



A HOWARD W. SAMS PUBLICATION



JULY 1965/75 cents

Broadcast Engineering

*the technical journal
of the broadcast-
communications industry*



▲
**STAIRSTEP
MULTIBURST
SINE² WINDOW
SMPTE TAPE TEST SIGNAL
SYNC & BLANKING INSERTER
B & W REFERENCE • TAPE REFERENCE**
TESTING?

**VERTICAL INTERVAL TEST SETS • BAR & DOT
PLUGE MONITOR SET UP SIGNAL
NEW VITEAC TEST SIGNAL
DIAGONAL CROSSHATCH
COLOR BARS
CUE DOT**

▼
and others

ONLY RIKER MAKES THEM ALL

First to manufacture all-transistor Test Signal Generators, RIKER equipment has been proven by years of use in all major networks, leading TV stations, long lines carriers, government agencies and the White House, showing the way to ultimate accuracy and reliability. All RIKER equipment is packaged in identical modules allowing unequaled flexibility.

The great variety of possible combinations guarantees a Test Set to meet your exact needs. Let us help in selecting proper modules. Try our equipment in your facilities—no obligation, of course. Phone or write today for description and waveforms.

30 Day Delivery Guaranteed

VIDEO TEST SIGNALS

All Signal Generator modules provide **Dual Isolated Outputs**. Test Sets offer 6 **simultaneous** isolated outputs. You may include only the waveforms required—expandable later.



VERTICAL INTERVAL TEST SIGNALS

VITEAC (Video Transmission Engineering Advisory Committee) recommended Vertical Interval Test Signals—4 simultaneous signals. Two in Field 1, lines 18 and 19; changing to two others in Field 2, lines 18 and 19; or automatic 2½ minute signal sequencing.

RIKER INDUSTRIES, INC.

NORDEN LANE, HUNTINGTON STATION, NEW YORK. PHONE 516 HA 1,3444



...thinking always of tomorrow

• ATLANTA • LOS ANGELES • DETROIT

Circle Item 1 on Tech Data Card

ANDREW

Lower attenuation...
new HELIAX®

**1/4", 3/8", 1/2" flexible
coaxial cables for**

- Military
- Broadcast
- CATV
- Mobile Radio
- Data Processing and
Instrumentation Systems

These new air and foam cables offer lower attenuation in small physical sizes. Type FH1, 1/4" Foam HELIAX has 30% lower attenuation, 60% smaller size and 50% less weight than RG8/U. The copper inner and outer conductors assure optimum electrical performance with long life reliability. Available in long splice free lengths with or without polyethylene jacket.

For additional information on HELIAX, contact your regional Andrew sales engineer or write P.O. Box 807, Chicago, Illinois 60642.

Andrew
CORPORATION
28 YEARS OF ENGINEERING INTEGRITY

6-65
EUROPEAN OPERATIONS: ANDREW CORPORATION, HØJSGAARDS-ALLE 82, HELLERUP, DENMARK

Circle Item 2 on Tech Data Card

July, 1965

publisher
Howard W. Sams

editor
Forest H. Belt

managing editor
James M. Moore

ass't to the editor
Norman D. Tanner

associate editor
Allen B. Smith

regional editors
George M. Frese, Northwest
Thomas R. Haskett, Central
Howard T. Head, Wash., D.C.
Robert A. Jones, Midwest
George C. Sitts, East

research librarian
M. D. Bishop

production
Esther M. Rainey, Manager
Robert W. Pool, Art
Paul A. Cornelius, Jr., Photography

circulation
Pat Tidd, Manager
Katherine Krise, Ass't
Cora La Von Willard, Ass't

advertising and editorial assistants
Hazel Boyer
Rebecca Clingerman

advertising sales offices
Hugh Wallace, Sales Manager

eastern
Gregory C. Masefield
Howard W. Sams & Co., Inc.,
3 West 57th Street
New York, N. Y., MU8 6350

midwestern
Robert N. Rippy
Howard W. Sams & Co., Inc.,
4300 West 62nd Street,
Indianapolis 6, Indiana, AX1 3100

southwestern
C. H. Stockwell Co.,
4916 West 64th Street,
Mission, Kansas, RA2 4417

western
The Maurice A. Kimball Co., Inc.,
2008 West Carson Street,
Suites 203-204, Torrance, California
320-2204; and 580 Market St.,
Room 400, San Francisco 4,
California, EX 2-3365

foreign
John Ashcraft, 9 Rue Lagrange,
Paris 5, France, ODeon 20-87
John Ashcraft, 12 Bear Street,
Leicester Square, London W.C. 2,
England, WHitehall 0525
International Media Representatives,
Ltd., Kisha Kurabu 14, 2-chrome
Marunouchi, (502) 0656

Copyright 1965
by Howard W. Sams & Co., Inc.

BROADCAST ENGINEERING is published monthly by Technical Publications, Inc., an affiliate of Howard W. Sams & Co., Inc. Editorial, Circulation, and Advertising headquarters: 4300 West 62nd Street, Indianapolis 6, Indiana. SUBSCRIPTION PRICES: U.S.A. \$6.00, one year; \$10.00, two years; \$13.00, three years. Outside the U.S.A., add \$1.00 per year for postage. Single copies are 75 cents, back issues are \$1.00.

the technical journal of the broadcast-communications industry



Broadcast Engineering

Volume 7, No. 7

July, 1965

CONTENTS

Features

- Increasing AM Transmitter Modulation Power** George M. Frese 10
A review of the techniques which can be used to increase modulation efficiency.
- Considerations for the Maintenance Log** Thomas R. Haskett 13
If maintenance-log requirements have troubled you, here's the answer.
- A New Look at Negative Resistance—Part 1** C. G. Cunningham 16
A whole new family of semiconductor devices utilizes this phenomenon.
- Choosing Cable for CATV** Lon Cantor 18
The lifeline of community-antenna systems deserves careful selection.
- Checking the Pattern** Eldon B. Chick 20
What to do with measured data to perform a series of quick checks.
- Cartridge Recorder/Playback With Automatic Cueing** Joseph D. Coons 22
A control system for using commercial units in the newsroom.
- Antenna and Transmission-Line Measurements** William H. Artzberger, Jr. 24
A practical maintenance procedure for checking the condition of antennas.

Departments

Letters	6	Engineers' Tech Data	54
Washington Bulletin	35	New Products	56
Engineers' Exchange	42	Advertisers' Index	57
News of the Industry	46	Classified Ads	58

Five of the six 235' towers in the complex array being readied for service at the new 50-kw facility of WIBC, Indianapolis, Indiana show in our cover photo. Additional information on the installation appears on page 52.



The soundest sound in broadcasting is the new sound of GATES



ATTACHE "70"



DYNAMOTE "70"



COURIER "70"



UNIMOTE "70"

Four new portable transistorized remote amplifiers from GATES

Four handsome, fully transistorized models. All rugged, compact and lightweight. Studio console quality.

ATTACHE "70"—three microphone mixing channels. Two are switchable to accommodate tape recorders or turntables. Extremely light weight—10 lbs. with batteries.

DYNAMOTE "70"—four channels. Broadcasting's newest and most deluxe. Accommodates nine signal sources, including two high-level inputs, two magnetic phonos and built-in tone oscillator. Weighs 12¼ lbs., including batteries. Ideal

for major news coverage or complex remote originations.

COURIER "70"—two-channel amplifier provides two microphone mixing channels, master gain control, illuminated VU meter. Weighs only 8¾ lbs. with batteries.

UNIMOTE "70"—single-channel, fully transistorized remote or utility amplifier is no larger than a table radio. Ideal for mounting under a lectern or pulpit.

For full details, write for ADV-160, our new attractive 8-page illustrated brochure.

**HARRIS
INTERTYPE
CORPORATION**

GATES

GATES RADIO COMPANY
A Subsidiary of
Harris-Intertype Corporation
QUINCY, ILLINOIS 62302

Offices: New York, Houston, Los Angeles, Washington, D. C.
Export: Rocke International Corporation, New York City
In Canada: Canadian Marconi Company, Montreal

Circle Item 3 on Tech Data Card

How Fairchild puts psycho-acoustics to work for your station!

Now you can fully utilize the listening capabilities of your audience! Scientists for years have investigated and tabulated the various phenomena that make people want to listen. These findings come under the broad category of psycho-acoustics. Now Fairchild has harnessed many of these findings and incorporated them into a line of unique world-renown audio control devices which produce a sound easier to listen to and easier to perceive... in short a bright, crisp, lively sound which keeps your audience listening. This is the sound you need to help you sell your station to your audience and to your sponsors.



THE DYNALIZER

the Psycho-acoustic way to achieve a bright, full bodied easy-to-listen-to, easy-to-perceive station sound. The Dynalizer contours your station's frequency response to fully utilize the listening capabilities of your audience. Makes your station sound really big, big, big even on the smallest pocket receivers.



THE CONAX

the world-accepted way to control high frequency spillovers in FM due to preemphasis. Lets your station maintain real high levels even with brass and crashing cymbals and still avoid FCC citations.

THE REVERBERTRON



the new compact reverberation system which gives your station that real big voice. With the Reverbertron you can have that Carnegie Hall effect as close as the gain control on the Reverbertron. And there's the added plus of an increase in apparent loudness of your station sound due to reverberation, as originally described by Dr. Maxfield.

For complete details on psycho-acoustic sound that sells write to Fairchild — the pacemaker in professional audio products.

FAIRCHILD
RECORDING EQUIPMENT CORPORATION
10-40 45th Ave., Long Island City 1, N.Y.

Circle Item 5 on Tech Data Card

LETTERS to the editor

DEAR EDITOR:

In the "Letters" column of the May issue, Mr. William A. Kingman (CE, KOWL, Lake Tahoe) brought up a point concerning my article "Protective Maintenance at the Studio" which appeared in the November, 1965 issue. Mr. Kingman was concerned about modifying the frequency response of a microphone channel in a broadcast console in the light of whether the equipment would then pass the tests required by the FCC. In answer, the Rules state in Section 73.40(4):

"The audio - frequency transmitting characteristics of the equipment from the microphone terminals (including microphone amplifier unless microphone frequency correction is included in which event proper allowance shall be made accordingly) to the antenna output does not depart more than 2 decibels from that at 1000 cps between 100 and 5000 cps."

The part overlooked by Mr. Kingman is the parenthesized phrase which allows frequency-response correction to be made in the microphone amplifier (pre-amplifier). The circuits are supposed to be flat so far as is practical, but frequency-response correction may also be added. As described in my article, the circuits as modified will have the same response after proper allowance has been made for the effect of the lower-value coupling or cathode-bypass capacitors.

Using an external filter between the microphone output and the preamplifier, as Mr. Kingman suggests, would provide similar results, but you will need to be careful about hum pickup, particularly if the filter includes inductances.

I should reiterate that these circuits were modified, not to make the audio sound "tinny" nor to give the station an unusual sound, but to improve the quality of the audio by removing excessive bass response caused by improper use of the microphone.

A series of defeat switches in the modified circuits will allow use with or without altered response, if such versatility is required. Care should be taken to keep leads short and avoid the use of multiple grounding points.

LYNN R. WILLIAMS, CE
WBEJ, Elizabethton, Tennessee

THIS IS A POWER MISER. THIS IS A POWER HOG...



The best definition of a "power miser" in CATV equipment is the Ameco ATM-70 Mainline Amplifier. It is strictly solid-state and consumes a mere 5 watts of power. ■ On the other hand, if it is a "power hog" you are seeking... turn to a tube-type mainline amplifier. You will find it is ten times the size of the Ameco ATM-70 (and it won't perform nearly as well), but the typical tube-type amplifier will gulp somewhere in the neighborhood of 120 watts of power for you. ■ Of course, the tubes will play havoc with the total power bill each month, but the local power company will love you! ■ Or you can bank all that money by going Ameco solid-state. Ameco is the *only* cable equipment manufacturer who can build you a 100% solid-state CATV system from head-end modulation to active taps.

ameco

P. O. Box 11326
PHOENIX, ARIZONA 85017
TELE: 602-252-6041

**AMECO QUALITY...
THE ENVY OF CATV**

Circle Item 4 on Tech Data Card
BROADCAST ENGINEERING

We'll do a month's work for you free!

Just send this page to CBS Laboratories. We will send Audimax and Volumax to your station. If you want to send them home after 30 days, we will pay the freight. But if you want to make your station their permanent home, all you do is pay \$665 each.

At the end of that period, chances are you will be so sold on Audimax and Volumax you will want to buy them.

And you should. After all, they can increase your program power 8 times.

Solid state Audimax is an automatic level control years ahead of the ordinary AGC. By automatically controlling audio levels, it frees engineers, cuts costs and boosts your signal.

Volumax, also solid state, out-modes conventional peak limiters by controlling peaks automatically with-

out side effects. By expanding effective range and improving reception, it brings in extra advertising revenue.

We can afford to give Audimax and Volumax away free. Because we know they're so good, most people can't afford to give them back.

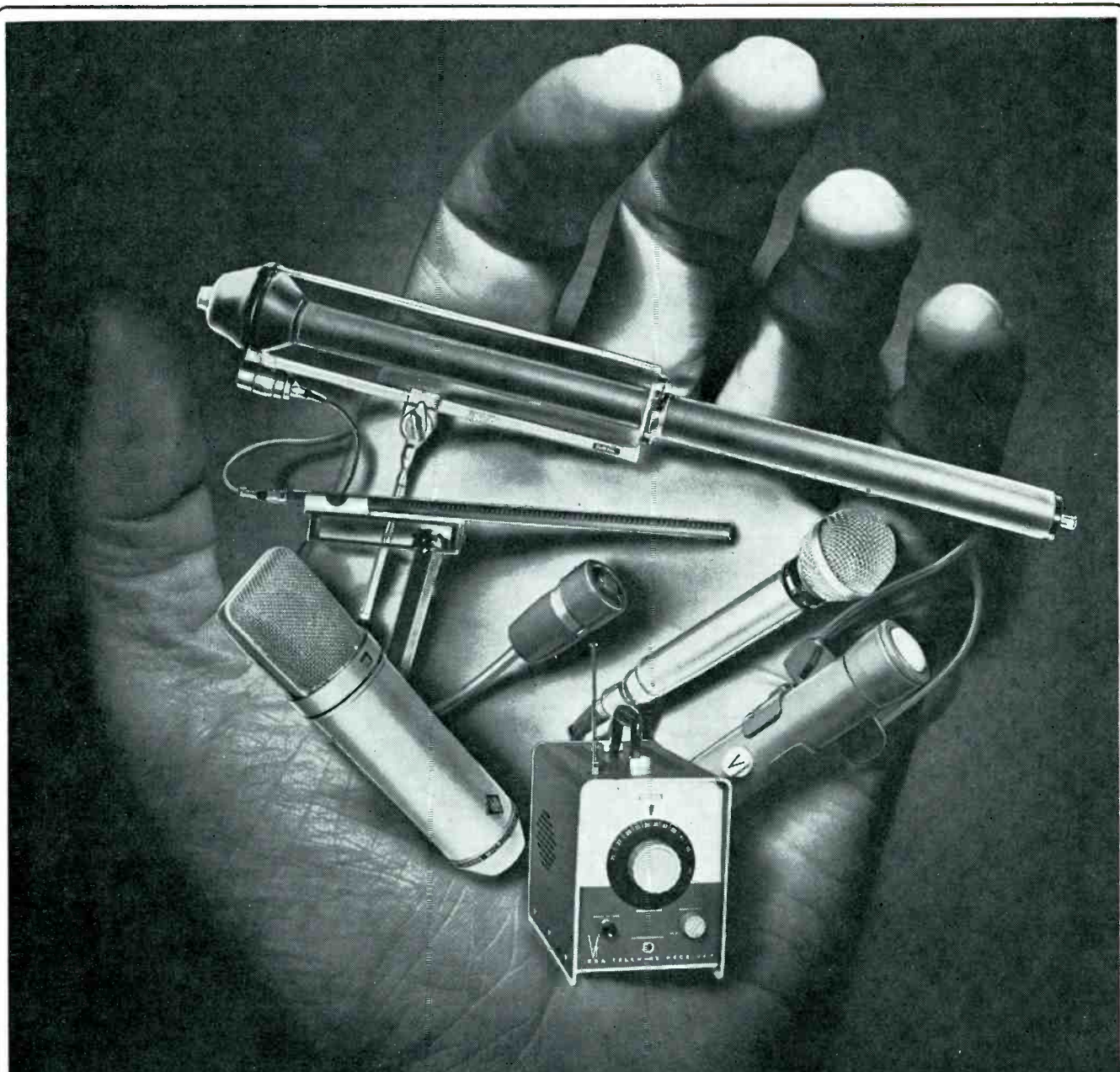


CBS LABORATORIES

Stamford, Connecticut. A Division of
Columbia Broadcasting System, Inc.



Circle Item 6 on Tech Data Card



NATION-WIDE SOURCE FOR MICROPHONES



HARVEY RADIO CO., INC.

103 West 43rd Street/New York, N.Y. 10036 / (212) JUdson 2-1500

Federal Electronics, Inc. (Subsidiary) / Vestal Parkway, Vestal, N.Y. / (607) PLoneer 8-8211

One call to Harvey covers every need for professional microphones. Shotguns, wireless mikes, boom mikes, lavaliers. We cover the spectrum from ultra-directional cardioids to bi-directional cosines to non-directional pressure types. Whether it's dynamic, condenser or ribbon, we're stocked in **depth** with all major brands and types.

As America's oldest distributor of professional broadcast and studio recording equipment, Harvey is also stocked in depth with everything from studio tape decks, image orthicons and cables, to the smallest replacement parts.

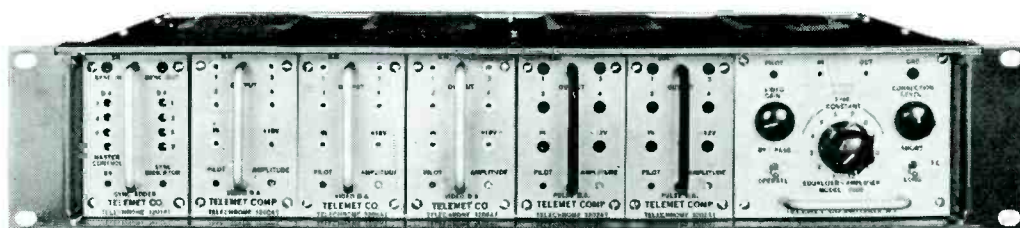
The three major networks rely on Harvey as their dependable source of supply. They save time, eliminate hunting around. Even if you're in Wichita Falls, you will too. To order, write or call collect today.

ALWAYS ON HAND: ALTEC • A K G • ELECTRO-VOICE • NEUMANN • R C A • SENNHEISER • SHURE • VEGA •

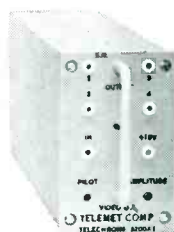
Circle Item 7 on Tech Data Card

SATISFY ALL DISTRIBUTION REQUIREMENTS

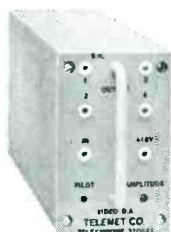
with these transistorized and completely self-contained modules



MODEL 4000 Rack Mounting Frame provides common mounting facility for any combination of modules.

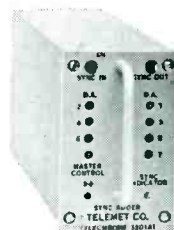


MODEL 3200

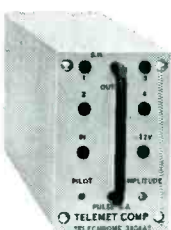


MODEL 3206

MODELS 3200 and 3206 Video Distribution Amplifiers feature high impedance bridging inputs and 4 identical isolated outputs, source terminated in 75 ohms.



MODEL 3201



MODEL 3202

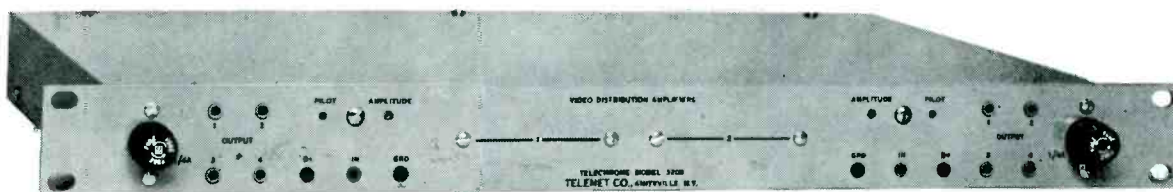
MODEL 3201 Sync Adder provides a means of mixing sync into any or all video amplifiers in the frame.

MODEL 3202 Pulse Distribution Amplifier regenerates sync, blanking or drive pulses, providing 4 identical isolated outputs.



MODEL 3205

MODEL 3205 Equalizer Amplifier now contains frequency boost circuits providing up to 10 db at 4.5 Mc. Slope adjustable to match cable. Also provides adjustable time constant correction. Ideal for Frequency Phone Correction of long coaxial lines.



NEW MODEL 3208 Dual Video Distribution Amplifier actually contains 2 separate and completely independent amplifiers and power supplies of the Model 3206 type in a space-saving configuration.



TELEMET COMPANY
a division of
GIANNINI SCIENTIFIC CORPORATION
185 DIXON AVENUE, AMITYVILLE, N. Y. • PHONE (516) 541-3600

Circle Item 8 on Tech Data Card

INCREASING AM TRANSMITTER MODULATION POWER

by **George M. Frese**, Western Regional Editor and Consulting Engineer, East Wenatchee, Washington—A discussion of various factors which contribute to an improvement in radiated modulation power.

Most broadcasters believe they can improve their service, sound more powerful, and extend their coverage using advanced modulation techniques. What can really be done in this area? If a transmitter is modulated 100% and working properly, what else is there? The technical standards for all United States broadcast stations are given in detail in Part 73 of the FCC Rules and Regulations. The broadcast service area of a given radio station is fixed by the license conditions of the facility as set by frequency, power, antenna system, and local terrain. The .5 mv/m primary service contour cannot be exceeded for any given licensed facility. Rule 73.57 requires station power not to exceed the limits of 5% above or 10% below the licensed value. Rule 73.55 says modulation power is not to be less than 85% on peaks, nor more than 100% on negative peaks. Other audio characteristics are defined in Rule 73.40 as to frequency response, distortion, carrier shift, and noise. All characteristics are to be held within reasonably close tolerances, so it may seem there is very little a broadcaster can do to improve the efficiency of his radiated

signal. The most reasonable way to proceed would be to increase modulation power, and even this seems to be pretty well fixed. The purpose of this article is to point out possible methods for increasing modulation power, consistent with improving demodulated audio levels in the receiver, while remaining within the framework of all FCC Rules and Regulations.

A Review of Modulation Basics

What then can be done to achieve increased modulation power on an AM transmitter, and how effective is each procedure? In the course of this discussion, we will cover eight different techniques, all of which are independent of each other and therefore additive. Before these procedures are attempted, the station equipment should be gone through carefully to bring it up to top performance. Electrical characteristics of concern are: frequency response, distortion, noise, carrier shift, and modulation capability. Frequency response should be ± 2 db from 50 to 10,000 cycles, distortion as low as possible—preferably below 2%, noise below -50 db, carrier shift below 1%—preferably positive, modulation capability

to 100% on negative peaks and over 120% on positive peaks. These are not always easy standards to meet, but basically good station performance is essential if we are to achieve better-than-normal performance.

Assuming now that the station equipment meets the standards set by the FCC, in what areas might technical improvement still be made?

1. A frequency response altered from flat might be advantageous.
2. Many limiters and compression devices leave room for improvement.
3. Transmitter carrier shift is almost invariably negative. This presents an area for improvement, as negative carrier shift reduces peak-modulation capability.
4. Control of audio-wave symmetry presents several avenues to further improvement.
5. Antenna-loading compensation can produce improved radiation of modulated side-band power.
6. Instantaneous peak clipping can be used to some advantage to bring up average modulation power.
7. Linearity correction of the audio signal fed to the transmitter sometimes can be used to improve the positive modulation capability of the transmitter and reduce distortion.
8. Reverberation and echo-chamber techniques have been used to give the aural impression of greater volume and "fill in" the lower-level periods.

Frequency Response

A frequency response flat from

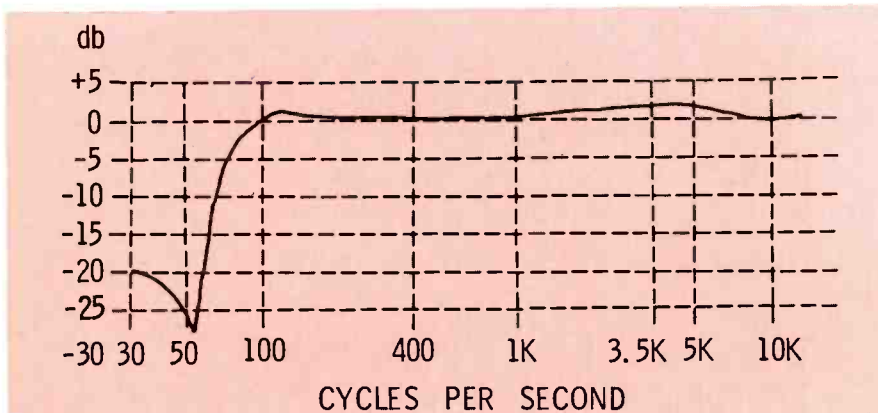


Fig. 1. Sharp - cutoff filter attenuates power - wasting frequencies below 100 cps.

30 cps to 15,000 cps is nice to attain, but it can waste valuable amplitude power space. For example, there are practically no radios built today that reproduce audio signals below 100 cps. Even a good hi-fi system suffers only a little when frequencies below 100 cps are removed. If we use amplitude power space to transmit the lower frequencies, we get very little from it, but we do subtract from the much needed midrange-frequency modulation capability. A sharp-cutoff filter which attenuates frequencies below 100 cps can allow for a slight increase in power for the midrange frequencies that better transmit intelligibility.

A slight increase in frequency response in the 3500-cps region will give a slight improvement in the "presence" of the audio—it will sound crisper and more alive. This occurs perhaps for two reasons: The response alteration is compatible to the ear's loudness-response curve, and IF response in selective receivers starts to roll off at about 3500 cps. Fig. 1 shows a response curve, within the limits of the FCC Rules and Regulations, that is tailored to accomplish the roll-off.

Automatic Level Control

Performance of automatic level-control devices varies considerably, and there is generally room for some improvement even in the best of them. The following topics indicate some of the performance errors which reduce their effectiveness: (1) first pulse of audio passes through at too high a level (see Fig. 2), (2) control pulse not balanced out of the audio, (3) attack control function is too violent, which overcompensates the audio level following a sharp rise (see Fig. 3), (4) noise and hum are "pumped up" during quiet periods, (5) gain reduction is triggered by signal elements other than the peak of the audio waveform, (6) full amplitude of the audio used for control, (7) control range too limited, (8) harmonic distortion increases excessively with increased input level, (9) control system is frequency selective, (10) recovery-time rate improper for the nature of the program material, (11) output level rises with increased input level. These characteristics all can be

measured or observed and corrected by adjustment or minor circuit changes. For example, apply a sinusoidal tone of any frequency into your limiter and set the negative peak to an exact line on an oscilloscope (connected to the limiter output). Now feed your program material into the limiter. How closely is the negative audio peak held to the line? Not very closely as a rule, but proper adjustment will usually bring it into line.

An ideal automatic level-control system for AM broadcasting should have the following characteristics: (1) the first burst of audio must be controlled quickly to preset value, (2) audio-output signal should be completely free from control-rate voltage, (3) gain changes should be deactivated during quiet periods, (4) output level should be clamped to the peak level of the negative excursion, (5) harmonic distortion must be held to a low value at all levels, (6) the control system should be insensitive to frequency, (7) pulses and "shots" should be controlled by differential circuits so as to give nearly instantaneous control and recovery, (8) average-level changes should be controlled by peak-integrating circuits, (9) output peaks should be kept absolutely constant over the full input range.

Carrier Shift

During the modulation process, the carrier-frequency amplitude should remain constant. In most broadcast transmitters, however, it drops from 1% to 5% under full modulation. This means that the transmitter attains rated carrier power without modulation, but when the carrier is called upon to deliver maximum intelligence, its power has been reduced proportionately to the square of the carrier shift. Negative carrier shift is caused by two factors, the first of which is poor power-supply regulation in high-level-modulated transmitters. Most transmitters use a common power supply for the class-C RF stage and the class-B modulator. During maximum modulation, the class-C B+ voltage falls causing the reduction in carrier power precisely at the time it is most needed. The second cause is a non-linear response of the class-C PA during the modulation process. With new tubes and a properly

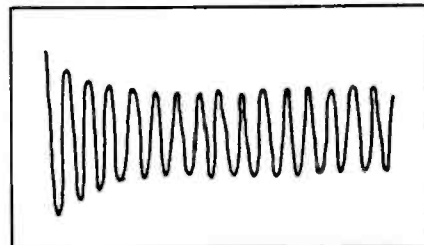


Fig. 2. Faulty limiter action allows first pulse to pass without limiting.

tuned transmitter, this nonlinearity has a positive characteristic, due to the operating conditions of the tubes, which nearly compensates for the negative shift due to poor power-supply regulation. As the PA tubes age, however, they no longer exhibit the positive linearity characteristic because their effective bias angle changes, and a higher value of negative carrier shift sets in for an appreciable part of the usable life of the tube due to a decreased modulation capability.

There are several solutions. The first would be to use two separate power supplies for the two functions. With most existing transmitters, this amounts to major rebuilding and is not too practical. A second solution would be to provide an external system of compensation modulation capable of modulation down to DC. This could be achieved by using a series-cathode modulation system as shown in Fig. 4. The cathode modulator should be capable of supplying around 10% the level of the high-level modulator. The control voltage should be of a DC nature to overcome inadequate power-supply regulation and of a nonlinear positive-pulse nature to correct for the nonlinear response of the PA under modulation. Using this system, carrier shift can be kept in the plus region for a longer period of tube life, so that expensive tubes can be used longer due to increased modulation capability.

Audio-Wave Symmetry

A pure sine wave and a fundamental wave containing only odd harmonics will produce a symmetri-

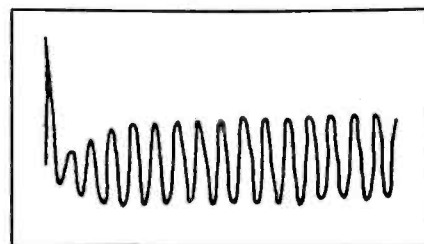


Fig. 3. Excessive attack action creates "holes" in keyed tone fed to limiter.

