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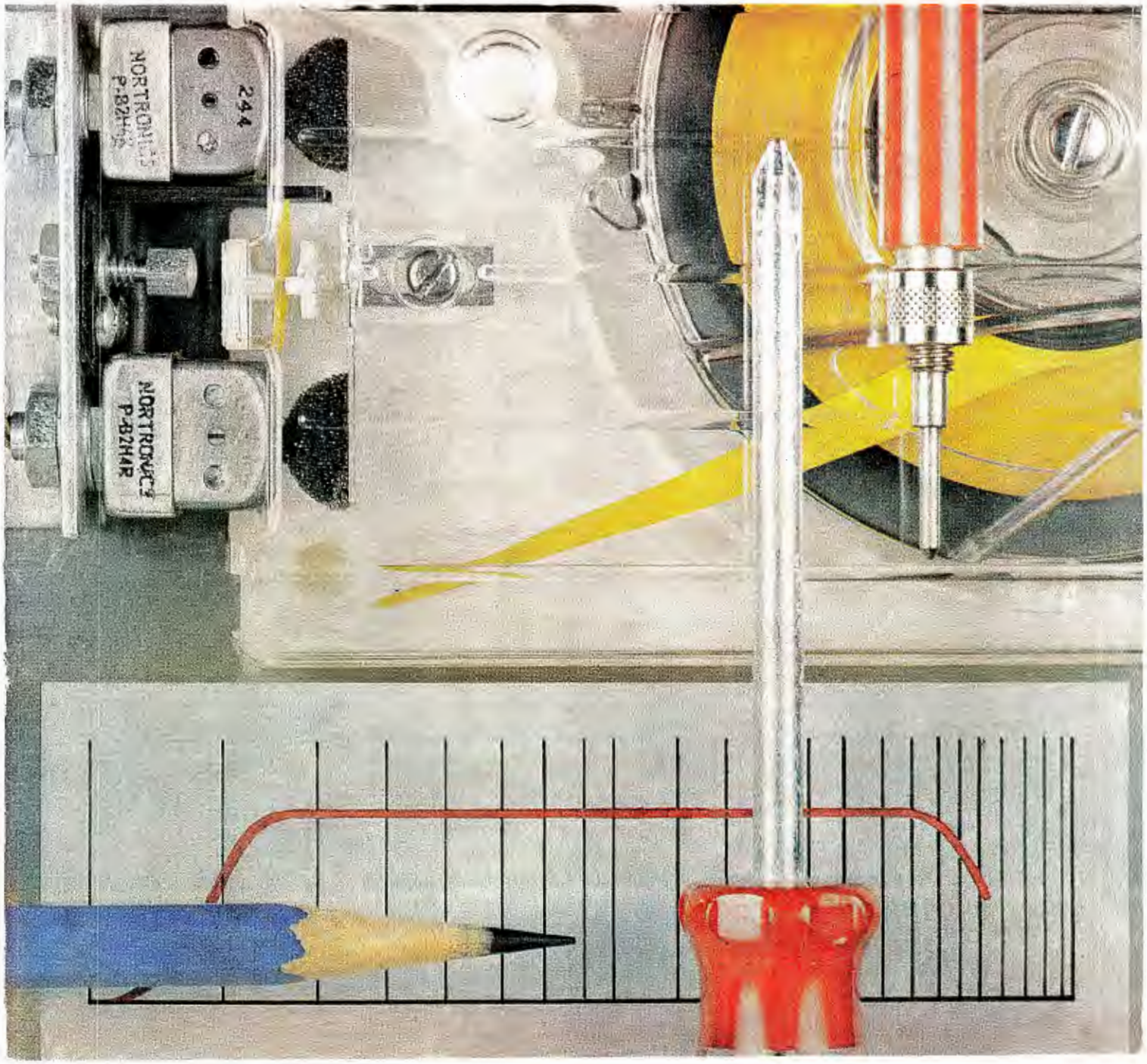
NOVEMBER 1964/75 cents

Broadcast Engineering

the technical journal of the broadcast-communications industry



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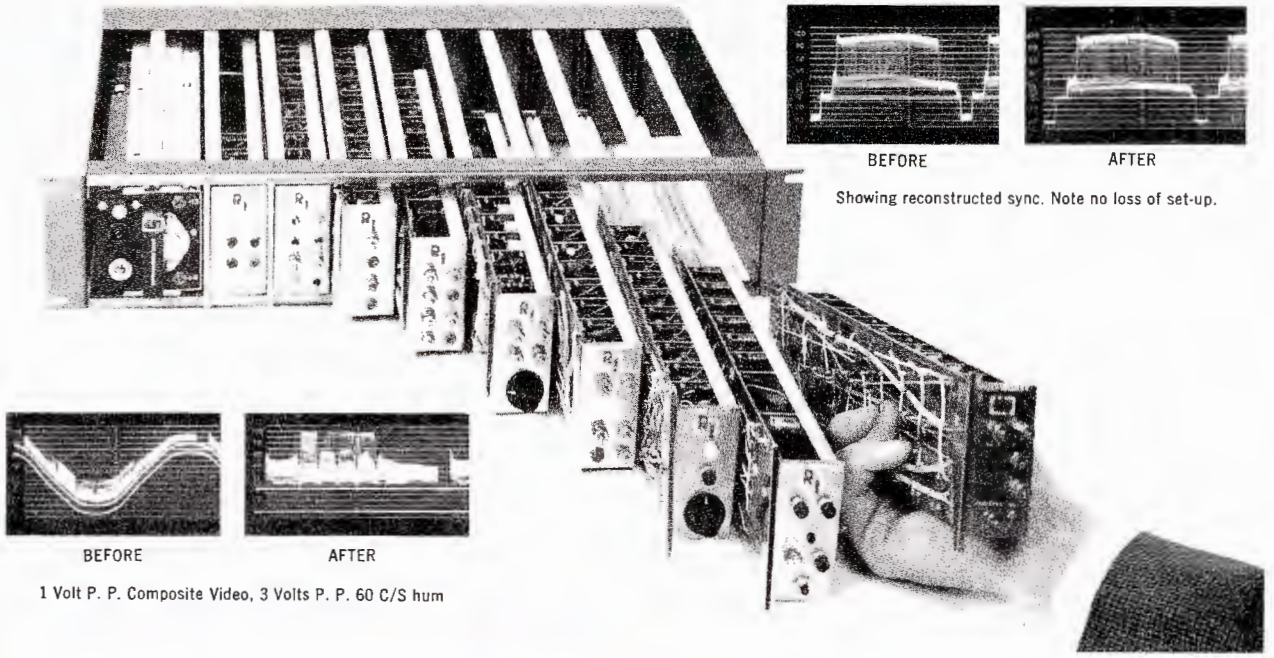

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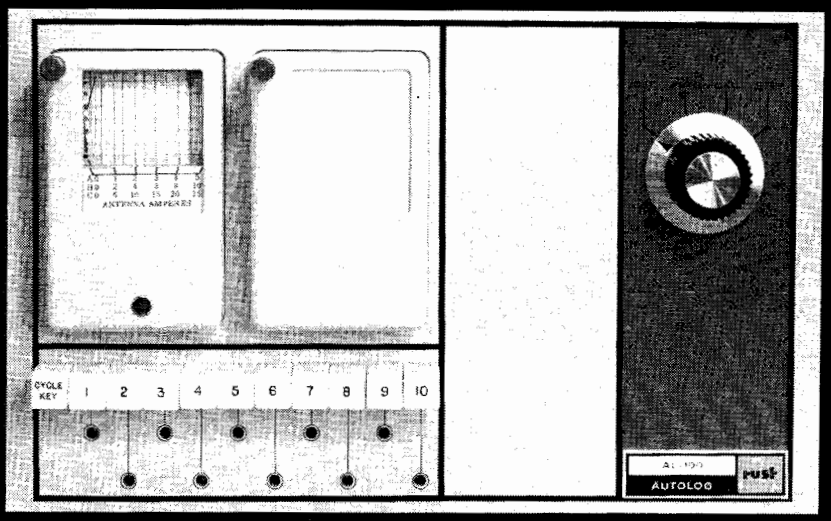

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Volume 6, No. 11 **November, 1964**

CONTENTS

FEATURES

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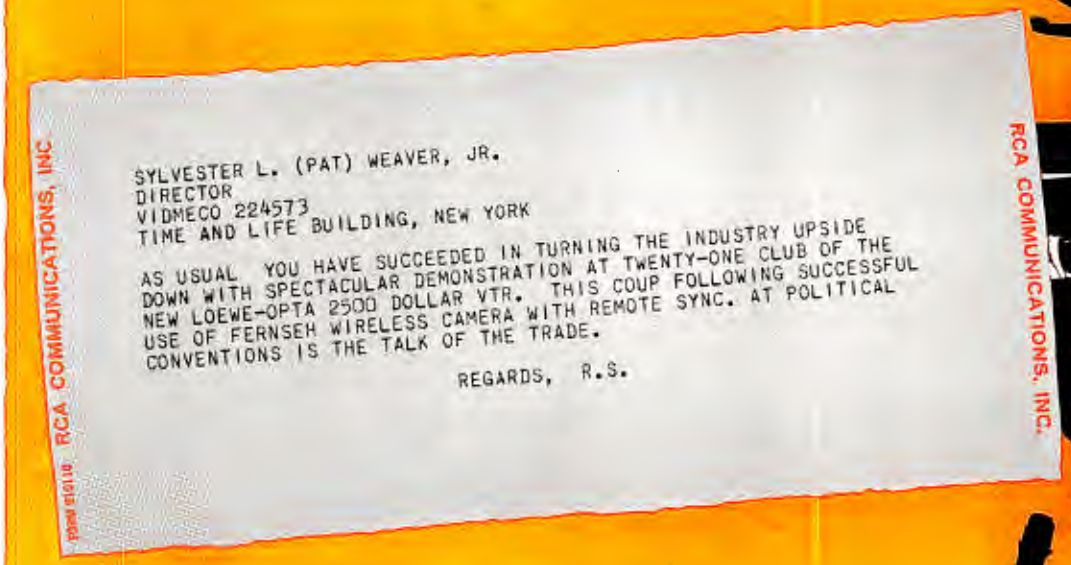

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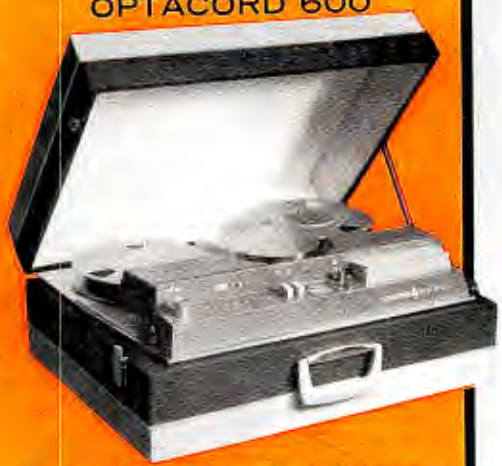

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LETTERS to the editor

DEAR EDITOR:

The article, "Procedures and Equipment in Microwave Maintenance," in the June issue of BROADCAST ENGINEERING contains on page 43 a diagram of a hum and low-pass filter. The value of capacitor C4 is not listed in the diagram. Since we have the unit under construction, we would like to know the capacitance of this component.

ELMO W. REED

Director of Engineering,
WEAU-TV,
Eau Claire, Wisc.

The value of C4 is 1000 mmf. Incidentally, L2 and L3 should have been shown on the diagram as 3.9 uh. Thanks for pointing out the omission, Mr. Reed. —Ed.

DEAR EDITOR:

In the September issue of BROADCAST ENGINEERING, the "Chief Engineer" very ably explained the Commission's "10% Rule." However, it should be pointed out that the so-called "10% Rule" has gone the way of the passenger pigeon—it, too, is now extinct. While this rule applies to applications filed prior to July 13, all new applications filed after that date are governed by the new rules released July 7, 1964, in the Commission's Report and Order in Docket No. 15084, which terminated the "freeze."

Under these new rules, no grants will be made for changes in existing stations or for new stations in markets with an existing station if interference is received or given. In the case of a first service, no grant will be made if the proposal causes interference to any other station or proposal, or if it receives interference within its 1.0 mv/m contour. Just as with the "10% Rule," there are some exceptions in the new rules which are best discussed with the station consulting engineer.

PAUL LESAGE

Associate Engineer, Charles E. Brennan
Consulting Radio Engineers
Milwaukee, Wisc.

Type for the September issue was set before we knew of the new ruling. Thanks, Paul, for helping us point it out to our readers.—Ed.

DEAR EDITOR:

I was happy to see Mr. Jones' article, "Winter to Summer Conductivity Effects," in the June issue.

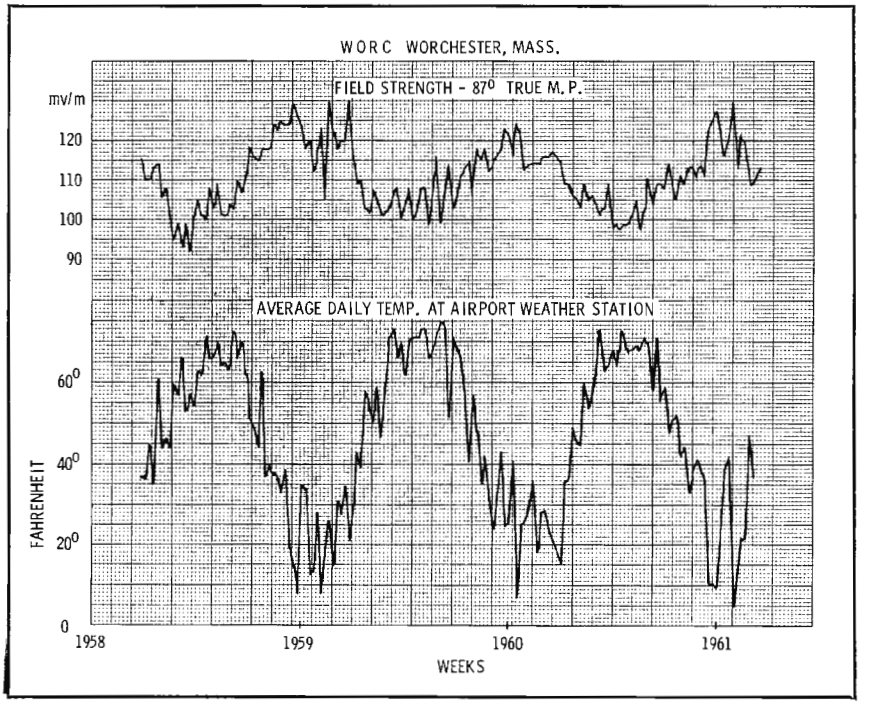
We here in New England thought we were plagued by these changes more than are stations in other parts of the country, since changes in field-strength readings appear to be exaggerated in the areas of low conductivity with which we are blessed.

I would welcome publication of any reliable data which may eventually lead to official recognition of varying conductivity. Perhaps Mr. Jones would like the enclosed copy of a series of measurements made in Worcester, Mass.

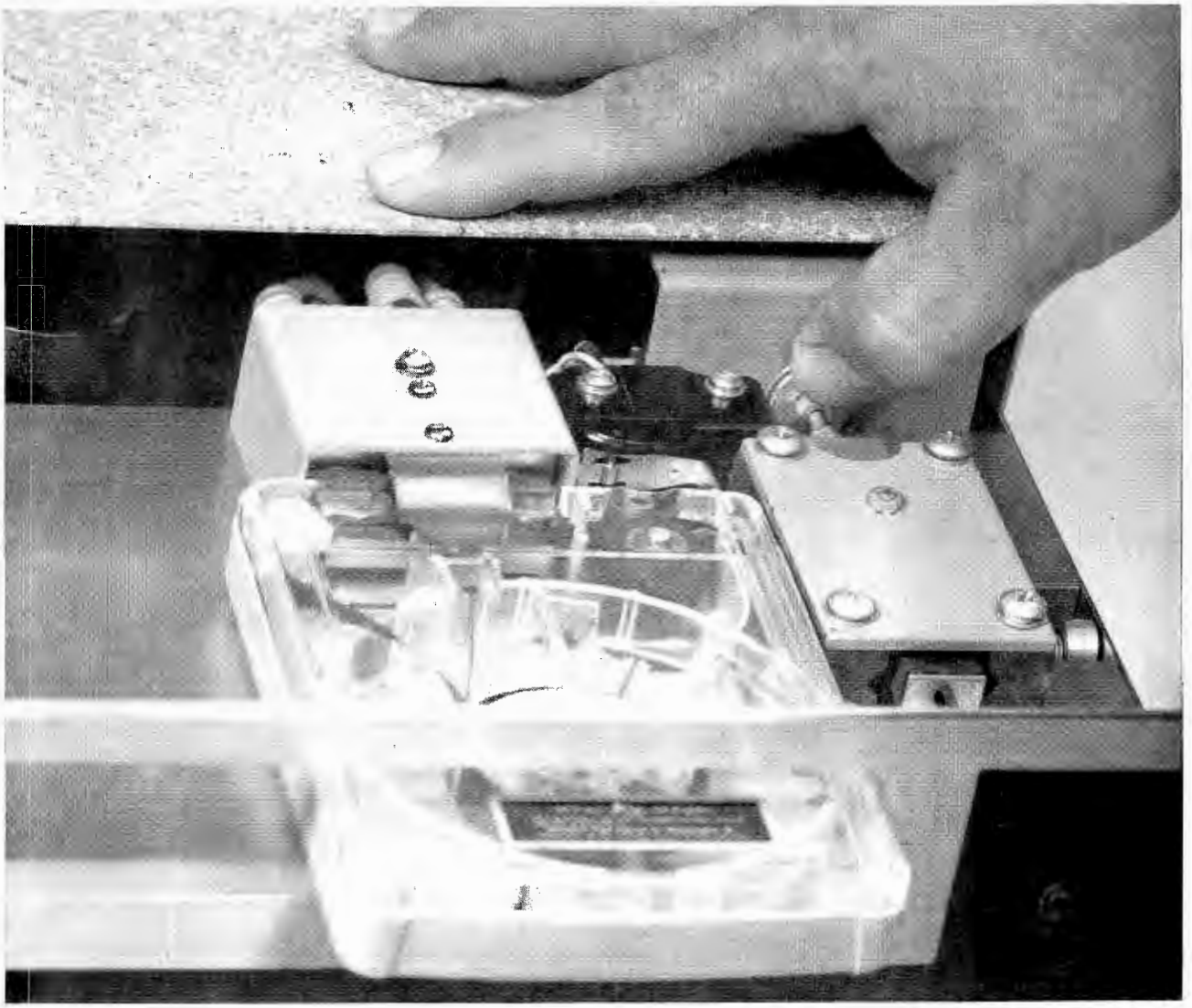
DONALD W. HOWE, JR.

Consulting Engineer
Worcester, Mass.

Perhaps other readers have developed charts showing the effects of winter-to-summer conductivity changes in their localities. If so, maybe we can develop and publish an overall picture of this effect throughout the country. Thanks, Don, for the idea.—Ed. ▲



YOU CAN'T SLOW IT DOWN . . .



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BROADCAST EQUIPMENT DIVISION BLOOMINGTON, INDIANA

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New VOLUMAX™ Automatic Peak Controller From CBS Laboratories Outmodes Limiters

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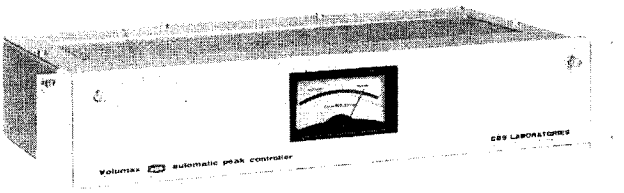

A new development from CBS Laboratories, VOLUMAX is the successor to peak limiters. Unlike conventional limiters, VOLUMAX does not force you to choose between reducing program level or suffering "pumping" and other audible distortions.

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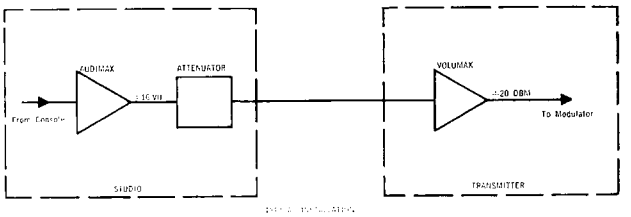
After limiting a severe peak, conventional limiters use a long recovery time to minimize audible "pumping". Valuable modulation capability is wasted while the unit recovers from reduced gain.

VOLUMAX works in a completely different manner. Operating with dual regulation speeds, VOLUMAX analyzes the waveform and provides either microsecond or millisecond action.

The net effect is that your effective radiated program level can be doubled.



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When VOLUMAX is used in conjunction with CBS Laboratories AUDIMAX automatic level control, the combination permits an astounding 8-to-1 increase in effective program power. The AUDIMAX "rides gain" in the studio to provide a 4-to-1 increase. Then VOLUMAX controls modulation peaks at the transmitter to provide an additional 2-to-1 improvement.

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Circle Item 7 on Tech Data Card

"PROTECTIVE" MAINTENANCE AT THE STUDIO

by Lynn R. Williams, Chief Engineer, WBEJ, Elizabethton, Tenn. — A system of devices and procedures that will prevent damage to radio equipment from improper operating practices.

