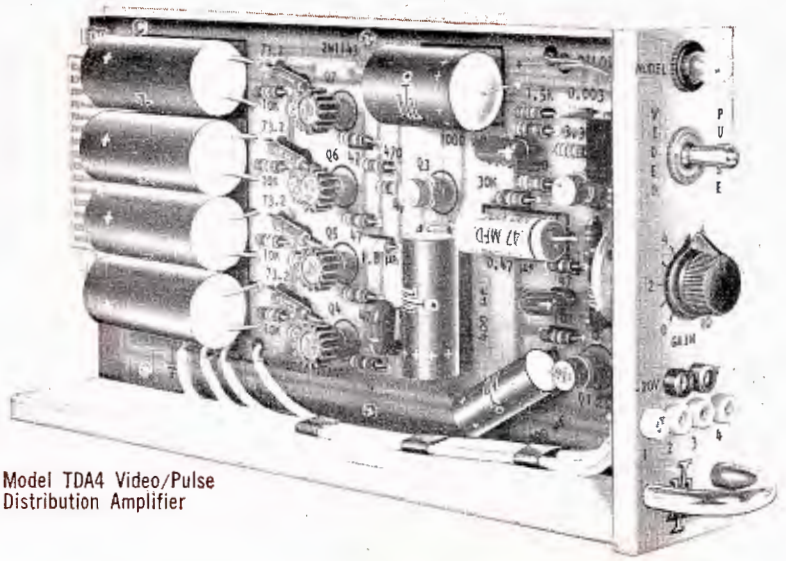
A HOWARD W. SAMS PUBLICATION

JULY 1964/75 cents

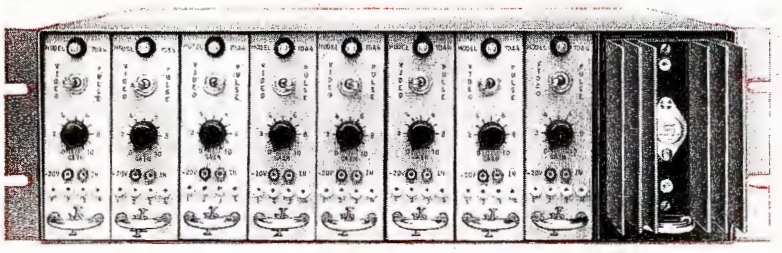
Broadcast Engineering

the technical journal of the broadcast-communications industry



Model TDA4 Video/Pulse
Distribution Amplifier

Model TDA4's with TPS4 Power Supply and TMF4 Mounting Frame



THE MODEL TDA4 VIDEO / PULSE DISTRIBUTION AMPLIFIER PROVIDES 32 OUTPUTS IN JUST 5¼ INCHES OF PANEL SPACE!

Completely transistorized and in plug-in modules, the TDA4 meets the most exacting specifications of monochrome and color distribution systems.

Compact and rugged, eight TDA4's and a TPS4 Power Supply provide 32 outputs at the rear of the mounting frame. The front of each amplifier is equipped with a pilot lamp, a gain control, video-pulse function switch and six test jacks.

While the older tube-type distribution amplifiers with only 30 output signals and producing 3200 watts of heat occupy a 50 inch rack, eight TDA4's occupy only 5¼ inches of panel space, provide 32 individual output signals and dissipate 35 watts of heat.

The initial design of the TDA4 was based on the time and use proven success of the now famous TDA2. The TDA4 uses exactly the same circuit and components as the TDA2.

The TPS4 Power Supply module is also completely solid state and provides 20 volts, regulated, to all eight amplifiers. It is designed so most of the heat dissipation is at the front of the cabinet.

TDA4 Video/Pulse Distribution Amplifier	$275.00 each, f.o.b. Nashville, Tenn.
TDA4K Video/Pulse Distribution Amplifier with sync mixing	$310.00 f.o.b. Nashville, Tenn.
TPS4 Power Supply	$275.00 each, f.o.b. Nashville, Tenn.
TMF4 Mounting Frame	$175.00 each, f.o.b. Nashville, Tenn.
TME4 Module Extender	$ 40.00 each, f.o.b. Nashville, Tenn.

Write for complete information and specifications Department T-4

INTERNATIONAL NUCLEAR CORPORATION

608 Norris Avenue — Nashville 4, Tennessee

Circle Item 1 on Tech Data Card

the technical journal of the broadcast-communications industry

®Broadcast Engineering

Volume 6, No. 7 **July, 1964**

CONTENTS

FEATURES

DEPARTMENTS

PUBLISHER: Howard W. Sams

EDITORIAL: Editor, Forest H. Belt; Managing Editor, Stuart N. Soll; Associate Editors, Allen B. Smith, George F. Corne, Jr., and James M. Moore; Washington Correspondent, Howard T. Head.

CIRCULATION: Manager, J. A. Vitt; Fulfillment: Manager, Pat Tidd; Assistants, Katherine Krise and Cora LaVon Willard.

PRODUCTION: Manager, Robert N. Rippy; Art, Robert W. Pool; Photography, Paul A. Cornelius, Jr.

ADVERTISING: Sales Manager, Dave L. Milling; EAST—Gregory C. Masefield, Howard W. Sams & Company, Incorporated, 3 West 57th Street, New York, N. Y., Phone MU 8-6350; MIDWEST—Hugh Wallace, Howard W. Sams & Co., Inc., 4300 West 62nd Street, Indianapolis 6, Ind., Phone AX 1-3100; SOUTHWEST—C. H. Stockwell Co., 4916 West 64th Street, Mission, Kansas, Phone RA 2-4417; LOS ANGELES 57, CALIF., Maurice A. Kimball Co., Inc., 2550 Beverly Blvd., Phone DU-8-6178; SAN FRANCISCO, Maurice A. Kimball Co., Inc., 580 Market Street, Phone EX 2-3365; PARIS 5, FRANCE, John Ashcraft, 9 Rue Lagrange, Phone ODeon 20-87; LONDON W.C. 2, ENGLAND, John Ashcraft, 12 Bear Street, Leicester Square, Phone WHitehall 0525; TOKYO, JAPAN, International Media Representatives, Ltd., Kisha Kurabu 14, 2-chome Marunouchi, Phone (502) 0656.

SUBSCRIPTION PRICE: U.S. $6.00, one year; $10.00, two years; $13.00, three years. Outside U.S.A. add $1.00 per year for postage. Single copies, 75 cents, Back issues, $1.00.

BROADCAST ENGINEERING is published monthly by Technical Publications, Inc., an affiliate of Howard W. Sams & Company, Inc. Editorial, Circulation, and Advertising headquarters: 4300 West 62nd Street, Indianapolis 6, Ind.

A HOWARD W. SAMS PUBLICATION

BPA

SOLID-STATE VIDEO DISTRIBUTION AMPLIFIERS

Self-Clamping Amplifiers

Sync Separating Amplifiers

Sync Mixing Amplifiers

Video Distribution Amplifiers

Pulse Regenerative Amplifiers

CBS Laboratories has developed broadcast-proven solid-state video amplification equipment to meet the rigorous specifications of the Columbia Broadcasting System Television Network.

Now available to all television broadcasters, these video amplifiers offer the highest quality, most distortion-free signal handling capabilities of any on the market plus all the advantages of solid-state construction.

. . . Quality Products for Professional Broadcasters

CBS LABORATORIES *High Ridge Road, Stamford, Conn.*
A Division of Columbia Broadcasting System, Inc.

Circle Item 3 on Tech Data Card

LETTERS to the editor

DEAR EDITOR:

In the Engineers' Exchange department of April 1964, Mr. F. C. Hervey, Transmitter Supervisor, WHKW, Chilton, Wisconsin, discusses the advantatges of reducing line input voltage to equipment to obtain lengthened component life; and he mentions the major problem is obtaining "special" stepdown ratio power transformers.

As an inexpensive solution to this problem, I suggest that the standard stepdown transformers be used, and voltage adjustment be made on the low side by using small auxiliary transformers. In Mr. Hervey's case 33KV/240V 25KVA 3-phase transformers furnished 240-256 volts per phase at approximately 100 amperes, while about 220 volts was desired. If a bucking voltage of 20 or 25 volts could be inserted in series with the output of each phase, the desired result would be obtained.

Since the current is approximately 100 amperes and the voltage about 20 volts, a transformer to provide this bucking voltage needs a capacity of only 2 KVA per phase (actually, of course, practically no power is actually consumed). Such transformers may be inexpensively wound to order in a small shop, or the high voltage winding cut from a residential service pole transformer leaving the usual 115/230 volt windings intact (they are usually wound next to the core) and the few turns of heavy wire needed to provide the 20-25 volts wound in by hand with space to spare. The use of flexible single-conductor cable with good insulation, such as 128/1 motion-picture projector cable, makes this simple and eliminates the need for additional insulation.

Many types of heavy-duty filament transformers are available with suitable specifications. We have a number of military surplus 230/115V/11.5V 200A radar power supply filament transformers which could be used, for instance, as well as other sizes. Two such transformers, unused, may cost less than one wound to 23 volts, so they may be used in pairs. The primaries are bridged across the lines and the secondaries connected in series bucking the line.

CHARLES C. LITTELL, JR.
Engineering Associates
Dayton, Ohio

Author Hervey's comments follow.—Ed.

DEAR EDITOR:

Mr. Littell of Engineering Associates has written regarding using buck-boost transformers, rather than getting the power company to supply tapped pole transformers to reduce incoming three-phase line voltage to more manageable limits, as I originally suggested.

Good idea. It works, and has been used for years. It also occurred to me

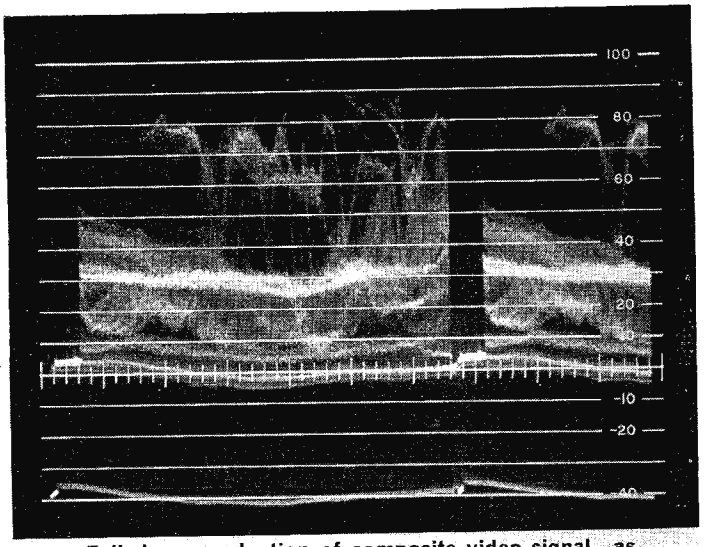
• Please turn to page 51

new camera

for Tektronix Oscilloscopes

Type C-27

pictures full 8-cm x 10-cm graticule on Polaroid* 3¼" x 4¼" film



Full-size reproduction of composite video signal—as displayed on Tektronix Type RM527 Waveform Monitor. Note that image is not reversed, right to left.

Includes f/1.9 lens with 1:0.85 object-to-image ratio, cable release, direct binocular viewing system with removable viewing tunnel, and Polaroid* Land Pack Film Back, using Type 107 black and white film or Type 108 color film.

One mounting bezel adapts C-27 Camera to Type RM527 Waveform Monitor. Another mounting bezel adapts C-27 Camera to most other oscilloscopes. Bezels available separately $15.

C-27 CAMERA $420

U. S. Sales Prices f. o. b. Beaverton, Oregon

* ®by Polaroid Corporation

- **BINOCULAR VIEWING**
- **DIRECT RECORDING**
- **ACCESSIBLE CONTROLS**
- **ONE-HAND PORTABILITY**
- **LIFT-ON MOUNTING**
- **SWING-AWAY HINGING**

Plus

COMPONENT INTERCHANGEABILITY . . . with C-27 Camera able to accept other lenses, film backs, shutter actuator, 35-mm film attachment, other accessories.

CALL YOUR TEKTRONIX FIELD ENGINEER FOR A DEMONSTRATION OF THE C-27 CAMERA.

Tektronix, Inc. / P O BOX 500 · BEAVERTON, OREGON 97005 · Phone: (Area Code 503) Mitchell 4-0161 · Telex: 036-691
TWX: 503 291 6805 · Cable: TEKTRONIX · OVERSEAS DISTRIBUTORS IN 25 COUNTRIES
TEKTRONIX FIELD OFFICES in principal cities in United States. Consult Telephone Directory

Tektronix Australia Pty., Ltd., Melbourne; Sydney • *Tektronix Canada Ltd., Montreal; Toronto*
Tektronix International A.G., Zug, Switzerland • *Tektronix Ltd., Guernsey, C. I.* • *Tektronix U. K. Ltd., Harpenden, Herts*

Circle Item 5 on Tech Data Card

JAMPRO

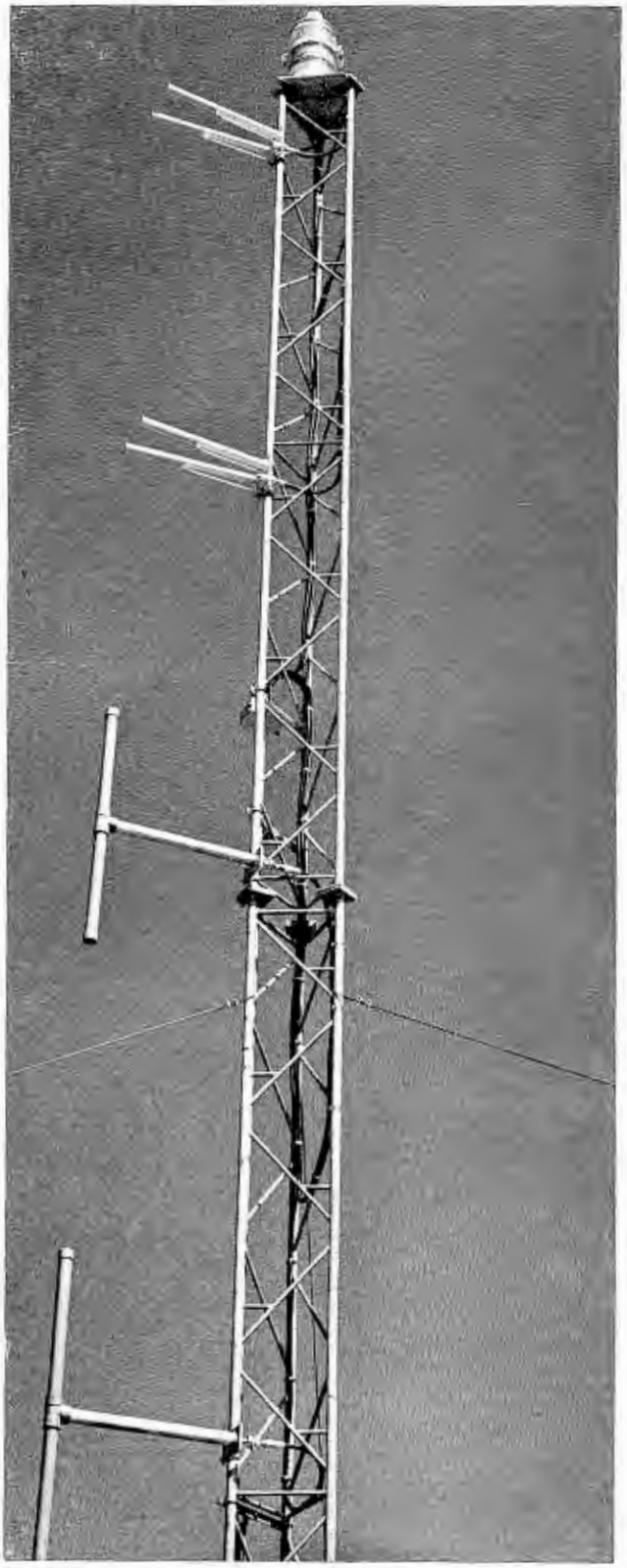
HORIZONTAL AND VERTICAL FM ANTENNAS

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

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

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

*U.S. PATENT PENDING



EXCLUSIVE ADVANTAGES OF THE JAMPRO DUAL POLARIZED FM ANTENNA SYSTEM

MORE SIGNAL INTO CAR RADIOS

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

MORE SIGNAL INTO HOME FM RECEIVERS

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

EXISTING JAMPRO ANTENNAS MAY BE CONVERTED

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

DIRECT ENGINEERING SERVICES

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

MORE LISTENERS IN HILLY TERRAIN

Signal levels in reflection areas are increased with dual polarization.

LOW PRICE — QUICK DELIVERY

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

JAMPRO ANTENNA COMPANY

6939 POWER INN ROAD
SACRAMENTO 28, CALIFORNIA

Circle Item 6 on Tech Data Card

Introducing a New Era in Television Tape Production: The Ampex VR-2000

More than a new look! More than a new name! The Ampex VR-2000 Videotape* television recorder offers a completely new concept in television tape recording. With the introduction of this all-new machine, the ability to achieve full production capability . . . on tape . . . becomes a reality. True "tele-production" becomes an accomplished fact instead of a glowing promise. From its Mark IV heads with rotary transformers and integral preamps, to its highly sophisticated control and monitoring system, the VR-2000 has been designed to entirely new parameters of quality and performance without regard for limitations of previous technology. The result is a recorder offering unparalleled results on current "low-band" standards . . . and opening the door to an entirely new "high-band" standard as an optional operating mode, providing a new performance level presently unattainable on any other recorder. For networks, television production companies, and quality-conscious stations, this "high-band" standard means vast improvements in band width and signal-to-noise ratio . . . permits tape copies to the third generation with picture quality equal to "master" tapes made on today's recorders . . . gives color performance that outstrips anything ever demonstrated. Yet, for all its sophistication, the VR-2000 achieves a new degree of simplicity, dependability, and ease of maintenance. Only Ampex could build the VR-2000 . . . and only Ampex offers a complete family of VTR production accessories: Intersync* (standard equipment on the VR-2000), Amtec*, Colortec*, Electronic Editor, Editec* . . . all proven products . . . not promises . . . ready now to increase your VTR profits and capabilities. So it's little wonder that a major European network is now installing the VR-2000. Ampex Corporation, Redwood City, California. Worldwide sales, service. Term leasing, financing.

*T.M. Ampex Corp.

AMPEX

Circle Item 7 on Tech Data Card

LINE VOLTAGE REGULATION FOR BROADCAST STATIONS

by Paul J. Mueller, Chief Engineer, WBKV, West Bend, Wisc.—Case history of one station's experiences in eliminating line voltage fluctuations.

Spasmodic fluctuation of input voltage spells grief for the broadcast engineer. Frequent power "bumps" play havoc with the station's signal, they necessitate constant correction and maintenance of broadcast equipment, and they sharply reduce the life of vacuum tubes and electronic components.

We became acutely aware of this problem at WBKV and WBKV-FM in 1960, when we increased the power of our AM station to 1000 watts. The increase in power, coupled with the demands of our 18,000-watt FM station, made it increasingly difficult to get stable input voltage for our stations.

WBKV and WBKV-FM are located near the southernmost perimeter of the city of West Bend, Wisc. Power is supplied on an industrial-rural feeder line. Some of our immediate neighbors were already drawing heavy power loads. These included a ready-mix concrete plant, a feed mill, and a factory with large stamping equipment. Consumer demands were high, too. All of these factors added up to a marked input voltage fluctuation. Our high cost of tube replacement was a conclusive indicator of this situation; an increase of only a few per cent in filament voltage cuts life in half.

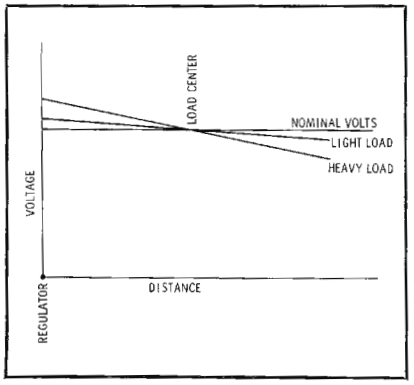


Fig. 1. Voltage distribution along a typical power line with a step-type regulator.

There were other ways the voltage problem made itself known. Under FCC regulations, the power level of a broadcast station cannot be more than 5% above or 10% below its established rating. A licensed engineer or engineer-announcer must take readings every half hour to assure compliance with the rules. Line-voltage fluctuations forced our engineers to make frequent adjustments of the control equipment for input voltage, PA plate voltage, and filament voltage.

Efforts of Local Utility

The local utility was most cooperative in attempting to provide the closest regulation possible. With voltmeters in hand, the utility engineers beat a path to our door. But the result of each test they made turned out the same: the utility was, in fact, maintaining the input voltage within the specified range of ± 10 volts from a pre-determined level on the industrial-feeder line. This performance complied with state regulations.

The service, although more than satisfactory for the industrial plants in our vicinity, was simply not up to the precise voltage needs of our broadcast equipment. However, the utility was not prepared to give up. It increased the size of the outside pole transformers to keep voltage losses to a minimum. Capacitor banks were also installed nearby. Then our connection was moved from one phase to another in the hope of finding the one phase that would provide adequate overall regulation. Unfortunately, none of these measures sufficed.

Types of Regulators

It was at this point that we decided to undertake an extensive study of various line-voltage regulators to find one suitable for the broadcast problem. We began by listing the following essential specifications:

1. The regulator must provide extremely fast voltage compensation in terms of cycles, not seconds.
2. Regulation must be for all line-voltage changes, not just for those that occur because of peak or light loading during certain times of the day or evening.
3. Voltage transients, such as those caused by motor starts or welding loads, must be compensated for.
4. The regulator must be virtually free of maintenance.

