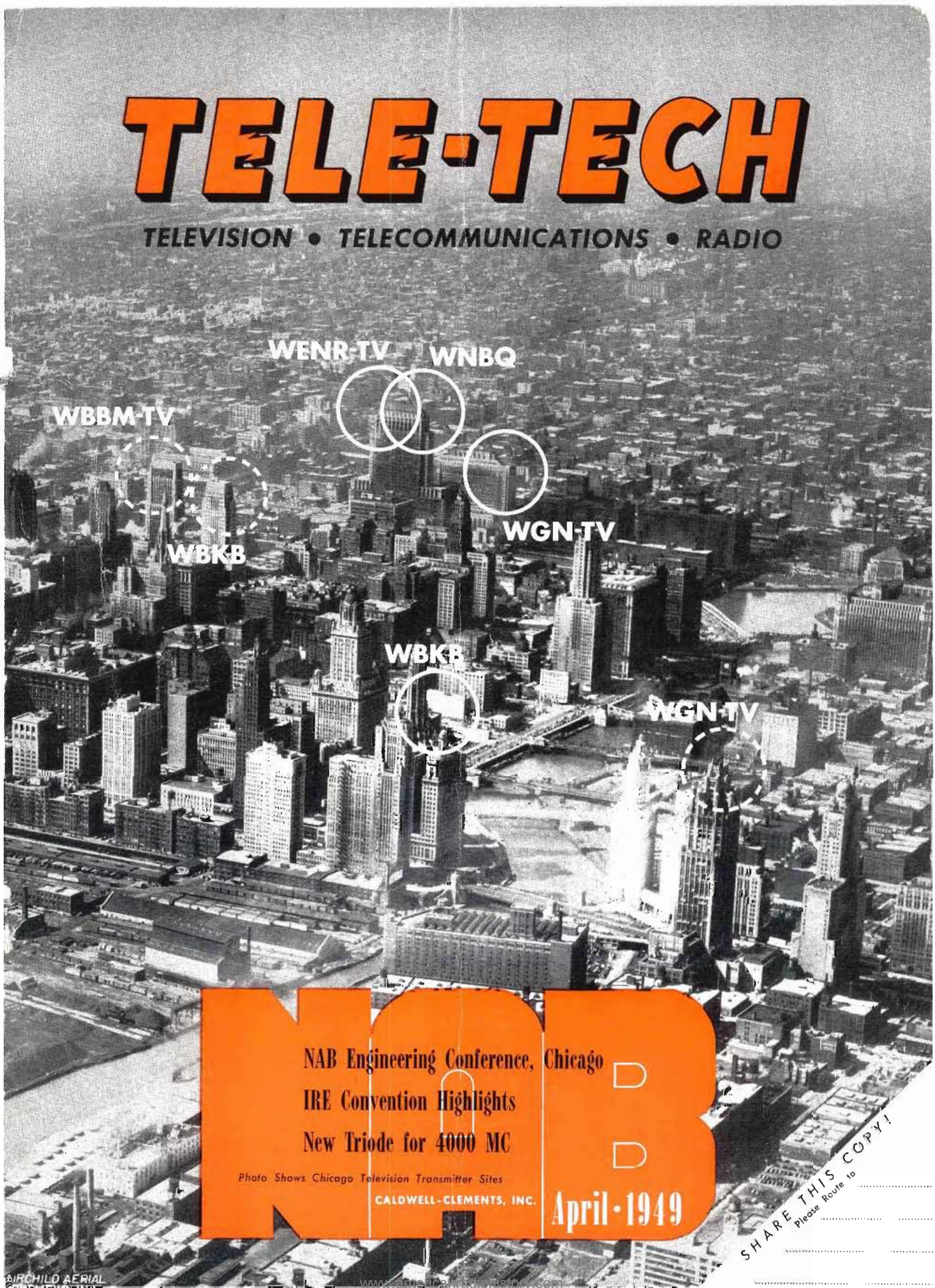
TELE·TECH

TELEVISION • TELECOMMUNICATIONS • RADIO



NAB Engineering Conference, Chicago

IRE Convention Highlights

New Triode for 4000 MC

Photo Shows Chicago Television Transmitter Sites

CALDWELL-CLEMENTS, INC.

April·1949

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AIRCHILD AERIAL

GENERAL INDUSTRIES
leads the L.P. Parade...

MODEL DM—Compact 2 pole, shaded pole motor, already being widely used by many of America's leading radio and record-changer manufacturers. Simple speed change mechanism incorporates a special long-lasting molded neoprene belt. Speed change lever extends beyond turntable rim

with a low cost, rim drive DUAL SPEED PHONOMOTOR

FOR BOTH 33⅓ AND 78 R.P.M. RECORDS

It's L.P. for *Larger Profits* when your record-changers and record-players will handle both the new long-playing microgroove and conventional 78 R.P.M. records. And it's General Industries—oldest name in the phonomotor field—which offers you an economical turntable unit to capture this popular, profitable market.

Like all GI Smooth Power products, this motor has undergone tests far more rigid than service conditions encountered in normal use. It is the result of years of research and development . . . built to exacting performance standards, but surprisingly low in cost.

General Industries offers prompt delivery of this motor in quantity lot shipments. For additional information, specifications and quotations, write *today.*

In addition to the Model DM, General Industries also manufactures a Model DR rim drive dual speed phonomotor. It is a heavy-duty 4-pole shaded pole motor for use where the ultimate in performance is desired. Novel speed change mechanism is both simple and positive in operation.

The GENERAL INDUSTRIES Co.

DEPARTMENT L • ELYRIA, OHIO

Formerly ELECTRONIC INDUSTRIES

TELE-TECH

TELEVISION • TELECOMMUNICATIONS • RADIO

APRIL, 1949

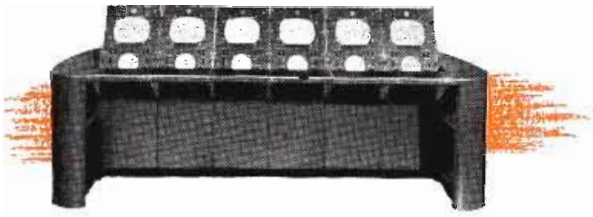
COVER: Aerial photograph of metropolitan Chicago showing the present and proposed new locations of the city's television stations. (Solid circles designate present sites; dotted circles show future locations.) Among the projected moves: WBKB from the American National Bank Building to 33 N. LaSalle St.; WGN-TV from the Daily News Building to the Tribune Tower. Meanwhile, it is contemplated that WBBM-TV be built at 1 N. LaSalle St., shown in dotted circle at extreme left.

Editorial Contents

CALDWELL-CLEMENTS, INC., Publication Office, Orange, Conn., Editorial and Executive Offices 480 Lexington Avenue, New York 17, N. Y., Tel Plaza 3-1340

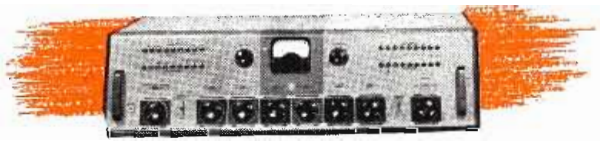
Publishers also of RADIO & TELEVISION RETAILING

Everything for TV...



RCA De Luxe Video Console. Everything you need to monitor, control, and switch camera pictures. "Add-a-unit" design enables you to expand these facilities as your station grows.

RCA Camera Control Type TK-10A. Makes it practical to watch and control the picture quality of station camera. Same size and appearance as RCA's switching units, film camera control, and preview- and line-monitoring units. These units can be grouped in any combination to form a video console (shown above).



RCA Studio Consolette Type 76-C4. This flexible and easy-to-operate control unit performs all the audio amplifying, monitoring, and control functions of a TV station—large or small. Can be used for single- or two-studio operation, and for two transcription turntables.

THAT PICTURE you see over there is a studio control room for a medium-size television station—complete by RCA, from sight to sound.

This room virtually puts entire programming under "push-button" supervision. From here you control and monitor studio programs . . . sound and picture . . . switch between *all* cameras, switch to network or remote programs, control and monitor recorded sound, monitor the programs on the air.

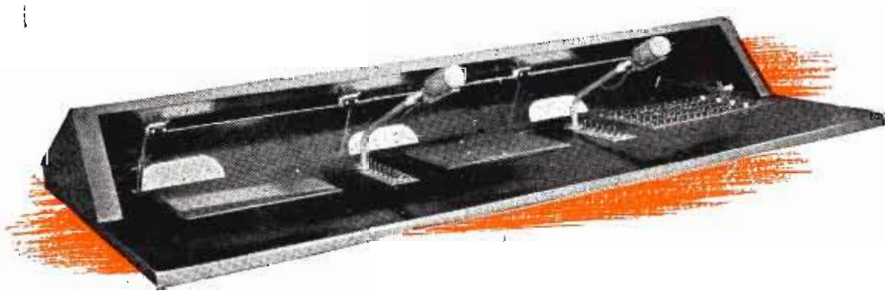
In this room are large picture monitors for previewing signals from remotes or networks and from the studio cameras. In this room also is an audio consolette that controls all program sound lines—from the studio microphones, network audio line, studio and announce microphones, and from the turntables shown in the foreground. A program console . . . with its picture monitor for viewing the studio line and the on-the-air picture . . . co-ordinates the programming. Nothing included in this room that should not be there. Nothing omitted that should be included.

Why do most TV stations go RCA all the way on studio control-room equipment?

Because RCA control-room equipment has design flexibility to meet every station's need and budget. Because RCA control-room equipment is *unit-built* . . . permits easy and economical addition of extra units without a worry about discarding the original equipment. Because a single company makes the entire line . . . *and backs it up!*

For professional assistance in planning your television station, call in an RCA Specialist. Or write Dept. 87D, RCA Engineering Products, Camden, N. J.

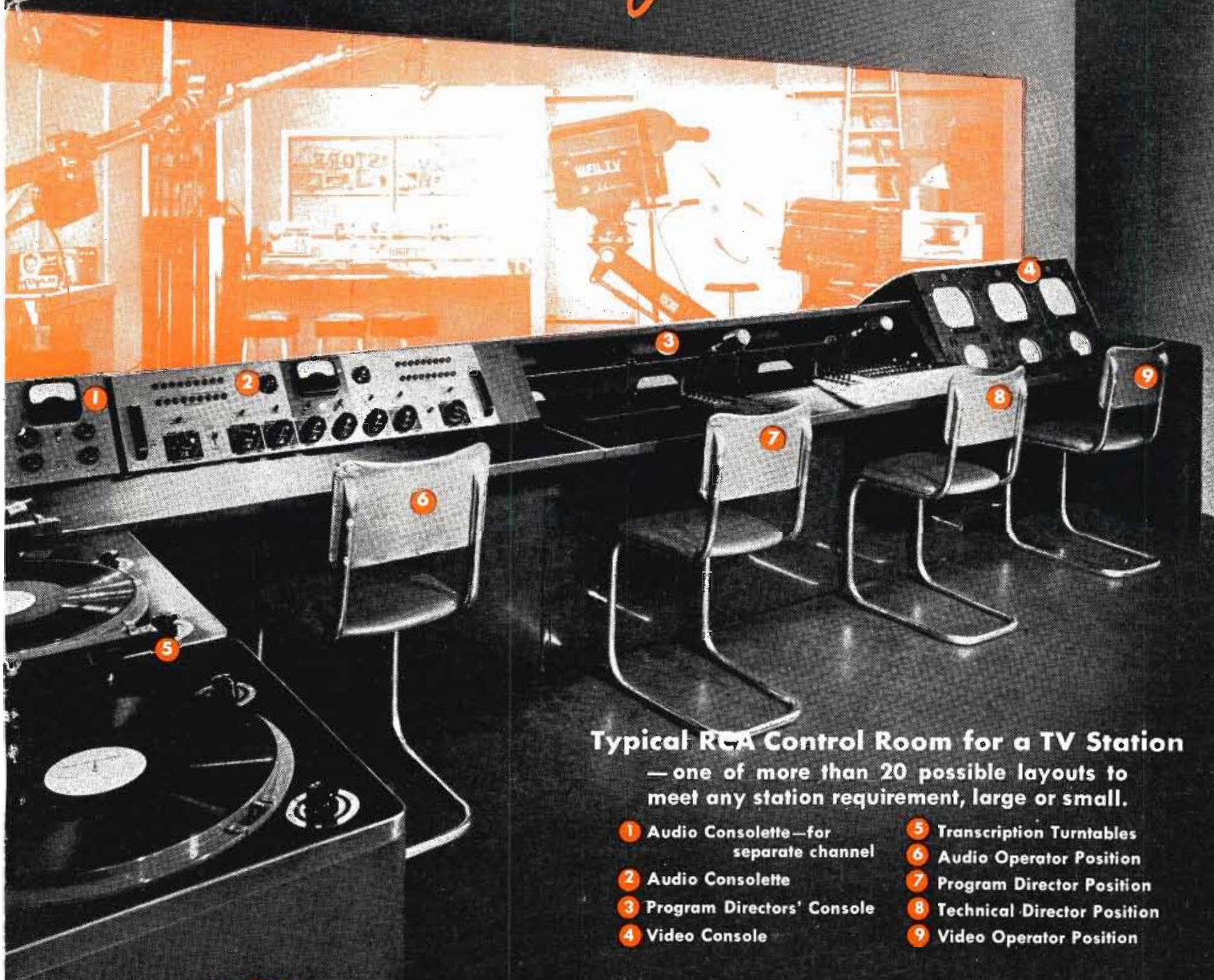
The One Source for Everything in TV—is RCA



RCA Program Directors Console Type TC-5A. Television's most up-to-date directors' control. Includes large-size picture monitors for the studio outgoing line, for previewing, and for "on-the-air" monitoring. All switching under finger-tip control. Low height for full studio visibility. Recessed monitors for maximum image brightness in a fully-lighted control room.

entire studio control rooms,

for instance—



Typical RCA Control Room for a TV Station
— one of more than 20 possible layouts to meet any station requirement, large or small.

1. Audio Consolette—for separate channel
2. Audio Consolette
3. Program Directors' Console
4. Video Console
5. Transcription Turntables
6. Audio Operator Position
7. Program Director Position
8. Technical Director Position
9. Video Operator Position

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In Canada: RCA VICTOR Company Limited, Montreal

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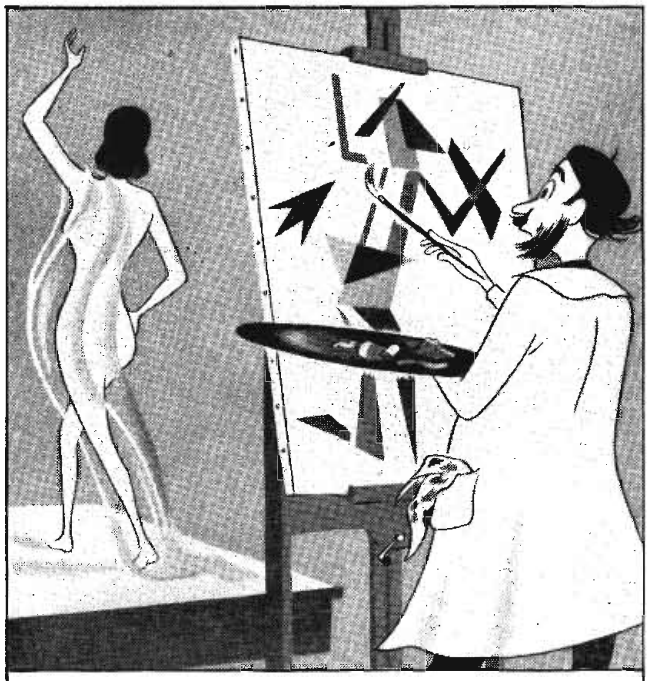
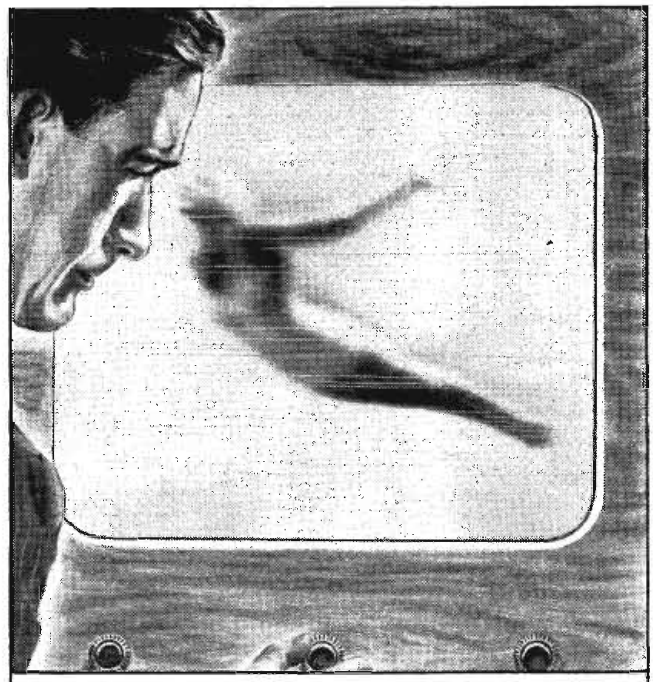
How to Improve the Picture



Use Curves



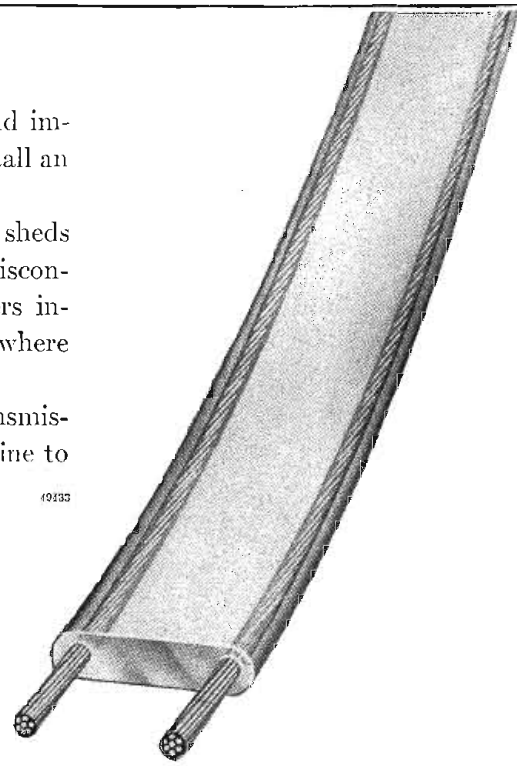
Install ATV* LEAD-INS

A SIMPLE SOLUTION to the effects of attenuation and impedance mis-match on television and FM reception: install an ATV Lead-In, the line that minimizes these effects.

The satin-smooth, *polyethylene* insulation of ATV line sheds water readily—thus avoiding subsequent impedance discontinuities. Besides, the new-type plastic insulation offers increased resistance to weathering—an important factor where lines run outside.

Count on Anaconda to solve your high frequency transmission problems, with anything from a new type lead-in line to the latest development in coaxial cables.

19133



WRITE FOR ATV BULLETIN. Anaconda offers a complete selection of ATV Lead-In Lines for every need: for 75, 150 and 300 ohms impedance unshielded and shielded lines of high impedance. For an electrical and physical characteristics bulletin, write to Anaconda Wire & Cable Company.

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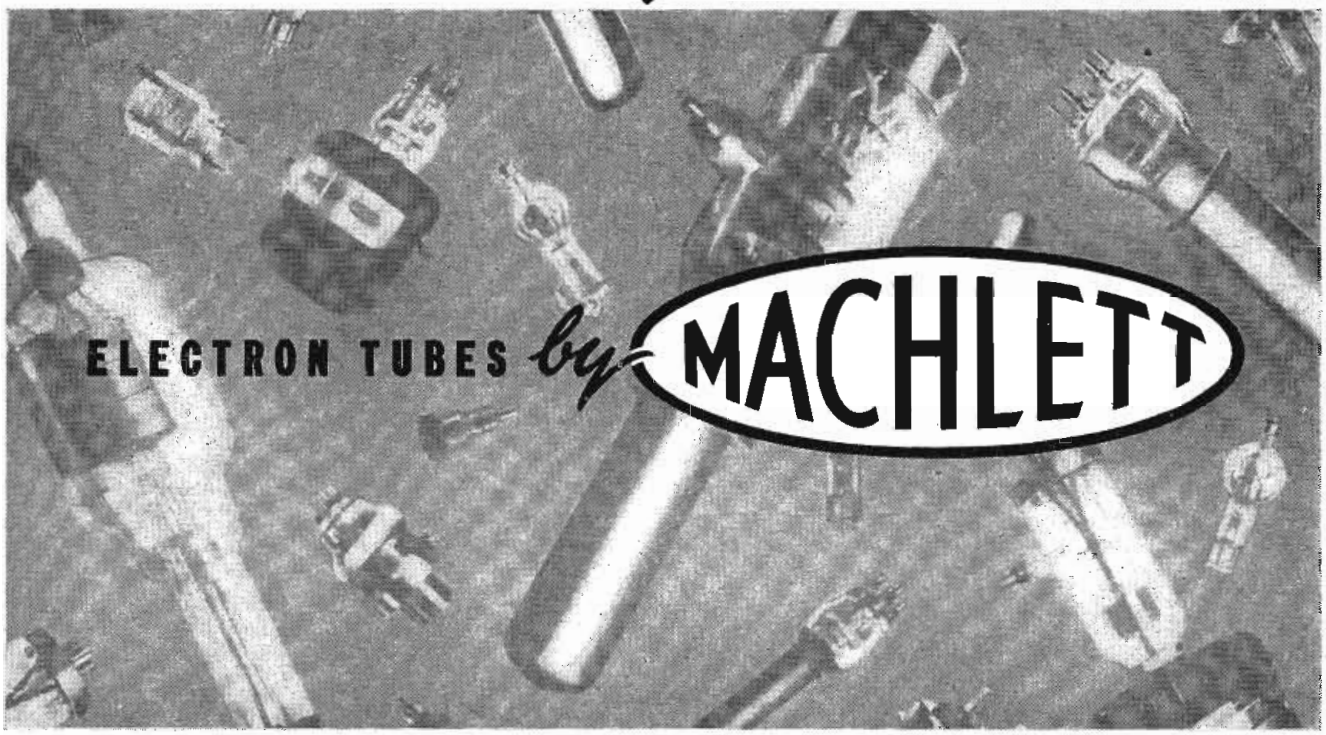
ANACONDA WIRE & CABLE COMPANY

25 BROADWAY, NEW YORK 4, N. Y.

Introducing A NEW TEAM



Combining Research—Development—Manufacturing Skill

Here's great news for Broadcasters. Machlett Laboratories and Graybar Electric Company have joined forces in a new distribution line-up to bring you more efficient and eomplete serviee on electron tubes.

For over 50 years, Machlett has pioneered and made notable contributions to the develop-ment of the electron tube art. Today, through its modern plant, development laboratories and skilled personnel, Machlett tubes will set the highest standard of performance in broadcast service.

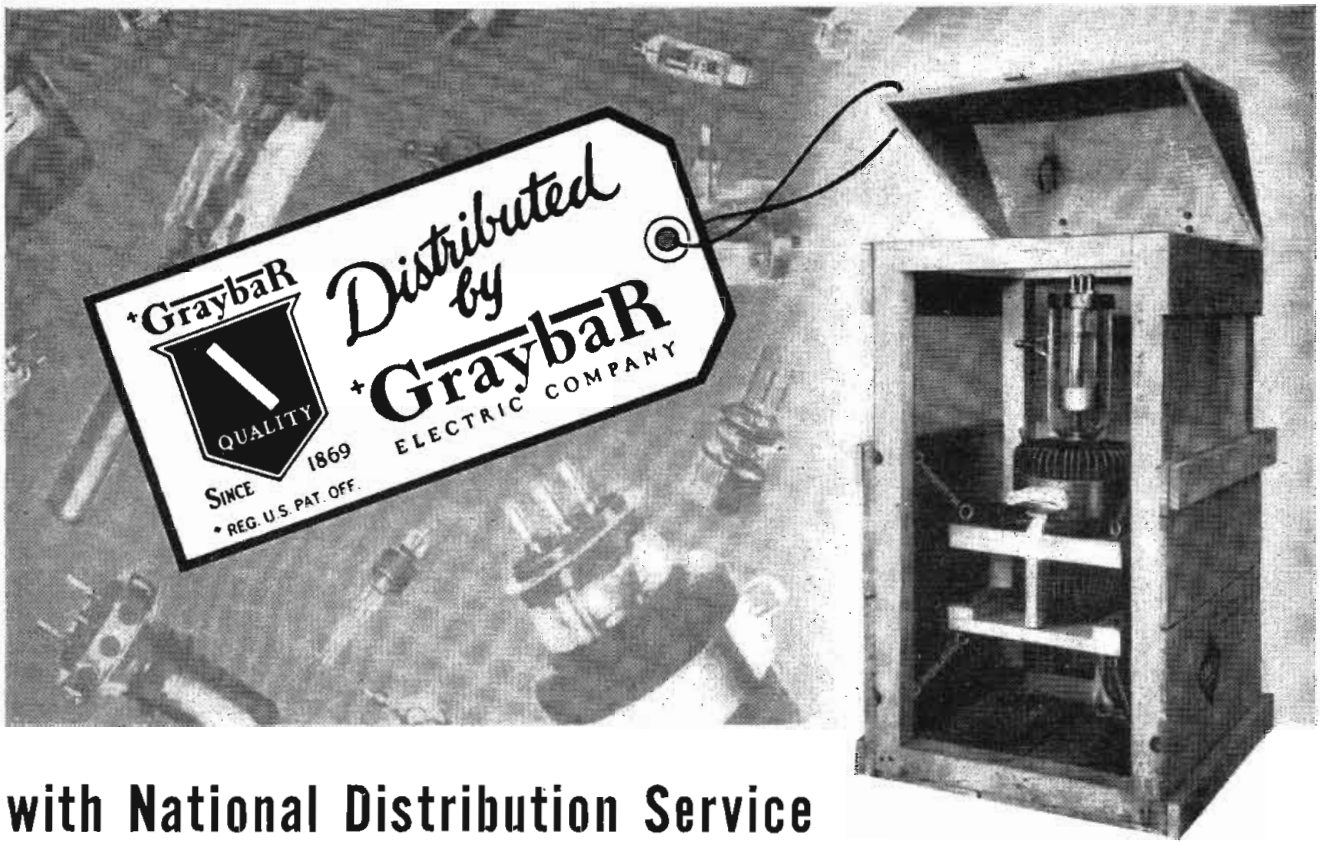
This combination of Machlett and Graybar is your best assurance of getting superior tubes. For better value—better service—try Machlett tubes now distributed via Graybar.

MACHLETT OVER 50 YEARS OF ELECTRON TUBE EXPERIENCE

Famous as the outstanding manufacturer of X-ray tubes, the name, Machlett, on electron tubes has been the mark of quality, top performance and long life for more than 50 years. Experience, skill and a "singleness of purpose" to produce the best in electron tubes have made Machlett first choice around the world.

MACHLETT LABORATORIES, INC., Springdale, Connecticut

TO SERVE BROADCASTERS . . .



with National Distribution Service

In keeping with its policy of "Bringing You Broadcasting's Best Equipment," Graybar is proud to assign its Tag—the Symbol of Distribution—to the Machlett line of electron tubes.

This new connection will bring you dual benefits: (1) products from an outstanding manufacturer of electron tubes, (2) distribution service from an organization offering specialized assistance in choosing the best type of product for your requirements.

Machlett tubes can now be quickly and conveniently ordered through near-by Graybar "Supply Stations" located in over 100 principal cities from coast-to-coast. When you order Machlett tubes "via Graybar," you'll have the right combination for extra service and performance.

Call your local Graybar Broadcast Equipment Representative. Graybar Electric Co., Inc., Executive Offices: Graybar Building, New York 17, N. Y.

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via GraybaR

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Vibration Control

Columbian Humming Birds, one of the famous drawings from nature by John James Audubon.

Wing vibration, nimbly controlled, keeps the humming bird in flight, enables it to feed without alighting.

Electric vibration is the essence of telephone transmission. Voice, music, pictures, teletype—no matter what type of signal—the story is told by the frequency and strength of not one, but many vibrations.

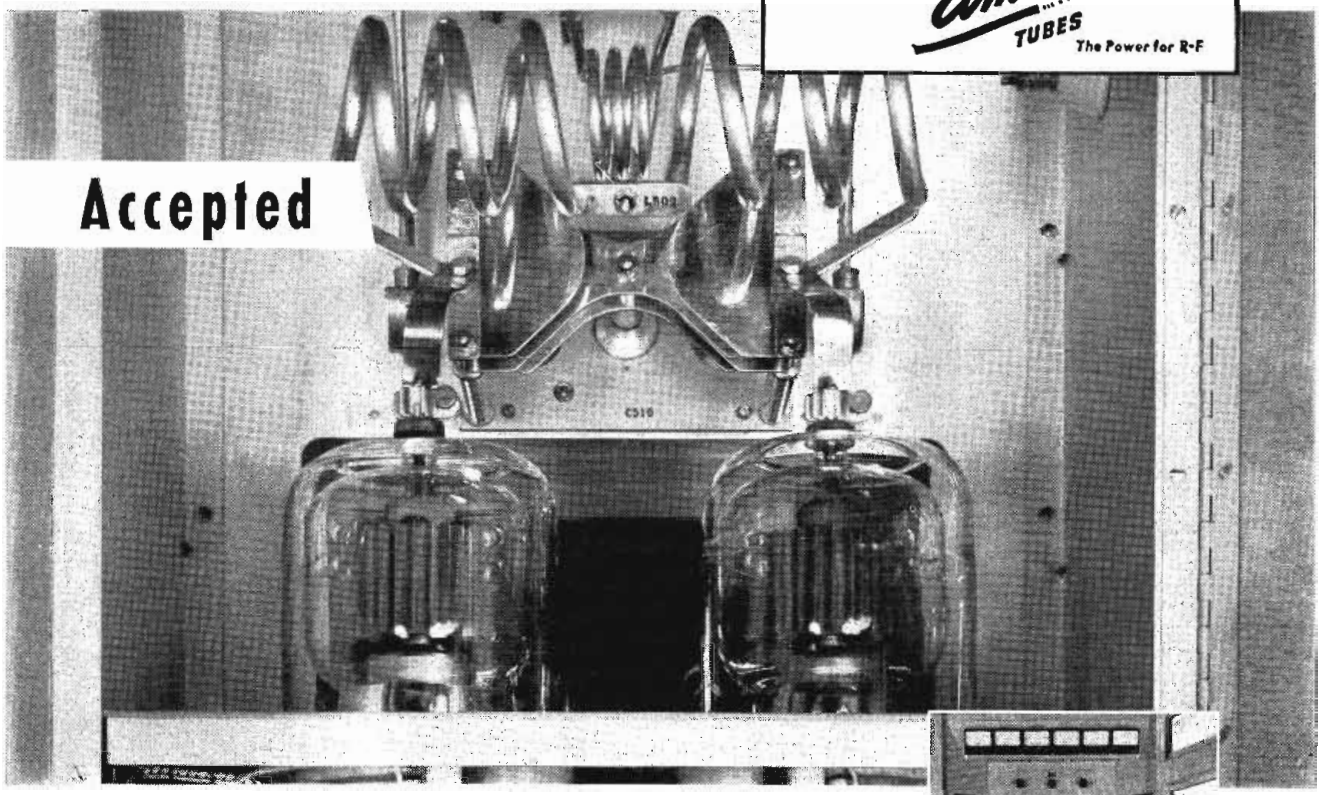
Learning how to control electric vibrations to pin-point accuracy has been one of the basic jobs of Bell Laboratories scientists in their development of the "carrier" art which enables the sending of many more conversations over existing wires. Among their inventions have been oscillators, modulators, filters, coaxials, wave-guides, and radio lenses.

