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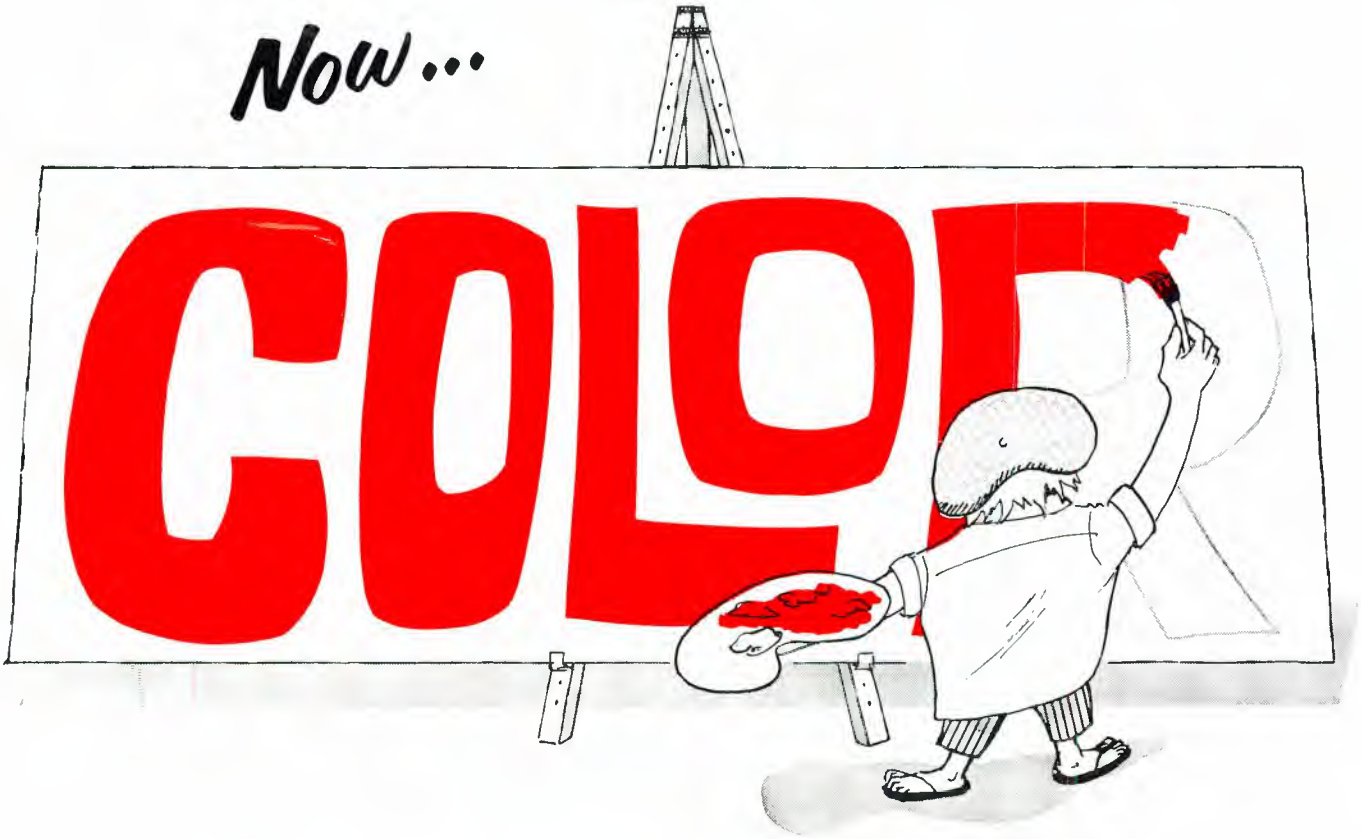

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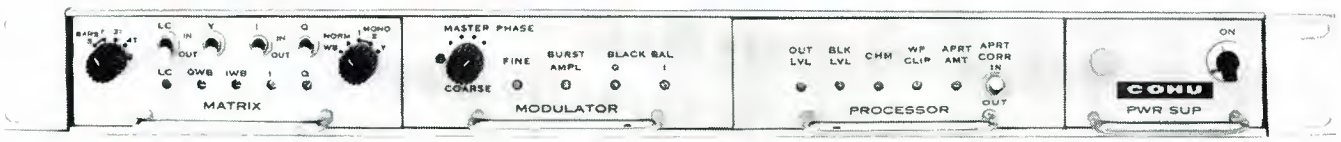

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Broadcast Engineering

Volume 9, No. 1 January, 1967

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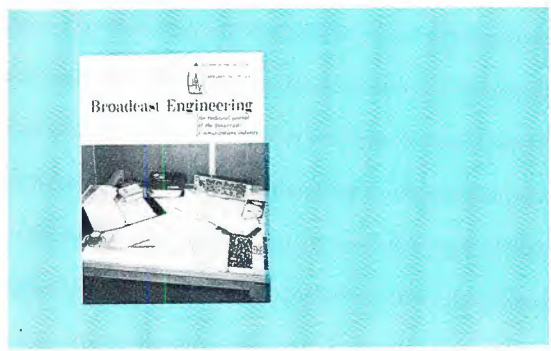
CONTENTS

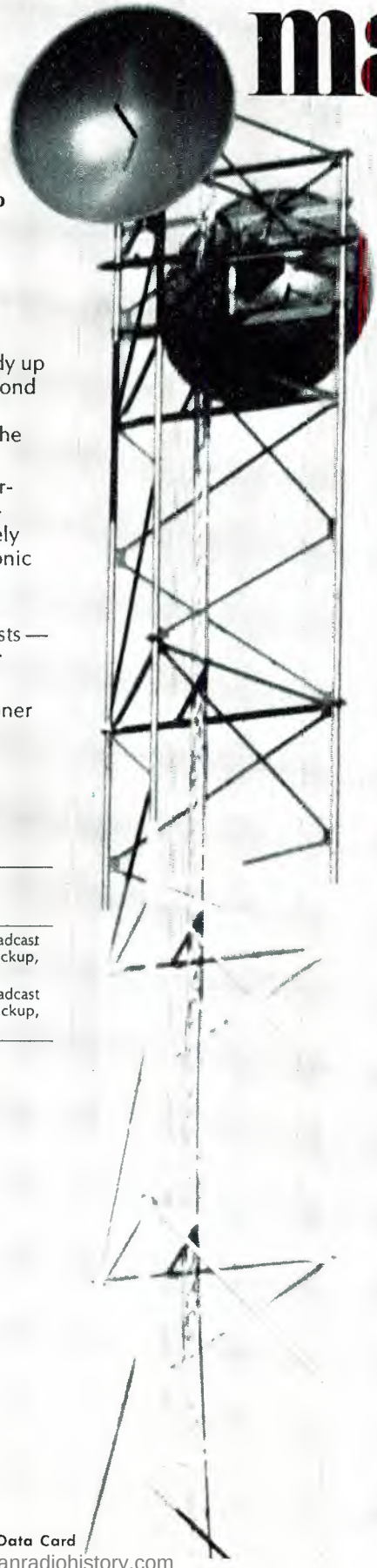
Features

Departments

Schematic diagrams are vital to the technical phases of broadcasting and all electronics industries. Our cover scene calls attention to the report beginning on page 18.



What's new in Reelsville, man?



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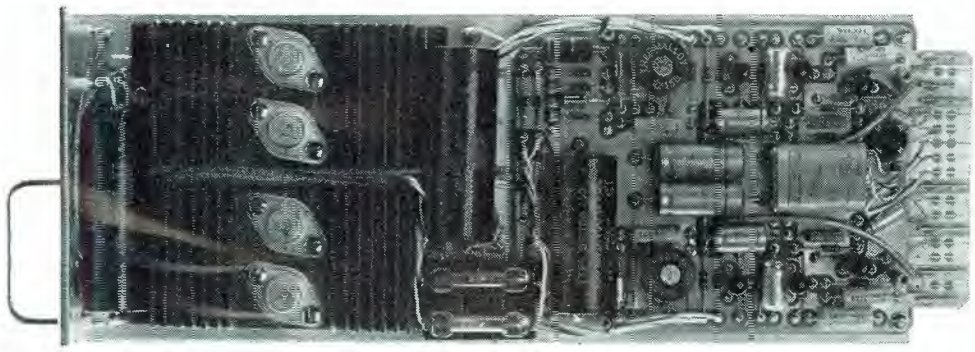

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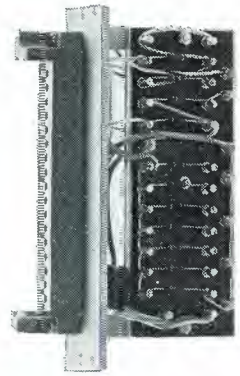

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Book Review

How to Build Speaker Enclosures: Alexis Badmaieff and Don Davis; Howard W. Sams & Co., Inc., Indianapolis, 1966; 144 pages, 5½" x 8½", soft cover: $3.25.

In this book, it is stated, "Regardless of the quality of your sound-reproducing equipment, the quality of the final sound output is only as good as your speaker enclosures." The statement is substantiated by an analysis, both graphical and mathematical, of the effects different enclosure types, materials, and construction have on the sounds emanating from the speaker-drivers

The volume begins with an evaluation of the five basic enclosure types: finite baffle, infinite baffle, bass reflex, horn projectors, and combination units. This is followed by an analysis of driver units, with statements regarding their limitations and the effects of changing sizes and types.

Next, speaker and enclosure placement are considered, with particular emphasis on phasing, efficiency, and equalization, both electronically and mechanically. This involves discussion of phasing and crossover networks, and how they are best related to individual components.

In the work are photographs, graphs, curves, and construction plans (including material lists) for many examples and combination units. Information in the book is sufficient to permit an individual to design the changes required for adapting any specific unit to the particular room or driver unit with which it will be employed.

Concluding chapters deal with crossover networks and how their design is achieved. Graphs and charts indicate frequency and power demands of various orchestral groups, and for the "coil winders" there is sufficient information to permit construction of networks in the workshop or home. The chapter dealing with constructing and testing describes the materials, tools, and methods by which the most satisfactory results can be obtained. Testing techniques, from simple arrangements to elaborate professional setups, are then presented.

This book has been written for a wide range of readership and essentially requires little more knowledge than what a speaker is. Source material is from those who manufacture both enclosures and speakers of the professional type. The authors are engineers who have been engaged in the design of enclosures and speakers for commercial manufacture. ▲

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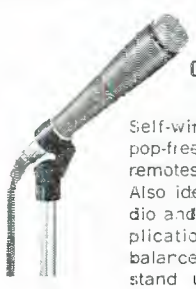

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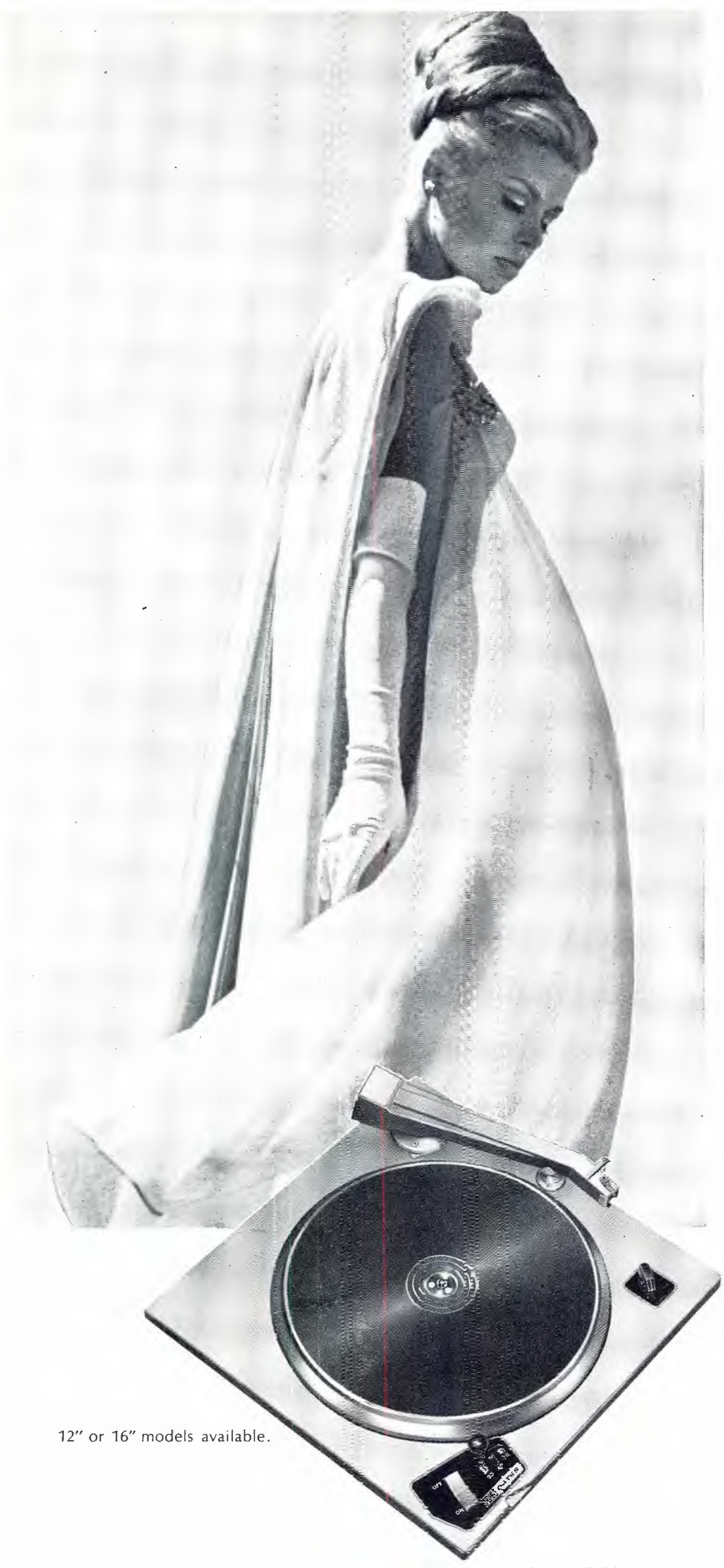

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A TELEPHONE SYSTEM FOR ON-THE-AIR USE

By Wayne Jones*—A large amount of telephone on-the-air programming requires an elaborate installation.

Since its opening in December, 1959, Montreal radio station CKGM has featured daily "open line" programs, inviting listeners' opinions, via their home telephones, on various topics. CKGM engineers, therefore, have spent considerable time developing the most functional and flexible system for airing the calls, keeping in mind the necessity for the best possible on-air sound, and for previewing the program (and when warranted, deleting objectionable material) during an actual broadcast.

Numerous installations have been tested during the past five years, but until now, all have been only partially satisfactory, while some left much to be desired. Most systems consisted of a key-set telephone, with the announcer using a handset, an operator's headset, and most recently, a simple speakerphone arrangement.

The telephone equipment was connected to the broadcast console through a standard recorder connector supplied by the telephone company. This system, however, had several disadvantages. The announcer, at times, had to contend with both his regular on-air headset and the cumbersome telephone headset. His voice would often feed through the telephone, via the recorder connector, into the console, causing an objectionable filter effect. The effect could be reduced if the announcer positioned his mouthpiece away from his mouth and if the operator "rode levels" on the telephone mixer at the console. The operator also had to close this mixer completely whenever the announcer selected lines, in order to prevent the loud click from sounding on the air.

During programs, an operator answers and screens all calls before the announcer takes them on the air. Although visual indication was provided to the announcer in the form of steady or flashing lamps on his key set, it was often difficult for him to discern which line to take next. Occasionally, he would take a call on the air while it was being screened by the operator. Also, as the lines used for this program appeared on other sets throughout the station, a call on the air could be interrupted by an unsuspecting party elsewhere in the station.

To solve these and other problems, the following system was developed and installed in cooperation with the Bell Telephone Company of Canada.

