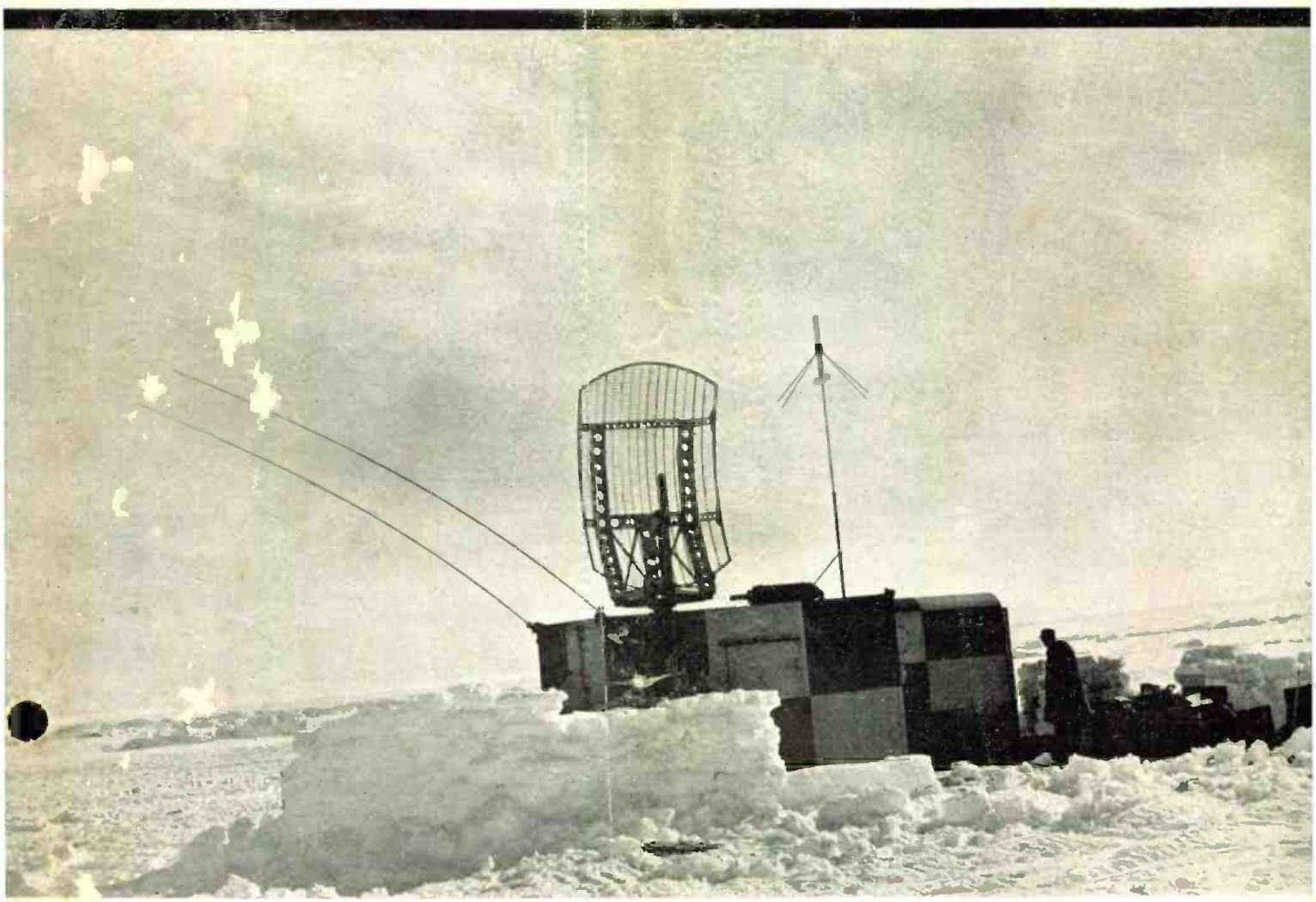
COMMUNICATIONS

INCLUDING "RADIO ENGINEERING" AND "TELEVISION ENGINEERING"



OCTOBER

* POWER COMPANY F-M SYSTEM * V-H-F AIRBORNE COMMUNICATIONS
* TWO-WAY TAXICAB-RADIO FLEET INSTALLATION

1947

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Nielsen *Audimeter* Uses

CLARE SEALED TYPE "K" RELAY

for Radio Audience Research

Pencil points to Clare "3K" Relay in Nielsen Audimeter

● One of the most interesting developments in radio listening research is the Audimeter, designed by A. C. Nielsen Company, Chicago marketing research organization, to provide information hitherto unobtainable.

Attached to home radio receivers, scientifically selected on a nation-wide basis, this device keeps an accurate 24 hour a day record of when each receiver is operated and the stations to which it is tuned.

Clare Sealed Type "K" Relays were chosen for use in the Audimeter because of their extreme reliability, capacity for precise, sensitive adjustment, and the fact that they are sealed so that dirt and handling cannot affect their operation.

In the Audimeter, the unusually sensitive Clare Sealed Type "K" Relay operates under the control of a vacuum tube to stop the recording stylus at the correct spot to identify station choice on the calibrated record tape.

