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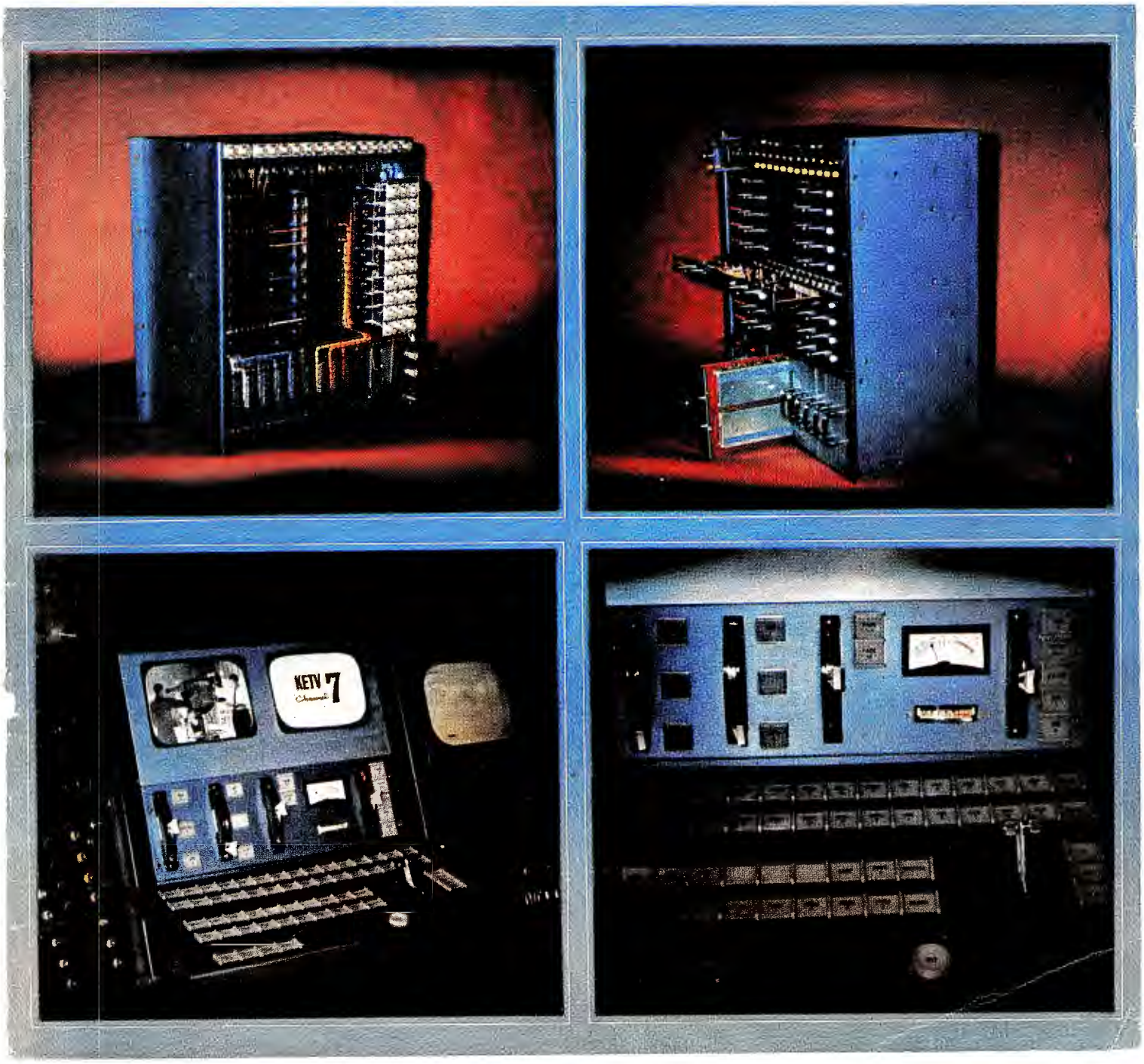
SEPTEMBER 1964/75 cents

Broadcast Engineering

the technical journal of the broadcast-communications industry



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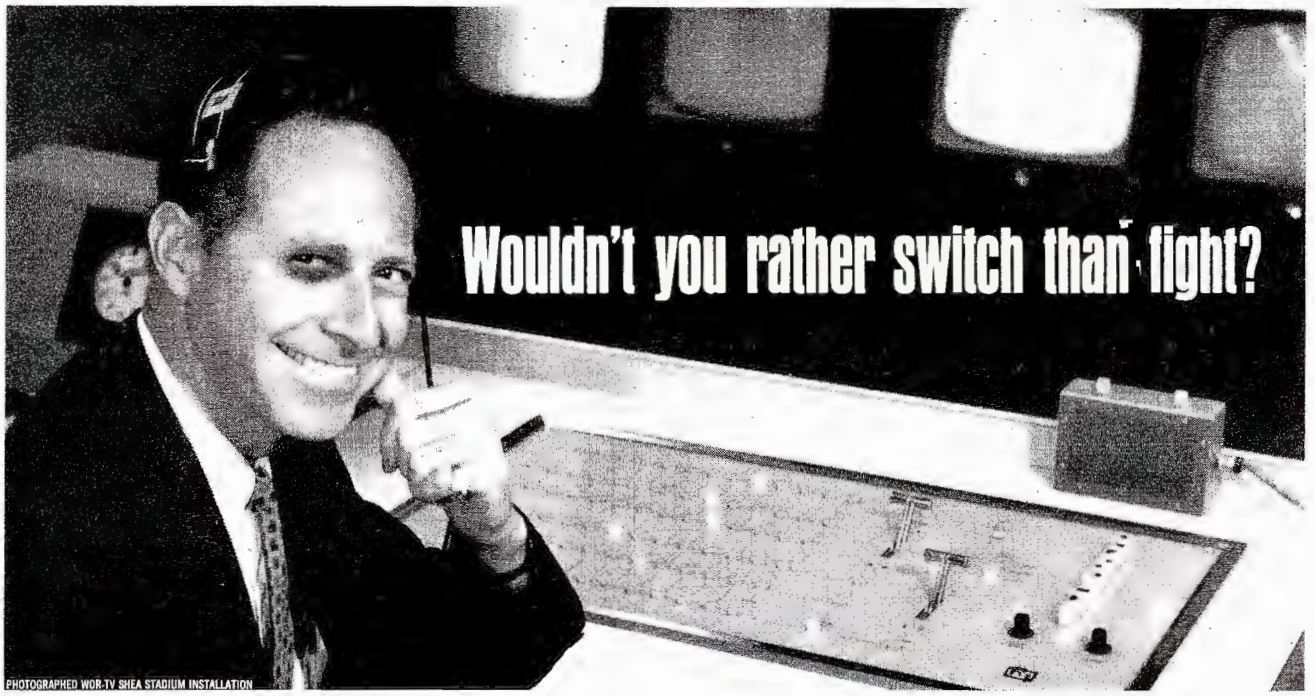

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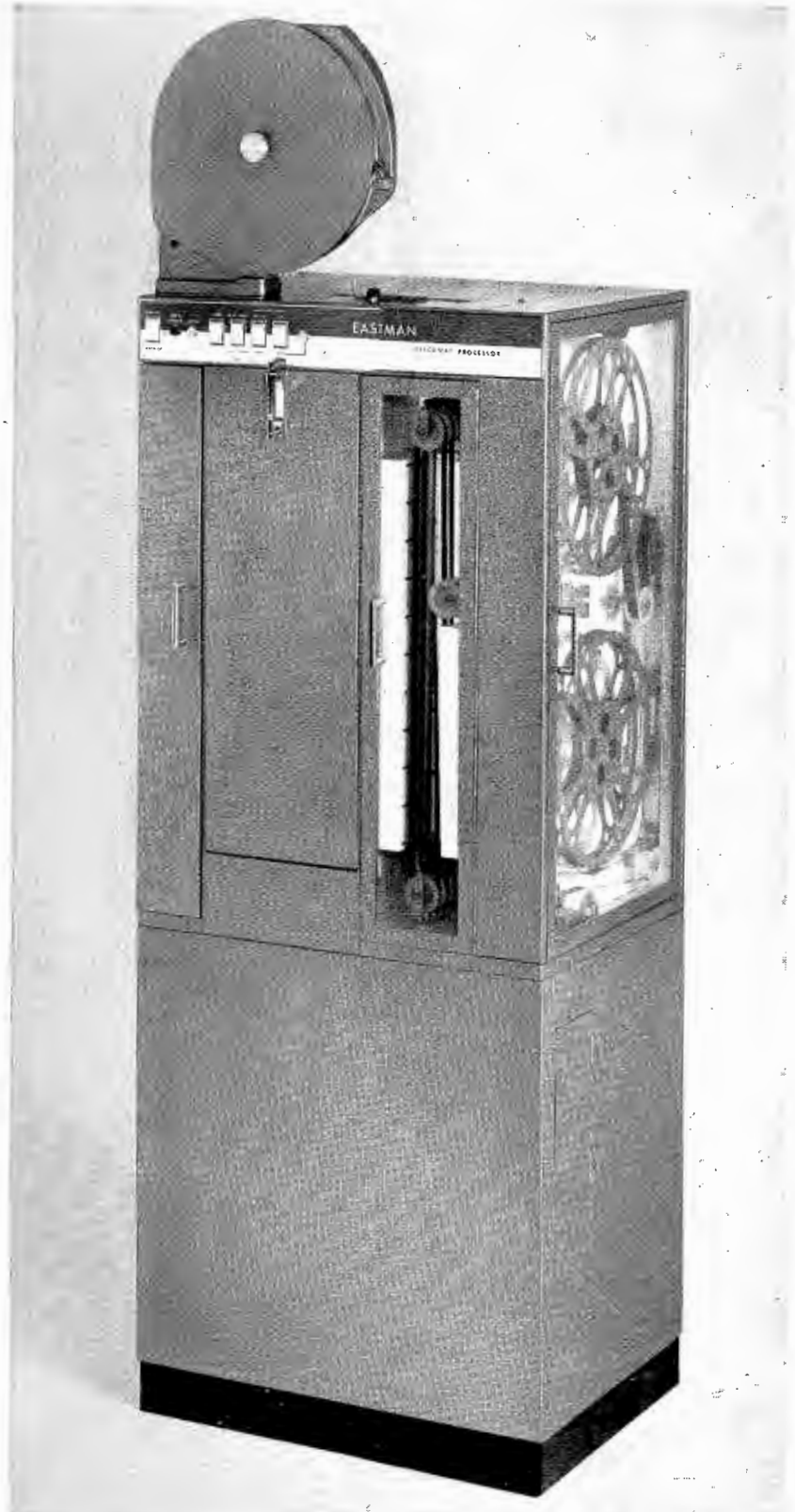

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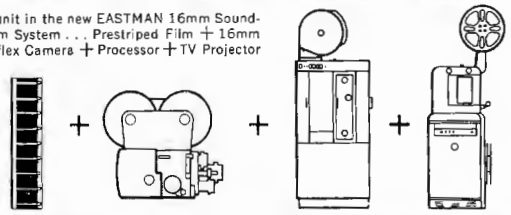

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IN THIS ISSUE

●

FM stereo and audio features

A brief examination of the Contents for this issue of Broadcast Engineering will reveal several features in the fields of *FM multiplex broadcasting and audio.* We call your attention to the first two articles: the one on stereo FM monitors and the one on multiplex principles by Jim Blake. These features should suggest answers to many problems in stereo broadcasting for newcomers to the multiplex medium, and oldtimers alike.

Of specific interest to many TV engineers is the cover story, by Jack Petrick, on the *glass-reed audio and video switcher* shown in the four-color cover views. This versatile unit was constructed by the engineering staff of KETV in Omaha and has given trouble-free service ever since its installation.

Audio interest is supplied by the varied approaches used by Robert Miers and Frank Ridgeway to provide two individual tools for *proof-of-performance measurements,* and by the Presto cutting lathe modification described by John Harmer. Additionally, you'll find the report on the AES Conference will give you a good idea of what to expect, if you have plans to attend.

Last, but certainly not least, Pat Finnegan's article offers some foretaste of what many engineers and technicians can expect with winter just around the corner — *ice on the antenna.* If forewarned is forearmed, you should find here some useful ammunition for this year's battle against the elements.

the technical journal of the broadcast-communications industry

®Broadcast Engineering

Volume 6, No. 9 **September, 1964**

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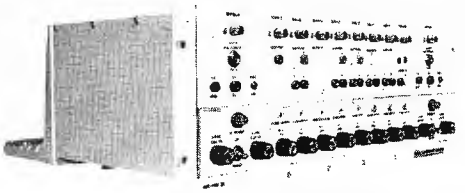

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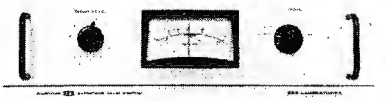

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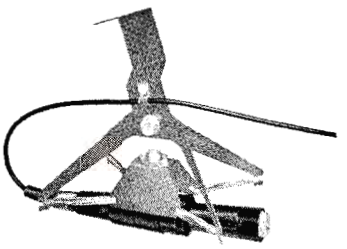
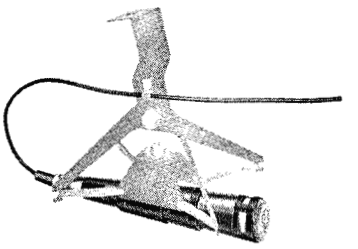
DYNAMIC NEWS FROM ALTEC

2 New Microphones Expressly for Professional Use

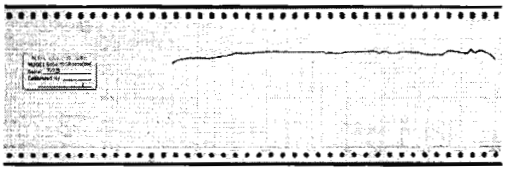
Two new studio dynamics—Altec 688A Omnidirectional; Altec 689A Cardioid—have been developed by Altec specifically for broadcast, recording, and TV use. Part of the famed Altec Series 680, these microphones offer maximal characteristics to meet and exceed the strictest professional recording and broadcast standards. Each is equipped with the exclusive Altec "Golden Diaphragm" which is not only extremely rugged in use but which also contributes inherent low resonance qualities and peak-free response. These two new microphones plus Altec's famed M20 Omnidirectional Condenser Microphone System and M30 Cardioid Condenser Microphone System now offer the industry superb qualities and characteristics to meet any and all requirements that can be imagined.



ALTEC 688A OMNIDIRECTIONAL DYNAMIC MICROPHONE—$90 net. Extremely uniform response from below 35 to over 20,000 cycles. Highly efficient. Low hum pickup. Shown in an Altec 181A Boom Mount. Output Impedance: 30/50, 150/250 and 20,000 ohms (selection by connections in microphone cable plug). Output Level: −55 dbm/10 dynes/cm². Hum: −120 db (Ref.: 10^{-3} Gauss). Dimensions: 1⅛" diameter at top (1½" largest diameter), 7½" long not including plug. Weight: 8 ozs. (not including cable and plug).

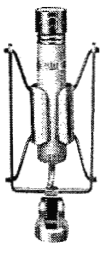


ALTEC 689A CARDIOID DYNAMIC MICROPHONE—$108 net. High front-to-back discrimination for an average of over 20 db from 40 to over 16,000 cycles. Virtually flat response throughout this frequency range. Output Impedance: 30/50, 150/250 and 20,000 ohms (selection by connections in microphone cable plug). Output Level: −54 dbm/10 dynes/cm². Hum: −120 db (Ref.: 10^{-3} Gauss). Dimensions: 1½" diameter at top, 7$^{13}/_{16}$" long not including plug. Weight: 11 ozs. (not including cable and plug).



Each 688A and 689A microphone comes with its own individual response curve made by a Bruel & Kjaer servo-driven recorder in conjunction with an Altec anechoic chamber. The curve serves as a permanent record of the unit's response characteristics for immediate reference at any time required.

ALTEC M20 OMNIDIRECTIONAL CONDENSER MICROPHONE SYSTEM—$233 complete with base, stand attachment, and power supply. This is the famous "Lipstik"—so named for its miniature size—the only American-made condenser on the market. The M20 provides the wide, uniform frequency response of a laboratory standard—an exceptional microphone for broadcast and recording of highest quality.



ALTEC M30 CARDIOID CONDENSER MICROPHONE SYSTEM—$280 complete. This directional microphone offers the superb response characteristics of the condenser with the ruggedness and small size available only from Altec. 20 to 20,000 cycle range with better than 10 db front-to-back discrimination at the extremes, better than 20 db in the mid-range.

ANNOUNCING AN IMPORTANT NEW DIVISION AT ALTEC

The Audio Controls Division was recently organized at Altec Lansing Corp. The new division specializes in design and manufacture of precision attenuators, equalizers, filters, networks and switches, as well as custom consoles and associated products specifically for the recording and broadcast industries. It is headed by Arthur C. Davis, a Fellow of the AES and well-known in this field as a leading design engineer and manufacturer.

For specific engineering details and free demonstration, call your nearest Altec Distributor (see Yellow Pages) or write Dept. BE-9

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LETTERS to the editor

DEAR EDITOR:

We recently had some very unusual noises from the two Ampex 601's in our recording studio. The noise was like an echo, but sounded filtered. The strangest part of it was that it would only appear on the last ten or fifteen seconds of a spot, no matter what the length of the recorded material; and it would not show up every time.

After having eliminated possibilities of print-through, I thought for sure we must be getting crosstalk somewhere in the system. It was found that when the playback circuit was disconnected from the console, the noise disappeared. I changed all the playback cables, relocated, grounded, and shortened them . . . but still "that noise" was there.

Having pulled out most of my hair, the solution suddenly hit me. A capacitor in the plate circuit of the recording amplifier was taking a few seconds to discharge the B+ after the machine was put in neutral position. After recording a spot, the announcers would open the playback on the console, turn the machine to neutral, and immediately rewind the tape. Due to the charge on C-114-A, the audio would then go through the console and be recorded right back onto the tape until the capacitor was completely discharged. Having instructed the announcers to either wait five seconds, or to remove the tape from the heads before rewinding, the problem was completely eliminated.

FRED GREAVES
Chief Engineer, WHLO Radio,
Akron, Ohio

This problem, Mr. Greaves, is quite interesting — a combination of natural and operational causes. The capacitor circuit is operating properly within the limits of the time constants. Evidently the complete circuit through the console back to the recording amplifier was the prime source of trouble. By waiting to punch up recorder playback until after rewinding, the announcer can avoid the condition you describe.—Ed.

DEAR EDITOR:

In the October, 1962, issue of BROADCAST ENGINEERING you carried a very good article called "WINC Satellite Remote Unit." I would like to duplicate the small transistorized console described but can find no transformers with the numbers shown on the schematic. Could you please send me specifications on these transformers or proper part numbers?

