TELE-TECH

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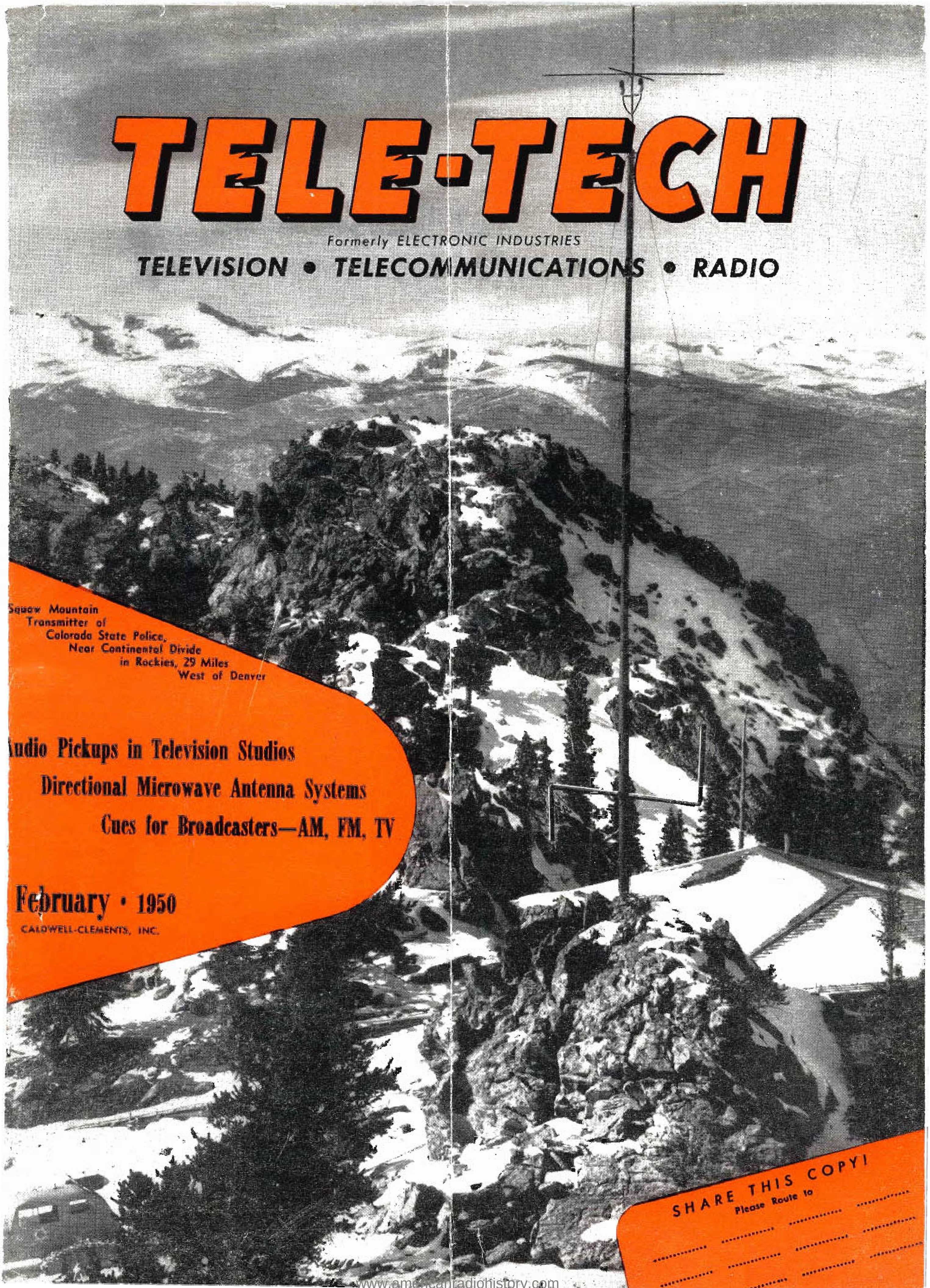

Squaw Mountain Transmitter of Colorado State Police, Near Continental Divide in Rockies, 29 Miles West of Denver

Audio Pickups in Television Studios

Directional Microwave Antenna Systems

Cues for Broadcasters—AM, FM, TV

February • 1950

CALDWELL-CLEMENTS, INC.

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RAYTHEON AM–FM & TV TRANSMITTERS are equipped with Adlake Relays

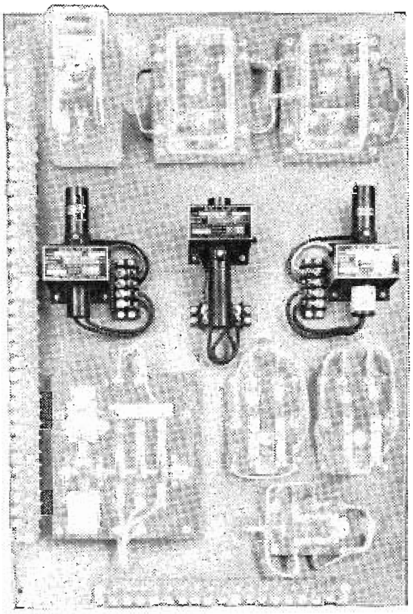
RAYTHEON Manufacturing Company's AM, FM and TV transmitters, including the famous "RF-3" 3-KW FM, "RA-5" 5-KW AM and the new "RTV-500" 500 watt TV and "RTV-5" 5000 watt TV equipment, employ Adlake Relays for CONTROL.

Silent and chatterless, Adlake Mercury Plunger Type Relays are an integral part of these streamlined transmitters which produce high fidelity modulation with a low noise level.

Besides silent operation, Adlake Relays bring these advantages to *any* job where relays are used:

- **Hermetically sealed contact mechanism is impervious to dust, dirt and moisture.**
- **Liquid mercury-to-mercury contact prevents burning, pitting and sticking.**
- **Adlake design armors relays against outside vibration or impact; they are usable on either stationary or fixed equipment.**

Whatever your relay needs are, there's an Adlake Relay to do the job. You'll like our free, illustrated folder giving full details. Write for it today to: The Adams & Westlake Company, 1117 N. Michigan, ELKHART, Indiana.



(Above) Relay panel in Raytheon's RF-3A 3-KW FM AMPLIFIER (shown below)

THE
Adams & Westlake
COMPANY

Est. 1857 • ELKHART, INDIANA • New York • Chicago

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

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Edited for the 15,000 top influential engineers in the Tele-communications industry, Tele-Tech each month brings clearly written, compact, and authoritative articles and summaries of the latest technological developments to the busy executive. Aside from its engineering articles dealing with manufacture and operation of new communications equipment, Tele-Tech is widely recognized for comprehensive analyses and statistical surveys of trends in the industry. Its timely reports and interpretations of governmental activity with regard to regulation, purchasing, research, and development are sought by the leaders in the many engineering fields listed below

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FEBRUARY, 1950

COVER:

THE COLORADO STATE POLICE TRANSMITTER on Squaw Mountain towering 11,000 feet among the Rockies uses a 250 watt Philco PRT 83G transmitter operating on 42.46 MC into a folded ground plane antenna. The unusual "Z" formation on the lower part of the tower supports two directional antennas for communicating with the dispatcher at Denver 29 miles away via a 156.69 MC link which uses a Philco PRT 60 GT and PRT-170 G transmitter and receiver. 110 mobile PRT 33 GTS 50 watt units are used by the patrol and service ranges of up to 120 miles are obtained.

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Publishers also of RADIO & TELEVISION RETAILING

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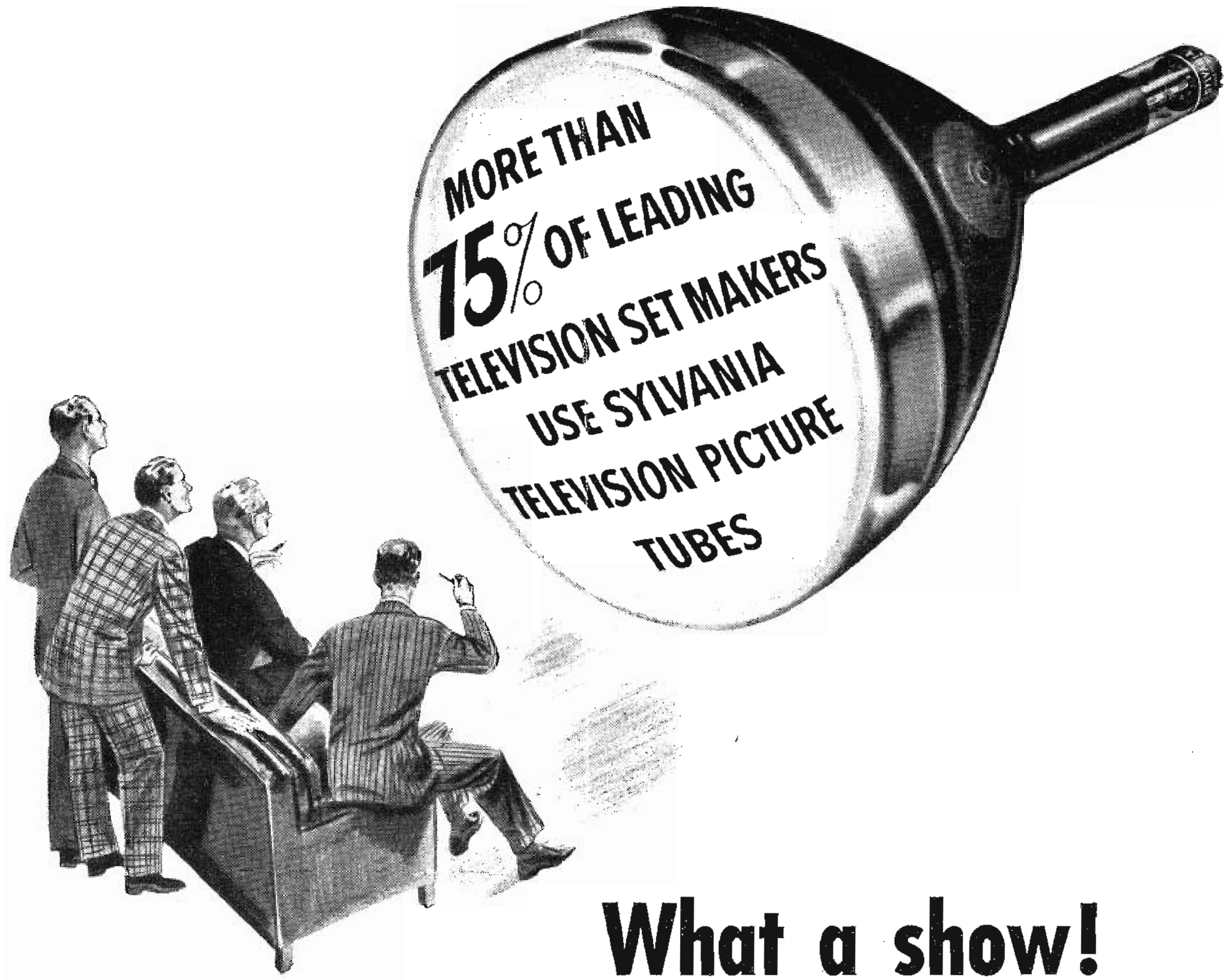

What a show!

A recent intensive survey discloses that among the major television set manufacturers, more than 75% use Sylvania cathode ray tubes! This impressive showing is a tribute to the research and quality production techniques employed by Sylvania in the making of picture tubes that are unsurpassed. If you wish full information about the entire Sylvania line of television picture tubes made by the manufacturers of highest quality radio tubes and electronic equipment, write Sylvania Electric Products Inc., Dept. R-2402 Emporium, Pa.

These leading television set manufacturers use Sylvania Television Picture Tubes

Admiral • Air King • Andrea • Ansley • Automatic
Bendix • Crosley • DeWald • Emerson • Fada
Farnsworth • Garod • Hallicrofters • Hoffman
Magnavox • Midwest • Motorola • National • Olympic
Packard-Bell • Philco • Pilot • Raytheon-Belmont
Regal • Scott • Sentinel • Silvertone • Sparton
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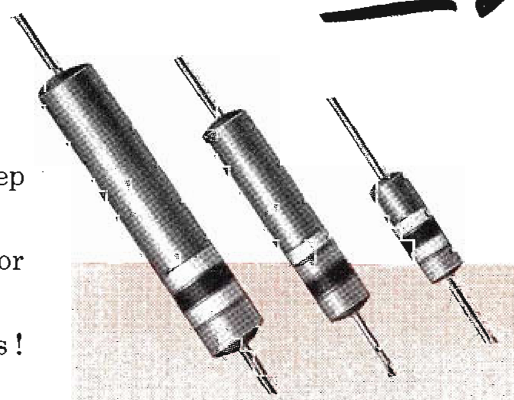
SYLVANIA ELECTRIC

CATHODE RAY TUBES; RADIO TUBES; ELECTRONIC DEVICES; FLUORESCENT LAMPS, FIXTURES, WIRING DEVICES, SIGN TUBING; LIGHT BULBS; PHOTOLAMPS

Specialization is

for resistors too!



Specialization—and *only* specialization—can keep manufacturers abreast of today's resistance needs.

The constantly-growing multitude of resistor applications demands full-time concentration on resistance products. *IRC has concentrated*—for 25 years! Result:—The widest line of resistance products in the industry; parts designed to suit specific circuit requirements in virtually every type of application; unbiased recommendations.

LOW-WATTAGE WIRE WOUND REQUIREMENTS are met efficiently by IRC Type BW Wire Wound Resistors. Exceptional low-range stability and economy suit these small, completely insulated resistors to use in meters, analyzers, cathode bias resistors, television circuits, low-range bridge circuits, high stability attenuators, low-power ignition circuits. Check coupon for Bulletin B-5.

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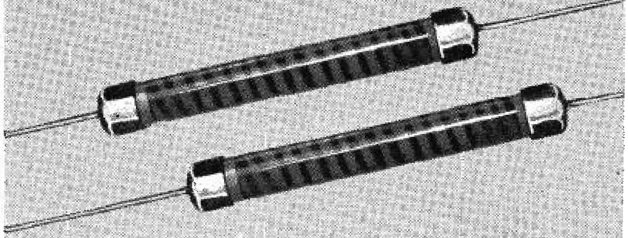
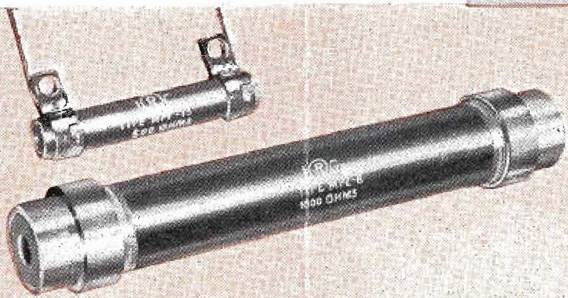
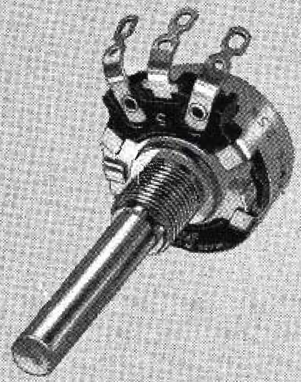


IN HIGH VOLTAGE APPLICATIONS where high resistance and power are required, Type MVX high ohmic, high voltage resistors afford exceptional stability. Construction is similar to that of Type MV, but distinctive terminal permits mounting through a hole in mounting block of insulating material without terminal interference. Long resistance path permits use of high voltage on resistor while keeping voltage per unit length of path comparatively low. Check coupon for Catalog G-2.



IN CRITICAL HIGH-FREQUENCY CIRCUITS, Type MP High Frequency Resistors offer dependable performance and unusual stability. Special resistance film on a steatite ceramic form provides a stable resistor with low inherent inductance and capacity—entirely suitable for broad band RF amplifiers, RF probes, dummy loads for transmitters, television side-band filters, radar pulse equipment, and other circuits involving steep wave fronts. Send coupon for Bulletin F-1.



NEW TYPE Q CONTROL offers many advantages to engineers and purchasing agents. Its modern 15/16" diameter size features a one-piece dual contactor of thin, high-stress alloy; simplified single-unit collector ring; molded voltage baffles; and special brass element terminals that will not loosen or become noisy when bent or soldered. Increased arc of rotation provides same resistance ratio as larger IRC controls. Salt-spray materials are employed. Complete mechanization in manufacture assures absolute uniformity and provides a dependable source of supply for small control requirements. Coupon brings you full details in Catalog A-4.

When you have special need of maintenance or experimental quantities of standard resistors in a hurry, simply phone your local IRC Distributor. IRC's Industrial Service Plan keeps him fully stocked with the most popular types and ranges—enables him to give you 'round-the-corner delivery of small order requirements. We'll gladly send you his name and address.

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- ☐ MP High Frequency Resistors
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TELE-TIPS

LONGER-RANGE RADAR equipment is needed for the great radar screen already laid out across the nation's northern frontiers. With enemy bomber speeds reaching 500 to 600 miles per hour, it is felt that the 250-mile limits of present radar units do not give enough time to start counter measures, even using centralized radarscopes at defense headquarters.

SUPER-INTELLIGENT GUESSING—A short decisive answer is usually expected for the majority of the simplest sounding problems put up to an engineer. Generally an answer involves the interrelated effects of many unstated factors. Sometimes the weight of experience permits an answer to be based on an intelligent guess. Usually however a quick answer would be either a pure guess or an honest "don't know." The present activity in automatic computing equipment seems to predict the advent of simpler computers that will turn guesses into estimates!

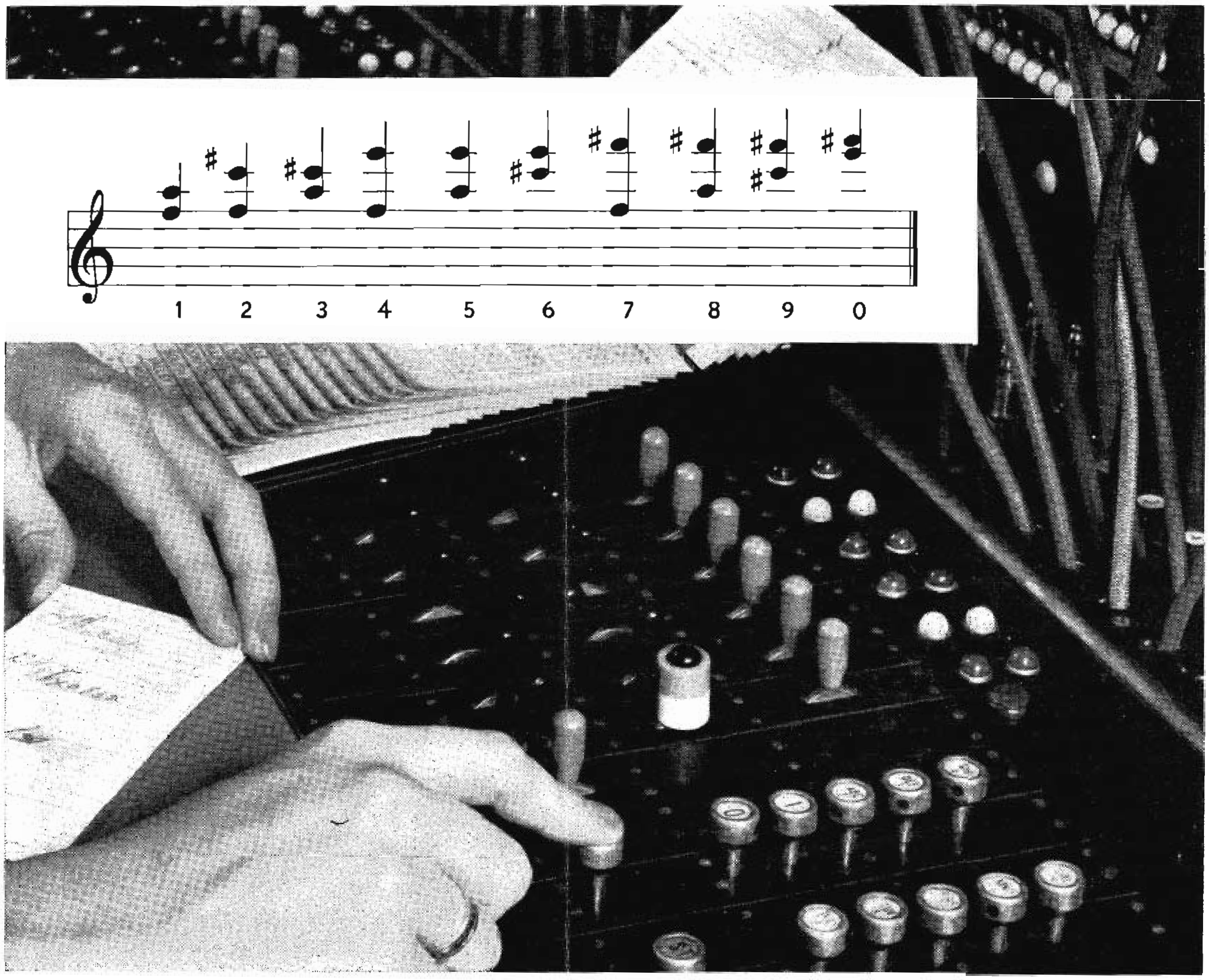
COMPLETE OR COMICAL?—The published literature on radio has always contained mathematics. Experience has shown that early analytical reports that omitted or avoided many contributing factors give useless results. Hence large groups of engineers avoid having their thinking contaminated by mathematics.

Thus these two groups of designers (they can possibly be distinguished by their exclamations when they see a complex formula, either Gee! or Haw!) have had to produce longer and more complicated formulas or more elaborate test set-ups and measuring equipment as the art grew more complex. Either system above will give results if all contributing effects are correctly considered. Wise management provides personnel and facilities for both.

ELECTRONIC & MECHANICAL THINKERS—and there are many forms, at present all too elaborate for any but the largest laboratories. This condition will be remedied before long because accuracies to seven or more places are not usually needed for routine designs. Such developments again show one more large area of industry built up from the building blocks of the radio engineer —a few basic electronic components.

SCOPHONY REORGANIZATION in U. S. has caused many engineers to look back into the basic developments of this system of TV projection. This non-cathode ray system utilizes many ingenious devices in its plan but whether they are capable of producing active competition with cathode-ray systems remains to be proven. Using American standards an increase in the number of sides on the high speed polygon to thirty facets needed over that which was used in previous demonstrations in London. The two parts of the problem now handled by the cathode-ray tube (i.e. light intensity modulation at a rate of several megacycles, and rapid line scanning) are handled by (1) a light modulation cell based on ultrasonic pressure waves in a liquid, and (2) a rotating multi-faced mirror that reflects this modulated beam at a rate of 15750 faces per second.

BC STATISTICS—Total AM stations operating 2055; total FM stations 742; total TV stations 100. Radio operators licensed 600,000. Amateur stations 85,000.



Above is the Bell System's new "musical keyboard." Insert shows the digits of telephone numbers in musical notation, just as they are sent across country.

Playing a tune for a telephone number

Before you talk over some of the new Bell System long distance circuits, your operator presses keys like those shown above, one for each digit in the number of the telephone you are calling. Each key sends out a pair of tones, literally setting the number to music.

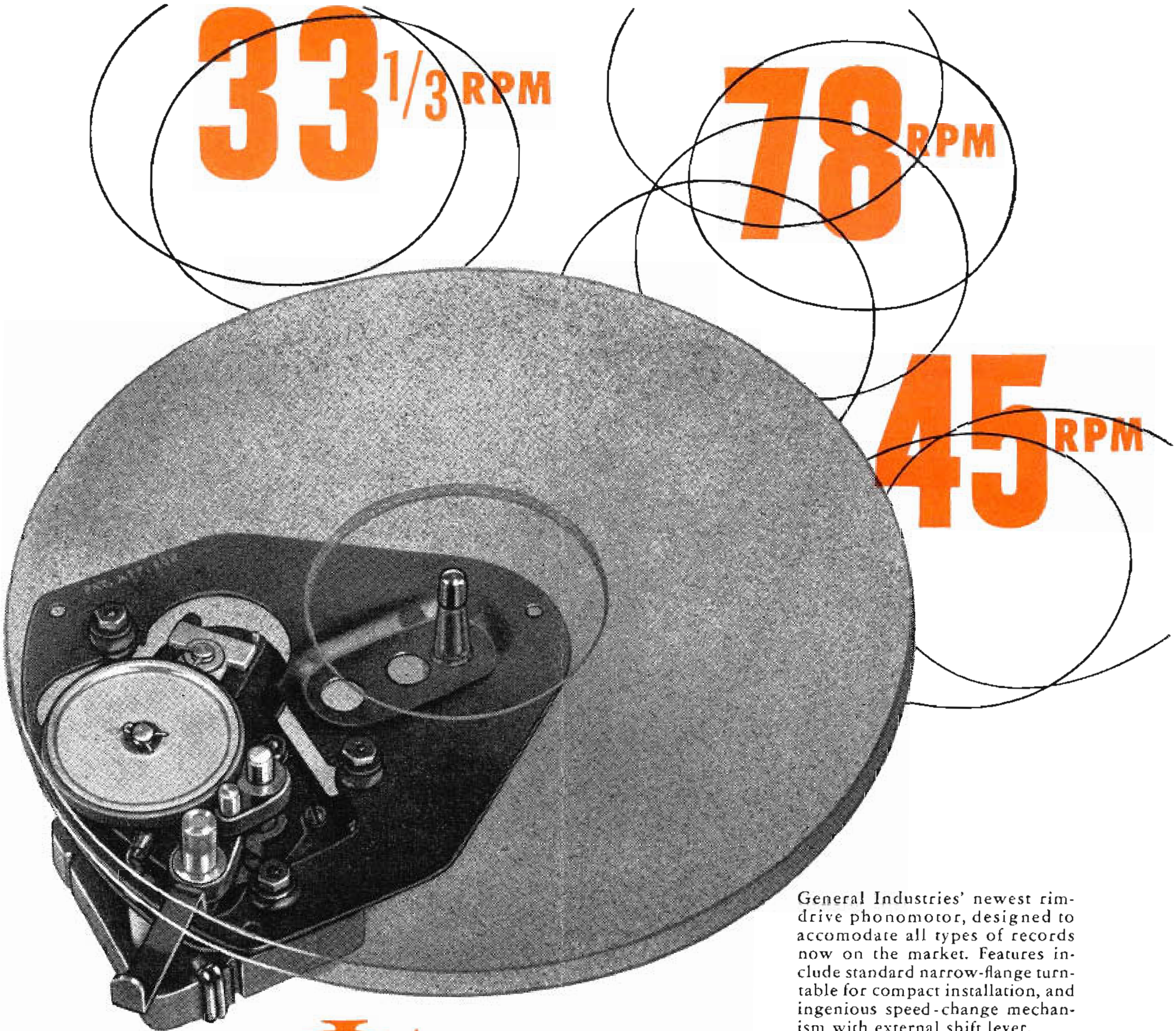
In the community you are calling, these tones activate the dial telephone system, to give you the number you want. It is as though the operator reached clear across the country and dialed the number for you.

This system, one of the newest developments of Bell Telephone Laboratories, is already in use on hundreds of long distance lines radiating from Chicago, Cleveland, New York, Oakland and Philadelphia, and between a number of other communities.

It will be extended steadily in other parts of the country — a growing example of the way Bell Telephone Laboratories are ever finding new ways to give you better, faster telephone service.

BELL TELEPHONE LABORATORIES

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



General Industries' newest rim-drive phonomotor, designed to accomodate all types of records now on the market. Features include standard narrow-flange turntable for compact installation, and ingenious speed-change mechanism with external shift lever.

This model for manual operation. Many variations are available to record-changer manufacturers.

MODEL TS (ALL THREE SPEEDS)

Here's the turntable that puts you right in the middle of the profitable market for consoles, table models and portable phonographs that will play all three types of records. Simple and fool-proof in operation, the Model TS incorporates all of the advanced engineering features which have long distinguished GI's *complete* line of Smooth Power phonomotors, recorders and record-changer recorders.

Quantity price quotations, specifications and blueprints mailed immediately upon request. Write today to:

The GENERAL INDUSTRIES Co.

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* FOR SAFETY ECONOMY CAPACITY

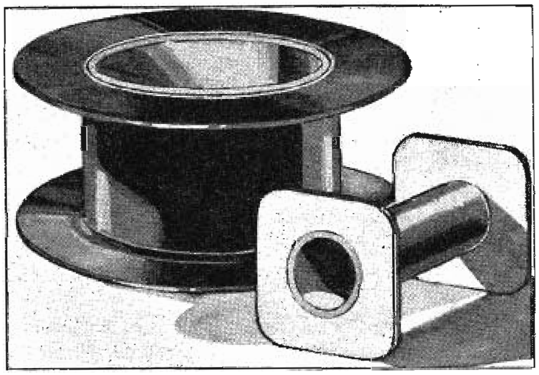
See our Exhibit No. 207 at the I.R.E. Radio Engineering Show.

#102 CLEVELAND high dielectric strength coil forms for high voltage power supply circuits of television receivers.

#96 CLEVELAND coil forms with collars insure high quality at low cost. Specify that the collars be included and positioned on the core and thus secure a snug fit and an electrically stronger assembly.

SPECIFY....

"CLEVELAND"



BOBBINS . . .

are additional applications of CLEVELAND phenolic and paper tubing. The Kirby Company, Cleveland, Ohio, whose samples are shown above, uses CLEVELAND products exclusively in their complete line of radio, television and other type bobbins.

COSMALITE* SPIRALLY LAMINATED PAPER BASE PHENOLIC TUBES

Furnished in sizes, and with punching, notching, threading and grooving that meet the customer's individual needs.

"Cleveland" quality, prices and deliveries are responsible for the universal satisfaction and prestige of this product.

Ask about our kindred products that are meeting both new and established needs in the electronic and electrical fields.

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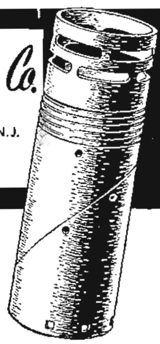

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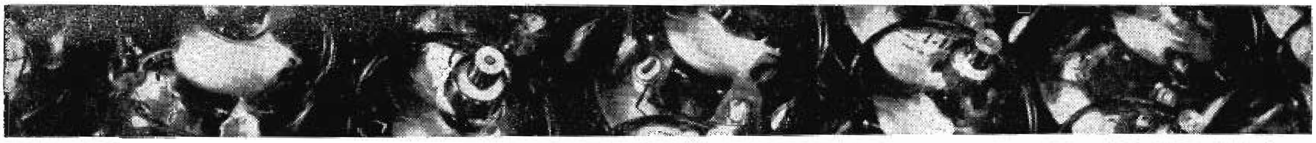
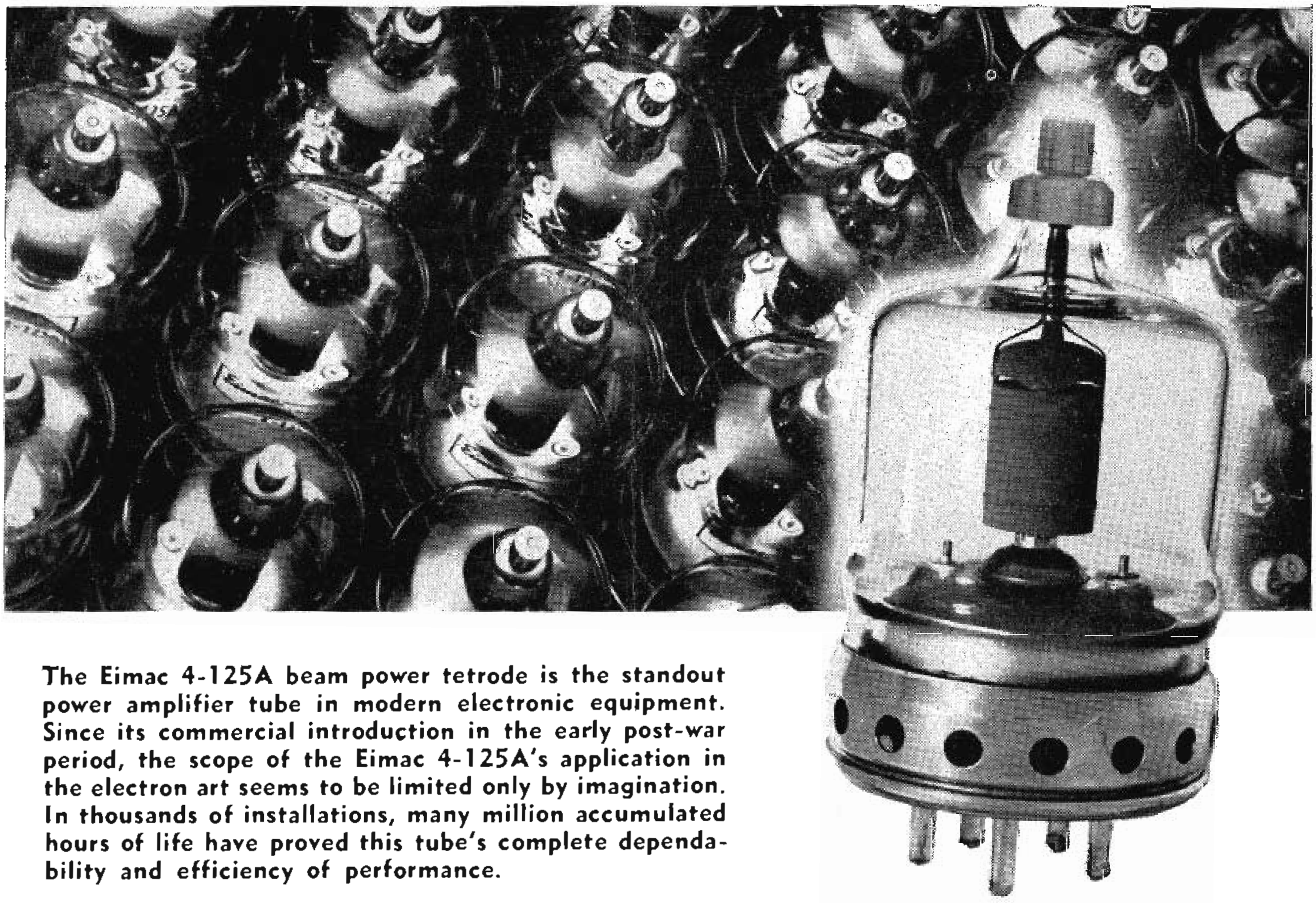


THE DEMAND STILL GROWS



The Eimac 4-125A beam power tetrode is the standout power amplifier tube in modern electronic equipment. Since its commercial introduction in the early post-war period, the scope of the Eimac 4-125A's application in the electron art seems to be limited only by imagination. In thousands of installations, many million accumulated hours of life have proved this tube's complete dependability and efficiency of performance.

