AUGUST, 1960

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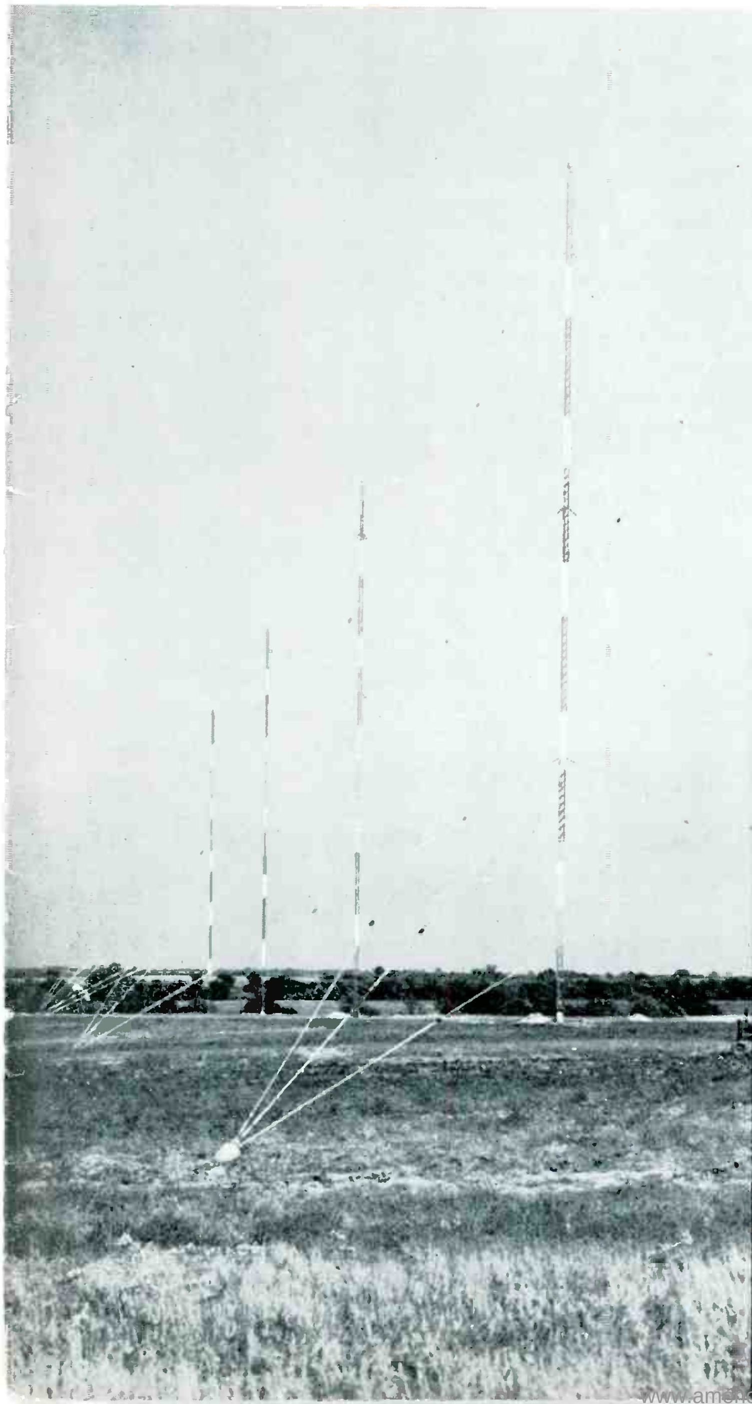
BROADCAST ENGINEERING

THE TECHNICAL JOURNAL OF THE BROADCAST INDUSTRY



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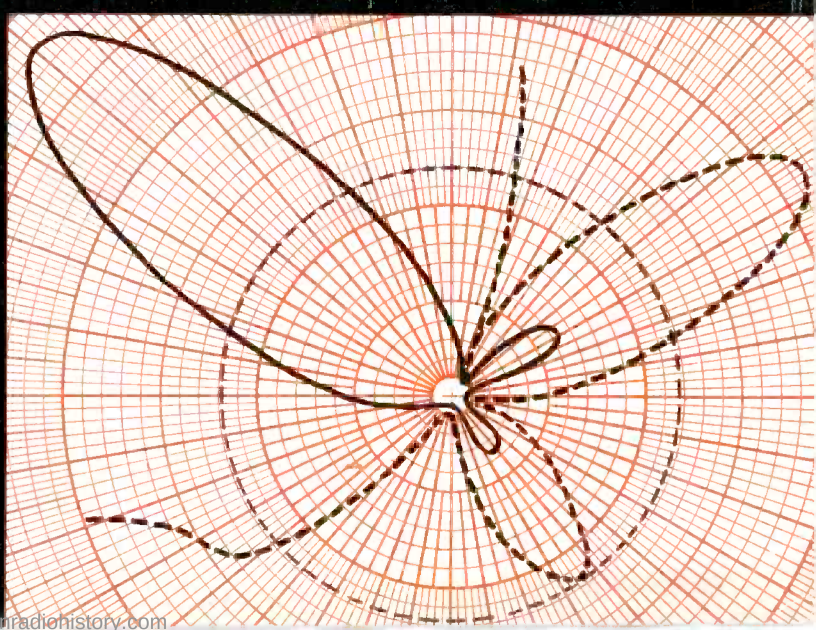

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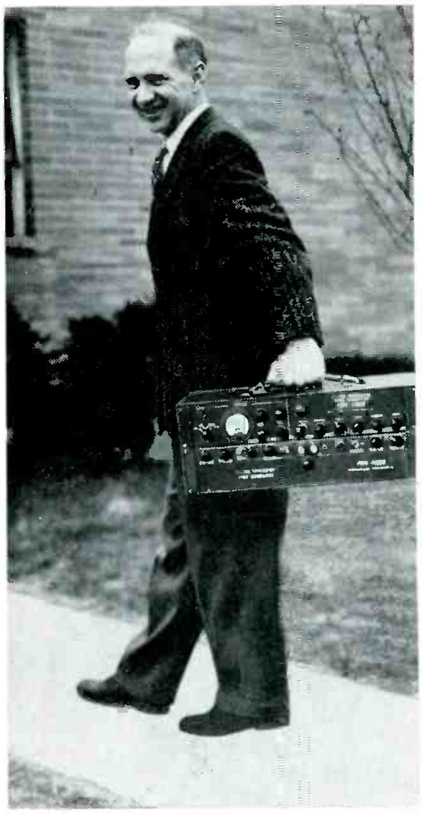

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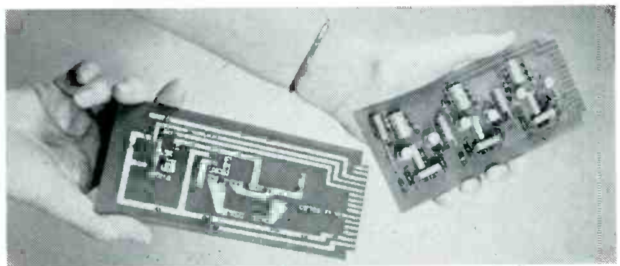

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Completely EIA (RETMA) sync signals • Stable and Highly Reliable Binary Counter. • All-transistorized • All-Modular, with *low-cost spare* modules • Easily repairable at site or at the factory • Carrying case. Light portable unit only 15 pounds • Meter reads peak-to-peak level of all four *controlled* outputs • 75-ohm load *and* source impedances • The V-701 is entirely self-contained as an industrial closed-circuit sync generator • With the V-702 it becomes a standard EIA studio sync generator • Power is derived from the built in 701 power supply — less than 2 watts • Occupies only 7" of rack space • Printed wiring.

ADD-A-UNIT BUILDING DESIGN

V-701 CLOSE-CIRCUIT SYNC GENERATOR

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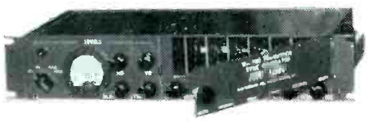

V-702 EIA (RETMA) SYNC ADAPTER

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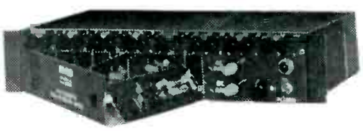
V-700 EIA SYNC GENERATOR RACK MOUNTED

V-440 TRANSISTORIZED PULSE DISTRIBUTION AMPLIFIER



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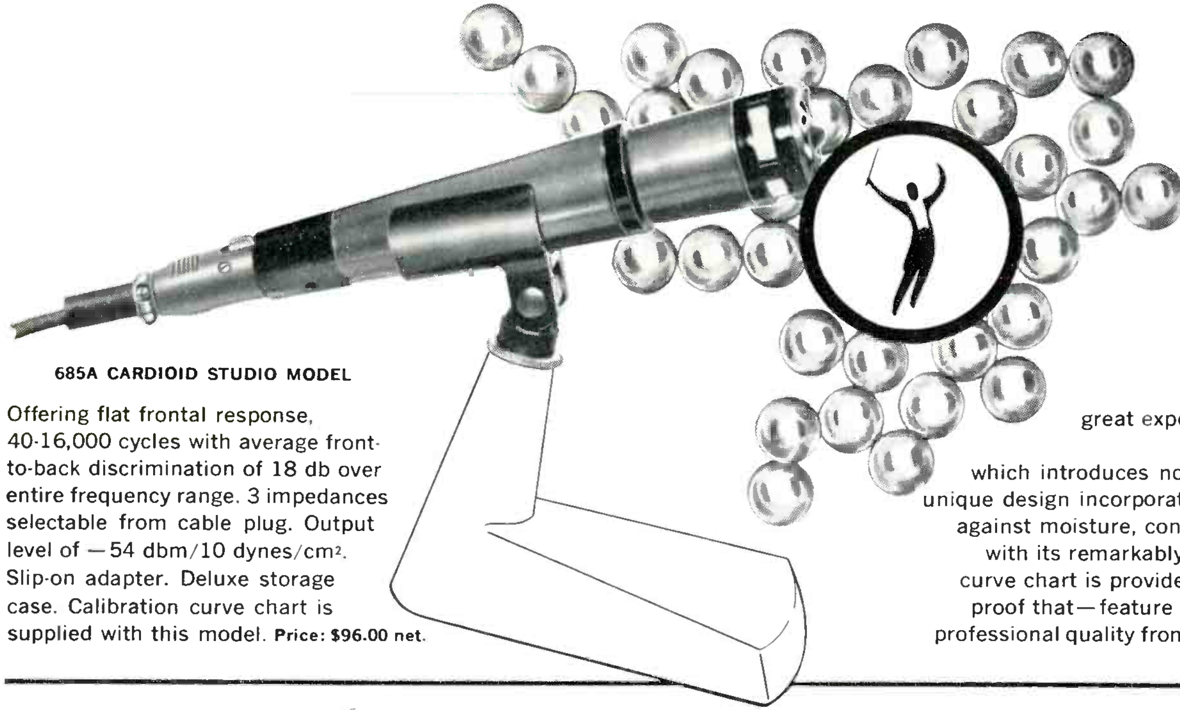

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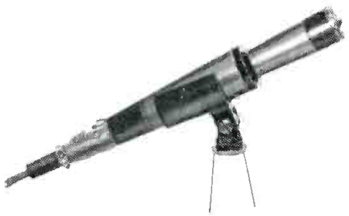
Offering flat frontal response, 40-16,000 cycles with average front-to-back discrimination of 18 db over entire frequency range. 3 impedances selectable from cable plug. Output level of −54 dbm/10 dynes/cm². Slip-on adapter. Deluxe storage case. Calibration curve chart is supplied with this model. **Price: $96.00 net.**

Big news of the year in microphones is Altec's recent introduction of a new concept in microphone design. From Altec's great experience in engineering and manufacturing broadcast equipment and extensive acoustical research, comes a breakthrough development which introduces notable improvements in microphone performance and styling. This unique design incorporates Altec's famous sintered bronze filter for unmatched protection against moisture, contaminants, and blast—and Altec's new rugged "golden" diaphragm with its remarkably smooth, wider response and output. Individual certified calibration curve chart is provided with models 684A and 685A. Make a comparison; it is convincing proof that—feature for feature—Altec offers the year's best value in microphones. True professional quality from Altec—the best you can buy, no matter what price you have in mind.



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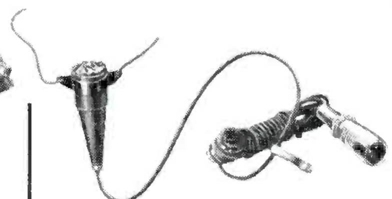

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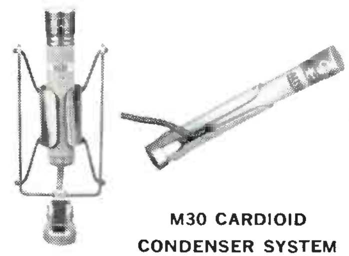

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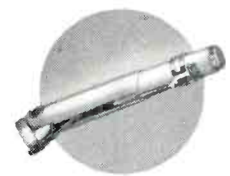
Frequency response of 20-20,000 cycles with directional cardioid pattern of outstanding discrimination. Balanced output of −53 dbm/10 dynes/cm². First miniature directional microphone capable of translating the entire frequency and dynamic range. **Price: $334.00 net.**



M20 "LIPSTICK"
CONDENSER SYSTEM

Just 3⅛" x ⅝", this small, versatile microphone is widely used in laboratory recording because of its extreme sensitivity as well as broadcast studios. Balanced output of −48 dbm/10 dynes/cm². Omnidirectional pick-up pattern. **Price: $236.00 net.**

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BROADCAST ENGINEERING

THE TECHNICAL JOURNAL OF THE BROADCAST INDUSTRY

VOLUME 2 AUGUST, 1960 NUMBER 8

Contents

Departments

Cover Story

Shown on the cover this month is the directional antenna array of radio station KCMO of Kansas City, Mo. The photo illustrates a typical antenna system as described in the article on directional antenna design in this issue.

EDITORIAL

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Broadcast Equipment Purchasing

A survey of radio and television stations reveals the interests and equipment plans of broadcasters.

THE FIRST survey of the Broadcast Industry by this publication was mailed to its readers on July 1, 1960. The purpose of the survey was to obtain factual data which would guide us in planning future editorial material and to develop a better statistical picture of the equipment needs of the industry. Separate questionnaires were prepared for television and radio. The questionnaires included inquiries on the type and subject matter of articles which readers prefer, opinions on equipment developments, and purchasing and expansion plans. Three weeks following the mailing 30 per cent of the questionnaires had been returned. This is considered to be a satisfactory return and provides an accurate picture of the thinking, plans, and interests of the industry concerning engineering and technical requirements.

EDITORIAL SUBJECTS SUGGESTED BY READERS

RADIO	TELEVISION
Automation	Proof of Performance
Directional Antennas	Automation
Remote Pickup Transmitters	Color TV
Maintenance	Microwave
Antennas	Video Recording
Studio Technical Practices	Station Design
Proof of Performance Measurements	Transistor Video Design
Transmitter Remote Control	Antennas
Reverberation	Maintenance Practices
FM and Multiplexing	Studio Techniques and Practices
Acoustics	TV Test Procedures
Stereo	Diode Switchers
Do-It-Yourself Construction Projects	F. C. C. Applications
Transistors in Broadcast Use	Two Way Radio
Studio to Transmitter Links	Field Intensity Measurements
Station Layout and Design	TV Lighting

Radio Survey

The radio survey measured the percentage of stations which planned to purchase various products during the next 12 months and asked questions concerning automation, tape equipment, multiplexing, automatic transmitter logging equipment and suggested subject matter for BROADCAST ENGINEERING magazine.

Automation was most often mentioned as being of top interest to radio stations. Twenty per cent of all radio stations indicate that they are using some form of automation. Most stations consider all types of tape systems as being a part of automation and particular interest is shown in tape cartridge equipment.

The second subject mentioned most often is directional antennas. Since most new AM stations and many stations planning power increases must install directional systems it is now necessary for many more people to become familiar with the problems of planning, installing, and maintaining directional antenna systems. This issue of BROADCAST ENGINEERING has an article on this subject.

Remote pickup relay transmitters is the third most popular subject, according to the radio survey. Other subjects mentioned are shown in the chart. We are interested in hearing from any reader who would be in-

Trends

terested in preparing articles on these or other subjects appropriate to the radio and television industries. We will forward information on rate of payment, method of presentation, and other details on request.

Equipment Purchasing

The volume of equipment purchasing in various product categories is revealing of the trends in technical development. The item purchased most by all radio as well as television stations is microphones. Thirty-five per cent of all radio stations state that they will purchase microphones during the coming year. The second item being purchased most often is tape cartridge equipment. Almost 30 per cent of all radio stations have plans to purchase this type of tape equipment. A figure which seems unusually high is the number of AM transmitters which stations indicate will be purchased. Almost one-fourth of all AM-only and 21 per cent of AM-FM stations have plans to purchase AM transmitters. The explanation is in the anticipated power increase of many Class IV 250-watt stations. Tape recorders and turntables make up the third largest category of items which will be purchased. The chart shows the volume of equipment purchases for many different items.

Tape Cartridge Equipment

Tape cartridge machines are rapidly becoming a standard item in

PERCENTAGE OF AM RADIO STATIONS PURCHASING SPECIFIC ITEMS

Microphone	35.6
Tape Cartridge Machine	29.5
AM Transmitter	24.5
Studio Tape Recorder	23.8
Turntable	23.8
Portable Tape Recorder	23.2
Jack Strips	14.4
Audio Console	13.4
Distortion and Noise Meter	13.4
Loudspeaker	13.1
Portable Turntable	12.8
Program Leveling Amplifier	12.8
Remote Amplifier	12.8
Program Automation Equipment	11.1
Reverberation Unit	10.7
Record Cabinet	10.7
Power Generator	10.4
Conelrad Receiver	10.4
Audio Oscillator	10.1

EQUIPMENT PURCHASE PLANS—

Percentage of stations planning to buy specific items

ITEM	AM/FM	FM
Microphone	34.5	39.5
Tape Cartridge Unit	32.7	15.8
Studio Tape Recorder	22.6	28.9
AM Transmitter	20.8	5.3
Program Leveling Amplifier	20.8	7.9
Multiplex Monitor	20.8	18.4
Portable Tape Recorder	20.2	10.5
Audio Console	19.6	18.4
Transcription Turntable	19.0	21.1
Multiplex Receiver	18.5	26.3
Jack Strips	17.9	18.4
Loudspeaker	17.9	18.4
Multiplex Exciter	14.3	23.7
Program Automation Equipment	14.3	2.7
Remote Amplifier	11.3	18.4
FM Transmitter	10.7	21.1
FM Relay Receiver	10.7	13.2

broadcast stations, according to the survey results. Considering that this type of equipment has only been on the market for a few years, the interest and present usage is unusually high. It is apparent from this trend that tape cartridges will become a standard broadcast item. Among all radio stations 22.6 per cent are presently using tape cartridge equipment and 29.5 per cent have intentions of purchasing this equipment within the next twelve months. Stations with both AM and FM facilities show a higher percentage of usage. 32.7 per cent of these stations are presently using tape cartridges and 32.7 per cent indicate that they will soon purchase the equipment. FM independent stations show the least interest, although 15.8 per cent have plans to make purchases soon.

Most stations expressed satisfaction with the presently available equipment, although there is considerable interest in higher quality, more dependability, quieter operation, and improved performance. Suggestions refer to both the cartridge itself and to the machine. A natural although an economically impossible desire is for the units to be built better and cheaper.

The most frequently mentioned feature in connection with the general usage and adoption of this equipment is for a standard cartridge. This will of course become necessary before distribution of spots and programs by national and regional advertisers can be made on tape cartridges. At the present time the Fidelipac cartridge is used by a number of manufacturers and one manufacturer uses a custom cartridge. Among the users of Fidelipac cartridges several different methods of tape control are used. New developments in tape, tape heads, and cartridges may offer other systems in the future. Standardization will not be easily arrived at and still have the best possible equipment in accord with technical developments. Multiple cartridge units are often mentioned as being a desirable feature. Several companies including Collins and MacKenzie presently offer multiple units. Separate tape decks and a system of preselecting spots on a tape were mentioned along with such features as easier loading, erase heads, fast forward and rewind, and improved cueing methods.