Clare Sealed Type "K" Relays, sealed in nitrogen in a metal cover, are immune to conditions imposed by high altitudes, dust, moisture or combustible gases. They function at maximum precision under extreme conditions. Like all Clare "Custom-Built" Relays they are available in a wide range of contact ratings and contact forms. flat or hemispherical contacts of rare metals or special alloys and with coil windings to match the circuit and application.

Clare "custom-building" makes it possible . . . with the utmost economy . . . to secure a relay exactly suited to specific requirements. Clare sales engineers are located in principal cities to help you secure just the relay you need. Write to C. P. Clare & Co., 4719 West Sunnyside Avenue, Chicago 30, Illinois. In Canada: Canadian Line Materials Ltd., Toronto 13, Ontario, Canada.

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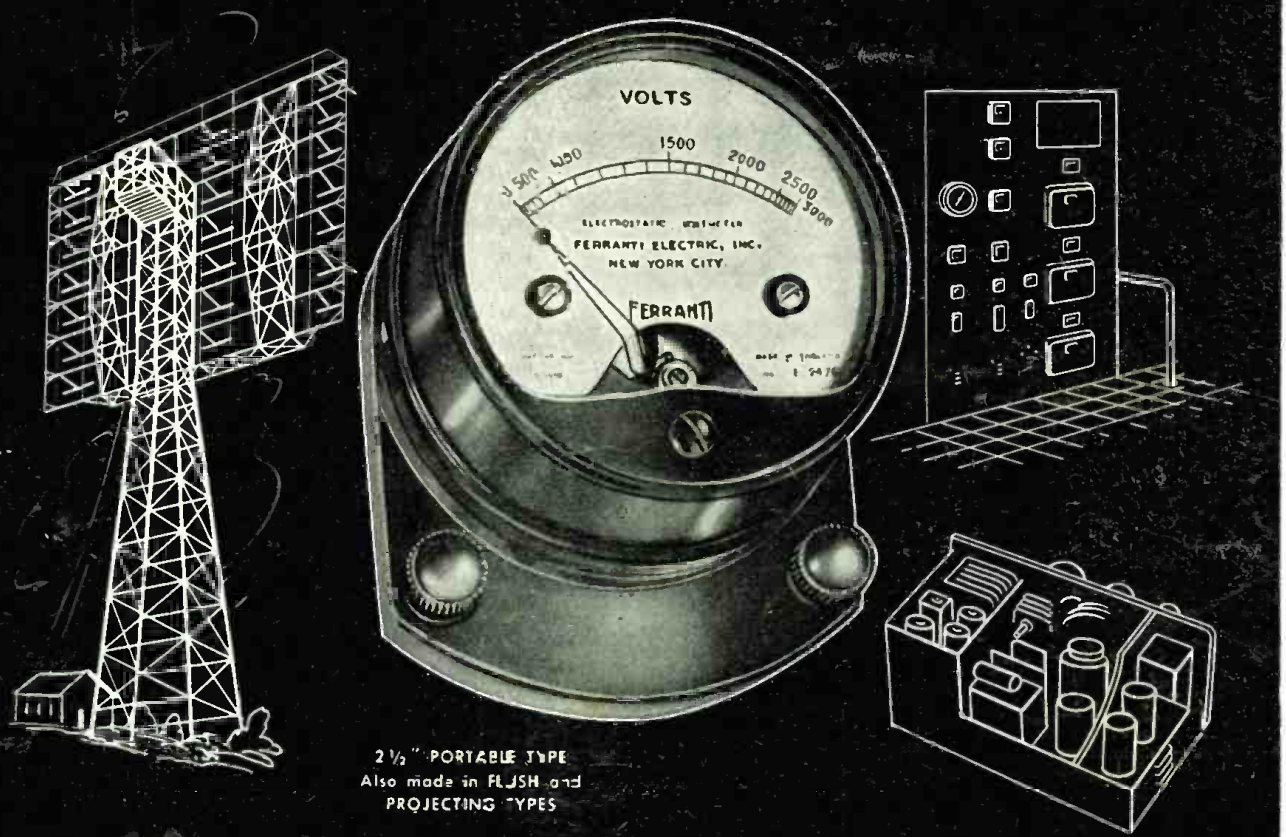

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OCTOBER, 1947 VOLUME 27 NUMBER 10

COMMUNICATIONS

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COVER ILLUSTRATION

Antarctic expedition airport-surveyance installation at Little America. Equipment was used to guide planes to landing area on the Ross Ice Shelf. *(Courtesy U. S. Navy and Bendix)*