When the FCC first permitted lesser-grade license holders to operate broadcast stations and allowed remote control of transmitters, we feel that one important facet of the problem was not given adequate forethought—the capability of many nontechnical people in (and their attitude toward) the proper operation of radio broadcast equipment. Maybe this was considered first and then brushed aside as a management problem rather than a potential technical trap, but it was then and is now a source of difficulty. The problem falls into the realm of the engineer who must walk a narrow path in maintaining peaceful personnel relationships while avoiding equipment damage and FCC citations.

For those engineers who must cope with this situation and who do not have time constantly to instruct personnel in correct operating procedure, we offer a few ideas that have been incorporated at WBEJ. An engineer acquaintance of ours termed these little tricks and gadgets "announcer defeaters," but they're really a system of "protective" maintenance.

The procedures that follow are formulated on a simple axiom: "If they can't adjust it, they can't misadjust it." Following this principle takes a little extra work and experimentation, but the results far outweigh the energy expended. However, be careful not to overdo this approach, or your system will become so complex that its benefits will be outweighed by extra maintenance.

Equalizers

Our equalizers were originally installed in the recommended manner, with the control knobs out on the panel for convenient adjustment. However, the announcers would more often than not turn the switches to position No. 4, "Poor Records," and leave them there. Thus, all audio frequencies above 2500 or 3000 cps were cut off, causing poor sound quality. In our first attempt to solve this problem, we removed the equalizer switches from the panel and hid them back under the operating desk, preset to position No. 2—"Quiet Records and Transcriptions." But, to our dismay, sooner or later someone would discover the controls and start experimenting. Sometimes one equalizer would end up on "Flat," while another would be in the "Poor Record" position.

Our final solution to the problem was to remove all switches, knobs, and boxes, and permanently wire the equalizers internally to position No. 2. The announcers have by now forgotten that there ever were equalizer adjustments. In fact, I doubt if anyone even realizes that we employ equalizers at all. (You also gain one nice little cabinet, a knob, a switch, and a dial plate for each rewired equalizer. And some of the equalizers have two switches.) In any case, the result is better and more constant sound quality. Announcers defeated, read on.

Proper Microphone Usage

The reason that announcers think they must be close enough to a microphone to smell the paint while talking will forever remain one of the mysteries of life; the practice, of course, usually results in poor sound. The NAB Handbook recommends about 2′ as the minimum distance between announcer and microphone—this is more than twice the distance used by many announcers. Some microphones will tolerate this sort of misoperation better than others, but all broadcast microphones will produce better results when used at the correct distance.

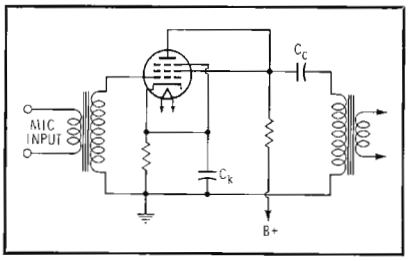


Fig. 1. Simplified mic. preamp circuit.

In our experience, getting an announcer to work away from the microphone is next to impossible. We've tried mounting the announce microphone at a reasonable distance on an iron pipe, but someone always had access to a pipe wrench. We also tried suspending an RCA 44BX velocity microphone on a rope, but a yardstick propped against the wall brought it out again to "smelling distance." We decided physical placement was not the solution—an electronic answer had to be found.

Working a microphone too closely causes over-emphasis of audio frequencies below about 100 cps and allows lip noises (below about 30 cps) to be heard. Since voice frequencies do not ordinarily extend below 100 cps, a microphone channel response can be attenuated below that frequency. This will help eliminate low-frequency distortion and minimize lip sounds and other noises picked up by direct mechanical vibration.

Fig. 1 is the simplified schematic of a preamp stage in our console. We found that adequate low-frequency rolloff could be accomplished by simply lowering the value of coupling capacitor Cc. If necessary, a greater effect may be had by varying the value of Ck (the

cathode bypass capacitor), if there is no hum problem. Adjust each preamp stage for the desired low-frequency response, but do not tamper with the response of the program amplifier—it should be as flat as possible.

The low-frequency attenuation obtained for various values of coupling capacitance is shown in Table 1. We use either .03 or .05 mfd depending on the announcer with whom we are working; you could even switch-select two or three capacitors, if necessary. However, do not use more low-frequency cut than you need to minimize noise—voice-range audio becomes "tinny" when rolloff extends above approximately 150 cps.

Alert Receivers

You would think that an item such as an Emergency Broadcast System (EBS) alert receiver would be relatively immune from misoperation, but this is not so, unless our case is unique. Our EBS receiver has five channels selected by a rotary switch on the front panel. Three channels are for primary EBS stations, and two are for the old CONELRAD frequencies of 640 kc and 1240 kc. When the switch is set to either of these latter two channels, the alarm circuit will not function.

Since our operating frequency is 1240 kc, we may be one of a group of stations which is most susceptible to misuse of alert receivers. At any rate, our announcers would turn the switch to the 1240-kc position and leave it there, even though we have a high-quality, off-the-air monitoring system. No amount of persuasion, fussing, or loss of EBS tests could prevent this, so we detuned the 1240-kc channel. We even labeled this position "NOTHING." But, even now, the EBS receiver may occasionally be found switched to the dead channel. How about that?

Should you modify your EBS receiver, it would be a good idea to disable the circuit that prevents the alarm from working when the receiver is switched to the old CONELRAD frequencies.

The output level of an EBS alert receiver is supposed to be kept high enough that the receiver may be heard if its alarm light burns out or is removed from its socket. Herein lies our second alert receiver problem—the volume control is usually turned down.

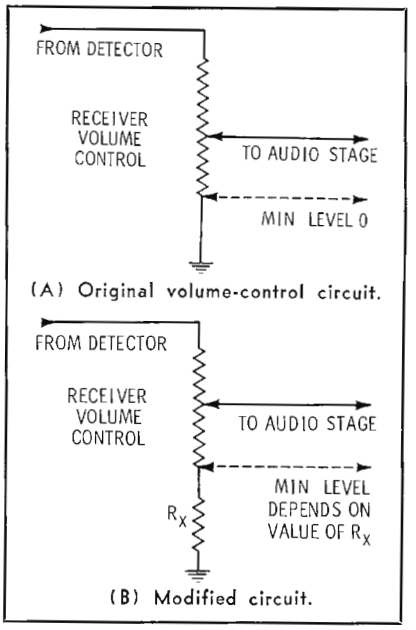


Fig. 2. Receiver minimum-level circuit.

A simple solution to this problem is a resistor in series with the volume control and ground (Fig. 2). The EBS could suddenly become very important, and any device that will make it more effective warrants consideration.

Modulation Monitor

At one time, we had our modulation monitor (a General Radio 1931-A) installed at the studio. However, announcer-operator misadjustment later forced us to move it to the transmitter; the story of that situation may be of value.

We used a Gates M-5144 RF amplifier at the studio to drive the modulation monitor, a frequency monitor, and an audio amplifier.

Table 1. Effect on Microphone Preamp Low-Frequency Response for a Number of Coupling Values of Capacitor Cc (Fig. 1).

f(cps)	Attenuation (db) for four values of Cc (0 db @ 1000 cps)			
	0.5 mfd	0.1 mfd	0.05 mfd	0.03 mfd
10	−12 db	−21 db	−28 db	db
15	−2.0	−11	−17	
20	−0.4	−6.6	−13	−18
25	0	−4.8	−11	
30	+0.3	−3.5	−9.0	−13.5
40	+0.2	−2.1	−6.5	
50	+0.1	−1.5	−5.0	−8.5
70	0	−0.9	−3.5	−6.0
100	0	−0.4	−2.1	−4.2
200	−0.1	−0.1	−1.0	−1.5
300	−0.1	−0.1	−0.5	−1.0

For proper drive, the bandwidth of the RF amplifier-modulation monitor must be just right. The unit is aligned by running a series of tones up to 10 kc through the station system and adjusting the inductor slugs and capacitors of the RF amplifier. All monitor adjustments and controls must be set to match the curve obtained when the modulation monitor is fed directly from the transmitter. You will find that the gain controls of the RF amplifier, particularly the screwdriver adjustment in back, have some effect on bandwidth. When the RF amplifier and the modulation monitor are properly adjusted, positive and negative peaks both will be indicated accurately on the percent-of-modulation meter. If any of the adjustments are disturbed, the positive peaks will be compressed, resulting in negative modulation indications.

Difficulties at WBEJ arose because the point of critical adjustment for correct bandwidth was not the same as that for maximum monitor volume. No amount of instruction prevented the announcer-operators from changing the control settings to raise the monitor speaker output to an earsplitting level. Whenever the controls were moved from the optimum settings, all sound from the monitor became distorted due to flattening of the positive peaks.

Since modulation monitors are type approved by the FCC, no circuit modifications should be made. Under the circumstances described above, about the best possible solution is to remove the modulation monitor from the studio, install it at the transmitter site, and procure a remote modulation meter for the announcers to ignore. "If they can't adjust it, they can't misadjust it."

Frequency Monitor

Our frequency monitor is an old Doolittle FD-1A that radiates a fairly strong RF signal over a distance of several feet. Since the signal is about 500 cps below the carrier frequency, it can cause an audible beat note if picked up by the monitor amplifier. This interfering tone can be eliminated by bypassing the monitor's AC line cord. There is, however, a low-volume, 500-cps note from the meter-discriminator that can be heard in the

• Please turn to page 44

CALIBRATION OF AM AND FM MODULATION MONITORS

by ***Robert A. Jones,*** Consulting Author, Consulting Radio Engineer, LaGrange, Ill.

—Methods for ensuring compliance with the FCC rules against overmodulation.

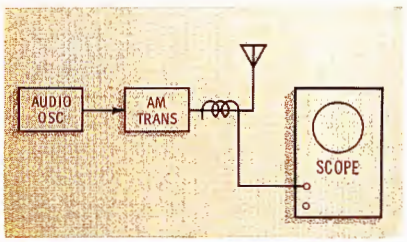


Fig. 1. A simple system for using scope in calibration of AM modulation monitor.

All competent broadcast operators know that overmodulation is against the FCC rules. Nearly every radio broadcast station is required to have an FCC-approved modulation monitor, but having a monitor is no assurance that its readings are right. A frequency monitor can be checked weekly or monthly by having an outside monitoring service measure the transmitter frequency, but who do you call for an outside modulation check? Fortunately, the station technician can make these measurements himself.

AM Monitor Calibration

By far the simplest way to calibrate an AM modulation monitor is to use an oscilloscope and an audio oscillator. Fig. 1 shows how the equipment is connected. The audio oscillator is set for a frequency of about 1000 cps, and this tone is fed into the transmitter, either directly or through the audio console. The vertical plates of the oscilloscope are connected directly to a source of modulated RF from the transmitter. This source can be a pickup loop placed near the tank circuit of the final stage. (High voltages might be present—be careful!) The horizontal frequency of the oscilloscope is set to about 250 cps so that the envelope of the pattern appearing on the scope will contain four cycles of the audio waveform.

If the peaks of the sine waves composing the envelope just touch as in Fig. 2A, 100% modulation is indicated. A pattern similar to Fig. 2B indicates overmodulation, and one similar to Fig. 2C indicates less than 100% modulation. The audio level should be adjusted to give a pattern similar to that shown in Fig. 2A. Then, adjust the calibration controls in the monitor until the percent-modulation meter indicates 100%. Remember also to check the calibration of the flasher light; the flasher, the percent-modulation meter, and the scope should all indicate 100% at the same time.

There is a second, and possibly more accurate, method of calibrating an AM modulation monitor with the aid of a scope. The equipment is arranged as shown in Fig. 3. The audio signal is fed to the input of the transmitter, and a small portion is also applied to the horizontal input of the oscilloscope. The internal sweep in the scope is not used. The RF pickup from the transmitter is fed directly to the vertical plates of the scope.

With 100% modulation, the well-known trapezoidal pattern shown in

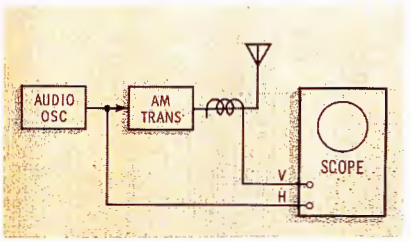


Fig. 3. Equipment arrangement for modulation checking by trapezoidal patterns.

Fig. 4A is obtained. Figs. 4B and 4C show examples of overmodulation and undermodulation, respectively. It is advisable to employ a low-frequency audio tone for this test, because phase shift may occur in the equipment at higher audio frequencies. A phase shift will distort the sides of the trapezoidal pattern.

A distinct advantage of this method is the ability to measure any percentage of modulation. The following formula is used:

$$\% \text{ mod} = \left(\frac{2A}{A+B} - 1 \right) \times 100$$

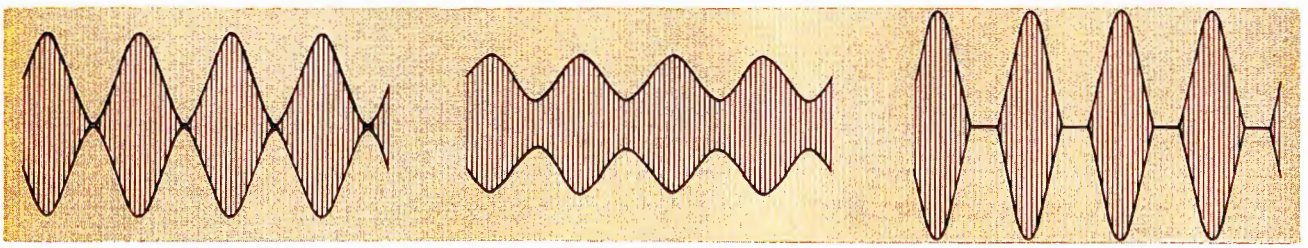
Where,

A is the height of the left side of the trapezoid, and

B is the height of the right side of the trapezoid.

FM Monitor Calibration

For an FM broadcast station, 100% modulation is defined as a maximum frequency swing of 75 kc. Thus, to check the percentage of modulation in an FM transmit-



(A) 100% modulation. (B) Over 100% modulation. (C) Under 100% modulation.

Fig. 2. Oscilloscope patterns obtained for three degrees of modulation when the measuring arrangement shown in Fig. 1 is used.

ter, it is necessary to determine the frequency deviation.

In frequency modulation, the following relationship applies:

$$\text{audio frequency} = \frac{\text{frequency deviation}}{\text{modulation index}}$$

The spectrum of an FM signal consists of carrier and sideband components. Mathematical analysis of the signal shows that the amplitudes of the various components depend on the modulation index; the amplitude of the carrier component varies in proportion to the zero-order Bessel function of this index. For certain modulation indices, the carrier amplitude becomes zero; thus, as the level of a modulating tone is increased, the carrier can be observed to go through a series of nulls. For each null (first, second, etc.) there is a definite corresponding modulation index, and if the modulation frequency is known, the frequency deviation can be calculated from the formula given previously. When the deviation is known, the percentage of modulation can be readily determined. Table 1 lists the audio frequencies necessary to produce a given percentage of modulation at various null points.

All this may sound like a puzzle at this point, but it has a practical application. Refer to Fig. 5. A tone signal of known frequency is fed into the audio terminals of the transmitter, and a sample of the FM transmitter output is supplied to the station's modulation monitor. A shielded lead is coupled from the IF section of the monitor to the antenna terminals of a good-quality communications receiver having a beat-frequency oscillator. On some monitors, a special jack is mounted on the back of the unit for IF pick-up. On monitors not having such an available terminal, connect a lead to the plate of the first IF tube through a capacitor.

With no audio applied to the transmitter, adjust the receiver to the intermediate frequency of the modulation monitor. (Check the instruction book for your particular monitor to determine the IF.) Adjust the receiver fine tuning until the IF signal from the monitor produces a maximum-signal indication on the signal-strength meter. The BFO switch should then be engaged and the pitch of the BFO adjusted to about 250 cps. With the audio generator set to one of the frequencies shown in Table 1 and with the BFO on, slowly bring up the level of the audio applied to the transmitter. For example, assume that the audio frequency is 5023 cps. As the audio level is slowly increased, a null in audio output of the receiver is heard. Then, as the audio level being fed to the transmitter is increased, the beat note returns. Increasing the audio tone still more causes a second, a third, and a series of successive nulls to be heard. As Table 1 shows, the fifth null corresponds to a deviation of 75,000 cps, or 100% modulation. If the monitor does not now read 100%, adjust the calibrating controls until it does. Again, as with the AM monitor, remember to check the calibration of the flasher.

Table 1. Nulls, Audio Frequencies for Determining Modulation of FM transmitter.

Number of Null	Modulation Index	Deviation (cps)	Percent Mod.	Audio (cps)
2	5.520	75,000	100	13,950
2	5.520	55,200	73.6	10,000
2	5.520	27,600	36.8	5,000
3	8.654	75,000	100	8,670
4	11.792	75,000	100	6,360
5	14.931	75,000	100	5,023
6	18.071	75,000	100	4,150
7	21.212	75,000	100	3,535
8	24.353	75,000	100	3,080
9	27.494	75,000	100	2,727
10	30.635	75,000	100	2,450

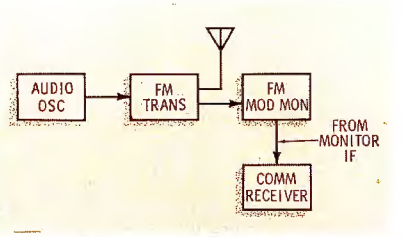


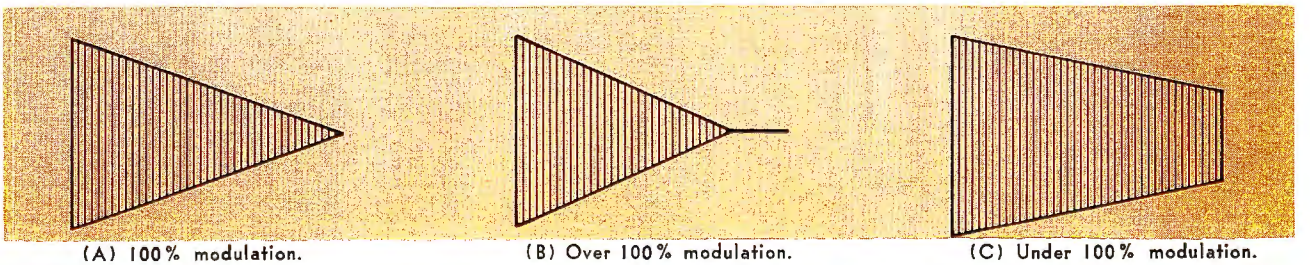
Fig. 5. Equipment arrangement for the calibration of an FM modulation monitor.

It should be noted that the accuracy of this method depends heavily on the frequency calibration of the audio generator. An error of a few cycles can cause a large error in the calibration accuracy. Also, the modulating signal must be low in distortion to insure sharply defined nulls.

The second null is the first one that can be used. This is because the first null is produced by an audio signal having a frequency above the range of most audio generators.

Conclusion

All stations check their frequency monitors periodically with an outside monitoring service. Well-operated stations also check their modulation monitors by one of the standard procedures just described. Because no unusual or highly expensive equipment is required, these checks should not be beyond the means of any station. Overmodulation is contrary to the FCC Rules and, if detected by the Commission, leads to a violation notice. This alone should be reason enough for periodically checking your modulation monitor. ▲



(A) 100% modulation. (B) Over 100% modulation. (C) Under 100% modulation.

Fig. 4. Oscilloscope patterns obtained for three degrees of modulation when the measuring arrangement shown in Fig. 3 is used.

SAFETY IN THE STATION

by Thomas R. Haskett, Consulting Author, Broadcast Consultant, Cincinnati, Ohio

In my travels as a consultant, I've seen many, many examples of station personnel taking unnecessary chances in their work. I'd like to pass some of these cases along to you, with the hope that they may avert some potentially hazardous situations.

Recently, funeral services were held for the chief engineer of a midwestern broadcasting chain. He was a young man with a bright future in radio enginering. Unfortunately, he made one mistake too many—**carelessness around a transmitter.** As we humans are creatures of habit, the only safe and sure way to avert such costly errors is to **make habits of safety practices.** Broadcast stations are no different from other places of business in at least this one respect: They contain sources of potential danger and require safety measures to avoid injuries to personnel.

Electrical Safety

Most of us know that it takes a completed circuit to injure. As Fig. 1 illustrates, the current through a load depends on the source voltage and the resistance of the load. If a part of your body becomes the load across a fixed voltage source, the amount of current will depend on your body resistance, a value which can vary anywhere from 100,000 ohms to less than 500 ohms. In Fig. 2 you see what can happen. If your hands are dry when you reach into a 12-volt circuit, accidentially completing a current path won't hurt you since only 120 μamps will flow (Fig. 2A). But get across 117 volts with hands dampened by perspiration, and 78 ma will pass through you (Fig. 2B); **this much current can kill!**

Transmitters

Knowing that electricity can be lethal isn't enough. We all must work around the stuff each day, and we should know what to expect. For example, you probably know better than to work inside a transmitter with the power on. But one point I find people overlooking is that a transmitter **panel** switch opens only the circuit **inside** the cabinet—in other words, line voltage is still present. It's much safer to break the circuit at the junction box (Fig. 3). Another trouble spot often overlooked is the crystal-heater and cabinet-light wiring which usually runs through a separate breaker; this line is live at all times. If you **know** where these circuits are, you can probably work around them while they're on. But it's always safer to turn them off if you must work inside the transmitter enclosure.