PERCENTAGE OF TELEVISION STATIONS PLANNING TO PURCHASE SPECIFIC ITEMS

Microphones	34.1
Picture Monitors	32.6
Vidicon Cameras	28.7
Video Distribution Amplifiers	27.1
Video Test Equipment	26.4
Microwave Equipment	20.9
Studio Lighting	19.4
Special Effects Generator	18.6
Audio Tape Recorder	18.6
Video Tape Editing Equipment	17.8
Camera Lenses	17.1
Switching Systems	17.1
Television Recorder	14.7
Film Projector	14.7
Program Automation Equipment	13.2
Rebroadcast Receiver	13.2
Limiting Amplifier	12.4
Audio Control Equipment	12.4
Antenna	11.6
Tower	10.9
Transmitter	10.1

FM and Multiplexing

The survey indicated the continued growth of FM and multiplexing. Of the AM stations without FM facilities 9.1 per cent indicate that they will purchase FM transmitters during the next year. Of these 47 per cent will purchase multiplexing equipment. Combination AM and FM stations report that 20 per cent of their number are presently multiplexing and that 27 per cent will commence during the next 12 months. This will also give a total of 47 per cent of this group multiplexing in about a year; 23.7 per cent of FM independents presently multiplex and 31.6 per cent will do so soon. In about a year, therefore, approximately one-half of all FM stations on the air will be using subsidiary services to supplement their income. Purchasing of various items of equipment such as multiplex receivers and monitors will be proportionately high, according to the survey.

Automatic Transmitter Logging

For several years the Minneapolis-Honeywell Co. has had under development equipment which will automatically record the various parameters of a broadcast transmitter. The recording is done on a strip chart recorder similar to those used in other industrial applications. WTOP in Washington has installed and tested the equipment for over a year and general authorization of this method of replacing manual reading and logging may be made by the F.C.C. at a later date. A permanent record of a transmitter's operation can be of considerable value especially where licensed engineers are not supervising the regular operation of the transmitter. According to the station survey, 60 per cent of the stations will be interested in installing the equipment when it is authorized and available. Considerable interest is expressed in costs and technical details.

Station Expenditures

The statistics on 1959 station expenditures for equipment show that

(Continued on page 10)

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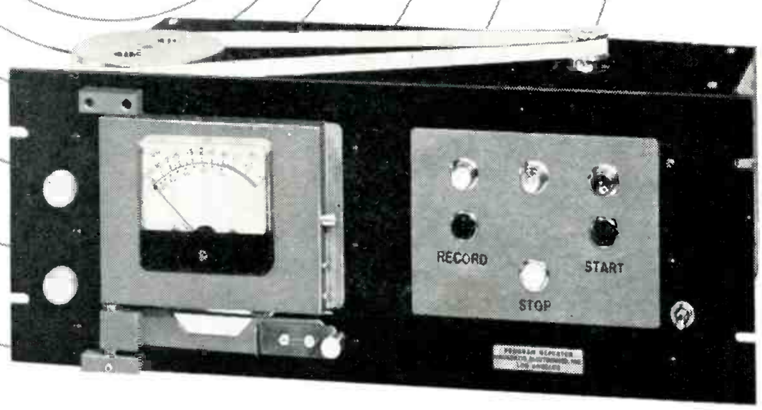

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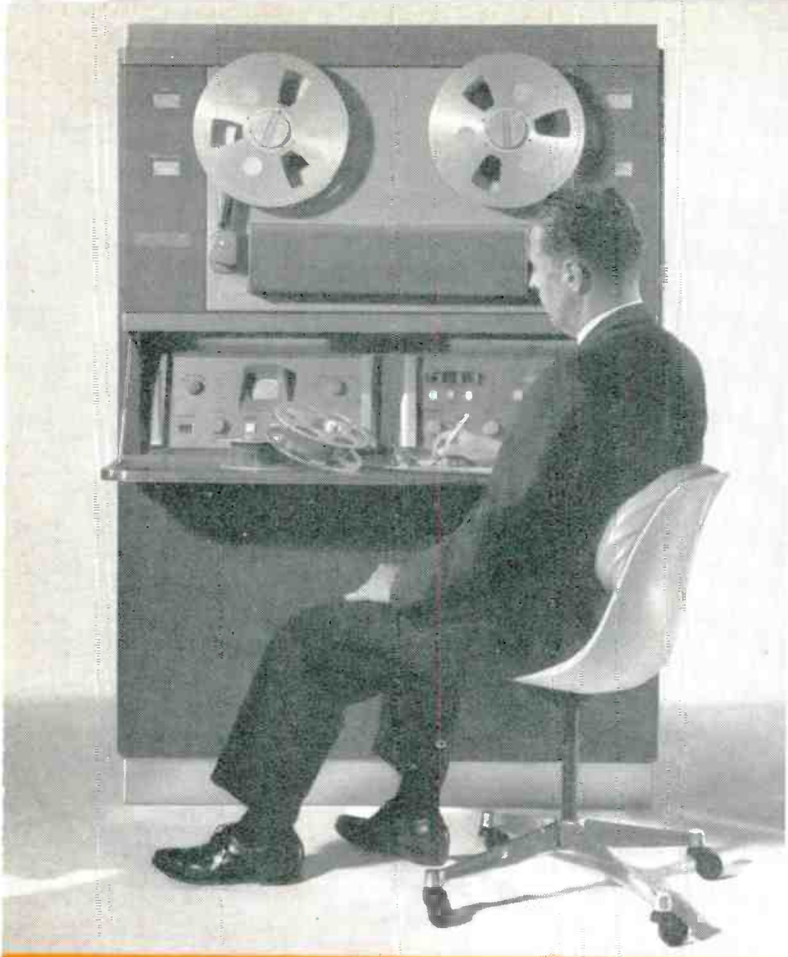

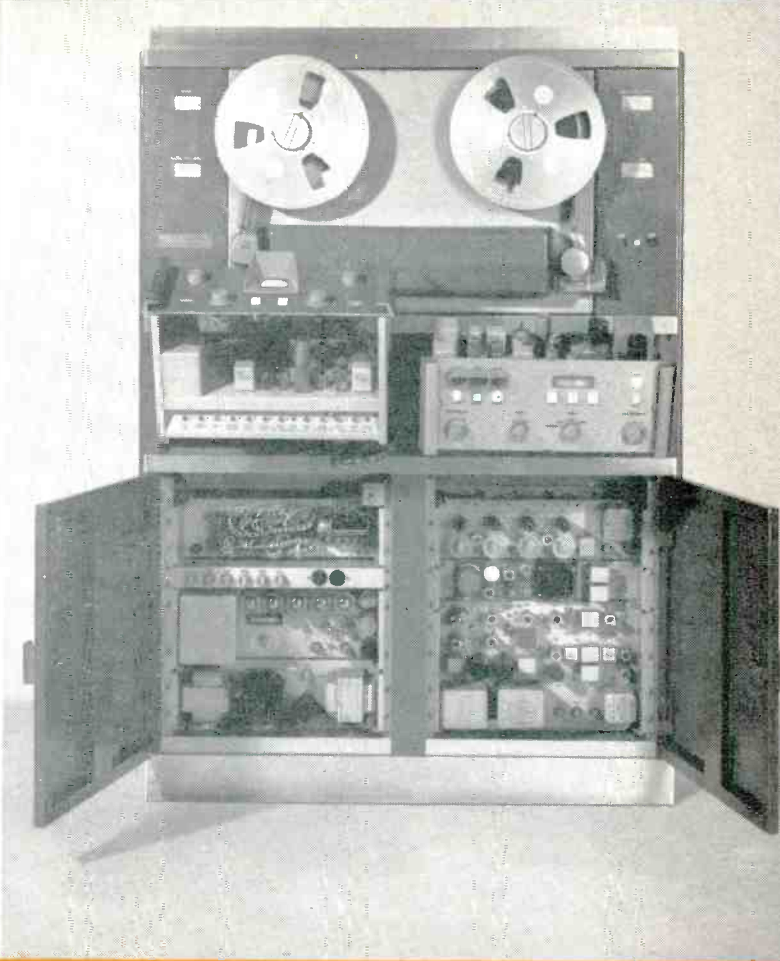

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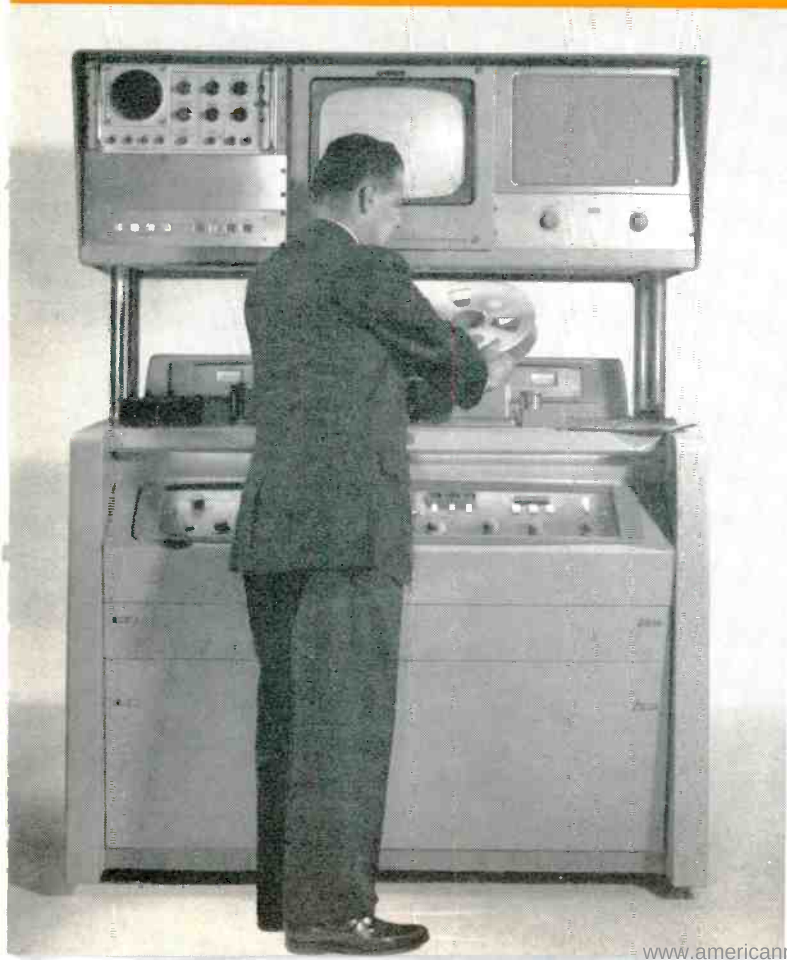

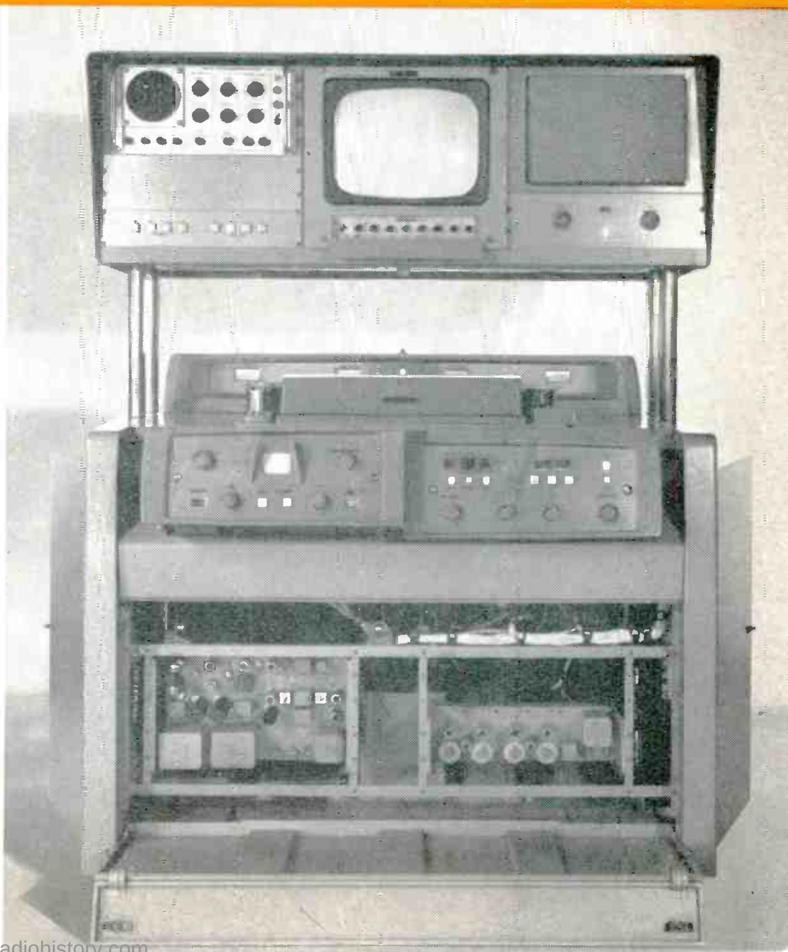

". . . single most purchased item is a microphone . . ."

PURCHASING TRENDS starts on page 4

the volume of purchases varies with the size of the facilities, as is expected. AM stations of 1000 watts and less reported that 34 per cent spent less than $1,000 for new equipment in 1959 and only 3 per cent spent over $20,000. Among the five- and ten-kilowatt stations with FM facilities only 2 per cent spent less than $1,000 while 27.5 per cent spent over $20,000. Approximately one-half of all 50-kilowatt stations spent over $20,000 for new equipment during 1959.

Television stations spent an average of $85,383 for equipment in 1959. AM-only stations spent $8,961, AM-FM stations spent $11,112, and FM-only stations spent $6,351. According to this, the total industry expenditure for radio equipment was approximately $37,500,000 and for television equipment it was $49,500,000.

Television Survey

The single item purchased most by television stations, as in radio, is microphones. Among all television stations 34.1 per cent report that they will purchase mikes in the near future. The second item on the list is picture monitors with 32.6 per cent of stations listing this as on the purchase list. Vidicon cameras are in demand, according to the survey, with 28.7 per cent of all stations planning to add this item. Video distribution amplifiers, microwave equipment, and special effects generators are also high on the list.

Many subjects were suggested as topics for the editorial pages of BROADCAST ENGINEERING. As in radio many readers would like to read of experiences, construction projects, techniques, and station layouts of other stations. We would accordingly like to receive any information of this type from readers who are interested in contributing. Among other subjects of top interest are methods of making Proof of Performance measurements, automation, microwave planning and installation problems, and color TV.

BROADCAST ENGINEERING wishes to thank everyone who took the time to complete and return the questionnaires.

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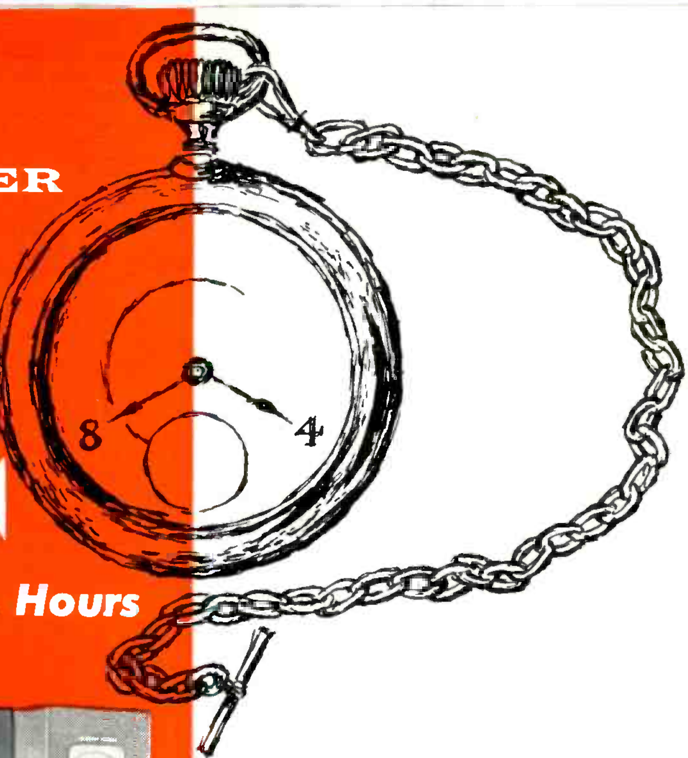

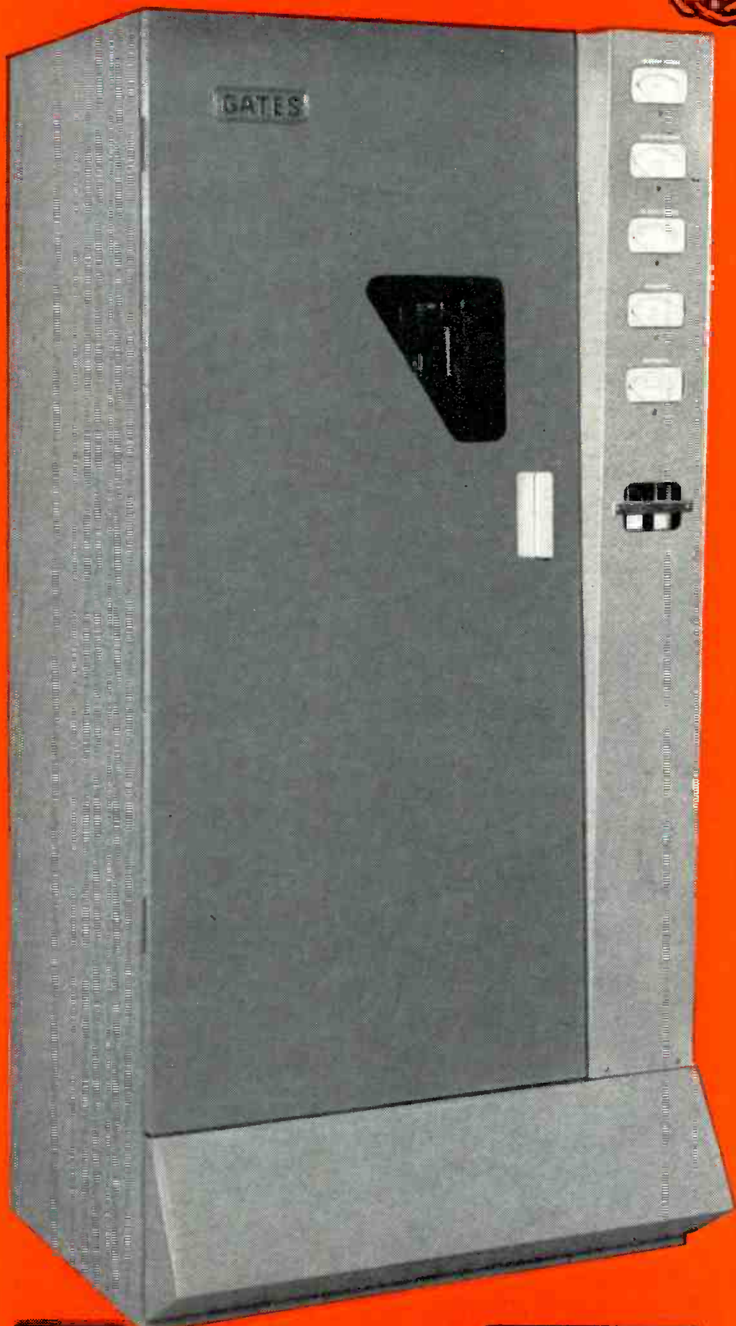

Every 3½ days (or 84 hours) since its introduction, broadcasters have bought a brand new, *newest* Gates BC-1T 1000 watt AM transmitter. What does this mean? It means that more BC-1T's have been sold to broadcasters than all other 1 KW models combined. It means that the Gates BC-1T is the largest selling 1000 watt broadcast transmitter manufactured in the *world* today. Here are 10 reasons why:

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- Crisp sparkling *new sound* highs through extended high frequency response.
- Lower than low noise via the largest filter system of any 1 KW made today.
- Inbuilt dummy antenna, full size for 100% modulation with fail safe included.
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- All relay control and protection, no circuit breakers. Easiest transmitter manufactured to remote control.
- Dual suction cooling with filtered air intake at bottom front.
- RF driver is modulated along with final amplifier for lower distortion at high modulation.
- Big Gates-made edgewound variable inductors in final tank and Pi-Net . . . no variable air condensers to flash over.