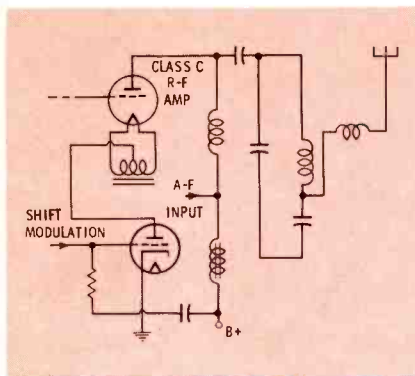


Fig. 4. Series-cathode modulation can be used to compensate for carrier shift.

cal waveform. Any even-harmonic component will introduce an asymmetrical component, therefore almost all broadcast material is asymmetrical. Such an imbalance results in heavier limiter action and a reduced modulation capability.

One approach taken to correct this situation is to add a passive device in the system which has an increasing phase-delay characteristic with increasing frequency. In this system, the phase relationship between the even harmonics and the fundamental is appreciably altered. This reduces high-level peaks in the audio waveform because the harmonics do not reinforce one another to produce a transient additive peak as often as in the unaltered material. Passing through phase-delay systems the wave still remains asymmetrical, however, and certain even-harmonic components that originally did not cause excessive peaking may be shifted to do so. If a phase-delay system is used, it should be placed ahead of the limiter.

The second solution to the problem is to keep all transducer leads properly polarized to fit the system. At first this may not seem practical because audio changes its polarity from moment to moment and program to program depending upon its point of origin. (If a transducer consistently produces asymmetry on

a wide variety of material, it is probably defective and should be replaced.) An automatic polarity switcher (asymmetrical wave switcher) provides an excellent solution to the problem. This device samples the input polarity and switches the output polarity so that the highest peaks are positive. To achieve maximum performance, this switched audio is fed into a very stiff negative-peak-controlled audio-level device, the output of which is the very maximum that can be used to modulate an AM transmitter. Any other overall control system will always produce something less than this optimum level, or will produce overmodulation on negative peaks. For this system to be effective, the transmitter should be capable of low-distortion modulation up to 100% on negative peaks, as modulation percentage will always be over 100% on positive peaks for any program material transmitted. For a quick and simple explanation of the above practice observe Figs. 5A through 5D.

Antenna-Load Compensation

In order to obtain the maximum possible efficiency from the modulation process, all RF sideband frequencies must be radiated in proper amplitude and phase relative to the carrier. With the modern vertical broadcast towers, these electrical characteristics are usually something less than optimum. A transmitter best delivers its modulated load into a pure resistance. This pure resistance seldom occurs unless special correction circuits are put into the tuning network. Even this is not the whole answer. For example, assume you measure the tower impedance at the carrier frequency and at the two maximum sideband frequencies, then design, build, and insert a network which will make the input to the antenna

system look like a pure resistance to the transmitter. Chances are you still may not achieve the results you are expecting. The reason for this situation is that the problem involves two factors, not just one. Assuming sideband radiation resistance is correct and sideband power has a proper amplitude relationship to the carrier, the phase relationship may be altered from optimum by the correction network! Therefore, the design of the antenna correction network must consider not only amplitude correction, but also phase correction, so that the radiated sidebands are correct in phase and amplitude.

In the case of a directional antenna system, the corrective networks must be placed at the base of each tower, not at the common-input point. Directional antenna systems with deep nulls often produce excessive null distortion which is caused by a difference in phase between the sidebands and the carrier. This results because the radiation pattern and field vectors are considerably different for the sideband frequencies. It is doubtful that even with perfect network correction this condition could be eliminated, because the directional antenna itself introduces some uncontrollable factors. In some cases, an improvement may be noted since the radiated system and pattern will have less variations with frequency than before.

Instantaneous Peak Clipping

Most engineers usually shudder when peak clipping is mentioned for broadcast use, because it usually results in harmonic and intermodulation distortion. Properly executed, however, noticeable improvement can be had. Using power-bias clipping, if the audio level rises 1 db, distortion will become excessive. Therefore, effective use of clipping dictates that the clip level must be held within close tolerances at all times. If this is done, float clipping, which is more effective and does not get out of adjustment with slight changes of level, can be used. Exact adjustment of the clipping level becomes rather involved. The use of a scope and distortion meter as a starter and finishing up with a subjective response from several

• Please turn to page 29

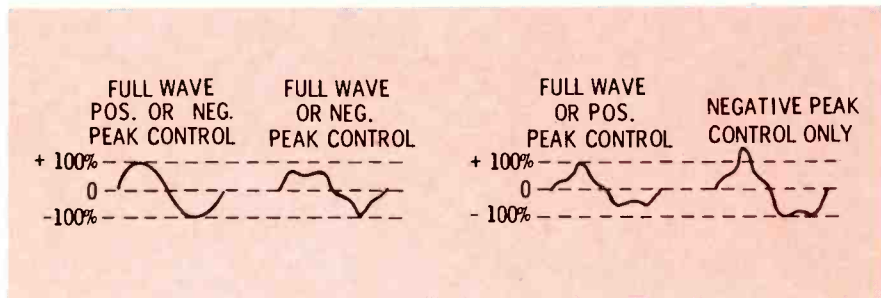


Fig. 5. Waveform symmetry affects limiting action and resultant controlled levels.

CONSIDERATIONS FOR THE MAINTENANCE LOG

by **Thomas R. Haskett**, Central
Regional Editor, Cincinnati, Ohio—
Important requirements dictated by FCC
Rules are examined carefully and
suggestions made to ensure compliance.
Be sure your log contains all
necessary entries.

A couple of years ago, the FCC instituted a rule which requires that each AM, FM, and TV broadcast station must keep a maintenance log in addition to the regular program and operating (transmitter) logs. The Commission made no attempt to specify the exact form the maintenance log should take, although they did specify its content. Because several sections of the Rules govern this log, there has been rather general misunderstanding of what should be contained in it; therefore, we have collected sample logs from a number of stations in order to analyze them and determine what an ideal maintenance log should contain.

In some radio services, a maintenance log has been required for many years. The licensee of a shipboard radar or taxicab radio station, for example, must keep a log in which are noted all repairs and service adjustments performed on all equipment covered by the license. When most broadcast stations employed several First-Class transmitter men, there was little need for a maintenance log, except as a convenience for the station staff. But with the expanding use of remote-control devices, and with many stations employing only a single First-Class operator or a "contract chief" (part-time First-Class licensee), it was quite natural for the Commission to require that certain inspections be made at specified intervals, and that notations be made concerning these inspections and the maintenance performed as a result of them.

General FCC Logging Rules

There are certain general requirements that apply to the maintenance log (as well as to the operating and program logs). These rules are found in Sections 73.111 (AM), 73.281 (commercial FM), 73.581 (noncommercial FM), and 73.669 (TV). All versions are substantially

identical and, briefly, here is what is required: Each station must keep program, operating, and maintenance logs. Each log shall be kept by the person who has actual knowledge of required facts, and this person shall sign the log when starting his shift and when he goes off duty. Each log shall be kept in an orderly and legible manner, so that all data are readily comprehensible. Key letters or abbreviations may be used if proper meaning or explanation is shown on the log. Each sheet must be numbered and dated. Time entries shall be either in local standard or daylight-saving time and times must be so indicated. No portion of a log may be erased, obliterated, or willfully destroyed, and all logs must be retained for at least two years (longer if specifically requested by the Commission). Any necessary correction may be made only by the person originating the entry, who shall strike out the erroneous portion, initial the correction made, and indicate the date of correction. You can keep a rough log and later transcribe it into a more formal appearance, but you must keep the original memoranda as part of the complete log.

The above provides us with a starting point for our ideal maintenance log. Certain items are obvious:

Title—Maintenance Log.

Station call and city of license.

Date—This should include both the day of the week and the day of the month, as "Monday, May 10, 1965." If the maintenance log is intended to cover an entire week, this should be stated with beginning and ending dates given. Individual entries must then also be dated.

Page number—Blank log forms should contain no numbers; these should be added as logs are filled out and filed. Some stations bind logs in a ledger or loose-leaf book

for retention, and they often place dates and page numbers at the bottom of the page for ease in referring back to a particular log.

Time zone—To prevent confusion, it's a good idea for the log to contain a printed statement of the time reference, for example: "All times entered herein are EST."

Operator on/off signature—A basic requirement of all logs, this provision is expanded below and may contain additional items.

Abbreviation code—You may use any code you wish to save space, but you must explain it. Examples: ANT—antenna; BUF—buffer; DRI—driver; Ep—plate voltage; Ip—plate current; K—1000. Note that you aren't required to use abbreviations; some stations don't use any and spell out every word.

Specific Maintenance-Log Rules

The exact language prescribing the maintenance log is contained in the following Sections: 73.114 (AM), 73.284 (commercial FM), 73.584 (noncommercial FM), and 73.672 (TV). In most respects, these requirements are similar. We shall note the differences below:

Tower base - current ammeters(s) (AM only)—a weekly reading and entry must be made.

Remote antenna ammeter(s) (AM only)—A weekly reading and entry must be made of each meter, **before** it is recalibrated against the actual base ammeter.

Remote antenna ammeter(s) (AM only)—A weekly reading and entry must be made of the same meter(s), **after** each has been recalibrated against the actual base ammeter.

Auxiliary transmitter (AM, FM, and TV)—Sections 73.63, 73.255, 73.555, and 73.638 require that an auxiliary transmitter be tested at least once a week (unless it has been used upon failure of the main transmitter). The maintenance log must contain a weekly entry of the time and the result of this test—

STANDARD AM/FM MAINTENANCE LOG

DAILY EQUIPMENT INSPECTION

[illegible]

EQUIPMENT STATUS

Defective Equipment	Removed from Service		Restored to Service		Signature
	Date	Time	Date	Time	
Frequency Monitor					
Modulation Monitor					
Final-Plate Ammeter					
Final-Plate Voltmeter					
Base-Current Ammeter					
Common-Point Ammeter					

WEEKLY CALIBRATION ADJUSTMENTS

OPERATOR:				LICENSE NUMBER:		
Date	Time	Meter Funct.	Main Mtr. Before Cal.	Rem. Mtr. Before Cal.	Main Mtr. After Cal.	Rem. Mtr. After Cal.
		Ip-Pa				
		Ep-Pa				
		% Mod.				
		Freq.				
		Tower 1				
		Tower 2				

MONTHLY FREQUENCY MEASUREMENT AND MONITOR CALIBRATION

	Independent Measurement Result	Frequency Monitor Reading
AM		
FM		

EXPERIMENTAL OPERATION & AUXILIARY TRANSMITTER TESTS

TIME	Description and Results	
		Signature:

TOWER LIGHTS

Inspection of tower lights made in accordance with Section 3.65 17.37 & 17.38 of FCC Rules	
Any adjustments, replacements or repairs made to insure compliance are noted here:	
	Signature: _____ Date: _____

Week of _____ to _____, 19__.

whether or not the transmitter operates properly. Note that an AM transmitter must be tested only between midnight and 9 AM local time, and a commercial FM transmitter must be tested only between midnight and 6 AM local time. No time period is specified for testing noncommercial FM or any television transmitter.

Frequency measurement (AM, FM, and TV)—Time interval is not specified for this entry, and will depend on your station's practice or license requirements. This entry must show frequency measurement by means other than the frequency monitor. It's a good idea to give the name of the company making the check. Measured deviation must be shown, the time of the measurement, a reading of the station monitor at that time, and a note indicating what adjustments (if any) were made to make the monitor agree with the independently measured frequency.

Calibration of automatic logging equipment (AM, FM, and TV)—Sections 73.113, 73.283, 73.583, and 73.671 permit all stations to use automatic devices to record entries in the operating log. These same rules require that such automatic devices be calibrated once each week and a notation to this effect made in the maintenance log.

Instrument failure—Whenever any of the following instruments become defective and are removed from service, an entry must be made; when repaired and returned to service, another entry must be made. Some stations also provide an entry showing date of occurrence and the location of the FCC district office to which failure notification was sent as required by the rules. Instruments covered and class of station involved are as follows:

Modulation monitor (AM, FM, TV)

Frequency monitor (AM, FM, TV)

Final-stage plate voltmeter (AM, FM, TV)

Final-stage plate ammeter (AM, FM, TV)

Base-current ammeter(s) (AM only)

Common-point ammeter (AM only)

Transmission-line RF voltage, current, or power meter (FM

and TV only)

(Note: For TV stations, each item above applies to both the visual and the aural transmitter.)

Tower lighting inspection and failure (AM, FM, and TV)—Tower light inspections must be logged as required by FCC rules or by the station's current instrument of authorization. Section 17.38 states that you must make a daily check for proper operation of the tower lights. Entries referring to these daily checks are made in the operating log by some stations and in the maintenance log by others; Section 17.38 doesn't specify which is preferred.

Section 17.38 also states that once every three months a complete inspection shall be made of all tower lights and associated tower lighting control devices, indicators, and alarm systems. An entry must then be made—although not specified, it's probably best to include it in the maintenance log—which must give the date of the inspection and the condition of the equipment. Details must be noted of any adjustments, replacements, or repairs made to insure compliance with the lighting requirements, and the date such adjustments, replacements, or repairs were made.

Section 17.38 also covers tower light failure. Entries must be made showing the nature of such failure, the date and time the failure was observed or noted, the date, time, and nature of the adjustments, repairs, or replacements made. You must also give the location of the Flight Service Station of the Federal Aviation Agency which you notified of the lighting failure, and the date and time of such notification. When the light is replaced and normal operation is resumed, you must notify the FAA again and make a further entry of this, together with date and time. It's a good idea also to record the name of the operator on duty at the FAA center to whom the report was given.

Experimental operation (AM, FM, and TV)—Complete details (date, time, purpose, result, whether carrier was modulated or not), time(s) of station identification, power, mode of operation) must be given for all operation during the experi-

mental period, **unless** such operation consists of regular programming as for stations licensed for unlimited operation.

Daily inspection (AM and FM only)—Sections 73.93, 73.265, and 73.565 require that a complete inspection of all transmitting equipment in use shall be made by an operator holding a valid Radiotelephone First-Class operator license at least once each day, five days each week, with an interval of no less than 12 hours between successive inspections. The operator must sign a statement that this inspection has been made, noting in detail the tests, adjustments, and repairs which were accomplished in order to insure operation in accordance with FCC rules and the station's current instrument of authorization. The statement shall also specify the amount of time, exclusive of travel time to and from the transmitter, which was devoted to such inspection duties. If complete repair could not be effected, the statement shall set forth in detail the items of equipment concerned, the manner and degree in which they are defective, and the reasons for failure to make satisfactory repairs. Some stations list the items to be inspected (tower, transmitter, console, limiter, patch board, frequency monitor, etc.) so that the condition of each may be noted individually. It's obvious that the maintenance log must be kept only by a First-Class operator. Some stations provide a space for the operator's signature which is preceded by a statement like: "I certify that I hold a currently-valid Radiotelephone First-Class license and that I have this date made the above required inspection." Some stations also provide a space for the operator to list his license number.

Other entries (AM, FM, and TV)—The rule says you must include any other entries required either by FCC Rules or by the station's current instrument of authorization.

Nonrequired Entries

In addition to the above items, which are required by FCC Rules, we found that many stations voluntarily include entries in the maintenance log that aren't required, but which may be helpful. A note of the instrument of authorization

• Please turn to page 26

A NEW LOOK AT NEGATIVE RESISTANCE

by C. G. Cunningham, Professional

Engineer, Taos, New Mexico—Part 1: A report on one family of semiconductors and the electrical phenomenon which makes them useful in myriad applications.

Negative resistance has been around, as a plague and a blessing, from almost the beginning of electronics. For most electronics people, negative resistance was a plague: it interfered with the operation of high frequency amplifiers; it couldn't be seen or touched since it appeared only in mathematical formulas and in the errant operation of circuits; and, it was ignored since it usually could be analyzed as feedback. As a result, the idea of negative resistance has been surrounded by confusion.

Most of the alibis for not accepting the idea of negative resistance are no longer true. Modern electronics has produced devices that can be analyzed no other way. Negative resistance exists across the terminals of devices, independent of external circuitry, as an observable and measurable characteristic. Because it sounds impossible it may give one a sinking feeling in the pit of the stomach, but it's time to see just what negative resistance really is.

It is natural for people working with electronic devices, to think in terms of the object that exhibits certain electronic properties. So, when one thinks of resistance he thinks of a resistor; when he thinks of inductance, coils come to mind. Usually, people think of objects with weight and shape; this has increased confusion about negative resistance. People keep wanting to think of a "negative resistor."

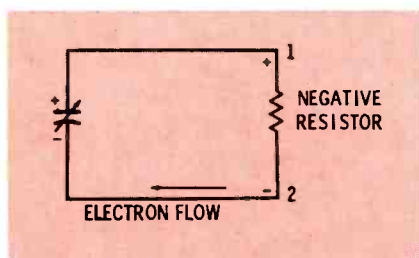


Fig. 1. Voltage-stable negative resistor.

If there were a "negative resistor" how would it behave? The answer to that question is quite surprising; it depends on what kind of "negative resistor" is used—a current type or a voltage type. Negative resistance occurs when either the current or the voltage in the familiar Ohm's law behaves directly opposite to the usual case:

$$\text{Negative } R = \frac{E}{-I}$$

$$\text{Negative } R = \frac{-E}{I}$$

The first equation describes the "negative resistor" in Fig. 1. As battery voltage is increased electrons start to flow from the negative resistor to the negative terminal of the battery. Furthermore, as the voltage increases, this backward current increases. This is known as a voltage-stable negative resistance; since it is against the laws of nature, such a device has never existed.

The second equation describes the "negative resistor" in Fig. 2. In this circuit, the variable resistor is large enough to control the current in the circuit regardless of what the negative resistance does. This is what happens: As the switch is closed, electrons start to flow from the negative terminal of the battery; but, voltage at terminal 2 of the "negative resistor" becomes more positive than terminal 1. As the current is increased, this voltage difference increases. This is the behavior of a current-stable negative resistance. Once again, however, there is no such device.

Since there is no such thing as a "negative resistor," what causes the excitement? Today, there are devices and circuits that display negative resistance over certain regions of conduction or under certain con-

ditions. Since there is no other word, we must call it just that—negative resistance; it is a characteristic, not an object. In order to make this clear, some people use the term "negative-resistance region" or "dynamic negative resistance" to indicate that special conditions are necessary to obtain negative resistance.

Now let's look at negative resistance as it really is, a negative-resistance region in the volt-ampere curve of some device. In Fig. 1, assume this new device instead of the "negative resistor" is connected between terminals 1 and 2. Also assume that there is a means of controlling precisely the voltage across those terminals. As the voltage increases, current starts to flow as in any ordinary resistor. As Fig. 3 shows, as the voltage increases, the current increases until we reach 10 volts with a 100-ma current flow; this is point 1 in Fig. 3. The ratio of voltage to current shows that, so far, this is a 100-ohm resistance. As the voltage increases past point 1, we observe that the current *decreases* until at 20 volts, point 2, a current of only 50 ma is flowing. From point 1 to point 2, there was a 10-volt change with a 50-ma decrease in current, or an apparent negative resistance of 200 ohms.

In this circuit there is apparently a 100-ohm resistor in series with a 200-ohm negative resistance. This is not a short circuit, however; the total resistance has actually in-

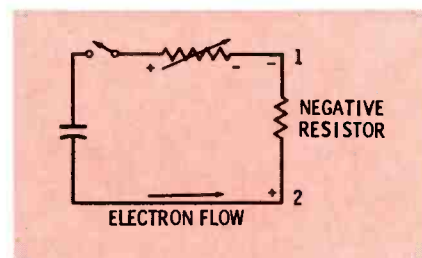


Fig. 2. Current-stable negative resistor.

creased! There is now a difference of 20 volts at 50 ma for a total resistance of 400 ohms across the terminals. This is the voltage-stable negative resistance that was described in Fig. 1. One way of looking at it is to assume that after point 1, current from the negative resistance started to buck the current that was flowing in the circuit. If nothing else changed in the circuit and the voltage was increased to 30 volts, there would be zero current flowing—an apparent open circuit. Of course no practical device works this way; at some point the slope changes again, and the current increases with increasing voltage. This is shown in Fig. 3 by the dashed line from point 3 to point 4.

If we replace the current-stable "negative resistor" of Fig. 2 with a practical device having a current-stable negative-resistance region, we get the results shown in Fig. 4. In this case, the current must be controlled to examine the characteristics. As the current through the unit rises to 100 ma, as shown by point 1 in Fig. 4, the voltage rises to 10 volts. Again, so far, the unit looks like an ordinary 100-ohm resistor. As the current is increased to 125 ma, as shown by point 5, the voltage *drops* to 5 volts. This is a 5-volt decrease with a 25-ma increase, an apparent negative resistance of 200 ohms.

Once again, there is a resistance of 100 ohms in series with a negative 200 ohms. In this case it appears to be more awesome, since the current increases as the voltage drops. This time, the net resistance decreases as we move further into the negative-resistance region. If nothing changed, the voltage would be zero when a current of 150 ma was flowing. Of course a short circuit with no voltage across it is not alarming; but this is a short circuit only when a 150-ma current flows. Furthermore, if the current decreases, the voltage increases; this is another fundamental characteristic of negative-resistance devices. The slope of an actual device would change at some point and the voltage would start to increase as shown by the dashed line from point 6 to point 7.

The relative magnitudes of the negative and positive resistances in these devices cannot be taken at

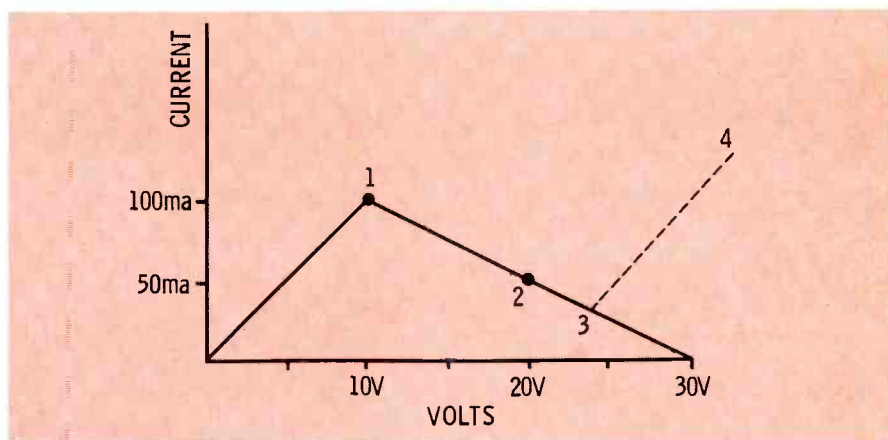


Fig. 3. Practical voltage-stable curve showing negative-resistance character.

face value. The negative-going elements are always dependent upon the real voltage and current. Devices having negative-resistance regions, as shown in the simple circuits of Figs. 1 and 2, always have a net positive resistance. They also continue to draw real current, show real voltage across their terminals, and dissipate real power.

In an ordinary resistor, the current is proportional to the voltage; for the negative-resistance regions, however, the proportion is opposite to that in the positive-resistance regions. This phenomenon is used in negative-resistance devices that are biased in or near this negative-resistance region with DC current or voltage. Signals are then AC-coupled to operate the circuit in the negative-resistance region. Under these conditions, the device can be used as an oscillator, amplifier, switch, or multivibrator. The useful energy delivered by such circuits comes, of course, from the bias source indirectly through energy stored in capacitors or inductors.

Before the advent of semiconductors, negative resistance in electronic circuits appeared primarily as a nuisance. High-gain amplifiers

with stray feedback appeared to have a negative input resistance at certain frequencies and would oscillate unless care was taken to prevent it. However, early manifestations of negative resistance were not all liabilities; the dynatron oscillator utilized the negative-resistance characteristics of the tetrode. Some types of multivibrators and flip-flops using vacuum tubes were considered negative-resistance devices. Relaxation oscillators using gas-discharge tubes and neon bulbs are current-stable negative-resistance devices similar to Fig. 4 except that their negative-resistance region is much sharper.

Most vacuum-tube circuits which were operated as negative resistance devices depended on feedback to achieve the desired characteristics. It was not an intrinsic property of the components used. More recent developments included video amplifiers, active filtering elements, and operational amplifiers for analog computers. These circuits could be arranged to present a pair of terminals that exhibited a negative-resistance characteristic. This region of negative resistance, though, was usually limited as to range of volt-

• Please turn to page 32

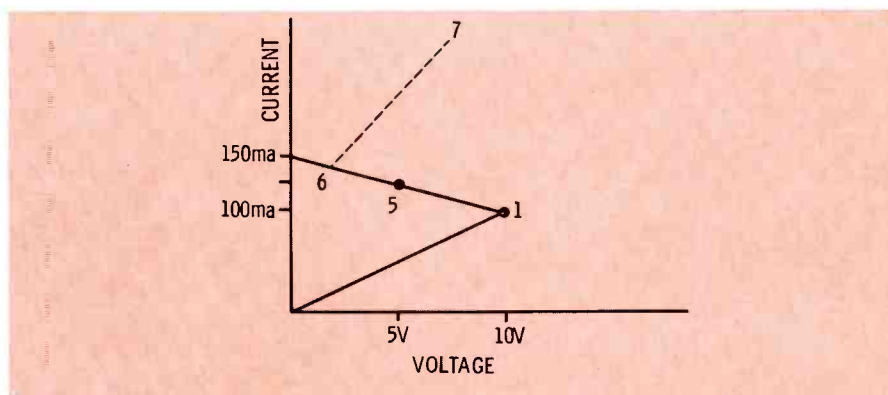


Fig. 4. Practical current-stable curve showing negative-resistance character.

CHOOSING CABLE FOR CATV

by **Lon Cantor**, Philadelphia, Pa.—The highly critical component in a CATV system comes under closer scrutiny.

Continuous expansion of multi-channel CATV service requires low-loss cables to allow operation at the high-channel frequencies and to minimize losses in systems covering large geographical areas. Since all cables cause signal losses that increase as the frequency of the signals fed through the cable increases, these losses determine trunkline-amplifier spacing. Because signal attenuation also varies with temperature, AGC units and thermal equalizers are required to maintain constant signal levels. In choosing cable for a CATV system, there are three basic factors to consider: attenuation; return loss; and moisture resistance. Of these, signal attenuation is the most significant parameter.

Automation Factors

Table 1 shows the loss characteristics of several commonly used CATV cables. Cable loss is primarily a function of the resistance of the center conductor. The larger the center conductor, the lower the attenuation figure. Increasing the size of the center conductor, however, necessitates an increase in the outside diameter of the cable. This is true because all CATV cables

have an impedance of 75 ohms, a characteristic determined by three factors: the size of the conductors, the spacing between the conductors, and the dielectric used. Thus, when the diameter of the center conductor is increased, the spacing between conductors must also be increased to maintain the 75-ohm impedance (unless a different dielectric is used). Naturally, larger cables are harder to handle and more expensive. In spite of these factors, however, more complex systems require cables that exhibit lower losses, so most CATV engineers lean to the physically larger and more rigid cables.

Notice that the attenuation figures shown in the table increase with frequency. Attenuation at channel 13 is almost double that at channel 6. For this reason, cable limitations restricted early CATV systems to the low band where the maximum number of channels is five. Many modern CATV systems, however, provide as many as 12 channels, using the entire VHF spectrum. This increased service has become possible through development of cables exhibiting extremely low losses.

Another cable attenuation factor is the increased loss as the ambient temperature rises. The loss figures shown in Table 1 were determined at 70°F. Each 1° ambient temperature rise causes an increase of .1% in attenuation.

Return-Loss Characteristic

Perhaps the best overall indicator of cable quality is its return-loss characteristic. Until a few years ago, coaxial cable simply was "swept" to determine its uniformity, or lack of it. The output of a sweep generator covering the required band of frequencies was sent through the cable, and the output level at each frequency was measured. Any significant notches, or

"suck-outs," indicated impedance variations at some frequencies. A marker generator and a calibrated attenuator could then be used to measure the amplitude of the notch and, using a nomograph such as that shown in Table 2, it was possible to determine the voltage standing wave ratio (VSWR) at any specific frequency.

The sweep-frequency evaluation method is not too accurate, however. Since attenuation readings more accurate than ± 0.2 db are seldom obtainable, the best possible VSWR measurement attainable was about 1.5 to 1. While this VSWR is sufficient for many applications, it is not good enough to evaluate a high-quality CATV system. Thus, a more accurate measurement is required.

Fig. 1 shows the type of test setup currently used by many CATV operators to measure cable quality. What actually is measured is "return loss"—the difference (in decibels) between a signal applied to a cable and the signal that is reflected back out of the same end of the cable. As shown in the illustration, one end of the cable is properly terminated, and the other end is connected to a sensitive impedance bridge. The cable is swept from 50 to 220 mc. A switcher provides simultaneous comparison of the signal fed into the cable and the signal reflected back. A bridge such as that shown can measure VSWR values as low as 1.01 using this technique. The marker generator enables you to determine the frequency of any notches which are observed. Return-loss figures are closely related to picture quality; the higher the return-loss figure in db, the fewer will be the reflected signals generated within the cable—and reflections cause ghosts.

It is difficult to determine just how much reflected signal is toler-

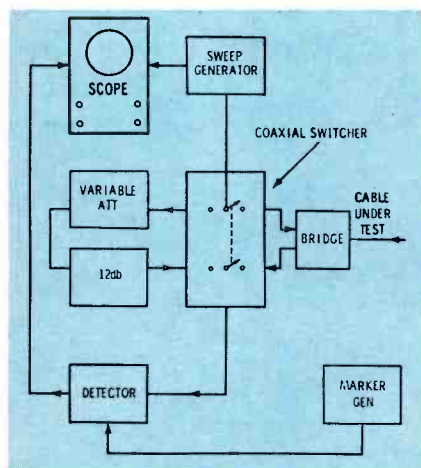


Fig. 1. Test setup for return-loss measurement provides evaluation of CATV cable.

able within a CATV cable. For one thing, reflections may be caused by system components other than the cable. Every connector, for example, introduces a discontinuity that may cause reflections. Also, the location of the "lump" (impedance change) is important. A reflected signal that travels only a short distance will create a ghost which is very close to the picture formed by the direct signal. Many of these reflection images are so close to the primary image that they appear as smears rather than distinct double images. Finally, a viewer's tolerance to ghosts is a subjective thing. What one viewer finds very annoying, another hardly notices.

In spite of these difficulties, equipment manufacturers have established workable standards. Careful experimentation has shown that cable with a return loss of 26 db at 54 to 60 mc (channel 2) will transmit very good pictures to CATV subscribers, if used with high-quality video amplifiers and tapoffs. Faint ghost images are present, but most subscribers ignore them. A return loss of 30 db (4 db improvement) insures CATV pictures of excellent quality, with ghost images just barely perceptible to the most keen-eyed viewers.