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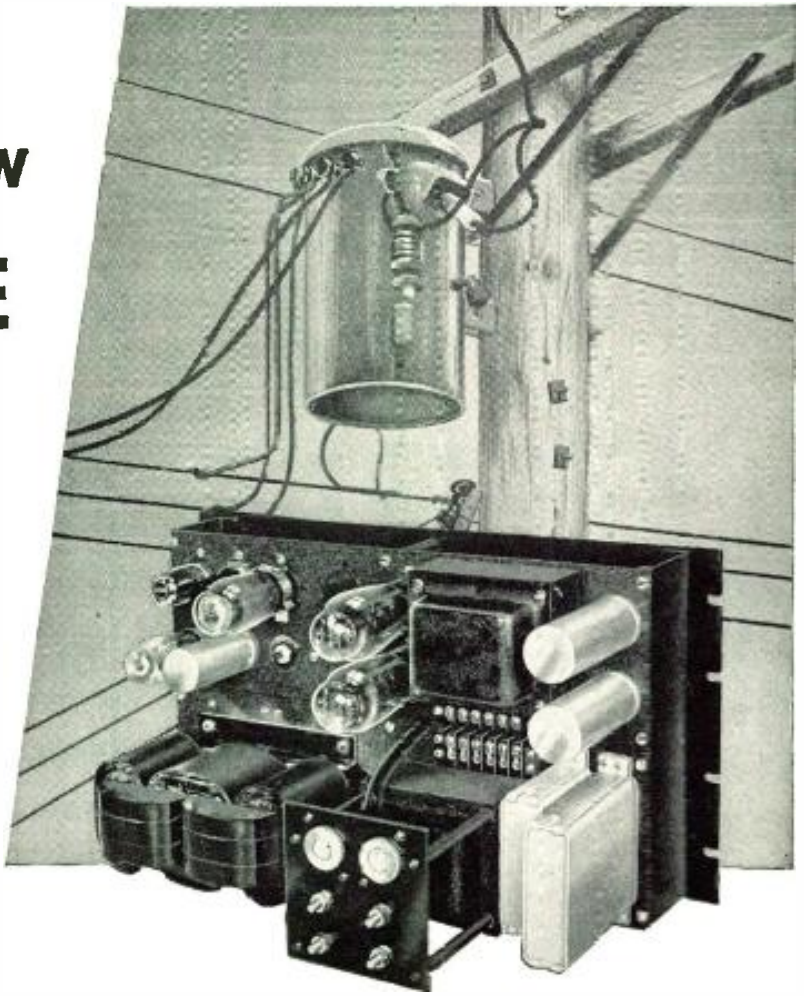
Do you really know the VOLTAGE CONDITIONS in your plant ?

208 Volts
195 Volts
220 Volts
115 Volts
255 Volts



To correctly answer this question is difficult. Your utility may quote a nominal voltage . . . but, by law, most power suppliers have up to ±10% tolerance. This condition plus changing loads in your own plant results in voltages other than the nominal. Only by engineered control can you be sure that line voltage will remain constant.

With a STABILINE Automatic Voltage Regulator in the power line, your electrical apparatus is assured of constant voltage.

Type IE . . . these all-electronic regulators provide instantaneous action in maintaining the delivered voltage to within ±0.1 volts of the preset value regardless of line variations. For any load current change or load power factor change from lagging .5 to leading .9, type IE will hold the output to ±0.15 volts. Maximum waveform distortion never exceeds 3%.

Type EM . . . for large size installations where low cost and high efficiency are paramount considerations but instantaneous action is not essential, type EM regulators find wide application. These units have zero waveform distortion; are not affected by changes in the power factor or magnitude of the load; and the regulator does not affect the power factor of the system.

Further information is available in Bulletin 547. Write for your copy.

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New! UNITIZED amplifier systems for recording

with plug in flexibility

Flexibility is the outstanding advantage of the *new* Fairchild Unitized Amplifier System. It includes 13 basic components which can be assembled in an endless number of combinations to meet the standard, special and changing recording requirements of schools, broadcasting and the professional recording industry. Related units are simply plugged in or cabled together. It's that easy . . . that quick!

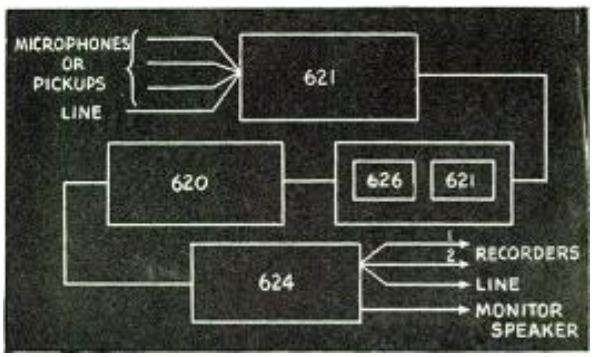
Fairchild's Unitized Amplifier System now makes it practical and economical to build highly individualized audio systems to satisfy all of the varied and changing requirements of the individual recording engineer. Further, the flexibility of the Fairchild system permits the units to be rearranged or the system to be expanded at will without obsoleting a single component.

Fairchild's 13 basic components have been especially designed by *recording* engineers to meet the specific requirements of the various types of *recording* systems.