BC-1T price, $4,595.00 with tubes and crystal. For Class IV operation, 1000/250 watts, $4,670.00 complete. Delivery immediate. Terms where desired.

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A New Approach to Balanced Audio Levels

In the past, television viewers have registered complaints that portions of television programs are sometimes unpleasantly loud. CBS Television Network undertook an extensive study of television audio volume levels in order to explore fully the reason for these complaints. This article presents the findings of the study and describes a new approach to the problem of achieving balanced audio levels in television broadcasting.

By ROBERT B. MONROE*

THE new CBS study of television audio levels, which was an extension of similar studies undertaken some years ago, got underway late in 1957 with the establishment of an observation point in the CBS Television Network Engineering Laboratory where television programs could be monitored in an environment acoustically similar to the average home living room. To further simulate home listening conditions, the monitoring volume was maintained at a level similar to that normally used in the average home.

The laboratory observation point was fully equipped with measuring equipment to analyze and measure audio program material. Programs could be monitored by wire line directly from the originating studio or off-the-air, the latter signal having passed through the transmitter and its associated peak-limiting amplifier.

Observation of programs continued over a period of several months. During this time, a permanent record of audio levels was made by means of a recording volume indicator, the continued use of which has proven very valuable in regular operation. Where levels were considered questionable, magnetic-tape recordings were made to permit more detailed analysis.

OBSERVATIONS AND FINDINGS

It has been the usual practice in both radio and television broadcasting to transmit audio program material at a uniform peak volume level as read on a standard volume indicator. At first consideration, it might be thought that this practice would automatically result in all portions of the program material sounding equally loud. However, this is not always the case. The standard volume indicator was designed expressly for measuring the electrical magnitude of audio program signals for network program transmission purposes. It indicates the volume of an audio program signal, not its loudness. Inasmuch as loudness is subjective in nature, it does not readily lend itself to measurement. Accordingly, even though two program sequences may produce the same deflection on the standard volume indicator, it does not follow that they will sound equally loud.

Quite early in this study of television audio levels, it became evident that, as listeners had reported, some television program material did sound louder than other material. The "loud" material included filmed program inserts in live programs, some program opening and closing announcements, and some station-break announcements.

Reasons for Loudness Discrepancies

As the study continued, it was found that there are three distinct reasons for differences in the loudness of various portions of programs:

1. *Modification of Audio Waveform*. One of the factors influencing the apparent loudness of audio program material was found to be the use of techniques that alter the waveform (and hence the subjective effect) of an audio signal. The following practices all result in the altered audio signal sounding louder than the original even though both are transmitted at the same peak value as measured by a standard volume indicator:

a. *Volume Compression*. Program material that has been compressed, thereby restricting its original amplitude range, will sound louder than similar uncompressed program material.

b. *Reverberation*. Reverberant program material will sound louder than program material that is acoustically dead. This principle was the basis of J. P. Maxfield's "Liveness in Broadcasting" technique 8 introduced in 1947 and

*CBS Television Network, New York, N. Y.

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still in common use in radio broadcasting and phonograph record manufacture. Maxfield reported the possibility of a 6 to 8 db apparent increase in loudness using acoustically live program pickup techniques.

c. *Bandwidth Restriction.* When wave filters are employed to attenuate low frequencies, a considerable portion of the energy is removed from an audio signal and its level, as read on a standard volume indicator, must often be raised if standard transmission level is to be maintained. Furthermore, most of the remaining sound energy occurs in the middle-frequency range where the ear is most sensitive. Program material so restricted in bandwidth will, therefore, usually sound louder than full-bandwidth program material (although it suffers in faithfulness of reproduction). By the same token, sounds having predominantly mid-frequency components will exhibit a similar apparent greater loudness.

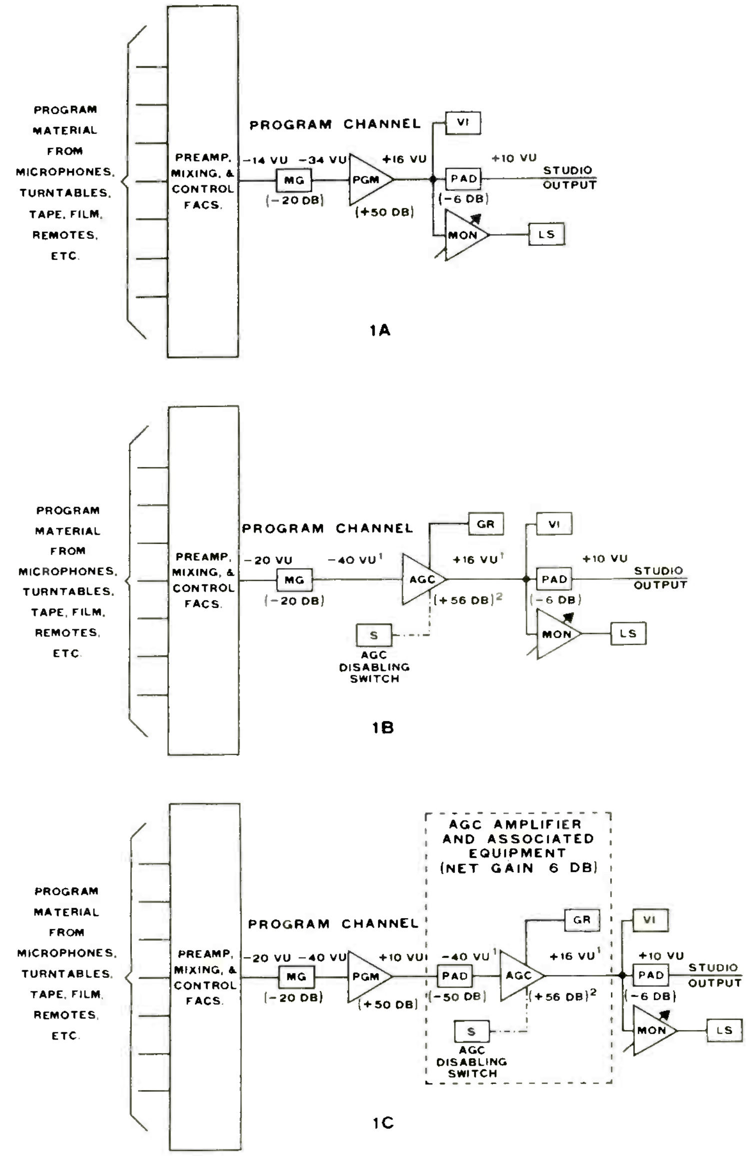
The foregoing techniques are often employed (individually or severally) in producing the soundtrack of sound-on-film television program inserts. To a considerable extent, these practices account for such filmed inserts sounding louder than the unmodified live-studio sound pickup.

2. *Listener Reaction.* Another factor that influences the apparent loudness of television program material is associated with listeners' subjective reactions to certain types of sound, such as:

a. *Irritating Sounds.* An irritating voice, like any irritating sound, often seems louder than a pleasant one even though both may be reproduced at the same volume level.

b. *Strident Delivery.* Speech delivered in a rapid-fire, strident manner with few pauses, if any, sounds louder than speech delivered in a more conversational manner.

In this study of audio levels it was noted that program material delivered in a rapid, urgent manner by an announcer or performer with



LEGEND

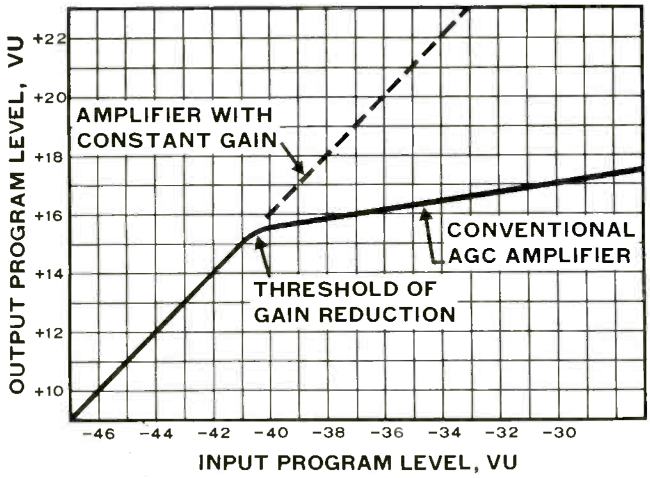
AGC	AUTOMATIC-GAIN-CONTROL AMPLIFIER
GR	GAIN REDUCTION METER
LS	MONITORING LOUDSPEAKER
MG	MASTER GAIN CONTROL
MON	MONITORING AMPLIFIER
PAD	RESISTANCE ATTENUATION NETWORK
PGM	PROGRAM AMPLIFIER
S	AGC DISABLING SWITCH
VI	VOLUME INDICATOR

(+56 DB)	GAIN OR LOSS OF EQUIPMENT. NORMAL OPERATING SETTING.
+10 VU	PROGRAM LEVEL

[1] PROGRAM LEVEL SHOWN IS APPROXIMATE. SEE FIG. 3 FOR EXACT LEVEL.

[2] GAIN SHOWN IS GAIN BELOW THRESHOLD OF GAIN REDUCTION.

Figure 1. Simplified single-line diagram of studio audio systems. (A) shows a typical studio audio system with a conventional constant-gain program amplifier. (B) shows the same studio audio system modified to use an AGC program amplifier. At times, it is desirable to retain an existing audio system intact and add AGC by merely introducing an AGC amplifier following the program amplifier. Such an arrangement is shown in (C).



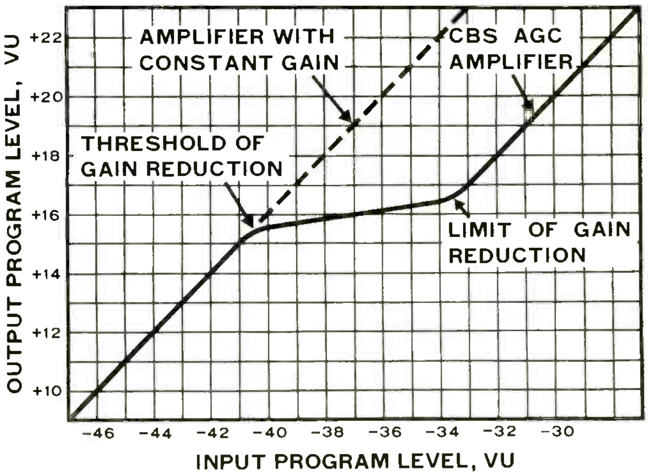


Figure 2. (Left) Characteristics of a conventional AGC amplifier.

Figure 3. Characteristics of the CBS AGC amplifier which limit gain reduction to a maximum of 6 db. The levels shown are program levels. Amplifier set-up is accomplished using a sine-wave signal 4.5 db higher than the indicated program levels. Because of the usual 6 db line pad, an amplifier output level of + 16 VU is required to deliver a transmission level of + 10 VU to the studio outgoing program line. As can be seen, an increase in input level of 7 db is required to increase the amplifier output level from + 15.5 to + 16.5 VU. This corresponds to 6 db of gain reduction. The amplifier has an attack time of 25 milliseconds and a recovery time of 0.5 seconds.

a slightly irritating quality in his voice invariably sounded louder than more normal adjoining portions of a program.

3. *Program Peaking Practices.* The third and perhaps the most important single factor that was found to influence the loudness of television program material is the program peaking practice employed in controlling audio levels at the audio console of the originating studio. Over ten years ago, after extensive investigation, program transmission standards were established by CBS in order to produce programs with audio levels as pleasing as possible to the listener.

Occasional cases of loudness discrepancies resulting from incorrect program peaking practices were observed during this study indicating that the program transmission standards were not being observed. However, unlike loudness discrepancies resulting from the reasons discussed in the preceding paragraphs, loudness discrepancies resulting from incorrect program peaking practices are readily visible as nonstandard deflections of the volume indicator.

A SOLUTION

As previously indicated, a most important requirement in achieving pleasing sound levels is good control of audio program peaks at the audio control console of the originating studio. Nevertheless, good audio control in itself will not reduce excessive loudness when it is caused by (a) the use of techniques that modify the audio waveform, or (b) the reaction of listeners to certain sounds. Other means must be used to make these types of program material match other portions of the program in loudness.

During this investigation, a relatively simple method of improving television audio level discrepancies was found. This new method entails the use in each studio of an automatic-gain-control amplifier with special, carefully chosen, gain-reduction characteristics and an associated gain-reduction meter. The new method also entails revising operating techniques to take into account readings of the gain-reduction meter. This new and highly effective approach to balancing television audio levels is described in some detail in the following paragraphs.

Automatic Gain Control

An automatic-gain-control (AGC) amplifier is one which automatically reduces its gain when an audio signal passing through it exceeds a predetermined threshold level. By its fast and automatic action, the AGC amplifier provides an excellent means of

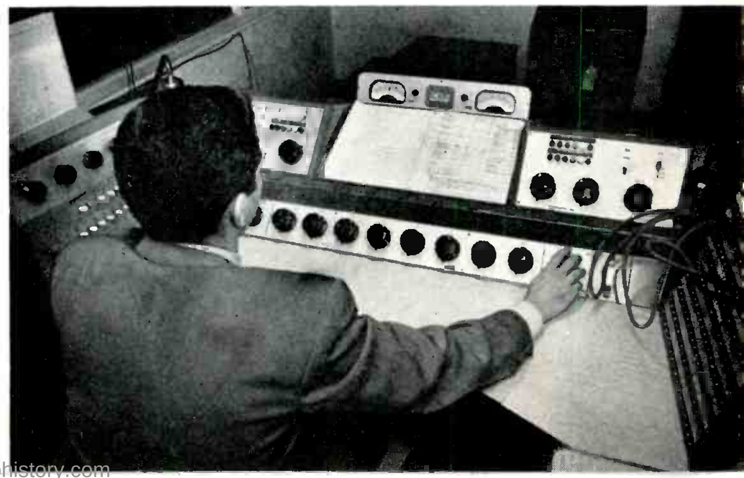


Figure 4. An audio control console modified for AGC. The meter to the left is the volume indicator, the one to the right is the gain-reduction meter. The gain-reduction meter was formerly a second volume indicator. It has been equipped with dual scales (VU and gain reduction) and can be quickly restored to its original volume indicating function in the emergency audio channel by operation of the small switch at its left. The other small switch to the right of the volume indicator serves to disable the automatic-gain-control when desired.

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Main Channel circuitry is more reliable because a pulse-counting type detector, utilizing a tube, is used in place of a discriminator-coil/diode combination. This circuitry is original and exclusive with Electro-Plex. Drift is a thing of the past and the receiver will stay on frequency from a cold start!

In the sub-carrier section, heterodyne circuits have been avoided due to the several added adjustments required to keep them in alignment.

The multiplex circuit is furnished on a separate mounting plate which may be easily removed. Other special intermediate and control circuitry may be supplied in this area when desired.

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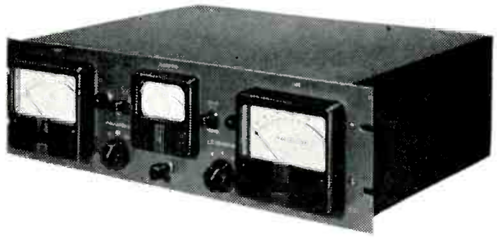

8-A MODULATION MONITOR

Demodulator circuits for both main and sub-channels are included in the monitor whose output may be checked aurally through a separate amplifier and speaker system.

Compact design: 5¼" x 19 engraved relay rack panel. Depth behind the panel 13".

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holding varying audio signals at a safe level. The associated gain-reduction meter indicates in decibels the amount by which the gain of the amplifier has been reduced to handle an audio signal that exceeds the threshold level.

Such an automatic level-controlling device is of considerable help in controlling widely varying audio levels and helps the audio operator do a better job of controlling a show. However, the automatic level-controlling action, in itself, does nothing to balance loudness differences that do not indicate as such on a volume indicator. On the other hand, the gain-reduction meter associated with the AGC amplifier does provide a new monitoring means which supplies quantitative data that permit the operator to make simple adjustments that will equalize loudness discrepancies.

Assume an AGC amplifier is installed in a studio audio channel and adjusted so that gain reduction takes effect one-half decibel below the volume-indicator reference point. If the audio operator now controls program levels in such a manner that 6 db of gain reduction is indicated on normal program material, but no gain reduction is indicated on louder-than-normal program material, loudness discrepancies will be greatly alleviated or even entirely eliminated. This balancing of unequal loudness levels is brought about in two ways. First,

TABLE I

REVISED CBS AUDIO PROGRAM TRANSMISSION STANDARDS FOR TELEVISION

		VI PEAKS	GAIN REDUCTION
A. SPEECH (live)	1. Normal passages	Peaks of 100	6 db
	2. Low-level passages	Not less than 40	None
B. MUSIC (live); C. RECORDED PROGRAMS (film, transcriptions, and magnetic tape); D. COMMERCIALS (both recorded and live*); E. PROGRAM OPENINGS AND CLOSINGS, STATION-BREAK ANNOUNCEMENTS.	1. Normal passages	Peaks of 100	None
	2. Low-level passages	Not less than 40	None
F. SYMPHONIC MUSIC	1. Normal passages	Peaks of 100	None
	2. Pianissimo passages	Must always move VI	None
G. APPLAUSE AND AUDIENCE REACTION		Maximum peaks of 70	None

H. TRANSITION

The transition from a low-level passage to a normal-level passage (or vice versa) must be in steps of not more than 4 db, preferably less (i.e., peaks of 40, then 60, and finally 100, or vice versa). Similarly, two succeeding passages (voice, then music, or voice, then a sound effect, etc.) must not differ in level by more than 4 db, preferably less, even when a contrast is intentional.

I. PEAKING PRACTICE

Peaking program material according to the prescribed standards means gaining in such a manner that the maximum VI peaks reach the specified values as frequently as possible without being inconsistent with the program content. It is understood that occasional peaks beyond the prescribed values are unavoidable, but these are to be kept to a minimum.

*Excluding live commercials presented in a conversational manner. These should be treated as in A.

the protection against excessive volume indicator deflections afforded by the AGC amplifier gives the operator confidence to transmit normal program material at a higher average volume level. Second, the small amount of resulting compression applied to the signal slightly increases its apparent loudness.

The method of balancing audio levels outlined above reduces itself to the following general operating rules:

1. Use 6 db of gain reduction on program material of normal loudness.

2. Use no gain reduction on louder-than-normal program material.

These generalized operating rules are set forth later in more detail.

Application of AGC

Basically, a studio audio system provides facilities for mixing, amplifying, and controlling audio program material from studio microphones, film projectors, transcription turntables, and other program sources. A monitoring loudspeaker is provided for aural monitoring to achieve the desired balance, while a volume indicator provides the visual monitoring means to adjust the studio output to the standard transmission level. Fig. 1A shows a simplified single-line diagram of a typical studio audio system.

1. *Adding AGC to Studio Channel.* Fig. 1B shows the typical studio audio system of Fig. 1A modified to employ AGC. In this case, the constant-gain program amplifier has been replaced with an AGC amplifier together with its associated gain-reduction meter and a switch for disabling the AGC action when desired. The gain of the AGC program amplifier (at program levels below the threshold of gain reduction) has been set 6 db higher than that provided by the constant-gain program amplifier in Fig. 1A. This increase in gain compensates for the 6 db lower gain under conditions of 6 db gain reduction, *i.e.*, the net program channel gain with 6 db gain reduction is the same as the constant-gain system of Fig. 1A.