The new system had to satisfy several conditions:

1. The announcer should not have to wear any headsets other than his normal broadcast headset.
2. There should be no objectionable filter effect in the announcer's voice while using the telephone; that is, the output provided by the telephone company should contain only the distant party's voice and not the announcer's.
3. Some means must be provided whereby a call already on the air could not be interrupted, and conversely, the announcer should not be able to put on the air a line in use off-air, for example, a call being screened by the operator.
4. The equipment must be silent in operation, both mechanically and electrically; *i.e.*, switches should not click, and it should be possible to leave the console mixer position for the telephone open while the announcer is selecting lines.
5. The equipment must be easy to operate and not allow "on-air" errors.
6. The equipment must be flexible. It should allow restricted conferencing and other special effects as the need arises.
7. The operator should retain overall control of the system and, from his position in the control room, be able to supervise its operation.
8. The equipment must be provided with a backup system in case the main system fails.
9. The aesthetic appearance of the studio must be maintained. Preferably, the equipment should be "built-in."

*Engineering Department, CKGM, Montreal, Quebec.

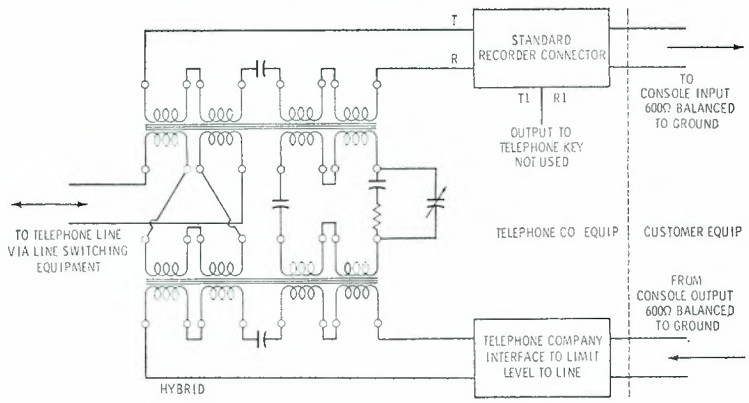


Fig. 1. A simplifield schematic of the hybrid circuit used at Montreal's CKGM.

10. A 1400-Hz beep to the caller every 15 seconds, as required by law, must be supplied to inform the caller that his conversation is being recorded and/or broadcast.

The telephone systems that evolved may be divided into two sections: the equipment used to connect the telephone line to the broadcast equipment, and the line-selecting, or switching, system.

Telephone Equipment

The initial work evolved around a basic speakerphone system. This unit is the familiar "hands-free" telephone supplied by the telephone company for commercial and private use.

Basically the speakerphone system is composed of four items: a control unit containing plug-in amplifier cards; a microphone, or transmitter, with a built-in preamp; a speaker; and a power transformer. The telephone line is connected to the control unit, where it is split by a hybrid coil into a transmit and a receive circuit. The transmit circuit consists of a series of amplifiers fed by a microphone, and the receive section is a series of amplifiers feeding a speaker. Because the hybrid is not 100% efficient, feedback would result if it were not for a unique feature of the speakerphone, its voice switching circuitry. Whenever sound above threshold level is presented to the microphone, the receive path is switched off and the transmit path is switched on, almost instantaneously. Because of this feature, information presented to the microphone appears on the telephone line and not at the speaker. The speakerphone is incorporated into the console by using the control-unit receive channel to feed the console. Thus the filter-effect problem is solved; that is, the announcer's voice feeds the console only by means of the broadcast microphone and not by way of the telephone microphone.

The use of this voice switching circuitry is the key to the new system. An additional modification to the standard system was the inclusion of two transmitters, rather than the conventional single transmitter. This was found necessary to maintain an adequate transmit level to the caller when more than one person was present in the studio.

To provide a greater control of the transmit level and to make up for the loss which occurs when two microphones are used in parallel, a variable-gain amplifier was inserted in the transmit path.

The voice switching circuitry causes another effect: The announcer's voice always takes precedence over the telephone caller. If both are speaking, the caller will not be heard. This may or may not be desirable in all applications, but it is helpful if the line is noisy.

Normally, speaker gain on the speakerphone is adjusted by means of a volume control on the transmitter chassis. This control was removed and relocated in the control unit. Adjustment of this control, and variable-gain amplifiers in the transmit path, permits the voice switching threshold to be varied over a limited range. In the "on-air" studio, it was found desirable to add a relay which operates simultaneously with the studio microphone on/off relay. This mutes the speakerphone speaker in the studio. At the same time, the relay transfers the speaker output to the telephone input on the console. Thus, the telephone output appears at the console only when the announcer's microphone is on. There is a slight leak from the transmitter to the control unit output and, if this switch were not made, the announcer's voice, via this telephone link, could appear on the air in spite of the fact that his announce microphone is off. The action of the muting relay permits the announcer to converse with callers prior to going on the air without fear of the call going on the air—even if the operator has neglected to close the telephone pot.

In an early trial, the speaker was not muted with the announcer's microphone so that the announcer could hear the caller without using his headset. It was found that this was not desirable, because the operator could not cut an unwanted caller off the air by simply closing the telephone "pot." The caller would come through the announcer's microphone. The speaker in the recording room is not muted, however, because immediate cutoff is not necessary.

An alternate to the speakerphone method is the use of a 4-wire terminating set. This device, basically a hybrid circuit, is used by telephone companies in toll circuits to change 2-wire lines to 4-wire lines.

A simplified schematic of the hybrid is shown in Fig. 1. By connecting the repeating coils as shown, it is possible to separate the two-direction (transmit and receive) pair into two single-direction pairs. This means that a signal presented to the transmit input will appear only on the telephone line and not at the receive output. Conversely, the receive output will contain only signals coming from the telephone line. This is accomplished by setting up a carefully balanced bridge circuit and nulling out the transmit signal from the receive section. The balancing network containing the vari-

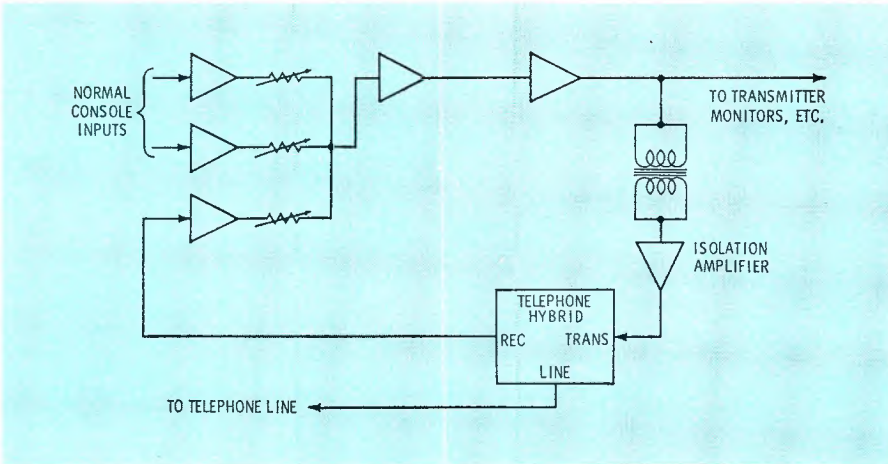


Fig. 2. Input from console to the hybrid is fed through isolation transformer.

able capacitor is used to balance the bridge against the telephone line. An optimum value is selected because each line has different capacitive, resistive, and inductive characteristics. These parameters are a function of line length, cable type, intermediate equipment in the line, and the equipment at each end of the the line.

As might be expected, the isolation between transmit and receive sections is not perfect. The leakage is, however, low enough to make the hybrid very useful in our application. No discussion of actual values in decibels will be given here because so many variables are involved.

In order to connect the radio-station equipment to the telephone-company equipment, an interface is required. On the receive portion of the hybrid, this interface takes the form of the standard recorder connector. This provides the isolation necessary and supplies a 1400-Hz beep at 15-second intervals to the caller as well. This is possible because the hybrid is not 100% efficient, and the beep presented to the receive leg is fed back to the caller.

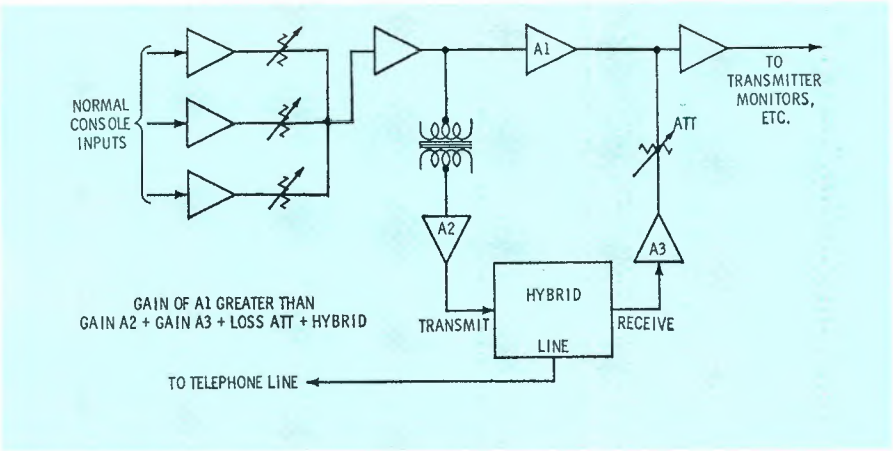


Fig. 3. Better method for connecting hybrid involves opening console circuit.

The interface inserted in the transmit leg is used to insure that the customer will not feed the telephone line with too much level, which would interfere with other circuits in adjacent cable pairs. The interface also provides the correct impedance match to the customer equipment.

The hybrid is connected to the console as shown in Fig. 2. Oscillation will take place if the gain of the console, a function of the telephone-pot setting, is equal to or greater than the loss between the transmit and receive sections. In practice, the loss should be sufficient to allow a satisfactory level from the caller. A somewhat better method of connection is shown in Fig. 3. It involves breaking into the internal circuitry of the console and could present problems in consoles with high-impedance, unbalanced circuitry.

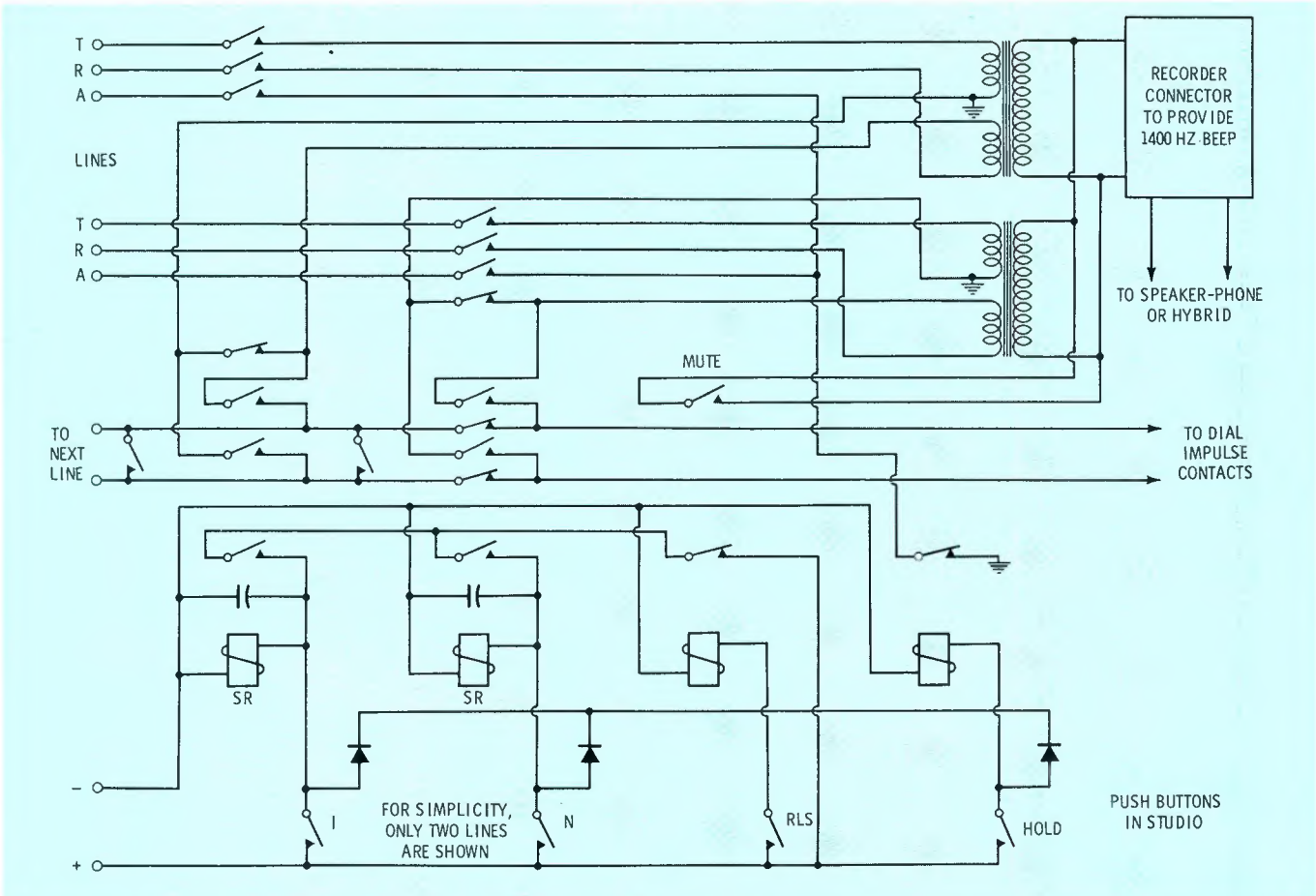


Fig. 4. Basic circuit of CKGM switching system shows only two line inputs for simplicity in explanation of operation.

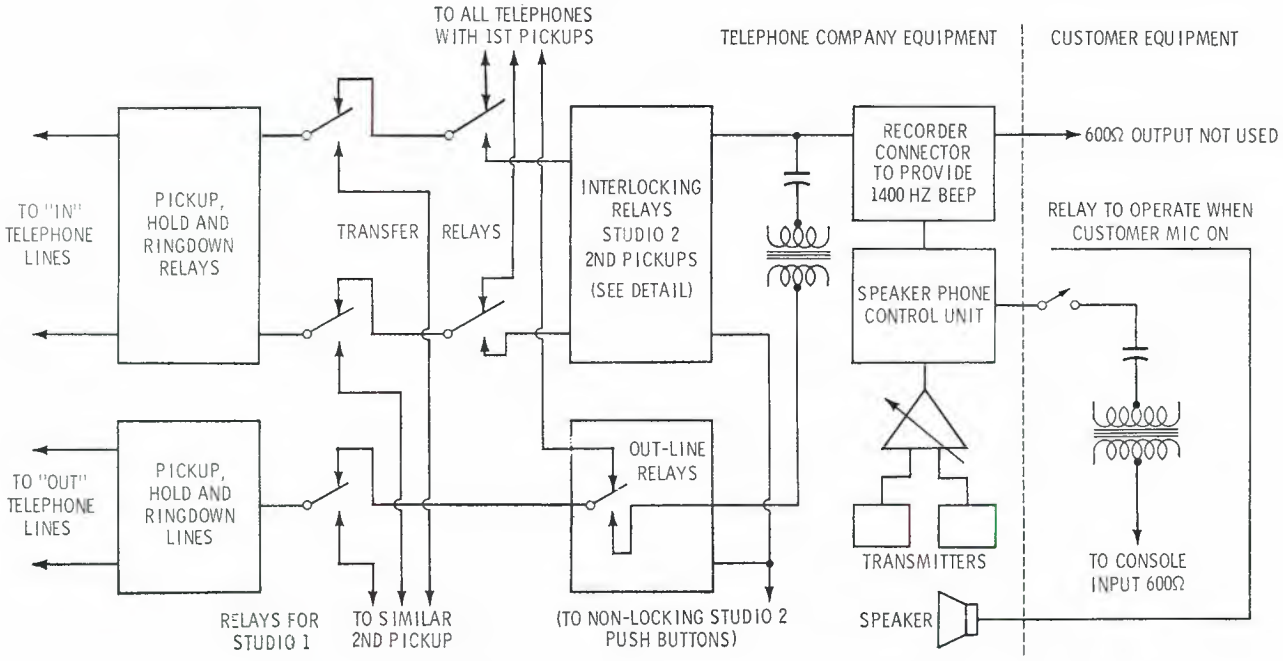


Fig. 5. Functional diagram of switching arrangement in Fig. 4. indicates relationship of various system elements.