Constantly Bell Laboratories scientists discover new and better ways to control and adapt electric vibrations by wire or radio to the needs of the telephone user. Their pioneer work in this field is one important reason behind today's clear, dependable and economical telephone service.

BELL TELEPHONE LABORATORIES

Exploring and inventing, devising and perfecting, for continued improvements and economies in telephone service.

Follow the Leaders to Eimac TUBES The Power for R-F

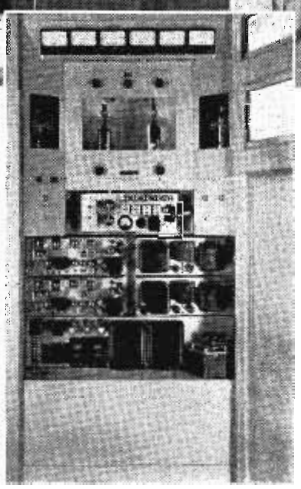


For Emergency Services . . . . The Link 3000UFS Transmitter and Eimac 4-1000A Tetrodes

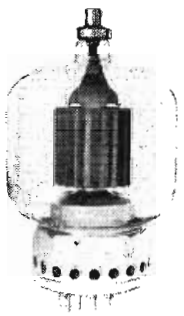
Here's a team that fills the bill by providing the dependability of performance required by police and other emergency communication services.

Link Radio, well known manufacturers of radio communication equipment, in designing their 3 kw 30-50 Mc. FM transmitter choose Eimac 4-1000A tetrodes to power the final amplifier. The high power-gain of these tubes enabled Link to use their standard 50 watt transmitter as a driver. The resulting compact simplified transmitter is ideally suited for control through telephone circuits from remote locations. A single pair of telephone lines carries transmitter modulation, power control, overload relay reset, and frequency selection plus receiver output and selection.

Because of their power-gain abilities, stability and other exceptional characteristics, the 4-1000A tetrode offers the design engineer interesting potentialities . . . write direct for further information, data is available.



LINK 3000 UFS



EIMAC 4-1000A TETRODE

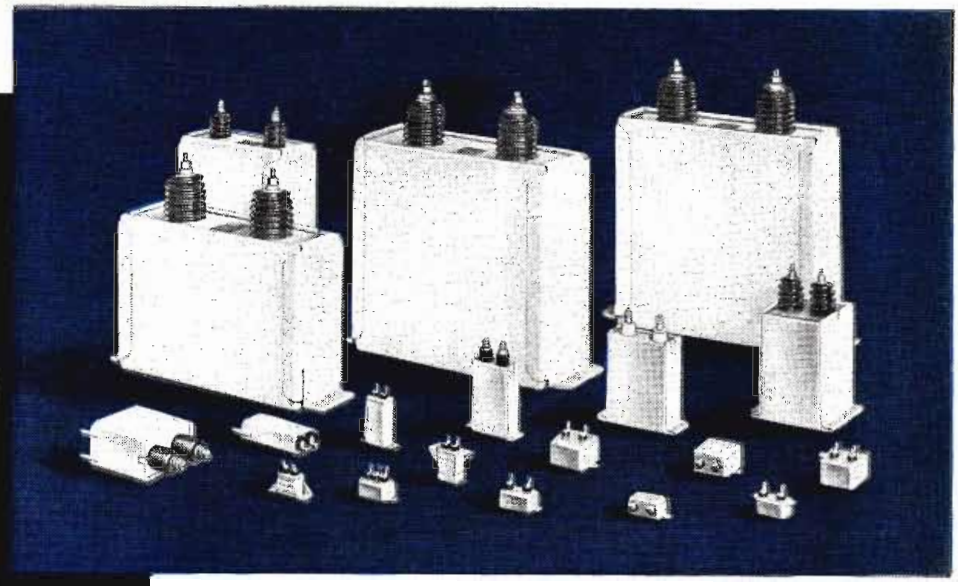
EITEL-McCULLOUGH, INC.

212 San Mateo Ave., San Bruno, California

Export Agents: Frazar & Hansen, 301 Clay St., San Francisco, California

ELECTRONICS

Designers



take your choice... FIXED PAPER-DIELECTRIC CAPACITORS

Readily available for DC electronic applications, these capacitors are manufactured in accordance with joint Army-Navy specifications JAN-C-25. Case styles include types CP 53, CP 54, CP 55, CP 61, CP 63, CP 65, CP 67, CP 69 and CP 70. Capacitance ratings are from .01 Muf to 15 Muf, and voltage ratings are listed from 100 to 12,500 volts.

These capacitors are constructed with thin Kraft paper, oil or Pyranol* impregnated, which provides stable characteristics and high dielectric strength. Plates are aluminum foil, manufactured according to detailed specifications. Special bushing construction provides for short internal leads, preventing possible grounds and short circuits. The cases have a permanent hermetic seal to provide longer life. A variety of mounting arrangements are available for various installation requirements. Write for detailed description and operating data: Bulletin GEA-4357A.

*Pyranol is General Electric's non-inflammable liquid dielectric for capacitors.

Less than one inch long, and only one inch square, this postage-stamp-size selenium rectifier offers radio builders substantial savings in production costs. Only two soldering operations and a minimum of hardware are necessary for installation in places where a rectifier tube and socket won't fit. They're built to safely withstand the inverse peak voltages obtained when rectifying (half-wave) 110-125 volts, rms, and feeding a capacitor as required in various radio circuits. Tests prove that selenium rectifiers will outlast the conventional type of rectifier tubes, at the same time costing less. Send for bulletin GEA-5238.

GENERAL ELECTRIC

Digest

TIMELY HIGHLIGHTS ON G-E COMPONENTS

HOLDS OUTPUT VOLTAGE CONSTANT

This 500-va voltage stabilizer is suitable for a wide variety of electronic applications where constant voltage is demanded. Voltage variations from 95 to 130 volts are absorbed almost instantaneously and output voltage maintained at 115 volts (plus or minus 1 percent). There are no moving parts, no adjustments to make. This unit will operate continuously at no load or short circuit without damage to itself. It will limit the short circuit current to approximately twice stabilizer's normal full load current rating. Other sizes available range from 15 to 5000 va. For details, check bulletin GEA-3634B.

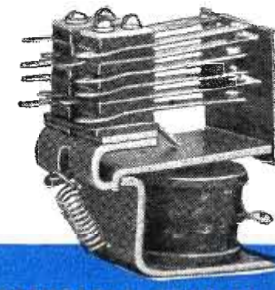
WANT TO TIME TUBE LIFE?

Suitable for installation in radio transmitters, these G-E time meters provide accurate record of tube operating time. They record in hours, tenths of hours, or minutes. Ratings range from 11 to 460 volts. Installation on a panel or switchboard is simplified by quick-wiring leads. Timer harmonizes with other panel instruments in appearance and size. Dependability is assured by Telechron* motor drive. Also available for portable use or conduit and junction box mounting. Check bulletin GEC-472.

FOR YOUR TELEVISION SETS

General Electric's television cord set comes in 6-foot lengths, made of 2/18 Pot-64 brown Flamenol* rip-cord. Set has brown plastic plug and new brown Flamenol connector molded on opposite end. Rip-cord has smooth finish, resists oil, water, acids, alkalies, or sunlight deterioration. Rating is 7 amps., no. 18 wire. Set is designed for assembly on television receiver rear panel, automatically disconnects when panel is removed. Write for further information.

*Trademark Reg. U. S. Pat. Off.



DEPENDABLE CONTROL FOR AUTOMATIC DEVICES

G.E.'s multi-contact relays are inexpensive units built specifically for appliances and vending machines. Construction features assure quiet, reliable operation, and compactness makes them adaptable to a variety of devices such as coin changers, phonographs, and television receivers. Single-circuit contacts or combinations of contacts for multi-circuit application are attached to the same sturdy frame and coil assembly, affording a multiplicity of relay forms. Ratings are 5 amperes at 115 volts or 24 volts, a-c or d-c. Get details from Bulletin GEC-306.

General Electric Company, Section C667-1
Apparatus Department, Schenectady, N. Y.

Please send me the following bulletins:

- ☐ GEA-3634B Voltage Stabilizers
- ☐ GEA-4357A D-C Capacitors
- ☐ GEA-5238 Selenium Rectifiers
- ☐ GEC-306 Multi-contact Relays
- ☐ GEC-472 Tube Timers

NAME .....

COMPANY .....

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CITY ..... STATE .....

TELE-TIPS

IRREGULAR-TERRAIN PROPAGATION of ground waves at 50 to 250 megacycles, is title of valuable report prepared by K. A. Norton and his National Bureau of Standards group for the Ad Hoc committee. Report comprises 15 pages and includes 27 graphs, but is supersecret—not to be quoted or reprinted. Analysis of data from 13 TV and FM stations indicates that corrections can be applied to the theoretical smooth-earth curve, producing dependable results that square with observations. Fortunately these corrections are not very large, greatest being about 12 db.

RECTANGULAR TV TUBE is being readied for the market by a large glass company which has already developed automatic machinery for fabricating these tubes. Flat form would take smaller cabinet and smaller shipping box. Since less glass and material are required, prices eventually are expected to drop below round glass or metal tubes.

3-by-4-FT PROJECTION—N. A. Philips engineers are reported working on adaptation of Protelgram (originally designed for 15-by-20-inch screen) to throw front-projection pictures onto screens up to 3-by-4-ft. in size. Story is that nearly eight million dollars has been spent on developing Protelgram equipment here and in Holland.

MOBILE ALLOCATIONS so long and repeatedly delayed by FCC, now appear to be coming through,, as we go to press. Definite assignments for the whole mobile field may therefore be determined before this is printed.

TV MFRS ASSN exclusively, was to be attempted March 21, at NY meeting called by Sightmaster's M. L. Caplan. Proposed association would devote whole energies to television-receiver matters, feeling being that the plunging new TV industry has problems too complex to be made part of agenda of another more general group.

BEER-GLASS MAGNIFIERS — Glass lenses incorporated into the bottoms of beer glasses for better television viewing is latest innovation being considered by tavern hosts along our neighboring Third Avenue, reports our East Side correspondent.

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BUILT FOR LONG, TROUBLE-FREE PERFORMANCE UP TO 450 VOLTS AT 85°C.

These sturdy little dry electrolytics have what it takes to match the toughest capacitor assignments in television and other exacting equipment where the use of ordinary components may only be inviting trouble. They're compact, easy to mount. They'll withstand plenty of heat. Thanks to a recently developed processing technique, they are outstandingly stable, even after extended shelf life. In every respect, they are designed for better-than-average service on tougher-than-average jobs.

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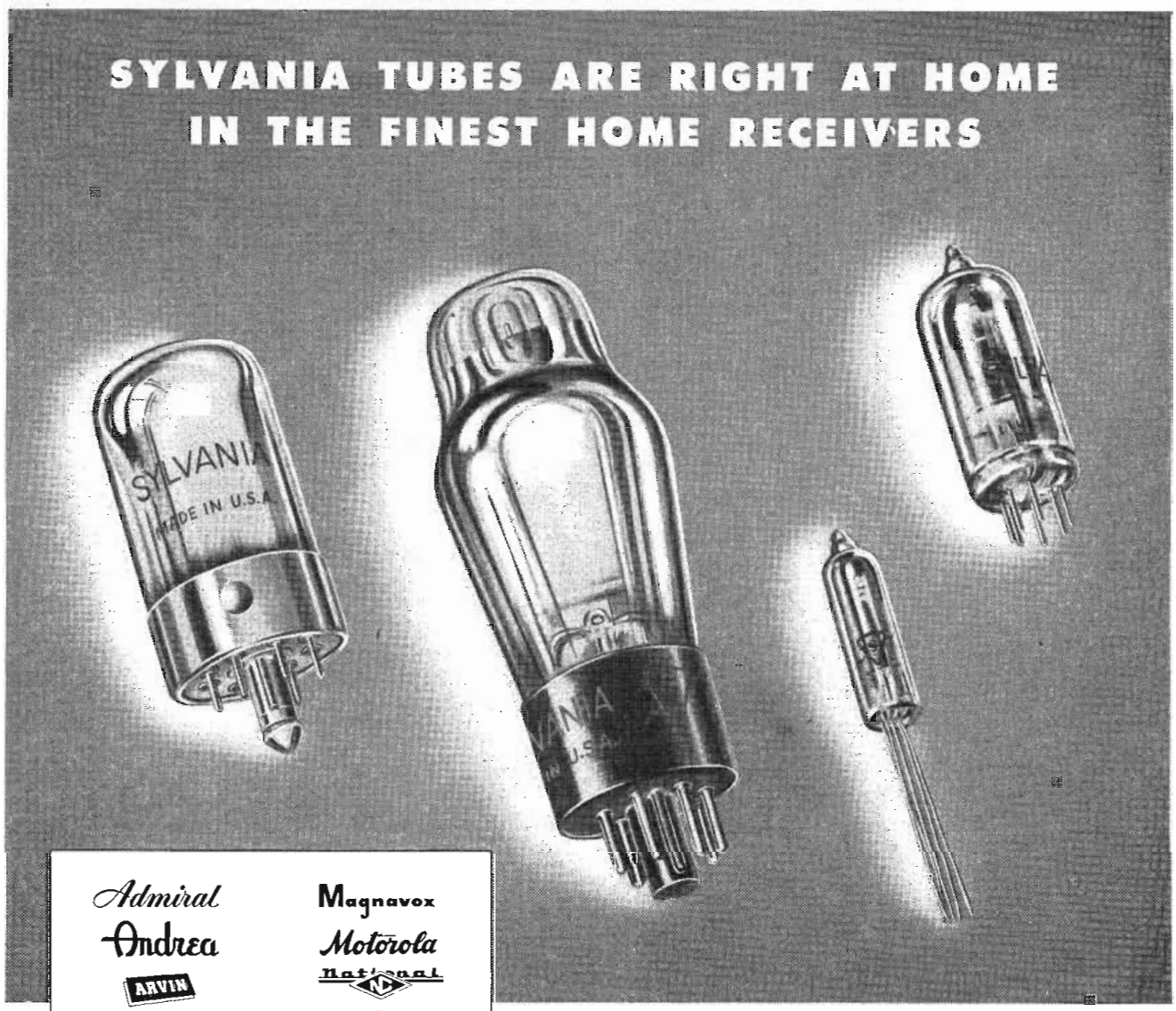

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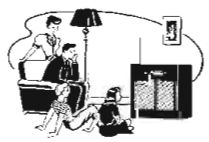

Sub-miniatures, seven- and nine-pin miniatures, standard types, and the great Lock-In radio tubes are all included in the famous Sylvania line . . . all represented in the leading makes of home receivers—from portable models to console combinations and television receivers.

It is the high quality of these Sylvania tubes that has made them preferred . . . has made them famous throughout the world.

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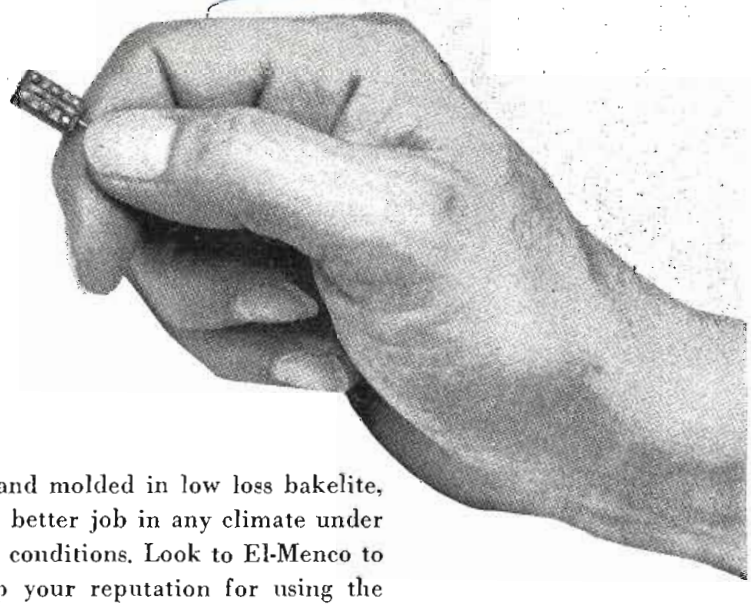

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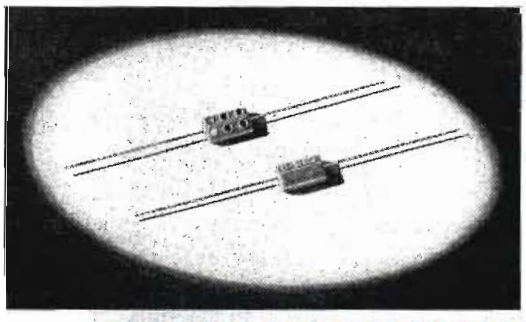

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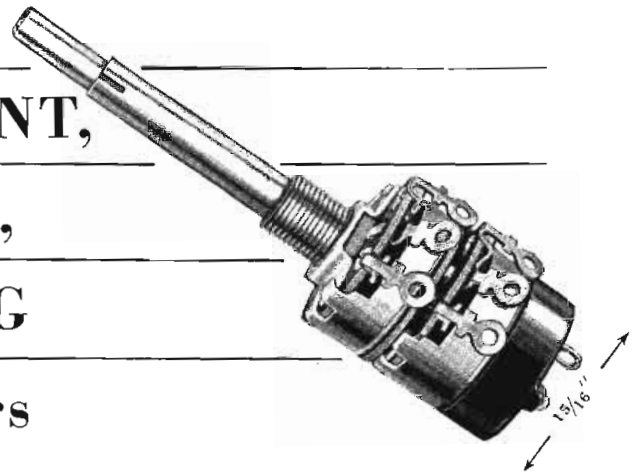

Highlights of the MALLORY MIDGETROL DUAL

1. Combines two quiet, compact controls on concentric shafts.
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4. Only dual control with two-point shaft suspension, which means—shorter bushing may be used, more stable resistance values are obtained, less danger of damage in assembly, longer life, longer shafts may be safely specified.
5. Available now for prompt delivery and competitively priced!

Now Mallory has produced a *Dual* Mallory Midgetrol with concentric shafts.

Mallory precision manufacturing PLUS small size (15/16" diameter) provide a method to move several key television adjustments from the rear of the chassis to the front. Eight single controls now required to make adjustments can be changed to only four Dual Mallory Midgetrols, permitting ready adjustment at the front of the chassis.

You get a cleaner-looking set, an easier set to produce —and the Mallory Midgetrol provides the ruggedness and dependability television parts must have.

Read the highlights of the Mallory Midgetrol *Dual* . . . and see why those who have seen what it can do to improve quality and cut costs are so enthusiastic about its future.

P. S. The unique qualities of the Mallory Midgetrol *Dual* make it perfect for many applications in other fields as well. Mallory engineers will be glad to tell you more about it. Write Mallory today.

Precision Electronic Parts—Switches, Controls, Resistors

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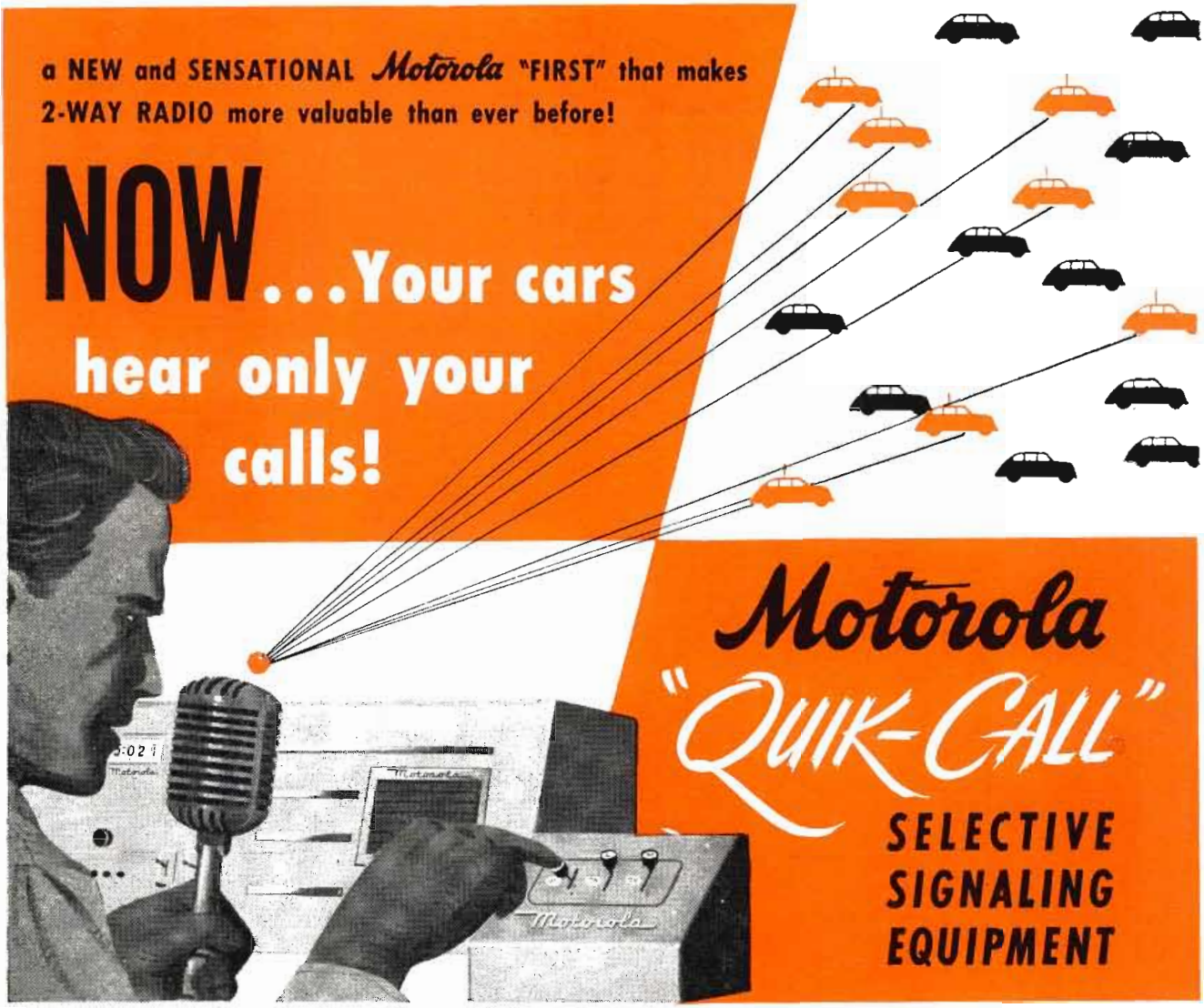

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Just press a button to call your cars—individually, or by groups

Now you can control and direct calls to your fleet, or to any one car in your fleet with the new Motorola "QUIK-CALL" selective signaling equipment! Your cars can be called only by *your* base station. Another "FIRST"—Motorola "Quik-Call" prevents your cars from receiving calls sent by other transmitters on the same or adjacent channels...they need not hear any calls except those coded from your station alone. Interference from diathermy is completely locked out during standby and, most important, skip interference false calling and squelch opening is eliminated.

Motorola "QUIK-CALL" prevents nuisance interference from stations in nearby communities, reducing driver fatigue and increasing the utility of any radio system.

Developed after two and one half years of exacting research, Motorola "QUIK-CALL" is based upon the use of a pure tone generator of instrument precision, called the Vibrasender, and a responding resonant responder—called the Vibrasponder. These "electro-mechanisms" in various combinations, are capable of calling your fleet (with the single-key system) or of selectivity calling up to 1,350 individual units (with the 24-key system) with the precision and speed of adding machine operation.

A product of Motorola Research Laboratories

Motorola "QUIK-CALL" can be added to your present *Motorola* equipment

It doesn't matter whether you're installing a whole new communications system, or if you already have 2-way radio...the Motorola "QUIK-CALL" can be adapted to your system in bringing it up to date. Enjoy the advantages of this new kind of 2-way radio.

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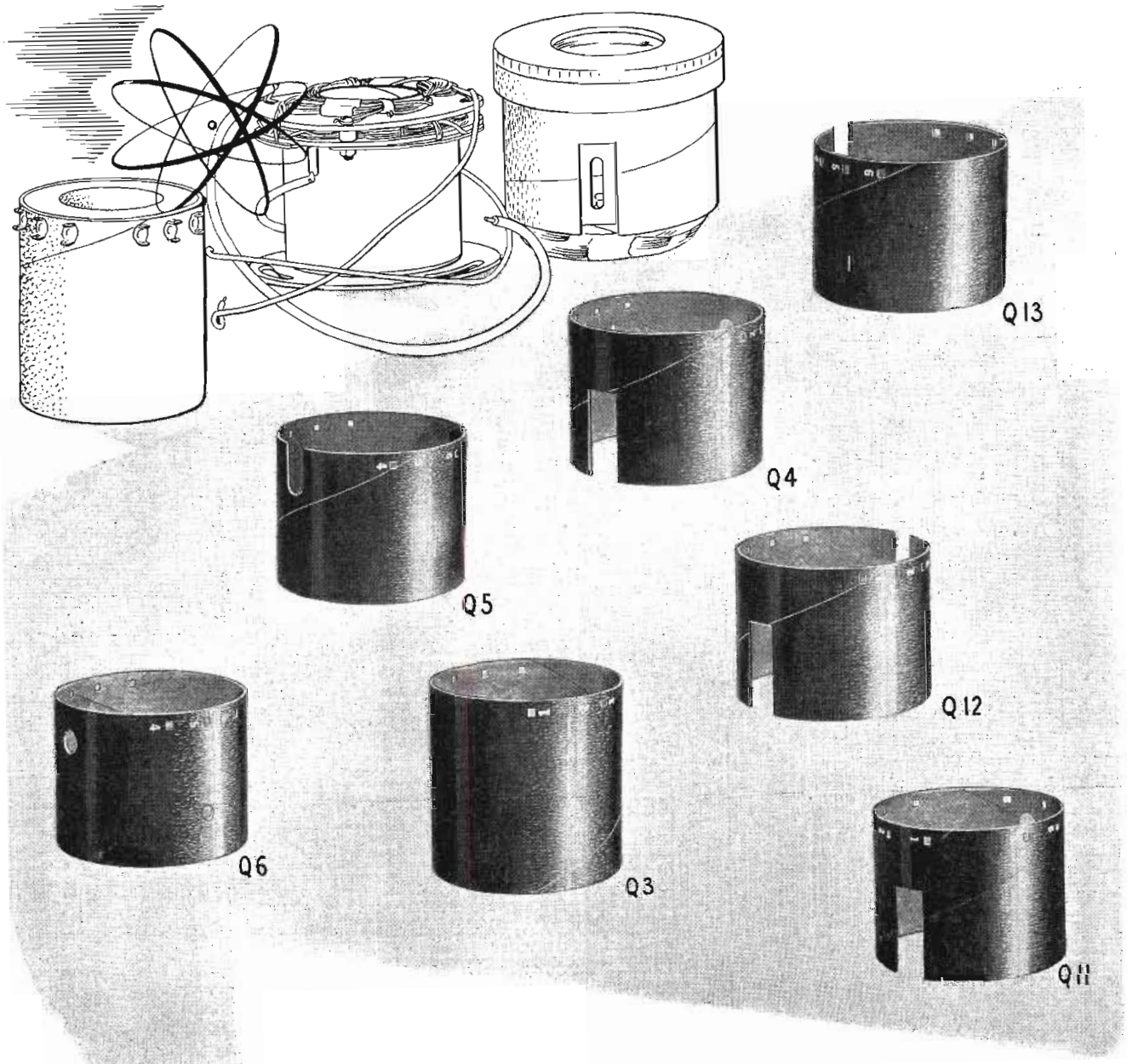

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for Television deflection yokes are made to meet your individual needs.

Keep in mind that we have tools available without charge for all Shells shown above. And . . . we can quickly make tools for other punching and notching as may be required. COSMALITE is known as a quality product. It meets the most exacting requirements.

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with black exterior finish, as illustrated above, have 3" inside diameter, 3.093 outside diameter.

Q-3 is 2-31/32" long. The others, Q-4, Q-5, Q-6, Q-11, Q-12, Q-13 are 2-11/32" long.

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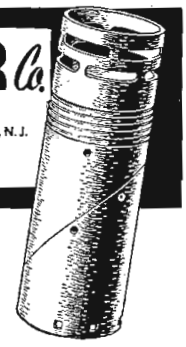

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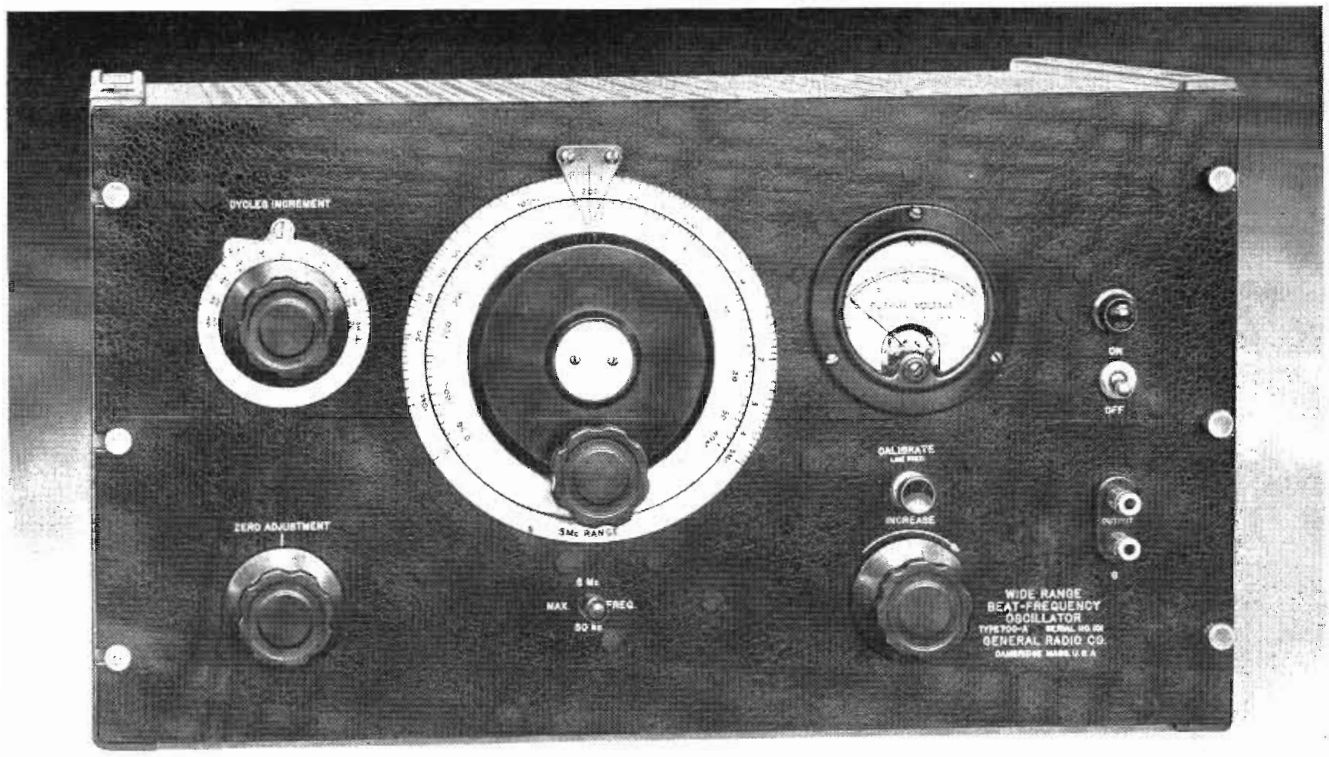

DIRECT READING from 50 Cycles to 5 Megacycles

THIS wide-range beat-frequency oscillator has a number of novel circuit arrangements which make it very valuable for use not only as a general-purpose laboratory oscillator but also for testing all sorts of wide-band circuits and systems.