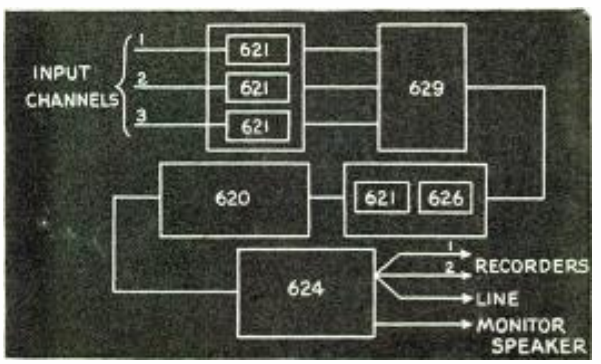
Unit 620 — Power Amplifier	Unit 626 — NAB Equalizer
Unit 621 — Microphone Preamplifier	Unit 627 — Variable Equalizer
Unit 622 — Pickup Preamplifier Equalizer	Unit 628 — Diameter Equalizer
Unit 623 — Line Amplifier	Unit 629 — Mixer
Unit 624 — Output Switch Panel	Unit 630 — VI Panel
Unit 625 — Input Switch Panel	Unit 631 — Bridging Device
	Unit 632 — Auxiliary Power Supply

Study the typical setups shown on this page. Then set down your own requirements . . . select the basic units you'll need . . . assemble them for convenient panel board operation . . . or let us do it for you. How will your specific amplifier system perform? Professionally! Like all Fairchild Sound Equipment—it keeps the original sound alive. Precisionized mechanical and electronic skill is the precise reason.

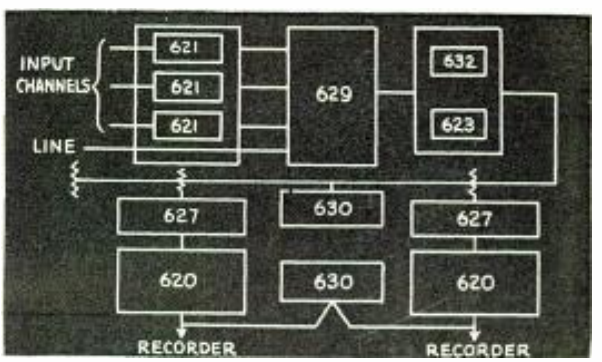
Want more details? Address: 88-06 Van Wyck Boulevard, Jamaica 1, New York.



Single Channel Systems: for recording from a microphone or record or playing back from a pickup.



Multiple Channel Systems: for recording simultaneously through multiple input channels in conjunction with a mixer.



Dual Recording Channels: for recording simultaneously on two machines through dual channels with separate variable equalizers.

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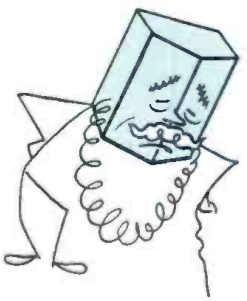
Why this team brings

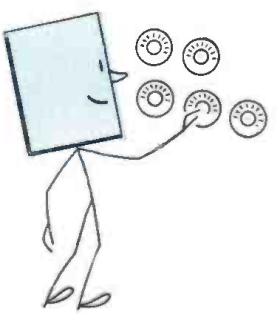
Early in the history of radio telephony, it became evident that further growth and expansion depended on accurate means of controlling frequency. The first step toward solving this problem was taken in 1915, when a Laboratories engineer developed the first master oscillator circuit for radio transmission. In 1917 came the first crystal controlled oscillator using Rochelle salt crystal, and in 1921 the application of quartz crystals.

From that day on, the Bell Laboratories-Western Electric team has pioneered in piezoelectric crystals. New cuts, new circuit applications, new methods of growing synthetic crystals . . . all have been developed by the Laboratories, and all mass-produced by Western Electric.

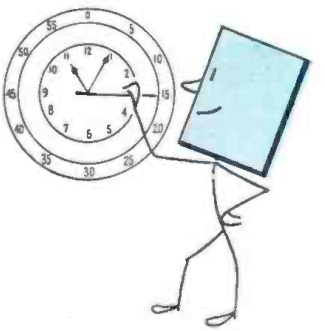
Today it is only natural to look first to this team for the finest quartz and synthetic crystals for every service.



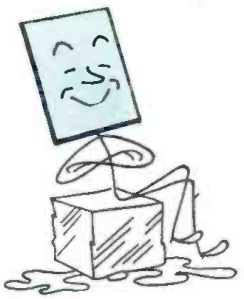
1917 A Rochelle salt crystal used by a Laboratories researcher to control an oscillator circuit was the granddaddy of all frequency control crystals.



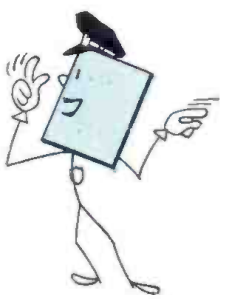
1924 Quartz crystal applied to frequency control of station WEAF by Bell Laboratories-Western Electric team greatly improved the quality of distant broadcast reception and laid foundation for more economical use of radio spectrum.



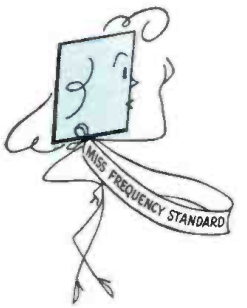
1927 Oscillating 100,000 times a second, a crystal served as the heartbeat of a clock far more accurate than any other timing device ever before made by man.



1933 Low - temperature - coefficient crystal cuts, utilizing for the first time specially selected shape, dimensions, and orientation characteristics, increased frequency stability, made temperature controls needless for certain applications.