We use the former method at CKGM. It is used in conjunction with an alternate back-up system to the speakerphone. It is also valuable in other ways; because it feeds anything going through the console to the telephone line, the announcer need not be in an adjacent studio to be heard by the telephone caller (as is true of the speakerphone system). He may be "on remote." Thus, although a particular program may be on location, all the telephone facilities of the studio are retained without the use of telephone equipment at the remote location. Since various telephone contests, etc., form an integral part of our daily format, this feature is very desirable.

It is difficult to indicate which of the two systems, the speakerphone or the hybrid, is better. The speakerphone is cheaper and easier to connect to the console, but the hybrid provides better quality to and from the caller and the other advantages enumerated.

The Switching System

Several switching arrangements are possible. Our primary system is similar in operation to the ordinary key-telephone set in that push buttons are used to select lines. (See Figs. 4 and 5.)

Figs. 6 and 7 show that the studio equipment consists of built-in, flush-mounted call directors. Six lines are associated with our system, four for receiving calls and two for placing outgoing calls. Each of the four incoming lines appears at two separate pickup buttons, a first pickup and a second pickup. The first pickup operates conventionally;

Fig. 6. ON AIR studio arrangement shows all components.

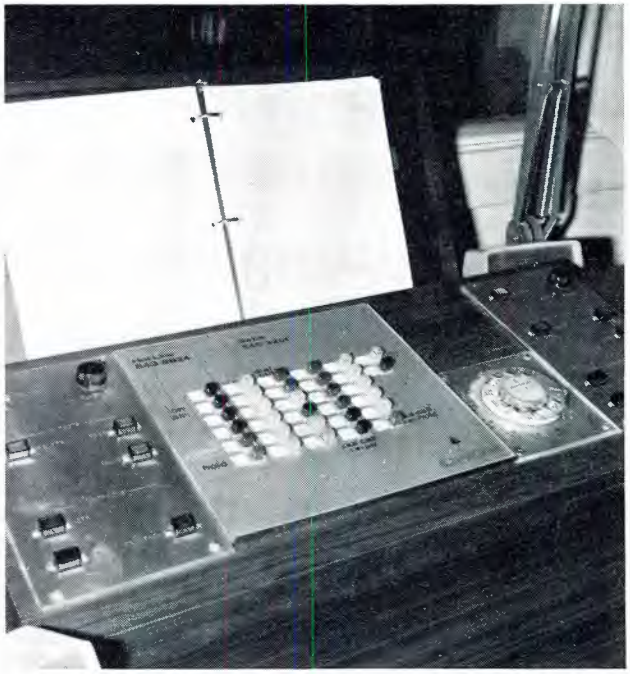


Fig. 7. Close-up of the flush-mounted call director unit.

that is, the button locks and is used in conjunction with a standard telephone handset. In practice, this pickup is used by the operator (who is equipped with an identical call director) to answer and screen the calls. If a call is to be used, the line is placed on "hold," and a transfer button is pushed. This excludes the line from all first pick-ups and transfers it to the second pickups. The second pickups appear at the studio call directors on non-locking, momentary-action push buttons. This type of button differs from a regular button in that it operates silently.

The reason for the transfer action is the prevention of interference with a line which is "on-air." In addition, the announcer cannot put a line on the air prematurely; the operator must first transfer it.

We wished to have a conferencing circuit incorporated into the system. While the regulatory tariffs of the telephone company are "sticky" on this point, they do provide it as a standard accessory to a PBX and conferencing circuit, which allows a maximum of two outside trunks and three internal stations to be bridged in a conference.

The circuit provides for capacitive coupling of the lines. Since no amplifiers are used in the circuitry, transmission is not guaranteed between the two outside trunks. If one or both of the outside parties is at a considerable distance from the circuit, transmission between these parties will suffer. We were willing to tolerate this disadvantage, however, and a circuit similar to the one provided for the PBX was incorporated.

Any two lines may be bridged by simultaneously pushing the pickup buttons associated with the particular lines. The objective is to allow the moderator to converse with two people simultaneously, and it is seldom necessary for the two callers to converse between themselves. Therefore, the nonamplified conferencing does fall within the telephone-company tariffs.

Normally the four incoming lines are jammed, and an alternate method for placing outgoing calls had to be provided. Two out lines were incorporated in the system in a manner different from the in lines. As before, they appear on first pickups, but these lines may be placed on the air by simply pushing a single, momentary-action button instead of by using a transfer button. This action excludes the line from all first pickups and connects it, via the telephone dial, to the speaker-phone. If the line is vacant (normally the case because these are unlisted lines), pushing the button will put dial tone on the speaker-phone, and a call may be dialed. By using the second out line, a sec-

• *Please turn to page 40.*

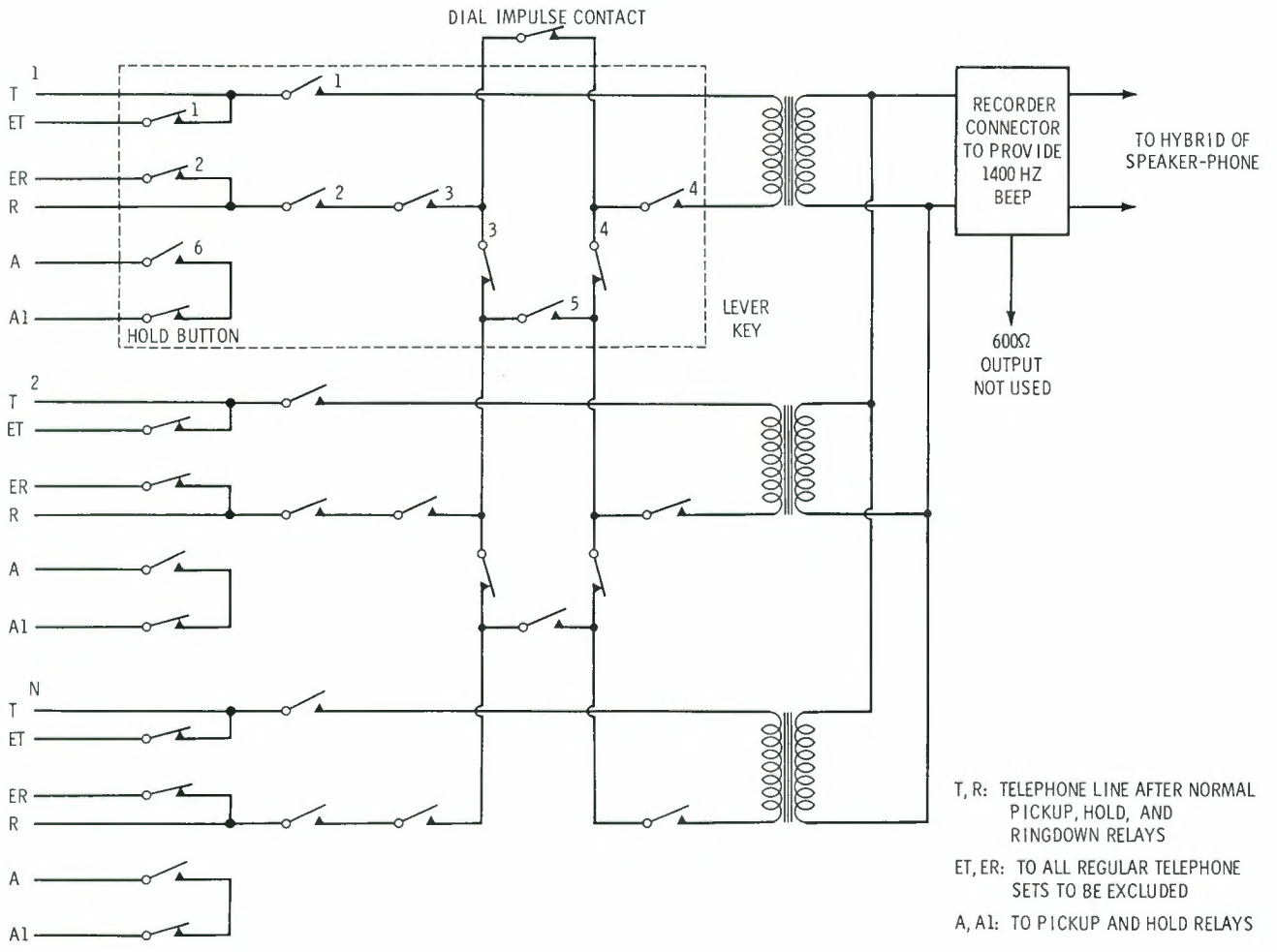


Fig. 8. Alternate switching method is simpler to construct, does not require relays, but is not as smooth in operation.

WHAT YOU SHOULD KNOW ABOUT ESSA

Although not always in the spotlight, the work of this agency is important to broadcasters.

When broadcasters think of government agencies, the set of initials that comes to mind first is bound to be "FCC." This is only natural, since any regulatory agency is certain to make its presence known to the people whose activities it regulates. There are, however, other government agencies which are not of a regulatory nature but which do carry on activities related to broadcasting, and therefore of interest to broadcast engineers and technicians. Such an agency is the Environmental Science Services Administration (ESSA).

What Is ESSA?

Although ESSA itself is less than two years old, its component parts have long histories of service within the government. In July 1965, ESSA came into being within the Department of Commerce when the Weather Bureau and the Coast and Geodetic Survey were brought together into one agency. In October of the same year, they were joined by the former Central Radio Propagation Laboratory of the National Bureau of Standards.

The mission of ESSA is to study our natural environment and, in so far as possible, to predict its behavior. The President has described ESSA as providing ". . . a single national focus to describe, understand, and predict the state of the oceans, the state of the upper and lower atmosphere, and the size and shape of the earth."

A simplified chart of the organzation of ESSA is shown in Fig. 1. The function of the Weather Bureau —observing, reporting, and forecasting the weather—is well known to all broadcasters, for broadcast stations have traditionally served as a vital link in disseminating weather information to the public. Likewise, most broadcast technical persons are familiar with the nautical and aeronautical charts prepared by the Coast and Geodetic Survey. Activities of this arm of ESSA also include measurements of the gravity, magnetic field, size, and shape of the earth. The Survey maintains a series of reference markers throughout the United States for use in mapping, surveying, and other projects. Other work relates to earthquake studies, warnings of seismic sea waves, and oceanographic studies.

Perhaps less well known are the Environmental Data Service and the National Environmental Satellite Center. The Environmental Data Service functions as a central agency for receiving, storing, and disseminating information on the physical environment from all over the world. It serves commerce, industry, and the general public.

The National Environmental Satellite Center, as its name suggests, has as its function the planning and operation of environmental satellite systems. Data from satellites is collected and analyzed to learn more about our environment.

The four Institutes for Environmental Research carry on studies of the earth, the atmosphere, and space. Research by the Institute for Earth Sciences involves geomagnetism, seismology, geodesy, and related earth sciences. The Institute for Oceanography studies the ocean and its relationship to the total environment. The Institute for Atmoshperic Sciences studies the behavior of the atmosphere so that weather forecasting can be improved and weather control ultimately may become possible.

Of most direct import to the broadcast industry are the activities of the Institute for Telecommunication Sciences and Aeronomy, and these will be the subject of the remainder of this report.

Many activities of ESSA are conducted in this building in Boulder, Colorado.

The Work of the ITSA

Although the ITSA became a part of the newly created ESSA in 1965, its predecessors date back to 1909. In that year, the National Bureau of Standards first undertook the study of radio-wave propagation. Four years later, the first NBS Radio Section was formed.

As the science and industry of

telecommunications advanced, so did the studies of propagation by the NBS. Its research led to the development of such systems and devices as the aircraft radio beacon and the ILS landing system.

In 1942, the Radio Section became part of the Interservice Radio Propagation Laboratory, which was set up within the NBS at the request of the combined Chiefs of Staff of the United States Armed Forces. After World War II, the functions of this Laboratory were taken over by the Central Radio Propagation Laboratory (CRPL), which became a Division of the Bureau in 1946. In 1964, the CRPL was designated one of the four research institutes of the NBS, and in 1965 it was transferred from the NBS to ESSA and renamed the Institute for Telecommunication Sciences and Aeronomy.

The new name is one which more fully describes the areas of responsibility of the organization. The primary mission of the Institute is support of the nation's telecommunications activity—an activity representing an annual expenditure on the order of $20 billion.

From the primary mission has evolved a second one, study and forecasting of periods of solar activity and disturbance of the ionosphere. Thus aeronomy, the science of the upper atmosphere, becomes a natural and essential part of the work and name of the Institute.

ITSA Laboratories

For carrying out its missions, the ITSA is divided into four Laboratories, each of which pursues a specialized field of research.

Ionospheric Telecommunications Laboratory

The work of this Laboratory has to do with long-distance communication by way of the ionosphere. Activities to which the research is related include AM broadcast, navigational systems, and over-the-horizon radar and communications systems.

The Laboratory conducts a number of research programs and furnishes consulting and advisory services to industry and government. In general the research encompasses four broad areas.

The first area of study is the prediction of attenuation and phase delay of signals having frequencies below about 1.5 MHz. Quantities of interest include frequency, direction of propagation, latitude, time of day, season, electrical constants of the earth, and the ionospheric parameters on which predictions can be based. Related studies are concerned with the effects of abnormal ionospheric conditions on propagation at these frequencies.

Other research is directed toward determining the effects of the atmosphere and the terrain on signals transmitted by forward and backscattered ionospheric propagation. Parameters of interest in this case are amplitude, phase, time delay, and angles of arrival.

Ionospheric predictions are of vital importance to many users of radio communications, both military and civilian. This service is a third area of involvement of the Ionospheric Telecommunications Laboratory. In this connection, a network of ionosonde observatories is employed to observe the state of the ionosphere. A facility at Long Branch, Illinois provides experimental transmissions to other ITSA and agency users.

The fourth area of research is communications technology. Its objective is stated as ". . . the development of information for improving telecommunications, and the utilization of the radio frequency spectrum." Specific research includes antennas, information transmission, and frequency utilization. Information obtained is useful in the design and evaluation of equipment and systems for telecommunications.

