condition exists, he must determine his own center references.

In-Line Arrays

One of the most prevalent directional antenna systems, the in-line array (Fig. 1), consists of two or more towers which are spaced a certain distance apart on the same bearing or azimuth. Where more than two towers are incorporated in an in-line array, the spacing between adjacent towers need not necessarily be constant. Ordinarily, in-line arrays use equal spacing between towers on the same bearing; however, unequal spacings are sometimes used.

Parallelogram Array

Another common directional antenna configuration is the parallelogram array (Fig. 2), which consists of four or more towers arranged in a parallelogram. In this system, the angle between the two center lines can vary appreciably, depending on the individual design. Ordinarily, the spacing between towers on a given center line or azimuth will be equal, but unequal spacing is possible. The spacing between towers in a parallelogram array, on the different center lines, is usually not constant, but could be in certain designs.

There are certain parallelogram configurations in which an offset tower is located somewhere within the array, but not on either center line. This so-called offset tower is generally to the center or off to the side of the center of the parallelogram.

Dog-Leg Array

A third arrangement used in directional systems is the dog-leg array shown in Fig. 3. Here, three towers are laid out in a triangle. One of the three towers is most often selected as a reference for the purpose of measuring distances and determining orientation. It is possible, however, to use a reference point somewhere within the triangle. The spacings and center-line orientation for this type of array can vary in a manner similar to those for an in-line or a parallelogram type.

Polaris

Extremely valuable in orienting an antenna system to True North is Polaris (or North Star), which is nearly on the extended axis of rotation of the earth. It is, therefore, almost True North, the limit always falling within 3°.

Fig. 4 illustrates the location of Polaris in relation to other constellations. Polaris, referred to as a star of second magnitude, is useful in determining directions because it rotates around the celestial North Pole at a radius of approximately 1° 30′. Referring to the diagram, it will be noted that Polaris is almost on a line between the middle star of the handle of the Great Dipper and the brightest star of a constellation called "Cassiopeia," which has five bright stars in the form of a large **W.**

The Great Dipper, so called because of the outline formed by its seven stars, rotates about 30° in radius from the celestial North Pole. It has a pair of stars, on the side of the bowl opposite the handle, known as the "pointers"—so-called because a line through them points at Polaris.

To furnish engineers with the precise variation of Polaris from True North, a collection of astronomical data called the Ephemeris 1962 has been prepared by the Nautical Almanac Office of the United States Naval Observatory.

Surveying

Surveying is the science which deals with the determination of relative position, or location, of points on the earth's surface. The determination of these parameters involves the art of measuring horizontal and vertical distances and of determining directions and angular relationships by use of surveying instruments.

Some familiarity with surveying terms and definitions will be of value to the broadcast engineer who is concerned with the planning of an antenna system. A working, or even a conversational, knowledge of antenna surveying terminology helps to improve communications between station engineer and the civil engineer or surveyor.

Surveying Terms and Definitions

Culmination — Culmination can be defined as the passage of a celestial body across the meridian of the place under consideration. All celestial bodies cross every meridian twice in twenty-four hours; the word transit is synonymous in this case to culmination. Culmination for the purposes of surveying is further divided as upper and lower culminations. Upper culmination, or upper transit, means that the celestial body has crossed the meridian above the pole, whereas lower culmination,

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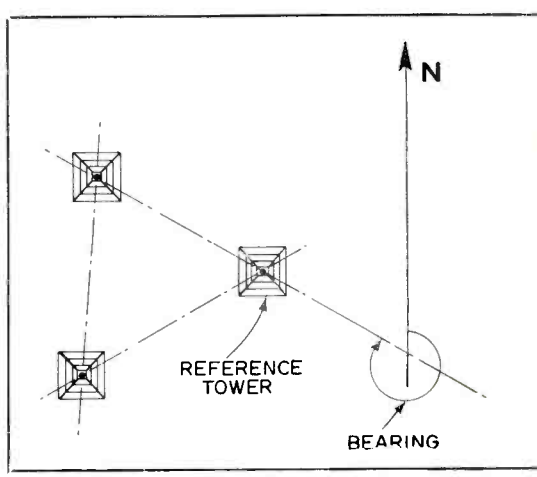


Fig 3. Dog-leg (triangular) array.

TECHNICAL TALKS

Contour Calculations

Every engineer who has ever opened his FCC Rules is familiar with graphs 1-19A — groundwave field intensity versus distance for various conductivities, frequencies, and powers. These are determined for groups of frequencies, from 540 kc through 1640 kc, in which the frequency of calculation is approximately the center. At the lower end of the band, where chances are ground conductivity is more pronounced, the graphs cover only 20 to 30 kc—whereas at the top of the band, where the effect is less, the last graph (Number 19-A) is computed for 1600 kc and covers 1560 to 1640 kc.

Power Adjustment

Each graph is computed for a radiated power of 100 mv/m at one mile. If the radiated power is different than this, some interpolation or computation is necessary. There are many ways of making an adjustment. One, described in the FCC Rules, results in the determination of a value corresponding to the desired contour and is thus read on the graphs.

Assume radiation at one mile to be 175 mv/m: To find the distance to the 500 uv/m contour of this station from the FCC curves (based on 100 mv/m at one mile) multiply the desired contour, in microvolts, by the ratio of 100/175. This becomes:

$$\frac{100 \times 500}{175}, \text{ or } 285$$

Therefore, for a given conductivity at any frequency with a radiation of 175 mv/m, the 0.5 mv/m contour will be represented by the 285 uv/m contour.

To find a given contour with any radiated power a divider is used as shown in Fig. 1. One leg is positioned at the 100 mv/m line on the appropriate graph (A). Remembering that the graph uses a logarithmic scale, the other leg is opened to read the desired power, say, 175 mv/m again; this point will be between the 100 and 200 mv/m lines on the graph. Now, maintaining this divider setting, slide the leg that was on the 100 mv/m line down the pertinent conductivity curve until the other leg rests directly above on the desired contour (B). The distance to the desired contour can then be read on the bottom scale (C). The ground conductivity line has been shifted to a new position so its intersection with the desired contour value is read as though it was the original calibration for 100 mv/m radiation.

No difficulty should be experienced in establishing the divider settings for any value of radiation. For example, if the desired value is 550 mv/m, the lower point is set on 100 mv/m as before and the upper to 550. If it is 1750, the lower point can be set on any unit line (1, 10, 1000, 0.1, etc.) and the reading multiplied mentally by the desired factor for scale conversion.

In the case of 1750 mv/m radiation, we could put the lower point on 1.0 and call it 100, because this scale is logarithmic. Be careful not to open the dividers to 175 mv/m, but go to 1750 mv/m in the second cycle. This point is found between 10 and 20 on the graph (Fig. 2). These points will correspond to 1000 and 2000 after the factor of 100 is applied (100 times 1 mv/m).

Radiations Below 100 mv/m

In the foregoing examples, we read **up** for radiations of 100 mv/m or more. However, for strengths less than 100 mv/m, you must read **down** from the conductivity line to the desired contour (Fig. 3). By placing one leg of the divider on the base line (100 mv/m) and the other leg on the pertinent radiation, 60 uv/m for example (A), you will move the ground conductivity line **downward** and obtain a distance to the desired contour **less** than that obtained with 100 mv/m (B). This is an easy check on the accuracy of the computation. If the graphical distance to the desired contour is more than that to the same contour with 100 mv/m, the computed

Equivalent Distance Method

Unfortunately, a complete contour is seldom involved with just one value of ground conductivity—sometimes there are as many as six or seven changes. A typical example is involved in going from the measured conductivity to the M-3 values when computing contours for an existing station, or for one on

EDITOR'S NOTE: This article is the first in a new series by John Battison. Content each month will be planned to provide the kind of information engineers most often seek from a consultant.

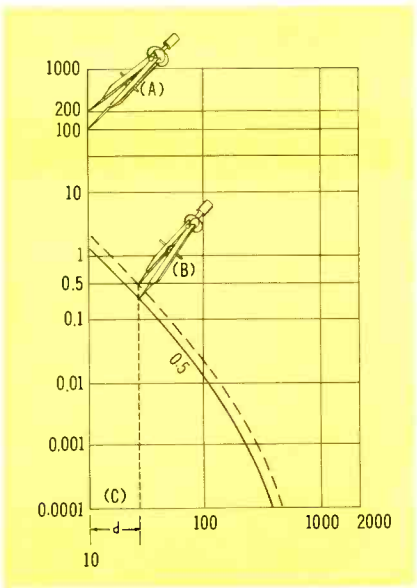


Fig. 1. Field intensity graph showing desired contour above 100 mv/m.

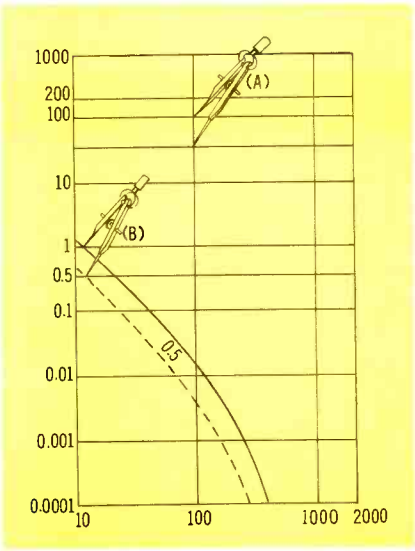


Fig. 3. Field intensity graph showing desired contour below 100 mv/m.