Incorporated in the design of the 4-125A are many features contributing to its outstanding capabilities. Most notable among these are:

Its pyrovac plate which enables the tube to withstand high momentary overloads.

Its processed non-emitting grids which impart the operational stability universally associated with this tube.

Its internal input-to-output-circuit shielding which allows considerable simplification of associated circuitry.

Its well engineered mechanical structures that make the tube physically rugged and maintain precise element alignment.

Detailed data and application notes on the Eimac 4-125A tetrode are, upon request, immediately available. Assistance in unusual application problems involving the use of the 4-125A is offered as a service of the Eimac Field Engineering Department.

EIMAC 4-125A POWER TETRODE
Electrical Characteristics

Filament: Thoriated tungsten	
Voltage	5.0 volt
Current	6.5 amp
Grid-Screen Amplification Factor (Average)	6.2
Direct Interelectrode Capacitances (Average)	
Grid-Plate (Without shielding, base grounded)	0.05 μuf
Input	10.8 μuf
Output	3.1 μuf
Transconductance (i_b = 50 ma., E_b = 2500 v., E_{c2} = 400 v.)	2450 μmhos
Maximum Ratings (Class-C FM or Telegraphy, key-down conditions, 1 tube)	
Plate voltage, d-c	3000 volts
Plate current, dc-	225 ma.
Screen voltage, d-c	400 volts
Grid voltage, d-c	-500 volts
Plate dissipation	125 watts
Screen dissipation	20 watts
Grid dissipation	5 watts

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

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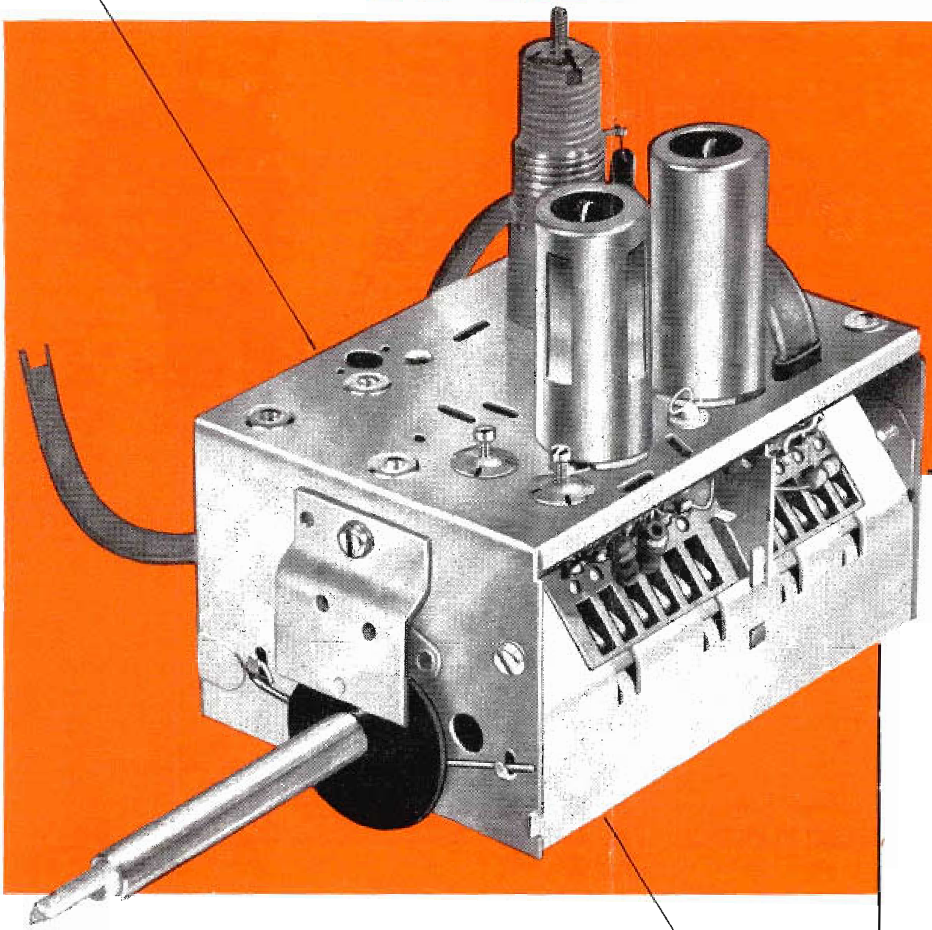
"THE STANDARD TUNER"

QUALITY PROVEN A MILLION TIMES



OVER

1,000,000

STANDARD TUNERS ARE NOW OPERATING IN OVER A MILLION OUTSTANDING TV SETS

More than one million TV sets produced to date incorporate "The Standard Tuner". These are the sets the consuming public will want and buy. The Standard Tuner's superior performance brings added brilliance and sparkle to the picture. Gives your TV sets that additional sales feature.

"The Standard Tuner." The outstanding front end tuning assembly that an ever-increasing number of TV engineers are specifying. It covers all 12 channels . . . gives higher sensitivity . . . quick interchanging of channel inductors . . . adaptable to U.H.F.

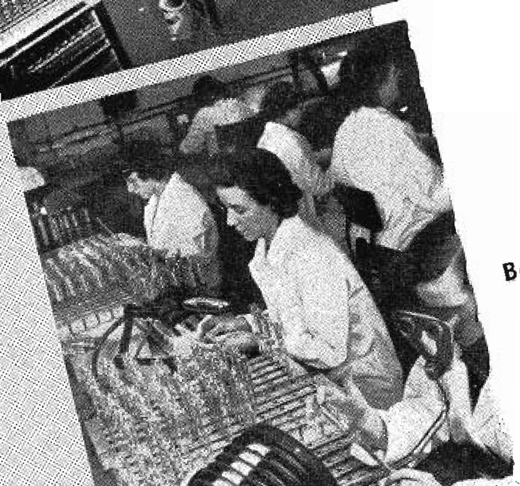
GOOD NEWS FOR SERVICE MEN

"The Standard Tuner" is now available to you as a replacement unit. See your jobber for details.

Standard COIL PRODUCTS CO., INC.

CHICAGO • LOS ANGELES • BANGOR, MICH.

HEART OF THE *Cathode-Ray* TUBE!



The HAYDU Electron Gun

Efficient mass production of today's cathode-ray picture tubes has been one of the outstanding contributors to the phenomenal growth of this new American industry. But no amount of production skill could have made this possible without the precise standardization of tube components such as the gun mount.

Haydu Brothers has made its contribution through the manufacture of more than ONE-THIRD MILLION electron guns, those all-important precision components which are the key to the cathode-ray picture tube — the heart of the television industry.

Look for the rugged, 3-pillar construction, and the imprint, "HB," the identifying mark of superior electron guns.

A few of our many satisfied customers include:

Capehart-Farnsworth Corp. . . . . Ft. Wayne
Tel-O-Tube Corp. . . . . Paterson
Thomas Electronics, Inc. . . . . Passaic
National Video Corp. . . . . Chicago

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I. R. E. SHOW
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Grand Central Palace
March 6-9

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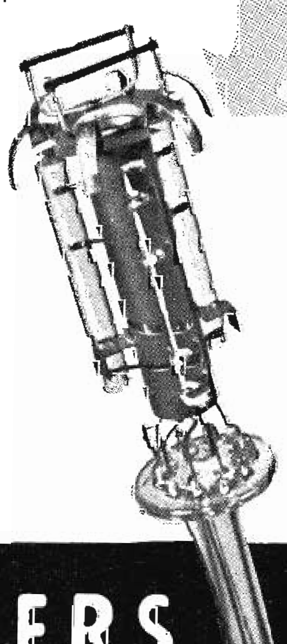
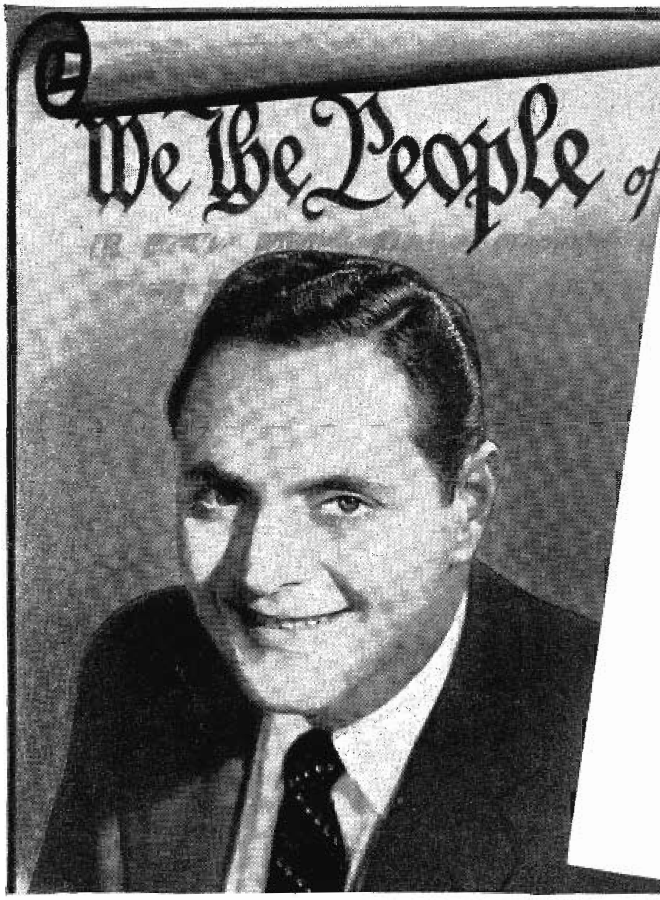


HB HAYDU BROTHERS

PLAINFIELD • NEW JERSEY

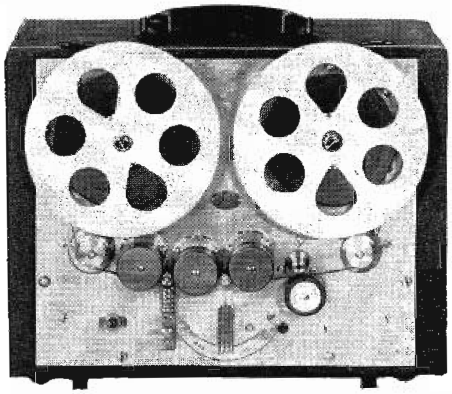


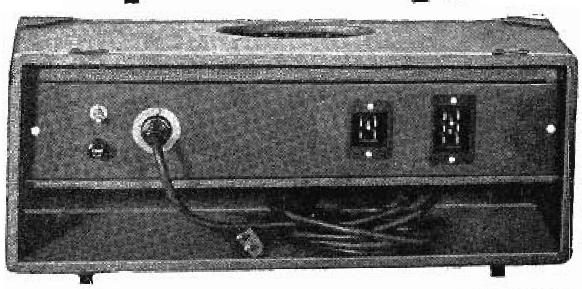
"Simple and reliable... and tops for fidelity"

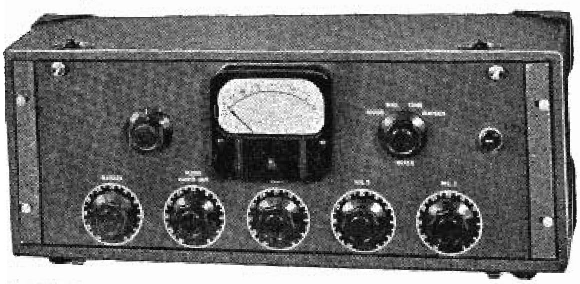
SAYS

DAN SEYMOUR

POPULAR M.C. OF RADIO AND TV'S "WE, THE PEOPLE"







NEW PRESTO

PT-900 PORTABLE TAPE RECORDER

Here's the answer for delayed special-events broadcasts—on-the-spot recording—wherever there is a need for field recording of complete broadcast quality. Look at these outstanding engineering features:

Separate recording and playback heads, each with its own associated amplifier, permit monitoring direct from tape. High fidelity unit—50 to 15,000 CPS at 15" per second tape speed. 3 microphone channels with master gain control in recording amplifier. V.U. meter to indicate recording level, playback output level, bias current and erase current, and level for telephone line. 2-speed single motor drive system.

Don't choose your tape recorder until you see the *new* Presto Portable Tape Recorder. Write for complete details today.

PRESTO

RECORDING CORPORATION

Paramus, New Jersey

Mailing Address: P. O. Box 500, Hackensack, N. J.

In Canada, Walter P. Downs, Ltd., Dominion Sq. Bldg., Montreal

Export: The M. Simons & Son Co., Inc., 25 Warren St., N.Y. Cable Address: "Simontrice" New York

WORLD'S GREATEST MANUFACTURER OF INSTANTANEOUS SOUND RECORDING EQUIPMENT AND DISCS

Here is a cylindrical d-c paper-dielectric capacitor that remains positively sealed, regardless of the position in which the unit is mounted. The G-E Case Style 40 utilizes a deep-drawn aluminum case with double-rolled base seams, avoiding solder-seams. The silicone bushing eliminates gaskets, maintains the hermetic seal by compression alone. And beneath the case, these units embody the excellent materials and construction, give the outstanding performance characteristic of General Electric capacitors.

The Case Style 40 capacitor for direct panel mounting with solder-lug terminals, is built in these ratings:

600 volts—1, 2 and 4 mu f
1000 volts—1 and 2 mu f
1500 volts—.25, .5 and 1 mu f

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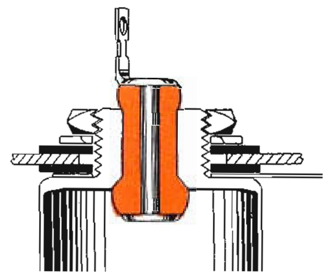

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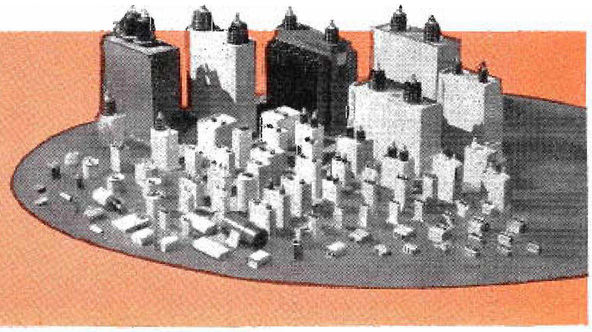


TELE-TECH

Formerly ELECTRONIC INDUSTRIES

TELEVISION • TELECOMMUNICATIONS • RADIO

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

RADIO-TELEVISION'S CROWDED "SECOND TABLE"

And a Way to Lift the "Freeze", While Avoiding the Unknowns of UHF

The annual report of the FCC just issued, calls attention to "the booming of television," the crowded condition of the radio spectrum and the great number of stations and services which are demanding licenses to operate in the scanty radio channels administered by the Commission.

In parcelling out the limited radio frequencies it controls, the Commission and its staff have done a devoted job of patient adjustment and makeshift compromises.

But few radio men or Washington legislators yet seem to realize that the FCC is *not* the *primary agency* in radio-channel determination!

★ ★ ★ ★ ★ ★ ★

Instead, the cold facts are that the FCC conducts only a "second table" in radio — taking, and distributing to its license holders, only such channels as are "left over" after a more powerful but little-known Federal agency has first casually pre-empted 42% of our precious radio wavelengths. It is only the remaining 58% that the FCC can throw into the "public-allocation" pot, with its interminable and costly legal struggles.

For ahead of the FCC, in taking its pick of radio channels, is the powerful but secretive Interdepartmental Radio Committee — IRAC, which has become a sort of radio Politburo operating in star-chamber sessions animated by those fierce inter-bureaucratic loyalties and jealousies which only experienced Washingtonians can fully comprehend.

★ ★ ★ ★ ★ ★ ★

As a result, 42% of radio's total channels are now set aside as government reservations, — often left empty and unused, while corresponding "second-table" FCC-assigned channels become ever more crowded and overloaded.

This interference by "Government" with the larger public interest again comes to the fore in blocking off expansion of a continuous television band above TV Channel 13, through say Channels 14 to 23, as proposed by TELE-TECH last month.

Television is fast becoming recognized as radio's greatest public service. Television should have a continuous spectrum, extending the upper TV band by ten channels into the 216 — 276 MC frequencies (now blocked by government pre-emption).

Such additional TV channels would immediately lift the "freeze", and simplify design and construction problems of receiver and transmitter manufacturers, station operators, and the millions of television owners. All this can be done promptly, without at this time plunging TV into the unknowns of UHF, which can be solved and utilized later.

BROAD CAST	GOVERNMENT	AMATEUR	AVIATION, MOBILE, COMMON CARRIER, ETC.
5%	42%	7%	46%

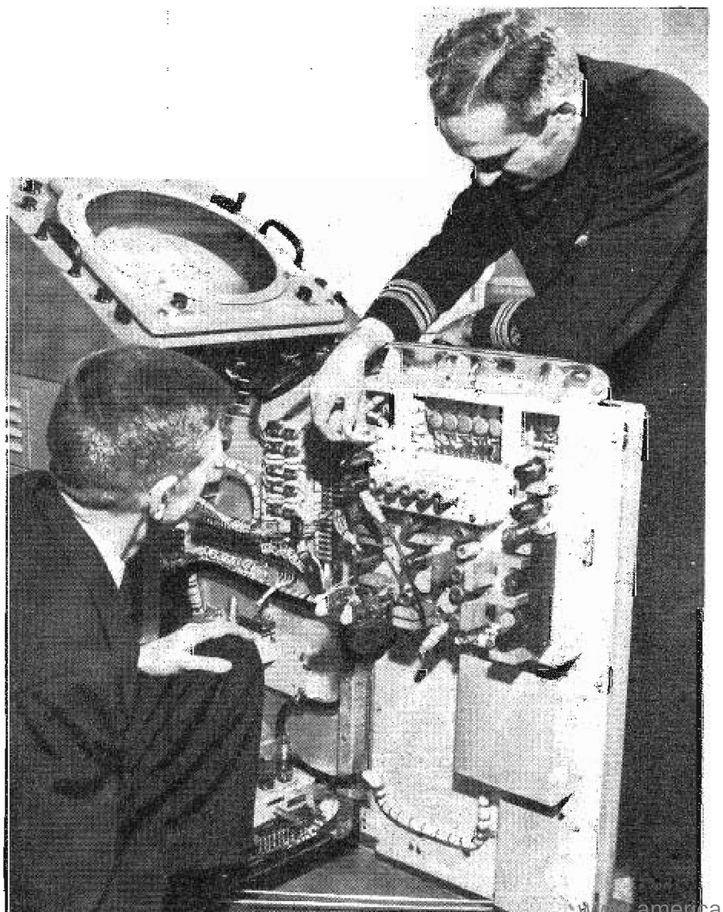
The RADARSCOPE Revealing at a Glance,

FCC OUTLOOK

LIFTING OF TV FREEZE BY SUMMER?—An augury that the "freeze" on television-station construction-permit applications will be at long last lifted during next summer or fall was regarded as indicated in the FCC's budget requirements for the fiscal year commencing next July 1 which, despite the Congressional cries of economy, carries an increase of $196,000 over the current funds allotment. The FCC is seeking an appropriation for the 1950-51 fiscal period of $6,912,000, as compared with its current appropriation of $6,711,460. Except for a minor boost of $20,000 for its work in regulating mobile radio services, the boosted funds all go to television, with the FCC's technical staff and laboratory being given $75,000 additional for television frequency research and equipment testing; and the broadcasting regulatory activities being allotted $45,00 with the FCC admitting the existing backlog of the AM applications should be cleared up by the end of the next fiscal year.

RE-ARMAMENT

BUDGET FOR RADIO $306 MILLIONS—The Federal Government's major procurement programs—$281 million by the Armed Services and $25 million by the Civil Aeronautics Administration—if approved by Congress under the recent Presidential budget for the next fiscal year, adds up to the tidy sum of $306 million as the 1950-51 for which radio manufacturers will compete. As during the present fiscal year which ends next July 1, the Air Force had the largest funds proposal of $115 million (which was $5.6 million below the current allotment) but the Air Force plans to continue the modernization of its ground and air electronics and communications installations. The Navy Bureau of Ships got $79,906,000 from the budget, and Naval Aviation was allotted $26,650,000. The Army Signal Corps apportionment totalled $60,085,997 for new communications equipment. (For further details, see Washington News Letter page, this issue).



TELEVISION

112 TV STATIONS is the probable total for 1950, provided no more construction permits are cancelled. A unique UHF experiment commenced in January on Success Hill, Bridgeport, Conn., when NBC began the long awaited UHF tests by rebroadcasting entire WNBT programs. This should answer a number of questions concerning the effect of UHF vagaries on modulation content. Meanwhile, the color furore calmed a little although the public demonstrations in Washington were well received. New color-TV systems continue to be proposed, but most of the proponents have "nothing technical to say, due to patent situations". DuMont. which has some fundamental electronic-color patents, is reported to be devoting a lot of quiet effort to color tests and may well be a dark horse.

FM & AM

ANNOUNCED MERGER of the Frequency Modulation Association and the National Association of Broadcasters spells hope for the FM broadcasters who are finding the going rather tough. Something needs to be done, for some of the new outlets which started after the war are turning in their construction permits and licenses. In certain cases union demands made dual operation uneconomical, in others there was just no audience. When 1949 began there were 930 licenses and CP's; as 1949 closed there are 849, including new CP's!

Cuba's demands for more AM space (which would seriously deteriorate the U. S. clear channels) could however be met by use of FM. In that small island, skywave service is not necessary and since the additional channels are demanded for local use only, FM would be entirely suitable. U. S. skywave signals of .5 MV/M would be subject to ruinous interference from .025 mv/m skywave signals and even a 250-watt transmitter could reduce a U. S. clear's secondary service area by one third if the AM demands were granted. Not only would use of FM ease the conferees' task but U. S. manufacturers with warehouses full of FM equipment would welcome the chance to enter new markets. In fact, while the FCC fiddles with TV allocations, FM salesmen could burn up the roads to Cuba!

Westinghouse radar equipment at the Loran-Radar School which is run by the US Maritime Commission in New York and is paving the way to the future when all the larger ships, numbering about 1,200, will have radar and loran. At present ships on the Alaska run receive a 50% reduction in insurance rates if radar is carried.

AIRPLANE RADIO

RADIO CONTINUES to play an increasingly important part in aviation as evidenced by the addition of 6369 new air and ground stations in 1949, raising the total to 27,227 stations. VHF communication is very popular with private plane operators, and 21,515 private plane installations of all types are in use. The requirements of many air fields restricting their use to radio-equipped planes adds importance to this phase of the industry. Aeronautical radio stations for safety communications, civil air patrol, airdrome control, mobile emergency, aeronautical navigation, flying school and flight test account for 3451 stations. Common-carrier phone and telegraph service is being developed for the 606 public service planes, now in operation.

TUBES

ELECTRON MULTIPLIERS—The remarkable amplification factors that have been produced in phototubes by the use of electron multiplier principles, have caused many tube users to wonder why this principle cannot be applied to amplifier tubes with cathode emitters.

Tubes are now in the development stage which show consistent g_m values of 25,000 plus, more than triple what can be expected from regular forms of tubes using grid amplification principles.

MATERIALS

SYNTHETIC MICA CRYSTALS—Mica, one of the first insulators of electricity, is still one of the best bets for tube construction and for capacitors for certain uses. The U. S. is the world's largest consumer of mica but produces only enough to meet a third of its requirements, having to import over 10,000 tons a year to meet this need. Synthetic mica, with essentially the same properies as natural mica, but able to withstand much higher temperatures, has now been crystallized successfully at the National Bureau of Standards, in cooperation with the U. S. Bureau of Mines and the Colorado School of Mines.

It is interesting to note that while mica could be synthesized by duplicating the conditions under which it is formed in nature, this would involve extremely high pressures and high temperatures. For that reason the Bureau's scientists are using fluorine as a crystallizing agent to grow crystals of mica without using high pressure.

The raw materials for making synthetic mica are similar to the raw materials sometimes used in making glass: quartz, magnesite, bauxite, and a fluoroscilicate compound (the only unusual ingredient). The largest crystals grown so far at the National Bureau of Standards have a surface area of four square inches. Experiments are now in progress to find ways of predetermining crystal growth even more completely in order to grow large parallel sheets.

COLOR TV

CBS public color demonstrations in Washington, D. C. during January were expected to be shown to 10,000 persons, including officials. Eight receivers were used, and many observers, when questionnaired, said they "liked color very much".

FILMS

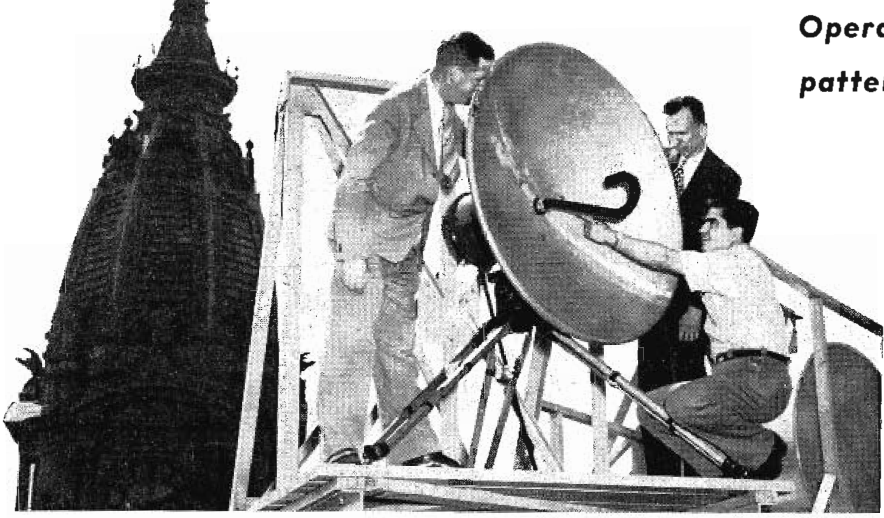
TELEVISION'S FIFTH NETWORK may well be the kinescope circuit. Slowness in completion of the cross-country coaxial cable due partly to normal time lags in construction, and partly to the scarcity of cross-country subscribers has given a tremendous fillip to the television film industry. The quality of most kinescopings is poor compared with live shows, but in some parts of the country, where viewers are not used to anything better, recordings are received rapturously. If the 112 TV stations expected by the end of 1950 use kinescopings two hours daily it will total 81,500 hours a year or 160,000,000 feet of 16 mm film—enough to circumscribe the United States boundaries four times.

SPECIAL SERVICES

RADIO COMMUNICATION for almost all industries is now available. Seven categories embrace power, petroleum, forest products, motion picture, relay press, low-power industrial and special industrial services. The electric-utility radio service with 18,000 potential users will have about 5,000 installations in the near future. Motion-picture radio services provide means whereby communication costs can be considerably reduced. With overheads running $2,000 to $3,000 per hour while on location, the low-power equipment used plays a large part in coordinating shooting procedures. Special industrial, and low power industrial services enable radio to be used by commercial concerns not specifically covered in the FCC rules. Many of these permits are for communication within the confines of the licensee's property and for low-power pack-sets over distances of a few blocks.

Directional Antenna

Operating notes and formulae for pattern and other important



TV microwave relay equipment installed on the City Hall building in Philadelphia, Pa.

By C. A. ROSENCRANS, *Engineering Products Dept., RCA Victor Div., Camden, N. J.*

BEFORE the commercial application of microwave relay equipment to television broadcasting, most radio link circuits were operated at frequencies between 170 and 350 MC. At these frequencies, however, such severe interference was picked up from broadcast transmitter harmonics, "ham" transmitters, ignition noise, and high frequency generators used in diathermy, that the lower frequency equipment was soon considered unsatisfactory for television broadcasting. Even though directional antennas were employed, the transmitted beam was so broad that multi-path propagation effects were quite serious. For ranges greater than a few miles, the equipment was too large to be portable and required considerable power for operation.

When microwave relay equipment was generally adapted for television broadcasting, most of the previous conditions of interference were no longer experienced. Microwave equipment operating in the 6800 to 7100 MC today serves well over 90% of the stations and provides virtually noise-free transmission over line-of-sight paths greater than thirty miles. The equipment is so compact that it is portable and so efficient that with a transmitter power of only 100 milliwatts, an equivalent power of 500 watts is obtained.

A more common type of antenna system employed in microwave systems uses an elementary radiator and parabolic reflector to form a highly directive antenna. It is the purpose of this memorandum to present some of the characteristics of such an antenna and the problems involved in its use with the RCA Television Microwave Relay Equipment.

Power Gain

The power gain of any antenna system may be obtained by comparing its effective area with that of an elementary antenna. In the material to be presented the effective area of an isotropic radiator is used as the basis of comparison. Thus the power gain for a system employing a parabolic reflector may be expressed as:

$$\text{Power Gain} = 4\pi a/\lambda^2 \qquad (1)$$

where "a" equals the effective area of the parabolic system. This equation simplifies to

$$\text{Power Gain} = 4\pi A/\lambda^2 \times .65 \qquad (2)$$

where A is the projected area of the parabolic reflector.

This equation will be only slightly in error as long as λ is small compared to the diameter of the reflector. From this simple equation the effect of various changes in antenna systems may be compared. It can be seen that the gain is directly proportional to the effective area, the frequency squared, or inversely proportional to the wavelength squared. Curves showing these first two relations are shown in Fig. 1.