Step-Type Regulator

The step-type voltage regulator was investigated first. Basically it is a motor-driven mechanical device for switching taps on an auto-transformer to compensate for high or low input voltage. A control element senses the input voltage. If the voltage is too high, the motor is energized to move a tap switch from tap to tap until the desired voltage is obtained. If the input voltage is too low, the motor-driven tap switch engages taps in the opposite direction.

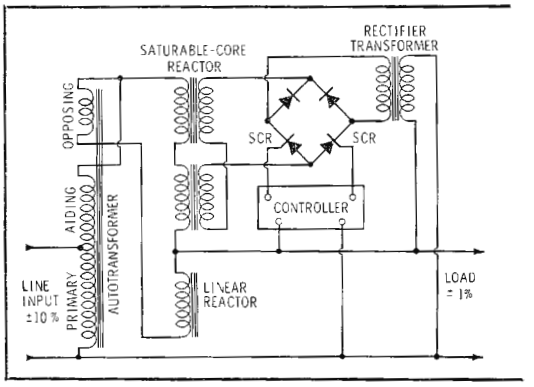


Fig. 2. Schematic diagram of voltage regulator employing saturable-core reactor.

Step-type regulators are used by the REA throughout the country for regulating voltage on high-KVA transmission or distribution lines. They do an excellent job of keeping voltage as close as possible to nominal over the entire line. It is important to note that step-type regulators are not designed to regulate transient voltage fluctuations but rather to automatically compensate for predictable line-voltage changes that occur during peak periods of loading. This is done by making the voltage somewhat higher than nominal at the regulator, nominal at the load center of the line, and below nominal at the end of the line (Fig. 1).

Thus, the primary function of the step-type regulator is to change the slope of a voltage line, depending on the degree of loading. Since it has a very slow response time — on the order of 20 to 30 seconds — it cannot regulate transient voltage surges that are gone before the device has even begun to correct them.

Variable-Autotransformer Type

We considered the variable-autotransformer regulator next. Our study showed it to be an improvement over the step-type regulator in that, instead of switching an electrical contact to individual taps on an autotransformer, a continuous adjustment was provided by sliding a brush over an exposed winding.

Although this device permitted more precise regulation, it still had the inherent drawback of the step-type regulator: since it was motor-driven, its response time was slow. Extra care and maintenance were needed, because of the continual contact of the brush and winding.

Induction-type Regulator

Because of the mechanical wear problem in other regulators, we checked out an induction-type device. By substituting inductive coupling of two movable windings for brush or tap-switch contact, output voltage can be controlled without physical wear in the regulator. Regulation of high or low input voltage is controlled by positioning two windings relative to each other. However, the induction-type regulator is motor-driven and therefore is also slow in response.

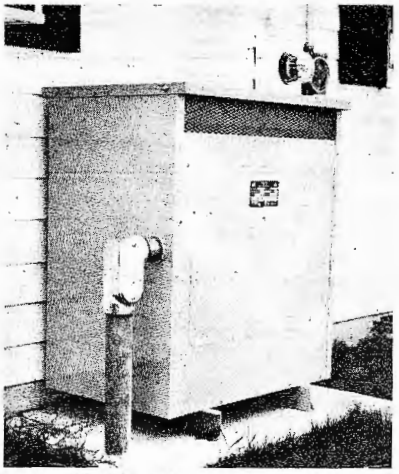


Fig. 3. 50-KVA voltage regulator installed in a weatherproof case outside building.

Static-Magnetic Regulator

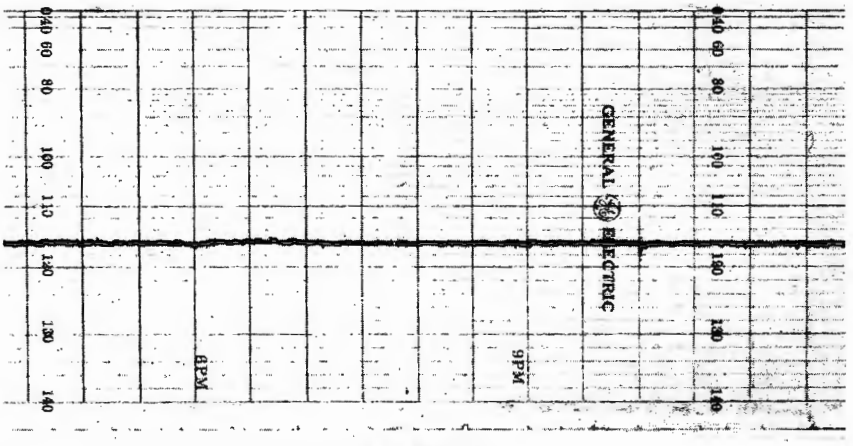
Obviously, no electromechanical device could give us the fast response time, reliability, and freedom from maintenance we needed. We next turned our attention toward the possibilities of a static-magnetic type of regulator.

This device differs from conventional electromechanical regulators in that voltage is corrected statically without motor-driven tap contacts, brushes, or induction windings. The static-magnetic regulator has three basic circuit components: an input autotransformer, a reactive voltage-dividing network, and a sensing circuit (Fig. 2).

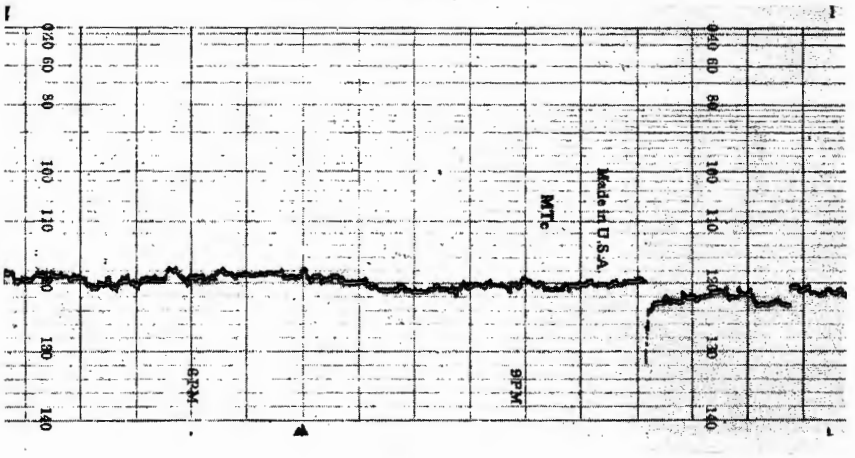
The input transformer has primary, aiding, and opposing windings. The primary and aiding windings are connected together as a step-up autotransformer; the opposing winding is connected in series with them and with opposite polarity.

A linear reactor and a saturable-core reactor are connected across the opposing winding. By varying the amount of DC applied to the saturable-core reactor, the voltage from the opposing winding is divided by a variable amount. The result is similar to that obtained from the standard potentiometer used on many voltage-dividing circuits. However, the static-type regulator achieves the result magnetically with reactive elements rather than by mechanically moving a brush or electrical contact.

• Please turn to page 42



(A) Output



(B) Input

Fig. 4. Chart recordings of static-magnetic regulator input and output voltage.

Electronics at the World's Fair

by Forest H. Belt

On April 22, 1964, in a large ex-swamp called Flushing Meadow near New York City, an exposition began that, for sheer complexity, almost overwhelms the imagination. The opening of the New York World's Fair, a gigantic international exchange of culture and technology, introduced an electronic era of trade and cooperation unknown in the annals of history. The Fair's deep commitment to electronics is affecting the lives and thinking of consumers, manufacturers, broadcasters, and those responsible for maintenance and servicing all over the world.

Your BROADCAST ENGINEERING editors recently visited the Fair to bring you a first-hand report. We saw electronics on display, electronics being used to activate and control other displays, and electronics at work in the complex administration of this 646-acre tract where thousands of people move in every direction, from pavilion to pavilion, in a continuous throng. Come along with us now, and we'll take you on a word-and-picture tour of the Big Fair, pointing out those features of particular interest to the broadcasting-minded visitor.

Color TV Center

Gate 1, the main entrance for most Fairgoers, opens directly in front of the **RCA** Color TV Communications Center, as you can see from Fig. 1. RCA plays a many-faceted part, providing dozens of services for the overall operation of the Fair and widespread facilities for broadcasts originating within the giant Fairground. The ultra-modern RCA building is laid out in the shape of three large cylinders on a 30,000-square-foot plot.

In the part of the exhibit that comprises the first cylinder, the visitor can stand in front of a live color television camera and see himself in both front and side views. For the 600 persons-per-hour who visit the RCA exhibit, however, the principal attraction is a guided tour of an operating TV broadcasting studio and control room, contained in the other two cylindrical sections of the building. The studio and control room are surrounded by a glassed-in elevated walkway that completely encircles the extensive facilities. Through the glass, visitors can see action in both the studio and control room. They can watch every move of

Fig. 1. Main entrance to World's Fair.

the directors, producers, and control operators, observe cameramen dollying in and out, and view, on several monitors, the results of those activities. They can also see how shows are taped, played back, retaped, and edited, and view all programs on monitors located throughout the building.

To serve the Fair itself, RCA's facilities will soon become part of the world's largest CCTV system, feeding some 300 color receivers situated throughout the Fairground. Programming will include: spot news reports from various points on the premises using a complete mobile color-TV studio; aid in locating lost articles; and other helpful highlights.

The RCA color CCTV facilities are also used to aid Pinkerton police in returning missing children to teachers or parents. Lost children are brought to the color studio where their picture is broadcast over the Fairgrounds system with instructions for reclaiming them.

An impressive array of station equipment fills the racks and panels of the control room. Three video tape recorders stand ready to record any of the program material for rebroadcast at any time, and elaborate video- and audio-control consoles permit broadcasting or recording any form of AM, FM, or TV show. In the circular studio, illumination is provided by the very latest **Kleigl** lighting equipment. Thus, color-sensitive electronic eyes serve the Fair from the most modern color-TV center ever built.

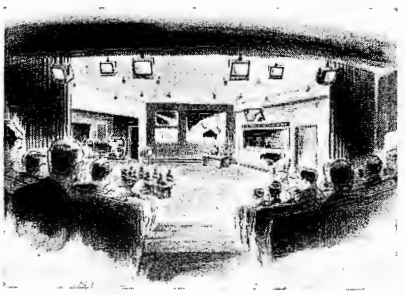


Fig. 2. Education methods demonstration.

Computers on Parade

Our next stop is the **National Cash Register** pavilion where, as you may suppose, electronic computers play an important part, with the Model 395 all-transistor system receiving the spotlight. However, the display of greater interest to the broadcast industry demonstrates —through a magnifier—a TV picture displayed on a 1/16″ television screen. The precision required, in the phosphor coating and in the sweep system, to achieve a clear image on so tiny a surface is impressive, and no doubt this CRT will open up important advances in high-resolution TV receivers.

The **IBM** exhibit was designed to give the average Fairgoer an insight into complex computer operations. Short plays, puppet shows, and films devoted to man's thought process and how he has developed computers to do certain portions of his thinking dramatize the computer story. The concepts established in the films are then reinforced by several mechanized puppet shows staged on the floor below, that demonstrate the logic of computers in a most entertaining manner.

Electronics for Learning

Housed in a 50,000-square-foot building facing the Pool of Industry, the Hall of Education contains dozens of displays that show present trends in education and imaginative concepts of what schools, classrooms, and teachers will be like in the future. Many techniques we see demonstrated here are already in use in classrooms around the country. Some experimental approaches are being tested here in actual classroom and home-teaching situations. Interest centers around the recently completed Communications Demonstration Center (Fig. 2), symbolized by the catchword "Educom." Coordinating the installation and operation of the complex electronic system in this exhibit is **Visual Electronics Corp.**, New York manufacturer and distributor of broadcast and communications systems and equipment.

Obviously, an undertaking of this size requires the efforts and products of

many companies. The Communication Center utilizes equipment designed by **KRS Electronics, McCurdy Radio Industries, Comrex, Electro-Voice,** and **Harman-Kardon.** Video equipment includes that of **Visual Electronics Corp., Conrac** Div. of Giannini Controls, **GPL** Div. of General Precision Instruments, **TeleMation, Inc.,** and **Jerrold Electronics.** Film and slide equipment comes from **Fairchild Camera & Instrument, Graflex, Bell & Howell, Bodde Screen and Projector Co., Radiant Mfg. Co.,** and **Spindler & Sauppe;** studio equipment from **Machtronics, Century Lighting, E. J. Baughman Co.,** and **Emcor;** and test equipment from **Harmon-Kardon** and **Tektronix.** This impressive list of manufacturers illustrates how important electronics will be in the classroom of the future. Electronic teaching aids include a special programmed - learning student - response system produced by **Edex Corp.,** a dial-controlled learning system from **Chester Electronics,** and a "Language Master" teaching machine from **Bell & Howell. WNYC-TV** has provided facilities for the radio and television studio.

Visitors to the Center will also see how, employing a device called the "Studysphere," a single student (or several) can receive personalized instruction through television — closed - circuit or aired. With ETV stations springing up all over the country, such programs not only are possible, they are actually in use. Some are received and studied at home, and some at school; many can be studied both places.

A Study in Communications

The **Bell System** exhibit is dominated by a 140′ microwave tower at the base of which is a glass enclosure that permits passersby to inspect racks which contain microwave relay equipment used to transmit Fair-originated TV programs into New York City. The Bell microwave tower and control-room facilities serve both the RCA and Hall of Education exhibits when live shows are relayed to New York for video taping or rebroadcasting.

The Bell display consists of about 50 scenes depicting the history of communications. A separate taped-sound system in each of the 1000 continuously moving chairs used to transport visitors is piped to each passenger through earphones, and is synchronized to provide the visitor with a commentary on each scene as he passes by.

In the lower level of the building, Bell demonstrates some unusual phenomena associated with electronics, such as the "visible speech" display (Fig. 3), which shows various graphic effects produced by the voice of the demonstrator. The lower hall is entered through an anechoic chamber that deadens sound by eliminating all reverberation.

In the hall are several of the experimental "Picturephone" systems—Fig. 4—which use "Touch-Tone" dialing (a feature incorporated in all telephones at the Fairground) and the hands-free "Speakerphone." The "Picturephone" contains only two tubes—a 1″ vidicon camera tube and the 6″ CRT picture

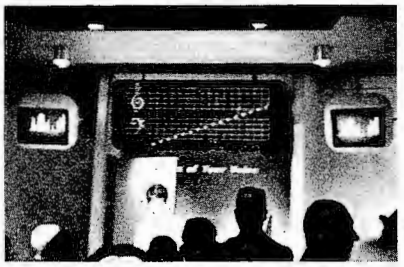


Fig. 3. Voice patterns on monitors.

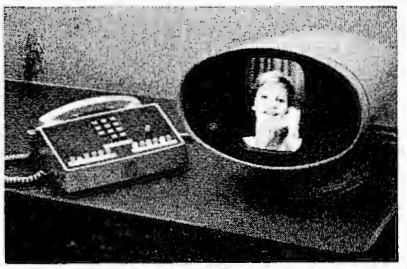


Fig. 4. "Picturephone" communications.

screen. Transistors handle the rest of the work inside this miniature CCTV system. The receiver section displays a reasonably defined picture, scanned "on end" at 275 lines per frame, 30 frames per second. The system requires a three-pair cable with a bandwidth capability of about .5 mc—not bad considering the definition; one pair is used for audio transmission and two pairs for video transmissions.

Electrical Progress

At the **General Electric Co.** exhibit, the visitor may ride in G-E's "Carousel of Progress," a huge circular auditorium that revolves around five stages depicting home electric progress from 1880 to the present. The dioramas are each populated by amazingly lifelike figures, created by Walt Disney and called "audio-animatronic" people. They are deceptively realistic, manifesting a wide range of human movements and mannerisms.

Leaving the Carousel, visitors move along a "time tube" past kaleidoscopic mirror effects (also arranged by Disney) that show over 100 photo-scenes relating to research being carried on by G-E scientists. Then, in a darkened theater, visitors watch the "Skydome Spectacular," projected on the theater's domed ceiling. Lightning flashes, thunder rumbles and then crackles startlingly; a storm that seems to stretch as far as the eye can see is unleashed on the screen (Fig. 5). The storm is replaced by the searing flames of the sun, and the flames give way to spinning atoms that move across the "sky"; the narrator explains the tremendous power unleashed by nature and suggests that man has learned to do the same.

Visitors then witness a demonstration of the controlled fusion of deuterium atoms. To produce the reaction, a bank of capacitors is charged to 60 kv, and deuterium gas in special quartz enclosures is preheated to a dull glow. Following a dramatic countdown, the capacitors are discharged through two coils positioned around the quartz tubes. The pulse sends nearly one million amps through the coils for part of a microsecond. There is a sudden sharp report and a blinding flash as the deuterium atoms fuse at temperatures as high as 100,000,000° F. The fusion reaction itself takes about six microseconds, too short to be dangerous but long enough to release significant and measurable neutron energy.

Downstairs, in a model all-electric community called "Medallion City," visitors can see: "Steinmetz High School," where CCTV and audiotape (language-lab-type) teaching machines tutor students in an electronically climate-controlled classroom; "City Hall," where two-way radio, CCTV, automated traffic control, and automated high-speed transit systems make city life safer; "Coolidge Hospital," where medical electronics, X-ray, and two-way and CCTV communications networks are saving lives; and modern homes where electronics is contributing to greater leisure.

While the theatrics at G-E are impressive, the real spectacular is behind the scenes, where some of the most advanced electronic techniques are at work. The heart of the giant "Progressland" display is a G-E 225 computer used to program the proper sequence of as many as 1400 separate actions. Four tape machines, built by **Precision Instruments Corp.,** handle automation for the audio-animatronic figures and for the "Skydome Spectacular." Using 1″ magnetic tape, preprogrammed with 32 tracks per tape, two of these machines alternate in operating the entire "Carousel" system. When the first machine finishes the sequence contained on one tape, an automatic switchover sensor places the other machine in operation while the first rewinds. The other two 32-track tape machines alternate with one another to control the projectors and provide sound effects for the audio-visual "Skydome Spectacular."

• Please turn to page 38

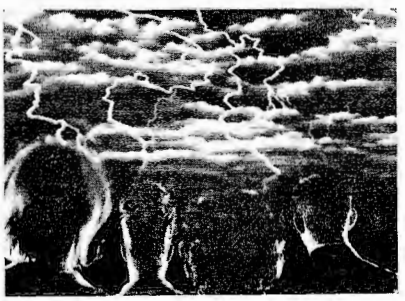


Fig. 5. Realistic storm projected on dome.

Fig. 6. CCTV video switching panel.

THE EARLY EVOLUTION OF TELEVISION

by Len Spencer, Consulting Author, Technical Director, CKAC, Montreal, Quebec, Canada—A chronicle of events in the development of television, from the Nipkow disc to the Madrid Conference.

Although Paul Gottlieb Nipkow is credited with the first conception of a spirally perforated rotating disc to dissect an image, it is not generally known that in the Telegraphic Journal of 1881 an inventor by the name of Shelford Bidwell described a device for "the telegraphic transmission of pictures of natural objects," which predated Nipkow by three years.

During May, 1891, an Illinois experimenter, Amstutz, successfully sent a halftone photo over a 25-mile wire circuit in eight minutes. The picture received was a celluloid photographic spiral around the receiving drum. When finished it was removed from the cylinder, flattened out, and made into a stereotype for relief printing. The engraved celluloid sheet could also be inked and printed on the intaglio press.

Amstutz also worked with scanning discs in 1894, but it was not until 1913 that Jenkins of Washington and John Logie Baird in England began the work which culminated by 1925 in the showing of animated motion pictures by television.

Among the many companies engaged in experimental TV work during the late twenties was Bell Telephone Laboratories who sent a picture from Washington to New York in 1928. Prominent among the experimenters were RCA-Victor in Camden, N. J., Jenkins Corp. of Passaic, N. J., General Electric at Schenectady, N. Y., Philo Farnsworth in Philadelphia, Penn., and U. A. Sanabria in Chicago, Ill.

From the magazine Radio News of February, 1925, a description of an RCA "photoradiogram" shows clearly the dependence of television on advances in other sciences. This transmission was from London to New York and took place on November 30, 1924. The following is an excerpt from that article.

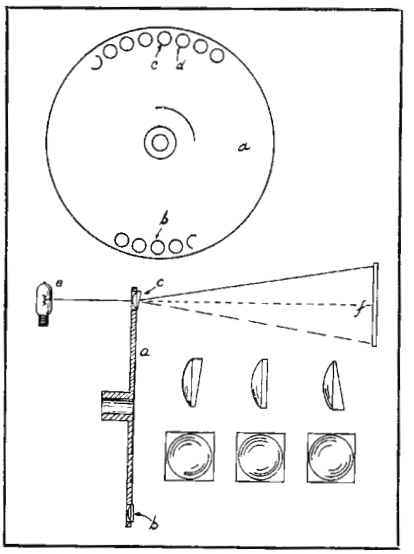


Fig. 1. Scanning lens disc system in which rotating lenses swept image across screen in horizontal direction, while the line was displaced vertically by changing angle of several successive prism elements.

"The transparent film is placed on a glass cylinder. An incandescent lamp inside the cylinder is focused in a minute beam onto the film as the cylinder rotates, and this transfers the light values of the picture into electrical impulses, in a General Electric Co. photoelectric cell.