1. The wide ranges are obtained with a single control knob and a two-position range selector switch
2. By means of an a-v-c circuit, the output voltage is held constant within ±1.5 decibels over the entire range
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6. The output voltage is measured by a vacuum-tube voltmeter across the output terminals
7. One output terminal is grounded

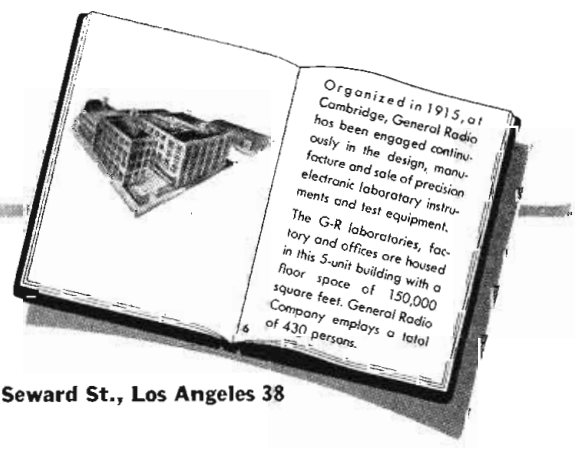
For taking selectivity curves on tuned circuits over a wide range of frequencies this oscillator is especially useful in that these measurements may be made very rapidly and accurately with it.

TYPE 700-A WIDE-RANGE BEAT-FREQUENCY OSCILLATOR $700.00

FREQUENCY CONTROL AND CALIBRATION

The main dial is direct reading on two approximately logarithmic scales for 50 cycles to 40 kilocycles and 10 kilocycles to 5 megacycles. The incremental frequency control is calibrated between —100 and +100 cycles and —10 and +10 kilocycles for the two ranges. Any frequency change made with this dial is added algebraically to the reading of the main dial.

The calibration may be standardized at any time, by setting the instrument to zero beat with the zero adjustment, to within 5 cycles on the low range and 500 cycles on the high range.



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The Right Switches... at the Right Price...

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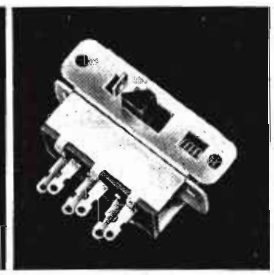
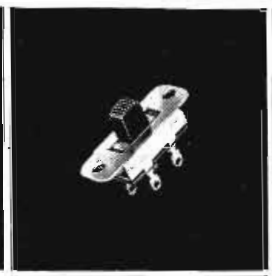
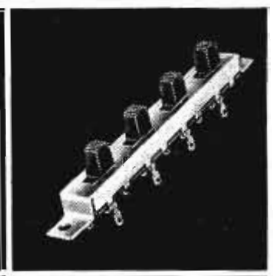
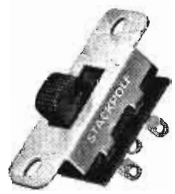





SS-26 Single-pole, single-throw

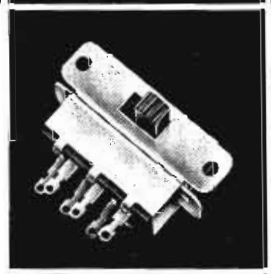


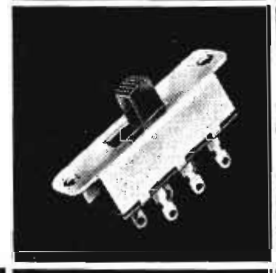
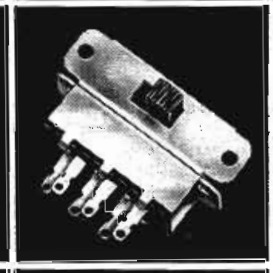
SS-26-1 Single-pole, double-throw

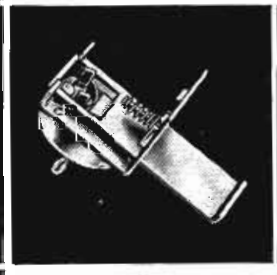
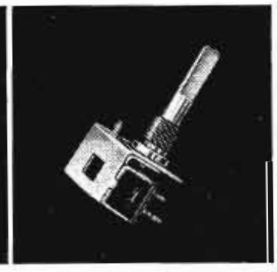
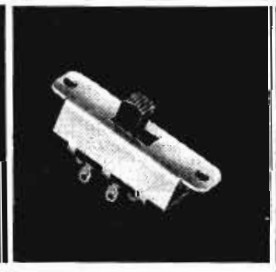
NEW!

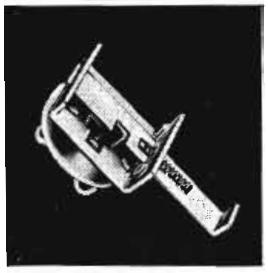
Two slide switches rated 1 ampere at 125 volts DC 3 amperes at 125 volts AC

These sturdy little switches are ideal for appliances, toys and electrical equipment requiring 3-ampere switch contact carrying capacity. Both are Underwriters approved. Write for SS-26 Switch Bulletin.



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Inexpensive types are available for practically any switching requirement and at prices that will please you. Samples to specifications on request to quantity users. Write for Stackpole Switch Bulletin RC7C.

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THE ADLAKE MIGHTY MIDGET RELAY (No. 1110)

IS IDEAL FOR

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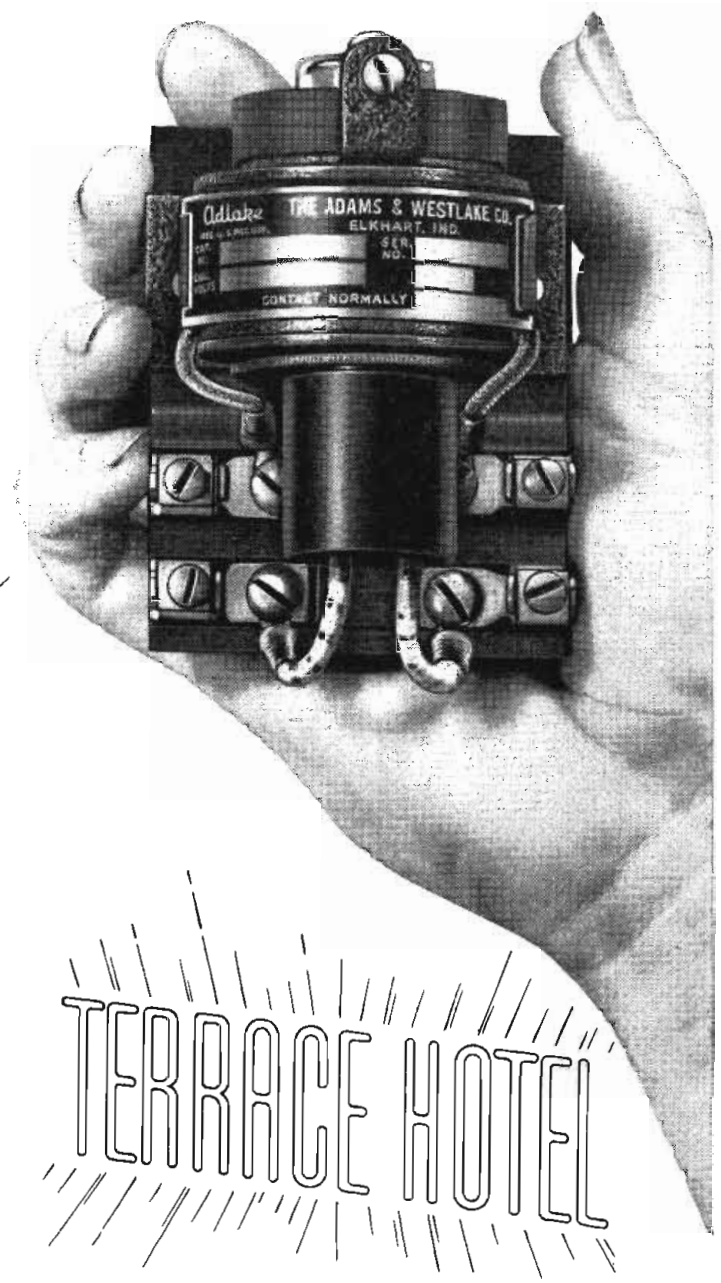

IT IS DEPENDABLE— REQUIRES NO MAINTENANCE

The Adlake No. 1110 Relay is small enough to fit in one hand, yet it makes and breaks 30 amps. easily, and with low operating current.

Like all Adlake Relays, No. 1110 is hermetically sealed against dust, dirt, moisture and oxidation; mercury-to-mercury contact prevents burning, pitting and sticking. It's absolutely safe, *requires no maintenance*, and is cushioned against impact and vibration.

These qualities make the Adlake "Mighty Midget" ideal for use with flasher installations—as well as in power circuits, motor and heater controls, traffic signals and a host of other uses.

WRITE TODAY for FREE illustrated catalog, with details on No. 1110 and other new Adlake Relays. The Adams & Westlake Company, 1117 N. Michigan, Elkhart, Indiana.

The Adlake Mighty Midget Relay gives you long, trouble-free service on outdoor installations. It's weatherproof, shockproof and absolutely dependable! Silent and chatterless! Equipped with compression-type terminals to simplify installations.

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Manufacturers of Adlake Hermetically Sealed Mercury Relays for Timing, Load and Control Circuits

For the finest sound, just pick from this line...

★ NO MATTER what your loudspeaker needs may be, one of these five Western Electric types will fit like a glove!

If you're looking for *superlative* reproduction, you can't beat the dual unit 757A, with its unequaled combination of efficiency, frequency response and power capacity.

If you want the finest in direct radiators, you'll get just that in any one of the four Western Electric types—simply pick the *power* you need.

All types are available for immediate delivery. Call your nearest Graybar Representative or write to Graybar Electric Company, 420 Lexington Ave., New York 17, N. Y.

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TELE-TECH

TELEVISION • TELECOMMUNICATIONS • RADIO

O. H. CALDWELL, Editorial Director ★ M. CLEMENTS, Publisher ★ 480 Lexington Ave., New York (17) N. Y.

TV ALLOCATION JUNE 1, is our guess, the way things have been dragging. Bureau of Standards group has completed its part of final report on ground-wave propagation at 50 to 250 MC. But Technical Information Division of FCC is still far behind in completing its work on tropospheric propagation, which has been occupying it since early February, despite Chairman Coy's speedup orders.

AD HOC APPROVAL APRIL 1 seems best possible date. Then it will take three weeks to call an engineering conference. Another four weeks will elapse before FCC is ready to announce the new rules under which new TV allocation will be made. Next will follow a hearing at which both the rules and resulting allocation will be discussed. If the opposition is not strong, the allocation would become fixed in about three weeks more. Which would bring us up to about June first.

And in the meantime the whole television situation in the United States remains frozen and up in the air!

MILITARY-SECRECY FARCE—On a following page we reproduce photograph showing the immense mass of paper work (400 lbs. of it) which went into the manufacture of one small routine radio-electronic unit. This is the photograph referred to on page 27 of March TELE-TECH, the picture which, after being approved by local Navy censors, was then deleted on orders from Washington, after it was on the press.

Then after we had finished printing the magazine, with the deleted page, word was received that the Washington bureau officials had withdrawn their objections to the photo and that their signed approval would come along in a few days. But when no word had come after a week, we made inquiry and were told the Navy had again reversed itself and now clamped down on any photographs of the transceiver being published.

On the same day, however, one of these identical transceivers was shipped to our building, Grand Central Palace, and put on public display at the IRE Radio Show, where it was freely viewed by thousands of radio men and members of the public during the week!

With this evidence of "left-hand vs right-hand," the bureau again reversed itself (for the fourth time!) and the photograph now appears with official approval.

TELEVISION FATHERS NEW LANGUAGE—The advent of television has marked the rise of one unforeseen event afflicting the merchandising trade and servicing fraternity, practically necessitating return to "school" for all except those engineers whose specialization led to the new developments. Not only has it been necessary to learn how technics and new technology, but the old chit-chat about tone, selectivity, tuneup, circuit noise, feedback, etc., is giving way to the new lingo about dipoles, rasters, turrets, clippers, synclocks, blanking, focusing, picture areas and a new world of other terms and methods. Routine stuff to TV engineers, its a new language to many concerned with a television era.

FACTORIES FOR DEFENSE—If another war comes —which heaven forbid—we can be sure it will be fought with radio and electronic weapons on a scale that will put into shadow even the best electronic achievements of 1942-1945. And the plain fact is that we have not half the radio manufacturing capacity that would be needed, even with our present huge peacetime radio-TV facilities. Adequate factory assembly lines and quickly-spread "know-how" are important in our defense plans for the future.

The May Issue of TELE-TECH will mark

Radio Broadcasting's 29th Year

RMA's 25th Year **Television's 10th Year**

Caldwell-Clements' 28th Year in Radio-TV Publishing

In commemorating these anniversaries the May Tele-Tech will include special features tracing the growth of radio invention and discovery, and pointing out the early inceptions of present-day-radio methods and practice.

Radio—TV Must Make Way

Youthful energy essential for new inventions and engineering advances in radio-electronic art: Today's technical complexities best utilized by 25-30-35-year groups — From IRE convention address, March 7

By I. S. COGGESHALL, Fellow IRE, International Communications Dept., Western Union Telegraph Co., New York City

THE scientific study of the process of aging is called gerontology. In this branch of knowledge, data have been made available showing age-distribution versus many human traits and accomplishments, a few of which have been converted by the author to his uniform statistical method of presentation, where the maximum 5-year group is given the index of 100; the results are shown in the table.

They may be summarized in the dictum: Don't grow older than 25, unless it is absolutely necessary. James set that figure in 1893 when he said: "Outside of their own business, the ideas gained by men before they are 25 are practically the only ideas they shall have in their lives. They *cannot* get anything new. Disinterested curiosity is past, the mental grooves and channels set, the power of assimilation gone. Whatever individual exceptions might be cited to these are of the sort that prove the rule."

Measurements by psychologists, of ability to learn, (see table, line 5), reveal an index of 100 at age 22, tapering off to 64 in the early 50s. Perception, not shown on the chart, measured by ability to recognize objects when exposed in succession at 0.1 sec. intervals, correspondingly falls off in middle age, (use of spectacles permitted). Another standard test of perception you can make yourself, by trying to recall, with your son, the scene-sequence in the movie you saw night before last. Statistically, he will beat you around the barn, one reason being that he is interested and you don't care particularly. Fading interest in things outside one's chief concerns, is a symptom of age which sets in early in maturity.

The Army Alpha speed-intelligence tests produced average scores which are distributed by age-groups on the chart, (line 6). A similar plot is made, on line 7, of an examination of citizens of 19 New England villages in common sense, practical information, and ability to solve simple problems. Both are peaked in the early 20s and show gradual deterioration as age creeps in.

That physical strength and prowess are maximal in the young hardly needs demonstration, but on the chart has been included line 8 to show that professional baseball, professional boxing, and tennis championships are won predominantly by men in their late 20s, and that said champions, in general, blow out like a bulb at 45. The speed of muscular reactions of fingers, hands, and feet to audible and visible stimuli have been carefully measured, (line 9), and produce maximum index figures in the late 20s; fortunately the tapering-off is one of the most gradual in the list, adding years to our lives in crossing the street. Muscular coordination reaches its peak in champion rifle and pistol shots and billiards champions; the age-distribution of their championships, (line 10), is at a maximum in the late 20s.

On account of its importance, automobile driving has been given much attention by applied psychologists, and three lines on the chart relate to the subject. The first, (line 11), on steering control and brake-reaction time in hundredths of a second, produces indices very much like those of general muscular reactions to various stimuli. (line 9), and shows that lads in their early 20s are quicker to react. Line 12 indicates, however, that older men are content to drive slower (especially in Connecticut); and line 13, which records the reciprocal of automobile fatalities gives men betwen 45 and 55, for once, something in their favor.

The hot blood of youth can be measured by calorimeter even when in state of repose; the figure is called basal metabolism and is expressed in calories radiated per hour per square meter of body surface. It is highest in youth, but on line 14 is shown at index 100 as the figure enters our chart from the left; it holds up well until middle age. This too is the mating and nesting season of life, the curve of marriage rate, (line 15), corresponding closely with that, (line 16), of the age of fathers whose children are born within a given year. The activity of married males, (line 17), produces a different type of curve from any other on the chart except that of baldness, which, by the purest coincidence, appears on the next line (18), expressed as an index-percentage of males showing no loss of hair at various ages. As our fires burn lower, our teeth

Young Men's Inventions

"The invention of young men is more lively than of old; and imaginations stream into their minds better. Men of age object too much, consult too long, adventure too little, repent too soon, and seldom drive business home to the full period, but content themselves with a mediocrity of success."—Froncis Bacon, 1625.

The Real Future of TV

When we are in danger of losing our perspective, let us remember that the important things in the future of television and jet-propulsion are not us, but the kids who for the first time are putting their ham-shacks on the air, or getting their model airplanes off the ground.

for YOUNG Engineers

fall out, our eyes unaided no longer come to a focus on the retina, acuity drops at the high end of the auditory spectrum until the DB loss at 1200 cycles interferes with the hour-after-hour communication of intelligence, and what hair we keep (no wonder!) turns gray.

Greatest Productivity

The psychology of invention has been closely studied, and some results are tabulated on the chart. Holders of patents and inventor-engineers replied to a Patent Office questionnaire as to their age when they made their initial invention, whether or not patented or a true "first-invention." Line 20 shows a broad peak in the late teens and early 20s. Most initial inventing is over by 40, although the curve shows scattering first attempts in the 60s. And not shown on the chart is an index of 13 at ages 5 to 9, and index 66 in the range 10 to 14 years! First patents, of course, lagged initial invention. Shown on line 21, the peak occurs in the late 20s.

On the next line (22) is shown an index representing the percentages of 150 typical inventive engineers, in three laboratories covering electrical research, electrical design, and non-electrical research, who made patent disclosures during each age interval over a period of years. The peak was in the early 30s, the single year of maximal participation being 33. As in almost all these curves, the combined age groups where the index exceeds 50 comprehend 75% of all the activity —in this case, ages 25 to 44. The next curve (23) is interesting by way of contrast: for the same group of engineers, it shows, not their numerical participation in making discoveries, but their individual outputs expressed as an index of the number of patent disclosures made per man-year at various ages. Note that the whole curve has thus been advanced 10 years—that the ages of maxima production are in the early 40s and that the curve holds up well in the late 40s.

When it comes to most important inventions, as distinguished from run-of-mine patents, the plotted results depend upon the make-up of the lists, which tend to be small. Wyman is responsible for selecting 85 firsts which produce the curve on line 27. Spooner took the World Almanac list of 100, and produced line 28. Your author similarly selected 79 of the more modern from "Radio's 100 Men of Science," listed by Dunlap, and their age-distribution is shown on line 29. Radio's curve of genius fits nicely on line 1, IRE's curve of present age of Associates!

Based upon a little different estimate of importance, Rossman, by questionnaire, ascertained from 421 professional inventors their ages at time of conception of what they considered their most important single invention, and got the curve which appears on line 30, with a peak in the early 30s. In fields other than electricity, Pressey et al, lines 31 to 34, give figures for outstanding works in poetry, chemistry, mathematics, and astronomy, indicating advancing ages, in that order, for greatest periods of productivity. The final figure in that group, line 35, is for run-of-mine literary output expressed as an index figure based on the number of books written per 5-year interval per thousand authors. By comparison, with these other fields, radio invention, up to now, has been a young man's game.

Ages of Maximum Abilities and Capacities

Indices of age-distribution by 5-yr. intervals beginning with ages shown. Maximal interval assigned Index 100 (shown as **).

Line	Characteristic	15	20	25	30	35	40	45	50	55	60	65	70	75
1	IRE Associates, current	1	13	**	95	78	67	31	16	8	2	1	0	
2	IRE Members, current age	0	0	61	**	80	88	71	8	10	5	0	5	0
3	IRE Sr. Mems., current	0	0	0	30	**	89	**	52	22	4	11	0	
4	IRE Tot. Mems., (A-M-SM)	0	12	93	**	90	83	52	22	11	3	1	1	0
5	Ability to learn, score	92	**	98	95	90	83	75	64					
6	Speed-intelligence, score		**	98	93	88	86	82	74	66	60	54	49	46
7	Intelligence, gen'l, score	98	**	98	95	92	88	85	82	79				
8	Athletic championships	12	52	**	60	19	5	0						
9	Digital-foot react., secs	95	97	**	97	97	95	93	93	89	87			
10	Billiards, pistol, champs.	8	58	**	83	71	58	25	17	4	4			
11	Automobile, steering, secs	99	**	98	98	97	96	95	93	92	91	89		
12	Pfd. driving speeds, MPH		98	**	96	96	93	91	89	89	89	86		
13	Auto. safety, 1/fatalities		10	65	80	85	90	**	**	95	80	60		
14	Basal metabolism, C/m² hr.	**	98	98	98	95	93	88	83	76	67	55		
15	Marriage rate, male, white	7	69	**	70	37	26	15	9	5	3			
16	Fathers of children born	17	58	**	83	67	33	17	8	4				
17	Sexual activity, m. males	**	85	74	63	54	45	46	34					
18	No loss of hair, males %	**	**	86	71	58	46	31	17	8	1			
19	No gray hair, % of males	**	**	80	63	45	25	7	4	1				
20	First invention, age, yrs.	**	**	90	45	26	10	4	1	1	1			
21	First patent issued, no.		69	**	69	43	22	7	5	2	1			
22	Engineer-inventors, lab.		26	78	**	83	59	34	15	5	1			
23	Eng'r-inv's, patents/year		12	57	84	88	**	80	36	28	14			
24	Dep't-Heads, lab, pats/yr.			57	90	93	**	79	50	20				
25	Prolific inv'trs, pats/yr.			29	51	65	**	34	17					
26	Regular inventors, age		2	9	29	70	95	**	94	77	53	26	13	6
27	Important inventions (a)		54	**	88	85	66	49	37	4	3	1		
28	Important inventions (b)		22	56	**	68	84	42	14	13	3			
29	Radio-elec. imp't inven's	0	31	**	88	80	74	33	11	0				
30	Reg. inventors, important		17	52	70	**	93	51	33	21	8			
31	Poetical work, outstand'g	9	74	**	93	46	30	30	35	33	26	40	40	30
32	Chemistry, important work	7	31	83	**	93	72	48	38	29	17	10	12	
33	Mathematics, imp't work	15	44	85	96	**	56	48	67	48	46	35	31	17
34	Astronomy, important work	5	5	17	67	77	**	75	55	40	33			
35	Lit. output, books/authors		10	48	63	80	99	**	61	51	39	15	9	
36	IRE ch'm, technical comte	0	0	5	15	50	**	**	65	40	0	0	15	
37	Ch'm stand'g com. 1946-48	0	0	0	0	60	90	**	50	60	20	0		
38	IRE Fellow, award, '41-'49	0	0	3	5	64	**	67	54	5	8	0	5	0

NAB Engineering Conference

THE third annual broadcast engineering conference of the National Association of Broadcasters will be held April 6-9 at the Stevens Hotel in Chicago. Registration will begin on the morning of Wednesday, April 6, and a tour of the Hallicrafters plant at 5th and Kostner Avenues is planned for the afternoon. Thursday and Friday will be devoted to the presentation of technical papers.

In addition to the formal meetings of the conference, 37 manufacturers of broadcast equipment and services will sponsor exhibits in the largest technical exposition in NAB history. Heavy equipment firms which are NAB associate members will occupy about 30,000 sq. ft. of floor space in the Stevens' exposition hall. Manufacturers of lighter equipment, and NAB associate members engaged in service enterprises, will use approximately 100 rooms on the fifth and sixth floors for display and reception.

Following are abstracts of technical papers which will be presented at the convention.

High Voltage Rectifiers Applied to Broadcast Transmitters

C. K. Hooper and N. B. Thorp, Westinghouse Electric, Baltimore, Md.

This paper concerns the use of metallic rectifiers in AM and FM broadcast transmitters. Special attention is given to the use of selenium rectifiers in high voltage supplies. Data is presented on the operating characteristics of high voltage selenium rectifiers based on theoretical considerations and actual station experience. Efficiency, regulation, aging effects, and other factors are discussed.

The operating features and costs of metallic rectifiers are outlined and compared with tube rectifiers. (Slides will be shown.)

General Purpose TV Studio Lighting

R. Blount, Engineer, Lamp Dept., General Electric, Cleveland, Ohio

A study has been made of some of the many factors that affect a television studio lighting arrangement. Among others these include the effects desired in the received picture, what effects lighting can accomplish, and the factors that determine the type of lighting equipment selected. Typical equipments suitable for the various lighting tasks have been chosen, calculations have been completed to predict the number of units needed to provide the desired footcandle level, and a layout has been drawn showing the arrangement in a general utility studio. From the calculations a number of ratios have been developed to aid in the design of lighting systems.

Iconoscope Film Pickup Systems

H. R. Smith, Head of Speciol Projects Group, TV Transmitting Equip. Div., Allen B. DuMont Labs., Clifton, N. J.

The paper presents a technical description of DuMont Film Pickup Systems starting with the optical image which is projected on the iconoscope mosaic and finishing with the video output signal which is sent to the master control equipment. Circuit details are discussed briefly, particularly those involved in preamplification, shading and line to line clamping. Mechanical features are illustrated by means of slides with mention being made of rim and black lighting, optical switching, accessibility of components.

Low-Cost TV Transmitting Antenna

M. W. Scheldorf and L. Krahe, Andrew Corp., 363 East 75th St., Chicago, Ill.

The development by Andrew Corp. of a new principle for broadband radiators has made possible a new simple transmitting antenna with a single-ended feed system. Elements consisting of multiple rods with a wide variation in lengths are assembled in a cone-fan shape. The absence of structural obstructions make servicing convenient. There is a reduction both in the cost of the antenna and the transmission line required to energize it.

The single-ended diplexer unit consists of simple sections of transmission line so interconnected and spaced as to achieve the necesary frequency discrimination with a minimum of physical material and without special intricate features. The entire arrangement is especially suited for small stations where economy is important.

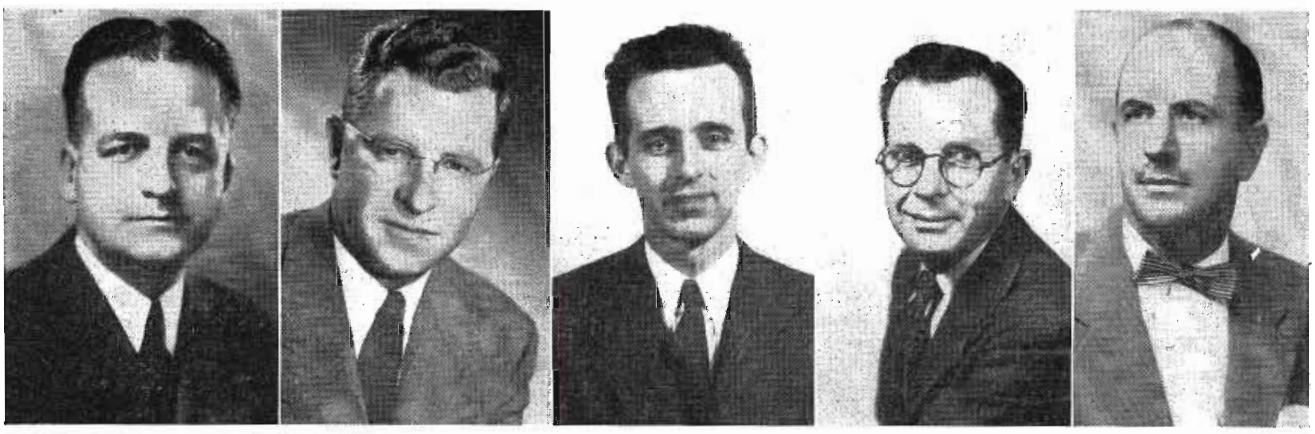
Kinescope Recording

R. V. Little, Jr., Supervisor, Theatre TV Engineering Section, RCA, Camden, N. J.

Film recording of television programs can most easily be accomplished by photographing directly the television picture appearing on the face of a kinescope monitor. The camera, however, must be especially designed for the purpose because of the difference between the TV system frame frequency of 30 per second and conventional motion picture frame frequency of 24 per second. It is also desirable to use a special kinescope with higher anode voltage.

This paper discusses the means by

Engineers scheduled to take part in NAB sessions, left to right: J. R. Poppele, member NAB Engineering Committee, vice-president WOR, WOR-TV and WOIC. William B. Lodge, vice-president and director of engineering, CBS. Curtis B. Plummer, chief television division, FCC. George P. Adair, consultant advisor to NAB Engineering Committee. Royal A. Howard, director of NAB Department of Engineering



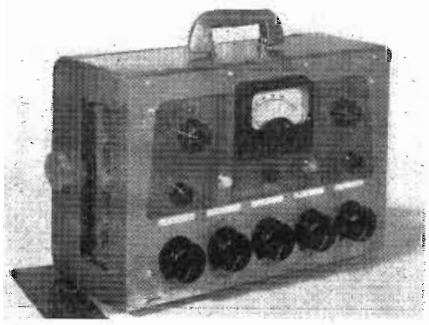
Topics, AM, FM, TV; April 6-9

which the two systems are reconciled and describes a commercial kinescope recording equipment which is now in operation in several network key stations. This equipment may be used in either the single (combined sound recording) or the double (separate sound recording) methods. It will produce film recordings which are of quality suitable for networking.

Portable Audio Amplifier for AM-FM-TV

W. W. Dean, Broadcast Engineering Section, General Electric, Syracuse

The paper will describe a new portable remote amplifier incorporating novel features. The single unit equipment designed for either AC or



battery operation is designed to meet the electrical performance characteristics required for AM, FM and TV yet weighs only 35 pounds. Incorporated in the assembly is a test-tone oscillator for checking line levels. Other new and novel features included in the equipment will be discussed.

Triode & Tetrode Tubes in HF Operation

H. D. Doolittle, Machlett Labs., Springdale, Conn.

The design of tubes for power generation in the frequency range from 100 to 1000 MC requires careful consideration. Transit time devices such as klystrons, magnetrons, etc., may be used, or triodes and tetrodes of more conventional design may be "broadbanded". In either case a decision must be made as to whether the circuit is or is is not to be external to the tube. The latter permits greater flexibility in application. There is at present no unique solution to the problem.

This paper discusses only the adaptation of triode and tetrode "switching" tubes to power generation in this frequency range. The problems of interelectrode capacitance, lead inductance, cathode emission density, and electrode dissipation are discussed in relation to farbrication techniques.

Loop-Antenna System for TV Broadcasting

A. G. Kandoian and R. A. Felsenheld, Fed. Telecommunicotion Labs., Nutley, N. J.

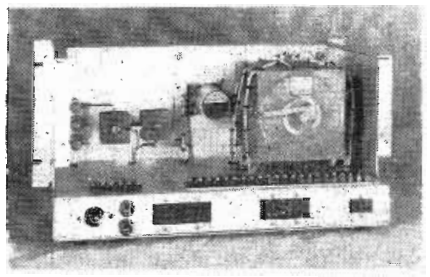
Horizontal loop antennas have been designed for a large number of applications in the very-and ultra-high-frequency ranges. They are particularly useful for solving TV problems since each loop has the required omnidirectional pattern in the horizontal plane and also some directivity in the vertical plane. Antenna power gain may be obtained by stacking and the tolerable standing-wave ratio at the antenna input can be held to less than 1.1:1 over the entire individual broadband television channel. Furthermore, TV requires diplexing to allow transmission of both picture and sound signals over the same antenna without mutual interferance and power loss.