Relative Power

Often questions arise as to the relative merits of two transmission systems utilizing the same type of antennas but operating on different frequencies. The two may be compared quite simply with the aid of equation (2) or

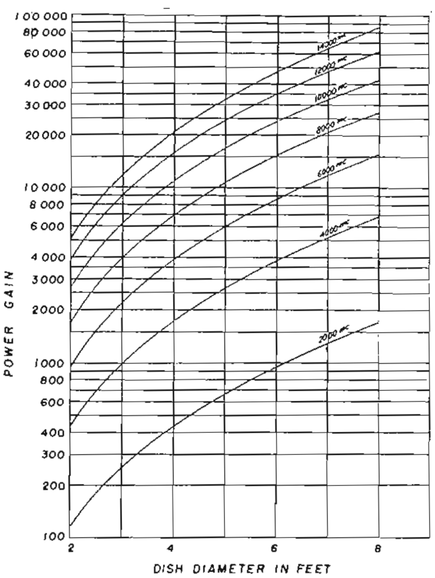
$$\frac{\text{Power Gain—System A}}{\text{Power Gain—System B}} = \frac{4\pi A_A/\lambda^2_A}{4\pi A_B/\lambda^2_B} \qquad (3)$$

When both antennas have the same area this becomes

$$G_A/G_B = \lambda^2_B/\lambda^2_A \text{ or } f^2_A/f^2_B \qquad (4)$$

in terms of frequency. Thus a transmitter operating under these conditions at 1100 MC needs approximately 40 times more power than one operating at 7000 MC to provide the same signal at the receiving

Fig. 1: Curves showing antenna system power gain as a function of reflector diameter



Systems for Microwave TV

PART ONE OF TWO PARTS

determining power gain, beam width, radiation characteristics of television microwave relays

location. The curve of Fig. 2 gives the relation of equation (3) based on a frequency of 7000 MC. The antenna systems are assumed to have the same effective area.

Beam Width

The beam width of a directional antenna system is usually defined in terms of the angle through which the antenna system must be rotated in order to reduce the power available at the receiver to ½ of the maximum value. Often, twice this angle is called the half-power beam width. An expression for this is as follows:[1]

$$\Theta = 70(\lambda/d) \text{ degrees} \qquad (5)$$

λ = wavelength.
d = diameter of parabolic reflector.

The equation (5) is quite accurate for angles less than 20°.

Thus, a parabolic reflector 4 feet in diameter used at 7000 MC (λ = 4.28 cm) would be expected to have

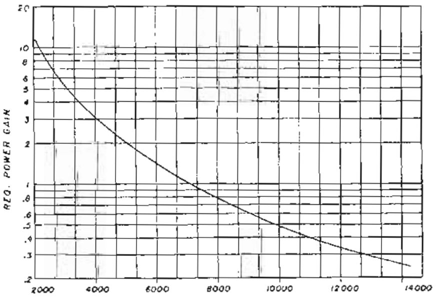


Fig. 2: Relative merit of 7000 MC transmission system used on different frequencies

a half power beam width of 2.46°. Practically, the figure is subject to variations and production antennas have a half-power beam width of approximately 3°. Fig. 3 presents equation (5) both in terms of wavelength (frequency) and reflector diameters.

It is possible to calculate the power available at the receiver for most practical setups. All cases are based upon line of sight propagation paths as figured from the actual terrain elevations and normal curvature of the earth. The formula is given in equation (6).

$$P_R/P_T = (A_R A_T)/(d^2\lambda^2) \qquad (6)$$

where

P_T = power generated at transmitter.
P_R = power available at receiver.
A_R = effective area, transmitting antenna.
A_T = effective area, receiving antenna.
d = line of sight distance between transmitter and receiver.
λ = wavelength.

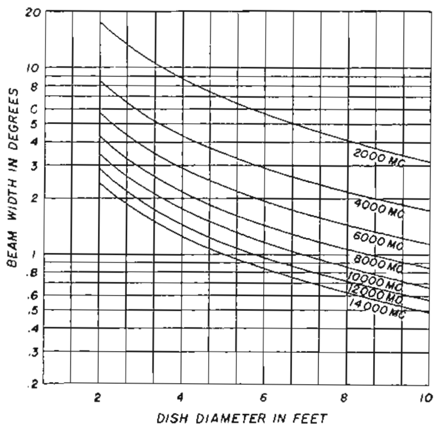


Fig. 3: Curves for half power beam width vs. reflector diameter at different frequencies

Where both antennas are parabolic reflector systems equation (6) may be arranged so that actual projected areas rather than effective areas can be used. It is also desirable to replace λ with frequency. Equation (6) then becomes

$$\frac{P_R}{P_T} = \frac{A_R A_T f^2}{d^2 \times 2290 \times 10^{+15}} \qquad (7)$$

where

f is in cycles per second
A_R, A_T, and d^2 are in ft²

The relations existing in any field setup are shown by this equation. Notice that the power available at the receiver is proportional to the frequency squared, the area of an antenna, and inversely proportional to the square of the distance between the transmitter and receiver. It is these proportional relations which are of interest to the engineer planning a field installation. The

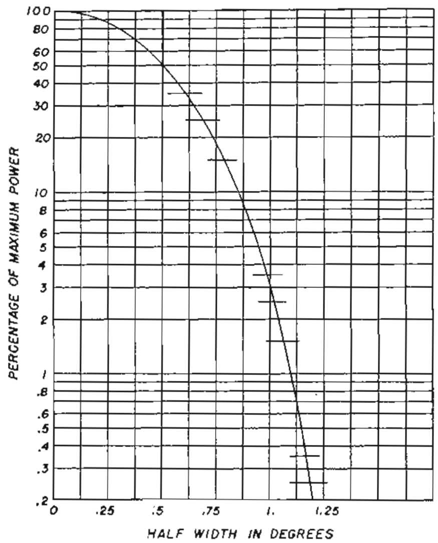


Fig. 4: Characteristics of normalized radiation pattern assumes symmetry about the axis of the reflector based upon a system having a unity half-power beam width

operation of a proposed installation may be readily evaluated in terms of the known performance of some other arrangement.

As a simple illustration suppose the performance of a system using 4 foot reflectors operating over a range of 10 miles is to be duplicated over a distance of 20 miles. Several choices not involving frequency are available although doubling the frequency would be one solution. First, the transmitter power could be increased by a factor $(d_1)^2/(d_2)^2$ or 4. A more practical arrangement would be to increase the area of the reflectors, each by a factor of 2. Practically, this means that 6 foot reflectors would be used in place of the 4 foot reflectors.

Radiation Patterns

The factors determining beam width have been discussed briefly in Section 3 but there remains the question as to the nature of the radiation pattern. This pattern is not completely specified by the beam width alone. It is a function of the electrical arrangement of the antenna reflector and feed (radiating element). For the purpose of this article the following discussion

[1] Reference Data for Radio Eng., 2nd Edition, page 219.

will be based upon the use of a normalized pattern shown in Fig. 4. This plot assumes the pattern to be symmetrical about the axis of the reflector, and is based upon a system having half power beam width of 1.0. Consequently, it can be used to specify the pattern of any antenna of this type by multiplying the θ scale by the beam width of the antenna.

It should be realized that this curve is not a complete pattern of the type obtained by actual measurements. A complete pattern would be something like that shown in Fig. 5 and would vary in detail from antenna to antenna. However, the normalized curve is useful in the solution of several field problems likely to be encountered in practice.

For example, consider the problem of determining the power level of the interfering signal between two systems operating on the same frequency but differing in physical location. A simple case is illustrated in Fig. 6. We will assume that both are using identical equipment; 3° reflectors, 0.1 watt power, and a frequency of 7000 MC. In order to solve the problem it is first necessary to evaluate the angle (θ) and the distance X.

From the simple geometrical relation

$$\text{Tan}\ (\theta) = \frac{1000}{5 \times 5280} = .0379,$$

$$\theta = 2.1 + \text{degrees} \qquad (8)$$

$$X = \frac{5}{\cos(\theta)} = \frac{5}{.9993} = 5 \text{ miles appr.}$$

Since the path length of the "B" system is almost exactly the same as the path length for the interfering signal the transmission loss over both paths may be taken to be the same. This leaves the interfering signal attenuated only by the directivity of the "B" receiving antenna and the "A" transmitting antenna. This attenuation may be obtained from Fig. 4. At 2.1 degree off the center of the beam the power is approximately 0.23 of maximum. Since this reduction occurs at both antennas the total reduction is .23 × .23 or .05 or 20 times. A similar calculation for the interfering signal at Receiver A from Transmitter B gives a reduction of approximately 5 times.

Calculating Line-of-Sight Path

Before any installation is made involving situations where the transmitter is not distinctly visible from the receiver, a plot should be made in order to determine the terrain clearance existing along the path. Good maps are required; contours should show at least 10 foot elevation intervals.

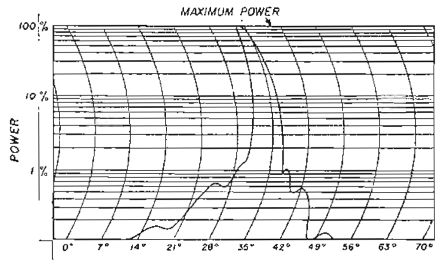


Fig. 5: Graph showing system radiation pattern obtained through actual measurement

The usual procedure is to lay out the path on the map and obtain elevations at frequent intervals along the whole path. These elevations must then be corrected to allow for the curvature of the earth. This correction may be calculated for each elevation from the equation

$$e = \left(\frac{D}{1.23}\right)^2 - \left(\frac{D-d}{1.23}\right)^2 \qquad (9)$$

where e is in feet

where D = ½ distance in miles between terminals

and d = the distance in miles from terminal to point on the path for which the elevation is being calculated

This is derived from the basic equation: $D = 1.23\sqrt{H}$ (10)

where D is the line of sight distance to the horizon, and H is the elevation (above sea level) of the sighting point.

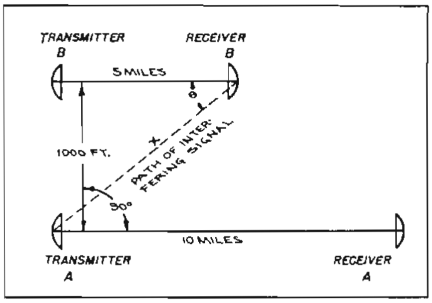


Fig. 6: Diagram for determining interfering signal power level between two systems in different locations on the same frequency

Fig. 7 shows a typical profile plot. The allowance for terrain clearance depends upon many things, but it is generally considered good practice to choose sites which provide a minimum clearance of at least 100 feet above the terrain. If this area is wooded or built-up, due allowance should be made for the height of the buildings or trees. Where the profile shows questionable clearance, it is best to make a test transmission over the path as a final check of the performance to be expected.

Special Considerations

So far multi-path transmission has not been a serious problem. There are possibilities of such effects occurring, especially over large cities. The general problem is pictured in Fig. 8. A receiving antenna at distance D subtends an angle (θ). An isolated, smooth reflecting surface is at a distance from the transmitter and subtends an angle B. The orientation of the surface is such that a wave front approaches it at an angle φ. Then the wave reflected from the surface will leave at an angle α and so reach the receiving

Fig. 7: Typical profile plot for line-of-sight path calculations

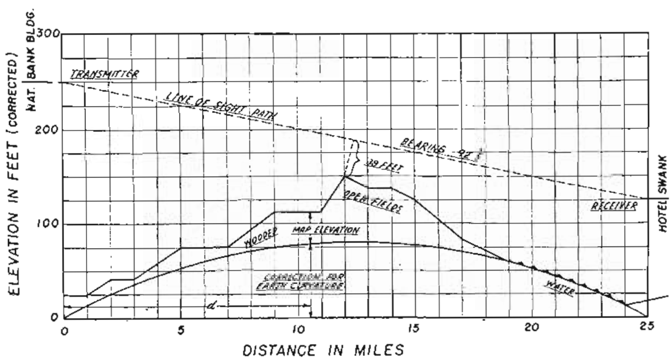
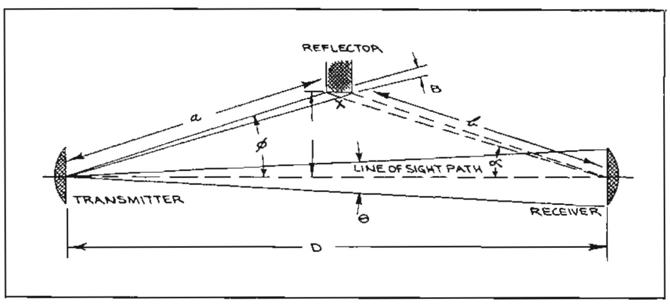


Fig. 8: Diagram illustrating multi-path transmission problem



antenna arriving from the same direction ϕ. Some general conclusions may be shown as to the effects to be expected without resorting to the elaborate calculations required to obtain a quantitative answer.

First, the energy reaching R because of the reflector will be approximately B/θ times that received over the direct path, when ϕ is small and B is smaller. This is further reduced by a factor $(P\alpha)$ $P\phi$ where $P\phi$ is the power radiated in the direction ϕ as found from the transmitter antenna pattern and $P\alpha$ the power received from a pattern α degrees as found from the receiving antenna pattern.

When B becomes equal to or greater than (θ) there is no further increase in the amount of energy reflected reaching R. However, the path attenuation along the path ab increases and, at the same time, the angle ϕ increases, all of which causes a reduction in the reflected energy reaching R. Since most reflectors are not perfect, the energy reaching R will be still further reduced by a factor E depending upon the reflective efficiency of the surface.

When the area of the reflector is very large as well as a plane surface, the reflected energy reaching R will be approximately

$$P_R = D^2/(a + b^2)\ P\phi\ P\alpha\ E\ P_T \quad (11)$$

where P_T is the power received over the direct path.

In practice, however, the situation is seldom as simple as that used in the illustration. The theory still applies but the solution is complicated by the fact that the nature and number of the possible reflectors is usually difficult to determine. Actual reflectors are seldom found to have plane surfaces so these may be effectively a large number of reflector systems operating at one time with a consequent reduction in the energy reaching the receiver. Nevertheless, the problem does illustrate the advantages of the highly directive transmitting and receiving systems in reducing the overall effects of multi-path transmission.

Part Two of this article will appear in the March issue.

NBC Commences UHF TV Tests on 529 MC

THE long awaited UHF television tests conducted by NBC on 529 to 535 MC commenced from a 250 foot high antenna on Success Hill near Bridgeport, Conn. on January 2nd.

Output from the 1 KW RCA TTU-1A transmitter is fed via a special 3⅛ inch transmission line with undercut spacing insulators to an RCA TFU-20-A slotted antenna mounted on the top of a 210 foot tower. The antenna, which is 40 feet high has a measured gain of about 17 on the ground, and the transmission line has an efficiency of approximately 87%. Taking into account the various losses encountered in the system the ERP will probably be somewhat less than 20 KW it is understood. A vestigal side band filter plus diplexer—cut from the UHF band of course—is used to provide standard FCC waveform.

The main section of the transmitter is actually the two center bays of a standard RCA TT-500-A transmitter. Eight tubes type 4 X 150A are used in parallel to the tripler and final stages in both the video and audio transmitters. Coaxial coupling is used between the tripler and final stages and a special UHF cavity is used for tuning. High level modulation is applied to the grid of the final stage, and results in good modulation efficiency.

The antenna slots are covered with polyethelyne to prevent icing, since no de-icers are used. The antenna impedance is 51.5 ohms, and as may be judged from the fact that it has an RCA serial number is now a regular RCA component, as is the transmitter. Also mounted on the tower is a 10 foot parabola containing a channel 4 dipole oriented on the Empire State Building in New York City. Output from this antenna is fed to a modified RCA receiver, and provides the video and audio modulation for the UHF transmitter. The entire program from WNBT in New York is relayed by this transmitter and subjected to the vagaries of UHF transmission so that the effect of hills and other natural obstacles can be judged.

Although at the time of writing no UHF adaptors have been issued or installed in the surrounding area, it is understood that at least two reports have been received from eager viewers in the neighborhood, thus proving the old theory that if the signal is there people will receive it somehow.

It is probable that a range of about 25-30 miles will be obtained since receivers will be installed within that area as soon as the transmitting equipment has been properly adjusted and is in regular operation. The experiment will provide an excellent indication of the service which may be expected from local small UHF TV stations in typical areas of hilly or rolling terrain.

Reading from left to right: the special slotted antenna being erected; view of the antenna tower, note channel 4 parabola left side near top; transmitter with video final and tripler stages on left, and audio transmitter on right, of low power section as shown in the center

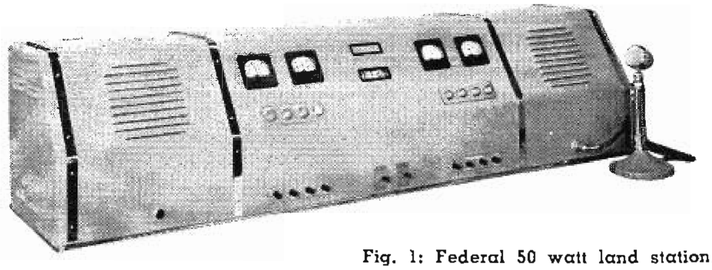


Fig. 1: Federal 50 watt land station, model FTR FT-111 which incorporates the Selecto-Call Decoder

Small-Town

By *EUGENE COOK, Mobile Radio Engineer, Federal Telephone & Radio Corp., Clifton, N. J.*

Four-channel mobile fire service telephone uses sub-carrier modulated by low audio frequencies to alert desired receivers

MANY of the volunteer fire departments and small municipalities throughout the United States feel that a mobile radiotelephone system would be too expensive and too difficult for them to operate with inexperienced personnel. However, in many instances this is not the case. In most small towns, a radio system would be a great advantage in increasing the efficiency of the department. Some examples are: 1—Rapid notification of emergency to volunteers. 2—Describing the fire and dispatching men to the necessary locations. 3—Communicating between headquarters and the trucks and cars at the fire location. 4—Ability to call im-

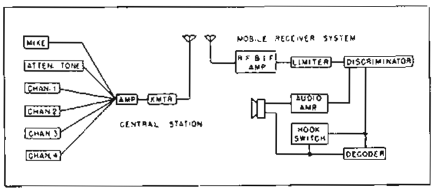


Fig. 2: Block diagram, transmitter and receiver

mediately for more assistance or supplies. 5—Immediate warning of other fires in the same service area. 6—Ability to serve a larger area. 7—Increased protection to the community.

The installation by the Volunteer Fire Department of the Town of Sudbury, Mass., is a typical example of what a progressive group of men interested in maintaining maximum safety for their people can do. Sudbury, twenty miles west of Boston, covers an area of about twenty-five square miles, and has a population of about 2800. It has a complete FM two-way mobile radiotelephone installation, that includes an exclusive "Selecto-Call" feature, whereby cars, trucks and land station are on the same carrier frequency of 37.74 MC. This selective calling feature enables the operator of the central station to contact a *particular* mobile station, land station, or group of such stations, even though all the receivers in the system are tuned to the same carrier frequency.

The FTR 102A Selecto-Call Decoder, used in connection with the receiver, functions to connect the speaker when a particular tone is present in the coded signal. In the model used at Sudbury, the coded signal consists of the channel tone (a specific frequency modulating the r-f carrier of the calling transmitter). This system is somewhat analogous to the party-line calling arrangement of conventional wire telephony where the bell in the subscriber's telephone set rings only to a particular dialing sequence initiated by the operator.

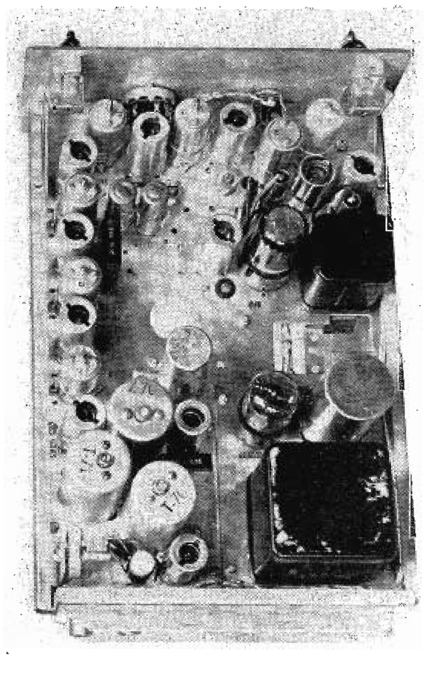
At Sudbury, a four-channel Selecto-Call system is used. Each channel can be selected individually by simply pushing a button on the land station console. Channel 1 is used to contact the Police Chief's car; Channel 2 is used to call the Fire Chief's car; Channel 3 serves the two fire trucks; and Channel 4 contacts the ten FTR-144AZ house receivers in the homes of volunteer firemen, strategically located throughout the town and service area.

Horn Blown by Coded Signal

The Selecto-Call feature in the police car is arranged so that the horn of the car will "blow" when the proper coded signal is received, providing the police chief throws a switch before leaving the car. This is an important and very useful feature particularly when the police chief is not in his car, but is nearby directing traffic or on other duty.

When a fire call comes into the Sudbury Fire Station from the Telephone exchange, a loud bell rings automatically. The operator on duty records the message and first pushes the Channel 4 button on the control console; then sends the 800 cycle Attention Tone for three seconds to alert the volunteers in their homes; then transmits the message. Each of the volunteers with a house receiver notifies one or two more volunteers by telephone and in a few seconds, all the men are on the way to the fire or their appointed locations. The Fire Chief (William E. Davison) proceeds to the fire immediately as does the Police Chief (John McGowan) who is called on his Selecto-Call channel immediately after the ten house receivers are called. The Police Chief, who is responsible for parking and traffic problems, has his own Selecto-Call channel because, in the course of a day, he receives many calls which are exclusively of a police nature and not

Fig. 3: View of 147AA mobile receiver



Mobile FM Operation

intended for the ten house receivers.

The equipment can be arranged so that the Selecto-Call feature is disconnected when the microphone is off the hookswitch. The receiver will then receive all "on-carrier" signals. When the fire trucks and cars of the police chief and fire chief are on the way to the fire or at the fire, the microphones are left off the hookswitches so that they can talk from car to car in addition to being able to communicate with the central station. Also the station house receivers can be arranged so that, after the Selecto-Call signal connects the speaker and the receiver system is operating, a button must be pushed in order to reset the Selecto-Call. Therefore, after a fire call has been received by a house receiver, the RESET button is not pushed immediately—thus any car or truck can talk to the homes as well as to the central station, and many times this is important in recruiting more men, materials, etc.

The Selecto-Call feature in both the cars and house receivers can be arranged so that it will automatically be restored after each call.

Fig. 2 is a block diagram of the Federal FT-111 central station calling a mobile station. To send a message, the operator presses the Selecto-Call switch. A yellow light is lighted, followed half a second later by a white light. The operator may then proceed with the message. During the time that the yellow light is on, the coded Selecto-Call signal is being transmitted. The frequency of the channel tones (153-442 cycles) must be very stable and exact to ±0.5% of proper value.

Transmitter Characteristics

The transmitter comprises a crystal oscillator, the output of which is phase modulated by a transconductance type modulator, and its frequency is multiplied thirty-two times by the subsequent stages. The frequency deviation is adjustable by means of a potentiometer mounted on the chassis; however the maximum deviation is limited to ±15 KC by the Automatic Deviation Limiter. The power output from the two Hytron 5516 instantaneous heating power amplifier tubes is fifty watts.

The single skirt co-axial antenna

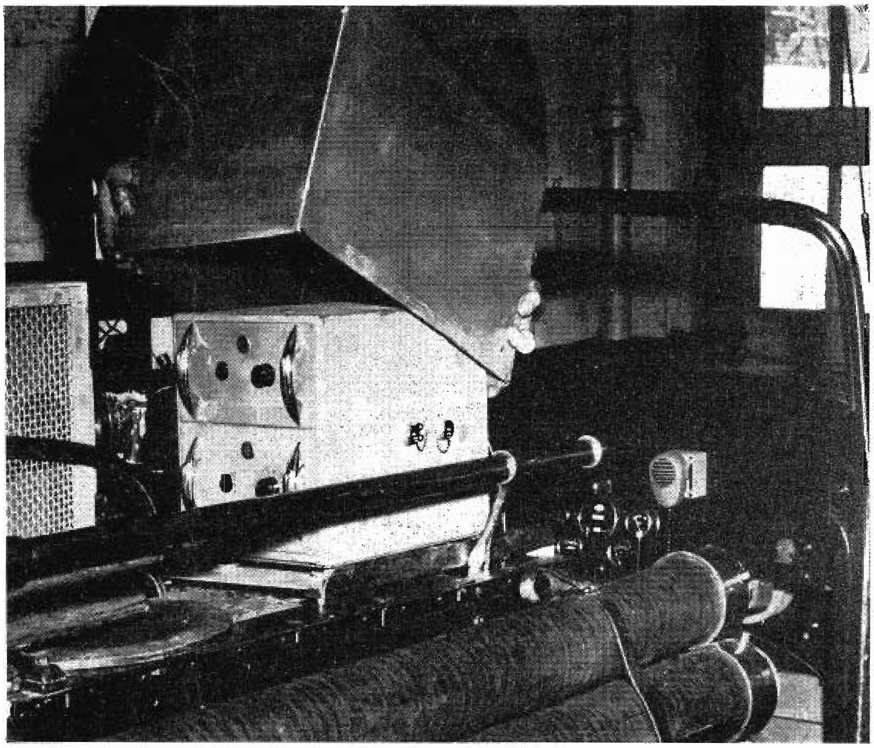
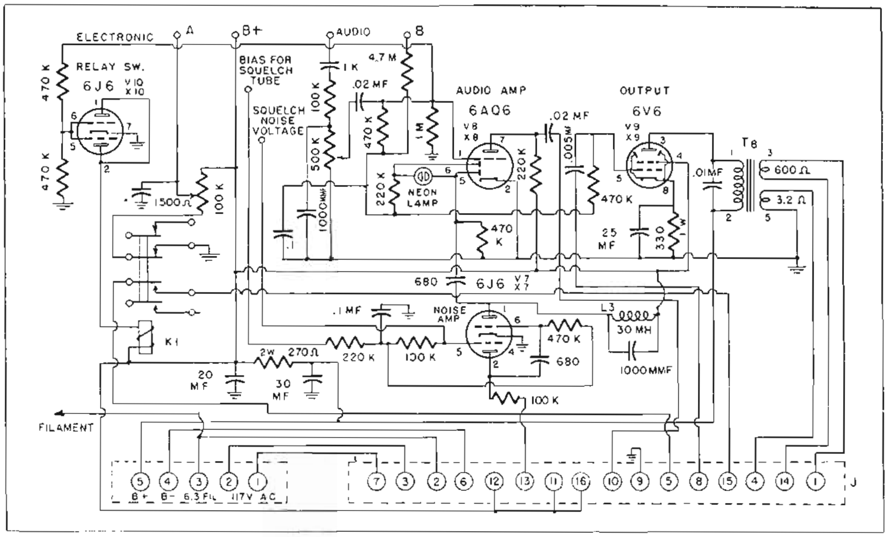


Fig. 4: Transmitter-receiver installation in Sudbury fire truck. The overall metal cover prevents water damage to the equipment during operational use at fires and is easily removed

is located on the roof of the fire department building and is about sixty feet above the ground. The surrounding territory consists of residential areas and low rolling hills. There is excellent two-way communication between the land station and mobile stations at all points in the service area, and "car-to-car" communication is likewise very good.

The receivers are fixed — tuned superheterodynes of the double-conversion type containing power supplies on a demountable sub-chassis. The r-f stages and first converter stage are also mounted on a demountable sub-chassis. The out-

Fig. 5: Circuit of the neon lamp squelch circuit, noise amplifier and electronic relay. Leads marked "A" and "B" go to remote squelch control and fixed audio bias respectively



MOBILE FM (Continued)

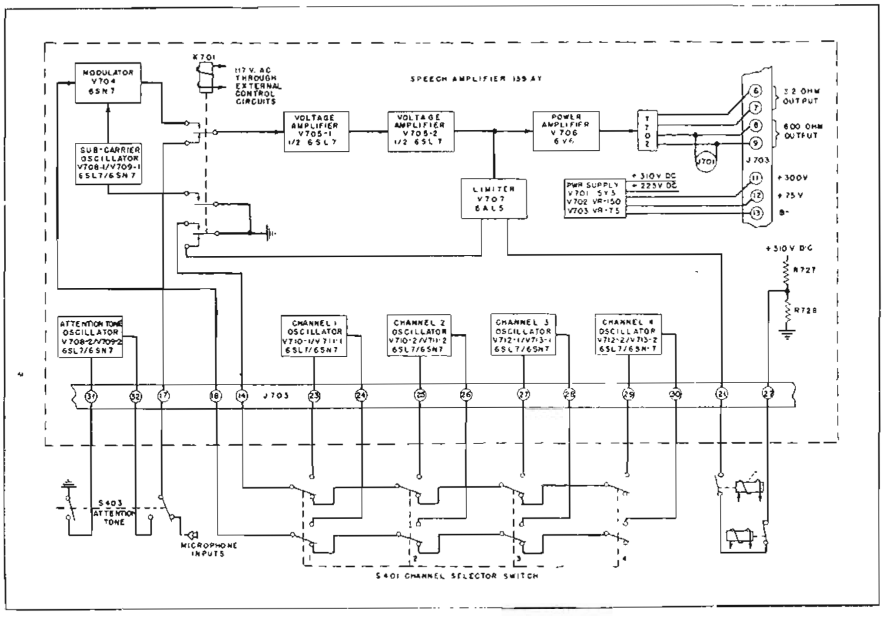


Fig. 6: Block diagram of speech amplifier modulating oscillator and coding oscillators. Use of degenerative feedback from plate to cathode maintains coding frequency stability

put frequency of this r-f head is 10.7 MC but the receiver can be used for other signals in the 148-174 MC band by merely exchanging r-f heads. The two r-f stages, 10.7 and 1.7 MC i-f stages, discriminator circuit, audio and neon squelch circuits are alike in the central station and mobile receivers. The land station receiver, Fig. 5 has a relay which operates when an on-carrier signal is received. This relay has contacts which can be used to complete an alarm circuit to indicate reception of an on-carrier signal.

The squelch circuits of all the receivers are similar in that they bias off the audio tubes and silence the receiver until an on-frequency carrier signal is received. Then, the cutoff bias is removed from the audio tubes and, because of noise quieting produced by the signal, noise-free speech is heard.

In the no-signal condition, a loud "rushing" noise (thermal noise) is heard in the output of the receiver. This noise voltage which exists across the plate circuit of the second limiter tube, V5, is applied through a tuned high pass filter to the grid of the first section of the 6J6 noise amplifier tube. (—3 volts fixed bias for the tube is obtained from the grid circuit of the second limiter by means of the voltage divider R25 and a filter circuit). The plate voltage of the first section of the 6J6 tube may be varied by an external SQUELCH CONTROL—on the dash control box of a mobile installation. The 6J6 tube is a two-stage amplifier, and the noise output developed across the tuned cirucit (C26 and L3) is coupled to a diode section of the 6AQ6 audio tube, V8, where it is rectified. The resultant negative d-c voltage across R29 is applied to the G.E. type T-2 neon lamp. When this voltage is sufficient to ionize the neon lamp, the lamp becomes conductive and the voltage is applied through a filter (removing remaining noise voltages from the bias voltage) to the grids of the audio tubes, V8 and V9. The receiver is then silenced.

When an on-carrier signal is applied to the receiver, the noise output of the second limiter is sharply reduced due to the limiting action, and so there is a corresponding reduction in the negative bias voltage applied to the neon lamp. When this voltage falls below the ionization potential of the neon lamp, the lamp extinguishes and the cut-off bias to the two audio tubes is then removed. The receiver is then operative as V8 and V9 act as normal audio amplifiers.

When the land station receiver is squelched, the grids of the 6J6 switching tube (V10) are also biased to cut-off by the same negative voltage that is applied to V8 and V9. Then there is little or no plate current flowing through the coil of relay K1, and it remains unenergized. When the cut-off bias is removed due to an on-carrier signal, V10 conducts and relay K1 is energized. Its contacts are used as switches in indicator circuits (bell, lamp, etc.) to show the presence of an on-carrier signal.

