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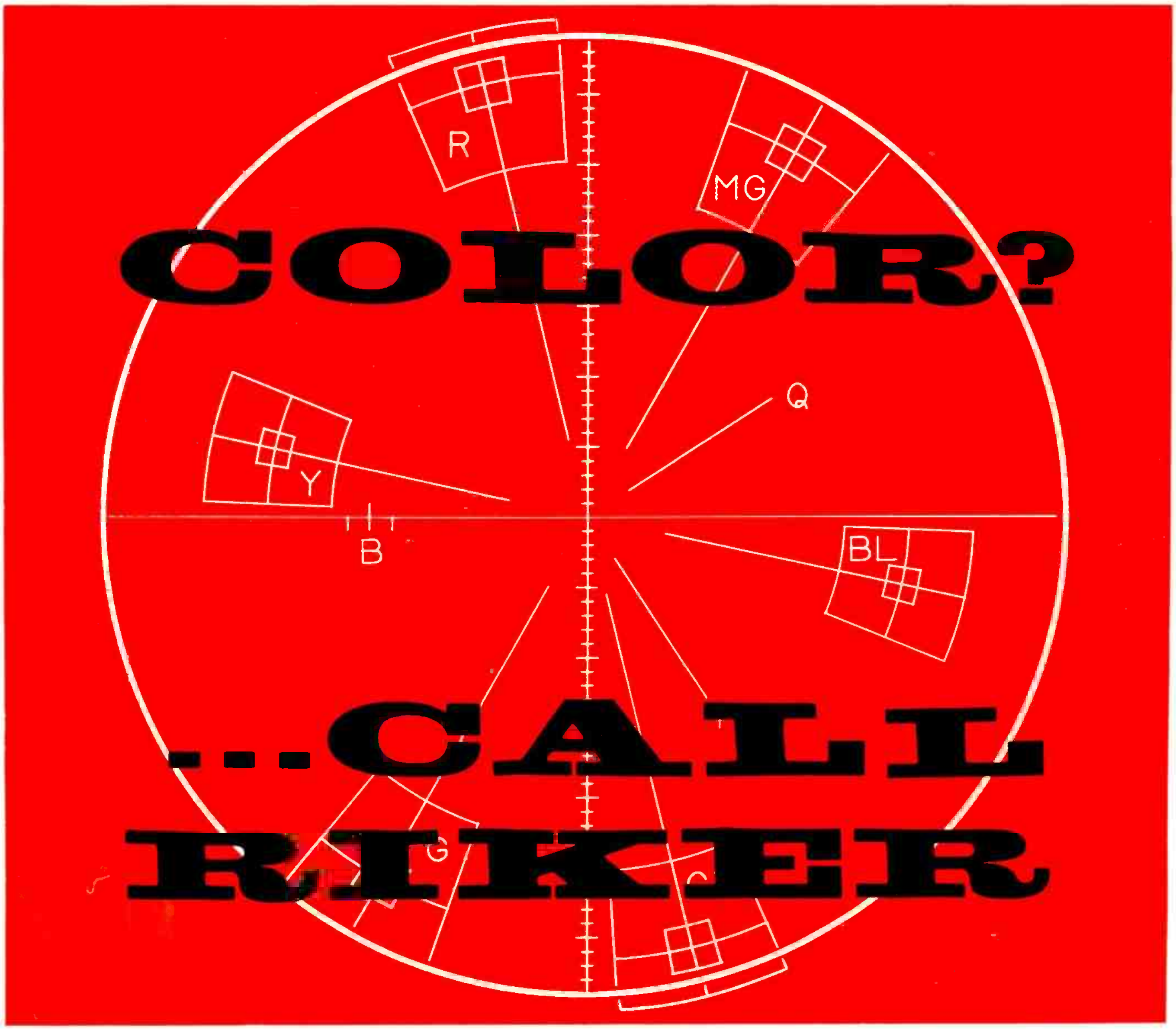

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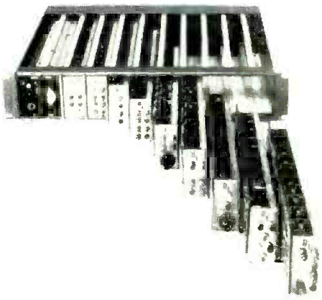

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the technical journal of the broadcast-communications industry

®Broadcast Engineering

Volume 7, No. 10 **October, 1965**

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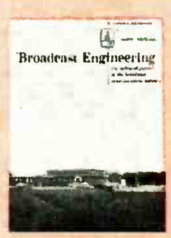
Features

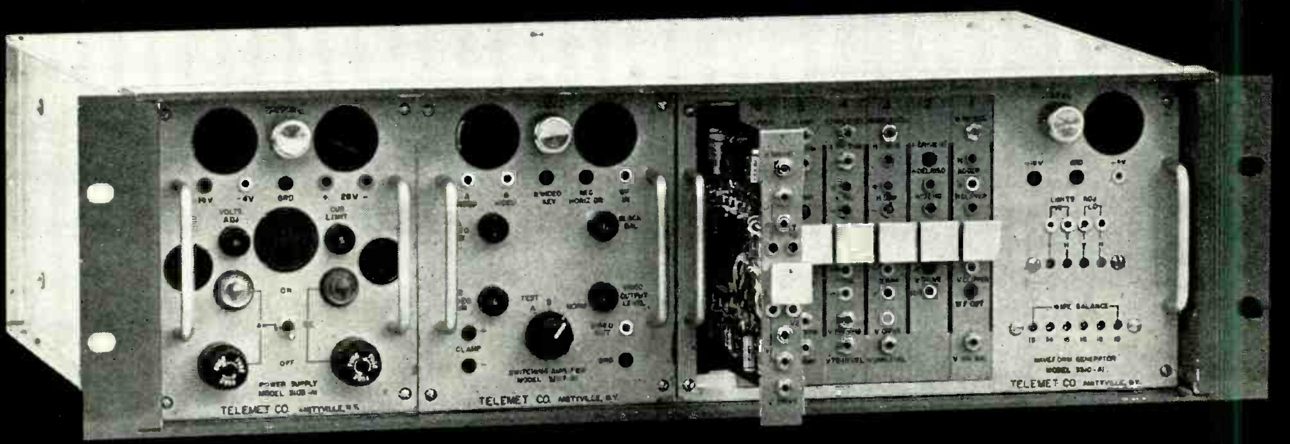
Departments

News was made on the banks of the Wabash when WTWO (popularly known as W-2) began broadcasting on channel 2 from Terre Haute, Indiana. For the story, turn to page 17

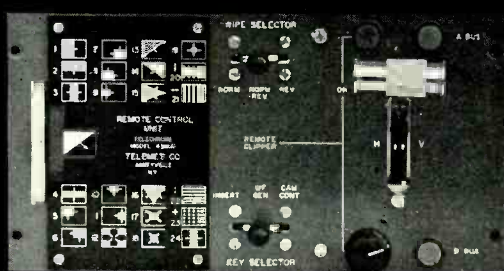


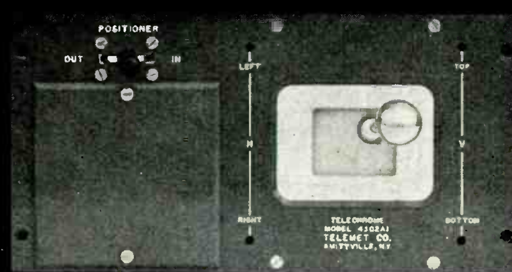
Telechrome*

SOLID STATE TV SPECIAL EFFECTS



MODEL 3801A1 TV SPECIAL EFFECTS PICTURED WITH MODEL 13802A1 POSITIONER





*Brand Name

Designed for studio or mobile applications, the new TELECHROME Solid State Special Effects Generator, Model 3801A1, produces a multitude of visual effects to enhance scene changes, insert keying for commercials and bulletins, etc. The system comprises a power supply, switching amplifier and waveform generator in a 5¼" high rack mounting frame and remote control units. The waveform generator contains 7 plug-in cards, 6 for the effects and one for the accessory joy stick positioner. A newly designed effects remote control unit provides an illuminated pictorial of the selected effects–plus Thumb-Wheel control for rapid and positive wipe selection.

FEATURES

- Occupies only 5¼" of rack space.
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LETTERS to the editor

DEAR EDITOR:

It would appear that a number of corrections, or additions, should be made in the printing of Engineers' Exchange in the July 1965 issue of BROADCAST ENGINEERING. These I would appreciate in a forthcoming issue.

Surely there will be many new engineers who will want the circuit diagram for the article "Warning Operator of Carrier Failure." While many of us old-timers will understand this rather simple device, there may be those who won't. Furthermore, the "Yard" modification diagram was used in connection with the article "Economizing on Tower Lighting Wiring."

I do appreciate the many fine articles appearing in this magazine and look forward to its coming each month.

JOSEPH L. McFARLAND
Staunton, Virginia

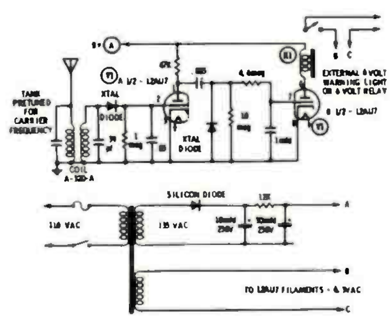
DEAR EDITOR:

In your July issue, on page 42, you described a loss-of-carrier alarm. The text refers to various tubes and relays; however, the diagram that was printed near the text does not seem to belong there. We would like to construct such a system for our station and wonder if you might tell us how to obtain a schematic for the unit that is described.

GARY C. MORGAN
Studio Engineer,
WUFM, Utica, New York

We'll be glad to help you, fellows—and all our other readers, too. Our pet gremlin really had a ball with page 44 of the July issue. Here's a step-by-step guide for undoing his handiwork:

1. **This is the schematic of the carrier alarm:**

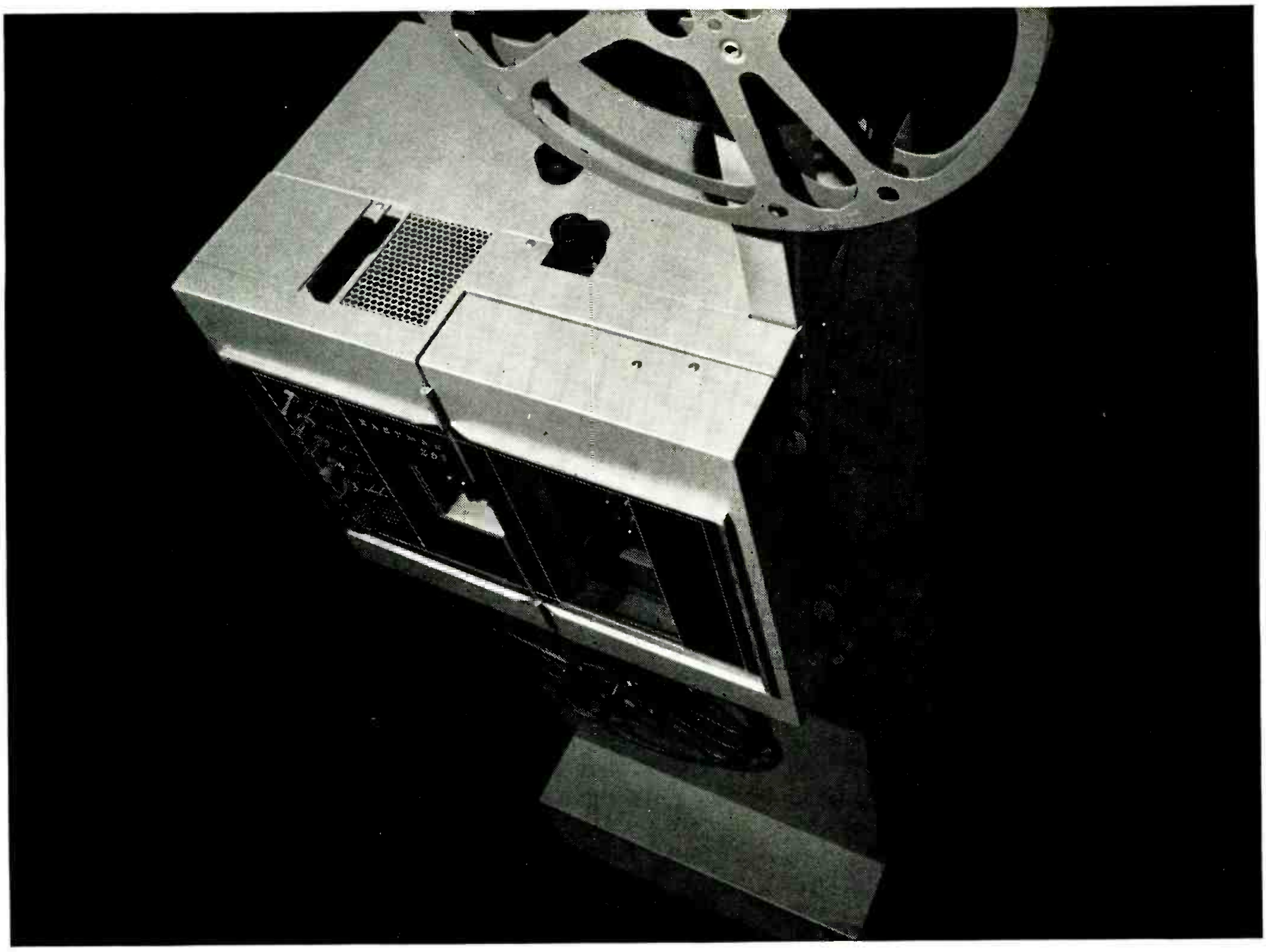


It belongs in the upper left-hand corner of page 44.

2. **The diagram that was in the corner goes to the middle of the right-hand column.**
3. **Just forget the diagram that was in the right-hand column—it appears in enlarged form on page 40, where it belongs!**

We hope this will clear up the confusion. We're keeping a sharp watch for that gremlin, and maybe one of these days we'll catch him. We do apologize for the mixup.—Ed.

Circle Item 4 on Tech Data Card



A TV projector should deliver highest fidelity in both picture and sound with uninterrupted performance for thousands of hours.

This is the story of the new EASTMAN 16mm TV Projector, Model 285

Nowhere can you get more dependable 16mm television projector performance. All components in the new EASTMAN Model 285 Projector — projection optics, sound optics and the mechanical system—have been conceived and engineered in the light of what television programming demands.

This projector has evolved from the EASTMAN Model 275 Projector, widely regarded as the quality standard for 16mm TV projectors. The Model 285 incorporates a *still frame* feature, which maintains the same brightness and color temperature as in normal projection; a *flat gate* which provides uniform resolution throughout the picture area, from corners to center; a take-up reel mounted near the operating controls; ready accessibility to the projector mechanism; and a contemporary-design cabinet.

Reliability is the prime requisite of a TV projector—and Eastman continues to assure this reliability by separating the film transport system from the Geneva-type drive, thereby isolating shock forces.

Several KODAK Television Projection EKTAR Lenses of exceptional resolving power are available with the Model 285. The projector also allows rapid replacement of a burned-out lamp. Light output is more than enough for black-and-white and color transmission. Sound reproduction, both for magnetic and optical tracks, is unequalled in the 16mm field.

A *magnetic sound playback kit* and *automatic cuing kit* are just two of the several optional pieces of equipment that make the Model 285 Projector so versatile. A film reverse accessory will soon be available. With or without these accessories, you'll find this projector an outstanding value.

The EASTMAN 16mm Television Projector, Model 285, is part of a rapid-access 16mm TV film system that takes you from "on the spot" to "on the screen" in minutes. It includes camera, pre-striped films, processor and projector. For a brochure with complete details, write to:

Motion Picture and Education Markets Division EASTMAN KODAK COMPANY Rochester, N. Y. 14650

or the regional sales offices: New York, Chicago, Hollywood, Dallas, Atlanta

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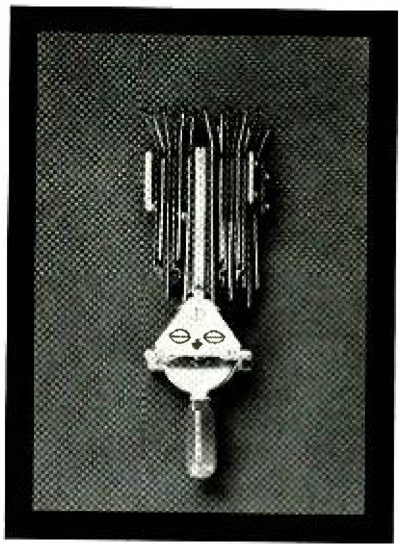

The pop-click-hum bug is dead.

Collins' new Speech Console hasn't a mechanical contact in the program circuits.

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A lot less wire (and a lot less hum).
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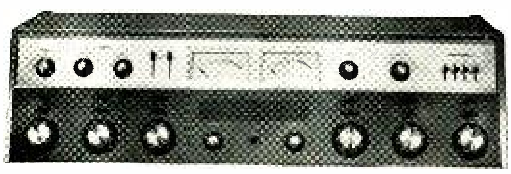
Module design ends time-wasting troubleshooting.
Simply take out one card and plug in another. Replace attenuator, input switches, and amplifier output switches with one quick shuffle of cards.

The Collins solid state 212S-1 is for stereo and dual channel operation for FM, AM and TV stations. The companion 212M-1 Console has fewer modules for mono program and monitor outputs.

For details, call your Collins representative. Or write: Broadcast Communication Division, Collins Radio Company, Dallas, Texas 75207.



This is the Collins 212S-1 that killed the pop-click-hum bug.

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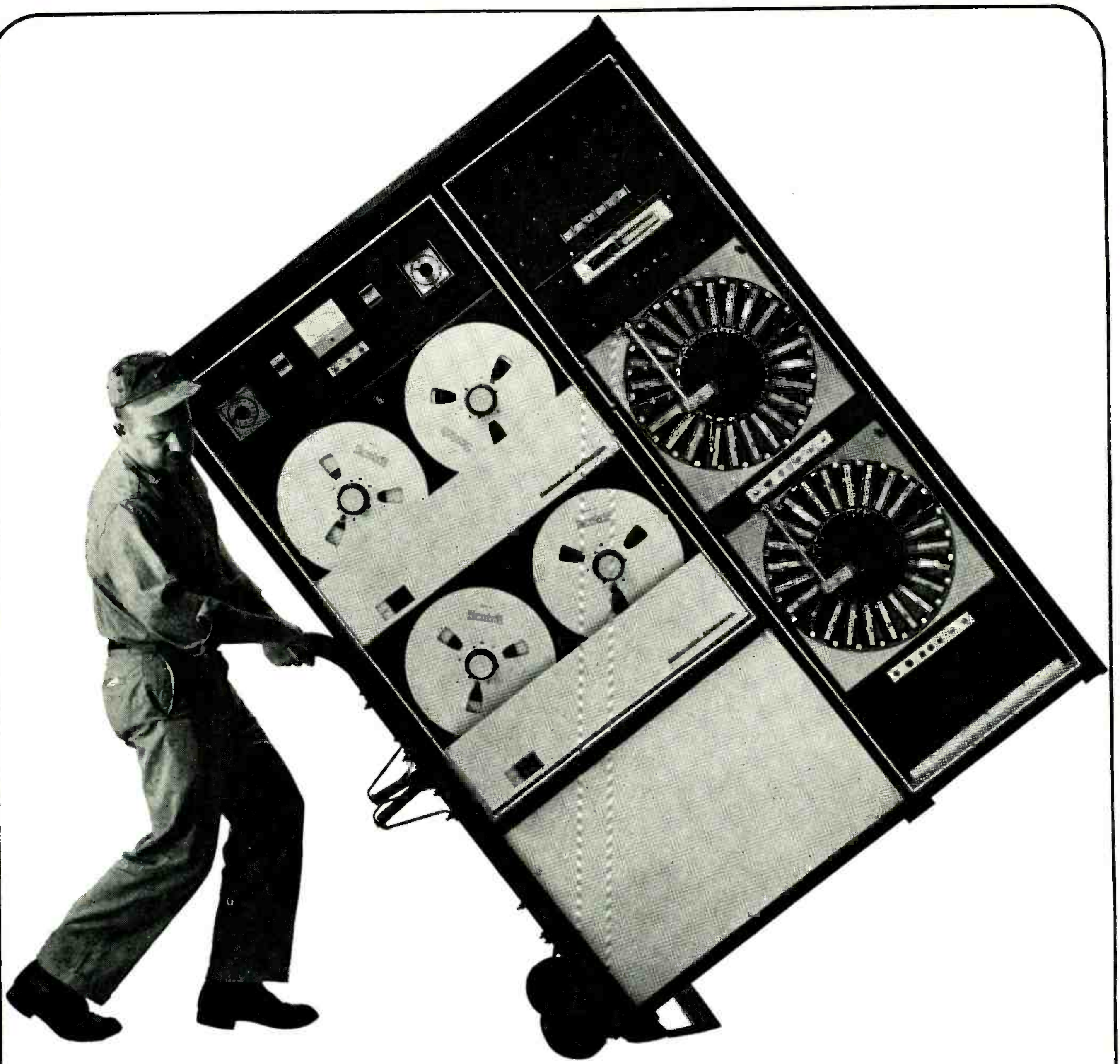

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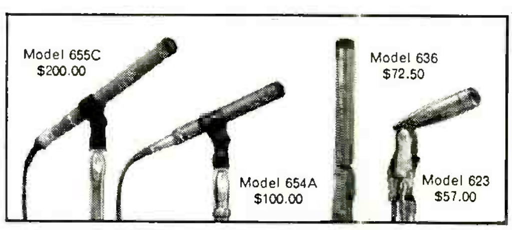

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MAINTENANCE OF FILM CHAINS

by ***Thomas R. Haskett,*** Central Regional Editor, Broadcast Consultant, Cincinnati, Ohio — No TV station can afford neglect of this primary source of program material.

The typical television station has much equipment to be serviced and maintained. Because of the volume of work required, maintenance is usually broken down into categories —transmitter, remote equipment, audio gear, studio cameras, video tape, power supplies and monitors, and film chains. In this article, we will discuss the elements of a film chain that require regular preventive maintenance: vidicon camera, multiplexer, film projector, and slide projector.

Vidicon Camera

The daily checkout of a vidicon-camera film chain usually begins when the morning projectionist sets up the camera (Fig. 1), and checks electronic and optical focus, alignment, aspect ratio, linearity, and electronic centering, while keeping a sharp eye out for any smearing or ringing. He accomplishes all these tests with the aid of a slide made from the RETMA or EIA resolution chart.

A separate slide is available, known as the **TV lines** chart, which contains multifrequency elements and is used to check maximum resolution. Another slide which is quite common in setup procedures is the **linear density** slide, or "stairstep" slide. The vertical bars on this slide are numbered left to right from 1 to 10 and represent ten separate ranges of density from black to white. In a checkout using this slide, the operator observes an oscilloscope display of the waveform, which should resemble a stairstep. Nonlinear steps indicate compression or stretch, which may be caused by a defective tube, plate-load resistor, coupling capacitor, or by misadjustment of a stretcher or clipper control.

Whenever the vidicon lacks resolution or any other quality necessary for optimum performance, and the trouble cannot be corrected on the spot by the projectionist, he notes this fact on his trouble sheet, maintenance sheet, or whatever report goes to the studio supervisor. A maintenance crew will then get orders to overhaul the camera. Monthly or bimonthly tube checks, control cleaning, vacuuming of housings, and test-point voltage measurements are all performed by the maintenance crew. This group will have a record of original performance for comparison with present performance. This record is often made when the chain is first installed, by adjusting the camera and associated monitor for best display of a test chart, then photographing the display. The print is

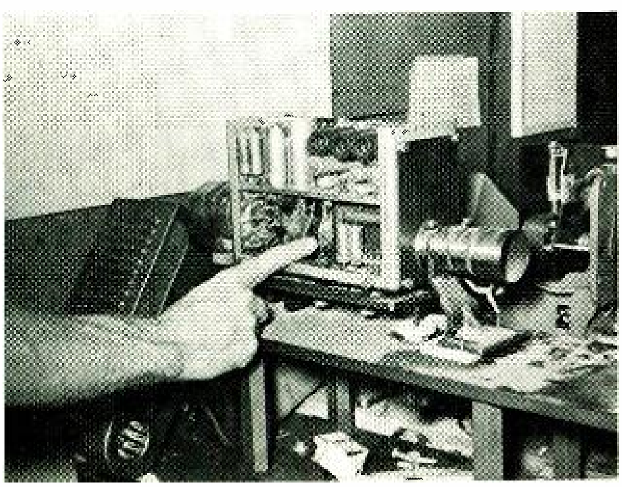

Fig. 1. A film pickup camera showing optical alignment of tube.

Fig. 2. Multiplexer using one camera with several projectors.

kept on file for reference during maintenance routines.

Multiplexer

There are various types of multiplexers on the market, but they all do the same thing—switch the optical output of two or more projectors to the same camera. Maintenance of such units (Fig. 2) is quite simple, as there are few things that can go wrong. Cable connections (for switching the mirrors electrically) must be kept clean and tight, and should be burnished perhaps every three months.

The other primary maintenance detail is to clean the mirrors, which should be done several times a week—or even daily if dust conditions are severe. First, the mirrors are brushed off with a camel's hair brush. Photographic-lens tissue is then moistened with a lens-cleaning fluid, and the mirrors are gently swabbed, picking up residue. Dry lens tissue is then used to absorb the remaining fluid until the mirrors are dry. You must exercise extreme care not to scratch the mirror surfaces even slightly, or optical distortion will be the result.

Film Projector

The film projector at the typical TV station is used more often than any other program source, with the exception of the slide projector. In addition, the film projector has a lot of moving parts, and there are consequently a lot of things that can cause trouble. For these reasons, it requires frequent and regular preventive maintenance to insure trouble-free operation.

Certain maintenance items are required for projector service:

- Mirror- and lens-cleaning fluid
- Denatured or isopropyl alcohol, or carbon tetrachloride (use with extreme caution.)
- Lens tissue
- "Q-tips" or cotton balls
- Wiping rags
- Lint-free rags
- Toothbrush
- Camel's-hair brush, 2″ wide
- Orangewood stick
- Oils and whatever other lubricants recommended by the manufacturer

Cleaning

One of the most common and necessary maintenance practices for all equipment is the removal of dust. It's practically impossible to prevent some dust accumulation in a plant that runs 12 to 18 hours every day. Dusting ought to be performed each day, although in some cases every other day will suffice. A handy tool for this purpose is a small hand-type vacuum cleaner which can either vacuum or blow. Sometimes it's convenient to blow dust out of a compartment, while at other times it is easier to vacuum it out.

Many stations clean the film path each time the projector is loaded; some do it several times daily. The parts to be cleaned usually include the film gate and aperture shoes or guide surfaces (Fig. 3), pad rollers or film guide surfaces, and tension rollers and sprockets. A toothbrush or an orangewood stick is useful for removing solidified deposits of emulsion or dirt, but be careful in using anything sharp which could scratch a metal surface—the scratches might cause film-gouging. After large deposits have been removed, "Q-tips" or lint-free cloths are wetted with alcohol or carbon tetrachloride and swabbed through the film path.

Reflectors, projection lenses, light and heat filters (where used), and sound-track optical lenses should all be cleaned daily. For nonoily dust, the camel's-hair brush should be used. Oil and greasy contaminants should be removed with a swab made of lens tissue wetted with lens-cleaning fluid. The surface is then dried by polishing with clean, dry lens tissue. Don't use too much pressure, or you may scratch the surface.

Lubrication

General lubrication procedures are impossible to describe here, because oiling depends to a large extent on the exact type of projector mechanism; therefore, the manufacturer's recommendations should be followed as to types of oil and/or grease and when to apply them. Generally, daily oiling of oil ports and certain moving parts in the film path is required. Periodic oiling at greater intervals is generally required for chains, shafts, gears, and oil holes under covers. Some motors have "oilite" bearings, sealed for

Fig. 3. Film path through the projector must be cleaned at regular intervals.

the life of the assembly, and don't require lubrication. It's important that you do not overlubricate, for this will simply cause oil to be thrown out of the bearing or component; it will then contaminate the film path, sound system, or some similar area. Lubricate only as much as the manufacturer suggests. After oiling, it's best to wipe any excess off carefully with a lint-free cloth dipped in carbon tet.

Replacements

Spare projector lamps (Fig. 4), sound-exciter lamps, and sound photocells (Fig. 5) should of course be kept on hand immediately adjacent to the projector, so that they are available for instant replacement. Some projectors have spare-lamp sockets built into the mechanism, with a changeover switch and solenoid that automatically throws the spare into operation in the event of a failure. In any case, re-

Fig. 4. Film projector has spare lamp in base; manual changeover required.

placements should be carefully wiped clean with a lint-free cloth before they are installed. Fingerprints left on lamps will bake into the surface and be impossible to remove, and they impair operation.

Other components which most stations keep on hand include sound-preamplifier tubes, belts, fuses, and any other part that is subject to frequent replacement. These spare items should be kept close to the projector so that quick maintenance is possible, to avoid prolonged down time.

Troubleshooting

There are a number of recurrent troubles which are often due to specific malfunctions. A list of faults, with possible causes, follows:

Loss of loop: Film-sprocket shoe out of adjustment; broken or torn sprocket hole in film; old, brittle film; film binding in gate; bad splice; pulldown claw out of adjustment; upper reel arm shaft binding; misshapen claw teeth on pulldown arm.

Film becomes scratched: Film pressure shoe dirty or damaged; pressure roller dirty; emulsion pile-up on film-pressure shoe; dirty aperture plate.

Noisy projector mechanism: Pulldown claw not engaging sprocket holes; misadjusted roller chain, drive chain, or gears; drive motor out of alignment; binding in gear box.

Travel ghost (vertical blurring of projected image) and picture jump: Shutter misadjusted or not synchronized with pulldown mechanism; poor film print—check with standard film; improper threading; aperture-plate side-pressure springs weak; dirty side-pressure shoes; misshapen pulldown claw teeth; worn rails or camshaft.

Picture indistinct or illumination low: Projector lens, condenser lens, or reflector dirty; projection lamp blackened; lens iris (where used) setting too low; film print too dense —check with standard film.

Picture okay, sound weak or missing: Improper threading; dirty light aperture; exciter lamp burned out; dirty sound mirror; low or no exciter-lamp voltage; low or no photocell voltage; gain control not properly set; defective photocell; defective tube, resistor, capacitor, or transformer in sound preamp; no power-supply voltage reaching sound section.

Sound, no picture: Both projection lamps burned out; lamp changeover system inoperative (if automatic system is used); "Variac" (if used) set too low; douser (if used) in closed position.

High hum level: AC-powered light shining on photocell; shield on audio line improperly grounded; heater-to-cathode leakage in preamp tube; open grid; open filter capacitor in power supply; hum pot on power supply improperly adjusted (if used).

Sound pitch unsteady: Pressure roller adjusted to wrong tension; sound drum dirty; sound-drum shaft bearings loose; nylon rollers on damping-roller assembly dirty; sound drum damaged; worn or defective sound-drum shaft bearings.

Projector-motor difficulties: No line power; open line switch; input voltage too low; open field winding; excessive load; wrong input-power frequency; motor loose on mounting; unbalanced rotor; motor frame bolts loose; bent shaft; motor coupling loose; motor support loose; motor shaft misaligned; dirty motor; shorted stator coil; rotor rubbing on stator.

Preamp oscillation, microphonics, or distortion: Loose ground wires; defective bypass capacitor; output leads too close to input leads; loose elements in or poor connections at photocell; defective input tube in preamp; low-emission preamp tube; open or leaky coupling capacitor.

Test Films

There are a number of standard 16-mm test films which are available at nominal cost from the Society of Motion Picture and Television Engineers, 40 West 40th Street, New York, N. Y. 10018. Each has a particular use in checking out a film chain.

The Sound-Service Test Film (Code SPSA) consists of high-quality music, both orchestral and piano, as well as spoken dialogue. The 3000-Cycle Flutter Test Film (Code Z22.43) provides an accurate test of flutter but requires a flutter meter. More useful for the average station are the Sound Focusing Test Film (Code Z22.42-7000) which lets you adjust the optical sound system, the 400-Cycle Signal-Level Test Film (Code Z22.45) that is handy for setting levels, and the Multifrequency Test Film (Code Z22.44) which is used for checking overall frequency response. The Buzz-Track Test Film (Code Z22.57) is useful for optically aligning the sound reproducer in the projector.

• Please turn to page 26

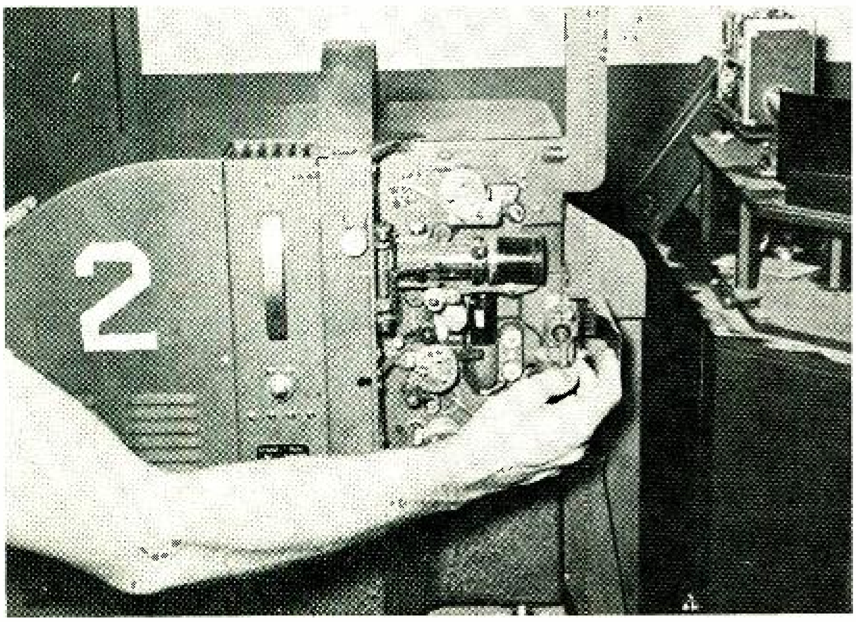

Fig. 5. View of film projector showing location of sound photocell and exciter.

USING THE OSCILLOSCOPE FOR RF MONITORING

by M. W. S. Barlow, Montreal, Quebec, Canada — A "direct" method of checking RF output of TV transmitters.

Two important parameters of a television transmitter that must be known with some certainty are the power output and the linearity of the system. Conventional monitoring is done by detecting some of the RF in the output transmission line and displaying this on a waveform monitor. By periodically "chopping" or short circuiting the video signal, a reference line corresponding to zero RF input is also displayed, making it possible to set picture white level correctly for intercarrier sound operation. The peak output at sync tips is calibrated by reference to a water-cooled dummy load. For linearity checks, a sawtooth waveform at line rate can be fed into the transmitter and the modulator "stretch" controls adjusted for optimum linearity at the desired power level.

A simple diode detection system has some disadvantages: First, the diode becomes nonlinear at low input levels, so that the zero reference line must be offset in some way. For the same reason, the linearity display may not be correct near black level, and finally there is always the possibility that the probe will be moved inadvertently or the waveform monitor gain will drift, requiring recalibration. More complex demodulators are still more liable to error, and more time may be spent in checking the demodulator than in checking the transmitter.