1934 "Traffic Cop" crystal filter designed by Bell Laboratories to act as separation unit for carrier systems. Led to today's 480 channel coaxial systems and single sideband radio transmitters.



1939 GT crystal serves as a "frequency model." Used for Loran, extremely accurate time signals (stable to 1 part in 10^{9}), and other applications requiring utmost frequency stability.

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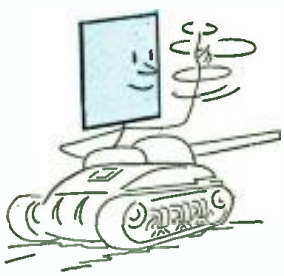
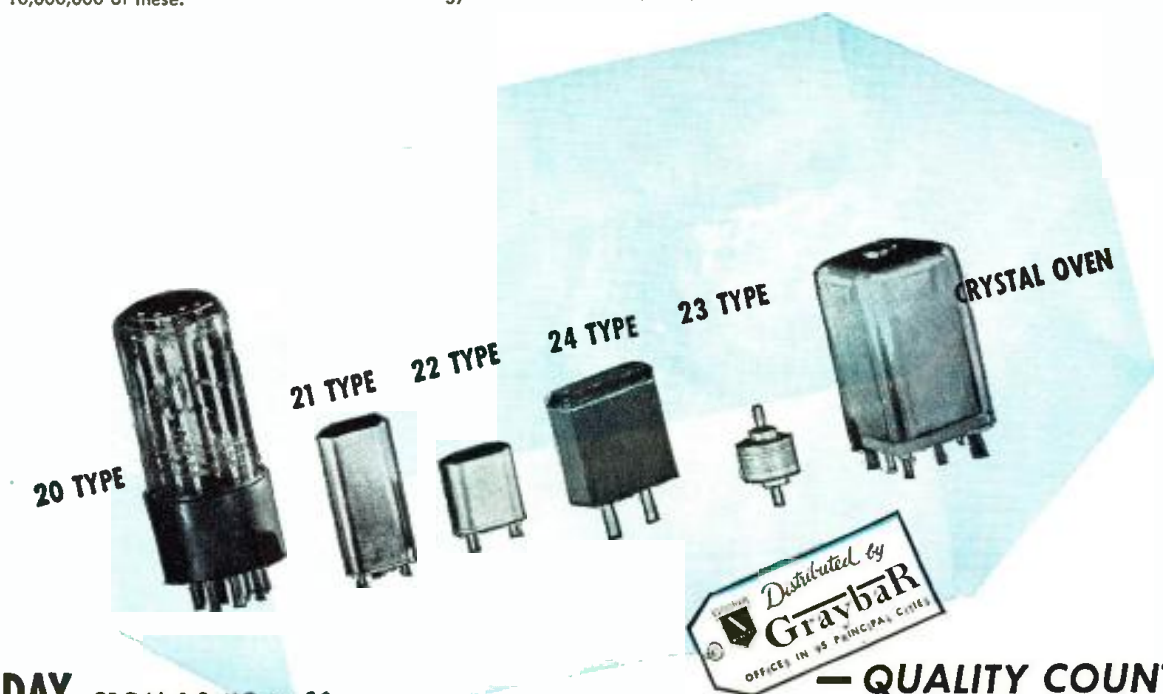
you more accurate frequency control



1942 Wire mounted crystal unit designed to withstand shocks and rough usage went into battle in tanks and with artillery. Western Electric produced over 10,000,000 of these.

1943 Synthetic ADP crystals, first mass-produced by this team, were also first applied by the team to underwater sound in Sonar. Change acoustic energy into electric and vice versa.

1947 EDT crystals — the first low-coefficient synthetics — are being grown on Western Electric's crystal farms to replace hard-to-get natural quartz.



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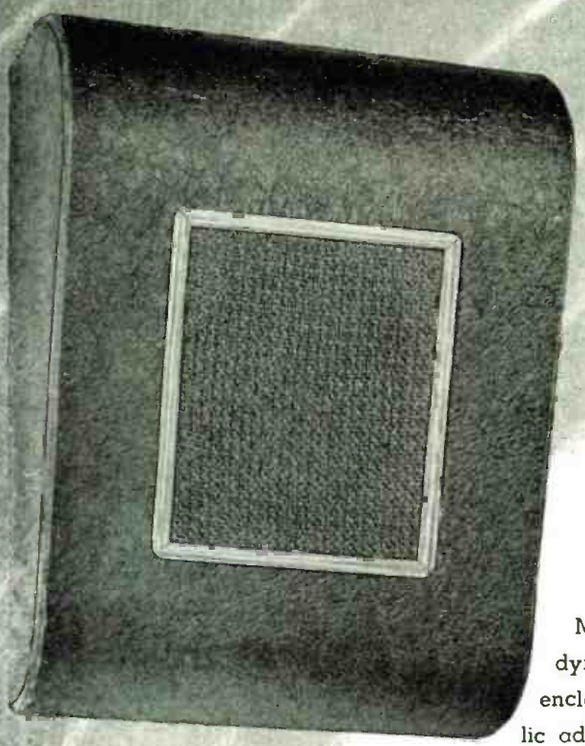

Jensen
Model J-61
WALL CABINET

Model J-61 Wall Cabinet, employing the Peridynamic principle, is another new JENSEN enclosure, destined for wide use in such public address installations as hotels, factories, schools, airports, railroad stations and offices. It may also be used to enclose extension speakers in homes. It can be used with any 6-inch speaker.