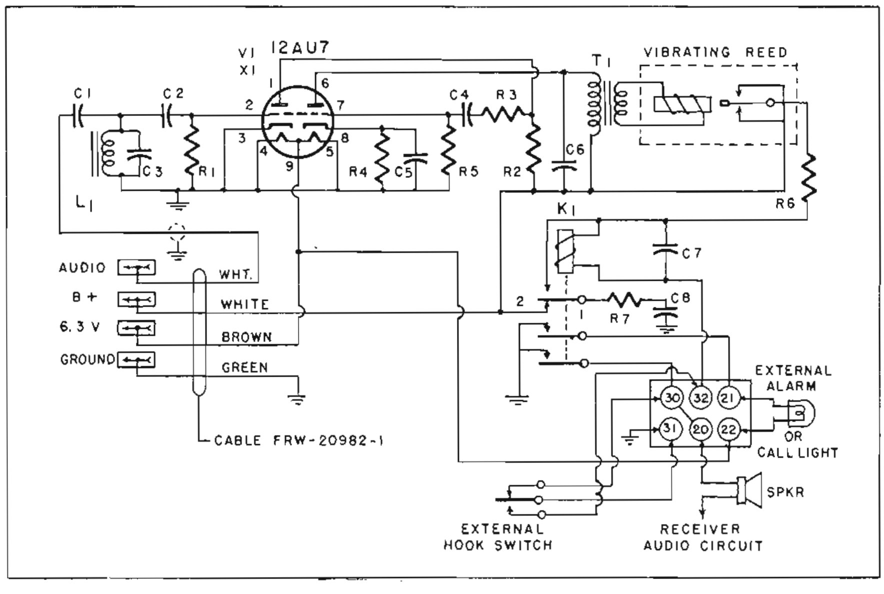
Speech Amplifier in Console

The coded signal of the Selecto-Call tranmission is generated in the speech amplifier, Fig. 6, in the land station console. The speech amplifier consists essentially of two stages of voltage amplification, one stage of power amplification, a limiter stage, Attention Tone Oscillator, 7000 cycle sub-carrier oscillator, and four channel tone oscillators.

Externally located switches control the operation of relay K701, and therefore determine the nature

(Continued on page 54)

Fig. 7: Decoder unit and sub-carrier demodulator. Hookswitch contacts in "mic off" position



Audio Technics for Television

Varying camera field dimensions and problems of acoustic interference present challenge to audio researchers in search for new electronic controls

By CHARLES D. COLE
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Special Devices Div., Austin Company
19 Rector St., New York City

Fig. 1: Scene in studios of WJZ-TV, New York City, in which the microphone is concealed in the flower bowl on the table. The lead to the microphone can be seen under the coffee table. The Electrovoice 655 dynamic or RCA 88 A are both used for this purpose

THE problem of TV sound transmission has received much attention in the past and is now beginning to reap the benefits of the work which has been done on it. Transmitters are handling audio signals in a very satisfactory manner and the treatment of what is picked up by the microphone and radiated is at least as good as the techniques applied to sound broadcasting. However, the actual problem of transducer operation in performing the physical feat of converting the sound waves to electrical impulses has not received sufficient attention. Many difficulties remain to be overcome. The new RCA directional microphone which is used in multiple units of two or more with a special operator to control pick up and selection of microphones in use is about the only real step forward in this field.

The problems involved in television sound pickup are severe and limiting. When Hollywood turned to sound movies camera technics had to be changed and discarded in favor of new methods in order to keep the microphone out of the camera field. However, this requirement was not nearly as limiting as those which exist on the present TV stage set. Movie sequences are recorded in short bursts of shooting in which, perhaps one minute of story is produced. Then action is halted, lights and props rearranged for the next scene, fresh microphone positions established and any other necessary changes made to maintain technical quality at a maximum. In other words because the story is shot intermittently the action can always be stopped at any time to restablish optimum conditions.

Compare this with a television set. Assume that a one-half-hour program is being produced with all the action taking place in one, or at the most two sets. If only one set is being used, then all lights and microphones must be positioned before the program starts, and must remain static with only very small latitude of movement until the program is over. The action is continuous with no stops allowed for equipment movements and changes in position.

If the rehearsal plans have been followed exactly the lights and microphone positions will remain more or less satisfactory, but should any of the actors change position from his rehearsal stand or any other changes be made, the probability is that either sound or light efficiency may be ruined.

Methods of Microphone Usage

The considerations involved in television sound pickup may be described under a number of headings. Most of these overlap so that a clear-cut boundary is not possible, however current methods of microphone usage fall into four categories:

Microphone booms mounted on dollies for mobility; Microphones concealed in pieces of furniture; Microphones pendant from the ceiling or a catwalk; Floor microphones.

Since generally speaking it is not desirable for the microphone to be visible in pictures . . . the floor type of mounting is immediately eliminated unless the show happens to be of the type where visible microphone is desirable. Disposing of the latter class first it is obvious that it can be used in very limited varieties of shows. Certain types of orchestra or participation shows which require the atmosphere of a radio station use this mike. Otherwise its presence merely serves to spoil the pictorial composition and detract from picture interest. Often the RCA 44BX or 88A type of instrument is used, although the new miniature microphone type K-B-2C (which is also used for concealed locations) is increasing in popularity due to its extremely small size and comparative invisibility. Another problem that has to be faced when using this type of microphone is the nuisance of cables trailing over the floor with their attendant rupture and tripping hazards.

The general practice today is to follow Hollywood and use boom microphones mounted on mobile doilies or trucks so that they can be moved around to follow the action and still remain out of the field of the camera.

The RCA 77 D is a popular choice. In operation these microphones are treated like cameras. A dolly pusher is assigned and both he and the boom operator wear earphones connected into the directors intercom circuit. While the degree of skill required is obviously not as great as that of a cameraman, the operators must keep on their toes and follow the action carefully. One of the two earphones carries program sound so that the operator can judge the results of his efforts.

In operating boom mikes three general problems occur which affect the composition of the picture and the correlation between the sound and video perspective. They are: prevention of microphone shadows in the picture, absolute provision that the microphone will not appear in the shot and, most important of all, the illusion of sound and sight perspective must be maintained.

In the first case microphone and boom shadows are the problem. In the tension of following action it is only too easy for the microphone operator to allow himself to place the boom or mike in such a position that a shadow is cast. Considering the large number of sources of illumination supported by floor stands it is a miracle that this does not happen more often. With the increasing use of fluorescent light banks suspended from catwalks or rigging another source of danger is introduced in the risk of damaging these lamps and casting shadows from the overhead lighting.

The initial planning of a production should devote considerable attention to the problem of light and microphone placement. Both the quality of the sound as well as the pictorial balance and depth are affected by these two items. Too often the shadow problem is overcome by the simple expedient of moving the microphone causing the shadow. That solves one problem but unfortunately often results in impairing sound pickup. Although it is more trouble, and takes longer, the proper solution is to rearrange the lighting layout so that optimum sound conditions exist together with satisfactory lighting.

Sight & Sound Correlation

Correlation between sight and sound is a matter which unfortunately has been neglected in the past. It is not a problem peculiar to boom microphone operation, however, but is common to every type of sound pickup.

In discussing it in connection with boom operation the assumption is made that no other type of sound pickup eg. concealed microphones, is being used. In sound broadcasting the illusion of closeness in dialogue is obtained by having the player speak closer to the microphone so that his voice sounds as it would if he were speaking from a distance of only one or two feet. If he is supposed to be on the other side of a room he speaks further from the microphone. When close up sound is used most extraneous noises are obscured by the closeness of the sound source and its subsequent high sound level, which is what is heard if a person speaks close to the listener. On the other hand, when speech comes from a distance it brings with it, and is modulated by, other noises such as footsteps and echoes from walls and other objects on the set. In each case the illusion is *real*. This is easily attained in sound work since the microphone placement is controlled by good audio requirements, and long distance effects, such as long echoes, are produced artificially in an echo chamber.

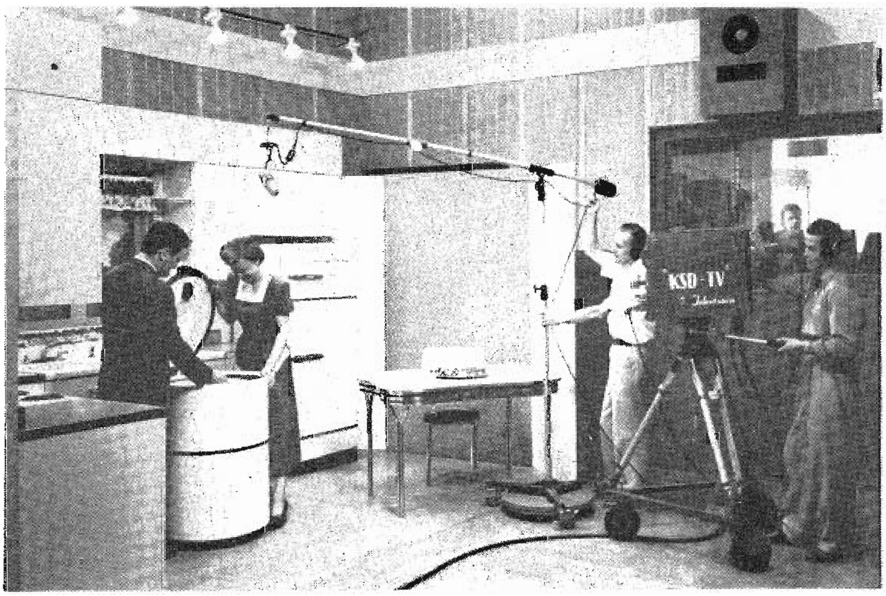

Fig. 2: RCA 77D microphone boom mounted for mobile use in KSD-TV, St. Louis, Mo. studios

Television cannot easily do this. When a close up is shown the microphone cannot be close to the lips of the speaker, and when a long or medium shot is used in which the characters are talking across the room the camera has a wide angle of view and will show the microphone unless it is well out of the way. That is satisfactory for long distance sound, but, unfortuately, since the microphone is not binaural it has no sound discriminating qualities and it picks up sounds from all directions with consequent confusion. Sound studios are treated acoustically to produce enclosures which while remaining "live" have very few interfering sound reflections. Television studios are likewise treated acoustically, but as soon as scenery is added the effectiveness of the treatment may be impaired by the hardness of paint covered flats and backdrops as well as erratic sound reflections introduced by the furniture. The purist says that the microphone should move with the camera since the human ears are connected to the head, which also carries the eyes. But if this is done to any great extent too much incidental noise is picked up, and the dialogue lost or confused. Another way in which motion pictures have an advantage is in the use of sound dubbing after the filming is finished.

Fortunately for programs where

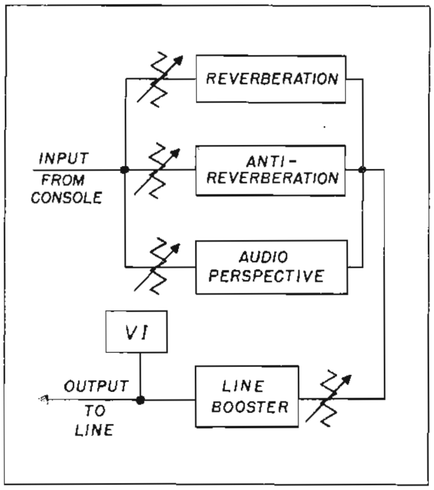

Fig. 3: Reverberation and perspective controls which could be interconnected with the camera controls to coordinate video and audio

music is featured, such as symphony concerts, the presence of a microphone is not so distracting although here too microphones are concealed whenever possible. However, sight of a microphone in front of the orchestra will not destroy an illusion as rapidly and thoroughly as the sight of one in the middle of a drama. When Hollywood wants to make a symphony picture the sound is usually recorded first with microphones in the best positions, then it is played back to the musicians who synchronize their playing motions to the music while the action is filmed.

Concealed Microphones

In scenes where close action is involved, or where the performer talks while seated at a desk concealed microphones are ideal. News commentators quiz shows, interviews and similar programs are suited to this type of sound pickup. So too, are some types of dramatic scenes where props and actors are so situated that concealed microphones may be used to provide adequate sound pickup. Unfortunately most productions of this type are not sufficiently static, or do not have suitable props to permit the use of concealed microphones. Another problem that occurs in this type of operation is that of sound absorption and reflection by the material which is concealing the microphone. There is a risk of high frequency loss in the area immediately surrounding it due to shadowing and absorption.

The pendant microphone is really a variation of the floor type in that its location is fixed, unless it is operated by a man on a catwalk who can raise, lower and move it horizontally in accordance with the director's orders. It is a handicap in many cases since it is less easy to maneuver than a regular boom microphone and thus slows the rapidity with which cuts can be made to long or middle shots with their attendant increase in the angle of vision. Therefore its use appears to be limited to certain types of show such as an interview or quiz. Very few studios have catwalks or facilities for installing operators above the studio floor to control this type of microphone.

The "machine-gun microphone" used for long-distance selective pickup of speech may find an application in the television studio if the frequency response can be improved so that a wider band of frequencies can be transmitted. The need to keep the physical size to a minimum conflicts with the requirement of a certain minimum size of barrel to keep the cut-off frequency as low as possible. We have not heard very much about this device recently—television may re-arouse interest in it. At the same time it may stimulate the use of parabola microphones with their slightly better fidelity although the rather unwieldly size is somewhat against their full employment in crowded studios. Use of this type of sound pickup equipment would require sound men who could aim their equipment like a camera and follow the action. But it might make for better sound and less pickup of extraneous noises which are today sometimes quite audible. In any case it is an interesting thought.

The question of actual studio design is somewhat different from the usual sound technics. Every engineer and designer differs in his reply to the question "What is the

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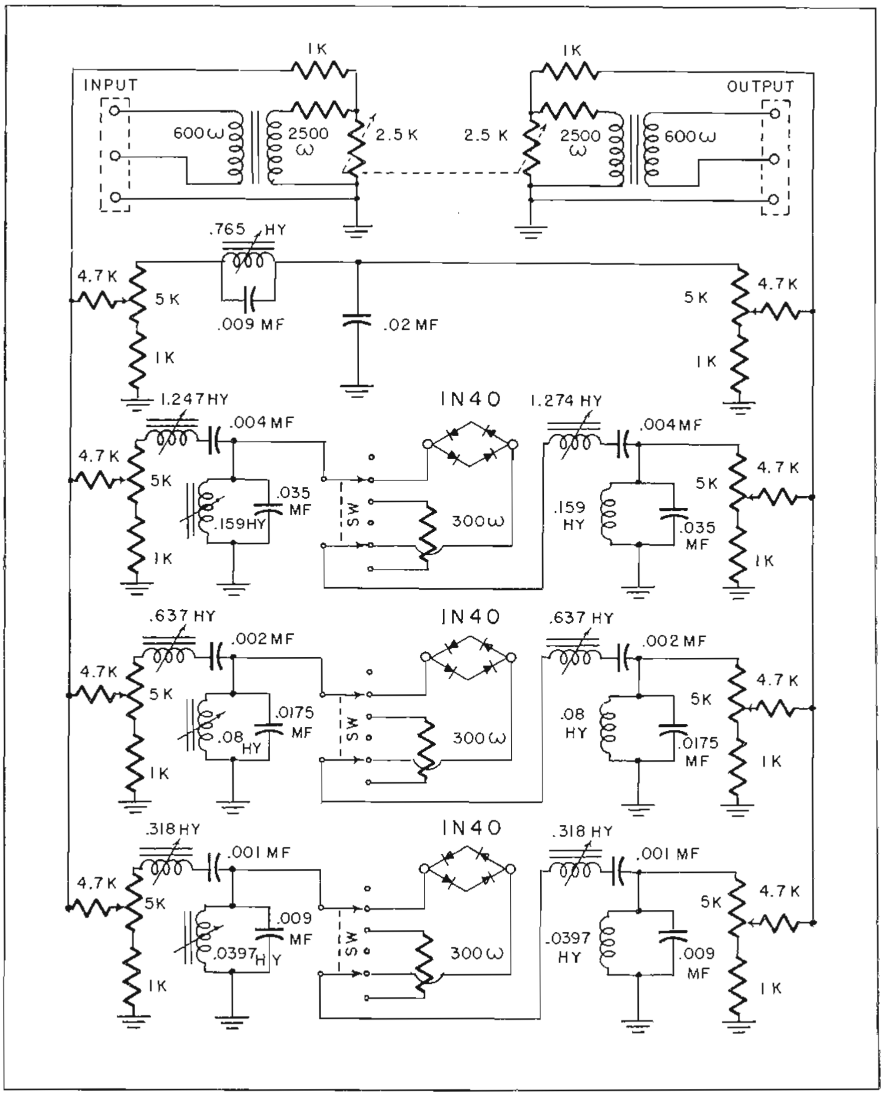
Fig. 4: The ABC Noise Suppressor which makes use of the cross-over characteristics of the germanium diodex to obtain selective octave filtering and control of reverberation



New One-Tube Limiter-Discriminator for FM

6BN6 gated beam tubes, aside from combined functions in FM receivers, have many other applications in such circuits as multivibrators, square wave generators, phase measurers, and TV sync clippers

By *A. P. HAASE*, *Receiving Tube Engineering, General Electric Co., Owensboro, Ky.*

PART TWO OF TWO PARTS

THE tube has been designed with the requirements of the overall tuning characteristic in mind. Considering the requirements of the limiter-discriminator circuit, it is essential that the average plate current remain constant whether a signal is applied to the input grid or not. To accomplish this, using cathode bias as specified, it is necessary that a certain relationship exist between the voltage applied to the accelerator electrode and that applied to the plate. This function is approximately:

$$E_b = 1.425\ E_{acc} - 13$$

for values of 35 E_{acc} 105 v.

When the circuit is operated at potentials other than those discussed, the plate load register should be designed to yield an electrode voltage compatible with the above requirement. For example, a circuit operating at $E_{acc} = 85$ v. requires $E_b = 108$ v. Using $E_{bb} = 175$ v. a plate load resistance of 124,000 ohms is required. ($I_b = .54$ ma. approx.) This circuit yields an output of about 15 v. rms for 75 KC deviation.

The application of the 6BN6 limiter-discriminator to intercarrier television receivers is of particular interest. The intercarrier frequency of 4.5 MC allows operation of this circuit at a frequency at which a high impedance quadrature grid tank circuit can be obtained and utilized since the undesired external coupling reactance due to capacitance between the input grid and the quadrature grid is in the order of 3.5 megohms. The dependence of the output voltage upon the Q of the quadrature grid tank is indicated in Table 1 in which variations of parallel resonant impedance of the quadrature grid tank from 141,000 ohms to 500,000 ohms yielded variations in output voltage from 2.47 to 5.5 volts rms at 22.5 KC deviation. These output voltages, too, were obtained with low supply voltages for the plate and accelerator electrodes. One application of the 6BN6 in an intercarrier TV chassis where higher plate supply voltage and load resistance are used yields 15 volts rms at 25 KC deviation with an input signal of 1.25 volts. This output voltage is sufficient to drive the power amplifier tube directly and so eliminates one audio amplifier stage completely.

TYPE 6BN6 — TABLE I

Center Frequency 4.5 MC — $E_{ACC} = 60$ v.
Deviation ..... 22.5 KC — $E_B = 80$ v.
$R_L = 68{,}000\ \Omega$

Coil Q	Resonant Impedance	E_{OUT} RMS
50	141,000 Ω	2.47 v.
92	247,000 Ω	4.00 v.
140	500,000 Ω	5.50 v.

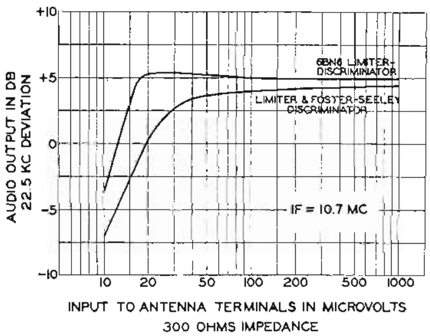


Fig. 10: 6BN6 vs Armstrong comparison

Operation of the 6BN6 at 21.5 MC has been realized but only when considerable care was taken to shield the input and quadrature grid circuits from each other. At this frequency, with 10 KC deviation and 30% AM, output voltage of 0.55 volts rms and AM rejection of about 20 db was obtained.

At all frequencies at which tests were made, the input voltage was varied from less than 1 volt to 40 volts rms so that the full range of input signals which we could expect to find in receiver applications was covered.

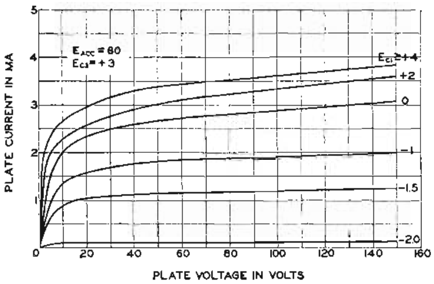


Fig. 11: Plate current vs plate voltage curves with #1 signal grid as control

A comparison between the performance of the 6BN6 limiter-discriminator and an Armstrong system, i. e., limiter and Foster-Seeley discriminator has been made using a now obsolete FM receiver made by one of the well-known receiver manufacturers. Fig. 10 shows the AM rejection characteristic vs. input to the antenna terminals of the receiver. In this case, 30 microvolts represents an input signal to the limiter-discriminator of approximately 2 volts and the receiver gain is reasonably linear to the 1,000 microvolt value. It can be seen that the 6BN6 yields superior performance in the low input voltage regions, is very slightly inferior to the Armstrong system at intermediate inputs, and approaches the AM rejection of the Armstrong system quite well at high input levels.

The performance of the limiter-discriminator, comparing audio output voltage with the input voltage to the antenna terminals, is shown in Fig. 11. Here again the 6BN6 performance is considerably better than that of the limiter and Foster-Seeley discriminator. The audio voltage reaches a maximum with about 1 volt rms signal at the input of the 6BN6 and remains essentially constant over the range of input voltages normally covered. In addition to these desirable characteristics, the limiter has associated with it no RC time constants of importance at the operating frequency and hence can respond at a rate limited only by the inertia of the electron beam. This means that ignition noise and other similar pulse noise is rejected to a degree previously unobtainable even when cascade limiter stages are used. Such response of the limiter circuit makes possible the effective reduction of common channel interference of both the beat note and cross-modulation type. The discriminator does not utilize separate cathodes as is the case in most of the other popular discriminator circuits, and hence unbalance due to variations in the aging characteristics of cath-

(*Continued on page* 36)

1950 IRE Fellowships and Awards Announced

Thirty Fellow Awards will be conferred by the IRE at its 1950 convention to be held March 6 to 9 at the Hotel Commodore and Grand Central Palace, New York City. The rank of Fellow, the highest membership progression in the Institute, is an honorary grade bestowed by the Board of Directors of the Institute, a professional organization dedicated to the theory and practice of radio and electronics.

Prof. Frederick E. Terman, dean of the School of Engineering of Stanford Univ., will be awarded the 1950 Medal of Honor, the Institute's highest award, given in recognition of distinguished service rendered through substantial and important advancement in the science and art of radio communication. Prof. Terman's medal will be accompanied by a citation reading as follows: "To Frederick Emmons Terman for his many contributions to the radio and electronics industry as teacher, author, scientist, and administrator."

Award to Dr. A. V. Haeff

Dr. Andrew V. Haeff, consultant with the Naval Research Laboratory, Washington, D. C., is the recipient of the IRE's Harry Diamond Memorial Award for 1950. It will be conferred for his general work in the field of high-frequency radio analysis, his work on the traveling wave tube, and his work on memory storage devices.

Recipients of the 1950 Browder J. Thompson Memorial Prize are Joseph F. Hull, research engineer, and Arthur W. Randals, research physicist. Both are civilian staff members of the U. S. Army Signal Corps. They have been named for the award for their paper entitled "High-Power Interdigital Magnetrons", published in the November, 1948, issue of *Proceedings of the IRE.*

E. J. Barlow, consultant in advanced devlopment of klystrons and radar systems, has been announced as the 1950 winner of the Editor's Award of the IRE. The annual award will be accompanied by the following citation: "To E. J. Barlow for an unusually clear presentation of a technical subject in his paper 'Doppler Radar' published in the April, 1949, issue of *Proceedings of the IRE.*"

Otto H. Schade, research engineer for RCA Victor Division of Harrison, N. J., is the recipient of the 1950 Morris Liebmann Memorial Prize awarded by the IRE. The award will be presented for his outstanding contributions to the analysis, measurement technique, and system development in the field of television and related optics.

Members who have been awarded the grade of Fellow and their citations are as follows:

Arthur L. Albert, professor of Communication Engineering, Oregon State College, Cowollis, Ore., "for his contribution to electronics as a teacher and writer."

Ralph R. Batcher, electronics consultant and consulting editor of TELE-TECH, Douglaston, L. I., N. Y., "for his pioneer work with cathode-ray instruments and more recently for his development of precision variable frequency standards ad meters."

Alda V. Bedford, research engineer, RCA Laboratories Division, Princeton, N. J., "for his many contributions to sound recording and the development of many circuits of basic importance to present-day television."

Rawson Bennett, director, U. S. Navy Electronics Laboratory, San Diego, Calif., "for his contributions in programming, guiding, and developing sonar systems for military use and his contribution to the administration of military electronics laboratories."

Frank J. Bingley, chief television engineer, Philco Corp., Philadelphia, Pa. "in recognition of his contributions in the field of television broadcast engineering."

K. H. Blomberg, Telefonactiebologet L. M., Ericsson, Stockholm, Sweden, "in recognition of his many contributions to development and engineering in the field of communications in Sweden."

John F. Byrne, vice president and director of engineering, Airborne Instruments Laboratory, Inc., Mineola, L. I., N. Y., "for his development of a system of polyphase broadcasting and for effective engineering administration in connection with radar countermeasures during the war."

William G. Dow, professor, Electrical Engineering Dept., University of Michigan, Ann Arbor, Mich., "for outstanding contributions to the teaching and understanding of electronics through the organization of educational material and the stimulation of students and others to critical thought."

Dudley E. Foster, engineer-in-charge, Hazeltine Research, Inc., Los Angeles, Calif., "for his contributions and technical direction of work leading to better radio receiver design."

George W. Gilmon, director of transmission engineering, Bell Telephone Laboratories, Inc., New York, N. Y. "for his contributions to the communication art and for his direction of important developments in the field of radio transmission systems."

George L. Haller, dean, School of Chemistry and Physics, Pennsylvania State College, State College, Pa., "for his work on aircraft antennas and for his diversified radio effort during the war."

Albert G. Hill, professor, Massachusetts Institute of Technology, Cambridge, Moss., for his work in the utilization of electronics to research in physics and his contribution in the conversion of war-time development laboratories to peace-time fundamental research."

Frederick S. Howes, Electrical Engineering Dept., McGill University, Montreal, Que., Canada, "for his contributions as a teacher in the field of communication engineering."

Harley A. Iams, North American Aviation, Inc., Downey, Calif., "for the development of electronic apparatus for converting images formed by electromagnetic waves to electrical signals, first in the television field, and later, using new principles, in the realm of short radio waves."

Willis Jackson, Electrical Engineering Dept., Imperial College, London, England, "for his service as an educator and his many contributions to the literature in both the radio and electrical fields."

Rudolph Kompfner, principal scientific officer, Royal Naval Scientific Service, Clarendon Laboratory, Oxford, England, "for his research in electron tube theory and particularly for his original contributions to the concepts of the traveling-wave amplifier."

Harry B. Marvin, project engineer, General Electric Co., Schenectady, N. Y., "for his outstanding contributions to the measurements art and pioneering work in FM, television, and allied fields."

Pierre Mertz, engineer, Bell Telephone Laboratories, Inc., New York, N. Y., "in recognition of his important contributions to the fundamental concepts of television transmission and reception."

John H. Miller, vice president and chief engineer, Weston Electrical Instrument Corp., Newark, N. J., "for his long activity and many contributions in the field of electrical metering and measuring technique."

Garrard Mountjoy, chief radio engineer, Stromberg-Carlson Co., Rochester, N. Y., "for his contributions to the design of radio and television broadcast receivers."

Emanuel R. Piore, director, Physical Science Division, Office of Naval Research, Washington, D. C., "for his many contributions in the fields of engineering and physical sciences, and for outstanding service in enhancing the national effort in basic research"

Jack R. Poppele, vice president, secretary, and chief engineer, Bamberger Broadcasting Service, Inc., New York, N. Y., "for his long and continued leadership in the broadcasting field and in particular for his recent contributions to television broadcasting."

Simon Ramo, director, Guided Missile Research and Development, Hughes Aircraft Co., Culver City, Calif., "for his many contributions to the analysis of electromagnetic phenomena and for his leadership in research."

Claude E. Shannon, member of the technical staff, Bell Telephone Laboratories Inc., Murray Hill, N. J., "for his contributions to the philosophy of new pulse methods and to the basic theory of communications."

W. Arthur Steel, chief engineer, Federal Electric Manufacturing Co., Ltd,. Montreal, Que., Canada, "for his contributions in Canada in advancing development of military radio, broadcasting, and international communication."

Jerome H. Steen, director, Quality Control, Sylvania Electric Products Inc., Flushing, L. I., N. Y., "for his work in the introduction and development of statistical quality control techniques in electron tube manufacturing."

George R. Town, professor of Electrical Engineering and assistant director of the Engineering Experimental Station, Iowa State College, Ames, Iowa, and formerly Manager of Engineering and Research, Stromberg-Carlson Co., Rochester, N. Y., "for his contributions in radio receiver engineering and research."

Dayton Ulrey, manager, Lancaster Engineering Section, RCA Victor Division, Lancaster, Pa., "for pioneering research and for administrative and technical contributions to the development of special purpose and power tubes."

Robert R. Warnecke, technical director, Electronics Dept., Generale de Telegrophie Sans Fil, Paris, France, "for his engineering and research contributions to vacuum tube theory and design in France."

Harold A. Zahl, chief of research, Signal Corps Engineering Laboratories, Fort Monmouth, N. J., "for his guidance of the Army Signal Corps research program in the transition from war to peace and for his contribution to radar in its early development stages."

Prof. Frederick E. Terman
Recipient of the 1950 IRE Medal of Honor

An Asymmetrical

Use of direct drive for horizontal scanning introduces correcting yoke coil makes linear scanning possible with-

By *ROBERT R. THALNER*, *Television Advance Development Engineer, Colonial Radio Corp., Buffalo, N. Y.*

HORIZONTAL output circuits for some time have been regarded with awe and mystery, not only in the manner in which they basically operate but in the apparent changes in linearity and size as various voltages are changed. In general all present day magnetic scan amplifier systems are alike, moreover, the direct drive system is perhaps the least complex and easiest to understand. With this system and the asymmetrical yoke, later to be described, some of the advantages are inherent uniformity of linearity, high efficiency and ease of adjustment.

In order to obtain a better understanding of the operation of the direct drive scanning system, the basic circuit of a deflection yoke shunted with its distributed capacitance in series with a battery and a switch is shown in Fig. 1.

The instant the switch is closed, current will begin to flow from the battery through the deflection yoke. Inasmuch as the battery is shunted directly across the yoke, and the voltage of this battery is constant, the current will rise in such a manner as to make the rate of change of current a constant, dictated by the formula, $E = (L)\, di/dt$. If now, the current in the battery and yoke is suddenly interrupted, the energy in the inductive branch of the yoke will begin to transfer to the capacitive branch. The current in the yoke will decrease from its positive value to zero and then to negative value equal to its prospective value, barring losses, in a cosine fashion. The voltage across the coil will, of course, rise from E_b to a high value and then decrease to zero in a sine function. Left in this condition, it would oscillate forever, this particular circuit having no losses. If at the moment the current in the yoke reaches its peak negative value, the switch is again closed, current will then flow through the battery in such a direction as to charge the battery until all the energy induced in the yoke has been returned to the battery. Current will then begin to flow in the opposite direction energy again being removed from the battery, with the same rate of change as before.

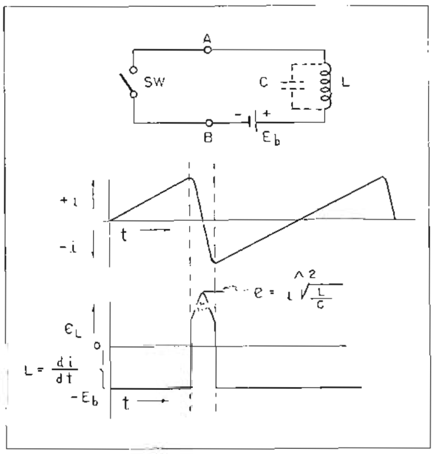


Fig. 1: Basic circuit of deflection yoke and power supply showing distributed capacity.

Two Oppositely Connected Tubes

Inasmuch as the switch will have to be replaced with a vacuum tube, and vacuum tubes are not bi-directional, two oppositely connected tubes will be required. For the first, a diode is shunted across the switch to enable the reverse current to pass through it and thereby charge the battery. The diode has also two other advantages: (1) the diode is automatic as far as the timing is concerned; it begins to conduct when the voltage across the open switch passes through zero, (2) it enables the switch to be closed at any time after that time at which the yoke current reaches peak negative and that at which it reaches zero current.