An alternative method, incorporated by some manufacturers in their transmitters, is to use an RF envelope monitor. Some of the RF is tapped off as before, but instead of being rectified it is applied directly to the Y plates of an oscilloscope. Since the deflection is proportional to the peak voltage developed, it is also proportional to the square root of the peak power. A simple graticule can therefore be engraved showing the deflections corresponding to sync tips, black and white levels, and so on, with no possibility of nonlinearity upsetting the results. Just as with a diode sampling RF at the same point, the deflection will be proportional to the sum of the carrier and its sidebands, so that care must be used in interpreting frequency-conscious measurements if these are made at a point in the system where the sidebands are not symmetrical. If the RF being monitored is double sideband, then the envelope monitor can be used for critical frequency or phase measurements, pulse and bar transients, and so on. The envelope shape corresponds exactly to a DSB diode-demodulated signal with the advantage of eliminating any detector nonlinearities. For a "white up, syncs down" display, the lower half of the envelope waveform is shifted up to the graticule region.

If the RF being monitored is vestigial sideband, the indicated frequency responses will be wrong in the same way as for a DSB diode. If a true "VSB" output is required, suitable filters must be added ahead of the envelope monitor. A sound trap is also required if the sound signal is present at the time measurements are made.

With the emphasis on simple vertical deflection to represent power levels, and a line-frequency display for linearity checking, the circuitry of these RF envelope monitors has been rather rudimentary. By using a modern oscilloscope time base, a much superior instrument can be made that is also useful for vertical-interval test signals whereby many transmitter adjustments can be made while the transmitter is actually on the air with program material.

Choice of Oscilloscope

The oscilloscope used for RF envelope monitoring must possess certain features:

1. Direct connection of RF to the Y plates must be possible.
2. Full television triggering facilities are required for the time base.
3. The envelope monitor section preferably should be a plug-in unit so that the oscilloscope is available for routine testing at other times with other plug-ins.

The problem of driving the Y plates is tied very closely to the capacitance of the Y plates and the deflection sensitivity; obviously the higher the capacitance the more energy is required to drive the plates at a given frequency. It is customary to tune the plates to resonance with an external inductance, in which case a high-capacitance deflection system will give a small RF bandwidth unless the circuit is damped; such damping again reduces the deflection voltage available. In some CRT's, the Y-plate connections are brought out through the base of the CRT. Such long leads cannot satisfactorily be made part of a tuned circuit, particularly for the higher TV channels.

Oscilloscope Y plates normally diverge so that their ends nearest the screen are farthest apart. If the voltage on the plates varies at a high enough frequency, the beam may perform several cycles while traveling through the Y plates. The final deflection is then caused only by the extreme ends of the plates which, being farthest apart, produce least effect on the beam. This effect could be reduced by increasing the velocity of the beam, but this is counteracted by a general loss of vertical sensitivity if the beam velocity increases. Some CRT's have split deflection systems driven by delay lines, but these are not normally found in oscilloscopes used in TV stations. Obviously only certain CRT's are suitable for RF monitors at VHF.

Practical System

To illustrate the techniques and problems involved in using the oscilloscope for envelope monitoring, a system devised for use at CFCF-TV will be described. The particular oscilloscope used was a Tektronix 561.

The heart of the system is the plug-in unit shown in Fig. 1. C760, a small trimmer near the main chassis connector of the oscilloscope, must be kept in circuit so as not to upset the operation of the unit with its other plug-ins. When the connections to the deflection plates are changed, the setting of C760 should be rechecked according to the instruction book.

The RF circuity consists of a simple parallel-line tuned circuit, with an adjustable coupling matching the 50-ohm RF input. The short length of 300-ohm ribbon (the small-conductor ribbon in the scope was replaced by the conventional kind) from the Y plates to the connector is not operated in a matched condition and can be considered merely as an extension of the main tuning-circuit lines. The size of the lines depend on the channel to be covered; for the low channels a few turns of wire will be required. For channel 12, we used two 2½″ No. 12 wires spaced 1″ and run from the connector directly to the split-stator tuning capacitor. At higher frequencies these lines can be made of wider material to reduce their inductance. The coupling arrangement also varies with the channel, and either a capacitive-potentiometer (shown) or inductive-loop coupling can be used. Care should be taken with the B+ on the main tuning lines. When the unit is complete, it is very simple to check for correct tuning and sufficient coupling to give about three screen diameters of vertical deflection.

In order to give control of vertical shift, B+ is fed to the shift circuit. Two 1K, ⅛-watt resistors are used as RF chokes, and two 47K resistors and a .001-mfd ceramic disc bypass capacitor filter the RF out of the shift circuit. Normal VHF wiring techniques must be followed in mounting the components. Between pins 9 and 11 are wired a diode and load resistor; their leads are not cut short but are bent so as to act as a coupling loop close to the main tuned circuit. The detected video acts a synchronizing feed for the time-base unit. At other channels the pick-up arrangements may need to be modified. It should be noted that the plug-in time-base units normally used with this oscilloscope do not have television-type sync separators built in. For measurements at line rate, the synchronizing information from the detected RF is adequate. More sophisticated waveforms may require external triggering from the modulating video test signal generator.

For single-channel operation, the main tuning can be preset, but the coupling and vertical-shift adjustments must be brought out to the front panel. If a variable-frequency oscillator is available, it is advisable to check the bandwidth of the unit and to make sure it is flat over the whole TV channel at all coupling settings. For the same reason, the unit should be constructed rigidly to good VHF engineering practice.

Calibration and Use

For power measurement, the unmodulated transmitter is run into a water-cooled dummy load, and the power dissipated is calculated from the water-temperature rise. At the desired level of peak sync, the setting of the scope vertical gain control is noted (or a preset control is switched in). If the transmitter will not run at this level continuously, or for other levels such as blanking, the corresponding CW power is calculated for the desired mark-to-space ratio of the pulses, and the graticule reading is noted. For everyday use, a special graticule can be made up showing sync, blanking, and white levels. As long as the tuning and vertical gain controls are not touched, these graticule lines will represent absolute power levels, provided the antenna is as well matched as the test load.

To use the oscilloscope as a waveform monitor, the vertical-gain and vertical-shift controls are moved to permit viewing of either the "positive" or "negative" part of the envelope as desired. (For a test extending from black to white, ap-

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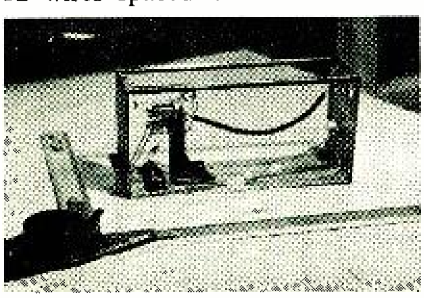
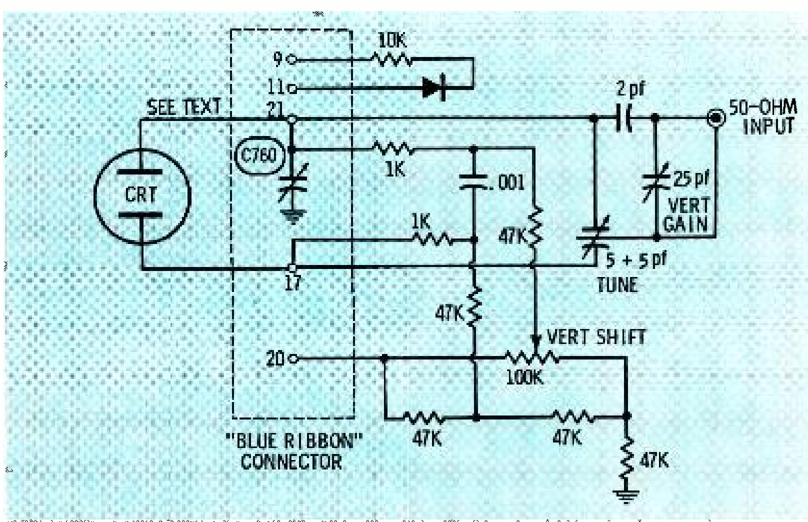


(A) Photo of unit



(B) Schematic diagram

Fig. 1. This adapter was developed at CFCF-TV for use with an oscilloscope for checking the RF modulation envelope.

VISITING THE NEW CHANNEL TWO

by James M. Moore—An all-new full-power VHF station has gone on the air.

The opening of a new VHF TV station—particularly a maximum-coverage station—on a previously unoccupied channel assignment is a rare occurrence these days. Such a station, WTWO, did begin program tests on channel 2 from Farmersburg, Indiana (near Terre Haute) on September 1. Here is a word-and-picture tour of the nation's newest VHF TV station.

From Allocation to CP

When the FCC lifted its freeze on new television-station construction, Terre Haute was allotted only one VHF channel—channel 10, on which WTHI-TV operates. In 1957, however, the Commission decided to "deintermix" (make all-UHF) Springfield, Illinois, and so channel 2 was withdrawn from that city and reallocated to St. Louis and to Terre Haute.

A number of applicants sought the channel in Terre Haute, and a number of hearings were held over a period of years. In December 1963, the Commission directed all the applicants to bring their applications up to date. Three remained in competition and, in December 1964, merged to form the present Illiana Telecasting Corp. The FCC approved the merger, and a construction permit was granted February 3, 1965. Work toward making WTWO a reality was begun immediately under the direction of J. R. Livesay, president of the station, and a 29-year broadcasting veteran.

Construction Phase

It was decided to construct a combined studio-transmitter installation for WTWO. Very little flexibility was allowed in the selection of a site. The FAA had determined that all tall towers in the vicinity of Terre Haute must be located in a small triangular area (measuring about three miles on a side) south of the city. The northern tip of the triangle is near Farmersburg, and so the WTWO tower is located about a mile southwest of Farmersburg and about 13 miles south of Terre Haute. It's no coincidence, then, that competitor WTHI-TV has its new tower directly across highway 41 from WTWO.

Orders were placed in February for equipment that had to be built or adjusted for the station's frequency. Orders for the studio and control-room equipment were not placed until April—after manufacturers had displayed their newest wares at the NAB Convention.

A target date of September 1 was set, and, through planning, hard work, and a measure of good fortune, the date was met. Most spectacular, perhaps, was the speed with which the 1000′ tower was erected. On one day, the crew put eighteen 25′ sections in place. The 9-ton antenna was lifted into position and mounted in just three hours. The entire job was completed, except for painting, in three weeks, and when the two painters arrived, they covered 880′ of tower in one day (using mittens).

Technical Facilities

The tower of WTWO rises to a total height of 1000′ above ground, 1549′ above mean sea level. The radiating center of the antenna is 950′ above average surrounding terrain. The station's peak video effective radiated power is 100 kw; its aural power is 19.5 kw. On channel 2, this combination of power and height gives the approximate coverage shown in Fig. 1.

The steel in the tower and guys weighs 105,000 lbs. The concrete foundation is 13′ square and is designed to support a maximum load

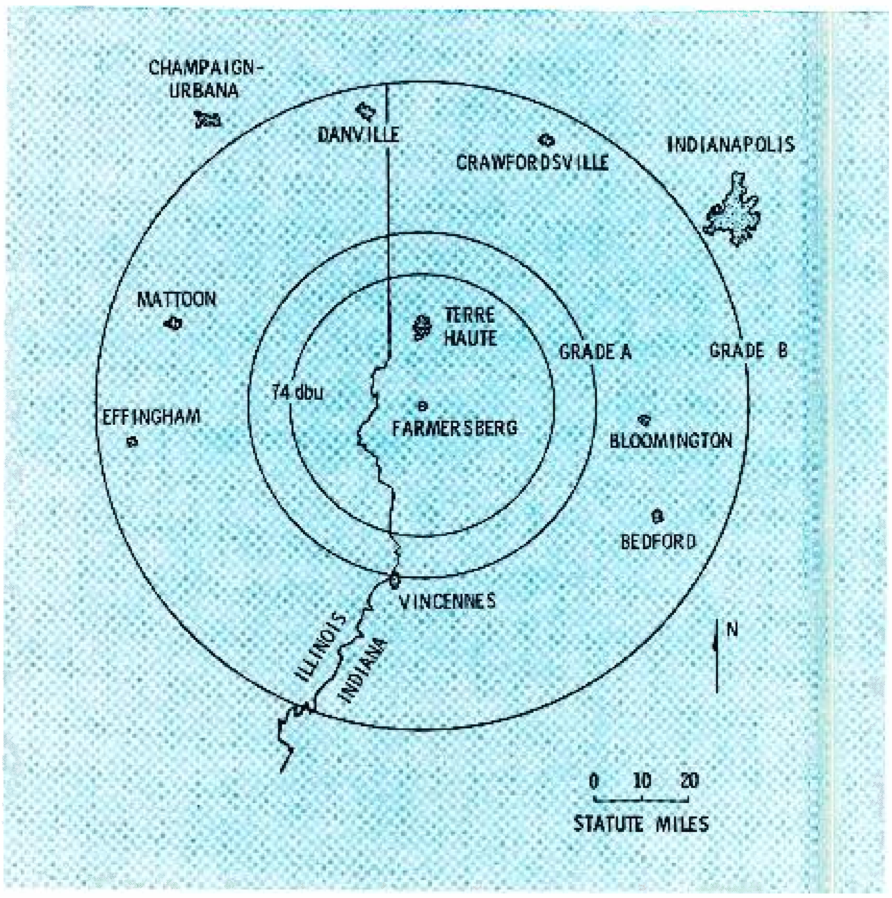


Fig. 1. This map shows the approximate signal contours of VHF station WTWO.

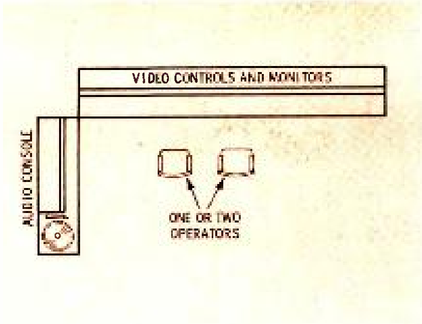
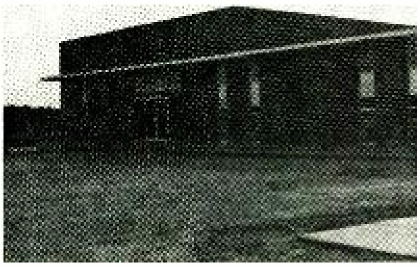
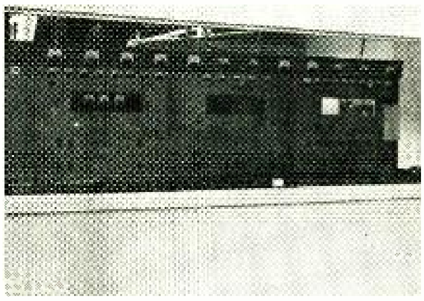


Fig. 2. Video, audio consoles are arranged so one or two can operate them.



This modern building, designed expressly for TV, houses television station WTWO.



The 35-kw transmitter is visible from the control room through a large window.

in excess of 300,000 lb. The outer guy anchors are 14′ deep. Obviously, test borings were made before this phase of construction started.

The six-bay batwing antenna is driven by a 35-kw (video) transmitter. Only 20 kw is required to produce the full erp, however, so the transmitter "loafs along" at considerably less than its maximum capability. This, of course, is expected to result in increased dependability and tube and component life.

Basically, the transmitter consists of three sections—an exciter, a driver, and the video final amplifier. The FCC's new Rule limiting the aural erp to 20% of the visual erp permits taking the aural output directly from the driver without the need for a high-level aural amplifier. This fact resulted in a saving of both dollars and space for WTWO.

The transmission lines in the area behind the transmitter are designed to allow flexibility of operation. The transmitter final can be fed to the antenna or to the dummy load, or the visual driver can be fed to the antenna in the event of failure of the final amplifier.

A 10-hp motor drives a blower that brings outside air into the transmitter room, and there is a ceiling exhaust fan (the driver exhausts its heated air directly into the room). In winter, hot air from the transmitter is used to help heat the building.

Program sources include the NBC network (more about that later), two studio cameras, video tape facilities, and a color film chain. The latter cost considerably more than a black-and-white chain, but with the increasing emphasis on color, station management is not sorry for the added investment.

The control console overlooks the studio area. The console is arranged (Fig. 2) so that one operator can control the station during relatively slack periods. During periods of greater activity, the console layout permits the use of separate audio and video operators. By turning one knob, the controls can be set up either for separate audio control or for an audio-follows-video arrangement. Special effects can be inserted into the video signal electronically at the console.

Audio sources include the usual microphones together with a turntable, tape-cartridge machines, and the sound outputs of the two 16-mm film projectors and the two videotape machines.

Network programs come to WTWO by way of its own microwave system. Programs are picked up from the network at WFBM-TV, Indianapolis, and are sent to Farmersburg by microwave relay stations near Danville and Reelsville, Indiana (Fig. 3). Ten-watt transmitters are used in conjunction with 10′ dishes; the system operates in the 2-gc band. The relay towers are 285′ high, and the receiving antenna is at the 300′ level on the station's main transmitting tower.

About the only thing the station doesn't have is a remote unit. For the present, it will make its remote pickups with rented equipment.

Although all of its equipment is of commercial manufacture, WTWO did not buy an equipment package. Instead, they shopped for each equipment item to be sure the one selected met their requirements. Wherever possible, solid-state equipment was chosen. In a few cases, manufacturers loaned tube-type gear to the station until the new solid-state models were ready.

The Building

The building was designed and built especially for television broadcasting. Design goals were efficiency, roominess (18,000 square feet of floor space) to accommodate future growth, and provision for adding to the building later.

The center of activity is the spacious control room. Large windows give a view of the transmitter, announce booth, studio, and property shop. Doors lead to the news room, film department, transmitter room,

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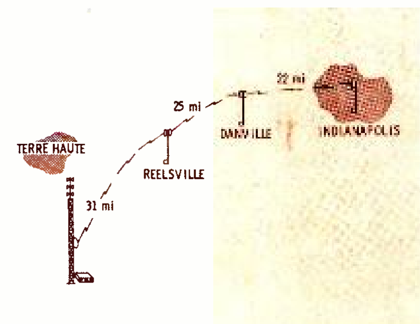
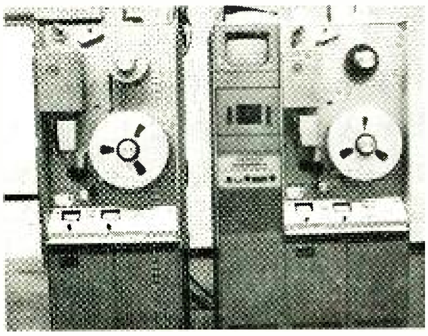
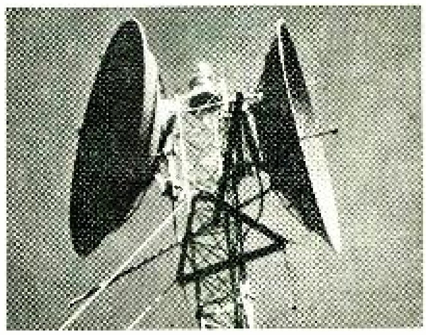


Fig. 3. A three-hop microphone system brings network programs to the station.



Video-tape recording facilities permit recording programs, station breaks, etc.



Microwave dishes at one of two stations relaying network programs to WTWO.

SILENCE SENSOR FOR SCA MUTING

*by **James L. Tonne,** Engineer, KBIM AM-FM, Roswell, New Mexico* — A subcarrier shut-off device to minimize problems with crosstalk.

There are a number of Gates FM-1B's in the field which have only one SCA subchannel. The subcarrier generator which was normally supplied with these units was a fine little unit with only one serious drawback: it had no muting provisions. During periods of silence on the subchannel, any crosstalk in the system was most obvious. If the subchannel could be turned off during these silent periods, the receiver-muting circuitry could quiet the system, and crosstalk complaints would surely be reduced. Crosstalk is not as noticeable if it is covered with legitimate sound. It is our experience that most crosstalk complaints arise during silent periods.

We decided to use the panel space allotted the second subcarrier generator, unused in our case, to install a silence-sensor to mute the subcarrier generator during quiet periods. The circuit had to be simple and reliable; the one shown (Fig. 1) evolved.

The input was bridged across the audio input to the subcarrier modulator. The signal at this point is a healthy 0 VU. The input transformer gives some voltage gain and isolates the chassis ground from the audio line. A single voltage amplifier gives adequate margin against low-level passages. The audio signal from this ampliifer is applied to a voltage doubler and is peak-detected. This DC voltage goes from nearly zero without audio to about 30 volts or so negative with normal audio. It is applied to the grid of a tube which operates at zero bias. The voltage at the plate of this tube idles, without audio, at about 20 volts. When sufficient audio is applied to the circuit to cause the plate voltage to rise to about 70 volts, the neon coupling bulb ignites, and a fraction of a milliampere flows through 2.2-megohm resistor R9. V2B, normally held at cutoff by the zener diode in its cathode circuit, then operates at zero bias, and relay K1 pulls in. The relay turns on the subcarrier oscillator and a pilot light.

Note that the device, although only slightly more complex than the usual silence-sensor, does not depend on relay characteristics for its operation. V2B is either at cutoff or saturation.

Other notes of possible interest: R1 isolates the input circuitry from the subcarrier modulator. The input transformer T1 was a surplus item, but checks show that almost any transformer with a 600-ohm and a high-impedance winding will work nicely. Connect the high-impedance side to the gain control.

The 22K resistor, R2, is installed here for the sole purpose of flattening out the poor frequency response of the particular transformer we used. Adjust R3 so that the lowest audio levels likely to be encountered will hold K1 pulled in. R4 is intended to keep stray RF out of the amplifier circuit. R10 provides a constant current through the zener diode and keeps this diode out of its "soft" region.

Audio and power connections (Fig. 2) were made just as if the unit were another subcarrier generator. We use a 6-pin Jones plug for these lines. The relay output is brought out to a male connector on the front panel and then over to unused pins on the subcarrier-generator input audio pad. This line parallels the On-Off switch on the SCA generator. That switch is now left in the Off position. A front-panel switch, S1, on the silence-sensor was added to override the relay. R11 and C3 reduce a transient click when the subcarrier is turned off.

The remaining set of relay contacts is used to operate green and red lights to show relay status.

This unit has performed admirably for us for several months. Crosstalk complaints have been reduced just as expected. ▲

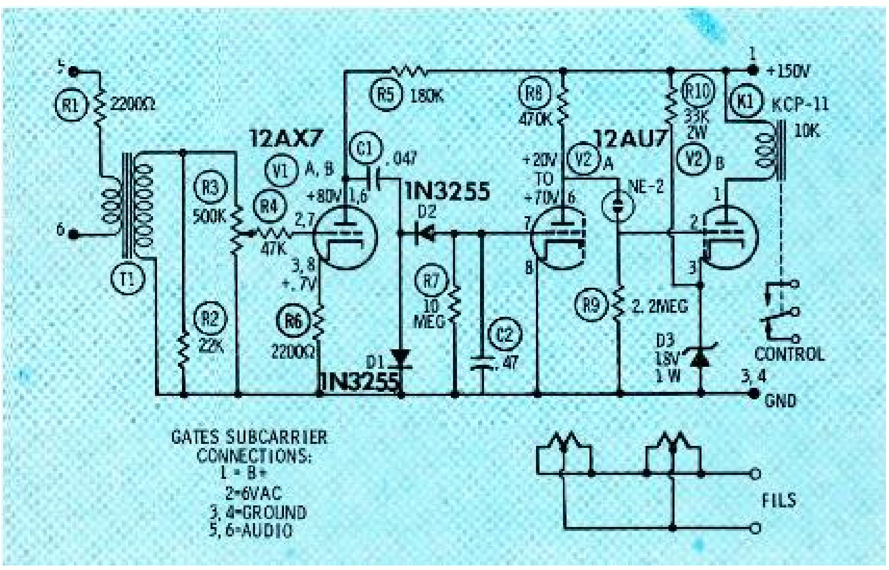


Fig. 1. Diagram shows circuit of the electronics of the silence-sensor unit.

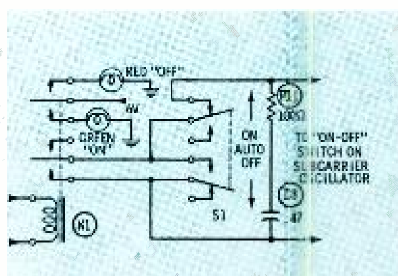


Fig. 2. Diagram of output connections.

HELICAL ANTENNAS FOR TELEVISION

by ***William F. Paige***, Syracuse, N. Y. — A detailed description of one of the important types of antennas for TV transmitting.

The side-fire helical antenna is of the traveling-wave type. It is capable of delivering a gain over a dipole of up to 30 and maintaining a pattern circularity within ±1.5 db, yet it offers simplicity of design and construction. It has the capability of operating over a wide range of frequencies from low-channel VHF through the 2000-mc microwave range, making it ideally suited for television transmission. In addition to these features, it has the capability of producing a certain degree of azimuth directivity and of shaping the vertical beam to distribute the RF energy effectively over a desired service area.

One Section

The antenna consists of a metal cylinder or mast mounted in a vertical position. Two helices having equal but opposite pitch are wound around the mast in opposite directions from a center feed point. The helices are supported from the mast by low-loss insulators.

The input signal may be fed through a coaxial transmission line extending inside the mast to the feed point, or the mast may be used as the outer conductor of a coaxial transmission line, with the feed point probe-coupled to the inner conductor. The feed system extending through the mast to the helix is isolated from the mast by a low-loss insulator bushing. The mast serves as the supporting structure of the antenna. Fig. 1 illustrates the general configuration of the side-fire helical antenna.

Traveling-Wave Principle

The traveling-wave antenna is a non-resonant type that is capable of exciting a large aperture from a single feed point. The aperture of a side-fire helical antenna is the linear length of the mast measured to the ends of the helix. As the wave progresses along the helix, it is highly attenuated because of radiation loss. Consequently, when the wave reaches the end of the helix only a small amount of energy remains, and the effect of reflections from the ends is negligible; therefore, the ends may be left open-circuited or short-circuited to the mast as required in a specific case.

The Helix

The helix must be designed to meet dimensional requirements dictated by the operating frequency. The currents at like points in each turn of the helix must be in phase. Thus, as the current progresses from turn to turn, it is delayed an integral number of cycles. This means that each turn must be an integral number of wavelengths in helical circumference as measured at the velocity of propagation along the helix. The most commonly used helical antenna utilizes two wavelengths per turn and is designated as a second-order-mode antenna. Any order mode can be used as long as the length of a turn is an exact multiple of a wavelength.

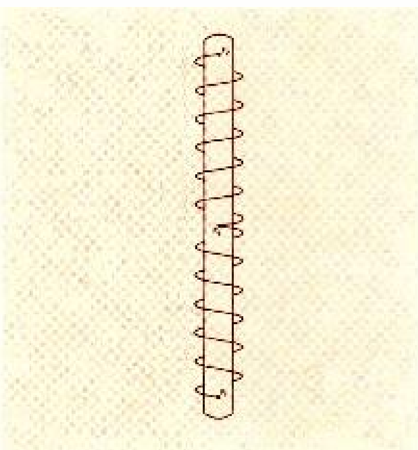


Fig. 1. Basic one-section helical antenna.

The upper and lower helices are wound in opposite directions around the mast to cancel or minimize the vertically polarized radiation components. This is also referred to as "cross polarization" and is a result of the helix pitch angle. The measured gain of the antenna is reduced approximately 5% to obtain the horizontally polarized gain value.

Current Distribution

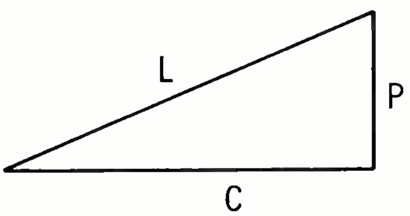
As the progressive wave travels from the feed point to the ends of the helices, there occurs an appreciable amount of radiation loss per turn. This loss is a function of the spacing of the helix from the mast. Assume an antenna with a fixed aperture length. If the spacing s/λ is made too small, the radiation loss per turn is also small; consequently, when the current arrives at the end of the helix there still remains a substantial amount of RF energy to be reflected back along the helix. This can cause severe horizontal pattern scalloping or "cloverleafing." On the other hand, if the spacing s/λ is made too large, the radiation loss per turn is large, and radiation takes place only around the feed point. This, in effect, reduces the effective aperture. The total length of the helix is adjusted, commensurate with the loss per turn, so that resonance effects due to end reflections are avoided and yet an effective aperture is maintained. The design center for this radiation loss is chosen as approximately 4 db per turn, and the s/λ spacing used to obtain this optimum value is .13.

As previously mentioned, the

pitch of the helix introduces "cross polarization." Let us again assume a fixed aperture length. If the pitch is kept small to minimize "cross polarization," the length of the helix would be extremely long and require many turns, thus reducing the effective aperture and beaming bandwith (the total frequency separation between the two points where the half-power beamwidth has increased 1 db). If the pitch is made large, the length of the helix is reduced, cross polarization becomes excessive, and resonance effects due to end reflections become prominent. A pitch of .5 wavelength optimizes the antenna performance. A decrease in pitch on the last two turns of helix permits the use of six full turns of helix within 2½ wavelengths of mast height.

The Mast

The mast dimensions are determined by the electrical parameters of the antenna. The diameter of the mast is easily calculated from the following:



$$D = \frac{C}{\pi} - 2S$$

where,
- D = diameter of mast
- S = helix spacing from mast
- $C = \sqrt{L^2 - P^2}$

where,
- L = length of one turn of helix
- P = pitch of the helix (see diagram above)

The length of the mast is 5 wavelengths, 2½ wavelengths from the feed point to either end. If a high gain is desired, these sections are stacked one upon the other, and the gain of one section is multiplied by the number of sections. If more than one section is required, a series feed system is used in which the distance between feeds must be an integral number of wavelengths to yield in-phase currents.

Insulators

If an insulator is inserted at a point along the progressive wave, a reflection occurs at this point, and a standing wave appears on the helix. The magnitude of this reflection is dependent upon the dielectric constant of the material. It is desirable to use an insulator material with a low dielectric constant and yet one that is mechanically strong and durable under adverse weather conditions. Teflon® meets these requirements and is the most commonly used material for the supporting insulators.

The location of the insulators is another important consideration. The traveling wave along the helix repeats its phase every full wave; consequently, if the insulators are placed at half-wave intervals, the reflections will be in phase and add in magnitude. Therefore, insulators are placed at quarter-wave intervals or any odd multiple of quarter-waves to place the reflections in opposing phase. Three-quarter-wave spacing is used on the second-order-mode antenna to insure good mechanical support for the helix.

Impedance

The radiating helix may be considered as a transmission line which uses the mast to form a single conductor over a ground plane. The characteristic impedance of such a line, with the spacing employed, is approximately 100 ohms. This impedance can be varied somewhat by tapering the spacing of the turns near the feed point. Since the helix behaves as a lossy transmission line, the impedance bandwidth is wide.

This low feed-point impedance and consequent low RF voltage make the helical antenna design inherently immune to moderate icing conditions. On the other hand, this antenna is readily adaptable to deicing by merely passing a high AC current through the helix, thus eliminating the necessity for additional heating elements.

Directionalizing

The antenna is adaptable to a certain degree of directivity by placing radial stubs of the order of .10 wavelength long on the helix—for maximum effect, usually on the first three turns of helix from the feed.

The helical antenna can be used for suppressing the radiated signal in a specified direction to a maximum of about —10 db. Fig. 2 shows a typical directional pattern. For installations requiring a highly directive pattern to provide better

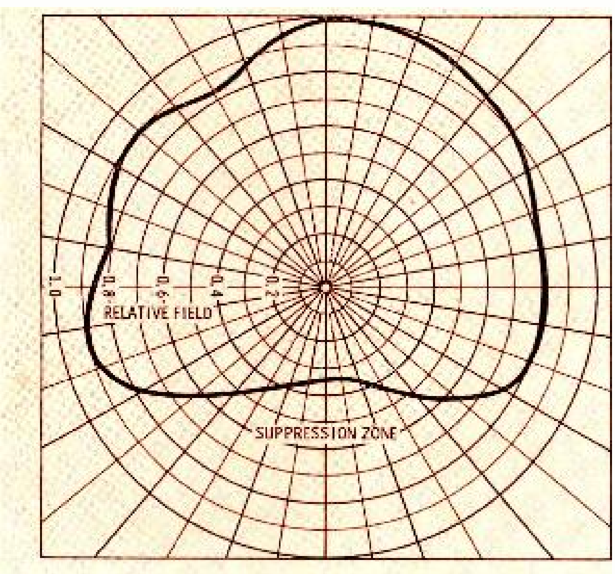


Fig. 2. Typical horizontal pattern of a directional antenna.

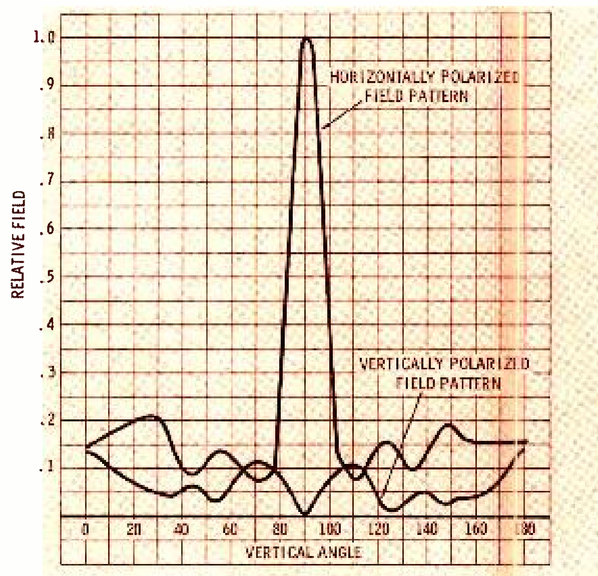


Fig. 3. Typical vertical pattern of single-bay helical antenna.

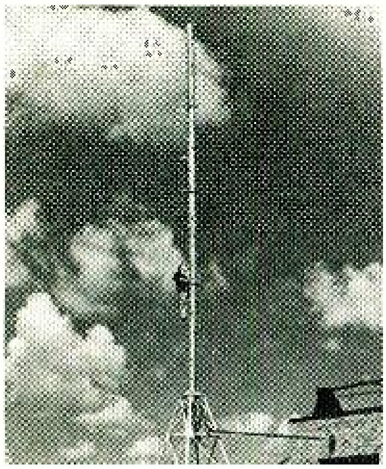


Fig. 4. A four-bay UHF helical antenna.

and more efficient coverage of populated areas, other types of antennas more suited for the purpose are available.

Summary

It can be seen that the combination of mast size, helix pitch, helix-to-mast spacing, and number of turns must be chosen to utilize the aperture most effectively and at the same time to provide adequate bandwidth. It has been determined that for a second-order mode antenna six turns for each of the helices, a pitch of .5 wavelength, helix spacing of .13 wavelength, and a helix diameter of about .01 wavelength will result in a bandwidth of approximately 5%. This bandwidth is adequate for all high-channel VHF and all UHF channels.

A typical vertical field pattern (Fig. 3) has a half-power beamwidth of 12°, very low side-lobe level, and a low vertically polarized field magnitude to produce a gain of 5 over a dipole. The horizontal field pattern is circular within ±1.5 db.