C. P. LEE
Chief Engineer, KOPY,
Alice, Texas

Your copy of the corrected schematic with proper part numbers is on the way, Mr. Lee. This information is available to readers who may be interested in constructing the units; just drop us a note.—Ed. ▲

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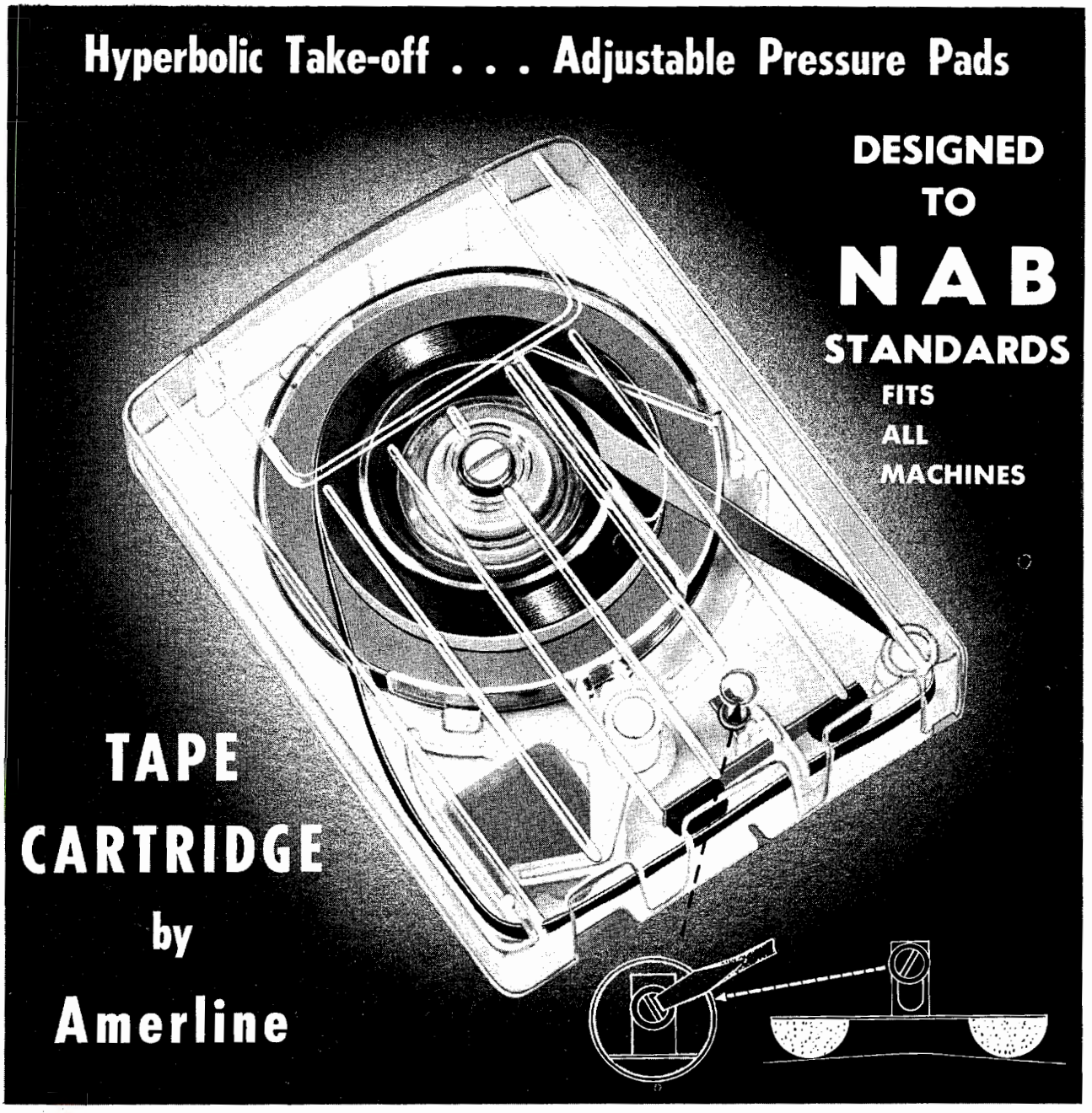
Hyperbolic Take-off . . . Adjustable Pressure Pads



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★ Center post bearing which holds the disk is made of DELRIN for smooth operation. Eliminates wear.
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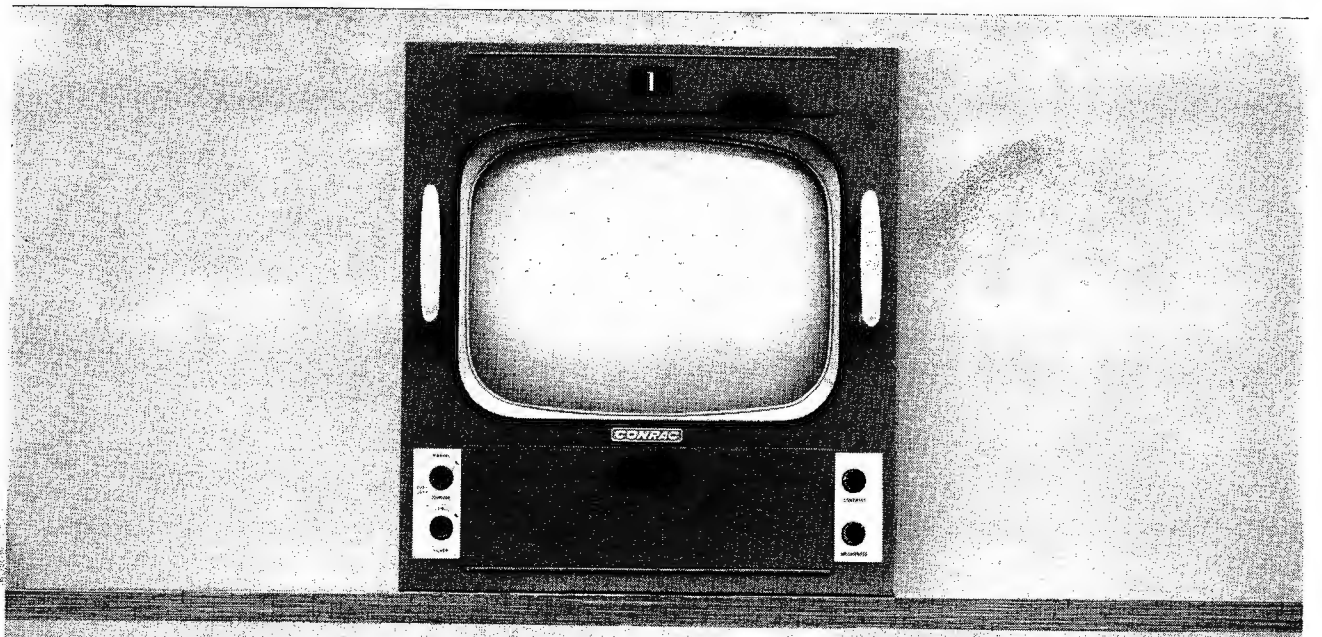


What's the difference between Conrac's 17″ and 21″ Color Monitors?

Both put color where black and white used to be.

Both have precision decoders cutting operating controls to just "contrast" and "brightness." A calibrated chroma control offers a "pre-set" position.

Both use solid-state switching instead of the mechanical relays normally found in color monitors.

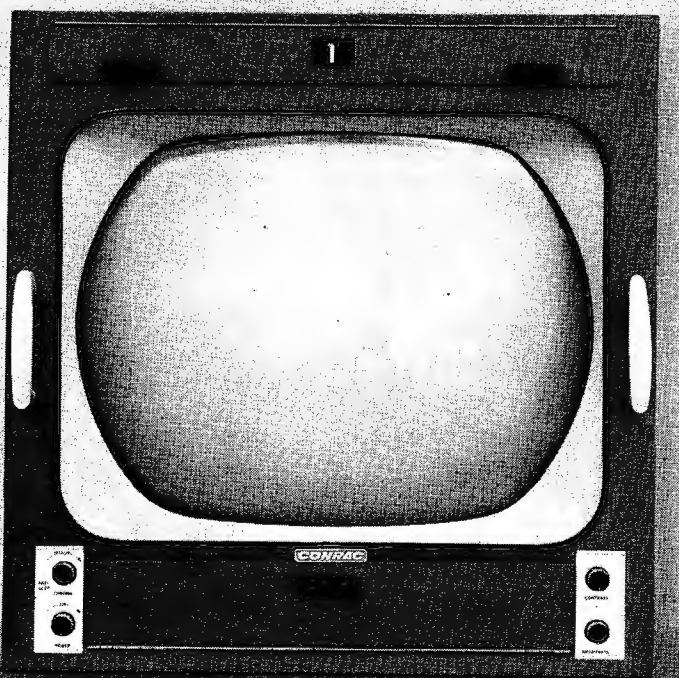
Both give the operator complete control of individual guns to turn on the beams in any combination and in any desired sequence. Setting up of the monitors is both fast and easy.

Both feature a keyed back porch clamp allowing set-up for true black level when operating on composite sync. A variable aperture corrector makes "crispening" of the picture possible.

Both offer a picture size switch which permits inspection of the picture edges, electrical centering controls, and bonded safety shields on the kinescope for the easiest possible tube cleaning.

So what's the difference? Oh, about four inches and thirty-six pounds.

CONRAC *GLENDORA, CALIF. / A DIVISION OF GIANNINI CONTROLS CORPORATION*



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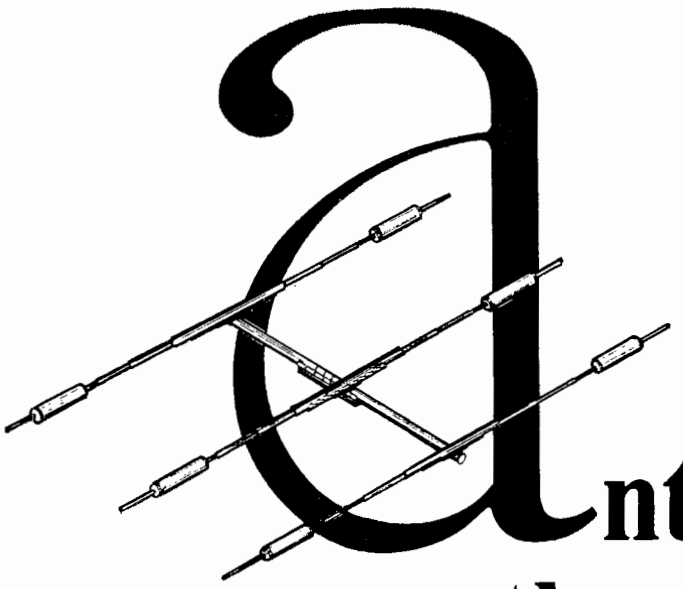
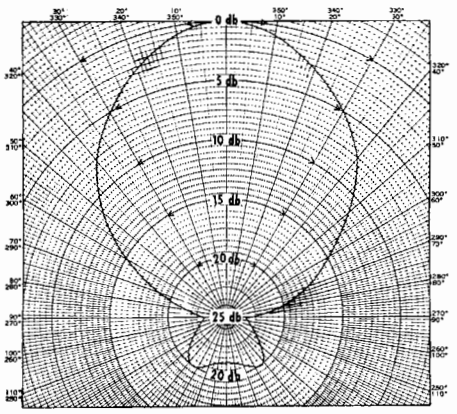


Antennas in the high frequency range



Typical Radiation Pattern

Two and three element multi-frequency Yagi Beam Antennas in the high frequency range are specialty items by Mosley (upper left). Two and three element multi-frequency beam antennas may be supplied with two to four frequencies in the 10 to 30 Mc. range to meet your precise requirements. Mosley multi-frequency Yagi Beams have power capabilities up to 1000 watts with continuous carrier, and may also be supplied for power requirements exceeding 1000 watts.

TYPICAL SPECIFICATIONS and PERFORMANCE DATA:

Forward gain (approximate)	10 Mc.	7 db.
	15 Mc.	8 db.
	20 Mc.	8 db.

Front-to-back–20 db. or better, Transmission line–52 ohm coaxial.

Wind Velocity Rating	150 MPH(no ice)	100 MPH(¼" radial ice)
Wind Load	336 Lbs.	395 Lbs.
Antenna Weight	200 Lbs.	310 Lbs.

Boom–2-7/8"x20', Maximum Element Length–32' 11¾", Turning Radius–20',

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Mosley Electronics, Inc. can produce a wide variety of multi-frequency Yagis, Verticals and Dipoles as well as other single and multi-frequency configurations to meet specific requirements.

You are cordially invited to submit your antenna problem to our competent engineering staff. Prompt evaluations and proposals will be made along with price quotations and delivery commitments.

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Please turn to page 40

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A REVIEW OF FM MULTIPLEX AND SCA PRINCIPLES

by *James Blake,* Chief Engineer, WSMJ-FM, Greenfield, Ind.—A reminder that the answer to many multiplex problems is a good understanding of the basic composite signal.

Since June 1, 1961, many U. S. broadcasters have operated FM-stereo multiplex equipment with excellent results. Increased use of this medium has, however, been accompanied by much confusion resulting from the many problems faced by the station engineer who must maintain his equipment within stringent parameters. This article is intended to dispel some of that confusion and to solve some of the seemingly insurmountable problems of multiplex operation.

The composite signal of an FM station engaged in stereo and SCA (Subsidiary Communications Authorization) broadcasting does not have the devilish personality one might at first think. When each signal is considered separately and in relationship to its sister signals, all becomes quite simple. A competent understanding of multiplex principles is just a matter of logical analysis by any engineer who works in the medium.

Previously in FM broadcasting, we have concerned ourselves only with the relatively narrow band of frequencies from 50 to 15,000 cps, which modulates the transmitter 100% through a deviation ±75 kc. It is an expanded band of frequencies—approximately between 15 kc and 75 kc—that we must consider in order to become familiar with FM multiplex practices. Additional signal elements necessary to provide compatible stereo, SCA (subscription music) capability, and precise stereo synchronization occupy this wider portion of the spectrum.

Stereo Basics

As shown in Fig. 1, the familiar main channel occupies the band of frequencies from 50 to 15,000 cps. In order to create the stereo illusion, another channel of information must be transmitted. This second channel (the stereo subchannel) occupies the spectrum from 23 to 53 kc, while the SCA subchannel, if used, takes up frequencies from 60 to 74 kc. A fourth component of the composite multiplex signal, the pilot or sync signal, occupies a narrow segment at 19 kc. This signal is an unmodulated carrier used to hold a receiver's reinserted carrier in proper phase relationship with main-channel and stereo-subchannel signals.

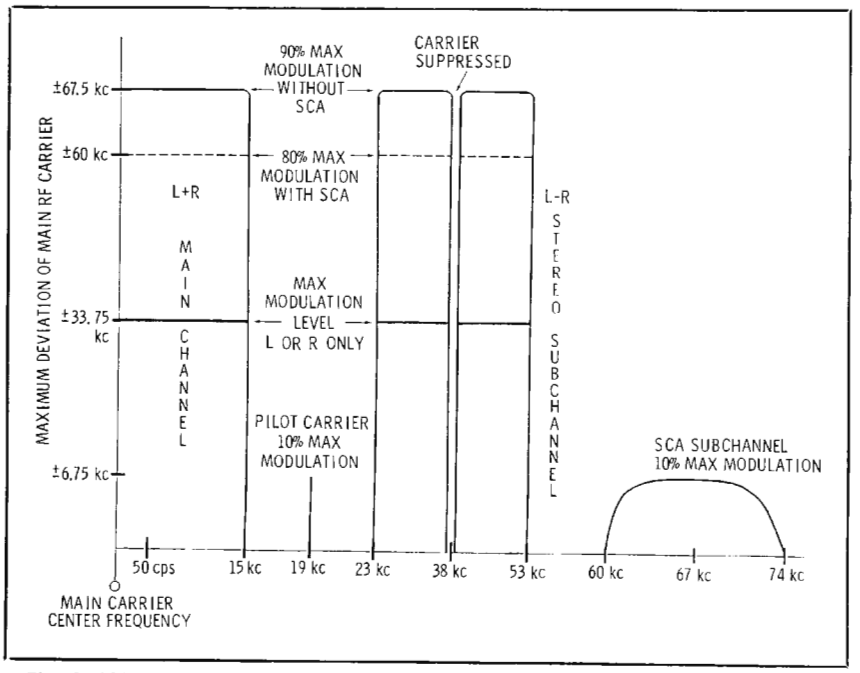

Fig. 1. This drawing shows the relationship of each element in a multiplex signal.

Stereo program material, whatever its source, has two separate channels or outputs. One channel contains Left or L information and the other contains Right or R information.

The main channel is used alone for monophonic transmission and therefore must contain all program material; i.e., both L and R information. This combined signal (L+R) is obtained from the matrix network shown in Fig. 2. This network also provides the difference signal (L—R) used to modulate the 38-kc stereo subchannel which occupies the spectrum from 23 kc to 53 kc. To ensure a high modulation percentage, both channels modulate the main carrier 90% (80% with SCA) on a time-sharing basis. A brief arithmetic examination shows how this is accomplished.

Assume that at one instant L = .45 volts and R = —.45 volts. Therefore, L+R = 0, and L—R = .9 [.45— (—.45) = .9] volts. Similarly, if L = .45 volts and R = .45 volts, then L+R = .9 volts and, at the same instant, L—R = 0 [.45 — .45 = 0] volts. Thus, in a correctly adjusted system in which a .9 volt audio signal equals a main-carrier deviation of 67.5 kc or 90% modulation, neither the

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L+R main channel nor the L—R stereo subchannel should modulate the main RF carrier more than 90%. In addition, neither L only nor R only should exceed 45% modulation.

The 19-kc pilot subcarrier (Fig. 1), of which more will be said later, is allowed to modulate the main carrier an additional 10% for a total of 100% modulation. When the SCA subchannel is used, however, the main channel and stereo subchannels are allowed an 80% maximum, the 19-kc pilot 10%, and the SCA subchannel 10% to achieve 100% main-channel modulation.

38-kc Stereo Subchannel

While the function of the L+R main channel is quite straightforward (L+R information is fed directly to the 10—13 mc exciter, where modulation of the main carrier takes place, as shown in Fig. 3), more must be said of the 38-kc stereo subchannel. In general terms, this subchannel consists of a 38-kc amplitude-modulated, suppressed-carrier signal impressed upon the main carrier. Referring again to Fig. 1, it is clear that the 38-kc subcarrier can be amplitude modulated to a maximum of ±15 kc (required for full fidelity in the stereo subchannel) without sideband interference to the 19-kc pilot signal or the 60-kc-to-74-kc SCA subchannel. The subcarrier is suppressed, so the reinserted carrier (in the receiver) must be synchronized by the transmitted 19-kc pilot signal. Since the second harmonic of that original 19-kc signal is used as the 38-kc subcarrier, the proper phase relationship between main-channel (L + R) and stereo-subchannel (L — R) information is rigidly maintained. Suppression of the subcarrier insures that there will be no stereo-subchannel output when L=R (monophonic condition), and therefore no deviation of the RF carrier, thus allowing full 90% modulation (67.5 kc deviation) of the main channel (L+R).

Generator Functions

As shown in Fig. 3, Left and Right outputs from the station console are passed through separate 15-kc low-pass filters to remove

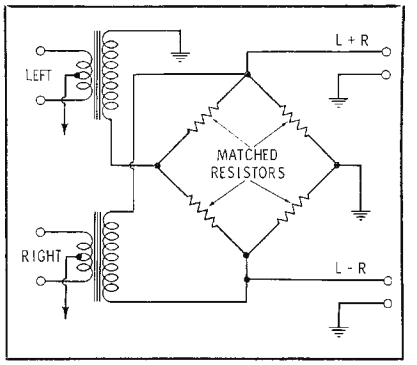

Fig. 2. The sum-and-difference matrix.

harmonics that might interfere with the 19-kc pilot or L—R sidebands, then through standard 75-usec pre-emphasis networks into a matrix system that produces the desired L+R and L—R signal components. L+R is amplified and fed directly to the audio terminals of the main-channel 10-13 mc exciter.

L—R is amplified and fed to the balanced modulator where it is mixed with the 38-kc carrier. The carrier is suppressed (to less than 1% of the main carrier), and the resulting double-sideband-suppressed-carrier (DSBSC) signal is passed through a bandpass filter to remove harmonics below 23 kc and above 53 kc. It is then fed through a delay network and added to the 19-kc pilot carrier at point A. The combined signal is then applied to the multiplex inserter (Fig. 4) which contains a phase modulator that frequency modulates the main carrier exciter.

Fig. 4 also shows how main-channel (L+R) information is applied to the multiplex phase modulator, and also that the SCA-subchannel information (60 to 74 kc) is mixed with the other signals. Output of the multiplex inserter, then, consists of the complete composite stereo signal as shown in Fig. 1.

The SCA Subchannel

Since SCA (background music, as it is more commonly called) provides an excellent way to supplement a station's income, many FM-stereo broadcasters include the service along with their regular stereo signal. Generally speaking, an SCA subcarrier consists of supersonic tones which are inserted onto the main carrier of an FM transmitter in much the same manner as is normal programming. When a stereo subchannel occupies the spectrum from 23 to 53 kc, there is room for only one SCA subchannel. Without a stereo signal, however, two SCA signals may be added to the main RF carrier; subcarrier frequencies of 42 kc and 67 kc are most common.

The FCC stipulates that the arithmetic sum of all SCA subcarriers shall not exceed 30% modulation of the main RF carrier. Since past experience indicates that subcarrier modulation percentages in excess of 10% do little to enhance the signal-to-noise ratio of the subchannel, it has become general practice to modulate SCA subcarriers no more than that, even when only one is used. The relatively low modulation percentage also reduces the probability of crosstalk in other channels.

While the audio for the stereo subchannel (L—R) amplitude modulates the 38-kc subcarrier, after which the resulting DSBSC signal is fed to the FM exciter, the SCA subcarrier is FM all the way.

The SCA signal usually is generated by a subcarrier exciter which

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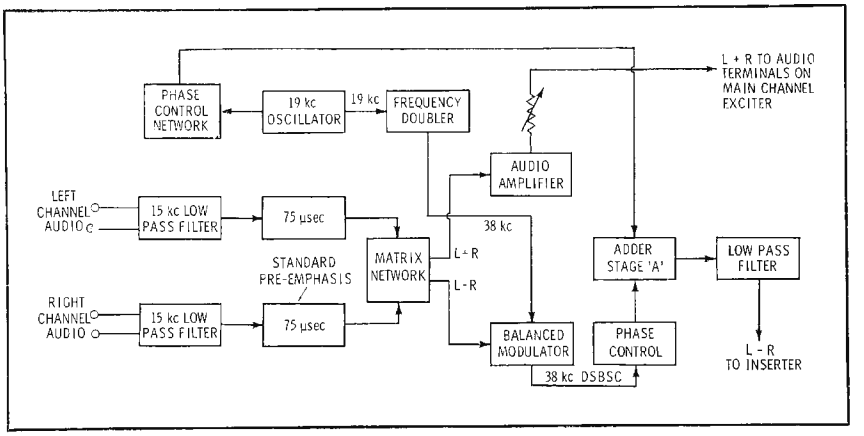

Fig. 3. Block diagram of the WSMJ-FM stereo generator showing paths of L+R & L—R.

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TWO LOW-COST TRANSMISSION SETS

A two-part transmission set construction feature which offers a choice of fixed or adjustable T-pad attenuators.