CATV system standards are steadily rising. When CATV systems were installed only in extreme shadow or fringe areas, subscribers were delighted to receive a viewable picture of any quality. Now, in competition with live TV in many locations, cable systems must deliver pictures equal to or better than those obtained on any channel by the best home receiving equipment.

Moisture Resistance

Since CATV cable is run outdoors, it must be able to withstand a variety of weather conditions. However, CATV systems have a problem not common to any other communication field. In CATV systems, frequencies as high as 220 mc must be sent through miles of cable, a practice which requires cascaded amplifiers. To design an adequate system and to space the amplifiers properly, the engineer must be able to predict the losses exhibited by a length of cable—that means knowing all factors which contribute to the total cable loss. As discussed previously, cen-

ter-conductor resistance and temperature variation are significant factors. An often overlooked contributor to loss, however, is cable moisture content.

Polyethylene Jackets

Since most cables are jacketed in polyethylene, nobody worried much about moisture until a few years ago. It was thought that polyethylene was completely waterproof, and waterproof it is; but polyethylene jackets are not vapor proof. Water

vapor easily penetrates the cable jacket and accumulates at a low point in the cable, usually at the bottom of a downhill run. Why didn't this accumulated vapor cause trouble in the early days of CATV? The answer is that it did, but nobody really noticed its effect until all-channel VHF systems became common; Fig. 2 shows why. To obtain the data for the graphs shown, a 2400' reel of foam-dielectric cable was sprayed with water

• Please turn to page 34

Table I. Common CATV Cables

MANUFACTURER	NUMBER	TYPE	ATTENUATION (db/100 ft)	
			Ch 6	Ch 13
Times Wire & Cable Company	JT-11625	Solid Aluminum Sheathed	.32	.60
	JT-116255	Solid Aluminum Sheath w/Jacket	.32	.60
	JT-1750	Solid Aluminum Sheath	.60	1.03
	JT-17505	Solid Aluminum Sheath w/Jacket	.60	1.03
	JT-1500	Solid Aluminum Sheath	.84	1.40
	JT-1500J	Solid Aluminum Sheath w/Jacket	.84	1.40
	JT-1412	Solid Aluminum Sheath	1.05	1.65
	JT-1412J	Solid Aluminum Sheath w/Jacket	1.05	1.65
Phelps Dodge	FXA 41-75	Solid Aluminum Sheath	.99	1.55
	FXA 12-75	"	.74	1.27
	FXA 34-25	"	.52	.92
	FXA 158-25	"	.30	.52
Plastoid Corporation	CT-48	Corrugated Copper	.84	1.40
	TA4	Welded Aluminum Sheath	1.04	1.60
	TA4J	Welded Aluminum Sheath w/Jacket	1.04	1.60
	TA5	Welded Aluminum Sheath	.73	1.26
	TA5J	Welded Aluminum Sheath w/Jacket	.73	1.26
Rome Cable	R075-038-1	Solid Aluminum Sheath	1.05	1.68
	R075-412-1	"	.99	1.54
	R075-012-1	"	.72	1.25
	R075-034-1	"	.50	.88
	R075-078-1U	"	.44	.75
	R075-078-1J	Solid Aluminum Sheath w/Jacket	.44	.75
Superior Cable Corporation	4910	Corrugated Copper Sheath w/Jacket	.86	1.85
	4920	Sheath w/Jacket	.98	1.5
	4930	Sheath w/Jacket	.65	1.15
	6030	Sheath w/Jacket	.64	1.13
Viking	VK1412	Solid Aluminum Sheath	1.05	1.65
	VK1412J	Solid Aluminum Sheath w/Jacket	1.05	1.65
	VK1750	Solid Aluminum Sheath	.57	1.00
	VK1750J	Solid Aluminum Sheath w/Jacket	.57	1.00
	CF480	Corrugated Copper Sheath	1.01	1.65

CHECKING THE PATTERN

by **Elton B. Chick**, Consulting Author,
General Manager, WLOU, Louisville,
Kentucky — A series of quick checks
for use in establishing maintenance
procedures for directional antennas.

Editor's Note

An earlier article by the author described a method for making a field-intensity survey. ("Running the Radial," **BROADCAST ENGINEERING**, June 1965). Here Mr. Chick discusses an important use of the field-intensity data collected from such surveys, specifically as applied to directional antennas. This information provides a quick-check method for evaluating antenna performance.

A typical field-intensity survey provides tabulated data which gives signal strength in millivolts/meter, the distance from the station at which the reading was taken, and the radial azimuth angle in degrees. Table 1 shows a typical tabulation. To provide meaningful information for evaluating antenna performance, the data for each radial are plotted on log-log graph paper (K & E No. 182 or equivalent). The distance of the measurement point from the transmitter is plotted as the abscissa, and the measured field intensity is used as the ordinate (see Fig. 1). The graph paper mentioned allows the measured data to be compared to the ground-wave field-intensity charts contained in Part 73 of the FCC Rules. Field-strength measurements taken on each radial are plotted on separate sheets of graph paper, and each sheet is labeled

Table 1. Field Intensity, 120° Radial

Point	mv/m	Distance (miles)
1	400.0	.50
2	300.0	.60
3	275.0	.70
4	235.0	.80
5	190.0	1.00
6	150.0	1.25
7	116.0	1.48
8	88.0	2.00
9	72.0	1.47
10	55.0	3.00
11	42.0	3.45
12	39.0	3.95
13	29.0	5.00
14	26.5	5.50
15	20.0	6.50
16	15.0	8.00
17	11.5	9.00
18	10.5	10.00
19	7.7	12.00
20	7.0	13.00
21	5.3	15.00
22	4.2	16.00
23	3.7	18.00

with the azimuth angle of the radial. It is customary also to list transmitter power output and other operating parameters directly on each graph.

Analyzing the Measurements

Analysis of the plotted data can be only as valid as the accuracy of

each point; that is, how nearly the point represents the actual conditions. Equally important is the matter of engineering judgment or experience. Because of this subjective influence, some variation can be expected in the results obtained by various engineers in evaluating the measured data. However, if all factors are considered carefully, there should be no unreasonable differences.

Data analysis is begun by comparing the curve indicated by the plotted points to the FCC standard curves by laying the plotted data over the appropriate set of FCC ground-wave field-intensity curves and moving the sheet of plotted data up or down over the FCC curves to find the best match of curve to plotted points. The left and right graph margins must remain aligned while this is being done. When the closest match of points on any curve is found, the curve is traced on the graph containing the points. Next, the inverse-distance curve is drawn on the graph by tracing the FCC curve marked 5000. The point at which the curve crosses the graph's one-mile distance line gives the inverse-distance field (at 1 mile) for the radial being analyzed. The inverse-distance and

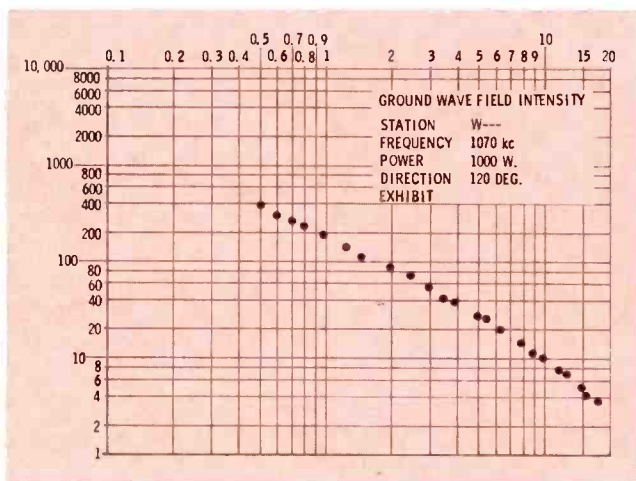


Fig. 1. Field-intensity measurements along 120° radial.

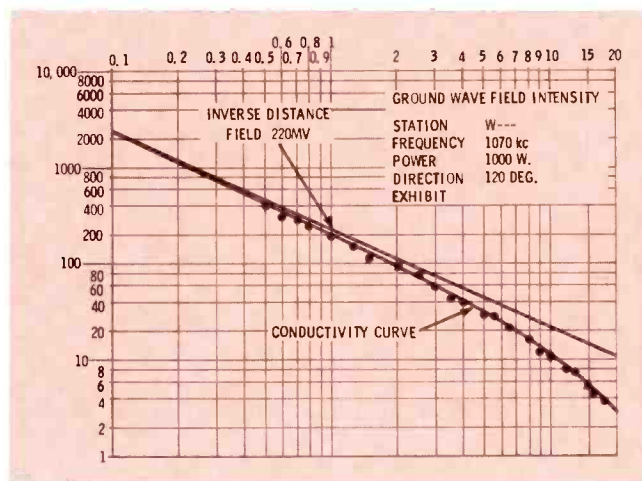


Fig. 2. Curves drawn using FCC field-intensity charts.

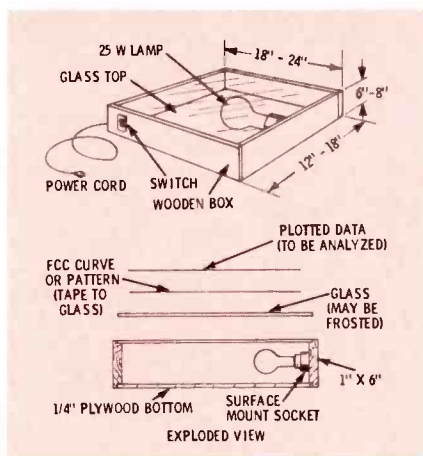


Fig. 3. Light box suitable for tracing FCC standard curves and other information.

ground-conductivity curves must be drawn to meet at a common point at the left-hand margin of the graph.

In some cases, the plotted data will not follow a single standard curve. If the points seem to follow one curve and then jump to another curve and follow it, a change in conductivity is indicated. In this case, the first curve is traced out only as far as it follows the standard, and the second line is traced from there on. If more than one change occurs, portions of several curves may need to be traced. This situation occurs frequently because of ground-conductivity changes and should be taken into consideration when difficulty is experienced in obtaining a good match between a single FCC curve and the plotted data.

As each radial is compared to the standard curves, a tabulation of inverse-distance fields is compiled. This data represents the unattenuated field intensity at a distance of one mile from the station along each radial and will be used later to determine the radiation pat-

tern. Fig. 2 shows the two curves for the data listed in Table 1 and shown plotted in Fig. 1. A convenient method for making the comparisons is to use a light box like that shown in Fig. 3.

Plotting the Pattern

To determine the actual performance of an antenna system and to compare its performance with the original design or with earlier measured patterns, it is necessary to plot the series of inverse-distance fields obtained for each radial. This is done by plotting the inverse-field values on polar graph paper. Table 2 shows a typical tabulation of inverse-distance fields, and Fig. 4 shows them plotted on the polar paper.

The unattenuated pattern shown is the theoretically perfect one which would result if the ground conductivity were constant over the entire field area; the actual attenuated pattern may show a considerably different shape. If no ground losses or other detrimental effects upset the pattern, its shape could be obtained simply by measuring the field intensity along a circular series of points equidistant from the station. Unfortunately, this condition seldom, if ever, exists.

The RMS Value

Once a pattern has been determined, its rms value can be found and used to evaluate the overall horizontal-radiation efficiency of the array. The rms voltage magnitude of a radiation pattern is equivalent to the radius of a circle (expressed in mv/m), the area of which is equal to the total area enclosed by the inverse-distance-field pattern.

Table 2. Inverse Distance Fields

Radial Azimuth (degrees)	Inverse Field (mv/m)
0°	88.0
30	119.5
60	88.0
90	5.0
120	120.0
150	220.0
180	280.0
210	295.0
240	280.0
270	222.0
300	120.0
330	6.0

There are several precise methods used to determine the rms figure: A polar planimeter can be used, if available, or the value can be computed by squaring the inverse-field values for each radial and taking the square root of their average. This latter method works best if the inverse-field values are taken for radials every 5 or 10 degrees around the pattern. Another method, of reasonable accuracy and usable to check performance periodically, is to estimate the pattern area by tracing the pattern on linear graph paper and counting squares inside the pattern as indicated in Fig. 5. When this area is known, the rms value is computed as follows:

To check the pattern, this value is compared to the original design value or to any previously determined value deemed acceptable. Any substantial change in rms value will suggest a fault in the antenna system. A smaller figure would in-

● Please turn to page 28

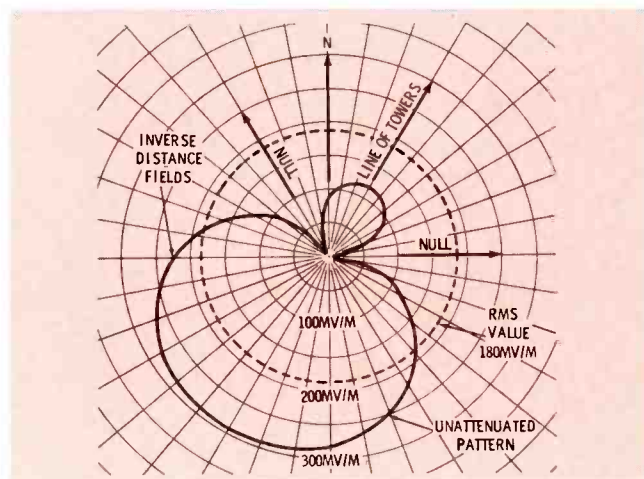


Fig. 4. A polar plot of inverse-distance-field pattern.

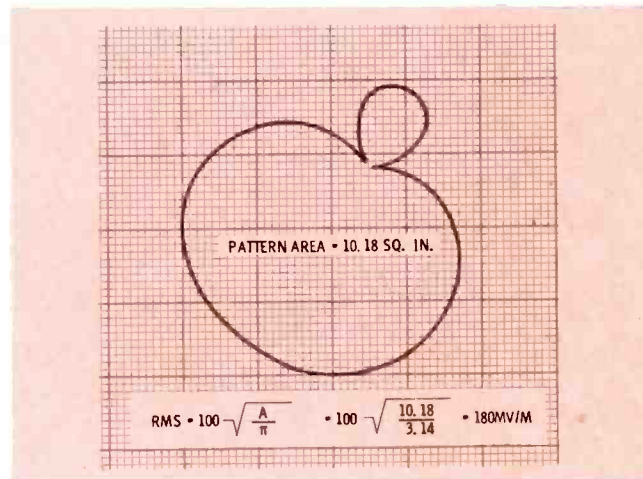


Fig. 5. Counting squares gives area to find rms value.

CARTRIDGE RECORDER PLAYBACK WITH AUTOMATIC CUEING

by Joseph D. Coons, President and General Manager, WOHI, East Liverpool, Ohio — A simple and versatile control system to coordinate use of commercially constructed cartridge-tape equipment.

This article describes the construction, from new parts, of a cartridge-tape control system capable of recording and playback of NAB standard cartridges with 1-kc cue tone. The machine is not intended to be the sole recording facility for any station; however, in the WOHI newsroom, it is in use as an everyday machine for recording "beeper" telephone reports, network spot-news releases, and story reports by WOHI announcers. It performs all these functions reliably.

In planning the function of this unit, there were three basic requirements which had to be met: The system had to be reliable and easy to operate, compatible with the other machines in the station, and constructed of new parts for as little money as possible. Our machine has met these requirements admirably, and the following paragraphs will explain the machine in detail in case you might be interested in one for your station.

Theory of Operation

A wiring diagram, complete with inputs and outputs, is shown in Fig.

1. The physical positions of all switches and indicators located on the front panel are shown in Fig. 2. The machine will accept any one of three line-level signals, plus a standard low-impedance type microphone. Switch S1, an eight-pole double-throw rotary, switches the input from LINE to MIKE, substituting a different primary winding of transformer UTC 0-1 and changing the connection on the Viking record playback preamp (RP-62C) from the low-level input to the high-level input. Utilizing the switch in this way eliminates the need for extensive mixing, padding, or the use of other switching equipment. Switch S2 selects which line is in use when switch S1 is in the LINE position.

For cartridge playback, a standard Viking tape deck, Model 36-R, is used. The power supply (Fig. 3) is modified to handle the additional load of the three relays and pilot lamp PL-R. The erase head on the left top of the deck is removed, and the new program head is moved into this position. A second program head is installed (to detect

cues) in the right-hand location adjacent to the capstan. We used a worn program head from our stock for the cue head. The program head records on the upper track, the cue head on the lower track.

Table 1 — Parts List

Panel	
S1—	Eight-pole, two-position rotary switch
S2—	Two-pole, three-position rotary switch
S3—	Two-pole, two-position rotary switch
PL-AC, PL-R	Neon-type pilot light assemblies
	Cough button
	On-the-air-light assembly to suit
	Phone jack
	Audio and AC connectors to suit
	Transformers—UTC 0-1—Input
	UTC 0-8—Output
	Fuseholder for 2A fuse
Deck	
	Viking Model 36-R
	250-ohm, 10-W wirewound resistor
	Cue record playback head (use worn head)
Record Playback Amplifier	
	Viking Model RP62-C (erase lead not connected)
Cue Preamplifier and Relay	
	Cue relay—10,000-ohm coil, 1-ma sensitivity (3-ma pull-in, 2-ma dropout), SPDT contacts

Viking Model PB-70 Preamplifier	
	.05/150 capacitor
	.01/450 capacitor
	8/450 capacitor
	1-meg, ½-watt resistor
	40-K, ½-watt resistor
	1N34 or equivalent diode
	10-K, ½-watt resistor
Control Circuits	
	Burst relay—110VDC coil, 4SPDT contacts
	Run relay—110VDC coil, SPDT contacts
	150 MFD—150WVDC delay capacitor
	2—Normally open SPST pushbuttons
	1—Normally closed SPST pushbutton

Tone Oscillator

Transistor module with 1-kc output (mercury cell operated) capable of delivering 3 volts audio (on VTVM) into head-load impedance (available in most radio parts stores for about \$5). Mini-box to suit.

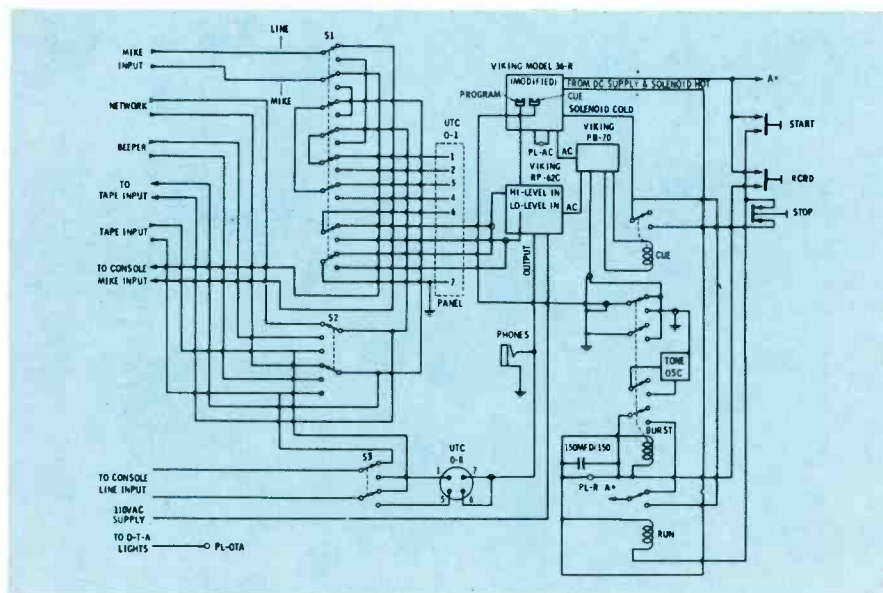


Fig. 1. Wiring diagram of the recording and playback control system.



Fig. 2. Front view showing panel detail and arrangement of all controls.

Trip cue is detected by a modified Viking playback preamplifier, Model PB-70. This model was chosen because of the price of the unit and to avoid power-supply and other construction problems. The output stage was modified (as shown in Fig. 4) to provide a load on the plate which in turn is across a sensitive relay coil. Other modifications involved removing the equalization control and adding a 10K resistor ground to the junction of the .047 capacitor and 10K resistor in the grid circuit of the first amplifier stage.

The relay in the plate of V2B is energized when the cartridge is running, with deenergization causing the cue relay to trip, stopping the machine. Use of the regular preamplifier gain control provides for adjustment of cue threshold. The signal from the cue head comes to the preamplifier from the normally-closed contacts of the burst relay. To understand how a cue-tone burst is impressed upon the tape, it is important to follow the relay wiring shown in Fig. 1. The RECORD button is depressed and, providing the run relay is not engaged, the burst relay is energized, latching through its own contacts and those on the run relay. Thus, when the burst relay is closed, the cue head is disconnected from the cue preamplifier and connected, instead, to a 1-kc tone generator. The tone generator is turned on by the relay action, and the input to the cue preamplifier is grounded.

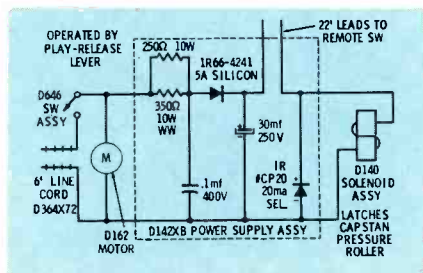


Fig. 3. Added resistor increases output.

When the operator presses the START button to begin recording, the run relay pulls in, breaking the latching circuit and opening the burst relay after a delay determined by the capacitor across it. This delay provides for a tone of about one second duration. After the delay, the relay opens, and the cue head is again connected to the cue preamplifier; thus, the preamplifier will fire the cue relay when a tone is detected (indicating that the machine has run around to the beginning of the recorded cartridge). When the START button is depressed, the capstan is engaged and the run relay is latched electrically, remaining in an energized state until either the cue relay opens (because of a cue-head signal amplified by the cue-head preamplifier) or because the operator has depressed the STOP button.

Physical Construction

Our unit was constructed to fit into space available on our news desk. It had also to provide a cough button, on-the-air light, and connections for a reel-type recorder also used in the newsroom. It isn't necessary for the cabinet to be either as long or as deep as ours; we suggest you work out the layout to suit your own requirements. The switches, relays, and transformers are all mounted on an aluminum panel for easy grounding of components. By hinging the cover, we have quick access for adjustments or checks. On our unit, we provided phone-jack connectors, mike connectors, and AC plugs for each connection to the console, etc., in order to provide for easy servicing. The parts list in Table 1 lists all components necessary to construct this equipment.

Maintenance

Initial adjustments of the cue threshold and of the spring tension on the cue relay are quite touchy,

and should be performed patiently by the builder. Following this, an occasional touchup of the threshold control will be all that is required, aside from periodic head cleaning. Check head alignment both for frequency response and compatibility with other machines.

Operation

Before making a recording, the operator should select the source from which the recording is to be made, switch the recording amplifier selector to R and adjust the RECORD GAIN control for maximum closure without overlap of the "V" on the eye tube. Having adjusted the levels, the cartridge should then be inserted, the capstan brought into ready position, the RECORD CUE button depressed, and the START button depressed as the program material is started. (When pressed, the start button should always be held in for about two seconds to avoid a false actuation of the cue relay as the burst relay drops out during recording or as the tail end of the cue tone on the tape is detected during playback.) When the machine starts during recording, the operator can hear a soft click—as the burst relay drops out—about a second after the start button is pressed. This click indicates proper operation of the cue-burst recording apparatus.

When the recording is completed, the STOP button should be pressed, the recording amplifier switched to P, and the START button pressed to allow the cartridge to run until it gets back to the cue at the beginning of the recording, at which time it will automatically stop. Pressing the START button again will cause the recording to be played back.

This efficient, inexpensive machine has served its intended purpose well and has helped us to provide our listeners with improved programming through increased versatility at a low cost. ▲

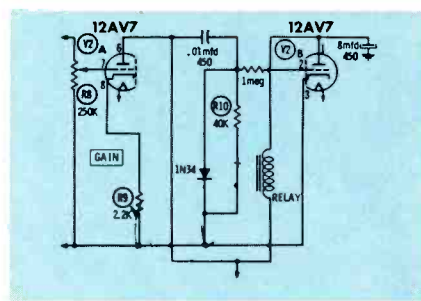


Fig. 4. Modified preamplifier output.

ANTENNA AND TRANSMISSION-LINE MEASUREMENTS

by William H. Artzberger,

Transmitter Engineer, KDKA-TV, Pittsburgh, Pennsylvania — Two well-proved techniques for keeping track of the condition of the television station's transmission line and radiating system.

Antennas and transmission lines are usually on the "neglected maintenance" list at television-transmitter plants. This is comprehensible, since there is very little that the broadcast engineer can do with reference to adjustments on these items. Nevertheless, good engineering practice requires station personnel to keep a regular check on this final link in the broadcast system.

This article describes two methods for checking the antenna system which have been used regularly at KDKA-TV and found to be very practical maintenance procedures. The first is the resistance-bridge method, and the second is the sweep-frequency method that can also be used to compute actual values of voltage standing-wave ratio (VSWR).

The Resistance-Bridge Measurement

This method is a rather basic one for troubleshooting, but when performed on a regular schedule for maintenance records, it can provide valuable reference information. The transmission line(s) should be disconnected from the transmitter at a convenient location; the resistance bridge is then connected to read the combined resistance of the transmission line and antenna. The impedance measurements thus obtained can be checked against readings made at the time of installation

Table 1. Typical Bridge Readings

	Original Resistance	Present Resistance
MAIN TRANSMISSION LINES		
Line 1	.0430	.0460
Line 2	.0495	.0495
AUX TRANSMISSION LINES		
Line 3	.0460	.0475
Line 4	.0350	.0350

or compared with manufacturers specifications. (See Table 1 for typical resistance values.)

Any change in resistance values indicates either corroded or burned transmission-line joints or poor connections at the antenna-feed straps. The consequences of these irregularities would be an increase in VSWR, overheating at the resistive spot, and loss of radiated power. The most serious indication would appear in the visual transmitter in the form of reflections or ghosts in the picture. Any one of these effects, of course, is undesirable.

Sweep-Frequency Measurement

The second method is more elaborate and more interesting, as the VSWR actually can be observed and measured by means of an oscilloscope. Fig. 1 shows the equipment setup for making this measurement. The sweep frequency should be adjustable to approximately 5 mc and should sweep from about 250 kc below the visual carrier frequency of the channel to be checked and continue to about 250 kc above the aural carrier.

At this point, let's stop and review some transmission-line theory. For maximum transfer of power from the transmitter final amplifier to the antenna, it is necessary to have the impedances of all signal-handling components perfectly matched. This is most important in the case of television antenna sys-

tems, as explained in an earlier paragraph. Therefore, the VSWR ultimately must approach one to one. To help explain this, look at the formula

$$VSWR = \frac{Z_o}{Z_r}$$

where,

Z_o = the characteristic impedance of the line, and

Z_r = the impedance of the load.

In the setup, you will notice a length of 51.5-ohm transmission line (RG 8/U). For need of better nomenclature, we call this test line a "delay line." (The characteristic impedance of this line must match exactly the characteristic impedance of the transmission line under test.) To insure getting a good comparison between the delay line and the system under test, the length of the line should exceed one-half the total length of the antenna-feed system. In the setup used at KDKA-TV, the transmission line was over 1000' long, and the delay line was approximately 600' long.

When a signal voltage is fed from the sweep generator into the delay line (with the delay line unterminated), the reflected and direct signals combine to produce a display on the oscilloscope as shown in Fig. 2 (the high-amplitude sine

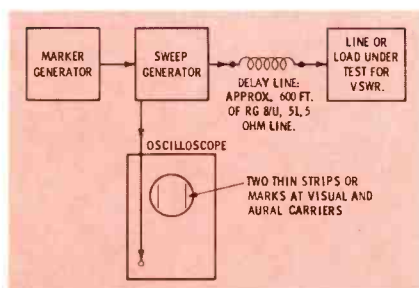


Fig. 1. Test setup used to determine condition of the transmission line and antenna.

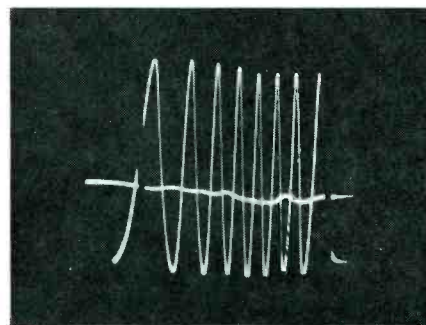


Fig. 2. Superimposed traces from the unterminated and terminated delay lines.

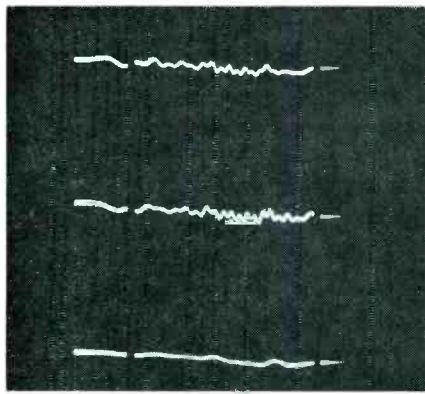


Fig. 3. Top two traces reveal impedance irregularities in two transmission lines.

wave). When the same signal voltage is fed into the delay line with the line terminated in a pure resistance of 51.5 ohms, there is no reflected voltage; this also can be seen in the illustration (the almost flat horizontal trace). The open-line and terminated-line traces were superimposed photographically by double exposure for comparison. It can now be seen that our system under test must look like a 1.5-ohm resistor to the end of our delay line!

The next step in the measurement is to insert a marker from the marker generator first at the aural carrier frequency and then at the visual carrier frequency. The limits set by these markers can be marked on the scope face with either a china marker or thin strips of black tape. (These appear as voids in the trace in Figs. 2, 3, and 4.)

Without changing any of the scope or generator controls, the sweep generator is fed to the antenna and transmission line under test through the delay line. Fig. 3 is a multiple exposure of three traces and displays a reference trace and the sweep patterns of two independent lines feeding a six-bay channel 2 antenna. A is for line 1

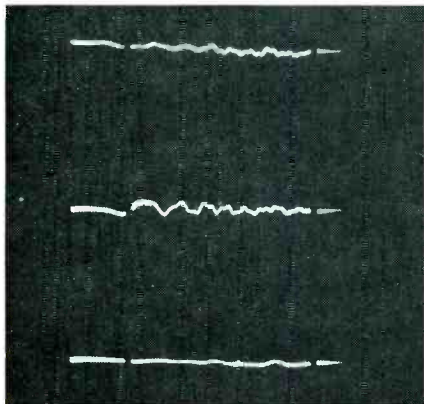


Fig. 4. Traces obtained at diplexer differ from those taken at transmitter end.

