PLANNING AM/FM RADIO STATIONS

PART THREE

Equipment Selection

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PART THREE: EQUIPMENT SELECTION, INSTALLATION AND MAINTENANCE

Editor's Note: This concluding article in our three-part radio planning series deserves, we believe, the special attention of all planners who now are or soon will be faced with decision-making in regards to AM and FM broadcast equipment. It explains many of the important differences between equipments and what to look for when making a choice. Also included are tips on the installation and routine care of broadcast station equipment for long term operating reliability.

Part 1 of the series, "Three Basic Floor Plans," was published in Broadcast News, Vol. No. 132, February, 1967 Part 2, "The Transmitting Plant," appeared in Broadcast News, Vol. No. 134, June, 1967. All three articles of the series are available in reprint form from any RCA Broadcast Representative.

While the technical equipment required for an AM or FM radio facility is determined basically by station size, layout and programming as outlined in Part One of this series, it should be remembered that the operating flexibility of the station depends to a great extent on the equipment selected.

An extra measure of versatility in the studio equipment may greatly promote program speed, accuracy and creativity, enhancing the station's audience and advertiser interest. Certainly, the transmitter plant with the highest efficiency and reliability will place the strongest and most consistent signal where the people are. More than just economy, therefore, each piece of equipment should offer all the added benefits of value and performance that modern technology allows.

Too many times the costly assumption is made that all broadcast equipments, if FCC type-approved, are basically the same "under the hood." So, all you have to do is to find the supplier with the lowest price. Several mismatched units and thousands of dollars later, however, price is very often found to be closely related to the quality and reliability of components, as well as the attention and service that can be expected from the manufacturer after the sale.

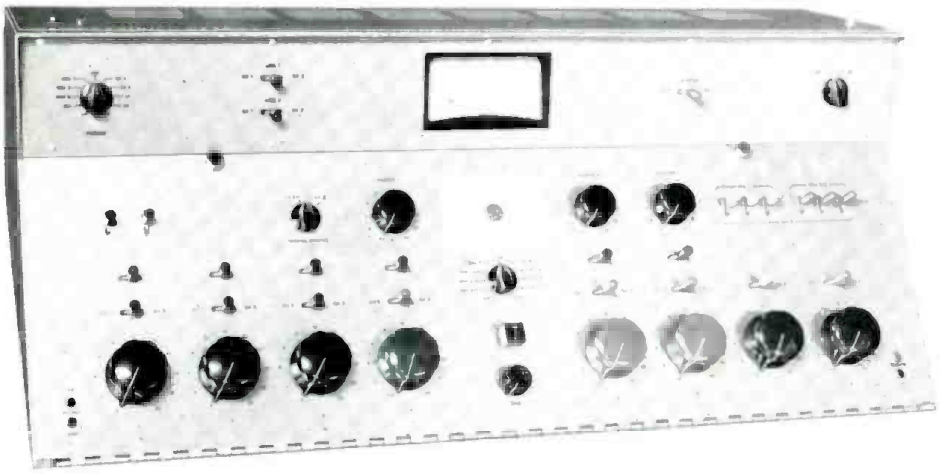
Audio Equipment

Since no two broadcast stations have the same operating requirements, the selection and arrangement of microphones, audio tape systems, turntables, consolettes, amplifiers and other equipment will differ for each installation. Many stations choose to have their control equipment tailored-made to the station's requirements.

Control Consoles

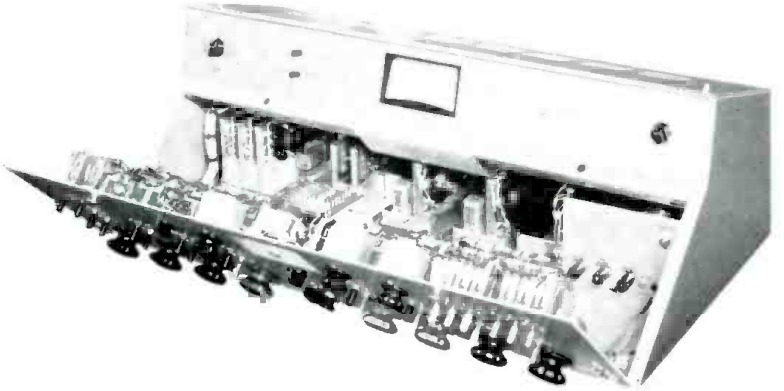
Usually the most important reason for the addition or replacement of a control console or consolette is the need for more input channels. This can be brought about by the addition of a new studio (and thus additional microphones) or by adding FM stereo facilities. It is convenient to be able to leave telephone lines connected to the "board", and thus as the number of remote programs increase, the telephone input requirements will increase. A consolette may also be added to a station in order to increase the flexibility of recording facilities. Many stations use a small board in a "production" control room where they make commercials and station promotion recordings. Another requirement for the addition of a small audio consolette is for the remote pickup of programs such as at sporting events, auditoriums, churches and nightclubs. In general, as a station increases its program variety and flexibility, its requirement for audio input facilities also increase.

Consolettes of the highest quality employ computer grade components throughout. In these equipments, components are selected for their long life and dependability. For example, the best consolettes use telephone type switches for their superiority over wafer types, and step attenuators rather than carbon pots. They are fully transistorized using the most advanced state of the art circuitry. Plug in modular design provides complete accessibility with interchangeability of subassemblies and quick, convenient servicing. Reliability of equipment is a priceless ingredient in the design of today's successful broadcast system in view of the increasing shortage of competent technical maintenance personnel.



Studio Consolette, BC-8

Completely self contained, high fidelity audio system for three channel mixing, switching, and monitoring. Dependable solid state plug-in amplifiers. Low impedance mixing circuits, built in cue/intercom amplifier.

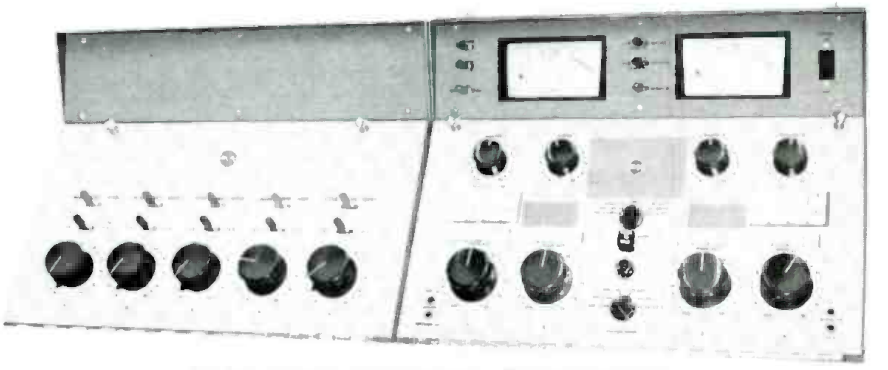


Compact, Modular Design

View of internal plug-in modules common to all RCA consolettes, including high level isolation units, amplifiers and power supply. All have built-in provisions for expansion.