High Gain - Second Order Mode

Up to this point, a one-section helical antenna has been discussed to explain the basic construction and operation of the type. Today's television market is leaning more and more toward high-gain antennas for adequate coverage of principal cities several miles from the antenna site while still contouring the vertical pattern to provide the desired close-in coverage. With the helical antenna, this is accomplished by stacking sections one upon the other to obtain the desired gain. Close-in coverage is obtained by proper phasing and current distribution between the sections that constitute the array.

Stacking of Sections

As previously stated, one section produces a gain of 5 over a half-wave dipole; therefore, a series multisection array produces a maximum gain of 5 times the number of stacked sections.

The average UHF station requires an antenna gain of 25. Since close-in coverage requiring null fill-in is a necessity for most installations, a six-section array is necessary to compensate for gain reduction resulting from null fill-in and electrical beam tilt. (Beam-tilt and null-fill-in requirements depend largely on the height of the antenna above average terrain and on local terrain conditions.) Fig. 4 shows a four-section UHF helical antenna. VHF stations usually require two or three sections.

Beam Tilt

As the gain of a standard antenna is increased, the vertical beamwidth is proportionately narrowed. Because of earth curvature, and possibly local terrain conditions, part of the main beam energy will tend to miss the horizon and go off into space. For maximum effective range, the main beam should be tilted downward to or slightly below the horizon (Fig. 5).

Beam-tilting may be achieved easily with the UHF helical antenna by introducing a progressive phase shift between successive sections. This can be accomplished by employing swivel flanges and mechanically rotating each section with respect to its adjacent section. Beam tilts up to 1° are possible without appreciable pattern distortion or loss of gain. Beam-tilting the VHF helical antenna is achieved by introducing phase shift between successive sections by varying the lengths of the feed lines to the sections.

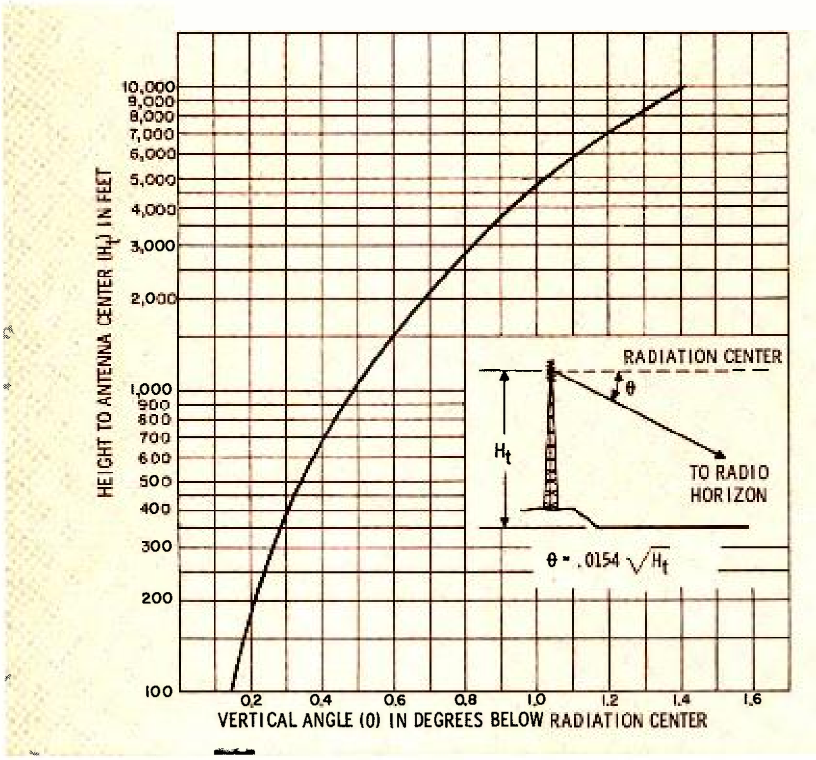


Fig. 5. Curve showing optimum angle of tilt for maximum range.

Null Fill-in

In the design of any antenna array there are nulls that appear at calculable angles below and above the antenna's radiation center. The first null is generally the one most likely to fall in populated areas close to the transmitter site, as illustrated in Fig. 6 which shows a cross section of the vertical beam and the associated nulls and side-lobes.

The first null of a standard helical antenna averages 20 db or more below the main-beam peak. If additional null fill-in is required, it may be obtained by proper power division between the antenna sections composing the array. For the UHF

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MAINTENANCE OF REEL-TO-REEL TAPE TRANSPORTS

by Larry J. Gardner, Chief Engineer, WCKY, Cincinnati, Ohio—Some tips on how to keep your taped programs rolling.

Most broadcast operators aren't mechanical engineers, but there are a few mechanical devices which they must understand and maintain. One of these is the familiar reel-to-reel tape transport. It is our purpose here to discuss the routine maintenance of these machines, and the troubles most often encountered.

Maintenance should consist of cleaning, lubrication, and adjustment, in that order. If the machines are properly maintained, the amount of work required in each of these categories should diminish in the order given. Cleaning and lubrication help prevent wear, and adjustments take up the slack when wear takes place.

Cleaning

Start by cleaning the pinch roller and drive capstan. These should be cleaned with ethyl alcohol or ordinary rubbing alcohol. Don't use carbon tetrachloride on rubber parts, since it will cause the rubber to harden or crack. Clean the tape guides to remove all caked oxide, which can be a source of flutter or faulty tape travel. On machines using band-type brakes, remove all traces of oil from the drum on which the bands ride. Whatever type of brakes is used, all oil must be removed from the braking surfaces. If felt or fiber parts show signs of oil, they should be replaced. Where replacements are not immediately available, a temporary improvement may be had by putting the felt between two blocks of wood with blotters on each side and then clamping them firmly in a vice. It may also help to roughen the contact surface with coarse sandpaper. This is especially helpful where the surface is matted with dust and oil.

Clean drive rollers in the same manner as the pinch roller, with alcohol. Be sure to remove all traces of oil. If the surface is badly glazed, it can be reconditioned by using "roller deglazing solution" which may be obtained from printing-supply houses. Rubbing with very fine sandpaper or crocus cloth may also help. Don't use an abrasive on rollers in the capstan drive chain, however, since this could cause speed variations.

A point on disassembly is in order here. When taking apart the bearings on the flywheel or motors, notice the amount of back-and-forth play in the shafts, so that the same amount may be had upon reassembly. Also, since many of these bearings are of the single-ball variety, be sure the ball doesn't roll into a dark corner of the bench and become a spare part! On machines with direct drive (i.e., no belts or idlers between the motor and capstan), it helps to rotate the motor a quarter-turn when it is reinstalled. This helps equalize wear on the sides of the top bearing and prolongs motor life. Often this method may be used to restore life to a dragging motor.

If the machine has become very dusty or oily, practically any part may be cleaned with soap and water. Use a small paint brush soaked in a strong soap solution to wipe away residue from wiring, fans, pulleys, and electrical parts. The water won't hurt the parts if the machine is allowed to dry completely before applying power. Let it air-dry for 48 hours or more. A heat lamp will speed the process. While you're laundering, don't forget the front panel.

Lubrication

Lubrication is important, but should not be overdone. Most manufacturers recommend lubrication every three months or 1,000 hours of operation. Their instructions are usually explicit and should be followed closely. In general, SAE 20 oil is suitable unless the manufacturer recommends otherwise. Extreme care should be observed to avoid over-oiling or spilling oil on drive surfaces. One of the best tools for lubrication is an ordinary hypodermic needle. Your doctor will probably let you have one of the disposable variety, which is ideal for this purpose.

Machines vary widely as to the points which require lubrication. The capstan-drive motor is almost always provided with oiler holes which will accept the hypodermic. Five or six drops in each bearing is ample. The same applies to the flywheel, the takeup motor, and the feed motor. The pinch roller, drive idlers, rotary tape guides, and tension arms should get only one or two drops of oil. Remove any excess oil with alcohol.

Adjustment

If the machine has been thoroughly cleaned and lubricated and is properly reassembled, it is quite likely that no adjustment will be necessary. Again, the instruction book is your best guide. A spring balance reading 0-16 ounces is very helpful in setting feed and take-up tension. Connect the balance to a length of twine, and wrap the twine around the hub of a 7″ reel, as shown in Fig. 1. If the reel used

TABLE I. Typical Reel Torques

MODE	TAKEUP	FEED
Fast Forward	5 - 7 oz-in	¾ - 1¼ oz-in
Rewind	¾ - 1¼ oz-in	5 - 7 oz-in
Record/Play	2 - 3½ oz-in	5¾ - 8¾ oz-in

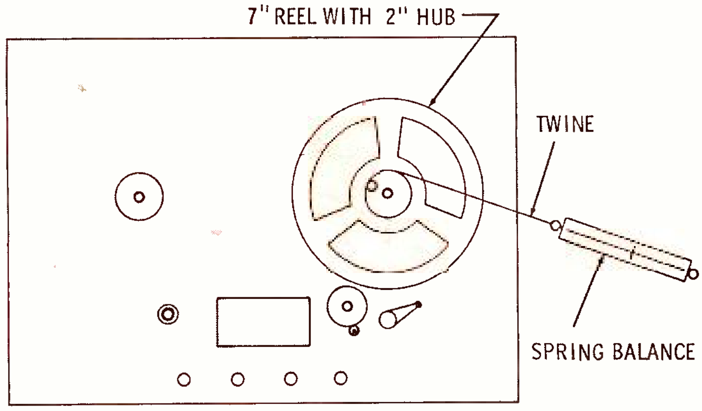

Fig. 1. Spring balance enables operator to measure the torque at the reel hub.

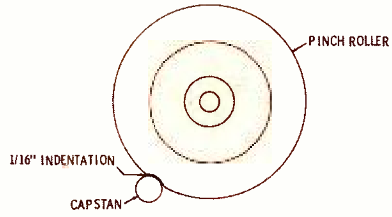

Fig. 2. Pressure exerted by pinch roller can be estimated from indentation.

has a 2″ hub, the balance will read directly in ounce-inches. The proper torque readings are often given in this form (see Table 1). Three-motor machines use resistors in series with the take-up and feed motors to set the tension in each mode. It should be necessary to change the settings of these resistors only if a part has been changed.

Single-motor transports pose additional problems, and the adjustment procedure is a bit more complicated. The take-up and feed tension is varied by changing the tension on felt clutches. Some machines use a split knob which has a locking screw and is threaded on the rear of the reel shaft. These are adjusted by loosening the locking screw and turning the knob clockwise to increase the tension, or counter-clockwise to reduce it. This adjustment should be made in eighth-turn increments, since it is quite critical. Once the proper setting has been found, tighten the locking screw securely. Other machines use a folded leaf spring which sets the tension. If this spring has been bent, the best thing to do is replace it. It may be bent slightly to secure the correct pressure, but draw its outline on paper before you change it, so it may be returned to its original shape if the trouble is elsewhere.

The pinch-roller tension should be set so it is tight enough to pull the tape reliably, but not so tight that it slows down the motor. A good rule of thumb is to set it for an indentation of about 1/16″ where the roller contacts the capstan, as shown in Fig. 2. If the roller is worn, hardened, or has flat spots, it should be replaced. It is also important to be sure the roller shaft is perfectly parallel with the capstan to prevent tape "skewing." This problem is most common on portable machines which have had rough treatment.

Tape guides should be adjusted so that the tape rides directly across the center line of the head gaps. If it is necessary to adjust the guides, it will also be necessary to readjust the head alignment with a standard tape before using the machine.

Defective Parts

Fig. 3 shows a functional diagram of the control circuits of a typical transport mechanism. Most of the troubles encountered in these circuits can be traced to bad switches, dirty relay contacts, or a fault in the 110-volt DC power supply. The selenium rectifiers used in some machines are frequent offenders. They may be replaced with silicon units with a rating of 400 peak inverse volts and 500 ma forward current. Poor solenoid or relay operation can be caused by a bad rectifier, but these symptoms may also be caused by an electrolytic filter capacitor which is open or has decreased in value. Check the rectifiers and the capacitors to be sure. If the rectifier turns out to be shorted, chances are the filter capacitors will also be shorted, since they don't work very well on AC.

Motor troubles usually fall into three categories: (1) open windings, (2) shorted turns in the windings, and (3) worn or frozen bearings. If you suspect a bad motor, take it apart carefully, noting the proper position of each part, and inspect it. Look for broken wires or burned

• Please turn to page 62

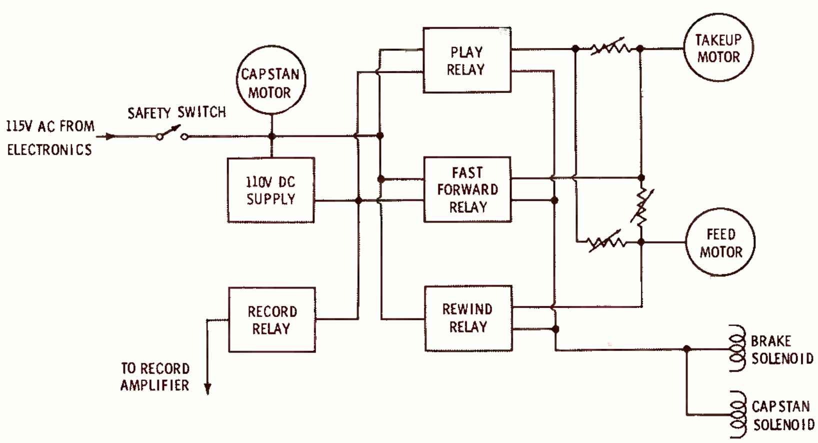

Fig. 3. Block diagram shows the control circuits of a typical reel-to-reel tape deck.

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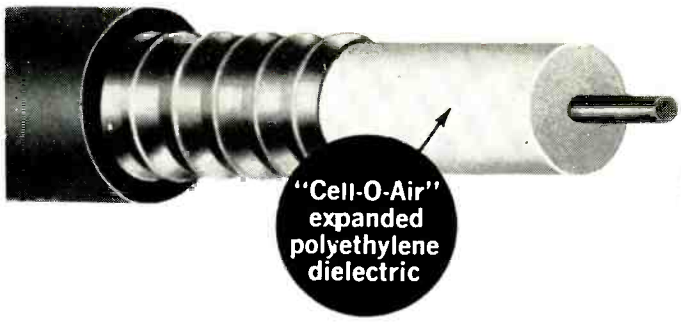

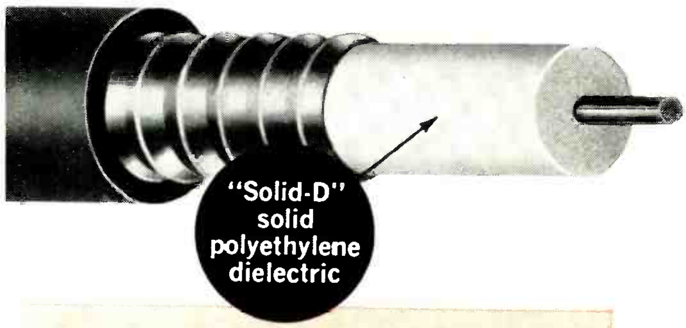

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Circle Item 11 on Tech Data Card

Film Chains

Continued from page 14

Picture adjustments can be facilitated by using the Television Test Film (Code TV16) which contains geometric patterns designed to test the following qualities: alignment and resolution; low-frequency response; medium-frequency response; storage characteristic; gray scale; brightness control. The Travel-Ghost Test Film (Code TG16) is used to adjust the shutter for synchronism with the pull-down mechanism to minimize travel ghost, and the Steadiness Test Film (Code ST16) permits checking unsteadiness in the transmitted frame.

Magnetic Sound

Magnetic sound heads are serviced the same as heads on a conventional audio tape recorder—by cleaning with "Q-tips" dipped in alcohol and by alignment with a standard multifrequency magnetic test film.

Slide Projector

Much of the advice given already concerning the film projector also applies to the slide projector (Fig. 6)—the mechanism must be kept clean and oiled, cable connections should be checked for tightness, and clean spare lamps must be available immediately.

At most stations, the slide projector is used on the air more than any other program source. Hence it's seldom available for preventive maintenance except when the station is off the air, and it must be given daily care.

Power Supplies and Monitors

The maintenance of power supplies and monitors associated with film chains is usually performed along with maintenance of all the

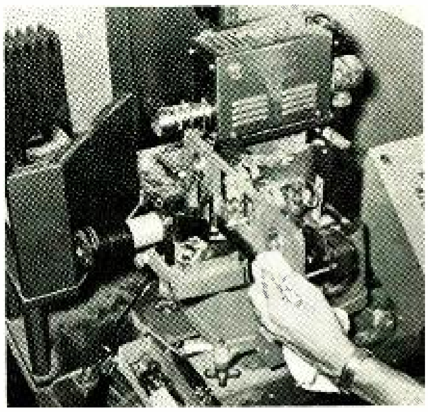

Fig. 6. Slide projector with cover off to show slide holders, lens, and gate.

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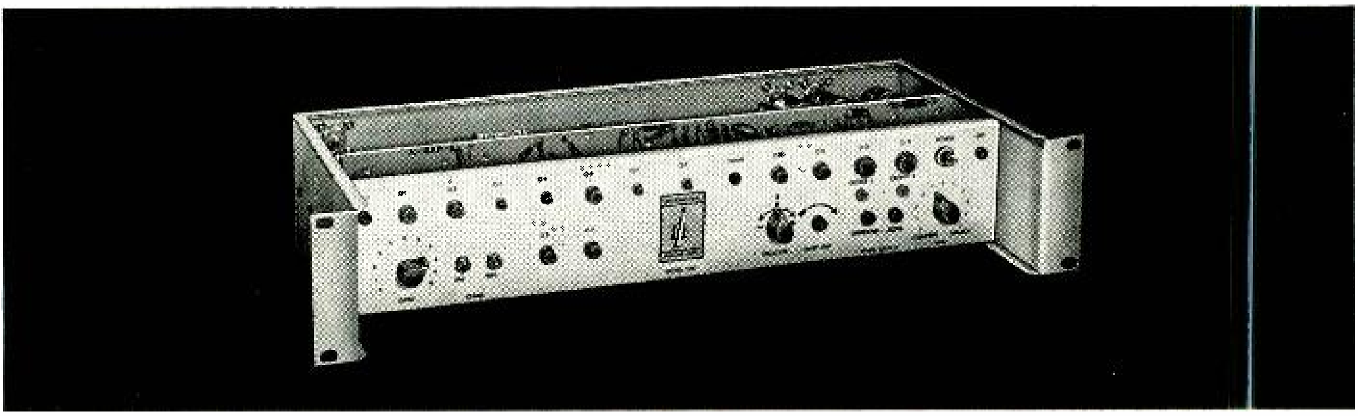
CLAMPING/EQUALIZING VIDEO AMPLIFIER

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.



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Circle Item 13 on Tech Data Card

Fig. 7. Technician checks output voltages of power supplies mounted in rack.

station's other power supplies and monitors.

Power supplies are usually checked by reading output voltages (Fig. 7) and comparing them with standard values. Improper voltages are usually traced to weak or defective tubes, sometimes faulty filter capacitors. A scope is useful to check output hum level, to make sure filtering is adequate.

Monitor troubleshooting usually consists of checking tubes, perhaps monthly, and regularly checking resolution and linearity (Fig. 8).

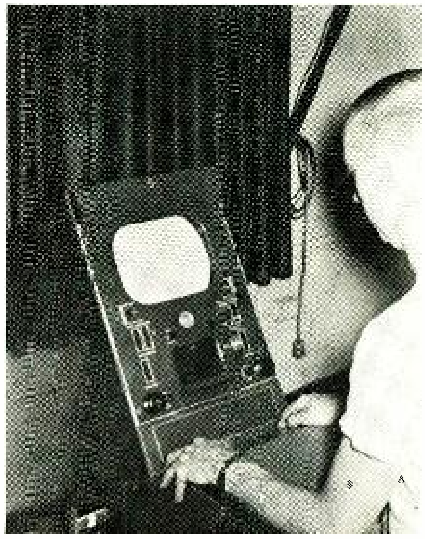
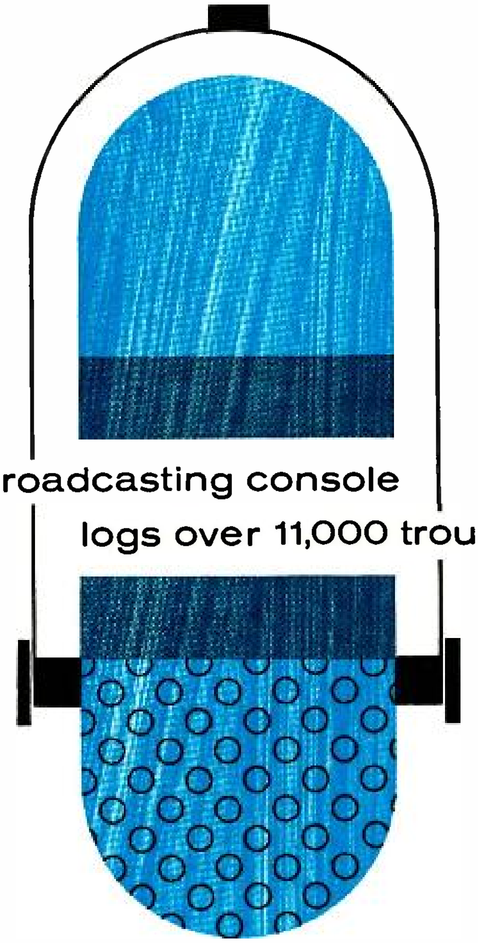


Fig. 8. Film-chain monitors must be checked regularly for picture quality.

These checks are made by feeding a monoscope test pattern to the station master monitor and to all other monitors; the pattern on each monitor is then compared to that on the master. The master is first calibrated with a grating generator. ▲



Belden wired broadcasting console logs over 11,000 trouble-free hours

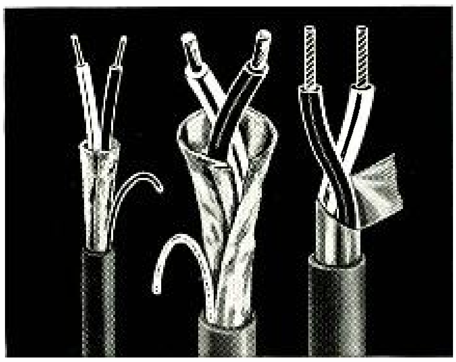
At radio station KDWB, St. Paul, Minnesota, where the disc jockeys are their own engineer and production man, a compact, highly reliable, and flexible broadcasting console was required. For flexibility, a custom console was designed to the critical specifications of the station's chief engineer.

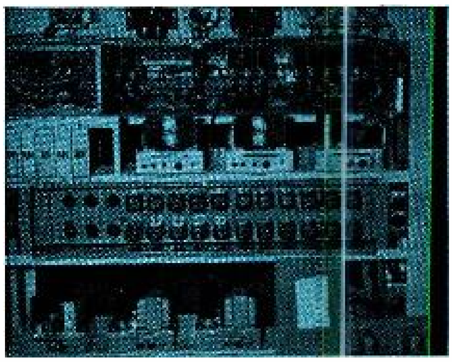
To assure highest operating reliability and facilitate the console's compactness, Belden Beldfoil* shielded broadcast audio cable was used throughout the unit. Beldfoil is "the total shield." For extremely sensitive circuit applications, it is superior to all other types of shielding for guarding against crosstalk and spurious signal impulses. Beldfoil also reduces cable diameters up to $66\frac{2}{3}\%$ . . . increases electrical integrity . . . and provides faster and easier shield termination.

Belden manufactures the most complete line of wire and cable for all radio and TV broadcasting, recording studio, remote control circuit, and similar applications. Ask your Belden sales representative for complete information or write for Catalog 865.

*Belden Trademark—Reg. U.S. Pat. Off.

In the studio, the disc jockey is in complete control. Looking over the installation are (left to right) Dick Halvorsen, Chief Engineer, KDWB; Sam Bridges of Electronic Design Company, console designers and builders; and Steve Gabor, Belden territory salesman. The disc jockey is Don DuChene.





The compact KDWB console is a solid state unit having complete broadcasting features and standby power. It provides mixing facilities for fourteen inputs including five cartridge tape machines, three turntables, microphone, news effects, tape machine, auxiliary, news room, and disc jockey studio.

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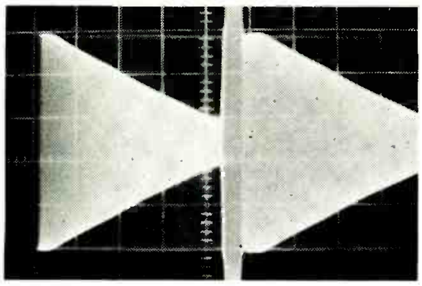
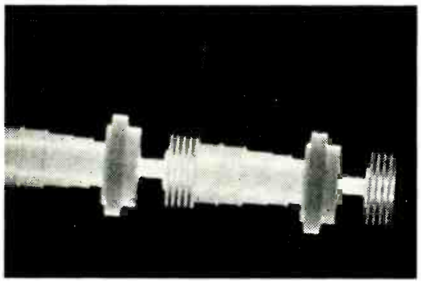
Circle Item 15 on Tech Data Card

Oscilloscope

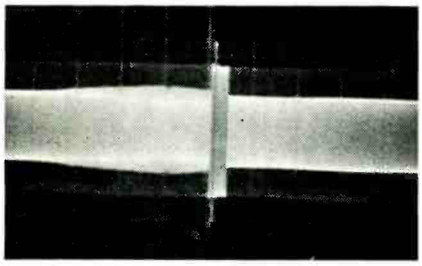
(Continued from page 16)



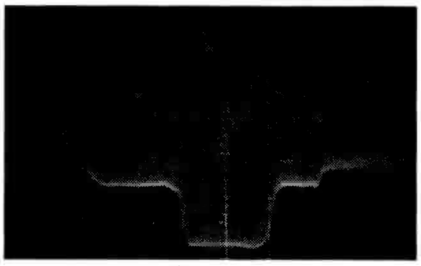
(A) Line-rate sawtooth for transmitter linearity and level checks



(B) Line-rate display of multiburst signal (monitor vert. gain reduced)



(C) Field-rate composite-sweep display



(D) Expanded horizontal blanking

Fig. 2. Typical displays obtained on the RF waveform monitor from TV transmitter.

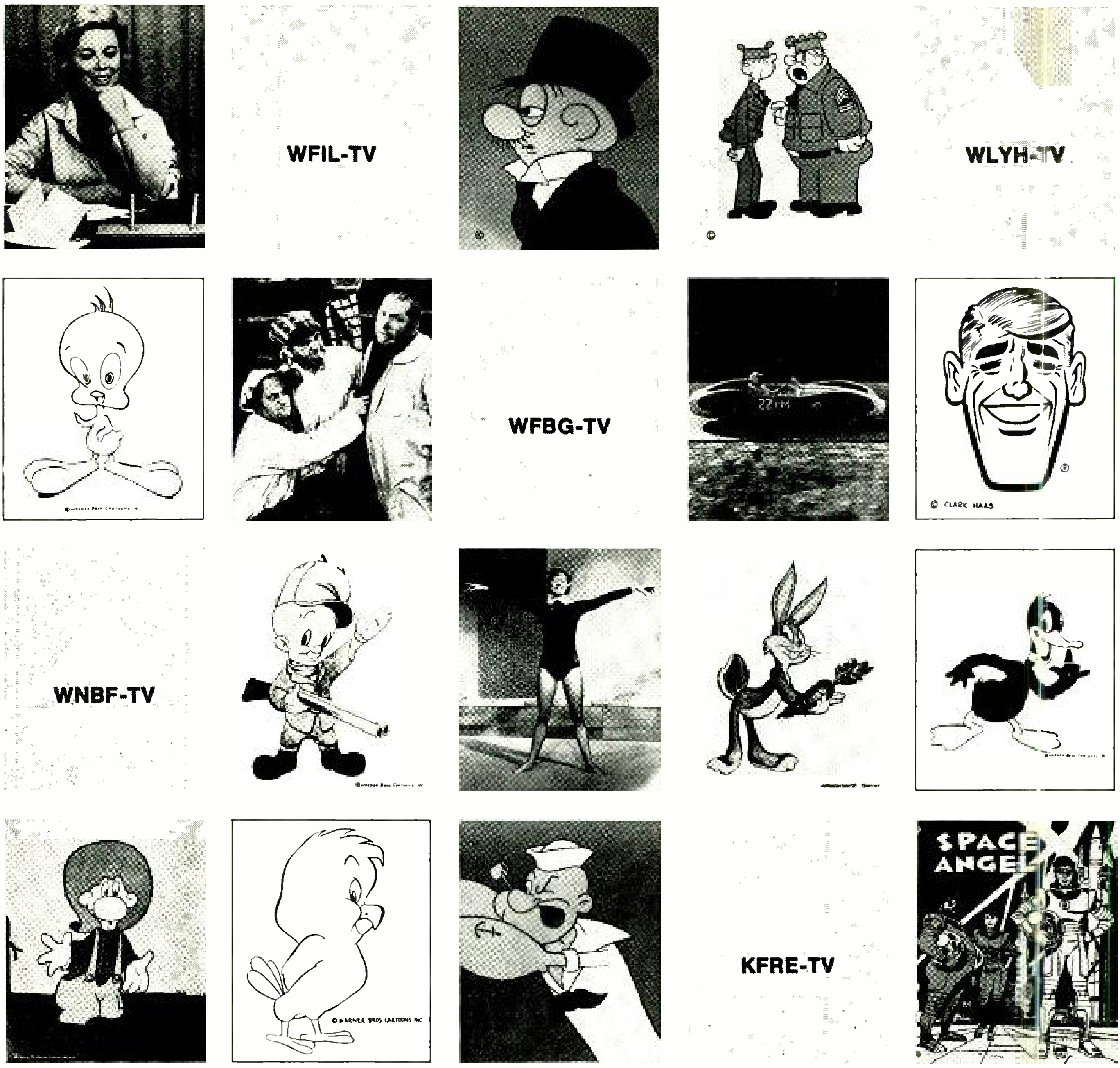
proximately 3 times more vertical gain will be required to fill the graticule.) If critical phase or frequency responses are being taken, some thought must be given to the transmitter sideband characteristic at the probe pick-up point. If necessary, an RF VSB filter must be added to the tuned-circuit arrangements. Some typical displays are shown in Fig. 2.

To check the phasing of paralleled transmitters, an identical adapter for the X-side of the scope must be made, and also tuned to the carrier frequency. If the CRT and plug-in connections are symmetrical for X and Y deflections, and if equal lengths of cable feed RF from exactly equivalent points in both transmitters, a Lissajous figure will result in which a phase error of 5° or so can easily be seen.

Conclusion

A simple plug-in unit for an oscilloscope which is commonly available in TV stations makes a useful RF envelope monitor capable of direct power measurements and "DSB-detector" type waveform displays without the disadvantages of real detectors. Additional uses can be made for phasing paralleled transmitters, and with the addition of suitable RF filtering, a VSB-type display could be obtained.

The prototype unit was constructed at CFCF-TV, Montreal, and the author wishes to thank Messrs. Berube and Laporte of that station for their work on the design and construction of the unit. ▲



G-E 4-V's "color" 94 programs a week—for Triangle

General Electric 4-V color film cameras are now at work for five Triangle stations...providing color for 94 programs a week.

Since late 1963, Triangle has demonstrated its leadership in local color film origination by installing G-E 4-V systems at WFIL-TV, Philadelphia; WNBF-TV, Binghamton, N.Y.; WFBG-TV, Altoona, Pa., and KFRE-TV, Fresno, Calif.

Recently, Triangle decided to install a 4-V at WLYH-TV, Lancaster-Lebanon, Pa. Because of the reliable and highly satisfactory performance of the other four G-E units, Triangle ordered its fifth G-E 4-V...even though there is now a competitive 4-V unit on the market.

This is the kind of customer acceptance that will put more than 100 G-E 4-V's on the air by autumn. No other manufacturer can even approach this record of field-proven performance and market approval. For details on television's most-accepted 4-V color film camera—the G-E PE-24—contact your G-E Broadcast Equipment Representative, or: General Electric Company, Visual Communications Products, #7-315, Electronics Park, Syracuse, N.Y. 13201 (Phone AC 315, 456-2105). GE-17

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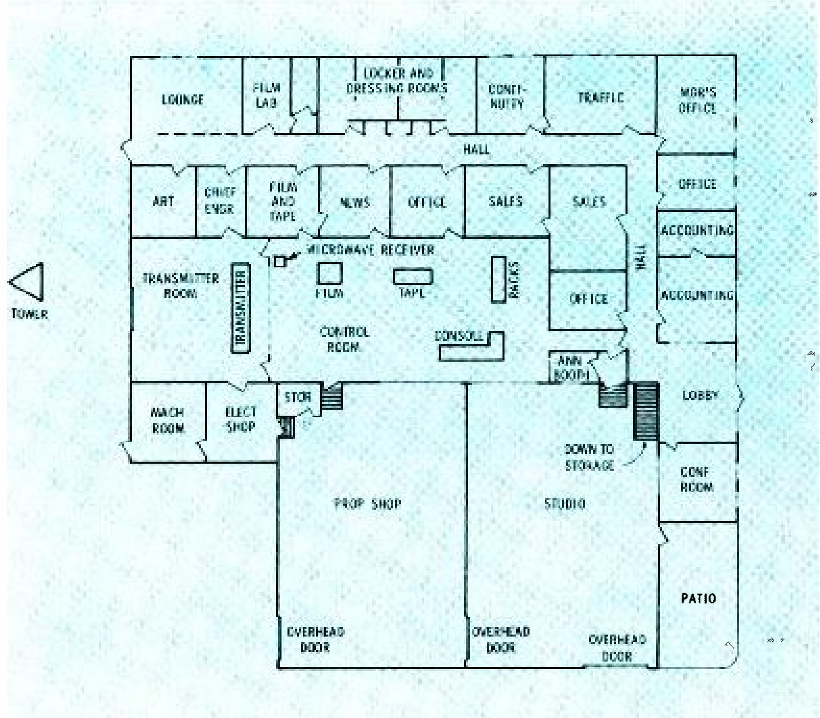
Circle Item 17 on Tech Data Card

Channel Two

(Continued from page 18)



The layout of the WTWO building was engineered to provide efficiency, room for expansion, and provision for later construction.

property shop, and—through a hall and sound lock—to the announce booth and studio.

The studio measures 40′ x 60′. Its ceiling is 24′ high and is acoustically treated. A permanently mounted grid is provided for the lighting, which is switch controlled; no dimmers will be used initially. Two large doors permit bringing props as large as an automobile into the studio. Large windows give a view of the studio from the building lobby and the conference room. A stairway leads down from the studio to a 2000-square-foot storage cellar.

A small door in the side of the main studio leads outside to the "patio studio," a concrete-paved area adjacent to the front of the building. The studio cameras can be dollied to the door for pickups of programs with an outdoor backdrop.