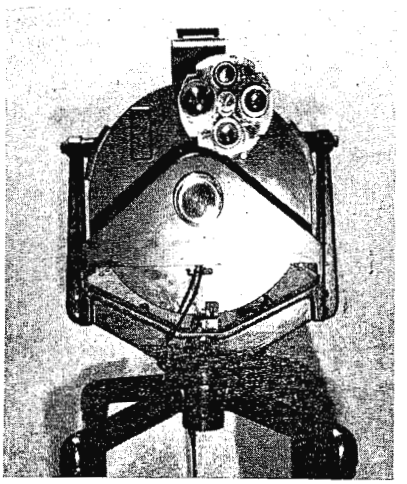


Fig. 2. 1931 flying spot scanner camera.

"The receiving cylinder has a white paper placed thereon, and the incoming dots-and-dashes, amplified in passing through a bank of vacuum tubes, are recorded in ink on this paper with a special vibrating fountain pen, drawn down by magnet coils to record the picture much in the style of an artistic stippled engraving. The cylinders of both the sending and receiving machines are rotated back and forth, the electric camera itself advancing down the length of the picture one notch at a time.

"The necessary synchronism of the two machines is maintained by the use of special driving motors and a special controlling mechanism based on the constant pitch of a tuning fork."

The pioneer work of Jenkins, who developed a transmission system using a prismatic ring and disc, demonstrated to those who followed the problems to be solved and indicated possible solutions.

The methods of scanning began with a disc having spiral holes. Next, these holes were replaced with lenses; then the lenses were focused on mirrors, and these mirrors in turn were viewed through a magnifying lens. Such complicated devices were required because of two basic problems—restricted size and low light density.

The height of the picture was governed by the vertical distance between the first and last holes of the spiral, while the width was controlled by the distance on the horizontal plane between the first and the last hole. Obviously, both of these criteria depended on the diameter of the disc.

To create the illusion of continuity the spiral must sweep the scene in about one sixteenth of a second, so in practice 900 rpm was used. For a 6″ square picture a 20″ diameter disc was required; imagine the whirling monster needed for 23″ projection! This prompted the

frantic search for other means of scanning. The first system in the sequence which eventually led to the development of all-electronic dissection and scanning was optical, employing changing angles of successive prism elements (Fig. 1).

There were in the beginning drum designs with prism-type lenses spiraling in a horizontal plane and using reflecting mirrors; some clever systems made use of two circular rotating prisms. As far back as 1913 a Russian, Dr. Boris Rosing, had used a cathode ray oscilloscope for receiving disc transmissions.

The problem of the actual transmission was not easy to overcome, for the frequencies assigned for TV experimentation were 2000-2100 kc, 2100-2200 kc, 2200-2300 kc, 2750-2850 kc, and 2850-2950 kc. It was obvious that even the scanning frequency of 60 lenses at 1000 rpm needed a sideband frequency of 60 kc, and the actual element frequencies were very much higher. But there were no power tubes available in the 'twenties that could generate useful outputs in the megacycle range. Even the task of modulating at video frequencies with the equipment then available was apparently hopeless.

By 1932 most television transmitters were using the "flying spot" method of transmission (Fig. 2). In this system a very bright light source, such as a 1-kw Mazda offset filament, was positioned behind the rotating spiral disc. The light focused (Fig. 3) on the scene to be transmitted was reflected back to photoelectric cells arranged around the source (Fig. 4). This basic method was also used for the transmission of motion-picture film images.

In January, 1932, there were 29 experimental television stations operating in the United States. Some of the most powerful were: the 20-kw General Electric station in Schenectady, W2XCW; the Westinghouse station, W8XAV, in East Pittsburgh; and Radio Corporation of America's W3XAD, in Camden, N. J.

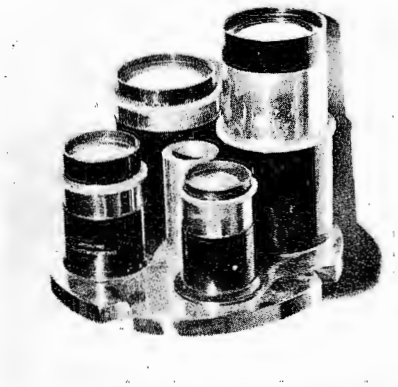


Fig. 3. Lens turret used on early camera.

Jenkins Laboratories had two stations, one in Wheaton, Md., and the other in New York City, both with 5 kw of power. Don Lee was the pioneer in California, while Chicago was represented by the Western Television Corp. and the National Broadcasting Co. The famous scientist, Lee DeForest, had stations in Passaic, N. J., and a portable license for New York State. The Milwaukee Journal station, W9XD, represented the newspapers.

During the 1932 period, reception was accomplished with superheterodyne circuits. There were also many tuned RF receivers, for at that time two separate frequencies were used for voice and picture. Since the transmissions were labeled "experimental," regular broadcast voice frequencies were used for the sound portion when the operator was a regular broadcasting station.

The great advances made in 30 years is indicated by the following excerpt from a technical magazine, "Radio Industries," published in April, 1932:

> "The frequency spectrum for television is not adequate for good picture transmission on account of the very wide sideband frequencies necessary for picture detail, so in addition to these bands (1600 kc to 2850 kc), on EXTREME short waves, 5-7 meters, frequencies from 35,000 kc to 80,000 kc have been requested for television service.
>
> "Further, with the present economics of broadcasting, it has been impossible to secure much data on the ENTERTAINING VALUE of the subjects that can be broadcast due to the cost in presenting programs.
>
> "The Federal Radio Commission has up to the present time considered television only experimental and will grant no commercial rights.
>
> "This means that all broadcasting must be done for the experimental value only and no paid programs can be transmitted by television. This ruling has made impossible the receipt of any money in staging television programs. With commercial rights granted by the Federal Government, the problem will still be complicated as to whether advertisers will continue to assume the INCREASED COSTS that television must impose for its successful operation or whether the public can be SATISFACTORILY TAXED to bear this burden."

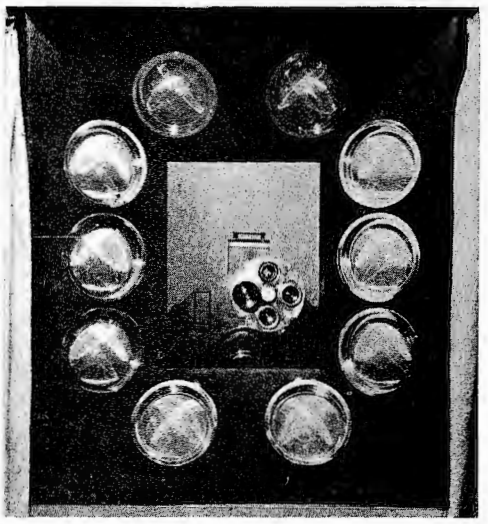


Fig. 4. Photocell bank used with flying spot scanner during 1931 to 34 at CKAC.

(I wonder if anyone, anywhere has ever been "satisfactorily" taxed.)

It was also in 1932 that regular television broadcasts were made with instantaneous electronic scanning replacing the rotating wheel. This was done at the Don Lee station in Los Angeles, W6XAO, where H. R. Lubcke was the television director.

The "extremely high" frequency of 44.5 mc was used, with the station on the air from 5 to 7 PM daily. Voice announcements of frequency and call letters were made every 15 minutes. This "compat-

Fig. 5. Dr. V. K. Zworykin holding his Iconoscope, the first television camera tube.

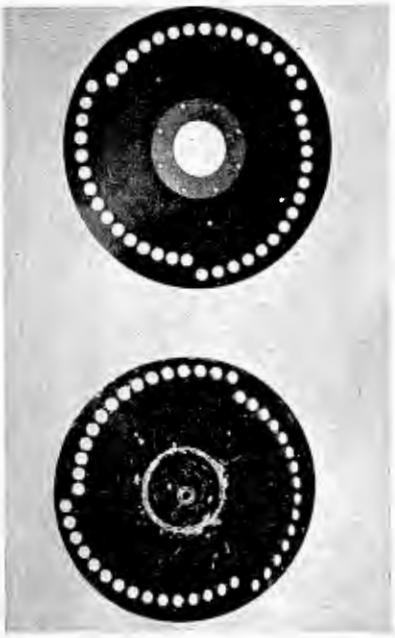


Fig. 6. A TV lens-type receiving disc.

ible" system used 80 lines at 15 frames per second and made possible reception by either disc or cathrode ray receivers. A single spiral of 80 holes which was revolved at 900 rpm by an adjustable motor provided scanning and synchronization.

A McFarlan Moore "corona" lamp was used as the picture tube. This was essentially a neon tube having a light-to-dark frequency of a million changes per second, so that TV pictures at this time were red and black. This will not be too hard to understand if you think of the roto-gravure pictures that are brown and black.

Only films or still pictures could be sent by this method; the spot on the cathode tube face was focused externally on a transparent film and the penetrated light refocused on a phototube. However, it did lead the way to the image dissector tube of Philo T. Farnsworth, the "Iconoscope" of V. K. Zworykin (Fig. 5), and the marvels of present day television.

All this television activity was interesting to Canadians but only the pioneer French Canadian radio station CKAC actually did any work on the new medium.

In 1926 CKAC experimented with a Jenkins drum scanner and a Nipkow disc over a wire link between two rooms. By 1931, they purchased a Western Television Co. transmission system which used the patents for the Sanabria 45 line, 3 spiral, 15 frame concentric lens scanner, which revolved at 900 rpm with synchronizing frames for 60 cps (Fig. 6).

The experimental station call letters VE9EC were assigned to 2050 kc early in 1931. After months of trial this Canadian station went on the air with a regular program on October 9.

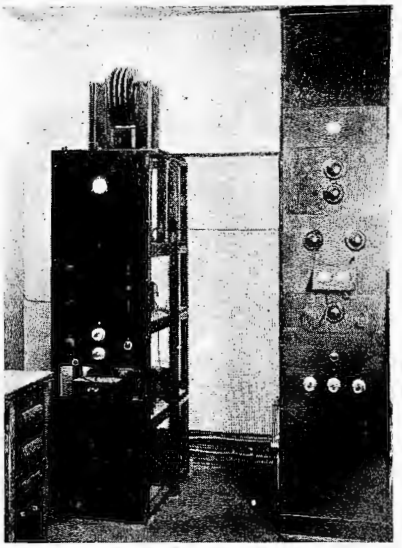


Fig. 7. The first TV transmitter at CKAC.

This was really one for the books! The studio was "illuminated" by four dark-red, 20-watt lamps which made it look like a large photographic dark room. Full lighting was allowed until the musicians—a pianist, a violinist, and a cellist—were placed in position. When the studio was darkened the flying-spot scanner whirled, causing the flickering light to dance across the ghostly looking figures and be reflected into the photo-cell bank. The image was transmitted to the audience, numbering about seven at that time (later there were nearly 20 viewers).

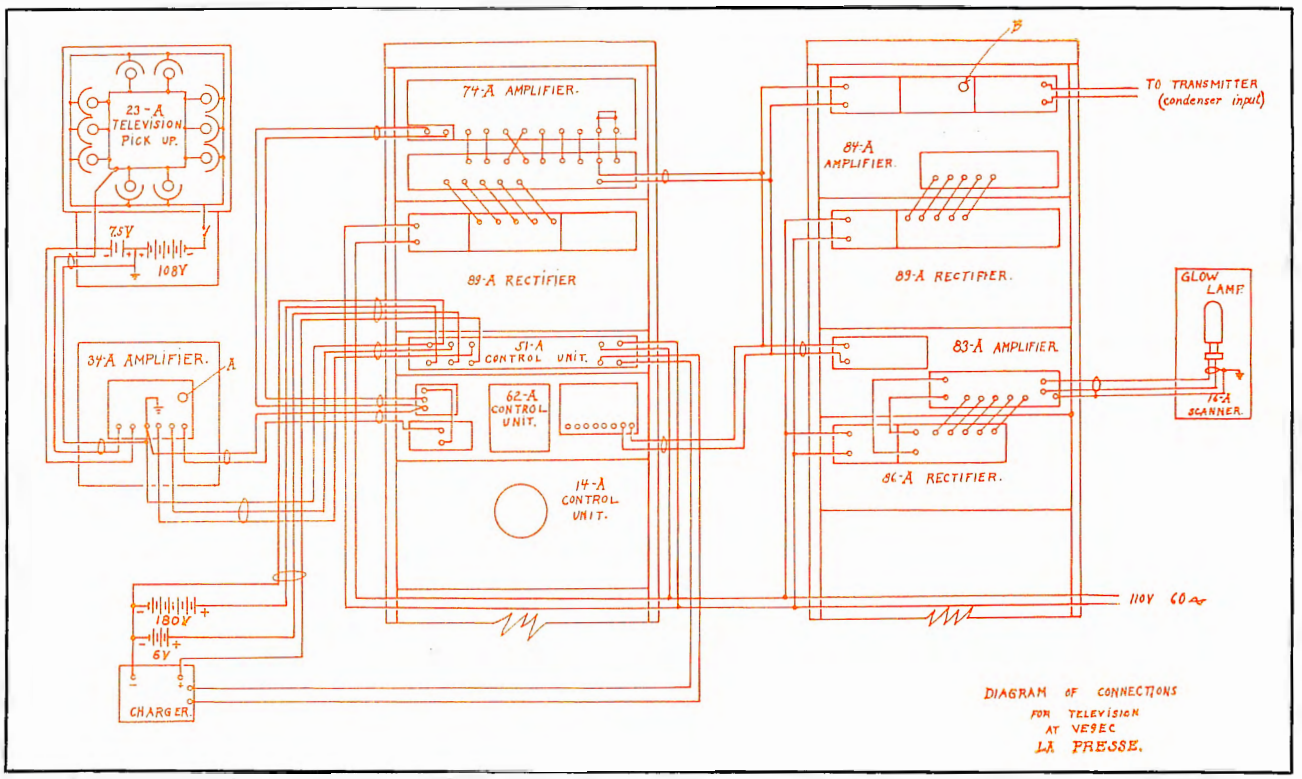
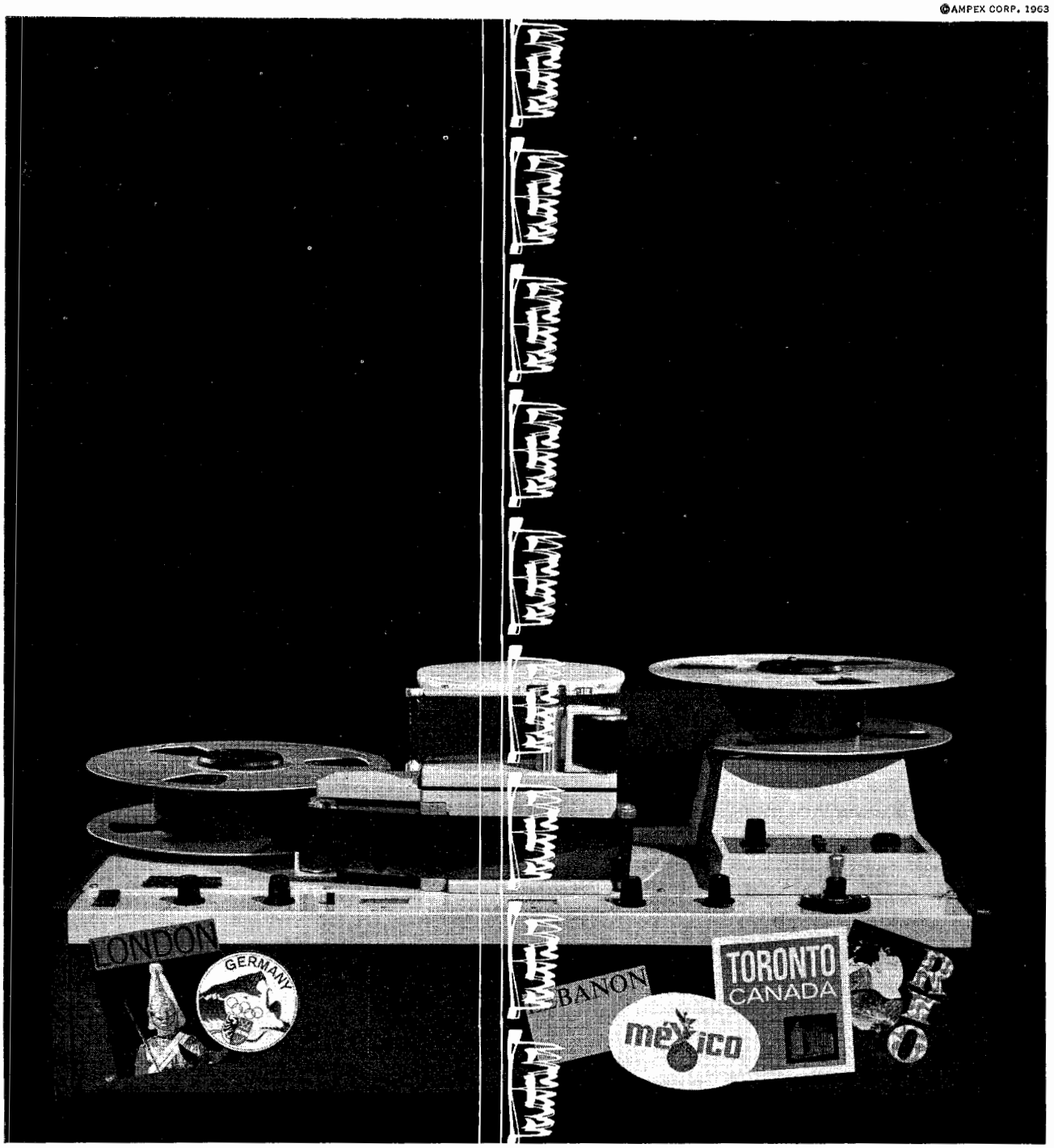
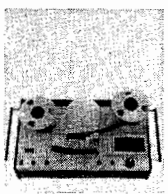


Fig. 8. A copy of an original systems diagram of the television transmitter installation at experimental station VE9EC.



What portable VTR kicked around the world a year and came back as good as new? The AMPEX

A test model never has a moment's peace. This one—the forerunner of our VR-660—was bumped, bounced, dropped and banged on four continents. By experts. But when it came back there was only one thing we had to do to get perfect performance: plug it in. And there's good reason for that. The backbone of the Ampex VR-660 is a single, unit-designed casting at the center of the machine. Every assembly that has anything to do with tape movement or position is mounted to it (so all critical tolerances can be referenced to a common surface). This top plate is all important, that's why we make it out of the most rigid, rugged cast aluminum available. Without that strength in the center, the VR-660 would be just another portable. With it, it's the most rugged little VTR that ever joined a mobile unit. Weight? 96 lbs. Price? just $14,500. For complete information call your Ampex representative. Or write the only company providing recorders, tape and core memory devices for every application—as well as Marconi television cameras and accessories: Ampex Corporation, 401 Broadway, Redwood City, Calif. Term leasing and financing available.



AMPEX

Circle Item 8 on Tech Data Card

Since music had to be played by memory, a blind pianist was a natural star for the show. Other musicians bumped into each other as they tried to stay within the circle of pale light; playing in almost complete darkness was bewildering and uncomfortable. Nevertheless, stand-up comics, cartoonists, and soloists came through quite well because close-up shots could be used.

In the ensuing months many innovations were employed. Small lights were mounted on the music stands and on the piano rest, while others were installed well out of the active field. Station engineers learned all about high-voltage transients that blew out oil-filled capacitors and ripped out what they thought were high-voltage insulators.

Then early in 1932 Canadian Television was formed which controlled licenses of Baird Television of England and patents of the Jenkins Television Corp.

This company exploited a 60-line, 30-frame optical system that could produce useful signals in a lighted studio, but what light! The four 1-kw DC lights used produced intense heat. But a program was broadcast on CKAC's television transmitter (Figs. 7 and 8); here is a newspaper report of the event, dated July 20, 1931:

Practical Test is Given
TELEVISION
Program Broadcast Foreshadows Great Developments in Near Future

"Television became an accomplished fact last night in the studios of CKAC. It was good entertainment, with very good definition of the performers' heads and shoulders.

"Mariette Mineau, violinist, accompanied at the piano by her sister, Francoise, added the vision of a charming smile and nimble fingers to her playing. Miss Violet Gridley sang, accompanied by Douglas Reid, while Edward Picard did some black-and-white cartoon work"

Two receivers which received this mishmash are shown in Figs. 9 and 10. There were four of these in Montreal at that time; all the other sets had been built by amateurs from kits which consisted of a 1/8 hp synchronous motor for 60 cps, a perforated spiral disc, and a neon gas light. The receiver electronics were mostly home-grown or bought from ham radio stores. At that time there were, as far as CKAC could guess, about 20 viewers. The transmissions continued twice each week during 1933 and about once a week in 1934, then ceased completely.

Fig. 9. Television receiver used in 1932.

One reason that the pattern of radio's growth, with its slow advance from coherer, magnetic, and crystal detectors, culminating with DeForest's Audion and modern tubes, was not repeated during the evolution of TV was the famous 1932 report of the RMA.

The Radio Manufacturers' Association's Television Committee under the chairmanship of D. E. Replogle of Newark, N. J., recommended to the FCC a new and completely different approach to the question of television standards. There were by 1932 all kinds of scanning rates and framing frequencies, from the 45-line, 3-spiral disc of Sanabria to the 60 lines of Baird in England, the 80 lines of Don Lee, and the 120 lines of Jenkins.