Until the switch is opened, the operation of the circuit in Fig. 2 is identical to the circuit of Fig. 1. At the time the switch is opened, the voltage across the coil begins to increase in such a direction as to hold the cathode more positive than the plate and hence no conduction occurs. After this voltage has gone through one-half cycle, it then attempts to go negative, but the diode conducts, holding the voltage across the coil constant and therefore (L) di/dt constant. Under these conditions, the stored energy can be returned to the battery through the diode circuit. The switch can be closed at any time after the diode has begun to conduct as it will merely short the diode.

Obviously, the procurement of a mechanical switch which will close and open in a fraction of a microsecond, and repeat at a frequency of over 15000 cycles per second, is rather difficult, and must, therefore, be replaced by a vacuum tube. Fig. 3 illustrates the same circuit as Fig. 2 with the addition of a tube and battery and deletion of the switch. The purpose of the battery is to supply the drop that will occur across the tube, which was not present when the switch was employed. This battery is also used to supply screen power.

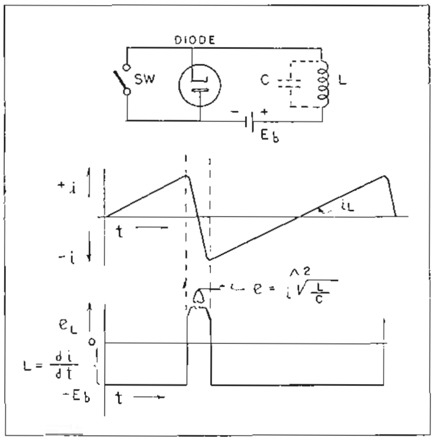


Fig. 2: Basic circuit with addition of diode shows how energy may be returned to source

A saw tooth of voltage, equal in amplitude to approximately twice that of zero bias to cutoff, at the proper values of plate and screen voltage, is applied to the grid. The

Horizontal Scanning System

difficulties in obtaining linear deflection. Properly designed out deterimental effects on vertical deflection or spot focus

tube obtains bias by drawing grid current and, therefore, the peak of the input saw tooth is held very nearly zero bias. During the first half of the cycle the diode is supplying current to the yoke. Just before the diode current reaches zero, the output tube will begin to conduct. The input wave form, to the grid of the output tube, can be shaped so that the rate of change of current supplied by it is constant. This is the most efficient mode of operation, but is not necessary as long as the tube supplies at least enough current to sustain the (L) di/dt drop. Any additional current supplied by the tube will flow through the diode, for if the current were allowed to go through the yoke, it would cause an additional drop greater than (L) di/dt which would then make the cathode of the diode more negative with respect to its plate. So it can be seen that the diode regulates the (L) di/dt drop across the yoke to exactly Ey.

The power losses in the direct

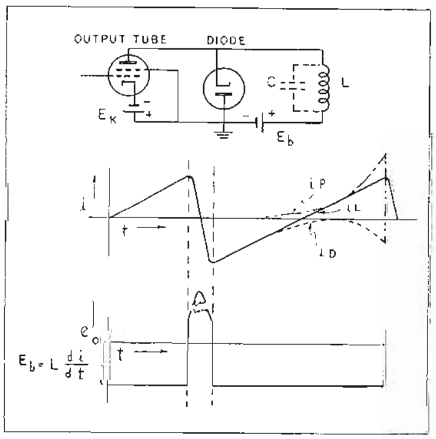


Fig. 3: The substitution of a pentode for the switch permits rapid switching of the supply

drive system can be divided into two distinct classes:

(1.) Power lost in the yoke.

(2.) Power lost in the deflection tube.

The second of these two items is wholly supplied by the battery in series with the output tube V_1. As the voltage on the plate is held at ground potential due to the action of the diode, the total power consumed by this tube is then equal to the voltage of the cathode supply, E_k, multiplied by the cathode current. Plate and screen dissipation can be separated quite easily by determining the screen dissipation and subtracting from the total power input to obtain plate dissipation. Screen dissipation is, of course, screen current times screen to cathode voltage.

Power Loss in Deflection Yoke

Power lost in the deflection yoke can be found with equal ease. In all previous examples this power has been zero due to the assumption of a loss-less yoke. If now, for example, the yoke has resistance, there would be some power lost due to this resistance. This power lost is a function of the effective "Q" of 20 at the retrace frequency then the logarithmic decrement will be:

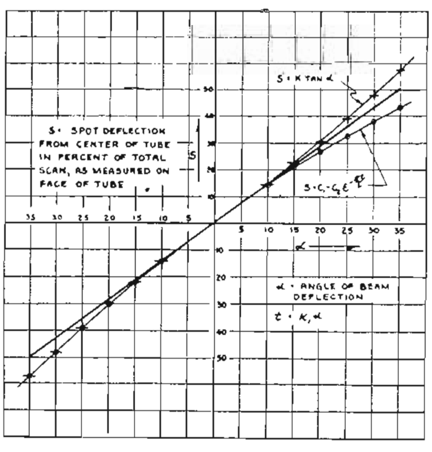
$$\varepsilon^{-N\pi/Q}$$

Where N=Number of cycles; Q=20

Then: $\varepsilon^{-N\pi/Q}=\varepsilon^{-0.5\pi/20}=$
$\varepsilon^{-\pi/40}=\varepsilon^{-.0786}=92.45\%$

Therefore, the peak negative excursion of the current during retrace time is only 92.4% that of the positive excursion of current just prior to retrace time. This also implies that *only* 92.4% of the energy stored in the yoke will be fed back to the battery during the first half of the scan. If the peak positive current is 100% (i) and the peak negative current is 92.4% (i), then the total current, peak to peak, is 192% (i). The positive peak current of 100% (i) minus (192%/2) i= 4%. The dc component is then 2% of the peak to peak current in the yoke due to the "Q" of the yoke. There are, however, other causes which raise this value of direct current through the yoke. One of these is the exponential rise of current, while still another is the "Q" of other circuit parameters. If, for example, the output tube is not cut off sharply at the end of the trace, the tube itself will dampen the ringing and thereby lower the efficiency of the circuit. It is not impossible to obtain a system for scanning 50° at 10 kilovolts that will draw as little as 15 milliamperes from the yoke supply. The total losses in the yoke circuit can then be computed by multiplying this direct current by the battery voltage E_y.

Fig. 4: Graph showing beam deflection as a percentage of distance across the tube face



The direct drive horizontal scanning system has an inherent uniformity of its characteristic. Under normal operating conditions, the output tube is made to supply more current than is necessary to support the (L) di/dt drop in the yoke, and the diode, therefore, absorbs this excess current. Under these conditions, grid drive, plate voltage, and screen voltage can be varied considerably without affecting either size or linearity of the horizontal scan. In order to change size with this system, it is only necessary to change the yoke battery voltage. This change of battery voltage does not affect the linearity as this voltage determines only the rate of change of current through the yoke.

In general, non-linearity of trace in the direct drive system can be traced to two causes: (1) non-linearity due to the exponential rise of current in the yoke and, (2) non-linearity due to tube geometry.

Fig. 4 is a graph in which α, or the angle the beam subtends from an axial line down the center of the tube is plotted versus S spot location as a percentage of the total

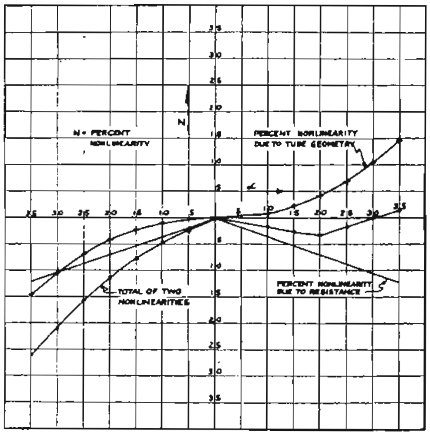


Fig. 5: Percent non-linearity plotted against beam deflection from the axis of the tube

distance across the tube.

Assuming constant angular velocity, the solid line indicates perfect linearity. This condition is not obtained in present tubes due to the flatness of the face. It can be proven, by simple geometry, that the observed scan will result in a tangent function. This curve has been plotted to the same coordinate, namely S and α in Fig. 4.

Non-Linearity of Tube

Picture tube geometry is such as to cause a stretch in the picture, as viewed on both the right and left hand sides of the picture tube. Somewhat compensating this non-linearity on the right side of the picture tube is the fact that the angular velocity is not constant, but varies in an exponential manner due to resistance in the circuit.

By a trial and error method this resistance was determined and the exponential was plotted. It can be observed from the graph that the two factors causing non-linearities compensate for each other on the right hand side of the picture while they are additive on the left side of the picture.

To illustrate these points more clearly, Fig. 5 is a graph in which percent non-linearity is plotted against α or, more accurately, against a constant multiplied by time. From this graph it can be seen that the non-linearity on the right side does not exceed 3%; however, on the left side of the picture, the non-linearity has been increased to the point where, for a 70° tube, it reaches 26%. This 26% non-linearity is, of course, not commercially usable but fortunately can be cancelled out by a judicious arrangement of the magnetic field in the deflection yoke.

Fig. 6 is an illustration of a cross section of such a deflection yoke. It will be noted that the coils are so constructed as to have the half of the winding on the right side, short and thick, while the other half of the same coil, which necessarily must have the same volume, is long and narrow. This has, of course, been exaggerated for illustration purposes and is not to scale.

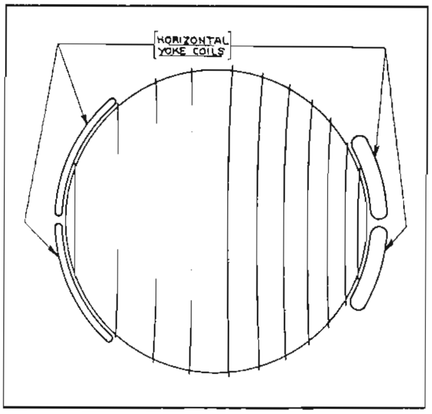


Fig. 6: Exaggerated view of deflection yoke, long and narrow, and short and thin, coils on opposing sides cancel non-linear deflection

The flux distribution in a yoke of this type is such as to produce non-linearities; however, these non-linearities are of magnitude and direction which approximately cancel the already existing distortion.

Moving the center of the window over, as is done, could produce a minor amount of trapezoidal and pincushion distortion. With a few geometric changes on the vertical coils these effects can be eliminated. The amount of spot defocusing that this yoke introduces is negligible and, in the order of that encountered in normal yokes for minimizing the pincushion effect.

Deflection yokes of the type described have only a minor change in the flux distribution and are not intended for deflection circuits other than the type described, as the non-linearities encountered in other circuits may not have the uniformity that is demanded. In practice, 4% non-linearity is not an uncommon achievement. This coupled with the stable circuit, provides good linearity for the life of the receiver.

Acknowledgment is made to H. R. Shaw and K. R. Wendt of Colonial Radio Corp. under whose direction this work was completed.

Gated Beam Tube

(*Continued from page* 33)

odes as the receiver is operated do not appear as a factor in discriminator performance. As has been indicated, the band-pass characteristic of this discriminator is not dependent upon transformer coupling and tuning and is linear over an unusually wide frequency range. Consequently, the discriminator accepts the full band over which modulation energy is distributed and yields low output distortion.

The plate current vs. plate voltage family with the voltage of the No. 1 signal grid as parameter has a characteristic similar to that of a pentode and is quite usual in every respect. This curve is shown in Fig. 12, while Fig. 13 shows the same plate current — plate voltage family where the quadrature grid voltage is used as parameter. In this instance, we have a very unique characteristic since the plate current is limited by the beam and the system utilizes an effective cathode whose density is determined to a large extent by the potential of the quadrature grid. When the quadrature grid is negative, the charac-

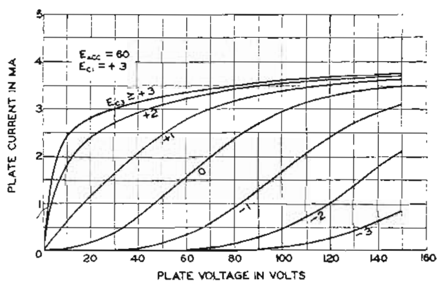


Fig. 12: Plate current vs plate voltage curves with #2 signal grid as control

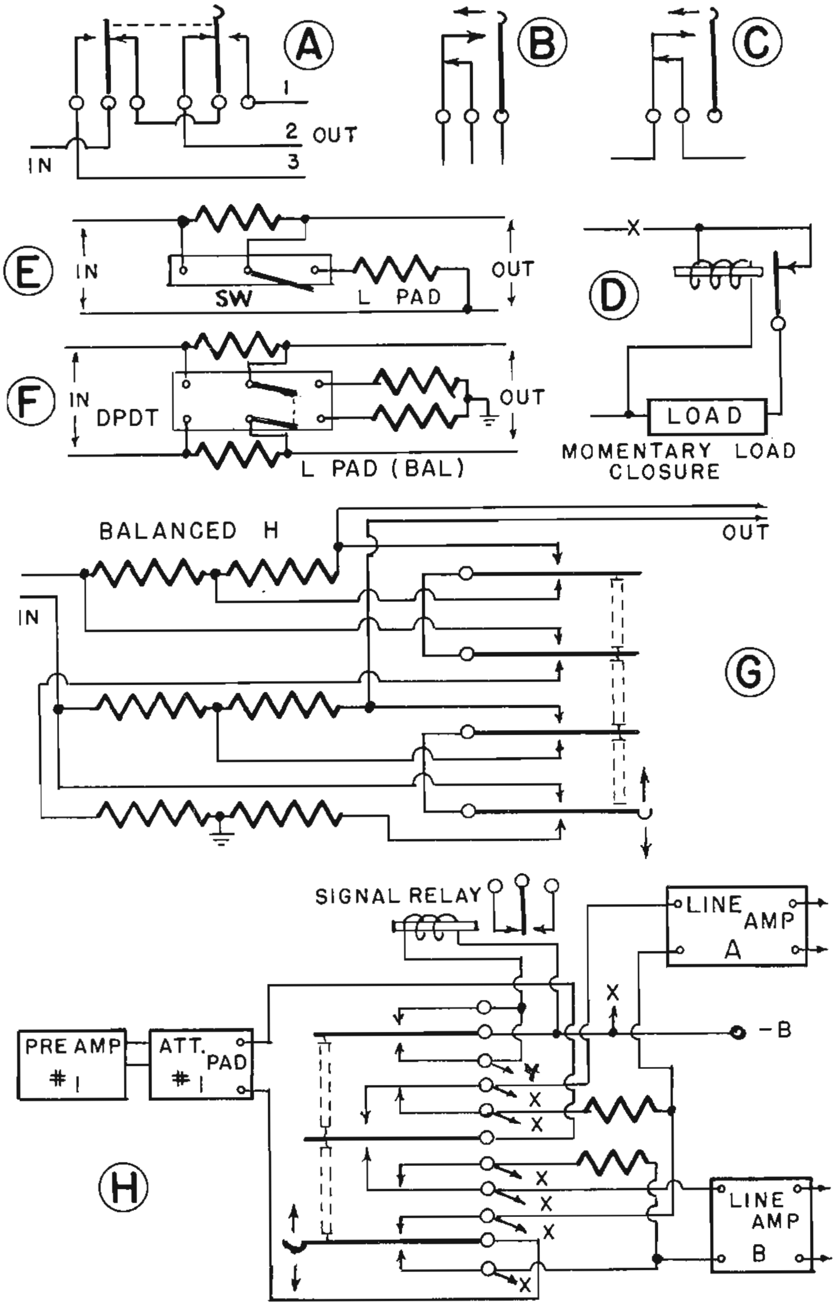
teristic triode plate family is seen with a plate current limit due to beam limits. As the voltage on this grid is made positive, the characteristic shifts to become similar to that of a pentode. Considering these factors, we see that plate current is essentially independent of plate voltage in the case of the input grid and for the quadrature grid varies from a dependence upon plate voltage similar to a triode, to that of a pentode. By applying proper biases to the two signal grids in the limiter-discriminator circuit, it is possible to optimize AM rejection and to obtain a ratio of plate current with signal to plate current with no signal to the input grid,

(*Continued on page* 60)

Page from an Engineer's Notebook

Switching Circuits for Sound Channel and Signal Control

Number 6



CONTROL engineers, continually faced with the job of setting up special switching circuits, soon gather together a number of special wiring arrangements that have come in handy. A few of these are reproduced herewith.

At (A) we have as a basic switch a form of D.P.D.T. lever switch (sometimes known as an "anti-capacity" switch). These are convenient control devices because they can readily be converted to several forms. In its usual form the switch is used to connect one line or device to either of two others with the center position neutral. However at (A) two contacts are bent, as shown so that they remain in contact in this central position, to provide a triple pole connection. One circuit can then be transferred to any one of three outlets.

A familiar spring arrangement on switches is the make before break assembly shown at (B). At (C) this same arrangement is used to provide a momentary contact, as might be needed to actuate a single stroke alarm or a solenoid, etc. Another form of momentary load closure is with a relay (as at D). Closure of the switch connects up the load and the relay. When the latter operates the load is disconnected. The closure interval depends on the operating time of the relay.

Circuits (E), (F) and (G) show simple attenuation pad controls. With a few resistors and a lever switch or even a common toggle switch or an effective fixed pad is obtained. The resistor values may be determined from earlier Notebook pages.

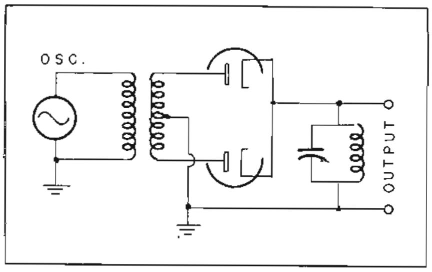
(H) shows the basic switching control in a popular broadcast and sound studio control console (Raytheon) which is designed to permit the connection of a particular program channel (through its individual preamplifier) to either or both of two lines. Preamplifier is not connected with any switch in center position. The second amplifier may be preset to a second program source and monitored in advance. More than one preamplifier may be mixed and faded at any time since line amplifier input impedance is not altered when any amplifier is connected in. In the circuit the (X) leads connect to equivalent points on all other similar transfer switches in the console and the (Y) leads may connect to equivalent points on certain of the other switches, depending on signal indicator system desired.

CUES for BROADCASTERS

Practical ways of improving station operation and efficiency

Extending Frequency Range of an Audio Oscillator

THE frequency range of an audio oscillator can be multiplied by a factor of two or four, using an audio transformer, a 6H6, and a tank circuit.



The arrangement—similar to that of the full-wave rectifier—has a tank circuit substituted for the usual rectifier filter and load. Tuning the tank to the second or fourth harmonic of the injected frequency produces an approximately sinusoidal output voltage, having a frequency of two or four times the injected frequency. Harmonic content in the output voltage depends upon circuit parameters and loading. If the circuit load is kept to a minimum, waveforms suitable for many laboratory uses can be obtained directly from the output terminals. For very low distortion the output voltage may be filtered by means of a tuned amplifier.—B. RIDER, 8 Mountainview Place, Irvington, N. J.

* * *

Vertical Radiation Calculation

FREQUENTLY in calculating antenna radiation characteristics it is necessary to know the amount of high angle radiation from the antenna. It is possible to calculate this factor from the formula.

$$f(\theta) = \frac{\cos(G \sin\theta) - \cos G}{(1 - \cos G)\cos\theta}$$

when θ = Vertical angle
G = Antenna height in degrees

and in cases where the exact height is not shown in the table it must still be done. The table gives the factor by which the horizontal radiation in the required direction must be multiplied to obtain the vertical radiation for towers of height of from 50° to 240° in height. Then, $E_v = F(\theta) \times E_n$ (horizontal radiation).

* * *

Remote Cueing Device

USUALLY on a remote broadcast it is very difficult to hear a cue sent down the program line. As a consequence the engineer has to strain his ears to pick it up at the proper time over the normal line noises. The circuit shown will enable the incoming cue to be amplified by the remote pre-amplifier with complete assurance of hearing it.

Components required are one UTC 0-9 Ouncer transformer and a Centerlab type 1457 4-pole DT switch, spring return type. The output circuit of the remote amplifier is broken at "X and Y". A switch is connected as shown to connect the station side of the program line to either the output circuit of the remote amplifier for normal relaying use, or to the UTC transformer which applies the cue signal to the grid of one of the pre-amplifier tubes. Thus the cue is amplified by the remote amplifier and heard in the line monitor phones at the line monitor jack position.

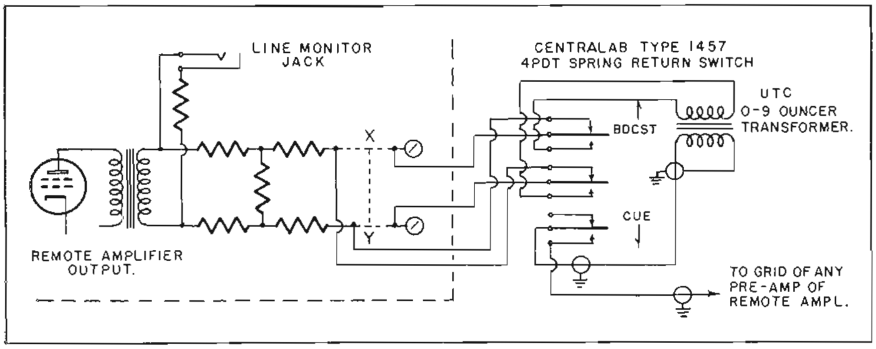
At WHEB all the remote amplifiers are fitted with this device which only occupies 1½ square

Table for Calculating Antenna Radiation Characteristics

G° / θ	50	55	60	65	70	75	80	85	90	95
					f(θ)					
0°	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
10	.9829	.9824	.9819	.9815	.9809	.9803	.9795	.9788	.9780	.9769
20	.9324	.9309	.9289	.9272	.9251	.9226	.9200	.9172	.9143	.9110
30	.8519	.8486	.8453	.8416	.8375	.8328	.8277	.8224	.8165	.8102
40	.7449	.7410	.7358	.7305	.7244	.7179	.7109	.7103	.6946	.6855
50	.6185	.6129	.6073	.6008	.5936	.5861	.5777	.5686	.5591	.5486
60	.4759	.4705	.4648	.4586	.4517	.4441	.4361	.4270	.4178	.4078
70	.3216	.3189	.3140	.3089	.3031	.2970	.2905	.2841	.2766	.2687
80	.1629	.1622	.1578	.1557	.1515	.1492	.1456	.1407	.1377	.1330
90	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000

G° / θ	100	105	110	115	120	125	130	135	140	145
					f(θ)					
0°	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
10	.9759	.9749	.9737	.9725	.9712	.9697	.9681	.9663	.9645	.9624
20	.9074	.9035	.8993	.8947	.8898	.8845	.8788	.8725	.8657	.8584
30	.8033	.7959	.7878	.7791	.7698	.7597	.7489	.7372	.7245	.7109
40	.6759	.6655	.6540	.6420	.6288	.6157	.5999	.5837	.5664	.5477
50	.5372	.5253	.5124	.4987	.4838	.4680	.4521	.4330	.4137	.3931
60	.3969	.3854	.3730	.3599	.3460	.3310	.3151	.2981	.2802	.2611
70	.2598	.2509	.2412	.2310	.2205	.2090	.1969	.1838	.1699	.1554
80	.1281	.1236	.1180	.1130	.1064	.1007	.0940	.0867	.0796	.0719
90	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000

G° / θ	150	160	170	180	190	200	210	220	230	240
					f(θ)					
0°	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
10	.9602	.9551	.9491	.9418	.9330	.9222	.9090	.8924	.8580	.8442
20	.8504	.8324	.8110	.7855	.7548	.7175	.6718	.6151	.5438	.4525
30	.6960	.6628	.6237	.5774	.5222	.4561	.3757	.2772	.1548	.0000
40	.5276	.4828	.4305	.3696	.2979	.2129	.1112	—.0116	—.1620	—.3489
50	.3710	.3220	.2657	.2008	.1256	.0378	—.0656	—.1885	—.3362	—.5163
60	.2407	.1960	.1451	.0873	.0212	—.0550	—.1431	—.2460	—.3673	—.5124
70	.1399	.1064	.0687	.0260	—.0220	—.0764	—.1388	—.2106	—.2935	—.3908
80	.0633	.0457	.0255	.0032	—.0218	—.0499	—.0818	—.1181	—.1599	—.2078
90	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000



Modification of program line amplifier permits cueing without risk of missing cue

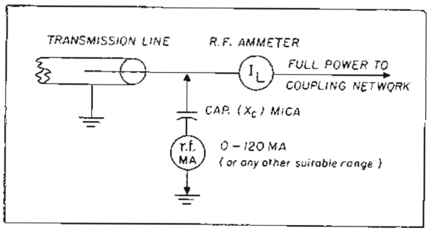
inches of space. Operation is simple in that the cueing switch is depressed until the cue is heard then it is released and program is fed to the station. The spring return feature makes it impossible for the circuit to be left in the cue position.—TONY VACCARO, Chief Engineer, WHEB, Portsmouth, N. H.

* * *

Continuous Antenna Resistance Measurement

In view of the trend towards directional antennas and stricter radiation controls it is important for the station engineer to be able at all times to check the antenna resistance. The device described provides a continuous check on the tuning of the antenna phasing and coupling networks. It consists essentially of an r-f milliammeter with a series capacity connected from the transmission line side of the antenna ammeter to ground, see figure.

The r-f milliammeter operates as a voltmeter by multiplying its reading by a factor which is a function of the reactance of the condenser and the frequency. The voltage measured at this point is then used in application with Ohm's law and



RF milliammeter connected to measure resistance

the antenna current measured at this point to calculate the impedance of the antenna coupling system and antenna.

$$\text{Example } f = 910 \text{ KC. } C = \frac{1}{2\pi f/X_c}$$

$$= (0.175)\ 10^{-6}/X_c$$

$$X_c = \frac{(1.75)\ 10^5}{C}\ \mu\mu f$$

If C is 24.2 $\mu\mu f$

Then $X_c = (1.75)\ 10^5/24.2$

$= 7231$ ohms

The factor by which the shunt current (in milliamps) is multiplied is: 7231×10^{-3}, equals 7.231 (I_s in milliamps, C in micro-microfarads)

Then if $I_s = 30$ ma

$I_s \times 7.231 = 217$ v. at point of connection

If the feeder current $I_{ant} = 3.02$ amps.

then: by ohms law $Z = E/I_{ant}$

$= 217/3.02 = 71.8$ ohms

The series capacity should be chosen so that the meter operates at about two thirds of full scale deflection with normal voltage.

This unit is very useful for checks of nominal conditions once the antenna network has been adjusted and is operating properly. Any change in constants will result in a change in the shunt current reading which is more easily noticed perhaps than the main antenna meter.—W. H. MEINERS, Chief Engineer, KRIO, McAllen, Texas.

* * *

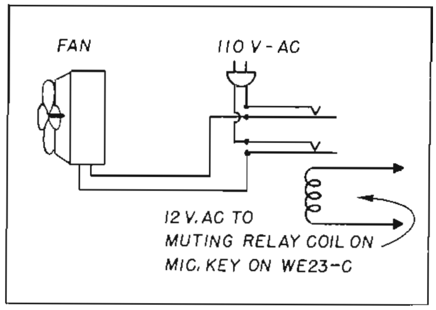
Microphone Maintenance

That old standby, the RCA 44 B microphone, is liable to get badly knocked about from time to time by careless handling and falls to the floor caused by pulls on the cables. The usual method of straightening the soft metal perforated guard case is to hammer it out with a piece of metal behind to prevent warping. This is slow and liable to cause injury. A much more satisfactory method is to shape a block of fairly firm wood into the contours of the half shell in the manner of a mold section and mount it on a piece of wood. If the case is removed from the microphone and each half in turn placed over the outline shape, a mallet can be used, with due care of course, to work the case carefully back into shape. This is a particularly valuable tool for the small station where equipment may be limited and it is necessary to maintain the highest possible level of operational efficiency.—CHARLES DAVID, Flushing, Long Island, N. Y.

Interconnecting Fan and Microphone

Last summer in New York's sweltering heat announcers in the station fell like flies, so to avoid the continual job of reviving them, fans were installed on the announce tables to keep them cool. All went well until listeners began telephoning to find out if we were keeping bees in the studio—the fans were being picked up by the microphones. So the modification shown in the sketch was made to the Western Electric 23-C console.

A 12-v. double pole-single throw relay was connected across the speaker muting relay in the console. The fan circuit was wired through the normally closed contacts, thus it runs as long as the



Simple modification to WE 23C audio console to permit fan control from mic. switch.

relay is not energized. When the microphone key is thrown the "on-air" indicator goes on, the microphone becomes live, the monitor speaker is muted and the fan stops. When the key is released the fan starts again. This automatic method is much more satisfactory than a hand operation by announcers for the latter sometimes forget to switch off the fan, or get confused with papers and switches.—VEIKKO WEST, Chief Engineer, WGHF, New York City, N. Y.

* * *

Readers are invited to contribute their own suggestions which should be short and include photographs or rough sketches. Our usual rates will be paid for material used.

Electronic Correlator for

By T. P. CHEATHAM, JR.
Melpar, Inc., 452 Swan Ave.
Alexdandria, Virginia

A NEW basis, scope and culture has been given to communications by the statistical approach (see references). Due to its unifying concepts, the new theory marks a turning point in the attitude of both research and development workers, especially in the field of electrical engineering. Hence, the next few years will witness a recasting of subject material, technics and theories of the branches of communication engineering on a single, broad foundation.

A FIRST insight into the statistical theory leaves one in awe of the scope of its implications. A reasonable investigation could conceivably require the lifetime work of a large staff of competent engineers drawn from every branch of science. From a practical standpoint it is feasible quickly to explore limited regions of the theory and then to devise experimental research procedures for realizing material implications within those regions.

A basic tenet of the philosophy, which was gradually formed by the research group at the Research Laboratory of Electronics, M.I.T., was that an initial experimental program must be restricted to key points from which it could expand and grow. Although one can rapidly speculate to the solution of many important problems in communications, the practical evaluation of these solutions always hinge on a knowledge of certain statistical parameters, the bounds of which are unknown. It is clear that a vital key point is the practical problem of measuring these parameters in a rapid and efficient manner.

Auto and cross correlation functions have been recognized as two of the most important and central statistical parameters within the theory. A few of the more important and general applications in which these functions play a vital, if not a central role are:

1. They are the most important single class of statistical parameters required in the synthesis of the optimum linear system.

2. They determine the bounds or at least a measure of the compressibility of a time function in terms of its optimum coding.

3. They are a powerful tool for the determination of actual power density spectra, and constitute an exact method for evaluating and comparing modulating systems on a spectral basis. (The Fourier transform of the auto-correlation function is equal to the power density spectrum).

4. Their properties are useful as a means of classifying the origins, the centers of distribution, and the regions of flow of various degrees of correlated data or information. For instance the measurement of time delay (or lead) in a communication system having paralleled paths of flow is an important time domain measurement which determines an equivalent frequency characteristic of the system.

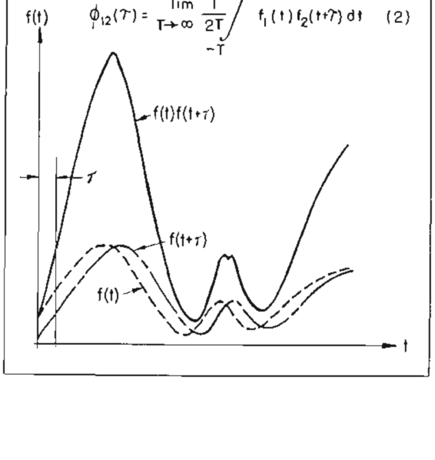
5. They provide a possible strong initial method of attack on the general problem of non-linear systems.

The auto and cross correlation functions whose computation is to be described as mathematically defined in Eq. 1 and 2, appearing with Fig. 1, together with a graphical representation of Eq. 1. Here the function $f_1(t)$ is first delayed by an interval τ_1 giving $f_1(t+\tau_1)$. This time function is then multiplied (continuously) by the undelayed function. The mean of the area under the product function $f_1(t)f_1(t+\tau_1)$ is then determined as the measure of the auto correlation function for the specific value of τ_1. The value of τ is changed and the process continued.