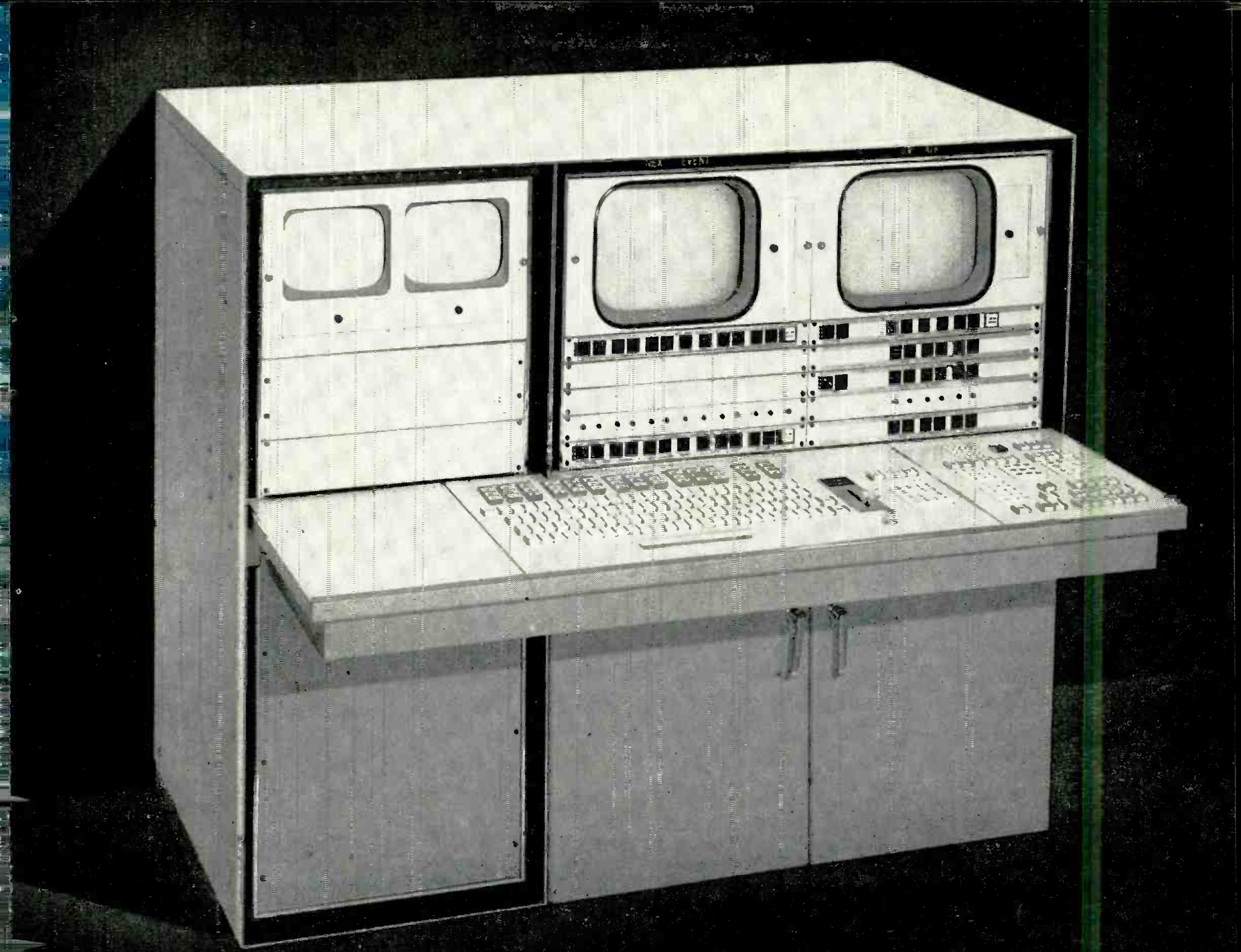
The prop shop is similar in construction to the main studio. Thus, as the station grows, it has a second studio already available. Space to build a new prop shop is available in the parking area behind the building.

An electronics shop just off the transmitter room will be available to the engineering department. This shop will be completely shielded with copper screen to keep out the strong RF field that would be present otherwise.

In the office area, most offices are 16′ x 16′ or 16′ x 20′ to provide space for more desks as the station grows. The accountant's office has a built-in vault, and doors link such departments as traffic with continuity and film with news. The hall was made wide enough that two people can walk side by side in it. Dressing rooms are provided with enough space to hang clothes neatly, and a closet just off the lobby is provided for the convenience of visitors.

No TV station would be complete without a darkroom, and WTWO is no exception. Film developing is done across the hall from the film-editing room. The darkroom is complete with a small machine for processing 16-mm movie film.

No place of business is complete without an employee lounge, and WTWO has one, adjacent to the



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Tarzian's APT-1000 is the most versatile television programming system in existence. In fact, performance of the APT has been so sensational, we invite you to try to stump it. We're confidant this solid state computer can handle any programming problem you have—better, faster, and smoother than you ever thought possible. Fact is, it has never been possible . . . before.

A special purpose computer, APT-1000 was designed solely for total and flawless television programming. It can't panic, prime time or any time. Easy operation develops an operator confidence that shows up in improved efficiency and quality of programming.

Television programming now enters a new era . . . for even while the complexity of operations continues to increase, a greater competence and significant cost reduction become possible with APT.

If Automatic Programming for Television sounds phenomenal . . . you should see it in action. All it takes is a call or letter. And ask, too, for details on Tarzian's revolutionary new TASCOM, the digital computer which solves those costly and time-consuming traffic-availabilities-scheduling problems.

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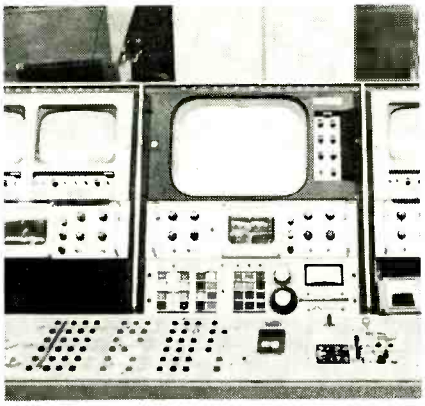


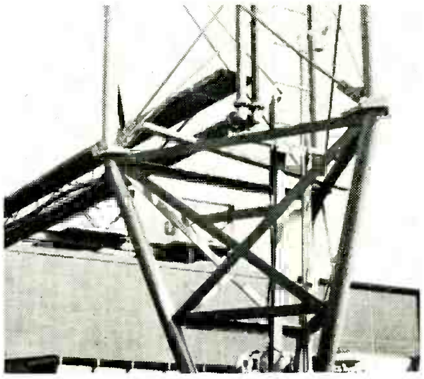
Video switching position. Lower knob below A-scope selects audio switch mode.

rear door. It is separated from the hall by a sort of "picket fence" made up of narrow panels.

To make all these rooms inhabitable during hot, humid Indiana summers, an air-conditioning system with a capacity of 60 tons is needed. Cooled air is circulated to all areas of the building except the transmitter room.

Conclusion

Terre Haute's new TV outlet is now operating from a plant that



WTWO's 1000' main transmitting tower is just outside transmitter-room door.

represents more than a million dollars in buildings and equipment. For their investment, Illiana Telecasting has a facility that should enable its staff to go about its job efficiently and well.

Our sincere thanks to Mr. Livesay, Operations Manager Bill Evans, and Chief Engineer Nile Hunt for helping us show you their new channel 2. ▲

SPECIAL
REMOTE CONTROL SECTION

Remote Control Systems . . . . How They Work

by Philip Whitney

Consulting Author, Director of Engineering, R. F. Lewis, Jr. Radio Stations, Winchester, Virginia—The most comprehensive explanation BE has ever put together on the basics of controlling the remote transmitter.

Pioneer Remote Control UHF TV

by Patrick S. Finnegan

BE Consulting Author, Chief Engineer, WLBC AM-TV, WMUN FM, Muncie, Indiana — The story of the first commercial UHF-TV station to apply for remote control on a regular basis.

Remote Control Systems . . . . How They Work

by Philip Whitney

Transmitter remote-control systems are either wire-line or radio. The latter classification covers operation through a microwave link and, in some instances, control of an FM or AM station by another FM station.

Wire-line systems can be either tone- or DC-operated. In tone-type systems, tuned circuits or resonant relays at the receiving end separate the various functions. Often, a system will embody both tones and DC, with the tone operations controlling transmitter functions and with meter readings returning as DC.

The basic remote-control system needs to perform five basic functions:

1. Turn the transmitter on and off
2. Provide a "fail-safe" circuit that will remove the carrier if trouble develops
3. Adjust the transmitter power control
4. Return selected meter readings to the operating point and display them, and
5. Provide for frequency- and modulation-monitor operation either at the transmitter or at the control point. If monitoring is at the transmitter, readings must be brought back to the control point via the metering line; if at the studio, accurate linear RF amplifiers must be provided for monitor operation.

Metering information may be brought back from the remote transmitter:

1. On a subcarrier
2. As a subcarrier
3. As voltage-differentiated DC, or
4. As signal voltages, either 60-cps or other tones, each representing a different meter indication. In some cases, the control or the metering circuit uses a single conductor with earth-ground return; this system, however, is often subject to problems caused by stray ground currents and by changing ground resistance.

Every station has a different set of requirements and conditions. Some station chiefs want filament voltages monitored for optimum tube life. Others, with directional antenna systems, require multiple antenna-current and phase readings. As with any electronic equipment, the simpler a remote-control system can be, the better. Instead of solving problems, complicated equipment often adds to them.

Wire-Line Systems

The earliest wire-line broadcast remote controls were uncomplicated DC systems (Fig. 1), patterned after telephone-company practices. In some, step-switches selected among many meter readings, and each reading was returned back through the line in sequence. These step-switches could be operated by a telephone dial or a push button.

As systems became more com-

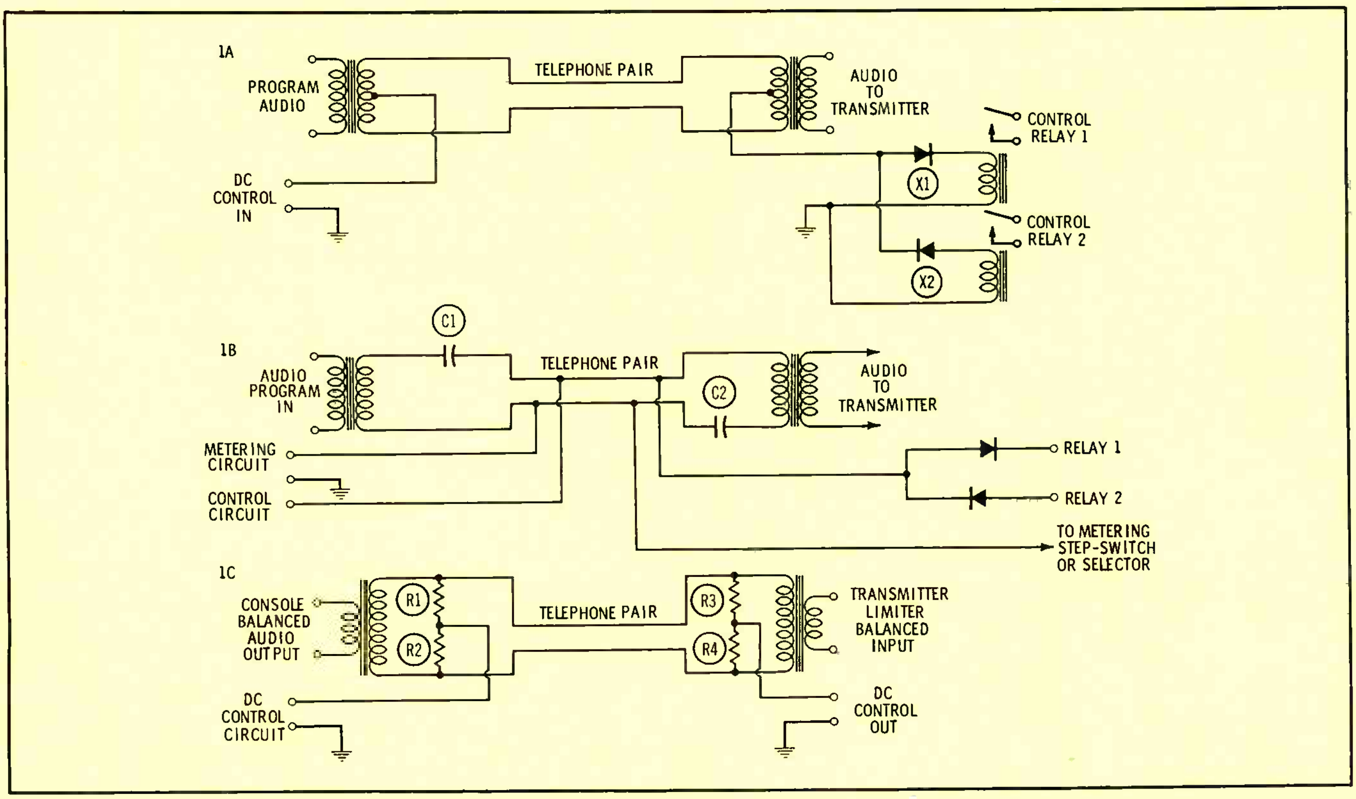


Fig. 1. Single pair of telephone lines can be used to link together parts of a system that will control several transmitter functions.

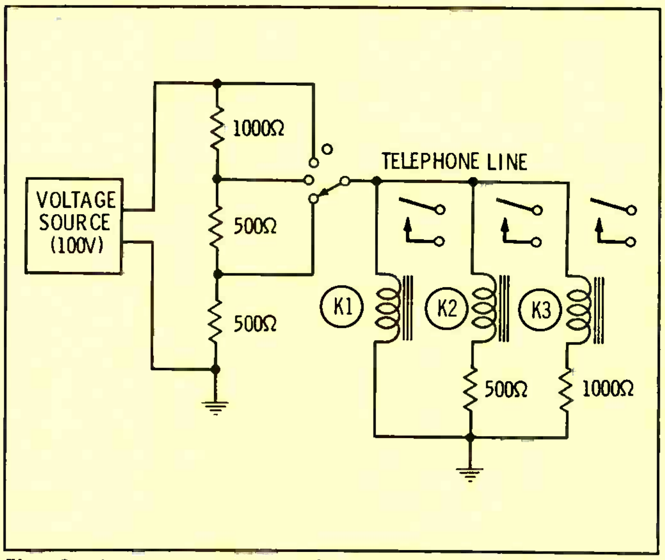


Fig. 2. A control system using voltage-differential metering.

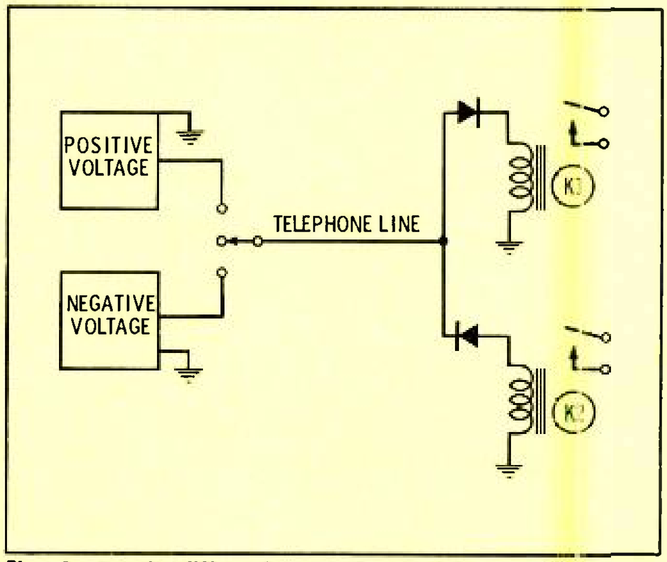


Fig. 3. Polarity-differential metering used in a remote system.

plicated, added functions were accomplished on the same two-wire line, using voltage differentials (Fig. 2). These functions operated in sequence from low-voltage through intermediate- to high-voltage levels, or from about 15 volts to something in the area of 100 volts. Many telephone companies required that potentials be kept below 70 volts; others allowed as high as 150 volts at specified milliamperes of current. The lowest voltage pulled in the filament-control relay, the intermediate voltage operated the plate-voltage relay, and the highest voltage actuated the metering stepper. Relays were made sensitive to various voltage levels by resistors in series with their coils. Today, this voltage-selectivity can be handled by zener diodes.

Next came the polarity-differential system (Fig. 3) using diodes connected forward and backward to allow current to flow through the proper relays. Two power supplies, one positive, the other negative, were part of the studio control equipment. Even newer DC systems control functions by current differential (Fig. 4), time differential (pulses) (Fig. 5), and sequential relay-lockout devices in cleverly designed circuits.

Modern control devices usually embody the best features of all the earlier systems. Most of today's DC systems combine more than one means of differentiation (Fig. 6), and a few use both DC and tones. One advantage to a dual system is that a DC "fail-safe" voltage can be maintained on the line along with the control tones.

One simple remote-control system utilizes a time clock to switch on transmitter filaments at a predetermined hour. The control-point operator needs only to switch on the transmitter high voltage. More than once, this system has kept a late-arriving morning man from ruining mercury-vapor rectifiers after a cold night. This basic system would return only four meter readings, on a DC line. They would be:

1. Final plate voltage
2. Final plate current
3. Antenna or output indication, and
4. Tower-lights indication.

A geared-down motor, remotely actuated, would raise or lower transmitter power by adjustment either of final excitation or of plate or screen voltage, or occasionally by changing final loading. (It is possible to hold transmitter output power within a close tolerance

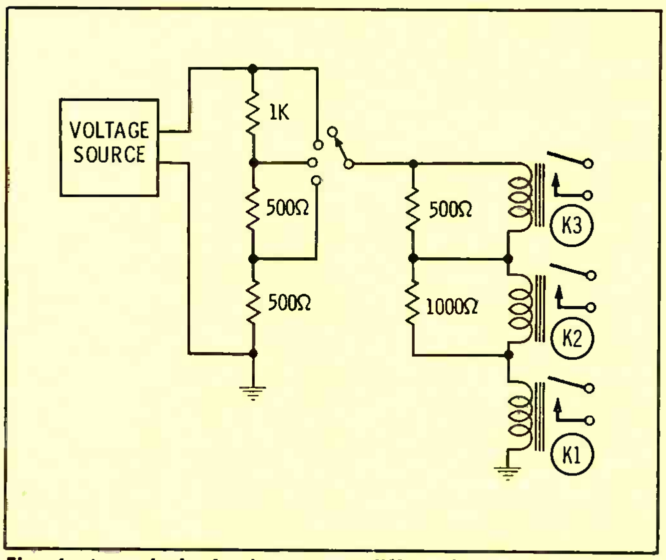


Fig. 4. A method of using current-differential remote metering.

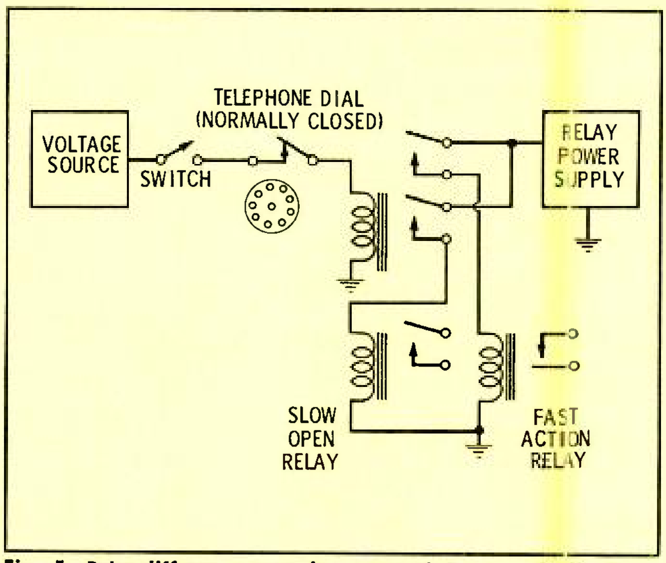


Fig. 5. Pulse-difference metering as used for remote readings.

automatically. An RF-output sampler feeds a bridge circuit where the resulting DC is compared with a standard voltage. A servo motor can maintain transmitter output to a closer tolerance than could an operator.)

One of the earliest uses of tone methods (Fig. 7) was in the Hammarlund "Fleet Control" tone system—Fig. 8—which was later adapted to broadcast remote control. It used a separate tone in the midrange audio spectrum to control each transmitter function. The Gates RCM-20 was similar to this. Both had stable oscillators at the control end, with tuned circuits, diodes, and relay-control tubes at the transmitter. Each relay closed as its specific tone was sent down the line.

Another frequency-selective control device (Fig. 9) was developed by Link. Still another company designed a control system around the tone-squelch they use in communications receivers, with frequency-sensitive relays. This remote control worked well in communications systems and in model-airplane control, but has never been widely accepted in broadcast work.

Radio Systems

Unfortunately, every transmitter location is not blessed with accessibility to telephone lines. This is true most often of FM transmitter sites on mountain tops. This made necessary the first remote-control system to operate through a microwave link.

First development in this area occurred in 1950 when WRFL, a Virginia FM station, worked on an experimental basis with the FCC. The system they devised brought meter indications back as a subcarrier on the main FM transmitter. With some modification, this system still functions today and is the basis for certain other commercial systems.

In the WRFL installation, a 20-kc metering subcarrier, generated by a stable phase-shift oscillator, was amplitude-modulated by DC meter samples (Fig. 10). Metering samples were introduced into the modulator-tube grid circuit to buck the normal negative bias voltage. Both the samples range and the normal bias were chosen so that tube operation remained near the knee of the curve, making possible expanded scale readings.

Plate-voltage sampling was by a simple divider (Fig. 11A) made from 4-watt high-voltage resistors; plate current (Fig. 11B) was sampled across a resistor in the ground return of the final-amplifier cathode circuits. Tower lights were sampled by reversing a heavy filament transformer—Fig. 11C—and rectifying and filtering the output. Transmitter output power was sensed (Fig. 11D) with a small "hairpin" in the transmitter "bazooka" output-coupling loop, which fed RF to a vacuum-tube rectifier. Because heater variations in vacuum-tube rectifiers can distort accurate RF sample readings, modern manufacturers almost universally use solid-state diodes.

Back at the WRFL control point, a simple tube amplifier (Fig. 12) with high-pass filter picked the sub-

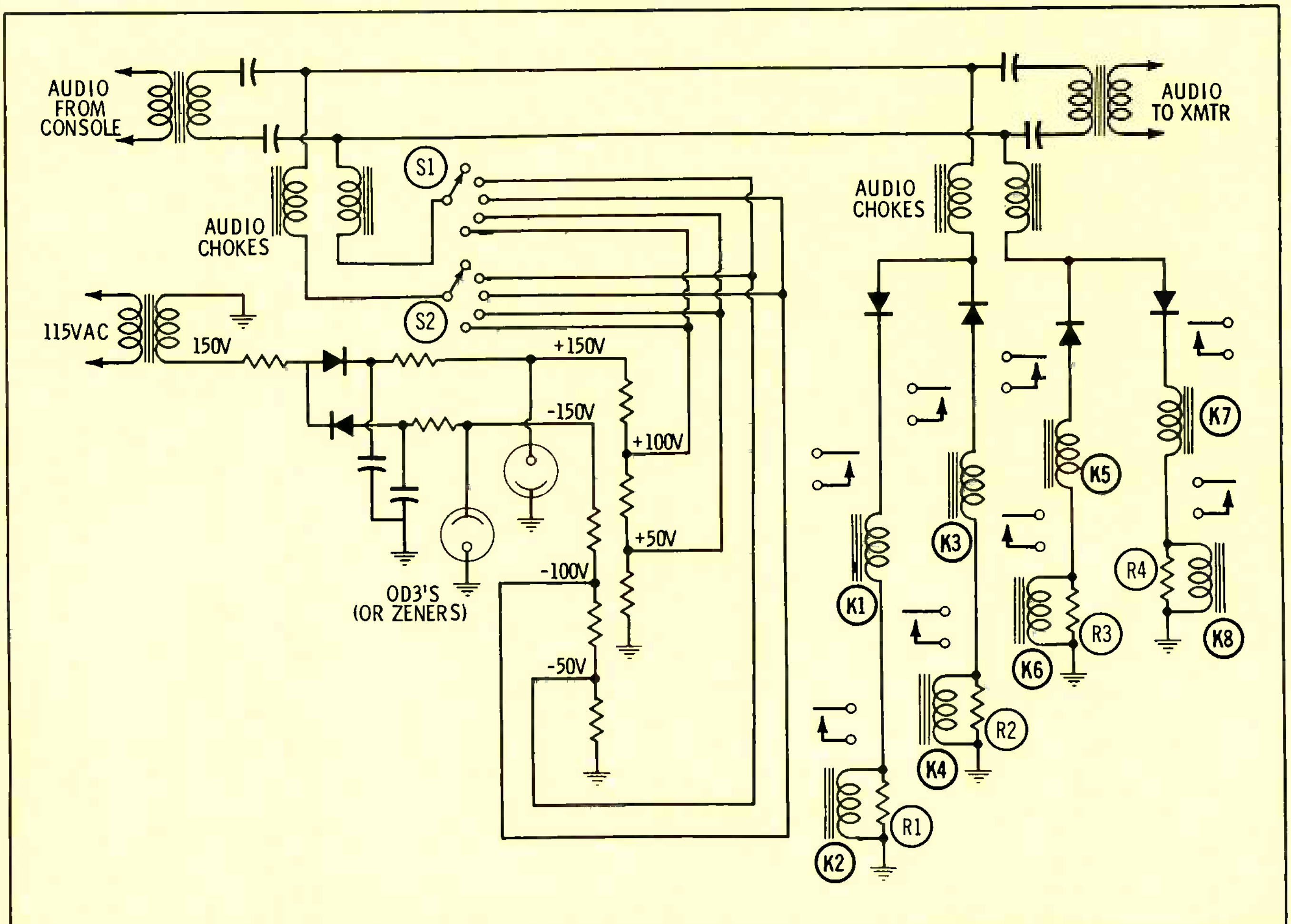


Fig. 6. Eight remote-control transmitter functions are handled by this complex DC system on a single pair of audio lines.

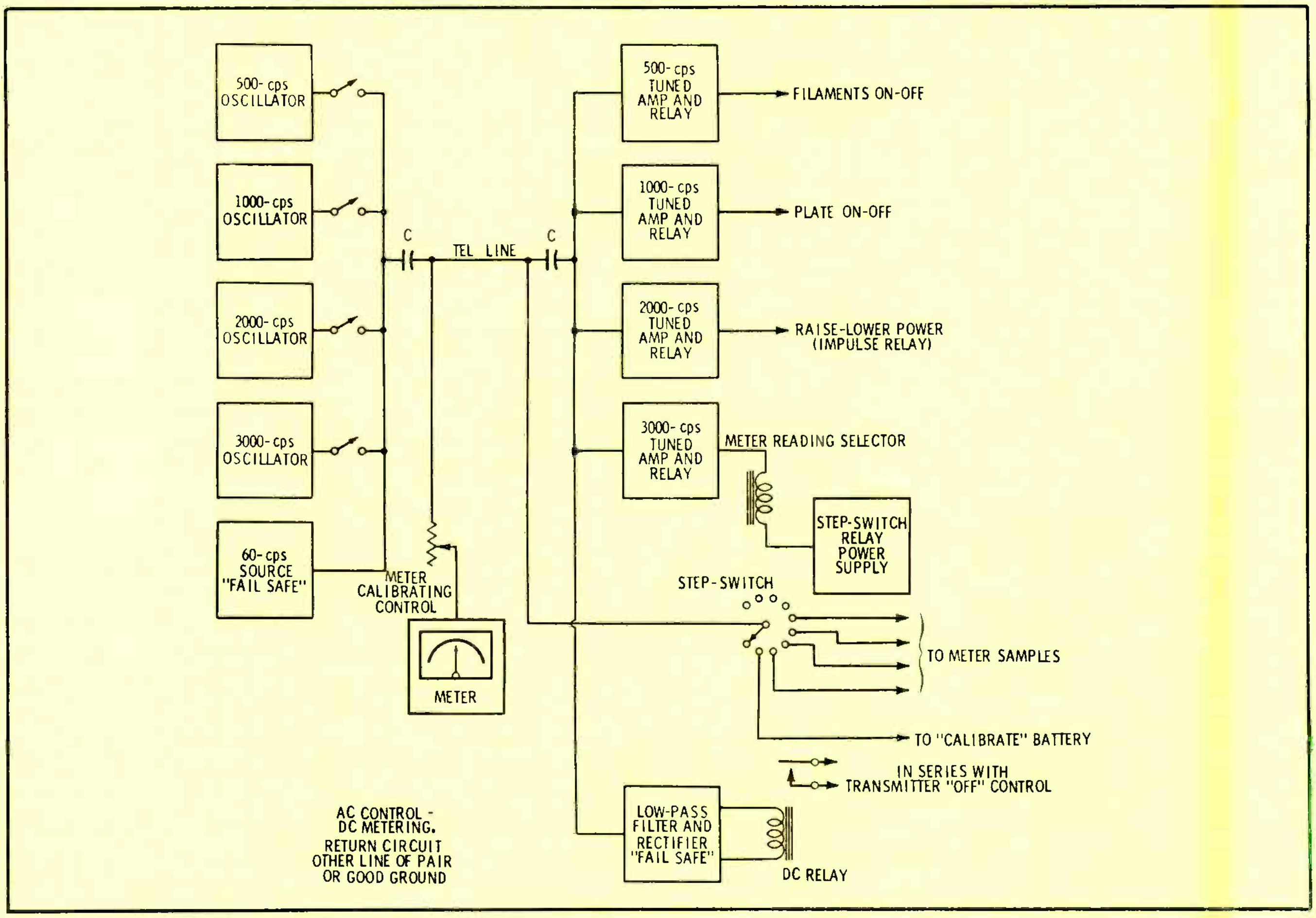


Fig. 7. Single-line remote control uses a separate tone oscillator and corresponding tuned relay for each function controlled.

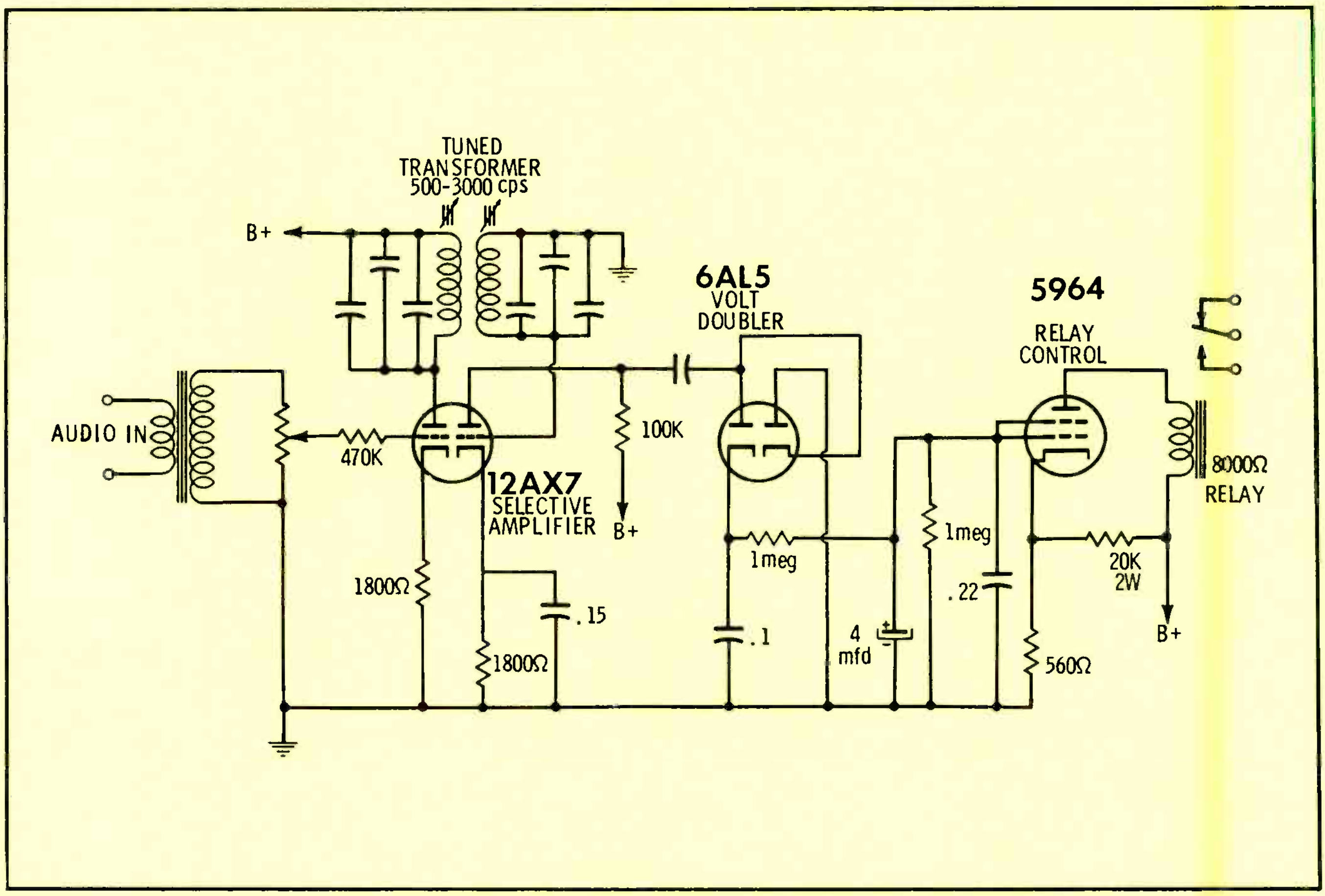


Fig. 8. The basic circuit of this old Hammarlund signaling device can be changed for a broadcast-type remote control system.

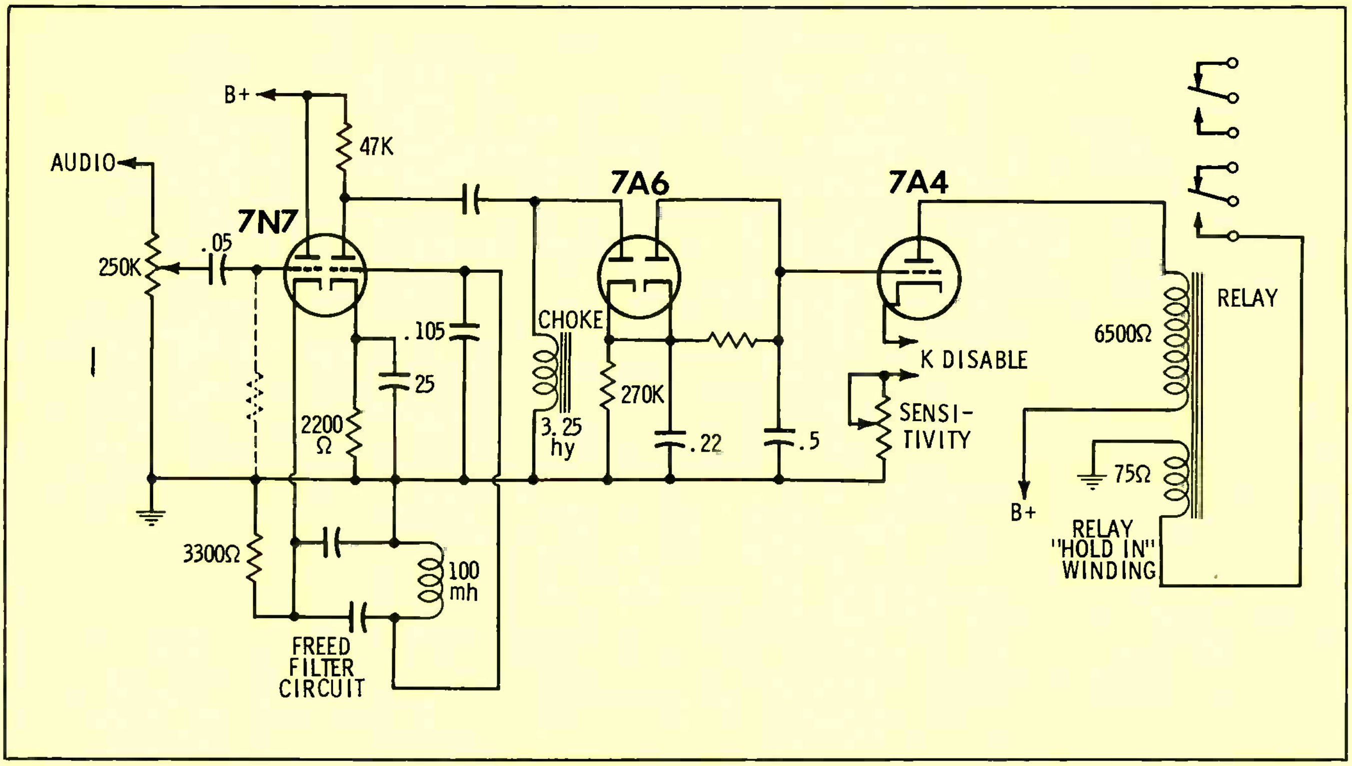


Fig. 9. Selective calling device built by Link (company now out of business) could be used for simple remote-control system.

carrier from an FM tuner's discriminator, before it reached the deemphasis circuit. A diode converted the amplitude-modulated superaudible tone into DC readings on a 500-ua meter. The station monitor, a combination monitor for frequency and modulation, was placed in the studio and fed from a five-stage broadband TRF amplifier (Fig. 13).