Tropospheric Telecommunications Laboratory

This Laboratory, as its name implies, is concerned with propagation

• *Please turn to page 44.*

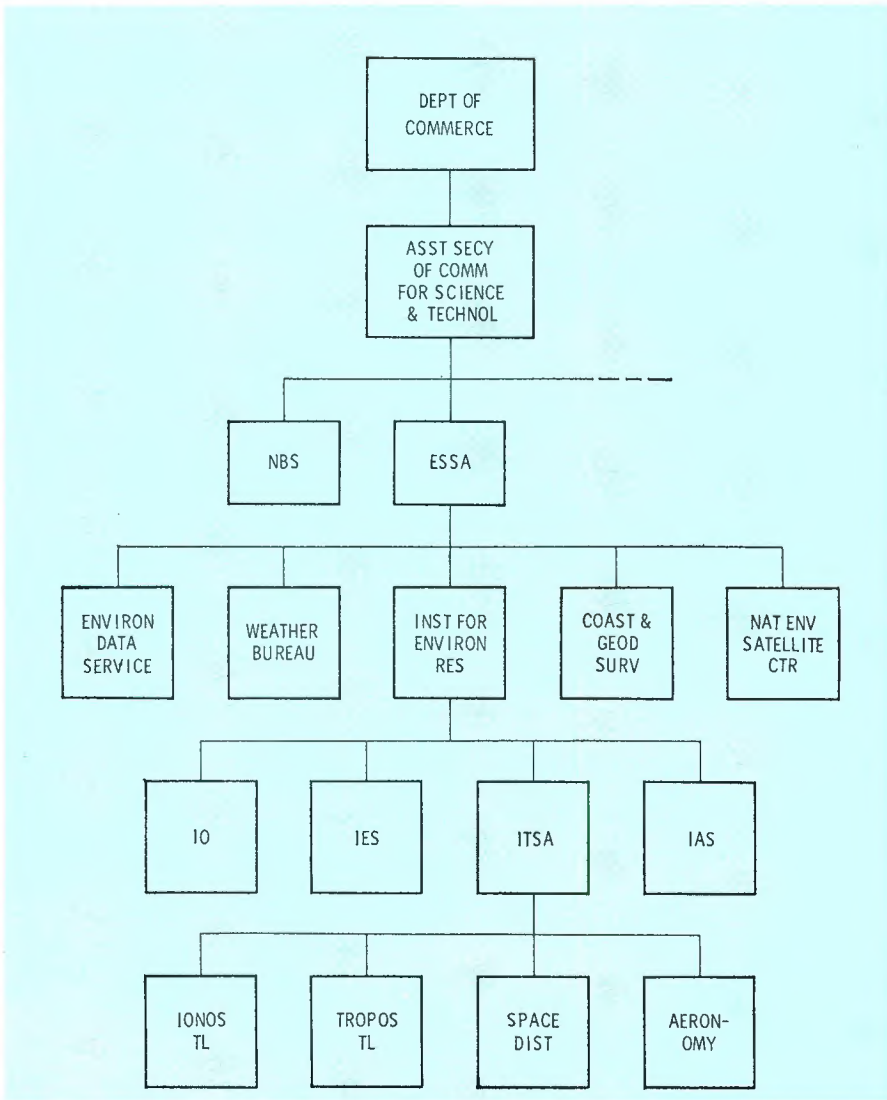


Fig. 1. Simplified chart shows organizational features of ESSA and the ITSA.

SYMBOL STANDARDIZATION

As a publisher in the electronics industry, Howard W. Sams & Co., Inc., has a vital interest in the standardization of schematic symbols. There is at present an industry-wide program to accomplish this. For many years now, each manufacturing company and sometimes, we suspect, each individual draftsman, had a different concept as to the proper method of symbolization.

The Electronic Industries Association (formed by participating electronics manufacturing concerns), in cooperation with the American Standards Association, has now published a list of graphical electronic symbols with the objective of simplification of symbols, reduction of drafting time, and a better understanding of schematics by all technicians.

We are reproducing a portion of the list as an aid to the technician. We feel that if all manufacturers and publishers were to adopt these symbols as standard, the time spent by technicians in interpreting symbols could be reduced greatly. The Howard W. Sams & Co., Inc., is adopting these standard symbols in all of its publications.

Definitions and Interpretation of Symbols

Symbol—A symbol is the aggregate of all its parts, but to improve readability, parts of a symbol, such as a multi-section capacitor, may be separated.

Orientation of Symbol—The orientation of a symbol one drawing, including a mirror image, does not alter the meaning of a symbol.

Arrow Heads—Unless otherwise noted, no significance is placed on open or closed arrowheads.

Angles of Lines—Generally, the angle at which a connecting line is brought to a graphical symbol has no particular significance unless otherwise noted.

Width of Lines—The width of the line does not affect the meaning of a symbol.

List of Symbols

1. Adjustability & Variability

(a) Coils

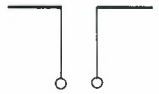
(b) Potentiometers—arrowhead parallel to symbol indicates direction of clockwise rotation viewed from knob, actuator, or mounted end.

(c) Capacitors—arrowhead indicates variability.

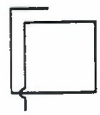
3. Antenna

3.1 General

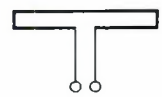
3.1.1 Dipole



3.1.2 Loop



3.1.3 Folded dipole



3.1.4 Ferrite antenna

3.1.5 Mono-pole

Completely transistorized... with modular construction and automatic operating features

RCA audio is the right choice for the bright sound!

AUDIO FOR AM, FM, TV

RCA's pioneering in space-age electronics has paved the way for a whole new generation of audio equipments. There's a complete line of cartridge tape equipment—and reel-to-reel recorders, new Universal turntable, audio relay switcher. Also a new line of audio amplifiers and an automatic programmer.

CONSOLETTES FOR FLEXIBILITY

Choice of four consolettes—from a four-mixer, 20-input equipment to the very versatile deluxe console for dual channel and FM stereo use. They all use plug-in chassis for custom-tailoring to needs and flexibility in operation.

TAPE RECORDERS WITH AUTOMATIC CUEING

Cartridge tape equipments have plug-in tape decks for versatility. They include tone-cue operation—a stop cue, end-of-message cue, and trip cue. And now, even the reel-to-reel types include these cue features, assuring semi-automatic operation between recorders. All these tape equipments are available in both monaural and stereo types.

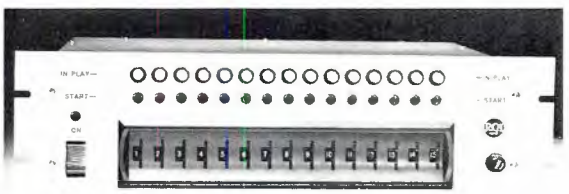
AUTOMATIC PROGRAMMING

Designed to program fifteen events from any 18 program sources. Number of events may be increased with ease by adding these Programmers in series.

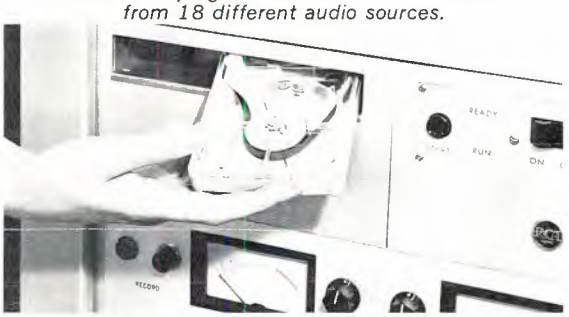
THE "NEW LOOK" IN AUDIO

This is the audio equipment with the RCA "New Look". It costs less to install and less to operate . . . provides highest flexibility. You would expect the best from RCA with its years of experience in radio and television.

Plug-in chassis give flexibility to consolettes.



Automatic programmer handles 15 events from 18 different audio sources.

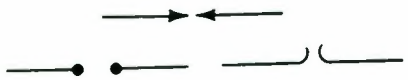


Cartridge tape features cue tone operation.

For further information about these RCA "New Look" equipments write RCA Broadcast and Television Equipment, Building 15-5, Camden, N.J. Or call your RCA Broadcast Representative.

The Most Trusted Name in Electronics

4. Arrester gap or spark gap



7. Battery
The long line is always positive, but polarity may be indicated in addition.

7.2 One cell

7.3 Two cells

7.3.1 Multiple cells

8. Capacitor
8.1 General—If it is necessary to identify the capacitor electrodes, the curved element shall represent the outside electrode in fixed paper-, mica-, ceramic-, and plastic-dielectric capacitors; the moving element in adjustable and variable capacitors; and the low-potential element in feedthrough capacitors.

8.1.1 Polarized capacitor (electrolytic)

8.1.2 When multiple-section, electrolytic capacitors are diagrammed, each section must be identified with the appropriate symbol to correspond with the identifier used on the actual part.

8.1.2.1 Nonpolarized electrolytic capacitor.

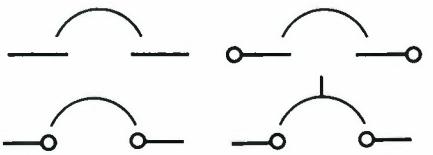
8.1.2.2 Multiple sections in common container.

8.1.3 Adjustable or variable capacitor.

8.1.4 Adjustable or variable capacitors with mechanical linkage of units.

8.1.5 Feedthrough capacitor.

11. Circuit breaker



13. Circuit returns
The rake symbol may be used to indicate accessible metal ground, earth ground, the chassis, or where chassis ground is different or isolated. The other symbols may indicate ground, chassis ground, or B—.

16. Coil, relay

18. Connector—disconnecting device.

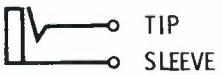
18.1 Female contact, commonly used for a jack or receptacle (usually stationary).

18.2 Male contact, commonly used for a plug (usually movable).

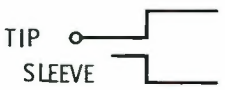
18.3 Separable connectors (shown engaged).

18.6 Communication (telephone) type connector.

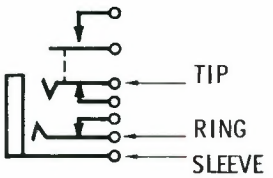
18.6.1 Two-conductor jack.



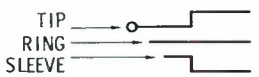
18.6.2 Two-conductor plug.



18.6.3 Three-conductor jack with two break contacts (normals) and one auxiliary make contact.



18.6.4 Three-conductor plug.

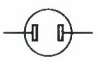


18.8 Connectors of the type commonly used for power-supply purposes (convenience outlets and mating connectors).

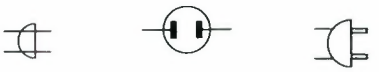
18.8.1 Female contact.

18.8.2 Male contact.

18.8.3 Two-conductor nonpolarized connector with female contacts.



18.8.4 Two-conductor nonpolarized connector with male contacts.

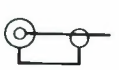


18.8.5 Two-connector polarized connector with female contacts.

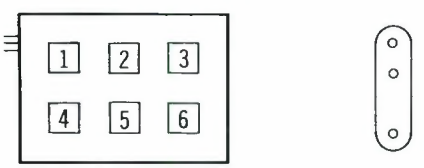
18.8.6 Two-conductor polarized connector with male contacts.

18.9.1 Phono-type connector plug.

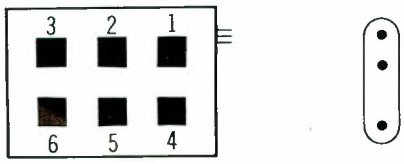
18.9.2 Phono-type jack.



18.9.3 Wire end of female socket (cap)



18.9.4 Pin end of male plug.



25. Core

25.1 General or air core

If it is necessary to identify an air core, a note should appear adjacent to the symbol of the inductor or transformer.

25.1.2 Adjustable core.

25.2.1 Laminated core.

25.2.2 Powdered-iron core.

25.3 Core of electromagnet.

31. Delay line.

36. Fuse.

36.1 General. 

36.2 Special types

* *Indicate type by note: e. g., wire, link, etc.*

42. Inductor.

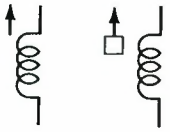
42.1 General

Use symbols as shown unless otherwise indicated or required by special considerations.

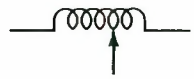
42.2 If it is desired especially to distinguish magnetic-core inductors.

42.3 Tapped, air core.

42.4 Adjustable inductor; arrowhead points in direction of adjustment location. Bottom of coil is at mounted end.

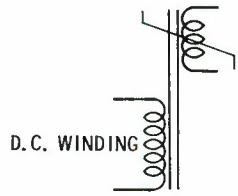


42.4.1 Adjustable inductor, air-core; arrowhead indicates movable tap. Unless noted, coil mounting end not specified.



42.7 Saturable-core inductor (reactor).

Polarity marks may be added to direct-current winding. Explanatory words and arrow are not part of the symbol shown.



44. Lamp.

44.1 Ballast lamp (tube)

The primary characteristic of the element within the circle is designed to vary nonlinearily with the temperature of the element.

44.2 Lamp, fluorescent.

44.3 Lamp: glow, cold-cathode, neon.

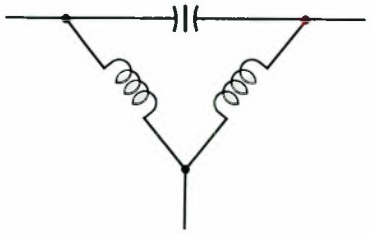
44.4 Lamp, incandescent.

46. Machine, rotating.

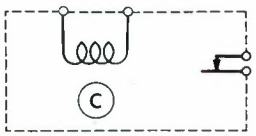
46.2 Generator.

46.3 Motor.

46.12.1 Alternating current reversible motor.



46.12.2 Alternating-current clock motor with time switch.

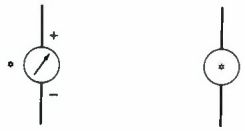


46.12.3 Phono motor.

48. Meter—instrument.

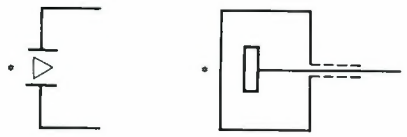
Note—The asterisk is not a part of the symbol. Always replace the asterisk by one of the following letter combinations, depending on the function of the meter or instrument, unless some other identification is provided in the circle and explained on the diagram.

DB or DBM	DB (decibel) meter
MA	Milliameter
O	Ohmmeter
R	Recording meter
T	Tuning meter
V	Voltmeter
VOM	Voltohmmeter
VTVM	Vacuum tube voltmeter
VU	Volume indicator, audio level meter
W	Wattmeter



51. Microphone.

51.1 Ultrasonic microphone or transducer.
** Indicate type by note: ceramic, crystal, dynamic, etc.*



51.2 Audio-frequency microphone.
** Indicate type by note.*

56. Oscillator, signal generator, or unspecified alternating-current source.

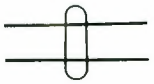
58. Wiring.

58.5 Crossing of paths or conductors not connected. The crossing is not necessarily at a 90° angle.

58.6.2 Junction of connected paths, conductors, or wires.

58.8.1 Shielded single conductor.

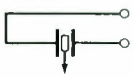
58.8.3 Two-conductor cable.



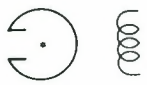
58.8.4 Shielded two-conductor cable, shield grounded.

61. Pickup head.

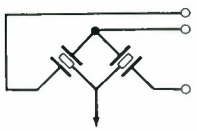
61.1 General.



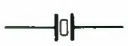
61.2 Magnetic recording head.
* *Indicate by letter*: RECORD, PLAYBACK, ERASE.



61.6 Stereo pickup.



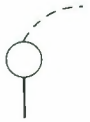
62. Piezoelectric unit.



64. Receiver-earphone, headphone.

64.2 Headset, double.

64.3 Headset, single.

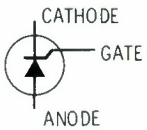


65. Rectifier, semiconductor.

65.1 General.
Note: Triangle points in direction of forward (easy) current as indicated by a DC ammeter, unless otherwise noted adjacent to the symbol. Electron flow is in the opposite direction.

65.2 Semiconductor rectifier.

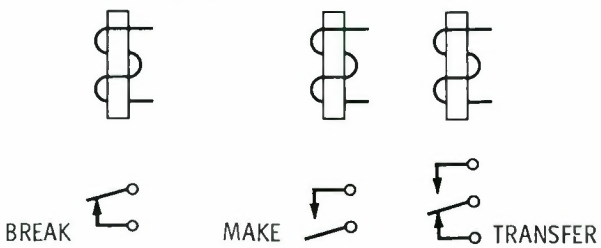
65.2.2 Silicon controlled rectifier (SCR).



66. Relay.
Fundamental symbols for contacts, mechanical connections, coils, etc., are the basis of relay symbols and should be used to represent relays on complete diagrams.