Fig. 1: Illustration of the graphical method of obtaining an autocorrelation function

$$\phi_{11}(\tau) = \lim_{T\to\infty} \frac{1}{2T}\int_{-T}^{T} f_1(t) f_1(t+\tau)\,dt \qquad (1)$$

$$\phi_{12}(\tau) = \lim_{T\to\infty} \frac{1}{2T}\int_{-T}^{T} f_1(t) f_2(t+\tau)\,dt \qquad (2)$$



Such a computation has the tremendous amount of time-consuming labor involved. In terms of building an analog machine, the method carries with it the additional serious handicap of requiring the delaying and storing of the entire time function. If electronic technics are used in order to attain a high speed of computation, a knowledge of the bandwidth requirements of the time function is then necessary. This is a general disadvantage, since in most cases the correlation function is of interest to determine the special distribution of the time function.

$$\phi_{11}(\tau_k) = \frac{1}{N+1}\sum_{0}^{N} a_n b_n \qquad (3)$$

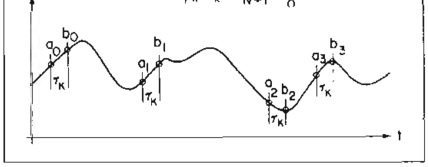


Fig. 2: Portion of a random time function showing graphical representation of equation (3)

Early methods which have been considered involve complicated storage tubes and scanning processes, magnetic tapes, rotating drums, etc. These methods are possible techniques for use on restricted and specific ranges of time functions. When the features of general flexibility and operation over a wide range with reasonable accuracy were added, the above methods became overly complicated in mechanical and electronic structure.

A similar process of computation is suggested by an interpretation of correlation functions as the mean of the product of all pairs of points of the time series in question, separated by an interval τ. That is, an arbitrary or random selection of a large number of pairs of points separated in time by τ seconds, the

Solving Complex Signalling Parameters

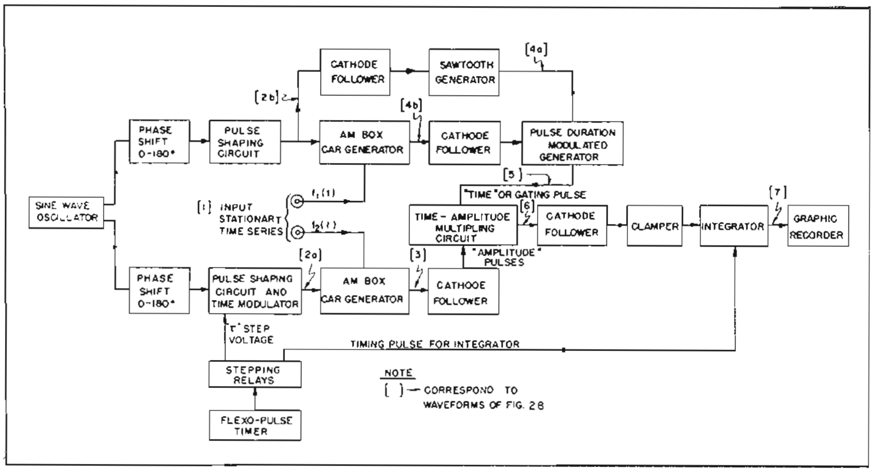


Fig. 3: Block diagram showing circuitry involved in electronic correlator constructed on basis of utilizing pulse sampling technics and multiplication in time amplitude coordinates

pairs multiplied together, the results summed and their mean taken determines one point on the correlation curve. The important point is that the correlation function can be represented by a summation and averaging of a large number of discrete multiplications, where sampled values f(t), rather than the entire time function, are delayed and stored. This means that the definition of Eq. 1 becomes approximated by Eq. (3) shown in Fig. 2, where a_n and b_n are samples of the function f (t). Eq. (3) is recognized as an approximated correlation coefficient for a discrete time series as defined in many texts on statistics.[1]

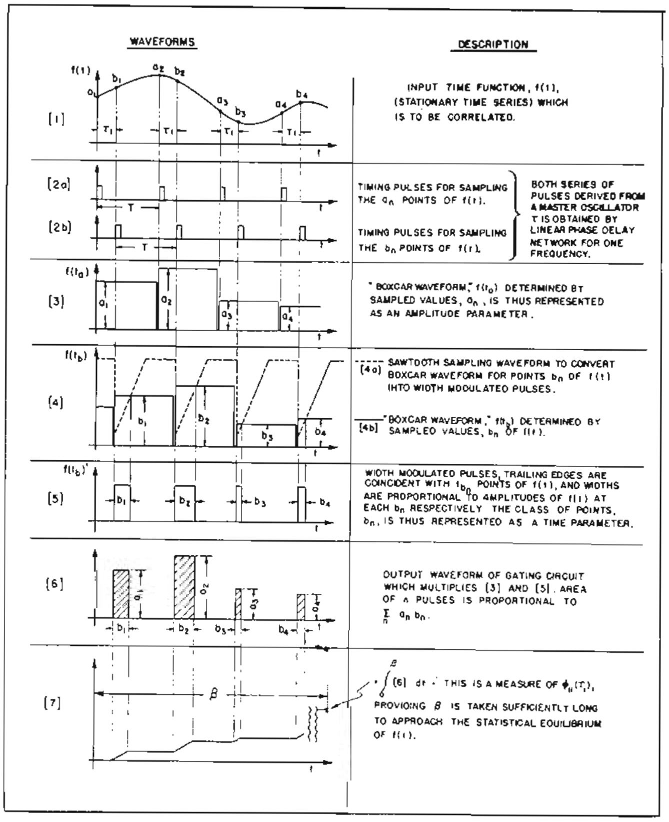
This simple procedure made it possible to design an electronic correlator in terms of well known pulse sampling technics where the delay τ is placed on a single frequency.

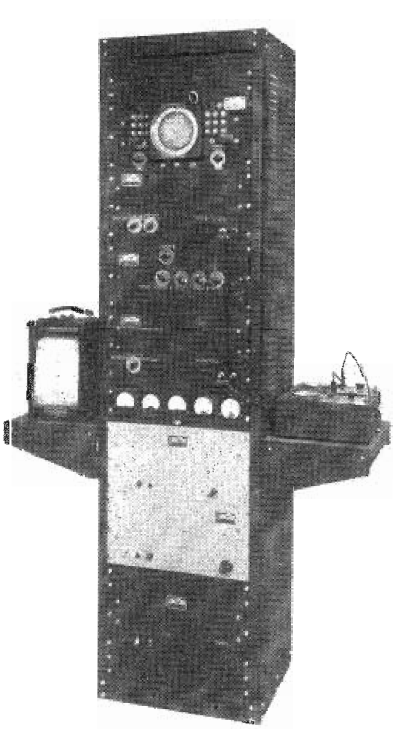
The general scope and the technics involved in the construction of an electronic correlator on the basis of a) utilizing pulse sampling techniques and b) multiplication in time-amplitude coordinates are outlined in the block diagram and waveform description of Figs. 3 and 4.

Waveform (1) of Fig. 4 shows a section of a random time function f(t). A sine wave master oscillator is used to derive the timing and sampling pulses of waveforms (2a) and (2b). In addition to wave shaping networks, the sine wave is passed through an R-C phase shift network to give an initial coarse adjustment of τ. The timing pulses are then time-modulated in discrete steps, the time modulation being accomplished by means of a stepping relay mounted with precision resistors and connected to a well-regulated supply. There are 90 discrete voltage levels available from the relay. These voltage levels are linearly

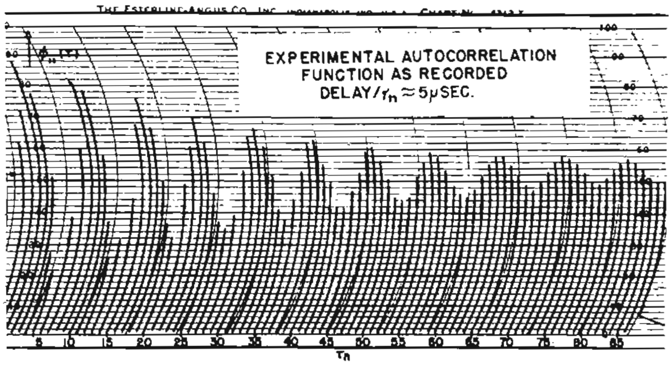
[1]The return to a discrete approximation as a practical means of computation of the correlation coefficient for a continuous time series was first suggested to the writer by Dr. G. Duvall, formerly of Research Laboratory of Electronics, M.I.T., and also later by Dr. Y. W. Lee, M.I.T.

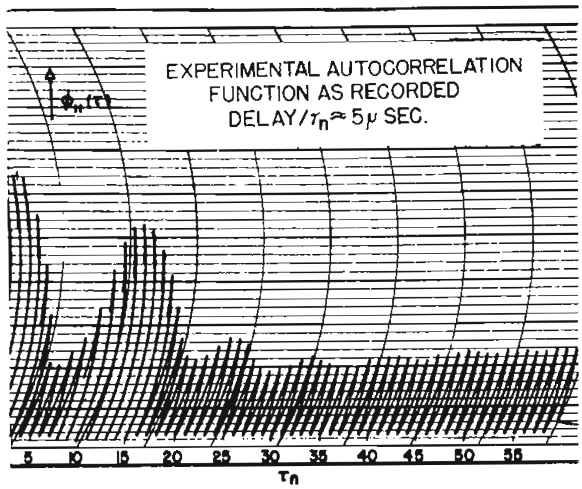
Fig. 4: Waveforms of the correlator using pulse sampling and multiplication of time amplitude coordinates →

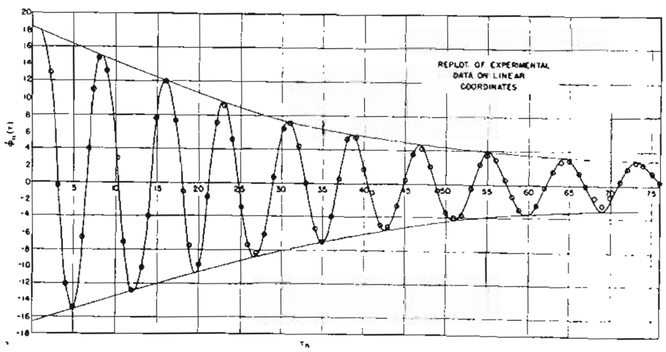




← Fig. 5: Photo of the research model correlator showing its size and general structural features







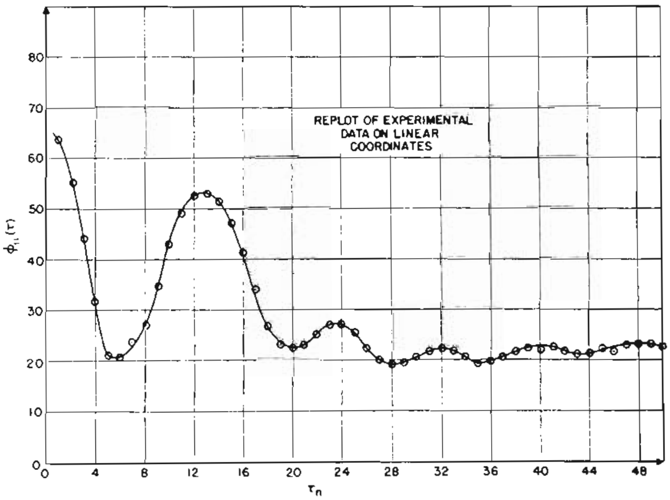


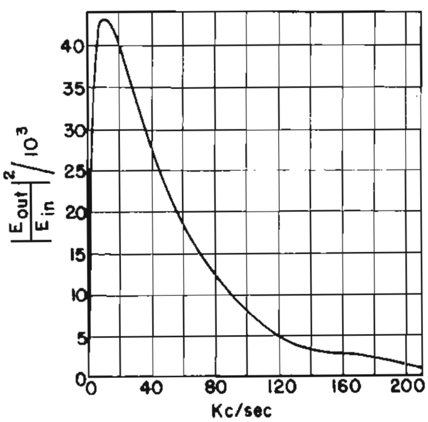
Fig. 7: (Above) Autocorrelation function of noise from an 884 gas tube after passing through transfer characteristic of Fig. 6

Fig. 8: (Right) Autocorrelation function of noise from an 884 gas tube after passing through a single tuned circuit (Q = 14)

converted to corresponding time delays by voltage intersection with a linear sawtooth. Since both the slope of the sawtooth and the voltage increment per step from the relay can be varied, a wide range of variation of τ_k can be selected to fit the time functions being investigated.

The sampling pulses are used to measure the amplitude of f(t) at the "a" and "b" points. These amplitudes are stored over a sampling period T as indicated by waveform (3) and (4b), Fig. 4. In this operation the amplitude of the "a" and "b" points are stored on a capacitor in a so-called "box-car" generating circuit.

Fig. 6: Overall transfer characteristic $|E_o/E_i|^2$ vs. kc/sec of noise source panel as measured with a signal generator



The amplitude of waveform (3), Fig. 4 is a function of the amplitude of f(t) at each "a" point, a_n, giving the desired amplitude coordinate. A linear sawtooth is used to transform the stored amplitude of waveform (4b), Fig. 4, to an equivalent time parameter represented by the width modulated pulses of waveform (5), Fig. 4.

Waveforms (3) and (5), Fig. 4, are then placed in coincidence in a gating circuit, the output being a series of pulses of varying amplitude and width as indicated by waveform (6). The area of each of these pulses is proportional to the product of a pair of points separated τ_k seconds in time.

As a final step, the integral or summation of the output pulses of the multiplying circuit, over a period B, which approximates the statistics of the random time functions, then gives a measure of $\psi^{11}(\tau_k)$. The final value of the integral is recorded, τ shifted, and the process is repeated.

Because of the method of multiplication used, a product of $a_n b_n$ is always positive with respect to ground, and is positive and negative only with respect to the average dc of the unmodulated pulse train from the multiplier. Initially it was found that the standard deviation of many random time functions under linear operation was only of the order of 10-20% of the dc component of the unmodulated pulses. This, at first, put a seemingly heavy restriction on the accuracy with which measurements of the "random" portion of the correlation function could be measured. If a means for generating an adjustable step function of the input to the integrator is provided, as much of the dc component of waveform (5), Fig. 4, as desired can be cancelled. This feature, together with an integrator sensitivity control, makes it possible to vary and control the final presentation of the correlation function not only in time but amplitude as well.

The operation of the electronic correlator is completely automatic. An adjustable timing circuit is used to operate the τ stepping relay and integrator relay of the circuits.

Fig. 5 is a photograph of the research model correlator showing its size and general structure. Reading from top to bottom, the chassis in the eight foot rack are: (1) Stepping relay and timing circuits, (2) Channel "a", (3) multiplying, control, and integrating net works, (4) channel "b" (5) voltage and current meters, and (6) power supplies.

Figs, 7, 8 and 9 show some illustrative examples of correlation functions for random input time functions—specifically noise from an 884 gas tube at the output of linear filters[2]. The transfer characteristic of the noise source amplifier is shown in transfer characteristic of Fig. 6.

The autocorrelation function of the noise signal at the output of the transfer characteristic of Fig. 6 is shown in Fig. 7. The autocorrelation function of Fig. 8 is obtained by inserting a single tuned circuit (Q=14, center frequency =20 kc), within transfer characteristic of Fig. 6.

Fig. 9 illustrates the flexibility of the correlator by showing the first part of the autocorrelation function of Fig. 8 in greater detail, i.e., the delay per step of τ_n is reduced to approximately 1/10 its value for Fig. 8, and the correlation function in the vicinity of $\tau_n=0$ is shown with the greater detail of approximately ten times as many points.

The electronic correlator has been

(*Continued on page* 58)

[2]The curves shown here are presented in a qualitative rather than quantitative sense. A detailed quantitative statistical study of various noise sources including their autocorrelation function as measured by the electronic correlator has been reported by Mr. N. Knudtzon, R.L.E. Technical Report 115, 7/15/48.

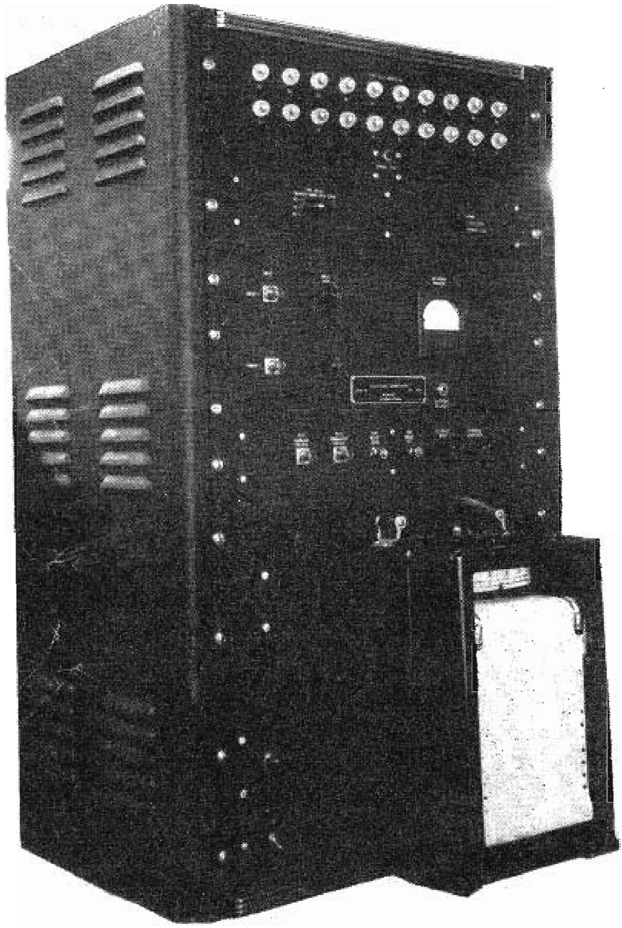
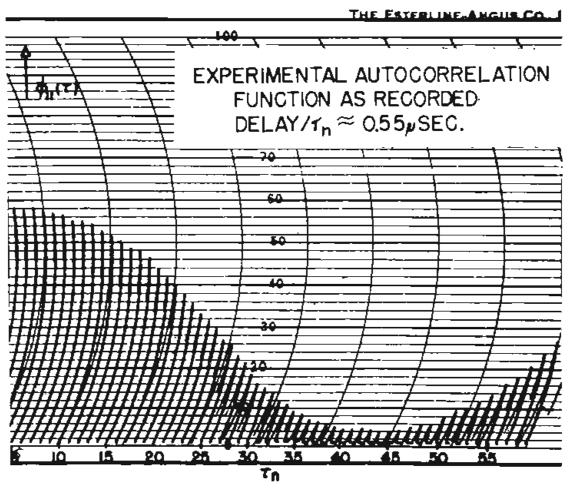


Fig. 10: (Above) Photograph showing the 1063 Correlator, the first commercial model developed and engineered by Melpar Inc.



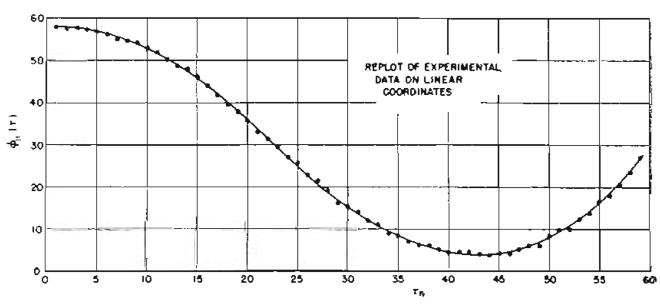


Fig. 9: (Right) Autocorrelation function of noise from 884 gas tube after passing through single tuned circuit (Q=14) show first portion of curve (Fig. 8) in detail

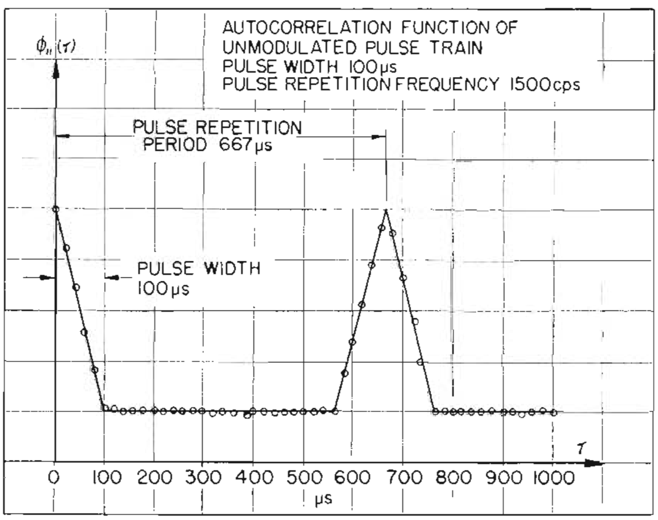


Fig. 11: (Below) Autocorrelation function of pulse modulation system as computed by model 1063 correlator

WASHINGTON

News Letter

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

ARMED SERVICES RADIO PROCUREMENT—The President's Budget, if approved by Congress, will allocate $281,000,000 to the radio-electronic requirements of the Armed Services and $25,000,000 for the radio needs of the Civil Aeronautics Administration. This makes a total of $306,000,000 for the coming fiscal year which begins July 1, 1950. As in the current fiscal year soon ending, the biggest appropriation went to the Air Force, which was given $115,000,000 for radio procurement, although this is $5.6 millions below the present allotment. Most of this huge sum will go for the radio modernization of ground and air electronic and communication installations.

ARMY AND NAVY RADIO ALLOTMENTS—The Navy Bureau of Ships with a program of expansion of anti-submarine and air-defense and replacement of worn out and unserviceable electronics-radio equipments in the Fleet and shore stations, had a Budget Bureau-approved allotment of $79,906,000 which was $43,270,000 greater than the current fund of $36,636,000. Meanwhile Naval Aviation for its electronics-radio equipping of Navy planes for anti-submarine work, was allotted $26,650,000 which was a boost of $23.8 million over the current appropriation.

The Army Signal Corps likewise got an appropriation of $60,085,997 to purchase the newest types of electronic and communications equipment for service testing and equipping of certain tactical units in the Army and this amount was $17,747,000 more than the funds allocated during the current fiscal year.

MORE CONGRESSIONAL VIEWS ON COLOR TELEVISION—Congressional leaders are giving the FCC more "instruction" on tackling the color television problem, the No. 1 item on the Commission's workload. And at the same time, the FCC is resuming its color television comparative demonstrations and hearings during the latter part of February as the most important subject of its hearing agenda for that month. In mid-February, the House Interstate Commerce communications-radio subcommittee plans to start hearings on the revision of the Communications Act, and Subcommittee Chairman Sadowski (D., Mich.) told Tele-Tech that color television was certain to be one of the most significant subjects considered.

FCC BAR ASSN. HEARS SENATOR JOHNSON—Senator Johnson (D., Colo.), Chairman of the Senate Interstate Commerce Committee who gave the original and greatest impetus to the FCC's inquiry into color video, was the principal speaker at the annual banquet of the Federal Communications Bar Association Jan. 12 and his pronouncements on color TV in this address have rekindled the FCC's interest in trying to launch this service. The FCC's schedule also includes the staging of initial demonstrations of the Color Television Inc. (San Francisco) system starting Feb. 20. Then will come an all-important two-day series of comparative demonstrations of the three color TV systems—RCA-NBC, CBS and CTI. The final round of hearings on color video starts Feb. 27 with cross-examination as the main *piece de resistance*.

FCC'S CROWDED SPECTRUM!—How the demand for frequencies far exceeds the supply is the keynote of the FCC annual report to Congress for 1949 fiscal year, made public in mid-January. When Commission came into being in 1934, standard broadcast was only form of radio program service and nonbroadcast stations were few in number, being mainly marine, police and overseas communication. But today radio spectrum is crowded with 50 different classes of stations engaged in radio communication. They represent more than 700,000 radio licenses and other authorizations, not including over 200,000 associated mobile units.

NON-BROADCAST STATIONS IN MAJORITY—Even with the advent of FM and television broadcasting, nonbroadcast stations outnumber broadcast program stations by 36 to 1. In new mobile radio fields, protection of life and property and business requirements are most important elements in frequency needs, while "war babies" of radar, microwave and radio relay links have had lusty growth. This, the FCC stresses, has brought many new and perplexing international and domestic problems, but Commission is hopeful 1950 will go a long way in solution of difficulties.

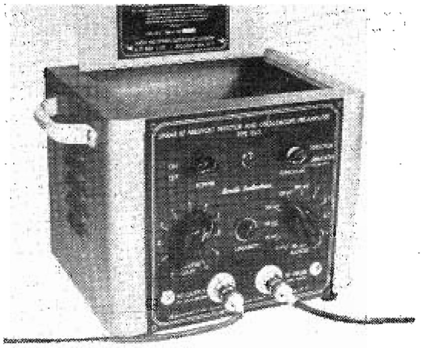
LONE STAR STATE LEADS—A tabulation of FM, FM and TV broadcast authorizations by the FCC for the 1949 fiscal year showed that Texas had more such grants collectively than any other state, being followed closely by Pennsylvania, New York, and North Carolina in that order. New York led the Television list and Pennsylvania had the largest number of FM grants. Chicago had more broadcast grants than any other city, and New York City and Los Angeles headed the FM and TV lists respectively. FM broadcasting stations decreased by 155 during the 1949 fiscal year, the FCC informed Congress, while only seven out of 133 reporting FM stations operated at a profit and the 4 TV networks and 50 TV stations on the air last year all recorded an operating loss.

National Press Building
Washington, D. C.

ROLAND C. DAVIES
Washington Editor

TV Flying Detector

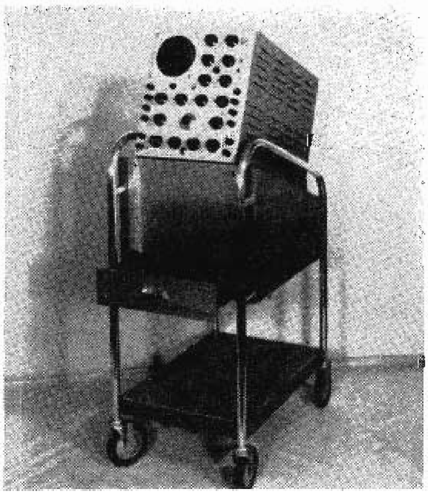
A flying detector for television alignment which is linear between 10 mv. and 10 v. has been developed. It consists of a germa-



nium crystal probe, a high gain oscilloscope pre-amplifier and non-linear correction network converting the square-law output of the crystal at low signal levels into an undistorted, linear output of 2 v. When used in conjunction with any standard oscilloscope, it does not interfere with the accepted sweep-signal and marker signal generator alignment routine. It simply raises the linear r-f detecting ability of the scope one hundred times, making possible bandpass curve observations at true operating signal-levels and greatly speeding up alignment.—**Smith Industries, 70 Chester St., Ballston Spa, N. Y.**

Mobile Scope Mount

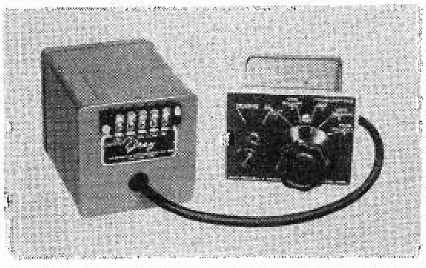
The R-500 Scope-Mobile has been designed to accommodate the Tektronix type 511, 511-A, 511-AD, 512 and X-513 cathode ray



oscilloscopes. Convenient observation of the CR tube face is facilitated by a 20° tilt back. A blank panel, 11 x 15 in., fronting a mounting space of approximately 1½ cu. ft. provides space for auxiliary built-in equipment as an aid in meeting specialized requirements. This space is adequately ventilated with louvres and a power input connector and three outlets appear at the back. A felt-lined drawer operating on roller bearing support runners is mounted above an open shelf (17 x 24 in.) which is topped with battleship linoleum. List $97.50, f.o.b. Portland, Ore.—**Tektronix, Inc., 1516 S. E. Seventh Ave., Portland 14, Ore.**

Equalizer

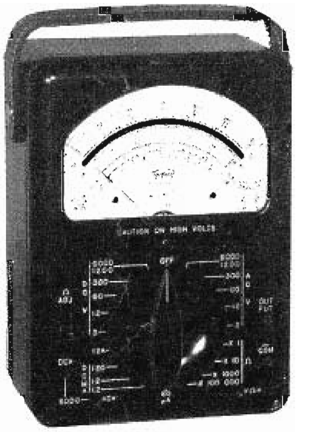
Model 603 equalizer supplements the features of the widely-accepted 602 by providing a greater range of response curves and



additional compensation to accommodate pick-ups of different characteristics. The high frequency characteristics obtainable range from flat response to a heavy roll-off for worn records. An auxiliary knob permits instant adaptation to the use of a Pickering cartridge, which has a flat response, or the GE variable reluctance pick-up, for which compensations are provided. In all cases exceptionally close adherence to the correct characteristics is obtained.—**Gray Research & Development Co., Inc., 16 Arbor St., Hartford 1, Conn.**

Combination Tester

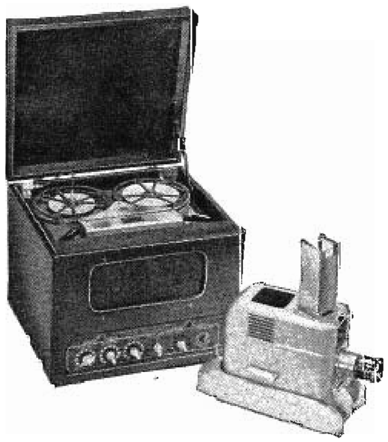
Greater accuracy has been facilitated in the 630-A volt-ohm-mill-ammeter through the use of special ½% resistors, each mounted



in its own compartment. There are 6 dc volt ranges from 0 to 6,000, at 20,000 ohms/v. and 6 ac volt ranges from 0 to 6,000, at 5,000 ohms/v. In addition there are 5 dc current ranges; decibels; output; and resistances ranges from 0 to 100 megohms. Mirrored, hand-drawn scale and distinct scale markings make readings easier and more accurate.—**Triplett Electrical Instrument Co., Bluffton, Ohio.**

Sound And Slide Film Synchronizer

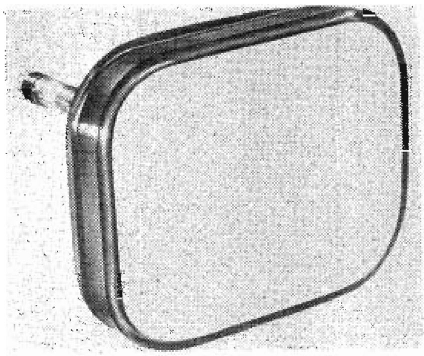
A simple and efficient system for synchronizing a magnetic tape recording script with any automatic slide projector is provided by a high-fidelity Twin Trax dual-



channel tape recorder which at preset intervals sends a pulse to the projector, activating the projector's tripping mechanism. A pair of leads from the recorder to the projector is the only electrical or mechanical connection required. The script is recorded in the normal manner on sound recording tape. At each point in the script where the slide is to change, a 2-in. long, ⅛ in. wide strip of special adhering copper foil is placed on the back, or uncoated side of the recording tape. As the tape passes a laminated switch on the recorder during playback, the copper foil shorts out a section of the laminated switch, which activates a relay to send a tripping pulse to the projector. —**Audio-Visual Div., Amplifier Corporation of America, 398-26 Broadway, New York 13, N. Y.**

Rectangular Tube

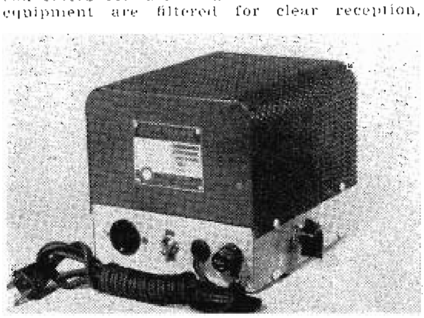
A rectangular all glass gray-black TV picture tube (16RP4) is the latest addition to the Sheldon line. Measuring 10¼ x 13½ x



18¾ in., the 16RP4 takes approximately the same space as the conventional 12½ in. round tube. It has a usable screen area of 130 sq. in.—**Allied Electric Products, Inc., Irvington, N. J.**