As early as June 1932, RCA was already transmitting a 240-line picture from the Empire State Building in New York City. They also had in operation a number of cathode-ray receivers. The DeFor-

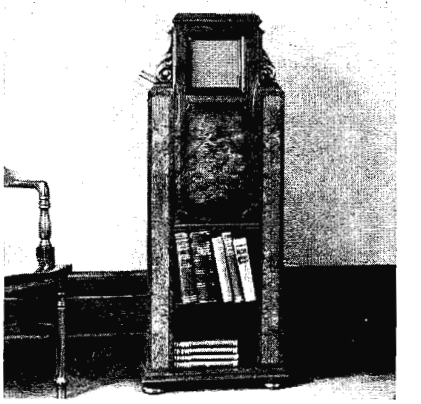
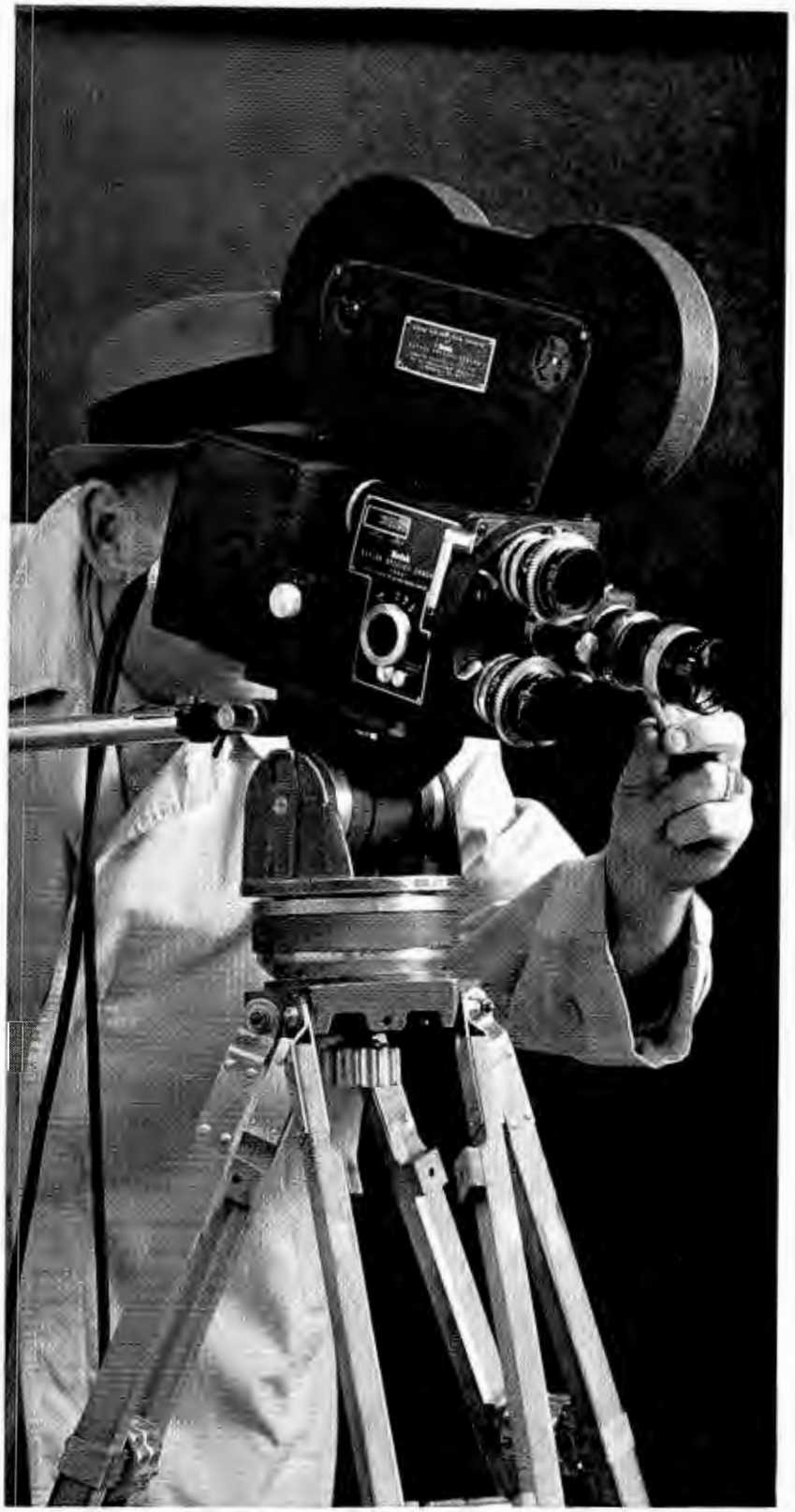


Fig. 10. Television receiver of 1931 to 34.



Flexibility to film any job with the 16mm KODAK Reflex Special Camera*

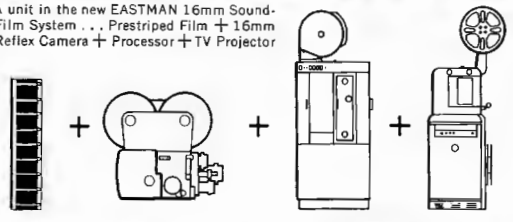
Here's a versatile 16mm camera designed for all types of filming situations—studio, field, animation. This superbly engineered, single-system camera features a precision reflex viewing system with virtually no image shift. Magnified ground-glass focusing and superb KODAK Cine EKTON lenses assure the sharp images required for telecasting.

At the same time, the 3-lens turret and variable shutter provide the versatility and exact control needed to meet any situation. Smooth transport system means optimum steadiness and resolution. Controls are simple, positive. Single-system sound is also available with the self-contained, completely transistorized sound recording unit.

The KODAK Reflex Special Camera is part of the new EASTMAN 16mm sound-film system, designed especially to speed and simplify film handling from exposure to playback. Other elements in this versatile system include prestriped EASTMAN RP Panchromatic Negative Film, Type 7229; the EASTMAN VISCOMAT Processor; and the EASTMAN 16mm Television Projector, Model 275.

For further information write or phone for special descriptive brochure S1-4:

*A unit in the new EASTMAN 16mm Sound-Film System . . . Prestriped Film + 16mm Reflex Camera + Processor + TV Projector



Motion Picture Products Sales Department

EASTMAN KODAK COMPANY

Rochester, N.Y. 14650

Circle Item 10 on Tech Data Card

est-Jenkins Television Co. was also working on this higher definition picture and development of "ultra short wave" (7-meter) receivers.

The Television Section of the RMA General Standards Committee represented the following companies: The Radio Corporation of America, Jenkins Television Corp., Philadelphia Storage Battery Co., U. A. Sanabria, Baird Television Corp. of England, Radio Pictures, Freed Radio and Television Corp., Stromberg Carlson Telephone Co., and the Kolster Radio Company. These names will bring back many fond memories of earlier radio days to the old-timers!

The recommendations made to the FCC for consideration at the Madrid International Conference that was held in May 1933 were:

1. Secure a continuous band from 35 to 80 mc, exclusive of the 56- to 60-mc amateur band.
2. Permit sound on channels assigned for television broadcast when and only when accompanying visual programs.
3. Allow a channel width of 2000 kc for experimental television transmission to provide sidebands wide enough for conveyance of adequate picture detail; allow the space required for synchronizing signals and the associated sound program; maintain a wide band between adjacent television channels which would allow for inaccuracy in the maintenance of television transmitter frequency; permit the easier construction of high-quality receiving sets for television and sound.

A report on the meeting stated:

"These recommendations are considered of greatest importance. They show the trend of television development for the next few years, namely, toward the use of the shorter waves hitherto believed unusable for sight and sound broadcasting.

"The discussion at the meeting also revealed that because of the properties of transmitted waves on these frequencies, it will be possible to operate hundreds of transmitting stations throughout the United States without objectionable interference."

Thus with one succinct announcement was the age of Nipkow ended, to be revived briefly many years later by the controversial color wheel of the Columbia Broadcasting System, but ultimately replaced forever by the electron. ▲

July, 1964

We interrupt this magazine to bring you ...

Late Bulletin from Washington

by Howard T. Head

Subscription Television

One of the projects attracting most attention in the television field this season is that being undertaken by Subscription Television (STV) in California. This is a system of pay television being installed in Los Angeles and San Francisco to distribute television programs by cable. Present plans call for the first programs to begin in July. These will include home baseball games of the Los Angeles Dodgers and the San Francisco Giants, which would ordinarily be "blacked out" on broadcast television, plus a number of programs of cultural interest.

Meanwhile, the Commission is analyzing comments relating to proposed FCC regulation of CATV systems. These comments have been submitted by the National Community Television Association (NCTA), the National Association of Broadcasters (NAB), and others. At the present writing, Federal regulation of either Pay-TV systems or CATV systems does not appear to be imminent.

Remote Control of Television Transmitters

The National Association of Broadcasters is preparing a petition to the Commission requesting that television broadcast stations be authorized to operate their transmitters by remote control as is now the case with AM and FM stations. Several stations are participating in a test program to determine the feasibility of remote-control television operation, and the results of these tests will be submitted to the Commission in support of the proposal some time this month.

High Power and Duplication on AM Clear Channels

The Commission continues to grapple with the problem of final disposition of the clear channels, which are presently reserved for the use of only a single 50-kw station in the United States during nighttime hours. Approximately two years ago, the Commission announced that 12 of these channels would be made available in specified Western states, each channel for a single Class II-A station to operate day and night with a minimum power of 10 kw. However, most of the proposals filed to date for Class II-A operation have been disappointing in terms of service provided to areas not already covered.

Meanwhile, seven of the Class I-A clear-channel stations have filed applications proposing experimental operation with powers ranging from 500 kw to 750 kw. The Commission must decide whether to authorize one or more of the experimental high-power stations, grant the standing applications for Class II-A stations, or seek a still different solution for optimum use of the clear channels. A decision is expected shortly.

Audio Tape Cartridge Standards

The Engineering Department of the National Association of Broadcasters has prepared a final draft of proposed standards governing the use of audio tape cartridges. Considerable urgency has been attached to agreement on tape cartridge specifications because of the dissatisfaction of many sponsors with poor audio quality resulting from inadequate attention to dubbing from ET's to tape cartridges. The drafted standard has been circulated to interested segments of the industry, and agreement is expected in the very near future.

Subaudible Telemetering

Tests are being conducted by Station WSM, Nashville, Tenn., to determine the feasibility of telemetering transmitter meter readings to a remote control point by means of subaudible tones modulated on the AM carrier. The present tests involve an audio tone variable in frequency between 20 and 40 cps. The modulation level is held to less than 10% and tests have been conducted with modulation as low as 5%. In operation, a command signal is sent from the remote control location to the transmitter, and the pertinent reading shifts the frequency of the subaudible tone.

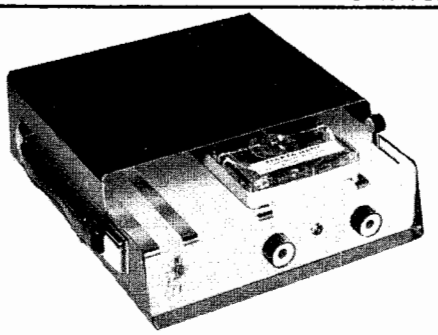
The WSM tests are of particular interest because WSM is part of the BRECOM network. The BRECOM system employs frequency-shift keying of the carrier for teletype communication, and it had been feared that the telemetering tone might interfere with BRECOM transmissions. No tests to date, however, have revealed instances of interference between the telemetering signals and the BRECOM transmissions.

Howard T. Head...in Washington

NEW

FOR THE BROADCASTER WHO WANTS:

- FULL FIDELITY SOUND
- SIMPLICITY OF OPERATION & MAINTENANCE
- COMPACT SIZE & SMART, MODERN STYLING
- FAMOUS SPARTA QUALITY & DEPENDABILITY
- *AND* – A CHOICE OF *LEASE* OR PURCHASE!



BP-11 BATTERY POWERED TAPE CARTRIDGE PLAYBACK

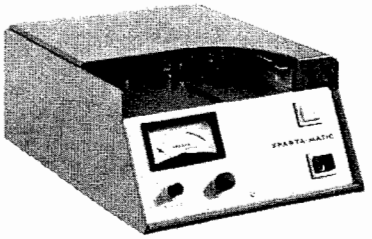
The sensation of the 1964 National Association of Broadcasters convention! Plays 40 minutes on rechargeable Nickel-Cadmium battery. Weighs only 11½ pounds. Fully transistorized . . . completely self-contained, including battery and charging unit. Plays all size cartridges. Comes with protective slip-cover with cartridge pocket and battery charger cord. **Now available with audible cuing as optional extra.**

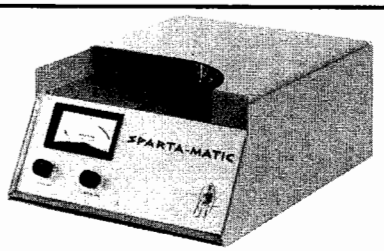
BP-11 . . . . $179.50 Optional Audible Cue 17.50

SPARTA-MATIC® 400 SERIES

400RP (Record/Playback) and 400P (Playback only) New, improved design permits faster, effortless cartridge insertion and release. All-transistorized circuitry. Amplifier modules constructed on individual epoxy-glass printed circuit boards. Heavy guage steel cabinets with anodized brushed aluminum control panel. Large, illuminated stop-start buttons. Each unit requires only 10½" X 14" space. Both units conform to the proposed NAB standards.

400RP . . . . $625 400P $450





CD-15 TIME DELAY AND "SPECIAL EFFECTS"

All transistorized tape cartridge unit with separate record, playback, and erase heads makes possible program time delays from 3 seconds to 30 minutes (for on-the-air telephone conversations, etc.) Length of time delay adjusted simply by changing length of cartridge used. May also be used to create "echo chamber" and reverberating echo effects.

CD-15 . . . . $395

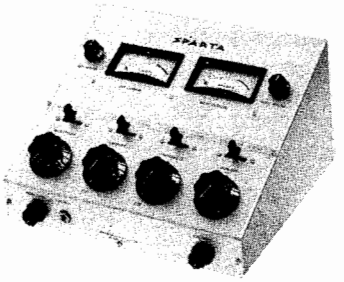
AS-100 STEREO AUDIO CONSOLE

All transistorized with stereo inputs for microphone, two turntables, and auxiliary.

Unit has plus 4 dbm 600 ohm balanced output. Contains plug-in program amplifiers, plug-in microphone preamplifiers, and line-balancing input transformers for all channels. Microphone muting, turntable cue, and program monitor contact terminals are provided. Individual controls for monitor headphone and cue gain, as well as master gain controls for program, right and left channels.

Unique, three position lever-switching for maximum flexibility of operation.

AS-100 . . . . $525



OUR PRODUCTS ARE OUR BEST SALESMEN!

For immediate delivery . . . or further details, Call, Write, or Wire Today:

SPARTA *ELECTRONIC CORPORATION*

6450 FREEPORT BOULEVARD • SACRAMENTO 22, CALIFORNIA • GA 1-2070

Circle Item 13 on Tech Data Card

CROSS MODULATION— Cause and Cure

by ***Robert A. Jones,*** Consulting Author, Consulting Engineer, La Grange, Ill. — Locating and eliminating sources of cross modulation between transmitters of nearby stations.

Cross modulation is a problem that doesn't appear frequently in normal broadcasting work, but when it does appear, it can be a major headache. First, what is cross modulation? A simple definition is: your modulation on somebody else's carrier, or vice versa. This is not always what happens, but it is the usual case. For example, the modulation of station B can be heard interfering with the programming of station A. However, the condition only exists in the vicinity of station C. Station A might be tempted to complain to the FCC that station B is causing interference. However, it is not wise to complain to the Commission until it can be established where the fault actually lies.

How It Is Produced

The frequencies of stations A, B, and C are shown in Fig. 1. The interference to station A could be due to an 840-kc parasitic signal from station B, but in this example it is assumed that no such signal is radiated. There are two common ways in which the interference could be caused by the combination in a nonlinear detector of signals on the frequencies shown in Fig. 1.

Notice that station B operates on a frequency 60 kc from that of station C. When the modulation of station B combines with the carrier of station C, one of the resulting modulation products is 60 kc above the frequency of station C, or 840 kc. This happens to be the assigned frequency of station A. It is also possible to beat 720 kc against the second harmonic of 780 kc (1560 kc) and obtain a difference frequency of 840 kc.

These two processes can easily be distinguished from each other. The first produces a signal of varying strength on 840 kc, whereas the second produces a more steady signal. The type of cross modulation can be determined by observation with a field intensity meter.

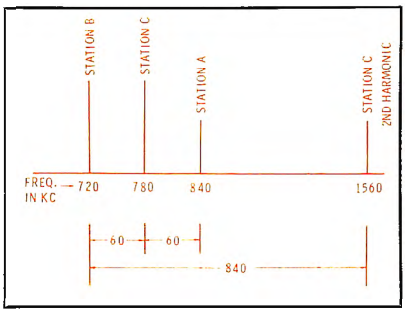


Fig. 1. Frequency relationships of three stations in the cross-modulation problem.

Eliminating the Source

If the spurious (spur) signal is steady, and a strong second harmonic can be detected from station C, the cross modulation is probably being generated in the final stage of the station C transmitter. A properly designed transmitter will not allow a second harmonic to reach the antenna. However, no transmitter can eliminate a second harmonic at the plate lead of the final stage, and it is there that the cross modulation occurs. To avoid cross modulation, the signal from station B must be prevented from reaching the plate circuit of the station C transmitter. A simple trap adjusted to the frequency of station B normally solves this problem.

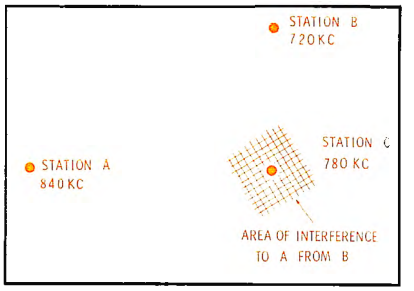


Fig. 2. Diagram showing the area of the interfering stations listed in Fig. 1.

The spur signal can be traced using a field intensity meter as a directional probe. In the example, if the spur is steady, but is found not to be coming from the station C site, this means that the second-harmonic radiation from station C is very strong and that the cross modulation with station B is occurring at some external point. The solution of the problem is to install a second-harmonic trap at station C.

External sources of cross modulation can best be located by touring the area until the field intensity meter reads the maximum signal or the interference is loudest. Use of a field intensity meter is best, since it indicates both signal strength and direction. Fig. 2 shows the area of interference in the example. Once the source is located, it can be eliminated by traps, filters, bypass capacitors, or in some cases simply by grounding.

If the spur signal is not steady, it is probably being caused by a beat between the carrier of station C and the modulation of station B. It is likely that this is occurring in the final stage of the station C transmitter. This problem is solved by placing a pass-reject filter in the antenna lead of station C. Fig. 3 shows how the filter is installed in a typical antenna setup. By placing the filter between the antenna ammeter and the LTU, the unwanted signal (from station B in the example) is prevented from registering on the meter of station C. In order to prevent the unwanted signal from being picked up on the transmission line between the LTU and the transmitter, it is best to employ coaxial cable and to be sure it is well grounded. In severe cases of interference, a second filter is sometimes added between the coaxial cable and the transmitter

Why WZZM-TV, Grand Rapids, chose a Raytheon Dual Link STL

HAROLD C SUNDBERG
VICE PRESIDENT GEN MANAGER

NATIONAL REPRESENTATIVE
PETERS GRIFFIN WOODWARD INC
A B C NETWORK

INCORPORATORS
GRAND BROADCASTING CO
WEST MICHIGAN TELECASTERS INC
M K O BROADCASTING CORP
PENINSULAR BROADCASTING CO

13 abc WZZM TV

CHANNEL THIRTEEN GRAND RAPIDS, INC ■ TELEVISION CENTER ■ GRAN

Februa

Raytheon Company
Communications and Data
Processing Operation
1415 Boston-Providence Turnpike
Norwood, Massachusetts

Attention: Mr. Varna E. Love, Jr.

Dear Gene:

In response to your inquiry concerning the performance of our Dual-Link microwave system, I can in all honesty state this: In the fifteen months we have been on the air, to date, we have not lost any air time due to any microwave equipment failure. Color video and program audio transmissions are excellent. I feel that Raytheon manufactures some of the most dependable equipment available to the industry.

I would like to take this opportunity to thank you for the splendid cooperation and assistance Raytheon gave us in our hectic "pre air" period.

Best regards, Gene.

Sincerely,

Dale Wolters

Dale Wolters
Chief Engineer

P.S. May we do the same for you? Write: Dept. BE-764, Raytheon Company, CADPO, 1415 Providence Turnpike, Norwood, Mass.

RAYTHEON

terminals to counteract any pickup or leakage past the first filter.

The circuit of the filter is shown in Fig. 4. The branch made up of L1 and C1 is adjusted to series resonance to pass the station C signal. Due to the presence of L2, the filter is parallel tuned at the frequency of station B. A parallel-tuned circuit rejects the frequency to which it is resonated.

In the construction of the filter, be sure to mount all parts solidly. For maximum rejection, a shield should be mounted between L1 and L2 to prevent mutual coupling. Care must also be taken in the choice of circuit components. Not only must the proper values of inductance and capacitance be used (based on calculations) but care must be taken in the proper selection of current and voltage ratings. For example, L1 and C1 in combination have zero reactance, but because of the current, each will have a high voltage across it. Thus these parts must be mounted on large stand-off insulators. The combination of L2 in parallel with the L1-C1 combination is resonant at the unwanted frequency. This will add a circulating current which increases the current in L1-C1 above the normal antenna-current value. Also because of the parallel resonance, a very high voltage at the unwanted frequency will exist across L2. Thus the unwanted signal necessitates high current and voltage rating, the magnitude depending on the strength of the unwanted signal.