Model J-61 Wall Cabinet is of durable construction and beauty of design and finish and is formed of attractively textured brown composition wood over solid wood frame. The grille is of matching brown fabric with chrome trim around aperture. Brackets for wall mounting are furnished. On the back is mounted a 5-lug terminal strip. Height, 16-2/3 inches; width, 12¾ inches; depth, 8¼ inches.

Model J-61 Wall Cabinet (ST-751)....$14.50

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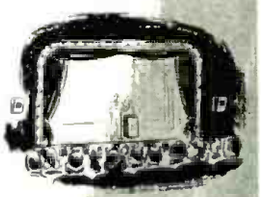

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HERE'S an Intelin* transmission line that's really designed to take plenty of punishment—to maintain peak performance of FM and television receivers under even the most rigorous conditions. Federal's K-1046 300-ohm line will withstand the scorching heat of the summer sun, the abrasion of wind-borne dust and dirt, freezing sleet and atmospheric moisture.

Its smooth solid polyethylene insulation resists water, acids, alkalies, oils and abrasion—won't embrittle or age in sunlight. It retains flexibility and demensional precision in hot or cold weather. Elliptical cross section enables it to withstand twisting—prevents accumulation of foreign matter and maintains stable capacity characteristics.

Stock up now to meet the increasing demand for new FM and TV installations. This 300-ohm line, as well as other Federal h-f cables—can be obtained through local distributors all over the country.

DATA FOR 300-OHM LINE

Type Number	Characteristic Impedance	Velocity of Propagation	Capacitance Per Ft.	Attenuation, Db per 100 Ft. Frequency in Megacycles				Physical Dimensions	
				1.0	1.7	3.0	100	Conductor Size	OD over Jacket
K-1046	300 ohms	81%	4.0 mmf	.38	.57	.85	2.0	7/# 30	.36" x .08"

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COMMUNICATIONS

LEWIS WINNER, Editor

OCTOBER, 1947

PRINTED CIRCUITS PROGRESS

PRINTED CIRCUITS[1], without which it would not have been possible to produce the all-important proximity fuse, have now become a vital factor in the communications industry. The extensive progress made in the art was revealed during a comprehensive symposium conducted in Washington by the Bureau of Standards in association with the Aeronautical Board, when 16 papers were offered covering new *pc* developments, involving transmitters, receivers, components and manufacturing procedures.

A. S. Khouri, of Centralab, analyzed the printed circuit techniques developed during the war and currently to produce many miniature items such as audio couplers. W. V. Patton of Dupont disclosed the intensive investigation that had been made on conductor paints. Jesse Marsten, I.R.C., discussed printed resistors; J. W. Jira, Continental Carbon, described metal film resistors; H. S. Crammer, Corning-Glass, covered the process of printing conductors on glass; C. A. Marlies, Associate Professor of Chemical Engineering of the City College of New York, detailed the application of circuits on plastics developed at Metaplast Company; spraying techniques were analyzed by G. W. Johnson, Spraywire Labs.; J. M. Ternes, Altair Machine Corp., covered hot die-stamping; C. L. Snyder, General Ceramics, described printed inductors; stamped wiring processes were analyzed by J. B. Straughn, Franklin Airloop and A. Gross, Gross Electronics, demonstrated a line of miniature *pc* circuit transceivers for the 470-mc band.

Dr. Cledo Brunetti, chief of the Engineering Electronics Section of the Bureau of Standards, who conducted the symposium, disclosed that there were 26 methods that could be employed to prepare a printed circuit item. These methods included painting, stencilling, printing, stamping, spraying, die casting, cathode sputtering, die stamping, dusting, firing, cracking hydrocarbons at high temperatures, decals, and catalyst action.

[1]Ralph G. Peters. COMMUNICATIONS, October, 1945.

Discussing composition of paints, Dr. Brunetti said that powdered silver, silver oxide, silver nitrate or powdered copper were suitable as pigments for conductors, while carbon black, colloidal graphite or flake graphite could be used as resistor pigments. Suggested binders for the resistors included phenol-aldehyde resins, melamine aldehyde, vinylite, silicones, styrene and methacrylate.

Conductor paint formulas were also offered. On ceramics, with a processing temperature of 450°C to 800°C, it is possible to use 65% of finely ground silver powder as a pigment. This pigment was also suggested for glass where, however, the processing temperature range is from 450°C to 650°C. About 70% of the finely ground silver powder was recommended for thermosetting and thermoplastic materials, with temperatures ranging from 25°C to 175°C for the thermosetting materials and 25°C to 75°C for the thermoplastics.

In the analyses of *pc* resistors, it was learned that the composition of one type of 1,000-ohm *pc* resistor was 38% graphite with 62% silicone resin as a binder, the resistance having a thickness of .003" and being approximately .1" wide and .4" long. The *pc* resistors having higher values of 50,000 ohms to 10 megohms use 11% carbon black and 23% graphite with a 66% ethyl cellulose lacquer. Thicknesses in this instance range from .001" (±) to .004".