Adjustable T-Pad Unit

Robert L. Miers, Consulting Engineer

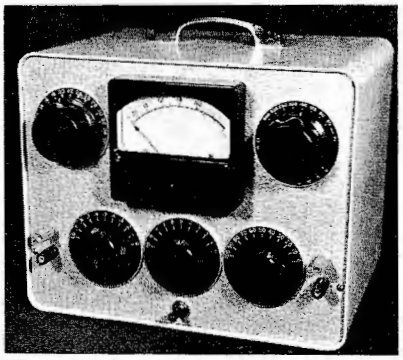

Fig. 1. The adjustable T-pad test set.

The transmission set used in preparing a station's "proof of performance" must measure the output of an audio oscillator and then attenuate the signal to a predetermined level. It must also match the impedances, if necessary, of the transmission set and the microphone preamplifier input terminals.

To obtain an instrument of professional appearance, one that would match the oscillator and noise meter already in use, the transmission set to be discussed was built into a matching, commercially-available case. A 19″ rack panel was then cut and trimmed to fit the case. The finished unit is shown in Fig. 1.

The schematic diagram of the unit that meets the necessary requirements is shown in Fig. 2. The circuit employs a conventional VU meter and several attenuation elements. Attenuators used in the construction of this unit may be purchased from any manufacturer of quality audio controls for about $25 each. Isolation is provided by a 600- to 600-ohm line-to-line transformer placed at the input where it matches the attenuators and the VU circuit, and isolates the audio-oscillator input signal from the transmission set. Placed elsewhere in the circuit, the transformer would be subjected to a variance in operating levels on the order of 120 db, an excessively wide range of operation for any transformer. The higher level at the input also reduces the effect of hum pickup that might be a problem if the transformer were operating at microphone signal levels.

Immediately following the transformer is the VU meter and its associated range attenuator, followed by the attenuator pads. The pads are precision decade units of "T" configuration providing a total loss of 111 db in steps of .1 db. All have a tolerance of ½% with a 1-watt power rating. If necessary for reasons of economy, the .1-db pad could be left out, thus reducing the total attenuation to 110 db in steps of 1 db. Fractions of a db could then be read directly from the VU meter. It is felt, however, that the improved accuracy outweighs the extra cost.

In making a noise test on an amplifier, it is customary to send an audio tone through the amplifier under test, adjust the amplifier to a given output level, and then calibrate the noise and distortion meter to full scale, or 100%. Removing the tone and loading the amplifier with a characteristic load impedance will enable the relative noise level to be read on the meter of the distortion analyzer.

Since the rotary impedance-matching network has an input impedance of 600 ohms, the network could be loaded with a 600-ohm resistor at the input; then the reflected impedance through the network would always be correct for the output impedance. This means that only one load resistor would be required. Following the attenuation pads (but before the impedance matching network) is a double-pole single-throw lever switch used to connect the impedance-matching network across the load resistor or across the attenuation section of the transmission set.

All of the attenuators were bonded together but left ungrounded from the case. When using the unit with a piece of equipment having a balanced input, difficulty might otherwise be encountered. Best results have been obtained when the case of the transmission set is grounded to the equipment under test. After completing construction of the set, it was found that the weight of the components mounted on the panel of the unit caused it to tip forward easily. The addition of about three pounds of lead to the

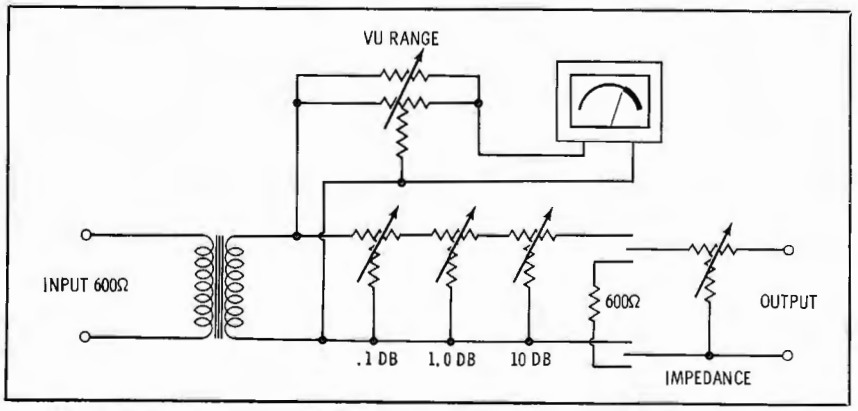

Fig. 2. A schematic diagram of the adjustable-pad transmission-measuring set.

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The FCC Rules and Regulations require that each duly licensed station conduct an annual "proof of performance" to ensure compliance with the prescribed technical parameters. Although the Rules stipulate that this series of tests may be performed by either the station's engineering staff or an outside consultant, they also make it clear that each station must have equipment available for conducting the "proof." This requirement is included to facilitate making additional periodic, nonreported checks of a similar nature that should be executed on a quarterly basis to keep the station's equipment operating at peak performance.

While most of the test equipment necessary to perform the measurements is a part of the normal station inventory, or can be acquired without undue expenditures, the expense of a commercially-built transmission set often seems hard to justify. For this reason, the two sets described in this article should be of interest.

Fixed T-Pad Unit

Frank B. Ridgeway, Consulting Author

Any broadcast engineer who has made an audio "proof of performance" at a broadcast station or any engineer who has tried to make frequency response, distortion, or noise measurements on audio equipment has found the need for inserting a known value of attenuation between the audio oscillator and the audio device under test in order to obtain the proper input impedance and a level equal to that of the microphone or other input equipment.

Transmission sets are made up of a volume indicator to show the input level (or oscillator output) to the attenuation network and a means of varying the amount of attenuation in calibrated steps. The input to the attenuation network is kept constant over the usable frequency range, and any change in the level fed to the amplifier is made by varying the amount of known attenuation. The attenuation network and output transformer should be as "flat" as possible over the entire frequency range, in most cases from either 30 or 50 cps to 15,000 cps.

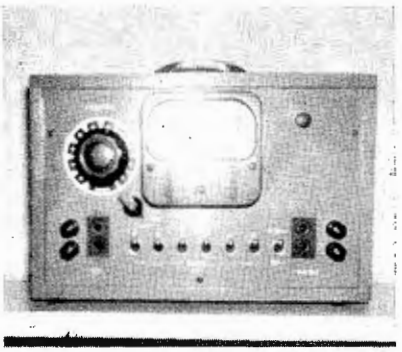
The transmission set shown in the schematic (Fig. 3) and in Fig. 4 has been in use for some time and has proven to be adequate for such measurements. The principal parts, most of which were on hand, consist of a VU meter, a 20-step attenuator of .1 db per step, a series of six fixed pads with switches for inserting them in the circuit, an output matching transformer, and a switch for changing the output impedance from 600 ohms to 130 ohms. A Western-Electric type 119C repeat coil was used to provide the two output impedances, but any high-grade transformer with good frequency response may be substituted.

The series of fixed pads was obtained by using a commercial unit which contains all the pads in one can. If the builder desires to make his own fixed attenuator pads, however, the networks may be assembled using individual noninductive carbon resistors of 1% tolerance. Table 1 lists the ideal resistive values, in ohms, for each leg of the pads (see Fig. 5). While these exact values are difficult to obtain, the nearest values possible should be used.

With the pads shown on the schematic, any attenuation from .1 db to 42 db can be inserted into the circuit in .1-db steps. If greater attenuation is needed, another pad of 40 db (see Table 1) may be added following the 20-db pad. Another switch would then be required to throw the added attenuator in and out of the circuit. This would give a total attenuation of 82 db in .1 db steps.

Table 1. Fixed T-Pad Resistance Values.

Pad Attenuation	R1	R2
1 db	34.2	4976.0
2 db	69.0	2562.0
3 db	102.6	1725.6
4 db	135.6	1243.6
10 db	311.4	421.2
20 db	490.8	121.2
40 db	588.0	12.0



A three-position switch was incorporated into the VU-meter circuit. When the switch is set at "VU", the meter is disconnected from the set and can be used for measuring external levels. In the "Test" position, the meter becomes part of the normal transmission set circuit. When the switch is in the "Set" position, the output level from the oscillator may be read on the meter with no signal applied to the amplifier. A 1200-ohm resistor is connected in parallel with the meter when the switch is in this position to replace the 1200 ohms of the attenuator circuits.

A resistor of 3900 ohms is connected in series with the VU meter at a meter terminal. But, the manu-

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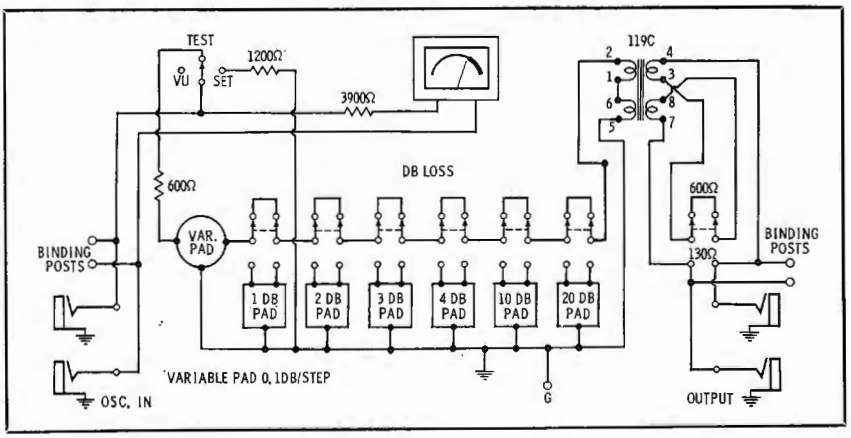

Fig. 3. Schematic diagram of the fixed T-pad attenuator transmission measuring set.

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A COMPLETE REED SWITCHING SYSTEM

by *Jack Petrick,* Chief Engineer, KETV, Omaha, Nebr.—The audio/video master control switcher, shown on this month's cover, was designed and constructed, making use of reed relays.

COVER STORY

Soon after development of reed-type relays, a few years ago, it became apparent that many characteristics of these new components would be advantageous in broadcast applications. These properties can be briefly summarized as: high speed operation (about .5 ms) compared to standard relays; high reliability in the order of 20 million operations or greater, depending upon the load; low contact capacitance, in the order of 1 mmf; and adaptability to modular circuit-board construction. In the fall of 1962, the engineering staff of KETV decided to employ reed relays in redesigning the station's master-control audio and video switching center. Use of reeds was planned for switching of audio, video, tally, and control circuits.

Audio Console and Switcher

We had previously decided that a fresh new approach was needed in the design of an audio console to be used with the video switcher by a single master-control operator. The premise was: The audio console should be simple, reliable, and always have the correct audio on the air.

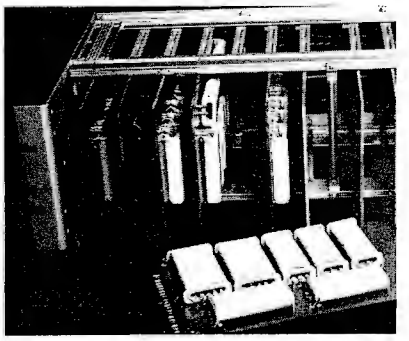

Fig. 2. The audio plug-in relay chassis.

Design Considerations and Features

As a basic feature, we provided an interlocking control system with the video faders, multiplexers, and video switcher to insure that the on-air audio would always be that normally associated with the video being transmitted; the operator must intentionally disable the normal audio, if desired. AGC and audio limiting were necessary to keep levels balanced within a reasonable range, since individual potentiometers are not provided for each audio source. However, a master gain control for slight overall level variations was provided. Fading, either into or out of an audio source, is done with a separate fader on a one-shot basis. This is the heart of our new audio console—one master potentiometer for slight gain variations and a **fade-in/fade-out** potentiometer for fading any of the audio signals.

In addition, two auxiliary potentiometers are provided for manual control of extra audio sources, those not normally associated with a particular video signal. Thus only four faders are used in the complete control panel. Switching is accomplished by reed relays which provide reliability and permit construction on circuit boards. The simple audio control console, utilizing plug-in vertical faders and dual-color illuminated switches, is the upper panel in Fig. 1. At the far right is the master gain potentiometer for all **track** audio (normally associated with video); next are two meters, one for VU level indication and the other for AGC db gain reduction; the second fader is the fade-in/fade-out control; the two faders on the left control auxiliary audio sources.

Reed relays are used for all control and audio switching circuits. A 5¼" rack chassis (Fig. 2) with modular plug-in boards contains all the relays and circuitry necessary for operation. Five solid-state audio amplifiers, plus AGC and limiting amplifiers, are used with the modules.

Any number of track audio inputs can be accommodated. We presently use 15 inputs (Fig. 3), each with a bridging potentiometer for level balancing. Six modular

Fig. 1. Audio and video control panels for reed-relay master control switching.

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boards are provided for additional audio switching of lines feeding conference room, kine record, and other positions. A VIDEO ONLY button (on the video board) allows video to be switched without changing the track audio on the air; conversely, the audio may be changed without switching the on-air video.

Typical Switching Functions

To fade the normal program audio out, the FADE OUT button is pushed, transferring the audio to that fader (Fig. 4A). The lever may then be pulled down as quickly as desired until the audio disappears. Upon taking the next video source, the track audio would once again appear on the right-hand master fader (Fig. 4B) at normal level, thus preventing the first few words after the video switch from being chopped. The master fader is **never** used to fade out or fade in audio, but only for overall level touchup.

Consider the case where it is desired to fade into the network. The FADE IN button is preset (Fig. 5A) so that, when network video is taken, the audio will be transferred to the fade-in/fade-out potentiometer which is in the off position (Fig. 5B). The audio can then be raised until normal level is obtained. In many cases it is desirous to hold a reduced level while an announcer reads the introduction of the network show. After fading in to normal level the audio can then be transferred back to the master potentiometer by pushing the TRACK button. The fade-out and fade-in function can also be used in tandem —i.e., for fading one audio out and the next in.

If no audio is desired or taped audio is to be used instead of the audio normally associated with a particular video source, one of the three buttons on the right—marked

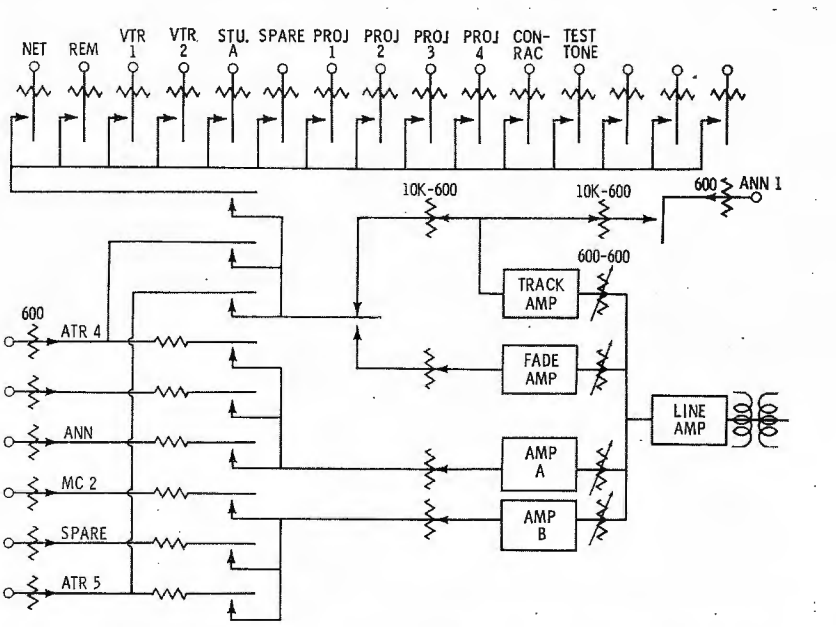


Fig. 3. Block diagram of audio control unit with inputs, switching, and outputs.

SILENT, ATR 4 (audio tape recorder), or ATR 5—is pushed (Fig. 6A). Upon actuation of the next video operation, and according to which function has been selected, either the track audio will be silent or taped audio will be taken and the appropriate tape machine started (Fig. 6B). When video is again switched, the audio will return to the normal track mode. The ATR 4 and ATR 5 buttons can also work in conjunction with the fade-in/fade-out potentiometer, if desired. The ANN A button, located above the TRACK button, is an override on-off control for the announce booth audio which is controlled with the master fader. At KETV the announcer normally switches his own microphone on and off, so this button is rarely used.

The two auxiliary faders provide separate manual control of the two tape machines as well as several other audio sources (e.g., ANN B, CONTROL B, MC 2) which do not track with any particular video sig-

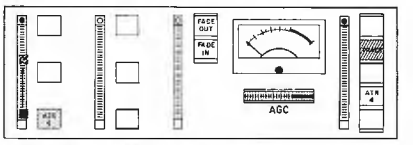


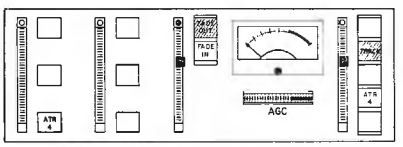
Fig. 7. Audio-source manual controls.

nal. Momentary-type push buttons ATR 4 and ATR 5 turn the tape machines on and off as well as switch the audio (Fig. 7). Since cue tones are used, the audio tape sources do not have to be switched off manually.

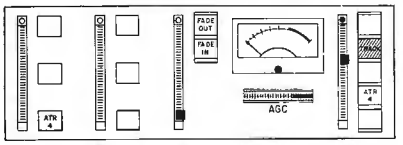
Video Switcher

Before undertaking the major task of building a video switcher and control system, an overall evaluation of cost, product, and performance criteria was made. Some of the factors which were considered are discussed below.

1. Cost—The cost of the project was not to exceed 25% of the price comparable manufactured units could be purchased for, if available. This included all outside expenses for labor and materials, but ex-

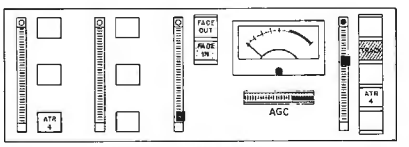


(A) FADE OUT button preset.

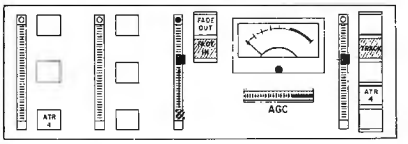


(B) Condition after switch.

Fig. 4. Sequence for fading audio out.

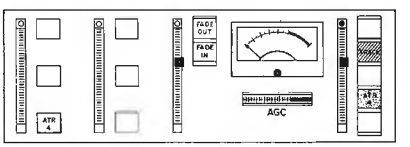


(A) FADE IN button preset.

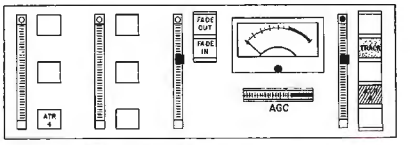


(B) Condition after switch.

Fig. 5. Sequence for fading to network.



(A) Audio source preset.



(B) Condition after switch.

Fig. 6. Sequence to take nontrack audio.

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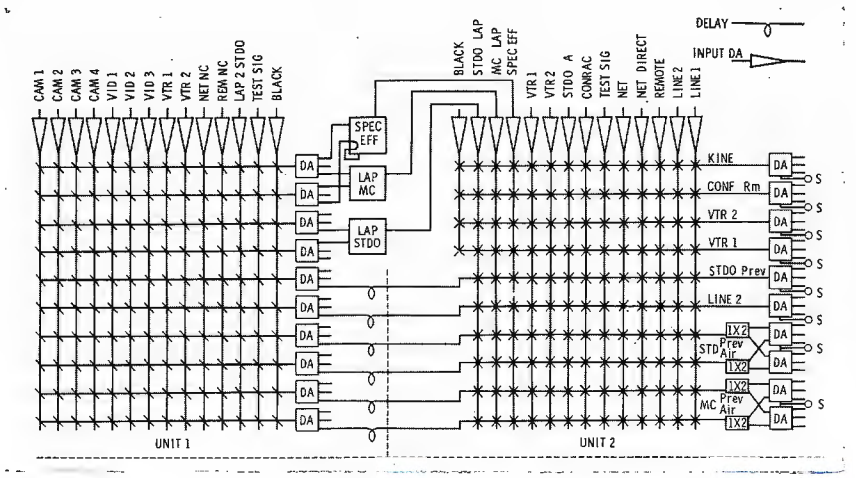


Fig. 8. A signal-flow diagram of video switching units in master control system.

cluded labor and facilities furnished by the station. Realizing progress would be relatively slow in a project of this magnitude, depending on the "spare" time of projectionists, cameramen, and MC operators, we set one year as a goal for completion of the video section.

2. Auxiliary Switching—A combination switcher was desired not only to perform on-the-air switching but also to switch such functions as VTR inputs, kine recording sources, and conference-room monitor inputs. We also wished to provide a sufficient number of inputs and outputs to accommodate not only present needs, but also future expansion. Fig. 8 shows a block diagram of the planned system. Whereas 12 inputs for each identical unit of the switcher were deemed sufficient in the planning stage, it became expedient to increase this number to 14 when the packaging of the device was considered.

3. Performance—Normal performance specifications were anticipated: 8 to 10 mc bandwidth, 1° phase shift, 1% linearity, and 50 db crosstalk.