66.2 Relay coil.

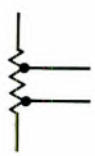
66.3 Relay contacts.



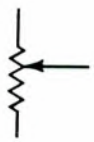
68. Resistor.

68.1 General.

68.2 Tapped resistor.



68.3 With adjustable contact.



68.8.1 Symmetrical varistor, voltage-sensitive resistor, etc.

* *Indicate variable by letter*
V voltage
I current
L light
T temperature

73. Semiconductor devices.

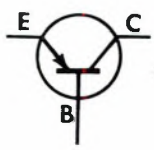
73.9.1 Semiconductor diode.

73.9.2 Capacitive diode.

73.9.3 Breakdown (Zener) diode.

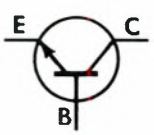
73.9.5 Tunnel diode.

73.10.1 PNP transistor.



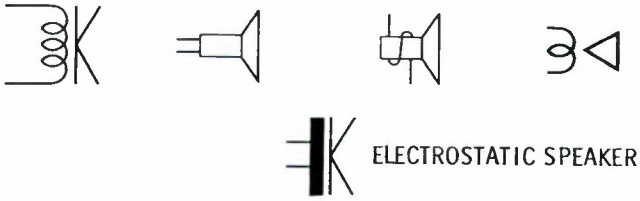
73.10.1.1 Transistor element connected to envelope.

73.10.2 NPN transistor.



73.10.3 Unijunction transistor.

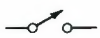
75. Speaker.



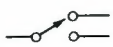
76. Switch.

Fundamental symbols for contacts, mechanical connections, etc., may be used for switch symbols. The standard method of showing switches is in a position with no operating force applied. For switches that may be in two or more positions and for switches that may be operated by some mechanical device, clarifying notes may be necessary to explain position shown and position at which actuation starts.

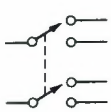
76.1 Single throw, general.



76.2 Double throw, general.



76.2.1 Two-pole, double-throw switch.



76.6 Push button.

76.6.1 Circuit closing (make).

76.6.2 Circuit opening (break).

76.6.3 Two circuit (transfer).

"...CBS Volumax performs flawlessly. Please do not invent any more until we wear these out. At the present rate of deterioration, we will need to replace them by 2015 A.D."

This is what station WRNC in Raleigh, North Carolina, said about our equipment. They own both the Audimax Automatic Level Control and the Volumax Automatic Peak Controller. Station WIGS in Gouverneur, New York, wrote, "Enclosed find check for Volumax 400. You couldn't get it back from us for twice the price . . ." KLIN in Lincoln, Nebraska, purchased Audimax. They told us, "It is an engineer's dream for absolute level control". WAYB in Waynesboro, Virginia, tells us, "Purchased a Volumax and we are tickled to 99 and 44/100% modulation with it . . . Congratulations on a fine product". Station KHOW in Denver, Colorado, said, "It was surprising to receive equipment that exceeded specifications".

There isn't enough space here to include all the letters we've received praising Audimax and Volumax. But judge for yourself. Like all CBS Laboratories equipment, they're available for a 30-day free trial. Audimax $665. Volumax $665. FM Volumax $695. Write to us, or better yet call The Professional Products Dept. directly — Collect. Telephone (203) 327-2000. Maybe you'll be in our next ad.

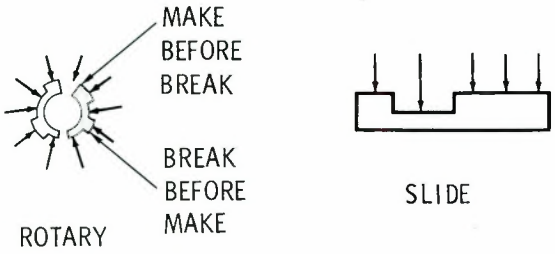
CBS LABORATORIES
Stamford, Connecticut. A Division of
Columbia Broadcasting System, Inc.

Circle Item 8 on Tech Data Card

76.12 Selector or multiposition switch.

76.12.1 General.

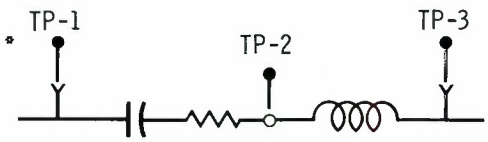
76.12.4 Segmental contact.



79. Test point, recognition symbol.

79.1 General.
Used to emphasize test-point location.

79.2.1 Test-point recognition for test jack and circuit terminal.
* *Reference designation. Not part of symbol.*



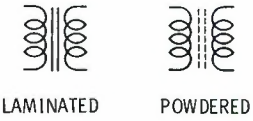
84. Thermistor.
"T" indicates that the primary characteristic of the element within the circuit is a function of temperature.

84.1 General.

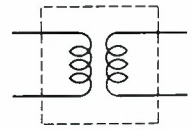
86. Transformer.

86.1 General.

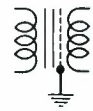
86.2 Magnetic-core transformer.



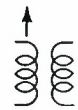
86.2.1 Shielded transformer.



86.2.2 Transformer with magnetic core and shield.

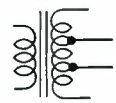


86.3 One winding with adjustable inductance.

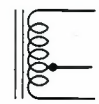


86.4 Each winding with separately adjustable inductance.

86.6 With taps, single phase.



86.7 Autotransformer, single phase.



If You Haven't Seen the Polychrome Camera, You're Missing the Finest Color in Television

Not to mention the most advanced live color camera on the market

Here's why...

1 Choice of pickup tubes. Some broadcasters prefer the four-Plumbicon* type camera. Others lean toward the IO-Vidicon tube complement. May even be that the best answer is still to be developed. Makes no difference with the Tarzian Polychrome camera. It accommodates any present or contemplated pickup tube. How's that for flexibility? And you avoid costly obsolescence, too.

2 Color fidelity. Exceptional. Original optical design delivers superior color performance—limited only by the capability of existing pickup tubes. Separate luminance channel assures excellent color and monochrome results.

3 Design. Rugged magnesium housing trims size and weight down to what you'd expect to find only with monochrome equipment. Viewfinder is removable for added mobility and accessibility. Bold contemporary styling and textured door panels mark a fresh departure from old fashioned, bulky look.

4 Electronics. All camera and processing circuitry is fully transistorized with plug-in module construction throughout.

More? There's plenty. Like 10:1 zoom lens. Looks built-in, but detaches readily. Powered zoom, focus and remote iris for smooth control. The list is nearly endless.

Exciting? You bet it is. Why waste time. Call today—collect. We're anxious to fill you in on the details. Area Code is 812/332-7251. That's Sarkes Tarzian, Inc., Broadcast Equipment Division, Bloomington, Indiana.

* Reg. T M. of N. V. Philips Co., Holland

Symbol of Excellence in Electronics

Broadcast Engineering

1966 ANNUAL INDEX

NOTE: The letter E indicates "Engineers' Exchange," L indicates "Letters to the Editor," N indicates "News of the Industry," and W indicates "Late Bulletin From Washington."

Don Ellington has a stubborn streak. Try to set up a shipping schedule on an upcoming Memorex video tape product before Don has given it his okay. Can't be done. Not with any number of previous approvals — from lab performance trials, field tests or production line checks. Don's job is to make sure, beyond all doubt, that when you screen a reel of a new Memorex video tape, it will look as good on the monitor as it does on paper. It's no job for a yes-man.

MEMOREX

Precision Magnetic Products

Santa Clara, Calif. Branch Offices in Boston, New York, Philadelphia, Washington, Atlanta, Orlando, Dayton, Chicago, Detroit, St. Louis, Dallas, Denver, Los Angeles, San Francisco, Honolulu. Offices and Affiliates in London, Cologne, and Paris. Distributors in Japan, Canada, India, Australia, and New Zealand.

Circle Item 9 on Tech Data Card

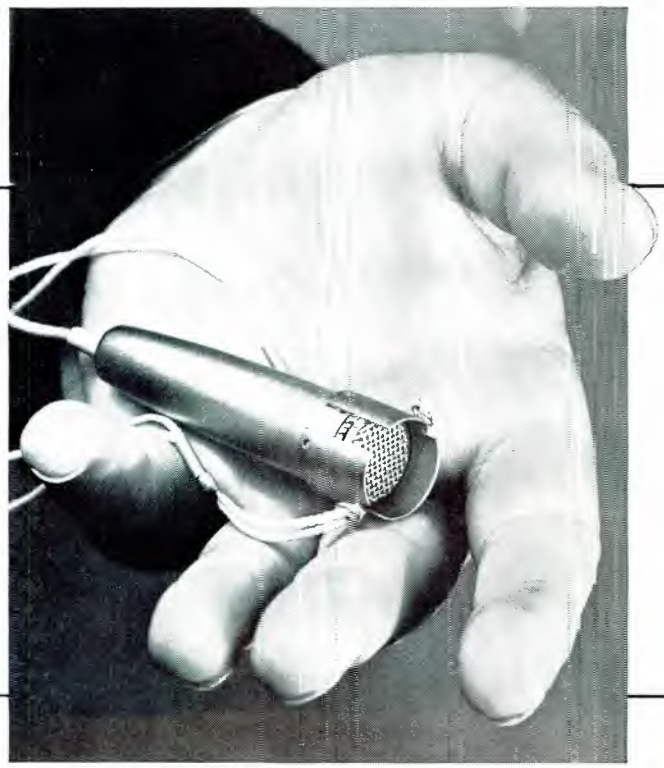
D-150 is a professional omni-directional microphone with high sensitivity and linear full-range response. It is ruggedly designed for hard use, and is attractive and inconspicuous because of its unusually small diameter. For public address, studio and on-location recording . . .

TECHNICAL DATA

Frequency range	30-20,000 cps.
Frequency response	± 3 db
Directional characteristics	Omni-directional
Sensitivity	– 55 db
Impedance	200 ohm
Connections	Cannon XLR
Dimensions	5¾" long x ⅝" diameter
Weight	4 ounces

The remarkably small diameter of the capsule used in both these microphones has been developed without sacrifice of the sensitivity characteristics found in our finest professional dynamic microphones. This is another significant development from the research laboratories of AKG.

Send today for data sheets and prices.



D-109 is an attractively styled Lavalier microphone . . . a smart, practical choice for inconspicuous use. Among other features—simple raising or lowering of the Lavalier attachment cleverly attenuates the frequency response curve to specific applications.

TECHNICAL DATA

Frequency range	50-15,000 cps.
Directional characteristics	Omni-directional
Sensitivity	– 56 db
Impedance	200 ohm
Dimensions	2¾" long x ⅝" diameter
Weight	1½ ounces

MADE IN AUSTRIA BY **AKG** GMBH.

Norelco® **PROFESSIONAL SOUND PRODUCTS**

NORTH AMERICAN PHILIPS COMPANY, INC.
Professional Products Division, 100 East 42nd St., New York, N.Y. 10017

Circle Item 10 on Tech Data Card

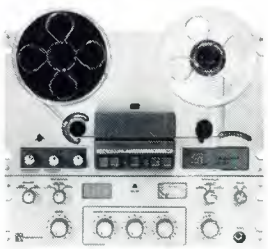
YOU WON'T FIND A PANIC BUTTON ON A MAGNECORD!

When Magnecord engineered a long list of safety factors into their professional line of tape recorder/reproducers . . . they engineered the emergencies out! A sturdy die-cast mainplate, supporting the transport in every model, insures precise location of internal parts under the roughest operating conditions. Rigid die-cast head mounts eliminate alignment problems. Professional quality hysteresis synchronous capstan motor and individual reel drive motors are heavy duty models, and the capstan shaft assembly is re-inforced for extra strength and longer life.

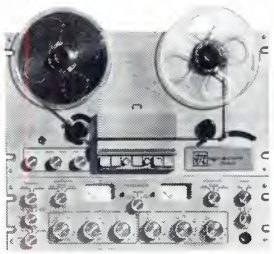
While you are taping, safe-guard operating features protect your thinnest tapes. With Magnecord you get top-notch performance and superb fidelity to keep your taping facility operating at maximum capacity, even after years of constant use. Ask a broadcaster who uses one . . . Magnecords are built to take it!

Write now for the full story on the complete line of durable quality Magnecord tape instruments.

Magnecord 8+ Reels now available from Audiotape®. See your local dealer.



MAGNECORD MODEL 1021
Fully transistorized professional tape recorder / reproducer for monaural operation. For use in main or production control room.



MAGNECORD MODEL 1022
Fully transistorized professional tape recorder / reproducer two channel (stereo) for use in main or production control room.

MAGNECORD MODEL 1028
Professional quality 2 channel (stereo) tape recorder / reproducer for recording master tapes. (10½" reel capacity) Available in ½- or ¼-track.

MAGNECORD MODEL 1048
Professional 2 channel (stereo) recorder/reproducer for use in main studio, production studio or conference recording. (10½" reel capacity) Model 1048 is available in ½- or ¼-track.

Magnecord®
DIVISION OF THE TELEX CORPORATION
P. O. Box 1526 / Tulsa, Oklahoma 74101
MANUFACTURER OF TELEX HEADSETS AND OTHER FINE ACOUSTIC DEVICES

Circle Item 11 on Tech Data Card

January 1967

We interrupt this magazine to bring you. . .

Late Bulletin from Washington

by Howard T. Head

Government Enters Dispute Over CATV vs. Rooftop Antennas

By a 4 to 3 vote, the FCC has denied a request by the Springfield (Massachusetts) TV Broadcasting Corporation for the issuance of a cease-and-desist order against a CATV operator in Ware, Massachusetts. The broadcasting firm had complained that the CATV operator, in its advertising for new customers, was offering a reduction in CATV installation costs if the subscriber would consent to removal of the rooftop antenna. In denying the request, the Commission emphasized that its refusal to issue an order did not constitute approval of this practice, but rather reflected its view that promotional activities of this nature were outside the scope of its authority. However, the FCC has referred the complaint to the Federal Trade Commission, which does have jurisdiction over matters of this nature, for whatever action the FTC may deem appropriate.

Commissioners Robert E. Lee, UHF's strongest supporter; Kenneth E. Cox; and Nicholas Johnson dissented.

Proposed Educational FM Changes

The Commission has proposed numerous changes in its Rules governing the allocation and operation of noncommercial educational FM broadcast stations. At present, these stations, which operate on FM Channels 201-220 inclusive (88 MHz - 92 MHz), are assigned on the basis of allocation standards much more flexible than those governing commercial FM stations. The Commission now proposes to establish three classes of educational FM stations -- Class A, B, and C -- corresponding to the classes of commercial FM stations. Existing 10-watt educational FM stations would be required either to conform to minimum Class A facilities, or to surrender their licenses.

Also proposed is a Table of Assignments which would make advance provision for educational FM channels in cities of various sizes. These would range from a single channel for cities with population under 50,000, to five channels for cities having a population of one million or more.

The Commission's Notice also expresses concern over interference to the reception of television Channel 6 (82 MHz - 88 MHz) from the operation of educational FM stations in the lower part of the band. Although the proposal contemplates protecting regular television broadcast stations on Channel 6 from FM interference, Channel 6 television translators would not be given such protection.

Land Mobile Services Continue to Seek Additional Frequencies

Pressures continue to mount from various land-mobile radio service users for additional frequency assignments. Proposals under consideration range from tests of sharing VHF television channels (see December 1966 Bulletin) to the

outright re-allocation of one or more television channels; the lower UHF channels appear to be most vulnerable in the latter regard.

In a recent Department of Commerce report, the Department's Telecommunications Science Panel has reviewed the increasing spectrum congestion, and proposed the establishment of a long-range program to review present technology and spectrum allocation, and to make plans for the future. A new organization, with an annual budget ranging somewhere between $10 and $50 million dollars, would be set up within the Commerce Department. In a counter-proposal, the FCC, with the tacit support of the White House Director of Telecommunications Management, has proposed a more modest study program (annual budget only $2 million) to be undertaken by the Commission.