I have learned through bitter experience not to perform transmitter maintenance alone; if an accident should happen, someone should be around to assist. However, one thing your partner should **not** do is turn the power on and off for you. It's too easy for him to misunderstand your instructions.

It is surprising how we all take chances. Some engineers continue working when they're tired and sleepy after a night of trying to clear up trouble. They may lean over the door of the rig in an awkward position and fire up the high voltage with fatal consequences. It's much safer to be in a comfortable position—clear of the door-panel opening—before turning the power on. And, if you have to adjust something inside the enclosure, **put one hand in your pocket and work with the other.** Do not provide a return to ground for the lethal current!

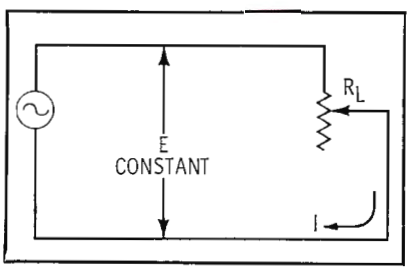


Fig. 1. Voltage, current, and resistance.

Conductors, Line Cords, and Leads

Probably every technical person in broadcasting has heard about the importance of safety grounds, interlocks, and "bleeder insurance." The general rule, however, is this: All metallic objects in the plant which are supposed to be carrying signal or power should be covered and insulated from accidental contact; all other potential conductors should be grounded. If you find one "floating," ground it. I once sat down at a studio console and rested my arm on a metal trim strip around the desk top. When my hand touched the front panel of the console, I received a shock. Inspection revealed that the ungrounded molding was picking up RF from the transmitter; 2′ of No. 10 wire was the cure. You can get into similar trouble with uncovered shields on audio wire because of random grounding in electrical conduit. "Bleeder insurance" is illustrated in Fig. 4—a grounding stick kept at the rear of the transmitter. I never work inside a cabinet without using such a stick first to ground each HV capacitor several times to ensure complete discharge.

Sometimes it's necessary to measure the voltage drop across a plate resistor. This usually means connecting the VTVM hot lead to the tube plate and the VTVM ground lead to the B+ side of the resistor. You know what happens then, don't you? The VTVM case becomes hot with respect to station ground. If

you **must** perform such a measurement, make the lead connections before applying power, and then remove all power before disconnecting the leads.

Hardly anyone pulls hot tubes barehanded anymore (I hope), and most of us take care when handling cathode-ray tubes, knowing they can implode. I'm touchy around CRT anode connections, however, and I won't handle such a tube without killing all power and running a clip lead from the second-anode clip to chassis ground. When installing a new CRT from the carton, I tape one end of the jumper to the aquadag coating and snap the other end into the anode connection.

Most of us get lazy at times and take short cuts. When using an electric hand drill, do you pull out the plug when you change twist drills? Suppose the drill switch shorts just as you put the key in the chuck. The rotating key could break a finger.

The cord is important, too. Most portable tools use three-wire cords today; the third wire is a safety ground connection. If this ground lead is not used, the drill case can become electrically hot. A few years ago, I was drilling through a mounting bracket inside a grounded rack. The drill was the two-wire type, so I stuffed my jacket in the rack and leaned against it. When the drill bit through the metal I slipped, and my arm flattened out against the rack —I received a nasty shock. Before I went any further, I bought 10′ of three-wire cord and rewired the drill.

You might suppose that no one would wire a polarized AC plug backwards, but I have found them hooked up that way. It's poor practice to wire any plug so it is hot, **except** when it's in a mating receptacle. It's also poor practice to connect AC extension cables to the source first, because you are then working with live cables. It's safer to work back from the load.

Transmission lines can be dangerous too. Some engineers don't realize that, at an AM transmitter site, static electricity and lightning hits from the antenna can back up the line as far as the phasor. Therefore, it's a poor idea to go out to the doghouse to read the antenna ammeter on overcast days or during a thunderstorm; and you'd be wise to stay clear of the phasor, too.

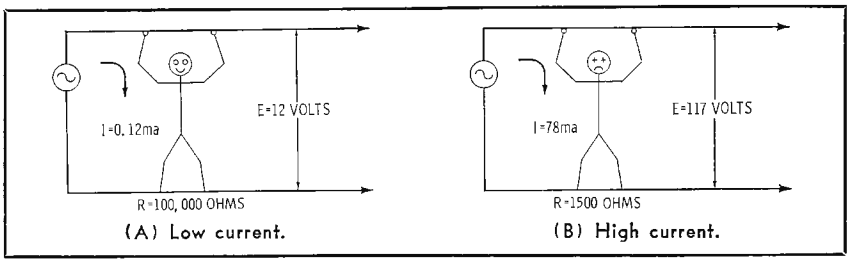


Fig. 2. Effects of human skin resistance on the severity of an electrical shock.

Nonelectrical Safety

When visiting a station recently, I noticed the newsroom door off its hinges and propped against the wall. A hydraulic door-closer had been removed for service, but the door was not replaced. A newsman in a hurry could have knocked the door over, injuring himself or someone else.

Tile floors and leather-soled shoes are poor mixers. While you can't require that everyone wear rubber soles, you can see that the floor is kept clean.

Try thinking: "What can go wrong?" When I came to work at a station some years ago, I found a coffee pot on a hot plate in the control room. The asbestos-insulated line cord was draped across a table full of cups, cream, and sugar, and the hot plate was very close to the wooden frame of a cabinet. It's easy to see that carelessness here could have caused a fire or severe shock. An unused steel cabinet was located and bolted to the wall with 2″ pipe standoffs. We put the hot plate inside and taped the slack portion of the line cord up out of the way. The supplies went on a shelf **beneath** the cabinet.

Climbing

You may climb a tower occasionally—I still do. Would you climb without a belt? I have one of the type used by electric company linemen. The belt and strap together cost about $35, but that's cheap when you consider it may save your life. When climbing a large tower, you'll have to pass the strap through the tower and around a member. With small towers, you can strap around the entire tower. A friend of mine uses **two** belts, unstrapping each one in turn as he passes guy levels. Thus, he is always strapped to the tower. For added precaution on towers, work with both hands only when absolutely necessary, and then only after double checking your belt and strap. A belt is not the complete answer; you should also wear the right shoes! The best shoes for climbing are GI field shoes, jump boots, or engineers' boots—with rigid, rubber-and-cord soles and over-the-ankle uppers.

Tools

Do you keep your hand tools in good condition? A dull knife or chisel can slip and cause injury. And, rust is the enemy of the competent workman. If your pliers and cutters aren't plated (the working edges seldom are), they should be rubbed with an oily rag now and then. Pliers with plastic-cushion grips are easier to use than those without; they not only protect you from shock, they lessen handgrip fatigue.

Remotes

Remotes have their own safety problems. Ladders are sometimes needed to erect microwave dishes

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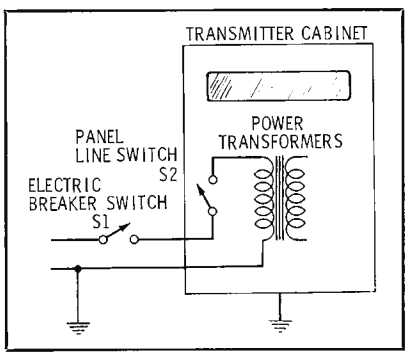

Fig. 3. Basic line wiring of transmitter.

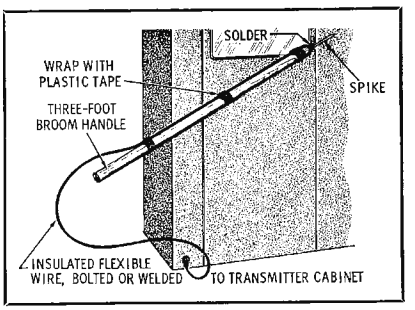

Fig. 4. Filter-capacitor grounding stick.

TAMING THE AM DIRECTIONAL ARRAY

By George F. Sprague, Chief Engineer, WLOS AM-FM-TV, Asheville, North Carolina—A systematic approach to a directional-antenna adjustment problem.

The adjustment and maintenance of the AM directional array is probably one of the most difficult and frustrating phases of radio engineering, mostly because the procedures involved often do not follow any well-established pattern. If it were possible to construct and operate a directional array in theoretical free space, it would also be possible to calculate the necessary operating parameters and be reasonably certain that a given pattern would result. Unfortunately this is usually not the case—there are factors such as terrain, variations in ground conductivity, buildings and other structures, power lines, etc., which make it just about impossible to predict the exact pattern that may result from a given set of parameters. In adjusting the directional array, the pattern can be set approximately by reference to the calculated parameters, but often the final adjustment may involve trial and error.

The Problem

At WLOS, more total time has probably been involved in the maintenance of the directional array than in all other phases of maintenance combined. Although the array itself is a four-tower, in-line system and is not particularly complex, the required pattern imposes rather critical conditions for its adjustment.

Table 1. WLOS Monitoring Points.

Monitor Point	Bearing	Distance (mi)	Allowable E (mv/m)
1	12°	2.85	1.73
2	40°	2.52	7.55
3	63°	2.79	9.13
4	181°	2.86	8.40
5	219°	2.17	6.45
6	302°	2.19	1.20
7	337°	1.79	13.60

Fig. 1 shows the overall WLOS pattern; Fig. 2 shows on an expanded scale the minor lobes and the relations of the seven monitor points to the pattern. Table 1 lists the monitor points together with their distances from the array and their allowable field strengths.

Points 2, 3, 5, and 7 have enough spread between their allowable and measured field strengths to permit a rather wide range of adjustments without exceeding the allowable field. On the other hand, points 1, 4, and 6 have always been uncomfortably close to their limits. In addition, array adjustments which may bring the reading at one of these points to a safe value may throw the reading at either or both of the other points unreasonably high.

Our problem consisted essentially of decreasing the field at points 1, 4, and 6 enough that any slight drift in the array would not cause operation outside the FCC-assigned parameters. Furthermore, we wanted to accomplish this with phase adjustments only, since any change of licensed current ratios requires a new proof of the array, which in the mountainous rural area WLOS serves would be an extremely difficult and time-consuming project. (It is important to note, however, that although the Commission's engineering standards do not establish any permissible limits on phase variations, it is desirable to operate with phase-angle indications as close to the licensed values as possible. Not only is this good engineering practice, but the Commission's Inspector may easily take a serious view of any appreciable departures from the licensed phase differences.)

One technique, which is sometimes used in adjusting a directional array, is to place a field-strength indicator (either an approved instrument or a receiver with an S meter) at each monitor point and use re-

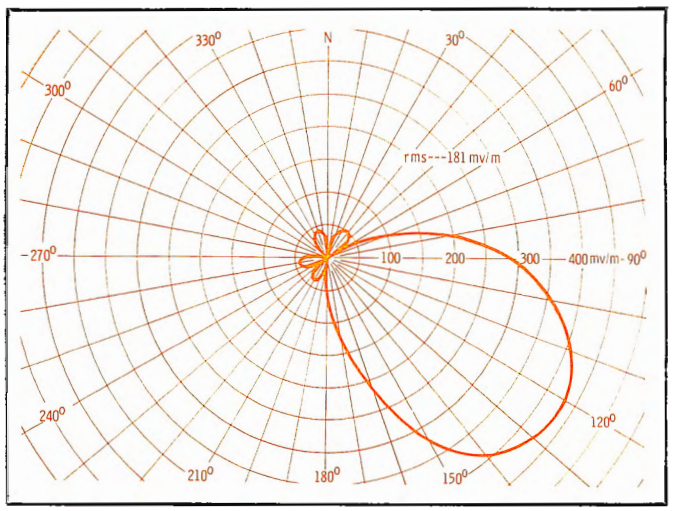

Fig. 1. The radiation pattern produced by the WLOS antenna array.

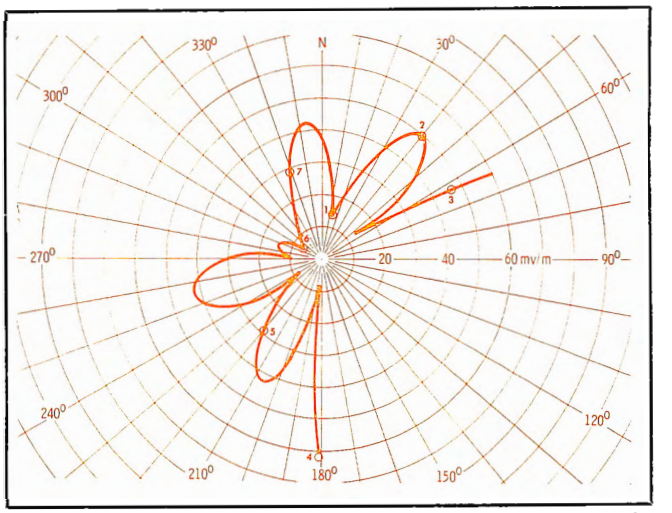

Fig. 2. Minor lobes and monitor points of the pattern at the left.

mote indicators wired from each one to the transmitter over a direct telephone line. Two-way radio communication employing a remote pickup unit may also be used for this purpose. The engineer may then make adjustments on the phasing and power-directing controls and note the result of such adjustments on each monitor point. This method can be quite unsatisfactory from more than one viewpoint. First, with the several controls available, there are probably a number of adjustment combinations which will result in an approximation of the desired pattern. Furthermore, the trial-and-error method of determining one of these combinations can be a long, drawn-out process; it is comparable to feeling one's way in the dark. This system can also become rather costly because of the direct telephone lines and the field-strength indicators involved.

The Solution

Rather than to pick our way using the system just described, we decided to try another system—one that is perhaps not so commonly used. It is not claimed that the method about to be described is novel or original, but we found it to be effective in our case, and we feel that it could prove useful to other stations with similar problems. In order to make use of the system, the array must already be somewhere "in the ball park." This is usually the case, and the necessity for minor adjustments arises from causes such as ground-system deterioration, terrain changes, or new construction. We were able to obtain the proper adjustment with current ratios and phase angles very close to those specified in our license, and we thus avoided the need for making a partial proof of performance.

We took our field-strength meter to each of the three critical monitor points in turn and tabulated the effect on the field of varying each phase and current control dial, one at a time, in two 25-division steps on each side of a mean setting. Tables 2 and 3 are the results. Examination of these tables reveals some very interesting facts. For instance, varying the phase-1 and phase-2 controls affects monitor points 1 and 6 oppositely but leaves point 4 relatively unchanged. The

Table 2. Effects of Phase Controls.

Dial Setting	Point 1 mv/m	Point 4 mv/m	Point 6 mv/m
Phase 1			
9652	1.70	8.70	.67
9627	1.65	8.70	.80
9602	1.55	8.60	.92
9577	1.45	8.70	1.10
9552	1.40	8.70	1.20
Phase 2			
9481	1.48	8.70	1.10
9456	1.50	8.70	1.00
9431	1.55	8.60	.89
9406	1.62	8.65	.87
9381	1.65	8.70	.84
Phase 3			
0938	1.82	9.20	.89
0913	1.66	8.90	.90
0888	1.55	8.60	.92
0858	1.43	8.50	.93
0833	1.26	8.00	1.00
Phase 4			
0213	1.50	8.90	.81
0188	1.55	8.85	.87
0163	1.60	8.60	.90
0138	1.65	8.60	1.02
0113	1.67	8.50	1.10

phase-3 control changes points 1 and 4 in the same direction but has an opposite effect on point 6, while the phase-4 control has a similar effect on points 1 and 6 but an opposite effect on point 4. Using this information, we were in a position to predict the effect of each phase control on each monitor point, and we felt that we could jockey the pattern where we wanted it with some judicious knob twirling.

Obviously, if the current ratios were to be maintained, we could not use the current controls to any great extent for pattern shaping. However, the tabulations for the current controls were useful in that,

Table 3. Effects of Current Controls.

Dial Setting	Point 1 mv/m	Point 4 mv/m	Point 6 mv/m
Current 1			
9954	1.68	8.50	.90
9929	1.60	8.50	.90
9904	1.61	8.60	.90
9879	1.55	9.05	.90
9854	1.50	9.05	.96
Current 2			
1700	1.67	8.25	.61
1675	1.65	8.50	.72
1650	1.56	8.60	.90
1625	1.55	8.95	1.20
1600	1.48	9.20	1.47
Current 3			
0824	1.68	8.90	.91
0799	1.64	8.40	.91
0774	1.58	8.60	.90
0749	1.52	8.45	.90
0724	1.49	8.45	.91
Current 4			
0780	1.60	8.25	1.26
0755	1.60	8.45	1.10
0730	1.57	8.60	.88
0705	1.58	8.70	.75
0680	1.54	9.15	.55

if it became necessary to correct the ratios after an extensive change in a phase control, we could predict the effect of the correction on each of the monitor points.

We proceeded with our adjustments, carefully checking each of the three troublesome monitor pionts after a change was made. First, the readings at points 1 and 4 were reduced by shifting the phase-3 control from its original setting (888) to 699. This adversely affected point 6 to such a degree that it became necessary to change the setting of the phase-1 control from 9602 to 9700. This did not affect point 4 but had a tendency to increase the field at point 1. In an attempt to obtain a greater drop at point 6, the phase-4 control was changed from 163 to 212. This caused reductions at both points 1 and 6 and a slight increase at point 4 (but not enough to be dangerously high).

After each adjustment of a phase control, the current ratios were checked and, if necessary, readjusted. The final current-control settings were as follows:

Current 1 — 9861
Current 2 — 1620
Current 3 — 774
Current 4 — 734

It will be noted that it had become necessary to shift all controls except number 3 from their original settings to maintain the proper ratios. These current controls, of course, also had some effect on the monitor points. However, it was found that such effects could be offset, after the ratios were corrected, by making an additional adjustment of the pertinent phase control.

After all adjustments were completed, the following field strengths were observed at the monitor points:

Point 1 — 1.15 mv/m
Point 2 — 4.40 mv/m
Point 3 — 5.50 mv/m
Point 4 — 7.00 mv/m
Point 5 — 2.50 mv/m
Point 6 — 0.97 mv/m
Point 7 — 9.20 mv/m

Setting The Common-Point Impedance

Any variation of a current or phase control will affect the common-point impedance. Therefore, several times during the procedure, it became necessary to readjust this impedance. It has been our experi-

ence that if the power-amplifier plate input looks reasonable and the common-point current is correct, the common-point impedance is also reasonable. Instead of using an RF bridge for each adjustment, we reset the impedance approximately by observing the transmitter operating parameters. After all adjustments on the phasing unit were completed, we set the common-point impedance more precisely.

To check the common-point impedance exactly, it is necessary to have an accurate radio-frequency bridge and a reasonably well calibrated variable-frequency RF signal source having a range that includes the carrier frequency of the transmitter. In addition, a suitable receiver is required as a null detector. This should preferably be a communications type having a beat-frequency oscillator for the reception of CW signals. Obviously, it should also provide coverage of the standard-broadcast band.

For a signal source, we used a BC-221 military-surplus frequency meter in conjunction with a power amplifier (Fig. 3) which we fabricated. The necessity for the power amplifier arises from the fact that the transmitting antenna system also functions as a highly efficient receiving antenna. This necessitates the use of an RF signal source having sufficient output to override the signals which are being picked up from outside stations. At night, when most of these measurements are conducted, such signals can be numerous and strong. The interference serves to obscure a low-level test signal, and, as a result, the reliability of the measurement is dubious at best.

Needless to say, the entire power-amplifier unit should be well shielded. In our case, we constructed it on a chassis which fits into the battery compartment of the BC-221; the amplifier power supply also furnishes voltages for the frequency meter. The power amplifier chassis also contains a modulator that provides audio modulation in those cases where the BC-221 has no provisions for this feature. This can be most useful when making bridge measurements.

The use of the RF bridge is quite thoroughly covered in the instruction manual for the instrument. However, the following precautions are important enough to deserve emphasis:

1. All equipment in the test set-up should be well grounded.
2. All interconnecting leads between the signal source, the bridge, and the receiver should be shielded, and the shields must be firmly grounded.
3. The leads from the bridge to the circuit under measurement should be as short as possible (a few inches), and they should be constructed to have low RF resistance — preferably of copper braid.
4. Make certain that the receiver is not tuned to an image of the test frequency.

It is customary to measure the resistance and reactance at 5 kc intervals for 30 kc on each side of the carrier frequency. The ideal condition is zero reactance and the specified resistance at the carrier frequency and all sideband frequencies. In practice this condition is impossible to achieve, so it becomes necessary to be content with the proper resistance value and a reactance as close to zero as possible at the carrier frequency. If the common-point parameters are reasonable to start with, adjustment of the common-point controls to achieve the best impedance should not affect the pattern. Fig. 4 shows a typical plot of the resistance and reactance values for the WLOS common point.