Fig. 1C shows an alternate method of adding AGC to a studio channel with minimum changes to the existing system. In this case, the AGC amplifier follows, rather than replaces, the existing program amplifier. A resistance attenuation pad is used to restrict the AGC amplifier net gain below the threshold of gain reduction to 6 db.

2. *Modified Gain-Reduction Characteristics.* Conventional AGC amplifiers have gain-reduction characteristics of the general shape shown in Fig. 2. As this figure shows, the amplifier gain is constant up to the threshold point. From the threshold point on, gain reduction takes place at a rate determined by the slope of the amplifier's input-output curve.

Early in the experiments, it was found that gain-reduction characteristics of conventional AGC amplifiers were not completely suitable for this application. When used, a sudden sharp sound, such as the banging of a gavel, would be followed by a short but noticeable period of low-level audio. This was the result of excessive gain reduction on unanticipated high program peaks.

This difficulty was solved by modifying the amplifier characteristics as shown in Fig. 3. With these modified characteristics, only a limited amount of gain reduction (in this case a maximum of 6 db) can be obtained after which the amplifier gain again becomes constant, but with 6 db lower gain. Therefore, excessive gain reduction can never, intentionally or unintentionally, be applied since the maximum available is 6 db. When this modest limit is placed on the gain reduction, the automatic gain adjustments of the amplifier can never be detected.

It should be noted that in both conventional AGC amplifiers and the CBS AGC amplifier, the exact point at which the threshold of gain reduction occurs is dependent upon the peak factor of the input signal. The points shown on Figs. 2 and 3 are for average program material.

Operation

When an AGC amplifier has been installed in a studio channel for the purpose of balancing audio levels, a revision of program transmission standards is required. These revised standards must take into account the readings of the new gain-reduction meter which is used along with the volume indicator in controlling program levels. (Fig. 4). Revised CBS program transmission standards developed for this purpose are given in Table 1. Complete understanding of the principles involved and strict adherence to the revised

(Continued on page 31)

MODERN FM TRANSMITTER

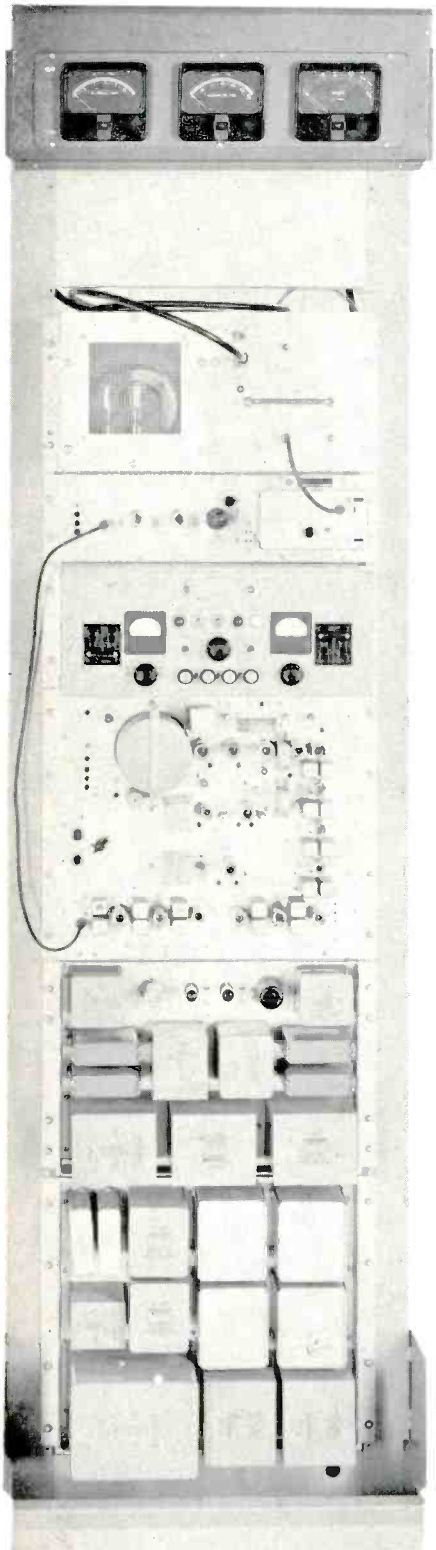

Figure 1. A complete 250 watt transmitter and exciter with outer case removed.

Design features of FM transmitters manufactured today offer improvements over earlier equipment. Multiplexing has imposed more stringent requirements and other advantages have also resulted from recent developments. The following article describes these features and includes a description of one of the transmitter lines being currently offered.

IMMEDIATELY after World War II, when commercial FM broadcasting had its birth, the broadcaster had his choice of transmitters from eight major firms. Each type featured certain unique engineering innovations and individual approaches toward meeting the F.C.C. standards.

When the new offspring of the industry failed to blossom, the market for the sale of new transmitters evaporated and little research or

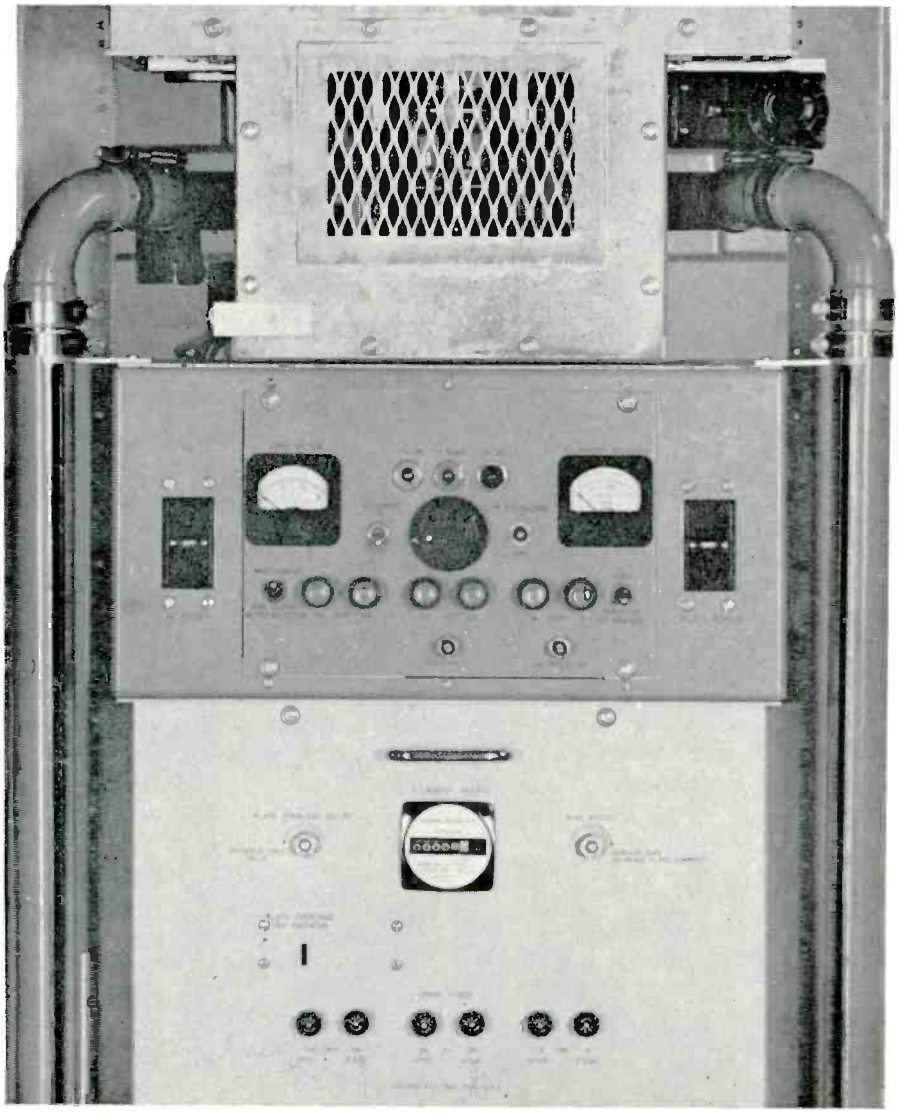

Figure 2. Five kilowatt amplifier front.

DESIGN

By DWIGHT "RED" HARKINS*

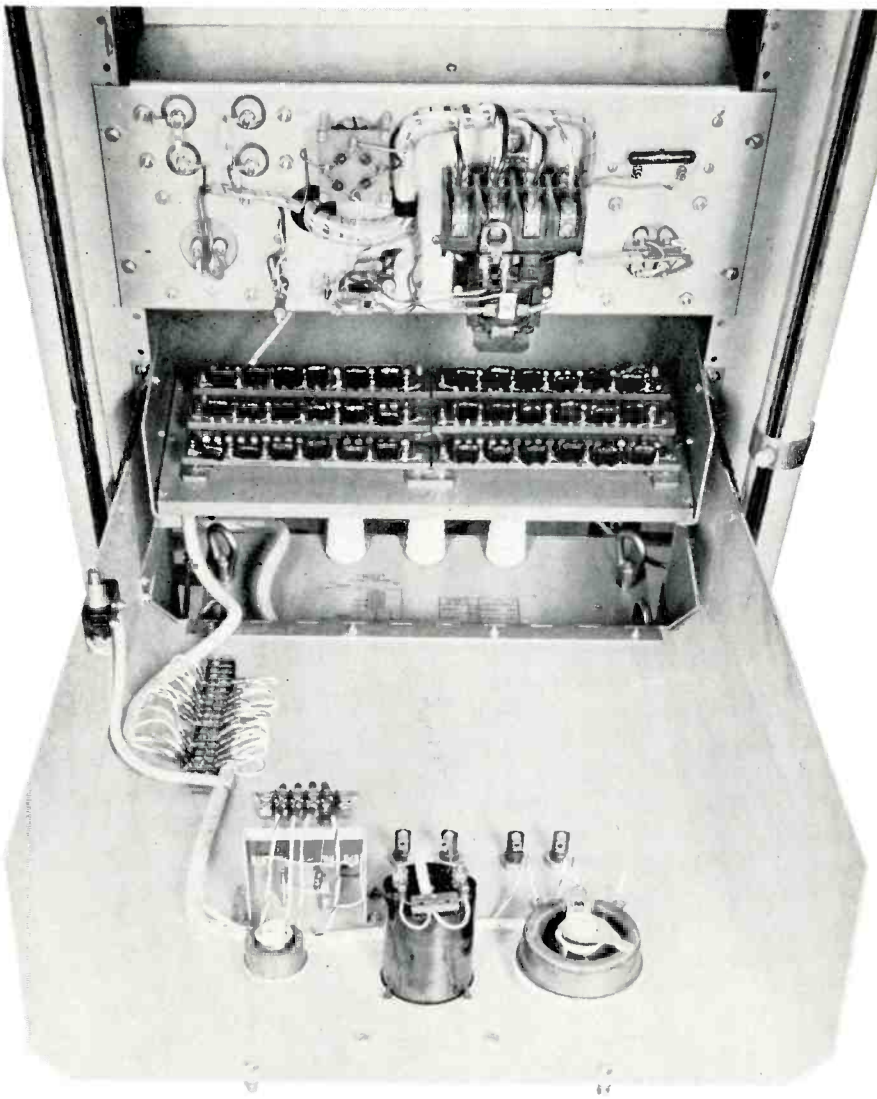

Figure 3. Five kilowatt amplifier front panel cover of power supply opened to show various components.

attention was given toward the improvement or further development of the units that first appeared on the market. This situation continued until just the past few years, when renewed activity in the FM broadcasting field created a new demand for transmitters.

One of the contributing factors toward this renewed activity has been the advent of FM multiplexing, which at the same time pointed up the shortcomings of the units designed to meet the requirements of another decade.

When multiplexing first was approved in 1955, all of the early installations were accomplished by modifying existing equipment, since new equipment was not available. In the process of exchanging exciters for more modern units that would accommodate the multiplex signals, it was discovered that the power amplifiers as well as the antenna systems left much to be desired in certain cases.

The first goal of the modern transmitter, then, is to design "out" all of the undesirable features discovered through actual operations during the post-war years. A summary of the undesirable features that exist in the early vintage transmitters clearly points the way toward the modern transmitter design.

Some of the unwanted features found in the early FM rigs are as follows:

1. *Center frequency instability*. This was usually caused by automatic frequency control of reactance tube modulated oscillators. The circuits were too complex and difficult to service and in many cases were "under engineered" in the first place.

2. *Special tube requirements*. Many of the early transmitters used tubes in the high power amplifiers that were designed just for that transmitter thus making them expensive and increasingly hard to get.

3. *Critical neutralization*. The mechanical and circuitry adjustments of the older transmitters often made correct operation an impossibility. Multiplexing requirements were more stringent than just the coarse adjustments required to stop self-oscillation.

4. *Insufficient metering*. Several of the old models provided no metering facilities for grid currents in the high power stages. Others used a multimeter arrangement that made it impossible to observe more than one circuit at a time, such as is required to check for dynamic neutralization.

5. *Improper coupling between stages*. Most of the older transmitters failed to provide means of adjusting and measuring the proper termination of the R.F. coupling between power stages resulting in high intermodulation when multiplexing as well as power losses.

6. *No provision for remote control*. Some of the early units practically had to be rebuilt to provide remote control functions.

7. *Large space requirements*. Early design called for plenty of floor space.

From these unwanted features

*Harkins Radio Co., 4444 E. Washington St., Phoenix, Arizona

"proven in the field" we could start to design a modern FM transmitter, but first we should turn to the engineering feats of television and steal a few ideas that have been well engineered in that field. TV like FM deals with the amplification of VHF R.F. power. Also in TV exists the problem of bandwidth together with phase vs. frequency characteristics.

Modern FM transmitters utilize the proven techniques developed in television transmitter design and the improvements developed in FM design through the field experience of the past decade.

The design features of one of these lines of FM transmitters which is manufactured by Standard Electronics is described in this article.

Available with output powers from 250 watts to 10 KW., the line of Standard Electronics transmitters all use the same type of exciter. This unit uses the Serrasoid* modulation circuit together with an auxiliary phase modulator for the introduction of the multiplex subcarriers at a high frequency stage of the multiplier chain.

The exciter-modulator unit delivers 10 watts of power at carrier frequency. Technical features of the Serrasoid unit that permit ultra fidelity of the audio range together with the circuitry surrounding phase linear multiplication have been covered in detail both in earlier articles by myself in Broadcast Engineering and in Section 8-16 of the new NAB handbook.

A 250-watt amplifier follows the modulator-exciter unit to make up a complete transmitter of 250-watt power all in one compact self-contained cabinet. This unit features the modern diffused junction silicon diodes in the high voltage and bias power supplies, thus eliminating the heat and replacement problems of the usual tube type rectifiers.

Full built-in remote control facilities are provided including the remote adjustment of power output. The front panel metering and tuning adjustments allow for correct alignment of each circuit. The 4X250B ceramic tube is positively neutralized by a unique circuit adjusted at the factory that insures trouble-free operation without field adjustments.

*Trademark Radio Engineering Laboratories.

This 250-watt unit can be used to drive either the 5 KW amplifier or a pair of 5 KW amplifiers to obtain 10 KW output power.

The 5-KW amplifier uses the TV-proven 5924A power triode in a grounded grid circuit that offers the utmost in stability and yet offers unusual power gain. Its TV design permits this amplifier to have a 3 MC. bandwidth at the 3 db. points which is unusual for an FM transmitter and contributes to the success of multiplexing.

As shown in the illustrations, the semi-conductor diffused-junction silicon diode type rectifiers permit the entire 5-KW amplifier to be in a self-contained cabinet. An entire rectifier leg is constructed on an easily replaced plug-in strip.

One of the features of both the 250-watt and 5-KW amplifiers is that they contain built-in directional couplers that enable positive reading of forward and reflected power. This feature must not be overlooked as in no other way can absolute correct tuning be achieved for multiplexing. The input to the 5-KW stage is adjusted by two tuning stubs separated by an eighth wave length. These are adjusted from the front of the cabinet until minimum reflected and maximum forward power are indicated on the directional coupler meter of the 250-watt stage. This, then, assures you of ideal flatness and phase linearity at this critical point.

The plate circuit of the 5-KW stage consists of a quarter wave line

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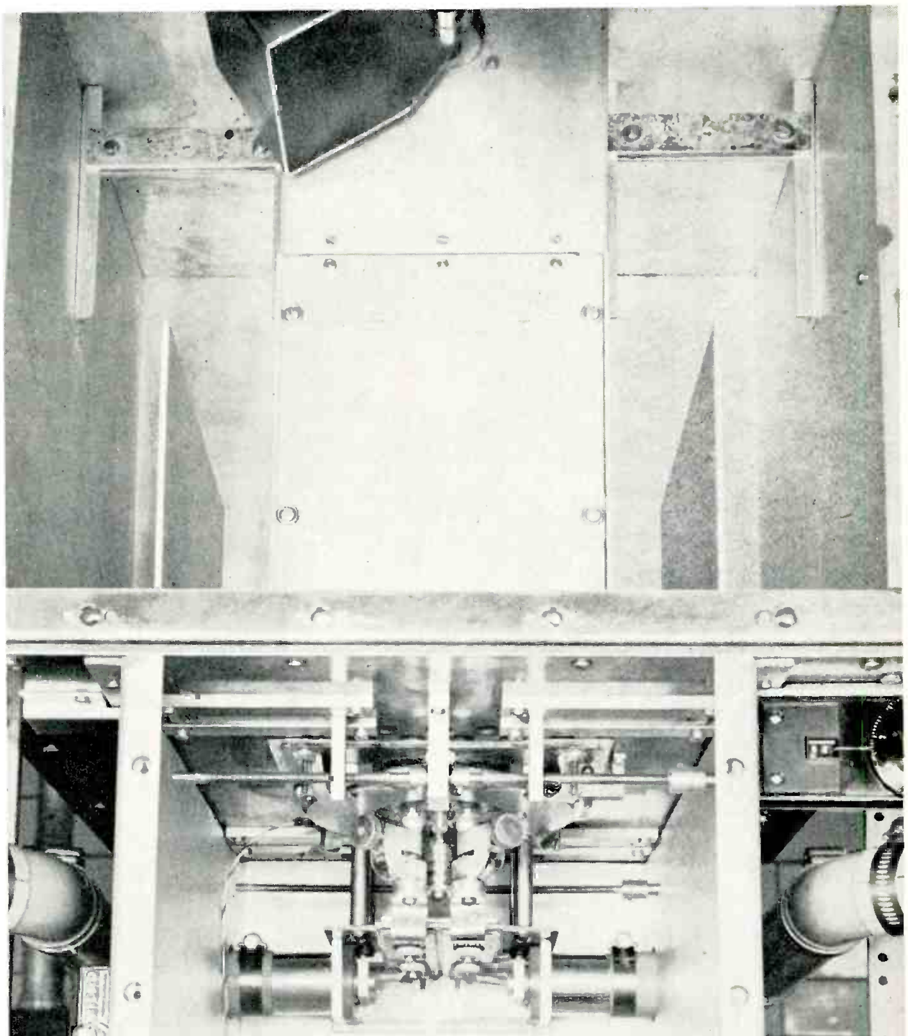


Figure 4. Cavity, final tube socket, and connections for five kilowatt amplifier.

CBS Audio

Starts on page 12

standards by operating personnel is essential.

Additional Benefits

In addition to the improvement in sound transmission already described, the use of gain reduction as detailed above will also provide the following additional benefits:

1. Listeners have sometimes reported that musical portions of programs sound too loud, *i.e.*, music sounds louder than speech. The AGC amplifier, together with the revised program transmission standards, will also improve or entirely eliminate this loudness discrepancy.

2. By automatically controlling unanticipated high program peaks, the AGC amplifier permits the audio operator to do a better audio mixing job.