4. Reliability—In order to obtain maximum reliability, we decided to make the electronics all solid-state and use reed relays for video and tally switching. This plan was later modified somewhat by the addition of extra tally contacts for any video crosspoint by using long-life conventional plug-in relays on an auxiliary chassis. Three reed-relay tally contacts per crosspoint were provided in the basic unit; this was dictated somewhat by packaging requirements but was deemed adequate for most situations. The reed relays in the tally circuits were equipped with rhodium contacts for rugged long-life operation.

5. Operation Times—Another desired feature was operation during either vertical-interval time periods or random time periods. Thus, a separate vertical trigger unit would not be necessary at each remote panel for such functions as monitor selection, conference room selection, or other auxiliary switching. As it turned out this was not a problem; even in an emergency any of the output busses can be operated in either mode.

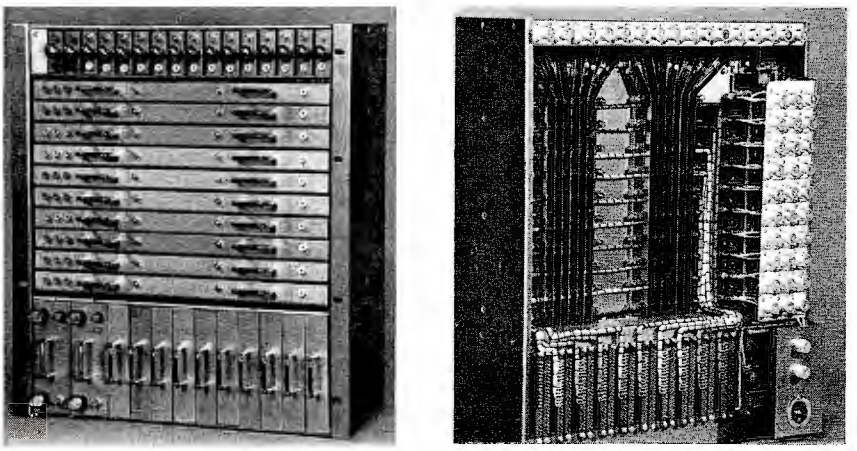
6. Amplifiers and Outputs—Each output buss was to have distribution amplifiers with three isolated outputs built into the switcher unit. Provisions for variable video gain and a sync-insert module would allow either composite or noncomposite input signals to be used.

7. Packaging — Each identical switcher unit was to be equipped with video switching relays, tally relays, output distribution amplifiers with sync mixing capability, trigger amplifiers, power supplies, and input amplifiers. Modular design and reasonable rack space requirements were also important considerations. Thus, the packaging of the unit was deemed extremely important — as much time was spent on mechanical layout as in electrical design.

8. Adaptability—Easy adaptability to future automation was another essential feature. Momentary-type push buttons and pulse-type operation were used throughout.

9. Direct Switching—We felt it was necessary that the portion of the switcher used for line-1 preview should operate from a cut-or-take button or by direct switching. This required two 2 x 1 switcher DA's for the outputs of line 1 and the preview busses. In the cut-or-take mode of operation the video-make relay is preset and the 2 x 1 switchers are activated by pressing the CUT button. In the direct mode of operation the line-1 video relays are switched directly without the preset step. In this mode, the preview monitor would remain on whichever video was up when the DIRECT button was pushed.

As shown in Fig. 8, the finished system consists of two identical units, each with provisions for 14 inputs and 10 outputs. Since it is built on the modular principle, any smaller number of inputs and outputs could be built into each unit. Figs. 9 and 10 show front and rear views of one switching unit. At the top is a row of 14 transistorized amplifiers which drive a very-low-impedance video switching buss. At the left side of the top row are two plug-in trigger amplifiers which



(A) Front view. (B) Rear view.

Fig. 9. Front and rear views of the video-switching-unit assembly rack cabinet.

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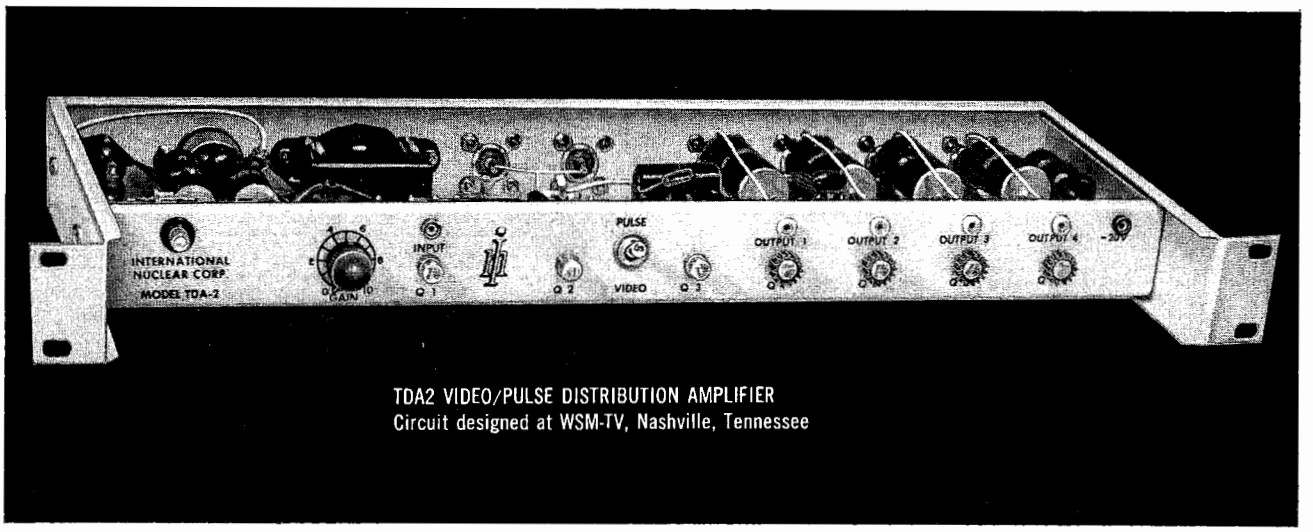
TWENTY TDA2 VIDEO/PULSE DISTRIBUTION AMPLIFIERS PRODUCE LESS HEAT THAN ONE 100-WATT BULB!



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The Model TDA2 Video/Pulse Distribution Amplifier is designed to accept composite or non-composite video at a bridging-type input of as little as 0.25 volt and delivers four individually isolated 75 ohm outputs of 1.0 volt, peak to peak. It will replace all tube type amplifiers without alteration of existing cables. Weighs under four pounds and is only 1¾ x 19 x 7 inches over-all.

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consist of solid-state vertical-interval keying circuits. Since each control panel requires only one such amplifier for vertical-interval switching, we therefore have two spares; random-time-switching panels do not require a trigger unit.

The ten horizontal trays running the width of the cabinet contain the video-switching relays, output-distribution amplifiers, and the sync-adding circuits. The three isolated video outputs are provided here for each output buss, and there are gain controls for both sync level and video-output level. The test jacks are for video outputs and sync input.

The two modules at the bottom left contain power supplies, one for operating the relays and another for the solid-state devices. If a separate master 24-volt supply is used at the station, the power supplies in the switcher can each be used to provide power to half of the input and output amplifiers.

The remaining ten modules on the bottom row of the unit contain the tally and auxiliary-contact relay boards, one board for each output buss. Three pairs of form-A contacts are provided for each cross-point; the additional contacts are obtained by adding the plug-in relay strips shown in Fig. 10. The entire switching system is contained in 21″ of rack space for each unit. The individual plug-in subassemblies can be seen in Fig. 11.

Dual-color lighted buttons are used in the control panel for the line-1 preview portion of the video switcher (Fig. 1) to indicate condition of video sources—red for on-the-air and green for preset. The CUT button transfers a source from the on-air condition to the preset condition with the accompanying change in colors. Two rows of buttons are provided in the fader circuit for making laps, wipes, and key inserts.

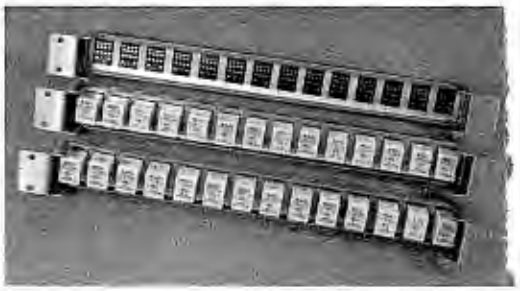

Fig. 10. Auxiliary plug-in relay strips.

Other panels contain the switching controls for output busses, VTR machines, conference rooms, kine record, and other functions. Several output busses are being used to update and augment the original studio switcher.

Conclusion

This switcher is certainly not a panacea for all stations. Each obviously must determine the important criteria for their own switching system. This type of switcher using reed relays does, however, offer reliability, high performance, as well as low cost. Prompted by the favorable results experienced with our reed equipment, we have designed a preset break switcher which is now in the construction stage. ▲

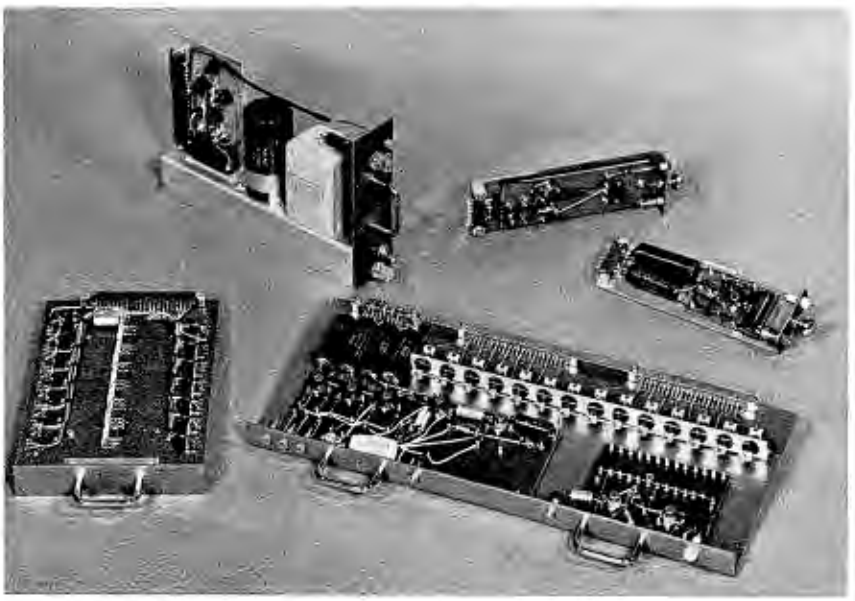

Fig. 11. Individual plug-in module assemblies used in the master control switcher.

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September, 1964

We interrupt this magazine to bring you ...

Late Bulletin from Washington

by Howard T. Head

New UHF Allocation Table

The FCC has now announced that the proposed new Table of UHF Television Channel Allocations (May Bulletin) is not expected to be adopted before January of 1965. A very substantial number of recommendations for changes in the Commission's proposal has been received, and many of these proposals have convinced the Commission that a re-examination of the basic UHF channel allocation philosophy is needed; hence the delay.

In the meantime, the Commission has announced its readiness to make a limited number of new UHF assignments where no conflicts are involved, and where applicants are ready and able to proceed with new UHF construction. A few new assignments have already been made on this basis, principally for noncommercial educational stations.

Field-Strength Curves for TV

In accordance with recommendations by the Industry-Government Committee for the Full Development of All-Channel Broadcasting (CAB) (see April Bulletin), the Commission's staff is preparing new curves of field strength vs distance for use in the television bands. Although CAB recommended adopting the new curves for UHF only, the Commission's staff is also considering possible changes in the VHF curves as well. The proposed new curves are expected to be released this fall or winter, with invitations to all interested parties to comment on the proposed changes.

Community-Antenna Microwave Service

The Commission has proposed a new assignment of microwave channels for use by CATV systems. At the present time, no microwave relay channels are reserved specifically for CATV use, but most CATV relay systems employ channels in either the 6 gc band or the developmental microwave relay channels in the 12-13 gc band.

Under the Commission's new proposal, the frequency band 12.7-12.95 gc would be reserved for CATV. Channel widths of 12.5 mc are proposed. This would provide 20 channels in the assigned band, permitting up to 10 channels on an alternate-channel basis over a single route.

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In addition to these assignments, common carriers would be permitted to provide CATV relay service on specified channels in the bands 5.925-6.425 gc and 10.7-11.7 gc. The 6 gc common-carrier assignments are intended only for long-haul circuits, involving distances of 400 miles or more, in instances where the higher band could not be used.

FCC Punishes Failure to Respond

The Commission has served notice that it means business in connection with enforcement of its technical and other regulations. As reported in the August Bulletin, the Commission in recent weeks has levied an increasing number of fines for repeated and willful violations of the Rules and Technical Standards. These fines, however, have ordinarily been imposed only on licensees who have been guilty of serious infractions of the Commission's regulations.

The Commission says now it intends to employ Notices of Apparent Liability (fines) when responses are not received in reply to Official Violation Notices issued by the Commission's field offices. Prompt response to official notices, within the time limit set, will avoid the risk of incurring these penalties.

IEEE Broadcasting Symposium

The annual Fall symposium of the Professional Group on Broadcasting of the IEEE is scheduled as a two-and-a-half-day session at the Willard Hotel in Washington from September 24 through 26. Highlights include papers on video practices; AM, FM, and TV transmitter operations; and audio systems. Field trips and papers are planned on the technical highlights of the Bell System "Picturephone" (see page 13 of July issue) and the USIA video center. Attendance is open to nonmembers as well as members.

Howard T. Head...in Washington

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MICROGROOVE MODIFICATION OF A DISC LATHE

by John D. Harmer, President and Chief Engineer, Capital City Sound Recording Co., Columbus, Ohio—
Application of this conversion will allow microgroove recording with the popular Presto standard-groove machine.

Data presented in this article permit modification of standard-groove Presto disc recorders to microgroove feed-pitch specifications. Twenty-four pitches in the range of 83 to 302 lines per inch are obtained by adding an auxiliary drive train that uses two belt-coupled, step-pulley transmissions to drive the standard 112 lines-per-inch leadscrew. Construction of the additional drive train (mounted behind the existing carriage) is simplified through the use of components obtained from an old Presto Model 6N or similar overhead assembly. Thus, fabrication of new parts is held to a minimum.

Probable sources for the used overhead units (Models 6B, 6N, and 8N are all suitable) are: Boynton Studio, 295 Main Street, Tuckahoe, N. Y., to the attention of Mr. J. W. Boynton; and Herbach and Rademan, Inc., 1204 Arch Street, Philadelphia 7, Pa. The modified carriage permits cutting at the standard groove rate (90 to 115 lines per inch) as well as the microgroove rate (150 to 300 lines per inch).

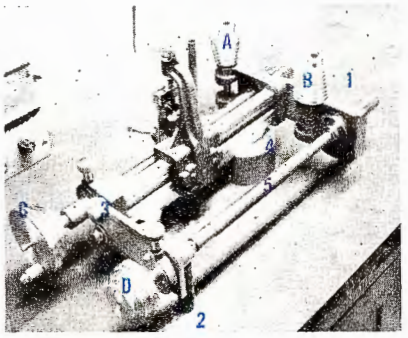

Fig. 1. The modified overhead assembly.

An earlier, similar modification engineered by Mr. C. W. French furnished the basic information for this simplified approach. Conversions in use at the Boyd Recording Service of Dallas, Texas supplied additional data.

Examination of the completed assembly shown in Fig. 1 will provide a general understanding of the modification. The two castings that were cut from the old 6N overhead can be seen at points 1 and 2. Note that the worm-gear drive has been removed from the original frame and retained in the added outboard assembly. The flat brackets used to support the rear drive castings are shown at points 3 and 4. The rear shaft (Fig. 1, point 5) is an unused leadscrew, but can, of course, be made from any suitable material (brass or steel, etc.). The configuration of the ratchet-gear hub is such, however, that an old or surplus leadscrew provides the simplest means of driving the outboard pulley. Leadscrews may be obtained from either of the two sources mentioned earlier.

The flange-driven shaft that held the original worm gear is too short to accept the setscrew in the collar of the front 8-step pulley (A), and must be replaced. The old shaft is removed from the driving flange, and a new ⅜″ shaft 6-5/16″ long is pressed into the flange hub and drilled to receive the turntable center spindle. The two 3-step pulleys (Fig. 2) and the two 8-step pulleys are machined from solid brass stock, and the two rear frame support brackets are cut from ¼″ brass plate. Rear castings 1 and 2 (Fig. 1) are cut from the used Presto 6N assembly—a hacksaw does the job nicely—and filed smooth for a better appearance.

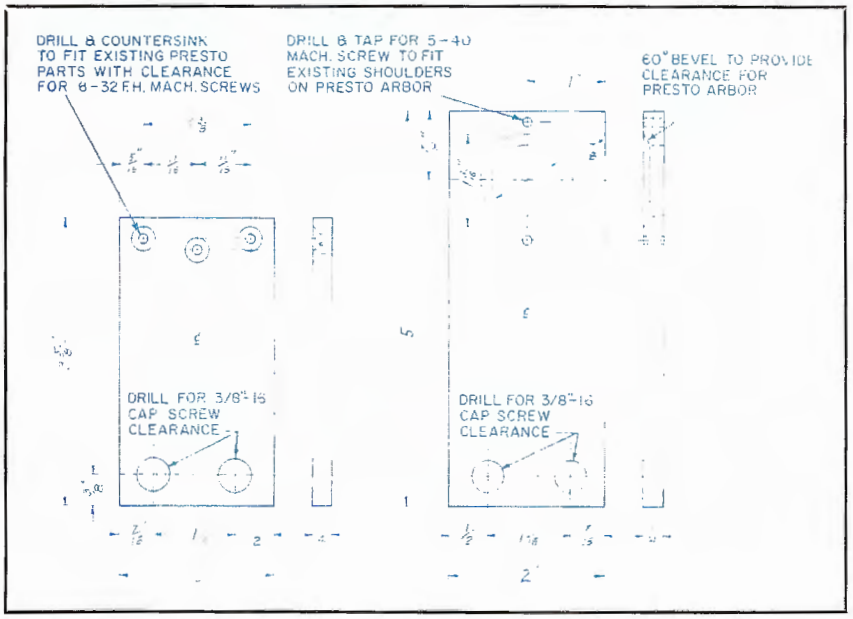

Fig. 2. Dimensional plan view drawings of the inboard and outboard support brackets.

Assembly

Assembly of the modified carriage is best accomplished with the entire overhead removed from its support brackets. The handwheel and worm-gear unit of the original leadscrew drive are removed; the crankpin from the handwheel should be retained for later use in the larger 3-step pulley (Fig. 3). The two flat support brackets are mounted by

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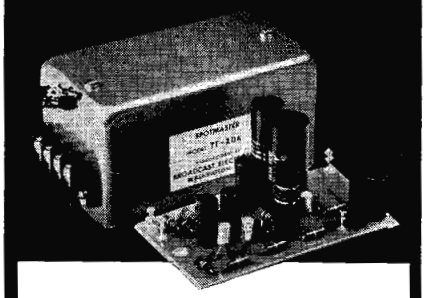

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means of the ⅜"-16 cap screws that hold the main carriage together; each mounts on the outer face of its respective original casting. Select the worm - gear unit with the smoother action, and mount the gears in the rear drive casing; then mount the casting to the support bracket using three flat-head 6-32 machine screws. The stub shaft on which the worm is mounted is long enough (with the flange removed, of course) to receive 8-step pulley B. As described earlier, the original flange-driven shaft is replaced with the longer one in order to accept 8-step pulley A.

Care must be taken to center accurately the hole that must be drilled in the lower end of the shaft to receive the turntable spindle. Mate the rear driveshaft and outboard casting, and mount the casting to the support bracket with two 5-40 machine screws (see outboard bracket drawing in Fig. 2). Three-step pulley D (Fig. 1) is pressed onto the 3/16" shaft at the outer end of the rear driveshaft. Pulley C is fastened, in the same manner, to the outer end of the leadscrew after the entire assembly is remounted on the turntable pivotal support.

Operation

Table 1 outlines the available pitches (lines per inch) as determined by the position of the O-ring belts on the 8-step and 3-step pulleys. The single belt (for 8-step drive) is a Parker O-ring, part No. 2-246, N-219-7, or equivalent, while the double belts (for 3-step drive) are each Parker part No. 2-254, N-219-7, or equivalent. Dimensionally, the single belt is of ⅛" cross section and 4¾" OD; the double belts are each of ⅛" cross section and 5¾" OD.

An additional modification of the original assembly was the replacement of the original Presto 1D cutter head with a Gotham-Grampian Model D system.