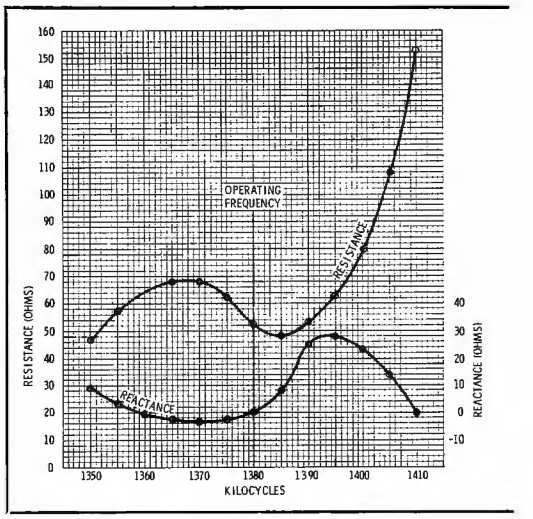

Fig. 4. Common-point impedance curves.

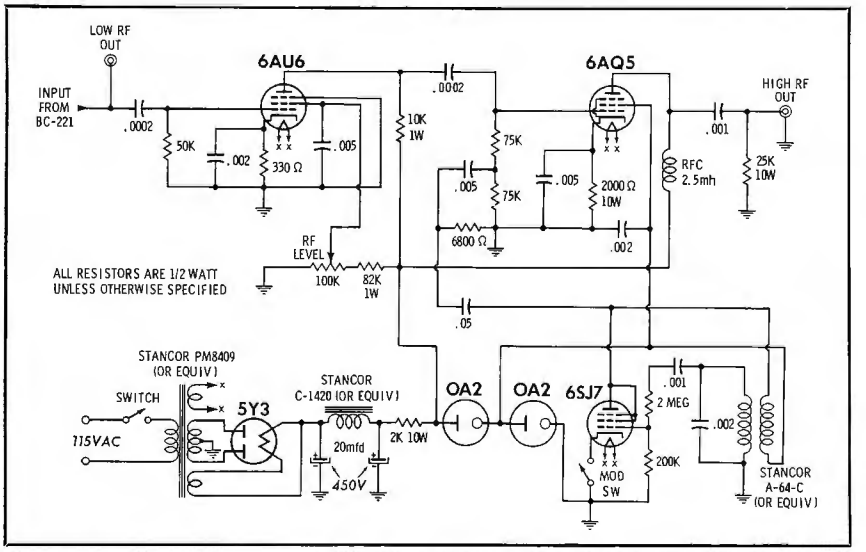

Fig. 3. The RF amplifier used at WLOS in measurements of common-point impedance.

Conclusion

In adjusting pattern shape by the method described here, station engineers should be aware of the inherent limitations. An entirely new set of tabulations may become necessary if a wide variation is made in any one of the control settings, since the effect of other controls might have been consequently altered. It is also possible to reach a crossover point where the effect of a control will be reversed.

Any method of adjusting a directional array is tedious and time consuming, but we have found this method to be quicker, easier, and more economical than others. It is also less frustrating because the effect of each adjustment is predictable and has a known significance. It is encouraging to the engineer to see the pattern slowly shaping up as each adjustment is performed and each new series of measurements is made. ▲

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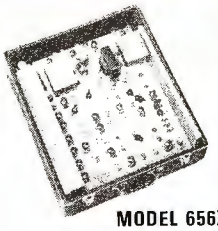

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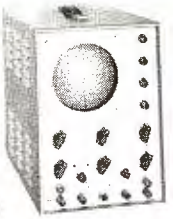

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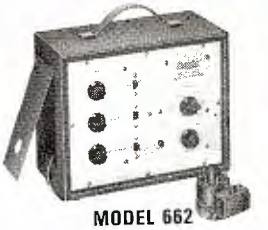

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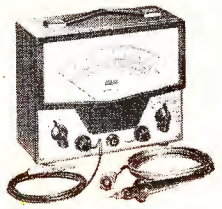

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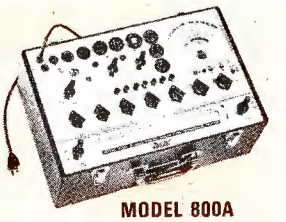

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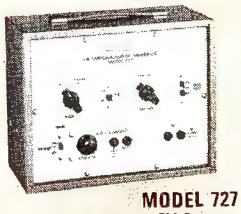

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Circle Item 8 on Tech Data Card

VIDEO MICROWAVE SPECIFICATIONS FOR SYSTEM DESIGN

by Donald Kirk, Jr., Microwave Engineer — Part 2. Concluding the microwave system analysis begun last month.

In the first part of this article, we examined bandwidth specifications of microwave systems for both single and multiple hops and also covered noise problems and system signal-to-noise ratios for a single hop. The information that follows concerns multihop signal-to-noise parameters and external noise.

Final System Considerations

Multihop Noise

To assist in determining noise specifications for a multihop system, received-carrier power and base-band noise power are shown in Table 3.

Table 3. Base-Band Noise Power In Dbm and Picowatts For Various Carrier Levels.

Received carrier power (dbw)	S/N db (p-p rms)	Base-band noise power (dbm)	Base-band noise power (picowatts)	rms noise voltage (across 75 ohms)
−60	+73	−61.5	708	.00022
−61	+72	−60.5	885	.00025
−62	+71	−59.5	1120	.00028
−63	+70	−58.5	1410	.00032
−64	+69	−57.5	1780	.00036
−65	+68	−56.5	2240	.00040
−66	+67	−55.5	2820	.00045
−67	+66	−54.5	3550	.00050
−68	+65	−53.5	4470	.00056
−69	+64	−52.5	5620	.00063
−70	+63	−51.5	7080	.00071
−71	+62	−50.5	8850	.00080
−72	+61	−49.5	11200	.00089
−73	+60	−48.5	14100	.00100
−74	+59	−47.5	17800	.00112
−75	+58	−46.5	22400	.00125
−76	+57	−45.5	28200	.0014
−77	+56	−44.5	35500	.0016
−78	+55	−43.5	44700	.0018
−79	+54	−42.5	56200	.0020
−80	+53	−41.5	70800	.0022
−81	+52	−40.5	88500	.0025
−82	+51	−39.5	112000	.0028
−83	+50	−38.5	141000	.0032
−84	+49	−37.5	178000	.0036
−85	+48	−36.5	224000	.0040
−86	+47	−35.5	282000	.0045
−87	+46	−34.5	355000	.0050
−88	+45	−33.5	447000	.0056
−89	+44	−32.5	562000	.0063
−90	+43	−31.5	708000	.0071
−91	+42	−30.5	885000	.0080
−92	+41	−29.5	1120000	.0089
−93	+40	−28.5	1410000	.0100
−94	+39	−27.5	1780000	.0112
−95	+38	−26.5	2240000	.0125
−96	+37	−25.5	2820000	.014
−97	+36	−24.5	3550000	.016
−98	+35	−23.5	4470000	.018
−99	+34	−22.5	5620000	.020
−100	+33	−21.5	7080000	.022

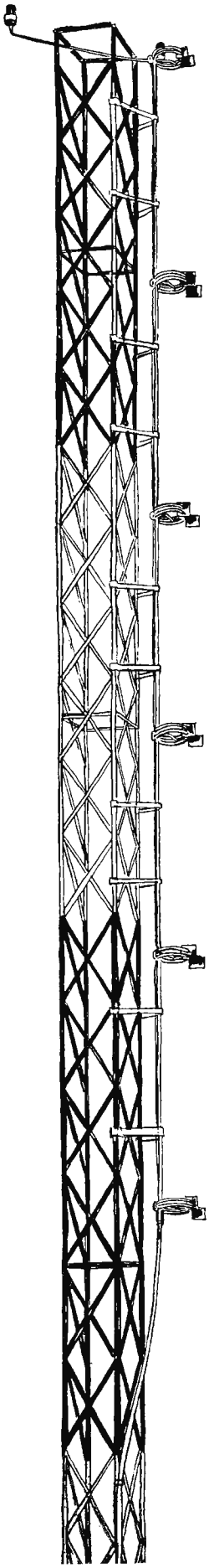
Applying this chart to a multihop system having received-carrier levels as shown in Table 4, the cumulative noise power is found by adding the contributions from each hop. To find the cumulative signal-to-noise ratio for the system, use the cumulative-noise figure as the index and read S/N figure in the S/N column. Noise voltages are included for comparison with measured values. Care should be taken to eliminate hum voltages before measuring noise power. The power transformation was based on a system adjusted for a 1 volt peak-to-peak signal.

Note that a degradation of 3 db in each hop would double the noise contribution of each hop, thus doubling the total noise and reducing the system's signal-to-noise ratio by 3 db. The effect of a given fade in one hop can be checked by assuming that the RF input level is reduced by the amount of fade. For example, let station No. 3 be faded by 25 db to a receive level of —98 dbw. The noise power for this hop would then be 4,470,000 picowatts. Assuming that the other hops would not be simultaneously faded to any great extent, the total system noise would be about 4,600,000 picowatts for a system signal-to-noise ratio of 35 db during the fade.

Outside Noise Interference

In addition to noise introduced by the equipment itself (hum) and noise introduced by the RF path (broadband noise), noise can also be introduced by nearby transmitters or receivers. One class of such spurious signals appears as an image or an adjacent-channel response in the receiver. The remedy is to provide an adequate filter in the receiver. If the filter is made with

Performance that Counts...



Mr. V. J. Kasper, Owner-Manager of Station WILO, Frankfort, Indiana, reports on the New Gates "Cycloid" FM Antenna:

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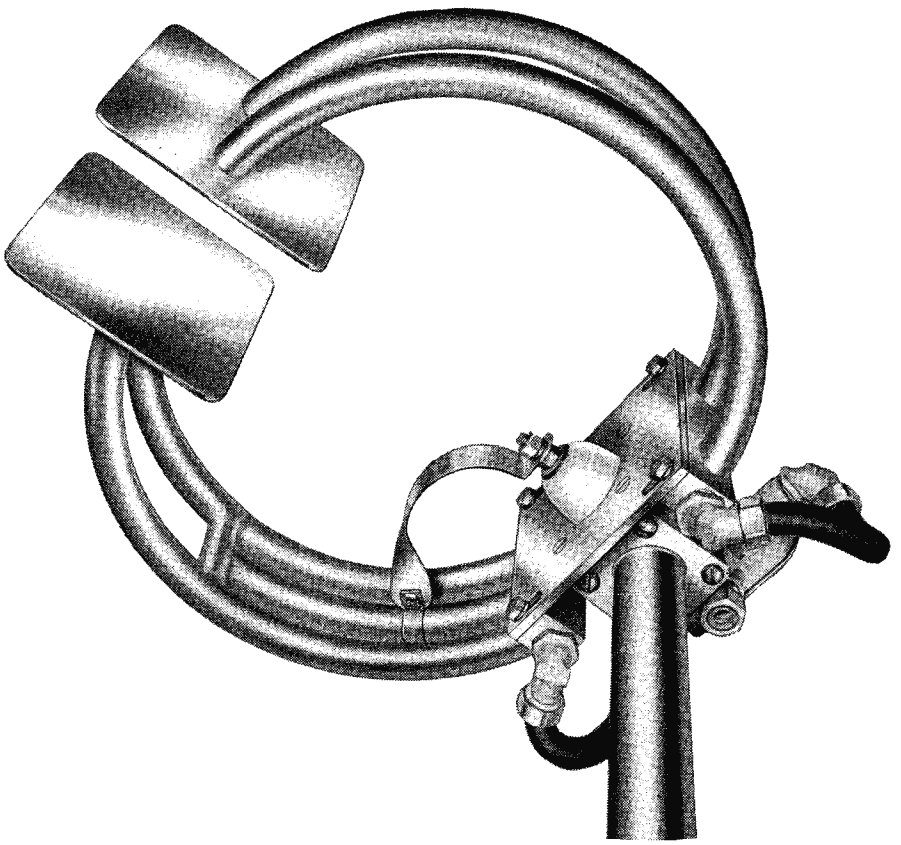

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too few sections, it won't have sufficient out-of-band signal rejection. If it has too many sections, it will attenuate the desired signal and degrade the receiver's noise figure. So, a good compromise is one having 4 to 6 sections. Occasionally, a microwave receiver must operate within the field of a high-level VHF signal (local TV station, etc.). Look for good mechanical construction to provide adequate shielding.

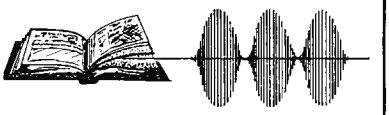
Video Bounce

Video bounce is a troublesome characteristic in some cascaded microwave systems. Its usual cause is poor control of feedback time constants in AFC circuits; it is increased by any low-frequency-gain spike (at 1 to 10 cycles per second) used to get adequate square-wave response. Bounce may be detected by measuring system video gain in the video band from ½ to 10 cycles per second. Its effect on video is most noticeable when picture information is suddenly removed, leaving only the sync signal. Since bounce introduced by the first hop (and the video change that caused it) is present in the second hop to produce still more bounce, the error can accumulate rapidly in a cascaded system. There is no standard means of specifying bounce. In good microwave equipment, the bounce in a five-hop system may be 5% of the amplitude of the video output. With poor equipment this figure might increase to 25% or more. Some form of video-stabilizing amplifier would be needed in the latter case.

Interference to Other Services

When microwave equipment is installed near other equipment, it is important to discover and correct any spurious radiations from the microwave equipment that may interfere with the other systems. In general, FCC type-accepted microwave transmitters will meet all system requirements in this respect. On receivers and auxiliary apparatus, look for good mechanical construction that will provide adequate electrical shielding. This will prevent such possible troubles as radiation of a high-level IF signal on a frequency that could interfere with the reception of a weak TV signal.

BOOK REVIEW



Single Sideband Principles and Circuits; E. W. Pappenfus, Warren B. Bruene, and Edgar Schoenik; McGraw-Hill Book Co., Inc., New York, New York; 374 pages, $14.75. Many engineers think of single sideband as a field that is of interest only to the amateur, because SSB techniques are not presently used in broadcast stations. As a matter of fact, such a system was proposed a few years ago; and, although the plan was rejected by the FCC, there is always the possibility that SSB might be used in the future to increase the number of broadcast-band channels available. For this reason, or if you are interested in SSB merely to increase your knowledge of communications, this book is recommended reading.

The 22 chapters in the book cover every facet of SSB from a simple analysis of the signal to descriptions of transmitter tests and measurements. Frequency-stability requirements and modulation methods are well covered. One particularly well done feature is the index, which truly lives up to its name.

This is a book written by practicing, not ivory-tower, experts in language that the operating engineer can understand. For example, the chapter on the rather "cloudy" subject of mechanical filters clears up many misunderstandings and concisely explains the principles of operation. Much of the information is also applicable to conventional AM and FM equipment and circuitry. The use of mathematics is held to a minimum consistent with the need to explain ideas clearly. However, the math that is used can be easily followed and should not deter the reader.

Some plain talk from Kodak about tape:

features and conveniences that result in better use characteristics

It's amazing what good things can happen when you've got a hobby. A lot of our scientists working on KODAK Sound Recording Tape have hobbies. And in almost every case, coincidentally, the hobby is tape recording. And engineers being the sort of restless, dissatisfied people they are, all kinds of off-hours research projects are in work to give Kodak tape a few extra features in terms of handling ease. One of our boys, for example, decided that he wanted to know just what kind of tape he was using in terms of thickness and base type, even when it was separated from its box. And he

wanted to know it at a glance. Another engineer decided that nothing would be more valuable from a quality-control standpoint than a method of knowing just when a given roll of tape was made. And even what part of the master web it came from. This led to a virtual revolution in the tape business. In an age when more and more companies are taking their names off their products and furtively selling them in unmarked white boxes, we are so proud of the quality and uniformity of our product that we are putting our name right on the back of the tape itself.

And not just our name. The kind of tape, too. Won't it be nice to know that you are using half-mil-polyester-triple-play every time you are using half-mil-polyester-triple-play? This means that even when you are using Kodak tape on an unmarked reel, you can still identify it. And you'll also know whether or not the reel has been rewound simply by looking at the imprint and noting how it reads as the tape comes off the reel.

Familiar with our Thread-Easy Reel? It's really worth knowing about because it cuts fumbling time down to zero. Here's how: you just take the end of the tape and drop it into the slot in the reel. Half a turn and it's engaged . . . securely. That's all there is to it. Not a worry about manhandling your tape, either. This reel's a real gentleman! Smooth surfaces. Bevelled edges. Dynamic balance. And notice, too, that each Thread-Easy Reel has a built-in splicing jig. That, plus the fact that it is calibrated on both sides, adds a few extra fillips well worth having. If you have been really keen-eyed, you have probably noticed by now that we have been referring to Kodak tape where in previous ads we have always called it Eastman tape. There's a good reason for that. We've changed the name. Goodbye good old Eastman tape. Hello good old Kodak tape. This brings up a small problem. With the name change there are also number changes. And so you'll know just what to ask for, here's how the nomenclature looks (old Eastman tape numbers are in parentheses):

KODAK TAPE	BACKPRINTING CODE		
Type 31A (Type A303)	DUROL BASE	1½ Mil	Std Play
Type 34A (Type A304)	DUROL BASE	1½ Mil	Hi Output
Type 21A (Type A203)	DUROL BASE	1 Mil	Extra Play
Type 21P (Type P203)	POLYESTER BASE	1 Mil	Extra Play
Type 11P (Type P103)	POLYESTER BASE	½ Mil	Double Play
Type 12P (Type P105)	POLYESTER BASE	½ Mil	Triple Play

Note that the above list contains a pretty broad spectrum of recording tapes on both Durol base (indicated by an "A" in the above chart) and polyester ("P"). That's another nice thing about the Kodak line. You can get just about anything you need.

KODAK Sound Recording Tapes are available at all normal tape outlets—electronic supply stores, camera stores, specialty shops . . . everywhere. Oh, by the way, why did we change the name from "Eastman" to "Kodak"? Don't know, just thought it was a good idea at the time.

EASTMAN KODAK COMPANY, Rochester, N.Y.

Circle Item 11 on Tech Data Card

Table 4. Determination of Base-Band Noise Power For Multihop Transmission Systems.

Receiver #	RF in dbw	Hop S/N	Noise for 1V p-p signal (picowatts)	Cumulative noise (picowatts)	Cumulative S/N (db)
1	—73	60	14100	14100	60
2	—74.5	58.5	20000	34100	56
3	—73	60	14100	48200	54.5
4	—71.5	61.5	10000	58200	53.8
5	—73.8	59.2	17000	75200	52.5
6	—72.3	60.7	12000	87200	52.1
7 (to	—70	63	7080		
8 add	—70	63	7080	87200	
9 a	—70	63	7080	28320	
10 spur)	—70	63	7080	115520	51.0

System Interconnection Specifications

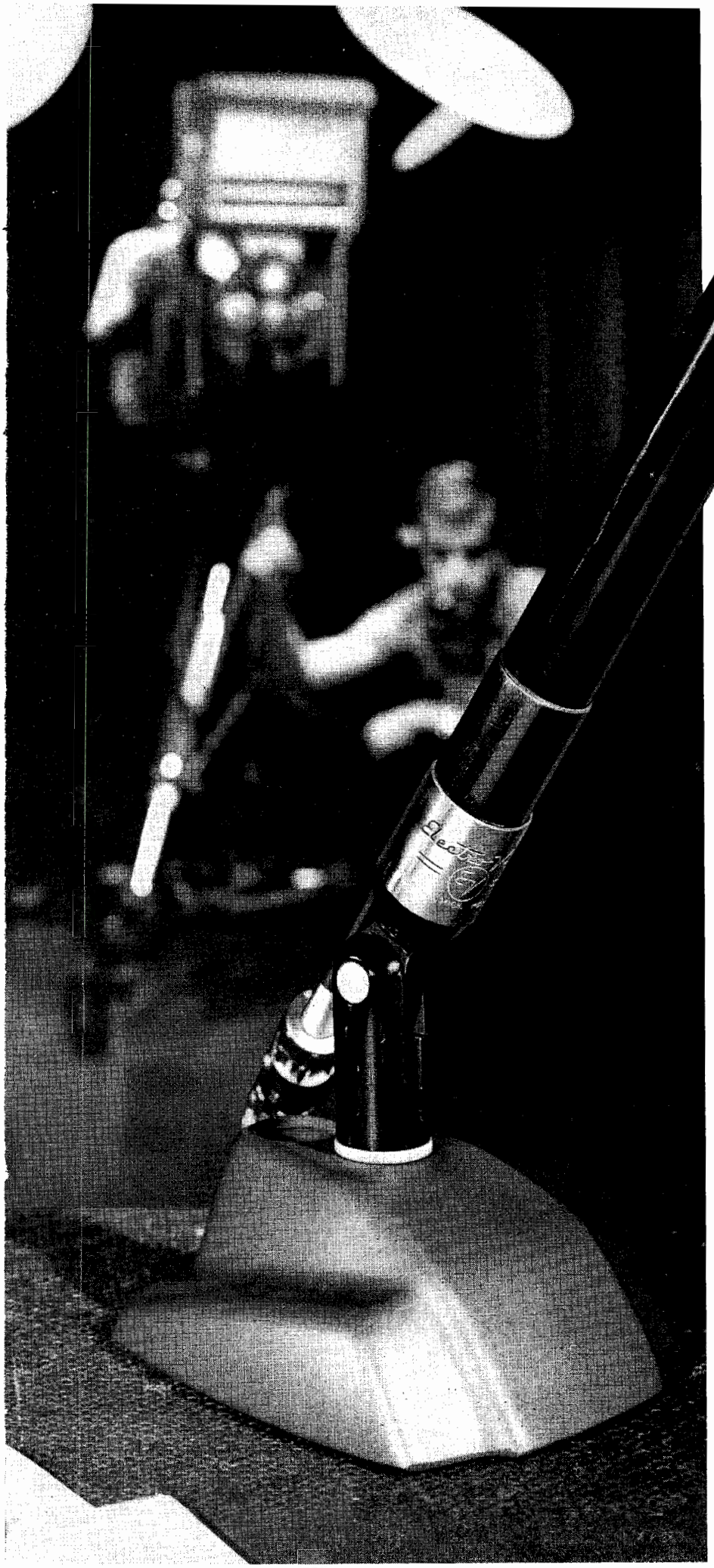
Where a video system is to include off-the-air receivers, studio equipment, microwave transmitters and receivers, and transmitter modulators, it is important to determine whether or not there is an inversion of polarity of the video signal going through the microwave equipment. This is especially important when power splits and new pickup points are being added to a system. Of course, this is no problem where the microwave transmitter and receiver are made for video of either polarity.