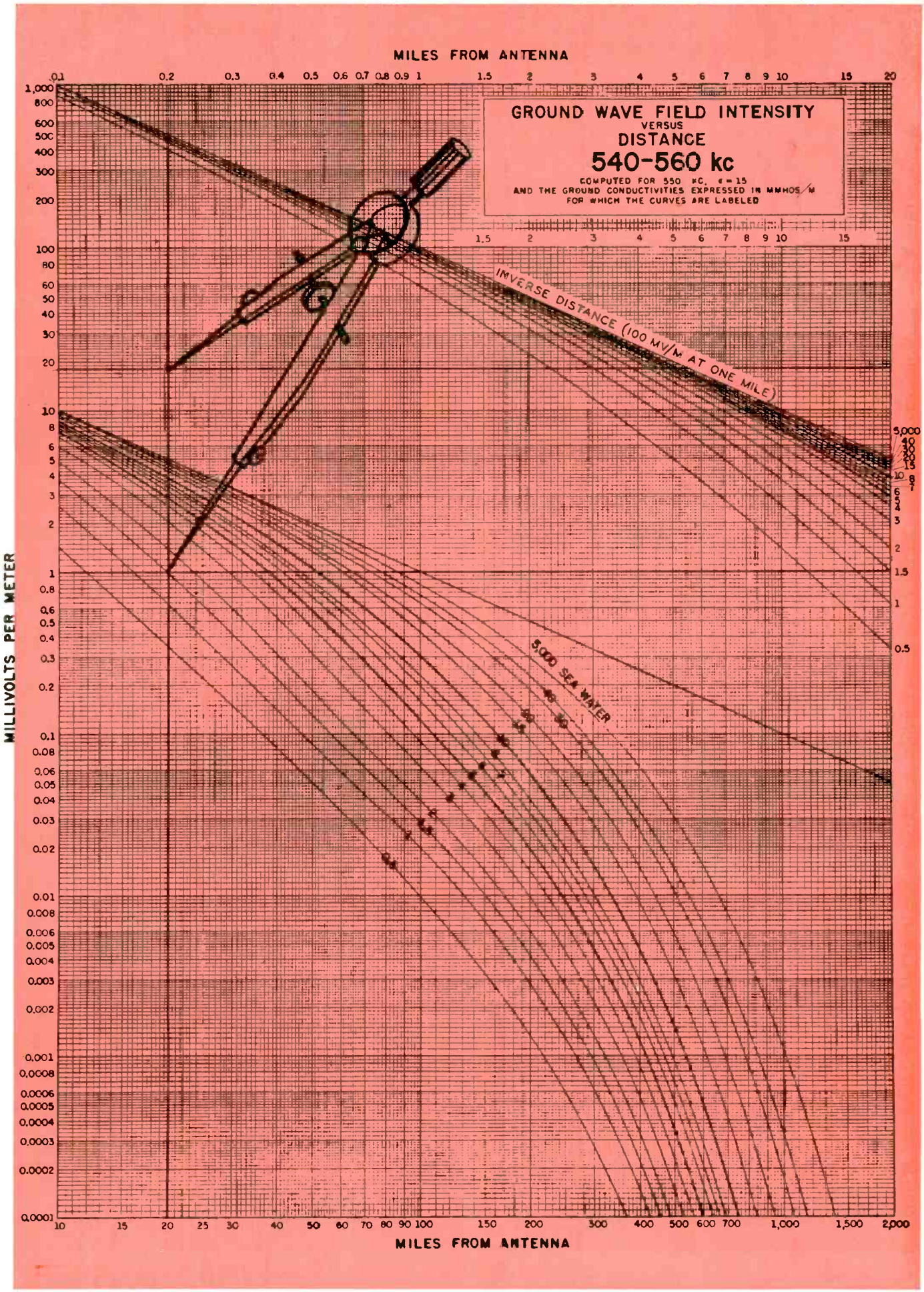


Fig. 2. GW field intensity chart for 550 kc showing divider at 1750 mv/m.

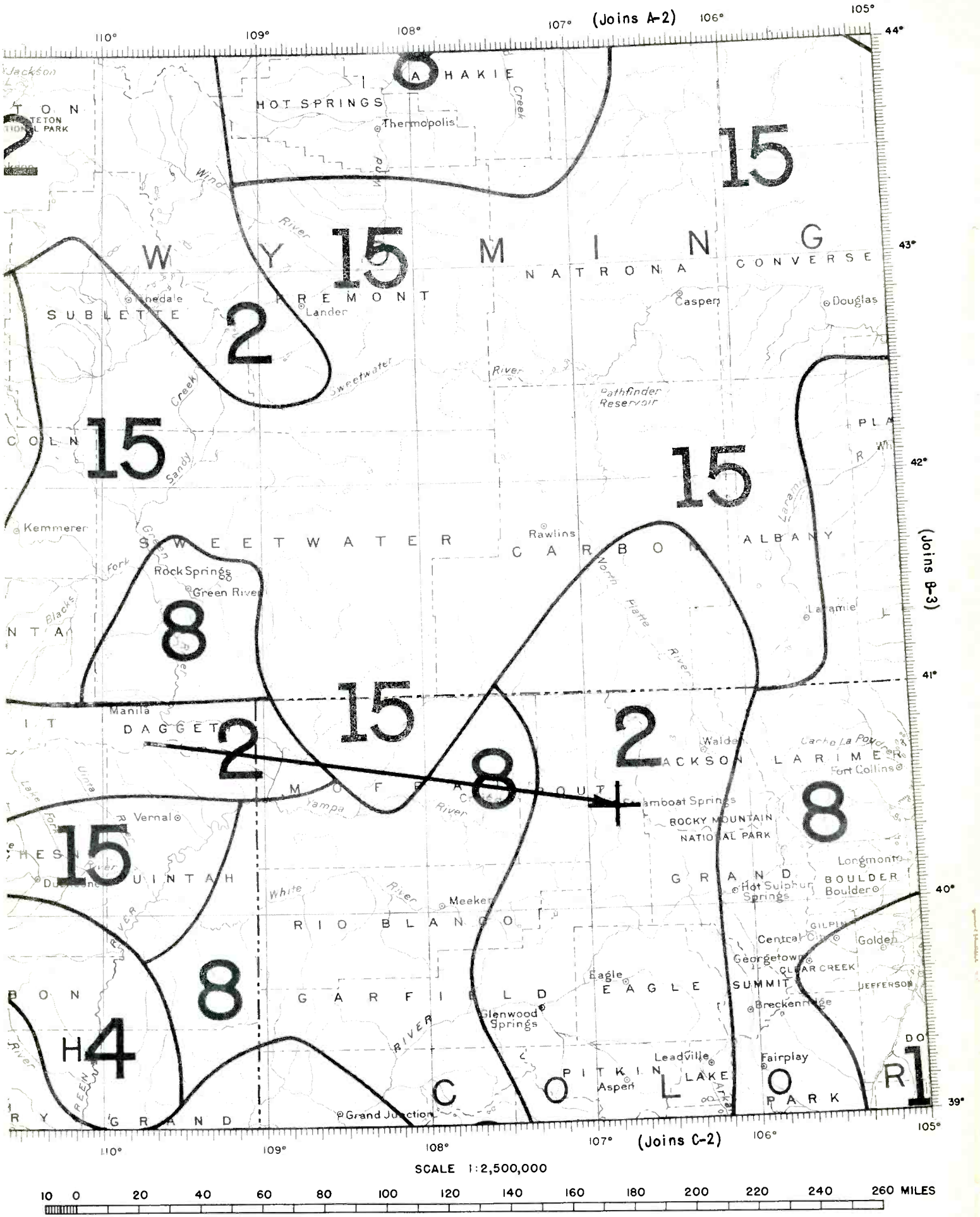
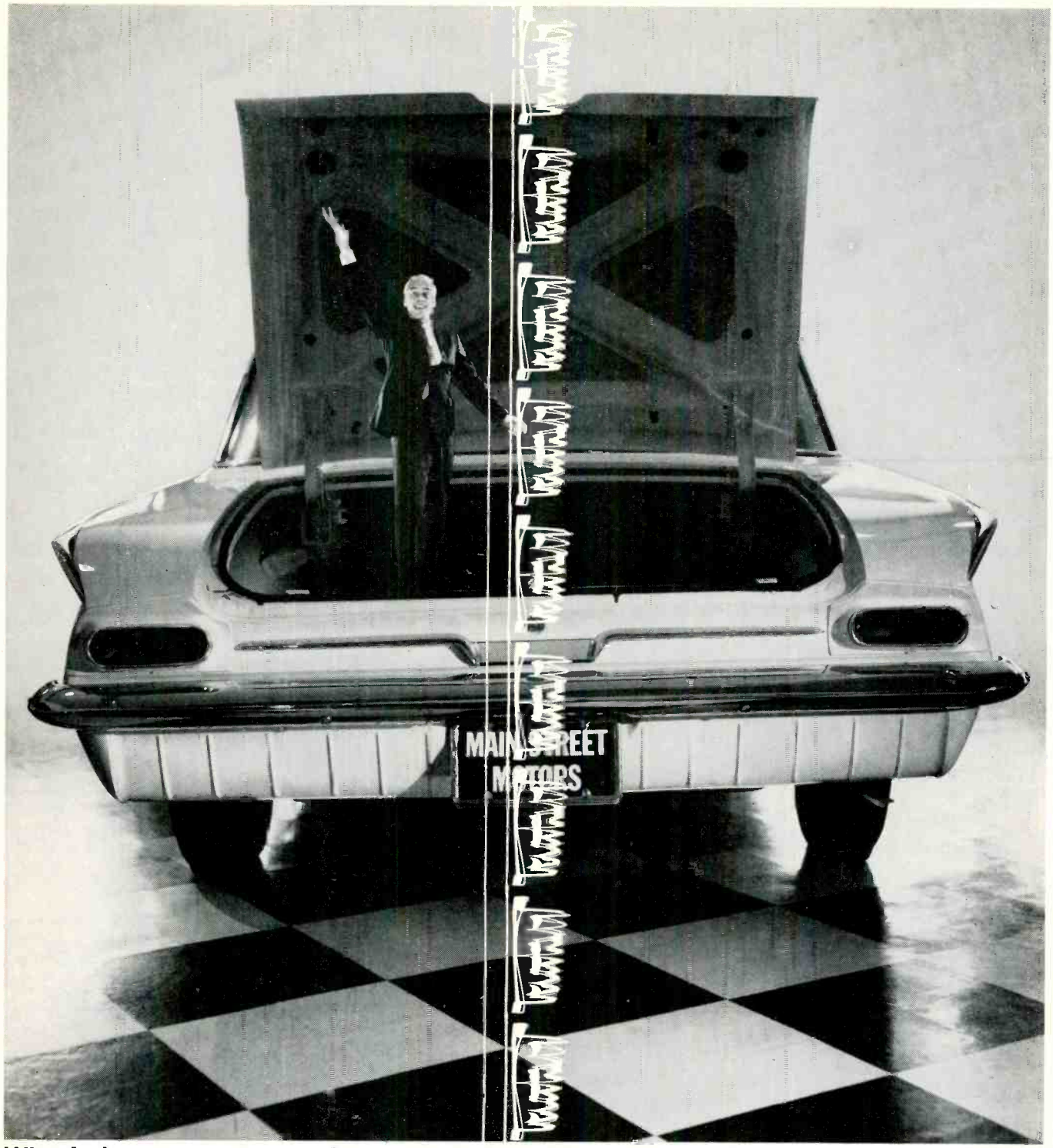


Fig. 4. Section of ground conductivity map (M-3).



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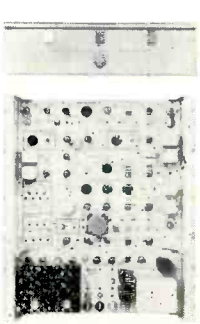

which a proof-of-performance has been made.

The FCC Rules give an example and details regarding the Equivalent Distance Method; however, as in any engineering application, there is more than one way of handling changes. For an example of a popular method, let's refer to Fig. 4. Here we see a section of an M-3, with a radial along which it is desired to compute the distance to the 0.025 mv/m contour. The transmitter is radiating 200 mv/m at 550 kc. First measure the distance, from the site indicated by the cross at Steamboat Springs, to the **center** of the first conductivity change line. The first distance is conductivity 2 for 26 miles (written 2 F 26). The next distance is 35.5 miles of conductivity 8 (8 F 35.5). Then we have 15 F 34.5, and finally 2 out. This is written:

2 F 26 : 8 F 35.5 : 15 F 34.5 : 2 out (1)

We now consult our appropriate groundwave graph (Fig. 2) and find the point 26 miles on the 2-mmho conductivity current. At this point the field is 0.8 mv/m. Now move the point of your dividers along this value to the curve for the next conductivity 8. Note the distance to the same field that would be obtained with 8 mmhos (the intersection of the 8-mmho curve and the horizontal field intensity line). Write this figure above the distance to the first change (see calculation 2).