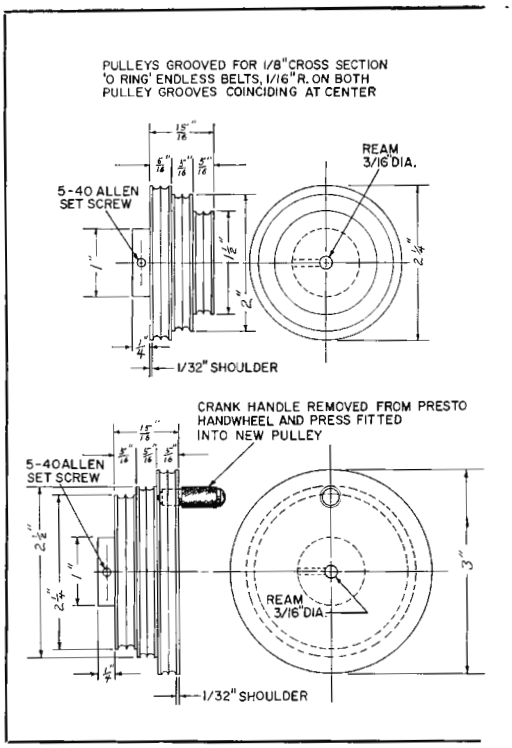

Fig. 3. Two views of the three-step pulleys.

The converted machine described here has given more than two years of excellent and trouble-free service at Capital City Recording Studios, Columbus, Ohio, where it is used to record masters in both 45 rpm and 33⅓ rpm formats. ▲

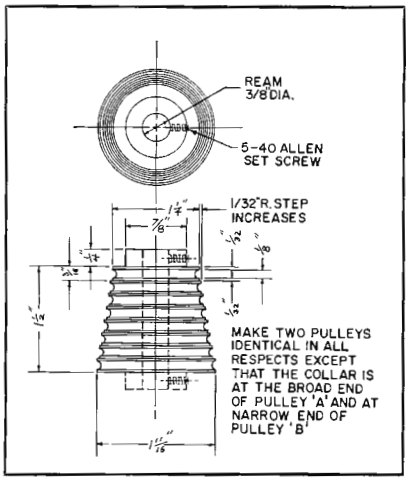

Fig. 4. A view of the eight-step pulleys.

Table 1. Changes of Belt Positions on the Pulleys for Various Recording Pitches.

8-Step Belt Position	3-Step Belt Position 1::1 (inside)	1::1.25 (middle)	1::2 (outside)
1 (upper)	82.88	103.60	165.76
2	90.50	113.12	180.99
3	98.56	123.20	197.12
4	110.66	138.31	221.31
5	123.65	154.56	247.30
6	128.02	160.02	256.03
7	138.66	173.31	277.31
8 (lower)	151.20	188.00	302.40

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Differential Gain	Less than 0.1db, 10-90% APL
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Preview of the AES 16th Fall Convention

The Sixteenth Annual Fall Convention of the Audio Engineering Society will be held at the Barbizon-Plaza Hotel in New York City on October 12 through 16. The society, we're told, expects record-breaking attendance based on a significant increase in membership during recent months.

The 13 technical sessions are to feature papers of interest to specialists in the various phases of the art, including disc and tape recording-reproduction, sound reinforcement, and broadcast-oriented audio, as well as many subjects of general appeal. Among the papers scheduled will be a group on **Audio and Man,** which is to present significant contributions by Harry F. Olson of RCA Laboratories, W. D. Ward of the University of Minnesota, and others, as well as a talk by an internationally known musician. During the **Consoles and Controls** session, six papers will be given, describing design and application of audio boards and mixers from several aspects. On Thursday, the 15th, a session on **Solid-State FM Stereo** will hear seven papers regarding semiconductor techniques in stereo reception based on multiplex transmission characteristics. As a special bonus, arrangements are being made for interested members and guests to be guided on a tour of the audio centers at the New York World's Fair. Climaxing the Convention will be the Awards Banquet on Thursday evening.

All demonstrations at the Engineers' Show of Professional Equipment will be silent to avoid confusion in the exhibit area. Several manufacturers and suppliers of audio components and materials will be represented in the displays.

TECHNICAL SESSION PAPERS ON BROADCAST AND RECORDING SUBJECTS

Below are abstracts of papers selected from those to be presented during the Technical Sessions of the 16th AES Fall Conference. While a number of the others are also of interest, space limitations have restricted our coverage to the following papers which are devoted to the fields of broadcasting and recording.

Microphones and Earphones

Considerations in the Design of a New Studio Boom Microphone, R. W. Carr and C. E. Seeler, Shure Brothers, Inc. Television and motion-picture use of boom microphones poses a peculiar set of design problems. While some have received considerable attention, others equally as important in attaining a consistently good sound track have been insufficiently recognized. Some unique approaches will be discussed.

The Use of Noise Cancellation in Modern Telephone Practice and Design, Gaston A. Marchand, Roanwell Corp. This paper discusses the definition of noise cancellation within the different methods of noise discrimination, the principal design considerations to obtain it, and the methods of evaluating the efficiency of the equipment.

Architectural Acoustics

The Balance Between Reverberant and Early Sound in a Concert Hall, T. J. Schultz, Bolt Beranek and Newman, Inc. In halls for speech, the sound arriving first provides the intelligibility; later reverberant speech energy is like background noise. For symphonic music, the tolerable range of balance between reverberant and early energy is narrow. Careful listening indicates that this parameter can range from over-definition and dryness to over-blendedness or muddiness of music. In addition, laboratory tests show that removing low frequencies from the direct sound does not degrade the quality of music, once the required balance of reverberant-to-early sound is achieved.

Sound Induced Vibration of Walls, Partions, and Windows, A. R. Soffel, The Bissett-Berman Corp. The walls, partitions, and windows of a building vibrate in direct response to sound waves impinging upon them; the sound may come from within or without. The vibrational response of such structures can be calculated and measured. Two methods of estimating sound-induced panel vibration are developed.

Sound Reinforcement

The "Anavac"—Ambient - Noise - Automatic-Volume-Adjustment-Control, Abraham B. Cohen, Executone, Inc. A system has been built and demonstrated that provides complete electronic automatic control of transmitted audio signals in a rigorous analytical relationship to the ambient noise in the area to be served without the use of relays and stepped fixed pads. The noise sensing is accomplished without the aid of sensing microphones, and there is provided an ideal one-to-one relationship between the noise sensed in an area and the sound reproduced in the same area.

Audio Techniques for a Business Video Conference System, Steven H. Harrison, Bankers Trust Co., Methods Research Dept. Unorthodox methods are needed to achieve an environment suitable for business conferences. This paper describes a successful system employing fixed unobtrusive elements in familiar office surroundings. An unusual gain-shifting technique eliminates singing and talker echo in the two-way voice channels, while avoiding excessive lockout or clipping. Good stereo levels are thus attained without resorting to disturbingly close microphones.

Disc Recording and Reproducing

The New Haeco Stereodisc Cutting System, Howard S. Holzer, Holzer Audio Engineering Co. The author will describe a unique type of stereocutter with associated driver systems. Emphasis will be on cost reduction, ruggedness and dependability, and basic simplicity in design.

An Improved Disc For Master Recording, John E. Jackson, Audio Devices, Inc. An improved master recording disc is being produced; the erratic quality heretofore common to lacquer discs has been eliminated. Presented is a description of

AES 16th ANNUAL FALL CONVENTION

Registration — Mezzanine, Hotel Barbizon-Plaza, Oct. 12 through Oct. 16, 1964

Technical Sessions
(Hotel Theater)

Monday, Oct. 12
9:00 AM — Annual Business Meeting
9:30 AM — Microphones and Earphones
1:30 PM — Architectural Acoustics
7:30 PM — Sound Reinforcement

Tuesday, Oct. 13
9:30 AM — Disc Recording/Reproduction
1:30 PM — Magnetic Recording/Reproduction
7:30 PM — Consoles and Controls

Wednesday, Oct. 14
9:30 AM — Music and Electronics
1:30 PM — Speech Processing
7:30 PM — Audio and Man

Thursday, Oct. 15
9:30 AM — Audio Amplification
1:30 PM — Solid-State FM Stereo
6:00 PM — Social Hour
7:00 PM — Annual Banquet, Presentation of Awards

Friday, Oct. 16
9:30 AM — Loudspeakers
1:30 PM — Audio at the New York World's Fair
9:00 PM — Visit to World's Fair Audio Centers

Audio Engineers' Exhibition
(Exhibit Hours)

Oct. 13 and 14 — Noon to 6:45 PM
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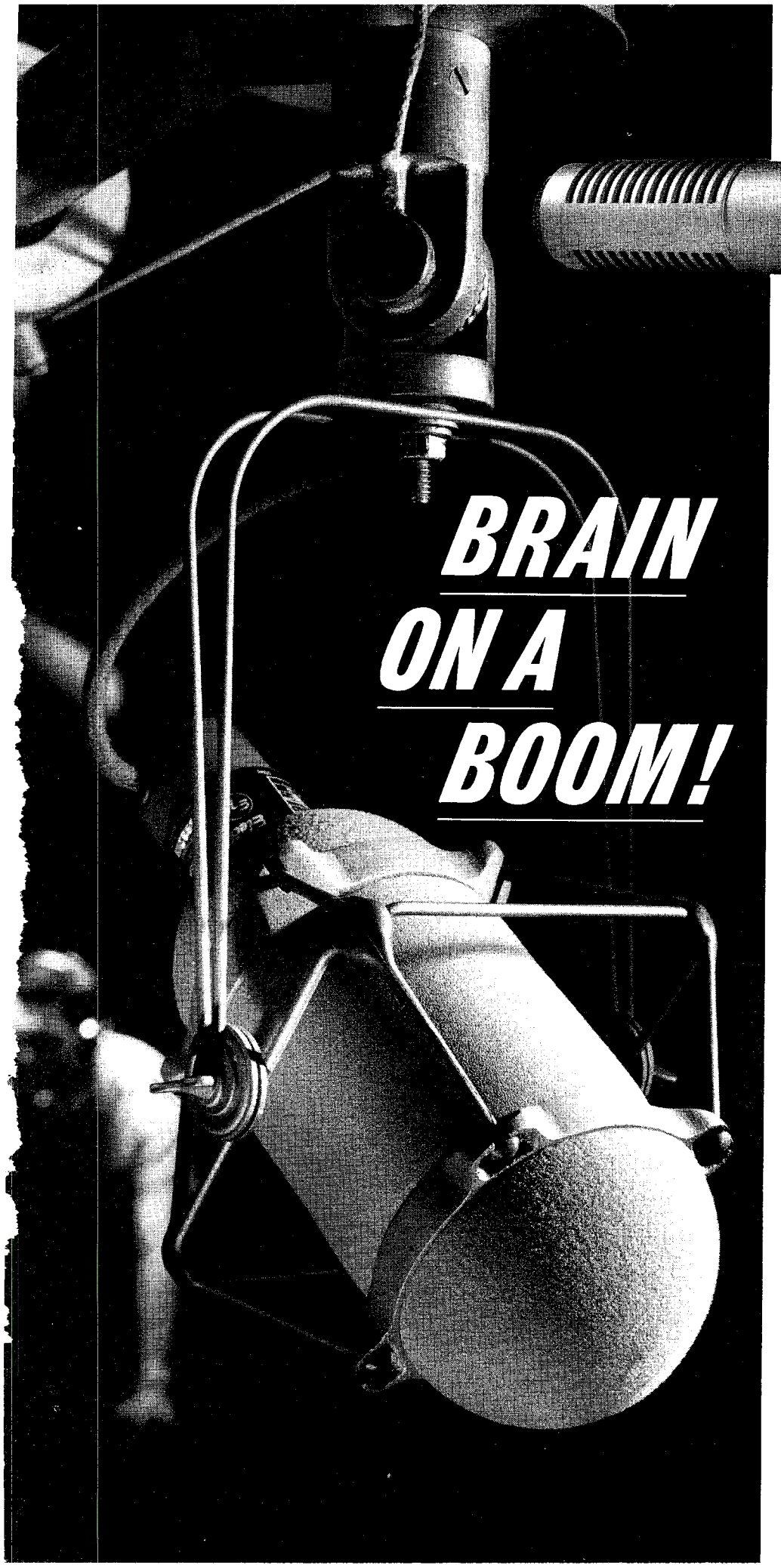

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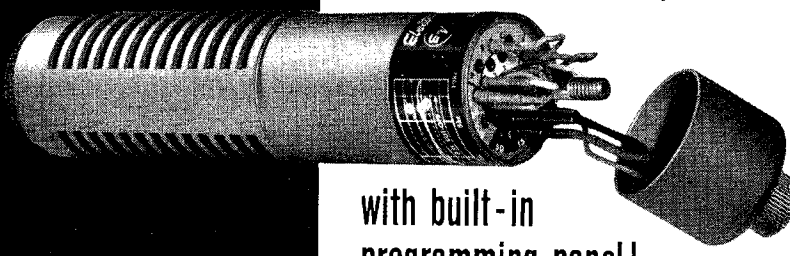

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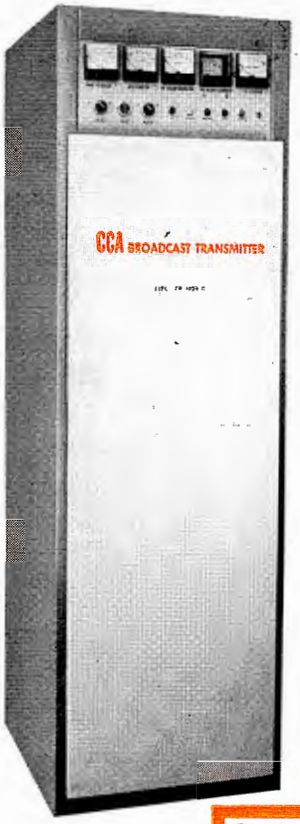

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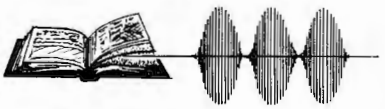
BOOK REVIEWS



The Oscilloscope, second edition; George Zwick, Gernsback Library, Inc., New York, N. Y.; 224 pages, $3.65. Many books have been written about test equipment, operation and applications, some too basic for wide appeal and some lacking enough practical information to be initially valuable to the less-experienced technician. To properly familiarize the reader with the use of an instrument, a manual must provide him with a good working knowledge of what goes on behind the control panel. The Oscilloscope is based on this premise.

Pointing out that, unlike most other test instruments, an oscilloscope depends to a great extent on the operator's ability to properly set up a test and interpret the results, the author first lays a solid groundwork of scope-circuit functions and then explains techniques and usage. In the first chapter, the basic function of the cathode-ray-tube device is set forth; the nature of waveforms and their properties are discussed. Next, the cathode ray tube is analyzed, as are the means of controlling the electron beam. The next two chapters explain sweep systems, the makeup of typical scopes, and the differences between instruments for various applications.

With equipment familiarity thus established, the remainder of the book discusses techniques particular to the oscilloscope, measurements and tests, methods of alignment employing a scope, and experimental procedures which can help the operator become comfortable with the external oscilloscope features and interpretation of the scope indications. Not an encyclopedia, but a clearly written instruction manual, this book will be studied before and referred to many times **after** your scope is put into use.

North American Radio-TV Station Guide, 1964 edition: Vane A. Jones, Howard W. Sams & Co., Inc., Indianapolis, Ind.; 128 pages, $1.95. A handy reference to the radio and television stations of North America, this book is brought up to date at each printing. The present version lists more than 7,500 stations by city, state, frequency, and call letters. Thirteen maps indicate the locations of TV stations in the 12 VHF bands, plus UHF stations both operating and yet to go on the air. A coding system gives information on the stations including frequency, time of operation, antenna height, and power.

manufacturing techniques, quality control procedures, and comparative test data against outdated discs.

Design and Use of Recording Styli, Richard Marcucci, Capps & Co., Inc. The art and science involved in the design and use of recording styli, a new type of stylus, and the need for custom-made styli will be described. The recording stylus will be examined as the linkage between the cutterhead and record. Frequency response as a function of stylus geometry and cutterhead performance will be discussed.

Measurement of Vertical Recorded Angle in Stereodisc Recording, Daniel H. T. Ong, R. C. Moyer, and H. D. Ward, RCA. Two techniques have been proposed: to find the minimum in first-order intermodulation sidebands, and to find the minimum in the second harmonic distortion of a vertically-recorded sine wave. Of the two, the former yields a much more accurate measure. The second-harmonic-distortion technique can give misleading results because of the sensitivity of the apparent vertical recorded angle to small percentages of distortion in the driving-coil current of the stereo cutterhead. (However, a new technique by which such inaccuracies can be eliminated is outlined.)

Magnetic Recording and Reproducing

The Measurement and Minimization of Print-Through of Magnetic Sound Recording Tape, Edward P. Koeppe, RCA Victor Record Div. Print-through of magnetic sound-recording tape is affected by storage time, temperature, time between record and playback, external magnetic fields, the magnetic properties of the oxide, and many other factors. The recording process of magnetic print-through, methods of measurement, and minimization of the printed signal are discussed.

Precision Performance Measurements Of A New Sound Recording Tape, Joseph Kempler, Audio Devices, Inc. Lack of standards and clear definitions make precise, repeatable performance tests on magnetic tape difficult. Typical problems and practical techniques for precise evaluation of sound tapes are described.

Design Considerations For Short-Term Audio Recording On Flexible Magnetic Discs, Erling P. Skov and Charles Vogel, Ampex Corp. Electrical and mechanical design considerations for a spiral-scanning, short-term (3 min.) audio recorder are discussed. Among them are wow and flutter, head wear, tape wrap, head stability, head tracking, dropouts, thermal and humidity characteristics of the media, crosstalk, and equalization.

Noise Limitations In Tape Reproducers, Erling P. Skov, Ampex Corp. Expressions for thermal noise in mixed resistance and reactive circuits are derived and applied to tape heads. The relationship between head thermal noise and amplifier shot noise, and the relationship between resistor noise index and the crossover frequency between thermal and 1/f noise are discussed.

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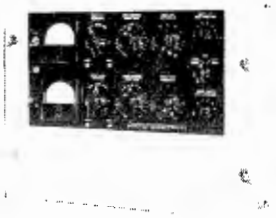

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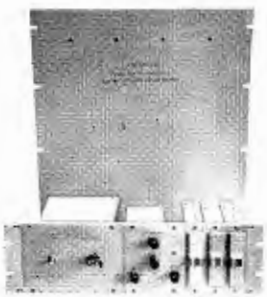

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Advanced Tape Mastering System — Mechanical Features, Kenneth Clunis, Minnesota Mining & Mfg. Co. Described is a tape transport which incorporates unusual features of design. Among these are a closed-loop drive with differential capstan resulting in significantly reduced flutter in the overall band from .5 to 5000 cps, gentle tape handling, easy threading, and more efficient editing.

An Improved Brake System For Tape Transports, Arthur E. Gruber, Scully Recording Instrument Corp. A disc-brake system for magnetic tape recorders is described. Shown is a novel method of obtaining relative reel-to-reel brake differential, while minimizing tape stretch when stopping, through logic circuits.

Consoles and Controls

Photoconductors For Sound-System Control, Robert C. Coffeen, Swanson Engineering and Mfg. Co. A discussion of the use of photoconductive cells for noiseless audio-signal switching, audio-signal level control, remote-amplifier gain and tone control, and control logic.

Essentials of Transmission Practice Pertaining to Stereo Console Design, Arthur C. Davis, Altec Lansing Corp. The following essentials will be discussed: grounding and ground loops, isolation (transformers where needed), mixer circuits, impedance matching and loading, phasing, gain and power handling, balanced and unbalanced circuitry.

Audio Program Mixing Systems, John P. Jarvis, Langevin Div. of Sonotec, Inc. Brief discussion of some aspects of audio control and program-mixing systems, with consideration given to: classical procedures and departures from them, stereophonic-channel separation, reverberation control, equalization, noise, and effects of switching.

Custom Studio Recording Console, William G. Dilley. A functional audio console utilizing both tube and solid-state design is described. Designed specifically for one-engineer studio operation, this unit provides a capability of 13 positions for one-, two-, or three-channel recording with remote control.

Audio Amplification

A Solid-State Amplifier With Current-Generator Drive for Magnetic Tape Heads. Richard Sieron, Chester Electronic Laboratories, Inc. Solid-state record amplifiers presently available for magnetic tape heads drive the head with a voltage generator and, accordingly, require involved passive-equalization circuitry to achieve a flat frequency response. This paper describes a technique whereby the head is driven directly by a current generator and equalization is accomplished actively with feedback.

Noise Considerations in Low-Level, High-Input-Impedance Transistor Amplifiers, David B. Jepson, Ampex Corp. Definition of noise figure, why it is useful, and how to use it with transistors. Transistor noise figure vs. generator impedance, frequency, and operating parameters. Design of high-input-impedance, low-noise amplifiers will be discussed. ▲

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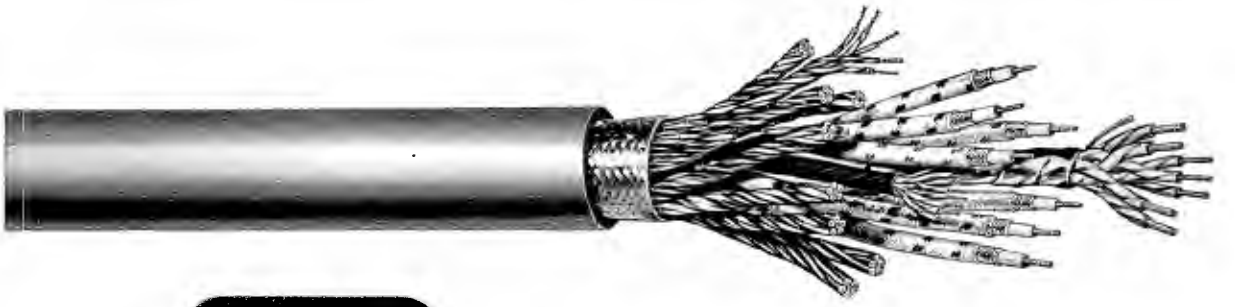

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DE-ICE CONTROL OF BROADCAST ANTENNAS

by *Patrick S. Finnegan,* Consulting Author, Chief Engineer, WLBC AM-TV, WMUN FM—An examination of the unfavorable effects of antenna icing, and a brief discussion of several practical solutions.