Studio Consolette, BC-9

Compact solid state mixing and switching, featuring pushbutton selection of high level sources, relay switching, and built-in intercom. Operation can be remoted. Plug-in modules interchangeable with other consolettes. Stereo version is the Type BC-19.

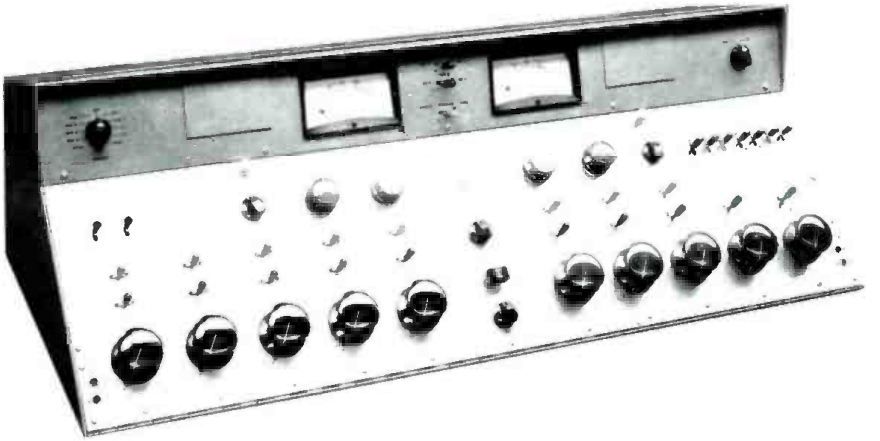


Audio Mixer Consolette, BC-19/BCM-2

Solid state BC-19 stereo consolette with matching BCM-2 Auxiliary which provides five additional mixing channels and 15 additional input sources. BCM-2 features plug-in modules, may be adapted for low level or high level inputs. Provides same expansion for BC-7, BC-8, BC-9 Consolettes.

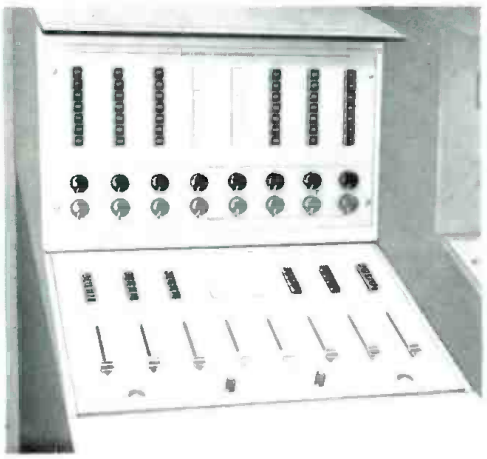
Studio Consolette, BC-7

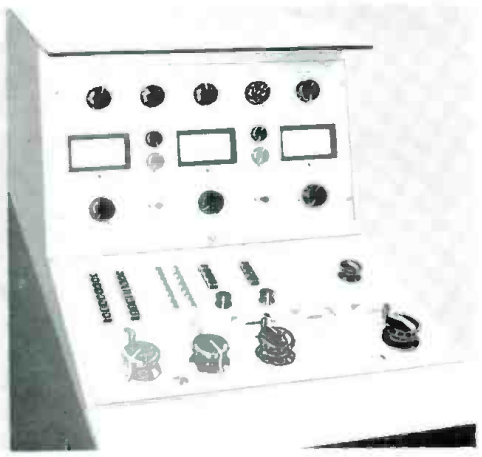
Versatile, completely self contained for both stereo and monaural mixing, switching and monitoring. Ten mixer positions: five low level, three high level, two line level. Dual mixer control in all stereo positions. Reliable solid state plug-in amplifiers. Built in cue/intercom.



Custom Consoles

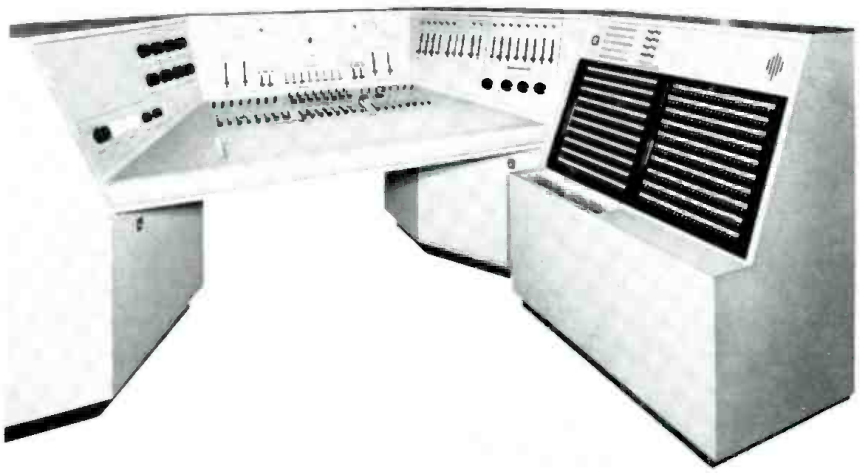
Below are three custom consoles designed for side-by-side installation. At the top is an eight channel microphone mixer with three sub-mixing channels. Vertical type faders, with bus selectors. Reverberation and equalizer controls. Center section is an eight channel master mixer featuring remote meters for new automatic gain control amplifiers. At bottom is record mixer and monitor section for control of cartridge and reel tape, turntables. Solid state circuits and voice operated relays are part of the equipment.





Custom Master Control

One of five master control consoles for a large radio network features sound effects controls, sub-mixers, equalizers, echo effects, unitized construction for complete accessibility.



Custom Operating Center

Modern control position designed for operating ease features built in turntables, dual channel stereo consolette and cartridge tape equipment.

Custom Audio Equipment

In addition to offering a comprehensive line of standard audio control equipment, leading equipment manufacturers specialize in custom designing and building complete speech input systems to meet individual needs of stations and networks. Their engineers have worked closely with the nation's leading broadcast engineers in the design, production and installation of many custom equipments. Studio control systems such as these are tailor-made, combining just the right facilities for the control of program operations and the reproduction of high-fidelity sound. This custom service is not limited to large stations and networks, it is available to everyone. Broadcast station engineers, in some cases, may wish to lay out and design the system themselves. In these instances, specifically built units or modified standard items can be supplied to meet these specifications. Or, as some stations may desire, a study of station requirements can be made with detailed layouts and specifications drawn up for the equipment needed.