Decision on Propagation Curve Case Expected Shortly

The Commission is expected to decide shortly whether to amend the curves of field strength vs. distance now contained in the Commission's Rules for FM and television broadcasting (see June 1966 Bulletin). Although there is general agreement that the present UHF television curves are in substantial need of revision, most engineers believe that new FM and VHF television curves proposed by the Commission differ so little from previous curves that a change would be unwarranted. Some engineers have insisted that the proposed new VHF curves are a poorer fit to the data than the present ones.

Consulting engineers have also supported a proposal made to the Commission by the licensee of a UHF television station in Ohio for a change in the Rules governing the calculation of distances to contours. The present Rules require that these distances be calculated not on the basis of radiation toward the contour, but instead using radiation in the horizontal plane, which in most instances is well above the surface of the earth. The consequence of this Rule has been that stations employing very high antenna gains and beam tilt, with narrow vertical beams tilted as much as 2^{o} below the horizontal plane (principally UHF stations), find themselves obliged to calculate contour distances on the basis of effective radiated powers only a fraction of the actual maximum power. The proposed change in this Rule, together with new field-strength curves, would bring about considerable improvement in the accuracy of contour prediction for UHF stations.

Short Circuits

The Commission has recognized the term "Hertz" as a synonym for "cycles per second"; the new usage is not mandatory, but Hz and c/s may now be used interchangeably . . . The Commission has removed all FM and television channel assignments from the "radio quiet zone," an area of approximately 4,000 square miles in Virginia and West Virginia centered roughly on two radio telescopes at Sugar Grove and Green Bank, West Virginia -- only exceptions were a television station already operating on Channel 3, and a special educational television station with a highly directional antenna on Channel 51 . . . The Commission has made final its proposal to relax the Rules for the identification of television auxiliary stations (see December 1965 Bulletin). . . The Commission has refused to waive its carrier-current Rules to permit radiation in excess of the carrier-current requirements along a Pennsylvania highway in a proposal to provide traffic and scenic information.

Howard T. Head . . . in Washington

BOOK REVIEW

Basic Electricity for Electronics; Robert G. Middleton and Milton Goldstein; Holt, Rinehart and Winston, Inc., New York, 1966; 694 pages, 6" x 9", hard cover; $9.95.

The authors have produced an instructive text which ranges from electrons and electricity, to electrical laws, circuits analysis, magnetism, reactance, meters, tubes, semiconductors, filters, and network theorems. Extensive appendixes, a bibliography, answers to the problems, and an index complete the book.

Numbered headings identify major topics in the text, and a chart-type summary and questions conclude each chapter. The book is adequately illustrated with line drawings, charts, graphs, schematic diagrams, and photographs.

If he studies this book thoroughly, the reader should be rewarded with a good understanding of basic electricity as it applies to electronics. The coverage of mathematics is not extensive; basic algebra will suffice for all computations.

Circle Item 17 on Tech Data Card

both studios are completely interchangeable, both electrically and physically, in the event of failure of either.

Conclusion

It is hoped that this article will aid the broadcaster planning an "open-line" program or one wishing to modify his facilities for this type of programming. The telephone equipment is a mutual project of the telephone company and the broadcaster. Careful analysis of needs by both should result in a flexible, functional, and reliable system. ▲

Editor's note: A new recorder connector, which supplies the filtered 1400-Hz beep in the caller direction only, has been developed especially for on-the-air applications for the Western Electric Company, and bears the part number KS-19645. It must be ordered through the local telephone company with the order number USOC-RCZ.

Circle Item 16 on Tech Data Card

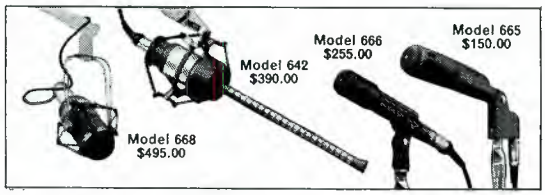
How does this 7 FOOT MONSTER help solve your sound problems?

The giant microphone shown here is the biggest microphone in captivity! The Model 643 is also the most directional microphone sold today. It helped E-V win the first Academy Award for microphone design in 22 years.

But beyond this, the 643 has been one of our most effective field research tools, offering a far-reaching insight into the nature of directional microphones, and their applications.

An obvious result of 643 research is our unique Model 642. Same E-V Cardiline™ principle*, but only 18 inches long. It reaches up to twice as far as any other broadcast unidirectional microphone to give you better long distance pickups than were dreamed possible a few years ago.

And this same basic research stimulated the development of our new Model 668 cardioid microphone. It uses the Continuously Variable-D® cardioid principle (a creative development from our exclusive Variable-D patent*) to provide smoother cardioid action—plus more versatility—than any other boom microphone you can use.



But let's not ignore the most popular professional cardioid microphone of all, the Model 666. Here's where the Variable-D principle got its start. And since the introduction of our seven foot laboratory, the 666—and its companion, the 665—has been further refined to offer better performance and value than ever before.

From such startling microphones as the 643, come continuing basic improvements—and the tools you need to solve your most difficult sound problems. Only E-V provides this kind of design leadership. E-V microphones in your studio will give you a big head start toward better sound. After all, we're at least seven feet ahead of everybody!

ELECTRO-VOICE, INC.
Dept. 171V, 638 Cecil St., Buchanan, Michigan

Electro-Voice®
SETTING NEW STANDARDS IN SOUND

Circle Item 18 on Tech Data Card

ESSA

(Continued from page 17)

through the lower atmosphere, or troposphere. Familiar examples of signals propagated by this means are TV and FM broadcasting.

The Laboratory's Consultation and Advisory Division is responsible for conducting and coordinating research and providing consultation on tropospheric propagation. As with the ionospheric research, an important aspect of the studies is prediction of transmission characteristics.

The research programs of this Laboratory include the following: The Tropospheric System Performance program area consists of studies of various modulation techniques and their effects on the performance of telecommunications systems. Optical Propagation and Laser Communications has as its purpose the evaluation of the optical-frequency portion of the spectrum for communications use. Data Reduction and Instrumentation provides specialized facilities to serve these functions. Electronic Interference Environment has to do with studying the characteristics and effects on communications of natural and man-made noise and other extraneous signals. Millimeter Wave Propagation is concerned with how waves of these lengths are affected as they travel through the troposphere. Tropospheric Propagation Predictions is a program aimed at learning how to predict the effects of the troposphere on communications systems. Spectrum Utilization Research seeks efficient use of frequencies affected by the troposphere and the terrain. Radio Meteorology has as its purpose the determination of how propagation depends on meteorological phenomena. Tropospheric Physics deals with the effects of the troposphere on waves at frequencies of 300 MHz and above; it includes studies of tropospheric refraction and signal phase modulation caused by the propagation medium. Atmospheric Spectroscopy concerns properties of the atmosphere relative to the transmission and emission of radiant energy; special attention is given to the infrared frequencies.

Space Disturbances Laboratory

As space exploration increases, so does the need for better knowledge of conditions in space as they affect both safety and communica-

tions. Research is conducted by this Laboratory to establish the nature of space disturbances, with emphasis on those associated with solar activity.

A second program area is called Space Environment Forecasting Services. Short- and long-term forecasts are made of geomagnetic activity, solar flux, solar flare probability, and HF radio propagation conditions. In preparing the forecasts, much solar and geophysical information is collected and analyzed. Important information is disseminated periodically.

Aeronomy Laboratory

As was mentioned earlier, aeronomy is the science of the upper atmosphere, and the work of this Laboratory supports the activities of the Ionospheric Telecommunications and Space Disturbances Laboratories. Some of the program areas include Geomagnetism, Sun-Earth Relationships, Ionospheric Structure Studies, Ionospheric Direct Measurements (using rockets and satellites), Consult and Advisory (to provide technical information and advice for government, industry, and universities), and Atmospheric Collision Processes. Still other areas are Instrumentation Research for Aeronomy, Laboratory Plasma Macroscopic, Ionosphere and Exosphere Studies by Scatter Radar, Equatorial Studies (of phenomena either existing only at or most easily studied near the magnetic equator), Upper Atmosphere and Space Physics, Optical Studies of the Airglow and Aurora, and Radio Transmission Properties of the Ionosphere and Exosphere. This impressive list gives some idea of the scope of the ITSA commitment to research.

ITSA Facilities and Resources

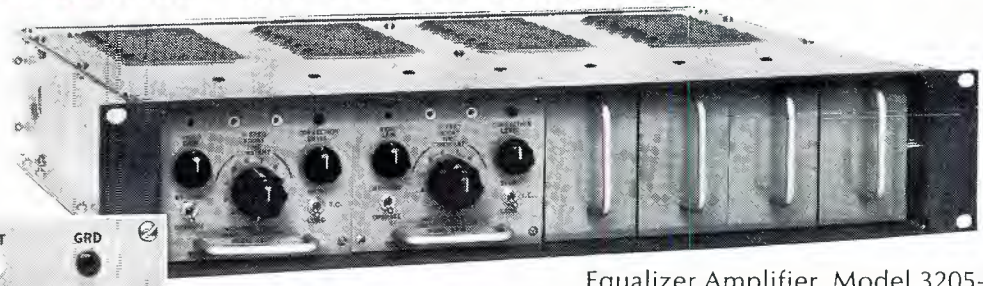
A scientific activity of the magnitude described here requires facilities and resources of comparable extent. These the ITSA has.

First is its staff of engineers, scientists, and supporting personnel. There are nearly 500 full-time and 100 part-time or temporary staff members. Over half of the full-time staff are professional personnel, and of this group about 13% have PhD

COLOR PROBLEMS?

These color processing accessories by TELEMET could solve most of your everyday color transmission problems—quickly and easily—during program time.

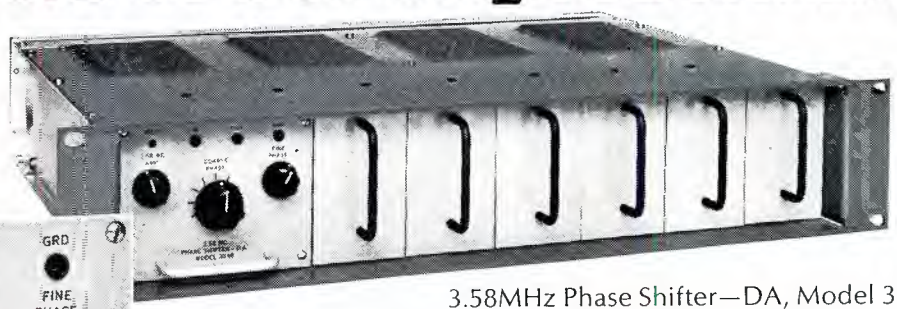
"ON AIR" ADJUSTMENTS



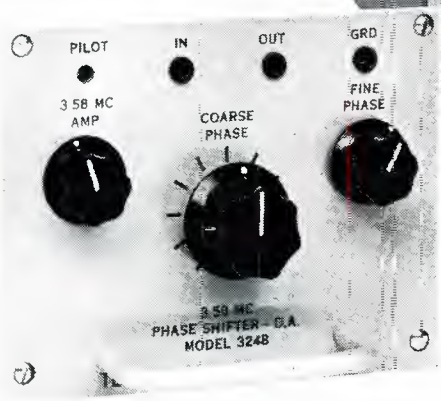
Equalizer Amplifier, Model 3205-B2

- STREAKING (tilt) positive or negative, low- and mid-frequency phase correction.
- BOOST chroma from program to program.
- EQUALIZE up to 2,000 feet of 75 ohm cable.
- PREVIEW and BYPASS facilities.

MATCH PHASE OF 3.58 MHz SUBCARRIER



3.58MHz Phase Shifter—DA, Model 3248-A1



- Four identical isolated outputs, phase adjustable 0° through 360° with respect to input.
- Four-volt peak-to-peak output.
- Coarse and fine phase adjustments.
- Built-in power supply.

Write for Complete Specifications

GIANNINI SCIENTIFIC CORPORATION

TELEMET COMPANY

185 DIXON AVENUE, AMITYVILLE, N.Y. • PHONE (516) 541-3600

Circle Item 24 on Tech Data Card

degrees. About twice that number have MS degrees. A number of graduate and undergraduate college students are employed on a part-time basis.

To finance the ITSA operations last year, some $5.5 million was appropriated directly by Congress. Additionally, another 7 million (approximately) was transferred from other government agencies, such as the Department of Defense and NASA.

The majority of the ITSA's activities is centered in the main building of the Boulder, Colorado, Laboratories of the National Bureau of Standards. The NBS facility occoccupies a 217-acre campus donated to the federal government by the citizens of Boulder. Other Colorado facilities are the Table Mountain Field Site near Boulder, and the Fritz Peak Airglow Observatory near Rollinsville.

Not all research can be conducted in one locality, however, and the ITSA maintains field sites from Point Barrow to Antarctica; other sites throughout the world are operated for the ITSA under contract. One of the world's largest radar antennas—covering 22 acres—is located at the Jicamarca Radar Observatory near Lima, Peru.

Conclusion

When one visits or reads about ESSA and the ITSA for the first time, it is difficult to comprehend the scope of the work that is being done. In talking to the ITSA scientists and engineers, however, one philosophy seems to stand out: The electromagnetic spectrum is a natural resource, and the efforts of these people are directed toward conservation of that resource.

Every ITSA project is related in some way to some form of electromagnetic communication. Part of this work potentially could have profound effects on broadcasting. These effects will not be felt tomorrow, perhaps not for years, perhaps never, but the necessary knowledge will be available for those who make decisions. Basically, that is the priceless product of ESSA—knowledge. ▲

Is there a swing to Norelco

Just ask these busy people

Better yet, ask the

Circle Item 27 on Tech Data Card

Scenes from North American Philips Company, Inc., Studio Equipment Division manufacturing facility, Mt. Vernon, N.Y.

3-tube Plumbicon* color cameras?

who build them.

people who are buying them.

Here's a partial list of stations now using the Norelco cameras. Ask them —at our expense—why they chose Norelco cameras. Call or write us. If you're in the market for a new color camera, we'll pay for your trip to one of these stations, subject of course to availability of their technical personnel to show and tell you the reasons for their choice.

STATION	LOCATION
EAST	
WNHC-TV	New Haven, Conn.
WNEW-TV	New York
REEVES SOUND STUDIOS	New York
SPORTS NETWORK	Rutherford, N.J.
SOUTH	
WAGA-TV	Atlanta, Ga.
WJBF-TV	Augusta, Ga.
WCYB-TV	Bristol, Va./Tenn.
WKRG-TV	Mobile, Ala.
WSPA-TV	Spartanburg, S.C.
WBTV (Remote Unit)	Charlotte, N.C.
MIDWEST	
WFIE-TV	Evansville, Ind.
WFRV-TV	Green Bay, Wisc.
WISH-TV	Indianapolis, Ind.
WEST	
KABC-TV	Los Angeles, Cal.
KTTV	Los Angeles, Cal.
KXTV	Sacramento, Cal.

Two major networks and dozens of stations now use Norelco 3-tube color cameras. Over a hundred of these "new generation" cameras are on the air today. And, just to keep up with orders, we've had to triple production personnel and quadruple the number of our factory test stations in less than a year.

Why the swing to Norelco 3-tube cameras? The big reason is superior performance through state-of-the-art innovations. *Item:* A sharper picture in both color and monochrome than with any 4-tube camera; Norelco's "contours out of green" system for both vertical and horizontal aperture correction provides that. *Item:* Lower noise, more detail in dark or shadowed areas with Norelco's superior gamma circuitry. *Item:* No lag because our beam split system is highly efficient; also, the light is split 3 ways, not 4. *Item:* Maximum stability and reliability because the Norelco 3-tube camera is inherently simpler (which also means fewer controls, less set-up time).