Adding this distance to that for which 8 mmhos is obtained (35.5), we have 88.5 miles. Write this over the 8 and go along the 8-mmho curve for this 88.5 miles. As before, move your dividers along the field intensity line to the next conductivity line, 15. Write the value, 121 miles, above the 15 and add the 15 conductivity (34.5) to arrive at 155.5 miles. Write this above the 34.5. Move the dividers along the 15-mmho curve for this distance and then horizontally along the field intensity line until the next conductivity, 2, is reached. Write this distance above the 2.

$$\underset{52(-27)}{2\ F\ 26} : \underset{88.5}{8\ F\ 35.5} : \underset{121\ (-32.5)}{15\ F\ 34.5} : \underset{155.5\ (+103.5)\ 52}{2\ out} \quad (2)$$

2 G 26 : 8 F 35.5 : 15 F 34.5 : 2 out

Now return to the beginning of calculation (2); when our path conductivity changes from 2 to 8 mmhos, the signal will travel further on the new higher conductivity. If the conductivity had been 8 all the way to 61.5 miles, the field intensity for the distance would be 0.6 mv/m. However, it was not 8 mmhos all the way, so we subtract the difference between the 26 miles of 2 mmho conductivity, and the distance it would take at 8 mmhos to produce the same field.

To determine the sign, consider the direction of the conductivity change—when going from a low to a high conductivity, the difference is negative; when going from high to low, the difference is positive.

Now all the positive numbers are added, all the negative numbers are added, and the two results are combined:

$$\begin{array}{rr} -27 & +103.5 \\ -32.5 & -\ 59.5 \\ \hline -59.5 & +\ 44.0 \end{array} \quad (3)$$

We now find the distance at which the 0.025 mv/m contour would fall if the conductivity were 2 mmhos all the way is 160 miles. Because there have been areas where the conductivity is higher than this, we expect the distance to be greater than if the conductivity had been 2 mmhos for the entire distance. So we add the positive number obtained above, and arrive at a figure of 204 miles to the 0.025 mv/m contour.

If we had wanted the 0.5 mv/m contour, we would have checked to see if it fell within the 2 mmhos area with our given radiation. If it goes further than 26 miles, we would measure it using 15 mmhos, and find that it falls at 130 miles. This is within the total distance to the end of the 15-mmho region, so we find the distance to the 0.5 mv/m contour with a conductivity of 15 mmhos and subtract the difference obtained at the change points between 2, 8 and 15 mmhos:

$$\begin{array}{l} \underset{53}{2\ F\ 26} : \underset{88.5}{8\ F\ 35.5} : 15\ F\ 34.5 \\ = 130 - 59.5 \\ = 70.5 \text{ miles to the 0.5 mv/m contour} \end{array} \quad \begin{array}{l} (-27) \quad (-32.5) \\ \\ (4) \end{array}$$

Although the written description may sound a little complicated, once you try a few examples, you will find this method rather simple. If each step is performed carefully, and accurate measurements are made, correct results will be obtained. ▲

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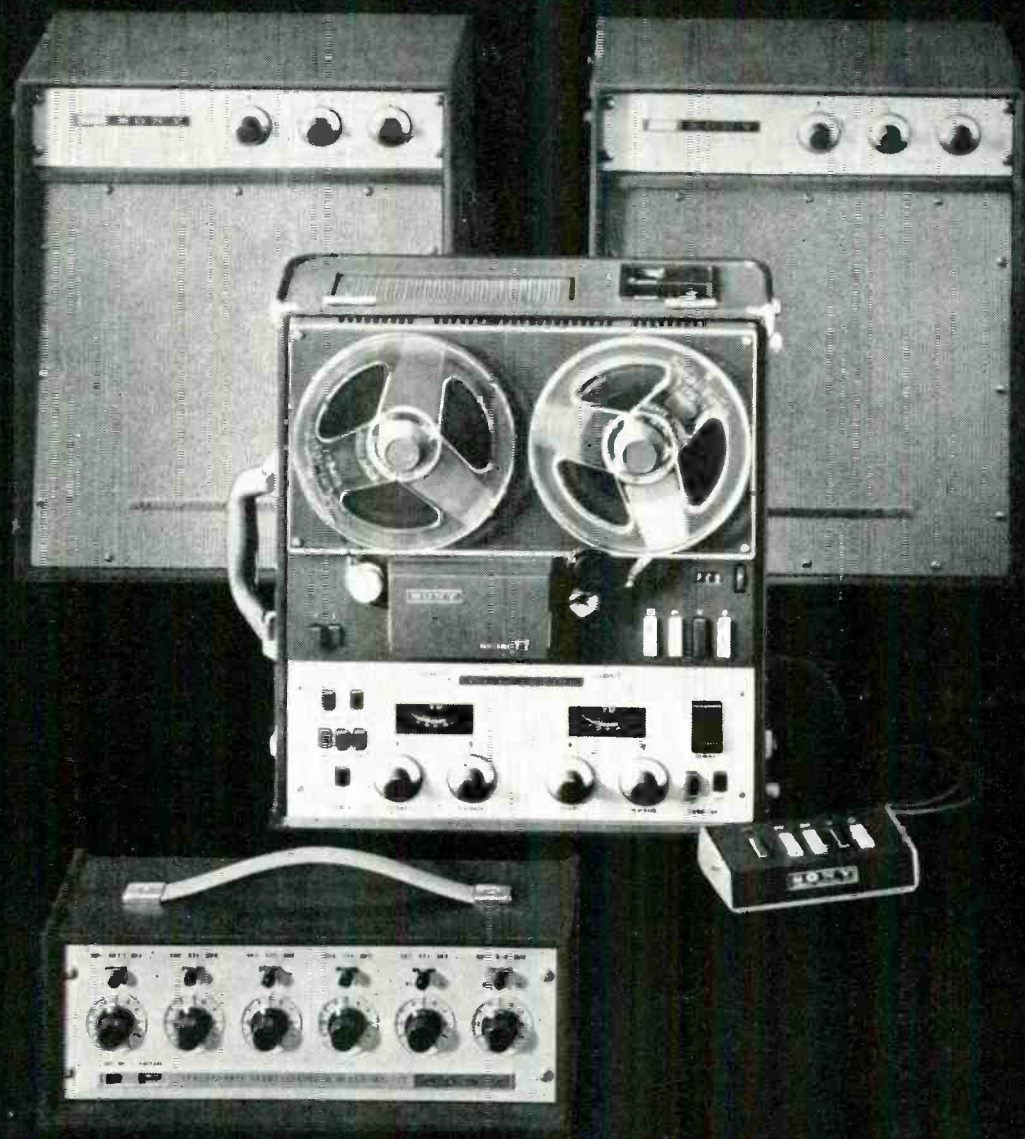

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PLANNING A NEW FM STEREO STATION

*by Lloyd M. Jones** — PART TWO.
Factors that go into a good audio system, and some pitfalls to avoid.

Audio Control Boards

The selection of audio control boards will depend to a great extent on whether a monaural or stereo station is to be built. Stereo broadcasting requires a dual channel board—one using individual faders, or one of the newer type with coaxial dual faders. If discs are going to be played, the latter is preferred, since it simplifies manual operations.

Also, for stereo use, be sure to get a board with two VU meters.

The control-board power supply should be external to minimize the heat in the console cabinet. One or two enclosed 7′ racks can be used to hold the power supply, limiter amplifiers, frequency and deviation meter, monitor receiver and amplifiers, audio patch or switching panels, and an off-the-air RF amplifier to drive the frequency and deviation meter if your transmitter is to be remote controlled.

Cabinets must be provided with cool-air intake at the bottom and hot-air exhaust at the top. If exhaust fans are used in the area, make sure they do not cause any sound or rumble in the control room or studio. Consider everything in the control room and studio as potential noisemakers, and soundproof all six sides of each room. Even fluorescent ballast-transformers are noisy, and there is noise from tape decks, turntables, etc.

*Chief Engineer, KMUZ, Santa Barbara, Cal.

View of control room looking into the studio. The console enclosure is a one-piece unit fabricated by a local cabinet shop. The audio console is a Collins 212-E Dual Channel with a full compliment of preamplifiers, dual limiters, and a monitor. It feeds the left channel when any key is in the up position, and the right channel when any key is down. The small control panel to the left of the console provides switching to turn the clock control on and off, and to start and stop the main automation tape decks. The panel to the right controls the stereo tape deck, mounted at the top of the rack, used to record stereo albums, programs from the studio or control-board microphone, and special interviews from the telephone; this stereo deck can also be used with the automation equipment. Mounted in the rack below the tape deck are a monitor amplifier, silence sense deck, and 25-cps generator for cuing the recorded tapes.

The teletype machine should be reasonably close to the control room and studio for functional operation; yet for noise considerations, it should be kept at least two walls away. All audio circuits must be balanced (not grounded on one side) and should be 600 ohms or less. Microphone lines must be well shielded and in separate conduit or gutters from medium and high level audio circuits. It is very important to keep all audio circuits away from the teletype lines! Run the teletype lines into the building through conduit. These lines carry sharp impulses which can get into low-level lines regardless of shielding. Be extremely careful of ground-loops which can cause hum—run 3″ copper strap in the gutters to each piece of equipment, and ground each to the console.

The shield of each audio cable must also be grounded to the audio console. With the exception of microphone cables, where the shield is used to ground the microphone case, all shields should be left open at the end opposite from the audio console. In large stations having several studios and cabling up to 200′ long, ground-loop voltages of ¼ volt, 60 cps are not uncommon and obviously can cause severe hum if the circuit is completed.

Limiting Amplifiers

In general, suppliers of audio consoles will also supply the limiting amplifiers, one of which should be installed in each channel. Set the gain reduction no higher than about 5; excessive limiting will only reduce the stereo separation. Riding gain is necessary to keep the audio level within the proper limits. Limiting amplifiers do not chop off the audio signal above a certain preset level; they only start reducing gain as the limiting action begins. For

example, for every 3 db of signal fed into the limiting circuits you can expect an output rise of approximately 1 db. Thus, the attack and release time of limiters should be adjusted to suit your needs.

Certain brands of limiters will perform an extremely important function for the stereo broadcaster —limit only the high frequencies.

This type of limiter has been used in sound recording on film, tape, and discs for several years and is essential to FM stereo broadcasting. It does not destroy the high frequencies, but reduces them on the high volume peaks only. At the same time, it permits the lower frequencies to pass at high volume levels, thus producing the desired effect of greater dynamic range. With this type of limiter, the average volume increase to the listener is about 6 db higher than without it. High frequency cross-talk, due to overmodulation from channel to channel, or from channels to background music (SCA), is virtually eliminated.

Microphones

There are many types of microphones available, several of which will do a good job. To be prepared for the majority of situations, use microphones with a frequency response of 50 to 15,000 cps. If good low response and physical placement causes the announcer's microphone to be susceptible to low frequency rumble, install an RC network in the preamp to reduce response to about 200 cps.

Turntables and Tape

One or two turntables will be needed for playing disc records on the air. If a minimum of tape equipment is used, you may need three or four turntables; however, tape machines are carrying the bigger load in today's operations. Stereo tapes can be purchased prerecorded or made in your studios from your choice of stereo albums. Remember, however, recording from records to tape requires turntables which are free from wow and low-frequency rumble and are mounted in solid, heavy enclosures. (With the good low frequency response of FM systems, rumble is not tolerable.) Since turntables meeting these requirements cannot usually be directly driven, select one that employs a belt or flexible shaft. The rumble should be guaranteed more than 30 db below program level; 40 db would be even more desirable.