One of the facts that broadcasters must acknowledge is that many areas of the country experience icing conditions during the winter months. Even in areas where the climate is mild, many stations have antennas located on high mountains where conditions are far different from those at lower elevations. So, where icing conditions exist, steps must be taken to combat them.

Ice formations affect antennas physically as well as electrically. An obvious physical danger is the additional weight of the ice, but perhaps the primary threat comes in the form of increased windloading. Structural members are increased in surface area because of ice buildup (Fig. 1). Successful design of antennas and towers takes into consideration a certain amount of icing based on predictable average conditions, but should icing continue for several days or weeks stresses can increase to dangerous proportions, especially if high winds develop. Failure to anticipate extreme conditions may have serious consequences. It is also possible that a tower may have become overloaded by the addition of microwave reflectors or a change to a heavier antenna system. If it was not originally designed to support the increased total weight, heavy icing and high winds can combine to collapse the entire structure.

The second major factor to be considered under icing conditions is electrical. Most antennas are designed to tolerate some icing without ill effects, but a heavy buildup can create many difficult problems.

The increase in standing-wave voltages reduces the system's efficiency and consequently its radiated energy. Distortion of the normal horizontal or vertical pattern results in reduced coverage of the station's service area. Other undesirable effects of an excessive VSWR include: deterioration or cancellation of high-frequency signal components because of unwanted phase shifts; flashovers, burned connectors, and charred insulators; and an unstable reactive load reflected into the output stage of the transmitter. This reactive element makes it impossible to resonate the stage properly, and instability results. High plate currents and poor efficiency, both caused by detuning, will cause additional RF power to be dissipated in the final tube, often exceeding its ratings. A damaged or destroyed tube can easily result.

Recognizing the Problem

Since temperatures at ground level are usually warmer than at increased elevations, moisture may be freezing on the tower and antenna when ground temperatures are

Fig. 1. A heavily-iced tower with fiberglass-covered FM antenna.

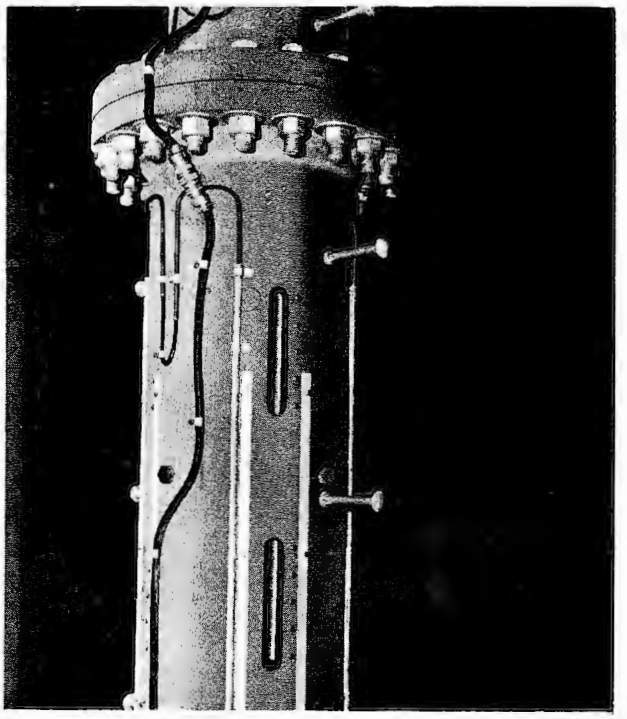

Fig. 2. A slotted UHF TV antenna with external heating elements.

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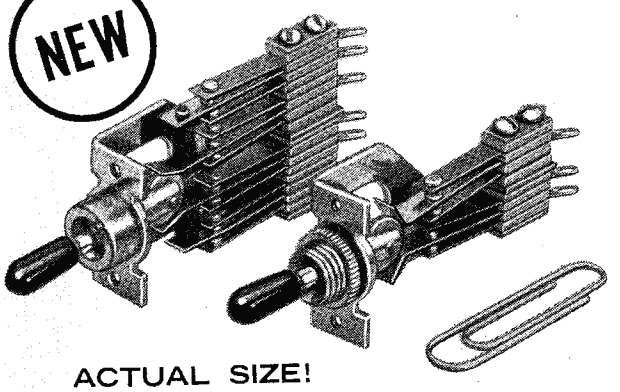

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well above 32°. Furthermore, because a metal structure resists temperature change, the entire system may be cold enough to freeze rain or condensed moisture even though the air has warmed considerably.

In the transmitter room or control position the first sign of excessive ice will usually be erratic meter readings. The efficiency of the final stage will decrease, and accurate tuning will become difficult. The line monitor will indicate a rise in VSWR. TV transmitters additionally develop ghosting in the video signal which usually gets progressively worse. Problems of instability are of course doubled because the picture and sound transmitters are both affected.

Ice Control Methods and Equipment

Deicing equipment is available for all TV and FM antennas. Some units must be factory installed in the field. Systems fall into two general classes. The first either heats the metal of the antenna by direct contact or heats the air within the antenna tubing. The second feeds a low AC voltage through the antenna itself at high current levels in much the same manner as do the popular soldering guns which use a wire tip.

FM antennas usually have a flexible heating element inserted into the antenna tubing so the whole structure is heated. Since the heaters are outside the RF field, they don't adversely affect the antenna pattern. Voltage reaching elements generates sufficient heat to melt the ice or prevent it from forming if the heaters are turned on before icing can develop.

TV antennas come in several shapes and styles, and so do their deicing systems. In the VHF batwing antenna, for example, heater units are installed through the bottom of the vertical support section; the air which circulates through the tubing is then heated by convection. The traveling-wave antenna and some of the slotted UHF antennas use heating units bolted directly to the outside of the steel cylinder (See Fig. 2). These heaters are usually insulated to minimize direct heat loss. Heating of the steel cylinder is by conduction through direct contact. Other slotted UHF antennas use a heating unit inside the base of the outside cylinder; the inside air is warmed by convection currents rising within the cylinder.

VHF and UHF helix and UHF zig-zag antennas both use the direct heating method. A heavy-duty transformer mounted on the tower just below the antenna feeds power directly through the antenna itself, so the resistance of the structure generates enough heat to keep it free from ice.

All heating units may be turned on and off manually from the ground, and automatic controls are available to apply heat as conditions require. The most common type uses two thermostatic controls mounted on the tower at antenna base—one to sense falling temperatures and the other to sense rising temperatures. Because icing generally occurs only in the rather narrow approximate temperature range of 27° to 35° F, the sensors activate the system only in that range. As the air temperature falls to approximately 35°, the falling temperature sensor will turn the heaters on. Then, as the temperature continues to fall past the critical icing point, the thermostat will turn the heaters off at

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approximately 25°. When the air temperature rises, the rising temperature sensor will actuate the heaters at about 27°. The heaters remain on until the temperature rises past 35°, at which time the sensor turns the heaters off. The sensors may be adjusted to suit particular climatic conditions.

Convection- or conduction-heating units as described will prove satisfactory for most conditions; but where very severe icing is common during many months of the year, as at moutaintop locations, the whole antenna is sometimes completely enclosed in a fiberglass radome.

Manual Ice Removal

Because of the size and complexity of their antenna installations, AM stations have no deicers available to ease the problem. Steps may be taken, however, to alleviate the situation somewhat. Ice may be gently chipped away from the base insulator, the feedthrough insulators, and the lightning-discharge ball gaps. On guyed towers, ice should be gently removed from the first insulator of each guy wire.

When FM or TV stations have no deicers, certain precautions should be taken to avoid damage to the antenna, transmission line, or output tubes. Transmitter power should be reduced to protect the final stage and transmission line. **For a simple rule-of-thumb to determine maximum advisable power under icing conditions, divide the rating of the line or antenna by the VSWR.** This will give a suitably reduced rating for the new conditions. On a line rated at 10 kw operating with a VSWR of 1.2/1, for example, 10 kw divided by 1.2 will give 8.3 kw, the adjusted maximum power that should be fed into the line while icing persists.

Without deicers on complex high-frequency arrays, there is nothing that can be done about the ice except to hope it soon melts. This involuntary procedure is slow because ice will often remain a day or so after air temperatures have risen above freezing.

A thaw presents new hazards because ice will fall from the tower in large chunks which can do much damage. Wind can scatter the falling ice over a large area possibly damaging the transmission line, the roof of the building, or automobiles. Personnel can also be severely injured.

Operating Reminders

With manually-operated deicers, current should be turned on before actual icing conditions occur, especially if ice or sleet is forecast.

Remember, too, that turning the heaters on does not mean they are operating properly. During the annual tower inspection, therefore, it is a good idea to have the maintenance technician inspect the heaters for proper operation while he is on the tower. Quite often individual heaters will burn out leaving a section of the antenna unprotected. Burned-out sections should be replaced before winter.

While this article has held to general comment rather than to suggest specific installation or construction data, station engineers may now be motivated to re-examine their own potential icing problems before cold weather brings them major headaches. ▲

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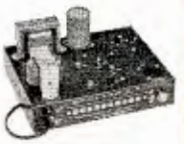

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Altec Lansing Corporation

SUPERIOR NEW INSTRUMENT SWITCHES AND ATTENUATORS

It's no longer a secret that our Audio Controls Division at Altec is well on the way to producing what we feel will be the best instrument switches and attenuators ever made specifically for the recording and broadcast industries. Without wishing to detract from my own three decades as a design engineer and manufacturer in this field, nor from the superb facilities available to me at Altec, I must admit that much of the credit goes to the fact that we are starting from scratch on all of our designs. Frankly, this is an engineer's dream—no preconceived ideas, no old designs that have to be adapted, no existing tooling that has to be used. Our only concern is the here and now, and how can we make it better.

LOW NOISE, LOW MAINTENANCE, LONG LIFE

Looks like our switches and attenuators will give you the best set of performance specifications ever available. Here are a few of the things we've done to achieve this superiority: Each brush blade is independently sprung to provide contact all the time. We predict a total absence of contact bounce. The brush springs are completely out of the circuit and will carry no current. Our brushes are made of fine silver ("coin" silver, normally used, contains copper and is subject to oxidation which reduces conductivity and raises noise level among other things). The fine silver does not oxidize—it sulfides. This has two advantages: conductivity is not affected and sulphide of silver has a lubricative quality which is actually beneficial.

MORE INNOVATIONS

As you know, most switches come in round cans. We're putting ours in square ones. You don't have any use for the space around the can anyway so we're using the corners for the wiring. The result is that our switches will give you more positions in less space. For example, most switches have 12 positions at the most. Ours have 31 positions on a 1½" switch and up to 45 positions on the 2¼" one.

To cap the whole thing off, we'll be able to gang up to 8 of our attenuators in tandem so you can operate the whole works with just one control.

NEW SOLID STATE 470A PREAMP NEARLY READY

We announced this device in our last "Studio Talk." It's the one you can use as a preamp or as a line, booster, or program amp with no internal changes needed. By the way, the 470A has a lower noise level than any vacuum tube unit on the market.

And by the time you read this, our 61A Program Equalizer and 62A Graphic Equalizer will be in full production. So give me a call or drop me a line. I'll be happy to send you the latest information on what's here now and what's coming soon.

Art Davis

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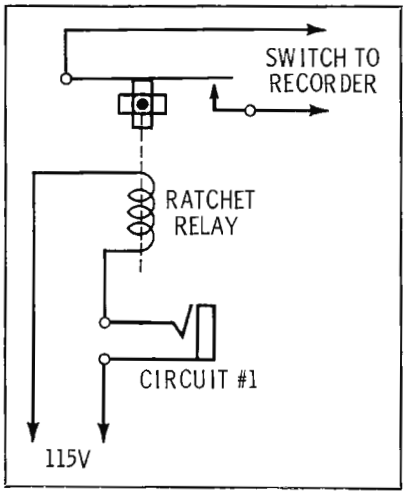
ENGINEERS' EXCHANGE



Recording Clock

by Marshall S. Macy, KASL, Newcastle, Wyoming

The original idea of Mr. Snider (page 22, December 1963) attracted our attention because we had been wanting just such a system; and it happened that we knew of two discarded IBM master clocks containing the necessary parts. (Incidentally, IBM is apparently out of the clock business; we understand they have turned over patents, maintenance, and parts to the Simplex Time Recorder Co.).

We connected to ratchet relays two of the six available individual circuits in the time drum. The initial pulse of voltage from circuit 1 contacts will energize the first relay, thus starting a tape recorder. A time-comb is set up to open the relay so that the recorder will stop running at the desired time. Circuit 2 operates in the same manner, as may the remaining four. With this clock arrangement, a maximum of six recorders, lights, alarms, monitors, or other devices can be controlled.

The time-drum mechanism also closes a switch on the 59th minute of each hour. We employ this switch to control a precise time-tone pulse by running the time-drum one minute late and removing the necessary time-comb teeth to correct for the delay.

We now have a preset clock which can turn recorders on and off in one-minute intervals during any hour of the day or night; it can also skip any day or days. This system enables recordings to be made after normal station hours—and the finished tape is waiting for us the next morning.

Record Cleaners

Velveteen material cut into handy pads, 4" x 4" or a little larger, and water in a small squeeze container make an excellent record-cleaning kit. The pads can be washed as needed, and the whole works costs far less than any of the commercially available packages.

Al Ortmann, KURL

Auxiliary Cue Tone

by Richard R. Haskey, Consulting Radio Technician, Ventura, Calif.

Many stations are installing new automatic cartridge tape equipment

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which has facilities for recording an auxiliary cue tone, in addition to the normal stopping and recuing tone. In a number of cases this feature was purchased with the idea of a future need, but is presently going unused. Here is an idea that can make use of the provision with little or no cash outlay.

Connect the dry contacts operated by the auxiliary tone in series with a small lamp and an appropriate supply voltage to visually alert the announcer or board operator that a spot or promo is nearly over. This proves useful when an announcer plays a tape for the first time and is not sure when it will end, especially for weekend people not totally familiar with every cartridge. It is also quite handy to foretell the conclusion of a musical passage in the middle of a spot, where the announcer must read a live insert.

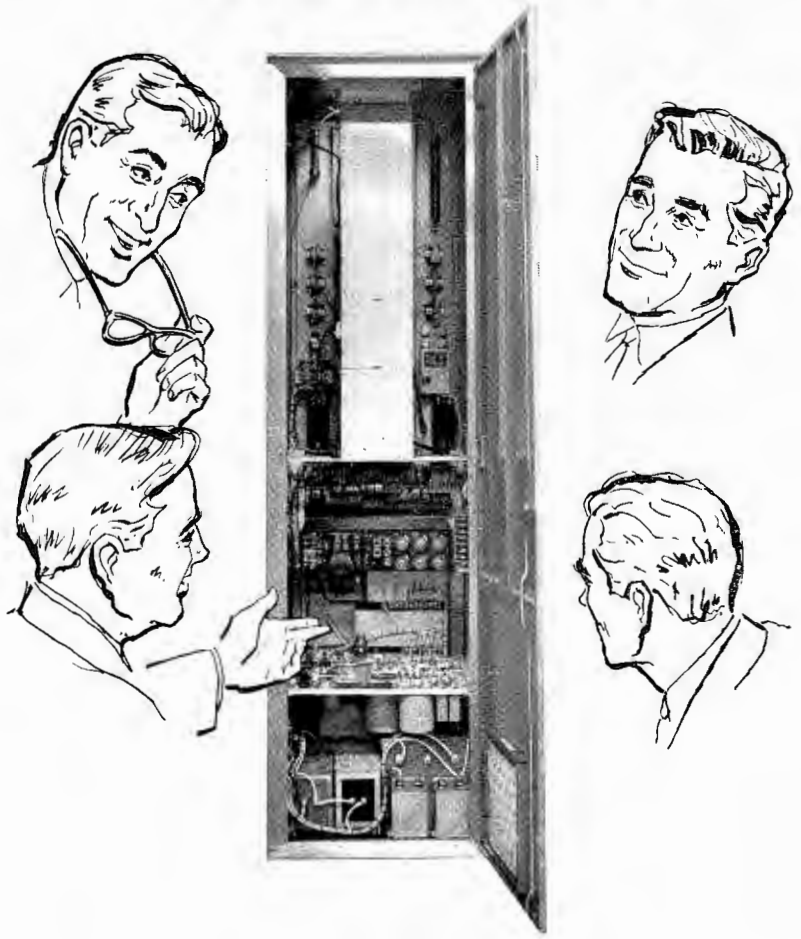
The production staff merely operates the tone-record button at a predetermined time prior to the conclusion of a recorded segment; 1½ to 2 seconds has been found to be about right, but will vary depending on whether the material ends abruptly or fades. With a little experimentation optimum placement of the visual cue will become apparent. In a tight, fast-moving operation many seconds of "dead air" can be eliminated for the cost of a pilot lamp and a few feet of wire—and most often the "junk box" will yield the parts. ▲

Using Audio Gear

Many stations have a distortion meter and an audio oscillator which are used about once a year for the FCC required proof. Why not mount this equipment on brackets in the control room, and take advantage of it! Wire the oscillator to a remote switch on the console and connect the distortion meter to the audio output of the modulation monitor. Then, it's a simple matter to train the board operator to make a spot check once weekly. As the operator notes readings in the log, a positive check on the operation is provided. If the readings vary too far from normal the chief engineer can investigate possible troubles. Thus, expensive test equipment is put to work profitably instead of staying on the workshop shelf and gathering a coat of dust.

Odes E. Robinson

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: **Sales Department**

rust corporation of america

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Cambridge, Mass.

Western Division
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Omaha, Nebraska

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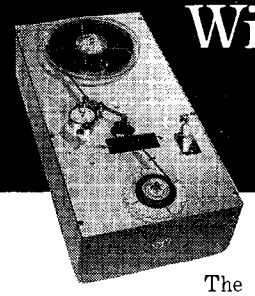
SPOTMASTER Tape Cartridge Winder



The new Model TP-1A is a rugged, dependable and field tested unit. It is easy to operate and fills a need in every station using cartridge equipment. Will handle *all* reel sizes. High speed winding at 22½" per second. Worn tape in old cartridges is easy to replace. New or old cartridges may be wound to any length. Tape Timer with minute and second calibration optional and extra. Installed on winder or available as accessory. TP-1A is $94.50, with Tape Timer $119.50.

Write or wire for complete details.

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Monitors for Stereo (Continued from page 11)

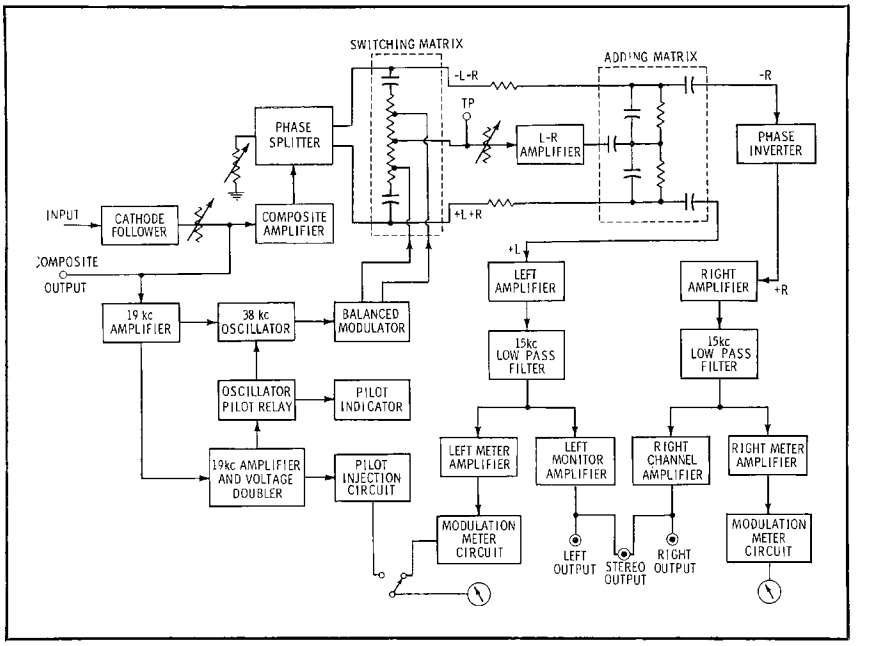

Fig. 4. Block diagram of stereo-channel monitor to be used with main-channel monitor.

grid of the 19-kc amplifier. In the plate circuit of this stage another 19-kc peaking coil further filters the signal, removing all other frequencies. Since the center tap of this plate coil is at AC ground, two signals (opposite in phase) appear at the ends. By means of two diodes serving as a full-wave rectifier, the signal is doubled to 38 kc and is used to sync the following stage, a push-pull 38-kc oscillator (Fig. 5).