CONCLUSION

The method of balancing television sound levels described above has proven so effective that automatic-gain-control amplifiers have been included in the control room audio facilities of all CBS-owned television stations. Since this was done, listener complaints of loudness discrepancies have been effectively eliminated. Furthermore, careful listening tests have shown that since this new equipment was installed and the revised transmission standards put into effect, transitions from sequence to sequence and from program to program are quite smooth with no noticeable change in loudness.

It is believed that the use of AGC amplifiers in the manner described marks another step forward in television broadcasting and represents one more technical advance to make television viewing as pleasant as possible.

This CBS Television Network project was under the general direction of A. B. Chamberlain, director of engineering, and R. S. O'Brien, director of audio-video engineering. It was carried out under the immediate direction and with the active collaboration of Howard A. Chinn, chief engineer. Acknowledgment is hereby made to D. R. Wells for his patient and meticulous laboratory work on this project.

PLANNING DIRECTIONAL ANTENNA SYSTEMS

A knowledge of the factors involved in directional antenna systems is important to all broadcasters planning new facilities or changes in existing facilities. The basic requirements which have to be determined and the design considerations which should be understood are pointed out in the following article.

By FRED DAMM* and DOUGLAS HEDIN†

DIRECTIONAL antenna systems are required to prevent stations from interfering with the established service areas of other stations, or to more effectively service areas without wasting power in relatively unpopulated or undesired directions. Few, if any, directional antenna systems can be exactly alike because each must be designed for a unique combination of pattern, power, frequency, terrain, antenna towers, etc., and results in a piece of custom-built equipment that is useful to no other station without possibly radical modification. Further, viewpoints and design practice among designers of this type of equipment vary so much that, generally, no two designers would build a piece of equipment the same way for the same station. Therefore, a purchaser of phasing equipment cannot merely look through a catalog and say, "I'll take this one." However, he can select the supplier of the equipment by objectively evaluating the reputation, capabilities, techniques, personnel, and experience of his supplier in the phasing equipment field.

After your consulting engineer has made channel studies for an available frequency, he will design an array to fit your location, frequency, and other requirements. He will determine the pattern shape and size in both the vertical and horizontal planes, the maximum expected operating values of fields in both the nulls (minimum signal areas) and the lobes (maximum signal areas), the proper size, shape, height, spacing, and orientation of the antenna towers, and the phase relationships and amplitude ratios of the radiation fields of the individual antennas. This information will then be submitted to the FCC with the application for your construction permit.

When your construction permit is granted, a manufacturer's representative will call on you to obtain the information necessary to design the phasing equipment that will properly complete your antenna system. The manufacturer will then design and construct easily adjusted and highly stable phasing equipment which will provide the proper power division, phase relationships, and impedance matching, with a latitude of adjustment great enough to accommodate all of the variations from the theoretical values that may occur, to produce the exact pattern designed by your consultant.

Design Data

The data needed to properly design phasing equipment, which will be supplied by your consultant, include the following:

1. The call letters and location of the station, the frequency of operation, the operating power both day and night, and the mode of operation (whether the station is operated directionally full time with the same pattern DA-1; night time only, DA-N; or full time with different patterns day and night, DA-2. DA-D indicates daytime only with a single pattern and is the same as DA-1.

2. A description of the towers. Generally, the name of the manufacturer, the type number, and the height of a tower is sufficient to describe it. This information will indicate whether the tower is guyed or self-supported, whether it is of uniform cross section, and the cross-sectional dimensions.

3. The spacing and orientation of all the antennas in the array. This data is needed to determine the exact spacing between each pair of antennas. The spacing, and the electrical height, provide the information needed to calculate the mutual impedance between each pair of antennas. The mutual impedance is used to compute the base-operating impedances.

4. The phase relationship and the ratios of the radiation fields. This information, along with the spacing and orientation of the towers, determines the shape of the pattern and makes it possible to calculate the base impedances of each of the antennas, the current flowing in each of the antennas, and the division of the total power.

5. The type and length of each transmission line.

Typical System

A directional antenna phasing and branching system consists of: A branching circuit in which the power is divided in precisely the amounts of power necessary to give the proper ratio of fields from the individual antennas; an impedance matching circuit to match the power

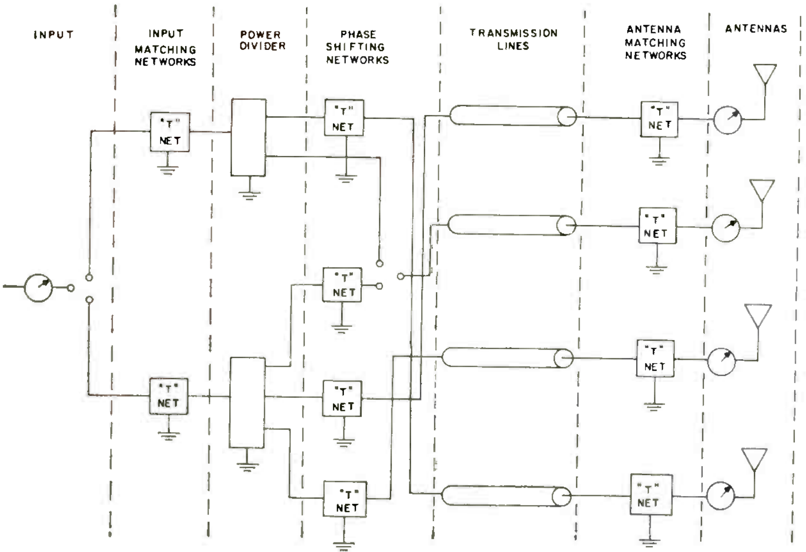


Figure 1. A block diagram of a typical directional antenna installation.

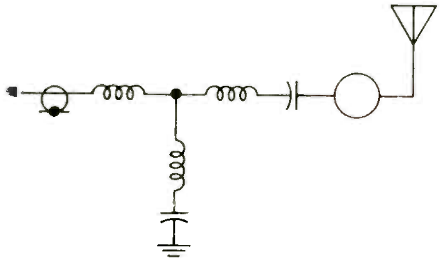


Figure 2. Antenna T-network.

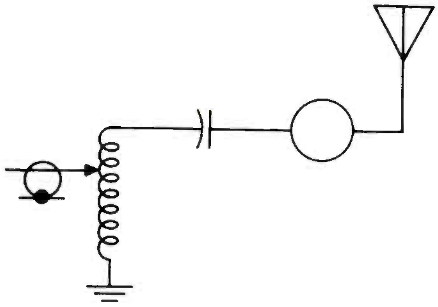


Figure 3. Antenna matching circuit.

divider input impedance to the common point impedance at which the power input is measured; phase shifting networks in series with each of the transmission lines going to the individual antenna towers; the transmission lines themselves; and the impedance matching network between each of the transmission lines and its associated antenna tower. A typical system is shown in figure 1.

Designing the System

One of the first steps in the design of phasing equipment is determining the base self-impedances of each of the towers in an array, and the base mutual impedance between every combination of pairs of antennas. When the spacing of the towers in the array, the necessary ratio of the fields, and the phase relationship of the fields are known, it is relatively easy to calculate the base operating impedance of each of the antennas in the array.

The phase shift occurring in each of the transmission lines is then determined so that the required phase shift from the branch point to each antenna may be found and so a satisfactory phase shift may be as-

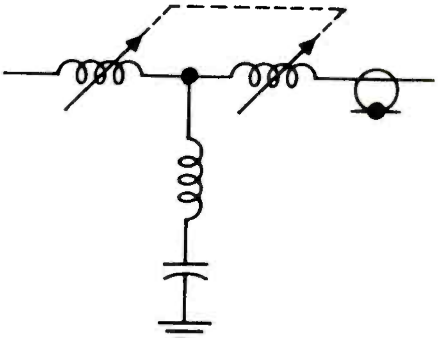


Figure 4. Branch point phase shifter.

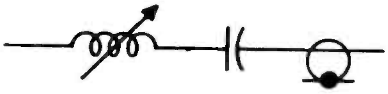


Figure 5. Phase shifter for small phase shifts.

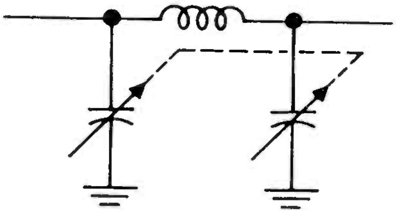


Figure 6. Pi-network.

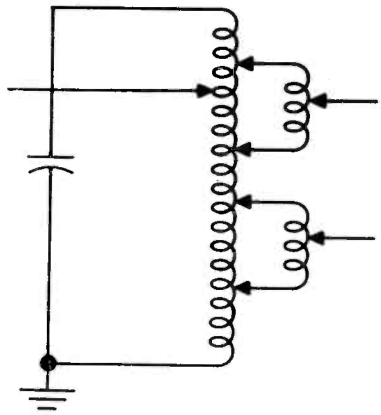


Figure 7. Simple tank circuit power divider.

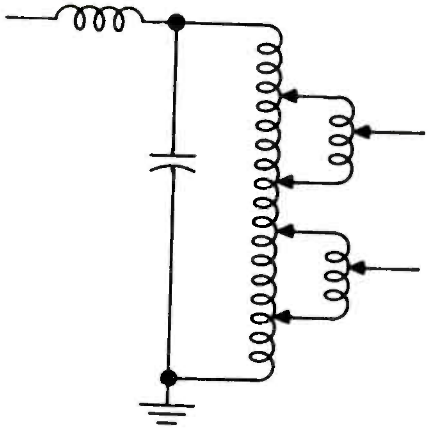


Figure 8. Modified simple tank circuit power divider.

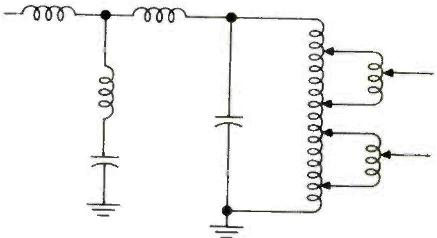


Figure 9. Modified simple tank circuit power divider with T-network input.

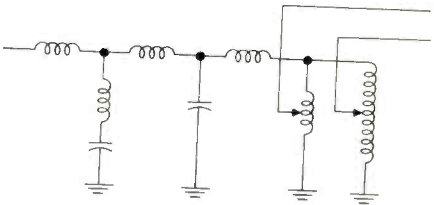


Figure 10. Modified power divider with variable coils.

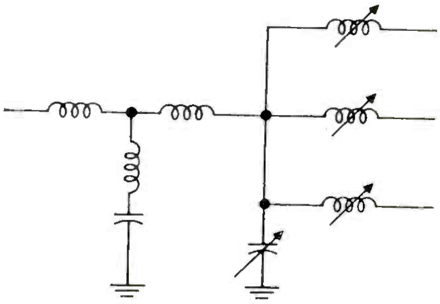


Figure 11. Common point circuit.

*Phase design consultant, Collins Radio Co.
†Engineering Writer, Collins Radio Co.

signed to each of the phase-shifting networks adjacent to the branch point and to the impedance-matching networks at the antennas.

The impedance-matching networks at the antennas are usually T-networks (figure 2) that provide an impedance match and the phase shift required, and which may be adjusted to compensate for any variations of electrical characteristics of the array that may be encountered.

If extremely low values of base operating resistance are encountered, a different type of circuit (figure 3) is justified. This may be a tapped coil between antenna and ground with the transmission line connected to the tap or it may be merely a series reactive element, a coil or capacitor or both, to tune out the antenna reactance with impedance matching accomplished in the transmission line and the phase-shifting network at the branch point. In all cases, the antenna reactance should be tuned out by a reactance of opposite sign.

The type of transmission line is usually determined by the customer, and the lengths of the lines are ordinarily determined by the position of the transmitter building and the towers. It is extremely important that the designer of the phasing equipment know the length and type of all transmission lines to be used.

The phase shifters adjacent to the branch point, or in the phasing cabinet, are usually T-networks (figure 4) and usually use variable coils in the series arms which are ganged together mechanically and provided with a front panel control.

Where only a small amount of phase shift is required, a series coil and capacitor (figure 5) are used.

If extremely high currents are encountered, a pi network (figure 6) with variable vacuum capacitors in the shunt arms of the network may be used.

The configuration of the power divider or branching network probably varies more than any other circuit in the system. The power divider may be a simple tank circuit with an input tap adjusted to the required input impedance and output taps adjusted to give the required power division (figure 7).

Some engineers prefer a modification of the simple tank circuit (figure 8), in which an inductor is connected in series with the input, and the tank capacitance is increased. This is equivalent to a tank with an input L-network, and permits the input impedance of the circuit

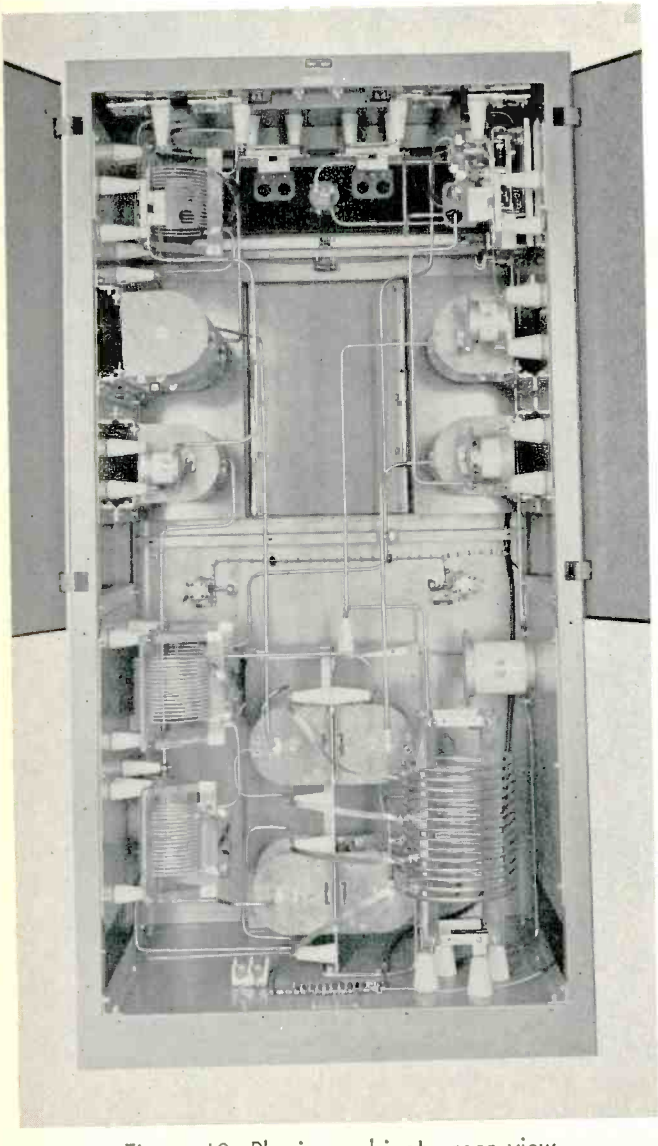


Figure 12. Phasing cabinet—rear view.

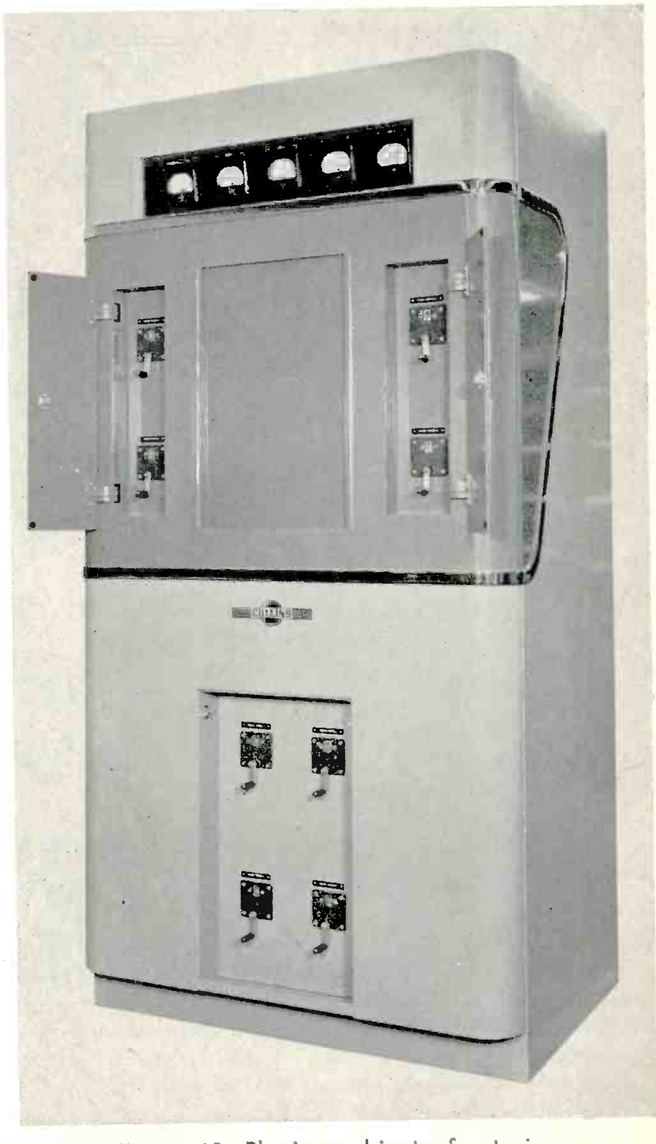


Figure 13. Phasing cabinet—front view.

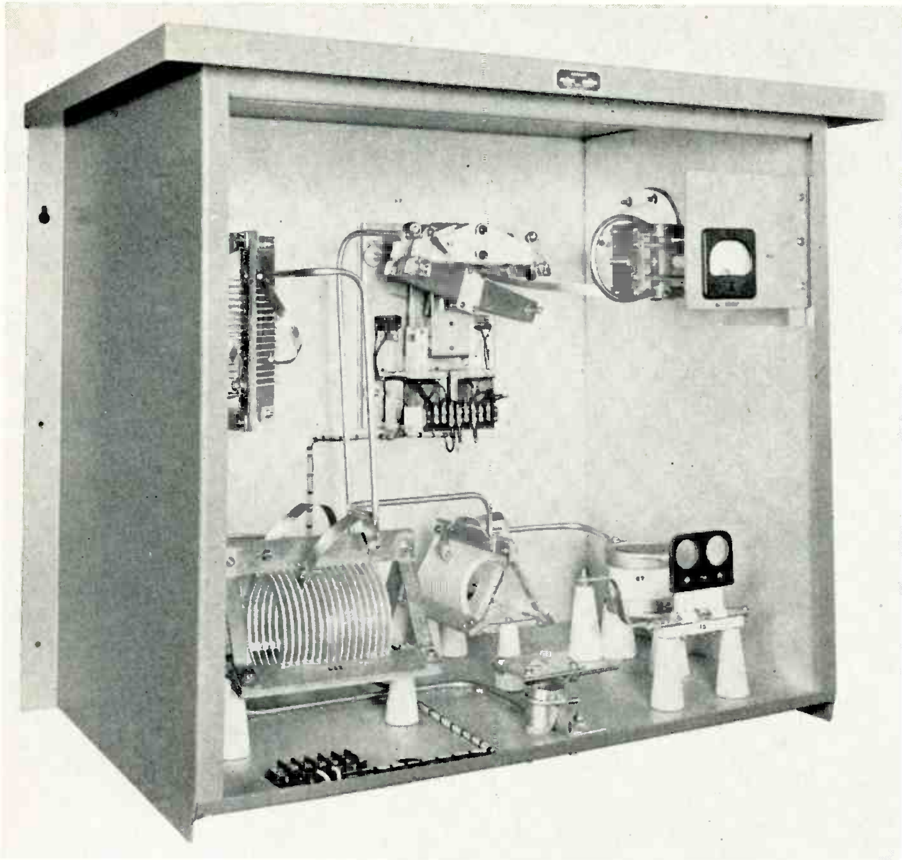


Figure 14. Antenna coupling unit.