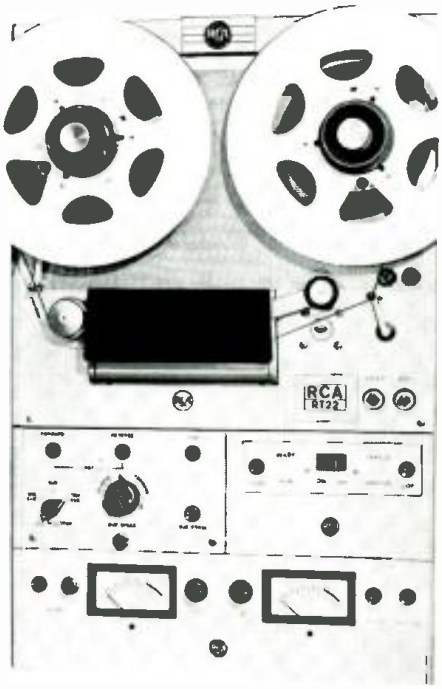
Tape Recorders

Program material on magnetic tape provides extra flexibility in scheduling, simplifies program operations and reduces the cost of program production. Modern stations utilize every possibility offered by the medium—mono or stereo, cartridge and reel to reel, two track and 4-track stereo, manual and automatic equipment. Cartridge tape systems permit the immediate playback of recordings without cueing and threading. They provide precision timing of program segments, and the program material will be exactly the same every-time a passage is repeated. They offer the most convenient storage medium and the quickest and easiest access to selected segments of material. The system of cue tones makes the equipment readily adaptable to automatic or semi-automatic systems. Multi-cartridge tape systems, designed essentially for the heavy traffic station, reduce the load on operating personnel by automatically handling a series of short (or long) program segments through start/stop and audio switching sequences in rapid errorless succession. Two hours of material can be programmed with one multi-cartridge unit, which can be teamed with as many other units as needed. Tape systems may be remotely controlled.

Reel-to-reel tape machines, on the other hand, take full advantage of the editing ease and speed that tape offers. Reel-to-reel machines can operate at various speeds so that the material can be tailored to program needs. Super thin tapes can be used to permit hours of programming on a single reel, and the equipment features portability for interviews and news stories. Manually operated and self cueing versions are available.

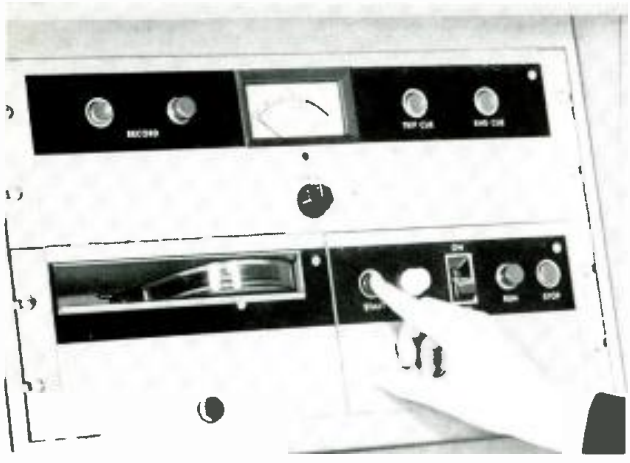
Audio Tape Recorder, RT-21

Professional, solid state recorder for monaural or stereo operations. Wide range of record input levels, high playback output levels. Either 7½/15 or 3¾/7½ ips tape speed. Full-track or dual half track. Plug in record equalizer, variable tape speed cueing. Console or portable carrying case available.



Automatic Tape Recorder, RT-22

Record/playback in stereo or monaural models. Variable tape speed cueing. NAB cue tones (reel or cartridge) recorded on tape for automatic operation. Plug in circuit modules. Remote control provisions. May be used in automatic systems with cartridge tape.

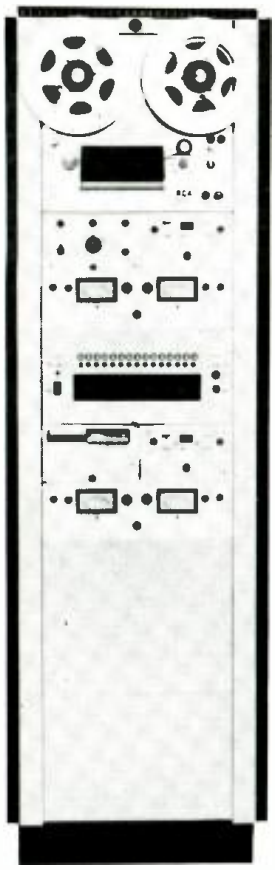


Cartridge Tape System, RT-27

Deluxe, solid state system for monaural or stereo cartridge record and playback. Separate record and playback heads, three cue frequencies, plug in circuit boards, pull out tape transport.

Multicartridge Tape System, RT-8

Compact monaural or stereo unit plays all NAB size cartridges. Units may be connected in multiples to give system of 8, 12, 16 or more automatic tape playback cartridges.



Automated Audio System
Completely automatic tape system consisting of RT-22 stereo reel recorder, top, BCA-15 automatic tape programmer, center, and cartridge tape system, bottom.

Dual Speed
Turntable, BQ-51
Compact, precision unit for 33⅓ and 45 rpm. Smooth, low rumble, rapid starts. Provision for two tone-arms. Cabinet accepts preamplifier.

FM use, such as smooth frequency response over the audio range, low distortion, high output levels, and well shielded (and sometimes shockmounted) output transformers to prevent hum and noise pickup. Certain types have selectable directional patterns useful in high noise areas. Public address microphones, on the other hand.

Tape Automation Systems

An audio tape programmer combining solid state and relay switching is available to automatically program multi-event sequences from several different tape systems with an absolute minimum of attention from station personnel.

For use with both monaural and stereo systems, the device is designed to select from several audio sources and sequence them in any preset pattern as consecutive events. It is particularly advantageous to stations requiring separate programming for AM and FM. The operator who may be handling both programs can preset the system to sequence the FM events during times when live broadcasts or program changes must be made on AM.

Microphones

Careful thought should go into the selection of type and quality of microphones for AM and FM facilities. Too often the microphones selected do not complement the quality of other equipment. This can seriously impair overall performance.

There is considerable overlap in the uses of available broadcast microphones, of the many types, but each has attributes for specific applications. High quality broadcast-type microphones have performance features that make them ideal for AM and

Polydirectional
Microphone, 77DX
High fidelity, ribbon type, easily adjusted to obtain a variety of directional patterns. Ideal for AM and FM. Frequency range 30 to 20,000 Hz. Three-position voice-switch for selection of best operating characteristics. Efficient shock-mounting. The accepted standard of the broadcast industry.

Pressure Microphone, BK-1
Ideal for interviews. Insensitive to mechanical vibration. Smooth response over a range of 50 to 15,000 Hz. Removable from base for hand use or floor stand mounting.