Systems have been designed which use a carrier-break dialing system on the carrier of the 900-mc microwave link. Using normally closed .1-second telephone dials, the carrier is broken in a short series of pulses which are nearly inaudible. The receiver "Codan" relay responds to these pulses, operating a stepper which is automat-

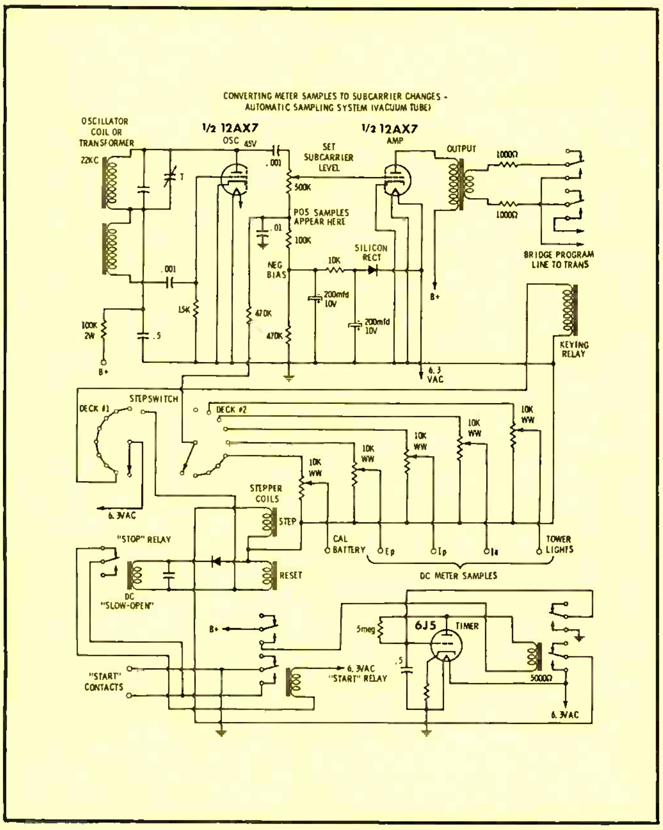


Fig. 10. Sampling system converts readings to amplitude changes.

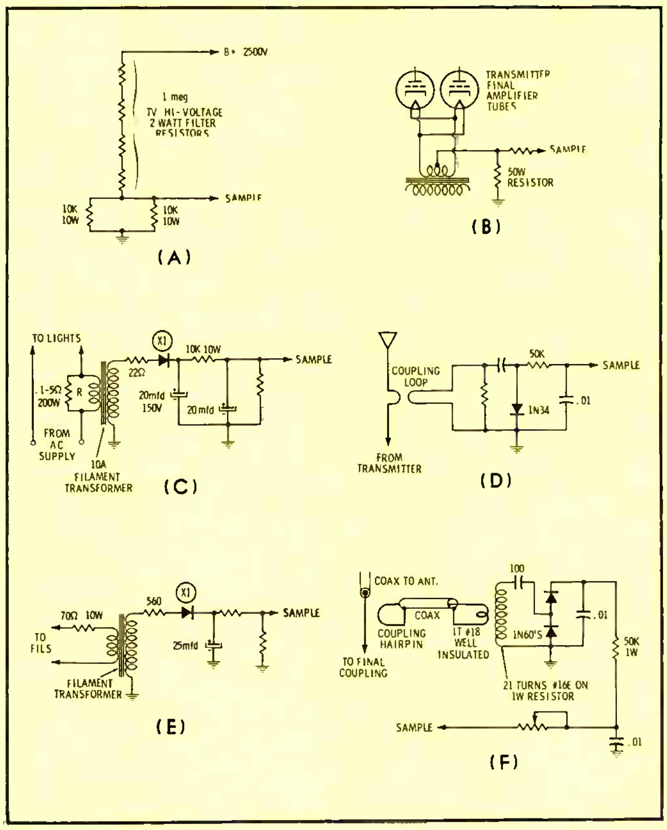


Fig. 11. Deriving DC samples to be used by metering circuits.

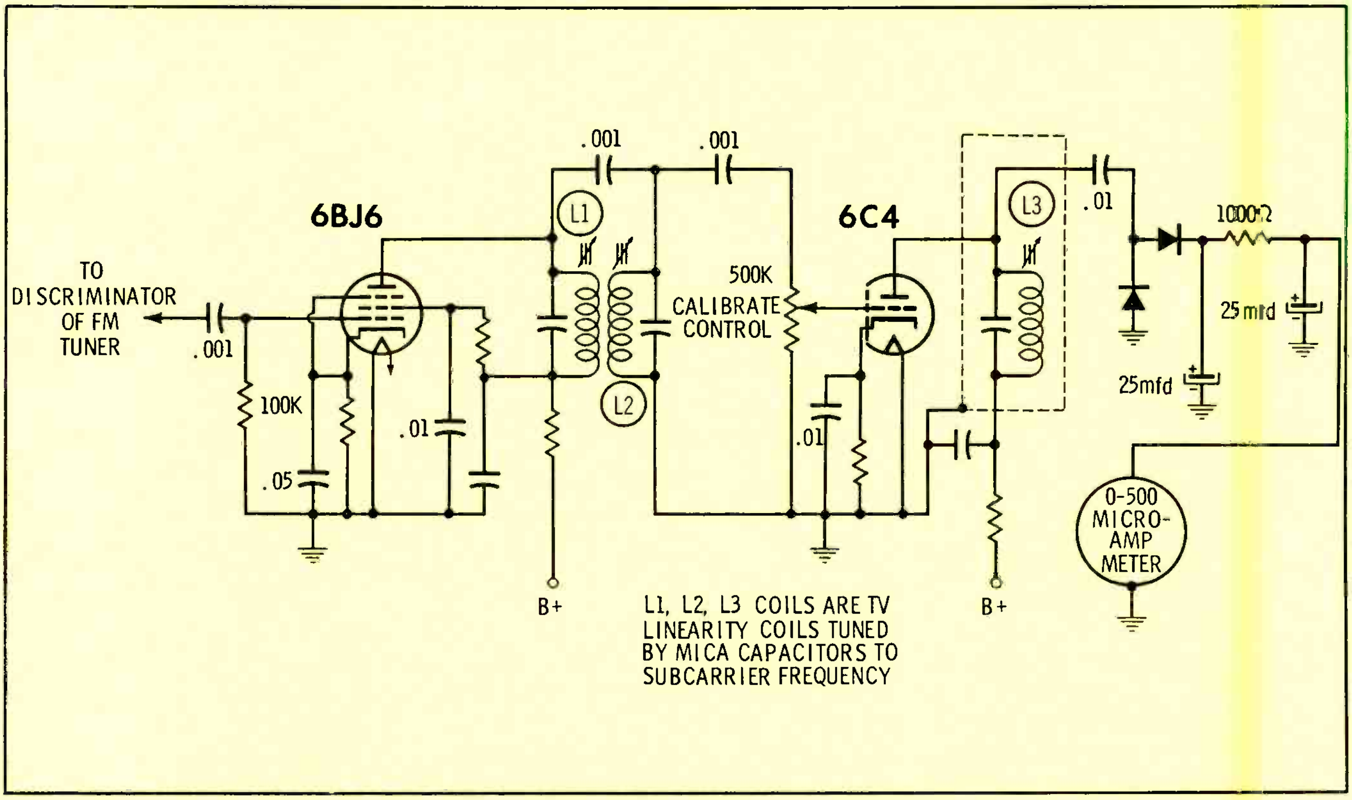


Fig. 12. Vacuum-tube model of subcarrier metering section of FM receiver has TV linearity coils as interstage tuned circuits.

ically reset after 15 seconds by a timer.

Since many FM transmitters are situated on mountain tops and FM antennas can be seriously affected by ice formations, some stations add weather-sensing devices to their meter readings. One system brings back all the necessary transmitter operating parameters, plus an intrusion alarm and temperature, humidity, and an indication of the presence of rain or ice. Temperature can be sensed with a thermistor, and humidity sensors are readily obtainable from electronics-supply houses. Rain gauges have been standard weather equipment for years.

When a transmitter is required to operate at some distance from the control point, it is good practice to install as many automatic protection and recycling devices as possible. Silicon rectifiers have often been substituted for vacuum-tube rectifiers, after special care is taken to suppress lightning surges. This means surge capacitors on the line, with **Thyrite** arresters and special grounding to kill steep waveforms that develop on long power lines.

At WRFL, all silicons in the small equipment were installed with a 300% or better rating. Mercury-vapor rectifiers were retained in the transmitter, but the 8008's were changed to 673's. Circuit breakers were substituted for fuses in the main supply lines, and sensing circuits were installed to detect when

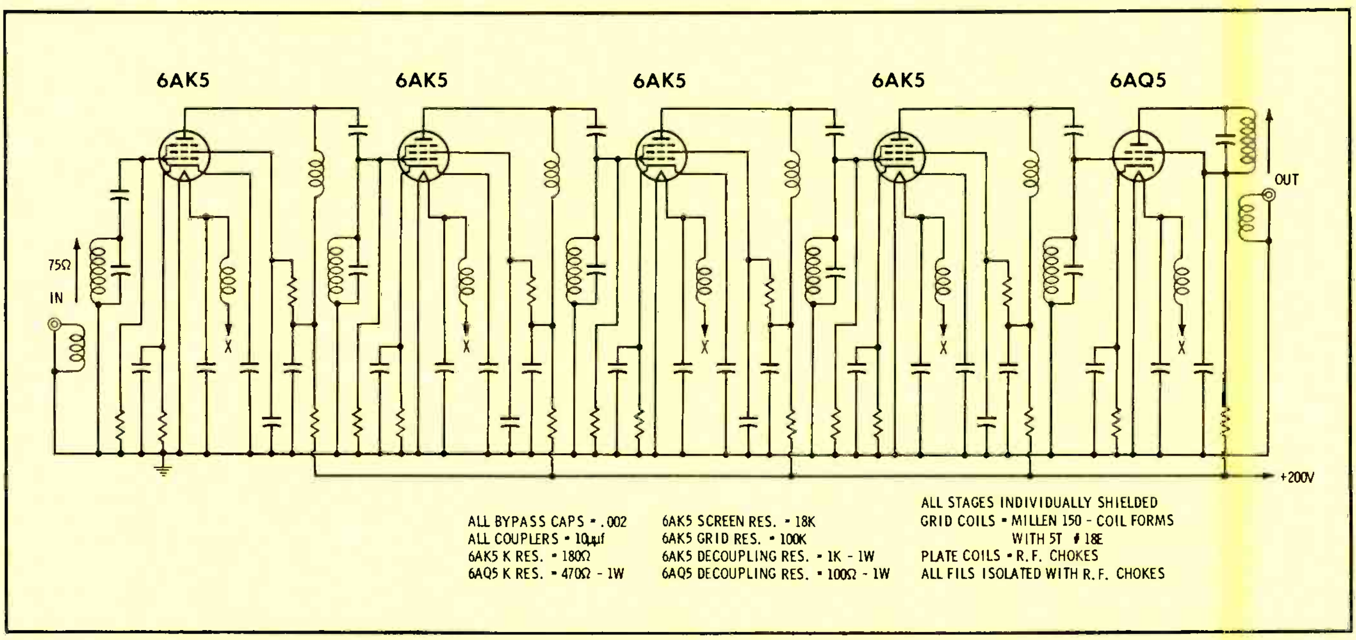


Fig. 13. Booster used to operate frequency-and-modulation monitor must be capable of furnishing several watts of RF power.

the breakers were open. If they opened for any reason, a timing device recycled them five times; if the overload persisted, the breakers remained open. Automatic recyclers (Fig. 14) were also installed for transmitter overload relays.

When a new transmitter was purchased for WRFL, the old one was retained as a standby; it can be switched on by remote control, too. A second emergency antenna, which is mounted on a power pole at the transmitter site, was also installed.

A 26-mc System

The FCC provides a licensing provision whereby a two-ray radio system may be used for remote control. The frequencies allowed for this type service are in the 26-mc remote-pickup broadcast band. No frequencies are available in the 150-mc and 160-mc bands. The 26-mc band can also be used to bring meter readings back from the transmitter site by telemetry; however, tropospheric skip effects make such systems somewhat unreliable.

In a radio system, the "fail-safe" device is generally a "Codan" relay in the link receiver. "Codan" stands for Carrier Operated Device, Anti-Noise. It is a relay control circuit actuated by the voltage which appears on the first limiter grid in the receiver. When there is no signal, limiter voltage disappears and the relay opens. The contacts are wired to hold the transmitter plate relay on throughout the broadcast day. When the link carrier is shut down at the conclusion of the broadcast day, the transmitter carrier is automatically cut off. If the link fails for any other reason, the transmitter is likewise shut down.

Other Systems

One interesting remote-control system evolved in New York State from the original WRFL supersonic system. There, a complete network of FM transmitters were operated from one another, with one transmitter controlling all. Each station had a tape recorder for its own station identification on cue, but otherwise all carried the same program. One interesting feature of this system was a set of triple-conversion frequency monitors, one for each station, but all driven by one RF amplifier with an 815 tube in the output stage.

Another unusual remote-control system operated experimentally in Pennsylvania some years ago. An AM location was selected, and, after construction began, it was found impossible to provide telephone-line service to the location. Subsequently, the station applied for an FM grant, and then fed the AM transmitter programs through the FM transmitter, which was located at the studios. Supersonic tones on the FM station controlled the AM functions. The FM receiver at the AM transmitter was outfitted with a "Codan" relay so that when the FM left the air, so did the AM. The biggest obstacle was in getting the AM meter readings back to the studio. This was accomplished finally by using a 12-kc subcarrier on the AM which, when cued from the studio, automatically sequenced through all meter samples during a period of a few seconds.

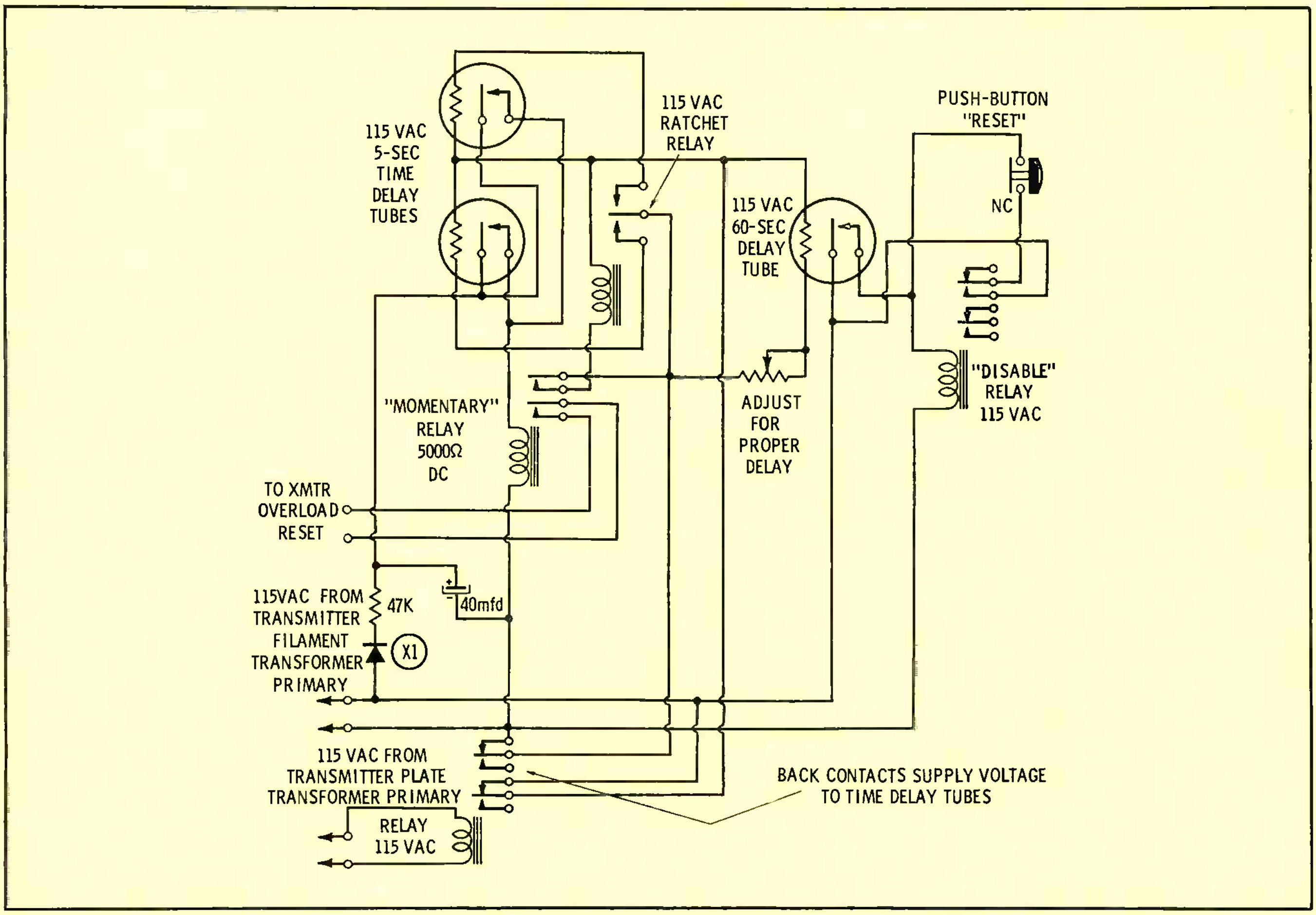


Fig. 14. A remote-control system needs a transmitter-overload resetting device; this one stays open after sixty seconds.

Remote Metering

The FCC, in their Rules and Regulations, specify that transmitter metering must be accurate within 2%. They further describe scale and division limitations for the meters. In remote-control work, it is not always an easy task to retain this 2% accuracy when the metering system involves a sampler, an oscillator, a modulator and transmitter, a radio receiver, a metering amplifier and detector, and finally, the panel meter itself. All of these components are necessary in a radio remote-control system; therefore, a great amount of care is necessary in design and construction of such a system to bring the transmitter meter readings back to the control point accurately.

The problem is somewhat less when a wire circuit is used, but this, too, has its drawbacks. Wires have a way of changing resistance with temperature — Table 1. Unwanted AC and DC currents can be induced into the lines and, the longer the line, the greater the problem. AC develops when lines run parallel to power lines; DC components appear with leakage, especially from dampness or water in a cable. Strange ground currents accompany solar storms and displays of Northern Lights, and are affected by the proximity of electric trains and other phenomena.

Therefore, it is almost mandatory that any remote metering system be self-calibrating or have provision for calibration, so that the sequence of meter readings can be verified each time they are made. To check calibration in most systems, the first metering position is used for a measurement of the overall system by comparing a system reading with a standard cell or a mercury-type calibrating battery. The system is adjusted to this known voltage; then all other parameters can be read with accuracy as they appear in sequence.

Generally, all transmitter meter readings are sampled independently and presented as a DC voltage. Several means of deriving these DC metering samples were shown in Fig. 11. In a wire system, the metering voltage is fed through the line back to the meter. In a radio system, this voltage modulates the telemetry system. Fig. 10 illustrated a vacuum-tube subcarrier generator and AM modulator. This device automatically sequences through all needed meter samples, remaining on each reading a predetermined number of seconds necessary for reading by the control-point operator. Since each meter reading is normally somewhat different from the preceding one, there is no trouble detecting when the sequence switches from one sample to the next. When the device has cycled through all readings, it returns the stepper to "home" and shuts itself off to await the next cycle.

The subcarrier frequency is about 20 kc. At the control point, the metering information is picked off the air with a crystal-controlled FM broadcast receiver. The 20-kc subcarrier is removed before the deemphasis network and fed into the amplifier diagramed in Fig. 12. The recovered DC operates the meter (preferably a 7″ or larger), which has several scales calibrated on its face.

Some DC wire-line remote controls offer separate meters for each transmitter meter. This necessitates providing a separate wire circuit for each meter. It can also be done by simplexing and providing phantom circuits from the telephone pairs between studio and transmitter. Such a system is illustrated in Fig. 15. This system carries both tone and DC metering signals in the same line, separated by chokes and capacitors.

Some DC wire systems provide separate meters that cannot be read simultaneously. A step-switch at both ends of the line synchronizes each metering sample at the transmitter with its appropriate meter at the control point. A little-known system of this type was developed by a Maryland station using a synchronous commutator

Table 1—Resistance of Telephone Wire at 65°

Copperweld	
.080 = 17.3	ohms per mile
.104 = 10.3	ohms per mile (This is the most popular size)
.128 = 6.8	ohms per mile
.165 = 4.1	ohms per mile
Steel	
.083 = 113	ohms per mile
.134 = 44	ohms per mile
.109 = 75	ohms per mile (high strength)
.109 = 66	ohms per mile (regular, most popular)
Copper	
19 gauge: 139 feet	= 1 ohm
28 gauge: 17 feet	= 1 ohm

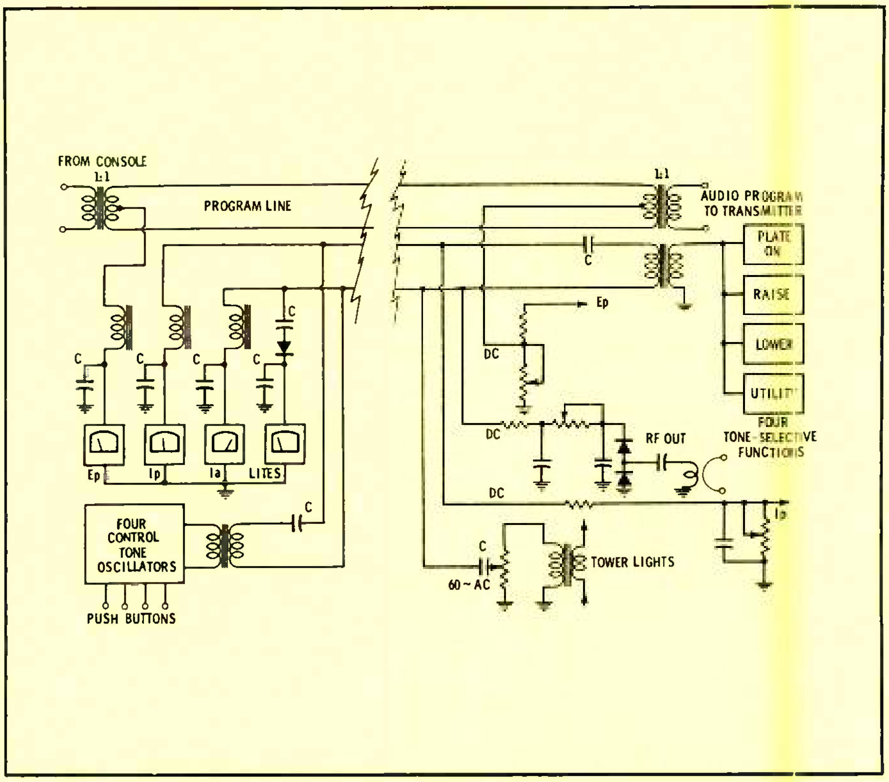


Fig. 15. System for program, control, and four metering samples on two wire pairs.

with a synchronizing signal so that all parameters appeared to be read simultaneously.

Getting transmitter readings is only part of the battle. It is also necessary to read modulation percentage at all times and frequency deviation every half-hour. There are two courses to take:

1. Leave the monitor meters at the transmitter and bring back their readings, or
2. Move the monitors to the control point and feed them RF from a pickup antenna and RF amplifier (such as was shown in Fig. 13).

Most stations operate the modulation meters and frequency monitor at the studio control point. The problem is simpler for FM stations than AM, since AM-band amplifier linearity has caused a few headaches.

These monitors frequently require **watts** of RF power for operation. Some later-model monitors have eased the problem a little by requiring less RF drive. At the present state of the art, it is almost impossible to find a solid-state monitor-driving amplifier for FM, but a few are available for AM. RF drivers for AM monitors must be linear, or modulation percentages indicated through them will be inaccurate.

Installing frequency and modulation monitors at the transmitter eliminates the RF-amplifier problem, but adds the necessity of bringing back either tone or DC metering signals to the control point. Some systems return only the DC that drives the frequency indicator; others separate the two functions of the monitor.

To operate a General Radio frequency monitor, Gates supplies with their remote-control system a small audio amplifier, reactance box, and meters. An audio tone, which is the beat between the crystal oscillator in the monitor and the station carrier, is fed back through the metering line to this small audio amplifier. The reactance box indicates on a large meter any variance from center frequency. A second, smaller meter indicates proper level of the beat tone.

Many modulation-monitor remote indications are merely a DC extension of the VU meter on the monitor. Generally, the metering line is left connected so that modulation percentages are being read at all times meter readings are not being taken.

There is one problem with many modulation monitors: They do not provide for a remote extension of the overmodulation or peak indicator. The FCC requires that this be visible as well as the modulation-percentage meter, and inspectors sometimes get a little sticky about not seeing one at the control point.

Transistor Telemetry

Modern broadcast systems demand "the best the state of the art affords," and this usually means all-transistor design. WRFL took on the task of converting from an AM tube-type telemetering setup to a transistor FM/FM system.

Fig. 16 shows the telemetry transmitter, which was developed over several months of experimentation. The transmitter contains a simple multivibrator, the frequency of which is controlled primarily by two tuned circuits in the emitter returns. These are television linearity coils bridged by .001 capacitors. During early experiments, although the coils helped stabilize frequency, temperature effects on

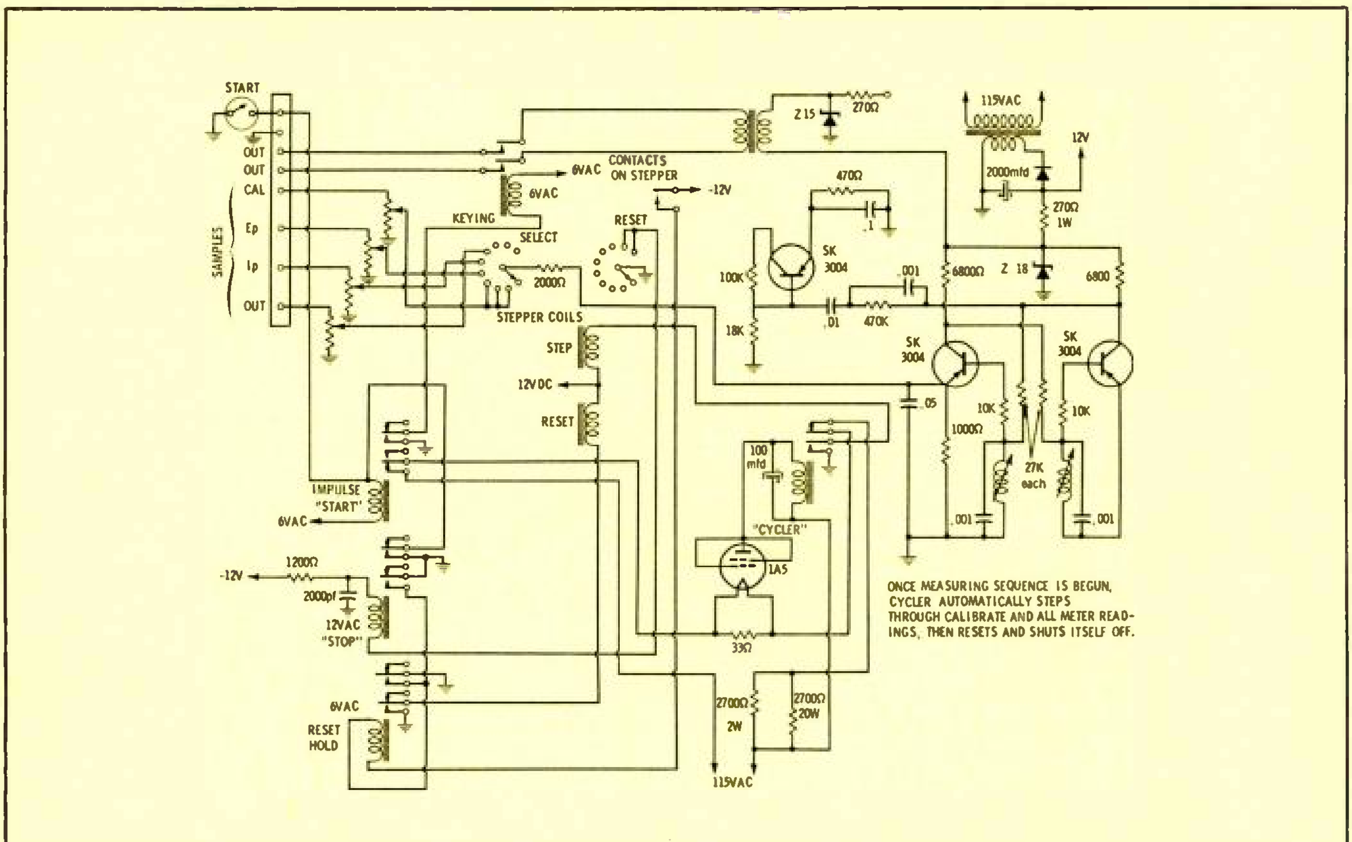


Fig. 16. Subcarrier transmitter used at WRFL for FM telemetry couldn't overcome problem of frequency shift with temperature.

the transistors quite seriously altered oscillator frequency. The overall system held calibration during the period while a metering sequence was being read, but it was felt that more stability would be desirable.

The FM/FM system was picked up for its advantages over an AM/FM system: Noise could be limited out. Harmonics of the audio program, which sometimes cause slight meter movement, could be almost eliminated in FM/FM by limiting and by using sharply tuned input circuits in the receiver (Fig. 17). System linearity is not such a problem with FM telemetry as with AM. Part of the system's ability to recognize the differential — excursion from the resting frequency — lies in the two tuned circuits at the receiver's input, although part is also due to action of the counter circuit in the output stage. Between the two, a satisfactory meter indication can be obtained with a comparatively small frequency shift in the oscillator.

When the system's frequency-shift-with-temperature weakness was discovered, it was necessary to decide whether a more stable type of FM circuit should be designed or the system should be returned to the old AM system, which is insensitive to frequency problems. After considerable thought, simple changes were made in the FM/FM system to change it to a transistor AM/FM system with certain refinements over the old tube-type setup.

Fig. 18 shows the final circuit. Modulation of the 20-kc output of the oscillator-buffer circuit utilizes the way a diode's resistance changes with applied voltage. The bypassing effect of capacitor C1 in the circuit is made greater or lesser by the varying resistance of the 1N60 diode in series with it. The diode's resistance is controlled by application of the positive sampling voltages through isolation resistance R1. Resistor R2 was installed across the diode to minimize resistance variations among the sampling circuits, which can distort the true effect—caused only by voltage variations.

Added refinements are the two zener diodes—X5 and X6. These keep the input carrier constant at the modulator device. One zener regulates the DC voltage on the oscillator collectors, the other levels off variations of oscillator output so that errors from signal variation are minimal.

Using the AM system, meter readings have held within 1% over a 5-hour period without the necessity to recalibrate. Since subcarrier modulation is kept constant at the transmitter, and thus subcarrier recovery at the discriminator output of the FM receiver at the studio is also constant, the AM system has proven stable enough to meet present needs. At WRFL, however, it is still felt that an FM/FM system would be preferable if an oscillator could be designed which is stable enough and at the same time easily frequency-modulated by sampled voltages. There is little doubt, of course, that such a system would be somewhat more complicated than the simple system which is now in use.

Tube burnouts and deterioration no longer are problems, because of the transistor equipment; on the other hand, the equipment is somewhat more susceptible to lightning-induced surges which have sometimes opened diodes and transistors in an unexplained manner. Therefore, extra protection is used to keep line surges to a minimum.

Conclusion

Many other remote-control arrangements are possible. Those shown in the two articles in this book section are only a few of the possibilities. Careful and adequate design and calibration can solve almost any remote-control problem.

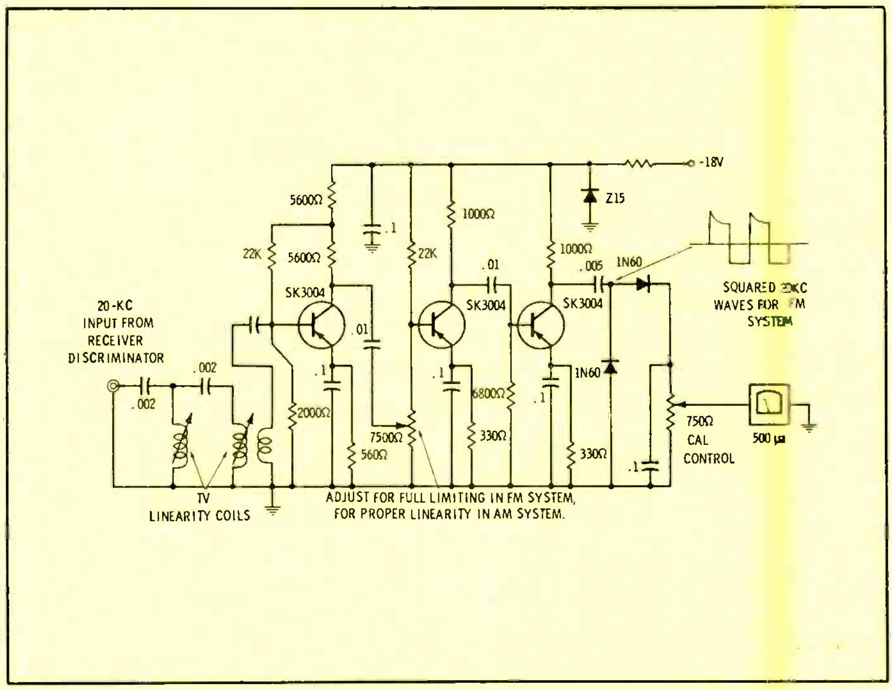


Fig. 17. Transistorized telemetry receiver can operate either an AM or FM unit.