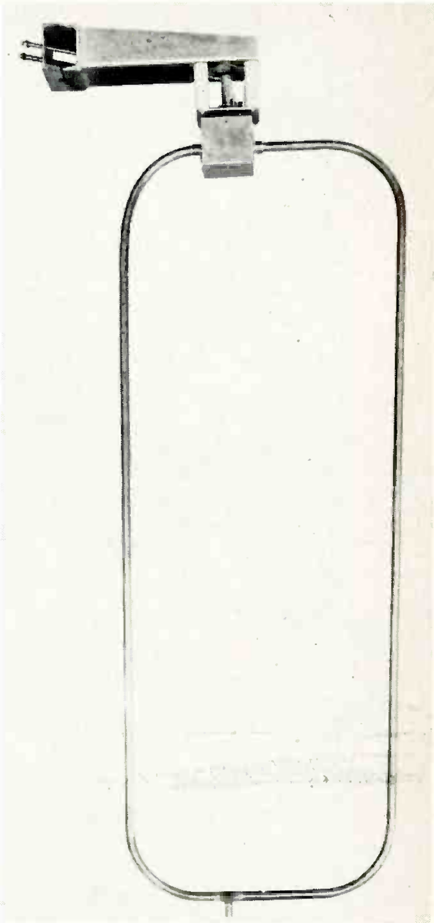


Figure 15. Phase sampling loop.

to be higher than that of the tank alone.

Another modification (figure 9) of the simple tank circuit uses an input T-network at the input of the tank. This provides the same advantage (higher input impedance) as a series input inductance, yet permits a little more flexibility of adjustment. However, the additional components may increase the power losses of the circuit.

Another modification (figure 10) of a tank uses a separate variable coil for each power tap feeding a tower. These variable coils are all connected in parallel; one end of each coil is connected to ground and the other to a common point. The variable taps on the coils feed the towers and the common point is built out into a tank circuit. This tank is then coupled to the input with a T-network.

Finally, each transmission line input can be matched to a common point with an L-network (figure 11) which gives an impedance transformation to the common point consistent with the amount of power required. The common point is then matched to a satisfactory input impedance.

All of these methods of power division can be made to give satisfactory performance for a given power division problem; the only differences in performance are ease of adjustments and the input impedance curves.

Switching

Switching of circuits for day and night operation or directional and nondirectional operation is accomplished by impulse-type, toggle-operated r-f relays, energized by pushbutton switches on the front panel. The pushbutton automatically removes the plate voltage of the transmitter before pattern switching and restores it when switching is completed. Interlocks on the cabinet doors also remove the plate voltage when doors are opened.

Components

Power-dividing circuits and phase-shift networks utilize heavy edge-wound copper ribbon inductors and ceramic-cased mica capacitors. Vacuum condensers are used where made necessary by high circulating currents.

Plated 5/16-inch copper tubing is used for all r-f buses, and insulation is steatite or Mycalex.

Amplitude and phase adjustment controls are recessed counter dials which assure accurate resetability. In complex arrays requiring additional controls, the counter dials are recessed behind a tilt-out panel in the middle of the lower half of the cabinet.

Input and output connections are provided at the top of the phasing cabinet unless otherwise specified. Special terminations are provided for solid dielectric cables in both the phasing cabinet and antenna coupling units.

An input common point r-f ammeter is supplied, along with line current meter jacks. Antenna current meters have make-before-break switches, which can be operated without opening the cabinet door on the weatherproof coupling units.

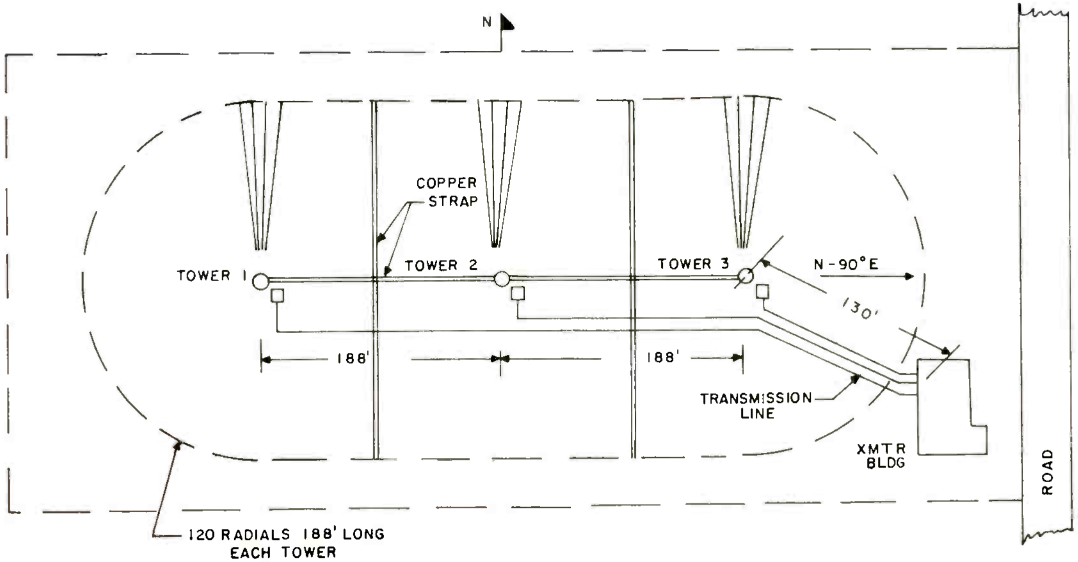
Examples of two directional antenna systems are shown on the following pages. Although they do not represent any particular installation, they are technically correct and could be utilized as they stand for any directional arrays which require the same characteristics.

TABLE 1

SPECIFICATIONS OF DIRECTIONAL ANTENNA ARRAY RADIO STATION XXXX

1310 KC 1000 W DA-N

Type of Towers	Uniform Cross-Section Guyed Insulated
Number of Towers	3
Height Above Insulator	198 feet or 95°
Height Above Ground	201 feet
Height Above Sea Level	640 feet
Orientation	On Line Bearing N 90° E
Spacing	188 feet or 90°
Phasing	Tower 1, West 0°
	Tower 2, Center 135.5°
	Tower 3, East −93.6°
Field Ratio	Tower 1, West .382
	Tower 2, Center 1.294
	Tower 3, East .735
Ground System	120 Radials 188 Feet Long Each Tower. 4 Inches Copper Strap Between Towers and at Junction of Ground Radials.



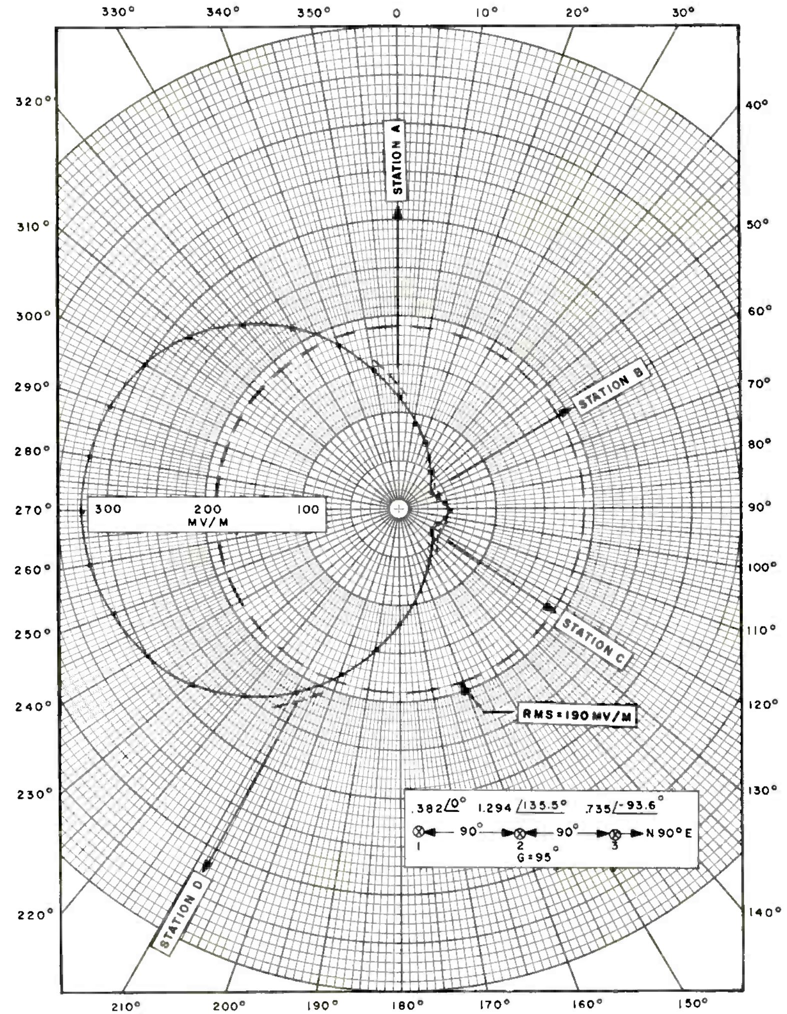


Figure 16. Horizontal plane pattern
Radio Station XXXX
1310KC 1000W DA-N.

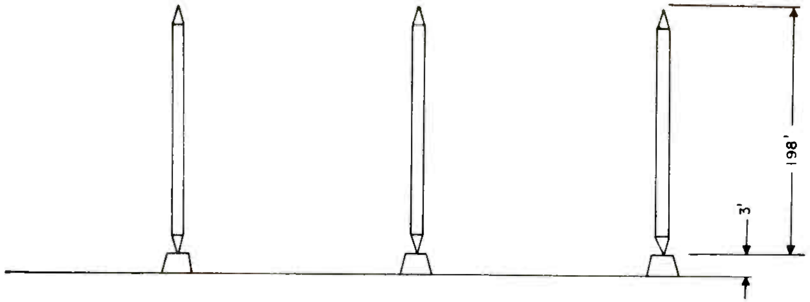


Figure 17. Antenna system and plot plan Radio Station XXXX 1310KC.

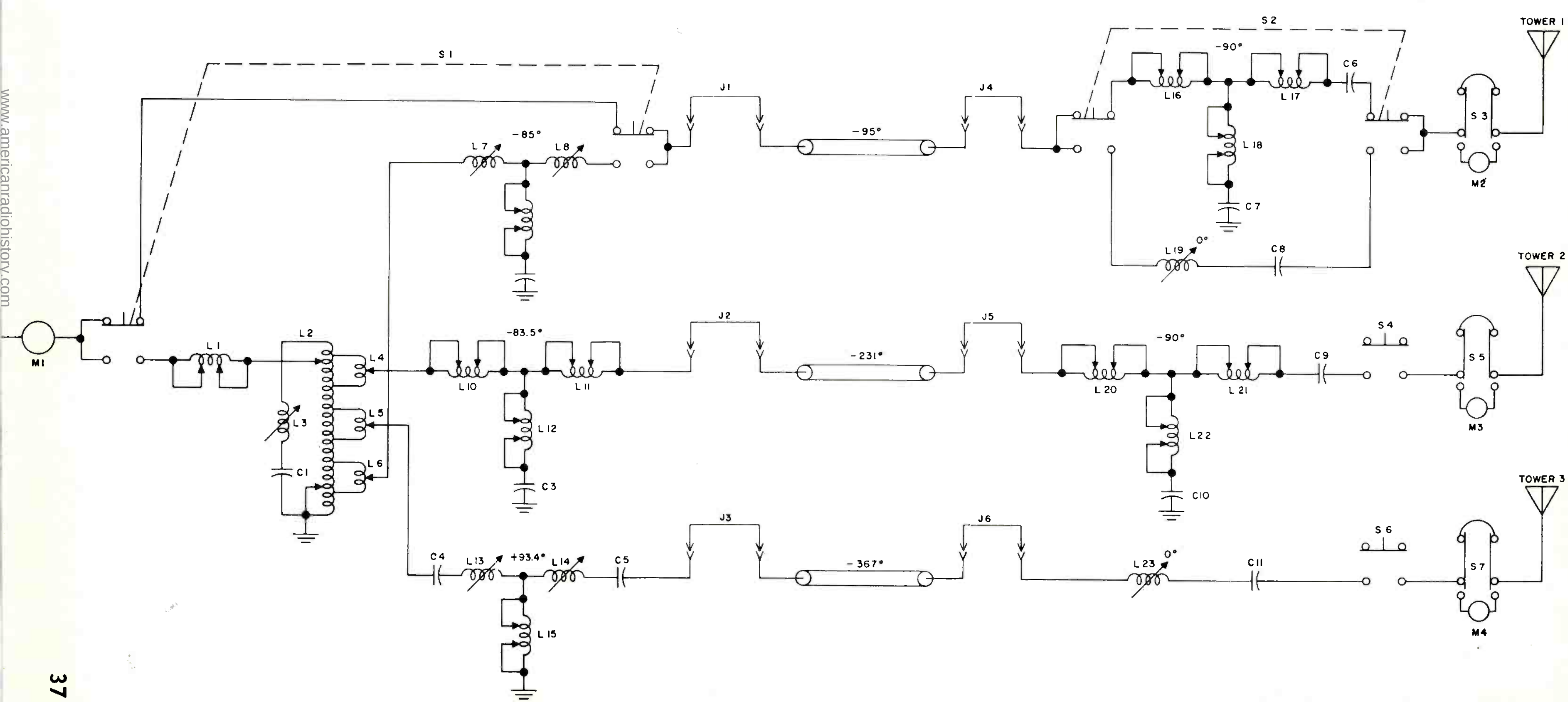


Figure 18. Phasing equipment for Station XXXX 1310KC.

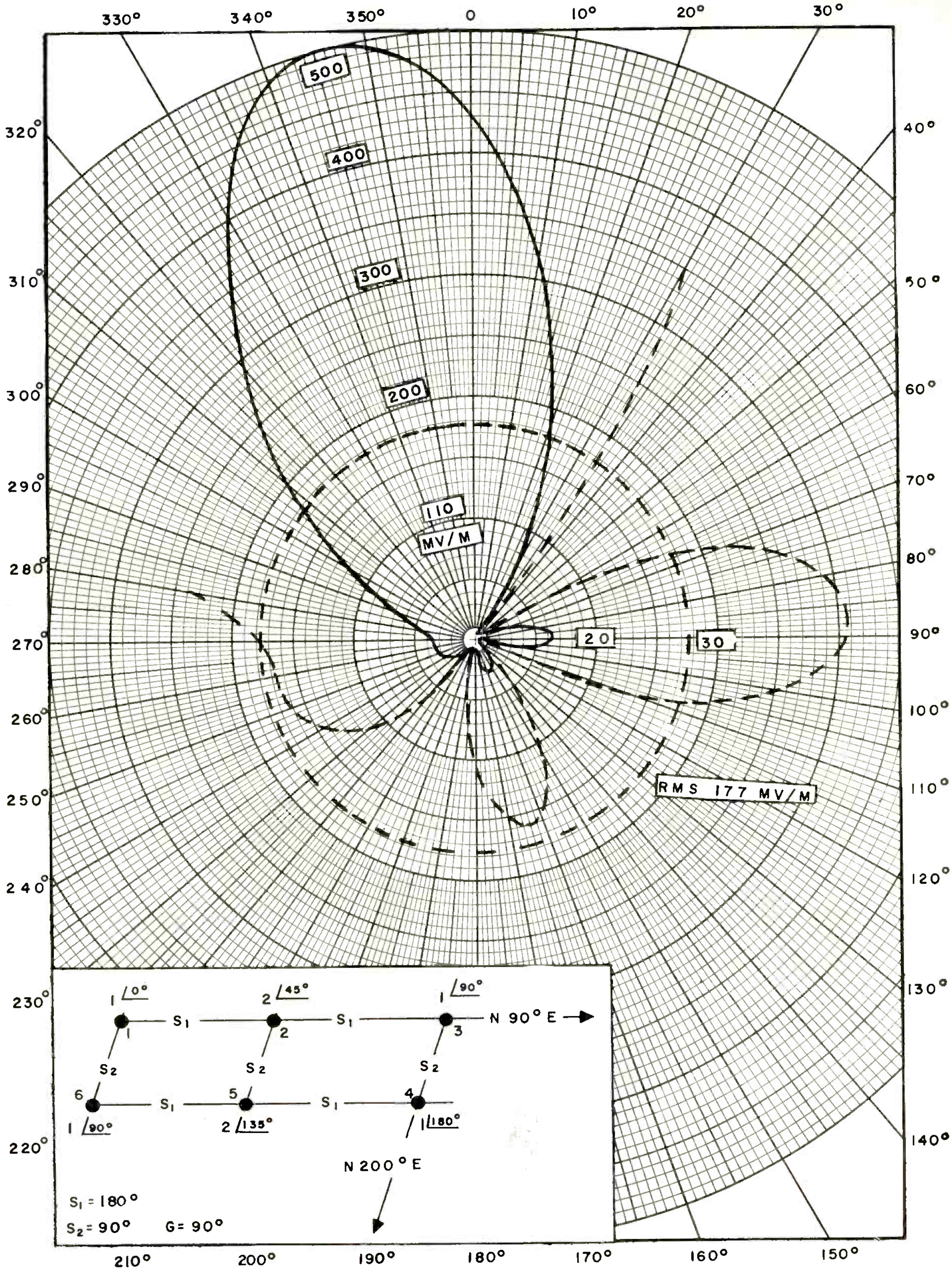


Figure 19. Horizontal plane pattern Radio Station XYZ 1360KC 1KW DA-1.

TABLE 2

SPECIFICATIONS OF DIRECTIONAL ANTENNA SYSTEM
Radio Station XYZ

1360 KC	1 KW	DA-1
(1) Number of elements	Six	
(2) Type of elements:	Uniform cross section, guyed base insulated	
(3) Top Loading	None	
(4) Height of each element above insulators	181 feet	
(5) Over-all height of each element above ground level	184 feet	
(6) Orientation of array	See figure 23	
(7) Spacing of towers	See figure 23	
(8) Phasing and ratio of fields	Field Ratio	Phasing
Tower 1	1	0°
Tower 2	2	45°
Tower 3	1	90°
Tower 4	1	180°
Tower 5	2	135°
Tower 6	1	90°
(9) Ground system	120 radials, 220 feet long and 120 radials, 50 feet long, equally spaced around each tower except for overlap. See figure 3.	