These problems have been solved by the design of a very-broadband triangular stack loop antenna. A coaxial diplexing filter combines the outputs of the transmitters in a single coaxial transmission line. Experimental data will be presented on the complete antenna system.

Automatic Selection of Broadcast Program Circuits

J. A. Green & R. D. Essig, Collins Radio Co., Cedar Rapids, Iowa

A new device, the Autopositioner, and its relation to broadcast engineering is presented. A specific application is discussed wherein fifty program circuits and fifty order wire loops are switched and controlled from a remote



Rear view of Autopositioner switching unit

point several miles distant resulting in a considerable saving in telephone cable pairs. The circuits to be selected can be preset in advance at the control point, and switching occurs when the operate button is depressed. Similar circuit arrangements in conjunction with the Autopositioner unit are an ideal solution to many remote control problems. Typical switching and control equipment will be operated.

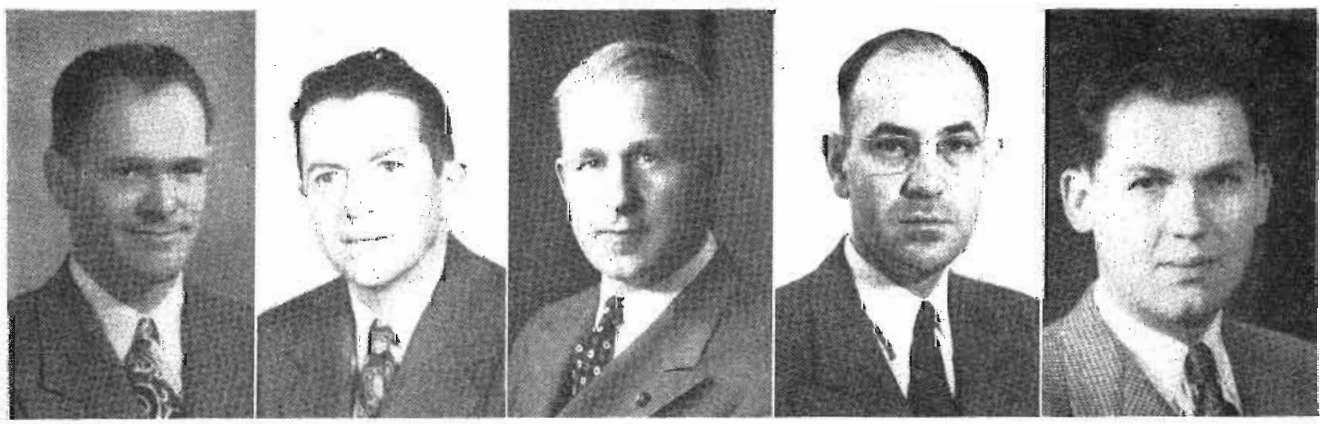
Recent Advances in Broadcast Facsimile

J. V. L. Hogan, President, Radio Inventions, New York City

This paper will discuss improvements in facsimile transmission within FCC Standards. It will discuss the importance of improved photographic reproduction, high definition and high speed. The latest developments in

(*Please turn to next page*)

Among authors of Conference Papers: Dr. T. T. Goldsmith, director of research, Allen B. DuMont Laboratories. Dr. S. J. Begun, engineering vice-president, Brush Development Co. Frank B. McIntosh, radio consulting engineer, Washington, D. C. Reynolds Marchant, development engineer, Minnesota Mining & Mfg. Co. Nelson B. Tharp, design engineer, Westinghouse Electric Corp., Baltimore.



multiplex facsimile will be outlined which maintain simultaneous transmission with regular sound programs. The multiplex system in effect gives an FM station a completely new and supplemental service without demanding additional channel space. Its addition to an FM station involves no extra expense other than the cost of the facsimile terminal equipment plus the staff required to prepare and process the facsimile newspaper. The economics of the facsimile newspaper will also be discussed.

2,000 MC TV Relay Link

M. Silver, Project Engineer,
Fed. Telecommunication Labs., Nutley, N. J.

The paper describes a link designed to interconnect television stations in various cities as well as for local portable pickups. The link operates in the 2,000 MC television relay band. A klystron delivering 15 watts is used. The transmitter is crystal controlled and frequency modulated. Complete monitoring facilities are provided at each transmitter including power, local picture monitor, frequency monitor, etc. The receiver is a single superheterodyne type. A high degree of preselection is used to avoid interference. The local oscillator of the receiver is crystal controlled providing maximum stability. Three outputs are provided: one for local monitoring; the second to feed the next link transmitter; and the third for local program service. The design of the equipment is such that long lengths of antenna cable may be used permitting fixed antenna installations at many points of service.

NAB Recording & Reproducing Standards

R. M. Morris, Radio Facilities Engineer,
American Broadcasting Co., New York City

This paper will present a brief history outlining the need for and establishment of recording and reproducing standards to facilitate the economical exchange of recorded material among the broadcasters of the United States. In 1941 the NAB Department of Engineering undertook to develop a set of standards of good engineering practice to be followed by manufacturers and users of recordings and recording and reproducing equipment for use by the broadcaster.

Various phases of the problems encountered in arriving at the present standards will be outlined and there will be a discussion of the many yet unresolved problems facing the Recording & Reproducing Standards Committee. It was not until 1947 that standards on magnetic tape systems were considered, however the phenomenal growth of this medium has required careful and thorough yet expeditious action. The standards thus far agreed upon on magnetic tape and those under consideration will be discussed.

Cathode Ray Tube Video Scanner

R. D. Thompson, Project Engineer,
Transmitter Div., Allen B. DuMont Labs.,
Clifton, N. J.

Production of a picture signal can be achieved by imaging the raster of a cathode ray tube onto a photographic transparency, and projecting the transmitted light upon the cathode surface of a photo tube. Such an arrangement, employing a CRT with a very short persistence screen, provides a simple source of program and test material.

The theory of the scanner is briefly outlined and a practical approach to circuits for producing the raster, correcting for CRT persistence, and gamma correction are presented. Although the unit described is intended to use 2 x 2" glass slides, versatility is achieved by an automatic fade and slide change sequence for artistic transition.

Properties of Magnetic Tape

R. Marchant, Development Engineer,
Minnesota Mining & Mfg. Co.,
St. Paul, Minn.

The fundamental physical and magnetic properties of magnetic tape must be fully considered in the design of a satisfactory magnetic recording and reproducing system. As an operating unit, the recording equipment must be properly maintained in order to insure continued performance of a satisfactory nature. This paper will explain the relation of tape properties to recorder design and call attention to the relative importance of various properties.

Suggestions will be given for checking the performance of recording equipment. These include, in addition to routine checking of amplifiers and electronic gear, checks of head alignment, tape tension, head wear, capstan drive speed, bias adjustment, etc. A brief discussion will be given concerning the optimum storage and handling procedures for recorded tapes.

Solutions of TV Installation Problems

R. D. Compton, Technical Manager,
WOIC (TV), Washington, D. C.

The practical problems facing the engineer for the first time in the installation of a television station are such that many of the engineers who have been in AM for a great number of years are inclined to two attitudes: one of overconfidence; and the other of fear of the installation.

Television, of course, is a dual installation of two transmitters, each specialized in its particular application. The aural transmitter is not unlike any normal FM installation, but the visual transmitter offers many new and challenging problems to a radio engineer.

The paper will cover the main factors of considerable consequence to the proper performance of the installed equipment, including antenna installa-

(Continued on page 58)

More authors of NAB Conference papers: (Left to right) M. W. Scheldorf, engineer in charge of research for Andrew Corporation, Chicago. John A. Green, director Broadcast Engineering Department, Collins Radio Co., Cedar Rapids, Iowa. Martin Silver, senior project engineer Federal Telecommunications Labs. H. B. Fancher, TV engineer, G.E., Syracuse, N. Y. J. E. Young, manager RCA Broadcast Xmtr. Section.

Barium Titanates as Circuit Elements

Characteristics and applications of piezo-electric ceramics in the production of numerous components for electronic circuits

Part One of Three Parts

By A. I. DRANETZ,

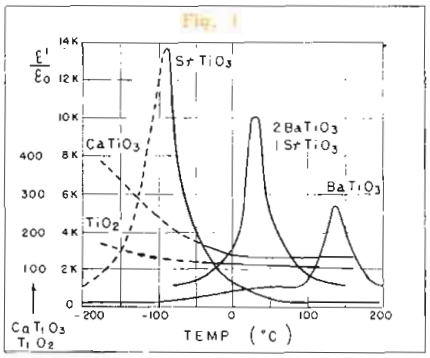
G. N. HOWATT,

J. W. CROWNOVER,

Gulton Manufacturing Corp., Metuchen, N. J.

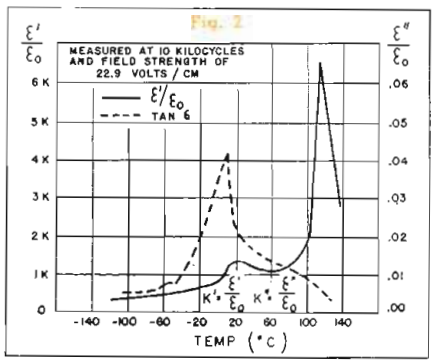
DURING World War II, the mica shortage forced the government to develop other dielectrics suitable for capacitors, etc. Since the rutile form of the ceramic TiO_2 had been used since the turn of the century, part of this program was made upon titania ceramics in general. In 1942, during the course of these investigations, Wainer and Salomen[1] of the Titanium Alloy Manufacturing Company observed that titanates of barium and strontium exhibit extremely high dielectric constants, which varied with temperature as shown in Fig. 1.

Fig. 1



Following this, investigations were intensified both in this country and in Europe as well. At the M.I.T. Laboratory for Insulation Research, under the direction of Professor A. R. von Hippel, measurements of the dielectric constant and loss tangent of pure barium titanate as a function of temperature, and their curves[2], show (Fig. 2), an extremely high and sharp peak at approx. 120°C as noticed by Wainer. (see also [3])

Fig. 2



It was shown [2,4] that the sharp peak in dielectric constant at 120° C represents a Curie temperature above which the polycrystalline barium titanate has a cubic structure and below which it has a tetragonal or pseudo-cubic) structure. This is borne out by curves of interatomic distance ratios, specific heat, and specific dielectric constant vs. temperature from ref (5), in Fig. 3. Both phases may exist between approx. 122°C, 129°C, (see the c/a curve). There are two other less marked Curie secondary temperatures, one at +10°C and one at −70°C.

A study by Jackson and Reddish[6] has shown that the Curie temperature varies linearly with the strontium content, (Fig. 4). Also in 1945, Wul and Vereshchagin[7] reported a study of pressure effects upon the dielectric constant of barium titanate. It is possible to alter the dielectric characteristics of barium titanate by addition of other materials as in Fig. 5. The Gulton Mfg. Corp. under programs partially supported by Signal Corps Engineering Labs. has undertaken an extensive program of research in this respect. Static measurements by the M.I.T. research group indicated that the dielectric constant also is dependent upon the charging potential, Fig. 6.

Fig. 3

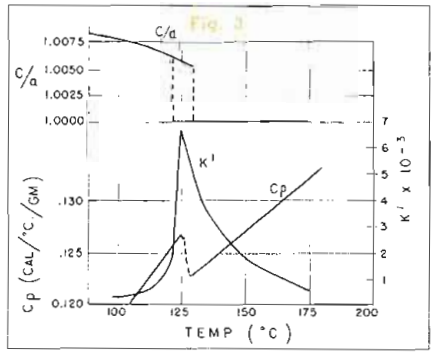


Fig. 4

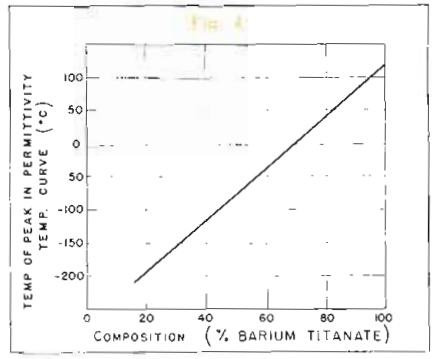
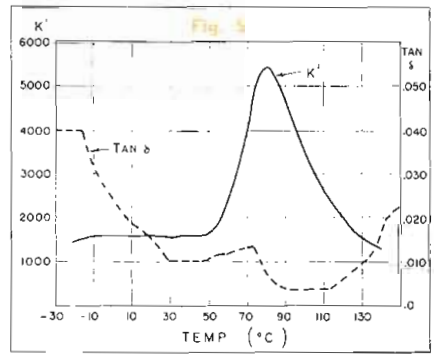
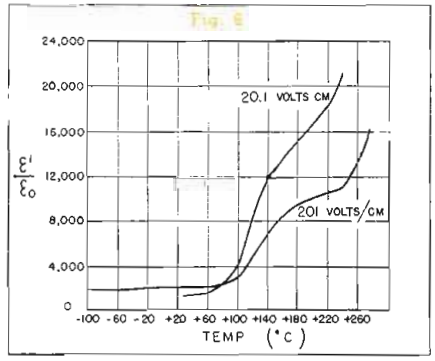


Fig. 5



These curves show no sharp peaks at the Curie temp. because of interfacial polarization, a situation in which most of the applied voltage appears across the ceramic-to-electrode boundary surface and

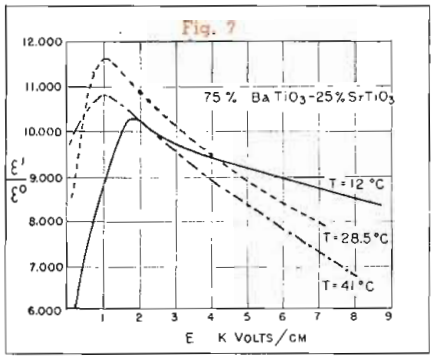
Fig. 6



BARIUM TITANATES AS CIRCUIT ELEMENTS (Cont.)

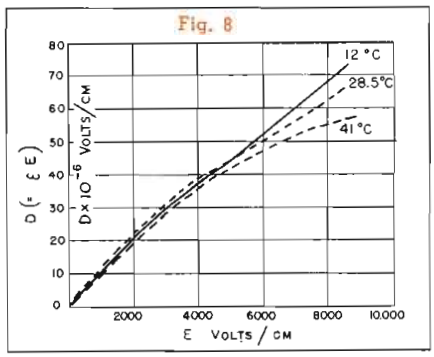
relatively little occurs across the ceramic itself. Extensive experiments on this observation with a mixture of 75% $BaTiO_3$ and 25% $SrTiO_3$ definitely showed the existence of a field dependence of the dielectric constant, as shown in Fig. 7.

Fig. 7



Measurements of reversible capacitance[6] on this same material were made by superimposing a small 1 KC signal on a relatively high DC bias. The curves of capacitance vs. DC bias were then plotted. Integration of this function with respect to DC bias and multiplication by a scaling constant then yield D, the electric displacement. A plot of this function as shown in Fig. 8 is similar to the familiar B-H curves for ferromagnetic materials. However, it was found that the maximum DC bias obtainable (8000 volts per cm) was insufficient to cause a saturation of polarization. Here again the non-linearity of dielectric constant with field was simultaneously reported by Wul and Goldman[9].

Fig. 8



This ferroelectric behavior was then confirmed by D-E hysteresis loops produced on an oscillograph at 60 cycles. These curves, taken at various temperatures, are shown in Fig. 9, and may be found along with adequate discussion in the literature in several places. (ref. 10-14). From these loops a plot of the initial slope (a measure of the initial dielectric constant) was made and appears in Fig. 10.

Fig. 9a

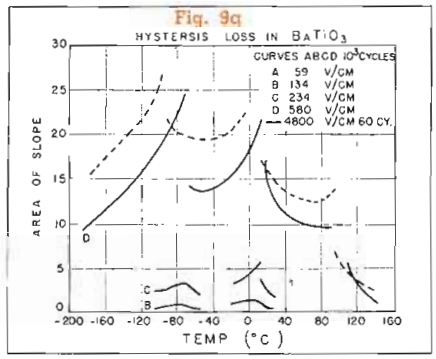
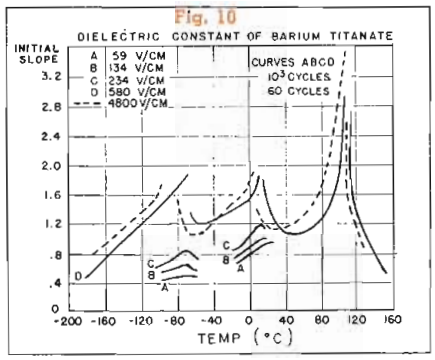
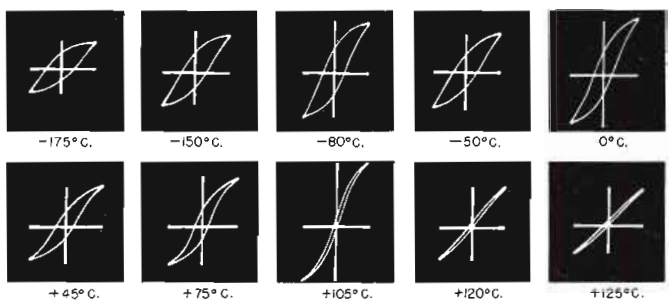


Fig. 10



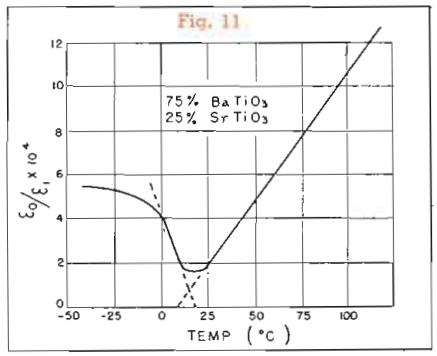
There are three regions of anomalous dielectric constant, at —70° C, +10° C and +120°C. These regions are shifted to lower temperatures with increasing potential, and the lower maxima become more pronounced at higher field strengths. Also the Curie points are at higher temperatures at 1000 cycles than at 60. Plots made of loop areas (a measure of the hysteresis loss Fig. 9a) as a function of temperature exhibit peaks at each of the anomalous regions. Also the remanent polarization exhibits peaks at these critical temperatures, while the coercive force apparently drops steadily and disappears, as do the loop area and remanence, above approx. 120°C.

Fig. 9



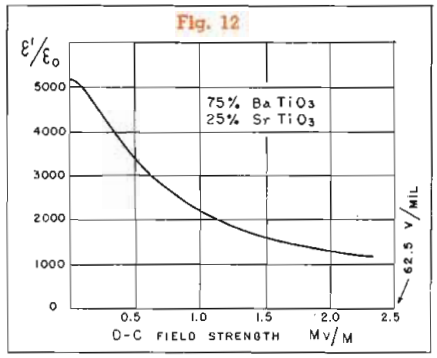
Although non-linear inductors and resistors had received some attention in the electrical field, at the time of this research, very little thought was given to circuit applications of non-linear capacitors. Such a development was undertaken by Roberts of the M.I.T. group[15], which included a further investigation of the fundamental properties of the material. Some of his more pertinent results are shown in Figs. 11 to 14. Fig. 11 shows that above the Curie temperature, the linearity of the curve satisfies the Curie-Weiss law.

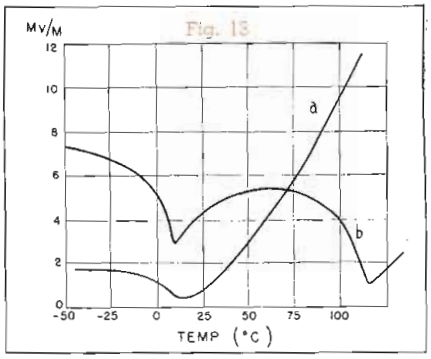
Fig. 11



The variation in reversible dielectric constant with DC biasing field (in the range up to approximately one megavolt per meter) the variation of capacitance is most rapid, dropping off at higher field strengths, Fig. 12. The variation with temperature of the critical field strength E_0 (defined as the DC bias necessary to halve the reversible no bias capacitance) is most active at the Curie temperature, for the (75-25 $BaSrTiO_3$) mixture (curve a) and for pure barium titanate (curve b). In (b) it will be noticed that there are two minima, or most effective ranges, corresponding to the two upper Curie temperatures. The curves (from ref. 15) show that a

Fig. 12



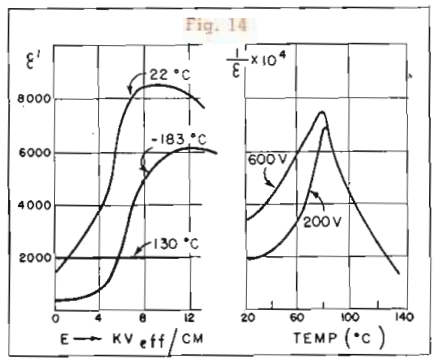


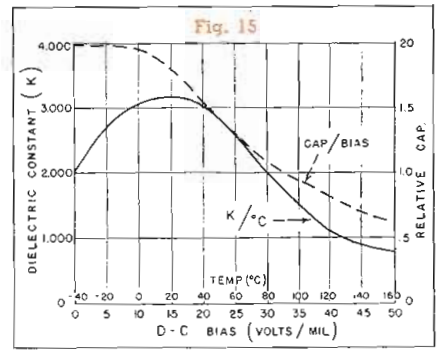
non-linearity of capacitance exists above, as well as below, the Curie temperature.

Concurrently with work done in this country, a great deal of study has been going on in Russia[16]. While most of the data obtained by Russian scientists agree reasonably well with those already discussed, the voltage coefficient of capacitance for $BaTiO_3$ was found to disappear above the Curie temperature[9], curves of Fig. 14. This was also reported by Donley[17].

The measurements made by Roberts were of reversible capacitance, where a small AC signal was superimposed upon a DC bias, while the measurements made by Wul and Goldman, and Donley utilized only a high AC voltage. The latter then represent an effective or integrated value of capacitance and unless correlated with other information are somewhat misleading. The apparent discrepancy between these results may be due in part to either some interfacial polarization or to the loss tangent becoming very small above the Curie temperature. Also what was considered in Roberts' data to be a *reversible* dielectric constant may be instead an *incremental* dielectric constant.

At the present time, the Gulton Mfg. Corp. has in production a





body which has a Curie temperature slightly below room temperature as shown by the curve of Fig. 15. This body has an extremely high dielectric constant (3300) and a small temperature coefficient. The voltage coefficient of capacitance, as also shown by Fig. 15, is also relatively large. Thus this body forms an effective non-linear capacitor.

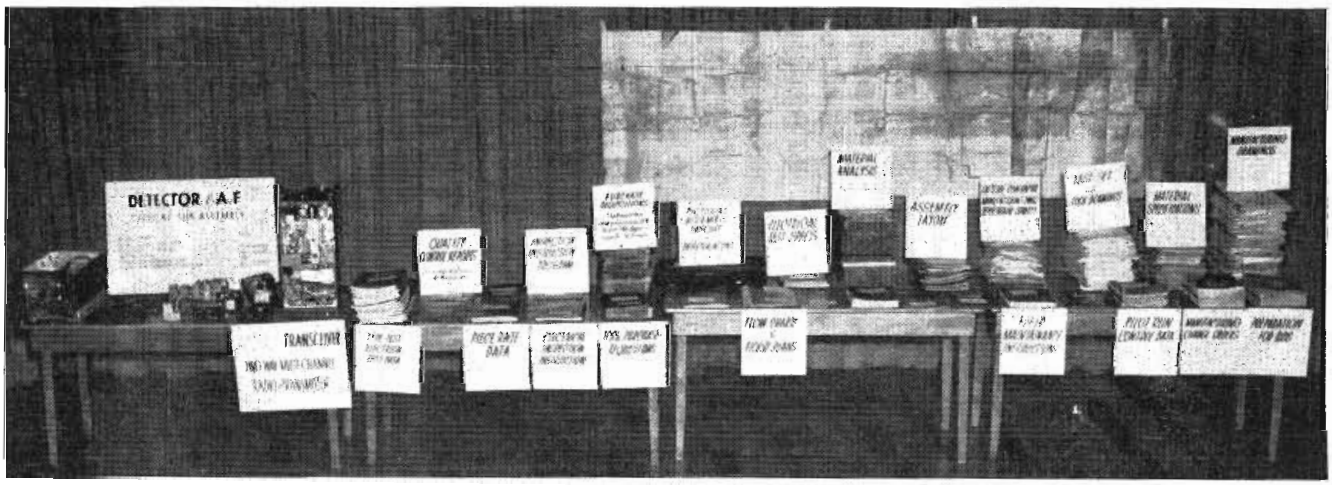
The piezo effect of barium titanate was discovered at the Gulton Mfg. Corp. when in testing capacitance after application and removal of DC potential it was found that the samples mechanically resonated at certain audio frequencies.

(*Continued on page* 53)

HUGE MASS OF PAPER WORK INVOLVED IN PRODUCING SINGLE ELECTRONIC UNIT

These 26 piles of unduplicated drawings, specifications, orders and correspondence, weighing nearly 400 lbs., show the tremendous quantity of paper work involved in manufacturing only one small routine piece of government electronic equipment. This is a photograph of the actual work-order material for Navy Airborne unit, a 2-way multichannel transmitter-receiver seen at left. The manufacturing drawings alone numbered 1650 and make a pile 24 inches high, seen at extreme right. The huge blueprint on the wall presents, as compactly as is readable, the complete circuit diagram for the unit. This exhibit was shown to New England radio-electronic manufacturers at Boston on Army Day, Feb. 4, by Chairman Lack of the Electronic Equipment Industry Advisory Committee, and has since been seen by other industrial and military groups.

The placards, labeling the various files, read as follows, left to right: Detector and A. F. Typical Sub Assembly; Blank blank Transceiver, Two-Way Multi-channel Radio and Transmitter; Type Test Electrical Test Data; Quality Control Reports; Piece Rate Data; Inspection Instruction Program; Electrical Inspection Instructions; Purchase Requisitions; Tool Purchase Requisitions; Pictorial Assembly Layout Detector-AF Unit; Flow Charts and Floor Plans; Electrical Test Specifications; Material Analysis; Assembly Layout; Outside Contractor Manufacturing Drawings Representative Quantity; Field Maintenance Instructions; Test Set and Tool Drawings; Pilot Run Control Data; Material Specifications; Manufacturing Drawings; Manufacturing Change Orders; Preparation for Bids.



New TRIODE for 4,000 mc Operation

Design provides adequate power at UHF for microwave relay systems with smaller gain-band limitations than encountered in klystrons and velocity-modulated devices

By J. A. MORTON, *Electrical Apparatus Development Engineer*
R. M. RYDER, *Member Technical Staff*
Bell Telephone Laboratories, Inc., New York City

FOR radio relay purposes currently available amplifiers operating at 4,000 MC are hard pressed by the required performance. In order to get sufficient gain and power output from a velocity variation tube, it has been necessary to use circuits with many adjustments and stagger tuning. The bandwidths obtainable have been sufficient to avoid distortion difficulties, and it has been determined that radio relay systems such as the one between New York and Boston can be extended to somewhat longer distances without appreciable distortion. However, if it were desired to extend transmission indefinitely or even for coast to coast linkages, it is fairly certain that severe amplitude and phase tortion would occur and there are good reasons for believing that equalizer networks would be difficult and costly to apply.

When this limitation became clear several years ago, a study was undertaken with the idea of determining which particular type of electron tube amplifier then in use had the best possibilities of being pushed to greater gain-band products. The results of this study indicated that a very promising way of achieving substantial improvement was to build an improved planar triode for 4,000 MC operation.

The possible devices considered were of two general types: velocity modulated, as in a klystron, and current modulated, as in a triode. In the usual velocity modulated devices, the bandwidth is limited in both the input and output cavity resonators equally; in the grounded grid triode only the output resonator limits, the input being very broad. Consequently, as the band is widened by loading down the circuit Q's, the klystron loses gain at 6 DB per octave of bandwith, while the triode loses 3 DB per octave. If the two devices start out with equal gains at some narrow bandwidth, the triode rapidly pulls out ahead in gain as the bandwidth is increased. In other words, the comparison between the two depends on the bandwidth, with the triode standing better and better as the band becomes very broad.

Consider now the relative possibilities of increasing the transconductance and hence the gain of the two devices. According to the simplest klystron bunching concept, transconductance of a klystron may be increased indefinitely simply by making the drift time longer. Unfortunately, this simple kinetic picture does not take account of the mutually repulsive space charge effects which set an upper limit to the useful drift tube length by debunching the electrons after a time. For a 2000 V. beam in the 4000 MC range, this upper limit is approximately 3μmho/MA. The 402D tube used in the New York to Boston system has already approached this limit within a factor of 2.