Be careful to choose a stereo pickup head guaranteed to have no measurable or aural AC pickup, and use great care in selecting the arm. It must be nearly perfectly balanced with minimum friction in the lateral and vertical directions. Since you probably will not be playing the discs time and again, it is permissible (and often desirable) to use a slightly greater tracking pressure when recording from discs to tape.

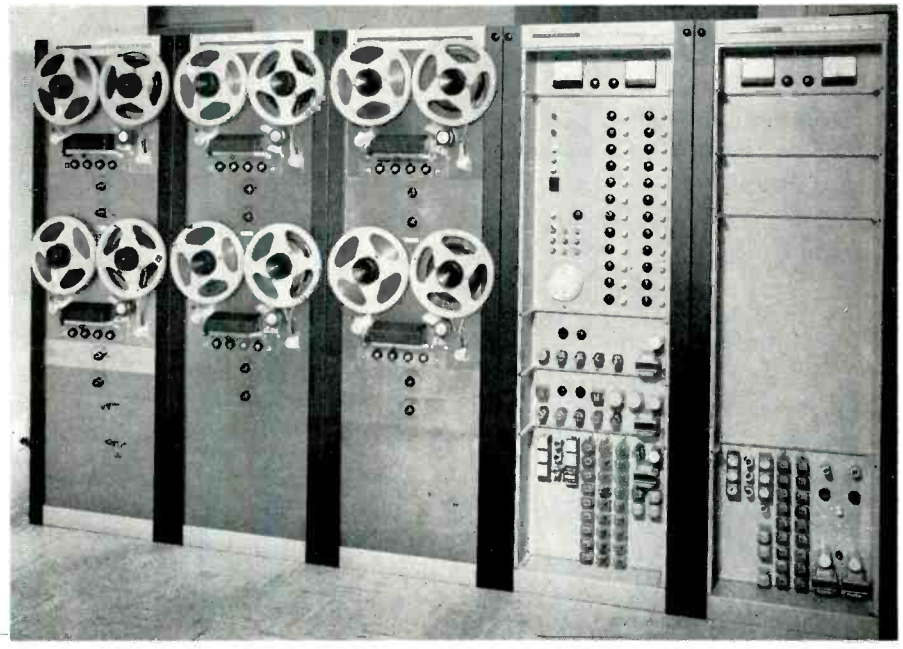
Many of the available broadcast pickups have a nominal output impedance of 47,000 ohms to feed an equalizer or the 600-ohm terminals of the audio console; either arrangement results in mismatch and inadequate reproduction. To regain "mellow and crisp" music quality, the stereo head must be fed into a preamplifier having a matching input-impedance. Most of the stereo preamplifiers made by reputable manufacturers, kits or wired, will do an excellent job. The only modification necessary is the installation of a matching transformer, approximately 20,000 ohms to 600 ohms, in each of the outputs. Any transformer similar to the Triad JO-23 specifications will work very well.

We have found it best, when transferring disc recordings to tape, to feed the turntable and preamplifier directly into the tape recorder with either patch cords or switching. Do not connect them through the main audio board. The preamplifier should be used with the function switch set in the RIAA Flat position. To facilitate weekly maintenance, obtain one of the many good stereo test-records. We use the No. 103L/105R Stereophonic Sweep-Frequency test record produced by Pacific Transducer Corp. This disc sweeps from 70 cps to 15,000 cps twenty times a second, has marker pips at 1, 3, 5, 10 and 15 kc, and provides a sync pulse for the oscilloscope. By employing such a record you can see your equalization as a continuous pattern. Set the equalization controls on the preamplifier first for one side (left), of the record, then the other (right), and the job is done!

Stereo phasing can also be checked at any point in the studio/transmitter equipment by noting the direction of the marker pips in both the right and left channels. If the pips are the same (either positive or negative) in both channels, the system is in phase.

Monitoring Equipment

A stereo monitoring system should be provided in the control room, and in certain offices. A good



The six stereo decks in racks 1, 2, and 3 are controlled by the equipment in racks 4 and 5. Rack 4 contains the left-channel controls, silence sense, cue-dot, and 25-cycle unit, as well as the clock control. Rack 5 contains the relays that switch the right channel; they are essentially in parallel with the relays that control the left channel.

stereo tuner, stereo preamplifier, and dual power amplifier are needed for this purpose. Up to three or four 8-ohm speakers can be fed from the 4-ohm output tap in each channel without serious mismatch. Line transformers are required for reproduction down to at least 50 cps in voltage distribution systems, or when some impedance other than 4 ohms is desired. To avoid resistance losses, No. 14 wire should be used for speaker wiring where lines must be long and in systems where transformers are not used.

General System

It is possible to broadcast twenty-four hours a day with live news every hour between six A.M. and midnight, live as well as recorded commercials, promos, and studio programs, through the use of remote transmitter-control and automated tape-equipment. Look over the automation equipment of several manufacturers before you decide which will best suit your needs. We strongly recommend that you select a system which includes the highest quality tape transports you can afford; the automation circuitry by each supplier has its own features and all do a good job. It is best to install enough decks to run automated for at least six hours.

One transport should be used for recorded promos and/or announcements, and must be set up to stop automatically. This can be done by means of the "cue-dot" system. A photocell is positioned to sense clear spots on the tape, where the oxide has been removed with lacquer thinner. By using a stop watch, place the cue-dots at intervals of 65 seconds, for example. This will give about 70 one-minute (or less) spots on a 1,200-foot reel playing at 7½ ips. When an announcement is played, the tape will continue running until the photocell-relay circuit stops the machine, leaving it all cued up for the next announcement. Other systems, including 25-cycle tone and silent-sensing, may also be employed.

The other decks can play music with a silence-sense, or 25-cycle tone system automatically and in various sequences. This technique essentially precludes the announcing of musical selections, but the consequence of this condition depends on the individual operation and its application.

Give considerable thought to the **layout** of your control room, studio, equipment room, teletype room, shop, offices, and storage rooms. They must be functional, and not too small. Of prime importance is adequate ventilation, air conditioning, and soundproofing in the studio and control room.

Conclusion

With consideration of the many points discussed here, plus the many others which will appear as you proceed, many headaches can be avoided, and much wasted money as well as a good deal of time can be saved. As a result, the FM Station that is built will remain modern and able to broadcast very nearly technically perfect entertainment for many years to come. Pioneering a new medium can be exasperating. But if you are going into stereo FM broadcasting, do the initial job correctly, and you will find the rewards are many. ▲

We are now in our completely modern new plant located in Nashville's largest industrial subdivision.
Like the equipment we manufacture for the nuclear and broadcast-television industries, the design was strictly our own and was planned to meet the ever increasing needs of the industries we serve.
We are very proud of our new home. Its facilities and our engineering talent will enable us to better meet the requirements of our customers across the nation. It will also enable us to accelerate the development of new television transmitting equipment, some of which will be announced in the near future!
Currently our TDA2 Video/Pulse Distribution Amplifiers and TDA26 High Gain Video Distribution Amplifiers are in constant operation in television stations and network studios in all states. A list of the owners reads like a "Who's Who In American Television". Owner-reports on performance have been gratifying.
The TDA2 and TDA26 are pictured below with a brief description of each unit. Your inquiries for additional information will be handled promptly.

TDA26 HIGH GAIN VIDEO DISTRIBUTION AMPLIFIER
Output Gain: 15 to 28 db in 3 steps plus potentiometer

TDA2 VIDEO/PULSE DISTRIBUTION AMPLIFIER
Output Gain: 4 or more

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CAMERA-TUBE ALIGNMENT USING 30 CYCLES

*by Bill Kessel** — Here's a simple 30-cps oscillator which provides a rocking-focus signal for camera adustment while in use.

Beam alignment of cameras using the 5820 image orthicon has never been a real problem—stopping the orth spot is a simple and reliable procedure. But how can vidicons be aligned? And what technique can be used with the newer image orthicons that employ a field mesh? Some other means must be devised for proper alignment of these tubes.

One way to quickly and accurately accomplish this adjustment is to rock focus at a 30-cycle rate, while observing a suitable test pattern. Two of our supervisors, Walt Baxley and O. G. Kelly, devised and built a generator which has performed this function efficiently for many months.

*Chief Engineer, KTVT, Fort Worth, Texas.

Circuit

The simple two-tube generator circuit shown in Fig. 1 consists of a 12AV7 tube, which is used in the input and output-amplifier stages, and a 12AU7, which is employed as an astable multivibrator. All resistors are the ½-watt size, and all capacitors are 400-volt units unless otherwise indicated. The input signal is composed of 60-cps vertical-drive pulses which can be looped through or terminated at the unit.

The circuit was designed to produce, at its output, a 30-cps submultiple of the input. These output pulses can be fed to any number of cameras in a manner similar to that shown in Fig. 2. The pulse amplitude is controlled by the 25K potentiometer in the output circuit. When switch S1 is closed, the pulses are applied to the center arm of the beam-focus control, thus rocking the focus at a 30-cps rate.