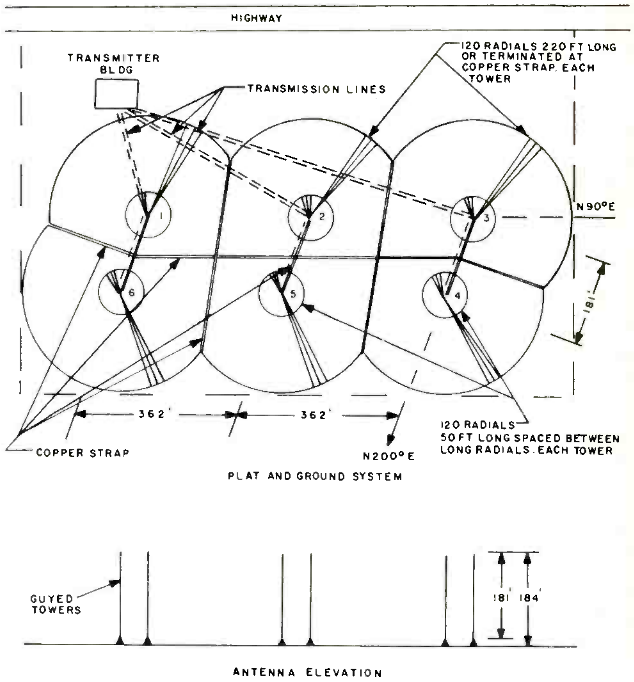
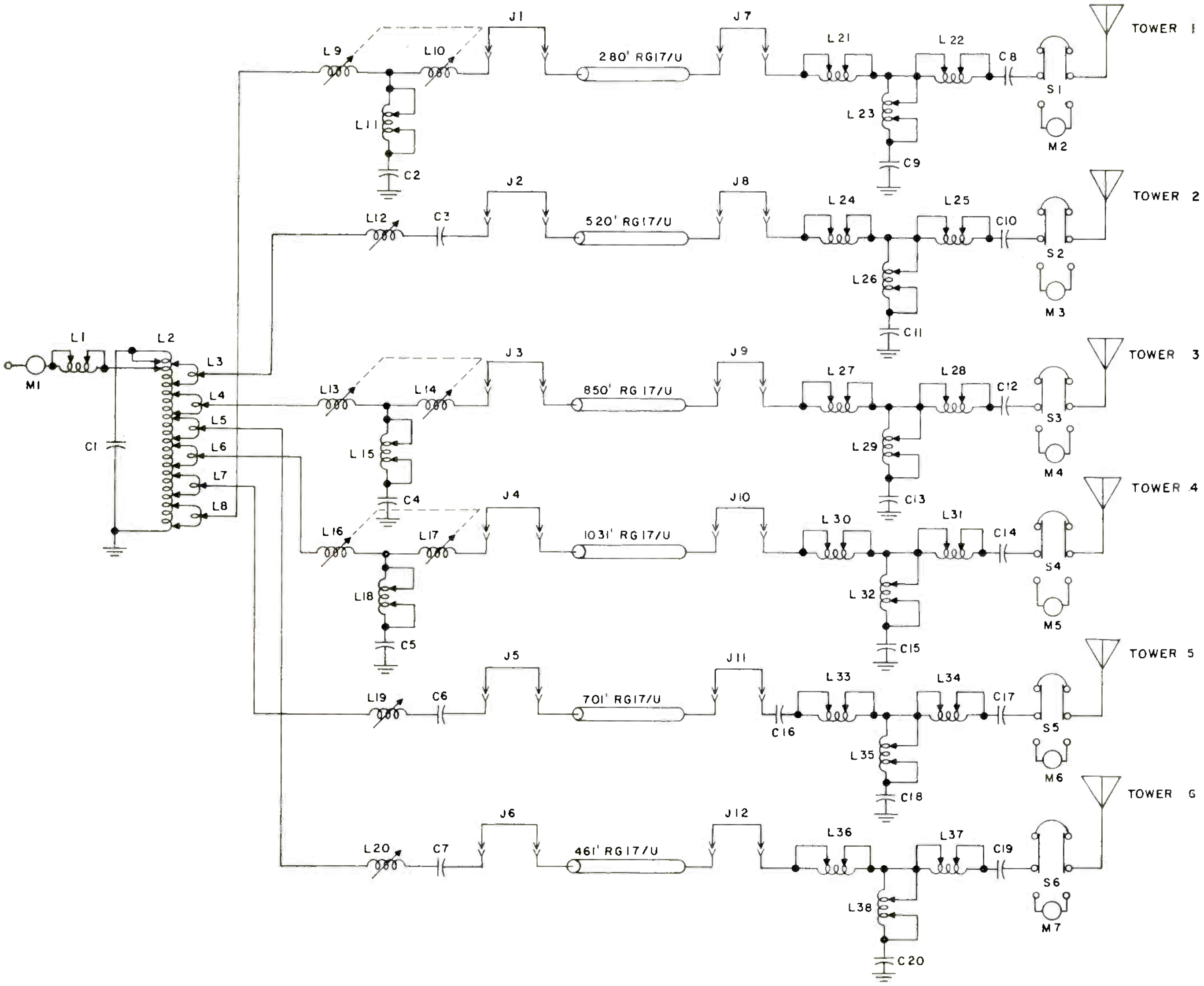


Figure 20. Diagram plot of transmitter Radio Station XYZ.

Figure 21. Direction antenna phasing equipment Radio Station XYZ 1360KC.



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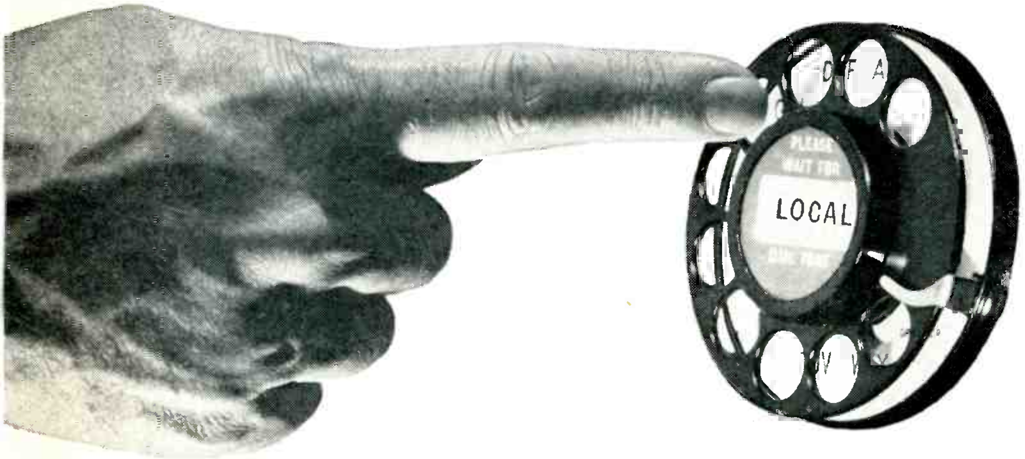

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Transmitter Design

Starts on page 18

cavity foreshortened by capacitance. This capacitance is controlled by a multiturn knob on the front panel permitting non-critical vernier tuning. A large variable loop controls the coupling to the antenna and the direction coupler indicates forward and reflected power. As with the 250-watt section, full remote control provisions have been made. A patch-over system is incorporated on the rear of the cabinet which permits the driver to be easily and quickly patched around the 5-KW stage directly to the antenna.

If an output power of 10 KW is desired, the 250-watt unit drives two 5-KW amplifiers, the outputs of each self-contained cabinet are fed into a TV type diplexer. This method of obtaining 10 KW with the minimum number of tubes has the advantage of flexibility of operation never found before.

For example, at any time, one of the 5-KW amplifiers can be shut off and the other patched directly to the antenna. Routine maintenance and cleaning can be accomplished without carrier interruption.

During a recent visit at the new Standard Electronics factory in Farmingdale, N. J., these transmitter units were completely "proofed out" by myself, especially in regards to multiplex operation. The measurements obtained at the factory agreed with actual field tests in proving out the design features. None of the circuits were critical to crosstalk, even when considerably detuned. Long range stability of operation coupled with ease of tuning makes this unit a real "dream" compared with the nightmares experienced with the older transmitters. With a 100 per cent modulation level on the main channel, normal tuning of the whole transmitter using the built-in indicators produced crosstalk measurements of 55 db. below a reference level of 10 kc. deviation of the subchannel. This was obtained while terminating into a dummy load. This indicates that when the Standard transmitter is properly coupled to a correctly designed and tuned transmitting antenna, the same results will be enjoyed throughout the coverage area.

AMENDMENTS AND PROPOSED CHANGES OF F.C.C. REGULATIONS

CONSTRUCTION, MARKING AND LIGHTING OF ANTENNA STRUCTURES

Consideration Regarding Possible Hazard to Air Navigation

1. The Commission has before it for consideration a request of the Storer Broadcasting Company to extend the time for reply comments in the above-entitled proceeding to July 19, 1960.

2. The Storer Broadcasting Company requests this extension so that it may further study the affirmative comments of various aviation interests and the Federal Aviation Agency who have injected into this proceeding a new issue challenging the basic jurisdiction of the Federal Communications Commission with respect to broadcast towers.

3. It is further stated that study of this new issue will require careful and rather extensive legal research if reply comments are to be of assistance in resolving the matter.

4. The Commission is of the view that an extension of time for the filing of reply comments in the above-entitled proceeding would serve the public interest, convenience and necessity and is warranted.

5. In view of the foregoing: *It is ordered*, That the date for filing reply comments in the above-entitled matter is extended to July 19, 1960.

INTERIM POLICY ON VHF TELEVISION CHANNEL ASSIGNMENTS; TELEVISION ENGINEERING STANDARDS

Further Notice of Proposed Rule Making

1. Pursuant to our notice of extension of time for filing comments in the above-entitled proceeding (FCC 60-668) issued on June 9, 1960, there are attached Field Strength Charts for Channels 2-6 and Channels 7-13. These charts are substituted for similar charts previously released in this proceeding.

2. The charts for Channels 2-6 are the same as those issued with our May 5, 1960, notice except for the label. The charts for Channels 7-13 were derived by merging the present high VHF Ad Hoc groundwave curves within the latest RPAC tropospheric curves.

3. The charts may be used for the preparation of comments and data in this proceeding and, in the absence of more refined data with respect to radio wave propagation, are proposed to replace the Field Strength Charts for the VHF channels in § 3.699 of the Commission's rules. The Commission will continue to seek additional data and measurements as well as refinements of the methods of analysis and prediction, in an effort to improve the accuracy and reliability of these charts.

FM BROADCAST STATIONS; PERMISSION TO PERMIT STEREOPHONIC PROGRAMS ON A MULTIPLEX BASIS

Order Extending Time for Filing Comments

On May 9, 1960, the Commission issued a Notice of Proposed Rule Making in the above-entitled matter (FCC 60-498) inviting comments and technical data on several systems of stereophonic program transmissions by FM broadcast stations. The time for filing comments was specified as July 29, 1960, and the time for filing replies was specified as August 8, 1960. On July 12, 1960, the Electronics Industries Association, in behalf of the National Stereophonic Radio Committee (NSRC) filed a Request for Extension of Time in this proceeding from July 29, 1960, until October 29, 1960.

NSRC states that it has undertaken to test the FM stereophonic radio systems and that the actual testing is scheduled to commence July 11, 1960, and will require several weeks to complete. These tests will deal with transmitter requirements, selection of receiving sites, measurements to be made, and standards for receiving equipment. It urges that it is not possible to complete the tests, the necessary analysis of the data and report to the Commission by the present deadline and that a 90-day extension is needed to do so.

We are of the view that the petitioner has made an adequate showing of need for the extension and that it would serve the public interest.

Accordingly, it is ordered, That the above request made by the Electronics Industries Association is granted, and the last dates for filing comments and reply comments in this proceeding are extended to October 28, 1960, and November 8, 1960, respectively.

NEW YORK UHF-TV TEST

Notice of Conference

At the request of the Commission, Congress has authorized a $2,000,000 study to be made during fiscal years 1961 and 1962 to ascertain the technical and economic feasibility of utilizing UHF channels to provide satisfactory television coverage to the New York City TV market area. The information is designed to supplement that which was gathered by the Television Allocations Study Organization and to carry forward a recommendation of TASO.

The project will be under the direction of the Commission's Chief Engineer, and for this purpose a UHF-TV Project Unit is being established. The project work will be done principally on a contract basis and those who are prepared to perform various phases of the project under contract should inform the Chief Engineer, so that they may be considered.

So that the Commission can be assured that the study includes as many facets of the problem as are reasonable and that the work may benefit from the active participation of the TV industry, an advisory committee consisting of members from all interested parts of the industry is desired. Representatives of the National Association of Broadcasters, the Electronic Industries Association, the Association of Maximum Service Telecasters, the Institute of Radio Engineers, the Joint Technical Advisory Committee, the Joint Council on Educational Television, the Television Allocations Study Organization, the Association of Federal Communications Consulting Engineers, and others, are invited to participate.

For the purpose of the test, it is proposed to construct a high powered UHF-TV station on the Empire State Building, the site of the existing VHF-TV stations. Another station will be located within about 15 miles of the first on a separate channel to study any improvement which might be obtained with the simultaneous broadcasting of a single program by two stations on two different frequencies. Transmissions with horizontal polarization will be used generally, but for a part of the time, one station will use circular polarization so that comparative observations and measurements can be made. An investigation will be made into UHF improvements in TV receivers, and any practical improvements which are immediately available will be incorporated in receivers to be installed at various points within the service area of the stations. Measurements will be made throughout the service area inside buildings, on roof tops, at street level, and other locations where TV reception may be desired, and correlated with observations of picture quality on the above receivers.

In order to discuss the plans for the project and formulate the membership of an Industry Advisory Committee to aid on this study, interested persons were invited to attend a conference at

10:00 a.m. in Room 7134, New Post Office Building, Washington, D. C., on July 29, 1960.

STANDARD BROADCAST TRANSMITTERS

Single Lever for Allowable Noise and Hum

In the matter of amendment of § 3.40 of the Commission's rules to specify a single level for allowable noise and hum in standard broadcast transmitters, Docket No. 13689.

1. Notice is hereby given of proposed rule making in the above-entitled matter.

2. Section 3.40 (a) (6) of the Commission's rules reads as follows:

(6) The carrier hum and extraneous noise (exclusive of microphone and studio noises) level (unweighted r.s.s.) is at least 50 decibels below 100 per cent modulation for the frequency band of 150 to 500 cycles and at least 40 decibels down outside this range.

3. Measurements to determine compliance with the requirements of this paragraph of the rules are directly affected by the bandwidth of the measuring instrument. In the case of random noise, which is uniformly distributed throughout the frequency spectrum, the noise power measured will be directly proportional to the bandwidth of the measuring instrument. If hum or other discrete frequency noise components are present the measured noise level will depend on whether the bandwidth accepted by the measuring instrument includes these frequencies.

4. In order to minimize the need for complex measuring equipment and to permit more uniformity in making measurements to determine compliance with the Commission's rules, it is proposed to amend § 3.40 (a) (6) to read as follows:

(6) The carrier hum and extraneous noise (exclusive of microphone and studio noises) level (unweighted r.s.s.) is at least 45 decibels below 100 per cent modulation for the frequency band of 30 to 20,000 cycles.

This proposal, which represents a compromise of existing specifications, will insure acceptable transmitter performance while providing for measurement procedures which are more in keeping with accepted practice.

5. Pursuant to applicable procedures set out in § 1.213 of the Commission's rules, interested parties may file comments on or before August 22, 1960, and reply comments on or before September 1, 1960.

6. Authority for the adoption of the amendment proposed herein is contained in sections 4 (i) and 303 of the Communications Act of 1934, as amended.

7. In accordance with the provisions of § 1.54 of the Commission's rules, an original and 14 copies of all statements,

briefs, or comments shall be furnished the Commission.

Minimum Operating Requirements of Broadcast Stations

1. On April 22, 1960, the Commission released a Notice of Proposed Rule Making (FCC 60-421) instituting rule making in this proceeding on a proposal to change the minimum operating requirements for standard broadcast stations to enable daytime only stations to sign-off the air at 6 p.m. It was also proposed to revise the requirements for notification to the Commission in the event of operation stoppages of standard, FM or television broadcast stations because of technical difficulties so as not to require notification when the off-the-air period is of such short duration that the minimum hour requirements for operation can still be met by a station. Additionally, it was proposed to require notification of resumption of operation in all cases requiring notification of operation stoppages.

2. No comments opposing the aforementioned proposals were received. The National Association of Broadcasters and The Scranton Times, licensee of standard broadcast Station WEJL, Scranton, Pennsylvania, filed comments supporting all proposals. Comments were also received from Milam Broadcasting Company, licensee of standard broadcast Station KMIL at Cameron, Texas, endorsing the proposal to permit daytime only stations to sign-off the air at 6 p.m. The New Orleans Television Corporation, which operates Television Station WVUE pursuant to special temporary authorization at New Orleans, Louisiana, filed comments supporting the proposed changes in notification requirements with respect to operation stoppages.

3. The comments received on the proposal to amend § 3.71 of the rules by placing operation after 6 p.m. on an optional basis insofar as daytime standard broadcast stations are concerned substantiate our conclusion that this relaxation in the rules would be beneficial to both the Commission and daytime broadcasters and would be in the public interest. In the past the Commission has been advised by numerous daytime only stations that they find it a hardship and economically unfeasible to meet the present minimum requirement for operation after 6 pm. during the months when their specified local sunset time falls after 6 p.m. Daytime only stations have also informed of their difficulty in acquiring an audience for their programs after 6 p.m., since listeners during the greater part of the year are not accustomed to receiving a daytime station after 6 p.m., and their listening habits are not easily changed, particularly when the required minimum operation for a few months after 6 p.m. changes from month to month, as the interval between 6 p.m. and local sunset increases or decreases. These reports are corroborated by the comments received in this proceeding. While we have found these reasons good cause for waiving § 3.71 of the rules to permit daytime only stations to sign-off the air at 6 p.m., during the months when their specified local sunset time falls after 6 p.m.—75 or more such waiver requests are acted upon yearly—a rule change making operation after 6 p.m. permissive for daytime only stations would obviate the necessity for these waiver requests, lessen our administrative workload and the paperwork of daytime stations, and is believed to be warranted.

4. We also believe it desirable to relax the present requirement in §§ 3.71, 3.261 and 3.651 of the rules which respectively requires standard, FM and television licensees to notify the Commission in writing of every operation stoppage due to technical difficulties so as to make such notification unnecessary for technical failures of such short duration that the minimum hour requirements for operation can still be met. A record of each operation stoppage because of technical difficulties must be kept in a station's operating log, and we consider

this to be sufficient information for the Commission's purposes with respect to those brief operation stoppages which do not make it impossible for a station to adhere to the minimum operation requirements. To best serve the Commission's purposes, however, we believe that, in addition to receiving notification of each operation stoppage which makes it impossible for a station to adhere to minimum operation requirements, we should subsequently be notified when operation is resumed. The revised provisions relating to notification in §§ 3.71, 3.261 and 3.651 below therefore provide for such notification also.

5. Authority for the adoption of the amendments herein is contained in sections 4 (i) and 303 (c) and (r) of the Communications Act of 1934, as amended.

6. The amended provisions of §§ 3.71, 3.261 and 3.651 respecting notification requirements are procedural in nature. The amendment to § 3.71 which enables daytime only stations to sign off the air at 6 p.m. is of practical utility now to those daytime only stations whose specified local sunset time falls after 6 p.m. In these circumstances, we find good cause for making the amendments effective prior to the 30-day publication period prescribed by section 4 (c) of the Administrative Procedure Act.

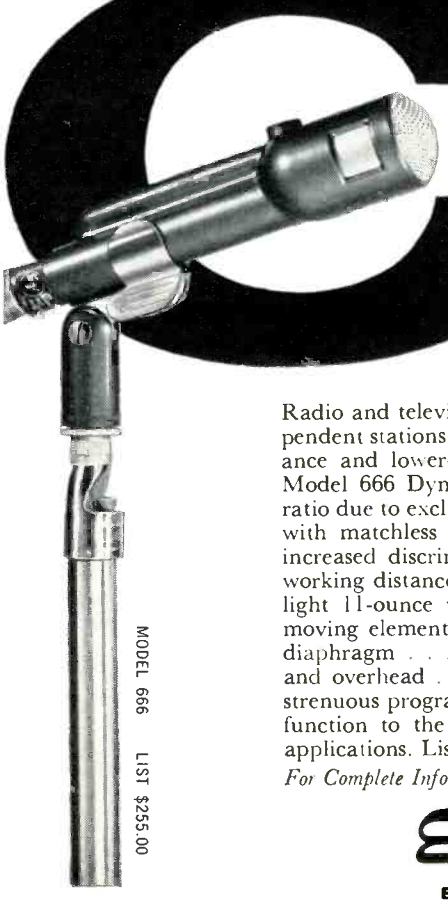
7. In the light of the foregoing: *It is ordered,* That, effective July 28, 1960, §§ 3.71, 3.261 and 3.651 of the Commission's rules are amended as set forth below, and this proceeding is terminated.

1. Section 3.71 is amended to read as follows:

§ 3.71 Minimum operation schedule.

(a) All standard broadcast stations are required to maintain an operating schedule of not less than two-thirds of the total hours they are authorized to operate between 6 a.m. and 6 p.m., local standard time, and two-thirds of the total hours they are authorized to operate between 6 p.m. and midnight, local standard time, on each day of the week except Sunday: *Provided, however,* That stations authorized for daytime operation only need comply only with the minimum requirement for operation between 6 a.m. and 6 p.m.