In a triode there is also an upper limit to transconductance which can be achieved by spacing cathode and grid more closely. This limit would be reached if the spacing were so close that the velocity produced by the grid voltage were small compared to the average Maxwellian velocity of cathode emission. The triode limit of some 11,000μmho/MA is however, many times greater than that for ordinary klystrons. Still more important is the fact that previous microwave triodes are a factor of 20 to 25 below this limit, leaving considerable room for improvement. Thus, if mech-

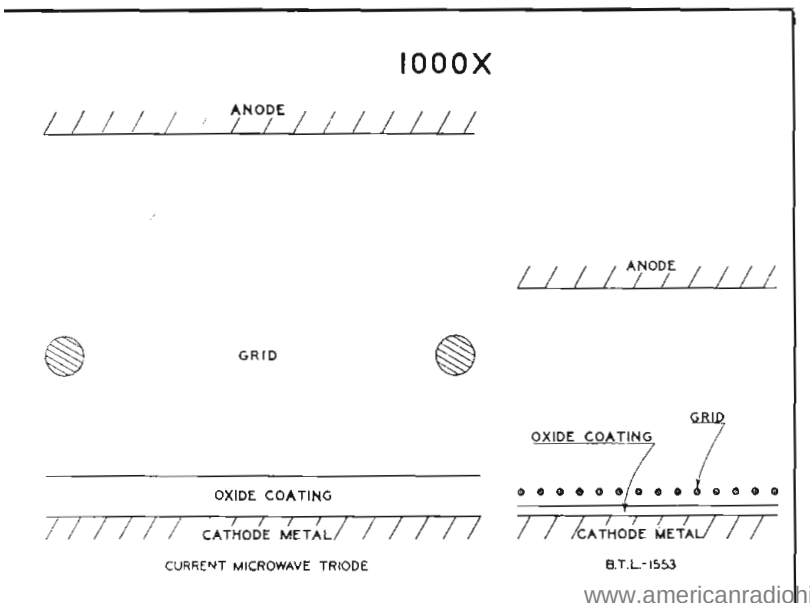


Fig. 1: Comparison between electrode spacing of BTL 1553 and that of commercially available triode for microwave circuit applications

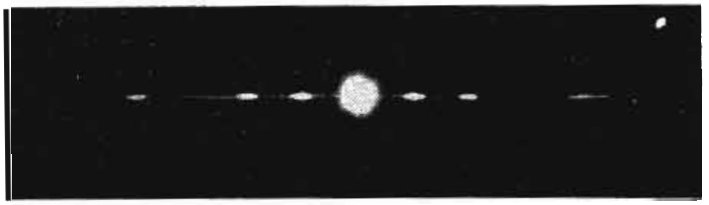


Fig. 2: (photo) Fourth order spectrum, diffracted by BTL 1553 grid

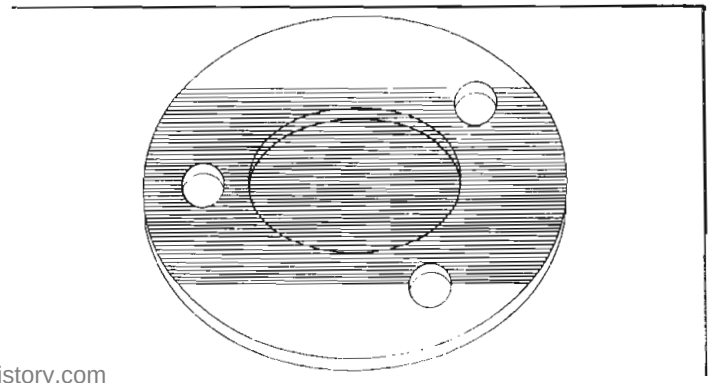


Fig. 3: BTL-1553 grid has 1000 turns/in. of ⅓ mil tungsten wire

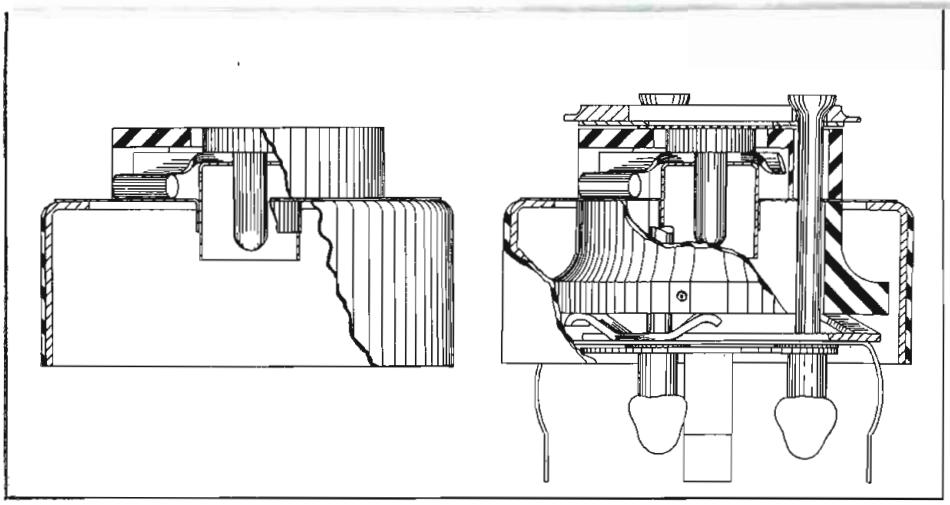


Fig. 4: (left) Cathode sub-assembly. Nickel core is mounted in ring of low-loss ceramic
Fig. 5: (right) The cathode grid sub-assembly, consisting of cathode, spacer, and grid

anical methods could be devised for decreasing the cathode grid spacing and at the same time maintaining parallelism between cathode and grid, it seemed highly probable that great improvements would be available from a new triode.

Improvements are possible in a klystron by lowering the beam voltage, to whose ¾ power the transadmittance limit is inversely proportional. To get transadmittance anywhere near the triode, however, would require low voltages and close spacings like the latter. Furthermore, the tube would be more complex, having several grids instead of one, and would encounter difficulties involved in handling large currents in low voltage drift spaces. A number of modifications of klystron operation were considered, but all looked more complex mechanically and more speculative theoretically than a triode.

By translating the known requirements on gain, bandwidth and power output into specifications on the actual triode dimensions, it was found that the input spacings of existing commercial tubes would have to be reduced by a factor of about five times. In addition, cathode emission densities would have to be increased by about three to four times.

A design was finally evolved in which the required close spacings could be produced to close tolerances by methods which do not require specialized laboratory skills.

For purposes of comparison, Fig. 1 illustrates the electrode spacings of the BTL 1553 and of the commercially available microwave triode. In the BTL 1553: (a) the cathode oxide coating is 1/2 mil thick, (b) the cathode grid spacing is 6/10 mil, (c) the grid wires are 1/3 in diameter wound at 1000 turns/in. and (d) the grid anode spacing is 10 mils.

The cathode subassembly is illustrated in Fig. 4. The cathode nickel core is mounted in a ring of low loss ceramic in such a manner that the nickel and ceramic surfaces may be precision ground flat and coplanar. The four-legged molybdenum spider which supports the cathode is held in the ceramic in such a way as to prevent buckling by providing free radial expansion without any axial motion. Subsequent to fabrication, high temperature processings do not alter its dimensions.

The thin smooth oxide coating is applied by means of an especially developed automatic spray machine tube and a coating of ½ ± .02 mils may be put under controlled specifiable conditions. In order to insure long life with such thin coatings, it was necessary to develop coatings two to four times as dense as existing commercial practice.

Grid Assembly

The grid assembly is shown in Fig. 3. The grid wires are 1/3 mil tungsten wire, wound at 1,000 turns/in. around flat polished molybdenum frames which have been previously gold sputtered. The winding tension is held precisely within ±1 gram weight to about 15 grams, which is 60% of the breaking strength of the wire. The gold is melted to braze the wires to the frame. The mean deviation in wire spacing is less than 10% and in fact the grids are regular enough and fine enough to be diffraction gratings as may be seen from Fig. 2. On this photograph a fourth order spectrum diffracted by one of these grids can be seen.

Proper spacing of the grid is obtained by means of a thin copper shim placed between the cathode ceramic and the grid frame.

The cathode grid subassembly, Fig. 5, consisting of cathode, spacer and grid is riveted together under several pounds of force maintained by the molybdenum spring on the bottom of the assembly. The rivets are three synthetic sapphire rods fired on the ends with matching glass. The cathode connector is welded to a glazed condenser can which provides an internal by-pass capacitance from the cathode to the shell of the bulb.

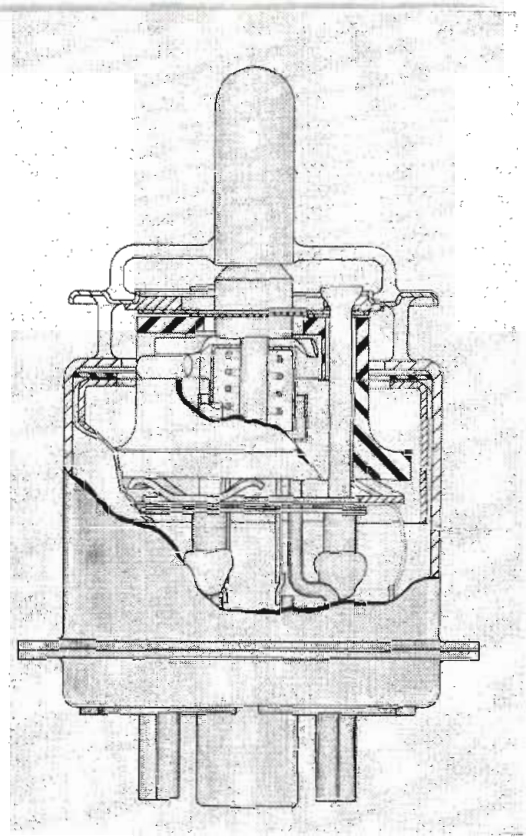


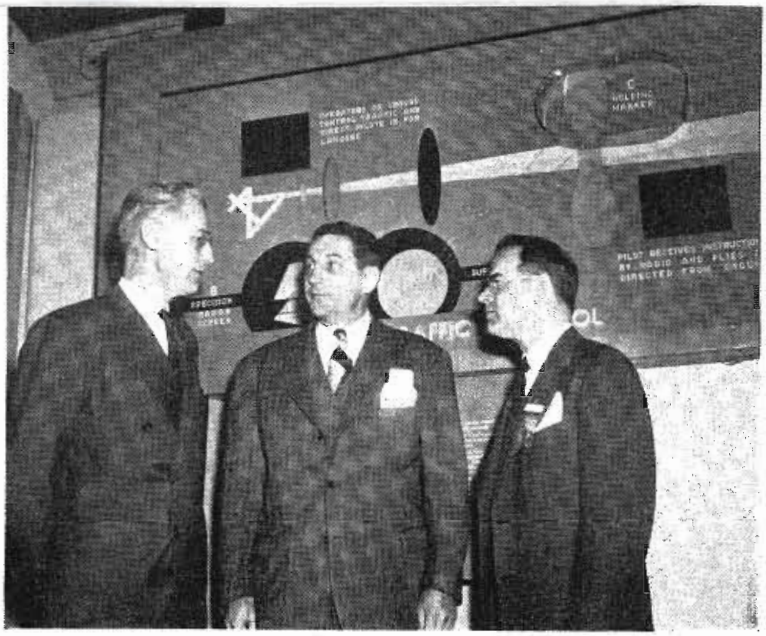
Fig. 6: Planar Triode completely assembled

The final assembly is shown in Fig. 6. The cathode-grid by-pass assembly is inserted into the preformed kovar - 7052 glass bulb and the press carrying the heater is welded to the cathode can. The grid-anode spacing of 10 mils is easily obtained by means of the adjustable anode plug whose surface is gauged relative to the bulb grid disc.

The high current density (180 MA/CM^2) thin dense cathode coating and very close spacings posed a problem in obtaining electron emission, which had to be solved by quality control methods because of the large number of factors involved. Accordingly, tubes, subassemblies, and testers have been made in batches and studied by statistical methods right from the start. Quality control proved very useful in working out the necessary processing of parts and in demonstrating the need of dust-free air-conditioned rooms for assembly. Such controlled conditions have led to good pilot production yields (50

(*Continued on page* 62)

Highlight of the convention was a side trip to WOR-TV, where the visiting engineers are shown inspecting the G. E. control console



H. R. Skifter, Airborne Instrument Laboratories, D. W. Rentzel, CAA, and IRE President Stuart Bailey discuss aircraft control problems

1949 IRE NEW YORK

WHEN the 1949 convention and radio engineering show of the Institute of Radio Engineers ended all records were broken: attendance reached more than 16,000; 172 technical papers were delivered; and the unprecedented sum of seven million dollars worth of equipment were displayed at the exhibits. The subjects covered in these talks showed most active interest in some of the newest fields of television, instrumentation on nuclear research, air navigation technics, computers, and application of "semi-conductors". It is evident that it is impossible to cover in satisfactory detail in a technical journal nearly 200 technical papers and special sessions heard, just as it was impossible for anyone attending to look in at more than one of the sometimes five simultaneous sessions held at a single time.

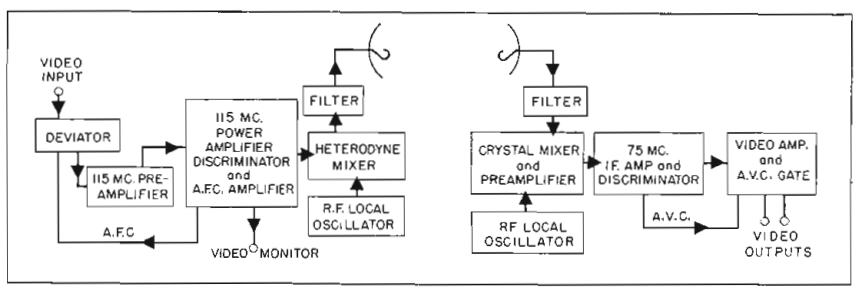
Each year one notes less stress being given on some of the most important fields of the radio industry, financially speaking. On the technical program standard AM broadcasting received little attention, FM none at all, and radio receiver designs hardly more. This indicates that these standard activities have been stabilized as to design arrangements. On the other hand the new world of the subatomic and its by-products was discussed by several leading authorities. An entire symposium was devoted to discussions of an almost magical new "semi-conductor" crystal the *transistor*.

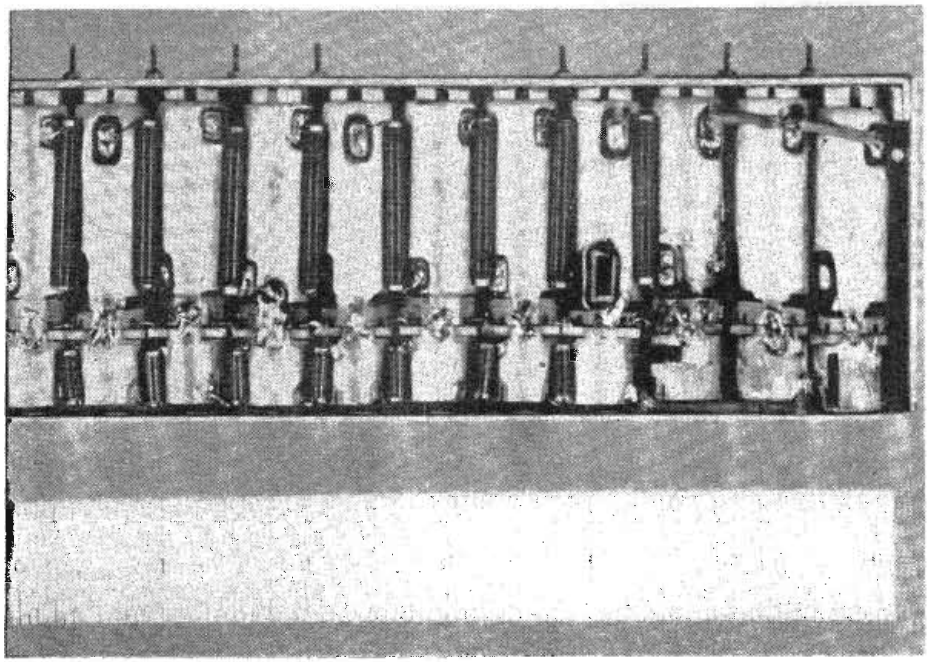
Thus these annual conferences do bring to the front a survey of trends in radio engineering thinking, and an insight into new fields of activity that are growing fast enough to claim a good percentage of current graduates of electrical engineering schools. For example, it was predicted that revolutionary changes in air navigation and traffic control system will take place during the next 15 years. D. W. Rentzel, Administrator of Civil Aeronautics, described a program which has been developed. By 1953 omni-directional radio ranges will blanket most of the country with static-free signals, permitting distance-measuring equipment and a course-line computer to make possible multiple airways between cities, relieving the traffic congestion which already has passed the saturation point in many parts of the country.

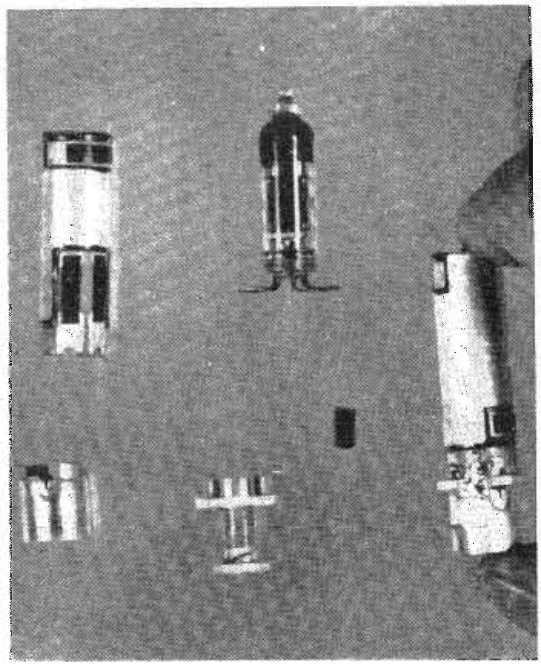
Ground-control approach radar will be installed in conjunction with instrument landing systems at the busiest airports, while at other large airports surveillance radar will be installed as a traffic control aid. The ultimate program envisions new applications of radar and television to solve the weather problems which plague aviation today and permit aircraft to fly their schedules with clock-like precision and absolute reliability.

The Radio Technical Commission for Aeronautics (RTCA) which coordinates aviation radio and electronics includes in its membership all interested bodies, both technical and financial. Several noteworthy integrated systems for the navigation and traffic control phases of aeronautical operations were described. During 1946 and 1947 certain development work was initiated, and aviation was confronted with a need for evaluating the systems to find which system or system elements had the greatest merit. Early in 1947, it was realized that

Philco 6000 MC television relay equipment employing dual conversion and AFC circuits







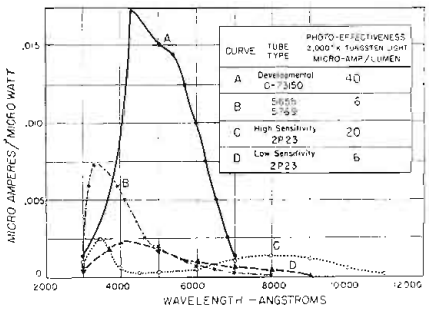
Advances in sub-miniaturization, using printed circuits in I.F. amplifier strips were displayed by the U. S. Bureau of Standards at exhibit

Convention Report

additional radio frequency spectrum was necessary in order to conduct the necessary development work and to provide space for installation and utilization of the adopted equipments. Frequency service allocations for these services were made by the International Telecommunications Union at Atlantic City during the summer of 1947.

Questions of interference-free mutual operation of the different functions, and duty-cycle requirements, are discussed in the RTCA plan. Novel features include a high-speed combination primary and secondary radar antenna, a two-color combination radar indicator, and altitude coding. The possibility of obtaining the full degree of multiplexing envisaged by the RTCA is outlined in the light of experience gained with this equipment.

Spectral response curve of a new orthicon under development at the RCA laboratories



As a part of IRE activities, an increasing responsibility is growing in the development and production of equipments related to the science of nucleonics. After describing the nuclear particles as to what they are, how they are measured, and what they do, the symposium concluded with a survey of the practical applications to which these can be put in industry and research.

To satisfy the widespread interest in high-speed computers a symposium on recent advances in the art was scheduled. During the past year some new forms of computers have been completed and operating tests carried to the point where new evaluations of their capabilities and limitations have become possible. At this symposium the construction and operating characteristics of new computers was discussed, including the BINAC, which achieves the performance of the ENIAC, with less than 5% of the number of tubes. This computer is essentially electronic but uses a mercury-delay-line memory and magnetic-tape input and output equipment.

A new large-scale computer developed at Harvard has greater speed and reliability, more flexible memory facilities, and greater ease of preparation of input data than were found in the earlier computers. The third type considered was the type 604 Electronic Calculator (IBM) which combines an electronic arithmetic element, including a 13-digit electronic counter, with punched-card input and output equipment and additional mechanical storage registers, with the possibility of carrying out automatically a "program" of as many as 20 arithmetic operations.

An electrostatic memory for a binary computer show great promise since they combine the high reading and writing speed of the delay line type of memory with a very short "access time." During a part of the symposium consideration of

(*Continued on page* 51)

See pages 48 and 49 for new equipment exhibited at Convention.

Louis Pensak, RCA physicist holding the new Graphecon, a picture storage tube whose face will retain radar or oscilloscope traces for more than a minute, to allow full analysis

Pulse Cross Generator Applied to

New equipment facilitates TV receiver quality control by providing continuously monitored test signals whose known characteristics conform with FCC standards

By R. P. BURR, Hazeltine Electronics Corp., Little Neck, L. I., N. Y.

MODERN manufacturers of television receivers are faced with a number of problems which are not characteristic of the AM and FM radio industries. In addition to the basic test equipment requirements, a video signal of good quality and known characteristics is highly desirable for checking final performance of the product. Regardless of whether the signal is generated by the manufacturer or obtained from a remote transmitter, its value as a testing medium is greatly depreciated unless the extent of its agreement or non-agreement with current FCC standards is known. Apart from such considerations as sound and picture carrier frequencies, which may be checked with relative ease by conventional methods, the amplitude and phasing or timing characteristics of the picture signal modulation should be determined.

The modulation depths of the transmitter corresponding to black level, pedestal level, reference white level and the uniformity of the transmitter peak power output, that is the amount of "clothesline" or "bobble" present on the carrier should be known. If this information is not available, receivers with normally unsatisfactory synchronizing characteristics might pass inspection with a picture signal having an excessive percentage of sync, or conversely, satisfactory receivers might be rejected on performance with a signal having insufficient sync.

In addition, the relative phasing and durations of the synchronizing information transmitted with the video signal should be known with a fairly high degree of accuracy. Misadjustments of the transmitter in this respect may lead to apparently poor horizontal or vertical synchronizing of the receiver, improper operation of automatic black level circuits, apparently poor retrace performance, inaccurate aspect ratio adjustment, and the like.

The amplitude values of the signal may be rapidly determined by means of an oscillographic display of the picture-carrier or rectified video signal with proper DC insertion, or through the use of a modulation monitoring receiver designed for this purpose.

The timewise monitoring of the synchronizing and blanking components of the picture information presents a more difficult problem since time measurements on the order of 1% of the line interval or 0.6 of a microsecond are required. As a result, accurate oscillographic measurements are somewhat laborious and time-consuming. In addition, phase modulation of the synchronizing information with respect to the video detail throughout a field of the picture is difficult to detect by this means.

The object of this paper is to describe the specialized and convenient technique known as the Pulse-Cross measurements for determining these time relationships. The system is by no means new, having first been described by Loughren and Bailey[1] in 1940. It would appear, however, that the present rapid expansion of the television industry provides justification for reviewing their work at this time.

Actually the measurement is an

[1] A. V. Loughren and W. F. Bailey, "Special Oscilloscope Tests for Television Wave-Forms," presented Rochester Fall Meeting Nov. 13, 1940.

Fig. 1: Television picture as viewed on the monitor screen

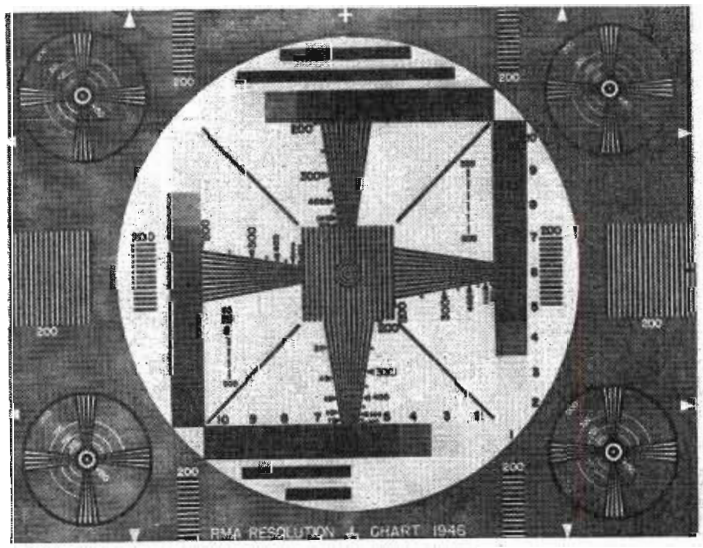
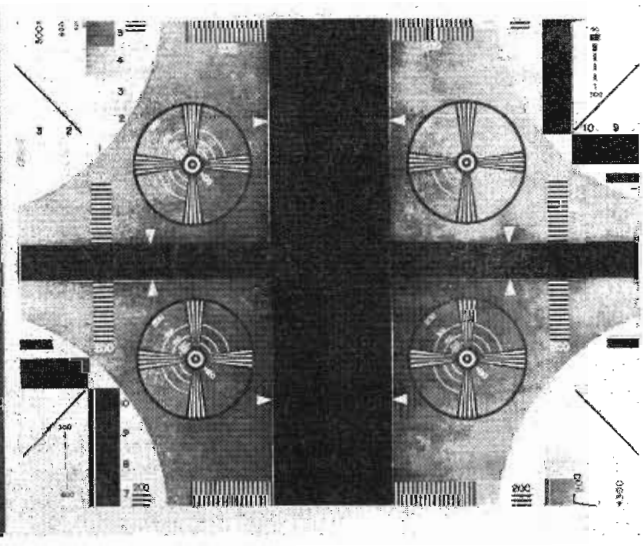


Fig. 2: Result of shifting scanning voltages 180° in phase



TV Production Test Equipment

oscillographic one, although it utilizes intensity modulation and the scanned raster of a normal picture tube to produce a pattern which may be interpreted rapidly in terms of the time relationships existing between the components of the television signal. The apparatus required is simple, and may be permanently connected at the video control position of the manufacturers' test set-up or as an accessory to a remote picture quality monitoring receiver.

The pulse-cross pattern is the result of three manipulations upon a video signal and its display system.

We start in Fig. 1 with a complete television picture, monoscope pattern, or the like, properly centered upon a monitor picture tube screen. If by some means the phase of the picture tube vertical scanning circuit is shifted 180° or half a field with respect to the video signal, the central region of the reproduced picture will contain a horizontal black bar corresponding to the vertical retrace blanking of the transmitted signal. Correspondingly, of course, the top half of the scene will be below the bar, while the bottom half of the scene will be above it.

In a somewhat similar manner, the phase of the monitor scanning may now be delayed by 180° with respect to the horizontal sync pulses of the video signal. As a result, a vertical black bar representing the horizontal retrace appears in the central region of the display. The picture detail is then relegated to the corners of the raster, as in Fig. 2.

Polarity of Signal Reversed

The final operation involved in setting up a pulse-cross pattern requires that the video signal applied to the picture tube grid be inverted in polarity. Fig. 3 shows that a readjustment of the brightness control for the monitor will then produce a picture in which normal highlights are black, normal black level is grey, and normally invisible or infra-black components of the signal, such as the synchronizing information, are white.

As a result, the formerly black cross region of the pattern will become gray, since blanking or black level is transmitted during this period. Similarly the synchronizing pulses which occur during the blanking time of the video signal will appear as a bright light, forming a definite contrast with the gray of the pedestal. During the vertical blanking period, the sync pulse pattern as displayed by the pulse cross becomes more complicated because of the presence of the narrow equalizing pulses and the broad serrated pulses. These occur at twice the line repetition frequency and provide the vertical sync signal for the television receiver. The manner in which this portion of the pattern is produced may be more easily understood by examining the time relations existing on the picture tube face with the FCC waveform chart of Fig. 4 as a guide.

Let us assume that scanning spot has completed one field of the television picture, and that the field traversed is one in which the last regular horizontal sync pulse is separated by one full line period from the first vertical equalizing pulse. Consequently, as the scanning spot moves over the raster, each horizontal pulse will be intensified, forming the vertical bright bar. After the last horizontal pulse in the field has appealed, the electron beam will move through a complete line of the raster before intensifying the first short equalizing pulse. This element of the pattern should be approximately one-half the width of the line pulse and should appear immediately below it. As the spot continues to move to the right, the second equalizing pulse will appear one half line removed from the first. The spot will then produce the third equalizing pulse one half line beyond the second, or immediately under the first, the fourth under the second, and so on until all six pulses have been

(*Please turn to next page*)

Fig. 3: Crossed video signal with the polarity inverted and with the brightness readjusted, gives this picture effect

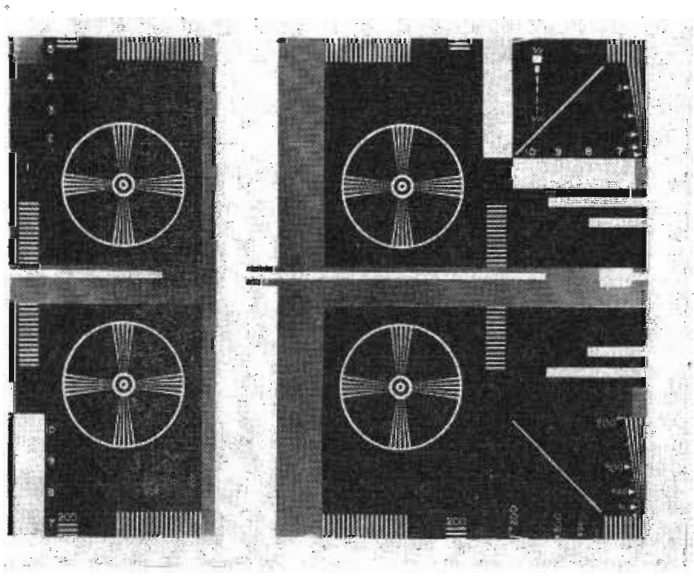
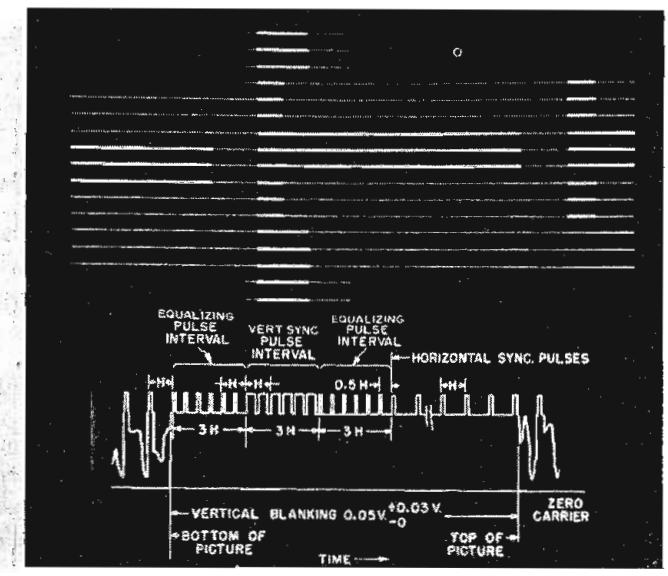


Fig. 4: Relationship between the FCC waveform chart and the pulse cross chart during the vertical re-trace interval



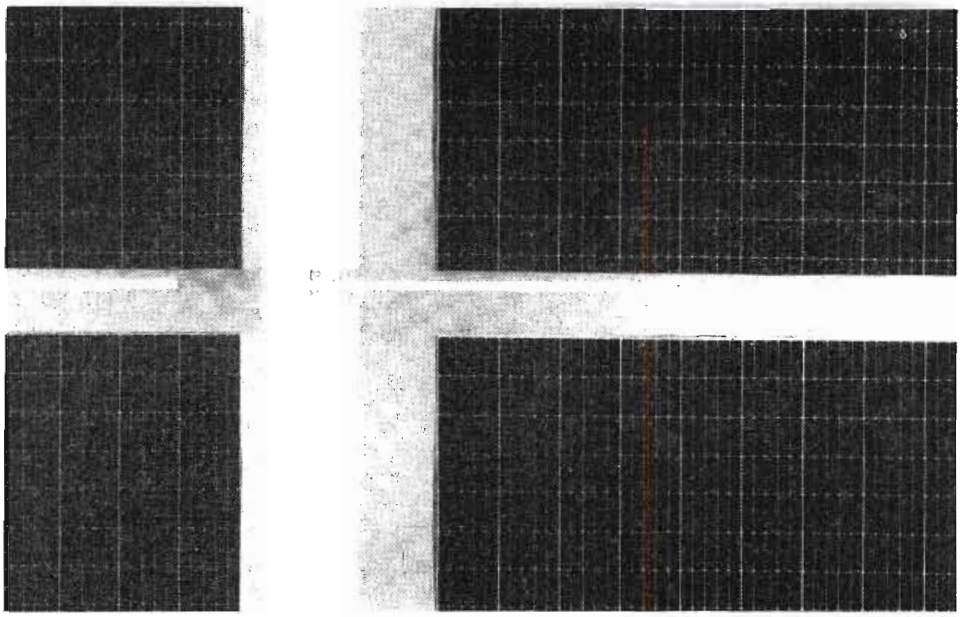


Fig. 5: Marker pulses produced by addition of 1575 KC sine wave to pulse cross picture

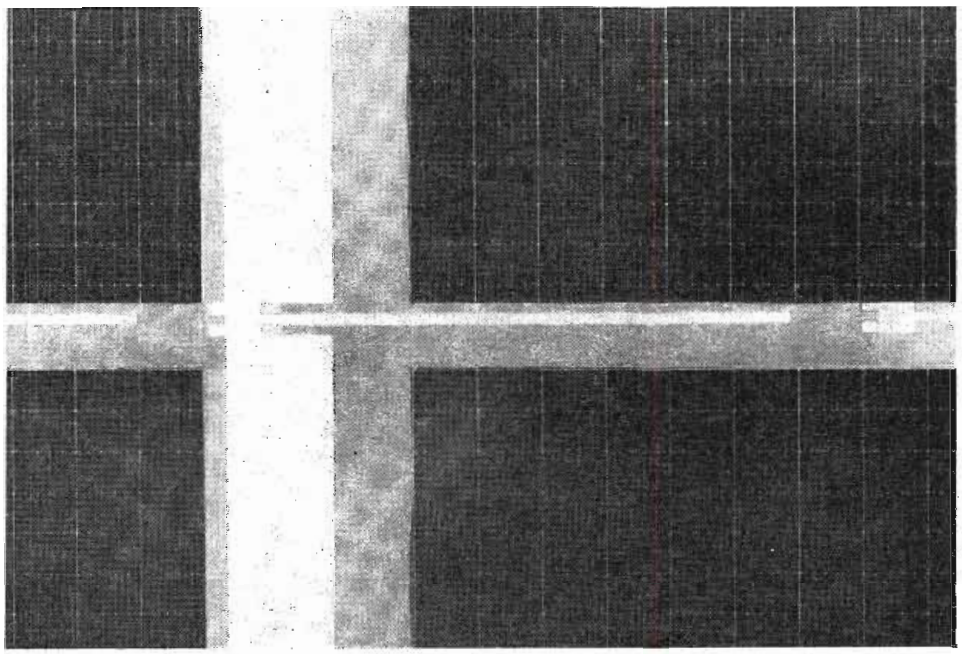
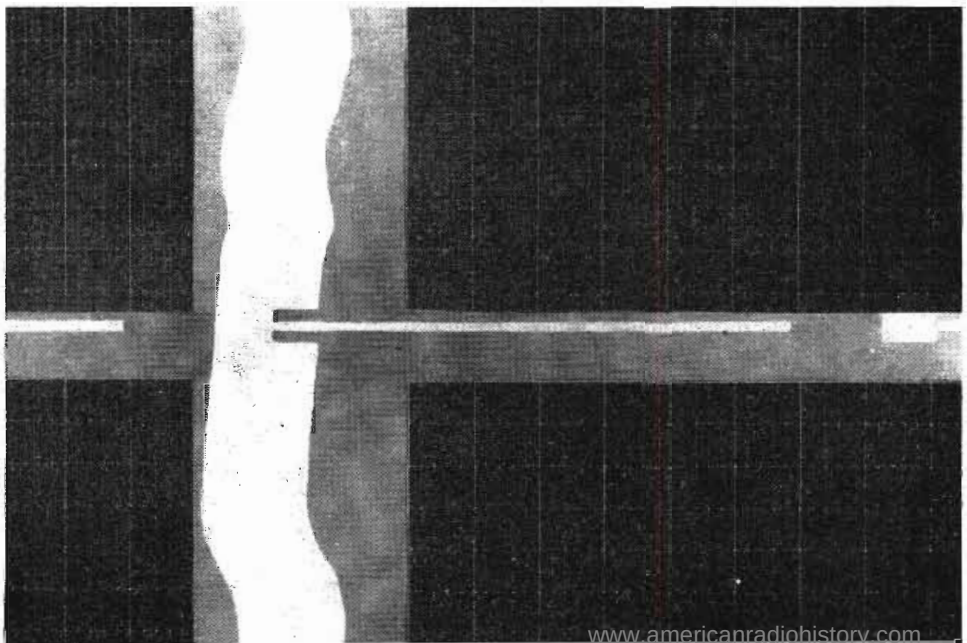


Fig. 6: Equalizing pulse misalignment in synchronizing signal shown by pulse cross image

Fig. 7: An illustration of severe phase modulation in line synchronizing pulse groups



Pulse Cross Generator

(*Continued from preceding page*)

laid down. The broad pulses will then be added in like manner—two to a line since they also occur at twice line frequency. Finally, the last six equalizing pulses will appear, and the regular line pulse intensification will be resumed for the following field of the picture.