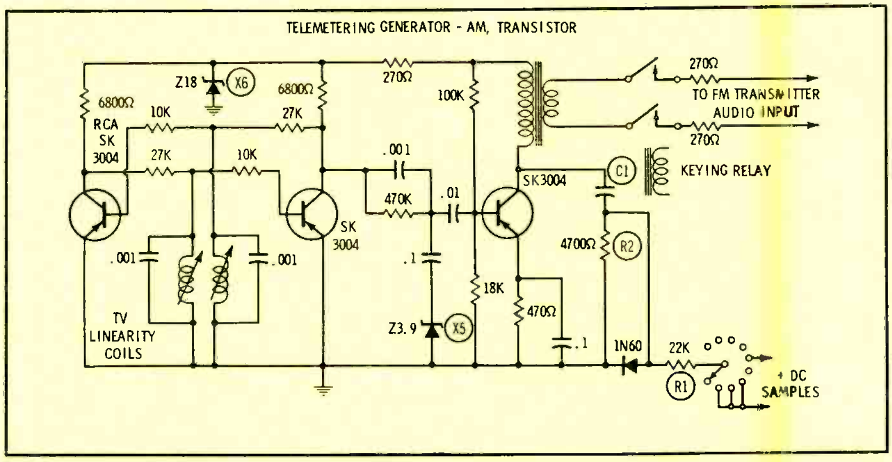


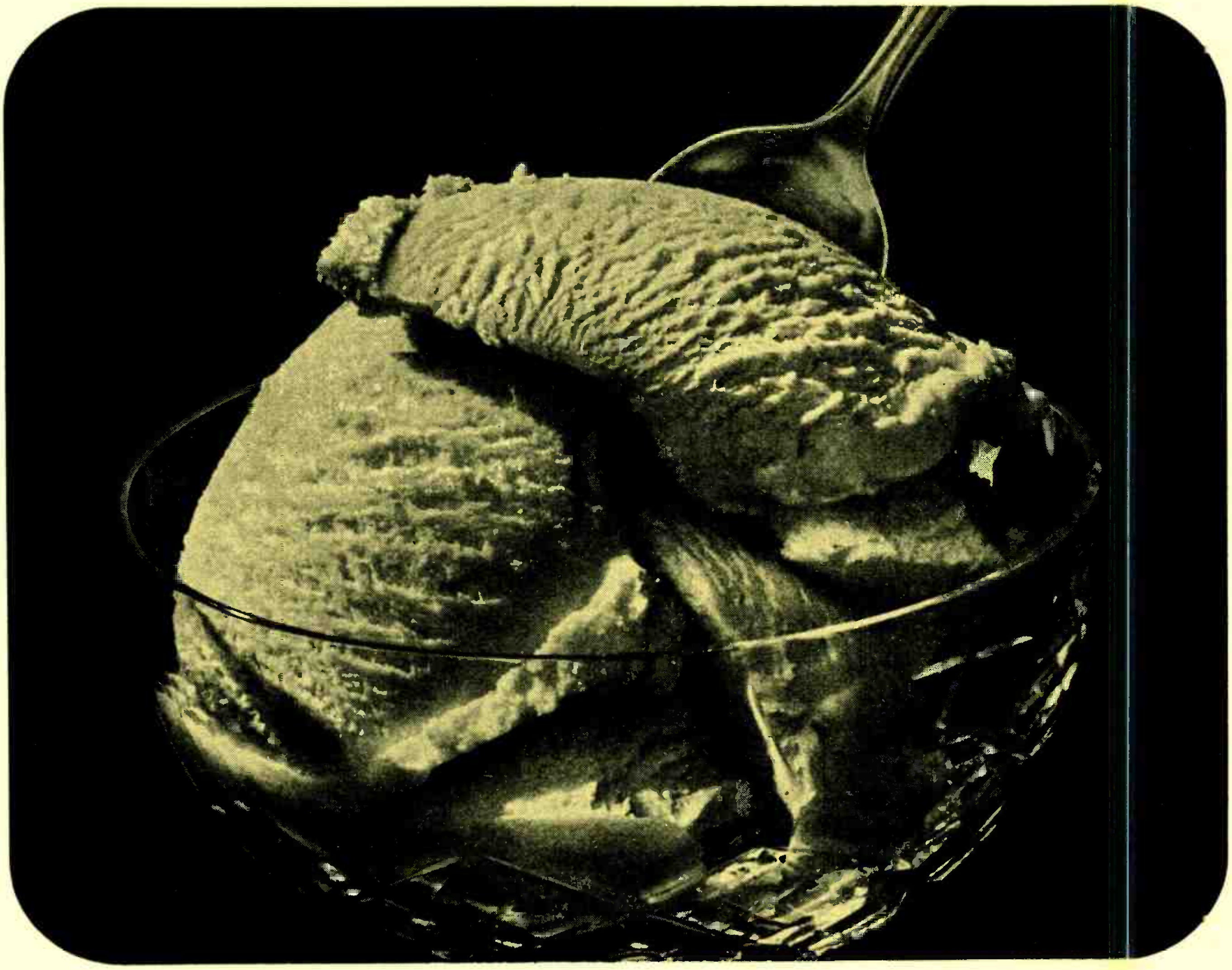
Fig. 18. Transistorized generator unit is used primarily for AM type of telemetry.

Most important in these articles, however, are the principles of remote-control systems — in particular, the ideas that introduce this first feature. Keep them in mind when you are designing, building, specifying, choosing, buying, or installing a remote control for your station.

Table 2, at the right, lists some of the systems that have been developed. There are others, and a careful study of the ads in BROADCAST ENGINEERING will regularly give you information on the most modern systems. ▲

Table 2 — Remote Control Systems

Manufacturer	Type No.	DC or Tone	Meters at Control Point
Hammarlund	RCR5, 10		
	DSU1, 2		
	DRU1		
	DUT1		
	RCT	Tone System	1
Gates	RCM-20	Tone System	3
	RDC-10	DC	3
	RCM-12	Dial Tone System	3 plus remoted meters
Rust	R1-108-1D, OC, 1C	DC Dial System	1
	108-S-1	DC System	5
		Series F	
RCA	Made by Rust, same as above		
Schaeffer	Economy	DC Dial System	1
	Deluxe	DC Dial System	4
Continental	TRC-5 and S	DC System	1 plus remote monitors
Mosely		Tone System for Link	
Bionic Instruments		DC-AC	4



Live couldn't.
Scotch® Brand Video Tape did.

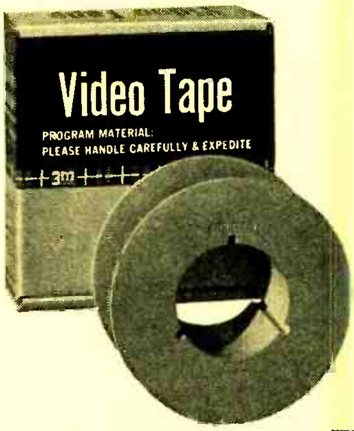
Kept ice cream from melting for KAKE-TV!

Video tape makes sure the ice cream always looks its most appealing on tv. Pleases the sponsor, Steffen's Dairy. Brings in the customers. And makes the commercials less expensive to produce.

Used to be at KAKE, Wichita, the ice cream dishes were set up under the lights prior to the 10 p.m. news. But began to melt before the mid-program commercial. Adding an extra man to put the ice cream in place at the last second was considered. But going to video tape proved both more convenient and less expensive.

KAKE now tapes virtually all evening commercials by local clients in advance. Less crew is needed during the evenings. The advertiser enjoys greater control over his commercials. And the commercials themselves have *live* picture quality without danger of an on-the-air goof.

KAKE is among more than 200 stations throughout the country that are utilizing 3M's video tape program to show advertisers that taped commercials best show their merchandise. Stations near you are now offering a variety of helpful reference materials as well as production service. Give them a call. Or write 3M Magnetic Products, Dept. MBX-25, St. Paul, Minn. 55119.



Magnetic Products Division 3M COMPANY

Circle Item 69 on Tech Data Card

Pioneer Remote-Control UHF TV

by Patrick S. Finnegan

Once the decision was made at WLBC-TV to increase UHF transmitter power, a number of problems immediately presented themselves.

The major problem was sufficient space to install the new equipment. Space was already at a premium. Expanding the present building was ruled out; not only would this idea be prohibitive in cost, but we did not wish to disrupt our AM and FM operations.

There were a number of reasons for ruling out expansion in the present transmitter area. On the outside of the building, numerous conduits carried AC power to the tower lights, emergency power circuits, and the emergency power generator, not to mention the coaxial transmission lines for the AM and FM transmitters. Far from least of the reasons was the utility pole which supported our highline, the main power transformers, and the telephone company's audio and video coaxial lines.

An additional space somewhere other than the present transmitter room seemed to be the best alternative. However, such a choice could increase operating costs through the additional personnel needed to operate a separate transmitter site. Fortunately, there were two factors which made the room-addition idea practical: the recent FCC Rule changes which permit UHF stations to operate by remote control, and the "new generation" UHF transmitters which are built for remote control.

And so the decision was made to build a small room attached to our present building, accessible by a small corridor, to house the new equipment. Also, we would apply to the FCC for remote-control authority along with our CP for the new transmitter.

A quick glance through the catalogs of commercial remote-control units available at that time did not turn up a model that was suitable for the particular system we had planned. We therefore decided to build our own and specified this in our application.

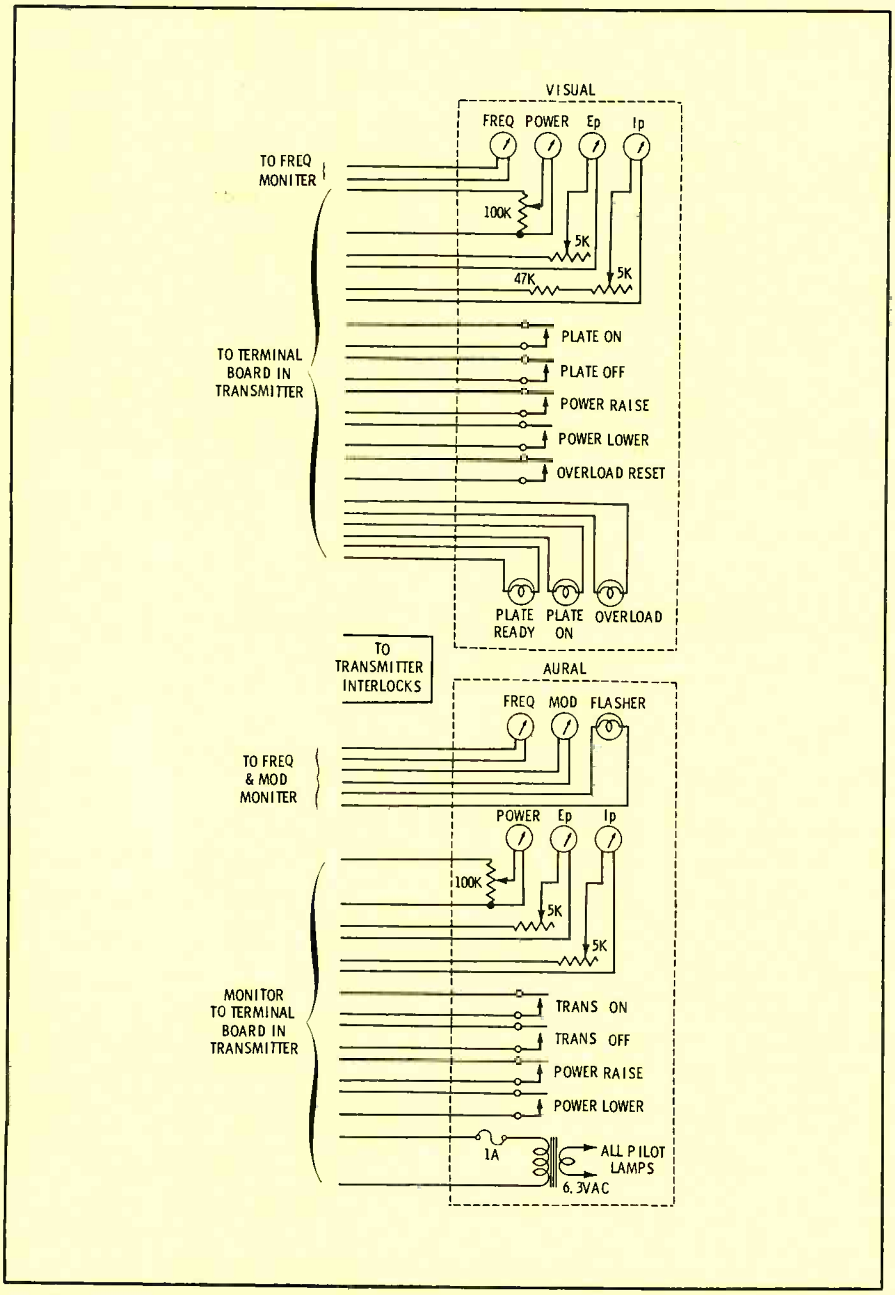


Fig. 1. Schematic of remote-control system built by WLBC-TV station engineers.

When our decision to go remote on UHF was made known, there were raised eyebrows in various circles, including some at the FCC. We also discovered that we submitted the first request by a commercial UHF station to operate by remote control on a regular basis. There have been several experimental authorizations in the past, for evaluation purposes, but ours was the first regular application.

Control Unit

Basically, our system is a **direct-wire remote control.** All the required metering and essential control functions operate through a cable between the remote unit and the transmitter itself. Such a system is simple and offers many operating advantages. One such advantage is that all the metering can be done simultaneously on individual meters, rather than via some sequencing method on one meter. Naturally, this increases the basic cost and number of circuits required. However, our system with all its meters and multiconductor cable priced out at about $500 plus a few meters we already had on hand. We thought this reasonable enough, considering we could get constant metering information and the unit was custom-made for our installation—the price was in fact lower than adapting a commercial system for our use.

Components

Obtaining the various meters was something of a problem, mainly because we had difficulty obtaining information on what energy would be available from the samplers in the transmitter (the transmitter we were buying was a brand-new model). After a number of phone calls to the transmitter manufacturer, we learned that the basic meters would require 200-ua DC movements, and that the power meters should have 20-ua DC sensitivities. We also were told the full-scale readings of the regular transmitter meters. We did not have the transmitter on hand during this design period, but we had to have the control unit ready so that the transmitter could be set up with it at the very beginning.

We wanted our remote meters to have the same scale readings as the meters on the transmitter itself; that is, if the transmitter meter reads 5.5 kv at full scale, our remote meter should also read 5.5 kv, instead of some arbitrary figure such as 100%. (Naturally, this voltage is not present at the remote meter, but the scale is drawn with the same designations as are used on the transmitter meters; the basic movement is 200 ua DC, and only a very small actual voltage is present.) Having these special scale designations applied to standard DC meters was not very expensive. In our case, we obtained four of these meters at a cost of $18.35 each—the total cost for the meter plus the special scale. Scales of different colors cost more.

The meters for indicating output power for the visual and aural transmitters were no problem at all; we could use the same standard meter as is used for the transmitter reflectometers. We had two of these on hand which were spares for the old transmitter. One was new, while the other was used but had been sent away for calibration. Although these spare meters were somewhat different in styling than those on the new transmitter, the basic movement was identical, as were the scale markings.

Carrier-frequency and modulation monitoring of the aural transmitter and carrier-frequency monitoring of the visual transmitter is necessary. For these meters, we used the standard remote meters supplied by the manufacturer of the monitor. Here again, we already had these; they had been in use at the control position for the old transmitter.

Monitoring the visual modulation was simplest of all. As we were already monitoring the old transmitter at the control position, the chopper, waveform monitor, and picture monitor were already in operation. All we had to do to put this setup into use for the new transmitter was to run a video coaxial cable from the diode of the new transmitter to the old control position.

The control cable joining the remote unit to the transmitter did present a problem; it was difficult to find a suitable cable and source. We could have laced a number of smaller cables together to form a larger cable of the correct number of conductors; however, we preferred to have a single cable. We finally did find such a cable, somewhat expensive, costing approximately $1.33 per foot. This cable was completely shielded, which was another factor we favored.

Our original estimate of how many conductors we needed proved to be wrong. This was because the new transmitter used some common control functions which we had not anticipated. We had already built the remote-control unit and wired up the cable before we learned of this, so we ended up with several spare conductors and switches. We originally expected to have a dual monitoring unit—one for the aural

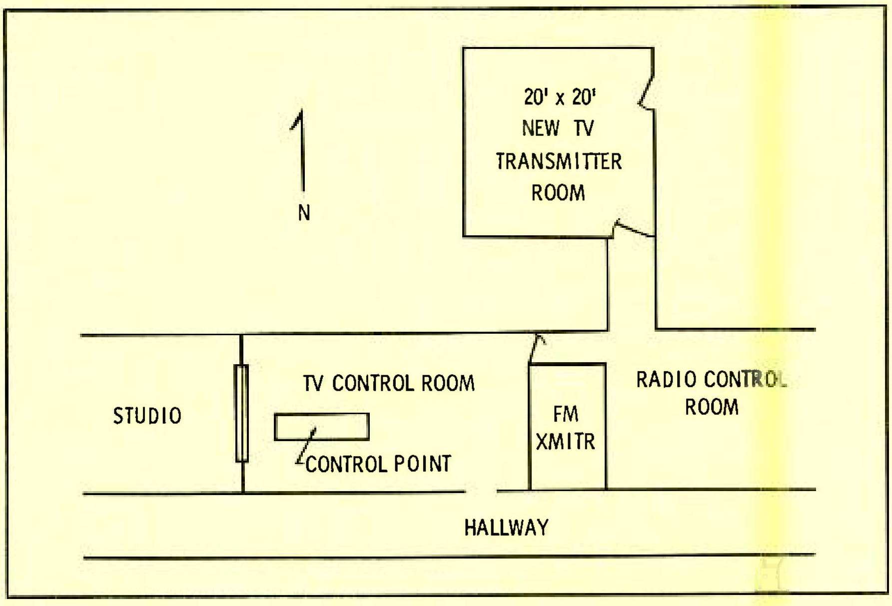


Fig. 2. Addition placed new transmitter out of view from TV control room.

and one for the visual—with separate meters, switches, and relays. As it turned out, we have two separate 38-conductor cables from the transmitter to each unit, with some circuit functions in each cable. A single 38-conductor cable doesn't provide enough circuits for all the functions required.

Circuitry

The circuitry throughout is simple and straightforward. Sampling devices in the transmitter supply low-voltage, low-current DC to operate the meters as with most remote-control systems. The 200-ua meters have 5000-ohm potentiometers in series for calibration.

The meters that indicate frequency and modulation are wired in series with the meters in the monitor itself, the normal practice for this sort of application. No calibration resistors are needed, for calibration is done at the monitor itself. These meters must have the same scale and movement characteristics as those in the monitor, so we used regular monitor meters.

All the switches are momentary-contact types. We used the double-pole type with which both a normally open and a normally closed circuit are available, because we were not certain at that time if the switch functions for this new transmitter would be normally open, closed, or a combination of both. As it turned out, all functions needed a normally open switch, with only momentary closing for operation.

Adjustment of transmitter output power to overcome power-line variations, etc., is accomplished in the new transmitter by two motor-driven RF potentiometers, one in each transmitter. This required four switches, two to raise and two to lower power. As all our remote-console switches are momentary-contact, nonlocking types, it is necessary to hold the appropriate power-control switch down until correct output power is obtained from that transmitter.

We used small neon lamps for indicators at the remote unit. These operate on 120 volts AC, which was picked up from a terminal board in the transmitter so that each lamp operates only when its counterpart on the transmitter is on. Actually, we found it unnecessary to repeat all the control lamps which are on the transmitter; we used only three: **Plate Ready, Plate On,** and **Overload.**

A small filament transformer was built into the remote unit, with the 120-volt primary AC supplied from the transmitter. The secondary supplies 6.3 volts AC for all the other pilot lamps and meter lamps in the remote unit. The primary voltage will be applied to the remote console only when the transmitter is turned on; thus the pilot lamps indicate that AC power is applied to the transmitter even though the plate circuit may not be ready.

FCC Rules require that any remote-control unit must be so designed that the transmitter will shut down if anything happens to the control circuits to the remote unit. In our unit, we carried the transmitter interlocks through both the cables and back, so that the transmitter will shut down if either control cable parts.

Operation

Although all the necessary functions of starting the transmitter can be accomplished from the remote control point, we don't use this procedure. Our sign-on technician fires

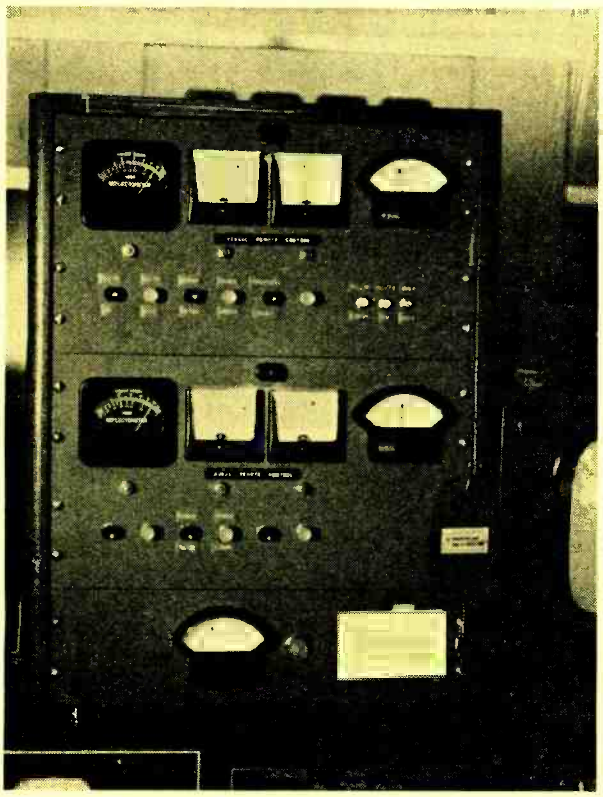


Fig. 3. Front of unit. Note key for transmitter-room door.

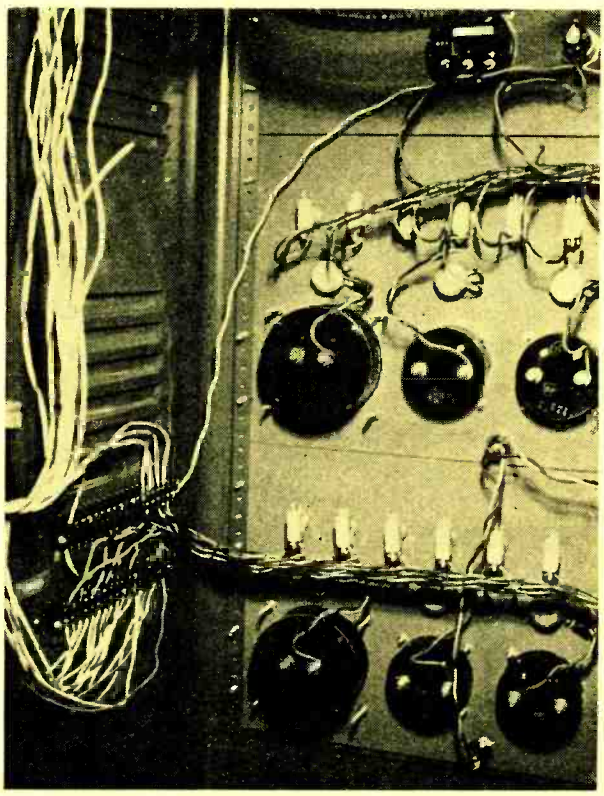


Fig. 4. Rear view shows meters, pots, switches, and cabling.

up the transmitters out in the transmitter room. This measure is somewhat precautionary, since the transmitter is a new model. Should any overloads occur, he can observe at first hand anything out of the ordinary, as well as see quickly any meter readings that are normal or abnormal. This startup procedure works no real hardship, since the transmitter is only in an adjacent room, even though it's out of sight from the control point.

Prior to actual use of the new transmitter, we had misgivings about its stability. We expected our control operator would be making trips to the transmitter room throughout the day, as he did with the old transmitter, touching up the cavity tuning of each stage to keep output power within range and the several stages in tune. But our fears were unfounded; the only time it has been necessary to retune a stage has been at tube-change time. We occasionally go out to the transmitter and rock one of the PA cavities through resonance, just for old-times' sake. The tuning is always right where it belongs—in tune. Such stability of the tuning circuits does make remote-control operation a very practical matter.

Naturally, with the first of any new-model transmitter, bugs will develop from time to time, and we have had our share. However, the only one that affected remote control was a sampler. This particular sampler, for the aural plate current, was hastily designed during installation so that we would have all the required meter readings. It worked okay, except that it was sensitive to temperature changes in the cabinet. This caused the remote meter to have to be recalibrated several times during each day. A new sampler has since been installed, which is very stable. It is a magnetic amplifier, which has no direct connection to the high-voltage circuit, but instead senses the magnetic field of whatever current is flowing in the plate lead.

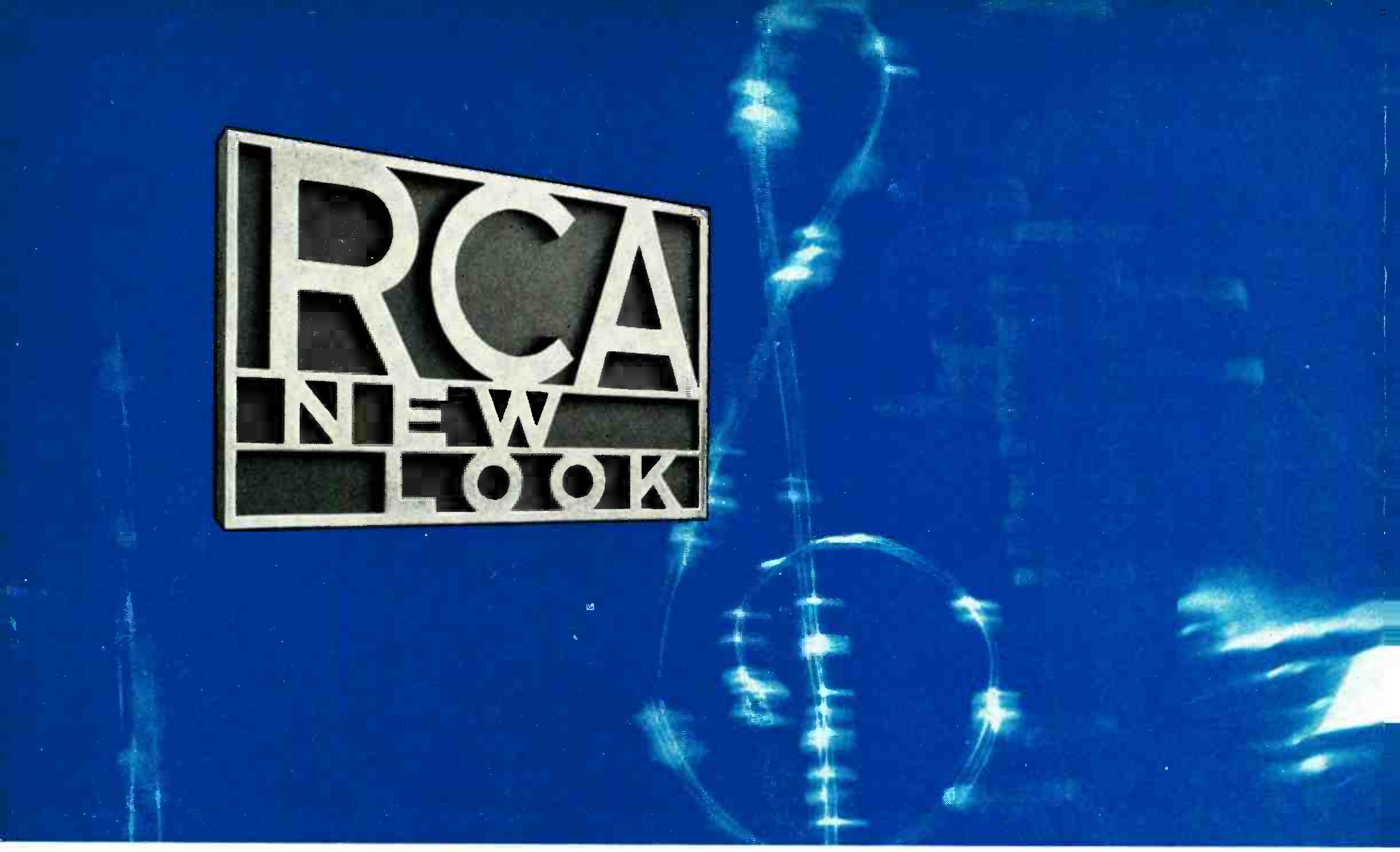
Any remote-control system must be calibrated at least once a week, as required by FCC Rules. Our calibration checks have proved very close every time, and only an occasional touchup of one or the other meter calibration has been necessary.

The transmitter room is kept locked at all times—both the outside door and the door into the regular building. This is also an FCC Rule (and a good one). Its purpose is to prevent unauthorized people from tampering with an unattended transmitter. The key to this room is kept at the control position, and the technician can get to the transmitter immediately if anything goes wrong out there. As a safeguard against someone locking the key in the transmitter room (the door locks automatically without a key), a spare key is kept inside the remote console cabinet.

As this is written, we have had the new transmitter operating on remote control, under Program Test authority, for over four months. We have decided we made a wise choice in this method of operation. The metering and control functions have proven effective, and the transmitter has been stable. We have not had to increase our technical staff at all to operate the transmitter in a separate location. There has also been another bonus feature: Both the noise of blowers and the heat from the transmitter have been removed from the transmitter control room.

Conclusions

Some people contend that our method of operation is not really remote control. But it is. Although we can imagine the problems that may arise in trying to situate an unattended transmitter out of town or on a mountain far separated from the studio, we are happy we did not have to face and solve those particular problems. But for any location where the transmitter can be controlled over a direct cable, as we are doing, our installation has proven that it can be done, and very successfully. ▲



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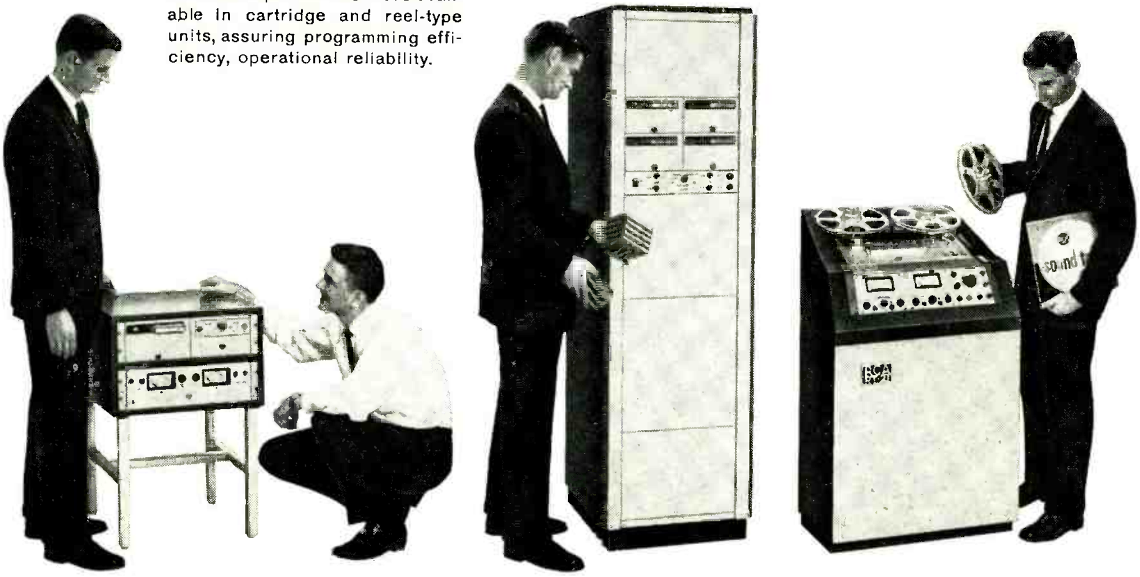

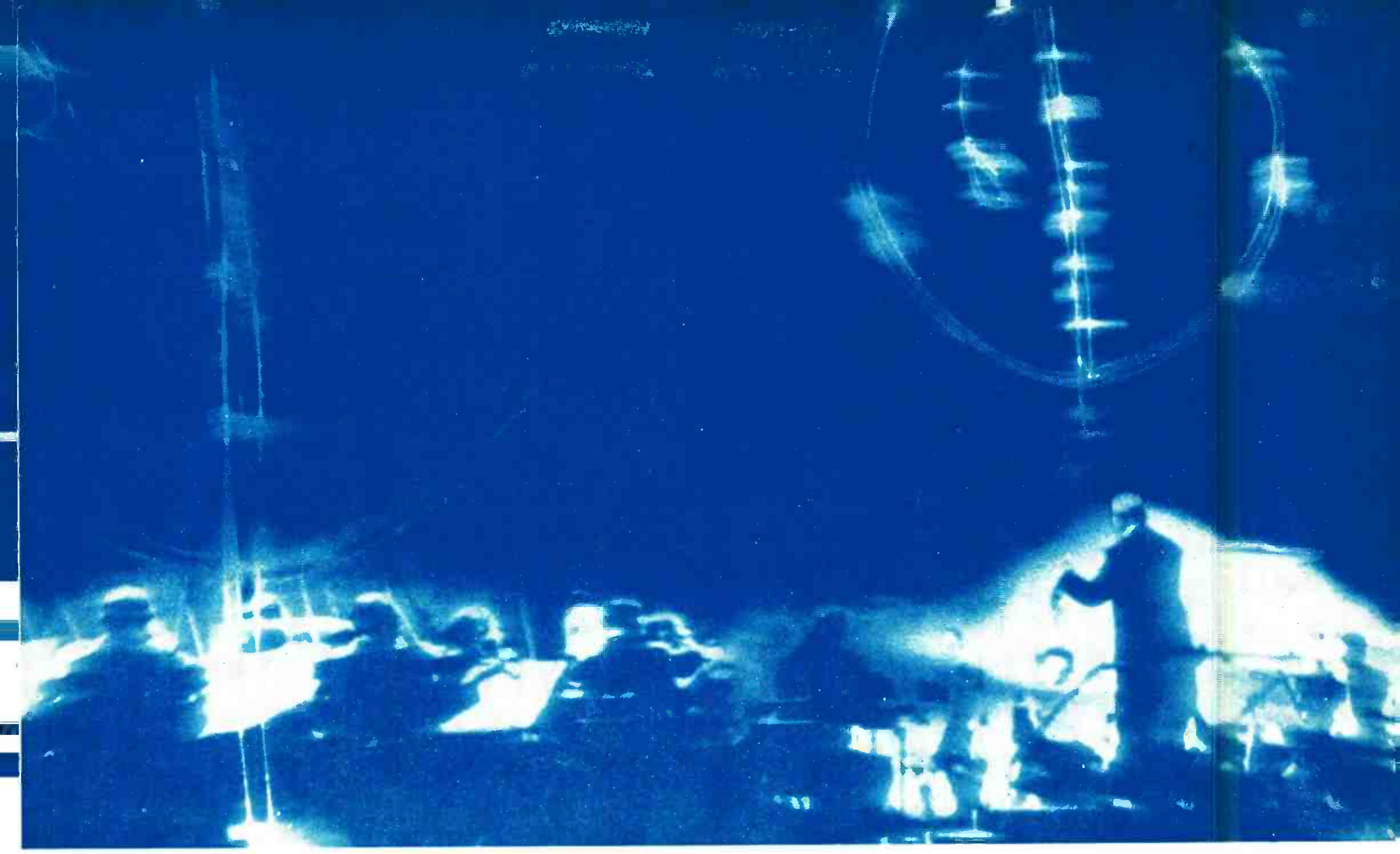

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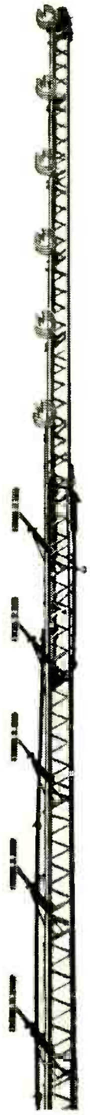

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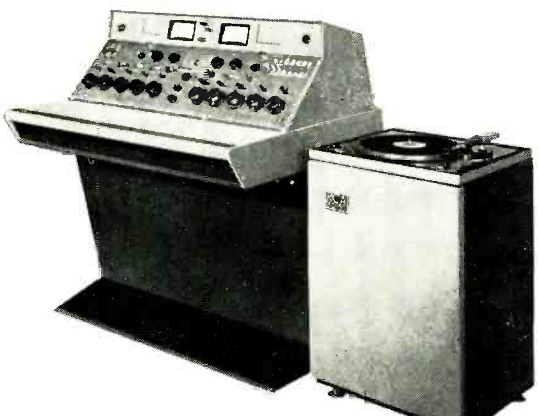

Helical Antennas

(Continued from page 22)

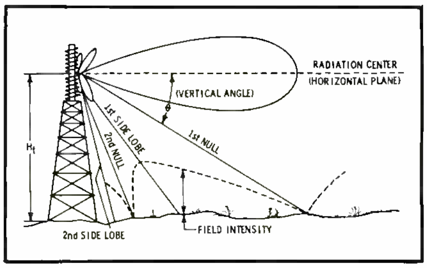

Fig. 6. Vertical nulls affect coverage.

antenna, the power distribution is adjusted by the probe spacing to the inner conductor. For the VHF antenna, it is accomplished by employing power-divider tees in the transmission lines between sections.