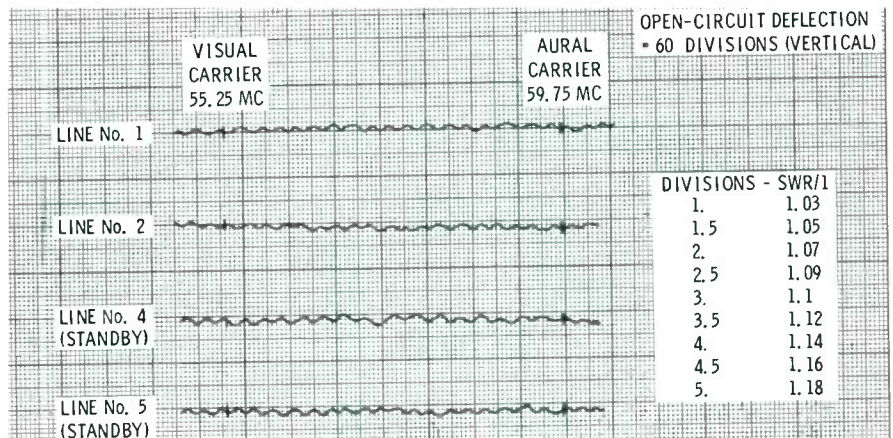


Fig. 5. Using graph paper, actual VSWR readings can be obtained from the traces.

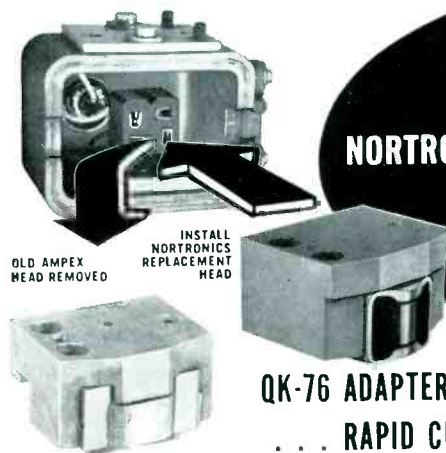
(E-W), B is for line 2 (N-S), and the remaining trace C is for the 51.5-ohm dummy-load resistor used for comparison.

Fig. 4 is another multiple exposure which exhibits a slight difference in configuration, as these traces were obtained at the diplexer input. It is interesting to study the photos very closely. Much information can be observed from them. It can be seen that the diplexer unit causes a slight VSWR in addition to that created by the antenna and transmission line.

The VSWR Measurement

The preceding tests may be conclusive enough to satisfy the station engineer that his antenna system is or is not in acceptable condition, but the USWR figure may be needed. It can be found by using the following procedure: Adjust the scope vertical-gain control so the maximum deflection for the open-ended delay line is exactly 3". Then, with the delay line connected to the transmission line in question, trace the scope display on a sheet of graph paper. (K & E 20 x 20 to the

● Please turn to page 39



Now - cut costs in replacing heads on Ampex 300, 350, 400, 3000 and 3200 series professional tape recorders... eliminate "down time"! New Nortronics heads and QK-76 adapter *equal* Ampex original equipment performance... easily mount within the shield cups of Ampex head nests.

- **VERSATILE** - You pick the head and track style! QK-76 adapts Ampex recorders to accept Nortronics full track, 2-track, 3 or 4 channel or 4-track styles... Record, Playback or Erase heads!
- **FAST** - No waiting... no units "out of service"! Head replacements made by simply loosening set screw and disconnecting plug! **You** make initial changeover... **you** schedule service or maintenance!
- **HIGHEST QUALITY** - Utilizes original equipment Ampex shield cups plus professional quality Nortronics replacements!

Nortronics offers the *largest* available variety of track and channel styles... *widest* selection of impedances and gap lengths... *greatest* versatility in mounting! Write today for detailed information.

Nortronics 

8143-G 10th Ave. No.
Minneapolis, Minnesota 55427

Circle Item 9 on Tech Data Card

**If
You're A
Professional
We Know
Your
Problems!**

**SALES!
RENTALS!
SERVICE!**

NEW!

WRITE FOR AUDIO CATALOG
NO. 5 ON COMPANY LETTERHEAD

**Midwest's
Largest Source
of Professional
Audio
Equipment**

BEHREND'S, Inc.

161 E. Grand • Chicago, Ill. 60610 • (312) 527-3060
BRANCHES Cleveland, Detroit, Memphis, Kansas City
Circle Item 11 on Tech Data Card

**CRYSTALS
are not all the
same!**



**INSIST ON
TEXAS
CRYSTALS
BY NAME!**

If your dealer is temporarily out of stock or does not carry Texas Crystals, send us his name along with your order. Minimum order, check or C.O.D. is \$5.00. Add 5¢ per crystal for postage, 10¢ for air mail.

Texas Crystals quality is outstanding as evidenced by use in numerous government space projects where there's no compromise with quality, reliability or accuracy. For commercial two way, ham operation or special frequency control crystals, Texas Crystals are your best buy.

Send for Free Catalog with Circuits



**TEXAS
CRYSTALS**

A Division of Whitehall Electronics Corp.

1000 Crystal Drive 4117 W. Jefferson Blvd.
Fort Myers, Florida Los Angeles, California
Phone 813 WE 6-2109 Phone 213 731-2258

Circle Item 29 on Tech Data Card

Maintenance Logs

(Continued from page 15)
could show that the station is operating on a construction permit, equipment test, program test, telegram, license, or post card. A listing of the mode of operation employed at the station is sometimes included—authorized frequency, power(s) DA or NDA pattern (for AM), ERP, antenna-power gain, line and transmitter efficiency (for FM or TV)—and the particular transmitter involved where more than one is licensed.

Some stations include readings of transmitter meters which aren't required on the operating log—oscillator plate, buffer plate, grid drive, etc. Another item found is a list of tube replacements in the transmitter, showing tube type, serial number, position or stage, and reading of time meter, if any. Calibration of remote control and failure, removal from service, and restoration to service of a phase monitor may be required by station license, but other stations add them to the log.

Regular daily inspection of the following items is logged by some

stations: Antenna-tuning unit, color and condition of PA and modulator tubes, all indicator and pilot lamps, spare and standby crystals, spare tubes, fuses, and parts stock, building-ventilating fan, air-conditioning and heating equipment, fire extinguisher, burglar-alarm system, frequency-monitor crystal-oven temperature, recording equipment (disc or tape), NDEA or EBS receivers, and the general condition inside and outside the building. An audio check is used by some stations—notes of input and output audio levels, distortion, noise, and transmitter-carrier shift.

Some stations may be required to take monitor-point readings with a field meter, and these are often entered in the maintenance log. FM stations with SCA or stereo sub-carriers sometimes have these frequencies checked by an independent measuring service and enter the results in the log. Latitude and longitude of the transmitter site are listed by some stations.

We found that some stations simply use longhand notes on the back of the operating log to describe maintenance work. While this may be acceptable from a legal standpoint, it ignores human nature and leaves too much to the duty man's memory. It's much better to have a printed form as a reminder of the various tasks to be performed. A few stations use large sheets (16" x 13") with the operating log printed on one side and the maintenance log on the other. There is space for an entire 24 hours' operation and for daily and weekly maintenance-log entries.

After examining many logs, two deficiencies were most often noticed—lack of space for remarks, and a tendency to encourage check-marking items. If there's space for only an "OK" after a listing, how can you expect the duty man to describe trouble? Many stations maintain completely inadequate records of previous service, which means that new employees or consultants have to troubleshoot equipment blind. Remember, your job can be made much easier if you and your coworkers describe fully any and all repairs, adjustments, and service in the maintenance log.

LIGHTNING SEASON GUARD AGAINST AC LINE SURGES

with the

**Wilkinson Electronics
Line Surge Protector**

Model S1-A

Protect Valuable Silicon Power Supplies and Solid State Equipment against Killing Line Surges due to Lightning, Transients, and Arcing —

120 Volt Single Phase \$ 89.50
220 Volt Single Phase 179.50
220 Volt Three Phase 259.50



Wilkinson Electronics, Inc.
1937 W. MacDade Blvd.
Woodlyn, Pa. 19094
Telephone: 215-874-5237

Circle Item 10 on Tech Data Card

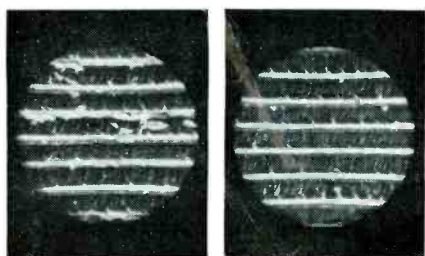
Some plain talk from Kodak about tape:

Slitting accuracy and skew angle

Tape is made in wide rolls which are slit to width— $\frac{1}{4}$ " for most audio tapes. There are three main considerations in this process: cleanliness, dimensional accuracy and trueness of cut. Cleanliness cannot be given too much consideration. When the tape is slit, particles of the oxide and the base can flake off. This condition arises from poor oxide adhesion and poor quality-control standards on slitters. Slitting dirt is virtually nonexistent in Kodak tapes because of our "R-type" binder and our unique slitting techniques.

Tape dirt clogs the recording gap and prevents the tape from making intimate contact with the head, thus causing dropouts and high-frequency losses. Oxide dirt can also cause a phenomenon known as re-deposit. During a normal tape transport operation, gummy oxide dirt can actually re-deposit on the magnetic layer and fuse in position. Just imagine Main Street strewn with giant boulders. Well, that's the way re-deposits appear to your recorder heads. Pleasant thought, isn't it?

To get some idea about how Kodak tape slitting compares to ordinary slitting, take a look at these two photomicrographs. The dirt you see between the turns on the left is oxide dirt. Compare it to the virtually spotless edges of KODAK Sound Recording Tape on the right.

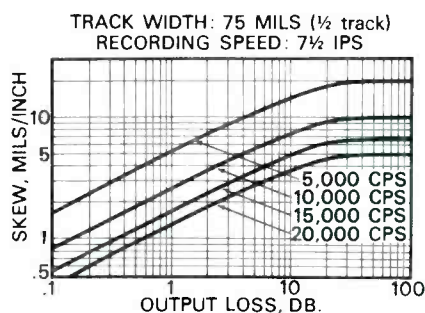


It's like splitting hairs,
only more critical

From our 42-inch-wide master web, we have to cut 160 quarter-inch ribbons of

tape — each almost two miles long. That's a lot of total mileage, especially when you think how straight and true those edges must be to assure optimum tracking on your recorder. In terms of slitting accuracy, the standard specs call for a tolerance on width of $\pm .0020$ inches. We decided that that was just about double what it really should be, so we hold ours to $\pm .0010$ inches.

But the really critical part of slitting is a bad guy known as weave. When a tape weaves, it passes the head at a continuously changing skew angle. Look at the graph.

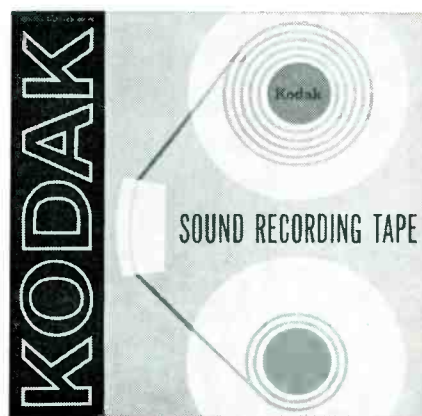


Note how losses pile up as skew angle increases. And as you would guess, the losses are in proportion to the frequency. Higher frequencies, higher losses. Same principle, really, as an azimuth loss.

The patterns of tension set up within the roll when the tape is wound are quite interesting. Normally, the tension at the outside of the roll will decrease until it reaches a point of zero tension about $\frac{1}{3}$ of the way from the core. Beyond this point the tension increases, but the direction of that force is reversed. Near the core the tape is in a state of compression. It's just the opposite with the outer layers. They're clockspringing.

Proper tape tension is also important if you want to prevent "stepping." Stepping usually takes place at the point of zero tension. You can visualize

it as a lateral shearing of a roadway during an earthquake. Shades of old San Francisco. This sets up stresses which cause fluted edges and prevent proper head contact. From winding billions of feet of motion picture film, Kodak has developed some pretty specialized tension-control techniques. The end result, of course, is that when you get Kodak tape on a roll, you know it's wound properly: not too loose, not too tight. Just right. Our Thread-Easy Reel is part of the story, too. Because it is dynamically balanced, we get a good wind right off the bat, and you get a good rewind, too, when you run it on your tape deck.



KODAK Sound Recording Tape in a complete variety of lengths and types is available at most tape outlets: electronic supply stores, specialty shops, department stores, camera stores . . . everywhere.

FREE! New comprehensive booklet covers the entire field of tape technology. Entitled "Some Plain Talk from Kodak about Sound Recording Tape," it's yours on request when you write Department 8, Eastman Kodak Company, Rochester, N.Y. 14650.

©Eastman Kodak Company, MCMLXI

EASTMAN KODAK COMPANY, Rochester, N. Y.

Circle Item 12 on Tech Data Card

CAN BE
USED TO CONTROL
CATV
RECEIVERS

\$895 Complete
With Four Meters

Maximum Reliability
No Dials or Stepping Relays

from Bionic Instruments, Inc. - 221 Rock Hill Road Bala - Cynwyd, Pennsylvania

New Instantaneous Function Selection

REMOTE CONTROL FOR ANY AM or FM STATION

Minimum
Rack Space
Requirement

BIONIC INSTRUMENTS, INC. MODEL 6155

Circle Item 13 on Tech Data Card

Checking the Pattern

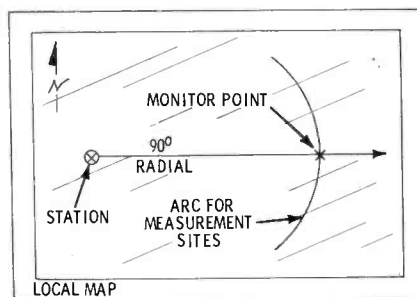


Fig. 6. Method used to establish measurement points for determining ratio points.

indicate greater losses or a lower power, whereas a higher figure would indicate the converse. In either case some change has taken place, and a check of the transmitter input power and common-point current values against the original values would be in order.

Ratio Points

Frequently, the shape and position of pattern minima or nulls should be checked. There are several methods of doing this, including the techniques just described; however, a quick, simple method is often needed. A null can be checked by making a series of measurements, under both directional and nondirectional conditions of operation, along an arc in the area of the null. As an example of this technique, assume that you wish to check a null which lies on a monitor-point radial of 90° . Using a map of the area under study, an arc which extends 20° to 30° each side of the radial is drawn through the monitor point. The station is the pivotal point as shown in Fig. 6. Under nondirectional operation, measurements are made at as many points along this arc as is practical. Next, the same points are measured under directional operating

(Continued from page 21)

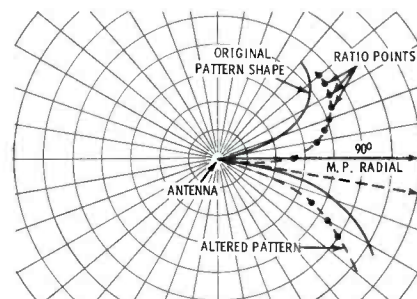


Fig. 7. Use of ratio points provides the means for determining shifts in minima.

conditions. To obtain the ratio for each point, divide the directional field strength by the nondirectional field strength and plot the resulting ratios on polar graph paper after determining the azimuth angle of each ratio point. Fig. 7 shows the result of such a determination. The original shape is shown by the continuous line; the modified shape by the broken line. This investigation shows that the null has shifted away from the 90° line to a higher azimuth angle of approximately 100° . Because of seasonal effects, it is desirable that ratio measurements, both directional and nondirectional, be made during the same season in the same day, if possible.

Conclusion

Whatever the purpose in checking a pattern, it is important to keep careful records so that information is on hand for investigating any future problems. Remember, too, that information presented in this article is designed primarily to provide several points of reference for setting up and maintaining performance records. With a means for running several quick checks, the station engineer will better be able to detect variation from established criteria. ▲

**all
systems*
GO...**

You're A-OK with **Q R K**

*Monaural or Stereo

Whether it's stereo or monaural... when you launch a recording on a QRK Professional Turntable, you can depend on an instant "cue" and the superlative performance that has made QRK famous. QRK Professional Turntables have only 3 rotating parts in their patented design. The exclusive "platter-dapter" adapts to all discs without pop-up gadgets. Every QRK unit is backed by a full year warranty and prompt service.

See your dealer or write for complete illustrated literature.

QRK ELECTRONIC PRODUCTS
2125 N. Barton • Fresno, California

Circle Item 28 on Tech Data Card

BROADCAST ENGINEERING



This is L.A.'s Mt. Wilson, where 6 out of 10* TV stations

*Soon to be 7 out of 11... by the end of the year a new station, KMTW (TV), Channel 52, also will be on the air (subject to FCC approval!) with a G-E Helical Antenna.

transmit sharper images with General Electric antennas.

Los Angeles has the greatest concentration of TV antennas in the world—and the majority of them are General Electric. These are the stations and their G-E equipment: KABC-TV, Channel 7, 6 Bay Batwing; KCET, Channel 28, 8 Panel Zig-Zag; KMEX-TV, Channel 34, 5 Bay Helical (4 Panel Zig-Zag on order); KPOL-TV, Channel 22, 2 Bay Helical; KTLA, Channel 5, 3 Bay Batwing; KTTV, Channel 11, 6 Bay Batwing.

G.E. can help you improve your image. Contact your

G-E Broadcast Equipment Representative, or, General Electric Company, Visual Communications Products, 7-315 Electronics Park, Syracuse, New York 13201. GE-14

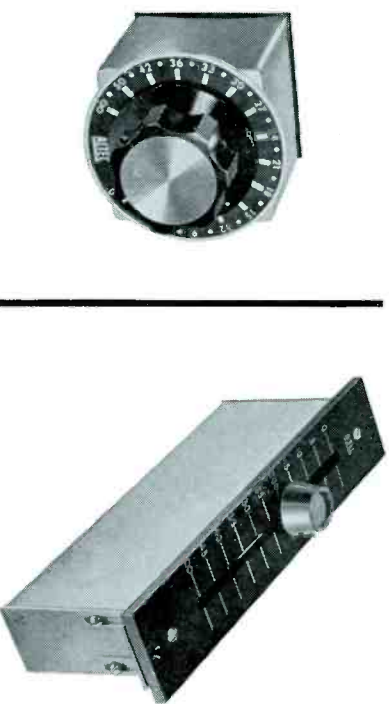
Visual Communications Products

GENERAL ELECTRIC

Electronics Park, Syracuse, New York

MORE NEW STUDIO EQUIPMENT FROM ALTEC

LATEST ATTENUATOR LINE ACHIEVES LESS THAN 1 MILLIOHM CONTACT RESISTANCE, LOWER NOISE, EASIER UPKEEP, LONGER LIFE



The hoped-for possibility has developed into working reality—we've managed to come up with the finest attenuators yet developed. More than 300 types are available with either solder terminals or as plug-ins, either rotary or straight-lines, and in such categories as mixers, calibrated controls, calibrated grid control pots, VU range extenders, decade attenuators, impedance matching networks, decade resistors, faders, and stereo pan potentiometers. And they're all listed in the new Altec Attenuator Catalog which we've printed as a convenient reference for your aid.

ALITTLE ABOUT A LOT OF IMPORTANT IMPROVEMENTS

You might like to know how some of these improved attenuators were engineered. For instance, "coin" silver, which is normally used to make brushes, contains copper and is subject to oxidation—reducing conductivity and raising noise level, among other things. So we've made our brushes of "fine" (pure) silver because it doesn't oxidize—it sulfides. Silver sulfide does not reduce conductivity; in fact, it actually has a helpful lubricity. We use dual brushes on all our attenuators—both rotary and straight-line models. They are independently sprung and so guided as to eliminate "stumble" from contact to contact.

ADDED DEVELOPMENTS

Our new attenuator line is designed so that we'll be able to gang up to 8 of them in tandem, enabling you to operate the whole group with one control. We've produced rotary attenuators that will give you more steps in less space. How? Instead of putting them in the conventional round cans—we're building ours in square ones. And we're using the corners (space that previously went to waste) for the wiring.

DON'T FORGET THE CATALOG

The new Altec Attenuator Catalog we mentioned above has all the technical characteristics and other relevant data on the new line. We'll be delighted to send it to you. So write today, Dept. BE-7.



ALTEC LANSING
A Division of *ESST* Ling Altec, Inc.
ANAHEIM, CALIFORNIA
© 1965 AL

Circle Item 15 on Tech Data Card

Negative Resistance

(Continued from page 17)

age, current, and frequency. There were few devices that displayed negative-resistance characteristics naturally; the phenomenon was achieved by means of feedback, and circuit operation could be analyzed validly either as negative resistance or as feedback.

The point-contact transistor was the first semiconductor device that had negative-resistance characteristics. The alpha of the point-contact transistor is greater than one over part of its range, which leads to a negative-resistance region that is either current-stable or voltage-stable, depending on the connection of the unit. Point-contact transistors rapidly went into use as miniature oscillators and switching units for early digital computers.

In the span of a very few years, many semiconductor devices displaying an intrinsic negative-resistance characteristic were invented. The variety of units with different characteristics now permits broad latitude in the use of negative resistance as a circuit element. The true scope of this new circuit tool is better noted by listing recently developed devices that display a stable negative - resistance characteristic. Among them are the point-contact transistor, the four-layer diode, the hook transistor, the silicon-controlled switch, the silicon-controlled rectifier, packaged negative-resistance elements, the unijunction transistor, and—the most promising device of all—the tunnel diode.

Next month, in Part 2 of this article, we'll examine this device and others in detail and investigate their operation and function in simple circuits. The entire electronics industry stands to profit enormously from this new generation of semiconductor in widely diverse applications. Even though broadcasting, so far at least, uses only a few such devices, the time rapidly approaches when they will become as commonly employed as simple vacuum tubes and relays are today. ▲

STANCLIFF-HOFFMAN CORP.

- MINTAPE PROFESSIONAL BATTERY Operated Portable Recorder, Mono Stereo, Synchronous, FILM RECORDERS, Single and Multi-Channel, 16, 17½, 35 MM.
- BROADCAST LOGGING Recorders, Slow Speed Single Channel to 32 Channels.
- HIGH SPEED TAPE DUPLICATORS for Full, Half and Two Track Stereo Duplication.
- 921 N. Highland Ave., Hollywood 38, Calif.

BROADCAST ENGINEERING

Modulation Power

(Continued from page 12)

critical listeners may provide the best results. Always use a very high quality demodulator, amplifier, and speaker system.

Linearity Correction

A linearity-correction amplifier inserted just following the limiter can correct for the nonlinearities that occur in the transmitter audio system. The amplifier produces precisely controlled distortion which is equal in amplitude but opposite in phase to the distortion produced in the transmitter. Amplifier adjustment is made by inserting a tone at a level equivalent to 100% modulation and adjusting the amplifier for minimum system distortion. In typical cases, distortions of 5% to 7% can be brought down to the 2% range; 3% systems can be corrected to below 1%. Some advantages are as follows: large transmitting tubes (modulators, modulator drivers, and PA tubes, etc.) can be used longer with satisfactory results; positive-peak linearity can be increased for older transmitters, thus allowing for additional modulation increases by other processes; distortions produced by carrier shift can be corrected—if a 5% positive carrier shift is introduced by the correction amplifier, a negative 5% carrier-shift distortion could be corrected, leaving the desired stable carrier.

Reverberation and Echo Chambers

To provide a "fuller" sound, audio is delayed by various processes: tape machine, delay line, echo chamber, or mechanical spring delay; the tape machine probably offers the most practical approach. The original audio is delayed using a second head and mixed back into the original signal. This produces a slight echo effect which, to some ears, makes the music sound more alive. It's doubtful that additional modulation power is attained by this process, but some of the low-level portions of the program material are filled in, giving the subjective impression of "more sound."

Conclusions

Increases in modulation power obtainable from the various techniques discussed are listed below,



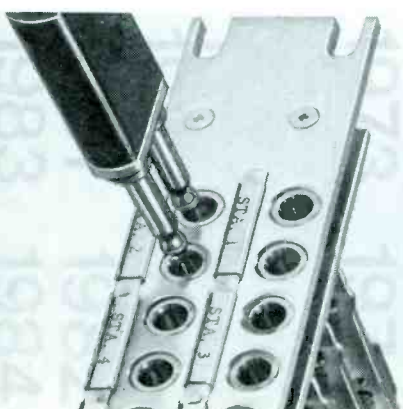
Fig. 6. Depending on negative-peak excursions, clipping level varies widely.

1. Frequency response alteration: .25db to 1db, average .5db.
2. Automatic level control: 4db to 10db, average 6db.
3. Carrier-shift correction: .25db to 1db, average .5db.
4. Control of audio - wave symmetry: .5db to 4db 50% of the time, average 1.5db.
5. Antenna-loading compensation: .25db to 1.25db, average .5db.
6. Instantaneous peak clipping: 1db.
7. Linearity - amplifier correction: 0db to 1.5 db, average .5db.
8. Reverberation systems: 0db.

The total average for all possible systems is 10.5db. What is the effect of this increase? Is it as effective as if the carrier power has been increased the same amount, say 10db—ten times? Yes, it is and usually better. Another question arises: Will the increased power modulation techniques upset present interference conditions? First of all, these techniques do not violate interference rules because interference rules are all based upon field-strength ratios, and nothing is being done to increase field strength (with the slight exception of increasing carrier shift in the plus direction). This is not to dodge the practical side of the interference question. Co-channel interference is determined mostly by carrier beating. Increased modulation will help some to extend the coverage signal beyond the 20:1 interference point, but will have almost no effect to giving increased interference to other co-channel stations.

Adjacent-channel interference is considered to be at a 1/1 field ratio, but in practice it may be influenced by modulation power. Today, most radios are sensitive enough so that objectionable interference is seldom experienced at the 1/1 ratio area. ▲

OUTLASTS THEM ALL



SWITCHCRAFT NYLON PATCH CORDS

Yes, nylon . . . where it counts! Bronze tinsel conductors are insulated with a thermoplastic over which a braided shield and black nylon braid are woven. Result: twenty (or more) times the cable life without fraying or shorting. It's built-in reliability insurance! Literally scores of stock types and sizes from 6" to 10' . . . with "Twin-Plugs" or 2 or 3-conductor Mil-Type phone plugs. You name it!

JACK PANELS



As trouble-free and reliable as can be. The industry's most complete line for all applications in your choice, or steel-reinforced black phenolic, or extremely lightweight aluminum frames, 24 to 32 jacks; single row or double row (spaced so that double - plugs cannot make cross-connections); highest quality die-cast, or military jacks; internally adjusted for perfect electrical connections. Special spring materials and configurations prevent them from taking a set, or breaking, yet they cost no more! Also available without jacks. Complete line of accessories, too (lamp jacks, dual jack blocks, dummy plugs, hole plugs, brackets). Switchcraft makes them all!

WRITE FOR NEW PHONE PLUG AND PATCH CORD CATALOG P-202 AND JACK CATALOG J-103, or see your local Switchcraft Authorized Industrial Distributor for immediate delivery at factory prices.

5535 No. Elston Ave.
Chicago, Illinois 60630
Canada: Atlas Radio Corp. Ltd.
50 Wingfield Ave., Toronto, Ontario

Circle Item 14 on Tech Data Card

Modulation Power

(Continued from page 12)

critical listeners may provide the best results. Always use a very high quality demodulator, amplifier, and speaker system.

Linearity Correction

A linearity-correction amplifier inserted just following the limiter can correct for the nonlinearities that occur in the transmitter audio system. The amplifier produces precisely controlled distortion which is equal in amplitude but opposite in phase to the distortion produced in the transmitter. Amplifier adjustment is made by inserting a tone at a level equivalent to 100% modulation and adjusting the amplifier for minimum system distortion. In typical cases, distortions of 5% to 7% can be brought down to the 2% range; 3% systems can be corrected to below 1%. Some advantages are as follows: large transmitting tubes (modulators, modulator drivers, and PA tubes, etc.) can be used longer with satisfactory results; positive-peak linearity can be increased for older transmitters, thus allowing for additional modulation increases by other processes; distortions produced by carrier shift can be corrected—if a 5% positive carrier shift is introduced by the correction amplifier, a negative 5% carrier-shift distortion could be corrected, leaving the desired stable carrier.

Reverberation and Echo Chambers

To provide a "fuller" sound, audio is delayed by various processes: tape machine, delay line, echo chamber, or mechanical spring delay; the tape machine probably offers the most practical approach. The original audio is delayed using a second head and mixed back into the original signal. This produces a slight echo effect which, to some ears, makes the music sound more alive. It's doubtful that additional modulation power is attained by this process, but some of the low-level portions of the program material are filled in, giving the subjective impression of "more sound."

Conclusions

Increases in modulation power obtainable from the various techniques discussed are listed below,

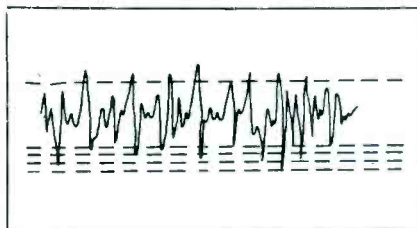


Fig. 6. Depending on negative-peak excursions, clipping level varies widely.

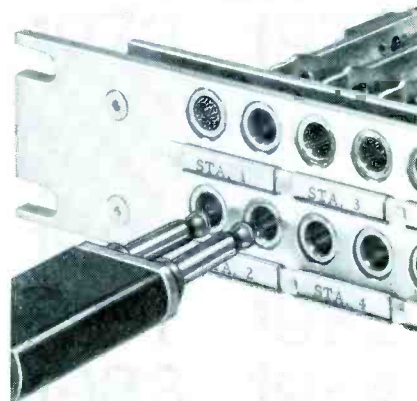
and minimum, maximum, and average expected db increases are also given:

1. Frequency response alteration: .25db to 1db, average .5db.
2. Automatic level control: 4db to 10db, average 6db.
3. Carrier-shift correction: .25db to 1db, average .5db.
4. Control of audio-wave symmetry: .5db to 4db 50% of the time, average 1.5db.
5. Antenna-loading compensation: .25db to 1.25db, average .5db.
6. Instantaneous peak clipping: 1db.
7. Linearity - amplifier correction: 0db to 1.5 db, average .5db.
8. Reverberation systems: 0db.