The significance of the display may now be fully appreciated when we remember that the linear velocity of the scanning spot may be calibrated with precision by intensity modulating the electron beam with a signal of known periodicity.

Therefore, let us apply a video signal consisting of a 1575 KC sine wave: that is, a signal which represents the one hundredth harmonic of the line scanning frequency as generated by suitable harmonic multipliers. The resulting pattern is sketched in Fig. 7. The horizontal bars represent the markers which would be produced by 1200 cycle pulses.

Measuring Time Dimensions

The time dimensions of the various components of the synchronizing and blanking signals may now be measured with a ruler. Since linear distance on the face of the cathode-ray tube is calibrated in terms of 1/100 or 1% of the line interval, it is only necessary to determine the unknown dimension in inches or what-have-you, and to count the corresponding number of 1% markers as they appear in the video region of the picture. In the event that the horizontal scanning velocity is known to be non-linear, greatest accuracy will result if the average speed of the spot as it passes the cross region is used as the "measuring stick."

A considerable proportion of the television synchronizing and blanking signal generators in use today generate each component of the output wave shape as a separate entity, and combine the line, equalizing, and serrated pulses in a group of keyed mixers. It is vital to good interlace performance that the leading edges of each of these signal groups be coincident in phase. The pulse-cross display makes any aberration of this type readily visible, since the observer is much akin to the mason who determines the trueness of his wall by sighting along the top layer of bricks. Fig. 8

shows that the equalizing pulse groups of the signal are advanced in phase by amount which might be sufficient to impair interlace performance. Phase modulation of the horizontal synchronizing information which would normally be construed as poor AFC performance is also made apparent by a straight-edge. Fig. 9 shows a sketch of a pattern representing severe phase modulation of the line synchronizing information relative to the blanking pedestal.

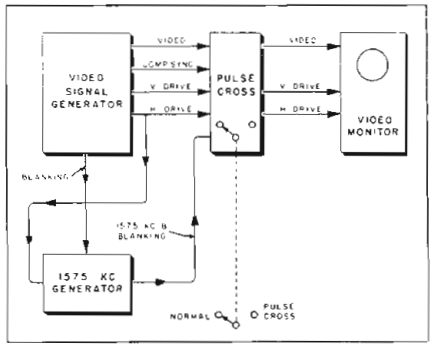


Fig. 8: Combining cross and video test signal

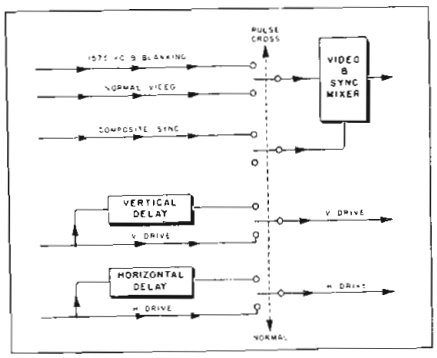


Fig. 9: Pulse cross generator block diagram

Two Methods of Generation

As may be inferred from the foregoing discussion, the actual mechanics of generating a pulse-cross is not difficult. Two methods, adaptable to almost any equipment arrangement, will be described.

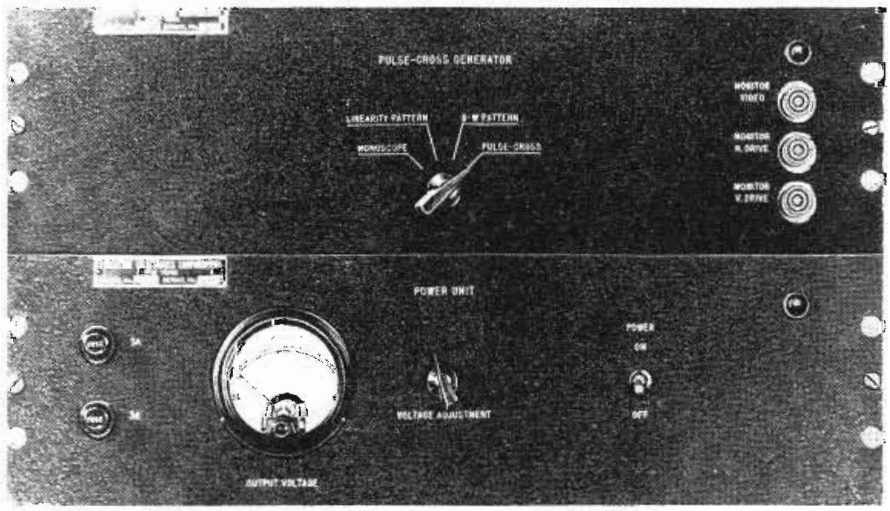
Let us consider first the case in which the manufacturer has a complete set of synchronizing generators, monoscope or other cameras, and a video monitor. In this instance a pulse-cross generator is of considerable value. The block diagram, Fig. 10, illustrates the equipment arrangement. It is assumed that the picture monitor, monoscope, and other such equipments are controlled by separate horizontal and vertical driving pulses available from the synchronizing signal shaper. Because of the manner in which these particular signals are usually generated, it is justifiable to assume that their frequency and phase stability is as good as that of the timer. The pulse-cross generator may then be inserted in series with the driving pulse and video lines to the picture monitor.

The block diagram of the unit, Fig. 11, shows that in the "normal" position of the pulse-cross switch, each line is connected straight through the unit. In the pulse-cross position, however, the horizontal and vertical driving pulses are each delayed for one half of their period by simple multivibrator circuits, and an inverted video signal containing sync, blanking, and a 1575 KC sine wave from a linearity pattern generator is applied to the picture monitor input. The photograph of the unit, Fig. 12, shows that the selector switch is actually a four-position device arranged so that any one of the three pictures available from the particular set of equipment for which it was designed may be displayed on the quality control monitor in addition to the pulse-cross display. Jacks for the permanent connection of all cables are provided on the rear of the chassis.

In the event that the manufacturer wishes to "cross" the video signal from a receiver tuned to a remote transmitter for quality control purposes, the problem may be readily solved if the receiver is equipped with some form of discriminator type AFC for the horizontal oscillator. In this case an effective horizontal delay of the trace may be obtained by reversing the leads to the discriminator circuit in the scanning system. Vertical delay may usually be obtained by syncing the vertical oscillator from a 60 cycle source of variable phase. Inverting the video polarity of a conventional receiver is sufficiently inconvenient to make such an alteration undesirable. Actually, it will be found that the synchronizing pulses will become usably visible if the brightness control of the set is properly readjusted. The timing signal may be introduced at any convenient point in the video amplifier such as the first video amplifier grid.

As a concluding observation, it should be noted that some precautions should be observed with the pulse-cross measuring technique. In particular, it has been tacitly assumed throughout this discussion that the rise times of all the components of the television synchronizing signal are approximately equal. The bandwidth considerations involved in any television system will usually conspire to produce such a condition, but it is important to ascertain that this is actually the case by means of a wide band oscilloscope before using the pulse cross to align the various components of the composite synchronizing signal. In addition, the width of the equalizing pulses may be more accurately adjusted by means of the integration method. The requirement that the equalizing pulse area be half that of the line pulse area is not necessarily satised by a simple pulse width measurement because of the slope of leading and trailing edges. However, the nature of these errors or corrections may usually be evaluated for any particular set-up, and is not likely to detract seriously from the usefulness of the pulse-cross method.

Fig. 10: Photograph showing the front panel and controls of the pulse cross generator



New Portable Tape Recorder

Highly adaptable to broadcast recording requirements, unit features automatic speed-frequency equalization

By W. E. STEWART, Audio Engineering Section, Engineering Products Dept. RCA Victor Div., Camden, N. J.

Fig. 1: Overall arrangement shows how recorder can be placed in control room in such a manner as to permit airing or recording of program material on tape by the operator

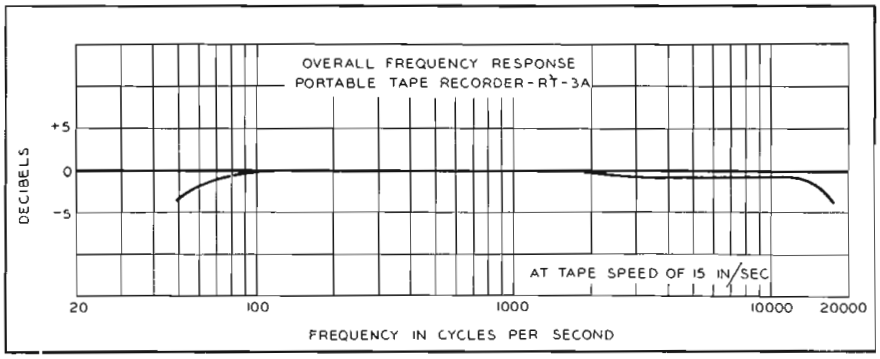
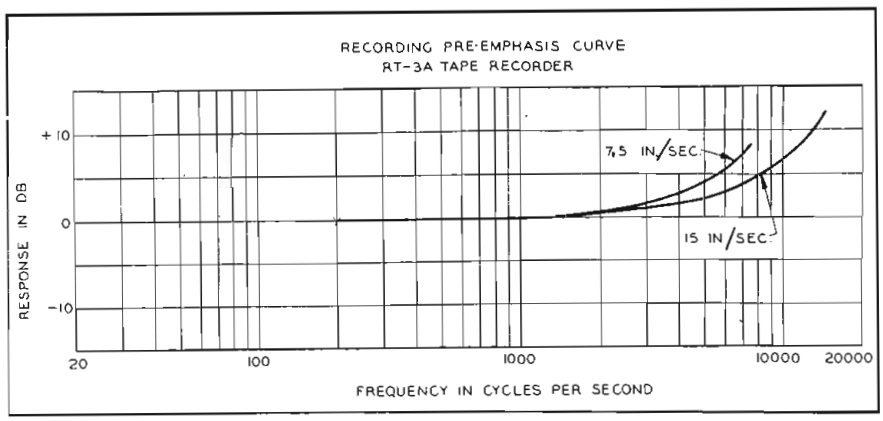


Fig. 2: (Above) Frequency response curve of magnetic tape recorder at speed of 15-in./sec.

Fig. 3: (Below) Pre-emphasis curves used in recorder at tape speeds of 7.5 and 15 in./sec.



THE new RT-3A portable magnetic tape recorder is designed to fulfill the broadcasters' needs for a lightweight, low cost recorder with true studio quality. Incorporating a smooth, two-speed, synchronous motor drive, the RT-3A is well suited for recording programs at remote points with the same high fidelity that is possible in the studio. The advantages of simplicity and ease of recording, long playing, easy editing are equally desirable for applications. The RT-3A is a complete recording system and consists of an amplifier unit, recording unit, plus necessary interconnecting cables. The amplifier unit includes a recording amplifier, playback amplifier and "erase" and bias oscillator.

All the controls for the recorder proper are front-panel mounted for easy accessibility, and two recording speeds are obtainable, one at 15-in./sec. and the other at 7.5-in./sec. 33 minutes of continuous recording are possible at the first speed, while employment of the slower rate will allow more than one hour of material to be put on tape. Flipping the speed switch control automatically introduces proper frequency response compensation. Reel shafts are designed to accommodate RMA proposed standard reels.

The recording amplifier is contained in a separate carrying case, with room for connecting cords, spare reels, and accessories which are provided. Sufficient gain is available to permit operation directly from microphone outputs. Another feature is the presence of line terminals and a bridging pad, to allow recordings to be taken directly from a 600-ohm line. Input level is variable at the grid of the first tube, and inverse feedback is applied over three stages, to reduce distortion.

A single oscillator supplies both erase and bias voltages, at a frequency of 100 KC. These are independently adjustable, however, and can be checked with the VU meter, while they are varied by means of a screw-driver adjusted potentiometers. Stability of the circuit precludes the necessity for frequent setting of these voltages, while the ease with which the VU meter can

Performs with Studio Quality

be switched to measure their values provides the operator with a means of confirming this fact. Further, a pilot light on the front panel, actuated by the erase current, gives a positive indication when the unit is set up to record. Accidental erasure of recorded material is virtually impossible, since the record head and the recording amplifier output are short-circuited, and the erase oscillator is de-energized, with the "Record" knob in the "Off" position.

In many tape recorders, the operator is not provided with a means of monitoring the material as it is recorded. The design of the RT-3A unit incorporates separate recording and play-back amplifiers, and provision is made to permit recording and monitoring simultaneously, a distinct advantage where a continous assurance of the quality of the program is desirable. When it is used for its primary purpose, the frequency response compensation of the playback amplifier is determined by the setting of the speed selector switch. In common with the recording characteristic, it can be altered, if necessary, by the change of R-C components. A gain control is employed between the 1st and 2nd stages, and amplification is sufficient to feed a line level of plus 18 DBM. The VU meter can be switched to measure cathode currents, as well as the level appearing across the output terminals. Binding posts for line connection, and a headphone jack for monitoring have been incorporated.

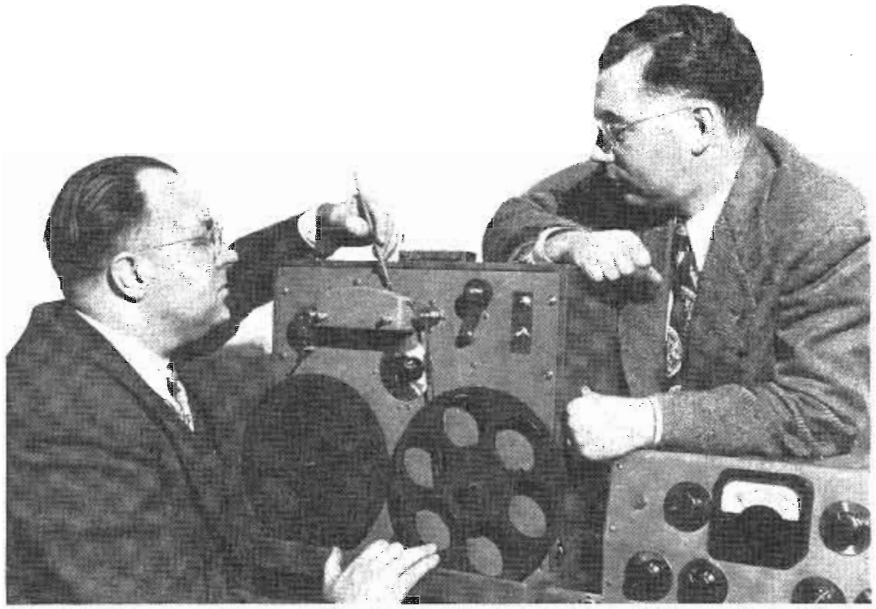


Fig. 4: Front view of recorder showing tape feed and recording amplifier control panel

The recording unit is built around a dual-winding hysteresis type synchronous motor, whose speed can be changed from 3600 to 1800 RPM. It is this design feature which makes possible instantaneous change of speed, eliminating mechanical speed changing devices, and the possibilities for "wows" they introduce. Torque on both the supply and take-up reels is maintained through a horizontal belt and friction drum arrangement. The weight of the tape on the reels is made to provide essentially constant tension on the tape. A knob near the center of the front panel actuates the mechanism for a fast forward or reverse wind. To avoid snarling the tape at the end of a fast winding operation,

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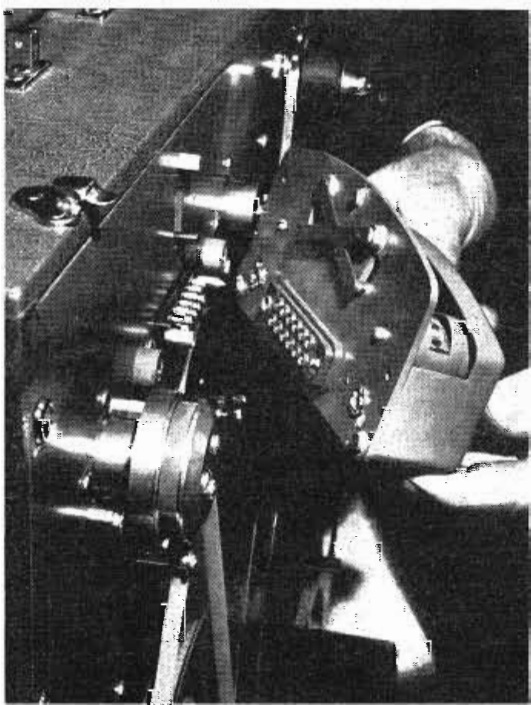
Fig. 5: Internal constructional layout of recording amplifier console and its controls

Fig. 6: Closeup of the plug-in recorder head



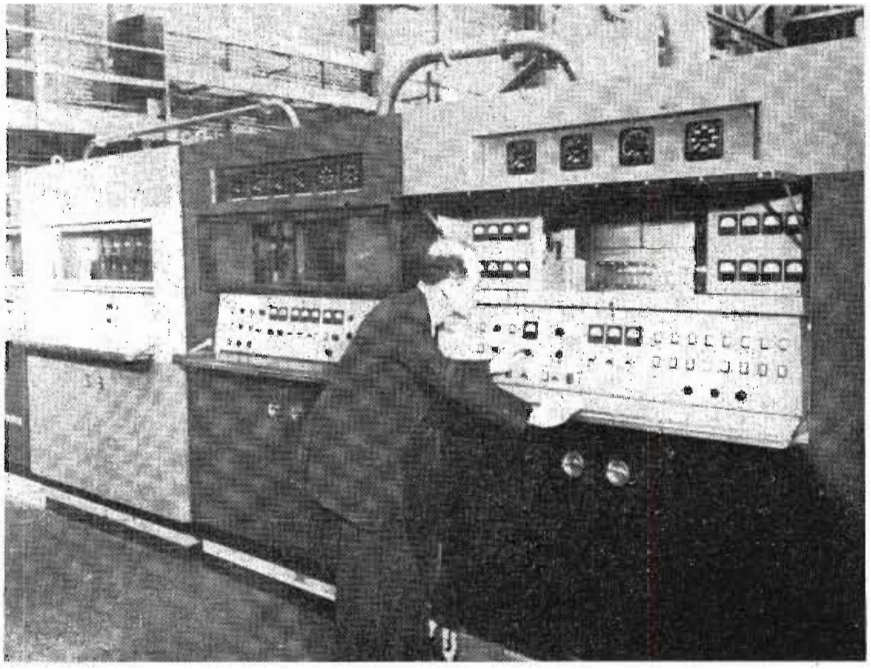


Fig. 1: Control view of 50 KW transmitter. Symmetron is visible through aperture

The Symmetron Amplifier

By D. L. BALTHIS, *Electronics and X-Ray Division, Westinghouse Electric Corp., Baltimore, Md.*

New Radio Frequency Tank for UHF and VHF regions

POWER amplification at high radio frequencies has always been a difficult technical problem. The higher the desired frequency or power level, the more difficult the task becomes. This problem can be alleviated by a novel tank circuit for which wide application is expected in the VHF and UHF bands (approximately 50-1000 MC). This circuit, a Westinghouse development, is known as the "Symmetron" amplifier.

The general pattern followed by the industry in recent years has been to obtain high-frequency power amplification by a circuit commonly known as the "grounded-grid" amplifier. Here the input signal normally is applied between grid and filament and the output signal removed between grid and plate. The advantages associated with this type of amplifier are not dependent on the grid being at RF ground potential. The essential consideration is that the grid be used as a shield plane between plate and filament. The advantages are lost completely if this consideration is not carefully preserved in both the design of the tubes and their associated tank circuits.

Once it is recognized that it is not essential for the grid to be at RF ground potential in a "grounded-grid" amplifier, present terminology does not adequately describe the circuit . The "grounded-grid" amplifier is actually a special case of what might be called the "grid-separation" amplifier family. Consequently, the term "grid-separation" will be adopted in describing the "Symmetron" amplifier. By removing the grounded-grid design restriction, the range of application and usefulness for amplifiers in the grid-separation family is extended.

The electrical advantages associated with all members of the grid-separation amplifier family are as follows. First, the grid plane, interposed as a shield between plate and filament, reduces the plate to filament feedback capacitance, C_{pf}. Thus, the grid performs one function of the screen grid in a tetrode. This makes possible the use of triodes as VHF and UHF amplifiers while avoiding the possibility of self oscillation without neutralization. Secondly the tube output capacity is lowered and is approximately equal to the grid of plate capacity, C_{gp}. This is much less than that associated with the normal capacity-neutralized amplifier and, at high frequencies, results in increased RF bandwidth capability and lower circulating KVA in the output circuit. Thirdly, the driving power acts in series with the output tube to supply the load. This results in higher power output for a given tube type than would normally be expected. In turn, the driving power required is increased but does not represent a power loss since this power is transferred to the output circuit except for normal grid circuit losses.

Typical grid-separation amplifier

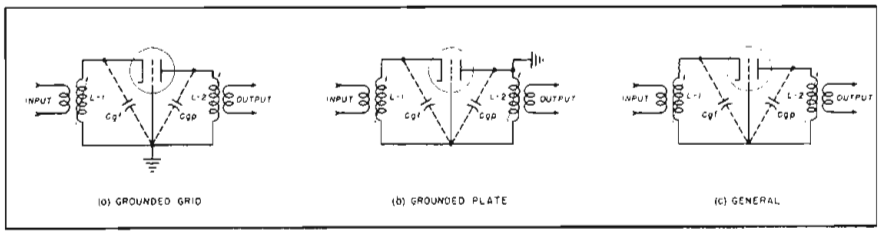
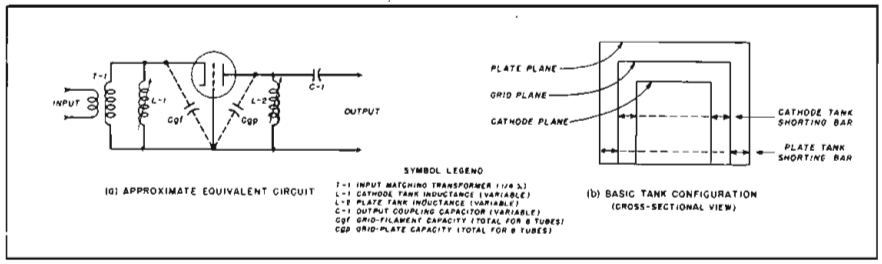


Fig. 2: (Above) Typical grid-separation amplifier circuits; various elements at RF ground

Fig. 3: (Below) Symmetron basic schematic and cross section of the cylindrical RF tanks



circuits are shown in Fig. 2. The first of these, Fig. 2(a), is the conventional grounded-grid amplifier. The second, Fig. 2(b), is a grounded-plate amplifier. Basically, there is no difference between these circuits except for the point selected to be at RF ground. In either case, the grid acts as a shield plane between plate and filament and both circuits have the operational advantages of the grid-separation amplifier family. Similarly, if desired, the filament could be operated at ground potential rather than the plate or grid, although such is not common practice.

Amplifier Configuration

Realizing that the selection of any given tube element to be at RF ground potential is only a matter of design preference leads to the general grid-separation amplifier configuration shown in Fig. 2 (c). Here, no element is at RF ground potential. Such a design can be physically realized, with definite advantages, if each of the tube elements is isolated from RF ground by high-impedance technics. The design of the Symmetron amplifier is based upon this general configuration.

The approximate equivalent circuit of the Symmetron amplifier for the 88 to 108 MC band, using lumped constants, appears in Fig. 3, together with a cross-sectional view of the basic tank configuration. This amplifier is a cathode-coupled, grid-separation circuit of straightforward design, with only three adjustable tuning elements. The input line is coupled directly to the cathode tank through the quarter-wave matching transformer that matches the cathode tank impedance to the input transmission line. The adjustable inductance elements are coaxial line sections with conventional shorting bar tuning technics. The output coupling capacitor is an adjustable, air-dielectric capacitor coupling the output line between the grid and plate planes of the tank.

The cross-sectional view of Fig. 3 illustrates the basic mechanical configuration of the tank. The transition from the lumped constants of the approximate equivalent circuit to this mechanical configuration utilizing linear circuit elements is conveniently accomplished. This tank is a figure of revolution and, consequently, two coaxial transmission line sections are formed by the three cylinders

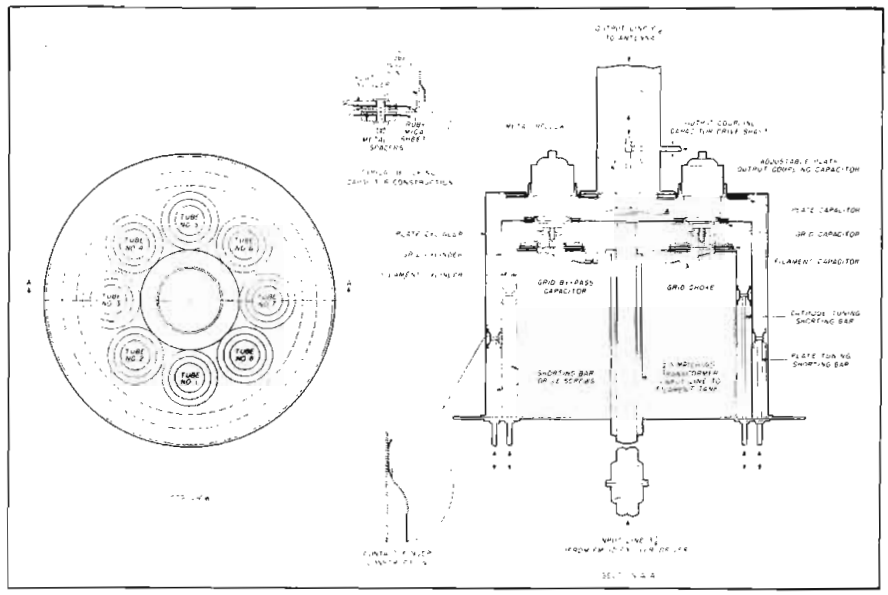


Fig. 4: Cross sectional view shows mechanical and electrical details of amplifier unit

extending downward from the plate, grid, and filament planes at the top of the figure. These coaxial line sections are tuned by ring-type shorting bars and, being less than one-quarter wavelength long, form the required plate and cathode inductive tank elements. The grid plane acts as a shield between filament and plate as shown in the approximate equivalent circuit.

Symmetron design is employed, in practical form, in the Westinghouse 50-KW FM amplifier. Its features, characteristic of the Symmetron design, will be described in terms of the cross-sectional and plan views of Fig. 4.

It is essential that electrical and mechanical symmetry be preserved in high-frequency amplifier circuits to assure balanced operation with uniform tube loading. Difficulty is encountered in this respect with conventional amplifiers employing shielded, two-wire, transmission line tanks. Such arrangements commonly employ tubes in push-pull parallel configurations at high power levels. The paralleling of the tubes increases circuit capacity and necessitates low-impedance inductive tank elements. In turn, the low-impedance tanks obtained by close physical spacing tax the ingenuity of the designer in providing means for tuning, input and output

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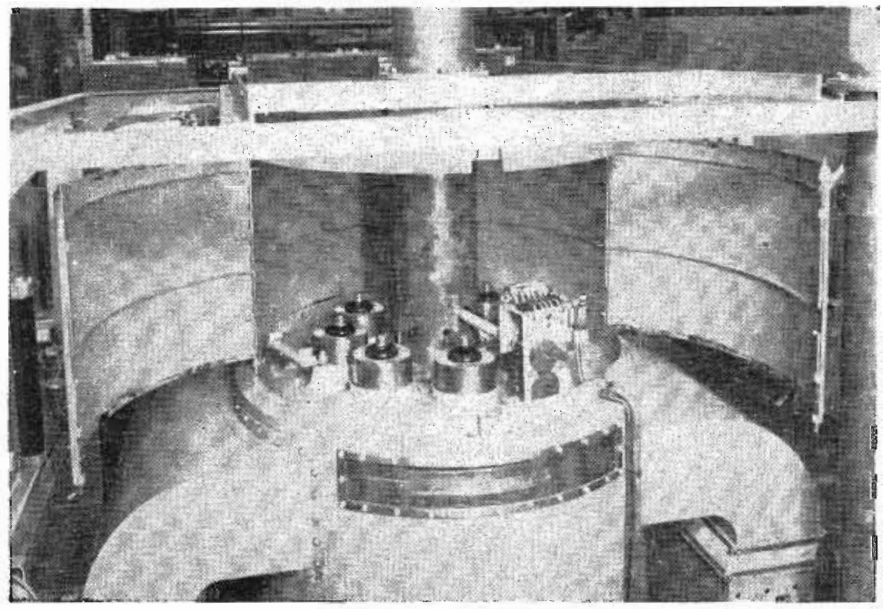
Fig. 5: External view of the 50 KW FM amplifier. Note the annular arrangement of the tubes around 6⅛-in. output coaxial line and motor driven antenna coupling control



Use of Tube Characteristics in Cathode Follower Design

By ED. M. NOLL, Temple Univ. Inst., 720 N. Broad St., Philadelphia, Pa.