Uniaxial Microphone, BK-5
A high quality ribbon instrument with a unidirectional pattern. Especially suited to use in high noise areas and for general studio applications. Wide frequency response of 30 to 20,000 Hz.

Subminiature
Microphone, BK-12
Lightweight, easily concealed lavalier dynamic microphone with excellent speech balance for studio and public address. Inconspicuous worn around the neck, clipped to the clothing, or hand held. Wide frequency response of 60 to 18,000 Hz.

Portable
Mixer-Amplifier, BN-26
Solid state, battery or AC powered unit providing four selectable inputs, cueing, monitoring and mixer bus paralleling. Completely self contained. Built-in 1,000 Hz setup oscillator. Cover serves also as tilt rest for unit.

are designed to offer additional economy. Frequency range and sensitivity are sacrificed to some extent for ruggedness and lower cost. Response limitations should always be considered when these microphones are used for broadcast applications.

Signal Processing Equipment

Audio signal processing equipment is available to automatically control audio peak and average levels into the transmitter, as required, to prevent overmodulation with consequent adjacent channel interference or even possible damage to the transmitter.

Automatic gain control (AGC) amplifiers, with their slower attack and recovery times, are used in control rooms and studios to maintain a constant average audio level. Peak limiters, with their faster attack times are normally used at the input of the transmitter because of their ability to limit the amplitude of high speed transient peaks.

In FM, however, a 75 microsecond pre-emphasis network normally installed at the transmitter input produces a high frequency boost which tends to cause overmodulation. This overmodulation can be

AGC Program
Amplifier, BA-43/45
Low distortion, solid state automatic gain control amplifier. Provides both expansion and compression. Wide adjustable AGC action. Step type attenuator. Plug-in chassis. Provision for remote meter.

Limiting Amplifier, BA-43/46
Solid state, low distortion unit for extremely fast, abrupt limiting action. Plug-in shelf mounting. Separate input and output controls. Remote metering.

Studio Speaker, MI-38351-A
Excellent frequency response provided by five in-line speakers. Twenty-five Watt rating.

Duo-Cone Speaker, LC-1
Ideal for control room monitoring and other broadcast applications. Wide frequency response (25-16,000 Hz), wide angle distribution and low distortion.

Peak Clipper, BA-47
Solid state unit for use with BA-43 Program Amplifier. Performs both pre-emphasis and peak clipping. When fed from a BA-43/46 Limiter Amplifier, only the signal peaks in the pre-emphasis range and above 100 percent modulation will be clipped. Assures absolute protection against overmodulation.

1 kW AM Transmitter, BTA-1R2

Selection of 500 or 250 watt power levels from front panel or remote location. Highly perfected audio circuits with large, high quality transformer and reactor for outstanding modulation and unusually high fidelity sound. Simple circuitry, solid state power supplies. Complete accessibility, designed for automatic operation.

5 kW AM Transmitter, BTA-5T1

New high efficiency Class C power amplifier featuring big power savings and long tube life. PA efficiency of 85 to 90 percent saves up to 15,000 kilowatt hours per year. Only two tuning controls. Silicon rectifiers, vertical chassis construction and automatic operation.

prevented by high frequency roll-off, or by peak *clipping* after pre-emphasis, or by a combination of both. Peak *limiting* after pre-emphasis is not usually desirable because the high frequency peaks will cause a serious reduction in gain and consequent lowering of the average modulation level. High-frequency roll-off, too, is obviously undesirable because of the degradation of the received signal. Peak clipping is the recommended method since it provides absolute protection against overmodulation without reducing signal gain and with no audible degradation of the signal. Signal processing units are used in tandem for stereo.

Notes on Transmitters

The ability of a transmitter to handle high levels of modulation and a wide frequency range with low distortion gives the transmitter a signal which stands out in any market. Some transmitters are available today that are designed to sound better and louder than others. Transmitters of this type employ highest quality components, proven design, and they operate at conservative levels. Transmitters in this class not only sound better but components last longer. Tube life is lengthened by using types best suited to the application, and by operating the tubes well within their ratings. Attention is given to all details affecting their proper cooling. The importance of having conservatively designed and operated components in a broadcast transmitter cannot be overemphasized, particularly for a station that wishes to maintain the highest reliability with minimum lost air time.

Weight Reduction

Some AM transmitter manufacturers are placing great emphasis on compact, lightweight units. One of these lightweight kilowatt transmitters weighs only 1,000 pounds or little more than half that of another design. Low weight, often associated with low cost, may not be economical for transmitters.

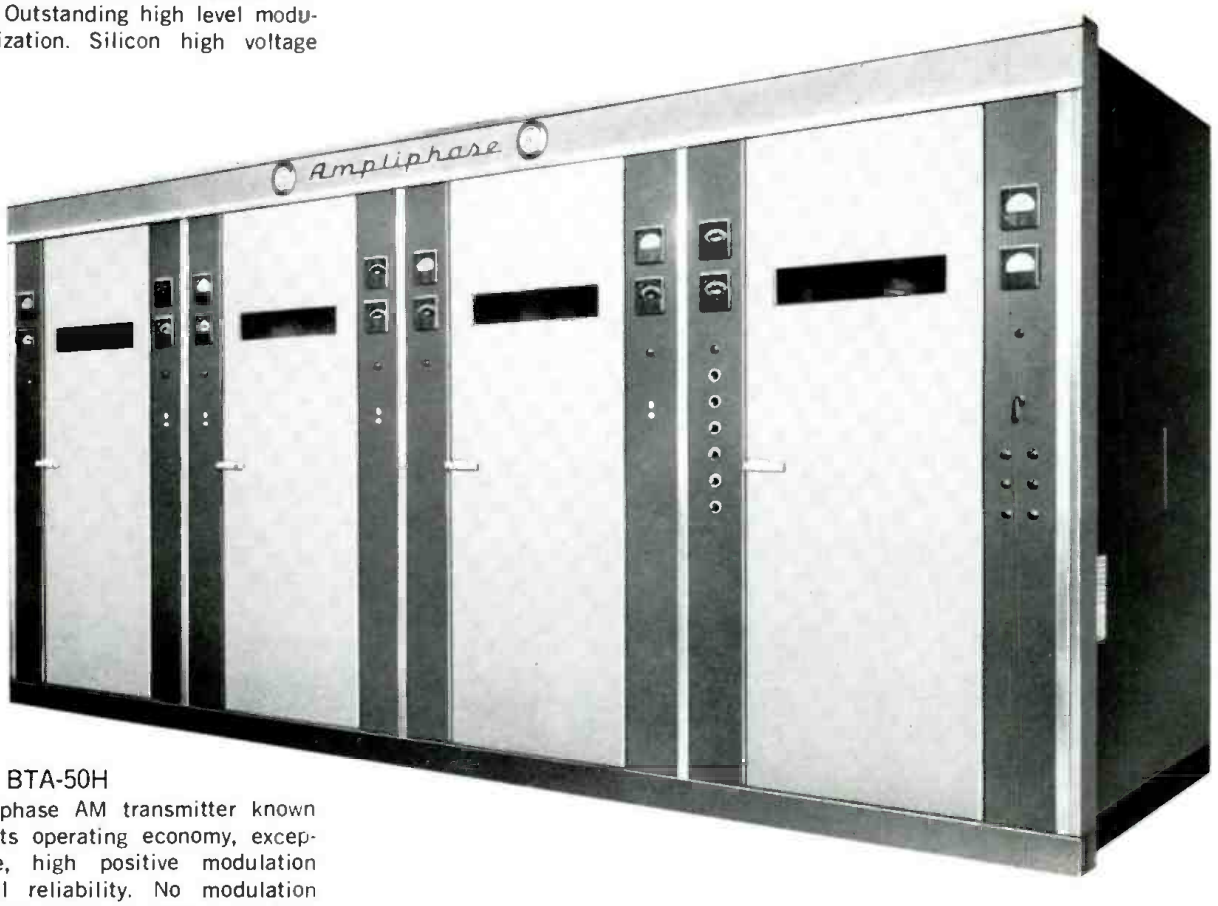
Reduction of weight is fine if it can be achieved without sacrificing reliability. But in AM radio transmitters, weight is usually concentrated in transformers and reactors to obtain high fidelity audio response and high transformer reliability. Unfortunately, this is where the most weight reduction is effected in so-called lightweight designs. It is advisable, therefore, to study and compare weights and transformer sizes between designs. Failure of one transformer could wipe out the savings in a lightweight design.