The total average for all possible systems is 10.5db. What is the effect of this increase? Is it as effective as if the carrier power has been increased the same amount, say 10db—ten times? Yes, it is and usually better. Another question arises: Will the increased power modulation techniques upset present interference conditions? First of all, these techniques do not violate interference rules because interference rules are all based upon field-strength ratios, and nothing is being done to increase field strength (with the slight exception of increasing carrier shift in the plus direction). This is not to dodge the practical side of the interference question. Co-channel interference is determined mostly by carrier beating. Increased modulation will help some to extend the coverage signal beyond the 20:1 interference point, but will have almost no effect to giving increased interference to other co-channel stations.

Adjacent-channel interference is considered to be at a 1/1 field ratio, but in practice it may be influenced by modulation power. Today, most radios are sensitive enough so that objectionable interference is seldom experienced at the 1/1 ratio area.

OUTLASTS THEM ALL

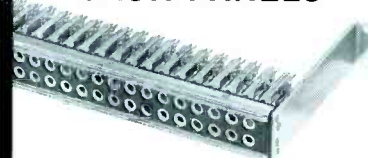


SWITCHCRAFT NYLON PATCH CORDS



Yes, nylon . . . where it counts! Bronze tinsel conductors are insulated with thermoplastic over which a braided shield and black nylon braid are woven. Result: twenty (or more) times the cable life without fraying or shorting. It's built-in reliability insurance! Literally scores of stock types and sizes from 6" to 10' . . . with "Twin-Plugs" or 2 or 3-conductor Mil-type phone plugs. You name it!

JACK PANELS



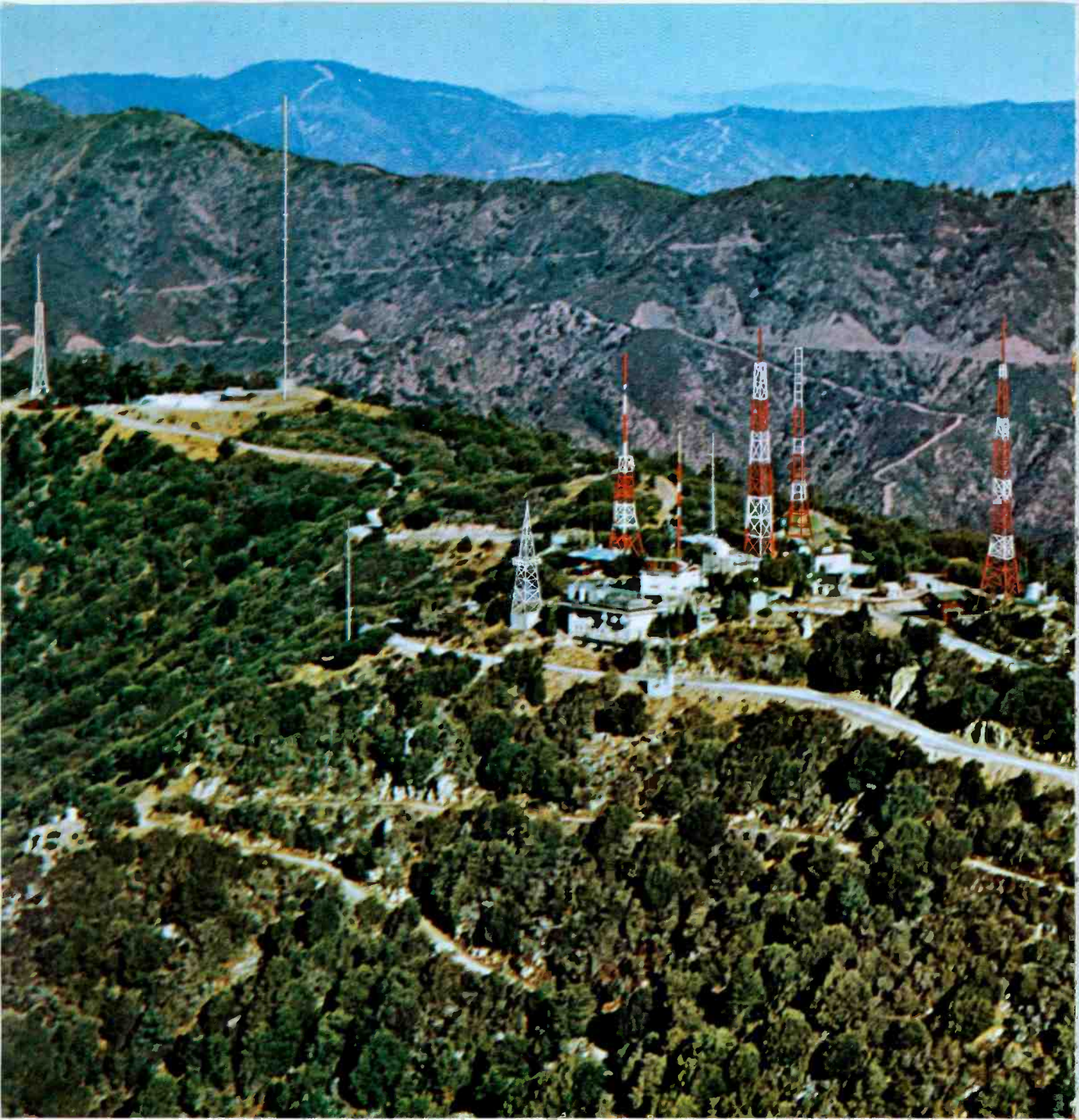
As trouble-free and reliable as can be. The industry's most complete line for all applications in your choice of steel-reinforced black phenolic, or extremely lightweight aluminum frames; 24 to 52 jacks; single row or double row (spaced so that double plugs cannot make cross-connections). Highest quality telephone or military jacks individually adjusted for perfect electrical connections. Special spring materials and configurations prevent them from taking a "set" or breaking, yet they cost no more! Also available without jacks. Complete line of accessories, too ("Lamp Jax," dual jack blocks, dummy plugs, hole plugs, brackets). Switchcraft makes them all!

WRITE FOR NEW PHONE PLUG AND PATCH CORD CATALOG P-202 AND JACK CATALOG J-103, or see your local Switchcraft Authorized Industrial Distributor for immediate delivery at factory prices.

SWITCHCRAFT®

5535 N. Elston Ave.
Chicago, Illinois 60630
Canada: Atlas Radio Corp., Ltd.
50 Wingold Ave., Toronto, Ontario

Circle Item 14 on Tech Data Card



This is L.A.'s Mt. Wilson, where 6 out of 10* TV stations

*Soon to be 7 out of 11...by the end of the year a new station, KMTW (TV), Channel 52, also will be on the air (subject to FCC approval) with a G-E Helical Antenna.



transmit sharper images with General Electric antennas.

Los Angeles has the greatest concentration of TV antennas in the world—and the majority of them are General Electric. These are the stations and their G-E equipment: KABC-TV, Channel 7, 6 Bay Batwing; KCET, Channel 28, 8 Panel Zig-Zag; KMEX-TV, Channel 34, 5 Bay Helical (4 Panel Zig-Zag on order); KPOL-TV, Channel 22, 2 Bay Helical; KTLA, Channel 5, 3 Bay Batwing; KTTV, Channel 11, 6 Bay Batwing.

G.E. can help you improve your image. Contact your

G-E Broadcast Equipment Representative, or, General Electric Company, Visual Communications Products, 7-315 Electronics Park, Syracuse, New York 13201. GE-14

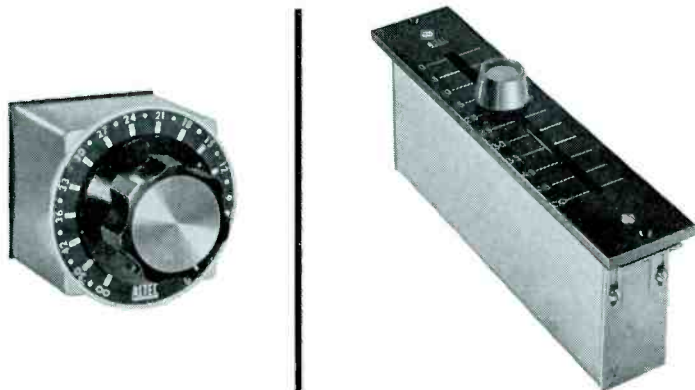
Visual Communications Products

GENERAL  ELECTRIC

Electronics Park, Syracuse, New York

MORE NEW STUDIO EQUIPMENT FROM ALTEC

LATEST ATTENUATOR LINE ACHIEVES LESS THAN 1 MILLIOHM CONTACT RESISTANCE, LOWER NOISE, EASIER UPKEEP, LONGER LIFE



The hoped-for possibility has developed into working reality—we've managed to come up with the finest attenuators yet developed. More than 300 types are available with either solder terminals or as plug-ins, either rotary or straight-lines, and in such categories as mixers, calibrated controls, calibrated grid control pots, VU range extenders, decade attenuators, impedance matching networks, decade resistors, faders, and stereo pan potentiometers. And they're all listed in the new Altec Attenuator Catalog which we've printed as a convenient reference for your aid.

A LITTLE ABOUT A LOT OF IMPORTANT IMPROVEMENTS

You might like to know how some of these improved attenuators were engineered. For instance, "coin" silver, which is normally used to make brushes, contains copper and is subject to oxidation—reducing conductivity and raising noise level, among other things. So we've made our brushes of "fine" (pure) silver because it doesn't oxidize—it sulfides. Silver sulfide does not reduce conductivity; in fact, it actually has a helpful lubricity. We use dual brushes on all our attenuators—both rotary and straight-line models. They are independently sprung and so guided as to eliminate "stumble" from contact to contact.

ADDED DEVELOPMENTS

Our new attenuator line is designed so that we'll be able to gang up to 8 of them in tandem, enabling you to operate the whole group with one control. We've produced rotary attenuators that will give you more steps in less space. How? Instead of putting them in the conventional round cans—we're building ours in square ones. And we're using the corners (space that previously went to waste) for the wiring.

DON'T FORGET THE CATALOG

The new Altec Attenuator Catalog we mentioned above has all the technical characteristics and other relevant data on the new line. We'll be delighted to send it to you. So write today, Dept. BE-7.



ALTEC LANSING
A Division of *LSV* Ling Altec, Inc.
ANAHEIM, CALIFORNIA

© 1965 AL

Negative Resistance

(Continued from page 17)

age, current, and frequency. There were few devices that displayed negative-resistance characteristics naturally; the phenomenon was achieved by means of feedback, and circuit operation could be analyzed validly either as negative resistance or as feedback.

The point-contact transistor was the first semiconductor device that had negative-resistance characteristics. The alpha of the point-contact transistor is greater than one over part of its range, which leads to a negative-resistance region that is either current-stable or voltage-stable, depending on the connection of the unit. Point-contact transistors rapidly went into use as miniature oscillators and switching units for early digital computers.

In the span of a very few years, many semiconductor devices displaying an intrinsic negative-resistance characteristic were invented. The variety of units with different characteristics now permits broad latitude in the use of negative resistance as a circuit element. The true scope of this new circuit tool is better noted by listing recently developed devices that display a stable negative - resistance characteristic. Among them are the point-contact transistor, the four-layer diode, the hook transistor, the silicon-controlled switch, the silicon-controlled rectifier, packaged negative-resistance elements, the unijunction transistor, and—the most promising device of all—the tunnel diode.

Next month, in Part 2 of this article, we'll examine this device and others in detail and investigate their operation and function in simple circuits. The entire electronics industry stands to profit enormously from this new generation of semiconductors in widely diverse applications. Even though broadcasting, so far at least, uses only a few such devices, the time rapidly approaches when they will become as commonly employed as simple vacuum tubes and relays are today. ▲

STANCIL-HOFFMAN CORP.

- MINITAPE PROFESSIONAL BATTERY Operated Portable Recorder, Mono Stereo, Synchronous.
 - MAGNETIC FILM RECORDERS, Single and Multi-Channel, 16, 17½, 35 MM.
 - BROADCAST LOGGING Recorders, Slow Speed Single Channel to 32 Channels.
 - HIGH SPEED TAPE DUPLICATORS for Full, Half and Two Track Stereo Duplication.
- 921 N. Highland Ave., Hollywood 38, Calif.

Circle Item 15 on Tech Data Card

SOUNDS THAT SELL... START ON FAIRCHILD TURNTABLES!

For over 25 years FAIRCHILD RECORDING EQUIPMENT CORPORATION has been supplying to quality-oriented broadcast studios throughout the world, the ultimate in "engineered-in-depth" turntables. The continuing search for better quality has rewarded FAIRCHILD with a reputation for unsurpassed performance.

Realizing the vital fact that your station's turntables are the heart of your station's sound has prompted FAIRCHILD to introduce a series of unique belt drive turntables. These turntables provide truly inaudible rumble, wow and flutter coupled with a minimal moving parts design for low low maintenance and high reliability.

Now FAIRCHILD offers three distinctively designed quality turntables to serve the broadcast industry...three new FAIRCHILD turntables unsurpassed in quality, performance and durability to give your station the sound that sells!



FAIRCHILD MODEL 750—Three-speed 16" turntable handles LP's, 45's and 78's. Unique cueing pad for easy slip cueing, and torque characteristics of the drive system, allows startups from standstill in 1/2 turn (slip cue factor). The belt drive system allows turntable to be in a "ready" state at all times—no idlers to disengage or adjust. Noise-free to operate close to open DJ microphone. Available in black or new warm walnut.



FAIRCHILD MODEL 755—A 12" turntable with 2 basic speeds—33 and 45. Unique 2-belt system provides high starting torque coupled with low low rumble and imperceptible wow and flutter. The FAIRCHILD 755 is an ideal quality answer for your turntable requirements—high performance design—compact and economical. High reliability and low maintenance performance have been part of the FAIRCHILD 755 design reputation for several years. Available in black or new warm walnut.



FAIRCHILD MODEL 750-2—Same outstanding performance as basic FAIRCHILD 750 with 2 speeds (33 and 45). Provides Ideal 16" turntable where 78's will not be used. Available in black or new warm walnut.

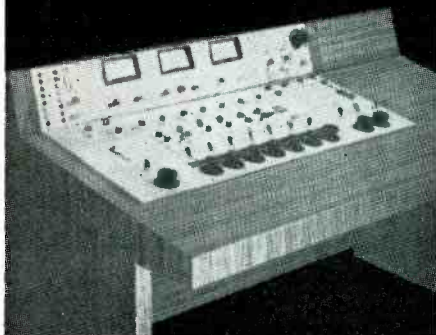


FAIRCHILD 676A TRANSISTORIZED PREAMP—Complements turntable performance by providing optimum accurate equalized output from any moving magnet or moving coil cartridge. Contains NAB or flat equalization curves, with individual gain control easily accessible and operable during operation. Single or stereo (676A2) version.

FAIRCHILD RECORDING EQUIPMENT CORPORATION
10-40 45th Ave., Long Island City 1 N. Y.

Circle Item 16 on Tech Data Card

Elliot, Unger & Elliot, Division of Screen Gems, Inc. Relies on the new



FAIRCHILD CONSOLE

A heavy production schedule... a demanding clientele... a reputation for quality... all these factors were considered by Elliot, Unger & Elliot engineers when they designed their new re-mix console. They examined the equipment field and their choice was FAIRCHILD, including the low noise, low distortion Model 662 Preamplifier; the 663 Compressor, the 661 AUTO-TEN and the 664 Equalizer.

Elliot, Unger & Elliot have found new versatility and flexibility in such devices as the FAIRCHILD AUTO-TEN for noise reduction; the 663 Compressor for over-load protection and the creation of apparent loudness effects, and the 664 Equalizer for accenting purposes. FAIRCHILD's Reverberation System... The "REVERBERTRON"... provides the answer to Elliot, Unger & Elliot's need for acoustic environmental effects, without tying up valuable studio space or allocating a large dollar outlay for equipment.

The FAIRCHILD modular console construction concept reduced the buildup time by months, and reduced fabrication costs by thousands of dollars. Why not join the growing list of film, phonograph and broadcast studios using FAIRCHILD RECORDING EQUIPMENT?

Write to Fairchild — the pacemaker in professional audio products — for complete details

FAIRCHILD
RECORDING EQUIPMENT CORPORATION
10-40 45th Ave., Long Island City 1, N.Y.

Circle Item 17 on Tech Data Card

CATV Cable

(Continued from page 19)

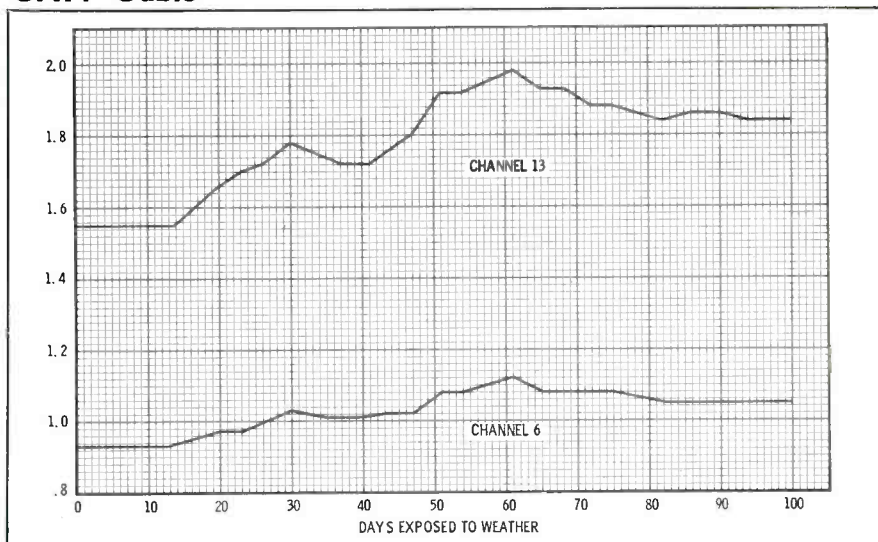


Fig. 2. Graphs show loss effects of moisture sprayed on polyethylene-jacketed CATV cable. each day for 50 days, then allowed to dry for 50 days. Attenuation increased as long as wetting continued and then dropped slightly under dry weather conditions. An important factor is the difference in attenuation between channel 6 and channel 13. A CATV system employing effective AGC amplifiers can handle the increase in attenuation at channel 6, but not the increase at channel 13, which can be as much as 28%.

Aluminum-Sheathed Cables

The problem of moisture, however, has an answer—semiflexible aluminum-sheathed cable (see Fig. 3A). For effective moisture prevention, the jacket is a seamless aluminum tube. The aluminum jacket is swaged down to the point that the foamed - polyethylene dielectric is compressed between the sheath and the center conductor. This compression prevents water and water vapor from traveling longitudinally along the cable. No cable—not even aluminum-sheathed types—can be permanently free from all pin holes along its entire length, but compressing the dielectric ensures that moisture cannot travel within the cable, thus eliminating moisture accumulation.

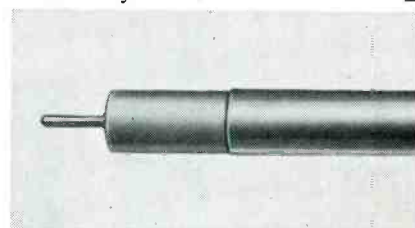
Because they are durable and moisture proof, aluminum-sheathed cables are now used almost universally in modern CATV systems. In most systems, the aluminum tube serves both as outer conductor and outer jacket. However, in some locations a polyethylene jacket is required (see Fig. 3B). Polyethylene-jacketed aluminum cable is used

under the following circumstances:

1. Where cable is to be buried for an underground system.
2. Where the atmosphere contains a high percentage of salt (sea-shore systems) or other chemical pollutants that attack aluminum.
3. Where the area abounds with squirrels. Certain species of squirrels will sharpen their teeth on aluminum cable, sometimes damaging it. They don't, however, like the taste of polyethylene.

Conclusion

Demands of viewers for increased fidelity of the TV signal provided by CATV systems has made necessary new cable-evaluation criteria and techniques. Methods for determining attenuation characteristics outlined in this article will assist operators in evaluating cables for various systems. ▲



(A) Without cover



(B) With cover

Fig. 3. Aluminum-jacketed cables with or without outer cover resist moisture well.

July 1965

We interrupt this magazine to bring you...

Late Bulletin from Washington

by Howard T. Head

New Table of UHF TV Assignments

The Commission has adopted a new Table of UHF Television Channel Assignments and has proposed a new class of lower-power, lower-height UHF station (April 1965 Bulletin) to be assigned on a demand basis on channels 70-83, inclusive. The new table provides for a total of 1080 assignments below channel 70, of which 508 are reserved for noncommercial educational television stations.

Under the new allocation table, no regular commercial assignments are made to cities with population less than 25,000, but channels 70-83 will be reserved for "community-type television stations" for these cities. Maximum permitted ERP would be 10 kw with an effective antenna height of 300'. Cochannel mileage separations of 50 miles, and adjacent-channel separations of 20 miles, would be established for the new low-power stations.

Television translators already operating on channels 70-83 will be permitted to continue, and new translators on these channels will be authorized on the same basis as previously. Translators will continue to be assigned on a secondary basis, however; that is, their assignments may be pre-empted by application for one of the new low-power stations.

AT&T To Delete Beep Requirement

The National Association of Broadcasters (NAB) has notified the Commission that it is withdrawing a complaint filed against AT&T relating to the present requirement for the insertion of a "beep" signal in material taken from telephone circuits and recorded for broadcast. In withdrawing the complaint, NAB informed the Commission that AT&T has agreed to voluntarily modify its tariffs to eliminate the requirement.

Field Strength/Distance Curves; Antenna Farms

In related actions, the Commission has proposed new field-strength-vs-distance curves for television use and has invited comments on a proposal to establish antenna farm areas for tall FM and television towers (March 1965 Bulletin). The new field-strength curves consist of new F(50,50) curves for television channels 2-6, 7-13, and 14-83 to replace the F(50,50) curves now in the Commission's Technical Standards.

Also proposed for the first time are F(50,10) curves for determining "equivalent protection" to existing FM and television stations. The provision for "equivalent protection" is made necessary by the proposed antenna farm areas,

since they may in many instances be located where not all stations using them will be able to comply with usual minimum mileage separation requirements. The Commission's proposal does not, however, include details of how "equivalent protection" will be established; this is expected to be a troublesome problem, particularly at UHF where the "taboo" requirements cannot readily be met by reducing height and power, nor by employing directional antennas.

New Multiple-Ownership Rules Affirmed

In a recent case involving two AM stations in North Carolina, the Commission has made clear its intention to adhere strictly to the letter of the new multiple-ownership Rules which forbid the licensing of two stations under common ownership in cases where there would be any overlap of the 1 mv/m groundwave contours. In the North Carolina case, the applicant had expressed his willingness to directionalize or reduce power of one of the stations to eliminate the overlap. The Commission refused to consider this proposal, however, stating that such a reduction in service would not appear to be in the public interest.

Interim Policy on Translator Grants

In a recent action granting new UHF television translators in Florida, the Commission announced its intention to formulate a definitive policy in the matter of licensing any television translator whose service would duplicate that of a television broadcast station (see February 1965 Bulletin). Under an interim policy, the Commission will require that a translator, upon request of a television broadcast station whose calculated Grade A contour includes the translator, not duplicate -- either simultaneously or 15 days before or after -- any program carried by the station. This interim policy is essentially the same as that now followed by the Commission in imposing restrictions on CATV systems that employ microwave relays.

Howard T. Head...in Washington

Get improved antenna VSWR with a simple field adjustment on JAMPRO's new **DIGITAL FM ANTENNA**

Digital tuning permits JAMPRO antennas to be field tuned by installation people in a matter of minutes by **EXCLUSIVE END TUNING CAPS***. The average 8 bay installation requires less than 30 minutes, using the transmitter reflectometer.

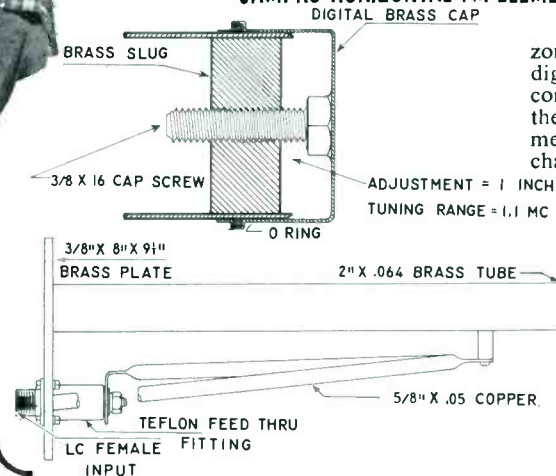
Actual mounting conditions may be different than those under which the antenna was tested. Tower lighting conduits, placement of ladders, tower construction and co-axial cable runs, all affect the installed VSWR of leg and face mounted FM antennas. The exclusive JAMPRO digital tuning feature permits fine field tuning to overcome these problems.

This exclusive JAMPRO feature permits overall VSWR values as low as 1.02 to 1. With tower leg or face mounted horizontal and vertical FM antennas, it is always possible to achieve 1.1 to 1 or better, 200 KC above and below carrier. JAMPRO antenna VSWR is not affected by fog or rain.

*Patent Applied For.

Write for catalog on Horizontal or Dual Polarized FM Antenna.

JAMPRO HORIZONTAL FM ELEMENT



Sketch shows horizontal FM element, with digital end tuning cap construction. Note that the 1 inch length adjustment, permit a frequency change of 1.1 megacycle.

JAMPRO

ANTENNA COMPANY

6939 POWER INN ROAD

SACRAMENTO, CALIFORNIA

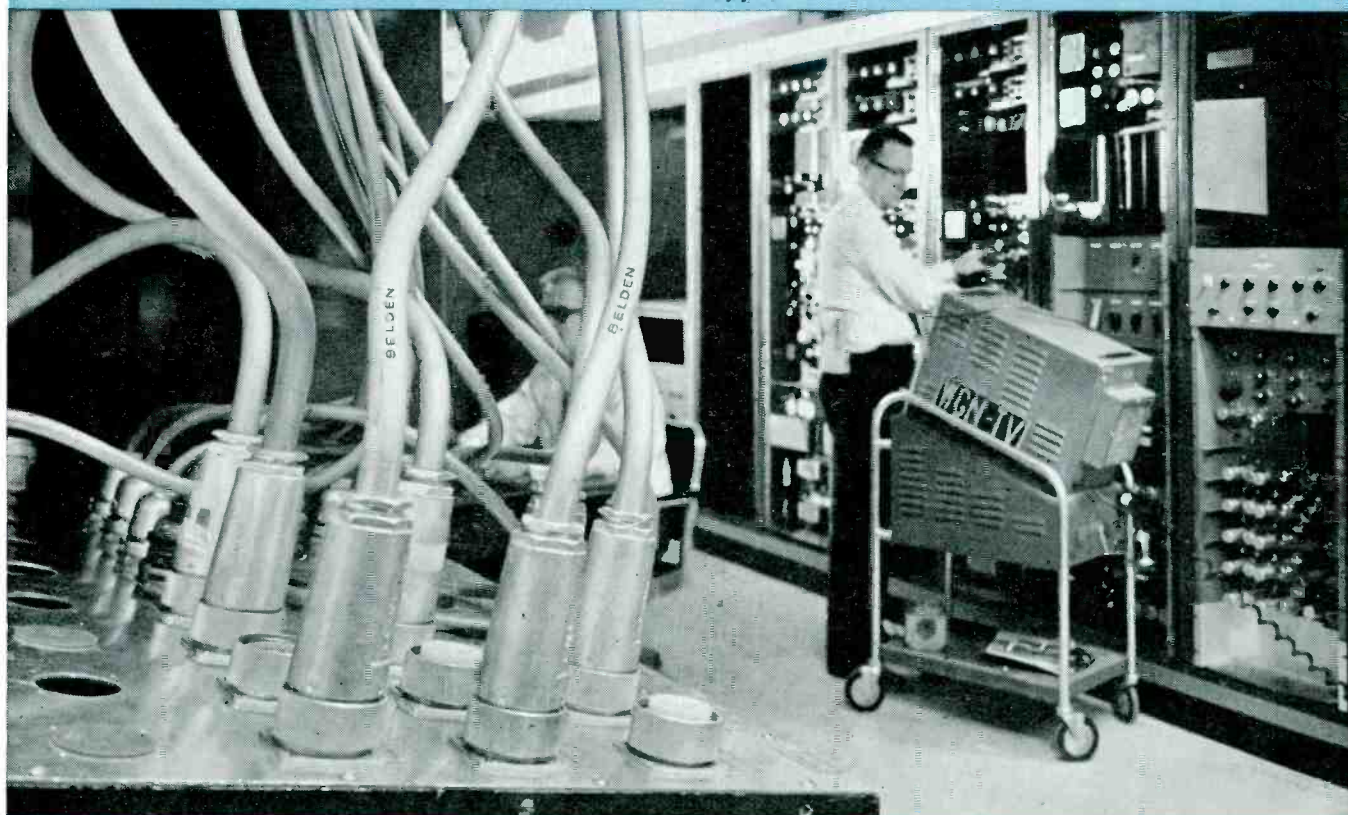
**Belden camera cable
in WGN-TV's unique
"Patch Panel" minimizes
switch over problems**



In their new Mid-America Broadcast Center, WGN-TV, Channel 9, Chicago, employs a unique centralized "patch panel" containing Belden TV Camera Cable. The panel allows a total of 15 black and white cameras, or seven color cameras, to be controlled from a single master control area by one engineer. The "patch panel" also greatly reduces the number of control units required and permits units to be changed rapidly in event of control failure. Defective cameras can also be replaced quickly using the same control unit.

90% Of all TV-Camera, Microphone, and Audio Cables at WGN-TV are made by Belden. And, according to Woody Crane, Chief Engineer for Television at WGN, Belden Camera Cable was specifically selected for the "patch panel" because of its extremely reliable performance, high-conductor insulation resistance, and ability to withstand the rigors of rapid switch overs.

Belden manufactures a complete line of wire and cable for TV and radio broadcasting, recording studios, remote control circuits, and similar applications. Call your Belden electronic distributor.



Better Built—Better Buy—Belden

Belden
WIREMAKER FOR INDUSTRY
SINCE 1902 - CHICAGO

power supply cords • cord sets and portable cordage •
electrical household cords • magnet wire • lead wire •
automotive wire and cable • aircraft wires • welding cable

8-5-3

Circle Item 19 on Tech Data Card

Antenna and Transmission

(Continued from page 25)

inch.) This graph paper is thin enough to see the scope trace, although it may be helpful to increase the intensity. This step must be performed with extreme accuracy for best results.

When the trace has been transferred to the graph paper, a careful inspection can be made of the excursion of any complete sine wave on any part of the trace. It is reasonable that a broad-band antenna will not be perfectly flat. This sweep method allows the engineer to determine the VSWR not only at the aural and visual carrier frequencies, but at any point in the sweep spectrum.