Pre-emphasis

In order to get best signal-to-noise ratio, pre-emphasis of the higher video frequencies is generally employed at the microwave transmitter. This accentuation of the higher frequencies is removed by a de-emphasis network at the receiver, which attenuates both the excess high-frequency video signal and the broadband noise which is greatest in the higher video frequencies. Different manufacturers use different amounts of pre- and de-emphasis. A good figure seems to be about 12 db. Less than this does not achieve all improvement that is possible in the signal-to-noise ratio. More than 12 db can cause trouble on color pictures because of overload at the color-subcarrier frequency. When using a receiver of one manufacturer for a signal generated by a transmitter of another manufacturer, be sure to check the pre-emphasis crossover frequency. Several manufacturers are now using a 400-kc crossover.

Miscellaneous Factors

A number of other specifications may be necessary to assure compatibility between the microwave and other equipment. Some of these are: video interconnection impedance, typically 75 ohms (1.1:1 VSWR or 26 db return loss); video voltage, typically 1 volt p-p (sync negative); audio subchannel frequency, typically 4.5, 5.8, or 6.3 mc; audio equipment input and output impedance, typically 600 ohms; audio level, typically —10 to +14 dbm; audio response, typically ±1 db from 50 cps to 15 kc; and audio signal-to-noise ratio, typically 60-65 db. ▲



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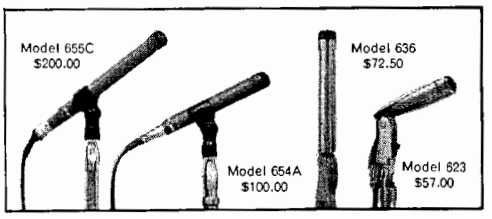

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CLEAN AIR PROTECTS TRANSMITTING EQUIPMENT

by Larry Larson, Director of Engineering Research, KSTP-TV, St. Paul, Minn.—An effective solution to an important maintenance problem.

During the last two decades, air conditioning—by controlled temperature and humidity—has become part of many industrial and commercial buildings. Recently, there has been increasing emphasis on a third element of environmental control—elimination of airborne dust and dirt. The benefits of temperature and humidity control are well known, but the advantages of clean air, particularly as a part of preventive maintenance, are sometimes overlooked.

Filtering vs Cleaning

Common air filters, as described by the American Society of Refrigeration and Air Conditioning Engineers, are constructed of a medium such as fiber or wire mesh which, when placed in an air stream, will catch airborne dust and dirt particles about 10 microns or more in size (there are 25,400 microns in one inch). However, air contains a tremendous number of microscopic particles smaller than one micron that pass right through such mechanical filters. Thus, air filtering is not air cleaning; potentially damaging contamination can be caused by the fine particles of dust, smoke, and fumes that remain in the air after simple filtering.

Particles smaller than one micron generally will remain suspended in a moving air stream. They remain in suspension until they are removed by physical contact or by some thermal or electrical influence. It is the latter factor that makes these microscopic particles a severe problem in broadcast transmitting systems. Components of such equipment actually attract particles from the air; dust accumulation, heat buildup, transmission power loss, and tube failures can ensue. And, once dirt particles are deposited on a component, they are very difficult to remove through ordinary housekeeping measures.

Electronic Air Cleaning

The answer to this maintenance problem is to keep dust from reaching these components in the first place—to make sure the air circulated within the transmitting station is as clean as possible. This can be accomplished by adding an electronic air cleaner to the station's air-conditioning system. This type of air cleaner can be effective against airborne particles as small as one-hundredth of a micron. The principle involved is similar to that which causes the dust particles to accumulate in transmitting equipment—that is, a particle exposed to an electric field will assume an electrical charge.

The heart of the typical electronic air cleaner is an ionizer/collector cell. The front of the cell contains the ionizers and is provided with high-voltage connectors. The rear of the cell has closely spaced collecting plates and connections for water. The cells are mounted within ducted housings to form air-cleaning units of various sizes and capacities. High-voltage connections are made to each cell, and a traverse washing header is added.

An air stream entering the electronic air cleaner passes through the electronically charged (at a potential of 10,000 volts or more) ionizing grid where the airborne particles receive a positive charge (Fig. 1). The air then flows past the stacked collector plates that have alternate negative and positive

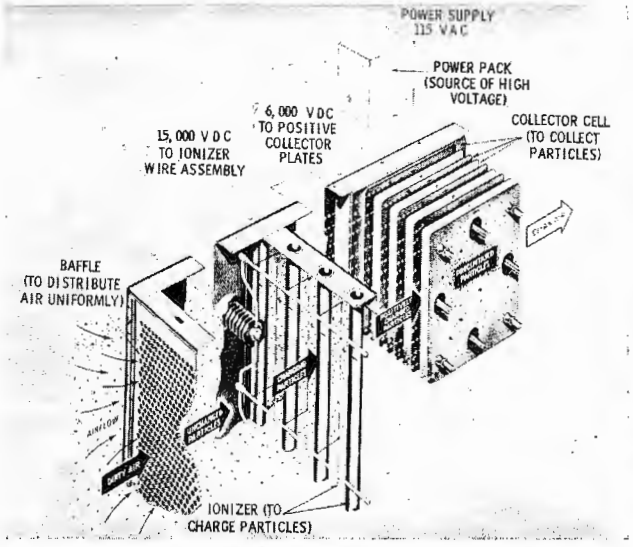


Fig. 1. Diagram shows basic electronic-air-cleaner principle.

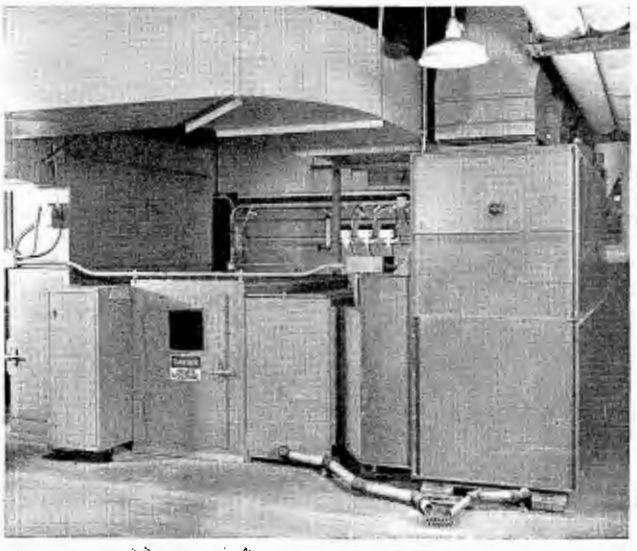


Fig. 2. Air handling and cleaning unit for transmitter section.

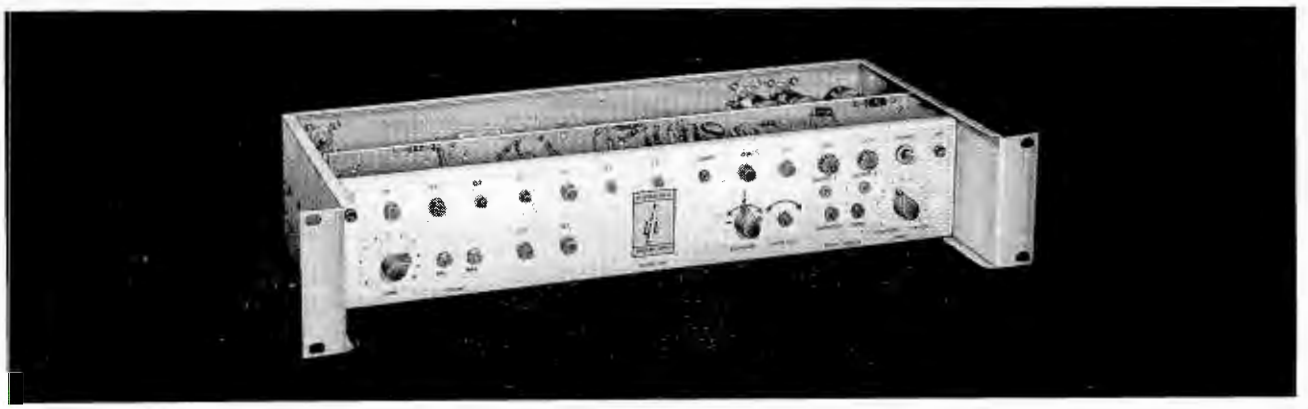
NEW!

CLAMPING/EQUALIZING VIDEO AMPLIFIER

Model TSA1 Clamping/Equalizing Video Amplifier is all solid state, designed to process signals from microwave, mobile gear, master control, or feed corrected signals to the input terminals of a television transmitter. It has a self-contained regulated power supply.

Controls are provided for sync stretching or compressing, white stretching and white clipping. The equalizer will equalize approximately 500 feet of cable. As in all International Nuclear solid state equipment, high stability is achieved with minimum maintenance.

The TSA1 Clamping Amplifier employs clamps to remove low frequency deficiencies. The clamping technique, however, is different. Tip clamping is employed which does not disturb burst and other chrominance information in or about blanking or back porch levels. This makes the TSA1 particularly adaptable for color transmission.



MODEL TSA1 CLAMPING/EQUALIZING VIDEO AMPLIFIER

. . . $750.00 each . . . f.o.b. Nashville, Tennessee

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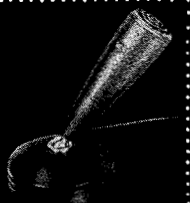

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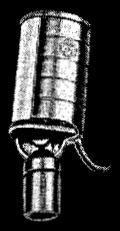

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charges (at a potential of about 5,000 volts). The positively charged particles are attracted to the negative plates and held there by a thin film of adhesive material. A motor-driven pump supplies the adhesive, through spray nozzles, to the collector plates. Voltage for the ionizer and collector-plate fields is controlled by an external power pack. Usually, an inlet screen is added on the entering-air side to trap large pieces of trash and lint, thus protecting the collector cells from excessive loading.

Once the unit is put into operation, there is a continual buildup of dust and dirt on the collector cells; the adhesive coating keeps this deposit from being blown back into the air stream. Periodically, the unit is shut off, and the traverse washing headers, operated either manually or automatically, are used to wash the dirt-encrusted adhesive from the plates. Adhesive is then reapplied to the collector plates, and the unit is reactivated.

Complete automation is possible in some systems through the addition of a clock-sequencing controller. The unit can be turned off, the washing and adhesive application systems operated, and the unit reactivated—all automatically. The equipment can be preset to cycle once every few weeks at a time when the station is inoperative.

A Typical Installation

An electronic air cleaner was recently installed in a three-story, 15,000-square-foot annex to station KSTP in St. Paul. The air-cleaning units installed are rated at 85% efficiency by the U.S. Bureau of Standards dust-spot test. (This means the units reduce the soiling power of dirty air by 85%.) Conventional mechanical filters are rated at 5 to 15%.

Four units were designed to clean the air supply for the following zones: the transmitting equipment (Fig. 2), by means of a closed-air system for the audio and video amplifiers and transmitters; areas containing equipment racks, videotape machines, control, engineering and announcing rooms, and the reception lobby; the television studio, capable of seating an audience of 200 to 300 people; and the third-floor general offices.

The system was designed to assure maximum comfort with the least amount of air motion and noise. This was accomplished by installing air-conditioning units that supply a large volume of air at low velocity. Diffusers are used to assure minimum air disturbance; the air in the auditorium, for example, is delivered through the ceiling by way of metal pans and acoustical tile.

The air-cleaning unit for the transmitter-equipment zone has a face area of 20 sq. ft. and a capacity of 12,000 cfm. The other three units have face areas of 33.33 sq. ft. each and the capacity to clean as much as 20,000 cfm of air. Each cleaner is a self-contained cabinet unit and has a motor-operated automatic washer. The adhesive film is washed off with cold water once every three weeks. Deactivation for less than an hour is required for both the washing operation and the application of a new adhesive layer.

System Benefits

In addition to the protection of critical transmitting equipment, other benefits have resulted from the supply of clean air. These include elimination of "drop-outs" in video tape (which result from dust particles being attracted to the tape) and a reduction in housekeeping maintenance. The glass enclosing announcers' and engineers' booths, for example, stays cleaner longer—an important result when the amount of glass around the studios is considered.

An unexpected bonus arose from the fact that all transmitting facilities were operational in the annex before the interior construction work had been completed. The air cleaners removed the construction grit from the air, saving KSTP-TV thousands of dollars in replacement parts for the sensitive equipment which might otherwise have been damaged.

To simplify sound and light control, the building was designed with virtually no windows. In such a building, climate control is particularly important. The electronic air cleaner contributes to optimum comfort and health conditions for working personnel and has proved to be a valuable addition to the preventive maintenance program at KSTP. ▲

November 1964

We interrupt this magazine to bring you...

Late Bulletin from Washington

by Howard T. Head

Changes in FM Allocations

The Commission continues to receive numerous requests for changes in the Commission's table assigning FM channels to individual cities and towns. Under present Rules, the Commission will not accept applications for FM operation unless the proposed channel is assigned by the table. In instances where a city is not assigned any channels, an unused channel may be "borrowed" from a city within 25 miles. This may be done, however, only when mileage-separation limitations are met at the new location.

The requests now being received fall into three categories. First, additions and changes are being proposed to make new channel assignments available; second, changes are being proposed to relieve or avoid short-spaced mileages between stations or allocations; and, third, general reallocations are being proposed to alleviate the increasing nuisance of FM second-harmonic interference to television broadcast reception (see June 1964 Bulletin). The Commission has granted a substantial number of these requests, and has announced its intention to accomodate as many of the proposals as is technically feasible without involving serious conflicts.

Tall-Tower Antenna Farms

The Commission has under consideration a new proposal under which the Commission would take the initiative in establishing "farm areas" where tall towers for FM and television broadcast use would be grouped. Under present procedures, each applicant must prosecute a request to the Federal Aviation Agency for a "Determination of No Hazard" for the specific individual proposal. Although these FAA determinations are not binding on the FCC, the Commission as a practical matter has been extremely reluctant in the past to approve tall towers in the face of contrary FAA recommendations.

Under the Commission's new proposal, antenna-farm areas would be established either on the Commission's own initiative, or at the request of broadcast licensees. Concurrence of the FAA would be required. An applicant subsequently proposing a tall tower would no longer be required to seek separate FAA approval except at locations outside of established farm areas.

Although the proposal is generally considered to be a move in the right direction, a number of objections have been raised. For one thing, the requirement for FAA concurrence does little to relieve the present unsatisfactory situation where the FAA rather than the FCC has the actual final say with regard to tower approvals. Also, the new proposals do not include

assurances that all of the broadcasters' technical requirements can be met -- such as the need for maximum permitted heights for the various classes of service, or the differing technical requirements presented by VHF-TV, UHF-TV, and FM broadcasting.

Nighttime Power Increase Urged for Class IV

The Community Broadcasters Association, Inc. (CBA) has filed a petition with the FCC requesting that the Commission raise the maximum permitted nighttime power for the Class IV stations on the six local channels (1230 kc, 1240 kc, 1340 kc, 1400 kc, 1450 kc, 1490 kc) from 250 watts to 1 kw. Several years ago, at the urging of the Association, the Commission authorized such an increase in daytime power.

The Commission's records indicate that, of the almost 1000 stations licensed on these channels, all but a handful have either gone to 1 kw daytime, or have expressed an interest in doing so. Obstacles to a uniform power increase for all class IV local-channel stations include outstanding treaty restrictions that impede or prohibit power above 250 watts near the Canadian and Mexican borders and in the southern part of Florida. These treaties, however, will soon be up for renegotiation, and the expression of interest by Class IV licensees may lead to relaxation or removal of these restrictions.

Relaxation Asked in FM Monitoring

The National Association of Broadcasters (NAB) has filed comments on the Commission's proposal to require type-approved frequency and modulation monitors for FM stations transmitting stereo or multiplex (June Bulletin), urging relaxation of the Commission's original proposal. NAB points out that some of the proposed requirements, such as continuous monitoring of the frequency of the stereo pilot subcarrier, would impose hardship on stations operating by remote control. Furthermore, frequency stability at the pilot subcarrier frequency (19 kc) would hardly be a problem with modern oscillators.

The NAB petition goes on to urge that monitoring methods employed by the Commission be the same as those required by stations. The petition reminds FCC of numerous past instances where FM stations have received citations for overmodulation or other technical discrepancies, citations which have been the result of inconsistencies between the techniques employed by the Commission's monitoring units and those incorporated in the station monitors.

Howard T. Head...in Washington

CLEANING MOTION PICTURE FILM ULTRASONICALLY

Film quality can be kept high by using ultrasonic cleaning techniques.

Many television stations are bothered by the problem of cleaning the motion-picture film they use. The generally accepted method of cleaning TV film (running it through a solvent-soaked cloth) often produces surface scratches and grinds dirt into film, even when the softest cloth and most delicate solvents are used. This method also builds up a charge of static electricity which attracts dirt to the film. Thus, in many cases, the solvent-cloth method actually contributes to scratched, fuzzy images. In addition, most 16-mm films shown on TV have optical sound tracks. These sound tracks do not normally offer fidelity as high as magnetic tracks, and anything that interferes with the exciter-lamp beam — even a speck of dirt — further distorts the sound quality. Conventional cleaning methods result in cracks, pops, and hisses in the sound track because of the dirt that is ground into the emulsion. These conditions are especially troublesome in the presentation of filmed commercials. Individual stations normally do not receive a new commercial print for each telecast; after repeated use, a commercial is likely to lose quality because of the effects just described.

One solution to the problem has been the use of ultrasonic cleaning techniques. Station WHDH-TV in Boston, Massachusetts, uses an ultrasonic film cleaner (Fig. 1) on every foot of film aired, including commercially filmed spots, local news film, syndicated programs, cartoons, and feature films. Altogether, an average of 200,000′ of film is cleaned each month. Film director Joseph Levine reports that the installation has brought to light some interesting results, foremost of which is a significant improvement in sound and picture quality.

The ultrasonic film cleaner used at WHDH-TV operates on the cavitation principle, in which intense sound waves are produced in a liquid. The alternating negative and positive pressures which are generated during each cycle produce effects similar to those that occur at the onset of low-temperature and low-pressure boiling; large numbers of minute bubbles containing vaporized liquid are formed. These bubbles then collapse, releasing energy in the form of intense shock waves. The violent impingement on the film of these local shock waves dislodges dirt particles and provides the intense scrubbing action which characterizes an ultrasonic cleaning process. Difficult soils (grease pencil, lacquer, and tape adhesive) are removed completely. Cleaning is uniform, and color balance is maintained.

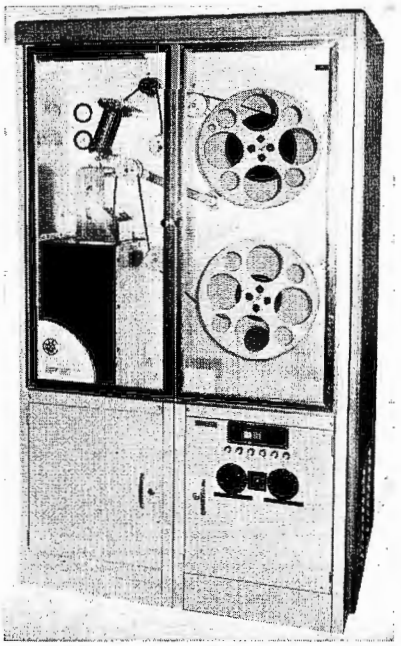

Fig. 1. An ultrasonic film cleaner similar to the machine used at station WHDH-TV.

The machine employs a specially designed dryer which removes the solvent from the surface before it has a chance to evaporate. A jet of high-pressure air is directed at both sides of the film, carrying away the thin film of solvent and any dirt held in suspension. In this way, loosened dirt is not redeposited on the film.