Potted cast-resin plug-in equipment with *pc* circuits were also described. These units have a-f, r-f, antenna and other transmitter and receiver functions, ranging in sizes from 1" x 2" to 2" x 4". Industry specialists also revealed that the *pc* idea was being employed to process equipment for the a-m, f-m and tv bands in unit and complete form.

The *pc* parade is on!

TAXICAB RADIO

ACTIVITY IN MOBILE COMMUNICATIONS development has been increasing daily, particularly in taxicab systems. It has been only a year since the FCC has allocated temporary bands in the 152 and 162-mc channel for cab radio and to date over $20,000,000 has been spent in development, research and production. The FCC records reveal that over 600 licenses have been granted to cab companies and approximately 30,000 cabs have or will have systems soon.

Since the early days of mobile systems, many radical changes have occurred in equipment design. Today, all taxi systems use f-m. Receivers use harmonic amplifiers, and resonant lines are employed instead of lumped inductance in many types of equipment. High orders of frequency multiplication appear, with 48 to 96 times the usual factor. Instant heating tubes are widely used to conserve transmitting power drain during standby periods. Miniature tubes are now used in most equipment, and the number of tubes in the transmitter and receiver have been increased to improve operating efficiency.

A variety of calling systems are employed, such as selective calling, lockout, instant calling, etc.

Operator licenses are no longer required. Manufacturers are providing locks on equipment to avoid tampering.

Equipment is compact and easy to service. Drawer type of construction is a feature of many types of equipment.

The ruggedness and durability of electrical and mechanical features, so essential to equipment of this type, has become a design and production *must* of all manufacturers.

Taxi radio is no longer a gadget, but an essential piece of equipment of inestimable value to the cab operator and public. Cab communications has become a major transportation service.

In reply to many inquiries we have received concerning this growing industry, we have arranged for a series of comprehensive articles which will analyze taxi radio research, design, production, installation, operation, maintenance, servicing and licensing. The series, beginning in December, will be written by Samuel Freedman, Commander, USNR (Ret.), author of the book *Two-Way Radio*.—L. W.

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Two-Way Taxicab Radio FLEET INSTALLATION

Cab Company, Operating Over One Thousand Cars, Employs 20-Watt Units On 152 to 162-mc Band. Tow Trucks and Supervisors' Cars Also Equipped with Radio Service.

by REID W. MALCOLM

Radio Engineer
Yellow Cab Company of Philadelphia

In 1945, the FCC allocated two frequencies from the *urban mobile group* to the taxicab industry for experimental use, one for land stations or jointly by land and mobile units if desired, and the second for mobile use only. Although these frequencies were allocated on an experimental basis, with no guarantee of permanency, there's been an unparalleled interest and request for this allocation for cab use.

Operating more than 1,500 taxicabs, we were among the first applicants for an experimental license for this new tool, although we maintain a most elaborate telephone network with more than 313 miles of leased telephone lines, 143 telephone-equipped cab stands, four branch exchanges serving the suburban area and a main telephone exchange which serves the city proper.

The first two-way radio equipped taxicab was placed in service on the streets of Philadelphia in July, 1946.

At the present time the simplex system or two-frequency simplex method of operation is being used to reduce the number of *cut-outs* caused by two or more cabs transmitting at the same time. With this system about half of the cabs are able to hear each other as well as the land station and thus know whether or not the circuit is busy.

The two-frequency simplex operation reduces the number of received signals in the cab which, to some passengers, is desirable. On the other hand, other passengers find it interesting and exciting. If the passenger finds the radio objectionable, the driver may request and obtain permission to turn it off for the duration of that trip.

The selective calling system has not been favorably received because of the time consumed in selecting the desired cab, which is approximately the same as that required to complete a normal contact.

We use a 15-tube receiver[1] which operates from a dynamotor supply.

This receiver features a double superheterodyne type of circuit, with one r-f stage (6AK5), a first detector (6AK5), second detector (6SH7), two i-f amplifiers (6SH7), two limiters (6SH7), one discriminator (6H6), one noise rectifier (6H6), one combined squelch and first a-f amplifier (6SL7-GT), one second a-f amplifier (6SH7), one class *B* audio power-output stage (1635) and first and second multiplier stages with 6SH7s.

The oscillator circuit is crystal-controlled.

In the noise-squelch circuit the noise voltage appears across the plate re-

[1] RCA, type CV-2A.

The receiver (left), transmitter (right) and power supply in trunk compartment of taxicab.

Radio dispatcher in soundproof booth. Pads of numbered tickets corresponding to numbers assigned to cabs provide destination or position of each cab.