A Case History

Both kinds of cross modulation can occur at the same time. Such a situation arose in the case of two Midwestern radio stations. The first station operated on 1480 kc. Some time after it was on the air, the FCC granted a new station an allocation on 1520 kc. Because of the closeness of the sites, this new station cross modulated the first station and produced a spur at 1560 kc. This turned out to be the frequency of a third station in the area.

Because of the steadiness of this spur and because a strong second-harmonic signal from the new station was discovered, the cross modulation was believed to be caused by

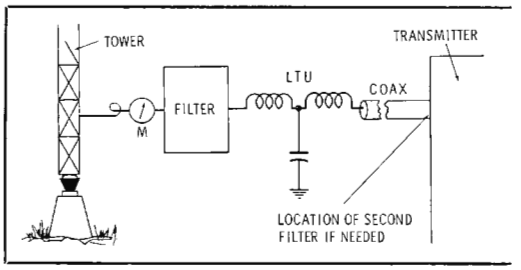


Fig. 3. Location of pass-reject filter installed in the antenna line of a station.

a stray second harmonic. The new station was requested to install a second-harmonic trap. After this was done, the strength of the spur diminished, but it now became unsteady, and its amplitude, as observed on a field intensity meter, varied with the modulation of the 1480-kc station. By again observing the direction of this spur, it was found to still be coming from the site of the new station. The only solution was for that station to install a pass-reject filter. This prevented the 1480-kc signal from reaching the final stage of the 1520-kc transmitter. After this filter was installed, the cross-modulated spur signal was significantly reduced, and there was no longer any objectionable interference on 1560 kc.

Conclusion

If you encounter cross-modulation problems, locate the source first, and make any simple corrections which are called for. If a pass-reject filter is needed, you may be wise in obtaining some help from your station's consulting engineer—proper choice of filter components is very important and the adjustment of the filter is extremely critical. Usually, special equipment is required to adjust such filters—equipment not normally found on the shelf behind your transmitter. Most important—keep in mind that cross modulation, like most problems, can best be cured at the source. ▲

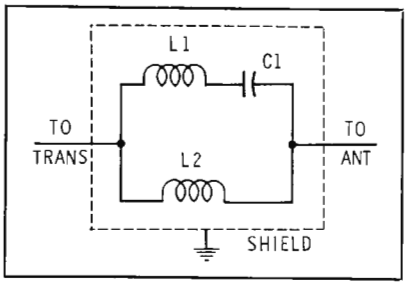


Fig. 4. Pass-reject filter employed to reduce cross modulation between stations.

STATIONS WITH STACKS* STAY ON THE AIR

* Westinghouse high-voltage silicon rectifier stacks, 250 watts to 50 kw

Why tolerate transmitter outages from rectifier arc-back? Mercury vapor tubes, the principal contributors to lost air time, are just plain old fashioned. Westinghouse solid-state rectifier stacks will give you 100% power-supply dependability—*no matter what the make or power level of your transmitter.*

Modernize your high-voltage cubicle. Join the growing group of key network and independent stations (AM, FM and TV) whose chief engineers have switched to Westinghouse silicon rectifiers. These men based their choice on the knowledge that Westinghouse high-voltage assemblies have racked up over 20,000,000 hours of failure-free operation.

Delay just doesn't pay, especially if you are running unattended or plan to do so in the near future. The cost of a silicon rectifier assembly for your transmitter can be less than *one* set of mercury replacement tubes. Take this important step toward trouble-free operation today. Call or write Ozzie Jaeger, Code 412, WA 5-7272. Westinghouse Semiconductor Division, Youngwood, Pennsylvania. SC 2002

P.S. Our megawatt rectifier assemblies are helping to carry the message of hope behind the Iron and Bamboo Curtains.

You can be sure if it's Westinghouse

Circle Item 16 on Tech Data Card

STANDBY PRODUCTION CONSOLE

by Robert V. Tiffany, Chief Engineer, WBBX, Portsmouth, N. H. — An inexpensive system built for auxiliary use.

Rccently, the need for a production console arose at our station, but along with the request for this "desperately needed" commodity came the management plea: "Make it good, but don't spend any money."

A little digging through the junk box revealed that everything was on hand except the parts needed to accomplish this miracle. Investigation of catalogs disclosed that to acquire the needed parts without spending any money would either be a revolutionary new business development, or theft. Armed with this evidence, we finally got management to change their plea to: "Don't spend much money." Heartened by this windfall, we sent out a purchase order for a VU meter, two pots with "snap cues," a blank 12″ x 19″ panel, and a 7″ x 9″ chassis.

The next order of business was an entire day spent scouring Boston's endless string of surplus houses. Among the bargains acquired were a husky power transformer of unknown brand, a used UTC A-25 output transformer, a couple of electrolytic capacitors, a 27-volt Zener diode, and some large knobs—clean but not matched.

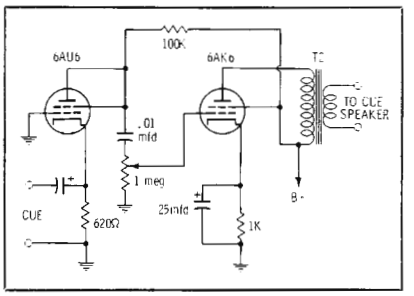


Fig. 3. A diagram of the cue amplifier.

On a rainy Tuesday morning, the postman arrived with the chassis and a few other parts, and the day immediately looked much better. As we worked gingerly along the rear edge of the chassis, something resembling a power supply began to take shape (Fig. 1). Soon we were able to apply power, and the supply worked fine. Now that we could supply all kinds of DC, it seemed we should have something other than a 50-watt resistor for a load.

The output transformer was mounted diagonally opposite the power transformer on the chassis. After a quick pass with a chassis punch, three empty holes stood ready to receive 9-pin sockets (three sounded like about the right number). A conventional output stage (Fig. 2) was installed and checked out. A 12AX7 was chosen for the voltage amplifier because of its ability to make little signals into big ones.

Everything seemed to be falling nicely into place, but suddenly a terrible shadow fell over the new project — there was no input transformer! Everybody knows that the grid of a 12AX7 and the output of a paralleled bunch of 300-ohm pads just aren't compatible. Why not ground the grid and use the pads as the cathode resistor? This may sound like a good idea, but it's not. A resistance of 75 ohms is just too low, even for a 12AX7. A resistance of 500 ohms gave enough bias so the stage operated quite well, and a 100-mfd blocking capacitor kept it that way.

At this point we ran a frequency-response check on the amplifier, and the curve went down like a wounded duck as we passed 6000 cps. A 500-mmf capacitor across the volume control propped the response to about 11 kc, where it started slipping again. We decided to settle for this response in a utility amplifier. The hum, however, was a

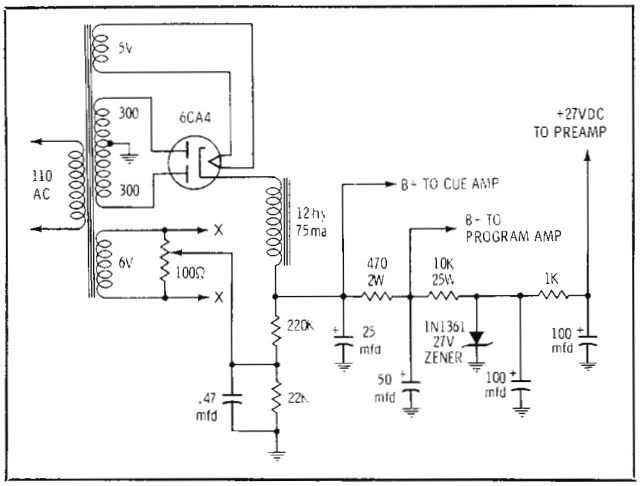


Fig. 1. A full schematic diagram of the console power supply.

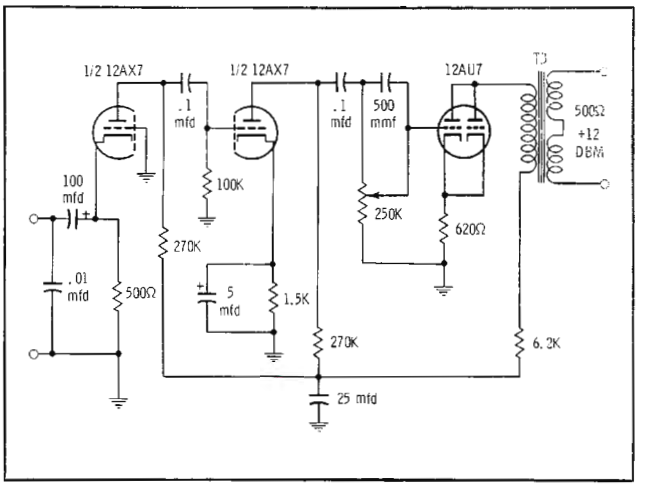
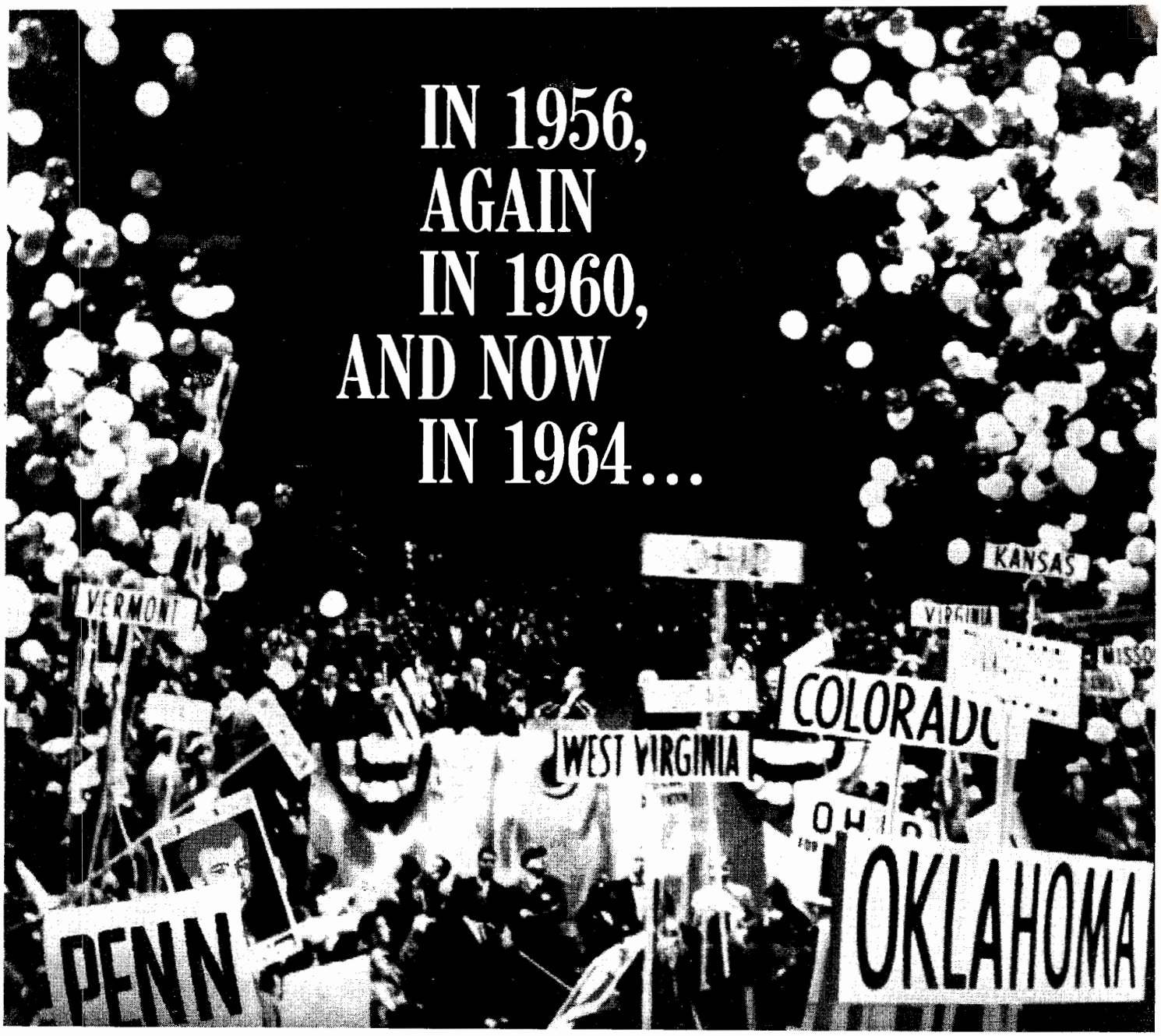


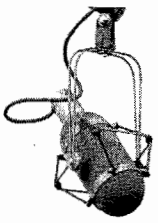
Fig. 2. A schematic diagram of the console program amplifier.



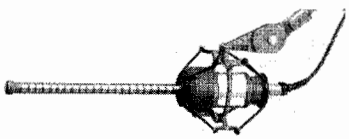
every microphone in the "pool" radio-TV coverage of both Republican and Democratic National Conventions is Electro-Voice. Performance—not politics—determined the choice, and for the third term, it's E-V by a landslide. Performance is the main plank on which every E-V microphone and speaker is built.

May we have your vote?

Model 643 Cardiline* Unidirectional Microphone



Model 668 Dynamic Cardioid Boom Microphone



Model 642 Cardiline* Unidirectional Microphone

Model 654 Dynamic Omnidirectional Microphone

Model 666 Variable-D® Dynamic Cardioid Microphone

*T. M.

ELECTRO-VOICE, INC. Dept. 741V, Buchanan, Michigan 49107

Circle Item 17 on Tech Data Card

Electro-Voice®
SETTING NEW STANDARDS IN SOUND

little too much for even this purpose. That was promptly taken care of by a hum balance pot across the filaments.

The cue amplifier (Fig. 3) was the next project. With the same logic used on the program channel, we started at the end and worked backward. An AC-DC type output transformer was teamed up with a 6AK6 for maximum sensitivity. Again the ugly matching problem appeared, but this time we were ready for it. A triode-connected 6AU6 operated with a grounded grid put us in business.

The available turntables had preamplifiers with them, but the microphone was another problem. The hole left vacant in the construction of the program amplifier was filled with an EF86 and its associated components arranged in preamplifier fashion. But alas, it was too close to the output stage, and it left no doubt in our shattered ears that it was unhappy there. We tried several cures before stumbling onto the idea of using a transistor preamplifier (Fig. 4) mounted in a small metal box several feet away from the amplifier.

The only remaining problem was the 12-volt DC supply for the preamplifier. A battery was used for checking but was discarded as a permanent source of power. That shiny bargain Zener diode seemed like a good bet, but it was rated for 27 volts, and we were running out of chassis space to build any more power supplies. There was

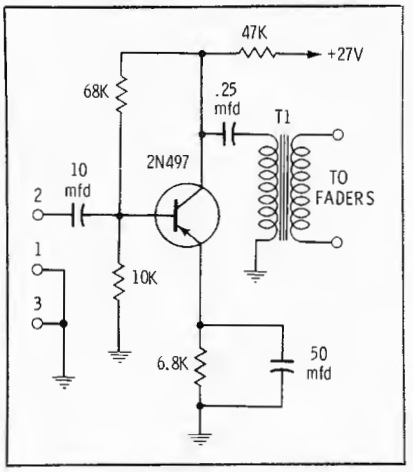


Fig. 4. Diagram of the set's preamplifier.

already a 10K bleeder resistor across the power supply, so we inserted the Zener diode in series with the ground end of the resistor and had 27 volts with almost no ripple. A Pi-section filter removed what little ripple there was, and a little more resistance in the collector circuit of the preamplifier stopped the paint from blistering on the transistor.

A few days were misplaced in the process of hooking the pieces together (Fig. 5), putting on the finishing touches, and connecting the new helpmate to existing equipment; but the entire project took only eight days.

So far everyone is happy with the new facilities, but we have yet to get the reaction of management on the expenditure. Tomorrow we present them with the total bill — $33.49. ▲

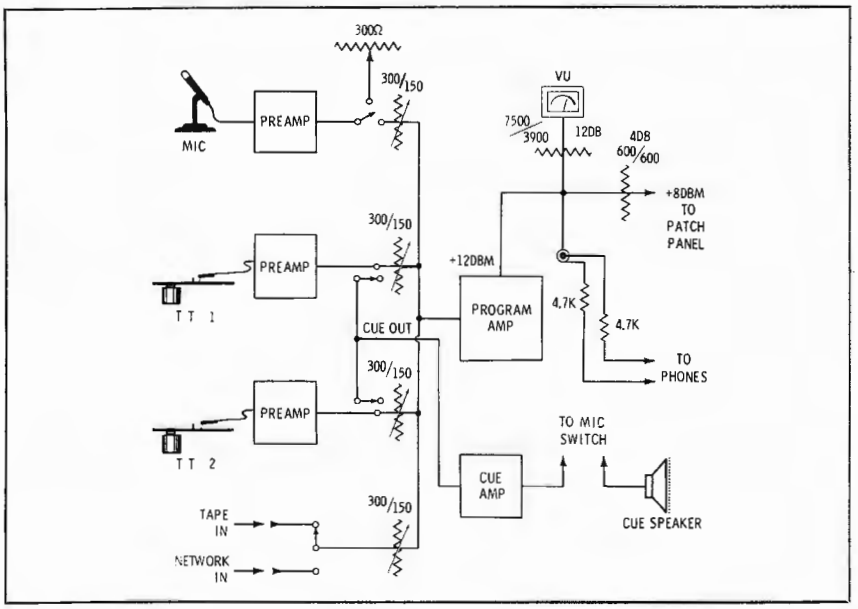
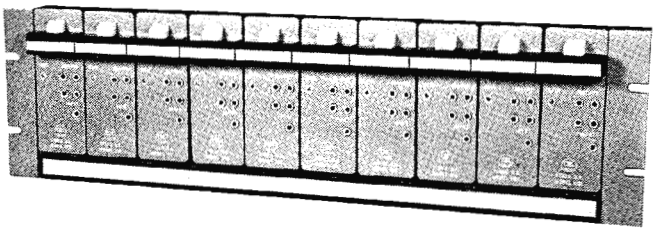


Fig. 5. Complete block diagram of the full auxiliary production system and console.

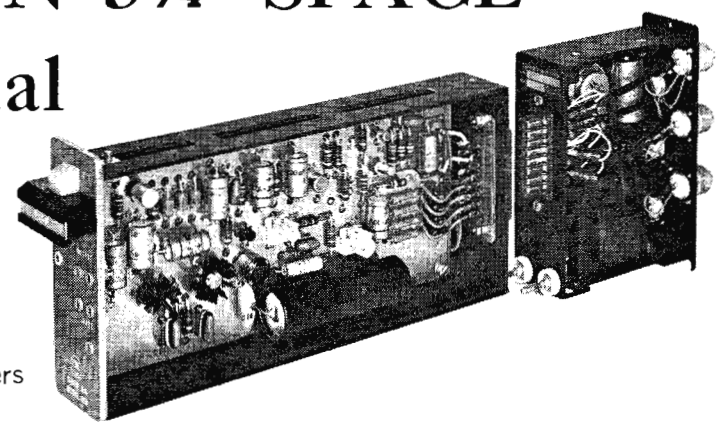
CDL

VIDEO & PULSE DISTRIBUTION AMPLIFIERS*



40 OUTPUTS IN 5¼" SPACE

...with individual power supplies



* **40 OUTPUTS IN 5¼" RACK SPACE** — each amplifier has 4 outputs; 10 amplifiers in 5¼" rack frame

* **INDIVIDUAL POWER SUPPLIES** — increased reliability and low cost/output, especially where less than a full rack frame of amplifiers is needed

* **HIGH GAIN** — Adjustable from −6 to +8db, ample for level recovery in long cable runs

* **40db ATTENUATION OF 60 CYCLE GROUND LOOP INTERFERENCE** — Where ground loops exist, eliminates bulky and expensive "stop coils" and in many cases even stabilizing amplifiers

* **ALL PLUG-IN CONSTRUCTION** — Amplifiers plug into individual power supplies, which can be used interchangeably between amplifiers

* **GUARANTEED PERFORMANCE FOR BOTH COLOR AND MONOCHROME —**

Frequency Response	±0.05db to 5Mc ±0.1db 5Mc to 8Mc
Differential Gain	Less than 0.05db, 10-90% level
Differential Phase	Less than 0.15°, 10-90% level
Input Impedance	Bridging 50K/5mmF, amplifier ON or OFF
Output Impedance	75 ohms ±2%
Signal to Noise Ratio	Greater than 60db
Squarewave, 60 cps	Less than 1% maximum tilt

Other CDL Products: Sync Adding Video Distribution Amplifiers
Solid State Vertical Interval Switching Systems
Video Crossbar Switching Systems
Solid State Mixing Amplifiers
Solid State Switcher Processing Amplifiers

Write for complete information and specifications

WARD ELECTRONIC INDUSTRIES, Inc.

P. O. BOX 1045, MOUNTAINSIDE, N. J. • (201)-232-1167

Circle Item 19 on Tech Data Card

NEW APPROACH TO RADIO CONTROL ROOM DESIGN

by ***Ronald T. Miyahira,*** Chief Engineer, Hawaiian Broadcasting System, KGMB, Honolulu, Hawaii — A modern control room planned for maximum efficiency of board operator.