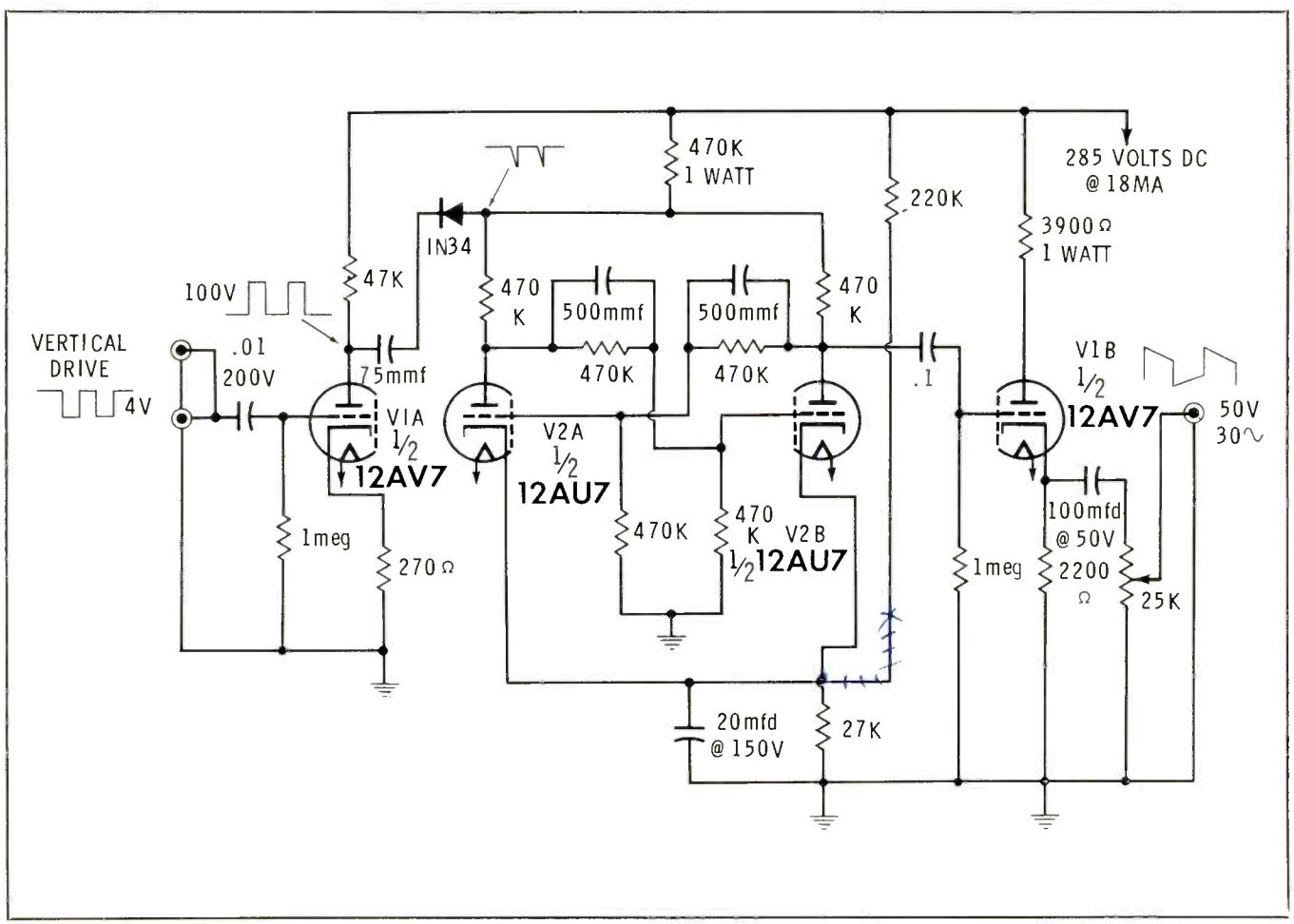

Fig. 1. Circuit of 30-cps pulse generator.

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Free yourself for just 20 seconds to check the advantages of using RCA Red Seal Magnetic Recording Tape:

- Developed by RCA sound engineers for their own professional use. (They insist on the very best!)
- Manufactured in the country's newest, most modern plant. (Everything's up-to-date in Indianapolis!)
- Supervised from basic oxide formulation to finished tape by skilled engineers. (All sticklers for perfection!)
- Quality control tested for frequency response, distortion, drop-out noise, print through. (Very rigid tests!)
- Mechanically tested for coating thickness, anchorage, layer-to-layer adhesion, aging, cupping, slitting. (It's got to measure up!)
- Precisely controlled to give every inch of tape the same magnetic properties, the same recording-bias characteristic. (So you can use tapes interchangeably!)
- Take another 20 seconds to make your job a whole lot easier—fill in the coupon for specifics on this great new tape!

RCA VICTOR

RCA The most trusted name in sound

Magnetic Tape Products Marketing
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Please rush me specifics on RCA Red Seal Magnetic Tape including all essential physical and magnetic characteristics.

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COMPANY .....

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CITY ..... ZONE ... STATE .....

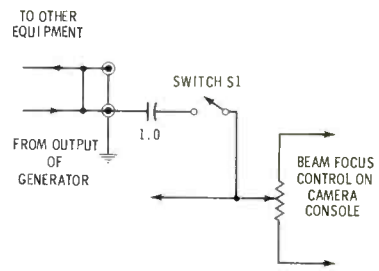

Fig. 2. Input circuit to camera consoles.

Operation

When the pulses are applied to a camera, a double-image pattern will be displayed on the monitor. The two images will be offset from each other in proportion to the degree of beam misalignment. To adjust a camera with a cross-hatch pattern, for example, the alignment controls are moved until the pairs of horizontal and vertical lines are as nearly coincident as possible. Once some experience is gained with this technique, almost any type of test pattern may be employed to obtain optimum alignment.

Our unit was built on a 19" chassis so that it could be rack-mounted adjacent to vertical-drive and power equipment. The output is fed through RG 59/U cable to vidicon and image-orthicon camera consoles. This generator is particularly valuable for use with vidicons—by throwing a switch you can tell at a glance whether or not the tube is aligned. If it is not, the amount of misalignment can be readily determined. ▲

About the Cover

Shown on the cover this month are central-office patching bays typical of those operated by the American Telephone and Telegraph Company's Long Lines Deparment in many large cities. Such equipment is employed in the major nation-wide radio- and television-signal relay system. The installations, which are designed for broadband operation, make use of microwave transmission techniques with high-frequency L-carriers. (Photo courtesy A.T. & T. Photo Service.)

Make lip-sync with the world famous NAGRA III

The NAGRA III is the self-contained professional tape recorder assuring independence, professional standard of performance, reliability, convenience and ease of use.

NAGRA III B:
list price in the US **$ 1045.–**

NAGRA III NP with pilot sync pulse head:
list price in the US **$ 1095.–**

SLP SYNCHRONIZER
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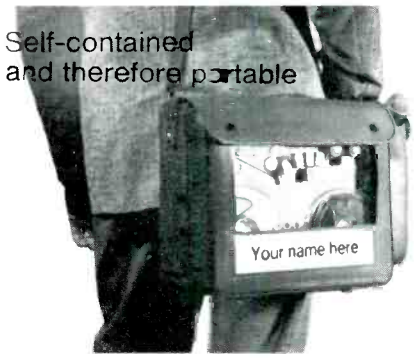
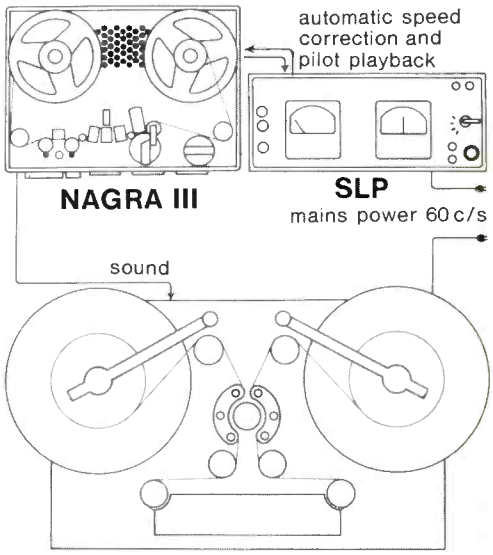
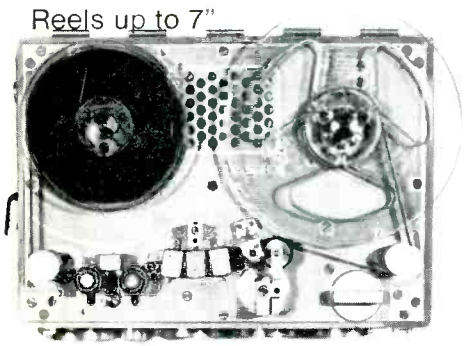


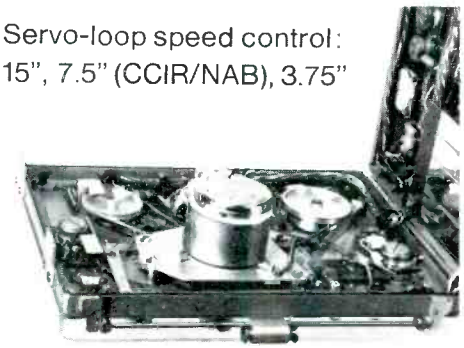
Performance

- 30 ÷ 16.000 ± 1.5 DB
- 58 DB ASA A signal/noise
- 0.1% peak wow and flutter
- Works from –13° to 122° F
- Micro imp.: 50–200 Ohms

The NAGRA sound-transfer system







Write for brochure and *new* dealer list to

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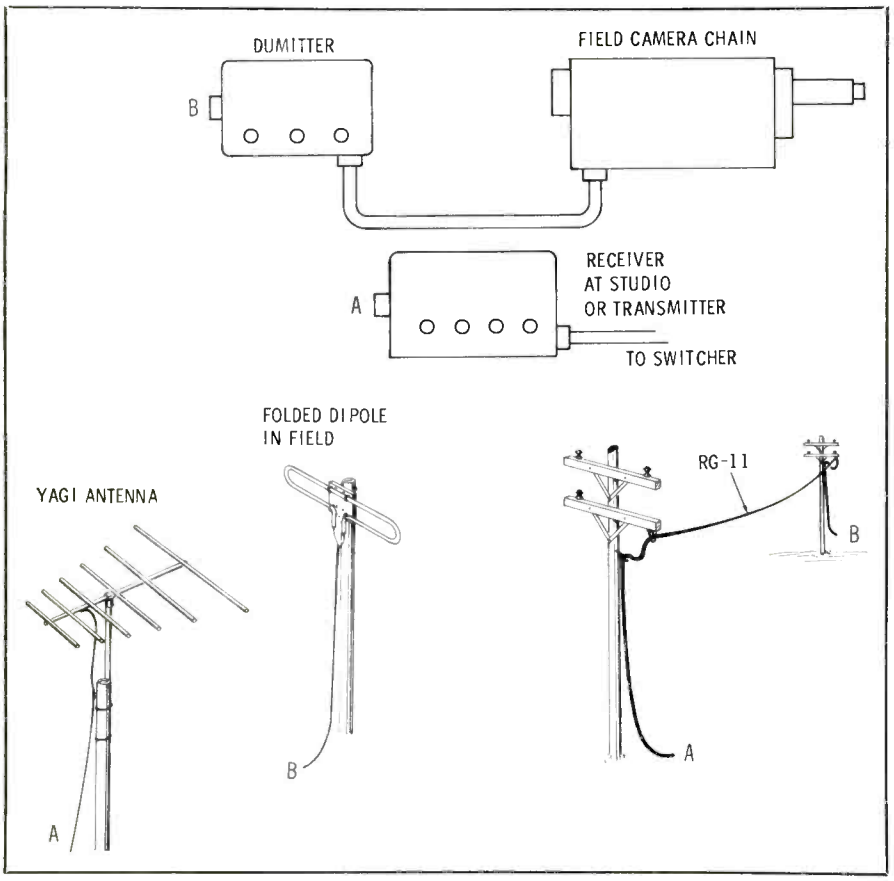
ENGINEERS' EXCHANGE



Carrier Current Cue Line

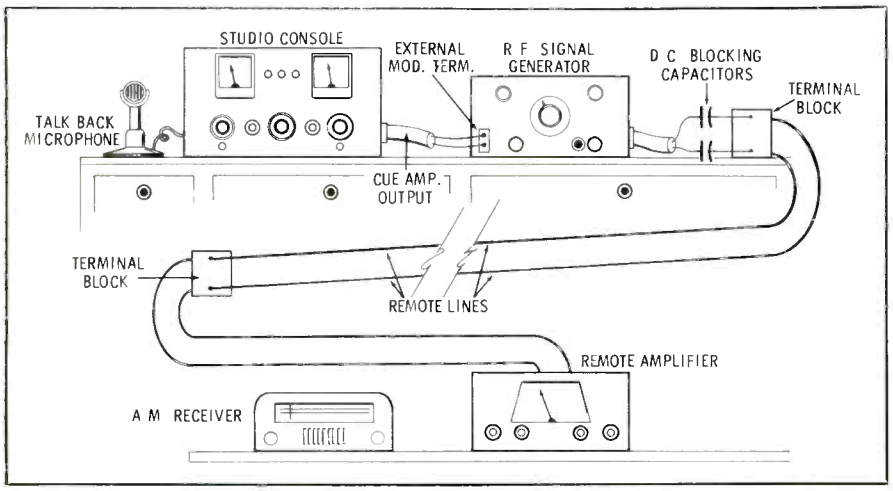
by Jack Alexander, Consultant, Washington, D. C.