A VSWR figure can now be computed by using the following formula:

$$VSWR = \frac{60 + X}{60 - X}$$

where,

60 = 60 divisions on the K & E 20 x 20 graph paper or 3" deflection on the scope, and

X = Number of vertical divisions that any one complete sine wave covers on the graph.

The resultant figure will be the ratio between the open line (maximum deflection of 3") and the terminated line (minimum scope trace).

Fig. 5 shows some traces taken from the face of a 5" scope and transferred to the graph paper. It also shows a chart, obtained by using the above formula, which can be used for a VSWR-reference calculation.

It may be preferable to take pictures of the tests to keep for reference. A Polaroid oscilloscope camera using 3000-speed film set with the lens opening at f1.9 and the speed at 1/25 sec. will produce excellent results.

Conclusion

These measurements should be made on a monthly basis. The results should be recorded and used for comparison with measurements repeated at the end of a one-year period. Any irregularities can be detected and corrected. By using these methods, the broadcast engineer can be confident of the performance of the television-station antenna system. ▲

PROGRAM DIRECTORS
CHIEF ENGINEERS
EXECUTIVES

SAVE TIME

Identifying, Evaluating, Cataloging,
Inspecting 16mm Motion Picture Film
on the



moviola LIBRARY READER

- View at up to five times sound speed.
- View at governed sound speed.
- Twelve sided prism, high quality, projection system.
- Rapid rewind without switching reels.
- Performs all functions forward and reverse.
- Available with or without sound.

moviola
manufacturing co.
motion picture | tv equipment

5539 Riverton Ave., North Hollywood, Calif.
Telephone: 877-2173
Cable Address: Moviola, North Hollywood, Calif.

Circle Item 21 on Tech Data Card

LOOK! A NEW ELECTRONICS SLIDE RULE with complete instruction program



Here's a great new way to solve electronic problems accurately, easily... a useful tool for technicians, engineers, students, radio-TV servicemen and hobbyists. The Cleveland Institute Electronics Slide Rule is the only rule designed specifically for the exacting requirements of electronics computation. It comes complete with an illustrated Instruction Course. You get four AUTO-PROGRAMMED lessons... each with a short quiz you can send in for grading and consultation by CIE's expert instructors.

See for yourself. Learn how to whip through

all kinds of reactance, resonance, inductance, AC and DC circuitry problems in seconds... become a whiz at conventional computations too!

This all-metal 10" rule is made to our rigid specs by Pickett, Inc. ... comes complete with top grain leather carrying case and Instruction Course. A \$50 value for less than \$20. Send coupon for FREE illustrated booklet and FREE heavy vinyl Pocket Electronics Data Guide. Cleveland Institute of Electronics, 1776 E. 17th St., Dept. BE-102, Cleveland, Ohio 44114.

GET BOTH FREE!



Send
coupon
today →

Cleveland Institute of Electronics

1776 E. 17th St., Dept. BE-102 Cleveland, Ohio 44114

Send FREE Electronics Slide Rule Booklet. Special Bonus: Mail promptly and get FREE Pocket Electronics Data Guide too!

NAME _____ (Please Print)

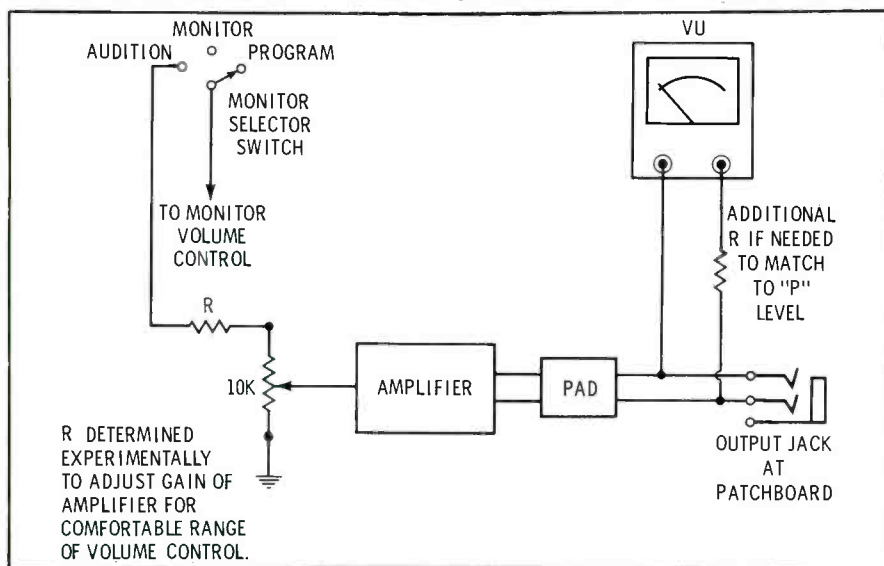
ADDRESS _____ COUNTY _____

CITY _____ STATE _____ ZIP _____

A leader in Electronics Training... since 1934

Circle Item 20 on Tech Data Card

ENGINEERS' EXCHANGE



Dual-Channel Modification of "Yard"

by Herbert Greenberg, Technical Consultant, and Richard Drake, WALI, Adelphi University, Garden City, N.Y.

A dual console is considerably more useful than one capable of handling only one program. Here at WALI, the Yard console "A," or audition, bus was connected to

a spare small amplifier through an isolating resistor and a gain control which becomes the "A" master. Once the master control is set, all "A"-channel gain adjustments are made with the individual mixer pots.

A spare VU meter was wired to read the output, and the audio pair from the added amplifier was

terminated at the patch panel. The gain of the amplifier was set to correspond to the "P," or program, side so that a remote line level could be checked in advance before switching for airing.


Good engineering practices indicate the use of an isolating pad at the output. The input impedance of the amplifier should be fairly high (or matched with a transformer), or resistance may be inserted for isolation. Similarly, the output can be terminated in a standard load resistor to maintain VU readings. The resistance can be arranged to lift at the patch terminals or be left in the circuit if bridging inputs only are used with the output. The increased capabilities more than justify the relatively simple modification, which disturbs no other functions of the console.

Dual Recovery Time For Gated Compressor

by Jim Dorsey, Chief Engineer, WLPM, Suffolk, Va.

In trying to boost our average modulation, we found that control-room noises became objectionable long before maximum efficiency was reached in our automatic gain

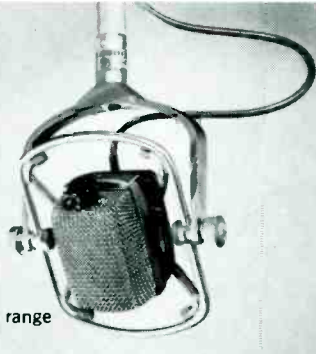
THE PROFESSIONAL'S CHOICE IN MICROPHONES



D-119CS

Range: 40-16,000 cps
Response: ± 3 db over entire range
Data sheet available on request

D-119CS—newest addition to the renowned D-19 dynamic microphone line. Its professional qualities make it the logical choice for sound recording, broadcasting, sound reinforcement and home entertainment. It features an extended frequency range, bass roll-off switch, true cardioid characteristics, on-off switch and many more desirable features.



D-25

Range: 30-16,000 cps
Response: ± 2.5 db over entire range
Data sheet available on request

D-25—The popular studio dynamic directional microphone, has an exceptional pronounced cardioid polar pattern independent of frequency. This unusually flexible microphone is ideal for television and recording studio applications in any location. Typical of the preferred features is a two-step (-7 db and -12 db at 50 cps) bass attenuation switch...and there are more!

CONDENSER • DYNAMIC MICROPHONES
MADE IN AUSTRIA BY AKG GMBH.

Norelco®
AUDIO VIDEO PRODUCTS

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

There are more International Nuclear TDA2



Video/

Pulse Distribution Amplifiers on the job in TV stations, networks and telephone companies than comparable units from any other leading manufacturer of broadcasting equipment.

MORE THAN 2,500 HAVE MILLIONS OF OPERATING HOURS

The TDA2 is a completely solid state instrument transistorized all the way with a regulated, built-in power supply. The circuit was designed to meet exacting color standards for the TV industry. These TDA2s will accept composite or non-composite video at a bridging type input of as little as 0.25 volt and will deliver four individually isolated 75 ohm outputs of 1.0 volt, peak to peak. They replace all tube type amplifiers without alteration of existing cables. Weighs under four pounds and is only 1¾ x 19 x 7 inches overall.



PRICE: \$325.00 EACH, F.O.B., NASHVILLE, TENNESSEE

For complete information and specifications write:

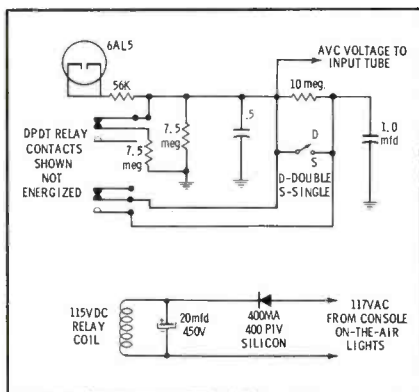
INTERNATIONAL NUCLEAR CORP.

608 NORRIS AVENUE • NASHVILLE, TENNESSEE • PHONE 615 254-3366

Circle Item 23 on Tech Data Card

amplifier. We sought to slow the recovery time of our unit only when the control-room mike was on. The circuit we developed uses a 115 VDC continuous-duty relay which operates from rectified AC from the on-the-air lights in the console. We used DC to prevent arcs on the key contacts.

This relay connects another resistor to ground from the AVC buss



and also changes the unit from single- to double-recovery operation. Since this relay controls accumulative AVC voltage, it makes no noise and doesn't noticeably change the level when it changes position.

Our unit is a Gates Sta-Level.

However, the circuit will work in any gated compressor. Using 25db compression for a reference, our time constants change from 1.65 sec to 11.25 sec recovery time when the relay is energized. The station engineer can change resistance values by consulting the instruction book and performing a little experimentation.

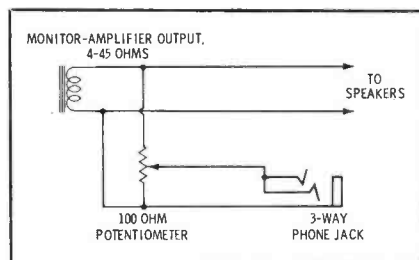
Level Control For Low-Z Headsets

by Ronald Pesha, Chief Engineer, KTHO, Tahoe Valley, California

Our announcers prefer to use the stereo headsets which are widely sold on the high-fidelity market. The innards of these headsets consist of small speakers with typical impedances of 4 to 16 ohms.

When so low an impedance is plugged into the usual headset jack wired across a 600-ohm program line, the line is virtually shorted out. Furthermore, these stereo headsets use three-way phone plugs, with each earpiece wired separately.

As shown in the schematic, a 100-ohm potentiometer is wired across the station's monitor-ampli-



fier output. The potentiometer allows the operator to control the level of his phones. The level is also dependent on the setting of the monitor-amplifier gain control, and the headset impedance is not matched. More sophisticated ap- could eliminate these minor drawbacks, but this circuit is quick and easy.

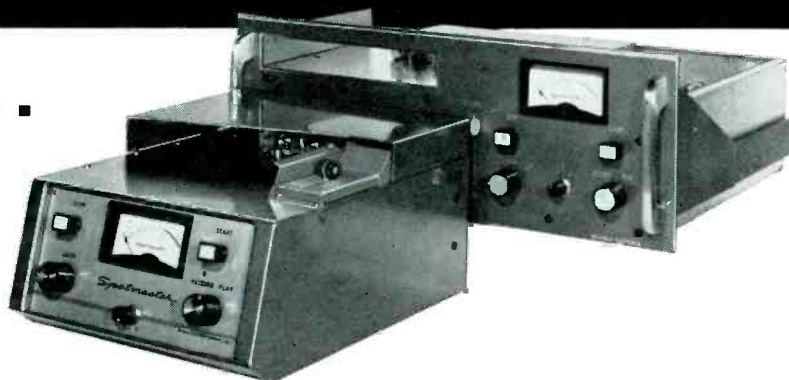
Warning Operator of Carrier Failure

by 1st Lt. George M. Durenberger, Jr. 269th Signal Comany, APO, N. Y.

A device which will automatically warn the operator of a carrier failure or lack of modulation is a must for every small station. The unit described here is simple and costs just a few dollars to build. It will announce carrier failure or loss of

Spotmaster

NEW 500 SERIES ... World's Most Advanced Cartridge Tape Equipment



From the established leader in tape cartridge systems —SPOTMASTER—comes today's most advanced units, the 500B series. Featuring all-modular, all-solid-state design and your choice of 1, 2 or 3 automatic electronic cuing tones, the 500B continues the SPOTMASTER tradition of superior quality at sensible prices.

Check these other SPOTMASTER features:

- Meets or exceeds all existing and proposed NAB standards.
- Separate record and reproduce heads. A-B monitoring. Biased cue recording. Zener controlled power supply.
- Popular 500A series, today serving over 1,000 sta-

tions world-wide, now available at new low prices.

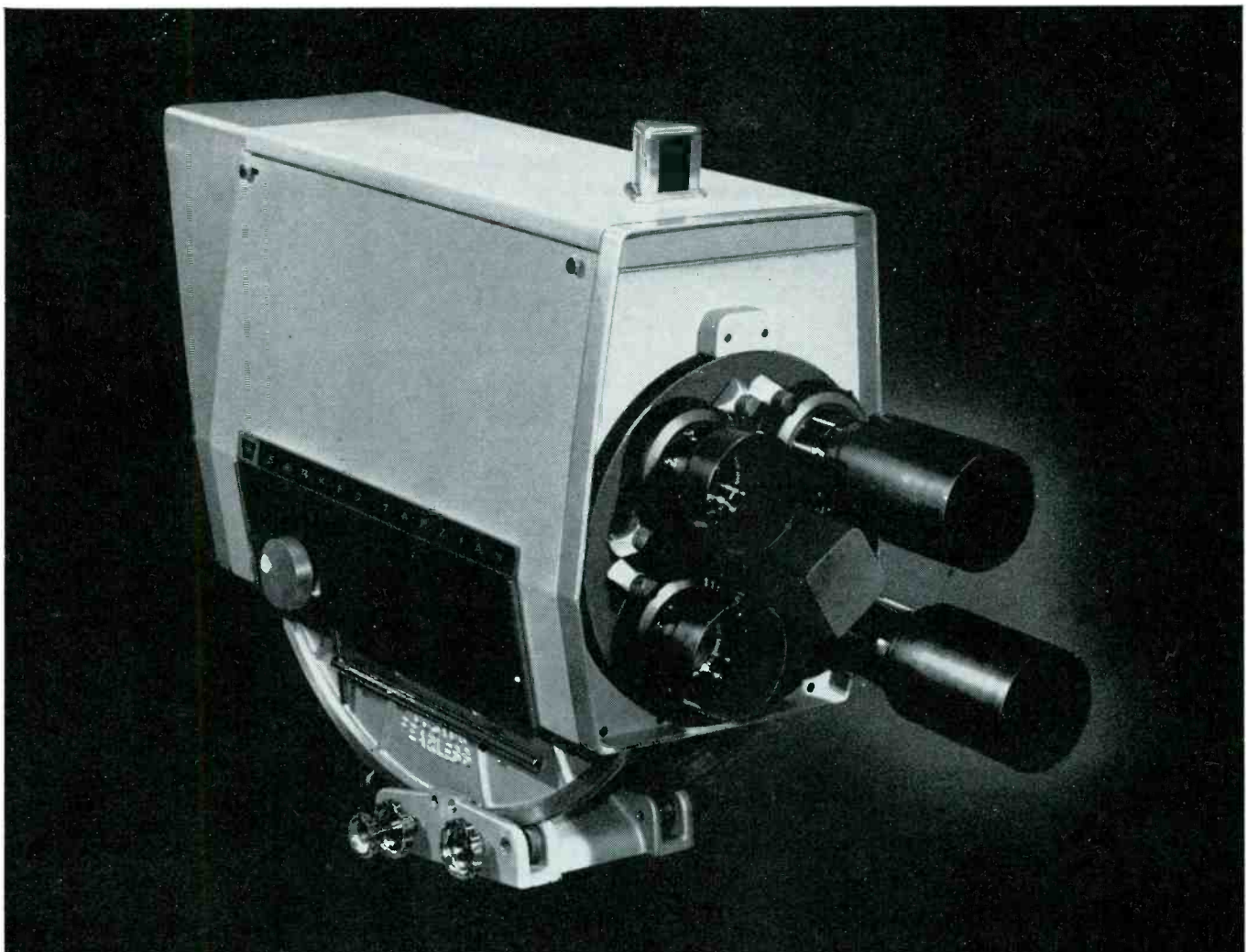
- 14 models match every programming need: recorder-playback and playback-only ... compact and rack-mount ... monophonic and stereo.
- Delayed Programming option permits instant deletion of objectionable material from live originations.
- Heavy duty construction throughout, with rugged hysteresis synchronous motors, top specs and performance.
- Lease/purchase option. Ironclad guarantee for one full year.

Write for complete information:

BROADCAST ELECTRONICS, INC.

8800 Brookville Rd., Silver Spring, Md. JU 8-4983 (301)





PLUMBICON

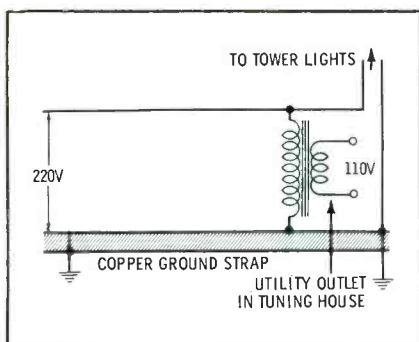
Field proven? Tarzian's is. Tarzian plumbicons are in use today . . . in actual station operation. And, Tarzian's on-the-job experience verifies plumbicon as the first really significant improvement in television camera pickup tubes in years.

Here's a camera with a high sensitivity and the ability to handle wide contrast ratios, like an IO, combined with an exceptionally high S/N ratio

(48 db) . . . especially well-suited for taping. The new plumbicon tube is excellent for both color and monochrome use, exhibits no lag, and has an exceptionally long life of several thousand hours.

For your early delivery or additional information on the Tarzian plumbicon, contact your Tarzian regional manager, or call or write direct.

S A R K E S  **T A R Z I A N**
BROADCAST EQUIPMENT DIVISION BLOOMINGTON, INDIANA
Circle Item 25 on Tech Data Card



modulation by flashing a light at the operator or by sounding an alarm. Here's how it works: Station carrier signal is rectified by the

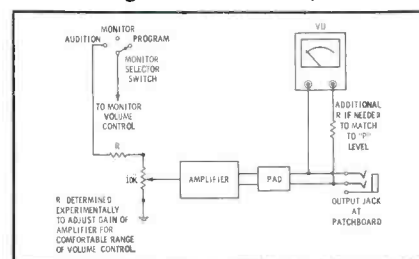
diode, and audio is applied to the grid of V1a as in an ordinary receiver. The audio output of V1a is rectified and applied as DC bias to the grid of V1b. As long as there is modulated carrier present, V1b is cut off and K1 remains open. Should the modulation drop below a certain level (or fail to appear), the condenser at the grid of V1b will discharge, causing the tube to conduct, closing the relay, and actuating an alarm. The parts values are not critical. Delay in warning can be adjusted by varying the RC combination at the grid of V1b.

Operation at reduced voltages results in extended tube life. The unit can be housed in a minibox and mounted near the control console. It draws just a few watts, gives off little heat, and has proved extremely dependable.

Economizing on Tower Lighting Wiring

by Robert A. Jones, Professional Engineer, Lorain, Ill.

In most directional antenna systems I've seen, two wires (sometimes even three) are run between each tower where tower lights are required; actually only one wire is needed. The fact that the copper ground system is an ideal return circuit or common wire (neutral) is often forgotten. In fact, for the



safety of the station operators where two wires are used, the neutral wire is always grounded both at the towers and at the transmitter.

Another method is to use 220 volts instead of 110 volts; this is sometimes done where Austin transformers are required. By employing the higher voltage, conductor size and current demand are both reduced. We installed just such a system at WBBY and added a small 220/110-volt stepdown transformer in each tuning house to use for a light-and-utility outlet. ▲

SALES ENGINEERS

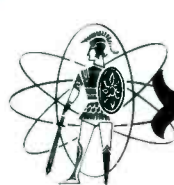
The continued growth of our CATV Systems Division has created the need for experienced sales engineers.

Experience in either CATV, communications or closed circuit TV desirable. Send resume including education, work history and salary requirements. All replies will be held confidential.

MARVIN J. KRANTZ,
Director of Personnel

**JERROLD
ELECTRONICS
CORPORATION**
15th Street and Lehigh Avenue
Philadelphia, Pennsylvania 19132

AN EQUAL
OPPORTUNITY EMPLOYER



INNOVATION

... ANOTHER KEY TO

SPARTA SUCCESS



The NEW
A-500
MONAURAL

STUDIO CONTROL & REMOTE UNIT

Another outstanding example of Sparta's constant effort to incorporate the latest advances and technology into existing products.

The original SPARTA A-50B, and now the NEW A-500 meets the industry need for an integrated studio facility of professional quality and flexibility to serve as a permanent installation. It also has the versatile portability required for remote broadcasts and temporary set ups.

The attractive new cabinet design of the A-500, the new 3 speed custom turntable, the solid state removable audio console, plus many new operator conveniences make the A-500 Studio Control & Remote unit today's most incomparable value at only \$950. — A5-500 Stereo also available \$1350.

Contact your SPARTAMAN today for full information.

only \$950.00

SPARTA

**ELECTRONIC
CORPORATION**

6450 FREEPORT BLVD. • SACRAMENTO, CALIF. 95822

Circle Item 26 on Tech Data Card

To what lengths must a cable manufacturer go to prove his product is better?

As long as the distance between your amplifiers—even up to one-half mile continuous lengths.

When Times Wire and Cable decided to build a CATV cable to outdistance any other in length and performance, we really went all the way: We built a cable that can span the entire distance between your amplifiers.

However, it's not just that Times JT-1000 CATV cable is longer that makes it better. It's also continuous. It's seamless for the entire length. And it's aluminum. Put them all together and you have *continuous seamless aluminum tube sheath CATV cable* in lengths up to ½ mile long—a feat nobody else has yet been able to match!

Here's what these new longer lengths mean to your CATV operations:

- Easily saves you 10% installation and shipping costs. Longer lengths mean fewer splices—8% saved. Another example: Only 1 reel needed for 2,500 feet of cable instead of 1 reel for each 1,000 feet—another 2% saved.

- Times seamless cable is waterproof. Puncture it, splice it, apply as many pressure taps as you like. Water vapor and/or water can't travel in Times self-sealing solid sheath cable. Complete dielectric adhesion to center conductor and complete compression seal to outer conductor eliminate longitudinal vapor or water paths.

- Times cable gives you minimum return loss guarantee. Your choice of guaranteed 26 db or 30 db minimum return loss—a must for minimum ghosting, true color reproduction.

- Increases profit by decreasing splices and scrap. Fewer splices mean less material wasted (fewer tailings), less maintenance needed, too. Less maintenance means less labor cost and more profit.

And don't forget: long after so-called economy cable has been replaced (it starts deteriorating the day you install it), Times continuous seamless aluminum tube sheath CATV cable will still be a top performer, keeping pace with your system's planned potential.

There you have it: the longer the cable, the fewer the splices, the lower the maintenance, the better the performance...and the higher the profits. Times did it all, with its new longer CATV cable...and we're shipping it right now!

Presenting the Times Family of Firsts—The Standards of the CATV Industry...

First to design a long-life cable specifically for CATV.

First with foam dielectric cables for CATV.

First with cable that made all-band CATV systems economically feasible.

First to offer 26 db minimum return loss guarantee for CATV.

First again with ½ mile lengths of seamless aluminum sheath CATV cable.



TIMES

WIRE & CABLE

DIVISION OF THE INTERNATIONAL SILVER CO.

Wallingford, Conn.

Visit Our Booths #77, 78 & 79
at NCTA CONVENTION

Transmission System Design and Engineering/Standard & Special Coaxial Cable/Multiconductor Cable/Complete Cable Assemblies/Teflon* Hook-Up Wire *A Du Pont Trademark

Circle Item 27 on Tech Data Card

NEW

SHURE SM5

UNIDIRECTIONAL DYNAMIC BOOM MICROPHONE

SOLVES THE AUDIO ENGINEER'S MOST ANNOYING BOOM PROBLEMS

THE PROBLEM	HOW THE SHURE SM5 SOLVES IT
Sound coloration—from stage reflections or off-mike performers.	True Cardioid pickup pattern—symmetrical about the axis and exceptionally uniform with frequency. Excellent background noise rejection.
Wind and Boom noise from fast boom swings.	Two-stage mechanical isolation—two-stage permanent windscreen assembly. Element and isolation completely surrounded by outer wind shell, minimizing wind and mechanical noise in any indoor or outdoor application.
Pickup of electrical hum	No transformers or inductors. May be used in extreme hum fields.
Maneuverability	Perfectly balanced, lightweight — excellent stability, minimum overswing.
Mechanical Damage	Element and isolation assembly protected by outer wind-screen and steel reinforcing rods.



50-15,000 CPS
CARDIOID PICKUP

SHURE STATION-ENGINEERED BROADCAST AUDIO EQUIPMENT

MICROPHONES

Specially designed for exacting studio applications.
Extensively field-tested, many in use by
leading radio and TV stations.



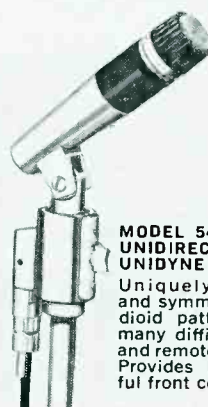
**MODEL 576
OMNIDIRECTIONAL
DYNAMIC**

Only 3/4" diameter!
40% smaller diam.,
60% smaller area
than popular dynamic
omnidirectionals. Virtu-
ally flat from 40 to
20 Kc. Rugged steel
case.



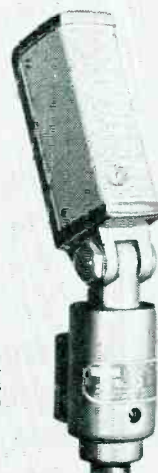
**MODEL 570
LAVALIER DYNAMIC**

Outstanding on the job. Specially
shaped response cuts "chest boom"
... provides unequalled presence.
Non-metallic "Flex-Grip" hanger...
silent, secure. Only 3/4" diam.



**MODEL 546
UNIDIRECTIONAL
UNIDYNE III**

Uniquely uniform
and symmetrical car-
dioid pattern solves
many difficult studio
and remote problems.
Provides broad use-
ful front coverage.

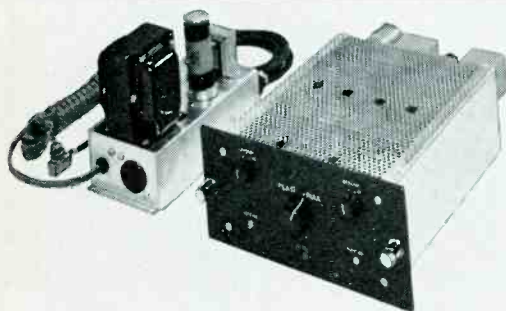


**MODEL 333
UNIDIRECTIONAL
RIBBON**

Extremely rugged.
Exceptionally at-
tractive and com-
pact. Ideal for
music (stereo or mono) and general
applications on
stand or boom.
Super cardioid,
flat wide-range re-
sponse.

CIRCUITRY

Shure stereo equalizer and preamplifiers are praised as MAJOR
contributions to upgrading station quality by broadcasters.



**SE-1 STEREO
TRANSCRIPTION PREAMPLIFIER**

Provides precise RIAA equal-
ization from magnetic phono
reproducers at line levels. Sep-
arate high and low frequency
response trimmers. Lowest dis-
tortion, noise level, susceptibil-
ity to stray RF fields.

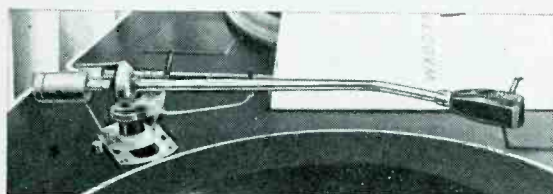
**M66 BROADCAST
STEREO EQUALIZER**

Passive equalizer compensates
recorded frequency to three play-
back characteristics: RIAA, flat,
roll-off. Provides precise equal-
ization from magnetic pickup at
microphone input level.



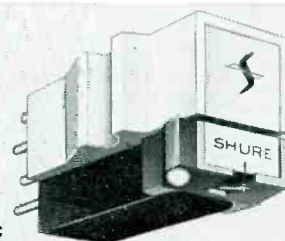
TONE ARMS & CARTRIDGES

World standard for quality sound.



**SHURE SME
"THE BEST PICK-UP
ARM IN THE WORLD"**

Utterly beyond comparison.
Supremely accurate, proved
reliable in quality music sta-
tions.



**STEREO DYNETIC
Phono Cartridges**

First choice on every count—standard in
the quality music stations.

Write directly to Mr. Robert Carr, Manager of Professional Products Division, for personalized assistance, technical data, samples for testing: Shure Brothers, Inc., 222 Hartrey Ave., Evanston, Ill.

NEWS OF THE INDUSTRY

NATIONAL

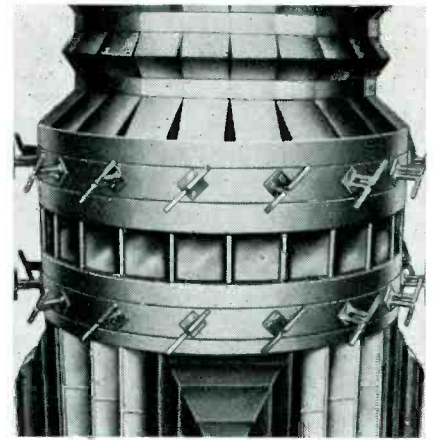
New Radio System Corrects Garbled Signals

A radio receiving system that would automatically eliminate static, blackouts, and any other atmospheric interference obscuring the signals it receives, was described recently in Houston, Texas, by a Purdue University electrical engineer.

Prof. Paul E. Wintz, of Purdue's Electronics Sciences Research Laboratory, said such a system is now being tested, using a tropo-scatter link between the

Purdue Laboratory and the Collins Radio Company, 265 miles away. He reported on this research during a meeting of the National Telemetering Conference in Houston.

Preliminary tests have confirmed the Purdue theoretical work—a mathematical model of the unique receiver; the self-correcting system works, Wintz said, but research is continuing to determine how well it will work under all circumstances. The research project is supported by The National Aeronautics and Space Administration.