For over 20 years, the design of control rooms was centered around the electronic equipment and the acoustics of the room. Console desks in control rooms have not varied much from the three basic types: the straight desk with turntables on either side, the horseshoe type, and the circular type. Our experience has shown that, aside from being impressive and unconventional, the circular type is not desirable for fast operation. A console desk with turntables stacked on top of each other was also tried, but the top deck was too high and the bottom deck was too low for the operator. One of our radio studios was recently converted into a control room. This afforded a rare opportunity to design a modern control room without being saddled by existing ducts and trenches, unsightly room configuration and appurtenances, and old equipment.

Design Objectives

A modern control room must be designed so that the room, furniture, console, and all facilities blend both aesthetically and electronically to contribute toward production of the best program that the man on the board is capable of creating. The majority of stations are playing recorded music today, and often the announcer also plays the role of transmitter engineer, board operator, news man, and librarian.

Some control rooms present the appearance of an electronic marvel with a maze of dials, pushbuttons, lights, meters, and patchcords. It may seem impressive to have a huge complicated control board, but who are we trying to impress? Certainly not the announcer. He has only one objective in mind, and that is to create a listenable program so he can push his ratings up and obtain a list of happy sponsors. The station's only product is the program that is put on the air by this busy individual. It therefore is sensible to make him as comfortable and efficient as possible by giving him pleasant working surroundings.

Our new control-room design was started with this objective in mind. Everything that was installed in the room was put there to make the announcer more comfortable and efficient. Although our new control room has complete facilities, and the control board is far from being small, everything in the design was aimed at de-emphasizing the electronic look.

Appearance

The control room is 16′ x 14′ and has an 11′ ceiling. A ceiling of this height is out of proportion with the length and width of the room and gives it the air of a dungeon, so a false ceiling of egg-crate design was constructed over the normal working area. This partial ceiling was installed with a curved front of glass-fiber sheets, as shown in Fig. 1. The ceiling lights were installed inside the false ceiling, and the light coming through the translucent yellow front gives the room a soft, comfortable glow. The floor was finished with light beige vinyl tile, and the walls were painted two shades of pastel blue. To anyone entering the control room, the high ceiling gives the feeling of spaciousness; to the announcer working in the console area the effect of the low ceiling eliminates the cold,

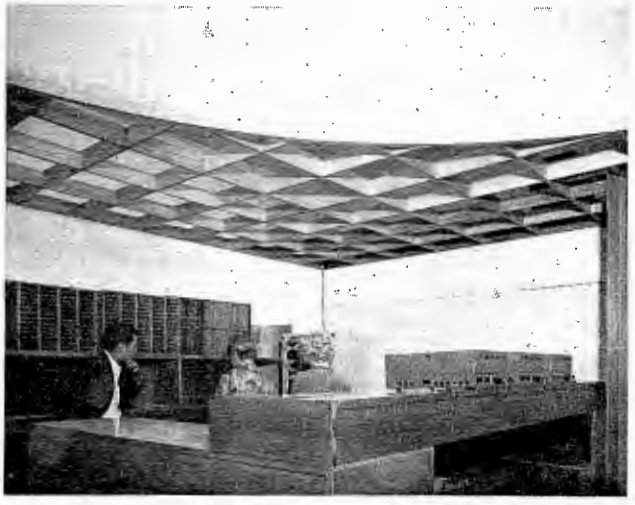


Fig. 1. View of control room showing location of false ceiling.

Fig. 2. Turntable positions chosen for convenience of announcer.

Why guess at monitor or kine-recorder linearity?

TELECHROME MODEL 3512-A1 DOT GRATING GENERATOR
(All Solid State)

TELECHROME MODEL 3512-A1 DOT GRATING GENERATOR provides an excellent linearity reference. It produces a white pattern on a black background, or a black pattern on a white background. Excellent for color conversion too.

Why guess at station performance when you can monitor 'On-Air' with inexpensive vertical interval test signals?

TELECHROME MODEL 3601-A1 VIT KEYER
(All Solid State)

ALL TELECHROME SIGNAL GENERATORS, past and present, can be keyed with the new MODEL 3601-A1 VIT KEYER. Alternate field keying and white reference also available.

TELEMET COMPANY
a division of
GIANNINI SCIENTIFIC CORPORATION
185 DIXON AVENUE, AMITYVILLE, N.Y. • PHONE (516) 541-3600

Circle Item 20 on Tech Data Card

mechanical feeling that is found in the average control room.

The false ceiling also played an important part in the overall plan. All wiring was done either in the console desk or above the false ceiling. Overhead wiring has certain advantages over wiring in floor trenches: It does not restrict equipment location, and the cable runs are more direct. Addition or deletion of cables can be handled very simply, and high- and low-level pairs can be kept separated very nicely in such an arrangement.

Equipment Arrangement

Considerable time was spent in studying the physical movements of announcers in the existing control rooms. Many long sessions were held with the announcers to discuss the problems they encounter in their routine operations. Numerous designs were drawn and discarded before final agreement was reached. The maintenance engineers were then brought into the picture to discuss their problems, because a control room functions only as well as it is maintained. An engineer is always reluctant to service equipment that is difficult to reach, so every facility in this control room was installed in a manner that makes maintenance convenient. A patch panel was installed on the side of the desk out of view of the operator. The patch panel was mounted on a swinging door to make it easily accessible for the engineers during maintenance. The announcers are not required to use it at any time.

The most desirable feature on any console desk is a large copy-holding board placed at eye level. This very important item is often given very little attention. The copy board here was given priority in the design of our console desk, and everything else was designed around it. It was found that the console height had to be limited to 7″ or less if the copy board was to remain at eye level. Since the console that we had obtained was too high, it was tilted back 30° from the horizontal in order to bring it down to an overall height of 6″.

Individual pots are desirable for every facility in the control room. A busy announcer cannot be expected to throw a key to select his facility on a channel that is used for two or three inputs. Furthermore, this limits the flexibility of the control room and is a potential source of error. Since our console had only ten pots, the least-used facilities, such as remote lines and extra tape inputs, were tied together through selection keys to two of the pots.

Attention was then directed toward the turntables. They were placed so they could be reached with a minimum of physical effort and movement. The turntable height was carefully selected so the stylus and groove were close to eye level. An announcer using turntables placed at desk level must bend over to find the proper track. This was all right during the days of the 78-rpm discs when he could cue the record by feel, but with modern fine-groove discs having four or five cuts on a side, he must be able to see his stylus for a proper cue. The pickup arms were placed in our new console so the announcer would be able to see the stylus head-on (Fig. 2). This was not the most symmetrical layout of the equipment, but from the beginning the design philosophy dictated that symmetry

Fig. 3. Control room with U-shaped console affords efficiency in a pleasant atmosphere.

and appearance would be secondary to efficiency of operation. Even so, the final appearance of the finished console desk was quite pleasing (Fig. 3). The microphone was mounted on a gooseneck so it could be moved to suit each announcer. Adequate lighting was provided over the copy board and the turntables so the console could be operated even with the ceiling lights turned off.

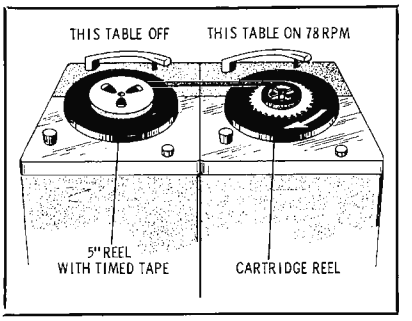
The standard consoles that are available from any of the reputable firms are well constructed, and any competent engineer can connect them into a system. Therefore, a detailed discussion of the electronics of this console will not be given. The mike preamps were modified and used as turntable preamps. They were equalized to give a slight rise from 100 to 30 cps and from 2000 to 12,000 cps. We found this curve to be the most pleasing one when used with the rest of our system.

A Final Touch

A mahogany cabinet with individual lockers and a coat closet was provided for the announcers to store their personal belongings. This eliminates the messy, cluttered appearance of our other control rooms and keeps this control room neat and businesslike. The cabinet also is designed to function as a coffee table and as a storage place for cups, lunches, and other miscellaneous items.

This control room has been in use for several months, and our announcers are delighted with the ease of operation and the fine working conditions of the room. ▲

ENGINEERS' EXCHANGE



Wind Cartridges on Disc TT's

by Julian E. Jetzer, Staff Engineer, WHBL, Sheboygan, Wisc.

Now that the tape-cartridge units at most stations are a few years old, the tape in many of the cartridges used day-in and day-out is beyond the point of good sound reproduction. Since replacement of the entire cartridge because of worn or damaged tape is very impractical, the only answer is winding new tape. This is our method of rewinding the cartridges we are using at WHBL.

Time the tape by running it through a recorder at 15 ips, winding it on a 5″ reel. Be sure to run the recorder for only half the tape time if you want standard 7½ ips cartridges. Put a twist in the tape after it passes through the head assembly so that the oxide is on the outside of the take-up reel.

Now you will need two turntables side by side as shown in the diagram. The reel of tape is placed on the left table with a small bushing or spacer under it to isolate the drag of the felt turntable top (we use a hex nut or washer).

Thread the tape to a cartridge resting on the rubber or felt pad of the second turntable. After wrapping two or three turns on the hub, start the turntable at 33⅓, then increase it to 78 RPM. Now there is nothing to do but wait until the tape is transferred from one reel to the other. It is not necessary to guide the tape since drag between the reels keeps the tape from riding up on the cartridge reel.

You will find that the tape tension is almost perfect as you run the cartridges. Now pull about 7 to 10 inches of tape from the center and splice in the usual manner; be sure to splice on the lubricated side and not the oxide side. Now, reassemble the cartridge and run it for a few seconds to assure proper operation.

We have used this method for 40-second to 10-minute cartridges with equal success. After you try our system a few times, you'll wonder how you got along without it.

Emergency Tuning Capacitor

by Odes E. Robinson, Radio Consultant, Biloxi, Miss.

Shunt capacitor breakdown in tuning unit T-networks at the base of towers is not uncommon. Without direct replacements on hand, a station can be off the air for several hours until one can be found. If an odd size unit is installed the network will be thrown way out of adjustment; attempts to retune the network by "guesswork" in order to restore normal readings are not usually too successful.

A simple solution is to keep a surplus variable transmitting capacitor immersed in a jar filled with castor oil, and tuned for normal line and antenna current—just connect this standby unit into the circuit until an exact replacement is obtained. (Naturally the variable should fall approximately in the range of he original shunt capacitors.)

The castor oil increases the breakdown voltage and total capacity of the variable capacitor. In many instances a small receiving-type variable works fine up to 1000 watts.

Shortwave Transmitter Maintenance

by John Basic, Director, Compania-Televisora, S.A., Inglewood, Calif.

Due to limited resources and small staffs, broadcasters using low-power shortwave transmitters need a sure and fast maintenance method.

The following procedure is short but accurate for small operations, but is not designed for high-power transmitters. We have used this method for several months with great success in conjunction with our 1-kw transmitter on 5955 kc.

Our weekly maintenance is simplified by dividing the transmitter into sections, with each part marked in our maintenance log. Shortwave and AM-band transmitters are similar in design and therefore require similar maintenance.

The following procedure is recommended:

Daily

1. Make visual inspection of all components such as relays and capacitors.
2. Turn transmitter on to warm up about 30 minutes prior to sign on.
3. Check meters and record readings.
4. Adjust meters if necessary.
5. Tune transmitter to proper frequency.
6. Check frequency.
7. Check modulation level for proper transmission.
8. Check for power input and power in the final stage.
9. Check temperature around air-cooled power tubes.
10. Check crystals for correct operating frequency.
11. Put audio input into transmitter and sign on.
12. Read meters regularly, preferably every 30 minutes, so that if trouble occurs it can be recognized in advance.
13. Record all meter readings in log.
14. Sign transmitter off.
15. Make final reading of meters and record in log with comments of day's operations and problems.
16. Check all major components.

Weekly

The transmitter must be completely overhauled with proper test equipment. Maintenance can be simplified by:

1. Referring to a block diagram of transmitter listing important components;
2. Dividing transmitter schematic into sections such as PA, oscillator, buffer, amplifier, and modulator;
3. Testing each section individually;
4. Printing each part on a sheet and checking as each test is completed.

The weekly procedures can be kept to a minimum by performing the daily procedures properly and regularly. ▲

World's Fair

(Continued from page 13)

Fig. 7. As music changes, so do fountains.

G-E also uses a 20-camera closed-circuit TV system to view various entrance ramps and areas in the "Progressland" pavilion. Video-switching panels and monitors in key spots (Fig. 6 shows one monitoring console) enable G-E personnel to monitor exhibit activity. In the event of trouble with the huge carousel theater, the system would facilitate orderly control and evacuation of the crowds.

Musical Showers

A breathtakingly beautiful display is that of the "Fountain of the Planets," a musical ballet (Fig. 7) of colored fountains accented by periodic showers of fireworks. This colorful performance of the largest fountain ever built is totally automated. The music, the changing spray patterns, the changing colors (including a true flame color achieved by using actual flames), and the fireworks, are all controlled by tone pulses on one track of a two-track RCA audio tape machine.

Satellites

Another impressive display contains replicas of several earth satellites (Fig. 8): communications satellites Echo II, Telstar, Syncom, Relay, and the weather satellite Tiros. Of particular interest are the solar cells used to power these electronic denizens of outer space.

Behind the Scenes

In the lobby of the **Ford Motor Co.** exhibit, visitors file past ten "International Gardens" displays, tiny reconstructions of communities from different countries. In each, the theme song of the Ford display can be heard—in perfect harmony with all other "countries," except that the music is being played with instruments in the style of that particular country.

In Ford's electronics control room, we find two **Precision Instrument Co.** recorders similar to those being used in the Disney audio-animatronic display at G-E. The units here are of 14-track configuration, threaded with Scotch-brand 1" magnetic tapes, and are used alternately to provide continuous synchronized sound for the "International Gardens." Banks of 70-watt RCA amplifiers provide sound power for all the systems in the building, including the audio-animatronic figures in scenes along the Ford Freeway.

The visitor rides through this display in a driverless brand new Ford-built convertible, which is pulled along a guide track. Narration for each segment of the exhibit is prerecorded on continuous-loop cartridges tapes; a four-track playback machine is mounted in the trunk of each auto. Each of the four tape tracks is recorded in a different language—English, French, German, and Spanish—to accommodate the international audiences. Passengers in each convertible, by depressing the appropriate pushbutton on the car "radio," can choose whichever track (language) they understand best.

The Ford dioramas also contain audio-animatronic figures whose voices, and the sounds of various prehistoric animals that accompany them, are recorded on four-track cartridge tapes, played back on **KRS** "Stact" tape machines, amplified in RCA amplifiers, and fed to speakers in the various scenes via 70-volt distribution lines.

Leave the Driving . . .

At the **Socony-Mobil** pavilion visitors can test their driving skill in a simulated "Economy Run." Thirty-six test units, complete with bucket seats, steering wheels, accelerators, brakes, and speedometers, allow drivers to test their reaction to several driving hazards during a four-minute test run. The system was designed and built jointly by **Dramaturgy, Inc.** of Cleveland, and **Dage Television Co.** of Michigan City, Ind.

Drivers view the road by means of Dage CCTV monitors placed at windshield levels. On the screen, various filmed traffic situations are shown. Potentiometers connected to the steering wheel, brake, and accelerator generate signals that correspond to the motions made by the test driver. These signals are factored in a computer to find an average score, which is shown to the driver as "miles per gallon."

In the control center, two Dage television camera film chains run in exact synchronism, one for the test and another for "crash scenes." If a driver in any situation exceeds certain limits of safety, a relay trips and his monitor is switched to a crash scene for that particular situation. A magnetic track contains "perfect-driver" reference information that is compared, in the computer, with the actions and reactions of the test "driver." These "perfect" reactions were prerecorded by an expert test driver under actual driving conditions over the course from which the filmed scenes were taken.

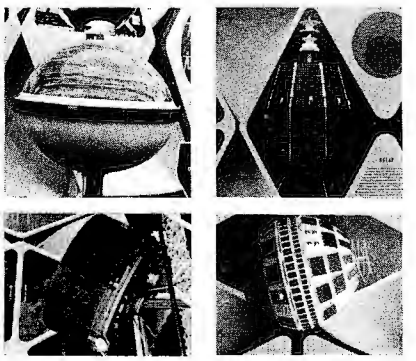


Fig. 8. Communications and weather satellites in modern electronics display.

Fig. 9. New color set uses three CRT's.

Future Living

At the **General Motors** pavilion (a huge structure that in profile looks like a jet airliner) the theme is "Futurama." The visitor transport system takes the Fairgoer through a series of imaginative "cities of the future" showing men at work on the moon, a community in Antarctica, a gigantic roadbuilder in the jungle, ultramodern cities within cities under a single roof, a continent-wide system of ultraspeed highways, and a complete series of settlements on the bottom of the ocean. Narration is recorded on tape and, as with displays described earlier, tape playback is synchronized with the movement of visitors past each scene. The sound comes from speakers built into the "wrap-around" chairs of the transport loop.

From the Orient

The Japanese pavilion, next to Eisenhower Promenade near the Fountains of the Fairs, presents the largest visible display of electronics equipment at the Fair. Participating in this comprehensive exhibit that showcases nearly every facet of the Japanese electronic industry, we spot the following companies immediately: **Sony Corp., Sanyo Electric, Inc., Nippon Electric Co., Hitachi, Tokyo Shibaura Electric Co., Ltd., Nivico (Victor Co. of Japan), Matsushita Electric Corp. of America, Mitsubishi Electric Corp.,** and **Japan Electron Optics Laboratory Co., Ltd.**

Attracting considerable attention in the **Mitsubishi** booth was a small-screen color TV receiver (Fig. 9) with an unusual approach to color. Three CRT's with filters are used, one for each of the three basic colors—green, blue, and red. Dichroic mirrors superimpose the three images, and the viewer sees only a single image converged on the viewing reflector.

Also on display is a bank of 6" tinyvision portables which **Singer Corp.** will market in the U.S. Most sets are equipped for UHF reception in accordance with the recent All-Channel Law. The UHF tuner is attached to the bottom of the set.

There are several other color receivers of the 16" rectangular format being introduced to the U. S. market by Jap-

anese manufacturers. All seem to be similar except for cabinet design. Some Japanese manufacturers indicate these sets are not ready for market yet, but certain U. S. importers have announced their intentions of selling them by late this summer.

Another interesting device at the **Nivico** booth is the video tape recorder shown in Fig. 10. Very little information is available, but its size is interesting.

Hitachi displays a wide variety of electronic parts, especially transistors and tubes. In addition to semiconductors and nuvistors, we see klystrons and vidicons for industrial electronics and broadcasting.

The **Toshiba (Tokyo Shibaura)** booth includes another 16" color receiver, some black-and-white sets (suspended on pipes from the ceiling), and several transistor stereo radio and phono sets. Along the walls, a display of parts built by Toshiba features a storage tube whose phosphor can hold a still picture for several hours, and then feed it into a TV set for as long as 30 minutes. The unit resembles an image orthicon tube. A small transistorized television camera, auto radios, tape recorders, and some small electrical appliances round out the Toshiba exhibit.

In addition to a color receiver, **Matsushita Electric** shows several models of home entertainment products, including their "Mitey-9" transistor portable TV, all marketed in the U. S. under the brand-name "Panasonic."

Sanyo Electric, Inc. exhibits a variety of home-entertainment products marketed successfully in the United States by **Channel Master** of Ellenville, N. Y.

The largest booth in the Japanese pavilion is that of **Nippon Electric Co.** which builds some electronics equipment of a most exotic nature. In the background at the booth is a large computer; telephone equipment is displayed along a front table. A tiny TV camera permits the passerby to see himself on a closed-circuit monitor at the rear wall. Also on display are several unusual medical-electronic devices. Literature available at the exhibit tells of microwave, broadcast, coaxial cable, power-line carrier, shortwave, mediumwave, and longwave equipment NEC has in operation all over the world.

Sony Corp. features its new "Videocorder," a lightweight video tape recorder they hope will find application for remote news and special-event coverage. Video information may come from its own camera system or from external sources. At a speed of 5¾ ips, a 7" reel of 2" video tape will record an hour of video and audio. Two recording heads are used to record on the 2" magnetic tape.

Brief Observations

Ten tower-mounted clocks located over the Meadow will keep Fairgoers informed of the time, and serve as easily located meeting places. These clocks are slaves to a highly accurate crystal-controlled master clock similar to those used in broadcast stations. This particular system is designed by **Favag** and installed by **Visual Electronics Corp.** From the master clock in the Timing Center at the Swiss pavilion, timing pulses are sent to the ten slave clocks, keeping them accurate within microseconds.

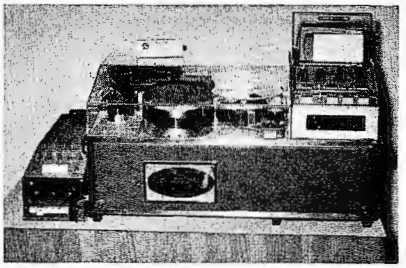


Fig. 10. Video tape recorder with controls.

In the U. S. pavilion, a point of interest is the Audiovisual Learning Center. In "Study Stations" students face a control panel and TV screen. Programmed study courses are projected on the screen and through speakers in the booth. The student responds via the control panel, and computers test his answers and accept or reject them and offer remedial supplementary instruction, if required. In short, the "Study Station" system does almost anything a teacher could do.