Tubes vs Transistors

The advantages of transistors are well known, particularly for handling small signals such as in low power, high frequency exciters and low level audio circuits. Good design employs transistors wherever adequate engineering and packaging considerations indicate their use will be beneficial. However, transistors and tubes are being mixed in some broadcast transmitters in a way that has certain disadvantages for the owner. Transistors do not work well in high RF fields. Often, very expensive tubes are required to overcome the low power of the transistors. The cost of one such tube may exceed that of several common types in another transmitter. In one highly transistorized transmitter the special tube and transistor complement required actually costs more than *twice* the complete set of tubes in a conventional tube transmitter of the same power. Moreover, due to the low drive power obtained from the transistor driver, the PA in this

5-10 kW AM Transmitter, BTA-5U1/10U1

High efficiency, air-cooled 5-kilowatt transmitter with provisions for power increase to 10 kilowatts. Essentially identical to popular BTA-5T1. Same high efficiency PA, power economy and long life tubes. Simplified power cutback to 1 kW or 500 watts. Outstanding high level modulation. Broadband neutralization. Silicon high voltage rectifiers.



50 kW AM Transmitter, BTA-50H

A true high fidelity Ampliphase AM transmitter known throughout the world for its operating economy, exceptional frequency response, high positive modulation capability and exceptional reliability. No modulation transformer or reactor is used. Power amplifiers are high efficiency, easily tuned Class C types. Silicon rectifiers. Automatic operation. 100-kW model available for international use.

1 kW FM Transmitter, BTF-1E

This compact kilowatt employs a time proven, ten-watt direct FM exciter featured in all RCA FM transmitters. Completely self-contained in a single, attractively styled cabinet. Silicon power supplies, only one power amplifier tube. Single-tuned circuits and M-derived harmonic filter. Designed for automatic operation.

POWER INCREASE TABLE

Move Up From	Outputs and Power
BTF-5E 5KW	
5E to 10E	One 10kW
5E to 20E	One 20kW
5E to 40E	One 40kW
5E to 5/5E	Two 5kW
5E to 5 PLUS 5E	One 10kW
5E to 10/10E	Two 10kW
5E to 10 PLUS 10E	One 20kW
5E to 20/20E	Two 20kW
5/5E to 5 PLUS 5E	One 10kW
5/5E to 10/10E	Two 10kW
5/5E to 10 PLUS 10E	One 20kW
5/5E to 20/20E	Two 20kW
5/5E to 40E	One 40kW
5 PLUS 5E to 5/5E	Two 5kW
5 PLUS 5E to 10/10E	Two 10kW
5 PLUS 5E to 10 PLUS 10E	One 20kW
5 PLUS 5E to 20/20E	Two 20kW
5 PLUS 5E to 40E	One 40kW
BTF-10E 10KW	
10E to 20E	One 20kW
10E to 40E	One 40kW
10E to 10/10E	Two 10kW
10E to 10 PLUS 10E	One 20kW
10E to 20/20E	Two 20kW
10/10E to 10 PLUS 10E	One 20kW
10/10E to 20/20E	Two 20kW
10/10E to 40E	One 40kW
10 PLUS 10E to 10/10E	Two 10kW
10 PLUS 10E to 20/20E	Two 20kW
10 PLUS 10E to 40E	One 40kW
BTF-20E 20KW	
20E to 40E	One 40kW
20E to 20/20E	Two 20kW
20/20E to 40E	One 40kW

5/10/20 kW FM Transmitters, BTF-5E, 10E, 20E

One attractive cabinet taking less than 12 square feet of floor space houses each of these three air cooled FM transmitters. Design features make it easy to increase power from 5 kW to 10 kW, 20 kW or 40 kW (See Power Increase Table). The separate unitized power supply for each transmitter can be remotely located.

same transmitter is a Class AB-1 linear, which almost doubles (45 percent greater) the *average* power consumption of the transmitter. RF Feedback is usually required in transmitters of this design which causes problems with antenna load changes. Since such circuits are more complex they require a high level of technical competence in the engineering staff; straightforward circuitry does not require a more expensive level of engineering ability. Tube complements and circuitry of competitive transmitters should always be compared for their cost, complexity and reliability.

Reliability and Economy

The economics of transmitter reliability are difficult to assess without previous experience with a given design. Loss of broadcast time because of equipment failure, if substantial, could be very expensive. The question arises, how much money will be lost in advertising time? How much will be spent on replacement parts? Will equipment problems cause the transmitter to be operated at reduced power for long periods of time? What about overtime payments to engineers? In short, what will this cost in terms of listening audience? Prestige? Income? Profit?

Operating costs may be difficult to measure but they can spell the difference between an economical and costly transmitter design. One method is to compare the costs of a full tube complement for each transmitter being considered. Then compare the expected tube life from "experience curves" on the types employed.