CATHODE follower circuits have a primary application as the power output stage or impedance transformer in video systems, although their use in other types of communication circuits is becoming more and more widespread. It is possible to ascertain the maximum power output that a tube will provide when operating with a specific impedance match from a study of the tube's static characteristic curves and by making a few simple calculations.

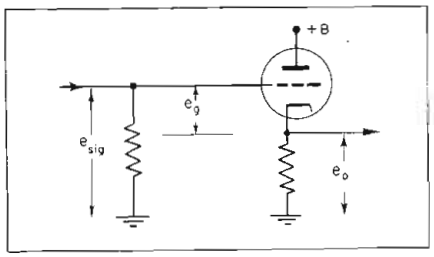
Referring to the figure below, the first step is to plot a maximum plate dissipation line between the highest recommended plate voltage for the tube and its zero bias curve. For a 6L6 connected as a triode the maximum plate voltage is 250 V and the maximum plate dissipation is 10 watts. Point A is obtained by dividing 10 watts by 250 V giving 40 MA. Other points can be found by using representative values of lower plate voltage, thereby completing the curve AB.

This curve is the loci of safe operating points any one of which does not cause excessive plate dissipation for the associated value of plate voltage. Absolute maximum output is obtained by operating at the point A while each of the other points represents maximum output for another value of output impedance. The value of the latter falls as the operating point chosen approaches the zero bias point. R_k, the cathode bias resistor needed to operate at point A is found by dividing 21V (E_c) by 40 MA (I_o), which in this case is 525 ohms.

In cathode follower operation R_k is also the effective plate load resistance. Therefore a plate load line can be plotted which includes the operating point A. The load line XY now represents the dynamic characteristic from which various parameters can be obtained. For an assumed change in e_g, values of i_p and e_p can be obtained. The output voltage e_o is the product of $i_p p_k$ and the grid drive is $e_o + e_g$. The output impedance is:

$$Z_o = \frac{(r_p/\mu+1)R_k}{(r_p/\mu+1)-R_k}$$

For operation at a specific output impedance use the output impedance formula and solve for R_k. For example if the 6L6 is to have an output impedance of 100 ohms the value of the cathode resistor becomes 214 ohms. The maximum power output operating point which corresponds to this output impedance is found by drawing a cathode load line. This will of course be some point on the maximum plate dissipation curve.

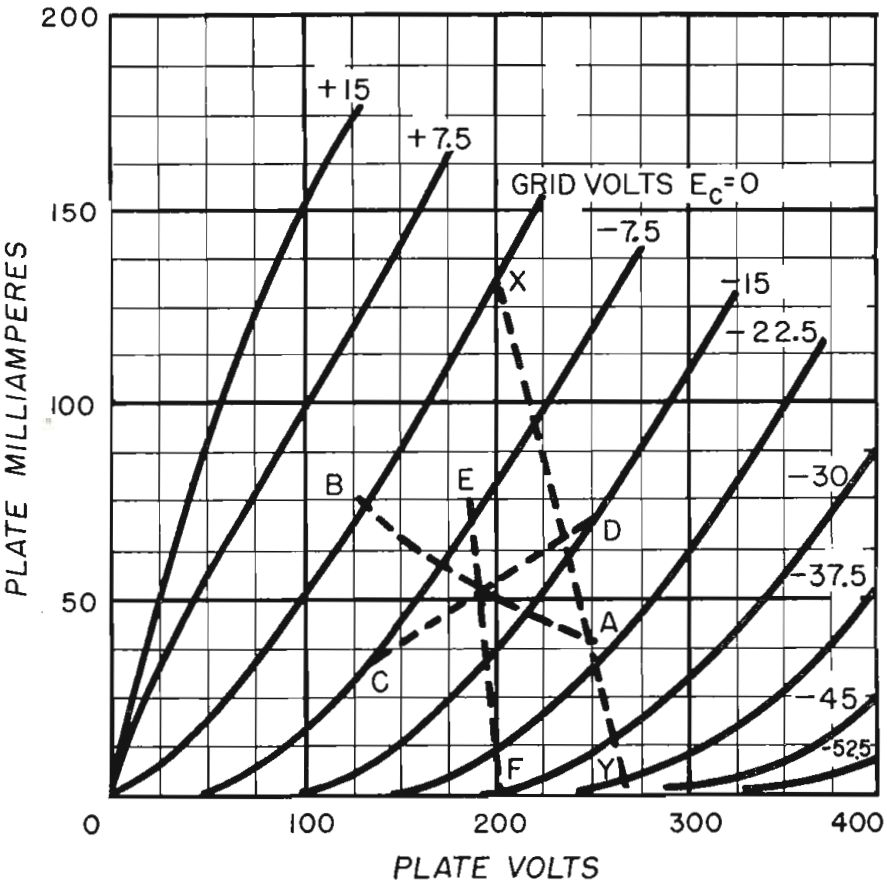


Basic Schematic of cathode follower stage

To find two points for plotting the cathode load line choose two representative bias curves near the plate dissipation curve and find the corresponding current values for R_k of 214 ohms. Such values would be 15V (E_c) divided by 214 or 75 MA and 7.5 V (E_c) divided by 214 giving 35 MA. These two points determine the slope of the cathode line CD which crosses the plate dissipation line at the desired operating point.

Now the plate load line EF can be drawn. The point at which it crosses the plate voltage axis represents the voltage needed from the supply source to obtain the correct operating point.

Average plate characteristics of triode connected 6L6 tube. Dashed lines show required graphical construction to depict conditions with tube operating as a cathode follower



WASHINGTON
News Letter

Latest Radio and Communications News Developments Summarized by Tele-Tech's Washington Bureau

TV MFRS. CAN'T BE FORCED TO LABEL VIDEO SETS with "caveat emptor" because of future obsolescence, FCC feels—The majority of the FCC Commissioners do not believe that any Commission rule can be formulated to require television-set manufacturers to notify purchasers of video receivers of possible obsolescence due to the transition to UHF television with its prospects of color TV. This was the reply of the FCC, signed by Chairman Wayne Coy, to a series of questions on the future of television propounded by the Senate Interstate and Foreign Commerce Committee in a letter by Chairman Ed C. Johnson. Senator Johnson indicated after receiving the 17-page FCC reply that further study of the regulatory aspects of television must be made before it could be determined whether or not legislation as he proposed would be necessary to compel the manufacturers to warn purchasers of future obsolescence.

STRATOVISION AS COMMON CARRIER—The "stratovision" system of relaying and broadcasting television also would have to be placed under the status of "common carrier" regulation, the FCC informed the Senate Committee. The questions, directed by the Senate Committee to the FCC over which the former has legislative jurisdiction, were definitely aimed to prevent the establishment of a future monopoly situation in the new video art by both manufacturers and broadcasters.

NAVY DISPLAY OF RADIO-ELECTRONIC DEVICES FOR AFCA—More than seven hundred "communicators," including leading officials in the radio-electronic fields of the Armed Services, manufacturing and operating industries, and laboratories, were in attendance at the third annual convention of the Armed Forces Communications Association in Washington March 28-29, to hear addresses by Admiral Louis Denfeld, Chief of Naval Operations; Brig. Gen. David Sarnoff, RCA Chairman and retiring AFCA President; FCC Chairman Wayne Coy; Maj. Gen. S. B. Akin, Chief Signal Officer of the Army; Rear Admiral Earl E. Stone, Chief of Naval Communications; and Maj. Gen. F. L. Ankenbrandt, Director of Air Force Communications. Piece de resistance, however, was an all-day tour through the Naval Gun Factory and the Naval Research Laboratories on March 29, together with an additional inspection visit on March 30.

SHIPS WITH RADIO ALL THE WAY—Features of the Naval Gun Factory visit of AFCA were the U.S.S. Adirondack, a Navy "communications" warship which is completely equipped with every major radio, radar and electronic navigation aid device, and a Navy "Guppy Type" submarine which had aboard the latest radar and sonar equipment. The Naval Research Laboratories and the Navy Bureau of Ships displayed aircraft television, early radar tubes, modern radar equipment and tubes, sonowaves, radar countermeasures devices.

FCC TECHNICAL STAFF PROGRESS TOWARD ALLOCATIONS AND UHF—Another engineering conference on the problems of allocations for television in the UHF region and synchronization of presently-available channels may be necessary, it is indicated as a result of the joint studies by the radio industry and FCC engineers. Meanwhile, FCC Chairman Coy has indicated that the Commission hopes to lift the television station "freeze" by midsummer. The FCC is planning to study new procedures, evolved by the engineers, for the UHF band and hopes that some video stations would be operating in that region of the spectrum by 1950. The Joint Technical Advisory Committee of the IRE and RMA recently advised Chairman Coy that it had formulated four plans to broaden video coverage from 140 metropolitan centers of the country through utilization of the present VHF channels plus portions of the 475-890 mc "upper band" for television.

TV STATION CONSTRUCTION COST NEAR $100 MILLION—Estimated construction cost of present 124 TV authorized stations was placed at more than $30,300,000 and $66,300,000 for 311 pending station's applications, making total of over $96,600,000, FCC recorded in recent report. Newspaper publishers have 128 stations, either licensed, CP's granted or applications, making 31.3% of total; broadcasting stations and networks ran next with 66 stations, granted, pending or applied for, or 16.1%; and motion pictures, radio manufacturers and merchants, etc., each accounted for a fraction over 6%.

MISCELLANY—Munitions Board and Armed Forces' Inter-Service Communications-Electronics Committee have been engaged in formulating plan which will consolidate proposals of Radio Manufacturers Association's mobilization plan and aims of M.B. and Armed Services; Army Signal Corps concentrates of newest types of radio and electronic military devices, it is keynoted in 86th Signal Corps anniversary addresses. . . Industrial Radio Services, with utilities and petroleum industry leading, now total about 2500 fixed or base stations and 33,500 mobile units; and taxicab radio systems have increased over 100% in last year from some 1260 systems last March to more than 3000 systems now.

ROLAND C. DAVIES
Washington Editor

National Press Building
Washington, D. C.

TELE-TECH's NEWSCAST

URSI-IRE Spring Meeting

The next regular meeting of the International Scientific Radio Union and the Institute of Radio Engineers will be held at the National Bureau of Standards, Connecticut Avenue and Van Ness Street, N. W., Washington, D. C., on May 2, 3, and 4. The old American Section, URSI, has been reconstituted as the U.S.A. National Committee, URSI; the new organization includes seven National Commissions which will sponsor the United States URSI work. These National Commissions and their chairmen are:

1 — Radio Standards and Methods of Measurement. — Dr. J. H. Dellinger.
2 — Tropospheric Radio Propagation. — Dr. Charles R. Burrows.
3 — Ionospheric Radio Propagation. — Dr. Newbern Smith.
4 — Terrestrial Radio Noise. — J. C. Schelleng.
5 — Extraterrestrial Radio Noise. — Dr. D. H. Menzel.
6 — Radio Waves and Circuits, including General Theory and Antennas. — Dr. L. C. Van Atta.
7 — Electronics, including Properties of Matter. — G. F. Metcalf.

The meeting in May will cover the work of Commissions 1, 4, 6, and 7. It is planned to devote May 2 and 3 to the presentation of papers dealing with subject matter pertaining to these four Commissions. This program will be devoted to fundamental scientific and research papers on the following topics: radio standards, methods of measurement, terrestrial radio noise (natural and man-made), communication theory, antennas, circuits, electron tubes, semi-conductors, and properties of matter.

Dayton IRE Plans Conference

The Dayton section of the IRE is planning a series of annual technical conferences. The first such conference will be held June 3 and 4, 1949, at the Biltmore Hotel, Dayton, Ohio. Presentations and discussions on the following general subjects are scheduled:

1—Aircraft Communications Equipment and Theory.
2—Air Navigation and Traffic Control Systems.
3—Antenna Developments for High Speed Aircraft.
4—Air to Air Radio Frequency Propagation.
5—Design Trends in Airborne Electronic Systems.
6—Physiological Aspects in the Design of Airborne Electronic Equipment.

Acoustics Conference, May 5-7

Acoustics as the servant of man will be the keynote of the 20th anniversary meeting of the Acoustical Society of America, May 5-7, at the Hotel Statler, New York City. Developments for each of the sessions are grouped as follows: acoustics in comfort and safety, acoustics as a tool in physics, acoustics in the arts, and acoustics in communication. For information write Prof. Harold Burris-Meyer, Stevens Institute of Technology, in Hoboken, N. J.

SMPE Convention April 4-8

A forum on television and motion pictures will open the annual convention of the Society of Motion Picture Engineers on April 4 at the Hotel Statler, New York City. Known authorities in their respective fields will present 10-minute resumes of the best technical methods utilized in producing industrial, educational, institutional, commercial, promotional, and entertainment sound-on-film motion pictures for television broadcasting. The following subjects will be discussed:

1. Engineering Techniques
2. Studio Lighting for Television
3. Sound-on-Film Recording for Television Broadcasting, with Demonstration
4. Laboratory Processing for Television, with Demonstration of High-Quality Composite prints
5. Requirements Placed on Producer, with Demonstration of a Promotional-Type Film Made for Television Broadcasts
6. Advertising and Sales Impact, demonstrated by Short Commercial Films

Coming Events

April 4-8—Society of Motion Picture Engineers, Television and Motion Picture Forum, Hotel Statler, N.Y.C.

April 6 - 9 — National Association of Broadcasters, Engineering Conference, Hotel Stevens, Chicago.

April 11-12—Conference on Industrial Use of Electron Tubes, American Institute of Electrical Engineers, Statler Hotel, Buffalo, N. Y.

April 18-20—Midwest Power Conference, sponsored by Illinois Institute of Technology, Sherman Hotel, Chicago, Ill.

April 19 - 21 — American Institute of Electrical Engineers, South West District Meeting, Baker Hotel, Dallas, Texas.

April 25 - 27 — Fourth Annual Spring Meeting of IRE and RMA, Benjamin Franklin Hotel, Philadelphia, Pa.

May 2-4—International Scientific Radio Union and IRE, Joint Meeting, East Bldg. Lecture Room, National Bureau of Standards, Washington, D. C.

May 5-7—Acoustical Society of America, 20th Anniversary Meeting, Hotel Statler, New York City.

May 16 - 19 — RMA and Radio Parts Show, Hotel Stevens, Chicago, Ill. RMA 25th Anniversary.

June 3-4—IRE, Dayton Section, Conference on Airborne Electronics, Biltmore Hotel, Dayton, Ohio.

June 20 - 25 — American Institute of Electrical Engineers, Summer General Meeting, Swampscott, Mass.

Audio Society Lectures

The Audio Engineering Society is sponsoring a series of lectures entitled "Elements and Practise of Audio Engineering" on consecutive Thursdays up to and including June 2. Lectures start at 7:00 P.M. in Room 311 of the RCA Institutes, Inc., 350 West 4th St., New York, N. Y. Tickets are available from F. Sumner Hall, course chairman, 153 West 33rd St., New York 1, N. Y. Prices of single lectures are $2.00 for members or applicants and $3.00 for non-members; for complete course, member or applicant fee is $12.00 and non-member fee is $18.00. A list of the lectures to be presented follows:

Apr. 7 — Audio Engineering Mathematics . . . Nicholas J. Rose, Stevens Institute of Technology.
Apr. 14 — Transducers I. . . . Norman C. Pickering, Pickering & Company, Inc.
Apr. 21 — Transducers II. . . . Theodore Lindenberg, Fairchild Recording Equipment Corp.
Apr. 28 — Amplifier Design . . . W. R. Ayres, RCA Victor Division.
May 5 — Attenuators and Mixers . . . J. P. Smith, Jr., The Daven Company.
May 12 — Equalizers and Wave Filters . . . P. W. Rounds, Bell Telephone Laboratories.
May 19 — Amplifier & System Measurements . . . Ivan G. Easton, General Radio Company.
May 26 — System Layout Philosophy . . . Donald H. Castle, National Broadcasting Company.
June 2 — System Layout Methods . . . John D. Colvin, American Broadcasting Company.

New Mobile TV Studio

A triple image orthicon camera chain, complete audio facilities, and many related operating conveniences have been mounted in a new mobile unit by engineers of the Du Mont television network. The "television studio on wheels" was first used as a remote location in January and it was a featured Du Mont unit at the IRE radio engineering show last month.

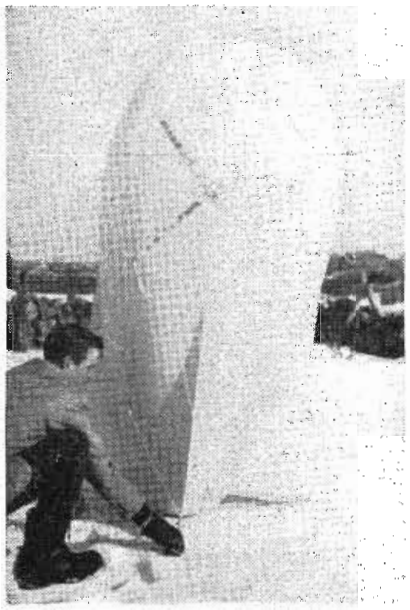
The vehicle is divided into three main compartments or sections. The forward compartment accommodates not only the driver but four additional passengers as well. This section provides transportation for the operating personnel when the vehicle is in transit, as well as serving as location for

the announcer at the point of pick-up. A sound proof door separates this front compartment from the remainder of the unit.

The central section houses the three cameras (when in transit) as well as the auxiliary camera equipment.

Balloon-Kite TV Antenna

Ralph C. Powell, Twelfthtee, Gloucester, Mass., has developed an airborne turnstile antenna mounted topside a Kytoon or combination kite and balloon measuring 6½ ft. long and 3½ ft. in diameter, for operation at elevations of 100 to 200 ft. and even up to 500 ft. The coaxial flying-transmission



line is made fast to the Kytoon bridle to prevent strain on the antenna connections and is brought to a reel on the hangar, equipped with a cable connector on the hub.

The transmission line is less than 3/32 in. in diameter and weighs around 6½ pounds per thousand ft. It has a breaking strength of more than 100 pounds, a characteristic impedance of about 57 ohms and shows an attenuation of 0.19 DB per meter at 100 MC. The Kytoon requires 40 cubic feet of helium for full inflation and will remain aloft for about 30 hours after which it should be lowered to add 4 or 5 cubic ft. of helium to make up for gas diffusion.

Helium is available at 100 regional offices of two manufacturers. The cost of a cylinder containing 240 cubic ft. is $19.50 plus a refundable deposit of $20.00 on the cylinder. This makes the cost per inflation $3.20 and the daily maintenance cost, for helium only, less than fifty cents. The neoprene bladder, however, is affected by sunlight and should be replaced after 30 days use at a cost of about $6.00.

NBC Applies for UHF Station

NBC has filed an application for an experimental ultra-high frequency television station with the FCC which will be erected in the vicinity of Bridgeport, Conn.

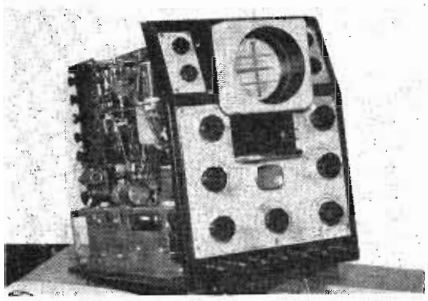
The application was made for the purpose of continuing the UHF television experiments which were conducted in Washington during the last six months on NBC's Washington station, WNBW. During that experiment WNBW operated simultaneously on Channel 4 (67 MC) and on 504 MC.

New Equipment at IRE Convention

A Representative Group of New Equipments Exhibited Publicly for the First Time at IRE Convention, March 7-10

Twin-Beam Oscillograph

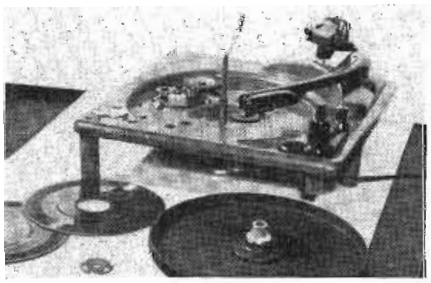
The model 1035 twin-beam oscillograph has 2 completely independent amplifiers. Both the Y_1 amplifiers have 3-tube circuits with nega-



tive feedback gain controls and a range switch which operates in conjunction with the shift control. The tube is 4-in. in diameter and the face is perfectly flat. A green screen is normally provided, but a long afterglow blue screen tube is available.—**Cosser (Canada) Ltd., 55 West 42nd St., New York 18, N. Y.**

3-Speed Disc Player

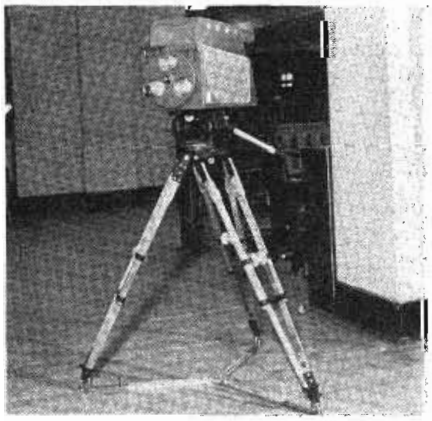
A newly-developed phonograph record player has a 3-position switch which will permit the turntable to be set for conventional 78,



33-1/3, or 45 RPM records. The 10 or 12-in. records can be played automatically, irrespective of speed, but the newer 7-in. discs require manual operation. — **Webster-Chicago Corp., 5610 Bloomingdale Ave., Chicago 39, Ill.**

Television Camera System

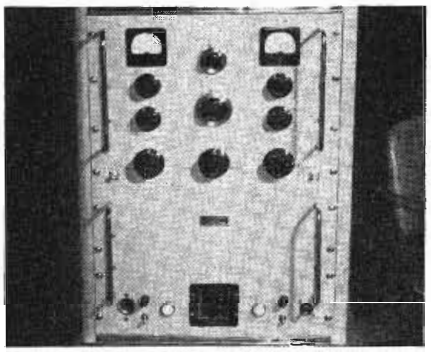
Extreme sensitivity and high definition make the new model 1200A portable television camera chain universally adaptable, even at



low light levels. Basically a single camera system using only 3 units of equipment, it may be expanded to a 4-camera system through the use of additional standard units. Self contained synchronizing generator for wired industrial applications makes basic single chain simple.—**Television Equipment Corp., 238 William St., New York 7, N. Y.**

Power Supply

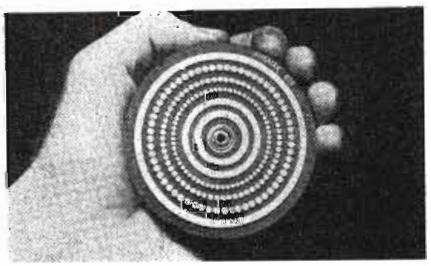
Provision is made for CW, square wave, saw tooth modulation or external modulation on the PRD type 801 universal klystron power



and modulation supply, an extremely versatile instrument capable of operating a wide variety of klystron oscillators. The assembled equipment contains a well regulated beam voltage supply adjustable in 2 steps over the range from —100 to —3600 volts DC.—**Polytechnic Research & Development Corp., Inc., 202 Tillary St., Brooklyn 1, N. Y.**

Molded Insulation

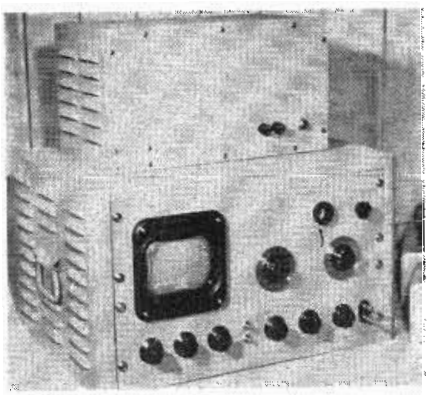
Mycalex 410 has set an astonishing high operational record for a telemetering commu-



tator used on aeronautical research projects. Commutator illustrated is made with Mycalex 410 molded insulation.—**Mycalex Corp. of America, 30 Rockefeller Plaza, New York 20, N. Y.**

Ultrasonic Amplifier

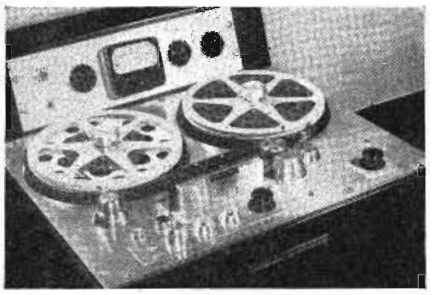
Model SB-7 ultrasonic analyzer is a scanning heterodyne receiver which automatically measures the frequency and amplitude of



ultrasonic signals. By means of a new stabilized sweeping system, the instrument tunes repetitively 6 times per second through a 200 KC range in any part of a 10 KC to 300 KC band. As signals are tuned through, they appear on a CR tube as sharp vertical pips located horizontally in order of frequency. The heights of pips indicate the relative magnitudes of their corresponding signals.—**Panoramic Radio Corp., 250 West 55th St., New York, N. Y.**

Magnetic Tape Recorder

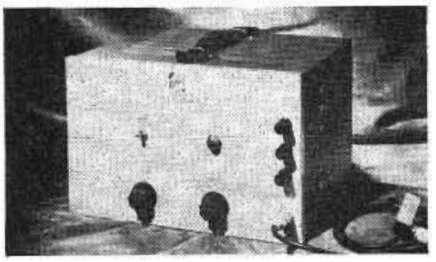
A smaller version of the model 200 Ampex magnetic tape recorder, known as the model 300, has been introduced and will operate at



15 and 7.5in./second from a switch on the top plate. The basic electronic and drive units will be available in portable, rack or studio console (illustr.) form. Playing time is ½ hour at 15-in./second, frequency response 50-15000 cps ±2DB; and 1 hour at 7.5-in./second, 50-7500 cps ±2DB, with a dynamic range of 60 DB.—**Audio & Video Products Corp., 1650 Broadway, New York, N. Y.**

Square Wave Generator

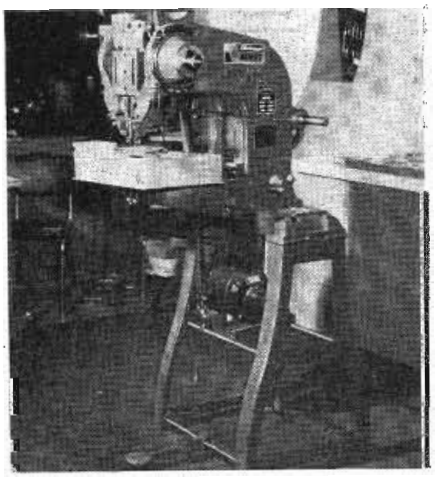
Most commonly used for general purpose wide band oscilloscope and amplifier response testing, type 204 square wave generator is



supplied with four frequencies: 2 in the range of 25 cycles to 10 KC, and 2 in the range of 25 KC to 1 MC. The proper choice of the 4 available frequencies, used in conjunction with a suitable wide band oscilloscope, makes possible convenient adjustment of video amplifiers and observation of their transient response.—**Tektronix, Inc., 712 S. E. Hawthorne Blvd., Portland 14, Ore.**

Automatic Riveter

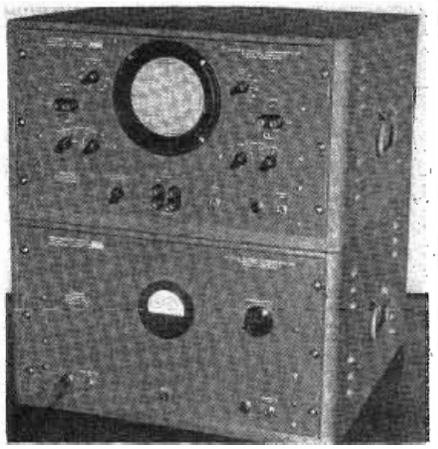
A 14-in. throat (considerably deeper than previous models) has been incorporated in



model 214 double setting automatic riveter to accommodate large television chassis. An adjustable center provides widths of ⅜ in. to 9 in.—**Chicago Rivet & Machine Co., 9600 West Jackson, Bellwood, Ill.**

Cathode Ray Indicator

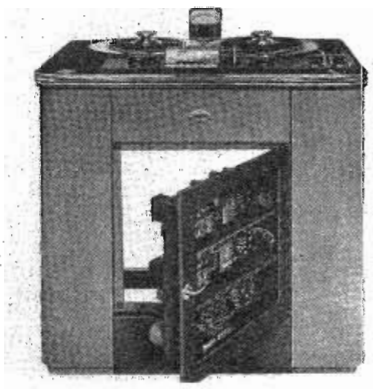
The combination of the 281-A cathode ray indicator (top) and the 286-A high voltage power supply (bottom) provides an extremely



bright cathode ray oscillograph. The 281-A is a basic instrument designed to utilize the full capabilities of the high voltage type 5RP-A CR tube. High voltage hazards are minimized in the 286-A because very little power is stored in the filtering circuits.—**Allen B. Du Mont Laboratories, Inc., Clifton, N. J.**

Magnetic Tape Recorder

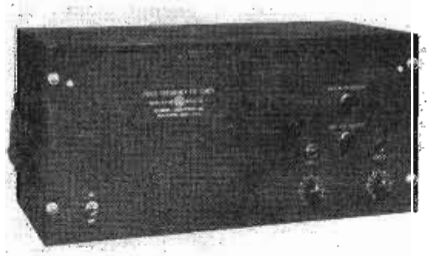
The amplifier section of the new Presto magnetic tape recorder consists of 2 completely separate units and a common regulated



power supply. One amplifier unit drives the recording head and contains the oscillator supplying AC bias and erasing power. The other unit is used for playback and provides monitoring during recording. Input and output impedances are both 600 ohms.—**Presto Recording Corp., P. O. Box 500, Hackensack, N. J.**

FM Tuner

Fixed frequency FM tuners for use in the 88 to 108 MC band are available in 3 models. Model RP-23 is a straightforward FM tuner using the Armstrong circuit with dual limit-



ers. Model RP-24 is the same tuner as the RP-23 plus relay circuits which operate on tones from 15 to 20 KC received from the transmitter and which select in sequence 2 preset audio volume levels which may be manually operated from zero to full output. Model RP-25 (illustr.) utilizes the same tuner as the RP-23 but has 2 relay circuits permitting audio level selection as in the RP-24 and also permits turning the audio on or off as desired.—**Browning Laboratories, Inc., Winchester, Mass.**

Portable Tape Recorder

(*Continued from page 41*)

braking positions are provided, permitting the speed to be such that one entire reel of tape can be transferred to another within less than three minutes. During both recording and playback, an inertia stabilizer is employed to smooth out variations in tape tension due to slack windings in the supply reel. It consists of a ball bearing movement and fly wheel whose rotating parts are held to very close tolerances in order to give the smoothest possible action while avoiding irregularities due to eccentric feed.