No scratching or abrasion has been noted in the nearly two-million feet of film that has been processed since the unit was installed. Existing scratches and sprocket holes are cleaned thoroughly, and there has been no evidence of static generation, water condensation, or embrittlement. Because the film is run through the machine under tension, just as it would be in the projector, any weak splices break, and the film can be properly repaired before air time. The machine imparts a negative charge to the film to help repel dust while the film is in storage or on the projector.

Film is usually run through the machine at 60 to 75 fpm, which is considered optimum for thorough cleaning. In cases of extremely dirty or stained film, a speed of 40 to 50 fpm is used. Approximately one gallon of the special cleaning solvent is required for each 20,000′ of film.

Alexander M. Tanger, Vice-President and Director of Sales at WHDH-TV, says the reaction of major advertisers and agency personnel has been favorable. He feels the improved film quality, due to ultrasonic cleaning methods, is a definite "plus" in the station's sales approach. Thus, the station considers that the cost of cleaning the film is negligible when compared to the advantages gained from improved film quality. ▲

viking

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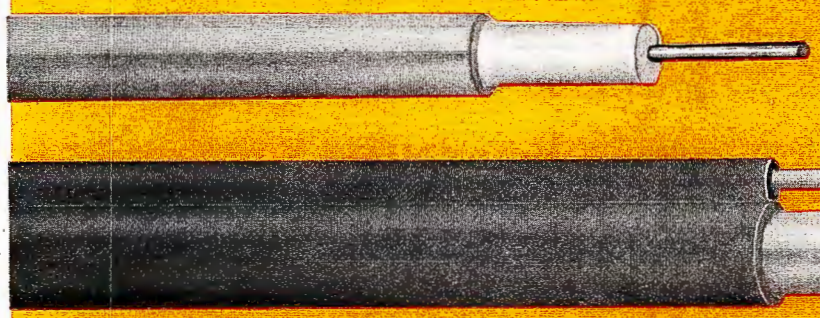
ENGINEERING SPECIFICATIONS



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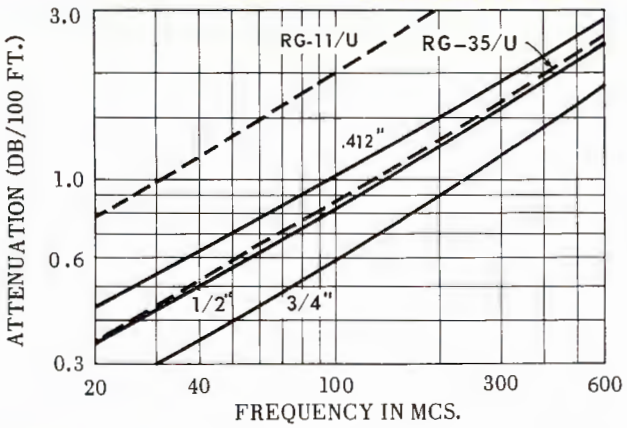

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Circle Item 17 on Tech Data Card

PLEASE INSERT THIS SHEET IN YOUR CATALOGUE

MAINTENANCE OF CARTRIDGE TAPE UNITS

A summary of manufacturers' suggestions for the care of this equipment.

Broadcast stations today depend on cartridge tape recordings for a significant portion of their program material. And, since modern broadcasting leaves little room for errors, missed cues, dead air, etc., dependability of the cartridge machines must be of a high order. A definite, thorough maintenance routine for this equipment is therefore mandatory. Maintenance details vary from machine to machine, but many recommendations of individual manufacturers can be generalized to apply to other units as well.

Cleaning

As tape is run through the mechanism of the cartridge machine, deposits of lubricants and oxide (and perhaps dust) collected on the heads, capstan, and pressure roller. Such contamination of these parts can cause deterioration of performance.

A layer of foreign matter on the heads prevents close head-to-tape contact and results in low volume levels, degraded frequency response, and loss of cues. A buildup of only .0001″ can cut the response at 15 kc by 10 db. Dirty heads can usually be detected by visual inspection; streaks of oxide can be seen across the surface on which the tape bears.

Heads may be cleaned by using a soft cloth or cotton swab saturated with denatured, wood, or isopropyl alcohol. It may be necessary to attach the wiper to a long stick in order to reach the heads through the cartridge slots of some machines. Avoid scratching the surface, and don't use acetone or other solvents that could have harmful effects on the heads. The required frequency of cleaning depends on the amount of use and such factors as temperature and humidity. In some cases, once a week may be often enough, but daily head cleaning is considered necessary at many stations.

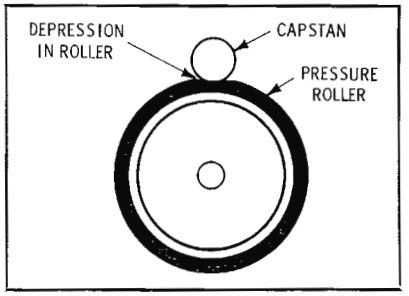

Fig. 1. Depression shows roller pressure.

Buildup of lubricant on capstans and pressure rollers can result in tape slippage, and a sufficiently large accumulation of material on the capstan can even result in a change of tape speed. These parts can be cleaned with alcohol; care should be taken, however, to keep solvent from entering the bearings. In general, the capstan and pressure roller should be cleaned weekly, or oftener if conditions warrant.

Lubrication

Proper lubrication of moving parts is essential to reliable performance of any mechanical device. There is a variety of lubrication requirements in cartridge tape equipment. Some portions of the machine require grease; others require a lightweight oil. Some machines have motor bearings that are permanently lubricated; others do not. In most cases, lubrication every six months is sufficient. Some parts may require lubrication only in a severe environment. The user of a cartridge tape machine is thus well advised to follow the manufacturer's recommendations regarding lubrication (and, indeed, all aspects of maintenance).

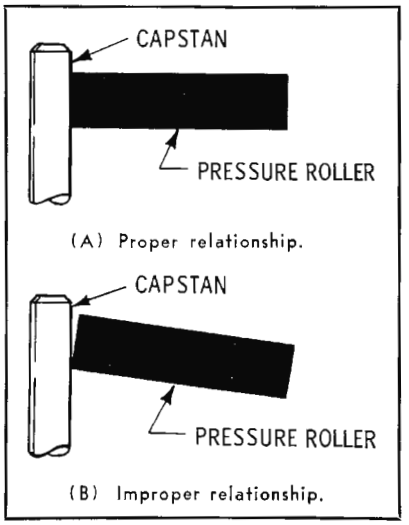

Fig. 2. Parallelism affects performance.

Demagnetization

Tape heads become magnetized when high-amplitude, unbalanced current pulses pass through the record head, or when they are subjected to strong external magnetic fields. Magnetization of the heads results in excessive noise and, if the condition is severe, in partial erasure of the recorded signal.

Because of this condition, several manufacturers recommend demagnetizing the heads weekly. Of course, the instructions for the particular demagnetizer in use should be followed, but these general hints should be kept in mind: Don't touch the heads with the demagnetizer unless it is protected so that the head surface cannot be scratched. Remove the demagnetizer slowly, and don't switch the power off while the device is still in the vicinity of the heads—avoid any action that would result in a rapidly collapsing field that could produce greater magnetization than was originally present. It's also a good idea to demagnetize the capstan while demagnetizing the heads.

Adjustments

In order to maintain peak performance, certain mechanical and electrical adjustments must occasionally be made. The required adjustments, and the proper ways to make them, vary; the operator should refer to the manufacturer's instructions. A few com-

If you are using video tapes that foul heads, shed (particularly at splices) cause headwear in less than 1,000 hours, scratch easily, show signs of wear at 700 passes or less, STOP.

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mon requirements deserve mention, however.

The force with which the pressure roller bears against the capstan is extremely important. If the pressure is insufficient, tape slippage occurs. In belt-driven machines, too great a pressure causes belt slippage which results in a slow speed. In some designs, a tight pressure-roller adjustment may also cause improper solenoid seating, and the solenoid may "drop out" shortly after the cycle is started.

Correct pressure can usually be gauged by the depression the capstan makes in the roller (Fig. 1). A depth of 1/64″ to 1/32″ is typical. The roller should also strike the capstan in a parallel fashion (Fig. 2). The roller should not touch the capstan except in the play mode.

Azimuth alignment of the heads is also important; for best results, the gap must be perpendicular to the direction of tape travel (Fig. 3). If this condition is not met, there may be loss of the high-frequency audio components when tapes recorded on one machine are played back on another machine. Head alignment is done at the factory, but realignment in the field sometimes becomes necessary. For this reason, the alignment of all machines should be checked with an alignment tape once a week, or at any time when high-frequency attenuation becomes apparent. The specific procedure for a given machine should be followed carefully. The depth to which the heads penetrate into the cartridge is also important and should be checked periodically and adjusted if necessary.

Certain electronic adjustments are required occasionally. These include amplifier gain adjustments, calibration of the VU meters, equalization, and AC bias level. Whatever procedure may be required for a given machine, any auxiliary equipment (signal generators, etc.) used during alignment must be of professional quality if broadcast-quality results are to be realized.

Other Maintenance

When tubes are used, they should be given periodic emission tests, and any weak tubes should be replaced with good ones. The recommended interval between tests varies from about two to six months. Unsealed relays should be checked regularly and, if necessary, cleaned and burnished. Recommended intervals for this operation range from two weeks to six months, depending on the manufacturer. Relay contacts should be cleaned with a burnishing blade, not with cloth or paper. Dust and dirt can be removed by using a soft brush, or by blowing. Cleaning fluids that leave a greasy residue should be avoided; the burnishing tool should be cleaned with alcohol before it is used, and the surface that touches the contact surrfaces should not be handled after it has been cleaned.

Like most machines, the cartridge tape transport is susceptible to increased wear when subjected to excessive heat. The motor and flywheel bearings are particularly vulnerable to accelerated deterioration due to high temperatures. For this reason, it is essential to provide adequate ventilation for the unit. Where possible, it is helpful to mount the machine with the top removed so air can circulate through the machine from bottom to top.

While performing routine maintenance on the car-

What kept WBKV going when the lights burned out in West Bend?

Acuvolt is a Hevi-Duty trademark

ACUVOLT—Hevi-Duty Electric's new static line voltage regulator.

At 10:00 PM on May 20th, an automobile crashed into a utility pole, causing a 26,000 volt feeder wire to cross a 2400-volt line.

200 television sets blew out.

The entire south side of the city of West Bend, Wisconsin, was blacked out.

WBKV's popular evening show kept right on going without a hitch.

The input voltage to *Acuvolt* had surged from 120 volts to a value higher than the recording voltmeter could measure. *Acuvolt* made an *immediate* correction (15 cycles) and the output voltage increased only 2 volts.

Why immediate? Because *Acuvolt* is *static*. Just like a transformer — it has no moving parts (maintenance is eliminated).

In addition, the new ±1 volt consistency that *Acuvolt* maintains has doubled the life of WBKV's AM and FM transmitter tubes, lights, and electronic components; saving the station at least $1600 a year . . . which is more than the cost of the regulator.

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tridge tape unit, the operator should look for signs of wear on parts and for overheated or broken wires, bad dress of the wiring, loose parts, and any signs of deterioration.

Cartridge Maintenance

Part of the cartridge tape system is the cartridge itself; consequently, care of this essential item should not be overlooked when considering system maintenance.

The pressure pads should be checked for alignment and condition every time the cartridge is handled. If felt pads are used, be sure they have not worked loose; also be sure the glue does not soak through the felt to solidify and form a hard surface to cause tape wear.

If the tape in the cartridge is too loose, it may tend to loop out of the cartridge enclosure, and it will also be loose on the reel hub. The condition can be remedied by opening the tape at the splice and winding the surplus tape onto the inside of the reel (by pulling on the outside end of the tape). The tape is then respliced, and slack is taken up by pulling tape from the inside of the reel (with the brake released).

When the tape is too tight, speed tape-guide post must be cemented in variations are likely to result in substandard quality of reproduction. This condition is eliminated by removing a turn (or more if needed) from the inside of the reel. The tape loop must of course be opened and respliced when this is done.

It should be noted that both of the preceding operations merely involve the number of turns on the reel; the amount of tape in the cartridge does not change. If it becomes necessary to add or remove tape, the playing time of the cartridge will be changed as a result.

If the tape in a cartridge tightens again after it has been loosened, the tape probably lacks proper lubrication and should be replaced. Tape that becomes worn, scratched, torn, wrinkled, or is otherwise damaged should also be replaced.

Any condition that leads to tape binding is a potential cause of wow and flutter. Guide wires should be in their proper positions, and the reel brake must be adjusted so that engaging the pressure roller causes the reel to be fully released.

Rough edges should be removed from the cartridge, and warped cartridges should not be used. The the proper position in the cartridge

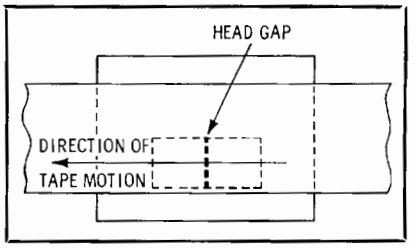

Fig. 3. Head azimuth should be correct.

to keep the tape in its intended path. If a cartridge is dropped, it should be played through to be sure that damage has not occurred.

Conclusion

Dependable performance of cartridge tape equipment requires a consistent and conscientious maintenance program. While it has not been possible to include here specific recommendations for each kind of machine in use, it is hoped that the general discussion given will at least serve to make the users of these units more maintenance conscious. ▲

About the Cover

The tape deck in this month's cover illustration was furnished courtesy of Automatic Tape Control, Inc., and the cartridge was furnished courtesy of Amerline Corporation.

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Circle Item 22 on Tech Data Card

Safety Hazards

(Continued from page 15)

or camera platforms. If ladders must remain in place for more than a few minutes, tie them down so they won't fall on a passerby or deprive the worker of an escape route. Ladders are not the only large objects that can cause problems. Be careful when handling microphone and/or camera booms in a strange location. Years ago, I worked a TV remote in a ballroom filled with screaming, dancing teen-agers. The MC and his guests used a boom mike located to one side of the bandstand. The overflow crowd streamed up beside the boom operator and hampered his movement so completely that we convinced the director to use a hand-held microphone and a lavalier from then on.

Emergencies

Sometimes, on a field trip as a consultant, I have cut or burned myself. While I carry a first-aid kit in my car, the station engineer will usually fix me up. But, I have found some station people who don't know what a first-aid kit is. While we're on the subject of first aid, it's a good idea to familiarize yourself and your co-workers with the method used to give artificial respiration. Call your local Red Cross or YMCA for details.

What would you do if someone at the station became violently ill suddenly, or broke an arm? You can prepare for such an emergency by calling your local academy of medicine or the nearest large hospital. Ask them if there is a local poison-control service—a center which can supply information concerning antidotes for almost every known poison, including many common household substances. You might also post prominently the location and telephone number of the nearest hospital or industrial first-aid station, in case of emergency.

Training

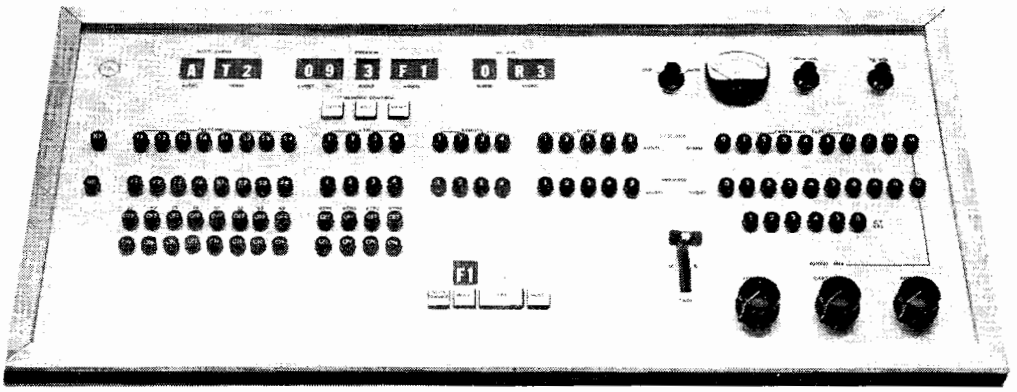
It's no insult to have safety precautions explained to you or to your staff. As chief engineer, you should outline such practices to all new engineering employees. You should watch your men to be sure they don't do things awkwardly or take unnecessary chances. If an accident **does** occur, the cause should be determined and explained to all personnel so it doesn't happen again. ▲

CDL

FIRST LOW COST AUTOMATED SOLID-STATE MASTER CONTROL SWITCHING PACKAGE

...eliminates switching chaos and possibility of error during station breaks

The VSA-102 Switching Package is a highly sophisticated yet simplified system that switches from event to event by merely pressing the "Take Bar".



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Circle Item 25 on Tech Data Card

"Protective" Maintenance

(Continued from page 11)

vicinity of the rack when the studio is quiet.

Through some process not fully understood, the announcers were able to hear this faint tone even though they ran the monitoring amplifer at near +40 db. To eliminate it, they would turn off the frequency monitor's power and crystal-oven switches. When the monitor was turned back on, its reading would be 20 cycles or more in error. At times, hours would pass before the crystal oven warmed up again and the monitor reading could be trusted.

To keep the monitor on, we first tried tape across the switches, but the tape was soon removed and the switches turned off. Wires were then soldered across the switches. That did not work either, because AC line cords can be unplugged. To make matters worse, the line plug often would be reversed making relay contacts "hot" with respect to ground.

If you have such problems at your station, you can either lock the rack door or move the frequency monitor to the transmitter site as we did ours. At present, we have our monitor securely mounted in the transmitter building and wired so it can be switched between the main and auxiliary transmitters. This arrangement enables us to make frequency-measurement transmissions from the transmitter site. We use a remote meter-amplifier at the studio for frequency-deviation readings.

(Caution: When working with frequency monitors, do not disturb or rewire any of the internal circuitry. These units are type approved by the FCC, and circuit modifications may not be legally undertaken.)

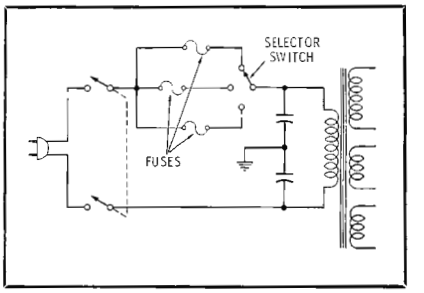

Fig. 3. Three switch-selected line fuses.

FIDELIPAC® WILL EVEN CUE YOUR COFFEE POT

Fidelipac is already used by over 2,860 stations as the standard tape cartridge for the continuous and repeated playback of recorded messages. But Fidelipac does more than repeat messages. It stores recorded information on **one** compact reel that never requires rewinding and is always ready to play the correct message at the correct time.

Now, about the coffee pot. Fidelipac accepts two kinds of cues: the first stops and starts the tape at the proper spot, so that it is never necessary to cue-up a commercial by hand; the second type of cue will activate turntables, slide and film projectors, other tape machines — and your coffee pot. With Fidelipac's automated assistance a whole day's programming can be set up and controlled with a minimum of supervision.

Your benefits? All material that has to be programmed can be contained in compact Fidelipac cartridges, **saving** the time usually spent cueing up discs and other tape machines. All of the material can be recorded at one speed selected by the engineer and played back at that speed without any chance of error. As a result of this efficiency fewer engineering hours are needed to control a day's programming, and this means savings to your personnel in valuable time. To sum up: Fidelipac saves engineering man hours, and **you** save money! What's more, you get better sound in the bargain.

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Write to TelePro Industries for free literature and the name of your nearest Fidelipac distributor. Then polish up the coffee pot!

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I need a coffee break! Please send me your free literature and the name of the nearest Fidelipac distributor.

*Name*_____ *Title*_____

*Street*_____

*City*_____ *State*_____ *Zip*_____

Adjustments at Power-Change Time

No announcer-operator should be expected or required to adjust audio, coupling, RF input to monitors, or other similar levels at power-change time. With this in mind, we planned our installation initially to handle these functions automatically through a system of interlocked relays. This is what our system does whenever power is changed either automatically or manually:

1. Plate voltage is changed to the correct value, within a small tolerance, to give the required antenna current. In most instances no further adjustment is needed.
2. An additional motor-driven rheostat is inserted in the RF final Ep supply for 250-watt operation, thus widening the range of Ep control.
3. Audio input to the transmitter is automatically reduced 6 db (adjustable in 0.5 db steps) when lowering power to 250 watts.
4. Separate and adjustable remote-meter multipliers are switched automatically when power is raised or lowered, so that all meters of the remote system may be adjusted to agree with the local meters. This is absolutely necessary when monitoring plate current of tetrodes by remote control because of the different ratios of plate current to screen current at the two power levels.
5. RF input to the modulation monitor is kept constant when going from 250 watts to 1000 watts, or vice versa, by means of a switchable pad.
6. Additional bleeder resistance is inserted in the power supply of the remote-control-system transmitter unit. In this way all coil voltages remain essentially constant when the auxiliary relays are drawing DC current—otherwise, relay stepping would be impaired.