It is possible to use a DC remote line for cueing while on the air.

We found that the line to one of our local dance band pickups was a DC pair without RF currents, and with no low-resistance shunts. To provide continuous cueing, we connected an old RF signal generator, set for maximum output, to the line and applied audio from the console cue amplifier to the external modulation terminals.

The signal generator and a standard AM receiver at the remote site (in this case, a club) were tuned to approximately 600 kc. By positioning the receiver at the operating position near the remote line, the modulated signal was picked up and detected in the normal fashion.

We thus had a perfect RF carrier-current cue line from studio to remote location, which could be used while the program was on the air. The same setup will operate two-way, of course, with two signal generators and a pair of AM radios.



Emergency Transformer Replacement

by Jack Alexander, Consultant, Washington, D. C.

Recently, our transmitter went off with a big bang, and we could not get it back on the air by means of the remote control system. At the transmitter site, we found that every time the B plus went on the main breaker tripped.

Quick checks with a VOM indicated a short circuit from primary to secondary, on the rectifier bank. Isolating the defective transformer was of no value because our B plus went directly to ground. We needed another transformer in a hurry.

Fortunately, one of our announcers was a ham and happened to have a transformer we felt would work. We insulated the unit from the transmitter rack with a large dry board, and connected it in place of the faulty transformer. When the power was switched on, it worked! Of course, some of the transmitter "insides" were hanging out on the floor, but only for the short time before a new transformer arrived.

A Remote TV Pickup System

by Torrance Downey, Chief Engineer, Voice of Cape Henlopen, Del.

The average small TV station has little or no money to spend for remote-pickup microwave transmitters. Yet there are many times when such a device would be quite valuable to such an operation.

Some years ago, DuMont introduced a device called the DuMitter. It is, in effect, a very low power television transmitter. The video is fed into a low-power RF amplifier which provides an output of about 2 watts on channel 2 or 3. This device can be used both as a line amplifier and a transmitter.

On one occasion, we wanted to televise the local high school football game, but had no way of getting the signal from the field to our transmitter. The local power company, in their usual generous way, gave us permission to string half a

mile of surplus RG-11 cable on their utility poles—and we were in business. Our field camera fed into the DuMitter which, in turn, fed the RG-11, on channel 2. At the other end, the signal was passed into our transmitter. This method resulted in a somewhat inferior picture, but enabled us, for the first time, to put our high school football team on television. The audio, of course, came along the telephone lines.

Another way of using these versatile units is as air transmitters! The output can be fed into a folded dipole antenna, and directed to a Yagi at the transmitter. If you are working on your own property, this is legal, as far as I can determine—provided power does not exceed that permitted by FCC Rules.

Make Your Own Station ID's on Film

by Herb Green, Consulting Engineer, Paramus, N. J.

Though 35-mm slides are fine for TV station ID's, a moving scene, which makes the presentation more interesting, is often desired.

Use a 16-mm movie camera that will take 100 feet of single perforated film. Load the camera with reversal sound film, and expose it all, in one continuous run if possible. We took our camera up in an airplane to shoot the transmitter and surrounding area.

Next, take the camera into a dark room, rewind, and again load the camera with the **same** film. This time, shoot a card lettered with the station call, or another suitable title. (If your previous scene was dark, use white letters on a black background.) Again expose the entire 100 feet of film without pausing.

The next step is to have an announcer record the ID on tape for two and three-quarter minutes, without pausing more than five seconds between phrases. Send this tape and the film to a processsing laboratory, and have them transfer the recorded ID to the sound track.

When the film has been processed and returned, you will have 100 feet of **positive** sound film with your station ID recorded both visually and aurally. The 30 short ID clips can be used over and over, and attached permanently to particular films and announcements.

1962 SUBJECT REFERENCE INDEX

Listings by subject, article title, and month of publication — for articles published January through December, 1962

NEW...
FROM CONRAC

A REGULATED 8″ MONITOR AND SCOPE HOUSING FOR DIRECT INSERTION IN THE STANDARD 13″ RCA CONSOLE

Available in two models:

CTA8/TU is designed to mount the Tektronix 527 Scope.

The **CTA8/RU** is designed to mount the RCA TO-2 Scope.

CONRAC DIVISION *Glendora, California*
GIANNINI CONTROLS CORPORATION

Telephone: AREA CODE 213-335-0541

DA Antenna Systems

(Continued from page 15)

or lower transit, means that the celestial body has crossed the meridian below the polar axis.

Horizontal distance—Horizontal distance refers to the distance between two points in surveying.

Local time—Local time is the true time at any given location. All points having the same longitude (lying on the same meridian) have the same local time; local noon is the moment of the sun's transit over the meridian on which a place is located, and is only used for astronomical purposes.

Mean solar time — The typical watch shows mean solar time. The expression mean time is derived from a mean solar day, which can be defined as the average time between two successive upper transits of the sun.

Optical distance — Optical distance is a distance measured optically, depending on a length from a small base at one end and the angle subtended by that base at the other. The base can be located at the observer's position, or at the far end, and may be vertical or horizontal; the base and the subtended angle may be fixed or variable. Typical methods of determining optical distance are by use of **stadia, range finder** or **subtense.**

Stadia is the method of determining distance by the solution of similar triangles, and involves the use of a transit and a level rod with two targets.

The range finder is an instrument which employs a known base, and is arranged so that angles to a distant point are observed from the ends of the base and translated directly into distance units.

Subtense is the method of determining optical distance by means of

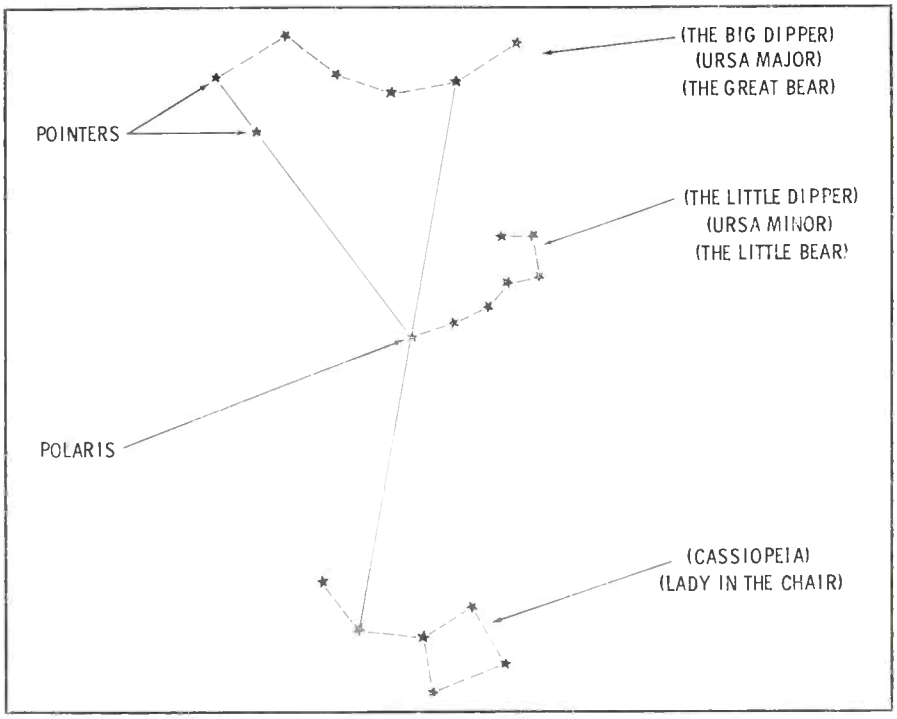


Fig. 4. Celestial diagram showing locations of the Big Dipper and Polaris.

a bar or base of known length, arranged horizontally. The angle subtended is measured by a transit or theodolite as accurately as possible, several times.

Sidereal time—Sidereal time is measured by the apparent motion of fixed stars. The sidereal day is the interval between two successive transits of the first point of Aries over the upper meridian of any place. and is equal to 23 hours, 56 minutes and 4.09 seconds of mean solar time. A sidereal day has 24 sidereal hours, each of 60 sidereal minutes with each minute of 60 sidereal seconds.

Standard time — Standard time is the civil time established by law or by general usage over a region or country. For each zone of 15° of longitude around the world the time varies by 1 hour; however, where a country overlaps a zone or more, in order to have a uniform national time, its legal time may differ by one-half or less from the neighboring zone. In England, the standard time is the mean local time on the meridian that passes through Greenwich. In the U. S. there are four official time standards—Eastern, Central, Mountain, and Pacific, corresponding to the mean local times of the 75th, 90th, 105th, and 120th meridian West or 5, 6, 7, and 8 hours respectively slower than Greenwich. In addition to these standards, Canada has Atlantic time, 4 hours slower than Greenwich, Newfoundland time, 3½ hours slower than Greenwich, and Yukon time, 9 hours slower than Greenwich.

Theodolite—A theodolite is also a precision surveying instrument similar to a transit, but has greater accuracy. It is used principally in geodetic triangulation, and is graduated so it can be read to the nearest second.

Transit—A transit is a precision surveying instrument used for measuring, laying out horizontal and vertical angles, and determining differences in elevations and distances. The vernier scales on transits are designed so they can be read to the nearest 10 seconds.

Traverse—Traverse is the procedure of surveying a line across a field.

Triangulation — Triangulation is also a surveying procedure which utilizes a triangle for determining the lengths of inaccessible lines. Trigonometry is used to determine all the dimensions of the triangle after three parts have been determined by measurement.

True solar time—True solar time is defined as the interval between two successive upper transits of the sun. The expression "apparent day" is used synonymously with true solar day. True solar days do not have equal length or duration.

The information presented above provides the necessary background for further considerations of antenna orientation. Such knowledge is important to the station engineer since he, as well as the consulting engineer and surveyor, has a definite responsibility in antenna system establishment.

We have already discussed the duties of the civil engineer or surveyor, who determines the exact geographic coordinates of the antenna site. Consulting radio engineers, on the other hand, do not perform surveying functions and are only responsible for:

1. The spacing (in feet) between towers.
2. The center-line of the array in relation to True North.
3. The base elevation for each tower (as determined from observation of a "Quad-sheet").
4. The accuracy required for triangulation and traverse.

The first two items have already been described; the last two will be covered next month. The concluding portion of this article will also discuss actual methods of, and equipment for, observations and orientation with Polaris: times, correction factors, and time conversion; procedures for observation of the sun. ▲

NEWS OF THE INDUSTRY

Ampex Sponsors Stereo Program

"Ampex Stereo Time," a half-hour FM-stereo musical program, is being sponsored by **Ampex Corp.** in 10 major markets. The program is being carried three times weekly by each of 10 FM stations. Featuring the first prerecorded Ampex stereo commercials, program format will be the same but music will be selected by the individual stations. Stations broadcasting the series are: KPEN-San Francisco, WVCG - Miami, WDTM - Detroit, SQXR-New York, WFLN-Philadelphia, WASH-Washington, D. C., KVIL-Dallas, KFMU - Los Angeles, WKFM - Chicago, and WBCN-Boston.