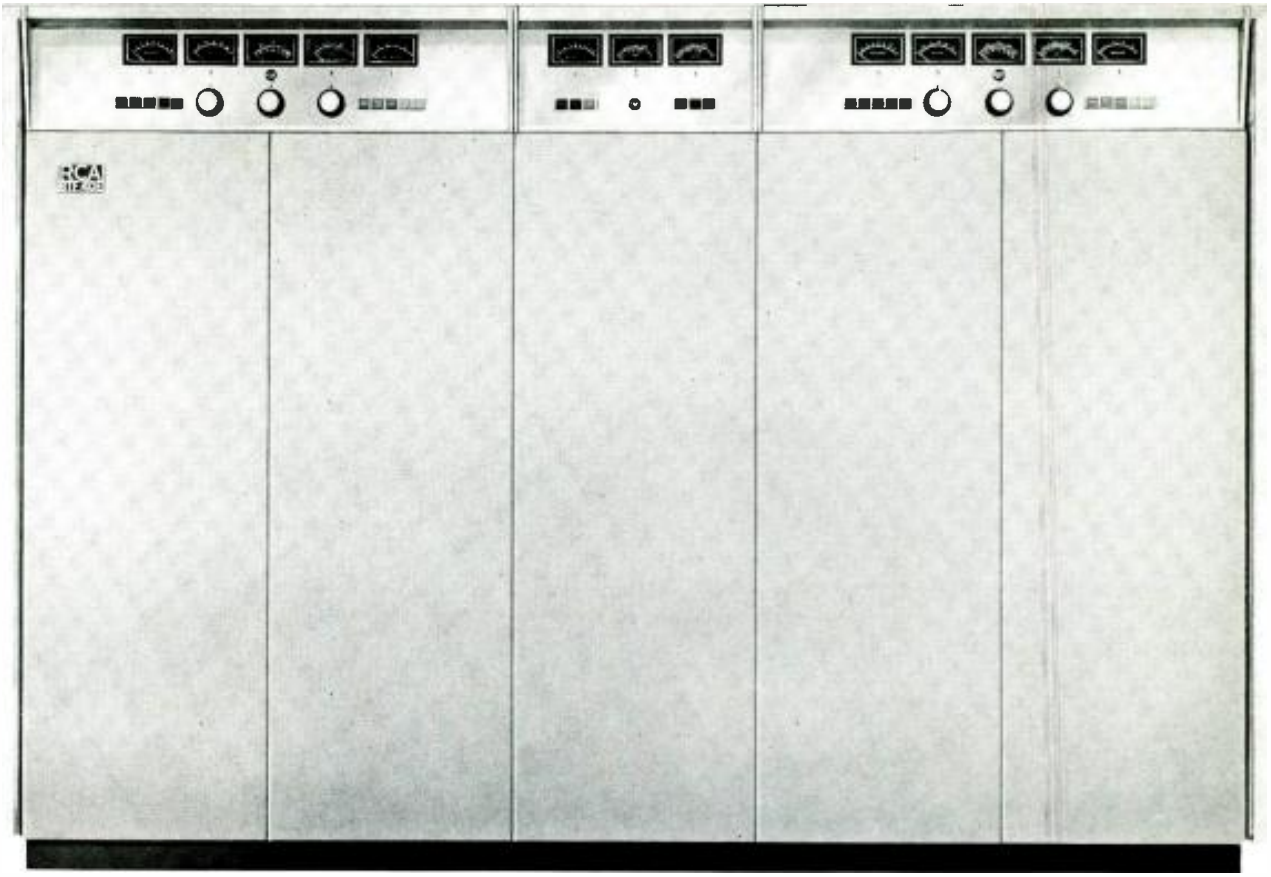
Automatic Operation

Will it be possible at a later date to automate operation of the transmitter being considered? Automatic operation, including remote control, logging and other functions, are becoming more widespread and many existing automatically operated installations have reported months of unattended transmitter operation without the need for a single adjustment at the transmitter site. If the transmitter when purchased is not designed for automatic control, and later, such is desired, the required modifications may be time consuming and expensive.

Many available transmitters include these provisions as standard equipment. This means that components such as relays, motor driven controls, wiring, meter shunts and multipliers used in automatic operation, are already a part of the transmitter and need not be added. Remote control signals may be DC voltages sent over telephone lines, or tone signals which permit operation on a single voice-grade telephone line or microwave link.

Transmitter Power

An important factor in transmitter design, particularly for FM, is the power expandability of the transmitter. This is related to the transmitter's susceptibility to obsolescence. For example, savings result if a 5 kW transmitter is expandable



40 kW FM Transmitter, BTF-40E

Efficient, fully air-cooled high power FM transmitter consisting of two 20 kW units driven by a single direct FM exciter. Offers added reliability of diplexed outputs over paralleled output stages. Features include single-tuned RF circuits, silicon rectifiers, provisions for remote control and unitized high voltage power supplies that can be remotely located from transmitter.

to 10 or 20 kW, and a 20 kW transmitter is expandable to 40 kW, etc., rather than replacing the original transmitter. In some designs, power can be doubled simply by substituting higher power electrical components with no increase in floor space.

Transmitter Redundancy

Some station owners will want to consider an FM transmitting plant with the complete redundancy of parallel operated transmitters. These installations start out with a transmitter that later can be diplexed with another identical transmitter to provide a power increase, plus the added reliability of two operating transmitters. Diplexed transmitters use a common exciter and a "hot" spare exciter which can be switched in at any time.

FM Exciters

By virtue of its design, the modern FM exciter adequately attenuates harmonics and other spurious signals, and produces a clean drive signal for trouble-free operation of subsequent stages of the transmitter.

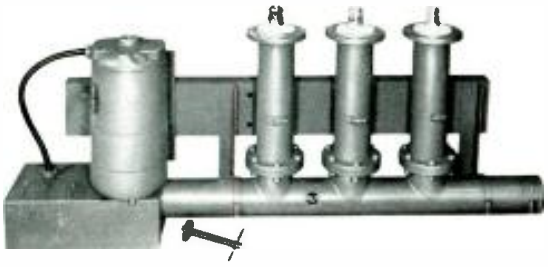
Some available exciters are deficient in instrumentation. The tendency today is to package the FM exciter in a very small space with a minimum of visual monitoring facilities. As a result, the operator must expend unnecessary time and effort to determine the operating status of some units. The best designs incorporate basic instrumentation such as metering and visual indicators, making it easy to see at a glance an inoperative unit.

Detachable Power Supplies

A trend in design that makes transmitters easier and less expensive to install, is the two-unit construction concept in which the high voltage transformer and its rectifier are housed in a separate enclosure. This enclosure is designed for out-of-the-way installation in a basement or other unused space in the transmitter plant. Locating the power supply near the commercial power entrance does much to reduce wiring expense during installation. It also simplifies power increases.