Large degrees of null fill-in will reduce antenna gain; however, the advantage of a higher signal level over the close-in areas usually justifies the loss in gain.

Conclusion

Though merely scratching the surface of the subject, this article has sought to point up the general mechanics and operation of the side-fire helical antenna. The antenna offers simplicity of construction for the high gain achieved through excitation of a large aperture by a single feed. ▲

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R. E. Fisk, "Side-Fire Helical Antenna for Television Broadcasting," Montreux International TV Symposium, May 19, 1961.

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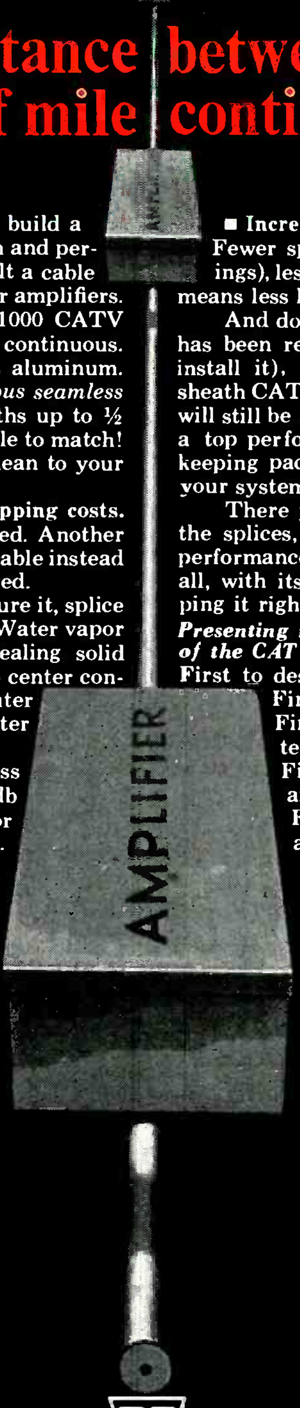

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Circle Item 30 on Tech Data Card

New Vice-President for Engineering of NAB

Vincent T. Wasilewski, president of the National Association of Broadcasters, has announced the promotion of George W. Bartlett from manager of the Engineering Department to vice president of the NAB.

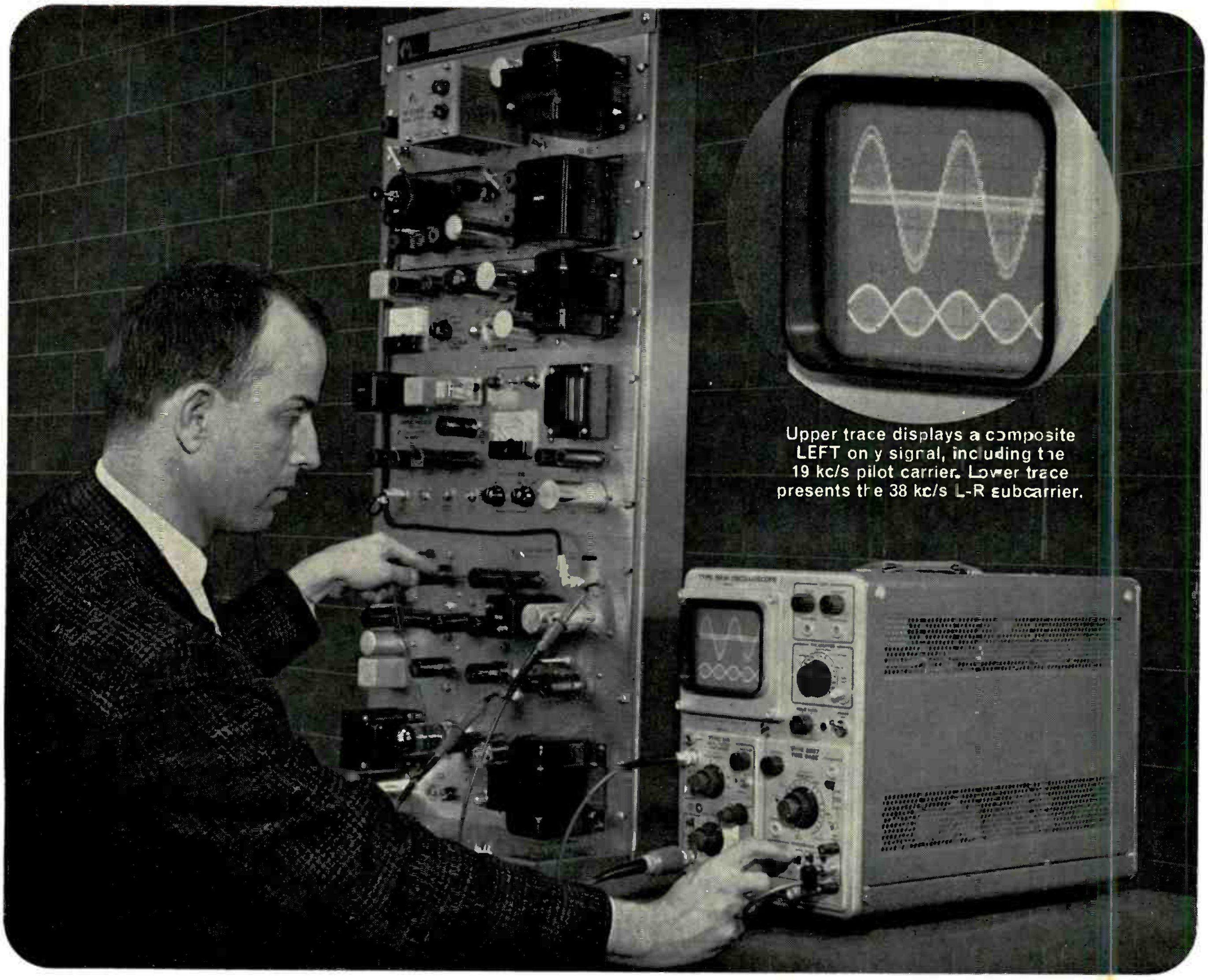
Since succeeding to the top engineering spot at NAB, Mr. Bartlett has successfully conducted annual engineering conferences as part of the NAB conventions, has worked to update engineering rules of the Federal Communications Commission, and has guided the development of new technical requirements for disc and tape recordings. He serves on various industry committees and represents the American broadcasting industry at international gatherings.

Mr. Bartlett joined the NAB staff in September 1955, as assistant manager of the Engineering Department. He became acting manager in May 1961 and was named manager on September 21 of that year.

Before joining the Association he served for nine years as chief engineer at WDNC (AM-FM), Durham, N. C., during which time he acted as technical consultant to several TV stations and applicants.

Before World War II, he served with the Federal Communications Commission. During the war, he was a radio officer with the United States Maritime Service.

A native of New Bedford, Mass., Mr. Bartlett attended Brown University, Providence, R. I., and is a graduate of the Massachusetts Radio Institute, Boston. He is a senior member of the Institute of Radio Engineers, a member of the Society of Motion Picture and Television Engineers, and a licensed radio amateur.



Upper trace displays a composite LEFT only signal, including the 19 kc/s pilot carrier. Lower trace presents the 38 kc/s L-R subcarrier.

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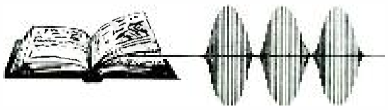
Circle Item 28 on Tech Data Card

BOOK REVIEW



Radio Operators License Handbook: Edward M. Noll; Howard W. Sams & Co., Inc., Indianapolis. Indiana; 136 pages. 5½" x 8½", paperback; $2.95 (Catalog No. RON-1).

As every manager of a radio station knows, the FCC operator requirements have been changed; holders of a Restricted Radiotelephone Permit may no longer operate a broadcast-station transmitter. Persons doing the routine operating must now hold a valid third-class license with a broadcast endorsement. This means that anyone who wishes to be a broadcast operator must pass FCC examination elements I, II, and IX. In addition, there are a number of types of stations that can be operated by holders of third-class licenses without endorsement (elements I and II only).

This text is designed to provide the student operator with the information needed to pass the appropriate examinations. Therefore, it does not go deeply into the technical aspects of radio transmission, but rather discusses the operating aspects.

The first chapter explains the requirements for licenses below second class. It also discusses the duties and privileges associated with each class of license and the Rules and Regulations applicable to all radio operators. Chapter two describes the various radio services and the grade of license required for each. Chapter three is devoted to radio broadcast operation. Enough basic technical information is included in this chapter to provide a background for the enumeration of the third-class operator's duties. Chapter four details the procedures necessary for obtaining each class of license below second class. Excerpts from Part 13 of the FCC Rules and Regulations (the Part applying specifically to radio operators) are included along with the addresses of the Field Engineering Offices. Chapters five, six, and seven contain questions and answers on elements I, II, and IX, respectively. Extracts from the 1959 Geneva Treaty, the Communications Act of 1934, and the Rules and Regulations of the FCC are contained in four appendixes that conclude the book.

The author has written his text with a two-fold purpose. First, of course, it is designed so that mastery of the question-and-answer section will enable the reader to pass the examination elements for the license he seeks. In addition, background information is included which, if studied, will enable him to understand somewhat the why as well as the what of radio operating. This is not to say studying this book will make the reader a qualified maintenance technician—that is not its purpose. It does offer some extra knowledge that can help him be a better operator. ▲

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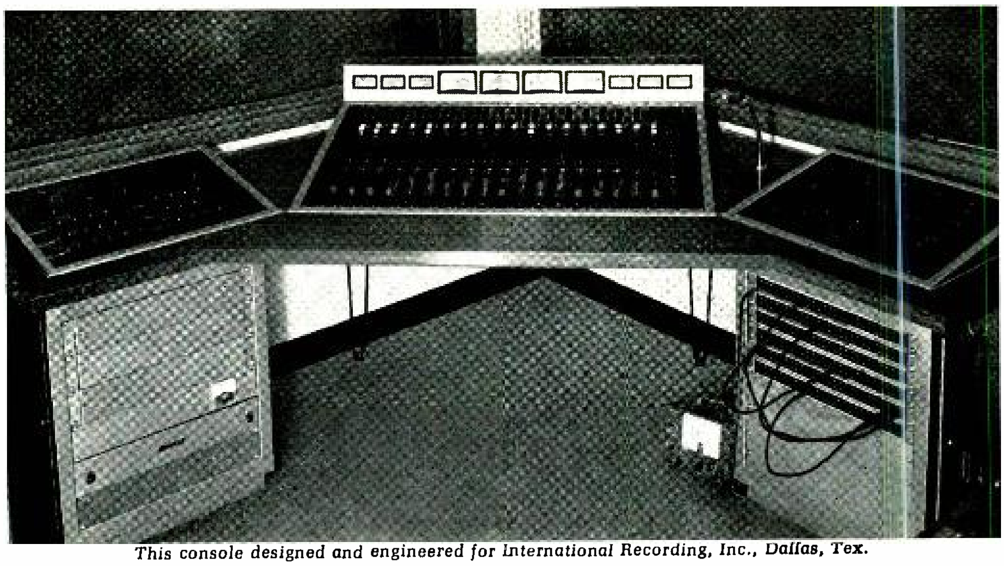

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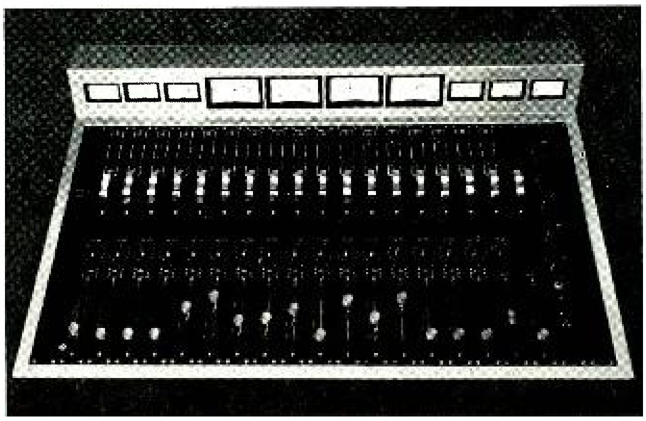

Happiness is more: it's a level control and selector switch on each microphone that allows the echo to be fed either before or after the mixer.

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Circle Item 36 on Tech Data Card

October 1965

We interrupt this magazine to bring you...

Late Bulletin from Washington

by Howard T. Head

New Program Form Adopted for AM and FM Applications

After more than four years of study and conferences with industry, the Commission has adopted a new programing section for its AM and FM broadcast application form. The new form requires detailed program information with each application for a new station, license renewal of an existing station, or transfer of control. The forms must also be submitted whenever major changes in station programing are undertaken.

In the new form, applicants are required to state the methods relied on to determine local programing needs. The Commission has emphasized that it expects broadcasters to ascertain community needs and desires, and to consult not only with the general listening public but also with leaders in community life and professional and civic organizations. Such efforts must be reported in the new application form.

The form is to be used for new applications beginning November 1, 1965. The same form will be used for all renewal applications which are due on or after November 1, 1966.

Considerably more detail concerning past programing is required than was the case with the previous application form, and it will be necessary to institute new program-logging methods to compile the statistical data required by the form. Consequently, the Commission has also changed the Rules on program logging to require the additional data. The effective date of the new program-logging Rules is set for December 1, 1965.

The new form relates to AM and FM stations only. Similar forms for television stations are in preparation, but are not expected to be ready before the end of the year.

Conference on TV Propagation Curves

At the request of the Association of Federal Communications Consulting Engineers (AFCCE), the Commission has scheduled a series of engineering conferences to study new television field-strength-vs-distance curves proposed for adoption by the Commission (July 1965 *Bulletin*). The

Commission wishes to obtain the views of all interested industry engineers, with particular emphasis on whether the proposed new curves represent any improvement over the existing curves in terms of correlation with available field-strength measurement data.

The consulting engineers' preliminary studies have raised a number of questions which should be resolved before adopting the modified propagation curves. These include the possibility that for most heights the new curves, like the old, predict average UHF field strengths greater than those indicated by actual experience. For extremely high antennas, there is some indication that the actual fields at both VHF and UHF are greater than the new curves indicate.

Directional-Antenna Licensees May Get Relief

Continuing to accumulate in the files of the Commission's engineers are field-strength measurement data indicating that in many areas of the country there are significant variations of fields with the season of the year. These reports have now become so numerous that the Commission's staff has under study some means of taking these variations into account. Recognition of this effect is of particular importance to licensees employing directional-antenna systems with close tolerances. In many instances, seasonal variations have been sufficient to raise monitor-point field strengths above tolerance values, requiring either continual readjustment of the directional antenna or the risk of a citation for out-of-tolerance operation.

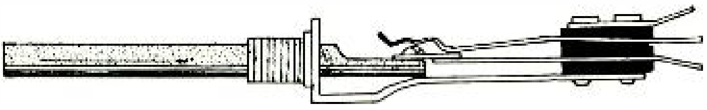
Although the general pattern of variation indicates higher field strengths in the colder months, attempts to correlate the variations with such influences as temperature and rainfall have met with limited success. The existence of the effect, however, is by now generally well established, and there appears to be a reasonable prospect that the Commission may acknowledge the variations in establishing maximum permissible field values at directional-antenna monitoring points.

Telephone Companies Active in CATV

An increasing number of reports tell of instances where local telephone companies are undertaking to supply distribution circuits for CATV systems. Typically, the telephone companies propose to install all needed circuits which are then leased back to the CATV operator. Not only are the telephone companies seeking this as a source of revenue, but the companies and the CATV operators involved are taking the position that local CATV franchises are not needed, that the telephone company can operate under existing franchises.

The Commission's staff has moved to investigate various reports concerning CATV activity by telephone companies. A recent FCC staff letter was sent to the Attorney General of California, with copies to the Attorneys General of the other 49 stages, requesting information concerning a recent California ruling on the subject. In the same letter, the Commission's staff also summarized the Commission's CATV policy, and expressed the hope that local authorities would take into account the fact that the Commission has under consideration federal regulation of all CATV (June 1965 Bulletin).

Howard T. Head...in Washington



TOOL IN USE

BURNISHING TOOL

Tool to Burnish Phone Jacks

by Ernest Schaufler, Staff Engineer, WHN, New York, N. Y.

How many times, while manipulating a patch cord in and out of the jack strip, have you wished for a simple burnishing tool to get between those elusive normal points? Here is such a tool made from junk-box materials. It consists of a scrap of brass rod cut from a volume-control shaft, a 6-32 screw, and a small strip of thin metal. When the tool is inserted in a jack, the screw head lifts the upper leaf allowing the burnishing strip to slide between the points.

Mono Playback From Stereo Cartridge

by John M. Rhodes, Rochester, New York

A monophonic FM station, with a library of mono records, was considering conversion to stereo and wished to start building a stereo library, to be played monaurally with a stereo cartridge until switchover. They had been using Gates turntables with G-E mono cartridges. The station installed high-priced stereo cartridges, but the results were somewhat unexpected: stereo lights flickering, high-frequency response too sharp, etc.

In the Gates turntable preamp, RIAA bass equalization is achieved by a frequency-selective feedback loop. The high-frequency rolloff is produced by the cartridge load resistor, in this case 6.2K for the G-E units. The new cartridges incorporated built-in matching transformers, and the recommended load was 47K.

Out came the AC VTVM and RIAA test record. The 1-kc reference tone was adjusted to 0 db on the meter; next the 10-kc tone was played and the meter read ± 14 db! Needless to say, this was the cause of all the trouble. After a trial-and-error search for a value of load resistance that would correct the response, the idea of a shunt capacitor struck. A decade box was used to make the 10-kc level the same as for 1 kc. Another frequency run was taken, and an exact match to the first curve was obtained. The solution to the problem was to install a ceramic capacitor inside the headshell.

It appears that the higher output of the cartridge at high frequencies (due to the higher stylus-tip velocity) was overloading the preamplifier. Hence, equalization ahead of the preamplifier solved the distortion problem. Experience with other cartridges, however, indicates that this idea can only be applied on cartridges having a fairly low output impedance with low inductance.

now read this

A well informed individual usually makes the wiser decision

INFORMATION:

Shown below is the rear of the rack mounting frame used with our video and pulse distribution amplifiers and other plug-in units. You will appreciate the easy accessibility afforded by the connector configuration. Note that no connector is closely surrounded by several other connectors, as is the case with many other frames. As a result, cables may be plugged or unplugged with greater ease and speed.

The pulse distribution amplifier, model VI-20, pictured above, offers superior performance with many desirable features. A few of these features are:

- **Self-contained, regulated power supply in each amplifier.**
- **Four plug-in amplifiers mount in a 1¾" rack frame providing a total of 16 outputs.**
- **High isolation between outputs during <u>and</u> <u>between</u> pulses.**
- **Maintains constant output levels.**
- **Indicator lamp shows presence or absence of output pulses.**

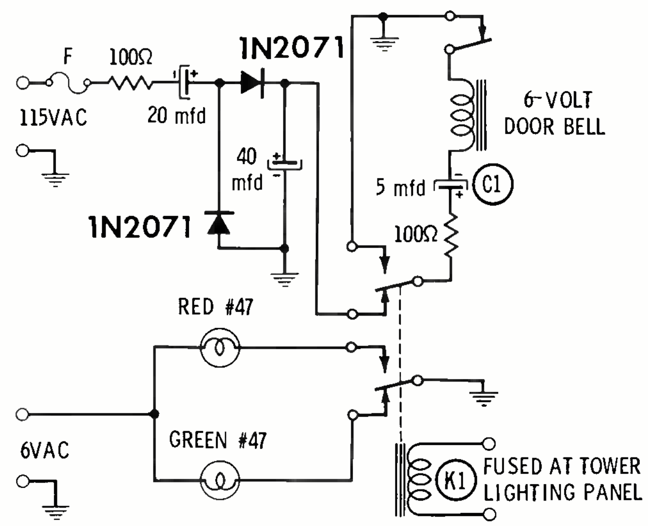
Clean and precisely controlled pulses assure stability of camera sweeps and improved tapes. Pulse defects such as ringing, overshoots, rounding, poor rise time, tilt and line reflections are overcome by the pulse reforming action of this unit. The VI-20 pulse D.A. is wired to operate in the same standard rack frame as the VI-10A video D.A.

Price: One complete frame with 4 pulse amplifiers.......................................$1100.00

Write for complete information and specifications

VITAL INDUSTRIES 3614 SOUTHWEST ARCHER ROAD GAINESVILLE, FLORIDA—PHONE 372-7254

Circle Item 38 on Tech Data Card



Tower Light Indicator

by James W. Thweatt, Staff Transmitter Technician, WPSD-TV, Paducah, Kentucky

We wanted an indicator in the control room to let us know whether or not the tower lights were on. We came up with this simple but effective system. In addition to serving as a visual indicator, it also provides an audible indication of when the tower lights go on **or** go off. It also acts as a reminder to make the daily tower lighting inspection.

Our tower lights are supplied from two phases of our three-phase power source. A relay with a 230-volt winding was chosen for K1 and connected across the two 115-volt lines, on the load side of the tower-light relays, so that failure of either of the 115-volt lines would be detected. One set of K1 contacts operates the green and red "on" and "off" indicator lamps. The other set of contacts operates the bell circuit. When K1 energizes, the bell hammer strikes the bell one time as capacitor C1 charges to the DC supply voltage through the bell winding. When K1 deenergizes, C1 discharges through the bell winding causing the hammer to strike the bell one time.

Portable Radio Checks Lines

by Al Roberson, Chief Engineer, WHOU, Houlton, Maine

That transistor receiver in your station is very handy for checking lines without using a tone oscillator. Just attach a couple of alligator clips to the earphone leads, tune to a competing station so you won't become confused, set your volume, and hook up to the line being traced or checked for continuity. The impedance mismatch doesn't matter. We use our receiver in this manner because of its easy portability in checking our permanent remote loops and line tracing in the studio.

Stereo-FM Off-Air Relay

by Walter Wierzbicki, Technical Director Mid-States Broadcasting Corp., Mich.

When the Mid-States Broadcasting Corp. began an off-the-air FM relay network for their four Michigan stations using WSWM, East Lansing, as the originating station, everything at first seemed to go well. Pickup of stereo programing by WQDC, Midland, and WGMZ, Flint, was accomplished through the use of commercially built FM tuners; WABX, Detroit, because of its distance and the terrain over which the signal travels, received monophonic signals using similar commercial equipment. Output

It takes an alert supplier like Harvey's...

to bring you an advanced mike like the E-V Model 635A.

In many ways, a supplier of broadcast and audio equipment is like a doctor. He must keep up with the latest advances in his profession to practice it efficiently.

We like to think that's the way we are at Harvey's. And when Electro-Voice came out with an advanced microphone like their 635A, Harvey did its homework. We studied it. We stocked it.

The E-V Model 635A is a modern prototype of the famous 635 known to all as "old dependable" ... but with these refined advances: Lighter and slimmer. A stronger steel case to reduce hum pickup. A new four-case filter to eliminate pops and wind noises.

Get the Electro-Voice Model 635A from Harvey's. We're "always on hand" with the newest and best in broadcast and audio equipment. Just call collect or write.

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Circle Item 40 on Tech Data Card

from the tuners was fed into the pickup station's audio equipment in much the same manner as in locally generated programing. Great care was exercised in selecting the tuners to be used to insure adequate bandpass and distortion specifications for the entire system.

The first hint of difficulty came in the form of listener complaints, vaguely describing "something wrong with your station." A far more specific indication came from one of the operators at WGMZ—he became violently ill while monitoring with a pair of stereo headphones. When asked to explain the cause of his nausea, the technician indicated that the stereo signal constantly seemed to switch channels. The continually changing spatial orientation which resulted apparently caused a form of motion sickness. While the channel "swimming" was evident in some degree at all times during relayed programs, the stereo signal was completely stable when locally originated programs were carried.

A lot of conjecture preceded intensive investigation of the problem; the final conclusion was that phase distortion of the relayed signal allowed enough variation of the 19-kc pilot to cause loss of sync with the receiver's 19-kc oscillator. The distance between the transmitting tower at WSWM and the pickup point at WGMZ is 41 miles, and it was soon found that reception of the multiplex signal could be improved to an acceptable level through use of a highly directional antenna carefully oriented to minimize multipath reception. This solution proved satisfactory for the relay to WGMZ, but the "swimming" phenomenon at WQDC in Midland proved to be a real tough one to solve and finally shed additional light on the entire problem, including the link to WGMZ.

At WQDC, Midland, (63 miles north of WSWM, Lansing) the reception point is located several miles from the Midland transmitter to prevent the local transmitter signal (99.7 mc) from beating with the signal (99.1 mc) from Lansing. Here, a new antenna installation did not completely eliminate cusmem

TO Chief Eng

Jim:
Did you see this?
Lets check with JAMPRO for our new FM Antenna!
phone: 916 422-1178
Bob

THE SACRAMENTO UNION Wed., May 12, 1965 B15

KHIQ-FM Scores Another Sacramento First! A New JAMPRO Antenna!

Pardon us for sounding off like this, but frankly, we're a little bit excited about our revolutionary **"Dual Polarized"** Jampro antenna! What's so revolutionary about it? Number one: It beams 2 (dual) signals instead of one. Horizontal — like before — and Vertical — never before now! And two: We're the first (and only) FM Station in Sacramento to have one! Further: Although all FM stations (including us) have HORIZONTALLY powered antennas, the signal transmitted, at its strongest, does not always reach every receiver within the station's coverage pattern. Differences in terrain cause it to deflect thus producing interrupted or weak reception in some areas. This is where our new JAMPRO comes in. It eliminates horizontal "fade-out" by filling in the gaps with a vertical signal. Result: More power and vastly improved reception — six times as much for your table receiver, 40 times as much for your car radio plus better-than-ever KHIQ stereo!

NEW JAMPRO "DUAL POLARIZED" ANTENNA FORMULA:

HORIZONTAL power assures you ALMOST no variation in signal strength + **VERTICAL** power added, assures you NO variation in signal strength = ***Vastly Improved RECEPTION for Table Receivers, Car Radios Plus Better-than-ever Stereo!***

KHIQ STE

JAMPRO ANTENNA COMPANY
6939 POWER INN ROAD SACRAMENTO, CALIFORNIA

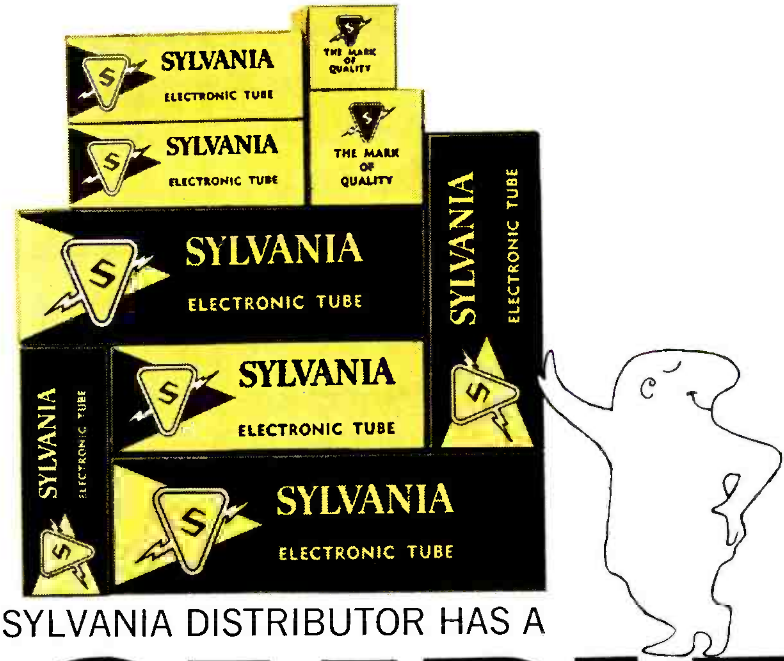
Circle Item 43 on Tech Data Card

tomer complaints about "swimming." When a local distributor exhibited stereo receivers at the Saginaw Fair, several of the receivers motorboated when receiving signals relayed by WQDC from Lansing; locally originated stereo broadcasts were okay. The distributor was advised to use a better antenna. When a good FM receiver antenna was pointed at the station antenna, the motorboating in the receivers changed to slow channel reversal—or "swimming"; also, the stereo-indicator light blinked with the phase reversal. An engineer representing the manufacturer of the radios affected suggested that the station replace the receiver used at the reception site. A different receiver completely eliminated the "swimming." Further investigation revealed that the receiver initially used had been leaking WSWM's 19-kc pilot signal through the audio circuits. The original 19-kc pilot signal was then beating with the 19-kc pilot generated at the WQDC transmitter which caused pilot phase reversal. Superior audio filtering in the new receiver solved the problem of channel reversal.

At all three stations it was noticed that distortion would momentarily occur on certain high frequencies; this was most apparent on trumpet notes—yet there seemed to be no evidence of overmodulation. A test was programed with WSWM, Lansing, and WGMZ, Flint, to determine the cause of this distortion. Initially, WSWM broadcast a monophonic 400-cps signal at 100% modulation to allow proper adjustment of the receiver and scope. Then, WSWM turned on their 19-kc pilot. The receiving-station engineers connected their receiver's left-channel output to the scope vertical input and the right-channel output to the horizontal input. Two equal in-phase signals were transmitted by WSWM to produce a L+R signal, and care was taken to prevent overmodulation. As the transmitted frequency was swept from 40 to 15,000 cps, the engineers noted that the scope trace shifted from a line slanting rightward to an ellipse. The same test was repeated with an L—R signal, and the same phase shift was again noted. A land-line test from WSWM disclosed no phase shift or beating at the stereo generator output. Because there had been previous problems with 19-kc pilot contamination of the audio, low-pass filters were placed at the receiver output. A repeat of the test using the filters showed a significant decrease in phase shift at all frequencies.

A research file maintained by the company was quite useful, as these stations had no prior experience with troubles of this type. Magazine articles and manufacturers' literature proved invaluable in helping to diagnose and eliminate the problems. ▲

Have you solved a technical problem at your station recently? Why not share your solution with other broadcasters by way of Engineers' Exchange? Send your items to: BROADCAST ENGINEERING, 4300 West 62nd Street, Indianapolis, Indiana 46206. We pay cash for those we use, and we'll award a book of the author's choice from the Howard W. Sams Modern Communications Course **or** Broadcast Engineering Notebooks **series for the item judged best each month.**



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From his full-line inventory of Sylvania industrial and commercial tube types, you get immediate off-the-shelf delivery. Electronic tubes for every application. Same-day service, wherever possible.

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Circle Item 47 on Tech Data Card

NEWS OF THE INDUSTRY

INTERNATIONAL

TV Recording Techniques at SMPTE Conference

Electron-beam recording will be the subject of at least four technical papers at the 98th **SMPTE** Technical Conference and Exhibit at the Queen Elizabeth Hotel, Montreal, October 31 to November 5.

Unlike previous recording methods using mechanical styli, photographic recording, or magnetic recording, electron-beam recording, or "EBR," depends on the direct action of a stream of electrons upon a recording tape or film. The information capacity of the system is enormous, but there are serious practical difficulties because of the need to run the recording film in a vacuum. If these problems can be overcome, EBR is expected to supplement and possibly eventually replace present video-tape systems for recording pictures.

Other topics of major interest to be discussed at the Montreal Conference include UHF and color transmission problems, vertical-interval testing and monitoring, automatic video switching, and quality-control procedures.

500,000-Watt Transmitter for Nigeria

Factory tests of a 500-kw medium-frequency AM broadcast transmitter have been completed by **LTV Continental Electronics Division** of **LTV Electro Systems, Inc.** The transmitter was built for the **Nigeria Broadcasting Corporation,** Enugu, Eastern Nigeria, Federation of Nigeria.

Completion of factory tests ends the first phase of a $1,228,374 contract between the manufacturer and the Nigerian Broadcasting Corporation. Under the terms of the contract, Continental is supplying the transmitter, directional antenna system, spare parts, installation, and supervisory services. The new facility is part of the Nigerian Government's long-range plan to improve communications and educational programing throughout that country.

The transmitter is made up of two 250,000-watt transmitters which are combined to deliver full carrier power of 500,000 watts. The directional antenna system consists of coupling and phasing equipment and three 840′ towers.

TV in Africa and South America

The Ghana television service has been officially declared open by President Kwame Nkrumah. Designed, built and installed by **The Marconi Company,** in collaboration with the **Ghana Broadcasting Corporation,** the new service has three television transmitting stations at Accra, Kumasi, and Sekondi-Takoradi. These stations cover approximately one quarter of the country including the Atlantic seaboard, the most heavily populated part of Ghana. Each of the three stations is served by a central studio complex in Accra, the capital.

All three stations use 5-kw picture transmitters and 1-kw FM sound transmitters. Three-bay turnstile antennas are mounted on 400′ towers at Accra and Kumasi and a 300′ tower at Sekondi-Takoradi. At each station the transmitters are located in a central transmitting area with a control room and adjoining workshops, stores, engineers' rooms, and generator buildings. In addition, at Accra and Kumasi, there are transmitter/receiver terminals for the microwave link which joins Accra and Ejura.

On the other side of the world, the company is installing a new station at Mar del Plata, the principal seaside resort and one of the largest cities in Argentina. It will be run by **Mar del Plata Television S.A.**

The station will use a 5-kw picture transmitter and a 1-kw FM sound transmitter in conjunction with a high-gain omnidirectional antenna system.

SOMETHING SPECIAL IN

COLOR VIIDEO

THE BBRC MARK VII: AN ADVANCED DEVELOPMENT IN COLOR SPECIAL EFFECTS GENERATORS

The Mark VII, designed for the most critical studio and van applications, assures low maintenance and trouble-free operation.