G.E. Asks FCC Adopt Stereo TV-Sound Standards

General Electric Co. has asked the FCC to adopt standards for compatible stereophonic sound transmission for television. At the same time, G-E has proposed a system developed by Robert B. Dome of the Television Receiver Dept. The company says the development program which resulted in its proposed TV-Stereo sound system has three main objectives: (1) To develop a compatible system which in no way would degrade the existing monophonic broadcast service; (2) To develop a system which would provide inexpensive stereo receivers; and (3) To develop a system which would not impose an unreasonable economic burden upon existing broadcast stations.

All of the objectives have been accomplished, according to G-E, and in its petition to the FCC, reported that its proposed system has had "limited field testing under actual operating conditions." This testing included operation under strong co-channel interference which occurred when temperature inversion produced exceptional propagation from a Canadian station operating on the same television channel. These field tests satisfied G-E engineers that their system produced consistently good stereo sound whenever a usable TV picture was being received.

Psychological tests, performed to determine reaction to stereo TV sound, indicated that it was more pleasant than monaural, the company said, adding, "it was a result that might not be unexpected." According to G-E, the separation inherent in stereophonic sound is enhanced by the addition of visual separation on the TV screen; with the added ability to both see and hear from which side of the orchestra sound is coming, realistic presence reaches a peak. Considering the perspective and depth TV-Stereo may lend to television plays, sports events, and the like, it may well be the next major improvement in telecasting.

European Antenna Mfr. Opens in U.S.

CO. EL. (Complementi Elettronici, S.P.A. of Milan), manufacturer of broadcasting and communications antennas, has announced the opening of its sales offices in the U.S. Although relatively unknown in the United States until recently, the company enjoys an excellent world-wide reputation and has supplied television transmitting antennas to all five continents. The company's U.S. offices, in Westfield, N. J., will be headed by R. J. Rainey. CO. EL's entire line of products will be made available, including low and high band and UHF TV antennas; VSB filters, notch diplexers, filterplexers, and harmonic filters; 10-mc bandwidth FM antennas; rigid transmission line; microwave parabolic antennas, passive reflectors, and waveguides; parabolic tracking and radiotelescope antennas; shortwave fixed and rotating high-power log periodic antennas.

FM-Stereo Stations To Hit 250

By the end of this year, two hundred and fifty FM stations—roughly 25% of those currently in operation—will be transmitting FM stereo. This is the prediction of **Harold L. Kassens, chief of the FCC's Aural Existing Facilities Branch.** Mr. Kassens said the rate at which conversion notifications are being received, the number of FM stereocasters could go as high as 300 before next January 1, and ultimately FM stereo will replace monophonic FM.

While the size of monaural record libraries impedes conversion of large stations, Mr. Kassens observed, new stations do not have this problem and the majority of them will be stereo. He also said the FCC hopes its proposed rules revision will provide frequencies needed for FM radio to expand as the country grows. The Commission believes, Mr. Kassens stated, that broadcasters now operating marginal AM stations will be

encouraged to convert to FM when they realize that the new frequency assignment plan will assure them of guaranteed service areas protected against interference.

McMartin Moves to New Plant

McMartin Industries, Inc., Omaha, Nebr., is moving to a modern new plant, according to Ray McMartin, President. The new location, which increases plant capacity by approximately 14,000 sq. ft., will contain the firm's general offices, engineering laboratories for research and development, and production facilities. The company, founded in 1956, manufactures audio amplifiers for the background music industry, and through a national sales force of 54 men, provides a large percentage of the multiplex receivers used by background music operators to service individual subscribers. The firm also produces electronic equipment for RCA and Collins Radio.

Sound Corp. Opens New Plant

Sound Corporation of America, manufacturers of "Channel-Matic" background music systems, tape cartridges, and other related play-back equipment has consolidated all administrative, R & D and production facilities at 45 New Street, Worcester, Mass. According to Richard P. Ellison, President of the firm, the Worcester plant not only provides additional R & D facilities presently required for their new production line, but will also enable the company to meet future production demands.

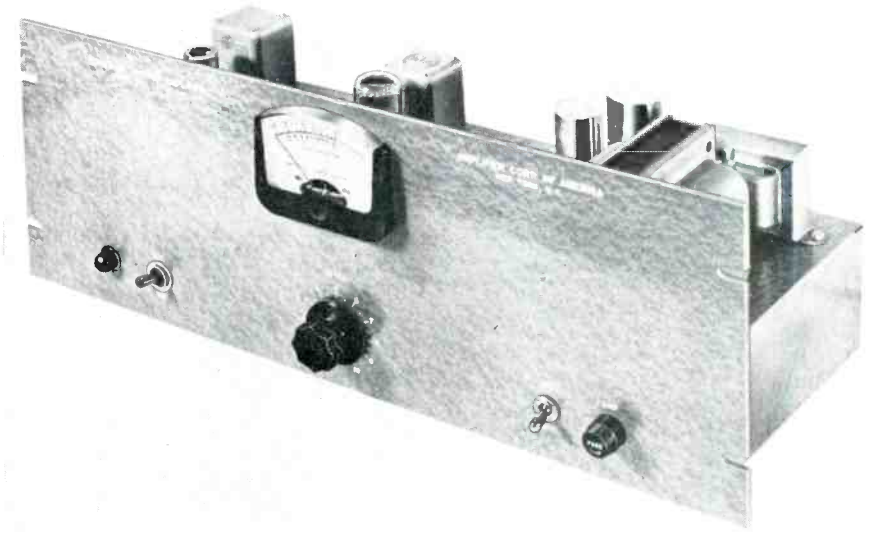
Electrical Engineering Exposition

Efforts are underway to assure the Electrical Engineering Exposition of the largest gathering of leading electrical engineers and management executives ever assembled in any one place. Literature and informative material, stressing the value of attending, have been placed before more than 200,000 electrical-electronic engineers and management executives by the **American Institute of Electrical Engineers,** sponsors of the Exposition. The Electrical Engineering Exposition will be held January 28-31 in the New York Coliseum as part of the 51st Winter General Meeting of the AIEE. The Reber-Friel Company, management firm in charge of the event, reports that nearly 50% of the available exhibit space has already been reserved.

Free Hunting and Fishing Tape Series

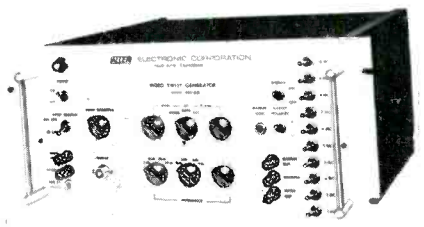
Authentic hunting and fishing stories are the subjects of two radio tape series now being offered by the **Utica Duxbak Corp.** and **Horrocks-Ibbotson Co.** Each series contains 13 scripts of 15 minutes duration, and are available on a free-of-charge, exclusive-market loan basis to radio stations. Each script contains breaks for local sponsors, one complete and authentic story, and a question-and-answer section.

NEW PRODUCTS



Constant-Output Amplifier

Consisting basically of a two-stage push-pull circuit, this new constant-output amplifier by **Amplifier Corp. of America**, New York, N. Y., provides optimum limiting action with minimum distortion. The input may be connected either directly to a balanced 600-ohm line or it may be bridged across an unbalanced line without upsetting the impedance. The gain control feature automatically keeps input changes as great as 40 db within ±2 db of peak modulation levels, eliminating the element of human error. Complete technical specifications and prices of the Model 740-C-1 are available from the manufacturer.

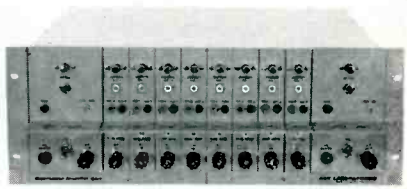


VTR Sweep Generator

A new generator designed for alignment and testing of video tape recorders has been announced by **Visual Electronics Corp.** Called the Video Sweep Generator Model 960-GM, the unit is manufactured by **Allen Electronic Corp.**, Palo Alto, California. It can test VTR signal systems from video input to video output; provide an output for simultaneous display of individual head and electronics performance; evaluate combined or individual performance of playback preamplifiers, switcher, modulator, and demodulator; and aid in pinpointing noise sources.

The unit allows all four head channels to be quickly matched to eliminate banding, simplifies the record-head-current optimization procedure, and provides a standard test signal that can be prerecorded on tape leader. The sweep

generator, which sweeps 0-10 mc at a rate of either 60 or 960 cps, can also be used for conventional TV broadcast-equipment alignment. In the 960-cps mode, it can be locked to the drum servo of a VTR to give a 0-10 mc sweep of each head pass to permit viewing a simultaneous display of all four head characteristics on a standard waveform monitor or oscilloscope. Markers may be individually switched in or out at frequencies of 1-10 mcs. The 960-GM has an internal gated mixer for adding sync and blanking for operation in a system with clamp amplifiers. With or without the gated mixer, the instrument is available for 525 and 625 line systems; other TV standards are available on request.



Solid-State Video Amplifier

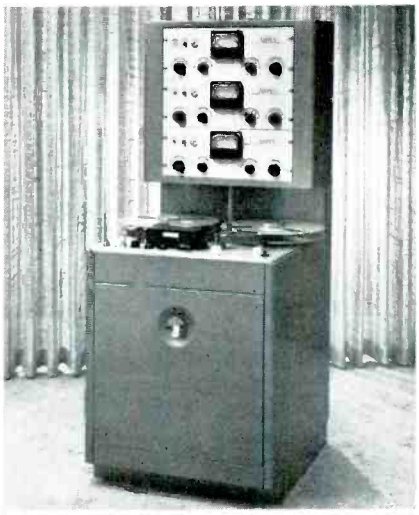
A transistorized video distribution amplifier, Model VA-1, has been introduced by **CBS Laboratories,** Stamford, Conn. Designed specifically for television broadcasting, military, and industrial video systems, the new solid-state package contains eight plug-in amplifiers (also sold individually) and two power supplies. Capacity is 24 outputs, at approximately $100 per output, in a package occupying 7¼" in a standard rack. Utilizing large amounts of feedback, the unit has provisions for presetting individual amplifier gains at 0, 3, 6 or 9 db. The package is powered by a dual supply arrangement in which a standby power supply takes over automatically if the prime supply power fails.

New 1-kw AM Transmitter

A new 1,000-watt AM broadcast transmitter, Model BC-1G, has been introduced by **Gates Radio Co.,** subsidiary of Harris-Intertype Corp. The transmitter is available with either silicon or tube rectifiers. In the solid-state model, the high-voltage power supply utilizes 60 silicon diodes, each rated at one full amp. The combination of a cathode-follower audio driver, low leakage reactance in the modulation transformer, and modulating the RF driver as well as the power amplifier, results in low intermodulation distortion.