(b) In the event that causes beyond a licensee's control make it impossible to adhere to the operating schedule in paragraph (a) of this section or to continue operating, the station may limit or discontinue operation for a period of not more than 10 days, without further authority of the Commission. However, the Commission and the Engineer in Charge of the radio district in which the station is located shall be immediately notified in writing if the station is unable to maintain the minimum operating schedule and shall be subsequently noti-



fied when the station resumes regular operation.

2. Section 3.261 is amended to read as follows:

§ 3.261 Time of operation.

(a) All FM broadcast stations will be licensed for unlimited time operation. A minimum of 36 hours per week during the hours of 6 a.m. to midnight, consisting of not less than 5 hours in any one day, except Sunday, must be devoted to the FM broadcast operation; time devoted to operations conducted pursuant to a Subsidiary Communications Authorization (see §§ 3.293 to 3.295) shall not be included in meeting this 36-hour broadcast requirement.

(b) In the event that causes beyond a licensee's control make it impossible to adhere to the operating schedule in paragraph (a) of this section or to continue operating, the station may limit or discontinue operation for a period of not more than 10 days, without further authority of the Commission. However, the Commission and the Engineer in Charge of the radio district in which the station is located shall be immediately notified in writing if the station is unable to maintain the minimum operating schedule and shall be subsequently notified when the station resumes regular operation.

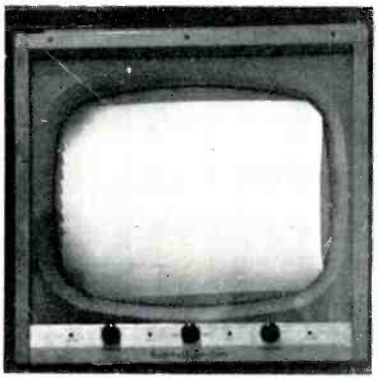
3. Section 3.651 (a) is amended to read as follows:

§ 3.651 Time of operation.

(a) (1) All television broadcast stations will be licensed for unlimited time operation. Each such station shall maintain a regular program operating schedule as follows: Not less than 2 hours daily in any five broadcast days per week and not less than a total of 12 hours per week during the first 18 months of the station's operation; not less than 2 hours daily in any 5 broadcast days per week and not less than a total of 16 hours, 20 hours and 24 hours per week for each successive 6-month period of operation, respectively; and not less than 2 hours in each of the 7 days of the week and not less than a total of 28 hours per week thereafter.

(2) "Operation" includes the period during which a station is operated pursuant to temporary authorization or during program tests, as well as during the license period. Time devoted to test patterns, or to aural presentations accompanied by the incidental use of fixed visual images which have no substantial relationship to the subject matter of such aural presentations, shall not be considered in computing periods of program service.

(3) In the event that causes beyond a licensee's control makes it impossible to adhere to the operating schedule in subparagraph (1) of this paragraph or to continue operating, the station may limit or discontinue operation for a period of not more than 10 days, without further authority of the Commission. However, the Commission and the Engineer in Charge of the radio district in which the station is located shall be immediately notified in writing if the station is unable to maintain the minimum operating schedule and shall be subsequently notified when the station resumes regular operation.



Off-the-air picture of the runaway Navy Research Balloon as seen by the John Westhaver 110-inch dual reflecting lens. Balloon altitude is 68,000 feet and 35 miles S/W of San Diego. The lens was mounted on a standard image orthicon camera.

Mr. Charles Abel and the John Westhaver 110-inch reflecting lens.

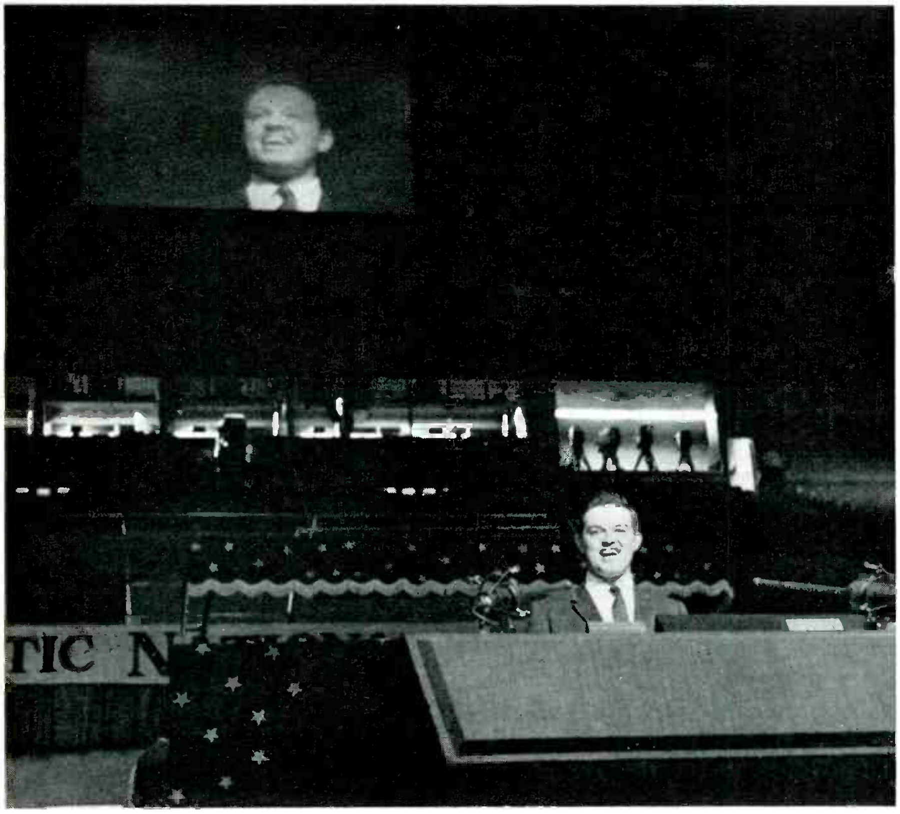
A unique 110-inch lens provided KFMB-TV's Southern California viewers with the *closest* look on record of the runaway Navy Research balloon as it passed over San Diego on June 9, Mr. George Whitney, vice-president and general manager of San Diego Transcontinent Station, reported.

The balloon's progress as it drifted at an altitude of over 68,000 feet, nearly 35 miles southwest of the city, was recorded by the station's news and special events department on video tape for its news programs.

Using a 110-inch telescopic dual-focal length reflecting lens developed by San Diegan John Westhaver, the KFMB-TV camera was able to provide viewers with close-ups of the mammoth sphere which were unequaled by any other media. It even surpassed movie films shot from high altitude jet aircraft.

The lens, which measures only 14½ inches long, operates on the reflecting telescope principle and is instantaneously convertible from an 83-inch focal length to 110-inch, and it also has a self-contained remote battery operated motor to adjust the focus.

Films of the lens in use along with video tapes of the air coverage were supplied to the CBS Television Network and were used on its national network news programs the following morning.



New G-E Light Valve Projection System

General Electric Co.'s new electronic Light Valve Projection System was used throughout the Democratic National Convention for close-up viewing of the proceedings by some 19,000 people packing the Sports Arena. TelePrompTer Corp., convention presentation consultants, leased the engineering model from G-E for the convention.

The system's spectacular brightness—accomplished by a light-modulation process—made possible the clear, large-screen presentation without reducing the surrounding lighting. The big hall's illumination actually was considerably greater than normal room brightness.

TelePrompTer employed the projector for display of convention orators, who were magnified by five or six times on the screen. This provided delegates, newsmen and others seated far from the convention rostrum with the equivalent of "first row" seating. Portions of the network telecasts from the TV pool feed were projected on the large screen to give variety to the show.

The new electronic large-screen projection system combines high-speed data acceptance, instantaneous (real-time) display, color, maximum picture quality, very high picture brightness and a wide range of image throw-distances. It is the first system ever built that combines all of these capabilities. The system can accept processed data or live television images for large-screen display.

In the light-modulation process employed in the Light Valve projector, a special control layer modulates the light from a high-intensity Xenon lamp. The optical characteristics of the control layer are changed by a beam from an electron gun, which is controlled by the input signal.

The projection system produces a picture with high geometric accuracy and allows flexibility in screen size and projection distance, including wide-angle capabilities for projection from a minimum "throw-distance."

Product News

SUBCARRIER GENERATOR

A new subcarrier generator for multiplex operation with FM broacast transmitters has been announced by Moseley Associates.

The Model SCG-2 is a highly stable phase shift oscillator producing a true frequency modulated subcarrier on any selected center frequency in the multiplex spectrum. Special features include automatic muting circuitry, which can be disabled from the front panel, and an illuminated VU meter for monitoring modulation deviations of 7.5, 10 and 15 per cent.

The unit can be inserted directly into many of the existing types of exciters in use today. The Model SCG-2, containing a regulated power supply, is mounted on a 5¼ by 19-inch standard rack panel. For further information, write Moseley Associates, Box 3192, Santa Barbara, Calif.

MICROWAVE LITERATURE OFFERED

Descriptive literature covering Microwave equipment, including full technical specifications, is available from Adler Electronics, Inc., One Le Fevre Lane, New Rochelle, N.Y. The literature describes the new RT-3A Heterodyne repeater which is intended for unattended TV and communications relaying in the 2,000 mc range. It features 10 watts output power, no demodulation, use of only 29 tubes, built-in metering and monitoring, crystal-controlled frequency stability, color or monochrome transmission, and use with standard multiplexing systems.

Professor Snikrah on Leave of Absence

Prof. Snikrah is spending the summer months south of the border developing new ideas which he plans to pass along to his followers. In his absence J. Sivraj of the Kazum Corp. contributes some observations which he has made through long years of experience and has passed along as Axioms of an Equipment Builder.

A chassis lay-out should not have socket-holes on the bend lines.

Do not get within striking distance of the purchasing agent, especially when the moon is full.

Nothing ever turns out in production like the sample was.

Tolerances never cancel each other. They all build up in the same direction.

The color you paint it will not match the color you painted it last time.

Machine screws are available only in lengths that are multiples of one inch.

Zoologists' claims that lower-order animals have a means of communication may be substantiated by reading claims written by patent attorneys.

All the parts used on the first production run are obsolete and no longer available.

The changes on the manufacturing drawings are now being modified.

The odds against the happening of what just happened are astronomical.

The bill of material alone always comes out more than the proposed selling price of the completed unit.

NAB Opposes Move to Provide Commercial Multiplex Services

The National Assn. of Broadcasters has announced that it is opposing a move to expand the activities of non-commercial, educational FM stations into commercial subsidiary broadcasting areas through the use of multiplexing.

NAB's stand was expressed in comments filed with the Federal Communications Commission in partial opposition to a petition filed June 24 by the National Assn. of Educational Broadcasters. NAB's comments, signed by Douglas A. Anello, chief counsel, and Robert V. Cahill, attorney, said that the authority requested in two sections of the NAEB petition would allow non-profit, educational FM stations "to engage in commercial broadcast operations."

NAEB's petition described these proposed operations as follows:

"Transmission of programs which are of a broadcast nature, but which are of interest primarily to limited segments of the public wishing to subscribe thereto. Illustrative services include: background music; detailed weather forecasting; special time signals; and other material of a broadcast nature expressly designed and intended for any public groups engaged in any lawful activity.

"Transmission of signals which are directly related to the operation of FM broadcast stations; for example: relaying of broadcast material to other FM and standard broadcast stations; remote cueing and order circuits; remote control telemetering functions associated with authorized STL operation, and similar uses."

NAB did not oppose other sections of NAEB's petition, in which authority was requested for non-commercial, educational FM stations to use multiplexing for the "transmission of in-school educational programs" and the "transmission of information for use in connection with governmental activities."

NAB's comments said, "The National Assn. of Broadcasters recognizes that non-commercial educational broadcasting stations can and do perform valuable services towards fulfilling some of the educational needs of the communities wherein they are located. However, under the present Commission's rules relating to non-commercial educational FM broadcast stations, such stations are licensed only to non-profit organizations upon a showing that the station will be used to the advancement of an educational program. Additionally, the governing rules require that each station furnish a non-profit and non-commercial broadcast service. Any commercial use of their facilities by educational stations is completely out of keeping with the general philosophy expressed by the Commission in its 'Sixth Report and Order,' wherein it said:

"'. . . The establishment of a genuinely educational type of service would not be furthered by permitting educational institutions to operate in substantially the same manner as commercial applicants though they may choose to call it limited commercial non-profit operation.'"

NAB Opposes FCC Proposed Ruling to Require New Conelrad Equipment

The National Assn. of Broadcasters has opposed a proposed rule by the F.C.C. which would make mandatory the installation of new equipment for CONELRAD. The NAB states that the broadcast industry has voluntarily cooperated with the Federal government since 1951 on matters of national defense and has already expended several million dollars on behalf of the CONELRAD system. The presently constituted attention signal can be received just as satisfactorily by means of the 221 million existing broadcast receivers in the hands of the public as could the one proposed. The chief functions of the CONELRAD system would not be significantly improved by the application of the provisions of this proposal, according to the NAB. NAB estimates that 75 per cent of all broadcast stations would have to modify their transmitters and purchase equipment which would cost the industry approximately ten million dollars.

Industry News

Gates Names Two Sales Engineers

Gates Radio Co., a subsidiary of the Harris-Intertype Corp., announces the appointment of George W. Yazell and Harold Arment as broadcast sales engineers.

Mr. Yazell was previously the assistant manager of WORY-TV of

Yazell

Arment

Oak Hill, W. Va. Prior to this, he was manager of WJLS Radio in Beckley, W. Va. Mr. Yazell will cover the territory of Pennsylvania and eastern Ohio.

Mr. Arment, previously employed by Gates, was responsible for opening up the mid-west, Rocky Mountains and western sales territories. More recently, he was vice-president and general sales manager of Lambda Pacific Engineering in Van Nuys, Calif.

New Offices for Consulting Engineering and Legal Firm

Hoyles, Niblock & Associates, consulting telecommunication engineers and attorneys, have located in new offices at 1234 Marine Drive, North Vancouver, B. C., Canada. The firm is Western Canada's only firm of private consulting engineers and attorneys for this industry.

Rappolt Joins Adler Electronics

William Rappolt has joined Adler Electronics, Inc., as systems sales engineer for TV broadcast relaying and repeating equipment. He formerly was with R.E.L. and Standard Electronics.

Fire-Stricken Station Continues on Air

With the help of fellow broadcasters and a rush shipment of replacement cameras, film projectors and other gear, WSPA-AM-FM-TV, Spartanburg, S. C., survived a disastrous fire recently without missing an hour of broadcast time. Damage was estimated at more than $250,000.

RCA dispatched several trucks loaded with equipment and stations WBTV, Charlotte, and WFBC, Greenville, dispatched their mobile broadcasting units to the WSPA transmitter location. Although some local programming was cancelled, a full broadcasting schedule was aired, according to Walter J. Brown, WSPA president and general manager.

Tape of Nixon-Khrushchev Debate Presented to Library of Congress

Vice-President Nixon is shown accepting the historic tape on behalf of the Library of Congress from Phillip L. Gundy, senior vice-president of Ampex. L. Quincy Mumford,

Librarian of Congress, is on Nixon's right. The recording was made on July 24, 1959, during a visit of Nixon and Khruschchev to the American National Exhibition in Moscow's Sokolniki Park. Their debate focused on a candid evaluation of U. S. technological progress versus that of the Soviet Union.

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TV VIDEO MONITORS—8Mc., Metal cabinets starting at $189.00. Never before so much monitor for so little cost. 30 different models, 8" thru 24". Miratel, Inc., 1083 Dionne St., St. Paul, Minn. 2-60 11t

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New RCA-7513 gives you **BETTER "PHOTOGRAPHIC" QUALITY** in Color and Black-White TV

Registration is achieved more easily. Dark corners in the picture area are reduced. Glaring "halo effects" are eliminated. The signal current has good purity and low noise. These are some of the important advantages you can obtain with the new RCA-7513—the remarkable Image Orthicon that offers better "photographic" quality.

RCA-7513 precision construction includes accurate coaxial alignment of all sections of the tube and accurate interelectrode spacings. As a result, the three images produced within a three-image-orthicon type color camera can be practically identical in geometry. However, to take full advantage of the 7513's precision capabilities, the color camera should employ deflecting yokes and focusing coils having precision construction and precision axial alignment with respect to each 7513.

A major design feature of the 7513...field mesh... assures that the scanning beam will strike the target perpendicularly at all points. This means improved corner resolution as well as reduced halo and edge effects. Moreover, the field-mesh defocuses the return beam, eliminating dynode spots from the picture.

Discover for yourself the new possibilities in color and black-white quality opened up by RCA-7513. Get in touch with your local RCA Distributor of broadcast tubes today for full details...or write RCA Commercial Engineering, Section H-115-0, Harrison, N. J.

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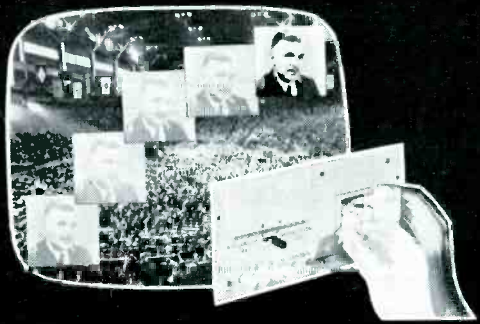
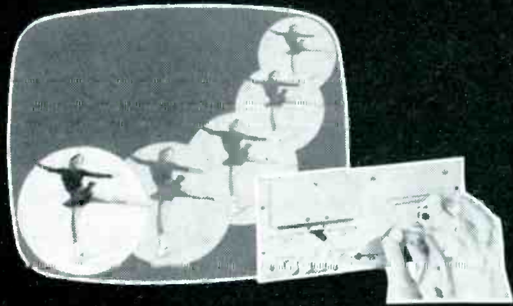
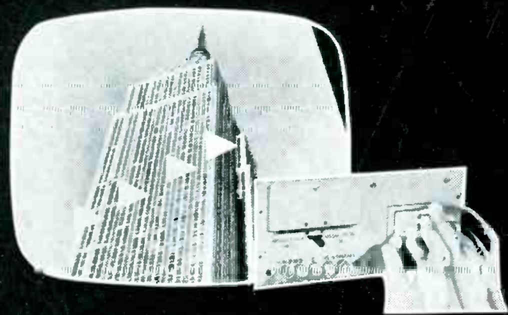


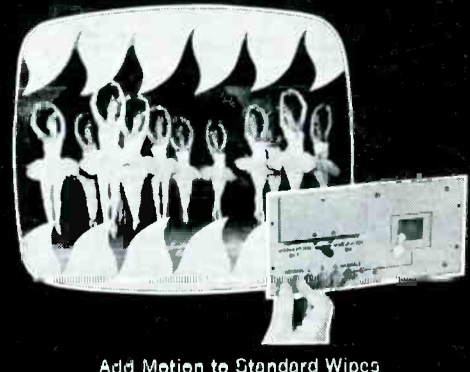
Insert May be Placed at Any Position on Raster



Electronic Spotlight



Electronic Pointer



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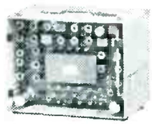
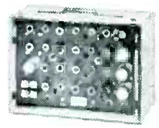
Now, You Can Offer Your Advertisers the Newest Facilities and Your Viewers the Most Varied Programming.

First, Telechrome provided broadcasters with a vastly improved system for producing a wider variety of dramatic wipes, inserts, keying and other special effects. Now, Telechrome engineering introduces the "Joy Stick" Positioner. This makes it possible to create many hundreds more effects and to move wipes, inserts, keying or other special effects to any place on the TV screen. The effects are startling! A new era in program creativity begins now! Ask to see the "Joy Stick" Positioner demonstrated, today!

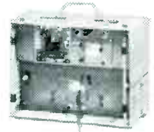
Full Specifications & Details or Demonstration Available on Request



490WA1 Waveform generator. Generates keying signals for the 72 different wipes.



490SA1 Switching Amplifier. Combines two picture signals in accordance with applied keying waveform.



490RA1 Remote Control Unit. Selects and controls desired effect. Designed for console or desk mounting. Easily modified for integration into existing studio facilities. Complete with power supply—Model 512C1

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