Master FM Antenna for Empire State Building

The nation's first master FM antenna, which will permit 17 FM stations to broadcast simultaneously, is to be installed atop the Empire State Building. Three FM stations will use the facilities as soon as they are installed, and leases for that use were signed on the building's 102nd-floor Observatory by representatives of **WQXR** (96.3 mc), **WHOM** (92.3 mc), and **WLIB** (107.5 mc).

Erection of the antenna will culminate more than six years of study by the Empire State Building and its consulting engineers, Dr. Frank Kear of Kear & Kennedy, Washington, D. C., and William Scofield of Edwards & Hjorth, structural engineers.

The antenna will be designed and fabricated by the Alford Manufacturing Company of Boston; installation of the system will be made by Gunnar A. Olsen and Belmont Electric Co., both of New York City. It will require about six months to install and will be erected on the 102nd floor at the 1250' level of the structure.

The new antenna will be omnidirectional, providing a substantially circular pattern with both vertical and horizontal polarization. One of the major results will be improved radio reception for automobile FM radios.

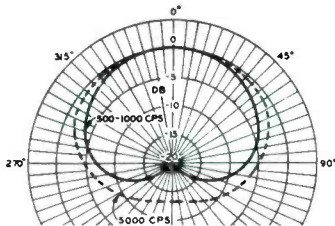
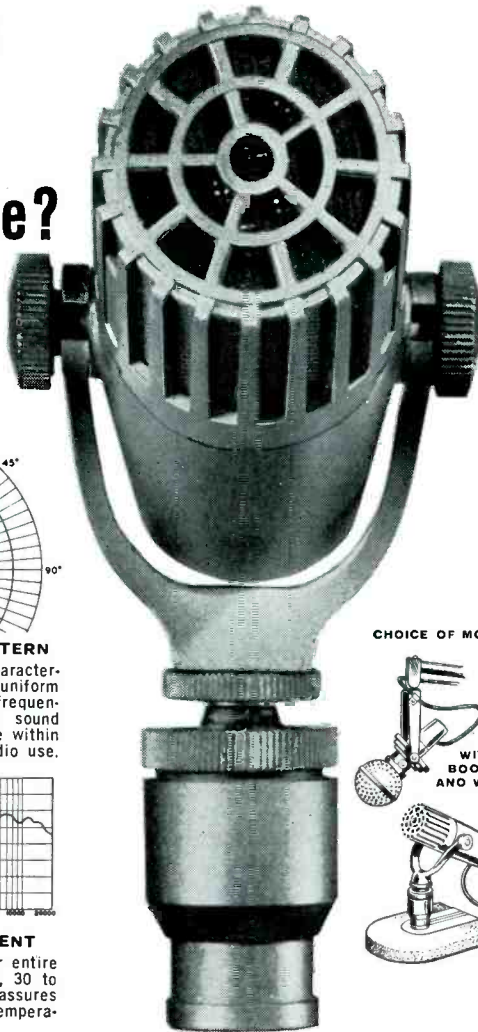
New York's nine television stations are currently utilizing antenna facilities atop the Empire State Building. The VHF stations are: **WCBS-TV**, Channel 2; **WNBC-TV**, Channel 4; **WNEW-TV**, Channel 5; **WABC-TV**, Channel 7; **WOR-TV**, Channel 9; **WPIX-TV**, Channel 11; **WNDT-TV**, Channel 13. The UHF stations are **WNYC-TV**, Channel 31, and **WNJU-TV**, Channel 47 (to be operational end of April).

GAB Grants Membership to CATV Organization

The Georgia Association of Broadcasters has approved Clearview of Georgia, Inc., one of the state's largest CATV operators, as an associate member. GAB indicated this is the first time any CATV company has been enrolled as an official member in any broadcaster's organization in the United States.

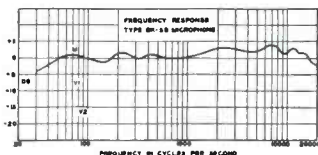
what more do you need in a microphone?

WHEN THE RCA BK-5B
HAS SO MUCH...



IMPROVED CARDIOID PATTERN

The improved unidirectional characteristic provides an exceptionally uniform response over a wide range of frequencies, and attenuates unwanted sound from directions other than those within the pickup angle. Ideal for studio use.



SENSITIVE RIBBON ELEMENT

Uniform frequency response over entire audio spectrum. Effective range, 30 to 20,000 cps. Ribbon element also assures low hum pickup, immunity to temperature and humidity variations.

CHOICE OF MOUNTING



You're looking at the business end of an RCA BK-5B...a superb unidirectional studio microphone—ideal for all broadcast, public address and recording applications. 3-position voice-music switch provides optimum response for any application. Blast filter eliminates damage from sudden noises. Inconspicuous TV gray finish. Exceptionally good shielding permits operation in high-hum fields.

ASK TO SEE THE BK-5B AT YOUR NEAREST AUTHORIZED RCA MICROPHONE DISTRIBUTOR.

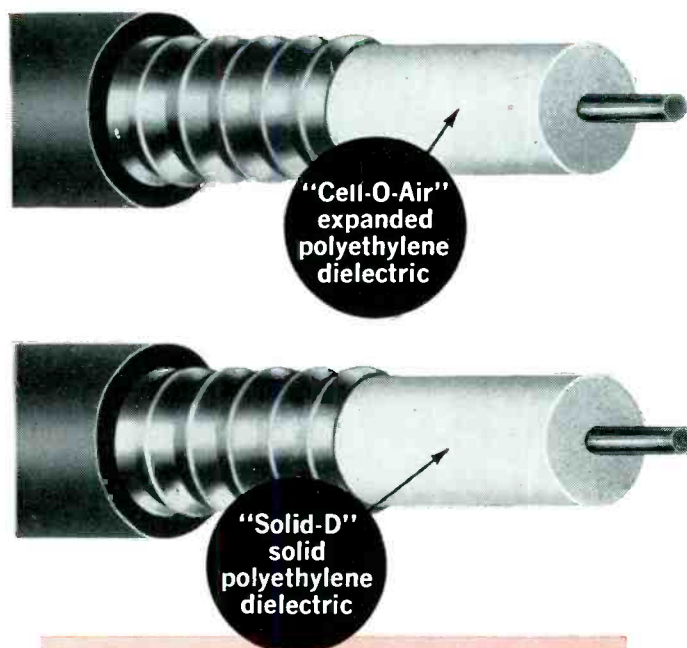
For complete specifications write RCA Commercial Engineering Dept. E115MC, 415 So. 5th St., Harrison, N.J.

RCA ELECTRONIC COMPONENTS AND DEVICES, HARRISON, N.J.



The Most Trusted Name in Electronics

The CATV Cable that GUARANTEES FULL-SPECTRUM CAPABILITY



SUPERIOR Coaxial Cable with "Coppergard"

Superior Coaxial Cable with Coppergard guarantees no attenuation discontinuity over the continuous range — through 219 MCS *and beyond!* This means you can *use* all the frequencies available to you. Unlike ordinary cables, which offer only the television band, Superior Coax was specifically designed for CATV to provide for full utilization of the frequency range in aerial and buried plant.

When you buy cable, insist on the brand that gives full-spectrum capability at no extra cost. Install Superior Coaxial Cable with "Coppergard," the cable your system will never outgrow.

CHOOSE SUPERIOR CELL-O-AIR® COAX FOR AERIAL PLANT

Guaranteed Maximum Attenuation db/100' at 58° F					
	Ch. 2	Ch. 6	108 mc.	Ch. 7	Ch. 13
4920	0.75	0.93	1.08	1.41	1.57
4930	0.58	0.68	0.80	1.07	1.20

CHOOSE SUPERIOR® SOLID-D COAX FOR BURIED PLANT

Guaranteed Maximum Attenuation db/100' at 58° F					
	Ch. 2	Ch. 6	108 mc.	Ch. 7	Ch. 13
6020	0.74	0.91	1.05	1.38	1.55
6030	0.56	0.67	0.79	1.05	1.19

*Every Reel Sweep-Tested
Over Its Full Length*



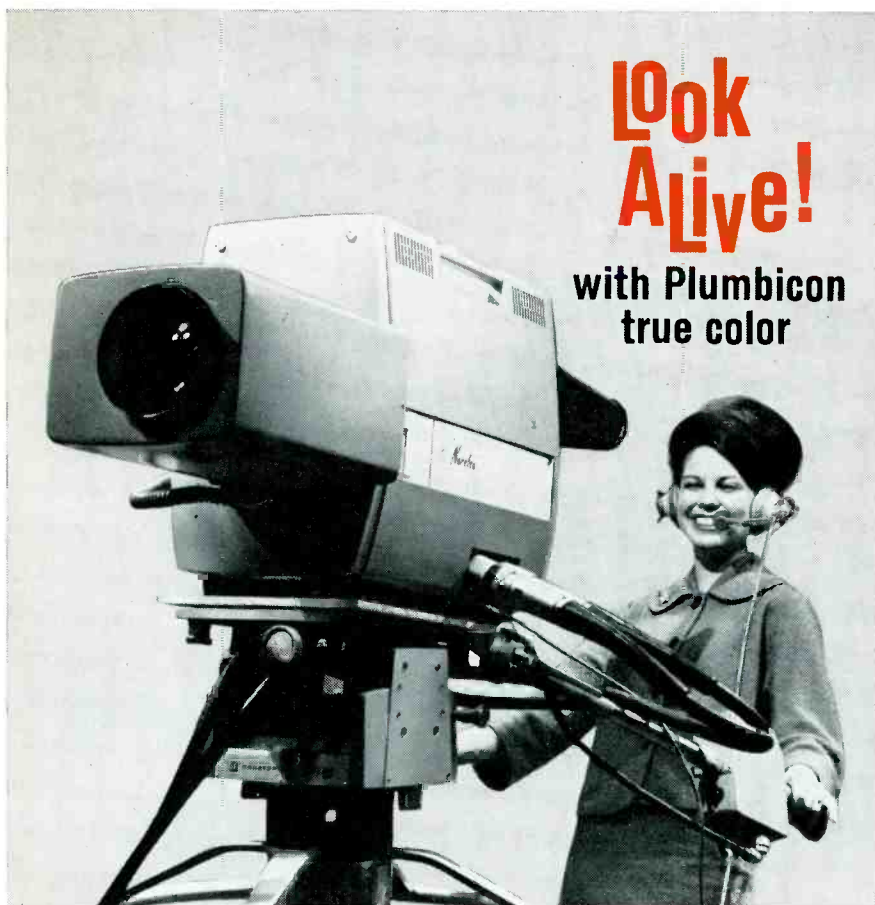
SUPERIOR CABLE

SUPERIOR CABLE CORPORATION • HICKORY, NORTH CAROLINA

Circle Item 32 on Tech Data Card

For detailed information and prices, write

**See Us at NCTA Show
Booth 47-48**



LOOK ALIVE, says Miss Nancy Edling

LOOK ALIVE

■ and see this amazing color camera boost TV audience and time sales ■ and see operating simplicity and economy never before possible in any color camera system ■ and see the results of the Plumbicon pick-up tubes — in a lightweight, compact camera, providing unexcelled color ■ and see why major broadcasters insist on "immediate first" deliveries to re-equip their studios ■ and see why universal opinion at the NAB was: "this achievement proves color is ready for me!"

LOOK ALIVE . . .

and join the many broadcasters going Plumbicon color.

Manufactured by North American Philips Company, Inc., Studio Equipment operations in Mount Vernon, N. Y.

Sold nationally by Visual Electronics Corporation.



VISUAL ELECTRONICS CORPORATION

356 west 40th street • new york, n. y. 10018 • (212) 736-5840

LOOK TO VISUAL FOR THE FIRST NEW CONCEPT IN COLOR BROADCASTING
Circle Item 33 on Tech Data Card

Charles Doss, GAB president from WROM, Rome, said, "We are delighted to open our membership rolls to Clear-view, Georgia, one of the largest and most progressive CATV companies in our state. A majority of GAB members are either in CATV or getting into CATV, and we can think of no better way to cooperate to mutual advantage than by having CATV members in the GAB. We will work to enroll any other CATV operator who wishes to take part in our activities."



Audio-Engineering Pioneer Passes

Clarence Joseph (C. J.) LeBel, president of the Audio Instrument Co. and vice-president of Audio Devices, Inc., New York, died in his sleep on April 14, at his home in New York City. He was 59 years old.

Mr. LeBel, a leading specialist in the field of audio and electrical engineering, held many patents during his career of nearly 40 years, including one of the basic patents on the fluorescent lamp (LeBel patent) and one for the surgeon's metal-locator electronic stethoscope (stethetron). Others touched on lacquer recording discs, magnetic recording tape and its applications, hearing-aid design, logarithmic amplifiers, intermodulation meters, and magnetic-tape time-delay units. He also authored two books, "Fundamentals of Magnetic Recording" and "How to Make Good Tape Recordings."

M. L. Koerner, Director of Engineering At Radio Liberty, Dies At 51

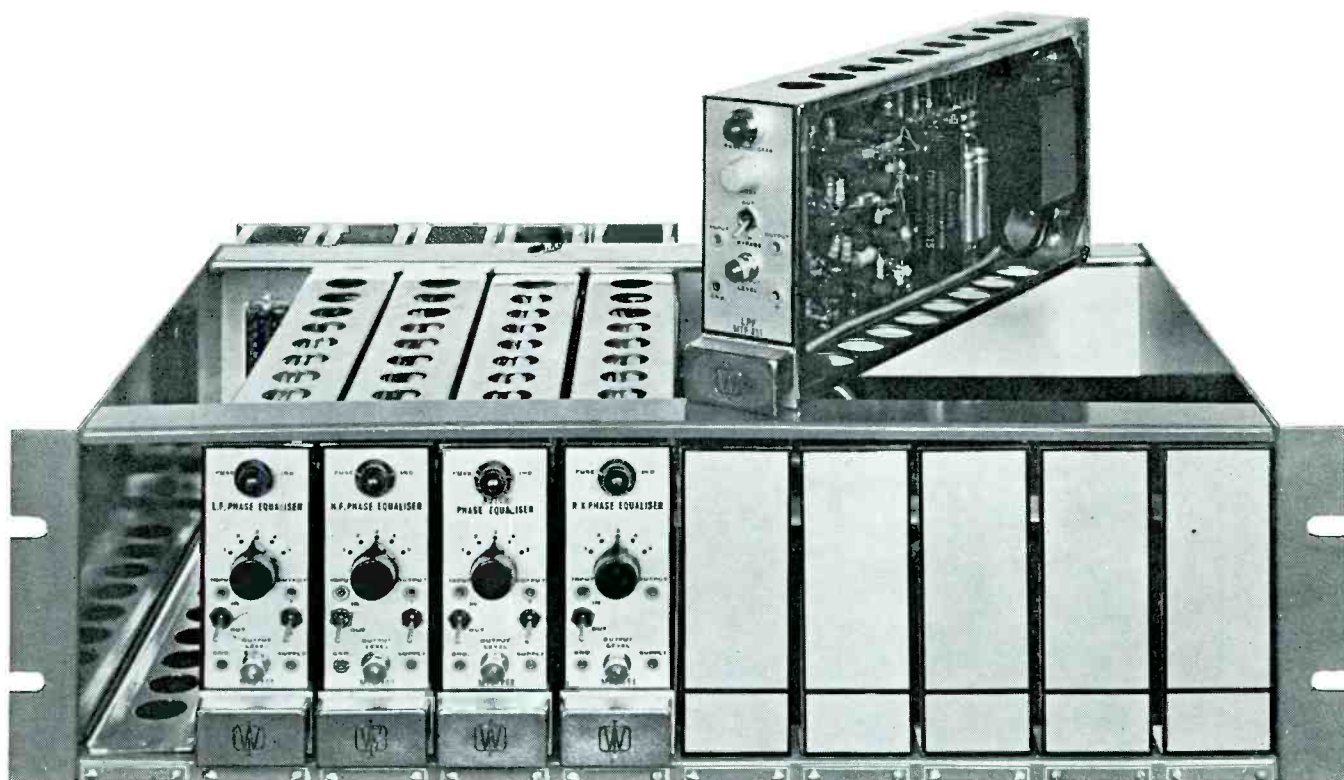
Meredith L. Koerner, Director of Engineering for Radio Liberty, died April 23 in Norwalk, Connecticut, at the age of 51. Prior to his assignment with Radio Liberty—the worldwide network which broadcasts to the Soviet Union—Mr. Koerner was project manager of Continental Electronics in Dallas, Texas; Deputy Director of Engineering for Radio Free Europe; Research Director at the Saginaw (Michigan) Broadcasting Co.; and Assistant Chief Engineer for the Office of War Information during World War II. He received his formal training in electronics at Valparaiso Tech, Valparaiso, Indiana.

BROADCAST ENGINEERING

ANOTHER 1st



NEW TRANSMITTER COLOR PHASE EQUALIZER AND LOW PASS VIDEO FILTER!



Designed to ensure compliance with FCC color transmission standards, plus optimum video results, the Ward Color Phase Equalizer System precompensates the television transmitter for signal phase errors introduced by the overall transmission system . . . while obtaining better transient response and time coincidence between luminance and chrominance information. The Ward Video Low Pass Filter helps ensure compliance with FCC rules for avoidance of out-of-channel radiation, by restricting the bandwidth in the output of monochrome and color video transmitters.

Other Features Include: Small rack size (5¼" rack frame) • Performance can be optimized on air using Vertical Interval Test Signal • Built-in self-powered input and output isolating amplifiers • Equalizing networks isolated from cables and work between accurate source and terminating impedance • Multiple delay characteristics for optimum color performance • Negligible low frequency bounce • Each equalizing function in individual module • Adjustable for flat frequency response • By-pass switch on each module for test set-up and emergency purposes.



WARD ELECTRONIC INDUSTRIES

1414 EAST ST. GEORGE AVE., LINDEN, N. J. 07036 • (201) 925-4690

Circle Item 34 on Tech Data Card

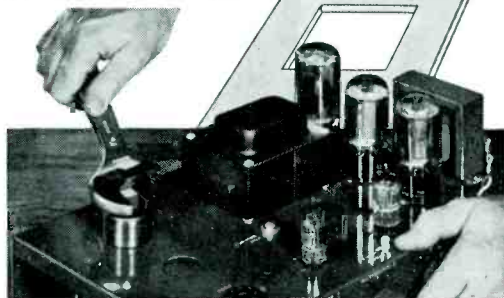
New 50-kw Transmitting Plant for WIBC

You often hear the saying that progress can be painful. In the case of WIBC, Indianapolis, Indiana, and the Interstate highway system, the adage has certain poignancy. When state and federal surveyors laid out a system to speed access to Indianapolis and modernize the highways north of the city, part of the six-tower directional array in use at the present location stood right in the path of the multilane expressway. Since operation with fewer towers than the licensed six is rather frowned upon by the FCC, the only recourse was to relocate in some other area. In spite of the fact that the expressway is not scheduled to be constructed until after 1967, Chief Engineer Clifford Luke and the station management decided to begin work on the new plant immediately so as to have as much time as possible to complete a satisfactory proof and work out the inevitable bugs in the array and in the transmitters.

New transmitting equipment using much solid-state circuitry, especially in the rectifier cabinets, was chosen for the new plant, and plans were laid for construction of the new installation. A new site was surveyed (this time they bought the property!), and Chief Luke worked out the myriad details of the transmitters, phasors, array, and the ancillary equipment that would be required. Power authorization for the licensee is for 50 kw days and 10 kw nights; daytime power uses four towers, and the nighttime pattern requires the entire six-tower antenna system. Two transmitters, therefore, are used to provide an element of redundancy; the main 50-kw rig has a 10-kw reduced-power setting, and its output can be fed into the nighttime phasing equipment. The secondary 10-kw rig can be fed either to the nighttime (normal operation) phasor or to the daytime phasor for emergency operation in case of failure in the main transmitting equipment.

The directional array consists of six guyed towers, each 230' high mounted on a 5' reinforced concrete base. A 3' beacon assembly tops each tower, and a 5' lightning rod attached to the base of the beacon assembly rises 2' above the beacon lens element. Chief Luke admits that he doesn't know if the rods will save the beacons during Indiana's frequent severe electrical storms, but he feels they are worth a try. Doghouses at the base of each tower contain phasing and lighting gear. The sampling loops are mounted 20' up the tower. At each tower, the base and doghouse are enclosed by an octagonal fence which has the ground radials welded to the base of the fence frame. The radials then run up the fence and across the top of the frame to a copper ring encircling the tower base. The radials also are grounded to a copper plate, forming the roof of the doghouse, which is then tied to the phasing-gear ground inside the doghouse. ▲

CUT HOLES FAST



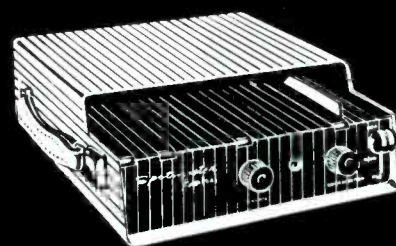
GREENLEE CHASSIS PUNCHES

Make accurate, finished holes in 1½ minutes or less in metal, hard rubber and plastics. No tedious sawing or filing — a few turns of the wrench does the job. All standard sizes . . . round, square, key, or "D" shapes for sockets, switches, meters, etc. At your electronic parts dealer. Literature on request.

GREENLEE TOOL CO. 
2028 Columbia Ave., Rockford, Illinois

Circle Item 35 on Tech Data Card

SPOTMASTER



PortaPak I Cartridge Playback Unit



Your time salesmen will wonder how they ever got along without it! Completely self-contained and self-powered, PortaPak I offers wide-range response, low distortion, plays all sized cartridges anywhere and anytime. It's solid state for rugged dependability and low battery drain, and recharges overnight from standard 115v ac line. Packaged in handsome stainless steel with a hinged lid for easy maintenance, PortaPak I weighs just 11½ lbs. Vinyl carrying case optional.

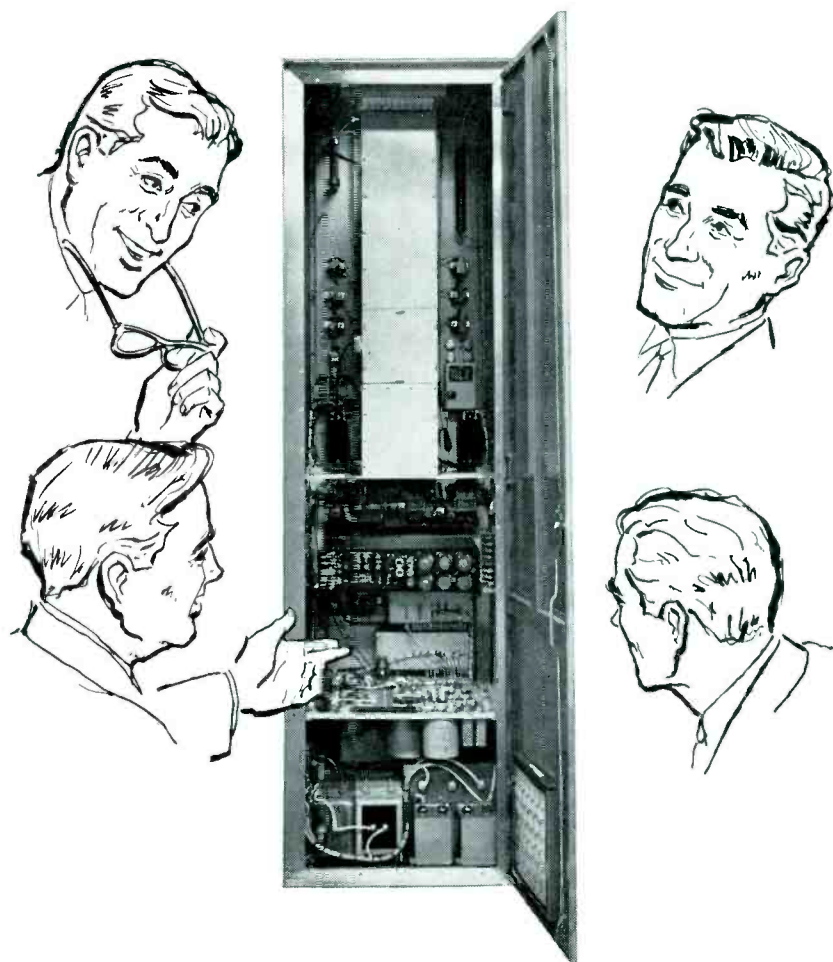
Write or wire for full information.

Spotmaster
BROADCAST ELECTRONICS, INC.
8800 Brookville Road
Silver Spring, Maryland

Circle Item 36 on Tech Data Card

BROADCAST ENGINEERING

LET'S LOOK UNDER THE HOOD AT RUST'S NEW 1 KW FM STEREO BROADCAST TRANSMITTER



Here's the new 1 KW FM stereo transmitter from Rust. Notice the elbow room? Space galore! (Once, we even found an employee cat-napping there.)

The main channel SWING OUT FME Exciter, plus both subchannel generators are crystal controlled for reliability. As for a stable signal — it locks on like a tiger — never drifts — never lets go. And no more burned knuckles checking tubes. The New Rust power supply is completely solid state and unshirkingly reliable. Incidentally, check the space-saver cabinet — only 24" wide x 28" deep — not to mention the new low price.

The Rust 1 KW, with built-in components, comes ready for remote control.

A very desirable optional feature is our Autolog automatic transmitter logging system. Simply turn it on — and forget it! It frees station personnel for other duties.

For further information, prices, specifications and/or a brochure of the complete Rust line, address your inquiry to:

RUST
corporation of america

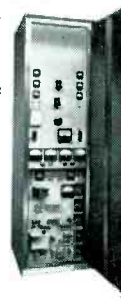
Eastern Division
195 Mass. Avenue
Cambridge, Mass.

Washington, D. C.
13205 May Court
Silver Spring, Md.

Western Division
2921 South 104th St.
Omaha, Nebraska

RUST FM STEREO TRANSMITTERS • AUTOLOG • RUST REMOTE CONTROL

Circle Item 37 on Tech Data Card



ENGINEERS' TECH DATA

AUDIO & RECORDING EQUIPMENT

45. ATC—"ATC's of Automation," a brochure, illustrates use of automation equipment for broadcast use.
46. AUDIO DEVICES—Technical data sheets on new "Audiotapes;" Formula 10, all purpose and Formula 15, low noise.
47. BROADCAST ELECTRONICS—Packet contains specifications and prices on

Spotmaster tape-cartridge equipment including: Portapak I, 400A Series, Ten Spot, and Super "B" series.

48. CINE SONIC—Data sheet describes rental service which supplies background music on 7", 10½", and 14" reels, stereo or mono.
49. CINEMA—Catalogs showing line of precision audio equipment including magnetic-tape and film degaussers.
50. CROWN—Specification sheets give data on Model SS700 and Models

SS824 and SS825 featuring solid-state modular circuitry.

51. HARVEY—Brochure and price sheet on Ampex Model AG-100-series magnetic mat recorder/reproducer.
52. NORELCO — Product sheets provide technical specifications for microphones, professional tape recorders, transistorized audio modules, and accessories.
53. QUAM—Folder lists replacement speakers for all automobiles from 1954 through 1965 for both front- and rear-seat applications.
54. RCA — Model BK-12A subminiature lavalier microphone illustrated and described technically in product report brochure.
55. VIKING—Series of technical bulletins provides data on Model 38 tape-cartridge handler, Model 96 tape transport, and other tape and audio accessories.

CATV EQUIPMENT

56. BIONIC — Data available describing 12-channel DC momentary-control unit for program switching by remote control between receiving site and control office.
57. ENTRON—Facility brochure describes product line and manufacturing procedures as well as general history of company's participation in CATV.

COMPONENTS & MATERIALS

58. AMPEREX—Condensed form of standard catalog lists available tube types useful in wide range of applications.
59. INTERNATIONAL ELECTRONICS SALES—Letterhead request will bring data on broad line of Mullard tubes for replacement.

MICROWAVE DEVICES

60. MICRO-LINK — Write for planning guide for 2500-mc ITV systems, data on Model 420A portable link, and Model 600 fixed link.
61. SWITCHCRAFT—New product bulletin No. 151 describes Series 3600 coaxial video jacks and plugs designed for microwave use.

POWER DEVICES

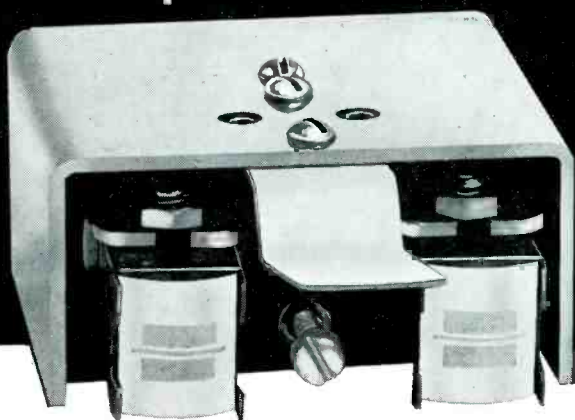
62. HEVI-DUTY — Bulletin 7-22 supplies data on line-voltage regulator using saturable-core reactor.
63. TERADO—Folder illustrates and lists specifications of Model 50-160 Trav-Electric power inverter.

RADIO & CONTROL-ROOM EQUIPMENT

64. CONTINENTAL — Twelve-page brochure describes Prolog system of automated programming, with emphasis on the function of the control log.
65. GATES — Transistorized audio-level control instrument especially designed for FM use allows maximum average-modulation level.

MAJOR N.Y. BROADCAST STUDIO REPORTS:

“We stepped up our cartridge machine performance to equal Ampex recorder specifications with the New Lang Cartridge Head Assembly!”



Tested and enthusiastically accepted by major New York broadcast studios, the new LANG CARTRIDGE HEAD ASSEMBLY provides performance characteristics far superior to any other cartridge head assembly. Not only is the performance so obviously discernable by an untrained ear but the LANG CARTRIDGE HEAD ASSEMBLY is directly interchangeable on all ATC cartridge machines.

The new LANG CARTRIDGE HEAD ASSEMBLY can be easily and quickly installed and azimuth and height adjustments are simply and rapidly made with a standard Allen wrench... just as you do on your tape machine.

Write for complete details on the LANG CARTRIDGE HEAD ASSEMBLY—the most important breakthrough in cartridge machine development.

LANG ELECTRONICS, INC. 507 FIFTH AVE., N.Y., N.Y. 10017

Circle Item 38 on Tech Data Card

66. MOSELEY—New information outlines specifications and uses of Model RPL-1 remote-broadcast pickup for 160-mc service.

REFERENCE MATERIAL & SCHOOLS

67. CLEVELAND INSTITUTE—Booklet outlines courses in electronics, including those for broadcast engineering and FCC-license preparation.