The Mark VII is capable of color inserts (color matting). The output video of the Mark VII is the combination of background video and artificially generated color inserts. Any color within the range of the NTSC spectrum may be generated by the settings of the manual controls. The basic system can handle a variety of monochrome or color signals of either composite or noncomposite format at the inputs.

A non-additive mixing technique, insensitive to variations in video brightness levels, is incorporated for a new effect with lap-dissolves. The Mark VII systems consist entirely of transistorized plug-in modules, expandable on a building block basis to allow for a variety of pattern cards. Control panels can be selected for present needs or future requirements.

Priced from $1810.00. For immediate information call your local distributor, or write to BBRC Video Marketing.

BALL BROTHERS RESEARCH CORPORATION • BOULDER, COLORADO 80301 • TEL: 303/442-2965 • TWX: 303/443-6290 BBRC

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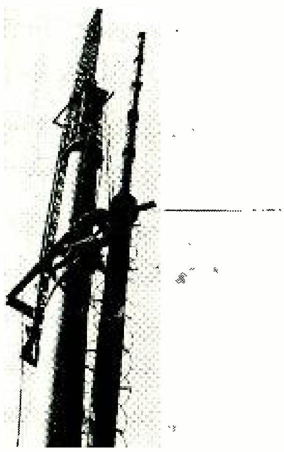
NATIONAL

New ETV Tower

The last section of what are believed to be the first UHF and VHF helical television antennas ever combined in a single tower has been put into place. When in operation, the antenna will transmit two television broadcast signals from the top of the new 1000 Lake Shore Plaza building in Chicago. It will serve both the city's educational television stations, **WTTW,** channel 11, and **WXXW,** channel 20. The 250′ tower atop the 55-story, 590′ apartment building will enable the two stations to transmit without interference from any building in the Chicago area.



The largest section to be raised was a 30′-high, 36″-diameter, 6-ton pipe mast that serves as a base for the antenna. It was raised by a crane attached to the top of the building. The crane was then shifted 15° to allow the collar to be set in place.

1925′ Tower Planned

An application for a tower to support an antenna 2000′ above average terrain has been filed by the Black Hawk Broadcasting Co. for **KWWL-TV,** Waterloo, Iowa. The tower is to be built on a site twelve miles south of Independence and two miles east of Highway 150. Work has already started on remodeling and installation which will give KWWL-TV the first all-color television facility in Iowa. Equipment on order includes two color cameras for studio use, a video tape recorder, and color film camera.

The Black Hawk Broadcasting Company was founded in 1947 and presently operates radio stations KWWL in Waterloo; KLWW in Cedar Rapids; and KAUS in Austin, Minnesota; television stations KWWL-TV in Waterloo and KMMT in Austin; and the Coca Cola Bottling Company of Waterloo.

Long CATV Relay

The Federal Communications Commission has granted **American Television Relay, Inc.** of Phoenix, Arizona, construction permits to bring the four Los Angeles independent television stations to Teleprompter's Farmington and Silver City cable systems in New Mexico. The applications have been pending about one year. The present common-carrier microwave service from Los Angeles to Yuma, Arizona, will be extended into these new areas with the signal path to be split at Pinal Peak, near Globe-Miami, Arizona. The northern branch will go to Farmington, the southern branch to Silver City. The signals will travel distances of 700 and 400 miles, respectively. Service is expected to begin by January, 1966.

American Television Relay operates common-carrier microwave in Southern California and Arizona and has applications on file to operate in Texas.

NAB Fall Conference Series

Recruiting of radio personnel, a new radio license form, color television, and the impact of community antenna television are among items to come up for review at the eight 1965 Fall Conferences sponsored by the **National Association of Broadcasters.** Also on the agenda are reports on NAB operations by President Vincent T. Wasilewski and Board Chairman John F. Dille, Jr. A member of the Federal Communications Commission will participate in each of the conferences. Each Commissioner will speak informally and answer questions during the second morning session of the Conference.

The day-and-a-half conferences, arranged by NAB for member radio and television executives, will be held in eight different cities across the nation from October 14 through November 23. Joint sessions for radio and TV delegates will be held each morning at each conference, with separate radio and TV meetings scheduled for the first afternoon. Each conference also will feature an opening-day luncheon, with a list of prominent speakers to be announced later. Each conference will open with Mr. Wasilewski's report to the membership at the first joint session.

Two presentations also are scheduled at the opening session: "The 1966 Elections—Action Now!" and "CATV—Your Association's Position."

Mr. Dille will present his report at the second joint session on the second day. Informal remarks by an FCC Commissioner, followed by a question-and-answer session, will be featured during the second-day joint meeting. Also on the second-day agenda: "The People vs. Dr. Buzzard or The Road to the Code." A roundtable discussion between delegates and NAB staff members will conclude each conference.

The separate radio session on opening day will include: "People, Programs and Payment" (on the recruiting, use, and reimbursement of radio-station personnel), "Candor and the Radio Code," "Logging for Renewal—Adjusting to the New Radio Form," and "Radio Bull Session" (an opportunity for comments, questions, and answers about modern radio.)

The first-day TV session program: "Transition to Color — Challenges for Every Department," "TIO Presentation" (new ideas form the Television Information Office), "The Economics of Community U's — Including the Latest on Equipment Leasing," "The Waking Giant — The TV Broadcaster as an Advocate", and "TV Bull Session."

Locations and dates for each of the eight Fall Conferences, and the FCC Commissioner appearing at each are:

Oct. 14-15	Louisville, Ky., Brown Hotel, James J. Wadsworth.
Oct. 18-19	Atlanta, Marriott, Robert T. Bartley
Oct. 21-22	Baltimore, Md., Lord Baltimore, Robert E. Lee
Oct. 25-26	Boston, Statler Hilton, Kenneth A. Cox
Nov. 11-12	Chicago, Sheraton Chicago, Mr. Lee
Nov. 15-16	Denver, Brown Palace, Lee Loevinger
Nov. 18-19	Spokane, Davenport, Mr. Cox
Nov. 22-23	Phoenix, Westward Ho, Chairman E. William Henry

(Commissioner Rosel Hyde will be out of the country during the six-week period when the Conferences are held.)

UHF Under Construction

The transmitter for **WPHL-TV**, one of the three new UHF television stations in the Greater Philadelphia area, has been delivered at the station's studio at 1230 East Mermaid Lane, Wyndmoor.

The station has scheduled equipment tests to begin September 1 and program tests to start September 17.

Mr. Franklin R. Valentine, Jr., has been appointed executive vice-president and director of **Unicom, Inc.** Prior to joining the firm, Mr. Valentine was associated with Charles A. Sammons and National Trans-Video of Dallas, Texas, for a period of 12 years. An attorney by profession, he will act as General Counsel for the Corporation.

Robert E. Lauterbach has been appointed manager-broadcast sales for **General Electric Visual Communications Products.** Mr. Lauterbach succeeds John Wall, who recently was appointed to the new position of manager-industry relations for G-E Visual Communications Products. He will make his headquarters at Electronics Park. Mr. Lauterbach is a native of Denver, Colorado, a graduate of California Institute of Technology in electronics, and holds a master's degree in business administration from the University of Denver.

Formerly general manager of cable operations, **John P. Campbell** has been named vice-president of **Cox Cablevision Corp.,** a wholly owned subsidiary of **Cox Broadcasting Corp.** Mr. Campbell has been active in CATV since 1954, having established the Dubuque, Iowa, cable system for **Jerrold Electronics Corp.** at that time. He was later eastern regional manager for **H & B American** for five years and has been with Cox Cablevision since July of 1963.

Charles L. Townsend has been promoted from director of product development to vice-president in charge of engineering operations at **TelePro Industries, Inc.,** a subsidiary of **Defiance Industries, Inc.**

Mr. Townsend has 27 years of executive engineering background with the National Broadcasting Company. An early television pioneer, he was designing and building television gear for studio operations as far back as 1931. Mr. Townsend is the author of numerous writings and publications bearing on the problems of sound transmission, amplification, and film testing as they relate to the television industry. He is an active member of many national organizations concerned with the technical aspects of radio and television broadcasting.

Norman Knight, president of **Knight Management Corp.,** Boston, has appointed **Walter Welch** general manager of CATV operations. Mr. Welch will develop various CATV properties including Virgin Isles TV, Inc., St. Thomas, Virgin Islands, U.S.A., and other Caribbean interest for the Knight enterprises.

After 15 years of broadcast engineering, Mr. Welch entered the CATV field in 1958 and has served as chief engineer of two CATV companies and vice-president and general manager another.

PROPERTY TRANSACTIONS

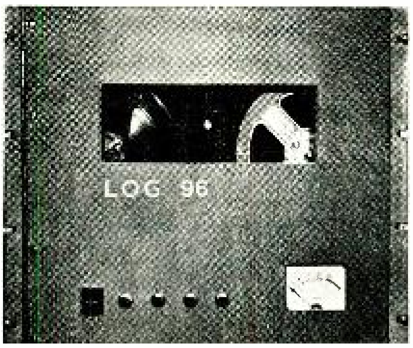
New Acquisition

Acquisition of the assets and business of **Dage-Bell Corporation** by **Raytheon Company** has been announced. Dage-Bell manufactures closed-circuit and broadcast television equipment, language laboratories, and learning-center systems.

Under the terms of the agreement, Raytheon assumes all of Dage-Bell's liabilities, and 161,534 shares of Raytheon common stock are to be distributed to Dage-Bell stockholders as part of the liquidation of Dage-Bell.

Dage-Bell is the sixth acquisition by Raytheon in the past 12 months. Earlier acquisitions were Amana Refrigeration, Inc., the computer division of Packard-Bell Electronics Corporation, the computer-memory business of Philco's Aeronutronic Division, Micro State Electronics Corp., and Penta Laboratories, Inc. Raytheon will operate the business as a subsidiary within its Equipment Division. ▲

NEW PRODUCTS



Automatic Logger

Log 96 is designed to meet FCC requirements for automatic program logging. It records 96 hours of program material on 1200′ of standard ¼″ recording tape; time reference is accomplished by a 1000-cps tone burst automatically impressed on the tape every five minutes. Electronics are fully transistorized, and a solid-state 28-volt power supply is included. The drive motor is of the synchronous, hysteresis type. The basic model of this **Autotronics of Oklahoma** product is priced at $595. A choice of blue wrinkle or blue enameled front panels is available.

Circle Item 120 on Tech Data Card

Remote Recorder Operation

A remote control station and relay control electronics are available for **Magnecord** 1021, 1022, and 1024 tape recorders, as options with new machines or for installation on equipment presently in use. The relay control electronics converts the standard electro-mechanical button control to touch-button control. The remote control station allows remote control of all transport modes. Tally lights permit the operator to identify the mode in use without visual monitoring of the recorder. The relay control electronics has an extra "delay" relay that prevents the recorder from going into normal forward mode from fast forward mode until tape comes to a complete stop; this prevents accidental tape breakage or spillage. To prevent accidental erasure of tape, record and safety buttons must be pushed simultaneously. The logic of the relay system cannot be disturbed by pushing more than one button, or all buttons at once. Prices for the remote units are $175 for the relay control electronics and $58 for the remote control station.

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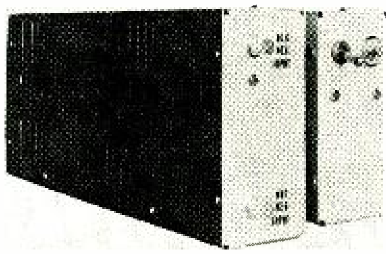

Solid-State Video Amplifier

The Model IT-284A video amplifier provides a 50% increase in output voltage over the original **ITI** design, the Model IT-284. The response of the Model IT-284A is down a maximum of 3 db at 14 mc; thus it provides 1100-line resolution capability. A peak-to-peak input of .25 volt provides a 75-volt output. The predecessor unit will continue to be available for those applications where its 1600-line capability is required. Both devices are all solid state. Single-unit price of the Model IT-284A is $400. The companion power supply, Model IT-285A, is optional at $200.

Circle Item 122 on Tech Data Card

Vidicon Viewfinder Camera

The VC-6 vidicon viewfinder camera has been developed by **Maryland Telecommunications** for broadcast or closed-circuit applications. The camera is designed to accept, from an external source, timing pulses conforming to EIA Specification RS170, paragraph 3.3. The unit consists of fully transistorized separate camera-viewfinder and control units which utilize broadcast-type IK connectors and Belden 8280 or 8284 cable. The VC-6 is equipped with a four-lens turret and tally lights. Lens selection and focus control are located on the right side of the camera. Specified resolution is in excess of 800 horizontal TV lines at .3 foot candle of target illumination, and over 500 horizontal TV lines at .04 foot candle. Other features are a cascode input Nuvistorized video preamplifier, nonmicrophonic video amplifier with 10-mc bandwidth, sweep protection, linearity of both horizontal and vertical axes within 2%, an automatically regulated electrical focus and target adjustment for light-level changes (4000 to 1), and a fully regulated power supply (±1%). The camera-viewfinder weighs less than 35 pounds, and the control unit weighs less than 8 pounds. The price is $3995 less cable.

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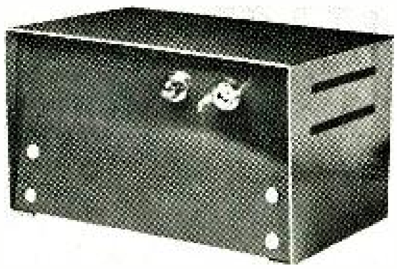

Vidicon Protection

Cam-Trol, a device that automatically protects the vidicon against burnout and damage due to flashing or reflecting bright light, is produced for use in closed-circuit television applications by **Centurion Products.** The unit, designated Model CT4, consists of a protective shield connected to a power-pack control. The shield automatically covers the camera lens when light exceeds a predetermined level. When the light returns to a safe level, the shield automatically returns to an open position, exposing the lens again. The standard Cam-Trol includes an opaque shield which cuts off picture transmission when it is activated by bright light. A filter shield is also available which cuts down on light intensity while allowing continuous transmission of the picture.

The product is designed to be effective both indoors and outdoors, and can be set for activation at various light levels. The device automatically caps the camera lens when the camera power is turned off. This is important, since bright light can destroy the photosensitive phosphors on the face of the vidicon even when the camera is not operating.

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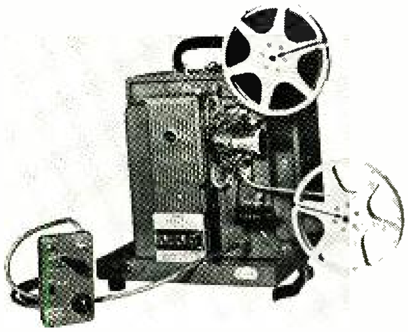

16-mm TV Projector

This multispeed 16-mm motion picture projector, Model 224-A-TV, features flickerless operation at all speeds—1, 2, 3, 5, 6, 10, and 30 frames per second. **L-W Photo, Inc.** designed the machine for video-tube projection. A continuous-hold control permits stop-motion projection onto a television camera pickup tube without loss of light intensity or color values. The projector incorporates a television-type shutter, a synchronous motor, and a timing-belt drive. A hand-held remote control unit is included with the portable, 30-lb projector. It operates the projector at all speeds, plus reverse and stop-motion, and at single-frame. Other features include an automatically-maintained film loop, digital frame counter, and a cooling and heat-filtering system to prevent film damage. The projector utilizes a 750-watt lamp and operates with standard 115-VAC power. A daylight projection viewer is built into the case for desk-top viewing.

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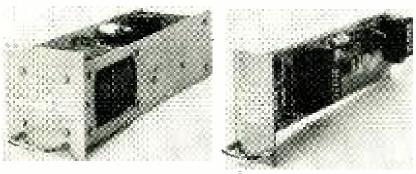

Solid-State Audio Amplifiers

Known as Model A-24 Preamplifier/Program Amplifier and Model A-40 Program/Monitor Amplifier, the units pictured here are designed to meet the requirements of broadcasting and recording. The Model P-2 Regulated Supply provides power for combinations of the two amplifiers. The Model A-24 has a maximum gain of 50 db and maximum output of +24 db. For applications requiring a higher line level along with a higher-loss line pad or output splitting network, the Model A-40 Program/Monitor Amplifier provides extra ceiling reserve capability. The units are products of **Melcor Electronics Corp.**

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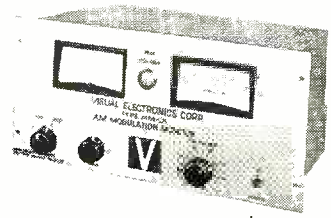
MOVING?
Don't Lose Touch . . .
Receive BE as usual at your new address
Write: **BROADCAST ENGINEERING**
Circulation Department
4300 West 62nd St., Indianapolis 6, Ind.



AM Modulation Monitor

The latest addition to the **Visual Electronics** line of auxiliary transmitter equipment is a new AM modulation monitor type MM-1A. The monitor is for use by AM broadcasting stations and reads both positive and negative modulation as well as carrier shift. The modulation meter is calibrated to read positive peaks to 133% and negative peaks to 100%.

An audio output is provided to feed the station's off-the-air monitor amplifier; a second audio output is provided to feed a noise and distortion meter. A peak indicating flasher unit is incorporated, which may be set to indicate modulation percentage from 50% to 120%. In addition, a relay is employed to operate a remote indicator or flasher.

Provision is made for use with remote meters; connectors and controls are built into the monitor to adjust the loop resistance of the external meters.

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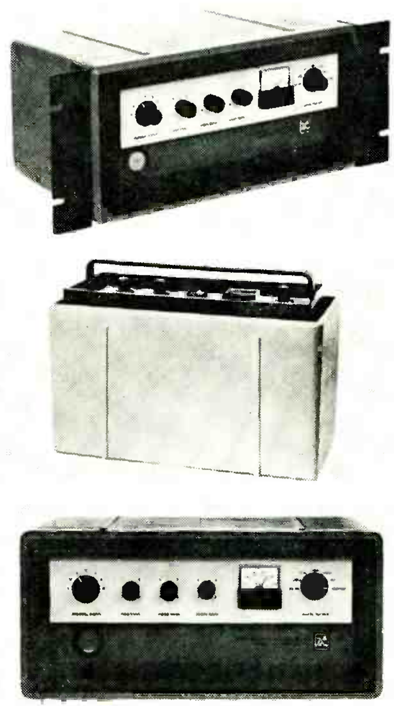

Television Relay Equipment

All solid-state television relay equipment, the MA-2 system includes the MA-8508 receiver and MA-8507 transmitter. **Microwave Associates** STL and mobile equipment is housed in rugged, cast aluminum cases for rack mounting in STL service or hand-carry in field use.

Both units are available in 1-, 3-, or 7-channel models. Transmitter output is two watts for a 1- or 3-channel model, and one watt for the 7-channel model. Transmitter differential phase and gain null are adjustable for optimum color performance. The crystal-controlled receiver operates in the 1990- to 2110-mc broadcast band and with an optional low noise preamplifier has a nominal noise figure of 6 db. Equipment meets all FCC requirements and applicable CCIR and Canadian standards for black and white or color television. Nominal power consumption using 110-volt AC or 28- or 12-volt DC is 60 watts: 35 for the transmitter, 25 for the receiver.

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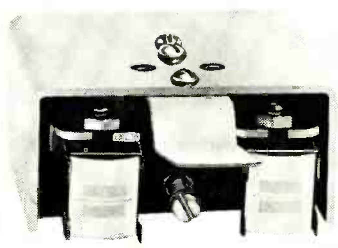

Cartridge Head Assembly

A cartridge head assembly that is directly interchangeable on all ATC cartridge machines is being manufactured by **Lang Electronics, Inc.** Azimuth and height adjustments on the assembly are made with a standard Allen wrench. ▲

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ENGINEERS' TECH DATA

AUDIO & RECORDING EQUIPMENT

67. CBS LABS—Literature on the "Volumax" automatic peak controller and the "Audiomax III" solid-state automatic level control.
68. CINE SONIC—Data sheet describes rental service which supplies background music prerecorded on 7", 10½", and 14" reels of tape, or in cartridges.
69. GOTHAM—Eight-page brochure describes Studer C-37 master tape recorder.
70. NORELCO—Fourteen-page brochure contains information about new C-12A condenser microphone which features variable pick-up pattern and bass attenuation.
71. QUAM—New general catalog No. 65 lists speakers for color-TV replacement, PA systems, high-fidelity, and general replacement.
72. SCULLY—Specification sheets and brochures give data on solid-state Model 270 tape player and Model 280 tape recorder.
73. VIKING — Technical literature provides information on RP110 and RP120 solid-state record/playback amplifiers, and Model 230 tape recorder.

CATV EQUIPMENT

74. BIONIC—Data is available describing 12-channel DC momentary-control unit for program switching by remote control between receiving site and control office.
75. ENTRON—Facility brochure describes product line and manufacturing procedures as well as general history of company's participation in CATV.
76. JERROLD—Eight-page brochure features "Starline" solid-state unitized CATV systems.

COMPONENTS & MATERIALS

77. SPRAGUE—Catalog IND-800A lists UNICIRCUIT® monolithic networks, compatible components, and transistors.
78. SWITCHCRAFT—New product bulletin No. 153 describes Series 32000, and Series 32000TL "T-Lite" illuminated switches.
79. TEXWIPE—Literature gives details on aerosol solvent for tape heads and films.
80. WILKINSON—Catalog sheets list full line of direct-replacement silicon rectifiers.

MICROWAVE DEVICES

81. MICRO-LINK—Planning guide for 2500-mc ITV systems, data on Model 420A portable link and Model 600 fixed link.

MOBILE RADIO & COMMUNICATIONS

82. MOSLEY—Literature describes Citizens band antennas.
83. SPRAGUE—Circular M-853 describes SK-1, SK-10, SK-20, and SK-30 "Suppressikits" for vehicles with alternators or DC generators.

POWER DEVICES

84. HEVI-DUTY—Bulletin 7-22 supplies data on line-voltage regulator using saturable-core reactor.
85. ONAN—Standby electric plant equipment and controls are listed and described in catalogs F-198, F-205, B-312, 11E/On, and 31D/On.
86. TERADO—Folder illustrates and lists specifications of Model. 50-160 Trav-Electric power inverter.

RADIO & CONTROL ROOM EQUIPMENT

87. COLORADO VIDEO—Sheet gives data for the Model 301 video analyzer which displays TV waveforms directly on picture monitors.
88. VISUAL ELECTRONICS—Literature lists specifications for MM-1A AM modulation monitor.

REFERENCE MATERIAL & SCHOOLS

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

90. HOWARD W. SAMS—Literature describing popular and informative technical publications; includes latest catalog of technical books.

STUDIO & CAMERA EQUIPMENT

91. CLEVELAND ELECTRONICS — Data concerns modifications using new yoke assembly to update 3" image-orthicon camera.

92. GENERAL ELECTRIC—Brochure GEA 7859 describes new PE-26 completely transistorized portable 3" IO camera system. "First With 4-V" (brochure GEA-8050) includes photos and user reactions to the first 27 G-E color film-camera installations. Brochure GEA-7858 lists specifications and tube complements for VHF transmitter cubicle combinations. Specifications for second generation UHF klystron transmitters are listed in brochure GEA-7555B.

93. MOLE-RICHARDSON — Technical bulletins 102, 104, 105, 106, and 107 illustrate Softlites, Nooklites, Single Broad, Double Broad, and Cyc-Strips.

94. TV ZOOMAR—Information on Angenieux lenses for IO's and vidicons, and data on Evershed Mark II servo-controlled pan and tilt equipment.

TELEVISION EQUIPMENT

95. DENSON—Flyers and catalog describe new, used, and surplus electronic equipment.

96. VITAL—Data sheets give specifications of Model VI-500 stabilizing amplifier, Model VI-10A video distribution amplifier, and Model VI-20 pulse distribution amplifier.

97. WARD—Specification sheets describe new solid-state color phase equalizer and low-pass filter.

TEST EQUIPMENT & INSTRUMENTS

98. BLONDER-TONGUE — Catalog features new "Lab-Line" series solid-state UHF/VHF test equipment accessories.

99. HICKOK—Brochures on industrial tube testers including new Model 580, Model 539C, and Model 752A instruments.

100. I.E.H.—Flyer lists full line of harnesses and adaptors for color tubes.

101. SECO—Folder illustrates 20 test instruments including color-bar generator.

102. TELEMET — Sheet supplies specifications for transistorized TELECHROME Model 3518-A1 color-bar generator.

TRANSMITTER & ANTENNA DEVICES

103. AIR SPACE DEVICES — Brochure describes "Saf-T-Climb" device used to ensure safety during tower erection or maintenance.

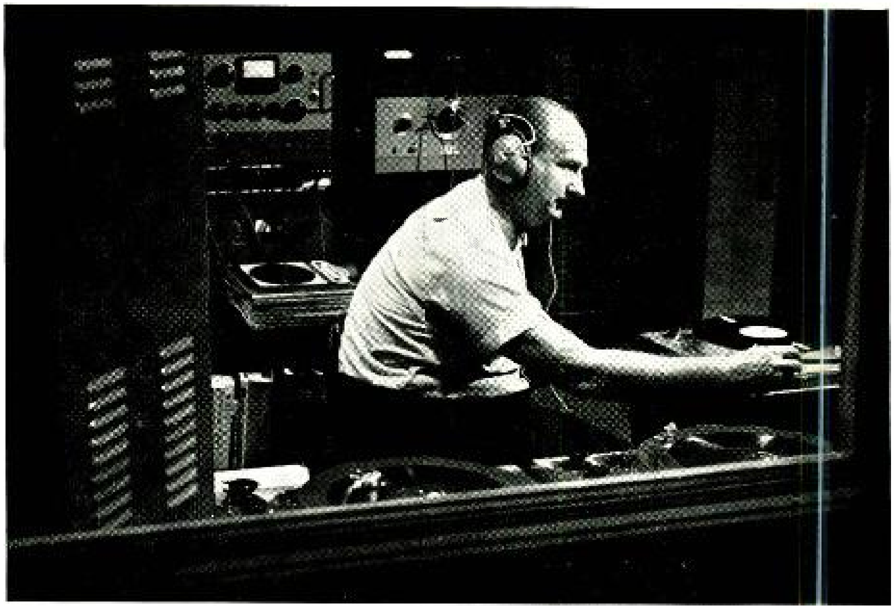
104. BAUER—Preliminary specifications are available for Model 605 7500/5000-watt FM transmitter.

105. DYNAIR—Flyers give particulars on RX-4A solid-state professional TV tuner. Illustrated bulletin introduces Series 6000 solid-state modular balanced-line transmission equipment and cites advantages of balanced-line video transmission.

106. GATES—Sixteen-page "FM Station Planner" makes equipment recommendations for class A, B, and C stations. Literature describes new FM-3G 3000-watt FM transmitter.

107. MOSELEY ASSOCIATES — Four-page leaflet gives details and specifications for Type II and Type III STL radio remote-control systems.

Advertisers' Index



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

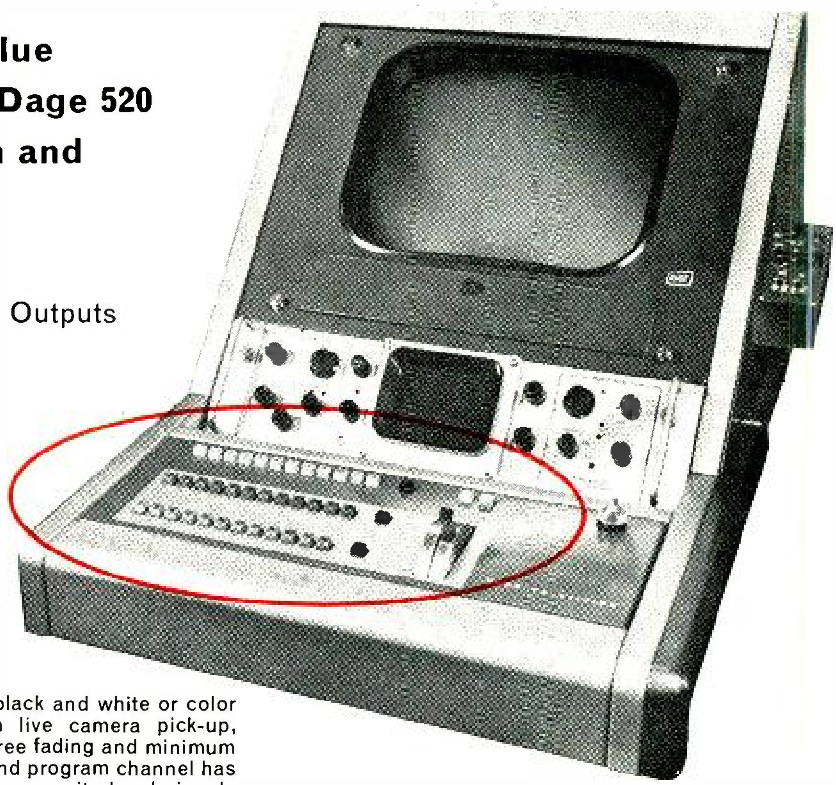
Employment

Business Opportunities

SWITCH

TO THE
NEW DAGE SOLID STATE SF-12 VIDEO
SWITCHER-FADER

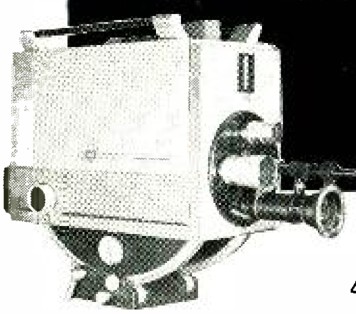
Another Outstanding Value Available with the New Dage 520 Broadcast Camera Chain and Program Center Control



FEATURES

- 2 Source Terminated Program Outputs
- Separate Preview Channel
- 8 or 12 Input Models
- Additive and Non-Additive Mixing (switch selectable)
- Self Contained Regulated Power Supply
- Illuminated Push Buttons

Stable solid-state circuitry provides excellent black and white or color performance, automatic sync insertion from live camera pick-up, transient-free push-button switching, bounce free fading and minimum cross talk. 8 or 12 camera inputs are available and program channel has two source terminated outputs. Any two non-composite local signals may be lap-dissolved, faded, super-imposed or instantly switched.



Choose Dage Plumbicon or Vidicon 520 Broadcast Camera

More features
Better resolution and detail response
High picture stability

DAGE BELL

Dage-Bell Corporation
455 Sheridan Avenue • Michigan City, Indiana 46360 • Dept. 30-9
A Subsidiary of Raytheon Company

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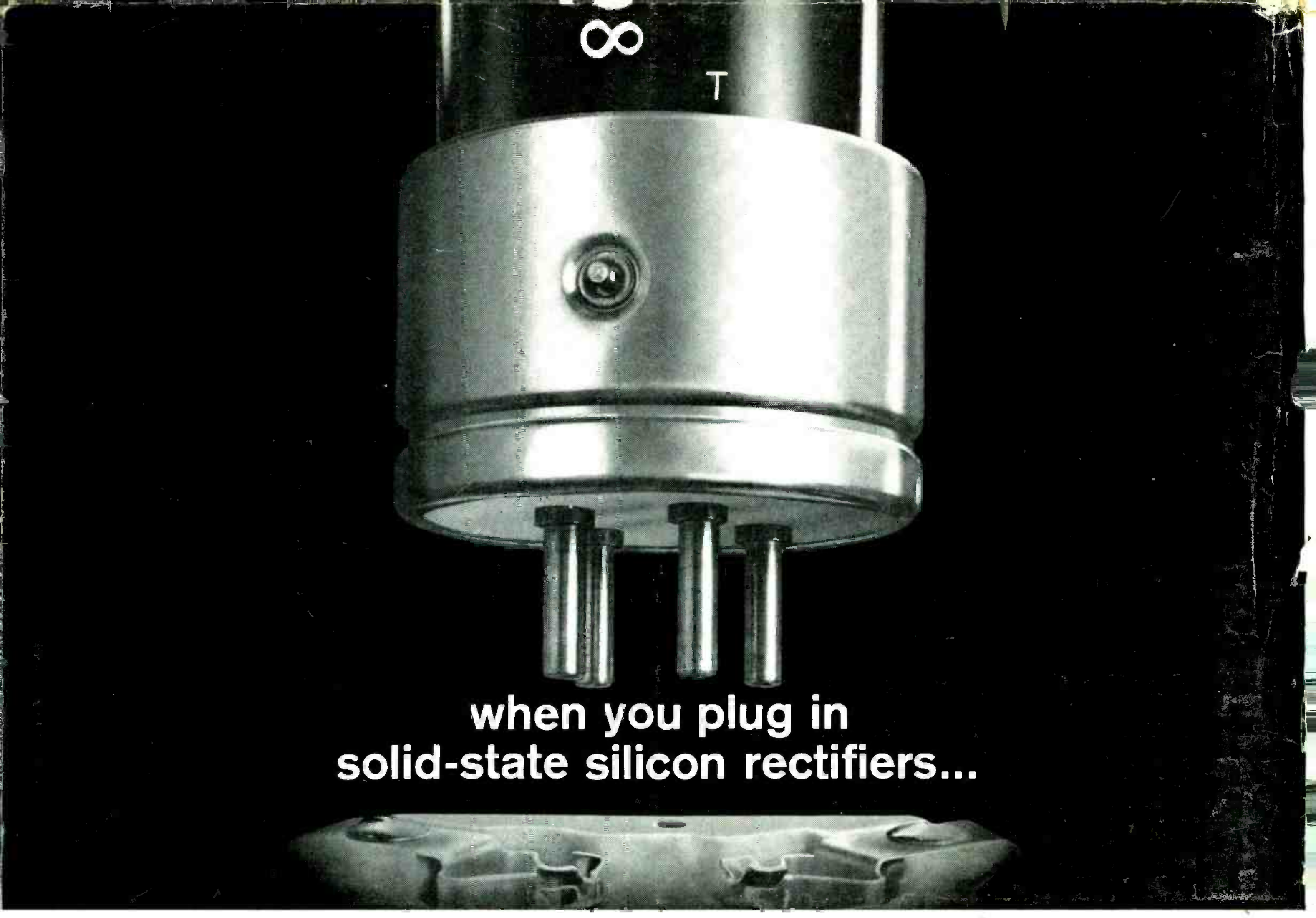

it pays to use the best

Before RCA's new solid-state silicon rectifiers became commercially available as direct plug-in replacements for mercury vapor and gas rectifiers, they had to be the best. At stake was RCA's reputation with the broadcasters.

Now, after 1,000,000 hours of cumulative life tests on prototypes and same-socket plug-ins, RCA types CR273/8008, CR274/872A, CR275/866A/3B28 are available for high-reliability performance in your broadcast equipment.

Here are benefits you can count on when you use RCA Silicon Rectifiers:

1. NEW SOLID-STATE RUGGEDNESS—nothing to vibrate or deteriorate.
2. INSTANT-ON—No warm-up time, no cool-down necessity.
3. INTERFERENCE-FREE—No arc-backs, no rectifier "hash."
4. LESS TO MAINTAIN—Long life—replacements minimized.
5. LESS EQUIPMENT—No filament transformer required.
6. SAME-SOCKET REPLACEMENTS—Type numbers identical to those of your present mercury vapor and xenon rectifier types.

RCA Silicon Rectifier plug-ins are available *only* through your RCA Industrial Distributor. Call him for price and delivery information.

RCA Electronic Components and Devices, Harrison, N.J.

The Most Trusted Name in Electronics

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