Briefly, that's why they're swinging to the Norelco camera. For technical details, call our sales representative, Visual Electronics. Or call us. Be a swinger.

Norelco STUDIO EQUIPMENT DIVISION

NORTH AMERICAN PHILIPS COMPANY, INC.
900 South Columbus Avenue, Mount Vernon, New York 10550

NEWS OF THE INDUSTRY

AES

The annual awards banquet of the Audio Engineering Society was held in the Barbizon Plaza Hotel, New York, on October 13. The banquet climaxed the annual East Coast convention, at which records for attendance and number of papers read (104) were broken. Highlighted in the papers were endless-loop and reel-to-reel tape cartridges, tape recording, and reproduction.

The John H. Potts Memorial Award was given to John E. Volkman, RCA Laboratories, in recognition of " . . . his elegant application of acoustic principles in the development of large-scale loudspeakers and sound systems."

Lawrence J. Scully, president, Scully Recording Instruments Corp., received the Emil Berliner Award for " . . . his many contributions to the art of cutting disc records, especially improvements and innovations in precision lathes."

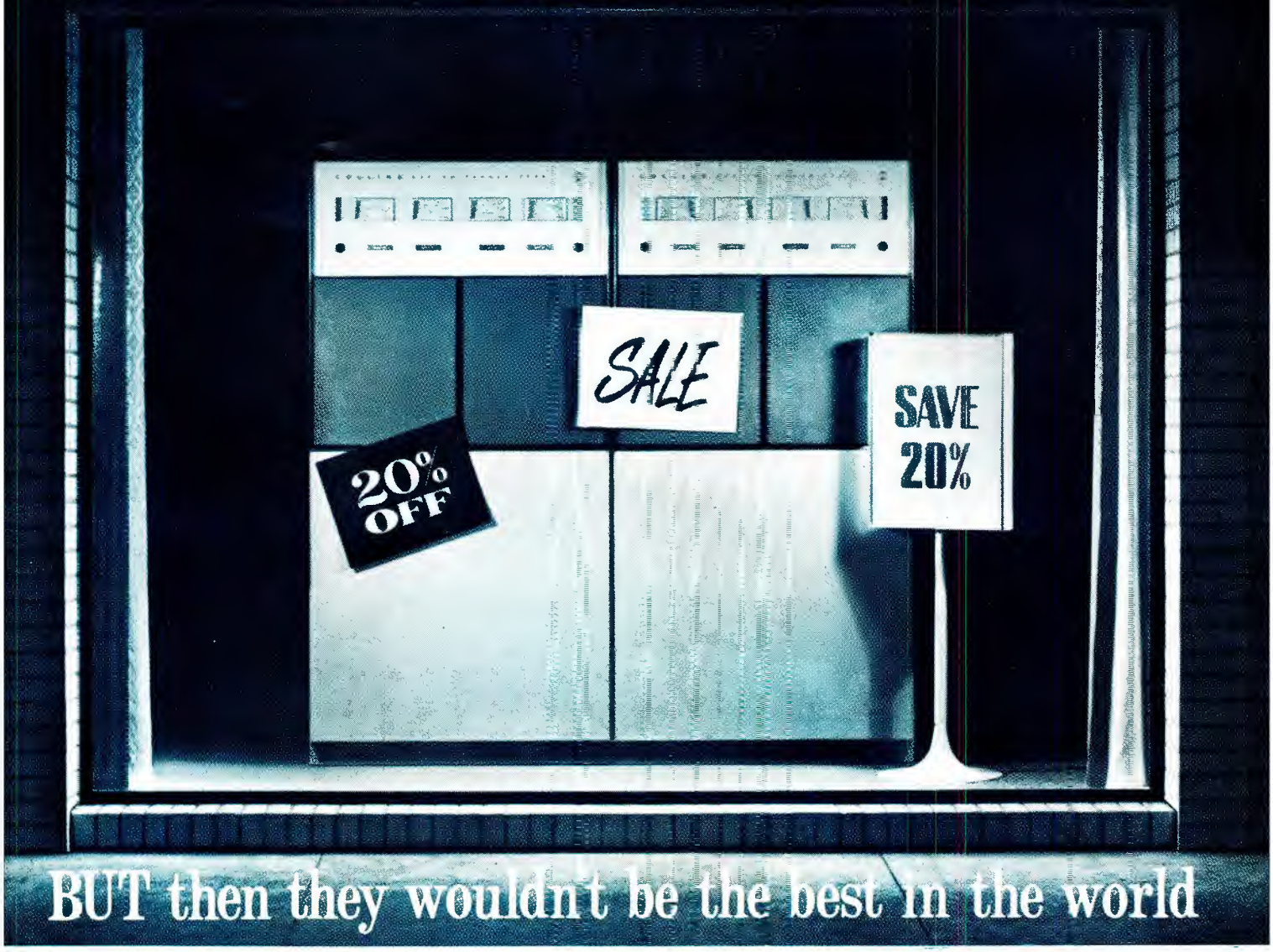
The Audio Engineering Society Award, reserved for the person who has helped most in the advancement of the Society, went this year to Donald J. Plunkett, president of Fairchild Recording Equipment Corp., " . . . in recognition of time and effort contributed to problems large or small, national or local."

IEEE

A call for papers has been issued for the International Electronics Conference, sponsored by the Canadian Region of the IEEE. The Conference is to be held next September 25, 26, and 27 in the Automotive Building, Exhibition Park, Toronto. Nonmembers are welcome.

Twenty-minute papers on electronics and related subjects are sought. Deadlines are as follows: Title and 100-word abstract, including author name(s), company affiliation, and telephone number—March 15, 1967; a 500-word summary, or equivalent material suitable for reviewing the paper—March 15, 1967; for accepted papers only, a two-page digest of the paper—June 23, 1967.

Collins could sell FM transmitters for 20% less



BUT then they wouldn't be the best in the world

All Collins transmitters could be sold for less.

- Corners could be cut on transformers (narrowing safety margins for continuous operation).
- Less shielding could be used against spurious radiation (sacrificing some degree of stability).
- Standards on components, wiring, cabling and switches could be lowered.
- Collins' rigid testing could be bypassed.
- Meeting proper load conditions could be left to luck.
- Money devoted to research and development could be saved.
- Collins' 2-year warranty could be cut to the 1-year period of other manufacturers.

All these compromises could lower the price—as well as the *quality, performance* and *reliability* of the product—about 20%. But then Collins transmitters wouldn't be known for their careful engineering, conservatively-rated components, and precision manufacturing techniques.

Collins gives the broadcaster a discount in the form of quality and service. And that's worth a lot more than 20%.

For technical information on any FM transmitter ranging from 250w to 20kw, contact Collins Radio Company, Broadcast Communication Division, Dallas, Texas. Area Code 214, AD 5-9511.

COMMUNICATION / COMPUTATION / CONTROL

COLLINS

COLLINS RADIO COMPANY / DALLAS, TEXAS • CEDAR RAPIDS, IOWA • NEWPORT BEACH, CALIFORNIA • TORONTO, ONTARIO

Bangkok • Beirut • Frankfurt • Hong Kong • Kuala Lumpur • Los Angeles • London • Melbourne • Mexico City • New York • Paris • Rome • Washington • Wellington

Circle Item 30 on Tech Data Card

Summaries and abstracts should be sent to:

Dr. Rudi de Buda
Technical Program Chairman
International Electronics Conference
1819 Yonge Street
Toronto 7, Canada

SMPTE

Color television broadcasting will be the subject of a technical conference to be held January 27 and 28 in the Rackham Memorial Building at the Engineering Society of Detroit. Major technical papers will be presented by representatives of networks, manufacturers, and broadcasters.

The Detroit Section (Michigan-Ohio) will be host for the conference, which is sponsored by the Detroit, Toronto, Rochester (N.Y.), and Chicago Sections of the Society in cooperation with the University of Michigan. Program chairman is Fred Remley, University of Michigan Center, Ann Arbor. Further information about the conference can be obtained from Howard W. Town, N.E.T., Inc., 2715 Packard Road, Ann Arbor, Michigan.

Specific areas of discussion are to be: colorimetry, color film reproduction, color video tape, color staging and lighting, color live camera operation, color remote production, and color film recording. A list of proposed papers follows.

Video Tape Recording Standards——Why They Are Important to You—Charles Anderson

Specialized Techniques for Producing 35 mm Color Slides for Television—David Corley

Color Television Mobile Units—P. Corio and G. Hurtubise

Conversion of Television Plant System Facilities From Monochrome to Color—I. S. Rosner and N. Gorchoff

Color Conversion of Television Studio Facilities—N. R. Grover

Video Switching—Irv Moskovitz

Video Testing—George Petrilak

High Efficiency, High Intensity Luminaries for Color Television Lighting—S. F. Quinn

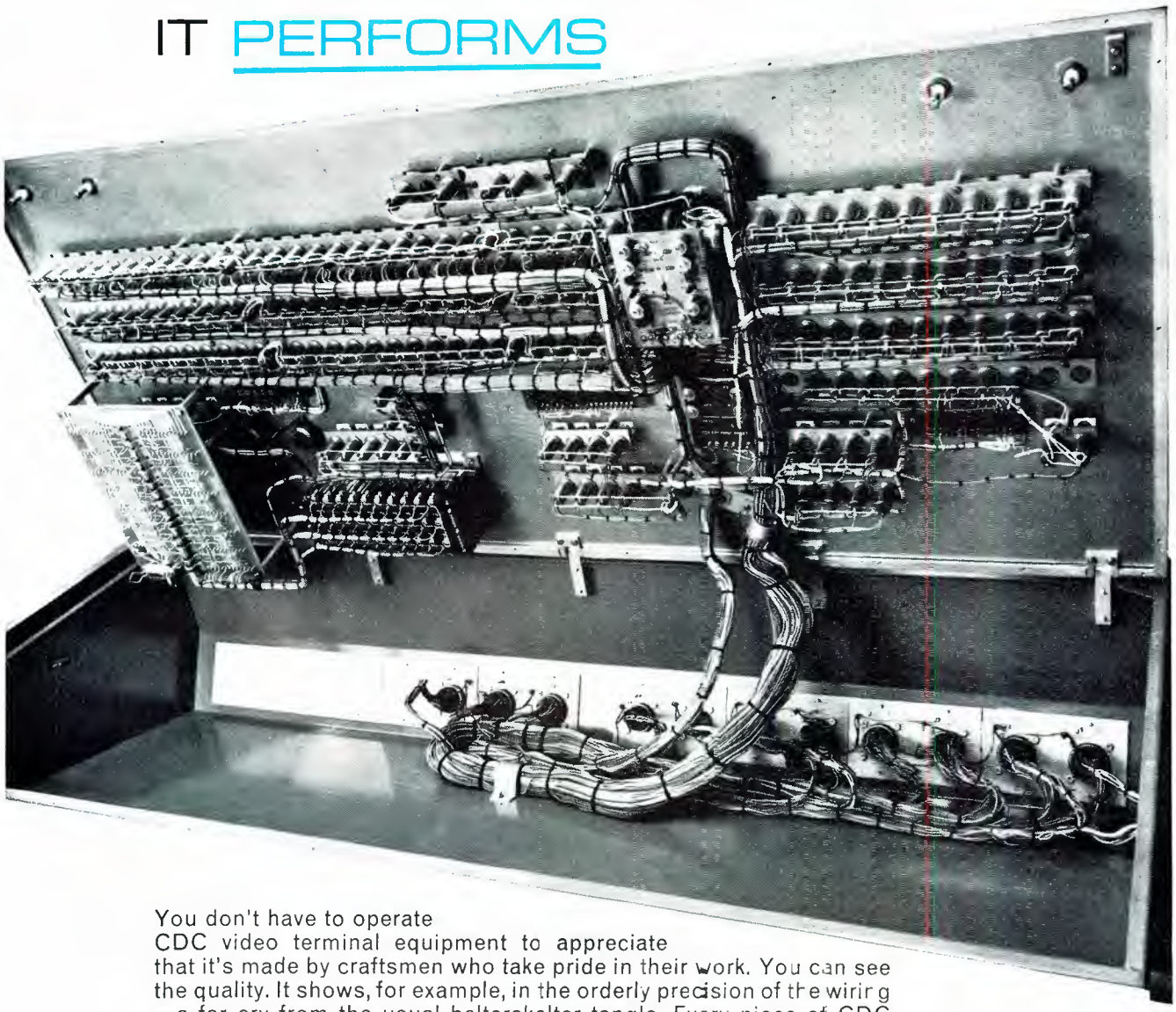
Engineering Economics of Color Conversion of VTR Machines—F. Rees and F. Bonvouloir

Color Film Reproduction—Canadian Telecasting Practices Committee, G. Robitaille

Contours-out-of-Green as Applied to a Color Camera System—Charles E. Spicer.

Color Fidelity in Camera Systems—Joseph F. Wiggin ▲

THIS IS WHAT QUALITY LOOKS LIKE. OVER 40 TV STATIONS IN THE U.S. KNOW HOW IT PERFORMS



You don't have to operate CDC video terminal equipment to appreciate that it's made by craftsmen who take pride in their work. You can see the quality. It shows, for example, in the orderly precision of the wiring—a far cry from the usual helterskelter tangle. Every piece of CDC equipment is a precise, skilled interpretation of the most sophisticated designs in the industry. Naturally, quality of product is reflected in quality of performance. CDC custom-designed equipment meets or exceeds the most stringent performance specifications.

CDC video terminal equipment is crafted in Canada, sold and serviced in the United States by our own people. Over 40 TV stations in the U.S. have installed it in the past year alone. Ask any one* of them how they feel about it. Then we're pretty sure you'll want to see us.

*Closest installation to your area supplied on request

CD corp

CENTRAL DYNAMICS CORPORATION

HEAD OFFICE: 903 Main St., Cambridge, Mass. 02139

Circle Item 32 on Tech Data Card

NEW PRODUCTS

For further information about any item, circle the associated number on the Tech Data Card.

Color Pulse Generator

(50)

A color pulse generator, Model 314A, has been developed by **Videometrics, Inc.** It produces the modulated 20T-pulse test signal for measurement of luminance-chrominance gain ratio and envelope delay. It also produces a sine-squared T-pulse and window. The unit (top of photo) will operate in either a full-field or vertical-interval mode.

The color pulse test signal combines a modulated color subcarrier having sidebands of approximately ½ MHz with a low-frequency sine-squared pulse of 2.5 μsec half-amplitude width. Gain or delay variations between low and high frequencies (luminance-chrominance) produce waveform distortions to the test signal which are observable and measureable using existing oscilloscopes.

The Model 314A generator is completely solid-state and contains its own regulated power supply. The unit measures 3 in x 8 in x 12 in and may be used as is, rack mounted in a 3½-in high rack mounting frame, or mounted in a special carrying case. A companion EIA sync generator, Model 308 (center of photo), is available for portable or remote operation.

IS YOUR VIDEO ON THE LEVEL?

Solid State Color STABilizing AMPlifier

with A.G.C. model VI-500

Ultra Stable Circuitry
through complete and accurate temperature compensation

AUTOMATIC VIDEO LEVEL CONTROL
Maintains video peaks constant to a preset level, with reference to blanking.

CLAMPING
Sync tip clamps remove hum, tilt and other low frequency disturbances.

SYNC LEVEL
Sync level is maintained at a constant amplitude despite large variations in input.

EQUALIZATION
Accurately compensates for losses in up to 1000 feet of coaxial cable.

REMOTE CONTROLS
Automatic/Manual video gain
Sync Level
White Clip
Chroma Control
By-pass switch

WHITE CLIP
Adjustable sharp white clip remains fixed with respect to blanking.

CHROMA CONTROL
Chroma response continuously adjustable ± 4 db. from unity.

WHITE STRETCH
Stretch adjustments provide a high degree of flexibility to compensate for transmitter characteristics.