The output of the composite amplifier is applied to the grid of a phase-splitter stage which produces signals 180° out of phase at plate and cathode. A control in the cathode circuit permits the signals to be matched in amplitude. The signals are applied to equal and opposite points in the switching matrix, the center of which appears as a test point and feeds the L-R amplifier through a phasing control.

The 38-kc oscillator output is transformer coupled to a balanced ring modulator (Fig. 5) which serves as a switch to alternately ground the two sections of the matrix at a 38-kc rate. The push-pull oscillator functions only when the pilot carrier is present; a relay circuit activated by a signal from the 19-kc amplifier completes the oscillator B+ circuit.

The action of the 38-kc switching pulses at the switching matrix develops L-R components at the grid of the next stage, the L-R amplifier. The amplified output is added to the —L—R and +L+R components from the phase splitter, to produce demodulated —R and +L at opposite sides of the adding matrix. The —R signal is fed to a phase inverter and then to the right-channel amplifier; the +L signal is applied directly to the input of the left amplifier.

The signal that corresponds to each channel is fed through a 15-kc low-pass filter to a meter amplifier and a program amplifier. The meter circuits contain feedback loops and corrective networks to produce the proper meter characteristics in compliance with FCC regulations; overshoot controls are provided to match the two meter circuits. The left meter can be switched to read either left-channel modulation or pilot injection. ▲

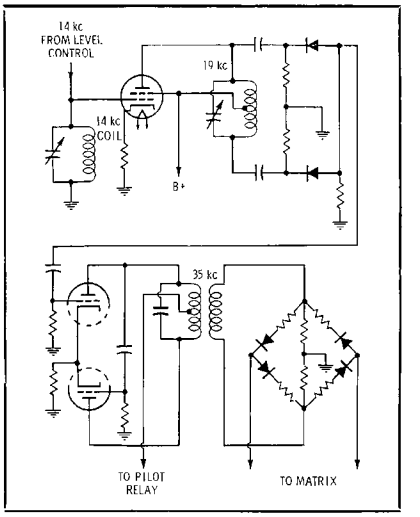

Fig. 5. Simplified circuit of 19-kc doubler, 38-kc oscillator, and balanced modulator.

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Adjustable T-Pad

(Continued from page 14)

rear of the cabinet solved this problem.

Total expense involved in building this transmission set was about $220 which, when compared to the cost of commercial models with equal features, is not expensive. ▲

Fixed T-Pad

Frequency—cps	Level—db
30	0
50	0
100	0
400	0
1,000	0
3,000	0
5,000	—0.3
7,500	—0.6
10,000	—1.0
12,000	—1.2
15,000	—1.5

facturer's instructions should be followed in selecting this resistor for each make of meter.

Since an audio oscillator is effectively a zero-impedance generator, a 600-ohm resistor is used ahead of the variable pad. This resistance may be considered to be the internal resistance of the generator.

A frequency response evaluation made on this particular test set gave the results listed in Table 2. The loss at the higher frequencies is believed to be due to the characteristics of the 119C repeat coil. Perhaps a more efficient transformer would give a better frequency response. If the loss at the higher frequencies in a transmission set is known, however, accurate measurements can be made by adjusting for the losses.

The components are mounted on a 7″ x 11½″ panel which is attached to a wooden cabinet 12½″ wide, 8″ high, and 5½″ deep. The handle on top is convenient for carrying, and rubber feet are used on the bottom of the cabinet and on the back to prevent scratching the desk or table during use. ▲

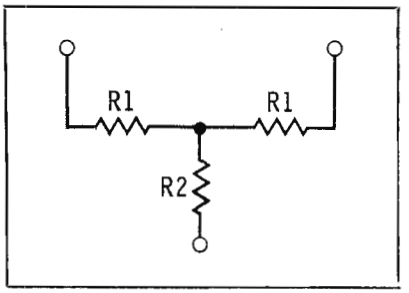

Fig. 5. Configurations of fixed T-pads.

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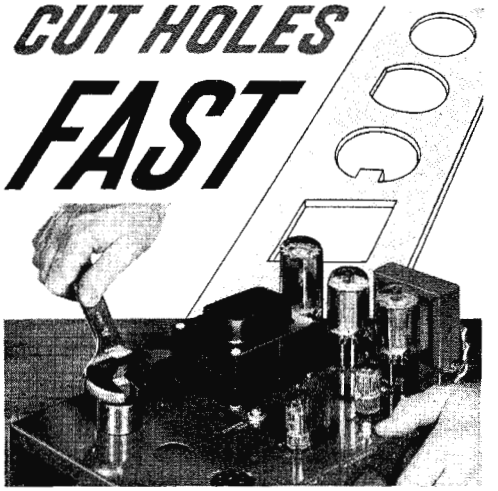

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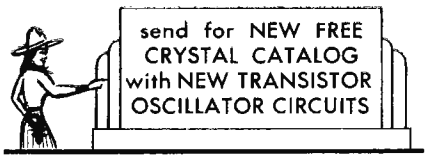

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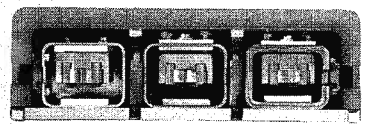
Three new Ampex head replacements



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AMPEX

Circle Item 31 on Tech Data Card

FM Multiplex

(Continued from page 13

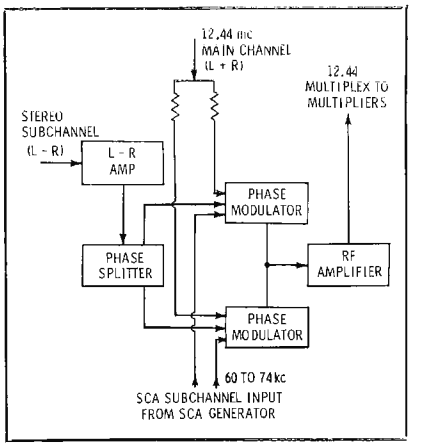
consists of the necessary audio amplifier stages and a phase-shift oscillator, the frequency of which is varied at the audio rate of the program material. While FCC rules stipulate that SCA subcarrier deviation may go as high as 7.5 kc, it is generally wise to limit it to ±5 kc for the following reasons: Excessive harmonics are often generated above and below the subcarrier if deviation exceeds ±5 kc; and, since the L—R sidebands extend to 53 kc, increased SCA bandwidth may induce crosstalk and intermodulation distortion.

Because the main-channel exciter at WSMJ has a limited bandpass at lower multiplication levels, insertion of the SCA subcarrier is made at 12.44 mc. Fig. 4 shows how the SCA and L—R subcarriers are mixed with the main (L+R) channel. Output of the inserter is the composite multiplex signal consisting of main channel (L+R), 19-kc pilot carrier, 38-kc stereo subchannel (L—R) and 67-kc SCA subchannel information.

Sources of Difficulty

The very nature of the composite multiplex signal suggests in what areas the most common problems will arise. Because the signal spans the spectrum more or less continuously from approximately 50 cps to 74 kc, it can be correctly assumed that inadequate (or improperly adjusted) bandpass in low-level multiplier stages, the power amplifier, the transmission line, or antenna will degrade the signal. The delicate phase relationships between the main channel, the stereo subchannel, and the 19-kc pilot carrier indicates potential grief from an excessive VSWR or from antenna-phase distortions. Finally, the segmented makeup of the multiplex signal gives good cause to expect some interchannel interference.

In a well-designed stereo generator and transmitter combination, most of these faults will have been eliminated as inherent causes of difficulty, but will continually need to be considered during alignment or adjustment. The standard FM exciter and/or transmitter that has been modified for multiplex, may need some additional attention where performance is marginal. Insufficient bandpass can be noted stage by stage during a progressive sweep alignment of the exciter and transmitter.



Block diagram of an inserter-mixer.

It should be obvious that low-level stages normally tuned for maximum output and efficiency may have too high a Q for adequate multiplex bandpass. This situation can often be cured by the addition of swamping resistors across the plate tank of the affected stage—such steps may also require some changes in operating conditions to ensure sufficient drive to succeeding stages.

A usual cause of cross talk is excessive modulation of various subchannels. Generation of harmonics increases rapidly as the modulation percentage is increased. Since the output of most 38-kc balanced modulators is normally rich in second harmonic content, it is wise to filter before the DSBSC signal is mixed with the main-channel subcarrier. The usual bandpass filter will be flat in response and be phase-linear to 53 kc with a maximum attenuation at 76 kc. A typical filter with such characteristics is shown in Fig. 5. A heavy residual 76-kc harmonic will beat with the 67-kc SCA subcarrier, creating an annoying 9-kc note.

Another possible "birdie generator" is the third harmonic of the pilot carrier (57 kc) beating with the 67-kc subcarrier. This one is a little harder to eliminate, since 57 kc falls very close to the upper limits of the L—R. Therefore, the harmonic must be trapped in the stereo generator before it is mixed with L—R.

Remember, too, that it is pos-

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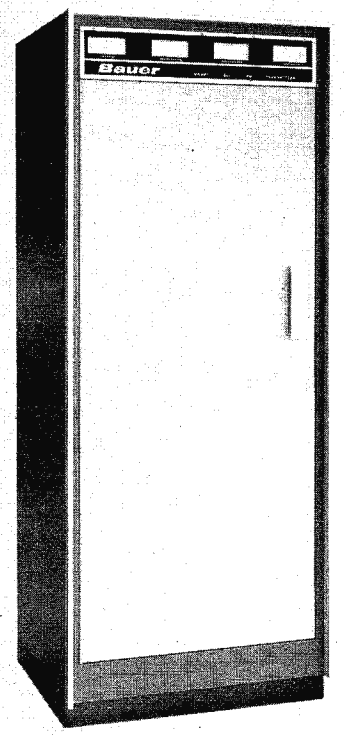
1 KW FM TRANSMITTER



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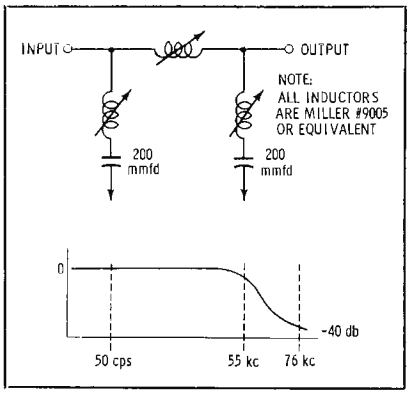

A low-pass filter for 76-kc cutoff.

sible to have a beat note within a stereo signal even without an SCA subcarrier. Since the fundamental crystal frequency of the exciter is in the order of 115 kc, and since the third harmonic of the 38-kc subcarrier is 114 kc, an approximate 1-kc beat note is possible. This usually indicates that the traps normally incorporated at the output of the 115-kc oscillator are maladjusted.

Perhaps the most prevalent cause of interference from the SCA subcarrier in the stereo receiver is the lack of, or misadjustment of, the 67-kc traps used in some stereo receivers. An annoying swishing sound is produced as a result of the 67-kc subcarrier beating with the second harmonic of the locally-generated 38-kc reinserted carrier. Sometimes the receiver's 67-kc traps are simply inadequately designed for the required attenuation, although the station that increases SCA subcarrier insertion above 10% increases the possibility of the beat notes becoming objectionable even in properly-designed receivers.

It is important that the 67-kc subcarrier be centered at exactly 67 kc for the following reasons: If too high in frequency, the upper excursions may extend into the guard band; if too low, the lower excursions may interfere with the L-R subcarrier, causing excessive crosstalk in receivers that have inefficient 67-kc filters.

Although many problems can exist in the multiplex operation of an FM station, a good general knowledge of basic concepts combined with a familiarity of your own equipment can help to ensure the generation of a clean signal. ▲

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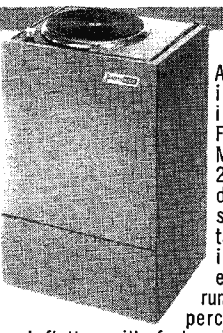
For over a quarter of a century FAIRCHILD Turntables have continued to provide, through radio stations of the world, the finest record reproduction. To meet the demands of the new proposed NAB standard and stereo broadcasting, FAIRCHILD pioneered the use of belt drives for professional turntables as exemplified in the FAIRCHILD Model 750—the only **3-speed, 16" turntable** with —65 db rumble, .03% wow and flutter, 3 speeds easily selected, whisper soft operation, cue pad provided, and minimal moving parts for long trouble-free performance.



AND now joining the 750 is the new FAIRCHILD Model 755—a 2-speed belt drive professional turntable. The 755 incorporates extremely low rumble and imperceptable wow and flutter with fast-cueing combined with attractive packaging and easy installation. The low price of the Model 755 allows every radio station to step up to quality for today's quality conscious listeners.

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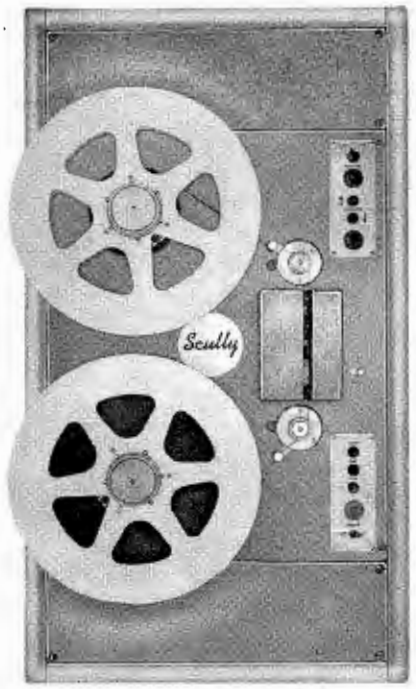

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Circle Item 17 on Tech Data Card

NEWS OF THE INDUSTRY

INTERNATIONAL

Austrian TV Changes

A technical directive from the **Bayerischen Rundfunk** (Austrian Broadcasting Network) reports that since June 11, 1964 a new television station of the Bayerischen Rundfunk located near Grassau has been broadcasting on European Channel 9. Since the coverage of the new broadcasting service generally duplicates that of the station presently broadcasting from Westerbushberg on Channel 5, and because a strong Austrian TV station has been assigned to that channel, the station now operating on Channel 5 will be abandoned. In order to provide a smooth transition for the new installation, the Westerbuchberg station will remain in operation until August 31, 1964, thereby allowing receiving antennas to be converted or changed to receive the new programming from Channel 9.

UHF in Puerto Rico

Puerto Rico's first English-language TV station, UHF Channel 18, has just begun its broadcasting operations. **WTSJ,** the most powerful television station on the island, will offer a heavy diet of filmed and taped network fare from the United States, directed at the growing English-speaking market of Greater San Juan. It is expected to open up the English-language market on a large scale to national advertisers from North America for the first time. The new UHF outlet is operated by **TeleSan Juan, Inc.,** a broadcasting enterprise which currently holds licenses for two additional UHF stations in the cities of Ponce and Mayaguez. Puerto Rico now has eight Spanish-language stations, all broadcasting via VHF. The FCC has assigned 25 UHF channels to the Commonwealth, because all VHF allocations have been exhausted.

Cross-Channel Microwave

Important new microwave radio links are to be provided between London and Lille in northern France by a subsidiary of **International Telephone and Telegraph Corp.** The additional equipment increases the available number of international telephone circuits and will also provide a permanent 625-line European television (Eurovision) channel to replace the British Broadcasting Corporation's temporary system between London and Folkestone on the English Channel. The latest transistorized microwave equipment will transmit as many as 1800 two-way telephone circuits between the new 600-ft. tower of the General Post Office in London and a 200-ft. tower on Tolsfold Hill, near Folkestone. Te'ephone circuits will be carried from Tolsford Hill to Lille by an existing microwave link completed by ITT's Standard Telephones and Cables, Ltd. in 1959 and by a further new STC microwave link of 600 circuit capacity.

Video Recorder to BBC-2

The first of six new Ampex VR-2000 Videotape television recorders has been delivered to the **British Broadcasting Corporation** for use in program production. The VR-2000 will be used by BBC-2, the first British television channel to use the 625-line standard which permits direct transmission to Continental countries on the same standard. The other two British channels are expected to phase out their existing 405-line operations over the next few years in favor of the 625-line standard.

NATIONAL

Protran Acquires Ferranti Div.

Negotiations have been completed for the acquisition by **Protran Company, Inc.** of the entire transformer division of Ferranti Electric, Light Equipment Division. Rudy Chiodo, general manager of Protran and formerly sales manager for Ferranti's Light Equipment Division, stated, "In addition to the acquired Ferranti transformer lines and specialty capabilities, we are now also engaged in full scale design and production of audio transformers and high power pulse modulator components."

WITI's 1078' Tower

Visible from more than 30 miles away, this three-sided self-supporting, 1078-foot-high TV tower at Shorewood, Wisconsin, a suburb of Milwaukee, heralds the presence to local viewers of **WITI-TV,** Channel 6, Milwaukee. The three columns consist of more than 1000 25-watt light bulbs set 30" apart. The tower lights (type FCB-12 beacons shown in inset) burn from dusk until midnight and are controlled by a photo electric device, manufactured by **Crouse-Hinds Co.,** which also produced the tower's flashing beacons and obstruction lights. WITI-TV is owned and operated by the Storer Corp., Milwaukee.

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Antenna for College Station

FM radio station **KRCC**, operating from **Colorado College**, has received permission from the FCC to put up its new 137-foot tower. The tower, valued at $1,400, was given to the college by radio station KRDO through KRDO president and general manager Harry W. Hoth, a member of the Colorado College class of 1948. KRCC, the oldest FM radio station in Colorado, has been operating with a 96-foot tower.

PROPERTY TRANSACTIONS

KGRT, five kilowatt daytimer at Las Cruces, New Mexico, has been sold by Taylor Enterprises to a group of Las Cruces businessmen headed by William R. Lask, manager of the station for the past five years. Taylor Enterprises owns KBIM in Roswell, and has a pending application for a TV station in Roswell.

Radio Station **WEBO**, Owego, New York, has been sold, subject to FCC approval, by Wego Radio, Inc., to **Community Service Broadcasting Corp.**, owner of Radio Station WCSS, Amsterdam, New York. The largest stockholder of Community Service Broadcasting Corp. is Phillip Spencer, general manager of WCSS. Wego Radio is owned by Mr. and Mrs. Amo Davis. WEBO is 1000 watts, on 1330 kc.

PERSONALITIES

John F. Meagher has joined the brokerage firm of Hamilton-Landis & Associates, Inc., recently, as announced by Ray V. Hamilton, board chairman. Mr. Meagher, who has been active in broadcasting for more than 25 years, served for the past 10 years as vice-president for radio of the National Association of Broadcasters.

Leroy A. Bellwood, director of engineering for the Time-Life Stations **KOGO-AM-FM-TV,** has been temporarily assigned to the Time-Life International Division and will headquarter within the next few weeks in Stockholm, Sweden, according to Mr. Clayton H. Brace, vice-president of Time-Life Broadcast, Inc., and general manager of the KOGO stations. The International Division of Time-Life Broadcast is participating in the organization of a Swedish production company. Bellwood has been with the San Diego television and radio stations ince 1947. He has been in charge of engineeering for the stations since that time.

David S. Wolfenden has joined **Automatic Tape Control** as a sales engineering specialist for broadcast automation. His specific duties will involve working with individual broadcasting facilities as they move toward full or part-time program automation.

Joseph R. Stiftel has been appointed assistant staff engineer for the **Society of Motion Picture and Television Engineers.** In this new position, Mr. Stiftel will be primarily responsible for augmented quality-control procedures in the SMPTE test-film program, and will assist in the development of new test films.

M. R. Broszio has been elevated to the position of manager of electronic assembly and test at the **Metrics Division** of **The Singer Company** is was announced by George M. Mayforth, operations manager. Mr. Broszio joined the Metrics Division early in 1962 and was later promoted to material manager, from which position he was named to his new assignment. In this new position, Mr. Broszio will be responsible for the electronic production and test of measurement instruments and related equipment.

Rafael C. (Cruz) Rivera has recently been appointed Manager of Sales for Latin America by **Visual Electronics Corp.**, it was announced by George H. Wagner, Sales Manager of the New York firm. Mr. Rivera came to Visual over two years ago as a sales engineer, assisting in the supervision and layout of various broadcast stations both in this country and in South America. ▲

The Neumann U-67 Condenser Microphone adds new life to live broadcasts, even with narrow band table and transistor type receivers. Your most significant single step quality improvement, immediately discernible by listeners, for a relatively small investment. The U-67 stands by itself, unmatched for its triple pattern versatility, sensitivity and rugged construction. Reasons why major market stations coast to coast, have switched to Neumann. Get the complete U-67 story . . . call or write: . . . . . .

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In Canada: J-Mar Electronics Ltd., P.O. Box 158, Don Mills, Ontario.