Fuses

You may or may not allow third-class operators to replace fuses at your station, but, assuming you do, here is some advice: Always leave plenty of fuses around! If the fuses used in your equipment vary widely in ratings, you might consider installing special types of holders in the devices that call for the lowest rating. Another possibility might be to install about three switch-selected fuse holders inside the equipment (Fig. 3) so that a new fuse is there when one blows. In some cases, it might be advisable to solder pigtail fuses directly into the circuit. This procedure might at first seem like a lot of extra work, but it will pay for itself the first time an announcer is prevented from putting a 30-amp fuse in a shorted FM tuner. Above all, be sure there are plenty of 1-, 2-, and 3-amp fuses on hand—this will lessen the possibility of dangerous substitution.

And While You're At It . . .

1. Run all fans, air conditioners, and heaters from thermostats locked against tampering.
2. Install AC receptables in your racks that will not accept plugs from coffee pots, TV sets, electric heaters, and the like.
3. Your studio should be wired so that when the announcer blows a fuse by use of the above items, power to any piece of operating equipment will not be interrupted.
4. Judicious use of time switches can be made to prevent operation of the station earlier than, or later than regular station hours.
5. By use of time-delay relays and/or timers you should be able to

devise a system that will give a warning when 30 minutes have elapsed between transmitter-meter readings.

6. And, if you are really interested in having your log reflect actual operating conditions, I suggest that you install automatic logging equipment.

These are some of the circuits and procedures we have employed at WBEJ to prevent equipment damage due to improper operation and to insure compliance with FCC rules. Therefore, we hope you may have picked up an idea or two in reading this article that will be of help in solving some "preventive" maintenance problems you may have. ▲

BOOK REVIEW

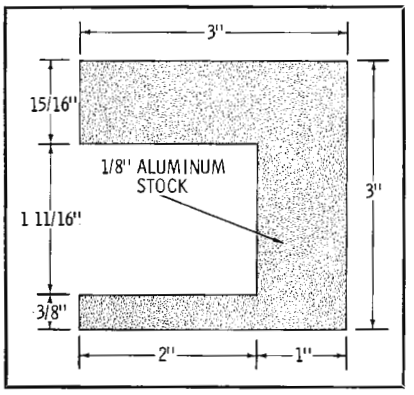
Magnetic Tape Recording, second edition; H. G. M. Spratt; D. VanNostrand Co., Inc., Princeton, N. J.; 368 pages, $10.50. Comprehensive coverage is given to magnetic tape recording from a brief history of its development, through a discussion of principles, to a discussion of the latest trends and developments. Following a brief introduction is an excellent chapter on the fundamentals of magnetism. This chapter can serve as either an excellent review or a good introduction to the general subject of magnetism.

The second chapter deals with electro-acoustics and sound reproduction. It is followed by a lengthy chapter on the principles involved in magnetic recording. The text here goes into considerable detail about the process of making magnetic recordings on tape.

Subsequent chapters cover the materials used in tape, tape manufacture, tape testing, tape recording equipment (two chapters), testing of tape machines, applications of tape recording (which includes a brief section on video tape recording), trends and new developments, and standardization.

Some mathematics and a number of graphs are used in developing the theory, and the reader will encounter a little elementary calculus. However, the trained technical person should be able to follow the discussion with little trouble. Much of the equipment described is of British manufacture, but the principles involved are the same the world over. ▲

ENGINEERS' EXCHANGE



Cartridge Head Alignment Jig

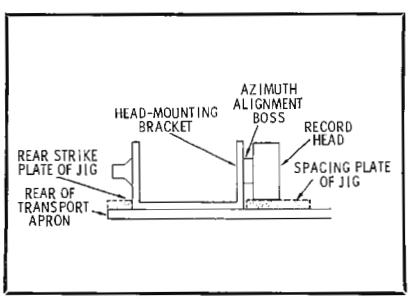
by Tad Jones, Director of Engineering, KAYO, Seattle, Wash.

We at KAYO and our sister stations had a perplexing problem in aligning replacement heads in our cartridge tape recorders. Each engineer who made the conversion produced a slightly different head arrangement. It was decided to find a means of insuring that every machine in our organization would have the same head positioning.

We determined that our head-mounting bracket should be ⅜" from the back of the transport mechanism and the head spacing from the transport deck should be ⅛". From a piece of old ⅛" panel found in the station junk box, we cut a jig to facilitate adjustments to these specifications. The actual alignment is simple. Assuming that you have removed the head-mounting bracket for head replacement or complete transport cleaning, proceed as follows. Place the jig flush with the back of the transport; you can hold the jig with a C-clamp or with your fingers. Place the head-mounting bracket on the deck so that the mounting holes are dead center. Then slide the bracket back until it strikes the jig; this positions the assembly with respect to the rear of the transport apron. Tighten both mounting screws in the head-holding assembly. Next, loosen the head-retaining nuts so that the heads can be moved up and down in the holder. Move the heads down until they strike the ⅛" plate. Make sure they are square, and then tighten the holding nuts.

The only remaining adjustment is azimuth alignment. This can be done with an alignment tape and an oscilloscope. The scope is far better than an audio VTVM because it will give a better indication of distortion that may be present. Run the alignment tape through the machine and adjust the program head for the greatest output as indicated by the scope. The cue head may be aligned in the same manner.

A word of caution: The jig dimensions we used may not work with your machines, so make your own measurements.

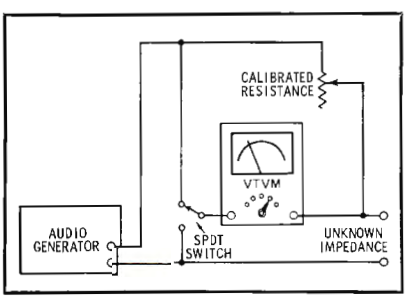


Quick Impedance and Inductance Measurement

by Marshall S. Macy, Chief Engineer, KASL, Newcastle, Wyoming

If you haven't already provided your workbench with a simple method of comparing the magnitudes of known and unknown impedances, you may want to try the circuit that we built at KASL.

Three short leads and color-coded alligator clips (black for the common contact and red for the other two contacts) were attached to an SPDT spring-return push-button switch. An audio generator, VTVM, known resistance, and the unknown impedance are connected as shown in the schematic. By pushing the switch, you can compare the voltage developed across the unknown impedance with the voltage across the known resistance. When the two voltages are equal, the magnitudes of the known and unknown impedances are also equal. We've had very good luck using the device on inductors (chokes and transformers), capacitors, and resistors and as a check of line impedances. (See also "Telephone-Line Impedance Matching," by John P. Tucker, in the August 1964 issue of BROADCAST ENGINEERING.)



In general use, we set the audio generator at 1000 cps for transformers and other audio components. Satisfactory results can be obtained by using inexpensive resistor substitution boxes or good-quality carbon potentiometers as the known resistance. We mounted a number of pots in a small cabinet and calibrated them with an ohmmeter.

Unstable Final

by Robert A. Jones, Consulting Engineer, LaGrange, Ill.

Recently, during the installation of an FM station in Michigan, we experienced difficulty with a new 1 kw transmitter. Everything functioned properly until the final stage was placed in operation; then, after about two minutes, the plate current began rising, slowly at first and then more quickly, until the overload relay operated. Variations in the screen and control-grid currents were also noted. The condition appeared to be the result of self oscillation in the final stage. We tried to stop the oscillation, but to no avail.

When we were just about to give up, we noticed that the VSWR-meter indication increased just before the transmitter shut down. Then all of a sudden the "bells of awareness" began to ring. A shift in the load on the transmitter could account for the plate-current variations. Since we knew the VSWR was almost 1:1 when the final was excited, it was obvious that something must have been heating during the first minutes of operation. Then we discovered that the FM transmission line had been installed in very humid weather and had not been pressurized for several days.

Armed with this information, we opened the end of the coax and, as we expected, found water. After the line and its fittings were carefully dried, the transmitter was reexcited and operated normally.

JAMPRO

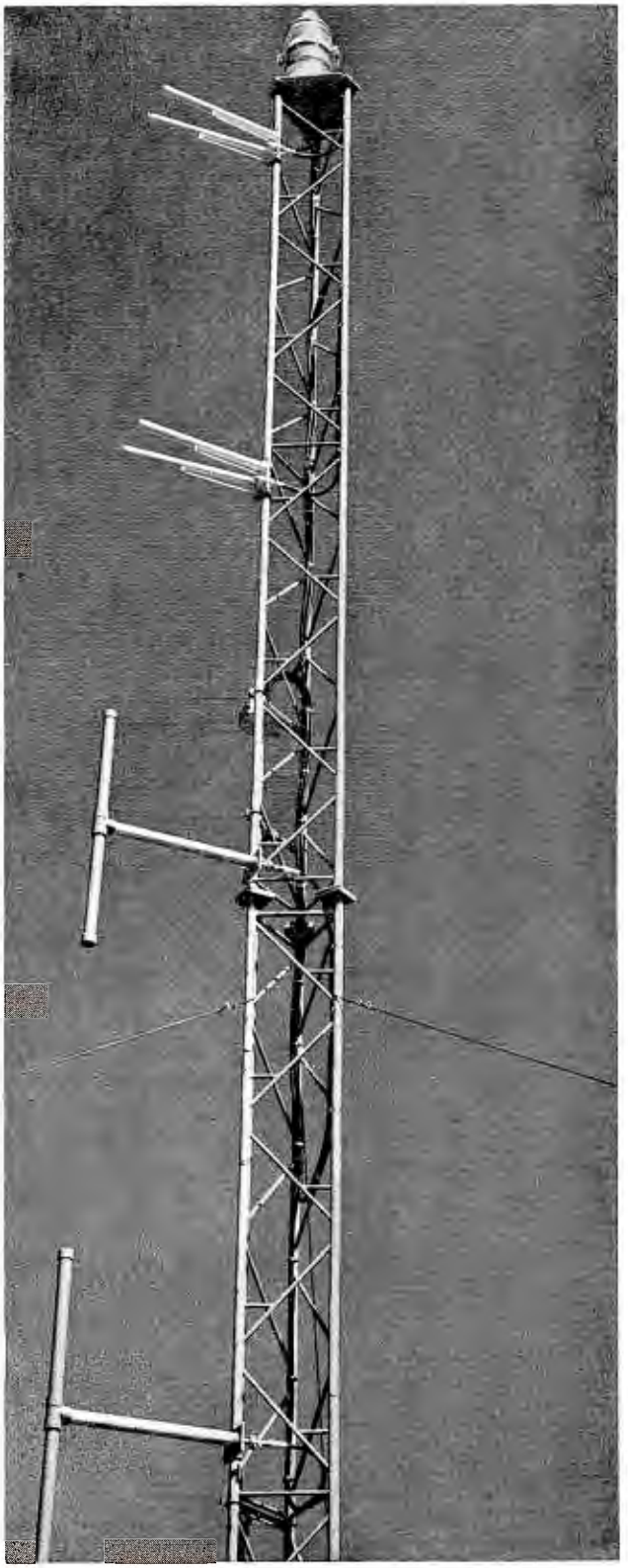
HORIZONTAL AND VERTICAL FM ANTENNAS

The JAMPRO dual-polarized* FM antenna system offers the most practical method of achieving maximum RF radiation under the 1963 FCC FM regulations. These new rules permit as much vertically polarized ERP, as authorized horizontally. Vertically polarized radiation increases the signal many times, in FM car radios, as well as in home radios using built in antennas.

The JAMPRO dual polarized antenna is available in several combinations of vertical to horizontal gain ratios. For class A stations, the equal number of horizontal to vertical is most appropriate. For class B and C stations other combinations may be more desirable.

Power ratings are equal to standard horizontally polarized JAMPRO FM antennas, and vary from 10 to 25 kilowatts. Power gains are available up to 7.0 for the horizontal and vertical.

*U.S. PATENT PENDING



EXCLUSIVE ADVANTAGES OF THE JAMPRO DUAL POLARIZED FM ANTENNA SYSTEM

MORE SIGNAL INTO CAR RADIOS

The vertical polarization puts more signal into vertical car whip antennas.

MORE SIGNAL INTO HOME FM RECEIVERS

The vertical polarization, due to reflections, puts more signal into built-in antennas found in nearly all modern console type FM radios.

EXISTING JAMPRO ANTENNAS MAY BE CONVERTED

All existing JAMPRO FM antennas can be converted to dual polarized arrays with reduced horizontal gains.

DIRECT ENGINEERING SERVICES

JAMPRO antenna engineers are available to deal directly with any antenna problem.

MORE LISTENERS IN HILLY TERRAIN

Signal levels in reflection areas are increased with dual polarization.

LOW PRICE — QUICK DELIVERY

The dual polarization FM antenna provides the highest performance at the lowest price. Customized service makes for fast delivery.

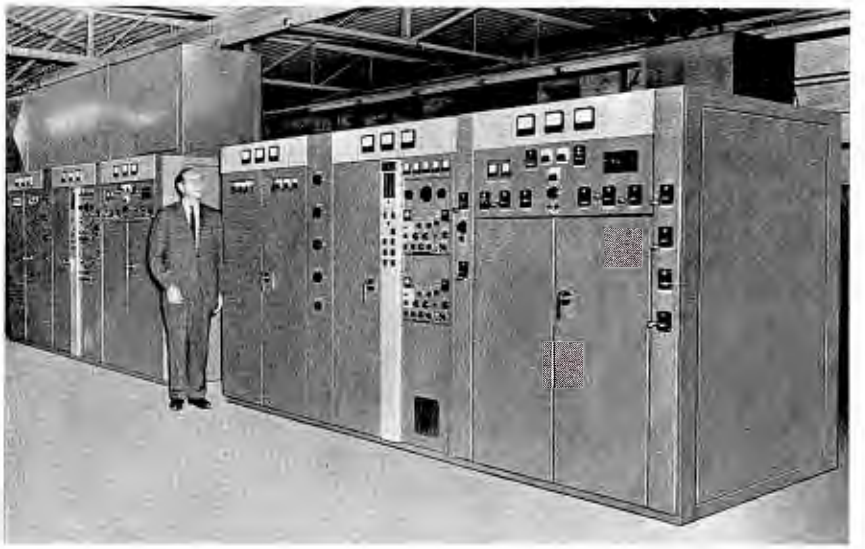
JAMPRO ANTENNA COMPANY

6939 POWER INN ROAD
SACRAMENTO 28, CALIFORNIA

Circle Item 31 on Tech Data Card

NEWS OF THE INDUSTRY

INTERNATIONAL



SW Transmitters for Malaysia

Gates Radio Company, a subsidiary of Harris-Intertype Corp., has completed a $450,000 contract received from the Government of Malaysia for three 100,000-watt shortwave broadcast transmitters. The 100 kw transmitters will be the most powerful in Malaysia and will be used by Radio Malaysia for long-range international broadcasting to inaugurate its new "Foreign Broadcast Service" to neighboring Southeast Asian countries.

Japanese Network Orders Computers

Japan's largest radio and television network, **Nihon Hosokyo Kai** (NHK), will install two Honeywell 200 computer systems next year to handle billing operations. The network will use the two systems to maintain and process charges for both television and radio time. NHK will also use them to perform all its general accounting operations and process the payroll for 14,000 employees. The systems, valued at more than $600,000, are scheduled for installation at NHK's Tokyo headquarters in June 1965. The two systems include two 28,000-character central processors, eight magnetic tape units, four high-speed printers, a card reader-punch, and a punched-tape reader.

English Company Expands

In order to expand its electronic-tube manufacturing facilities, the **English Electric Valve Company Ltd.,** of Chelmsford, England, has bought an additional, fully operational tube-manufacturing plant from Associated Electrical Industries Ltd. About 1000 people will ultimately be employed at this plant, which is located in Lincoln, about 100 miles north of the Chelmsford headquarters. The company manufactures camera tubes for television, magnetrons for radar, traveling-wave tubes for radio-relay communications, power tubes for radio broadcasting, and high-power klystrons for radar and communications.

Company Offers Catalog In French

Telonic Industries, Inc., Beech Grove, Ind., is offering its condensed line catalog, translated into French, for use in Canada and overseas. The four-page, two-color catalog 63-S, describes sweep generators, RF attenuators, RF detectors, and coaxial switches and includes a discussion of sweep-generator techniques, physical descriptions, electrical specifications, and applications.

NATIONAL

Expanded Use of TV Stressed

Leaders in education from the various schools and colleges in the nation recently listened to a talk by a prominent authority on educational television in the fifth and final day of Fordham University's Fourth Annual Summer TV Conference held at the **Communications Demonstration Center,** Hall of Education, New York World's Fair. Professor Charles A. Siepmann, Chairman of the Department of Communications in Education at New York University, made the point that ". . . instructional television makes it the birthright of every child to know what it means to sit at the feet of a great teacher. Our business is to use television to make excellence available to all. We should substitute it in every teaching situation when either individual supervision or seminar relations are not required." Professor Siepmann then explained to his audience how instructional television can best be implemented with the tools presently available to the profession.

AMST Engineering Conference

More than 80 engineers representing member stations of the **Association of Maximum Service Telecasters** (AMST) gathered in Washington's Willard Hotel on September 23 to hear reports on the Association's past and present activities with respect to television allocations policy. Principal speakers at the First Fall Conference were (from left to right in the photo) Howard T. Head, A. D. Ring & Associates, AMST engineering consultant; Orrin W. Towner, WHAS-TV, Louisville, Ky., Chairman of the AMST Technical Committee; Lester W. Lindow, AMST Executive Director; and Edgar F. Czarra, Covington and Burling, AMST legal counsel. Mr. Head reviewed AMST's work in gathering much needed

information on field strengths at UHF, antenna pattern and gain measurements, directional-antenna performance, and adjacent-channel interference studies. A panel discussion featured members of the AMST Technical Committee, who answered questions from the floor dealing with the Association's present and future technical program. Serving on the panel in addition to Messrs. Czarra, Head, and Towner were: John H. DeWitt, Jr., WSM-TV, Nashville, Tenn.; Joseph B. Epperson, Scripps-Howard Broadcasting Co., Cleveland, Ohio; Clyde M. Hunt, Post-Newsweek Stations, Washington, D. C.; and Henry E. Rhea, WFIL-TV, Philadelphia, Pa.

New Cartridge Distribution

The Conley Division of **TelePro Industries, Inc.,** Cherry Hill, N. J., has begun the second phase of its "Conley Helps the Broadcaster" program directed to distributors of the "Fidelipac" continuous tape cartridge. The first phase of the Conley program consisted of a test program by a few selected distributors to make the cartridge more available on a local level. From this exploratory phase, Conley has determined that the market requires 50 additional distributors to service over 2800 broadcasters throughout the country. For the convenience of these customers, distributors will be required to stock "Fidelipac" cartridges in all available sizes and tape lengths. Foreign distribution of "Fidelipac" has been handled by Weidemann Export Corp. of Chicago since 1959.

PROPERTY TRANSACTIONS

Radio Station **WMAX,** Grand Rapids, Mich., has been sold by Mr. Joseph C. Hooker to **Mid-States Broadcasting Corp.,** East Lansing, Mich. WMAX is a 1000-watt daytime station operating on 1480 kc. Mid-States owns and operates WAMM in Flint, Mich., KFEQ AM-TV in St. Joseph, Mo., KLIK in Jefferson City, Mo., and FM stations in East Lansing, Flint, Midland, and Detroit, Mich.

Chris-Craft Industries, Inc., has purchased **WTCN-TV,** Minneapolis, Minn., from Time-Life Broadcast, Inc. The Federal Communications Commission approved the sale on August 25. The station is the third independent television station of Chris-Craft Industries. The other two are KCOP-TV, Los Angeles, Calif., and KPTV, Portland, Oregon.

Television Station **KOVR,** Stockton-Sacramento, Calif., has been sold by Metromedia, Inc., to the **McClatchy Newspapers.** Metromedia had acquired the station in February, 1960, from the Gannett newspaper chain.

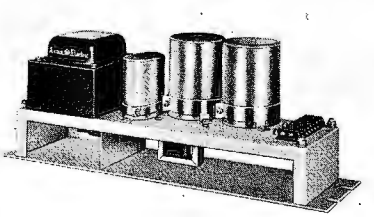
Radio Station **KKAS,** Silsbee, Texas, has been sold to **Mr. Jewel P. White** of Nevada County, Ark. The station was formerly owned by Val D. Hickman and Billie J. Holmes of Hardin County, Texas.

NEW PRODUCTS

Magnetic Sound Added to Films

The loop has been closed on a new film processing system which will make it possible to (1) record a 16-mm black-and-white motion picture negative and magnetic sound in a single system camera, (2) process the negative ready for projection within minutes, and (3) maintain a low-overhead, full-time film processing system. Thus, one person, working with a lightweight or hand-held camera, could record pictures and sound of a news event, rush the film back to a television studio, and have it on the air within minutes. The system was completed by **Eastman Kodak** with the introduction of a new prestriped black-and-white motion picture film, especially developed for new viscous systems. The new film, called Eastman RP Panchromatic Negative Film Type 7229, offers many of the same photographic characteristics as Double-X film. Eastman simultaneously announced that it would also market all its standard 16-mm black-and-white professional films with the same magnetic prestriping. None of these films, however, are recommended for use with viscous processing systems.