NON-COMPOSITE COLOR OUTPUT
Mono. or **Color** non composite output board in lieu of white stretch is available at additional cost.

APPLICATION
Wherever there is video and you want to assure:

• Constant levels • Constant clean sync • Elimination of tilt, hum and low frequency disturbances.

Price for the VI-500 $1,750.00 Remote controls $150.00 . . . Have you placed your order yet?

GOOD ENGINEERING IS VITAL

Write for complete information and specifications.

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

Circle Item 36 on Tech Data Card

Small-Space Fader With Unbalanced Bridged-T Network

(51)

A flat-fronted stud fader designed for use on existing and new studio consoles in broadcasting and recording applications is being produced by **Painton** of England. Designated type FM-1, the unit occupies ¾ in. of panel width and extends 2⅝ in. below the panel surface. Unbalanced bridged-T networks are in stock, and the first model offered has input and output impedances of 600 ohms. with a tapered attenuation in a maximum of 30 steps, plus off position. Cue lighting and switches are built in. External connection is made with a miniature plug and socket arrangement in the rear. Connector contacts are of the low-noise type, gold finished for reliability and long service.

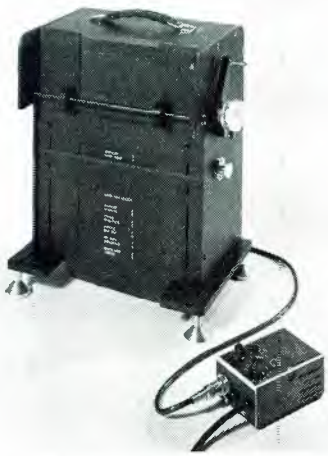
Camera Pod

(52)

A lightweight camera pod is now

available from **Leopold Enterprises, Inc.** The unit, designed to free a cameraman's movements, includes a hand-adjusted device which tilts the camera 30° upward or downward, permitting the operator's back to remain upright.

Quick release for both the camera and the harness is included, and provision has been made for a built-in power supply. List price of the "Leo-Pod" is $177.50.



Moving Title Display

(53)

A new model of the **Q-Tv** "Graphic" Q-Crawl eliminates polarity reversal and utilizes white-on-black typing. Stop frame action is optional. The unit can be used to present stock-market quotations, football scores, and other information in a vertical manner.

Transfer Recording Channel

(54)

Westrex, a division of **Litton Industries,** is now manufacturing a record-

ing channel built specifically to transfer the output of a high-quality magnetic tape reproducer to the company's 3D StereoDisk recorder. Known as the Westrex 2300, the new system consists of a stereo limiting amplifier with fast attack time, variable release time, and low distortion and noise; variable high-pass and low-pass filters; variable program equalizers; 20-step, 600-ohm balancing attenuator; 30-step, ganged recording attenuators; mono-stereo capability; and a complete monitoring and playback system.

Zoom Lens

(55)

A 10 x 9.5 Angenieux Zoom Lens for 16-mm motion picture cameras is now available from **Zoomar International, Inc.**

The new lens offers apertures from F/2.2 to F/22 and focal lengths 2.5 through 95 mm. This optic offers the advantage of short minimum focusing distances (29″ from subject to film plane) and substantial depth of field, even at full aperture. When focused at the 29″ minimum distance, objects only 22″ from the film plane will be at the forward limit of the depth-of-field range.

Another valuable feature is the choice of either a 4:1 zoom crank or a new zoom lever. Models are also available with viewfinders.

Accelerated Film Service

(56)

Acme Film & Videotape Laboratories, Hollywood, has inaugurated an accelerated service in response to numerous requests for what amounts to "crash" delivery schedules. The extra-expedited service on transfers, dupes, and 16-mm prints is intended to cut days off normal lab delivery time. ▲

Engineers' TECH DATA

ANTENNAS & TRANSMISSION LINES

70. MOSELEY ASSOCIATES — Information describes Model ICU-2 isocoupler for mounting 150-172 MHz base-station antenna on standard broadcast tower.

AUDIO EQUIPMENT

71. ATLAS SOUND — Catalog 566-67 contains illustrations and descriptions of speakers, microphone stands, and accessories for commercial sound applications.
72. COLLINS — A 16-page brochure, "A New Approach to Audio Systems," concerns audio systems including stereo and mono speech consoles, audio control console, and mixer add-on unit.
73. HARTLEY PRODUCTS — Literature gives information on full-range 10-inch coaxial speaker for monitoring use.
74. MARANTZ — Sheet has data on solid-state power amplifier available as one-channel Model 14 and two-channel Model 15.
75. QUAM-NICHOLS — General Catalog No. 66 lists replacement speakers for sound systems, radio-TV, and other uses.
76. SPARTA — Product brochure includes prices of Sparta tape cartridge and audio console equipment.

COMPONENTS & MATERIALS

77. DIALIGHT — Catalog L-161F is a 16-page digest of information on incandescent and neon indicator lights.
78. INTERNATION ELECTRONICS — Offer includes specifications and curves for Mullard 6076/QY5-3000A transmitting tube, and folder which lists complete IEC/Mullard special-purpose tube range including the 10M series.
79. MOSSMAN — Catalog 110-61 and supplementary data sheets contain specifications of push-button, lever, and turn switches.
80. SIGMA — Literature is concerned with heat-shrinkable protective coverings for sealing cable connections.
81. SPRAGUE — Short-form Catalog C-559 provides listing of electronic components for industrial, military, and commercial applications.
82. TEXWIPE — Leaflet includes sample "Foam-Swabs" for cleaning tape heads or other areas where noncontamination is essential.

MISCELLANEOUS

83. DENSON—32-page flier 966-A1 lists new, used, and surplus electronic equipment.
84. KEMLITE—Descriptive literature covers condenser-discharge flashtubes for photography, stroboscopy, laser and maser pumping, and other scientific applications.
85. MAGNE-TRONICS—Information relates to background music and motivational sound. Franchise and sale-promotion ideas are explained.
86. TEXAS ELECTRONICS—Specification sheets describe meteorological instruments for use by broadcast stations and CATV systems.

MOBILE RADIO & COMMUNICATIONS

87. MOSLEY ELECTRONICS—1967 catalog lists line of Citizens-band antennas.

POWER DEVICES

88. HEVI-DUTY — Bulletin supplies data on line-voltage regulator using saturable-core reactor.

RECORDING & PLAYBACK EQUIPMENT

89. AMPEX—Eight-page brochure No. A063 describes features of solid-state AG-300 audio recorder for making master tapes. Brochure No. V008 contains information on portable VR-660 video tape recorder for broadcast and closed circuit television use.
90. AUDIO DEVICES — Audiodiscs ® recording blanks, Audiotape® magnetic recording tape, and Audiopak® continuous-loop cartridges are subjects of literature.
91. GATES—Brochure illustrates and provides specifications on transcription turntables and accessories.
92. VIKING OF MINNEAPOLIS — Literature about Model 230 tape transport with RP120 amplifier is offered.

REFERENCE MATERIAL & SCHOOLS

93. CLEVELAND INSTITUTE OF ELECTRONICS—Pocket-size plastic "Electronics Data Guide" includes formulas and tables for: frequency vs wavelength, dB, length of antennas, and color code.
94. HAYDEN BOOKS—Catalog contains list of texts, professional books, and references for scientists, engineers, and students.

TEST & MEASURING EQUIPMENT

95. HEWLETT-PACKARD—Application Note AN 77-2 explains how a vector voltmeter can be used to make high-resolution frequency comparisons quickly.
96. SECO—New test-equipment folder features Model 107-C voltage-regulated tube tester.
97. TRIPLETT—Catalog No. D-66-1 shows line of panel meters, shunts, and portable instruments.
98. VITRO—Subjects of leaflet are Nems-Clarke phase monitors, spectrum display monitor, field-intensity meters, FM re-broadcast receiver, and RF and video jack panels.

TOOLS & SAFETY DEVICES

99. AIR SPACE DEVICES—Brochure STC5-65-10M illustrates applications of "SAF-T-CLIMB" for safety in climbing structures.

VIDEO EQUIPMENT

100. CLEVELAND ELECTRONICS — A 52-page quick-reference step-down die-cut catalog covers complete information on vidicon, Plumbicon®, and image-orthicon deflection components.
101. COLORADO VIDEO — Data sheet gives specifications and general description of Model 601-A laboratory sync generator.
102. GRANGER ASSOC.—Technical-data sheet contains information about infrared-sensitive TV system with 600-line vertical and horizontal resolution.
103. TELEVISION ZOOMAR—Literature describes Model 10x40C 10-to-1 zoom lens for image-orthicon cameras.
104. TROMPETER—Patching and delegate switching systems for broadcast and video distribution are covered in literature.
105. VITAL—Data sheets give specifications of Model VI-500 stabilizing amplifier, Model VI-10A video distributing amplifier, and Model VI-20 pulse-distribution amplifier.

Advertisers' Index

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

JAMES C. McNARY
Consulting Engineer
National Press Bldg.
Washington 4, D. C.
Telephone District 7-1205
Member AFCCE

AMPEX HEAD ASSEMBLY RECONDITIONING SERVICE for all Ampex professional model recorders. This professional service features precision relapping of all heads for maximum head life. Your assembly is thoroughly cleaned and guides are replaced as required. Price includes optical and electrical inspection and complete testing on Ampex equipment in our plant. Full track or half track assemblies . . . $35.00. One to two day service. "Loaner" assemblies available if necessary. LIPPS, INC., 1630 Euclid Street, Santa Monica, California 90404. (213) EX 3-0449. tf

VIDEO TAPE RECORDER AUDIO HEAD ASSEMBLY SERVICE
Precision relapping of all heads and supporting posts, including cleaning and testing. Ampex head assembly with "cue" tracks, $75.00 complete. RCA units also relapped. One to two day service. LIPPS, INC., 1630 Euclid St., Santa Monica, Calif. 90404. (213) EX 3-0449. tf

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

CO-AXIAL CABLE Heliax, Styroflex, Spiroline, etc. Also rigid and RG types in stock. New material. Write for list. Sierra-Western Electric Co., Willow and 24th Streets, Oakland, Calif. Phone 415 832-3527 5-66-tf

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

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

NEW QRK TURNTABLES, all models available, will take any equipment in trade, regardless age or condition. Audiovox, 4310 S.W. 75 Ave., Miami, Florida. 9-66-4t

OBSOLETE TUBES—80% discount — 6SD7, 7E6, 19V8, 1616, DF91, 6C8, 6J7, 6L7, 12K8, 14H7, 14R7. Large variety of other obsolete numbers. List free. H. Goldman, 28 Joseph, Bethpage, N.Y. 11714 10-66-6t

Trimm 504 Audio Patch cords $4.00. Audio jack panels for 19" racks, 10 pair $8.95. Repeat coils 500-500 ohm flat to 20kc $4.00 —Relay racks and equipment cabinets. Write for list. Gulf Electro Sales, Inc., 7031 Burkett, Houston, Texas. 4-66-tf

"AUDIO EQUIPMENT — Whatever your needs, check us first. New and used. Ampex, Altec, AKG, EV, Fairchild, Neumann, Langevin, Rek-O-Kut, Uher, Viking. Send for equipment list." Audio Distributors, Inc., 2342 S. Division Ave., Grand Rapids, Michigan 49507 6-66-6t

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

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

FREQUENCY MONITOR SERVICE for A.M. monitors including G.R., RCA, Gates, Doolittle, W. E., etc. Frequency change and other services. Reasonable prices, prompt service. Call or write before shipping. Eidson Electronic Co., Temple, Texas. 9-66-tf

RADIO AND TELEVISION STATIONS for sale in all parts of United States. Qualified buyers may receive further details by writing to Inter-Media Communications Corporation, 246 Fifth Avenue, New York, New York 10001. 1-67-12t

EMERGENCY POWER GENERATOR, International Harvest Model U-21, 30kw, 3-phase, 60 cycle, 90.4 amperes, 240 volts. Only slightly used. WKYX, Paducah, Kentucky. 10-67-1t

For Sale: Fairchild Stereo Conax for FM control of modulation. $350. KPEN, 1001 California, San Francisco, California. 1-67-2t

EQUIPMENT WANTED

We need used 250, 500, 5K & 10K Watts AM Transmitters. No Junk. Broadcast Equipment and Supply Co. 1314 Iturbide St., Laredo, Texas 78040. 3-66-tf

EMPLOYMENT

FREE PLACEMENT for TV and Radio Chief Engineers and both studio and transmitter engineers. All fees paid by the station. Send resume to: Nationwide Broadcast Personnel Consultants, 645 North Michigan Avenue, Chicago, Illinois or call: 312-337-7075. 9-66-1t

Job Headquarters for all Radio and Television Engineers. Immediate openings exist in 9 western states and elsewhere for qualified engineer and technical personnel. All categories from trainees to experienced transmitter maintenance, chief, assistant chief, live color video maintenance and technical operations. Send us your complete resume now. The AMPS Agency, 3974 Wilshire Blvd., Los Angeles, California 90005. Telephone DU 8-3116.
By Broadcasters — For Broadcasters 11-tf

WANTED: Technicians for RCA closed circuit television—systems planning — color television — video tape — TV cameras — maintenance — sales engineers etc. RCA representative, 143-08 94th Avenue, Jamaica, New York, 212-297-3336 9-66-tf

Prominent Hollywood independent film and general recording facility seeks crackerjack engineer; small secured stock investment buys 10% interest for right man. Box 38027, Hollywood, California, 90038. 1-67-1t

How to turn an ordinary color television set into a highly useful monitor for $195.00.

Money-saving engineering ideas are what put International Nuclear in business. Pre-testing the ideas by in-station use is what guarantees you of the practicality of the ideas. Take the TVM2 Video Modulator pictured above, for example. This self-powered, printed circuit unit (completely transistorized) accepts composite monochrome or color signals and feeds the signals into the IF circuit of any TV receiver, at a frequency of 45.75 megacycles. The TVM2 is simple to install.

If you're interested in saving money, spend $195.00.

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Ray Weiland, President
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Circle Item 48 on Tech Data Card

Announcing...

for color and black and white, the new family of RCA image orthicons with a *big difference here* that *shows up big here*

Now RCA brings you the "BIALKALI PHOTOCATHODE" in the new RCA-8673 and -8674 Image Orthicons. This major engineering innovation has greatly improved compatibility with its non-stick target, maintaining resolution and sensitivity over an extended tube lifetime and improving performance of *existing* color or black-and-white cameras. A simple change in a resistor chain provides proper voltages for a trio of these new Bialkali Photocathode Tubes. Wide-range, the 8673 and 8674 fit spectral requirements of all three channels... eliminating the need for another tube type for the blue channel.

Another big difference: the re-designed image section provides reduced distortion and freedom from "ghosts." These new tubes are available singly or as matched sets—a trio of 8673/S or 8674/S types for color service... types 8673 and 8674 for black and white. Main construction difference is in the target-to-mesh spacing. The closer-spaced 8673 enhances S/N ratio for quality performance under sufficient illumination. The 8674 has greater sensitivity under limited illumination. For complete information about the new RCA Bialkali Photocathode Image Orthicons, ask your RCA Broadcast Tube Distributor.

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

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USE THIS CHART TO SELECT REPLACEMEN TYPES FOR THE TUBES YOU ARE NOW USIN(

UNDER SUFFICIENT LIGHTING LEVELS	
For color pick-up,	
If you're now using...	You can replace with:
4513/S 7513/S	8673/S
For black & white pick-up,	
If you're now using...	You can replace with:
4513 7513 7513/L 8093A 8093A/L	8673
UNDER LIMITED LIGHTING LEVELS	
For color pick-up,	
If you're now using...	You can replace with:
4415S 4416S	8674S
For black & white pick-up,	
If you're now using...	You can replace with:
7293A 7293A/L	8674

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