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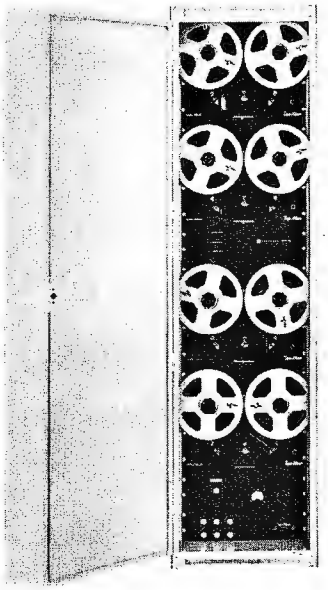
NEW PRODUCTS



Background Music System

A background music system capable of providing a wide variety of music formats has been introduced by **Tape-Athon Corp.** The system incorporates four 10½" Tape-Athon tape transports and a programming system to increase its versatility. The system can be set to play either the upper or lower banks of decks or both banks, intermixing numbers from the four tapes. It can also be programmed for time-of-day and day-of-the-week, permitting an entire 7-day format to be established and automatically sequenced. Thirty-two hours of music, approximately 800 different selections, are available on the four tapes; thus, the operator can provide as many as 4 types of music and select tempo or mood as required. Using the front panel "Intersperser" switching unit, and the time clock, these selections can be alternated in a wide variety of sequences.

Circle Item 42 on Tech Data Card

Zoom for Kodak Camera

An Angenieux 10-to-1 room lens is now available from **Zoomar International, Inc.** for owners of the Kodak Reflex Special Camera. This lens has a range of 12 mm to 120 mm, F/2.2 and is delivered with a special Kodak Type R mount of hardened steel to ensure proper alignment over extended periods of use. A 4-to-1 reduction crank for slow smooth zooming and a lever for rapid zooming are supplied. Motor adaptations are also available.

Circle Item 43 on Tech Data Card

New Industrial Triode

Designed for industrial heating service and for use as an amplifier or modulator in AM broadcasting service the **Westinghouse Electronic Tube Division** WX-5394 features a heavy-walled, vapor-cooled anode capable of dissipating 50 kw. The cathode is a self-supporting thoriated tungsten filament. The tube is sealed onto the anode air cooler by a self-contained "O" ring and is held in place by its own weight. Changing the

If the cardioid pattern is an essential consideration in selecting a professional condenser microphone . . .

The AKG-C60, for its size, has an unsurpassed cardioid pattern—*front-to-back discrimination is never less than 18 db over the entire frequency range.* These superb characteristics are ideal for difficult acoustical installations, particularly concert halls, auditoriums, broadcast and film sound studios.

Here is an exceptional high-quality dynamic microphone which measures up to professional standards . . .

The AKG-D24 possesses unusually excellent characteristics which make it eminently suitable for a wide variety of applications. This multi-use adaptability pin-points the D24 as your number one choice for high-performance standards — whether for studio, indoor or outdoor field work.

CONDENSER • DYNAMIC MICROPHONES

AKG of America
Division of North American Philips Company, Inc.
125 Park Avenue, New York, N.Y. 10017

6-64

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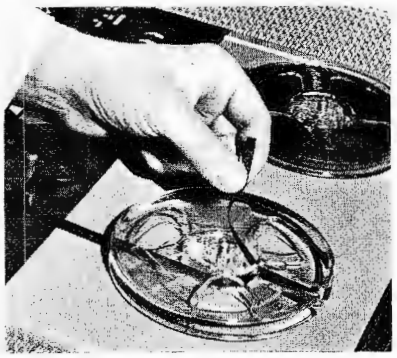
tube is accomplished by lifting it out of the cooler and replacing it. The WX-5394 has a maximum direct-current plate voltage of 12.5 kv, a maximum DC current of 8.0 amps, and a maximum plate input of 80 kw at frequencies up to 30 mc. Useful power output can be obtained at frequencies as high as 100 mc with plate voltage and plate input reduced accordingly.

Circle Item 44 on Tech Data Card



5" Thread-Easy Reel

A 5" "Thread-Easy" reel that can be threaded in a single motion simply by drawing the tape through a slotted flange, has been announced by **Eastman Kodak Co.** The reel replaces the ones now used on 5" Eastman Tapes and will also be available empty for use in editing or for take-up. The reel incorporates all the features of 7" Kodak "Thread-Easy" reels: a slotted flange, built-in splicing jigs, index scales, write-on panels, and stury, one-piece, molded construction.

Circle Item 45 on Tech Data Card

New IO Conversion Kit

A deflection components conversion kit for 3" image orthicons by **Cleveland Electronics, Inc.** consists of a deflection yoke, Model OY-64, and alignment coil, model OA-3. The conversion is said to upgrade the performance of older cameras to a point where they are compatible with currently accepted standards. The OY-64 deflection yoke and OA-3 alignment coil also offer economic advantages, thus making their incorporation into existing equipment most attractive. Specifically, these new components offer the following features: Improved cooling larger yoke ID, improved signal/noise ratio due to improved electrical shielding for extended orthicon life as a result of of the OY-64 yoke, and improved linearity and resolution as a result of very close control of winding geometry.

Circle Item 46 on Tech Data Card

TV Camera Antenna

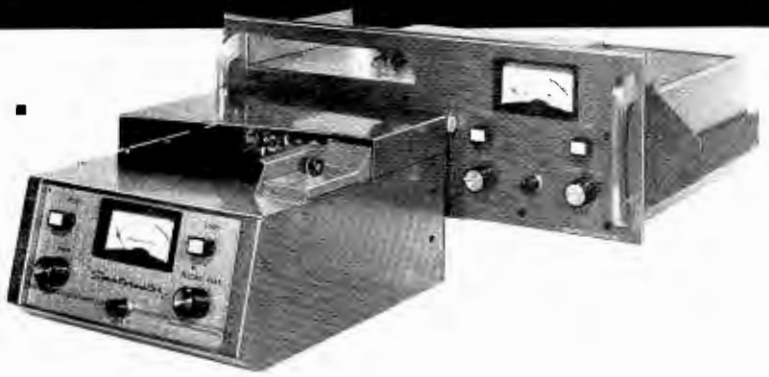
A new microwave antenna that significantly increases the transmitting range of portable television systems has been developed to RCA specifications by **PRD Electronics, Inc.,** subsidiary of Harris-Intertype Corp. The entire RCA television unit—including the camera, microwave transmitter, antenna and battery—weighs about 40 pounds. It is carried on a special harness allowing TV cameramen to move freely, facilitating on-the-spot coverage of conventions, sports contests and other news events without the normally required cables. Although PRD's antenna weighs less than a pound, it markedly increases the camera's effective range which is further increased by the addition of an adapter which beams the radio signals in a narrow pattern. This concentrated type of transmission also minimizes ghosting. ▲

Circle Item 47 on Tech Data Card

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 stations 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)

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World's Fastest Selling FM Wireless Microphone

IMP II

Transmits voice or signal with power and fidelity to any standard FM tuner or radio. Perfect for use where mike cords are inconvenient. For broadcasting, remote tape recording, communicating or hundreds of other applications in schools, churches, theatres, plants, stores, homes and sporting activities, indoors or out. Tunable: 88-108 mc band.

IMP II-221 Transmitter only.... 39.95

IMP II/M-222 Complete with built-in pin-head microphone 49.95

See distributor or write BE-9

Made in U.S.A.

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Chicago, Ill. 60612 Area 312 • 666-0066

Circle Item 36 on Tech Data Card

the Chief Engineer

. . . Helps Solve Your Technical Problems

Readers are invited to send their questions to the "Chief Engineer"; those of most general interest will be published in this column.

I often hear references to the Commission's "10% Rule." Just what is the "10% Rule"?

The Commission's standard broadcast (AM) allocation rules specify certain groundwave contours as "normally protected." The values of field strength depend upon the class of station and are different for daytime and nighttime operation. For example, the .5 mv/m groundwave contour is normally protected for a Class III-A station during daytime hours, and the 2.5 mv/m groundwave contour is protected at night.

The Commission's rules also define interference between stations operating on the same channel or on adjacent channels. A limitation is placed upon the amount of objectionable interference that may be **received** by listeners during either daytime or nighttime hours. The "10% Rule" (Section 73.28 of the Commission's Rules) provides, among other things, that interference within a station's normally protected contour may not affect more than 10% of the population included within that contour. Exceptions are provided for certain local-channel (Class IV) stations and for those Class II and Class III stations which would either provide the first nighttime facility to a community or would provide 25% or more of nighttime primary service to an area presently unserved at night.

Can anyone who is familiar with the use of a field-strength meter take measurements in support of an application for remote control, or are there special qualifications required?

Anyone competent to operate a field-strength meter may take the field-strength readings; there are no special qualifications prescribed by the Commission. As a practical matter, however, the individual must be thoroughly experienced not only with measuring techniques but also with interpretation of the results. This interpretation, in accordance with Section 73.186 of the Commission's Rules, is required by Question 11 of the remote control application form (FCC Form 301-A). Should their accuracy be questioned, the person making these measurements may be called on to testify.

There are, of course, several other requirements for engineering data in support of an application for remote-control authorization. Antenna impedance measurements are required (Question 7 of the form) and the qualifications of the engineer making these measurements are called for, along with a description of the method used. Also, a statement concerning the stability of the array must be submitted, plus data on operating parameters and monitor-point readings. ▲

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Tape Recorders
deliver a wallop bigger than many twice its size. WE HAVE THE MOST COMPLETE SELECTION ANYWHERE. NEW MODELS INCLUDE: 524, 1220, 600, 1400, 1414, 1500, 1515, 1280, 1281, 1580, 1780, 1980, 1981, Your order receives prompt attention.
FANTASTIC PRICES for name brand and special purpose magnetic tapes!
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SAXITONE RECORDING TAPE

275' Plastic, 3" reel	.35
600' acetate (plastic), 5 inch	.70
600' MYLAR 5 inch reel	.75
900' MYLAR (Polyester), 5 inch	.89
1200' MYLAR, ½ mil. 5 inch reel	1.18
1200' acetate (plastic), 7 inch	.99
1200' MYLAR, 1½ mil (strong)	.98
1800' acetate (plastic) 7 inch	1.19
1800' MYLAR 1 mil. thick, 7 inch	1.59
2400' MYLAR, untensilized, 7 inch	2.25
2400' MYLAR, untensilized, 7 inch	1.99
3600' MYLAR, tensilized, 7 inch	3.89

(Greater discounts to quantity buyers)

Plus Postage Save 30-60 %

4-track Stereo music on tape. FREE 50-page catalog

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PROLOG®

A simple, easily operated system that automatically performs station PROGRAMMING, LOGGING, AUTHENTICATING.

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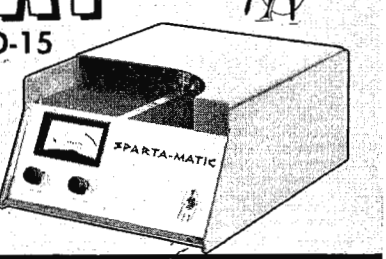
Get 3 to 30 Second
TIME DELAY
. . . with the new SPARTA-MATIC CD-15
TAPE CARTRIDGE UNIT



★ Separate record, playback and erase heads allow time delays for "on the air" TELEPHONE CONVERSATIONS!

★ Can be used as a "special effects" generator to create ECHO CHAMBER and REVERBERATION effects.

SPARTA ELECTRONIC CORPORATION
6450 Freeport Blvd.
Sacramento, Calif

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ENGINEERS' TECH DATA

AUDIO & RECORDING EQUIPMENT

53. AKG—Folder contains specifications and prices of condenser microphones, dynamic microphones, and accessories.
54. ALTEC—"Voice of the Theatre" brochure describes playback and speech input equipment for recording and broadcast studios.
55. ASTATIC—Brochure 111 lists condenser microphones, cartridges, needles, and tone arms.
56. ATLAS—Catalog 564 contains descriptions, specifications, and illustrations of public address loudspeakers, microphone stands, and accessories.
57. AUDIO DEVICES—Information gives recording characteristics of new high-performance audio tape.
58. BROADCAST ELECTRONICS—Packet contains specifications and prices for Spotmaster tape cartridge system.
59. FERRODYNAMICS—Assorted magnetic recording tapes are described in brochures and specification sheets.
60. GOTHAM—Features of condenser microphones and reverberation units outlined in brochure.
61. MAGNASYNC—Catalog covers magnetic film and tape recorders and accessories.
62. MAGNUSONICS—Mechanical and electrical characteristics of multiple-track magnetic recording heads are given in brochure.
63. SENNHEISER—Data sheet describes frequency-compensated lavalier microphone which features spring-mounted inner housing to reduce mechanically-coupled noise.
64. SWITCHCRAFT—Product bulletin lists features of new Q-G audio receptacles and discusses problems of grounding in AL connectors.
65. QUAM-NICHOLS—General catalog lists speakers for replacement, background music, PA, and high-fidelity use.
66. VIKING—Brochure describes modular tape-cartridge handling system, with application notes.
67. WALLACH ASSOCIATES—Six-page brochure illustrates wide variety of record and tape-reel cabinets.

COMPONENTS & MATERIALS

68. AMPEREX—Condensed catalog lists receiving and transmitting tubes.
69. ELECTROVERT—Four-page brochure describes line of cable harnessing, strapping, and wrapping systems.
70. IEH—Exact-replacement catalog cross references 1N and 2N type semiconductors; data also given on power transistors and various diodes.
71. INTERNATIONAL ELECTRONICS — New listing includes range of Mullard industrial and special-purpose tubes for broadcast and industrial replacement; includes comprehensive cross-reference guide.
72. LEECRAFT—Eight-page catalog C-664 covers indicator lights, lampholders, and pilot-light sockets.
73. MALLORY—Bulletin 9-354 describes line of versatile industrial sequence timers variable from 1 min. to 24 hr. with 5, 10, or 15 SPDT contacts.
74. TIMES WIRE—Product sheets describe various flexible and semiflexible coaxial cables, and connectors for same.

MICROWAVE DEVICES

75. MICRO LINK—Brochures describe 10.5 gc and 12.2 gc to 13.6 gc microwave links, and 2.5 instructional TV system.
76. TACO—Data sheets give specifications on parabolic and cylindrical parabolic antennas for the 2.5 gc ITV band.

MOBILE RADIO & COMMUNICATIONS

77. FINNEY—Catalog 20-307 covers line of cut-to-frequency VHF-FM antennas, in various connector configurations.
78. MARCONI—General catalog NA2 covers communication test instruments. Also available are papers covering intermodulation testing of multichannel systems and multiplex testing using 12-channel noise generator.
79. WINEGARD—Factfinder describes versatile coupler that mixes, equalizes, and matches cut-to-channel antennas.

POWER DEVICES

80. LECTROTECH—Separate bulletins detail solid-state modular power supplies and meter-protective devices.
81. TERADO—Product report lists features of Galaxy DC/AC power inverter for 140 watts of continuous-duty 117-volt power.

RADIO & CONTROL ROOM EQUIPMENT

82. COLLINS—Comprehensive catalog 42 offers descriptions and specifications of wide line of broadcast equipment.
83. SPARTA—Product sheet illustrates, describes, and prices studio turntables, preamplifiers, and combinations.

REFERENCE MATERIAL & SCHOOLS

84. BIRD—Six-page guide specifies application parameters for use of coaxial filters and describes preferred testing methods.
85. JAMPRO—Reprint of article, "Antenna System VSWR and Stereo Separation Effects" available to those interested in stereo FM broadcasting.
86. ENDECO—New, faster way to replace soldered components in PC boards is discussed in application bulletin.
87. CLEVELAND INSTITUTE—Booklet describes courses in electronics, including those for broadcast engineering and FCC license preparation.

CAMERA & STUDIO EQUIPMENT

88. BLONDER-TONGUE—New catalog lists broad line of CCTV products and accessories.
89. CBS LABS—Two bulletins describe new Volumax Peak Controller and solid-state video-distribution consoles and equipment.
90. DAGE—Six-page brochure gives features of transistorized studio camera Model 420, with application notes included.
91. ZOOMAR—Interesting brochures on variable-focal-length lenses and remote-controlled pan/tilt heads for studio applications.

TELEVISION EQUIPMENT

92. HOUSTON FEARLESS—Brochure gives complete details and photos of new cam-actuated camera head for heavy-duty applications.
93. TELESCRIPT—Material offered on audio systems and components, cameras, projectors, and closed-circuit systems.
94. WARD—Information describes CDL solid-state vertical-interval switching systems.

TEST EQUIPMENT & INSTRUMENTS

95. DATA INSTRUMENTS—Specification sheet describes Model S32A portable 10 mc oscilloscope.
96. SPRAGUE—Circular describes features of Model TO-6 capacitor analyzer.
97. TEKTRONIX—Catalog insert sheets cover oscilloscopes for TV maintenance, monitoring, and measurement; trace-recording cameras are also detailed.

TRANSMITTER & ANTENNA DEVICES

98. ANDREW—Product report describes operating parameters of heatless transmission-line dehydrator.
99. CCA—Information available on complete line of AM and FM broadcast transmitters and accessories.
100. GATES—Booklets cover FM transmitters, stereo generators, cartridge tape equipment, and direct crystal-controlled cascade exciters.
101. McMARTIN—Data sheet lists specifications of AM noise meter Model AM-25 used for proof-of-performance measurements.
102. RUST—Brochures list various remote-control systems and automated 1-kw stereo FM transmitter with built-in automatic logging equipment.
103. TRYLON—Rhombic and log-periodic antenna systems and varied line of matching devices and dummy loads covered in brochures.

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Professional Services

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and
Program Transmission Engineers
2nd Avenue — P. O. Box 117
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SPECIALISTS FOR AM-FM-TV
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Cambridge 48, Mass.

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

Antennas, Parabolic; 6 ft. diameter, Solid Surface Aluminum with dipole, pole bracket, de-icer. 100 available. New Surplus. $100.00 set. Sierra-Western Electric Cable Co., Willow & 24th Streets, Oakland, Calif. 9-64 1t

Laboratory Test Equipment, microwave components, all frequency and makes at real low prices. Write or call for information. Jericho Electronic Supplies. Sid Gordon Electronics, 80 West Jericho Turnpike, Syosset, Long Island, N. Y. (516) WA 1-7580. 8-64 3t

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

GOVERNMENT SURPLUS. NEW 10 CM WEATHER RADAR SYSTEM—Raytheon, 275 KW peak output S band. Rotating yoke P.P.I. Weather Band 4, 20 and 80 mi. range. Price $975 complete. Has picked up clouds at 50 mi. Wt. 488 lbs. Radio Research Inst. Co., 550 5th Ave., New York, New York. 5-64 tf

New Gates Model M-5309A 5KW broadcast antenna coupler units, $295.00; Trimm 504 audio patch cords, $4.00; audio jack panels 19" rack mounting, 12 pair $9.95, 10 pairs $8.95; repeat coils 500-500 ohm flat, $4.00; racks, cabinets, transformers, etc. Write for free list. Gulf Electro-Sales, 7031 Burkett, Houston, Texas. 8-64-3t

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

Brand new surplus BC-645 Transceiver, 435 to 500mc, complete in original cartons with PE-101C dynamotor, 12/24V input, UHF antenna, control box, plugs. Limited supply, price $32.50. Slep Electronics Company, P. O. Box 178BE, Ellenton, Florida. 8-64 3t

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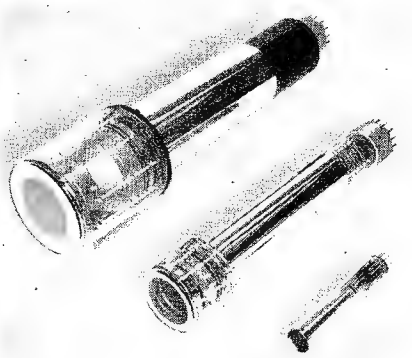

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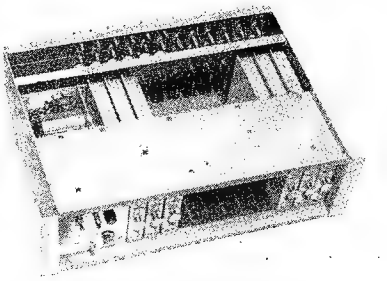

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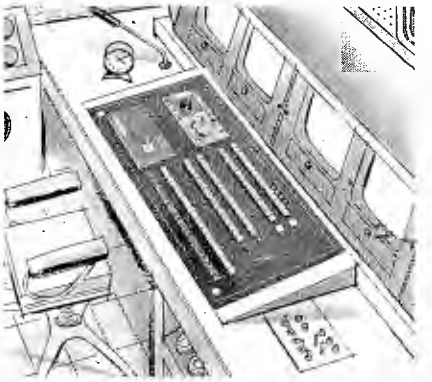

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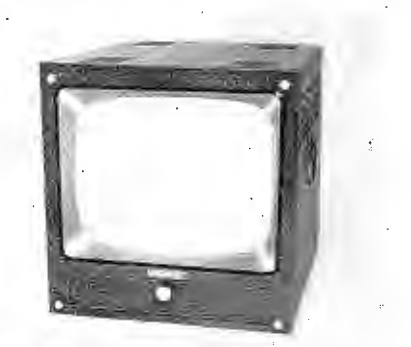

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