Circle Item 90 on Tech Data Card



Power Supplies

Thirty-six regulated DC power supplies are being marketed by **Acme Electric Corp.** of Cuba, N. Y. DC output voltages range from 10 to 250 volts, with power capabilities up to 2400 watts. Line regulation is ±1% for ±13% line-voltage change; load regulation is ±2% for any change between one-half and full load. Output ripple is specified as less than 1% rms. All solid-state components are mounted on a steel chassis with relay-rack panel for easy mounting into existing banks of test equipment.

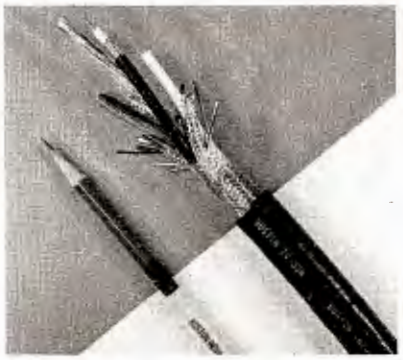
Circle Item 91 on Tech Data Card

Tempo Regulator

A device capable of changing the tempo of a tape recording without affecting its pitch, and — conversely — changing the pitch without affecting the tempo, will be marketed by **Gotham Audio Corp.** under the name of ELTRO. The Model MLR 38/15 was briefly available in this country some five years ago, but in the meantime has changed manufacturers and been re-engineered throughout. This device, an invention of Dr. Anton Springer of West Germany, features a rotating head assembly and variable-speed capstan drive which permit a tempo range from 50% to 180% of

normal speed without change of pitch, and a pitch change of approximately seven half-tones above normal and more than three octaves below normal without change of tempo. The unit is available on special order for stereo, three-track, and four-track tape with widths up to 1".

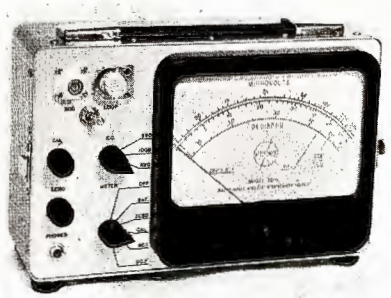
Circle Item 92 on Tech Data Card



Camera Cable

A new 33-conductor TV-camera cable features improved flexibility, lighter weight, and smaller size than previous cables. BIW TV-33, made by **Boston Insulated Wire & Cable Co.,** is a polyethylene-insulated multiconductor cable designed specifically for the television industry. The stranded conductors and coaxial cables, rope-lay construction, and tough neoprene or plastic jackets combine flexibility and reliability with light weight. Twelve #24 AWG conductors cabled together and wrapped with protective "Mylar" tape form the core of the cable. Three shielded quads of #19 AWG conductors and three 75-ohm coaxial cables are twined around the core with six #24 AWG conductors filling the interstices. Each conductor and coaxial member in the cable is individually color coded. A "Mylar" barrier tape protects these conductors from the overall braided, tinned-copper shield. An extruded neoprene or plastic jacket safeguards the cable from external damage.

Circle Item 93 on Tech Data Card



Field Strength Meter

The Model 32L Radio Noise and Field Strength Meter is a lightweight portable instrument for making measurements from 2 to 200,000 microvolts with the rod antenna and 10 microvolts to 1 volt using the loop. The solid-state Model 32L, built by **Ferris Instrument Co.** of Boonton, N. J., permits measurements at three crystal-controlled frequencies in the broadcast band such as 990, 1000, and 1010 kc. This enables the operator to avoid interference from local broadcasters when making field measurements. Exact frequencies are supplied in accordance with customer specifications. The instrument is self-contained and portable, weighing only 11 pounds with all accessories. These accessories include rod, loop, and dummy antennas, headphones, and an input cable for making conductive measurements. Sealed nickel-cadmium rechargeable cells provide approximately 10 hours use before recharging is necessary. A complete charging circuit is built in. A zener diode controls the load voltage. Bandwidth, diode time constants of 1/600, and other features are in accordance with recently released A.S.A. specifications for a tube-operated instrument and will provide identical results at the three fixed frequencies.

Circle Item 94 on Tech Data Card

Spot Exposure Meter

Greater image clarity and increased ac-

curacy are among improvements in the new Foto-Meter spot exposure meter that measures light from any distance. Known as Model 92, it is a product of **Fotomatic Corp.** of Indianapolis, Ind. A new optical system and a more compact photocell permit analysis of smaller areas. Lens setting may then be based on the light readings of any area desired, or upon the high and low values. Meter readings are translated to lens settings on built-in calibration dials. Powered by a single mercury cell, the unit weighs just 10 oz. Dimensions are 5½" x 2½" x 2". The price of $49.95 includes leather case.

Circle Item 95 on Tech Data Card

Copy Inserter

A new horizontal copy-tape dispatcher

has been developed by the research and developmental department of **Q-Tv, Inc.** The unit enables broadcasters to insert news bulletins, political returns, and weather reports without interrupting the continuity of their regularly scheduled programs. The package includes a "Q" horizontal bold-face typer, which prepares copy right in the studio for insertion in the dispatcher. Used in conjunction with either "Tele-Cine" or a studio camera, the tape dispatcher projects a clear-cut horizontal band of continuous copy across the bottom of the viewer's screen.

Check Item 96 on Tech Data Card

FM Detector

The Model FMD-1 FM Detector, designed by **Belar Electronics Laboratory,** is a wide-band, tunable, direct-carrier FM discriminator that is capable of demodulating an FM signal with very low distortion and wide frequency response. It can be used for the accurate measurement of frequency response, distortion, and stereo separation in FM transmitters. The center frequency is tunable from 85 to 115 mc. Frequency response reaches from DC to 400 kc, and stereo separation is kept in excess of 40 db. Input impedance is 50 ohms, at a VSWR less than 1.2:1, and the maximum input level is ½ watt. The FMD-1 will produce 1 volt of output per 75 kc of deviation, into an impedance of 10 K ohms. Price is $89.50. ▲

Check Item 97 on Tech Data Card

THE CHIEF ENGINEER

. . . Helps Solve Your Technical Problems

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

A Central American station is bothered by lightning damage and RF arcing during rain showers. The station has a 590′ tower located at an altitude of 6400′. It operates on 880 kc with a power of 10,000 watts. Can anything be done about this problem?

A 590′ tower has a very high base reactance at 880 kc, and the voltage across the base insulator with a power of 10 kw is quite high. Thus a static discharge, having ionized a path across the base ball gap, would find plenty of RF voltage waiting to start an arc. Furthermore, at an altitude of 6400′, the breakdown voltage of the atmosphere is considerably lower than at sea level, and the static discharge finds it easier to occur in the first place.

There are two aspects to the problem. First, the static problems can be minimized by placing a static drain across the base insulator. Ordinarily, stations in the U. S. rely on lighting chokes or sampling coils for this function, but it is possible that the Central American station does not have one; if not, the first thing to do would be to get one. These are actually fairly simple inductors or resistors, and any radio supplier can furnish them.

If the tower is guyed, the static-discharge problem may extend to the insulators in the guy wires, and if the static discharges are heavy, there will be plentiful displays of St. Elmo's fire. If this occurs and is causing trouble, static-drain resistors will be needed across each guy-wire insulator. These can be obtained from insulator manufacturers.

Lightning is a different problem. Not much can be done about direct lightning hits, except to set the ball gap as close as practical and hope for the best. This can complicate matters because a close setting of the gap aggravates the flash-overs caused by static discharges, but chances are the troubles arising from the static greatly outnumber those from true lightning hits.

Will you please suggest a height above ground to obtain maximum signal coverage from a horizontal dipole operating at 4.82 mc?

Obtaining maximum signal coverage from this type of antenna involves a lot of engineering considerations, and you'd do best to work with a qualified consulting engineer. As you may realize, as Chief Engineer I can hardly qualify myself to act in that capacity. My services to BROADCAST ENGINEERING readers will necessarily be confined as much as possible to maintenance problems, explanations of unusual or difficult terms or theories, and application of FCC Rules & Regulations. I'd like to help you more in this instance, but I'm sure you understand. You can find various aspects of this particular problem covered in any of several reference books.

What special requirements must we comply with for emergency operation of our broadcast station?

The procedural requirements to comply with the Commission's rules in the event of equipment failure vary somewhat depending on which piece of equipment is defective. A broadcast station may operate up to 60 days with a defective indicating instrument or monitor—provided log entries are properly made and the Engineer in Charge of the radio district is notified. Power must be determined by the indirect method during this time if the defective meter is the antenna-current or common-point meter and no remote meter is employed. Provision for determining the degree of modulation or external frequency measurements at least once every seven days must be made in cases involving defective modulation or frequency monitors.

The broadcast station may operate with reduced power up to ten days in cases involving defective transmitting equipment, provided both the Commission and the Engineer in Charge of the radio district are notified at the time the emergency occurs and upon resumption of operation with licensed power. In cases involving directional antennas, the ratio of antenna currents must be maintained within 5%.

Operating power must be determined by the indirect method in cases where the antenna system has been damaged or where any changes are made which might affect the antenna system. The Commission must be notified and authority requested to operate with antenna parameters different from the licensed values. If the changes affect the antenna resistance, new antenna-resistance measurements must be made, and an application to determine operating power by the direct method must be filed with the Commission.

During an emergency period in which severe climatic or other conditions seriously and generally endanger life and property, full-time AM broadcast stations may (under certain conditions) operate during nighttime hours with daytime facilities, or daytime-only AM stations may operate during nighttime hours (under certain conditions) for the duration of the emergency. The licensee must, as soon as possible, notify the Commission and the Engineer in Charge of the radio district giving full details in justification of this emergency operation. The full requirements for permitted deviation from normal technical operation are contained in Sections 73.98 (for AM), 73.298 (for FM), and 73.675 (for TV) of the Commission's Rules. ▲

ENGINEERS' TECH DATA

AUDIO & RECORDING EQUIPMENT

45. AKG — Technical specifications, application notes, and other information on microphones and microphone accessories are provided in brochure.
46. ALLIED RADIO — New 1965 catalog No. 240 shows latest Hi-Fi, Citizens band, and Amateur radio equipment and accessories.
47. AMPEX — New 12-page catalog lists complete specifications and prices on the full professional audio equipment line; also information sheet and price schedule on alignment tapes.
48. BROADCAST ELECTRONICS — Packet contains specifications and prices for "Spotmaster" tape-cartridge systems.
49. CINE SONIC — Data sheet describes rental service which supplies background music prerecorded on 7", 10½", and 14" reels of tape or in cartridges.
50. CONCERTONE — Four-page brochure gives information on Series 800 "Reverse-O-Matic" stereo tape recorder.
51. CROWN INTERNATIONAL — Literature tells about solid-state 700 Series recorders.
52. EASTMAN KODAK — Folder A3-230 describes the manufacture of magnetic tape; also available are triple-play tape folder S3-5 and high-speed sound-film system brochure S1-4.
53. GATES — Data concerns transistor system-type plug-in audio amplifiers; includes preamplifier, program amplifier, program AGC amplifier, and other equipment.
54. GIBBS — Folders describe principles of sound reverberation and "Stereo-Verb" reverberation units.
55. GOTHAM — Newsletter contains service information for EMT 140 reverb unit, "Neumann" microphone, and MLR pitch and tempo regulator.
56. GRINNAN — Catalog on fixtures for record libraries, complete with prices and order blanks.
57. HARVEY RADIO — Engineering bulletin offers specifications on IEM heads for Ampex professional recorders.
58. NORTRONICS — Engineering bulletin CEB No. 2 explains factors which should be considered when designing a 3.75-ips tape system; bulletin CEB No. 9 gives engineering data on silicon-transistor recording amplifier.
59. QUAM-NICHOLS — General catalog lists speakers for replacement, background music, PA, and high fidelity use.
60. REEVES — Specification sheet describing Micro-Plate video tape; technical paper covers properties of Type 302 recording tape.
61. SPARTA — Data sheet describes Model BP-11 battery-powered portable tape cartridge playback and its many uses.
62. VIKING — Specification bulletin describes Model 96 tape-transport system.
63. WALLACH ASSOCIATES — Brochure lists and discusses variety of record and tape-reel cabinets and tape-storage containers.

COMPONENTS & MATERIALS

64. AMPEREX — Condensed catalog lists receiving and transmitting tubes.
65. CLEVELAND ELECTRONICS — Technical brochure on EDI transformers for industrial electronics, missiles, aircraft, and military electronics.
66. DYMO INDUSTRIES — Catalog sheets on industrial and consumer model labeling system.
67. JENSEN — Catalog containing complete line of replacement cartridges.

68. PHELPS DODGE — Brochure gives electrical and mechanical characteristics on coaxial cable.

69. SLEP ELECTRONICS — Information on transistorized ignition systems for automobiles, trucks, and marine and industrial engines.

70. SWITCHCRAFT — Product bulletin No. 145 describes a new kit of "Tini-Stack" switch components for use in studio, lab, or new switching arrangements.

POWER DEVICES

71. HEVI-DUTY — Bulletin No. T-12 describes line-voltage regulator that uses saturable-core reactor.

72. ONAN — Catalog sheet describing diesel-driven electric generating plants.

73. TERADO — Product report lists features of Galaxy DC/AC power inverter for 140 watts of continuous-duty 117-volt power.

RADIO & CONTROL ROOM EQUIPMENT

74. COLLINS — New 173-page broadcast catalog shows complete line of AM and FM equipment and accessories; complete with technical data, tables, charts, and graphs.

REFERENCE MATERIAL & SCHOOLS

75. CLEVELAND INSTITUTE — Booklet describes courses in electronics, including those for broadcast engineering and FCC license preparation.

76. HOWARD W. SAMS — Literature describing popular and informative technical publications; includes special 1964 catalog of technical books.

STUDIO & CAMERA EQUIPMENT

77. GIANNINI — Two-page data sheet describes 21" color television monitor, available with or without cabinet.

78. ZOOMAR — Bulletins contain descriptions of zoom lenses and remote-control systems for television cameras.

TELEVISION EQUIPMENT

79. INTERNATIONAL NUCLEAR — Illustrated price list on all-transistorized video equipment.

80. VITAL INDUSTRIES — Data sheets describing video distribution amplifier Model VI-10A and pulse distribution amplifier Model VI-20.

81. WARD ELECTRONICS — Data is offered on video and pulse distribution amplifiers and solid-state video mixing amplifier.

TEST EQUIPMENT & INSTRUMENTS

82. DELTA — Application bulletin describing new measurements that can be made with operating impedance bridge.

83. HICKOK — Brochure on newly introduced tube tester Model 580.

84. SIMPSON — Bulletin No. 2065 lists and describes over 1325 stock sizes and types of panel meters.

TRANSMITTER & ANTENNA DEVICES

85. AIR SPACE — Eight-page brochure describes and pictorially illustrates a new safety device to prevent falling when climbing any type of structure.

86. ENTRON — Specifications on distribution amplifier Model LHD-404R, designed to feed low- and high-band VHF and full FM signals into as many as four distribution lines.

87. FINNEY — Catalog 20-307 lists models in the "Color-VE-Log" series of VHF-TV-FM receiving antennas.

88. JAMPRO — Technical data on FM antenna VSWR and stereo separation.

89. RUST — Descriptive literature gives details of transmitter automatic logging systems. Data sheets on stereo and on 24"-wide automated 1-kw FM transmitter are also available.

Professional Services

VIR JAMES
CONSULTING RADIO ENGINEERS
Applications and Field Engineering
345 Colorado Blvd.
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DENVER, COLORADO 80206
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MEASURING SERVICE
SPECIALISTS FOR AM-FM-TV
445 Concord Ave. Phone 876-2810
Cambridge, Mass. 02138

Classified

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

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

EQUIPMENT FOR SALE

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

Will buy or trade used tape and disc recording equipment—Ampex, Concertone, Magnecord, Presto, etc. Audio equipment for sale. Boynton Studio, 295 Main St., Tuckahoe, N. Y. 1-64 tf

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

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

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

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

TV antenna system—RCA 12 layer batwing and filterplexer for channel 10. Can operate as bi-directional antenna with max. power gain of 25 and circularity better than 10 db. Cost over $50,000. Make offer. Hammett & Edison, Box 68, International Airport, San Francisco 28, California 415-342-5208. 10-64 3t

Parabolic antennas, six foot dia., new, solid surface with hardware, dipole, etc. $100.00 each. S-W Electric Cable Company, Willow & Twenty-Fourth Streets, Oakland, California. 832-3527. 10-64 1t

Magnecord M-90 portable complete with remote control. Full track 7½ x 15 I.P.S. Excellent condition, $650... Box 119, Broadcast Engineering. 11-64 1t

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

TRANSMITTING TUBE SALE: All items new with a 1000 hour pro rata warranty. 4CX250B—$25, 4X150A—$14, 5736—$110, 891R—$250. Call collect 201-354-2420. THOR ELECTRONICS CORP., 287 Morris Avenue, Elizabeth, N .J. 07207. 11-64 2t

A 469-B condenser manufactured by Western Electric Company for their 504 B2, 3 kw FM transmitter. Contact Bill Bratton, Chief engineer, WLAP, Lexington, Ky. 606-255-6300. 11-64-6t

FOR SALE—Immediate delivery 980' long 2" wide MYLAR RECORDING TAPE. For use with Soundscriber recorder models No. 116 and No. 124. Made for government to military specifications. New in sealed original cartons. Cost 980'—$9.80. Would normally cost from manufacturer $9.50 for 300'. Tremendous value. Golden State Record Sales, Inc., 1604 West 139th Street, Gardena, Calif. 11-64 1t

Personnel

Communications Engineers
Design and operating experience in audio, video and RF systems by a major television network. Applicants should have a B.S. degree or equivalent and have at least 5 years experience in television. Applicants should also be well grounded in solid-state techniques. Send resume and salary requirements to:
AMERICAN BROADCASTING CO.
ENGINEERING DEPT. R.L.P.
7 West 66 Street N. Y. 23, New York

First Phone. Two years of classroom training in Industrial Electronics. Six years of installation and maintenance experience on AM, FM, TV, and Communications Antennas. Prefer electronics primarily, but will combine rigging ability part time to increase salary and job potential. Dept. 117, Broadcast Engineering. 11-64 1t

Technician — First Class Radiotelephone license, A.A.S. degree in electrical technology, over one year experience with A.T.&T. carrier and microwave. Desire technical position with television station. Good announcing voice. Twenty-one years old, willing to relocate any part of country. Dept. 118, Broadcast Engineering. 11-64 1t

Advertisers' Index

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A COMPLETE LINE OF QUALITY BROADCAST TRANSMITTERS

AM	FM
1,000 Watt	250 Watt
5,000 Watt	1,000 Watt
10,000 Watt	5,000 Watt
50,000 Watt	7,500 Watt
	10,000 Watt
	20,000 Watt

OFFERING BROADCASTERS THESE OUTSTANDING FEATURES...

- meets all FCC specifications
- local or remote control
- uses standard components
- designed for easy maintenance/accessibility
- pre-tuned to your frequency
- solid-state silicon rectifiers
- color coded wiring
- vacuum capacitor tuning

. . . and many more.

Write for complete descriptive information.

For the best and most modern broadcast systems and supplies, look to **VISUAL**—your **SOURCE** for *Superior Equipment from Specialist Manufacturers.*

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Keeps You in View!

Circle Item 43 on Tech Data Card

Created by the hand of experience

RCA-5820A 3-INCH IMAGE ORTHICON

Today's Most Popular General Purpose Camera Tube

- HIGHER SIGNAL-TO-NOISE RATIO than the original 5820: 45:1 at 4.5 Mc.
- HIGH SENSITIVITY: requires only 5 footcandles scene illumination, 0.02 footcandles on faceplate.
- UNIFORM SIGNAL OUTPUT
- UNIFORM BACKGROUND
- IMPROVED AMPLITUDE RESPONSE FOR HIGHER RESOLUTION
- LOW MICROPHONICS
- EXCEPTIONAL UNIFORMITY FROM TUBE TO TUBE
- THE MOST POPULAR AND RELIABLE general-purpose image orthicon on the market. For black-and-white pickup outdoors or in the studio.

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

The Most Trusted Name in Electronics

AVAILABLE THROUGH YOUR LOCAL RCA BROADCAST TUBE DISTRIBUTOR

FOR NAME AND ADDRESS OF YOUR LOCAL DISTRIBUTOR WRITE OR CALL YOUR NEAREST RCA DISTRIBUTOR PRODUCTS SALES OFFICE—NEW YORK, NEW YORK: 36 W. 49th St., (212) MU 9-7200; NEEDHAM HEIGHTS 94, MASSACHUSETTS: 80 "A" St., (617) HI 4-8480; WASHINGTON 6, D. C.: 1725 "K" St., N.W., (202) FE 7-8500; ATLANTA, GA.: 134 Peachtree St., N.W., (404) JA 4-7703; CLEVELAND, OHIO: 1621 Euclid Ave., (216) CH 1-3450; CHICAGO, ILL.: Merchandise Mart, (312) 467-5900; DALLAS 7, TEXAS: 7901 Carpenter Freeway, (214) ME 1-3050; KANSAS CITY 14, MO.: 7711 State Line, (816) EM 1-6462; HOLLYWOOD, CALIFORNIA: 6363 Sunset Boulevard, (213) 461-9171; SAN FRANCISCO 2, CALIFORNIA: 420 Taylor St., (415) PR 5-5135-6-7.