Vibrator Convertor

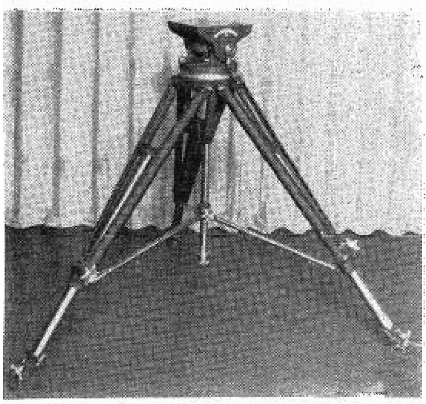
The Powercon line of dc to ac vibrator converters for use with radio and television equipment are filtered for clear reception,



and are capable of starting under full load without the necessity of starting the converter first and then applying the load. Several of the 32 and 110-v. models include the C-D Phantomswitch circuit for automatic starting and stopping when the ac load switch is operated. The most frequent use of these units is to create 110-v., 60-cycle ac from battery or other dc sources to permitting the operation of ac equipment in locations where commercial ac is not available.—**Cornell-Dubilier Electric Corp., South Plainfield, N. J.**

All-Purpose Tripod

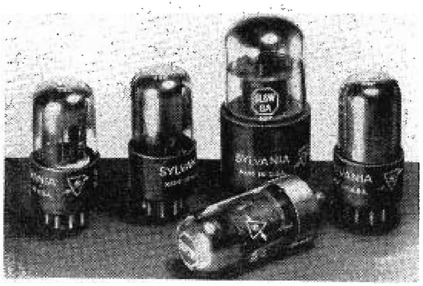
A mounting for microwave relay receivers or transmitters, or field or studio television cameras is provided by the TD-11 tripod,



an all-metal structure of aluminum castings and tubular steel, finished in deep umber gray wrinkle and hard chrome. Three-point leg bracing with individual tie rods and a sturdy center post insure rigidity and stability. Working height may be varied between 25 and 42 in. Lower tubular portion of each leg is easily adjusted, leg calibrations aiding in accurate positioning. The lower end of each leg is provided with a self-aligning, universally-mounted base which has a flat surface in one plane for use on level flooring, and in another plane, a steel spike for use on rough surfaces.—**Radio Corporation of America, RCA Victor Div., Camden, N. J.**

"Ruggedized" Tubes

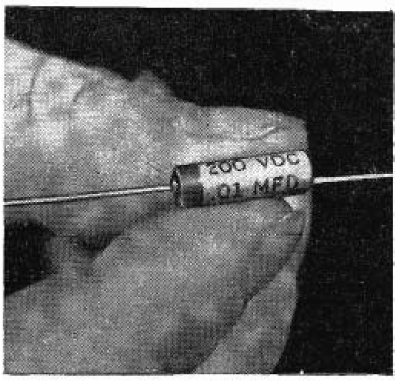
Radio tubes, specifically designed to provide dependable communications service under conditions of severe vibration and shock,



are now available in five types; the first of twenty different tubes presently under development. They include the 6X5WGT, a full-wave rectifier; 6L6WGA, a beam power amplifier; 28D7W, a double-beam amplifier; 6SL7W, a high-mu duotriode; and a 6SN7W, a medium-mu duotriode. Electrical characteristics and circuit applications of these tubes are similar to corresponding standard types but physical design of tube structures has been modified to assure maximum dependable service life in conditions of unusual shock and vibration.—**Sylvania Electric Products, Inc., Emporium, Pa.**

Paper-Case Tubular Capacitors

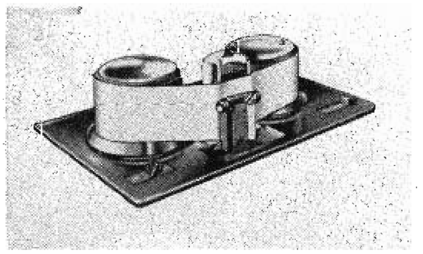
Smaller paper tubular capacitors, known as type P85, feature the same materials and general processes used for Aerovox Aerocon



type P87. To achieve the miniature size new production technics were required for handling minute sections, wires and other components without sacrifice of quality and mass production requirements. The paper section of the P85 is Aerolene-impregnated and the capacitor is sealed with Duranite. The resulting rock-hard paper cased tubular offers the heat and humidity resistant qualities associated with the best plastic tubulars.—**Aerovox Corp., New Bedford, Mass.**

Tape Recorder

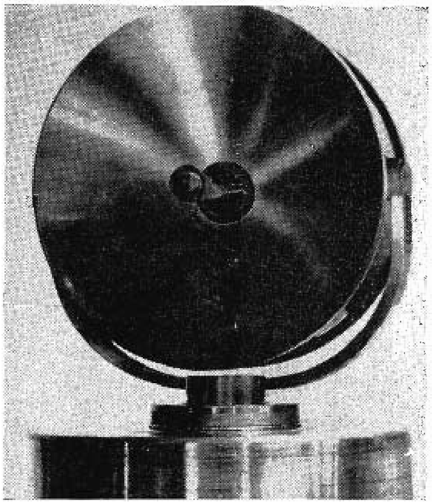
Two hours of recording time (at 7.5 in./sec.) is provided by a new tape recorder, operating on a patented principle which



eliminates the rewinding of tape before playback. Instead of the conventional quarter-in. tape, a tape 2-in. wide is used. This wide tape allows the recording of 12 tracks per in. instead of one per quarter-in. When the end of the tape is reached, the recording head drops down one track, and the tape reverses, giving continuous recording in the opposite direction. The time cycle required for this operation is 1/60 sec., so fast that the ear cannot detect the charge on any recording. For play-back, the hand is merely set to the selected track and played. No rewinding is necessary.—**National Recorders, Inc., 629 N. La Brea Ave., Los Angeles 46, Calif.**

Navigational Radar

Characteristics such as lightness, compactness, simplicity of operation and adjustment, and dependability have served as a guide in



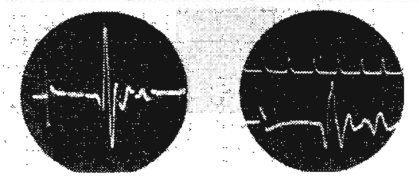
the design of models E and ES navigational radars. These new units can be easily mounted in the nose of DC-3's, DC-4's, and DC-6's without materially altering the streamline feature of the plane. The model E (non-stabilized) weighs 58 lbs. installed; the model ES (stabilized) weighs less than 65 lbs. A special operational feature of the units is their ability to produce a "co-secant squared" beam for terrain mapping on one of two reflectors mounted back-to-back, while the other reflector delivers a pencil beam to indicate the proximity of hazards such as mountain peaks and other aircraft on the same level as the radar plane.—**Allison Associates, Inc., Albuquerque, New Mexico.**

Balanced Output Adaptor

A balanced output adaptor has been developed for use with the GE ST-4A sweep generator. The sweep generator presently has single ended output but with the addition of the ST-8A adaptor, balanced output is available. The ST-8A will give flat and balanced output when working into a 300 ohm resistive load. Vernier output control of the sweep generator, normally incorporated in the output cable, is incorporated in the adaptor when using balanced output.—**General Electric Co., Syracuse, N. Y.**

CR Wave Shaper

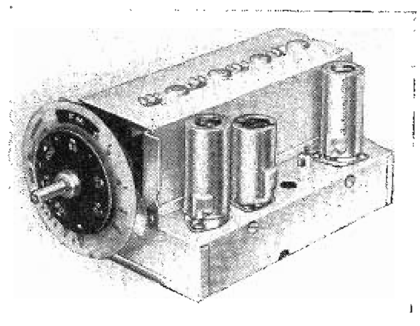
The Berkshire Labmarker is essentially a wave shaping device used to produce time marks in cathode ray oscillography. A



sinusoidal input voltage (amplitude 30 v., RMS) can be converted by the Labmarker into a series of sharp unidirectional pulses. These pulses may be displayed directly on the face of a cathode ray tube by connecting the output of the Labmarker to the vertical input. Timing marks consisting of short breaks in the oscillograph trace are obtained by connecting the output of the Labmarker to the "Z" input terminals of the oscilloscope. Both of these timing methods are shown in the photo. The output binding posts may be used with leads having single or double banana plugs, spade tips, phone tips, or plain wire ends.—**Berkshire Laboratories, P. O. Box 70T, Concord, Mass.**

Spiral-Type TV Tuners

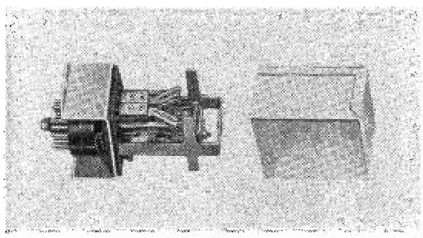
A new 4-section Inputuner, incorporating the latest Mallory-Ware spiral-type Inductuner, has been developed which effectively



doubles the gain of previous models. Tuning range is continuous from 54 to 216 MC, inclusive, covering TV channels 2 to 13 as well as the FM band. Operation is efficient on either 300- or 72-ohm antenna systems. Even though it is a 4-section tuner, it is considerably smaller than previous 3-section models, and the selling price is about 40% of that of the earlier tuner.—**Allen B. Du-Mont Laboratories, Inc., 2 Main Ave., Passaic, N. J.**

Relay Dust Cover

Entrance of dust into a new plug-in enclosure for the small Clare type "J" relay is prevented by a steel cover and the use of



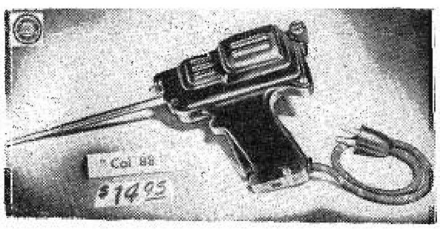
a neoprene gasket which is closely fitted to the relay terminals at the factory. Installation is facilitated by use of a standard radio-type plug and the base is secured to the chassis to prevent the plug from being jarred or accidentally pulled from its socket.—**C. P. Clare & Co., 4719 West Sunnyside Ave., Chicago 30, Ill.**

20 Million Megohmmeter

Designed for precise measurement of electrical resistance over a range of 300,000 ohms to 20,000,000 megohms in 6 decades, the model 29 is simple to use and safe to operate. A precision 6-in. edgewise meter provided with a mirror scale and a knife-edge pointer facilitates precise reading. Voltage supply may be between 110 and 115 v. and 190 and 260 v., ac. There are 2 test potentials of 85 and 500 v. dc.—**(Electronic Instruments Ltd., Richmond, Surrey, England), c/o Herman H. Sticht Co., Inc., 27 Park Place, New York, N. Y.**

Soldering Gun

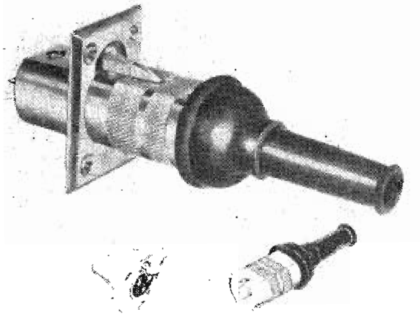
A new high-speed soldering gun (CAL 88) with a single pole electrode speeds up assembly operations by enabling the operator



to work in very narrow spaces between component parts on a chassis without melting condensers, burning wire insulation, or damaging other parts near the hot electrode. Work is also speeded because a "Full-view" light shines directly on top of the electrode and the parts being soldered. Overloads from the power line or from within the transformer will blow the 1.5 amp. fuse connected in series with the primary winding. Operation is from 115 v. ac, 60 cps. List, $14.95.—**Caliri Manufacturing Co., Inc., 45 Washington St., West Orange, N. J.**

Audio Connectors

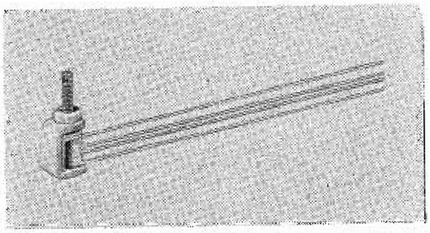
A new series of audio connectors designed in cooperation with the Audio Facilities Sub-Committee of the RMA has been developed



with steel shells and zinc receptacles finished in satin chrome. Named the "UA" series, it consists at present of two plugs and four receptacles, carrying 15-amp. contacts rated at 1500 v. minimum flashover. Flattened plug top provides an even better polarization means than ordinary keyways, having a finger "touch" design. The safety latchlock device is improved and strengthened; socket contacts are full floating.—**Cannon Manufacturing Corp., 3209 Humboldt St., Los Angeles 31, Calif.**

Copper Oxide Rectifier

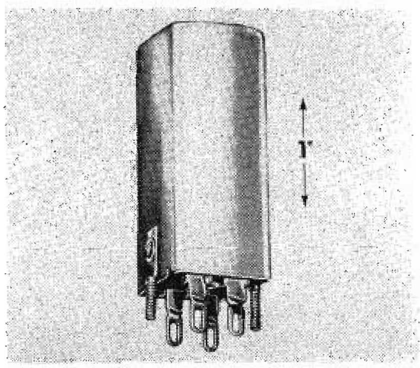
The CX14 series copper oxide rectifier features a gold-to-gold internal circuit arrangement made up of vacuum-processed



rectifier plates with gold contacts, specially-treated gold terminals and copper alloy brackets. Impregnated and sealed to withstand extreme humidity, the new rectifier is also fungus resistant. According to the manufacturer, maximum stability under extreme operating conditions is insured with the CX14. Dimensions are ½ x 3/16 x ¼ in. —**Bradley Laboratories, Inc., 82 Meadow St., New Haven, Conn.**

TV Receiver Transformers

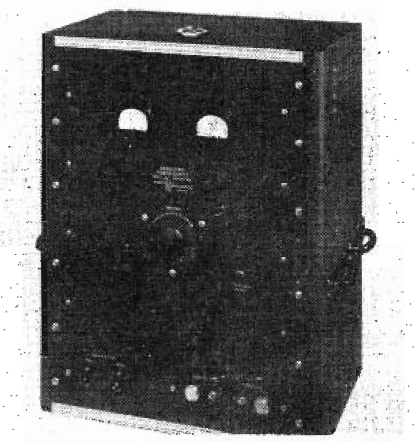
A sound i-f transformer (206K1) and a sound-discriminator transformer (207K1) are two newly-developed components for tele-



vision receivers. The 206K1 will operate at 21.25 MC with the miniature sharp-cutoff pentode 6AU6 as sound i-f amplifier tube, and is capable of providing a voltage gain of about 35 times between the grid of one sound i-f tube and the grid of the following sound i-f tube. The 207K1 is designed for use between the last sound i-f stage utilizing a 6AU6 tube and the sound-discriminator stage employing the miniature twin diode 6AL5. This transformer can provide 0.08 v. of audio output for each kilocycle of frequency deviation from its operating frequency of 21.25 MC, when a 1 v. signal is applied to the grid of the last sound i-f tube.—**Radio Corporation of America, Tube Dept., Harrison, N. J.**

Power Supply

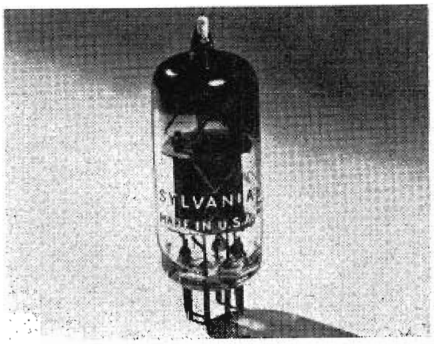
Models 1110 and 1110-A power supplies are versatile power sources for laboratories, test stations on production lines or other applica-



tions where a well-regulated source of power is desired. They produce dc power at constant output voltages, independent of variations of the power line voltage and of the currents drawn by the load. Maximum dc output is ½ kilowatt; 175 to 1000 v. at 0.50 amp (model 1110) or 175 to 1500 v. at 0.33 amp. (model 1110-A), continuously adjustable without switching. Output voltage varies less than 5 v. for line voltage variations between 105 and 125 v., ac.—**Furst Electronics, 12 S. Jefferson St., Chicago 6, Ill.**

Noise Generating Diode

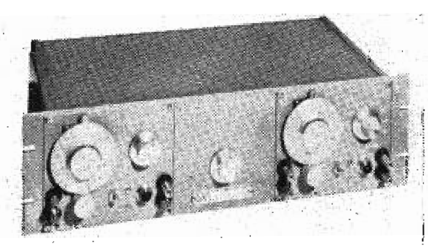
A new miniature noise generating diode type 5722, has been designed for standard laboratory noise measurement. Suitable for



measurements at frequencies up to 500 MC, the 5722 is operated with 150 v. on the plate and at filament voltages ranging between 2 and 5.5 v., depending on desired plate current or noise output. In intermittent service maximum plate dissipation is 5 watts.—**Sylvania Electric Products, Inc., 509 Fifth Ave., New York 18, N. Y.**

Variable Electronic Filter

Model 302 dual-section variable electronic filter has a continuously variable cutoff from 20 cps to 200 KC. Each section has an at-



tenuation rate of 18 db per octave, and sections can be cascaded to provide 36, 54, etc. db attenuation. A range switch selects the type of section desired (high-pass or low-pass) as well as 4 decade frequency ranges. In addition, it can be switched to a band pass position so that any bandwidth between 20 cps and 200 KC can be selected.—**Spencer-Kennedy Laboratories, Inc., 186 Massachusetts Ave., Cambridge 39, Mass.**

Hermetically Sealed Rectifier

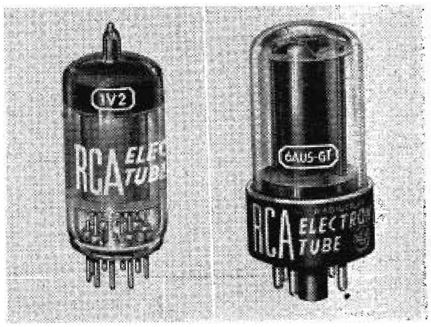
A hermetically sealed version of the Collins SE-8L rectifier has been developed for use in the 51 R aircraft radio receiver. The

SELENIUM SE8L

function of this rectifier is to demodulate an FM signal which provides navigation data in the newly-developed moni-range system. The rectifier's characteristics are retained even under the extreme variation of temperature stipulated by the CAA in testing suitability for use in scheduled airlines service. The unit, according to specifications, must be capable of operating continuously within limits at 95% relative humidity.—**Bradley Laboratories, Inc., 82 Meadow St., New Haven, Conn.**

TV Receiver Tubes

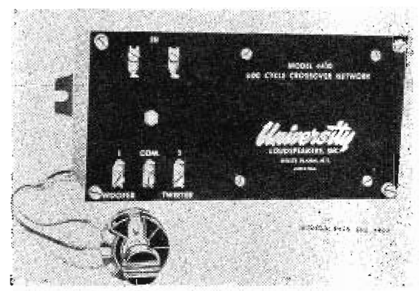
Substantial economies are claimed in the design of high-efficiency, magnetic-deflection systems for TV receivers (with 10- and 12-in.



picture tubes) when the 6AU5-GT horizontal-deflection amplifier tube (right) and the 1V2 high-voltage, miniature, rectifier tube (left) are used. The 6AU5-GT is a high-perveance, beam power amplifier of the single-ended type. Because of its features including low mu-factor, high plate current at low plate voltage, and a high operating ratio of plate current to grid-No. 2 current, the 6AU5-GT makes possible the design of an efficient horizontal deflection circuit in which the plate voltage for the tube is supplied in part by the circuit and in part by the low-voltage, dc power supply of the recever. The 1V2 is a high-voltage, half-wave rectifier tube of the single-ended, 9-pin miniature type.—**Radio Corporation of America, Tube Dept., Harrison, N. J.**

Crossover Network

Providing a proper attenuation rate at a crossover of 600 cps, model 4410 is a filter network of the LC type for use with coaxial



or duplex loudspeaker systems. A high frequency attenuater is supplied with the network for balancing the highs and lows to suit the surrounding acoustic conditions. Ample caple permits mounting of the attenuator in any convenient location. Designed primarily for use with the new high frequency tweeters, this filter network is particularly efficient when used with University Tweeter models 4408 and 4409.—**University Loudspeakers, Inc., 80 South Kensico Ave., White Plains, N. Y.**

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RELAYS

AUTOMATIC ELECTRIC

SWITCHES

TELE-TECH's NEWSCAST

1950 Dayton IRE Conference To Be Held May 3-5

The Dayton section of the IRE will hold its annual technical conference on May 3, 4, 5 at the Dayton Biltmore Hotel, Dayton, Ohio. In addition to the presentation of technical papers and exhibits, there will be a tour of near-by Wright Field, the home of Air Force research and development.

Official theme of the conference will be "Modern Trends of Air Borne Electronics." Appointment of the following members to the conference executive committee has been made by the section board of directors: George Rappaport, President; Harold V. Noble, Vice President; Gerald C. Schutz, Secretary; Gilbert H. Arenstien, Treasurer; Edward P. Spandau, Chairman, Arrangements Committee; Paul G. Weigert, Chairman, Exhibits Committee; Emanuel A. Blasi, Chairman Program Committee; Albert O. Behnke, Chairman Publicity Committee; Miss Mary Wheeler, Chairman, Ladies Program Committee. (Chairmen for the publications and registration committees have not yet been selected).

Some of the papers which will be presented are:

"Some Psychological Characteristics of the Human Operator," Dr. W. C. Biel and M. J. Warrick, Aero-Medical Laboratory, AMC.

"The Aircraft Engine Analyzer — A New Electronic Maintenance Tool," W. Van Rosenbergh, Sperry Gyroscope Co., Brooklyn, N. Y.

"The Effects of In-Phase Feedback on Balanced D. C. Amplifiers," Prof. J. M. Cage, Head, Department of Electronics, Purdue Univ., Lafayette, Ind.

"Slotted Wave-Guide Antenna Array," S. Hershfield and W. V. Foley, The Glen L. Martin Co.

"Development of a Flush-Mounted Non-Directive Airborne Antenna System," S. M. Kerber and R. Krausz, North American Aviation, Inc.

"The Effect of Moisture and Fungi on the Electrical Properties of Electronic Hook-Up Wire Insulations," Dr. R. H. Luce, Head, Department of Biology, Rensselaer Polytechnic Institute, Troy, N. Y.

"Development of a 9310 MC. Magnetron," G. A. Espersen, Philips Laboratories, Inc., 100 East 42nd St., New York City.

"Analogue Computer for Linear Arrays," T. T. Taylor, Hughes Aircraft Co.

"Problems in the Design of Very-High-Frequency Navigational Receivers," R. T. Adams and A. G. Kandoian, Federal Telecammunications Laboratories, Nutley, N. J.

"Oscillographic Study of Noise Meter and Receiver Response to Interference Pulses," J. M. Bryant, Prof. Emeritus of E.E., Univ. of Minnesota, Minneapolis, Minn., E. B. McNulty, Director of Engineering, Seattle College, Seattle 22, Wash., M. M. Newman, Director of Research, Lightning and Transient Research Institute.

"Experiment Evidence of the Effect of Scattering on Tropospheric Radio Propagation," Dr. A. W. Straiton, Director E.E. Research Laboratory, Univ. of Texas, Austin 12, Texas.

"The Theory of Bi-Conjugate Networks," L. J. Cutrona, Aeronautical Research Center, Univ. of Michigan, Ann Arbor, Mich.

SMPE Changes to SMPTE

The name of the Society of Motion Picture Engineers has been officially changed to the Society of Motion Picture and Television Engineers, according to a recent announcement by Earl I. Sponable, president of the Society.

Endorsed originally by the board of governors of the Society in June, 1949, and discussed at the business meeting during the SMPE Fall convention in Hollywood, the change of name was then submitted as a proposal to the entire voting membership by letter ballot in November. The count of ballots approved the change of name by an overwhelming majority.

Outstanding among the reasons for the change are the increasing mutual interests of technical people in both motion pictures and television, as well as the Society's active participation in the development of new television techniques, such as its new test film for television station use which, although completed just a short time ago, has already been enthusiastically received. In addition, the Society has filled a brief with the FCC proposing specifications for a nationwide theatre television system.

Radio, Radar Sales to U. S. $35 Million in 3rd Quarter

Sales of communications equipment, radar and other radio transmitting apparatus to the U. S. Government during the third quarter of 1949 totalled $35,489,327, according to a report by the RMA. Sales of radar equipment amounted to $23,914,281 and accounted for the largest portion of the U. S. Government radio transmitting equipment purchases. Third quarter government purchases were slightly under the second quarter total of $40,140,586.

Sales of communications transmitters, receivers, and transceivers during the third quarter totalled $4,752,395, and laboratory and test equipment purchases by the government amounted to $3,563,910. RMA member-company sales of radio navigational aids to the government accounted for another $2,620.516 and sonar apparatus sales for $595,037, while quartz crystals sales totalled $43,188.

Public Plays Major Role in Color TV Tests

The general public played a major role in extensive color television test operations which the Columbia Broadcasting System conducted in New York, Washington, and Philadelphia between January 2 and February 1. These operations constituted the most comprehensive and intensive test in television history. Involved were pickup devices in New York and Washington; 4 broadcast transmitters; 450 miles of coaxial cable; and more than 50 color receivers.

Cooperating with CBS in the tests were the Bamberger Broadcasting Service; the American Telephone & Telegraph Co. and local telephone companies; Smith, Kline & French, Philadelphia pharmaceutical house; television stations WOR-TV and WOIC of the Bamberger Broadcasting Service; the *Philadelphia Bulletin* television station, WCAU-TV; and WTOP, Inc., Washington, D. C.

SPAAK VISITS PHILCO

Paul-Henri Spaak (left), former Premier of Belgium and now first President of the Consultative Assembly of European Nations, visited the television and radio plant of the Philco Corp. in Philadelphia last month. Shown with him are William Balderston, Philco's President, and Cecilia Rafa, operator of television chassis riveting machine

Coming Events

January 30 - February 3 — American Institute of Electrical Engineers, Winter General Meeting, Hotel Statler, New York City.

February 8—Annual Television Clinic of the Television Broadcasters Assoc., Waldorf-Astoria Hotel, New York City.

February 27-March 3 — American Society of Testing Materials, Committee Week and Spring Meeting, Hotel William Penn, Pittsburgh, Pa.

March 6-9—IRE 1950 National Convention. Hotel Commodore and Grand Central Palace, New York City.

April 5-7—Midwest Power Conference, Sponsored by Illinois Institute of Technology with cooperation of 18 universities and professionel societies, Sherman Hotel, Chicago.

April 19-22—Electrochemical Society, Fourth Annual Meeting, Hotel Statler, Cleveland, Ohio.

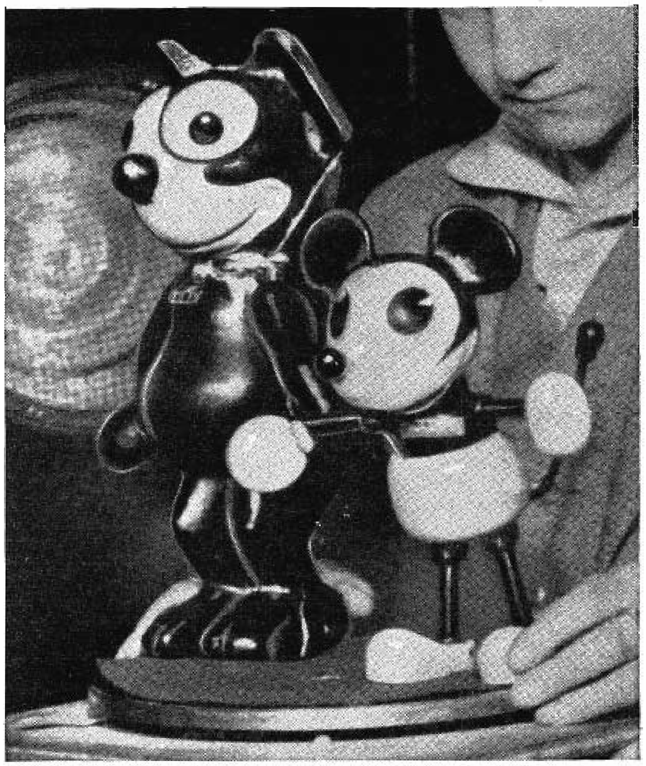
April 29 — IRE, Cincinnati Section, Fourth Annual Spring Technical Conference Engineering Society Hdqts., Cincinnati, Ohio.

May 12-13—Armed Forces Communications Association. Fourth Annual Meeting, Astoria, New York City, and Fort Monmouth, N. J.

June 26-30 — American Society for Testing Materials, Chalfonte-Haddon Hall, Atlantic City, N. J.

August 28-31—Associated Police Communication Officers, Inc., National Conference, Hotel Hollenden, Cleveland, Ohio.

When Mickey and Felix were our leading "TV" stars...



Felix the Cat and Mickey Mouse *were, during television's experimental period, the most frequently televised actors on the air. Using them as "stand-ins," RCA engineers gathered basic data on instruments and techniques.*

Those celebrated "movie actors"—Mickey Mouse and Felix the Cat—were pioneer helpers in television research

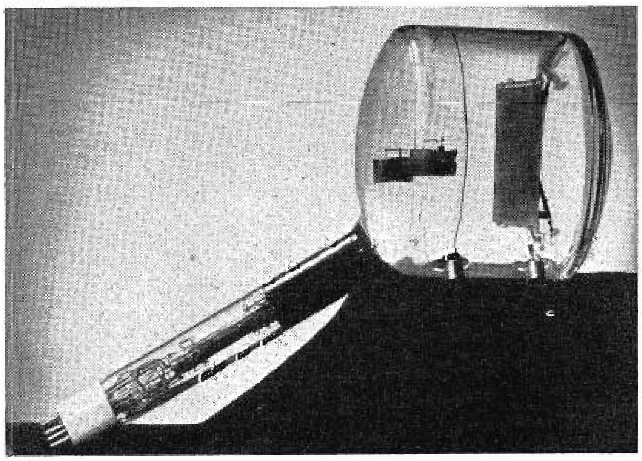
No. 1 in a Series Tracing the High Points in Television History

Photos from the historical collection of RCA

● Strange though it seems, two toys had much to do with television as you now enjoy it! As "stand-ins" during television's early days, Mickey Mouse and Felix the Cat helped RCA scientists and engineers gather priceless information.

Choice of this pair was no accident. Their crisply modelled black-and-white bodies were an ideal target for primitive television cameras. The sharp contrast they provided was easy to observe on experimental kinescopes.

Would living actors have done as well? No, for what RCA scientists were studying—as they trained their cameras on the two toys—was the effect of changes and improvements in instruments and telecasting techniques. With living actors it could never have been absolutely certain that an improvement in the televised image came from an improvement in equipment and techniques—or from some unnoticed change in an actor's appearance, clothing, make-up. Mickey and Felix provided a "constant," an unchanging target which led to more exact information about television . . .



The iconoscope, *electronic "eye" of television, invented by Dr. V. K. Zworykin, of RCA Laboratories.*

Problem after problem was met by RCA scientists, with the results you now enjoy daily. For example: In the "Twenties" and early "Thirties," there were still people who argued for *mechanical* methods of producing a television image, despite the obvious drawbacks of moving parts in cameras and receivers. Then Dr. V. K. Zworykin, now of RCA Laboratories, perfected the iconoscope, to give television cameras an all-electronic "eye"—without a single moving part to go wrong. Today, this same all-electronic principle is used in the RCA Image Orthicon camera, the supersensitive instrument which televises action in the dimmest light!

Also developed at about this time, again by Dr. Zworykin, was the *kinescope*. It is the face of this tube which is the "screen" of your home television receiver, and on its fluorescent coating an electron "gun"—shooting out thousands of impulses a second—creates sharp, clear pictures in motion. Those who may have seen NBC's first experimental telecasts will remember the coarseness of the image produced. Contrast that with the brilliant, "live" image produced by the 525-line "screen" on present RCA Victor television receivers!

Credit RCA scientists and engineers for the many basic developments and improvements which have made television an important part of your daily life. But don't forget Mickey Mouse and Felix. They helped, too!