A **B & K** Model 1076 flying-spot scanner is used to transmit slides for the Study Station. Video tape recorders by **Ampex Corp.,** video monitors by **Miratel Electronics, Inc.,** video distribution panels by **Anzac Electronics, Inc.,** scopes from **Tektronix, Inc.,** video and audio tapes from **Minnesota Mining & Mfg. Co. (3M),** and various other equipment from **Maryland Telecommunications, Inc., North American Industries, Inc., Pendar, Inc.,** and **Temple Sound Equipment**—are all incorporated in this working exhibit of the most advanced audio-visual teaching methods. Electronics all the way!

A modern library in the same pavilion uses computer techniques similar to those shown at the NCR pavilion. Books, trained librarians, and a **Univac** information-recovery system offer a ready reference service to World's Fair visitors. Some 2000 standard reference books were used to compile information in the computer storage system. If a system like this were programmed centrally with all knowledge that presently exists on any particular subject, "branch" readout systems located at colleges and libraries all over the country could have research information available almost instantaneously. Something to think about.

In the Austrian pavilion, visitors can view Austrian electronic products mounted inside plastic bubbles. One company well known to American broadcasters—**AKG of Vienna**—has a display of their most popular microphones.

In their huge pavilion at the Fair, **The Singer Co.** exhibits home entertainment products made by their recently purchased **KHL Electronics Div.** Several **Sylvania** Model 800 CCTV systems allow visitors to witness sewing-machine demonstrations.

The Travelers Insurance pavilion uses stage projection equipment and relay-controlled lighting—all controlled by

magnetic tape—to present their "Triumph of Man" show, a 2½-million-year history of Man's progress.

Pepsi-Cola Co. has what is probably one of the most intricate and colorful displays at the Fair. Several hundred foot - high audio - animatronic doll - children, designed by Disney, represent UNICEF. The hundreds of dolls representing the countries of the world sing the theme song "It's a Small World, After All" in their respective languages. Passage through the exhibit, by boat, takes the visitor on a memorable simulated tour of the world of children.

In the field of electronics, **Eastman Kodak** offers sound-track movie equipment for the home and professional photographer, and shows a new line of sound tape for both the amateur hobbyist and the professional audio recordist.

A Last Look Around

Everywhere, familiar electronics companies take an active part. Some participate behind the scenes; others play a more direct part: **Conrac** Div. of Giannini Controls, whose weatherproof TV monitors are discovered in some of the most unexpected places; **RCA,** who supplied 550 small speakers for the World's Fair public-address system and has color TV sets spotted all over Flushing Meadow; **Crown International,** who furnished stereo playback machines for several exhibits at the Fair, including some thirty-odd for the Bell Telephone display; **Altec Lansing Corp.,** who developed sound systems for more than 15 separate pavilions and exhibits, and who has its own exhibit of stereo playback equipment in the House of Good Taste; **Acoustic Research, Inc (AR, Inc.),** whose exhibit in the Better Living Center features their own turntable and speaker systems, along with a tuner, preamp, and amplifier from **Dynaco** of Philadelphia, and cartridges by **Shure Bros.** of Evanston, Ill.; **Reevesound Co., Inc.,** Div. of Reeves Industries, who devoted much time, equipment, and talent to the development and operation of several exhibits. Other electronics and acoustics companies have designed and equipped at least two large auditoriums at the Fair as well as several theaters.

The **Pinkerton's National Detective Agency** uses a $250,000 communications system designed jointly by World's Fair Fire Chief Thomas P. O'Brien and **Bell Telephone Co.** engineers. In addition to the ordinary communications sets used by regular police and fire departments, the elaborate Pinkerton system has interconnections with public and private telephones all over the Fairground. The network is one of the most elaborate ever developed for public safety purposes.

Conclusion

Countless other companies, large and small, participate in or contribute to electronic applications at the Big Fair, and on **your** visit you'll probably see electronic skills that will amaze you. You're sure to develop a better appreciation of our vast field, and how effectively electronics is helping to shrink the boundaries of the modern world. ▲

Voltage Regulation

(Continued from page 11)

A change in output voltage is sensed and compared to a stable reference in the controller. The stable reference is a rectified AC voltage that is regulated by Zener diodes. When the output voltage is compared to the stable reference, any difference that exists is amplified and causes the silicon-controlled rectifiers to conduct. The output from the rectifier bridge is applied to the DC windings. When the output voltage rises, the current in the windings is reduced, thus allowing the consequent increase in opposing voltage to restore the output to its rated value. When the output voltage drops, the reverse action takes place.

In our study of the static-magnetic regulator, we learned that tests had shown it will make complete corrections for changes in input voltage or power load within 15 cycles when supplying its rated load at 100% power factor. Furthermore, these corrections are made continuously.

Installation

We decided to install a 50-kva static-magnetic regulator. With the broadcasting building already filled to capacity, the regulator was installed outside on a small concrete slab (approximately 3′ x 2½′ x 6″). It is protected from the elements by a weather-proof enclosure of heavy-gauge steel (Fig. 3). Wiring was very simple. We had only to reroute wires from the disconnect point to the regulator and then back into the building service and distribution system.

Results

After the regulator was put into service, voltmeters and chart recorders were connected to the 120/240-volt input from the power line and the output from the regulator to determine the results. After a six-day period the records showed the static-magnetic device had held the output voltage at smooth, constant levels despite continual fluctuations in input voltage.

These charts (Fig. 4) are scaled in such a way that the normal input level is read as 120 volts and the output as 116 volts, rather than 240 and 232 volts, respectively. On this basis, the regulator held the total spread of output voltage within ¾ to 1 volt. And even this spread was merely the difference between the constant levels of voltage during the periods when the FM station was either on or off the air.

The close regulation achieved was dramatically demonstrated when a car smashed into the guy wire of a utility pole in West Bend. This caused such severe vibration and shock that the 26,000-volt feeder wires slapped together, burned, and fell across a 2400-volt line. The result was a severe voltage surge until backup protection operated.

Lights were out on our side of the city. Two hundred television sets failed. But we continued broadcasting without interruption because the static-magnetic device and the station lightning arresters absorbed the surge.

The input voltage reading on the chart recording (Fig. 4) showed a sharp break from 120 to at least 132 volts, the point at which the recorder recovered and resumed the line graph. In comparison, an increase of only 2 volts is all that

Table I. Filament Voltage and Tube Life.

Filament Voltage	Hours of Useful Life	Unit Cost per Hour
100%	100	100
105%	50	200
110%	26	415

can be definitely traced on the chart recording for output voltage. Furthermore, the correction was immediate and not on a gradual scale.

With 120 volts as the base, the input voltage for the six-day period increased and decreased continually during both day and night hours. The minimum reading was 116 volts and the maximum 126½ volts (except when it surged to 132 volts after the car hit the utility pole).

The regulator, on the other hand, held the output virtually steady at 116 volts during the hours between 9 AM and midnight when the FM station was broadcasting. After midnight, the voltage reading would rise to 116½ or 117 volts and hold there at a constant level until the early morning hours when it would start to move back to 116 volts.

Savings on Replacements

Because of this precise regulation, we figure our stations are saving 30% on the cost of tube replacement and component failures due to power surges. The average annual cost of replacing transmitting power tubes had been approximately $1600. To this was added another $700 for receiving tubes, rectifiers, and other electronic components, making a total of about $2300 a year. With the 30% savings, replacement costs are reduced by nearly $700 a year. This alone will recover the initial cost of the regulator in a little more than 2 years.

Table I shows comparative figures on how increases in filament voltage affect the life and per-hour cost of a tube.

Conclusion

In addition to reducing tube costs and time spent in maintenance, the regulator eliminates the need for the station engineers to make frequent adjustments in voltage settings. The device handles this automatically so that both WBKV and WBKV-FM are always operating well within the power limits set by the FCC. ▲

NEWS OF THE INDUSTRY

WABC Engineer Retires

Niklaus Hagmann, WABC engineer, is retiring after 37 years of service to that station. Hagmann joined WABC in 1927 when its call letters were WJZ. A pioneer in broadcasting, he played an active part in early experimental work that helped bring radio to its present level. In the photo above Hagmann (second from right) holds an early WABC mike as Walter Schwartz, WABC V.P.; Frank Marx, president of ABC engineers; and Harold L. Neal, Jr., president of ABC-owned stations, look on.

SMPTE Meeting Plans Set

Arrangements for the **96th Technical Conference of the Society of Motion Picture and Television Engineers (SMPTE)** to be held September 27-October 2 at the Commodore Hotel in New York continue at a brisk pace. General chairman for the conference is C. Russell Dupree of J. A. Maurer, Inc., and J. Miller of DuArt Film Laboratories is vice-chairman. Program chairman is **John J. Kowalak** of Movielab, Inc. Topic areas for technical papers to be presented during the conference are: new techniques for World's Fair projection; cinematography; motion pictures and television for education; special effects and optics; laboratory practices; medical motion pictures and television; instrumentation and high-speed photography; television engineering and production; 8mm and small format films; space technology; and sound recording.

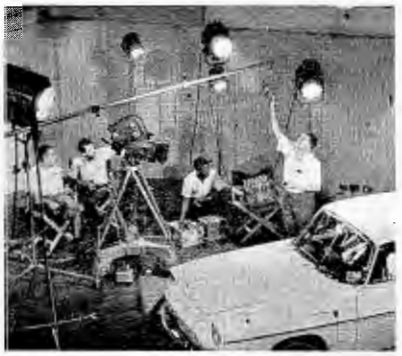
Consulting Service Announced

A new acoustical consulting service, under the direction of **Michael Rettinger** as engineer in charge, has been announced by the Burbank facility of the **RCA Broadcast and Communications Products Division.** The new service, previously available only to users of RCA film recording equipment, is being extended to include architects, builders, and others requiring professional counsel in acoustics.

About The Cover

One of the technical highlights of the New York World's Fair is RCA's circular television studio, shown on the cover and in the accompanying photo. Continuous live and taped programming is broadcast in color, via a closed-circuit system, to receivers located throughout the Fairgrounds—in restaurants, exhibits, and rest areas. Visitors can view the studio from a circular ramp above the area and watch the actual production of color shows. The studio is a self-contained facility with adjoining control rooms, automatic lighting control, and network hookup. Color monitors are located on the ramp, so visitors can simultaneously see the scenes being broadcast. Performers, as well as cameras, lighting fixtures, and other broadcast apparatus are in full view.

Visitors are given the thrill of seeing themselves on color-TV, too. At the entrance to the viewing ramp, the fairgoer steps on a moving platform, passes in front of a color camera, and views himself on the "live" monitor. The pickup is taped, delayed a few seconds, and then played back through a second monitor on which the visitor sees himself again.



Jamaican TV Film Studio

Kenneth Khouri, managing director of **Federal Records Manufacturing Co., Ltd.,** has announced expansion of the company's facilities to provide Jamaica with its first independent television film studio. The new studio, though not fully completed, is in use for the preparation of filmed commercials; feature productions and plays are soon expected to be staged as well. Equipped with 16mm and 35mm cameras and full audio mastering equipment for tape or disc recording, the studio will provide a means for developing locally produced programs and talent for television. Plans for the modern studio were developed by the parent company, previously involved only in the manufacture of records, in cooperation with the **Jamaica Industrial Development Corp.** Additional assistance was provided by Jamaica's Pioneer Industries Law, an incentive program designed to permit accelerated depreciation allowances for corporations entering or expanding into fields new to the West Indies. Photo above shows production crew filming a commercial in the new studio.

Distribution Set Up

AKG of Vienna, manufacturers of condenser and dynamic microphones, are being represented in this country by AKG of America, a division of **North American Phillips Company, Inc.** The new division has become the sole authorized distributor of AKG products in the United States, according to **Fritz Sippl,** director of international marketing for AKG. Repairs and service, as well as a complete inventory of AKG products, will be available at the Long Island City service center.

Telephone Cable to Puerto Rico and Virgin Islands

A second telephone link from Florida to Puerto Rico via the Virgin Islands will be established on completion of a communication installation now underway. The new system, intended to provide supplemental telephone facilities, will consist of a coaxial submarine cable between Florida and the Virgin Islands, as well as a microwave relay system between the Virgin Islands and Puerto Rico. The submarine cable will be capable of handling 128 simultaneous telephone conversations, and, with certain additional equipment, capacity will be almost doubled. Necessary licenses for the cable landings in the Virgin Islands and Florida, in addition to construction permits for the microwave portion, have been obtained from the FCC.

Stockholm Technical Fair

The U. S. Exhibition at the **Stockholm Technical Fair,** October 2-8, will feature American electronic products, offering U. S. manufacturers an opportunity to test the growing Scandinavian market. Sponsored by the Stockholm Chamber of Commerce, the Fair is the most important sales engineering event in Sweden, with attendance limited to the trade. Twenty-five U. S. firms exhibiting at the 1963 Technical Fair reported cash sales of $350,000 and estimated future sales of $4 million as a direct result of their participation. Surveys indicate that Sweden's $180 million electronics market is growing at an annual rate of 25%, and will reach $351 million by the end of 1966. Imports will supply the major part of the projected increase. Swedish production, $80 million in 1963, consists mainly of radios, television sets, and phonographs.

Property Transactions

Chris-Craft Industries, Inc., has entered into a contract to acquire television sta-

tion **WTCN-TV,** Minneapolis-St. Paul, from **Time-Life Broadcast, Inc.,** subject to the approval of the FCC. Announcement of the contract was made by John G. Bannister, president of Chris-Craft, and Weston C. Pullen, Jr., president of Time-Life. WTCN-TV will become the third independent VHF television station of Chris-Craft Industries; the other two, operated through subsidiaries, are KCOP-TV, Channel 13, Los Angeles, and KPTV, Channel 12, Portland, Ore.

Radio Station WRIS in Roanoke, Virginia, owned by **Cy Bahakel** has been purchased by **Lloyd Gochenour.** Gochenour also owns station WAFC in Staunton, Virginia.

Robert E. Ingstad, president of Interstate Broadcasting Co., has announced the sale of Radio Station **KEYD,** Oakes, North Dakota, to **Q. P. Coleman** of Mobridge, South Dakota.

PERSONALITIES

Boyce Nemec has been elected Vice-President of **Reeves Industries, Inc.** Nemec is also President of Reevesound Co., Inc., a wholly-owned subsidiary of Reeves Industries, and is widely known in the field of photographic technology and motion picture engineering.

The appointment of **Barton C. Conant** as director of engineering services of **CBS Laboratories** was announced recently by Frank B. Sobieralski, vice president, Administration and Business Development. Mr. Conant's responsibilities will include production planning, supervision of model and wire shops, and facilities maintenance.

Charles H. Donahue has been named eastern regional sales manager for **Reeves Soundcraft, Division of Reeves Industries, Inc.** Donahue, who has been active in advertising for the magnetic recording industry, will be responsible for the sale of Reeves Soundcraft products throughout the Eastern region of the country.

John L. Boyer, nationally-known engineer and holder of 38 U.S. patents, has been appointed senior engineering consultant at **International Rectifier Corporation.** Announcement was made by **Eric Lidow,** president of the firm. Mr. Boyer will be responsible for development of new and advanced products, particularly in the heavy power field, with special emphasis on products using epitaxial controlled rectifiers.

Gates Radio Co., a subsidiary of Harris-Intertype Corp., announces the appointment of **Howard Dempsey** as broadcast sales engineer covering the territories of Colorado, New Mexico, Utah, Wyoming, and Nebraska. Mr. Dempsey was formerly with the engineering staff of WIRE, Indianapolis, and more recently was chief engineer of KFML in Denver.

F. Sibley Moore has agreed to continue in his present position as vice president, administration, for Radio Stations **WJR-AM and FM** when ownership of the stations is transferred (subject to FCC approval) from The Goodwill Stations, Inc., to Capital Cities Broadcasting Corp. **Frank M. Smith,** president of Capital Cities Broadcasting Corp., announced the arrangement.

William B. Allen has been appointed manager of engineering at **Ampex Corp.'s** video and instrumentation division, it has been announced by **Robert J. Weismann,** general manager of the division. In his new post, Allen is responsible for development of magnetic recording equipment for television broadcasting, space exploration, defense, industry, and medicine.

Richard P. Gifford, general manager of **General Electric's** Communication Products Department, has been elevated to the highest ranking membership grade —Fellow—in the **Institute of Electrical and Electronics Engineers.** Gifford was cited for leadership in the field of communication techniques and practices.

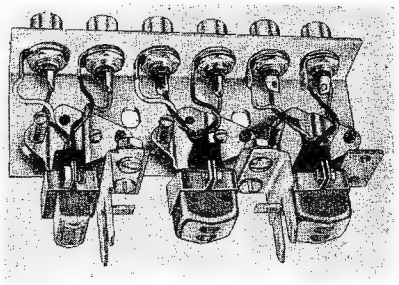
Election of **Benjamin Adler** as vice president of **Litton Industries** has been announced by **Charles B. Thornton,** chairman of the board. Adler was president of **Adler Electronics** which was recently made part of Litton's Systems Group. ▲

NEW PRODUCTS

AM Noise Meter

McMartin Industries, Inc. has announced the availability of an AM Noise Meter, **Model AM-25,** designed to facilitate the measurement of AM noise of an AM or FM transmitter. The small, self-calibrating meter assembly replaces the "haywire" collection of parts familiar to most station engineers. When the instrument is used with a calibrated AC voltmeter, noise measurements may be made with accuracy.

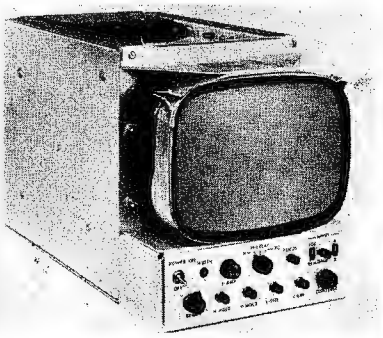
Circle Item 47 on Tech Data Card



Cartridge Mount Kits

Designed for cartridge-tape handlers using endless-loop cartridges of the Fidelipac type, this **Nortronics** head mount accommodates up to three "no-mount" heads on a single assembly, eliminating the need for rear-mount heads. "Micrometer" adjustments permit setting head height, azimuth, and face perpendicularity, and a special lock screw on each head bracket locks the adjustments; heads are fastened to the bracket with a quick-release screw clamp for rapid installation. Kits, with all necessary hardware, are available for the conversion of existing cartridge players using rear-mount heads. Model QK-110 is used for "B" size heads; model QK-111 is used for "G" types.

Circle Item 48 on Tech Data Card



Stabilized Video Monitors

Performance-stabilized video monitors which permit simultaneous display of subtle picture shifts have been introduced by the **Conrac Division** of **Giannini Controls Corp.** Utilizing full voltage regulation, keyed clamps, controlled feedback loops, and a variety of circuit innovations, the new CZB series assures that variations in picture quality are not caused by the monitor. Black-level drift is detected by 100 per cent direct coupling from input to picture tube and a unique keyed "back porch" clamp, which also permits hum, noise, or other spurious signals on the incoming line to appear on the screen. A front-panel signal-analysis switch allows the operator to shift the picture one half line while simultaneously increasing the horizontal time constant to spot tape recorder hunting. Another position of the same switch displays a pulse cross-pattern while increasing the brightness automatically for better observation of the sync pulses.

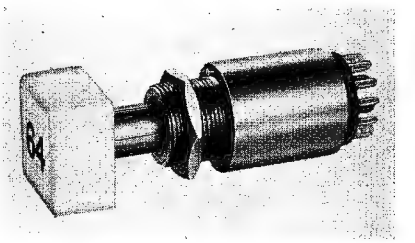
The CZB series combines 29 transistors with 11 tubes plus rectifiers, and is also available in 8", 14", and 17" sizes for rack mounting or field use.

Circle Item 49 on Tech Data Card

Master Tape Recorder

A new two-speed master audio tape recorder for the most exacting requirements of the recording industry was introduced by **Ampex Corp.** at the recent NAB Convention in Chicago. Called the **MR-70,** the new recorder achieves improved dependability through the use of military grade nuvistors which have a failure rate 10 to 20 times lower than conventional vacuum tubes and about half that of germanium transistors. The MR-70 has a signal-to-noise ratio of 70 db (full track at 15 ips), a full 10 db better than previous Ampex master recorders. It thus takes full advantage of low-noise tapes and anticipates future tape improvements through improved electronics. Fast, positive starts, essential to master recording techniques, are provided by a power boost to the reel idler, motors, and solenoids during the start function. Stability of tape motion is assured by heavy ribbed castings, viscous damping of reel idler, and a flutter idler. The MR-70 is available with either of two tape-speed combinations: 7½ and 15 ips; or 15 and 30 ips. Prices will start at $4,450 (single channel).

Circle Item 50 on Tech Data Card

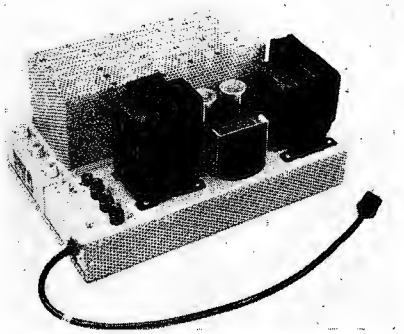


Illuminated Pushbutton Switch

Switchline Div., Electro-Mech Components, Inc. announces a new 6-pole double-throw illuminated pushbutton switch with high reliability and long life for use in a variety of electrical and electronic equipment. Switches are rated for 30 volts DC or 115 volts AC, at 2 amps resistive, or 1 amp inductive. Operating pressure is approximately 2 lbs, with a plunger travel of 3/16". Lenses are translucent Lexan and are available in white, red, green, blue, and yellow with standard letters and numerals or

special engravings. Standard switches will be offered with momentary- or alternate-action operating modes with specials on request, as well as 2-, 3-, 4-, and 5-pole double-throw configurations, with or without the illuminated lens feature.