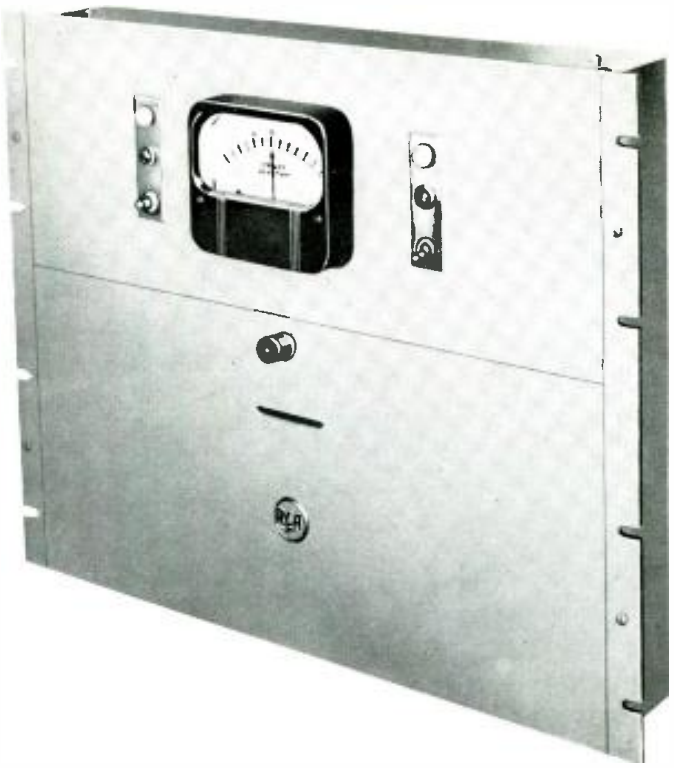
AM Phasors

The ideal phasor of course provides the kind of radiation pattern wanted, assures a reliable, fade free signal in the coverage area, and is easy to maintain. It is possible to meet these conditions with either of the two general types of phasors that are available, the "jeep" or "ohms law" types, depending upon the installation. The jeep phasor, a simpler, less expensive type, should not be used in big arrays with four or five towers because of interaction of controls. Although more expensive, the ohms law phasor has less interaction, takes less time to set up and therefore may offer savings. It also makes it easier to achieve the proper power distribution throughout the phasor resulting in higher efficiency and less chance for failure. The engineer-



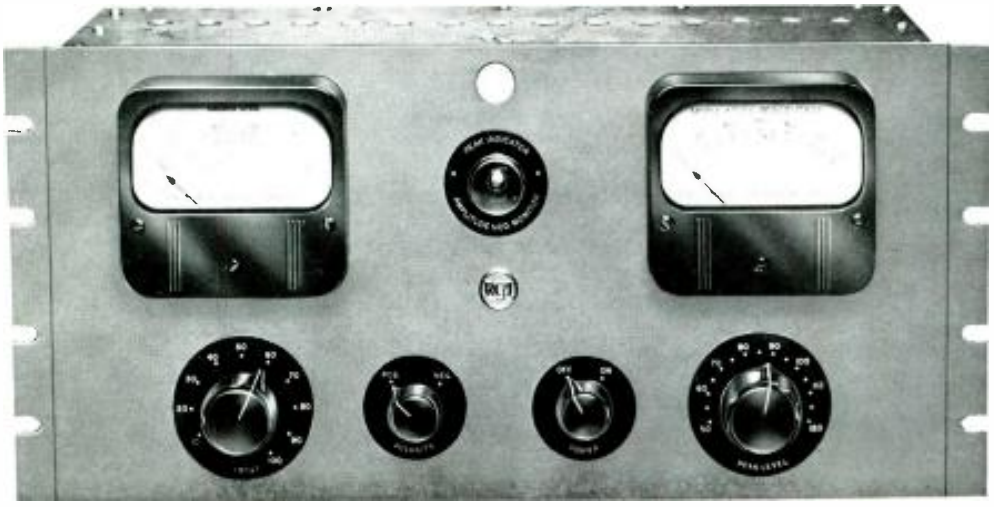
Coaxial Transmission Line Switches

Manual and motor driven switches available in a variety of styles. Manual panels in 3-pole version with U-type connector, 7-pole panel with three U-type connectors, plus custom arrangements. Motor driven are single pole, two-position switches. Maximum VSWR 1.04 to 1.0 or better.



AM Frequency Monitor, BW-11A

Continuous indication in magnitude and direction of any departure of carrier from its proper frequency. Wide input range of 10 mV to 25 Volts. Minimum accuracy of ±5 Hz for one year. Provisions for remote meter or recorder.



AM Modulation Monitor, BW-66F

Direct reading indications of percentage modulation. Operates at input power as low as 0.35 watt. Indicates either positive or negative peaks in percentage and in dB. No input circuit to tune. Remote meters can be used.

Circularly Polarized
FM Antenna, BFC

Omnidirectional radiator for all FM services, and specifically any application which requires both horizontally and vertically polarized signals of equal power. Lower windload and weight than combined antennas. Lower installation and maintenance. Excellent bandwidth and high power capabilities.

Horizontally Polarized
FM Antenna, BFA

Ideal for all FM broadcast services. Highest gain at low weight and windloading. Low VSWR over entire 200 kHz band. Can be top mounted or side mounted on existing towers. Provisions for de-icing. Easy to install, minimum maintenance.

Vertically Polarized
FM Antenna, 300 V

Designed for use in all FM broadcast services, particularly where vertical polarization is required. May be used with existing horizontally polarized antennas to provide dual polarization. High gain, low VSWR. Essentially omnidirectional when top mounted.

ing consultant should be given the opportunity to specify the phasor required.

In planning transmitting facilities, the customer should take into consideration future needs for a standby transmitter, if not being installed initially, so that the necessary transfer switches and relays between transmitters and antenna system may be built in, instead of added-on later.

Dummy Loads

The dummy load is an essential component in all transmitting installations, and one should be purchased with the AM or FM transmitter. The dummy load offers the opportunity for better adjustment and maintenance of the transmitter, particularly if a standby transmitter is used. Loads are offered in a range of impedances and power ratings. Loads for FM at 5 kW and below are air-cooled, and for 7.5 kW and above are water cooled. The AM dummy load should be selected with a power rating to handle the modulated peak power.

AM dummy loads are usually wirewound types, and although they are carefully designed to be non-inductive, they do have some inductance. This becomes apparent at the higher frequencies. The customer purchasing a wirewound dummy load should also procure an adjustable compensating network to cancel out the inductance. This is best obtained before the engineering consultant arrives to work on the array at which time he can use his bridge to find the proper adjustment.