STUDIO & CAMERA EQUIPMENT

68. AMPEX—Three new product sheets available to describe Marconi cameras and video-handling equipment including Mark V 10 camera, master switcher, and waveform generator.
69. BENDIX—Specification sheet gives information on BX-8A broadcast-type image-orthicon camera.
70. CLEVELAND ELECTRONICS — Data concerns modifications using new yoke assembly to update 3" image-orthicon cameras.

TELEVISION EQUIPMENT

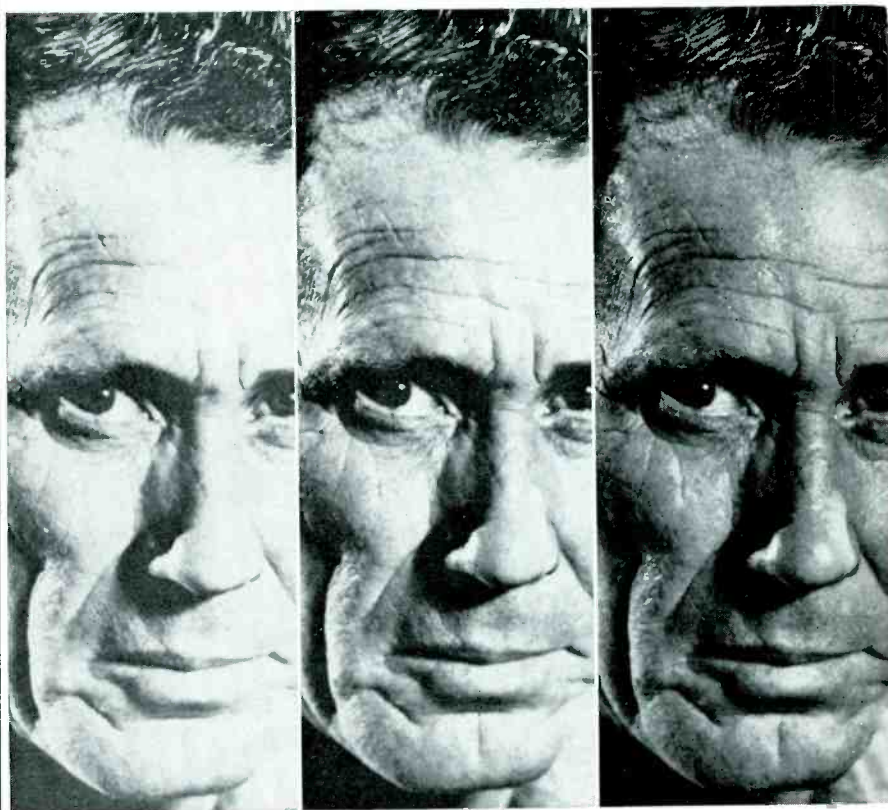
71. COLORADO VIDEO — Eight-channel "Bar/Graph" generator is described in illustrated specification sheet.
72. DAGE-BELL—Specification sheets give particulars on Model 520 solid-state broadcast vidicon camera chain useful for commercial or educational broadcasting.
73. DYNAIR—Illustrated mailer describes use of solid-state audio/video modulators to provide inexpensive color-TV monitor using standard color receivers.
74. INTERNATIONAL NUCLEAR — Completely transistorized Model TVA1 stabilizing amplifier (featuring plug-in units for stripped video, white stretch and clip, and monitoring amplifier) described in brochure.
75. VITAL—Data sheets give specifications of Model VI-500 stabilizing amplifier, Model VI-10A video distribution amplifier, and Model VI-20 pulse-distribution amplifier.

TEST EQUIPMENT & INSTRUMENTS

76. ANALAB — Eight-page brochure describes oscilloscope camera system called Rapromatic® used for trace recording. Features use of 35-mm film and has on-camera processing unit.
77. BALLANTINE — Product sheet gives technical description of AC/DC digital voltmeter Model 355.
78. HICKOK—Brochures on industrial tube testers including new Model 580, Model 539C, and Model 752A instruments.
79. MARCONI — Data on Model 1099 video-sweep generator for color videotape testing and head alignment.
80. SECO—Eight-page tube tester brochure includes specifications and prices.

TRANSMITTER & ANTENNA DEVICES

81. AIR SPACE DEVICES—Brochure describes "Saf-T-Climb" device used to ensure safety during tower erection or maintenance.
82. CCA—Catalog sheets give specifications and features of several AM transmitters.
83. COLLINS — Two four-page brochures describe new Model 212 S/M-1 speech-input console and Model 820E/F 5- and 10-kw AM transmitters.
84. GATES — Sixteen page "FM Station Planner" makes equipment recommendations for class A, B, and C stations.
85. JAMPRO—Copy of engineering study titled "A Study into the Effects of Dual Polarization in FM Broadcasting" available on request.
86. RUST — "Base-Current Ratio Alarms" data sheet describes new method for automatic supervision of AM directional antennas.



How do you measure quality in film transfers?

You know it when you see it! Your eye is our judge. That's why we demand perfection in clarity, definition and true grey scale. We get perfection by complete control. All of our work is done under one roof... a unique way of operating in our industry. And we feel the results are worth it. So do our clients—companies like AMERICAN MOTORS, MGM-TELESTUDIOS, MCA-TV, HEATH DE ROCHEMONT, even AMPEX. Their names tell you a lot about our standards. But there's a better way to find out. Try us. We offer "in by 9—out by 5" processing—with your transfer jetting back the same night. And optimum quality is guaranteed (backed by two decades of expert Hollywood technology). If you believe your eyes call Acme Film Laboratories, Inc., Hollywood, 1161 North Highland Avenue, HO 4-7471; New York, 400 Madison Avenue, HA 1-3400.

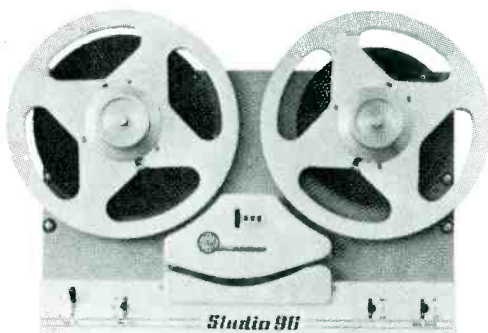
Acme Film Transfers **A** 

Circle Item 39 on Tech Data Card

A NEW HEART FOR YOUR STUDIO

Studio 96

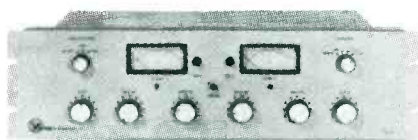
QUALITY DESIGNED FOR BROADCASTERS AND SOUND STUDIOS



Two speed tape transport with automatic sequence braking, choice of hyperbolic head configurations, hysteresis capstan drive and heavy duty reel drive motors, remote control jacks and 10½" reel capacity. Superbly smooth tape handling — interlocked "fool-proof" switching — fit for every studio.

Rack mount ready from \$585.45

MATCHING SOLID STATE ELECTRONICS



Rack mount ready

Monaural RP110-R2 \$299.00
Stereo RP120-R2 \$399.00

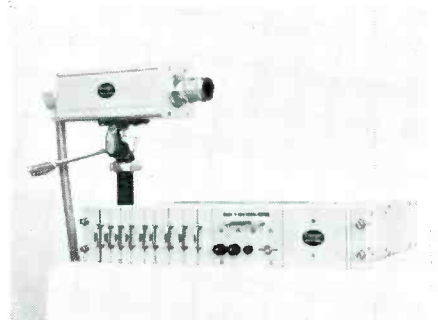


MADE BY SKILLED AMERICAN CRAFTSMEN AT

Viking OF MINNEAPOLIS®

9600 Aldrich Ave. S. Minneapolis, Minnesota, 55420

Circle Item 41 on Tech Data Card



High-Resolution TV System

A compact TV film camera has been introduced by **Granger Associates**. The camera chain has a 30-mc bandwidth, which provides excellent transient response and phase characteristics. A 60-gauss focus field and high G_s voltage produce a very small scanning spot. Shading content is very low and signal-to-noise ratio is 40 db or better.

The camera and control unit use integrated circuits and silicon transistors for maximum reliability and minimum size. The 9" camera weighs 7 lbs. Two plug-in camera-control units and an EIA sync generator will fit in the 19" wide chassis with 3½" panel height. Price for one camera chain is less than \$4000. The optional plug-in EIA sync generator is \$920.

Circle Item 87 on Tech Data Card



Vidicon Film Chain

A new vidicon film chain, with optical multiplexer that completely eliminates secondary or "ghost" images, makes the use of expensive field lenses unnecessary. The Model FC-11 developed by **Dage Television Co.** requires less critical setup and adjustment, and has been designed for use by both commercial and educational broadcasters. The new vidicon film chain is housed in a heavy-gauge metal cabinet containing the optical prism multiplexer. Facilities for as many as four input sources are provided to permit any desired combination of film or slide projectors.

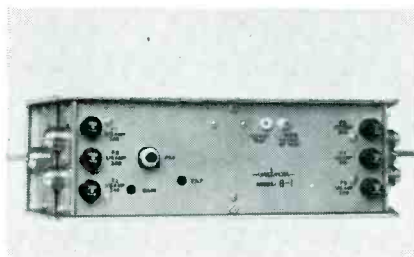
All power supplies for the film and slide projectors are contained within the film-chain cabinet. The dust cover is easily removed for maintenance. The cabinet measures 18"x26"x55" and is finished in gray baked enamel. The monochrome camera is compact and uses modular construction throughout. A 10-mc bandwidth guarantees a minimum of 800 lines horizontal resolution. Any standard 16-mm C-mount lenses may be

BROADCAST ENGINEERING

NEW PRODUCTS

used. Options include installation of an intercom at the cabinet for communication between the cabinet location and the control center. An AC-supply receptacle is provided for test-equipment power.

Circle Item 88 on Tech Data Card



Solid-State Bridging Amplifier

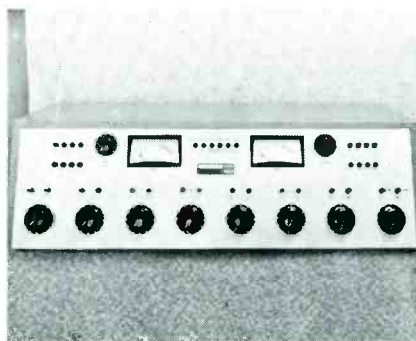
A fully transistorized, remotely powered outdoor bridging amplifier covering the low-through-high VHF band, including FM and intermediate bands, is available from **Entron, Inc.**, CATV equipment manufacturers.

Known as Model B-1, the new Entron unit features 20 db gain to four distribution-line outputs and is designed for strand mounting. It is also weather and atmosphere protected by a cast aluminum housing. Remotely powered through the coaxial cable, it is available with electronically regulated power-supply circuits for 28 volts or 60 volts. From the trunkline, the remote-power voltage can be fed to any or all distribution outlets to feed remotely powered extender amplifiers. Each distribution outlet is individually fused.

The Model B-1 bridging amplifier also features a built-in directional coupler which serves to tap signals off the trunkline with minimum interference to the line's signal. The amplifier section may be removed without interrupting the trunkline. Other features include variable gain and tilt controls.

The Model B-1 is available with a variety of connectors, including UHF and aluminum flare types for 0.412", 1/2", and 3/4" cable.

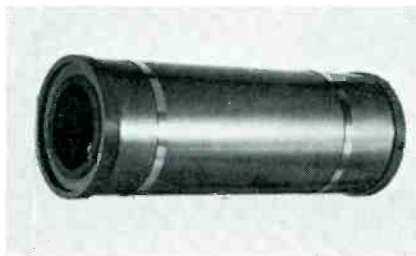
Circle Item 89 on Tech Data Card



Transistorized Mixer Console

A new solid-state mixer, designed to handle AM, FM, and FM-multiplex channels, will accept up to 24 separate audio sources. The AC8A-2S from **Rust Corp. of America** is compact and features simple operation. The solid-state circuitry in the dual-channel console uses silicon-planar transistors chosen for high reliability and for their ability to withstand damaging transients.

Circle Item 90 on Tech Data Card



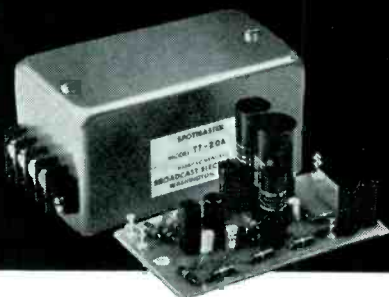
New Deflection Assembly

The availability, from **Cleveland Electronics, Inc.**, of a new Plumbicon® deflection assembly designed to operate in conjunction with the new North American Philips Plumbicon® tube, using the

basic 30-40 gauss field as design center, was recently announced. Incorporated into this assembly are a deflection yoke, a focus coil, and an alignment coil. The deflection-yoke portion will furnish line resolution in accordance with the tube capabilities with geometric distortions held to less than 1%. The focus/alignment-coil portion of the assembly is covered with a Mumetal shield, thereby reducing normal ambient electrical interferences and attenuating the deflection fields.

Circle Item 91 on Tech Data Card

SPOTMASTER



EQUALIZED TURNTABLE PREAMPLIFIER

The Model TT-20A is a compact, low distortion, transistorized turntable preamp for VR cartridges, with built-in NAB equalization. Design ingenuity reduces residual noise level to better than 65 db below rated output. Small current requirements permit 6 volt dry cell battery operation, eliminating AC hum worries. Response, 30-15,000 cps \pm 2 db... output—12 dbm, 600 ohm emitter follower... distortion under 1% at double rated output... size, 2 1/2 x 2 1/2 x 5 1/2". Priced from \$46.50; transformer output and power supply available. Also available as a flat amplifier Model BA-20A. Write or wire for complete details.

Spotmaster

BROADCAST ELECTRONICS, INC.

8800 Brookville Road
Silver Spring, Maryland

Circle Item 30 on Tech Data Card

Advertisers' Index

Acme Film Labs.....	55
Altec Lansing Corp.....	32
AMECO	6
Andrew Corp.....	3
Behrends, Inc.	26
Belden Mfg. Co.....	38
Bionic Instruments, Inc.....	28
Broadcast Electronics.....	42, 52, 57
CBS Labs, Inc.....	7
Cleveland Institute of Electronics...	39
Continental Electronics.....	47
Eastman Kodak Co.....	27
Fairchild Recording Co.....	6, 33, 34

Gates Radio Co.....	5
General Electric Co.....	30, 31
Greenlee Tools	52
Harvey Radio	8
International Nuclear Corp.....	41
Jampro Antenna Co.....	37
Lang Electronics, Inc.....	54
McMartin Industries.....	Cover 3
Movialo Mfg. Co.....	39
Norelco Audio Video Products.....	40
Nortronics	25
QRK Electronics.....	28

RCA Broadcast and Communications Div.....	48, Cover 4
Riker Industries.....	Cover 2
Rust Corp. of America.....	53
Sarkes Tarzian, Inc.....	43
Shure Brothers.....	46
Sparta Electronics Corp.....	44
Stancil-Hoffman Corp.....	32
Superior Cable Corp.....	49
Switchcraft, Inc.....	29
Texas Crystals.....	26
Telemet Co.....	9
Times Wire & Cable Co.....	45
Viking	56
Visual Electronics Corp.....	50
Ward Electronic Industries, Inc.....	51
Wilkinson Electronics.....	26

Professional Services

VIR JAMES

CONSULTING RADIO ENGINEERS

Applications and Field Engineering

345 Colorado Blvd.

Phone: (Area Code 303) 333-5562

DENVER, COLORADO 80206

Member AFCE

JAMES C. McNARY

Consulting Engineer

National Press Bldg.

Washington 4, D. C.

Telephone District 7-1205

Member AFCE

LAWRENCE BEHR ASSOCIATES, Inc.

RADIO ENGINEERING CONSULTANTS

FM Applications and Field Engineering

also

AM — Communications — CATV

LAWRENCE BEHR, PRESIDENT

2501 East Fourth Street

Greenville, North Carolina

919-PL 8-3966

OSCAR LEON CUELLAR

Consulting Radio Engineer

AM-FM-TV

411 Phoenix Title Building 623-1121

Directional Antennas Design

Applications and Field Engineering

Tucson, Arizona 85701

Member IEEE

CARL E. SMITH

CONSULTING RADIO ENGINEERS

AM, FM, TV and CATV

8200 Snowville Road

Cleveland, Ohio 44141

Phone: 216-526-4386

Member AFCE

CAMBRIDGE CRYSTALS

PRECISION FREQUENCY

MEASURING SERVICE

SPECIALISTS FOR AM-FM-TV

445 Concord Ave. Phone 876-2810

Cambridge, Mass. 02138

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

Classified

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

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

EQUIPMENT FOR SALE

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. 1-64 tf

Ampex Head Assemblies for 300 and 400 series recorders reconditioned. Service includes lapping and polishing all three head stacks, cleaning entire assembly, readjusting and replacement of guides, and realignment of stacks as to azimuth and zenith. Full track assemblies—\$60.00. Taber Manufacturing & Engineering Co., 2619 Lincoln Ave., Alameda, California. 5-64 tf

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

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

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

AMPEX 350 SERIES reconditioned capstan idlers for \$7.50 exchange. Send us your old ones, or order them for \$10.00 and get \$2.50 back after sending the old ones in. Ours have new bearings, the rubber softened and surface precision ground. **TABER MANUFACTURING & ENGINEERING CO.**, 2619 Lincoln Ave., Alameda, California. 1-65 12t

AMPEX 350 SERIES reconditioned capstan drive motors (BODINE NCH-33 only) \$85.00 exchange. Send us your old one, or order for \$100.00 and get \$15.00 back after sending old one in. Ours have new bearings and rewound stator. Package motor well. **TABER MANUFACTURING & ENGINEERING CO.**, 2619 Lincoln Ave., Alameda, California. 1-65 12t

CO-AXIAL CABLE Heliac, Styroflex, Spiroline, etc. Also rigid and RG types in stock. New material at surplus prices. Write for list. Sierra-Western Electric Co., Willow and 24th St., Oakland, Calif. Phone 415 832-3527. 5-65 tf

ELECTRONIC TUBES—Top Brands SOLD at substantial savings; (Minimum Order \$15.00). Authorized GE, Amperex, DuMont and Eimac Distributor. Send for FREE Buyers' Guide for all your Tube Requirements. TOP CASH PAID for your excess inventory. (New Only—Commercial Quantities). Metropolitan Supply Corp., 443 Park Avenue South, New York, N.Y. 100161 (212) MU 6-2834. 3-65 5t

Everything in used broadcast equipment. Write for complete listings. Broadcast Equipment and Supply Co., Box 3141, Bristol, Tennessee. 11-64 6t

New and Reconditioned Remote Pickup and 2-way radio equip., Fire and Police Receivers. All brands and models. Sales Manager, Box 238, Phone 817-594-5171, Weatherford, Texas. 5-65 12t

Audio Equipment—Ampex, Altec, Fairchild, Langevin, Neumann, etc. Trades, New and used. Get our list. Audio Distributors, Inc., 2342 S. Division, Grand Rapids, Michigan. 7-65 6t

ITA FM10B EXCITER AND POWER SUPPLY, completely rebuilt, schematics but less filament transformer, \$500.00. KDFM, 1581 Botelho Drive, Walnut Creek, Calif. 7-65 1t

Employment

OPPORTUNITY for technician familiar with CATV maintenance. Must have at least second phone. Right man can start at \$750. Write to Ketchikan Alaska Television, Box 1852, Ketchikan, Alaska. 6-65 1t

Need TV engineer, experienced in all phases of station operation, to teach college accredited communications course, plus limited assignment in major ETV station operations. Chief Engineer, WMVS, Milwaukee, Wisconsin. 7-65 2t

Expanding operations. Openings for several experienced studio, recording and/or maintenance broadcast television technicians with 1st phone. Major midwestern university ETV complex with flagship ETV station, developing statewide network, rapidly expanding closed circuit system, major recording and duplicating facility with 6 video recorders. Opportunity to develop professionally in various aspects of television engineering, to work with fully-equipped facility in challenging atmosphere with creative young professionals. Responsible positions with substantial potential for growth. Competitive wages; university benefits. Send resume and picture with application to Box 132. 7-65 1t

Business Opportunities

EXCLUSIVE FRANCHISE

Amazing new liquid plastic coating used on all types of surfaces interior or exterior. Eliminates waxing when applied on Asphalt Tile, Vinyl, Linoleum, Vinyl Asbestos, Hard Wood, and Furniture. Completely eliminates painting when applied to Wood, Metal, or Concrete surfaces. This finish is also recommended for boats and automobiles.

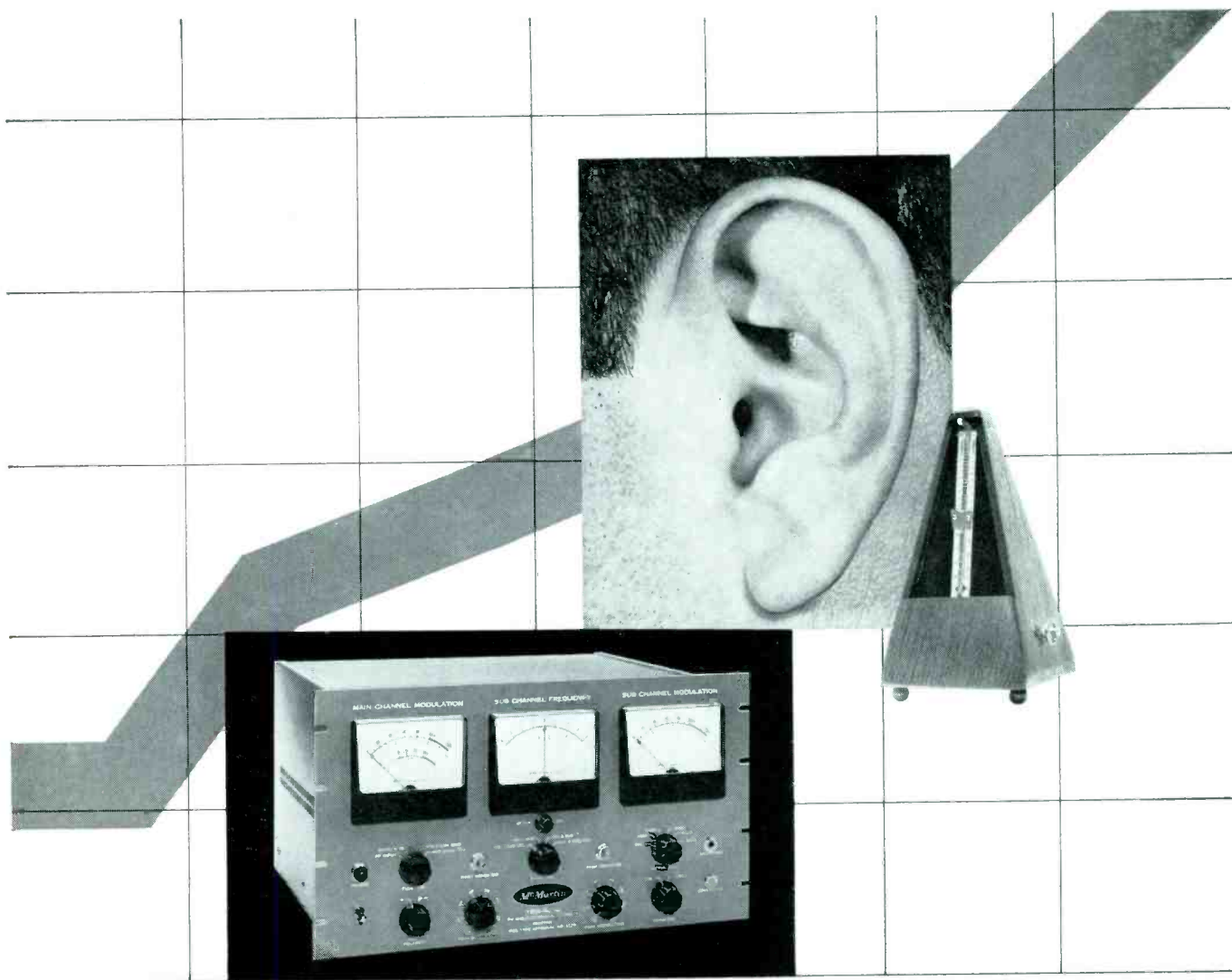
NO COMPETITION

As these are exclusive formulas in demand by all businesses, industry and homes. No franchise fee. Minimum investment—\$300. Maximum investment—\$7,000. Investment is secured by inventory. Factory trained personnel will help set up your business. For complete details and descriptive literature write:

CHEM-PLASTICS & PAINT CORP.

1828 Locust, St. Louis 3, Mo.

6-65 14t



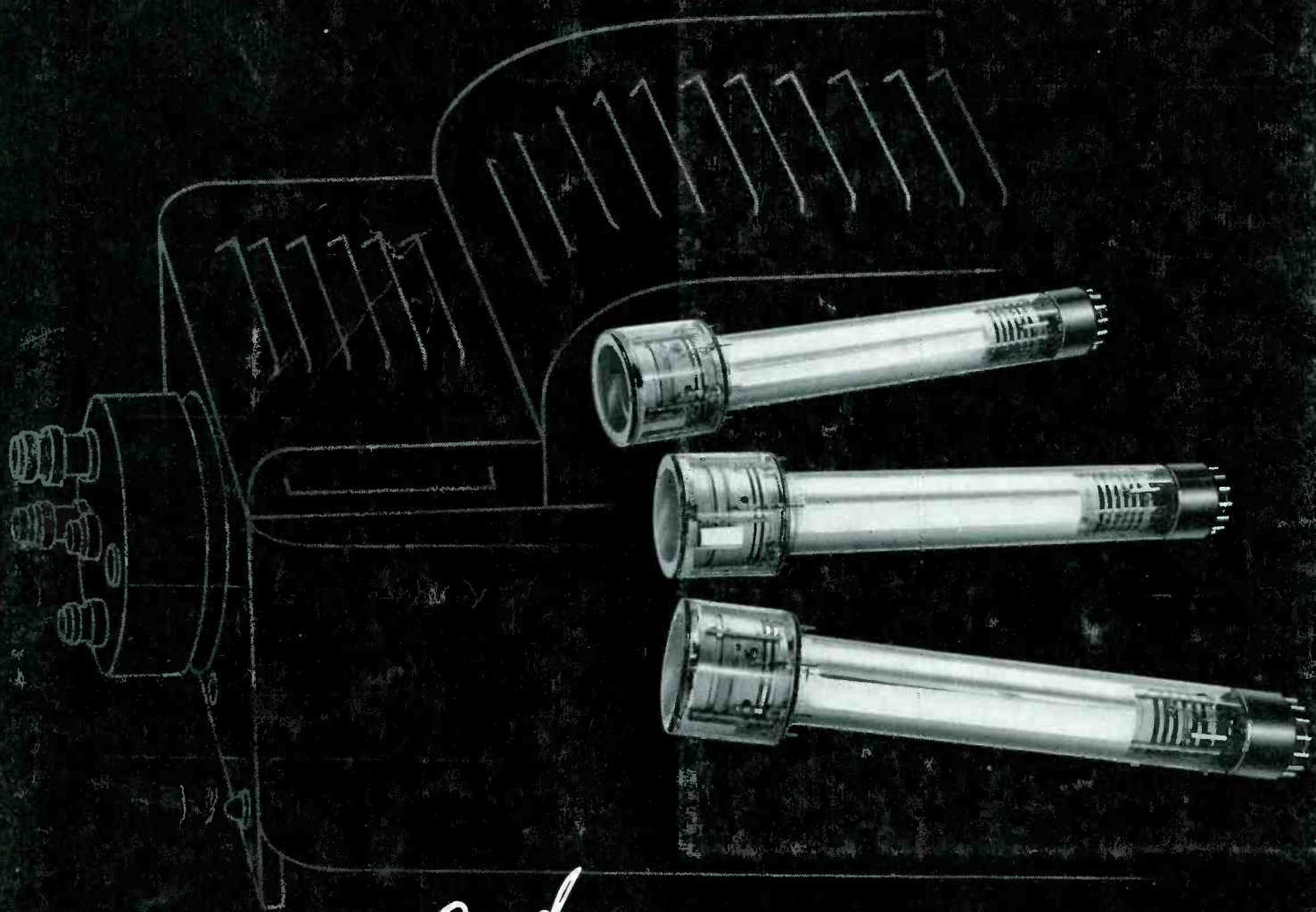
We're Graded on the Curve

A sales curve is generally an indication of Customer Acceptance. That's why we're particularly impressed by the rapid and dramatic growth in our sales during the last year. ■ Each Customer who contributed to that has judged us upon the value that he received versus the money that he spent. We like to believe that he got his money's worth through product excellence. ■ Product excellence is no accident. It results from training the workmen, inspiring the supervisors, and having pride in putting your name on a quality product. ■ There is something new, exciting and different going on at McMartin. It's reflected in the products that we produce for the broadcast, background music and commercial sound industries. If you're now a Customer, look for continued satisfaction; if you're not yet a Customer, why not let us send you our catalog — no obligation, of course; just write to:

McMARTIN INDUSTRIES, INC.
605 North 13th Street
Omaha, Nebraska 68102

McMartin®

Circle Item 40 on Tech Data Card



Good

IT TAKES THREE IMAGE ORTHICONS FOR LIVE COLOR!

Whether you're buying a single Image Orthicon—or a factory-matched set—RCA's tube-to-tube uniformity helps you attain "balanced" color-channel performance. Every major performance characteristic of RCA Image Orthicons for color is quality-controlled by rigid production standards. Precision construction of RCA Image Orthicons for color means that all tube parts are manufactured with precision, spaced with

precision, and aligned with precision. Result...you get exceptional tube-to-tube uniformity of:

- Amplitude response • Registration capability • Resolution • Sensitivity • Signal-to-noise ratio.

And, if you're buying matched sets, your tubes are carefully matched for:

- Background • Grey scale • Highlight signal • Sensitivity for each color channel requirement.

AVAILABLE FROM YOUR RCA BROADCAST TUBE DISTRIBUTOR

RCA'S IMAGE ORTHICONS FOR COLOR					
Type	Light Levels	Field Mesh	Precision Construction	Matched Sets	Targets
4415 4416	Black and White	Yes	Yes	Yes	Glass
7513	High	Yes	Yes	7513/V1	Glass
7513/L	High	Yes	Yes	Yes	Non-stick
8092A	Low	Yes	Yes		Thin-film

Complete information on the RCA Camera Tube line is available from your local RCA Broadcast Tube distributor ...ask him for booklet CAM-600.



RCA ELECTRONIC COMPONENTS AND DEVICES, HARRISON, N. J.

The Most Trusted Name in Electronics