A feature of the record-playback head assembly is its arrangement as a plug-in unit. Two thumb screws loosen the entire assembly, and ejector springs force the contacts apart, obviating the necessity for pulling or prying. When the mounting is replaced, exact re-alignment is assured by positioning pads, facilitating quick removal and replacement, for inspection or minor maintenance.

With a 15,000 cycle tone on a tape moving 15 inches per second. one full wave-length of the recorded tone will only be .001-in. long. If the gap in the magnetic head, across which the signal is produced, is .001-in. wide, then it would span

Summary Of Performance Characteristics

INPUT: Microphone level, 150/250 ohms, or bridging from 600 ohm line. Gain control on recording amplifier.

OUTPUT: Maximum + 18 DBM at 150/600 ohms. Gain control on playback amplifier.

MONITORING: Play-back and recording amplifiers separate, permitting monitoring of material as it is recorded.

TAPE SPEED: 15-in/sec. or 7.5-in./sec. Speed change switch also changes amplifiers frequency compensation.

PLAYING TIME: 33 min. at 15-in./sec.
66 min. at 7.5-in./sec.

REWIND TIME: Approx. 3 minutes in either direction.

FREQUENCY RESPONSE: 50 to 15,000 cps at 15-in./sec. 50 to 7000 cps at 7.5-in./sec.

SIGNAL-TO-NOISE: Better than a 50 DB rotio on the tape, (below peak recording level).

WOW AND FLUTTER: 0.2% RMS at 15-in./sec. 0.3% RMS at 7.5-in./sec.

METERING: All plate currents, erose ond bias voltages, recording and output levels can be checked with VU meter.

MAGNETIC HEADS: Single plug-in assembly.

MECHANICAL: Amplifier case dimensions; 15x 21x10¾-in. Weight 49 lbs.
Recorder case dimensions; 19⅞ x 18¾ x 11⅛-in. Weight: 44 lbs.

just one wavelength of the recorded signal and no signal would be reproduced. This is the so-called "cancellation frequency" well known in sound-film, magnetic wire, and tape recording. It is obviously necessary to use a gap shorter than this, preferably one which is less than a half wave length (.005-in.) This gap must be perfectly straight and smooth, and for this reason, tolerances on the order of a micro-inch are adhered to in the manufacture of the recording and reproducing heads. Lapping techniques, similar to those used in optical work, have been developed by RCA for application in the RT-3A magnetic heads.

Several points concerning good tape recording practice are worthy of mention. Overmodulation in recording on tape should be avoided particularly since it results in several undesirable effects. Among these are increased distortion, and poor erasure, which may cause the next program recorded to have more noise in the background. Further, the signal may "soak" through from one layer to another, in storage, so that crosstalk may appear in the content, in time. Storage of the tape in warm places increases this tendency on the part of the program to "soak" through.

The RT-3A will also be available to the broadcaster in a modified version for studio use, which will retain all the design features of the portable model.

1949 IRE Convention

(*Continued from page* 35)

the analogue or continuous-variable computers was included.

The television art received a great deal of attention at a number of technical sessions and many of the problems that concern the designing engineer were discussed in detail. Here is a field of activity that is a practical outlet for diverse groups of engineers—utilizing microwave technics in intercity networks, plus regular broadcast receiver design methods with the unusual problems added due to wide band considerations, together with giving a chance for the study and solution of UHF propagation problems, and affording a field where improved circuitry pays out with better and cheaper receivers. Three sessions were mainly devoted to propagation and modulation problems associated with transmission of TV signals, and a fourth session on UHF relaying problems associated with network operation.

PERSONNEL

Robert E. Moe has been appointed division engineer for electronic receiving tube production lines of the General Electric Company's Tube Divisions. He will have his headquarters at the Owensboro, Ky., plant of the Divisions.

Advancement of **W. C. Johnson** to the newly-created post of vice-president n charge of sales of Admiral Corporation, manufacturers of electric ranges and refrigerators, radios and television sets, has been announced by the board of directors of Admiral.

Paul A. de Mars, consulting radio engineer of Washington, D. C., left in February for Teheran, Iraq to be section head of Communications Survey Group. He will be responsible for planning of wire telegraph & telephone systems, navigation aids and radio

Dr. J. R. Dedrick, formerly associate professor of powder metallurgy at the University of Cincinnati, has been appointed section head of the advanced development group at the Metallurgical Research Laboratories of Sylvania Electric Products Inc. **E. Bruce McEvoy, Jr.,** formerly assistant manager, Eastern Division, equipment tubes sales has been appointed east central manager of distributor sales for the Radio Tube Division.

E. D. McArthur has been appointed head of the General Electric Research Laboratory's High Frequency Electronics Division. He is holder of 39 patents in the field of electronics and was head of the laboratory's ultra high-frequency vacuum tube section.

J. R. Duncan has resigned as chief engineer of WLW-T. He has been with the station since 1939 and was responsible for much of the development work for WLW-T.

Edgar H. Felix, formerly Washington representative, Transmitter Division, Allen B. DuMont Laboratories, Inc., has been promoted to Northern District Supervisor for the Division. His new territory comprises New England, upstate New York, Michigan, Wisconsin, Minnesota, Nebraska, Washington, Oregon and California. His home address is 176 Franklin Ave., Malverne, N. Y.

Paul H. Burbage, Jr., for the past two years Purchasing Agent for Cornell-Dubilier Electric Corporation, has been advanced to the post of Director of Purchases.

Louis Silver, vice-president and sales manager of Garod Electronics Corporation, Brooklyn, N. Y., has been appointed executive vice-president and general manager.

Barium Titanates

(*Continued from page 31*)

Measuring the dielectric constant of small thin discs of barium titanate through the frequency spectrum, Roberts at M.I.T. showed very high and erratic resonant peaks, which shifted in frequency when the sample edges (not coated with electrodes) were chipped away. Further investigations involving the production of voltages by direct pressure alone proved conclusively that this was a piczoelectric material. Simultaneously, Koren and Crownover, at the Sonotone Corporation, in studying the voltage coefficient of capacitance, noticed that *upon removal of a biasing voltage*, barium titanate produces a small voltage when struck with a hammer. The piezoelectric effect of barium titanate had been previously predicted by Ginsburg[15] and Wainer, but it remained for these later experiments to prove the matter.

The piezo effect, has received considerable study because of the many possible uses. Several groups have published data (references 19 to 23) concerning the size of this effect permitting the table Fig. 16 to be compiled. The dielectric constant and piezoelectric modulus depend very much upon the density of the ceramic. Consequently as indicated in the table, the constants of materials processed under different conditions may vary over relatively wide limits. Matthias and von Hippel[24] state the directional piezomodulus of a single crystal of barium titanate may approach a magnitude at least one order higher than d_{14} of Rochelle salt. Since $d_{11} \simeq 2 \times 10^{-15}$ coulombs/dyne [25], the relatively high value of our material is a reasonable order of magnitude.

Reference	Piezo Constant
(19) (20)	2.2×10^{-10}
(21)	4.2×10^{-10}
(22)	6.6×10^{-10}
(23)	63×10^{-10}*
(23)	3.3×10^{-10}**

*Unidirectional compressional modulus.
**Hydrostatic pressures.

Fig. 16: Table of published piezoelectric constants for BaTi03. Values (coulombs per dyne) are approximate.

Also there appears to be a difference between our values of hydrostatic and unidirectional compressional moduli. Both are static measurements involving the use of the same measuring equipment with

(*Please turn to next page*)

(Continued from preceding page)

the exception of the mechanical force-producing equipment, and in considering the nature of piezoelectricity itself this large difference can be justified. When a force is applied between two faces of a material, the material becomes compressed in the direction of force and becomes expanded in the two directions perpendicular to the force. This combination of compression and expansion results not only in a macrosopic distortion of the material but also in an atomic rearrangement within the material.

This atomic displacement is essentially a shifting of positive, with respect to negative charges and hence charges become built up on opposite sides of the material. With equal pressure to all faces the perpendicular expansions become restricted and, since the distortion is also severely reduced, the piezoeffect also becomes reduced. Hence the hydrostatic piezo effect is much smaller than the unidirectional effect, depending to a certain extent upon Poisson's mechanical coupling ratio of the material.

Part II of this article will appear in the May issue.

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Metal TV Tubes

A new mounting and insulating sleeve of Aeroflex, a polyethylene compound has been specifically designed to facilitate mounting and insulating any metal TV tube. A sleeve of Aeroflex plastic fitting snugly over the tube cone is held in place by an extruded plastic mounting ring. All metal portions of the tube including the rim are covered by the protective sheathing and ring, making accidental contact impossible.—**Anchor Plastic Co., 533 Canal St., New York, N. Y.**

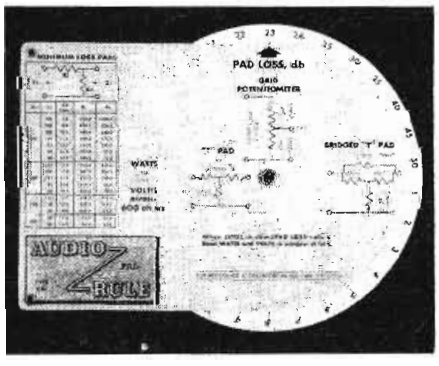
Audio Frequency Oscillator

The Jackson audio frequency oscillator provides a continuously variable frequency from 20 cycles per second to 200 KC. It is resist-

ance-capacity tuned and is accurate to 1 cycle or 2%. Output is ½ watt and there is less than 1 DB deviation.—**Jackson Electrical Instrument Co., 18 South Patterson Blvd., Dayton 1, Ohio**

Pocket Calculator

The Audio Rule is a pocket-sized circular slide-rule, designed to provide instantaneous solutions to problems of bridging and attenuation pad design. Among the information that can be obtained at a glance: for a desired loss between 1 and 50 DB, the values of resistance required for a matched T pad, a bridged T pad, a grid potentiometer,



and an L section bridging pad; the voltage appearing across a 600 ohm load when powers from .0013 to 100 watts are applied; a separate scale, which shows difference in DB when voltage ratios are known, or the converse, from 0-20 DB; the voltage ratio for corresponding impedance ratios, from 1-10,000, and related difference in DB; a table of minimum loss pads for matching from impedances of 600, 500, 250, and 200 ohms to each other, and also to 150, 125, 50 and 30 ohms. Made of vinylite it is furnished with leather case, 4½ by 5½-in.—**Audio Equipment Sales, 153 W. 33rd St., New York 1, N. Y.**

SYMMETRON AMPLIFIER

(*Continued from page 43*)

coupling, and in obtaining satisfactory electrical clearances. Secondly, conventional coupling methods upset the circuit symmetry.

The Symmetron amplifier employs coaxial tanks (cathode and plate) arranged about a common axis to form a figure of revolution. The tubes are operated in parallel and symmetrically inserted into the tanks about this common axis. Each tube, consequently, sees the same electrical and mechanical configuration for all operating frequencies. This design lends itself to multiple tube application; two to ten, or more, tubes may be operated in parallel without affecting the circuit symmetry. In turn, the low-impedance tank elements required are easily realized using the coaxial transmission line construction with proper selection of the tank parameters. The Symmetron tank shown in Fig. 4 employs eight WL-3X2500 A3 tubes to provide a 50-KW output with a driving power of approximately 12.5 KW.

The Symmetron design is associated with simplified, wide-range, tuning. Typically, the 50-KW FM tank shown in Fig. 4 requires only three adjustable tuning controls — cathode tuning (shorting bar), plate tuning (shorting bar), and output coupling (capacitor). These controls are motor driven and tune through the complete 88 to 108 MC band without mechanical adjustment of the tank. This is in direct contrast to conventional FM grounded-grid, push-pull amplifiers utilizing two-wire transmission line tanks where, even at much lower power levels, as many as nine adjustable controls are needed.

The cathode and plate shorting bars, in Fig. 4, are used for both coarse and vernier tuning of the tank. These bars consist of closely spaced phosphor-bronze contact fingers segments mounted about the inner and outer peripheries of a circular supporting ring. The contact surfaces of the fingers are formed in an elongated spoon-shape to assure a free sliding line contact, and are buffed chrome finished to provide a durable wearing surface against the silver-plated tank cylinders.

Capacitive or direct coupling is incorporated in the Symmetron design to preserve the overall circuit symmetry. Accordingly, in Fig. 4, adjustable coupling to the 6⅛-in. output line is provided through the circular plate capacitor in the plate cavity. The outer conductor of the line is attached directly to the plate tank. The inner conductor is extended to the positionable capacitor plate through a flexible metal bellows approximating the diameter of the inner conductor. This bellows provides a smooth transition between the capacitor plate and the inner conductor, and allows the capacitor plate to be positioned along the axis of the tank by the rack and pinion drive mounted inside the inner conductor. The capacitor couples the output line, as required for grid-separation amplifiers, between the grid and plate planes of the tank. Likewise, the central location of the capacitor preserves the electrical symmetry of the circuit.

The input line is coupled directly across the cathode tank through a quarter-wave matching transformer. In turn, the matching transformer is centrally located to preserve the circuit symmetry. This method of coupling requires no adjustable elements and performs effi-

ciently throughout the FM band without alteration.

The Symmetron design reduces danger to operating personnel from either RF or DC voltages, and minimizes RF radiation. Suitable blocking capacitors isolate the DC tube voltages from all of the tank cylinders. RF voltages are confined to the interior of the tank due to the basic electrical operating characteristics of cavity or coaxial line tanks. The exterior of the tank is, consequently, free of dangerous RF potentials, and, at the same time, RF radiation is held to a minimum.

The construction of the plate blocking capacitor for the 50-KW FM tank is shown in the expanded view at the top left of the tank in Fig. 4. The eight tube anodes are tied together by affixing the individual tube anode contact rings to a common plate which is a part of the plate blocking capacitor. The DC anode voltage is fed to this common plate at a single point through a feed-through insulator in the top of the plate tank. The outer tank cylinder and top plate are, consequently, free of DC potentials except for the protruding tube anodes and their associated contact rings.

The plate blocking capacitor construction is also representative of that employed for the grid and filament capacitors. However, for purposes of individual tube metering, these respective elements are not tied together. The individual grid metering leads are brought directly downward from the individual grid contact rings, through the cathode cavity, and out through the top plate of the filament cylinder, using feed-through insulators, to RF chokes. These chokes, followed by ceramic bypass capacitors, prevent the RF voltage induced in the grid leads in passing through the cathode tank from reaching the external metering circuit.

Utilizing tube types available today, the Symmetron technic makes possible the following RF power levels: for FM broadcasting, 75 KW in the 88 to 108 MC band; for black and white TV, 25 KW in the 54 to 88 MC band and 10 KW in the 174 to 216 MC band; for black and white or color TV, 1 to 2 KW in the 500 to 1000 MC spectrum. These power levels are 1.5 to 5 times greater than those obtained with commercial equipment currently in manufacture for the 50 to 1000 MC region. The design of special tubes for Symmetron amplifiers will further increase their range of utility.

NAB ENGINEERING CONFERENCE

(*Continued from page 28*)

tion and support design arrangements; transmission line installation for low "standing wave ratios"; housing, transmitter building design; power requirements for various sections; operating space requirements; testing procedures and equipment; different from normal requirements of vacuum tubes for television; operating personnel and training; recommended maintenance procedures; operating costs; studio design and equipment; switching and controls; and TV pickup equipment and methods.

AM, FM & TV Audio Measurements

F. H. McIntosh, Consultant,
710 Fourteenth St., N.W., Washington, D. C.

This paper describes the current audio requirements of the FCC concerning measurements of gain frequency characteristics, harmonic distortion, and the methods currently used or recommended for their determination. Included is a definition of percentage modulation for both FM and AM transmitters; harmonic distortion analysis, both by summation process of individual harmonic components and RMS measurements, using a suitable distortion factor meter; practical suggestions for the measurement of these characteristics and requirements for suitable equipment and filters to assure acceptance before the Commission. The charactertistics of different types of transmitters, such as those of "squirt" carrier, compressed carrier, and their effect upon modulation percentage are discussed. A number of slides to simplify the description will be shown.

Design & Operation of TV Mobile Unit

W. I. McCord, Monager, TV Specialties Dept., Allen B. DuMont Lab., Clifton, N. J.

The paper will cover the design, development and operation of a television mobile unit for use in field operations. The construction of the vehicle is discussed, as well as the installation of equipment in the completed unit. The use of the vehicle in handling remotes is also described, as well as the many problems incidental to handling this type of unit in the field.

The unit described is of an advanced type, accommodating a triple Image Orthicon Camera chain, together with a full complement of audio facilities. Microwave relay equipment is provided for transmitting the remote program back to the master control room or studio.

Operation of Image Orthicon Camera

J. H. Roe, Supervisor, TV Systems Engineering Group, RCA Victor, Camden, N. J.

Specific adjustment and operating techniques for obtaining the best possible picture from image orthicon type television cameras will be discussed in this paper. Subjects such as beam aligment, choice of lens and stop, and adjustment of beam current and target potential will be covered in detail. The four types of image orthicons will be reviewed, particularly as regards relative sensitivity, spectral response and general suitability for various applications. The pitfalls most frequently encountered will be discussed and a list of "do's and don't's" presented. This paper assumes a previous knowledge of the general design of image orthicon cameras and the discussion will be on an advanced level.

Magnetic Tape Recording & Reproducing

S. J. Begun, Vice-President in charge of engineering, Brush Development Co., Cleveland, Ohio

Magnetic recording equipment, as it is now available, meets all requirements (frequency response, distortion, flutter) for high quality work. The relative performance characteristic of magnetic and disk recording equipment will be discussed. With the NAB standardization program sufficiently advanced during the last year, the station engineer and manager must give serious consideration to employ magnetic recording equipment, wherever it can be used.

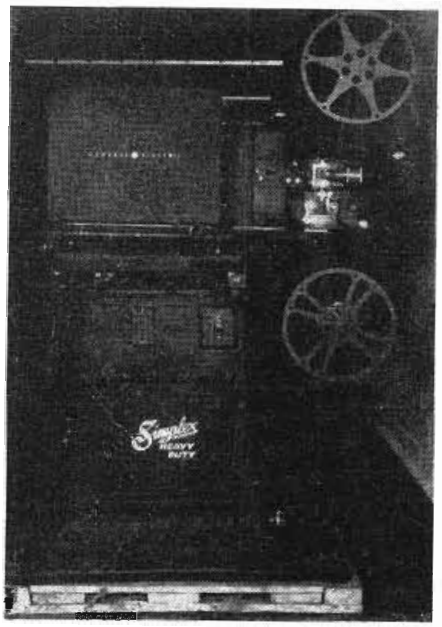
The most important fields of application are: recording of programs to be transmitted at some later time (time delayed programs); composing a show (editing of programs); and on-the-spot recording (portable equipment). The requirements for these three uses will be reviewed briefly.

Improved 16 mm Synchrolite Projector

H. B. Fancher, Television Engineer, TV Engineering Section, General Electric, Syracuse, N. Y.

This shutterless projector especially designed for television service uses

pulsed light from a krypton flash lamp controlled by the sync generator. This permits transmission of single frames at full intensity and furnishes a higher



light output than previously available. The optical system consists of a separate lamp house with precision mounting and control for the flash lamp reflector and lense system. The projector head uses a standard pull down ratio with an extremely fast starting and stopping time, and the audio system provides equalized response well beyond the capability of most film.

Selecting an FM/TV Transmitting Site

E. S. Clammer, Commercial Engineer, Engineering Products Dept., RCA, Camden, N. J.

This paper describes an experimental system for evaluating a proposed television or FM transmitting antenna location. This system provides information on field strength and incidence of echoes within the proposed service areas. The method employs an airborne transmitter and an antenna radiating pulses of short duration, high peak power and low recurrence rate, and a receiving equipment capable of indicating strength of received pulses and the amplitude of delayed echoes. Included is a description of tests made with this equipment when supported by a captive balloon. Correlation with existing television station coverage is discussed. The paper is of special interest to those directly responsible for selection of television transmitting antenna locations.

Training AM & FM Engineering Personnel for TV Operations

W. Baston, Technical Training Director, NBC, New York City

The ultimate success achieved by modern engineering operations in the field of broadcasting, FM and television depends to a large extent upon the electronics engineeer's ability to convert technical knowledge into practical use. In recent years, the term "know-how" has been used to describe this ability in a broad sense.

The paper will outline a course of instruction designed to train engineers for the practical application of their electronic knowledge. It is based upon the assumption that the individual engineer has completed at least two years of academic study.

TV & FM Field Intensity Measurements

C. P. Adair, Consultant, 1833 M St., N.W., Washington, D. C.

It is normally considered that TV and FM field intensity surveys are only a necessary evil to satisfy the requirements of the FCC. However, when properly made and used they have much more valuable uses to the licensee. There are a number of methods having various advantages and disadvantages. Several of these methods are described and discussed. The essential equipment and methods and procedures are described briefly. Although the taking of accurate measurements is essential, they are of little value other than to meet the requirements of the FCC unless they are analyzed and interpreted to give a practical indication of what the measurements mean with respect to actual reception.

Super Power Frequency Modulation

J. E. Young, Manager, Broadcast Transmitter Engineering Group, RCA, Camden, N. J.

Three FM stations now on the air (WTMJ-FM), Milwaukee; WBRC-FM, Birmingham; and WMCF, Memphis) are operating with radiated powers of between 300 KW and 600 KW. Powers of this order—sometimes called "super-power"—are obtained by the use of a 50 KW transmitter in combination with a high-gain antenna. The design of a

(*Continued on page 62*)

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2J27	2965-2992 mc.	275 KW.	$25.00
2J32	2780-2820 mc.	285 KW.	$25.00
2J37			$45.00
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2J39 Pkg.	3267-3333 mc.	87 KW.	$35.00
2J40	9305-9325 mc.	10 KW.	$65.00
2J49	9000-9160 mc.	58 KW.	$85.00
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2J62	2914-3010 mc.	35 KW.	$65.00
3J31	24,000 mc.	50 KW.	$55.00
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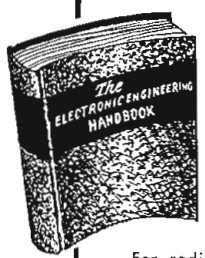

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Engineering Conference

(*Continued from page 59*)

50 KW transmitter for operation in the 88-108 MC band presented a number of new problems and considerable laboratory development (in advance of commercial design) was required before a satisfactory design was achieved. This paper discusses the course of this work and some of the interesting features of the final design, and describes the installation and proof of performance measurements.

Progress Report on UHF TV

T. T. Goldsmith, Jr., Allen B. DuMont Labs., Clifton, N. J.

This paper will discuss the utilization of the UHF channels extending from 475-890 MC. Interest has grown with the realization that adoption of standards by the licensing authority, to put these channels into use, would open up a truly nationwide television service. Therefore, this paper will deal with the propagation problems in the UHF band and will discuss the possible allocation of frequencies to UHF stations, the present status of transmitting and receiving equipment, together with information as to performance, time schedules and cost. Also, some consideration is extended with reference to bandwidth, black and white, color, and other essential factors which must, of necessity, be reconciled before commercial operation in this region is possible.

New Triode for 4,000 MC

(*Continued from page 33*)

to 70%) and to electron emission densities 5 to 6 times higher than those previously obtained.

Table I is a summary of the pertinent low frequency characteristics of the 1553 triode.

TABLE I
Low-Frequency Characteristics

For $V_p = 250$ V, $I_p = 25$ MA, $V_g = 0.3 \pm 0.2$ V.

$C_{kh} = 10$ μμf
$C_{gp} = 1.05$ μμf
$C_{kp} = .005$ μμf
$g_m = 50{,}000$ μmhos
$\mu = 350$
$r_p = 7{,}000$ ohms

It should be noted that at plate currents of 25 MA the transconductance/MA is about 2,000, that is, 1/5 of the theoretical upper limit. At lower currents this figure is higher, for example, at 10 MA it is 3,000 μmho/MA.

An amplifier circuit designed by Mr. A. E. Bowen of these Laboratories provides simple resonant cavities and coupling windows such that the amplifier may be tuned and matched to waveguides in a band from 3,700 to 4,200 MC. One stage of class A amplification will pro-

(*Continued on page 64*)

TELE-TECH

Advertisers April 1949

While every precaution is taken to insure accuracy, we cannot guarantee against the possibility of an occasional change or omission in the preparation of this index.

(*Continued from page 62*)
vide at 4,000 MC 7 to 10 DB gain over a bandwidth 3 DB down of 80 to 100 MC. One stage of class B amplification having a gain of 4 to 6 DB delivers from ½ to 1 watt over the same bandwidth at a plate dissipation of about 6 watts.

In a modulator circuit designed by Mr. W. W. Mumford the input signal frequency is 65 MC and the output sideband frequency is in the 4,000 MC band. With about 150 milliwatts of beating oscillator power, the 1553 will provide modulation gains of 4 to 6 DB over bandwidths 3 DB down of 60 to 80 MC, with output power about 20 milliwatts. This is to be compared to the 10 DB loss which is obtained in the New York to Boston system with crystal modulators giving output powers about 6 milliwatts.

Messrs. Bowen and Mumford have also developed a new amplifier circuit which provides considerably greater gain band products with the 1553 triode in the 4,000 MC range. As an example, gains of 8 DB at bandwidths of 200 MC for a gain-band product of 1250 MC have been obtained.

The tube also works well as a harmonic generator. In the present New York to Boston system, reflex oscillators are employed to provide the local and transmitting oscillator power. Buffer amplifiers are necessary to provide frequency stability and raise the oscillator power level. As an improvement on this, Mr. D. M. Black has produced enough power for use as a 4,000 MC transmitting oscillator from a chain of multipliers beginning with a piezoelectric crystal oscillator at 40 MC. The last stage of his array is a 1553 doubler going from 2,000 to 4,000 MC with a gain of from 0 to 3 DB at an output level of 300 milliwatts.

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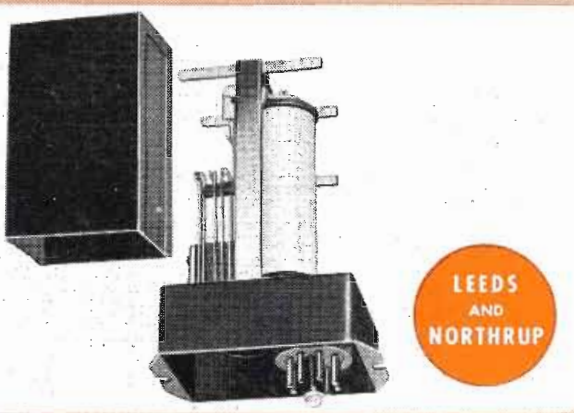

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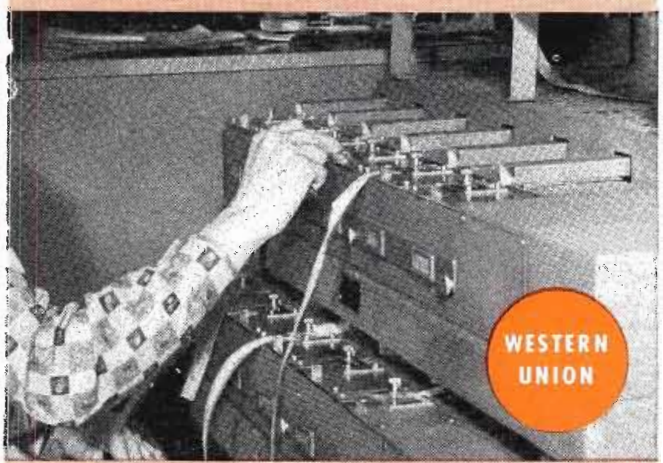

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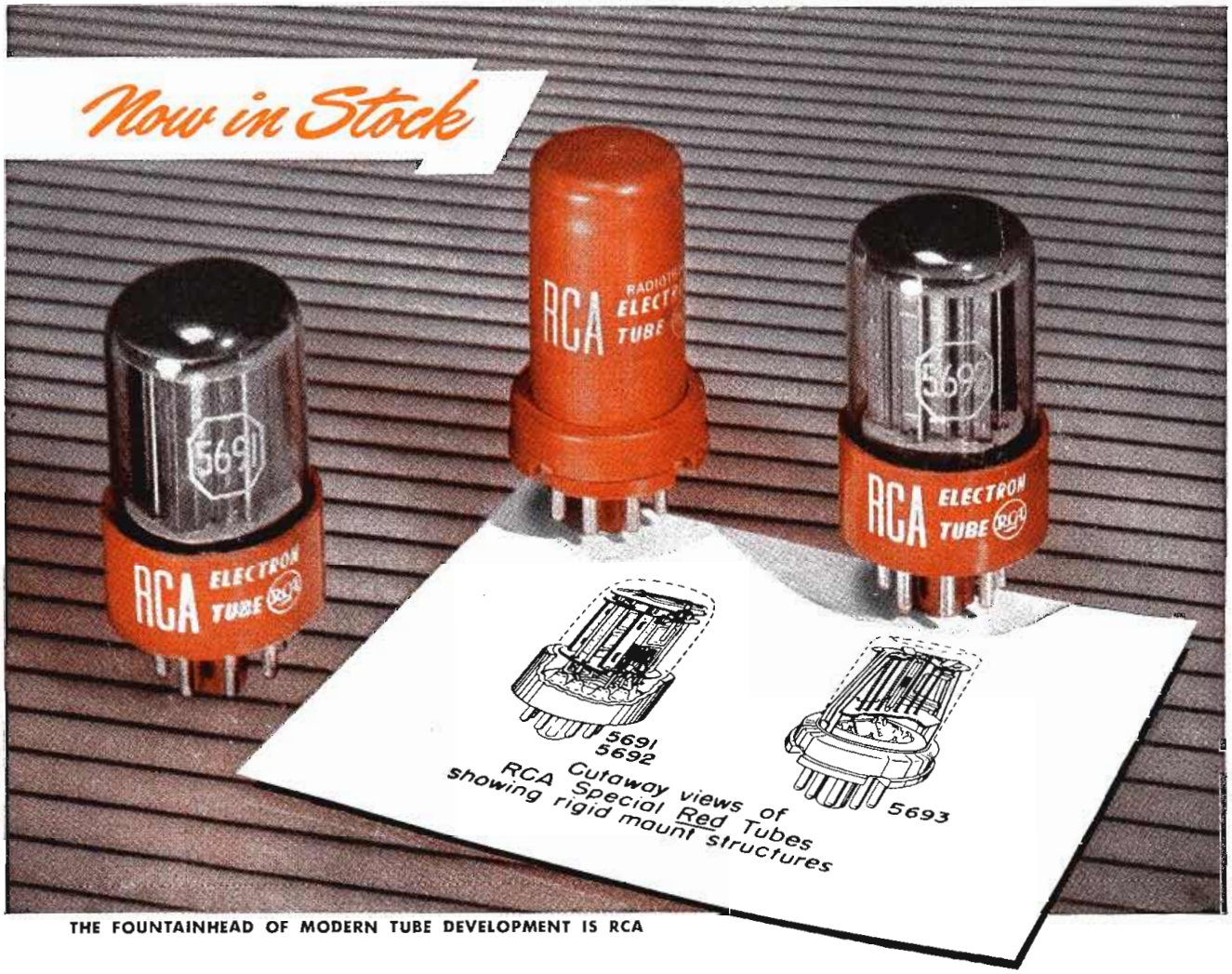

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