Radio Corporation of America

WORLD LEADER IN RADIO—FIRST IN TELEVISION

NEWS • • •

Coast Manufacturers Elect

The Los Angeles Council of WCEMA in December elected 1950 officers: H. P. Balderson, chairman; G. E. Swanson, vice-chairman and Fred W. Falck, Jr., re-elected secretary-treasurer. These will form the board of directors with Robert Newcomb, retiring chairman, and three newly elected: E. P. Gertsch, R. G. Leitner and W. V. Phillips. Ralph L. Power, public relations director for the 1950 sixth annual Pacific Electronic Exhibit to be held Sept. 13, 14 and 15 at the Long Beach Municipal auditorium, was reappointed Council press liaison.

Revised Technical Broadcast Services

A new series of technical radio broadcast services over radio stations WWV, Beltsville, Maryland, and WWVH, Maui, Territory of Hawaii, were inaugurated on January 1. Except in certain details, these services of the National Bureau of Standards do not differ greatly from those given in the past.

The revised services from WWV include (1) standard radio frequencies of 2.5, 5, 10, 15, 20, 25, 30 and 35 MC, (2) time announcements at 5-minute intervals by voice and International Morse code, (3) standard time intervals of 1 second, and 1, 4, and 5 minutes, (4) standard audio frequencies of 440 cps (the standard musical pitch A above middle C) and 600 cps, (5) radio propagation disturbance warnings by International Morse code consisting of the letters W, U, or N, indicating warning, unstable conditions, or normal, respectively.

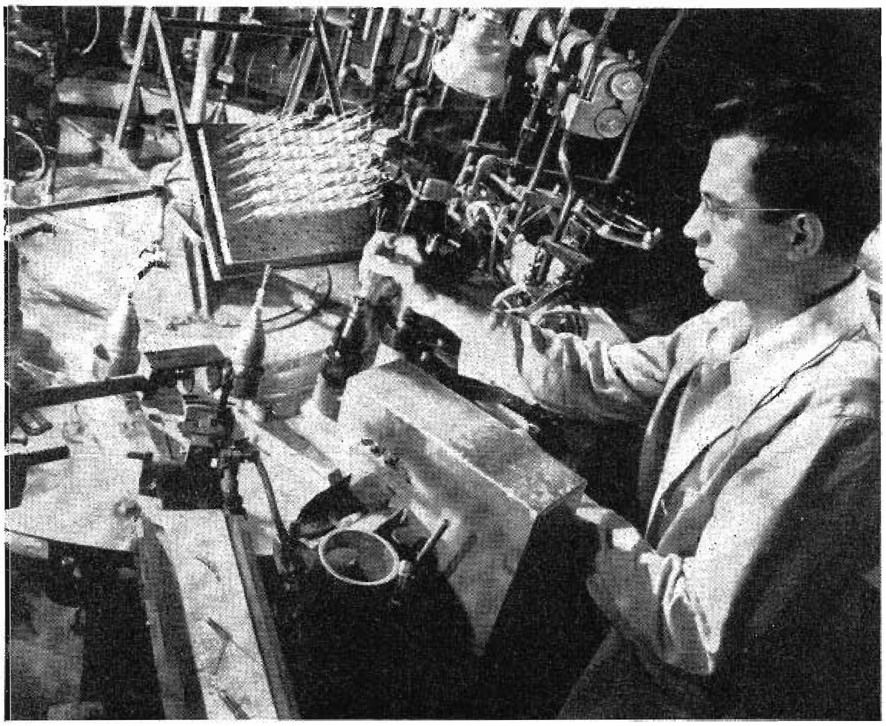
Further information on the technical radio broadcast services may be obtained on request from the National Bureau of Standards, Washington 25, D. C. Reports on reception are welcomed; forms on which to submit such reports may also be obtained on request.

Four TV Antennas On Empire State Building

A unique TV antenna installation will soon be erected on the Empire State Building in New York City. WNBT is going to share its unparalleled site with WJZ-TV, WPIX, and WABD. Installing four TV antennas covering the channels 4, 5, 7 and 11 on a 200 foot mast thus increasing the overall height of the building to 1,490 feet will pose a complex problem for Messrs. O. B. Hanson, Engineering Vice-President of NBC and Dr. Frank Kear, Consulting Engineer of Washington, D. C. who are in charge of the design work. Eight carrier frequencies from 67.25 MC to 203.75 MC are involved and there is the possibility of a number of sum and difference frequencies appearing in transmission as a result of the multiple combinations possible.

Any system of four radiators for this installation will have to overcome problems of interaction between the coupling circuits also, since powers of from about 5 KW to 7 KW will be involved. Preliminary work is now proceeding but some time will elapse before the stations concerned move to their new locations. When in operation a unique TV transmitting tower will exist which may well pave the way for all future television cities.

AUTOMATIC SEALING AND EXHAUSTING MACHINE DEVELOPED



Machinery for mass production of special and commercial subminiature tubes in pilot plant stage at Product Development Labs.. Sylvania Electric Products Inc., Kew Gardens, N. Y. T-3, T-2, and T-1 subminiatures require finishing technics that differ widely from those used in commercial T-9 and miniature types. Equipment shown above exhausts and seals finished mounts and bulbs in more than a score of automatic operations. New models are developed when the demand for experimental tube types has reached commercial proportions

Improved Quality Topic of Technical Conference

Under the sponsorship of three industry organizations, radio and electrical engineers will meet with military and other government representatives for a "Conference on Improved Quality Electronic Components" in Washington May 9-11. The three-day conference will be sponsored by the IRE, the RMA with the assistance of the military services, the AIEE, the Research and Development Board of the Dept. of Defense, and the National Bureau of Standards.

New technics for producing longer-life components, especially for military, aircraft and industrial electronic equipment, will be discussed at the symposium to be held in the new Department of Interior auditorium. A program is now in preparation.

The symposium will include the following topics:

(1) Improved quality of circuit elements for greater dependability of electronic equipments.
(2) Unitized packaging as a means for greater dependability through simplified maintenance.
(3) Miniaturization, particularly as applied to the unit package.
(4) Circuit elements compatible with design requirements of the unit package.

Erie Resistor's Research & Development Dept.

The Electronics Division of Erie Resistor Corp., Erie, Pa., has created a new department, to be known as the Research and Development Department, for the investigation of new principles, methods, and materials which may be applied to new and existing products. The department will be headed by J. D. Heibel as Director of Research and Development. Mr. Heibel has been with Erie Resistor for 13 years, and as Chief Electrical Engineer has pioneered many engineering developments.

Nello Coda, research engineer, succeeds Mr. Heibel as chief electrical engineer, and will be in charge of both the Electrical Engineering Department and the Quality Control Laboratory. In his seven years with the company he has devoted most of his time to the development of test equipment, methods, and procedures.

J. C. Van Arsdell, electrical engineer, has been promoted to the position of manager of the sales engineering department. He will work with the Sales Department in the proper interpretation of customers' specifications, as well as in the development of new products and of new applications for existing products.

Distillation Products Changes

Distillation Products, Inc., has been dissolved and the organization has become a division of Eastman Kodak Co. instead of a wholly-owned subsidiary corporation, as in the past. Henceforth, it will be known as Distillation Products Industries, Division of Eastman Kodak Co. All communications, orders, etc., should be addressed to: Distillation Products Industries, Rochester 3, N. Y.

McGraw-Hill Loses N.Y. Supreme Court Case Brought By Caldwell-Clements

We have had many inquiries about the December 8, N.Y. Supreme Court decision against McGraw-Hill, limiting their "Electrical Merchandising's" publication of radio-television reading and advertising matter, in the suit brought by Caldwell-Clements, which also publishes TELE-TECH.

In 1941 McGraw-Hill's "Radio & Television Retailing" and Caldwell-Clements' "Radio & Television Today" were merged, under Caldwell-Clements' operation, as a constructive service to the radio industry, by Caldwell-Clements and McGraw-Hill.

Through Caldwell-Clements' purchase of "Radio & Television Retailing," McGraw-Hill acquired a stock interest in Caldwell-Clements and held such minority interest until February, 1948 when the stock was repurchased by Caldwell-Clements, and McGraw-Hill completely ousted.

At that time, McGraw-Hill in its sales contract, agreed not to "start, operate or interest itself directly or indirectly in publishing any publication primarily in the field of distribution of radio and television sets, parts and accessories" until at least April 1951.

Limit TV Contents

As we interpreted the language and understood the purpose of this agreement, no issue of "Electrical Merchandising" would devote more editorial space to radio-television or would contain more radio-television advertisments than the average of "Electrical Merchandising's" issues from February 1945 through January 1948. McGraw-Hill did not interpret the contract the same way as we did, so Caldwell-Clements went to court to obtain a ruling on the meaning of the contract.

On December 8, 1949, Mr. Justice Dickstein, of the New York Supreme Court, decided the case in a way that upholds our interpretation of the contract. In the words of the judge:

McGraw Hill **"had earlier divested itself of its radio-television property, restricted its freedom of competition, and now seeks to re-enter the field in unlimited degree*** It enlarged participation in a manner which the parties agreed would not be done. ***It had for itself closed the door to radio and television for such treatment."**

On January 13, Justice Dickstein ordered McGraw-Hill's "Electrical Merchandising" to limit its radio-television reading pages to less than 4¼% of the total reading pages of any issue. On the basis of recent issues (which have averaged 60 reading pages) total TV-radio reading material would thus be held down to about 2½ pages per issue. This includes the total of all radio-TV feature material, new-product descriptions, trade news, picture pages, etc.

Also Judge Dickstein has ordered that radio-TV advertising in any issue of "Electrical Merchandising" be limited to 15% of the total advertising contents of that issue.

In addition to the above severe restrictions, the Judge has stipulated that even with this limited radio-TV material, emphasis shall not be given any matter that would make the magazine appear primarily radio and television in character.

Mobile FM

(Continued from page 28)

of input signals and output connections. Relay K701 is de-energized at all times except during the Selecto-Call transmission. When relay K701 is de-energized, the microphone signals, Attention Tone signal, or the voice signals from the system receiver are fed to the voltage amplification stages through contacts on relay K701. During the Selecto-Call transmission, relay K701 is energized and the output of the modulator tube, V704, is fed to the voltage amplifier.

The limiter stage, V707, is cut out of the amplifier circuit during Selecto-Call transmissions and while voice signals from the system receiver are being amplified.

When the externally located Selecto-Call and Channel Selector switches are operated, the cathode circuits of the 7000 cycle sub-carrier oscillator and one of the channel tone oscillators are completed to ground. Also their outputs are fed to the modulator stage and to the voltage amplifiers to modulate the transmitter.

The oscillators are essentially the same, differing mainly in the value of frequency determining elements. These are conventional resistance-capacitance type circuits using a two-stage arrangement. Positive feedback from the plate of each output section of the grid of each first section provides oscillations at a frequency determined mainly by the resistance-capacitance networks connected to the grid of the first section. Stability of operation and improved wave form are obtained by degenerative feedback from the plate of the output section (in each oscillator) to the cathode of its corresponding first section.

Potentiometer R703 controls the level of the Selecto-Call signal fed to the transmitter, and therefore, changes in its setting will affect the percentage of modulation of the associated transmitter.

The coded signal of the Selecto-Call transmission is taken directly from the discriminator and fed into the Decoder Unit, Fig. 7, which uses a 12AU7 miniature dual-triode tube, V1, as a demodulator-amplifier. The first section of V1 acts as a demodulator and the 7000 cycle sub-carrier frequency components are essentially removed. The channel tone frequency components are then amplified in the second section of V1 and appear across the primary winding of the impedance matching transformer, T1. The secondary winding of T1 is coupled to a coil of a vibrating reed which is the mechanical equivalent of an extremely high-Q circuit. If the channel tone frequency is of the correct value, the reed will vibrate and B+ will be intermittently connected to resistor R6, capacitor C7, and the coil of relay K1. When the voltage across C7 reaches the energizing voltage of the relay coil, K1 will close. Then the speaker "ground return" will be completed, and the receiver system becomes operative.

Before relay K1 was energized, capacitor C8 was charged to the B+ voltage. After K1 closed, C8 discharged through R7 and the coil of K1; the time constant being so as to cause K1 to remain energized for about three seconds. When K1 again opened, the Selecto-Call feature was again operative. In Fig. 7. if C8 is not used and R7 is connected across contacts 1 and 2 of K1, the relay (once closed) will remain closed until the microphone is removed from the hookswitch.

The speaker ground return is also completed through the hookswitch when the microphone is removed. This by-passes the Selecto-Call feature and leaves the speaker open for all calls so that the operator of the central station does not have to press the Selecto-Call switch for each transmission during a series of calls to a mobile station. The Selecto-Call feature is reset when the microphone is returned to the hookswitch.

If the channel tone frequency is not of the proper value for the reed in the Decoder Unit, the reed will not vibrate, the relay remains open, and the speaker remains disconnected.

Audio for TV

(Continued from page 31)

best TV studio design?" Some demand rectangular areas others square. But all seem to agree that a minimum height of 20 feet is essential to allow for headroom for moving large flats and drops. If the ceiling is this high it is possible to build catwalks for light and microphone placement. A studio size of 30 by 50 feet is the minimum advisable to allow for camera movements in getting back for occasional long focus shots. Some authorities advise a long narrow studio, perhaps 30 by 70 feet so that the various stages can be set up side by side and the cameras moved along the open fronts with the control room on one side facing the sets.

(Continued on page 57)

PERSONNEL

B. C. "Cliff" Gardner has been appointed an engineering staff member of Varian Associates, 99 Washington St., San Carlos, Calif. He was formerly engineering department head in charge of klystron development activities for Raytheon Manufacturing Corp.

Alfred S. Backus, who has been acting plant superintendent, has been named plant manager of the Mycalex Corporation of America, 30 Rockefeller Plaza, New York City, with full responsibility for all plant operations.

Antony Wright, for the past two years chief engineer for the Magnavox Company, has joined the Capehart-Farnsworth Corp., Fort Wayne, Ind. as chief engineer for the Consumer Products Division. From 1944 to 1947 he was chief engineer of RCA's home TV division.

Norman L. Harvey formerly head of the applied research branch of the physics laboratory of Sylvania Electric Products, Inc., Bayside, N. Y., has been appointed director of engineering of Colonial Radio Corp., a fully-owned subsidiary of Sylvania Electric.

At the recent annual meeting of stockholders and directors of Hermon Hosmer Scott, Inc., 385 Putnam Ave., Cambridge 39, Mass., **Edmond G. Dyett, Jr.,** production manager since last July, was elected director and assistant treasurer of the corporation.

J. W. Crownover, who co-authored the three-part article "Barium Titanates as Circuit Elements" which appeared in the April, May, and June 1949 issues of TELE-TECH, has joined the research and engineering staff of the Electrical Reactance Corp. in Franklinville, N. Y.

Rear Admiral Walter S. Macaulay, USN (Ret.) has been appointed assistant executive engineer in the Knolls Atomic Power Laboratory, located near Schenectady, which is being operated for the Atomic Energy Commission, as part of the General Electric Research Laboratory.

Frederic C. Young, formerly vice president in charge of research and engineering and a director of Stromberg Carlson Co., has joined the staff of Designers for Industry, Inc., 2915 Detroit Ave., Cleveland 13, Ohio, as vice president. Designers for Industry is a development engineering organization, specializing in creative product development.

(Continued from page 55)
Others demand that the studio be square with a minimum size of 70 by 70 feet. In this case they maintain that sets should be in the corners and the cameras in the center.

The choice of studio design and layout depends on the wishes of the individual station owner and the suggestions of his chief engineer. Every case is so different that it is beyond the scope of an article such as this to lay down any hard and fast rules, however, in general the larger the studio the better it will lend itself to production operations.

As TV continues to grow, the designer will no doubt be allowed to exercise greater latitude in his preliminary studio layout, but at present, economic considerations generally dictate the site and size of the studio. It is not surprising to find therefore that many studios are conversions from AM to TV. Bearing in mind that most AM studios are not large by video standards, the designer frequently finds himself literally making the most of every inch of space rather than selecting optimum studio dimensions.

Assuming on the other hand that sufficient area and height has been made available for the construction of a large studio, excessive reverberation and high ambient noise may severely limit microphone technic. In a "live" studio, the hanging mike was more or less ruled out for speech until the introduction of the new RCA directional microphone and generally all microphones should be placed as closely as possible to the performers to overcome this signal-to-noise problem.

Attendant to improved microphone technic, the suggestion of electronic reverberation control and filtering, bid strong for recognition.

Heretofore, the problem of deadening a studio or eliminating excessive reverberation has never proved a serious problem. The use of drapes or movable vanes has proved sufficient to control studio reverberation time, but with the addition of flats and scenery, the standard methods of control are masked.

This suggests that another method of reverberation suppression independent of studio geometries is needed. A short-time ago the A.B.C. Noise Suppressor was tested for this purpose although the device was originally designed to eliminate needle hiss on recordings, it was found that reverberation could be controlled by the proper "blank

(*Continued from preceding page*)

level setting." A device such as this could be used in conjunction with hanging mikes with the resultant elimination of much ambient noise and reverberation.

The effect of liveness can be achieved by generally accepted methods of reverberation injection with the standard echo chamber. Electronic methods for accomplishing this effect have been under development and test for a number of years.

Insofar as audio perspective is concerned it may be said that boom movement emphasizes and creates shadows. It might be suggested that initial microphone placement be supplemented with frequency-level compensated filters. Filters of this nature have been used in Hollywood with success and their use is warranted in the TV studio. Program material when passed through these filters may be altered to create the illusion of closeness or distance to correspond with the camera distance to the performer. When calibrated properly, these filters will subtly but nevertheless markedly enhance the entire tone of a television production.

Correlator

(*Continued from page 43*)

applied to several quantitative research studies during the past year.[3] Included are: (a) The evaluation of a priori information in the detection of sinusoidal signal in normally distributed noise, (b) The measurement of autocorrelation functions of general speech and spoken numbers, (c) The measurement of autocorrelation functions of random noise through linear and non-linear circuits, (d) The measurement of correlation functions of heart-beats for use in the detection of a murmur, and (e) The measurement of cross-correlation functions as a means of determining the prediction or delay time between two time series.

Increased stability, discrete selection of parameter values and reduction of power and space requirements have been included in the first commercial model of the electronic correlator[4] developed and engineered by Melpar, Inc., Alexandria, Virginia. Fig. 10 is a photograph of this improved correlator illustrating its significant reduction in size. As an illustration of a practical engineering application of correlation functions, Fig. 11 shows the autocorrelation function of a simple pulse train as computed by the Model 1063 correlator.

Acknowledgment: The writer wishes to express his gratitude to Dr. E. R. Kretzmer for his assistance in the design of the first model of the electronic correlator and for his contributions to the second model described here.

The research reported in this document was made possible through support extended by the M.I.T. Research Laboratory of Electronics, jointly by the Army Signal Corps, the Navy Department (Office of Naval Research) and the Air Force (Air Materiel Command), under Signal Corps Contract No. W36,039-sc-32037, Project No. 102B; Department of the Army Project No. 3-99-10-022.

[3]Described in detail by the writer in R.L.E. Report No. 122, September 30, 1949.
[4]Model 1063 Electronic Correlator.

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N. Wiener, "Cybernetics, or control and communications in The Animal and The Machine", John Wiley and Sons, New York, N. Y., 1949.

C. E. Shannon, "A Mathematical Theory of Communications", Bell System Technical Journal, Vol. 27, 379-423, 623-656; July and October, 1948.

W. G. Tuller, "Theoretical Limitations on the Rate of Transmission of Information", M.I.T. Sc.D. 1948.

GATED BEAM TUBE

(Continued from page 36)

which is very close to unity. This means that the overall tuning characteristic of the FM receiver, using the 6BN6 limiter - discriminator would be characterized by a broad region of smooth tuning with noisy regions on either side due to slope detection in the i-f stages. This is a distinct advantage by comparison with the ratio detector and other systems in which the band-pass characteristic yields multiple tuning points for a single station. In this respect, the input signal level is not of great importance to the tuning characteristic since the discriminator output is very low in regions where slope detection in the i-f system occurs.

The objective of obtaining low input conductance with the input grid positive has been achieved quite well in the 6BN6 design. The limited input grid current is approximately 500 microamperes and the limited quadrature grid current is about 200 microamperes with both grids positive under static operating conditions.

The 6BN6 can, of course, be used as a plain limiter where it is desired to remove ignition or pulse-type noises from AM signals or amplitude variations of any sort from FM signals.

Since two step function control characteristics are available, the tube would also find application wherever coincidence counting is desired and where such coincidence can be indicated in terms of several volts of signal.

A third application is that of a square wave generator where the input voltage may be of any frequency up to approximately 30 MC.

By using the two control grids, pulse-time modulation may be obtained directly from the output circuit of the 6BN6 stage.

A sync clipper circuit has been designed which, due to the limiting of grid current, does not respond to variations of amplitude of the incoming signal due to noise modulation. This sync clipper, therefore, is capable of differentiating between the sync pulse and other pulse voltages and provides a uniform sync pulse to the horizontal sweep circuits of television sets even though the noise pulses may be several times the amplitude of the TV signal.

The 6BN6 has been used as an efficient speech amplifier-clipper for communications type audio equipment in which it is desired to maintain high modulation levels.

Considering power circuits, the 6BN6 finds application as a phase measuring device in such manner that power-factor can be metered directly or as a synchroscope type of instrument in which the relative phase angle and frequencies of alternators or alternator and line is indicated directly.

It has been found that the unique characteristic of the 6BN6 which allows generation of cathode bias sufficient to cut off plate current completely can be utilized to form a highly efficient frequency multiplier which requires little driving power and so makes possible high multiplication in cascade stages without generation of sidebands due to amplitude variation associated with conventional multipliers.

The 6BN6 has also been used in "flip-flop" circuits and as one-kick and free-running multivibrators.

Use of the tube as a self contained oscillator to which load can be coupled either directly or through the electron stream where isolation is desired, should be possible due to its accelerator's negative transconductance. Since the output of such an oscillator can be controlled in both phase and amplitude by the quadrature grid and plate circuits, another variation of its limiter-discriminator application is that of obtaining phase modulated output from the plate circuit or obtaining four voltage vectors displaced 90° in phase from each other.

The original objective of developing an improved limiter discriminator for FM and TV applications has been realized in the completion of the 6BN6 development. Many circuit components are eliminated completely and several are simplified to an extent. The alignment problem is simplified by the elimination of the discriminator transformer and, in the case of operation with supply voltages up to 200 volts, audio output voltage is sufficient to drive the power amplifier stage directly. All of these factors combine to make a very desirable performance-to-price balance for the manufacturer of electronic equipment.

The author wishes to acknowledge the contributions of the Zenith Radio Corporation, particularly those of Dr. Adler, and the assistance of messrs. W. T. Millis, J. R. Somerville, and R. R. W. Lacy of the General Electric Company's Tube Division and R. B. Dome of General Electric Company's Receiver Division in the design, development and testing of the tube described in this paper.

This is part of a paper which was presented at the Fifth Annual National Conference in Chicago Sept. 26-28, 1949 and will appear in Volume V of the "Proceedings of the National Electronics Conference."

FMA Merges with NAB

Edward L. Sellers, formerly executive director of the FM Association, has joined the staff of the National Association of Broadcasters, after a vote of the FMA board of directors to accept an NAB invitation to join forces.

TV Motion Picture Course

A course in films for television is being given by John H. Battison, Associate Editor of TELE-TECH at Washington Square College, New York University on Saturdays from 9:30 A. M. to 1:00 P. M. commencing February 11th. The course which consists of 60 hours of instruction offers preparation for film work in a television station. While course project is the production of a film, the purpose is to turn out personnel who are familiar with the potentialities and handling of movies for television.

BULLETINS

Tool & High-Speed Steels

Technical data certified by the metallurgical staff of Allegheny Ludlum Steel Corp., Pittsburgh 22, Pa., is now available in a 16-page booklet titled, "The Working Tool and High-Speed Steels." The booklet begins with a simple selector chart and then tersely gives procedures and tabulations that form working manual for markers and users of cutting tools and dies. (Mention T-T)

Aluminum Alloys

A new folder, first to cover the range If aluminum products made by the Baltimore, Md. Magnesium-Aluminum Div. of Revere Copper & Brass, Inc., 230 Park Ave., New York 17, N. Y., is now available as a handy reference guide. The folder, "Properties of Revere Aluminum Alloys", contains a condensed, but comprehensive chart which gives the properties of most of the aluminum alloys available in the form of wrought products. (Mention T-T)

Recording Oscillographs

"Consolidated Recording Oscillographs" is the title of a new 16-page bulletin just issued by Consolidated Engineering Corp., 620 North Lake Ave., Pasadena 4, Calif. Sample records of actual applications are presented along with detailed assembly drawings. (Mention T-T)

Pulse Transformer Designer

Raytheon Manufacturing Co. offers a complete line of pulse transformers suitable for use in driver circuits as blocking oscillator or interstage units. A chart giving complete data on the most popular of Raytheon's numerous pulse transformer designs has been completed and is available upon request. Write for DL-K-315, Raytheon Manufacturing Co., Dept. 6460-NR2, Waltham 54, Mass. (Mention T-T)

Recording Paper

Alfax papers for direct and permanent recording over a wide range of writing speeds are described in a new brochure compiled by Alfax Paper & Engineering Co., 46 Riverside Ave., Brockton, Mass. These papers record without delicate papers or stylii and without specially compensated mechanical movements or magnetic actions. (Mention T-T)

Fabricated Natural Mica

The Mica Fabricators Association, 420 Lexington Ave., New York City, have announced the publication of the "Handbook on Fabricated Natural Mica." Pertinent facts on natural sheet and block mica are included with particular emphasis on characteristics required for its use in the radio and communication industries. (Mention T-T)

Hermetic Seal

A new 16-page catalog on hermetic seals that is said to be the most complete ever produced has been released by the Hermetic Seal Products Co., 37 South 6th St., Newark, N. J. Covering both standard and custom designed hermetic seals, the catalog fully illustrates Hermetic's exclusive multi-point plugs and multi-headers; high voltage terminals; and solutions of miniaturization, high altitude and high ambient temperature problems. (Mention T-T)

Relays

Catalog No. D-20A, recently published by the Ward Leonard Electric Co., Mount Vernon, N. Y. fully illustrates and describes seven standard types of magnetic relays for industrial and general purpose control applications. Complete technical data on relay ratings, dimensions, coil specifications and applications is included. All relays listed are available for immediate shipment from stock in limited quantities. (Mention T-T)

Steel Equipment

A 12-page catalog featuring steel shelving, clothing lockers and other steel equipment has just been published by Precision Equipment Co. A new type of heavy duty steel shelving and streamlined work benches are among the many types of steel equipment offered for immediate delivery. Address Precision Equipment Co., 3714 N. Milwaukee Ave., Chicago 41, Ill. for your copy. (Mention T-T)

TELE-TECH

Advertisers February 1950

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.

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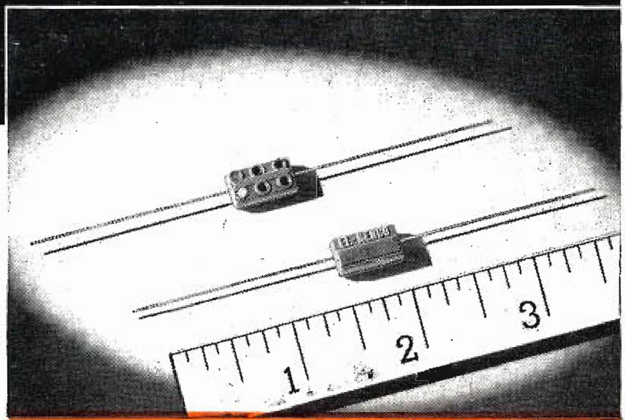

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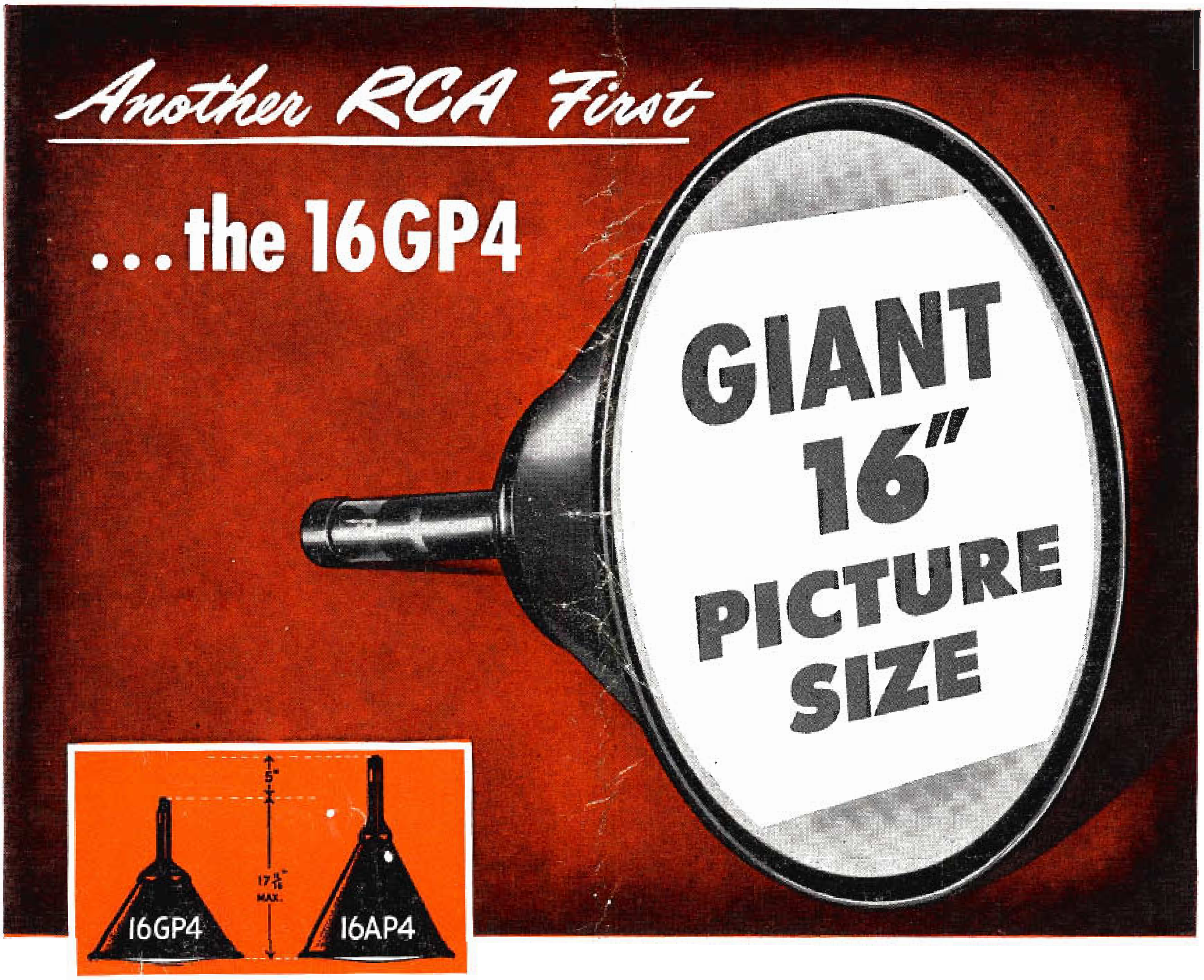

...the new, short metal-cone kinescope with "Filterglass" face plate

The new RCA-16GP4 offers special advantages to designers of large-screen television receivers:

Shorter—Nearly 5" shorter than the 16AP4, the new, wide-angle RCA-16GP4 permits reduction in depth of chassis and cabinet, and thus makes possible greater compactness in receiver styling. In addition, the 16GP4 permits economies in tube stocking, packaging, and shipping.

"Filterglass" Face Plate—Of high-quality glass and almost flat, the "Filterglass" face incorporates a neutral light-absorbing material to give improved contrast by minimizing ambient-light reflections and reflections within the face plate itself. The circular face plate provides a large picture with full scan.

Tilted Ion-Trap Gun—New tilted gun requires only a single-field, external magnet.

Duodecal 5-Pin Base—Permits use of lower-cost segment socket.

Less Weight—The RCA-16GP4 weighs substantially less than a comparable all-glass tube so that, with ordinary precautions, it can be safely shipped in the receiver.

RCA Application Engineers are ready to co-operate with you in applying the 16GP4 and associated components to your specific designs. For further information write RCA, Commercial Engineering, Section B57R, Harrison, N. J.

ANOTHER new RCA tube . . .

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