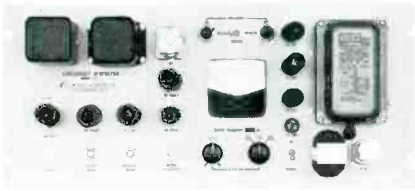
Line Voltage Regulator

Availability of the Model VR-6 voltage regulator has been annnounced by **Flow Corp.,** Cambridge, Mass. The device is a servo-controlled motor-driven variable autotransformer designed particularly to maintain line voltage at 115 ±2 volts with inputs from 80-115 volts VC, 60 cps. The compact unit measures 15" by 8", can handle loads up to 30 amps, and is easily mounted due to its smooth, non-protruding outer surfaces. The VR-6 is priced at $275, f.o.b. Cambridge.



Wide-Track Magnetic Recorder

The first wide-track magnetic tape master recorder was introduced by **Ampex Corp.** at the recent Audio Engineering Society convention. The new three-channel Model 330-3 uses 1" tape, specially-designed heads, and modified Model 300 transport and electronics to provide improved signal-to-noise ratio, frequency response, distortion and flutter over previous tape and 35-mm magnetic-film recorders. Major modifications include: two heavier torque motors for optimum performance with 1" tape on 14" reels at 15 and 30 ips speeds; a fluid-damped flywheel which reduces flutter and wow (0.05 rms max.); and an improved recording amplifier power output with reduced distortion. The recorder employs wide-track and fixed-azimuth heads with three 250-mil tracks on 335-mil centers. Priced at $7,500 unmounted and $7,875 console-mounted, it is available on a special order basis.



SCA Subcarrier Generator

Moseley Associates, Inc., Santa Barbara, Cal., announces their newest subcarrier generator, Model SCG-4, for SCA multiplex operation. The unit is designed to operate on any frequency in the SCA spectrum and meets FCC specifications for multiplex and stereo operation. Mounted on an 8¾" panel, all tubes, plug-in relays and capacitors, and adjustments are available from the front. Heat dissipating shields are used for reliability and extended tube life.

New Transmitting Tube Manual

The new RCA Transmitting-Tube Manual includes the latest information on power tubes and their applications, as well as the new "cermolox" family of

Advertisers' Index

Professional Services

ceramic-metal types. The 320-page handbook, just published by the **RCA Electron Tube Division,** has been revised and updated to contain new single-sideband ratings, a discussion of linear RF amplifiers, and calculation of operating conditions for 2-tone modulation. Maximum ratings, typical operating values, curves, and characteristics are given for more than 180 types of transmitting and related rectifier tubes in the technical data section. The popular circuit section contains typical transmitting circuits. Available from RCA distributors or directly from the company, price is $1.00.

New Tube Tester

A new tube tester, Model 539C, by **Hickok Electrical Instrument Co.,** Cleveland, will test VR Tubes, low power thyratrons, "4-digit" industrial types and all the newest tubes, including compactrons, Novars, Nuvistors and 10-pin types. This industrial and laboratory tube tester checks tubes to handbook specifications, and evaluates voltage-regulator tubes under actual operating conditions. The instrument has provision for monitoring of plate current, through panel terminals, facilitating matching or balancing of tubes. Tests may be conducted under fixed or self-bias conditions, and nonstandard tests are facilitated by the panel terminals giving access to grid, plate, cathode, and heater circuits. The unit is available from Hickok distributors and carries a suggested user price of $485.00.

Sound Reproduction Book

"Reproduction of Sound," by Edgar Villchur, is announced by its publisher, **Acoustic Research, Inc.,** Cambridge, Mass. This 93-page book is a nonmathematical analysis of the nature of sound and of how reproducing components work. The illustrated book may be used as a general survey of principles, or as a pre-engineering text and introduction. The first few chapters deal with the fundamental nature of sound and the standards applied to high-fidelity reproducing systems. A brief discussion of recording, with emphasis on stereo, is followed by a treatment of each of the reproducing elements in turn: pickups and needles, preamplifiers and amplifier, speaker systems, and the listening room. Available directly from Acoustic Research, price is $2.00, postpaid.

Broadcast Station Guide

The new Howard W. Sams "North American Radio-TV Station Guide," by Vane A. Jones is a ready source of information on any TV as well as any AM or FM station in the U.S. and its possessions, Canada, Cuba, Mexico, and the West Indies. Contains over 7,500 station listings, including 5,000 AM and 1,500 FM radio stations by city, state, and frequency; and nearly 1,000 VHF and UHF TV stations. Also included are the 14 U.S. maps—one for each of the 12 VHF channels, a UHF TV map, and an FM station map. Price is $1.95.

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

GOVERNMENT SURPLUS, NEW 10 CM. WEATHER RADAR SYSTEM—Raytheon, 275 KW peak output S band. Rotating yoke P.P.I. Weather Band 4, 20 and 80 mi. range. Price $975 complete. Has picked up clouds at 50 mi. Wt. 488 lbs. Radio Research Inst. Co., 550 5th Ave., New York, New York. 5-62 8t

Will buy or trade used tape and disc recording equipment—Ampex, Concertone, Magnecord, Presto, etc. Audio equipment for sale. Boynton Studio, 295 Main St., Tuckahoe, N. Y. 10-62 6t

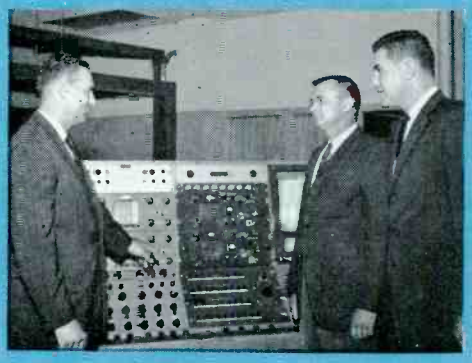
Collins Tape cartridge machines $275 ea. Gates Sta-Level $150. Concertone Stereo Recorder $375. Excellent condition. Write —Box 125, Lafayette Hill, Pa. 11-62 2t

POSITION WANTED: Will receive my BS degree in Speech, with Area Concentration in Radio and Minor in Psychology, Jan. 63. Have 3 years experience announcing and producing news, classical and popular music, sports, and commercials. Can run my own board. Seek permanent position on Broadcasting Staff—will relocate for right opening.
BROADCAST ENGINEERING Box 1162-1

10-inch Soundcraft blank recording discs, package of 25, $9.00, postpaid; cash, check or M.O. Studio, 6110 Santa Monica Blvd., Hollywood 38, California. 12-62 2t

MISCELLANEOUS

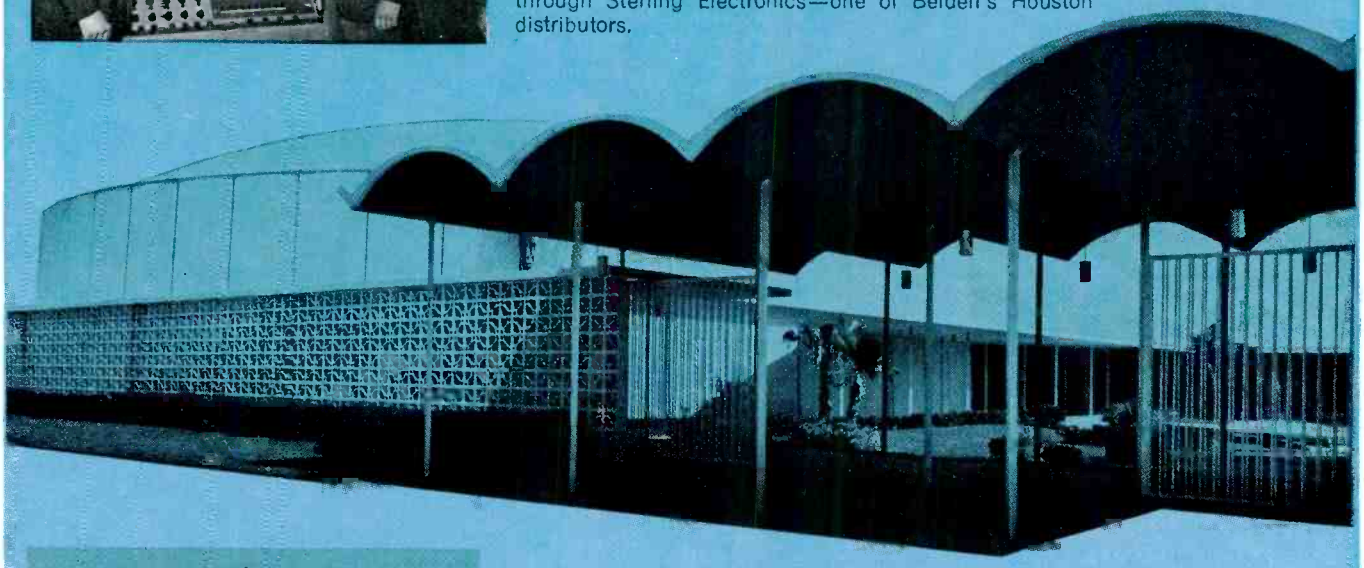
ENGINEERING And Art Degrees earned through home study. Electronics, Mechanical, Liberal Arts. When writing specify course desired. Pacific International College of Arts & Sciences, primarily a correspondence school. Resident classes also available. 5719-W Santa Monica Blvd., Hollywood 38, California. 8-62 6t



This is KTRK-TV's new broadcasting station in Houston, Texas. The exclusive use of Belden camera, audio, and control cables by this ABC affiliate helps assure KTRK of continuous, highly efficient programing.

Looking over part of this 155,000-foot Belden wire and cable installation are Byron Turner, Salesman, Sterling Electronics (left), Jess Mitchell, KTRK Engineer (center), and Bill Donahoe, Belden Territory Salesman. They are standing in front of a Belden wired control panel in one of the many KTRK studios.

All of the wire and cable for this installation was placed through Sterling Electronics—one of Belden's Houston distributors.



155,000 ft of Belden Audio, Camera, and Control Cable helps keep KTRK-TV on the air

For all TV and radio broadcasting, recording studios, remote control circuits, and similar applications, Belden manufactures the most complete line of application engineered wire and cable. Call your Belden electronics distributor for complete specifications.

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WIREMAKER FOR INDUSTRY
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power supply cords • cord sets and portable cordage
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8-10-2

Can a tube conversion in your transmitter result in major improvements?

Yes... and here's why:

Amperex transmitting tubes—more reliable than the tubes in your transmitter at present—give you these improvements in 1KW to 25KW AM, FM and TV transmitters: longer life without premature failure worries and lower dollar-per-hour operating cost.

The proof? For the past 3 years, Amperex has successfully assisted with conversions in broadcasting stations all over the country—and we'll be glad to tell you where and how.

Interested? Amperex has not only the tubes but the accessories and all the applications engineering assistance necessary for your conversion.

If your transmitter is one of those listed below:	...and, at present, it uses any of the following tubes:	...these Amperex tubes give you major improvements:
1KW FM	7C26	5759/501-R
3KW FM	7D21	6076
5KW FM or TV	8D21	6076
10KW FM	5518	SD505
5-25KW AM or FM	5762/7C24 or 5762A	7459
5-25KW TV	5762/7C24 or 5762A	7900

For complete information, write to Amperex—or call your local Amperex distributor. Amperex Electronic Corporation, Power Tube Department, 230 Duffy Avenue, Hicksville, L. I., N. Y.
In Canada: Philips Electron Devices Ltd., 116 Vanderhoof Ave., Toronto 17, Ont.

Ask Amperex