Transmission Line Switches

Manual and motor driven transfer panels are available in a variety of styles to provide a convenient and rapid means of switching coaxial transmission line circuits between the transmitter and antenna for power cutback, dummy load switching, emergency antenna or spare transmitter switching and other functions. Microswitches are built into the motor driven types to operate indicators and power interlock circuits since RF power removal is necessary during operation of the switch.

Input & Monitoring Equipment

The input and monitoring equipment for the AM or FM station consists of FCC type-approved frequency and modulation monitors—and phase monitor if an AM directional antenna is used—plus limiter amplifier, VU meter panel, jack panel, fuse panel and possibly utility amplifiers for house monitoring. An unattended, remotely controlled transmitter would require, in addition, a remote control and automatic logging system which would provide control and measurement facilities for transmitter functions.

FM Antennas

Considerations in the design and planning of FM antenna systems are detailed in Part Two of this series of articles, where some discussion is devoted to means for achieving either horizontally polarized signals, vertically polarized signals or a combination of the two. As stated, antennas are available to produce either type signal, and both can be radiated simultaneously by interlacing the two types of antennas or more simply, by use of a circularly polarized antenna, which provides the equivalent of combined horizontally and vertically polarized radiators.[1] FM antennas should be supplied with a matching transformer. This provides a precise match between transmission line and antenna after the antenna has been mounted on the supporting structure.

It should be emphasized that the elements of some circular polarized antennas

[1] See "Dual Polarization FM Broadcasting With A Single Antenna," Broadcast News, Vol. No. 134, June, 1967.

have radomes available which is a feature worth considering in choosing an antenna. While radomes add wind loading in the order of 100 psf per section, this figure is still below the wind load of combined vertically and horizontally polarized antennas. Also antennas with radomes require no deicing, so there is a significant saving in power consumption, temperature control equipment and wiring. Radomes also provide not only a measure of protection for the antenna against the effects of rain, snow and ice but against atmospheric deterioration as well.

Prepare A System Diagram

After equipment for the new station has been evaluated and decided upon, the planner should next prepare a simple line diagram covering the units of his broadcast system from microphone to antenna. This will provide a functional checklist to assure that the system is complete and the design meets FCC approval. This planning diagram will also be helpful in installing the equipment and finally testing the system for proper operation.

Equipment Installation

It is well to establish a systematic procedure for checking equipment as soon as it is received at the station building. Equipment should be unpacked carefully and all parts identified with those on the packing sheets to avoid accidental loss of parts in discarded packing material. One good method is to prepare a list of the items received, giving dates and notations about any missing or damaged items.

Several of the heavy components will have been removed from transmitters and packed separately for shipment, along with large tubes, frequency determining parts and certain power determining components.

Careful study of the instruction book supplied with each equipment is necessary for proper installation and operation. This includes observation of any addendas that may be supplied with the book. Addendas are very important because they usually reflect beneficial changes that result from field experience.

Beyond that, sound wiring practices must be observed. A good station ground must be established and equipment connected to it by copper strap. Leads carrying AC should be well separated from audio wiring, and high level audio wiring should not be cabled with low level audio wiring such as microphone cables. Microphone shield should be grounded at one point only, and that is as near to the input of the associated preamplifier as possible.

Preventive Maintenance

Much improvement has been made in the reliability of broadcast equipment. However, there are still areas of equipment care for which a preventative maintenance schedule should be established and adhered to in order to sustain the value of the broadcast investment. The instruction book should be referred to for detailed maintenance procedure, but each station owner should take the time to analyze his equipment and prepare a check list to be sure maintenance chores are performed regularly.[2]

Dust is the number one enemy, by preventing proper heat dissipation, by changing electrical values of components, causing arcing, and by preventing proper electrical contact in relays and switches. Dust filters on equipment, though effective, do not prevent all dust from reaching components. Wherever possible, air brought into the building should be filtered. Any improvement in dust elimination will contribute to improved reliability of the equipment. Of course, air filters should be inspected and cleaned or changed at regular intervals.

Routine visual inspections should be made. Tighten screw type connections that may have loosened with vibration. Periodically test high voltage contactors. Check all moving and rotating items for proper functions. Keep switches and relays contacts clean. Low-current circuits sometimes use small fuses. It is good practice to change them once a year.

The antenna system usually requires maintenance. Tower spark gaps should be kept clean, and weeds kept cut around the towers. Guy wire tensions, insulators, and ground straps should also be inspected. Tower lighting equipment must be maintained in proper working order, and the tower kept painted in accordance with FAA requirements. Pressurized lines should be inspected regularly for leaks. Approximately five pounds pressure should be maintained on gas lines. Electrical junction boxes, or "pull boxes", should be checked. If moisture is present, check gaskets. Be sure breather hole is open and in down position. The antenna meter must be checked and calibrated against the base current meter at regular intervals.

It is necessary to check the modulation monitor with an oscilloscope at regular intervals to insure its accuracy. The same applies to the frequency monitor, which must be checked with an outside frequency measuring service. At the same time the modulation monitor is checked, operation of the limiter amplifier should be observed. The calibrations of the various functions of remote control systems should be checked.

Frequency response, noise, and distortion measurements should be made more frequently than the once-a-year overall proof of performance tests required by the FCC. It is good practice to check all station equipment at least four times a year in addition to proof of performance measurements.

Tools and Test Equipment

Even the smallest well equipped AM or FM radio station will have access to an adequate set of hand tools for use in making repairs and maintaining the equipment. Stations should acquire and make frequent use of good test equipment. Test equipment that will prove helpful when performing routine maintenance and making proof of performance checks will include an audio oscillator, noise and distortion meter, transmission set or set of calibrated attenuation pads, volt-ohm meter or VTVM, oscilloscope, tube tester and field intensity meter.

Supplier Qualifications

The qualifications of the equipment supplier very often are a key to equipment performance and customer satisfaction. The purchaser should give careful consideration to the various companies who will be called upon to supply the equipment, their experience, their record in the industry, their ability and desire to solve field problems. Many purchasers express a preference for doing business with one company, for the greater ease and convenience of a single source of contact and responsibility, and for an ideally matched system. This also may assure an orderly future expansion with units electrically and mechanically designed to work together.

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[2]The National Association of Broadcasters Handbook, available from NAB Headquarters in Washington, D. C., contains valuable information to guide the broadcaster in the operation and care of his station.

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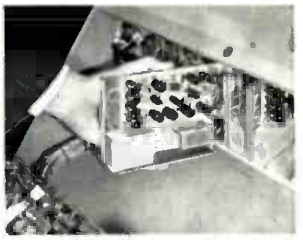

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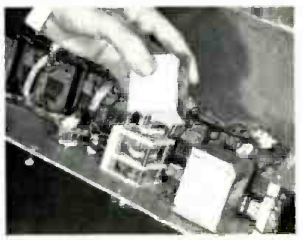

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