Circle Item 51 on Tech Data Card



Distribution Amplifier

Low- or high-band distribution amplifier is being offered by **Entron, Inc.,** manufacturer of community, master, and educational TV equipment. Designated as **Model LHD-404R,** the unit is designed to feed low- and high-band VHF and full FM signals into as many as four distribution lines with an output level of 50 dbmv on channel 13. It utilizes a combination of 10,000-hour tubes and highly reliable compactrons to deliver high-level signals; systems layout is simplified since the need for most distribution line extender amplifiers is eliminated. Its matched single input terminal allows the LHD-404R to be fed from a directional coupler or from the end of a distribution line; therefore, it can serve as either a bridging amplifier or a distribution line extender.

Circle Item 52 on Tech Data Card

Antimagnetic Tape Cases

An improved protective carrying and shipping case for magnetic tapes has been announced by **Records Reserve Corp.,** manufacturer of computer accessories. The cases are made to shield tapes from extraneous magnetic fields, and are available in three sizes to accommodate three, five, or nine 10½" reels. They are extremely sturdy, having

welded seams, piano hinges, wire reel-rack separators, and rubber padding to prevent movement of the reels when the cover is closed. The cover has rounded edges and is equipped with a rubber gasket as protection against dust and moisture.

Circle Item 53 on Tech Data Card

Closed-Circuit TV Camera

A low-cost closed-circuit television camera with both sight and sound, designed to operate through the ordinary home TV set as well as a professional video monitor, was shown recently at the Chicago Parts Show. The new camera, offered by **GBC America Corp.** and designated Model AE-50, is a one-piece 9-lb transistorized unit incorporating its own power supply as well as sound pickup circuitry. A ¼" coaxial cable running from the camera to the antenna leads of a household television receiver or a video monitor completes the hook-up. The AE-50 has a built-in automatic light compensator to take full advantage of changing light conditions, and comes equipped with a 25mm f/1.4 lens. Additional lenses are available for wide-angle viewing, telephoto, or extreme closeups.

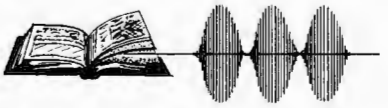
Circle Item 54 on Tech Data Card

Recorder Microphone

Martel Electronic Sales, Inc., exclusive U.S. importer of the Uher tape recorder, announces a new microphone for the Model 4000-S portable transistorized tape recorder. Designated M-512, the microphone is capable of meeting professional needs, according to the company. The unit has a frequency range of 70 to 14,000 cps, built-in wind screen, music-speech selector switch, and thumb-operated "pause" control. ▲

Circle Item 55 on Tech Data Card

BOOK REVIEW



Microphones; A. E. Robertson; Hayden Book Co., Inc., N. Y., N. Y.; 351 pages, $12.75. Mr. A. E. Robertson, director of the engineering training department of the British Broadcasting Corp., has written an informative and useful volume on microphones, one that should find a place on the shelf of broadcasters and sound engineers. The wealth of well-organized data presented in this book will do much to dispel the cloud of confusion with which the microphone is regarded by many who work with sound.

Chapters 1 through 6 comprise a general discussion of the basic parameters (acoustical, electrical, and mechanical) which determine the usefulness of microphones. Of particular interest is Chapter 5, dealing with diffraction and dimensional effects, an important and frequently overlooked aspect of sound recording and reproduction in the studio. Chapters 7 through 11 are devoted to a description and analysis of the many general types of microphones, e.g., omnidirectional and unidirectional. Sufficient mathematical formulation accompanies the text to provide a clear understanding of the subject matter. The chapters on unidirectional and highly directional elements and arrays (Chapters 9 and 11, respectively) are quite clear, and are of particular use in studio and sound stage recording where booms are employed. Chapter 12, on noise, should provide an answer for many particularly elusive problems attendant to both studio and location recording and broadcasting. Finally, an 11-part appendix further develops the basic text and should prove useful to the student of electroacoustics, and to those who require a more theoretical approach. Ample bibliographical information is provided for additional reference. This excellent book is recommended for use by all who regularly work with microphones, and to the student or practicing engineer who requires a concise and compact reference. ▲

Letters

(Continued from page 6)

that I might have handled things this way. But, I go on the theory that "The Customer is ALWAYS Right," even with a utility—and the power company **has** pole transformers available to supply lower than usual line voltages, even though they may not be "standard" items with them. Therefore, holler until you get them to supply the proper line voltage, don't stand still for 240 volts or more. Bucking transformers cost more, and they cost money to excite, so why bother? Just get the good old utility off of their corporate posteriors long enough for them to round up pole transformers that are tapped to supply the desired voltages.

I see no reason why the customer should pay for something like this, especially when the light bill already exceeds $200. I think it is 100% the power company's problem—not mine. If I want and need a 220-volt nominal service, that is what I intend getting. I see no reason why I should re-process their delivered power to get things down to where I want it, much less buy a transformer to do so.

My point was, and is, that most radio station gear gets along much better on line voltages a shade on the low side than it does on high line voltage; and furthermore, a little persistence will get the power company to arrange things to suit.

F. G. HERVEY
Transmitter Supervisor, WHKW,
Chilton, Wisc.

DEAR EDITOR:

I certainly enjoyed the article "Use of Audio Level Devices" in your May issue. but I question Mr. Mackey's use of one unit.

I am speaking of the Symmetra-Peak. This device should be used before the AGC amplifier instead of after it. I have tried the one we have both ways and find that the action of our AGC amplifier is greatly improved with the Symmetra-Peak ahead, since positive and negative peaks are nearly equal; thus, the AGC amplifier is not required to compress heavily on a high amplitude positive or negative peak. This is one of the advantages claimed for the device by the manufacturer.

LARRY J. GARDNER
Chief Engineer, WKIX & WKIX-FM,
Raleigh, N. C.

Thanks for the information, Mr. Gardner; readers, more follows.—Ed.

DEAR EDITOR:

I was happy to see my article in the May issue of BROADCAST ENGINEERING.

There is one correction that should be made so as not to mislead anyone. The variation of audio levels from average program levels should be listed as ±10 db, or a **total** of 20 db variation, rather than the ±20 db indicated by the next to the last paragraph on page 41.

BRUCE L. MACKEY
Chief Engineer, WKRT Radio,
Cortland, N. Y.

ENGINEERS' TECH DATA

AUDIO & RECORDING EQUIPMENT

60. AKG—Folder contains specifications and prices of condenser microphones, dynamic microphones, and accessories.
61. AMERICAN ELITE—Fifteen-page booklet describes variable-pattern Telefunken condenser microphones.
62. AMPEX—Applications and operation of Electronic Editor for television tape are described and illustrated in new product sheet.
63. ASTATIC—Catalog lists microphones, cartridges, and replacement needles.
64. AUDIO DEVICES—Information on "Audiopak" continuous-loop tape cartridges.
65. BROADCAST ELECTRONICS—Packet contains specs and prices for "Spotmaster" tape cartridge system.
66. CINE-SONIC SOUND—Data sheet describes background music rental service which supplies, 7", 10½", and 14" pre-recorded reels.
67. CONCERTONE—Data folder on new 800 series tape recorders featuring solid-state circuitry.
68. CROWN INTERNATIONAL—Brochure and price list covers professional all solid-state tape recorders.
69. GIBBS—Folders describe principles of sound reverberation and "Stereo-Verb" reverberation units.
70. HARVEY RADIO—Engineering bulletin offers specifications of Ampex MR-70 master recorder.
71. 3M—"Sound-Talk" bulletin discusses frictional problems inherent in continuous-loop cartridge systems and investigates solutions.
72. QUAM-NICHOLS—General catalog lists speakers for replacement, background music, PA, and high fidelity uses.
73. RCA VICTOR—Bulletin lists physical and electrical properties of magnetic tapes.
74. SCULLY—Brochure describes professional solid-state record-playback units, Models 270 and 280.
75. SENNHEISER—Data sheet describes frequency-compensated lavalier microphone featuring spring-mounted inner housing to reduce mechanical noise.
76. SWITCHCRAFT—Engineering Bulletin describes new Q-G audio connectors, and discusses problems of grounding in AL connectors.
77. TELETRONIX—Data sheets detail leveling amplifiers and other audio products.
78. VIKING—Brochure describes modular tape cartridge handling system, with application notes.
79. WALLACH ASSOCIATES—Brochure lists and discusses variety of record and tape reel cabinets.

COMPONENTS & MATERIALS

80. AMPEREX—Condensed catalog lists receiving and transmitting tubes.
81. BELDEN—Catalog covers broad line of wires and cables for recording and broadcast installations.
82. BOSTON WIRE—Two brochures list and provide detailed data on television cable assemblies and connectors.
83. BRADY—Data sheet describes 3½" vinyl markers for heavy cables and coax.
84. CORNELL-DUBILIER — Reference sheet covers replacement components, capacitor assortments, and rotor systems.
85. INDUSTRIAL DEVICES—Short-form catalog describes wide variety of pilot lights, switches, panel displays, and other electro-mechanical devices.
86. MULTI-FLEX—Molded rubber gaskets, seals, shock mounts, and other high-pressure elastomeric components listed in catalog folder.

87. PAINTON—Three bulletins describe various miniature vertical and rotary faders.

88. RCA—Special April NAB issue of "Broadcast News" describes complete line of new broadcast equipment.

MICROWAVE DEVICES

89. MICRO-LINK—Brochures describe 10.5 kmc and 12.2 kmc—13.6 kmc microwave links, and 2500 mc instructional TV system.

MOBILE RADIO & COMMUNICATIONS

90. FINNEY—Catalog lists cut-to-frequency FM antennas in various connector configurations.

91. MOSLEY—Literature describes Citizens-Band antennas.

92. TENNA—Catalog folder lists CB antennas for mobile or fixed station use.

POWER DEVICES

93. CENTRAL TRANSFORMER — Technical bulletins describe constant-current AC supplies.

94. LECTROTECH — Separate bulletins detail solid-state regulated DC power supplies and miniature DC supply for use in multimeters.

RADIO & CONTROL ROOM EQUIPMENT

95. EICO—1964 catalog lists test instruments, audio components, recorders, CB, and amateur equipment.

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

97. METALAB—"Sectional Equipment and Furniture" catalog describes units for building-block assembly.

98. SPARTA—Product sheet covers transistorized stereo audio console for production studio and remote use.

CAMERA & STUDIO EQUIPMENT

99. BLONDER-TONGUE — Data sheet describes CCTV camera-monitor equipment suited to classroom applications.

100. GENERAL ELECTRIC—Several comprehensive brochures list features of transistorized cameras and camera equipment, including 4-vidicon color system.

101. PACKARD-BELL — Automatic, self-contained, transistorized CCTV camera is described in new brochure.

TELEVISION EQUIPMENT

102. DYNAIR—Illustrated 60-page catalog provides information on CCTV and broadcast transmission equipment, and modular solid-state switchers, processors, and distribution equipment.

103. ENTRON—Information is available on repeater, distribution amplifier, and extender amplifier.

104. REEVES—Technical paper gives specifications on Soundcraft video recording tape.

TEST EQUIPMENT & INSTRUMENTS

105. BIRD—Bulletin introduces 4-range absorbtion wattmeter with 150W max. capacity, 25 mc to 1000 mc. Also available, "How to Measure Watt You Have," on measurement methods.

106. DELTA—Application and installation of common point impedance bridges described in bulletin.

107. MARCONI—Technical brochure covers new transistorized distortion analyzer with program weighting filter for noise measurement.

108. TERADO—Specification sheet gives information on Galaxy 140W continuous duty AC/DC inverter.

TRANSMITTER & ANTENNA DEVICES

109. BAUER—Brochure describes 1-kw FM transmitter.

110. GATES—New information available on 5-kw transmitter, dual polarized FM antennas, and vertically-polarized FM antennas and power dividers.

111. JAMPRO—New catalog covers line of VHF TV antennas for channels 7-13, and CCIR band III channels.

Professional Services

VIR JAMES
CONSULTING RADIO ENGINEERS
Applications and Field Engineering
345 Colorado Blvd.
Phone: (Area Code 303) 333-5562
DENVER, COLORADO 80206
Member AFCCE

LAWRENCE BEHR ASSOCIATES, Inc.
RADIO ENGINEERING CONSULTANTS
FM Applications and Field Engineering
also
AM — Communications — CATV
LAWRENCE BEHR, PRESIDENT
2501 East Fourth Street
Greenville, North Carolina
919-PL 8-3966

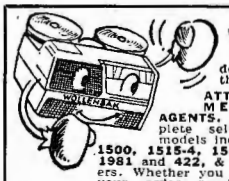
Classified

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

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

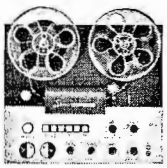
EQUIPMENT FOR SALE

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



WOLLENSAK
Tape Recorders
deliver a wallop bigger than many twice the size.
ATTN: SCHOOLS & GOVERNMENT PURCHASING AGENTS. We have the most complete selection anywhere. New models include: **524, 1400, 1440, 1500, 1515-4, 1570, 1780, 1580, 1980, 1981 and 422, & SA-421** speaker/amplifiers. Whether you order 1 or 1000 units, your order receives prompt attention.
REQUEST COMPLETE TAPE RECORDER DISCOUNT SHEET

EICO new Transistor Stereo/Mono 4-track Tape Deck
Model RP 100W
Completely assembled, wired and tested with 3 heads, and stereo record and stereo playback preamplifiers.
Model RP 100K
Semi-Kit includes transport completely assembled and tested with 3 heads; and control electronics, stereo record, and stereo playback pre-amplifiers in easy-to-assembly kit form.



We now have the EICO 2400 series, 3 motor decks in both factory and kit form. Write SAXITONE for low quotes on EICO decks.

TAPE STORAGE OR CARRYING CASE
reg. 9.95, now **5.95**
Heavy wood construction, waterproof vinyl covering. Holds up to 24 tapes.)
reg. 2.75, now **1.79**
(Pressed cardboard, holds 10 tapes or 60 45 rpm records.)

SAXITONE RECORDING TAPE

275' Plastic, 3" reel	.35
600' acetate (plastic), 5 inch	.70
600' MYLAR 5 inch reel	.75
900' MYLAR (Polyester), 5 inch	.89
1200' MYLAR, ½ mil, 5 inch reel	1.18
1200' acetate (plastic), 7 inch	.99
1200' MYLAR, 1½ mil (strong)	.98
1800' acetate (plastic) 7 inch	1.19
1800' MYLAR 1 mil, thick, 7 inch	1.59
2400' MYLAR, unstenslized, 7 inch	2.25
2400' MYLAR, tensilized, 7 inch	2.79
3600' MYLAR, tensilized, 7 inch	3.89
Revere M-2 blank cartridge tapes	3.33
30% off Revere automatic music tapes	

Plus Postage (Greater discounts to quantity buyers.)

SAVE 30-60%
4-track stereo music on tape
FREE 50-PAGE CATALOG

SAXITONE

1776 Columbia Road, N. W., Washington 9, D. C.

Circle Item 45 on Tech Data Card

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

GOVERNMENT SURPLUS. New 6 foot diameter aluminum parabolic reflectors solid surface. $175.00 ea. Radio Research Inst. Co., 550 5th Ave., New York 36, N. Y. 3-64 tf

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

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

RCA FM EXCITER MI 7016 complete with one crystal for 104.3 MC; good condition; $350.00. Write Broadcast Engineering, Dept. 112. 7-64 1t

FOR SALE — V.R. 1000—A-Mod-Demod. Write Randal Hackett, 1051 Roewill Drive, Apt. 8, San Jose, California. 7-64 1t

Gates Subcarrier Inserter and Power Supply M5688 with Subcarrier Generator M5689 for single or dual channel SCA Multiplex. Above items form M5633. Like new; $700. Write Broadcast Engineering, Dept. 111. 7-64 1t

GEL FMC Multiplex System, including main and sub-channel exciters, regulated power supplies and enclosed rack. In good condition. Inquire CE, WNCN, 11 E. 47th St., New York City 10017. 7-64-1t

TOWER—600-foot stainless G36, two tapered sections. One top section, two base insulators, guy wire, disassembled. Priced to sell. Baker, WTPA-TV, Harrisburg, Pa. 7-64 1t

For Sale: Grampian record cutterhead; will sacrifice. Also recording lathe and Ampex Stereo recorder, very reasonable. We offer repair service of Grampian cutters. 3 weeks required; work done in England. Complete overhaul. New coils; fully guaranteed. Cook Enterprises, 3905 West Sauson Ave., Los Angeles, Calif. 90043. 7-64 1t

Hammerlund SP-600JX, Panaramic Electronics SA-8B T 100 High Resolution (50 CPS) panadaptor 100KC Sweep with 455 KC input. Both less than a year old. Absolutely like new, used only a few hours, $750.00 each. Reason for selling, need money urgently. George Bullock, 2003 Hampton Avenue, Augusta, Georgia. Phone RE 3-7937. 7-64 1t

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

Antennas, Parabolic; 6 ft. diameter, Solid Surface Aluminum with dipole, pole bracket, de-icer. 100 available. New Surplus. $100.00 set. Sierra-Western Electric Cable Co., Willow & 24th Streets, Oakland, Calif. 7-64 1t

Personnel

TRANSMITTER SUPERVISOR - MAINTENANCE TECHNICIAN - ENGINEERING ASSISTANT. 22 years electronics experience, 18 years continuous employment broadcasting, AM-FM, Directionals. Returning USA after 3 years overseas supervising installation, operation, maintenance of international short wave broadcasting transmission facilities, two 100 kilowatters, curtain arrays, quadrants. Including training of indigenous nationals. Mature, family man. Available August 15th. Write Dept. 113, Broadcast Engineering. 7-64 2t

ELECTRA MET. INC.
REMOTE THERMOMETER
(Electronic)
Outside temperature from mike position. Installed in less than 1 hour. Ask about our other weather equipment. Send for Brochure. P. O. Box 6111, 1246 Shafter St., San Diego 6, Calif. 2-64 1t

- SYNCHRONOUS MAGNETIC FILM RECORDER/REPRODUCER
- MAGNETIC TAPE RECORDERS
- NEW—THE portable MINITAPE synchronous 13 lb., battery operated magnetic tape recorder for field recording.

THE STANCIL-HOFFMAN CORP.
921 N. Highland, Hollywood 38, Calif.
Dept. B **HO 4-7461**

Advertisers' Index

Odds Are—The Choice Will Be Tarzian for Elaborate New Switching Facilities

Why? Start with a proven system capability. In recent years, Sarkes Tarzian, Inc. has developed some of the most sophisticated switching complexes in the exciting world of television. Complicated master switching control systems, multiple studio controls, remote controls, automated control systems, delegation systems—each custom designed to fulfill an individual station's specific requirements. Each proving an impressive technical competence. Tarzian's modular concept permits notable flexibility in planning. Solid state design delivers total reliability—dependable, maintenance-free performance.

Why not translate this technical competence into increased programming capability and smoother broadcast operation for your station? Complete system engineering is available if desired.

SARKES TARZIAN

BROADCAST EQUIPMENT DIVISION — BLOOMINGTON, INDIANA

Circle Item 46 on Tech Data Card

RCA-7293A FIELD-MESH IMAGE ORTHICON

Clean...Precise...Ghost-Free Pictures

The RCA-7293A maintains the same flexibility and latitude of exposure and lighting that you experienced with the RCA 3" image orthicons while providing all of the benefits of field mesh construction. An additional feature of the RCA-7293A is the anti-ghost design which minimizes the highlight flare encountered in over-the-knee operation, providing a clean, precise picture.

Other design advantages of the 7293A include: *anti-porthole feature*—the tube provides a uniform, distortion-free background to the edge and corners of the picture; *exceptional sensitivity*—equivalent to film rated ASA 8,000...produces broadcast quality pictures with only 5 footcandles of incident light on the faceplate; *high signal-to-noise ratio*—45:1; *high resolution and contrast*—field-mesh construction assures sharp transition from black to white, minimizes distortion due to beam bending, and improves corner focus.

Get the most out of your camera tubes. Pick up a copy of this wall-chart (1G-1160A) on "Do's and Dont's for Operating Image Orthicons and Vidicons". Operating characteristics of all RCA camera tubes are listed on the back. It's free at your local Authorized Distributor of RCA Broadcast Tubes.

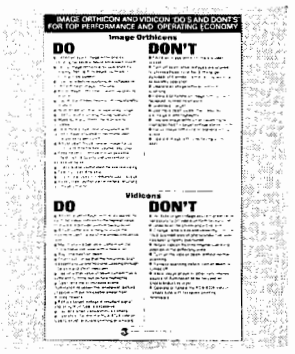


IMAGE ORTHICON AND VIDICON DO'S AND DONT'S FOR TOP PERFORMANCE AND OPERATING ECONOMY

Image Orthicons

DO DON'T

Vidicons

DO DON'T

3

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

The Most Trusted Name in Electronics

AVAILABLE THROUGH YOUR LOCAL RCA BROADCAST TUBE DISTRIBUTOR

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