Order-taking clerks

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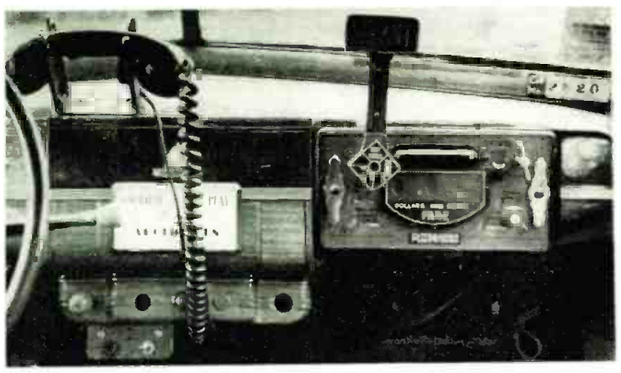


Two-way setup in cab. Control positions are part of the vehicle's instrument panel, with on-off switch at left of ignition key and indicator lamp at right of key.

sistor and is coupled through a capacitor to the noise rectifier tube, where it is rectified and doubled to produce a d-c control voltage. This rectified voltage controls the squelch-amplifier section of the 6SL7-GT twin triode, which in turn controls the bias on the first a-f amplifier section of this tube, thus muting the noise when no signal is being received.

Selectivity is 6 db down at 22.5 kc and 85 db down at 120 kc off resonance by 20 db of quieting method. Sensitivity is 1 microvolt for 20 db of quieting with 50-ohm series matching resistor. Squelch sensitivity is adjustable from .4 to 1.5 microvolt. Intermediate frequencies are 17.0 to 18.0 mc and 1940 to 2060 kc.

Our 20-watt transmitters[2] have an r-f circuit which consists of a 6SJ7 oscillator, 6SJ7 phase modulator, 6SJ7 first doubler, 6SJ7 second doubler, 2E24s as third and fourth doublers, two 2E24 triplers, and two 2E24s as power amplifiers. The audio circuit consists of a 6SG7 audio amplifier and 6SL7 limiter.

Direct crystal control is incorporporated with a Pierce type oscillator.

A coaxial antenna changeover relay maintains constant transmission line impedance.

Crystal frequency range is 3100 to 3400 kc, and crystal multiplication is 48 times.

Modulation (phase) is ±15 kc for 100% modulation.

Under present operating conditions conservation of air time is of utmost importance. When two or more companies are operating in the same general area the chance of completing lengthy messages is materially reduced since all taxicab companies operate on the same frequency. In addition cabs are unable to hear each other, even using the simplex system, when separated by more than six or seven miles (in urban areas). It is therefore imperative that each contact be limited to the amount of information which is absolutely necessary for intelligent operation, without codifying reports to the point where considerable schooling and practice are necessary for efficient operation. Normal contact in our system, including acknowledgment, requires about four seconds.

Cab Dispatching

The problem of dispatching the radio cab presents an entirely different problem than that offered by any other service. In most mobile services the mobile unit has a predetermined route and destination controlled by the dispatcher or other controlling official. Their problem is to coordinate subsequent orders with that route schedule and destination. In taxicab operation neither the route nor the destination is known in advance of the loading passenger and the problem becomes one of coordinating available orders with that movement. Further, the duration of the trip is much shorter than that of other services. Thus the time element becomes of the utmost importance, for if too much time is consumed in obtaining an order for a vacant radio cab it may be hailed by a pedestrian and its usefulness in filling nearby orders lost. Thus another cab from a more remote point has to be dispatched to fill the order that was too late in coming, resulting in reduced service and increased operating cost.

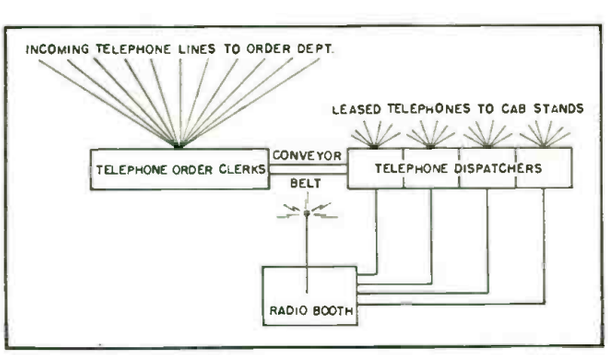
The dispatching section consists of several switchboards each of which serves a certain section of the city in much the same way that the various telephone exchanges of the telephone company serve particular areas of the city. In our system, though, the dispatchers subscribers are cab stands strategically located throughout the area to provide rapid cab service to that area. The radio cab is used to augment this service. As a radio cab enters a dispatcher's area in effect it establishes another cab stand in that area.

The radio dispatcher is located in a soundproof booth in our main telephone offices. Small pads of numbered tickets, corresponding to the numbers assigned to the radio cabs, are mounted in tiers in numerical order on a *control board* on the desk of the radio dispatcher. By means of these tickets the destination or position of each cab is always before the eyes of the dispatcher.

When the driver of a radio cab leaves the garage at the beginning of a shift the location of the garage is entered on the ticket bearing that cab number, and these data are sent to the

(*Continued on page 42*)

[2]RCA CM-3B



Cab dispatcher setup used by the Philadelphia Yellow Cab Co.

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Figure 1

Kentucky utilities Service Man, George Showalter, at his f-m equipped service truck.

Power Company F-M SYSTEM

by E. W. BROWN

Vice President and Director of Operations

Kentucky Utilities Company, Inc.

WHEN THE LIGHTS GO out, minutes count to an electric company repair crew. Cutting down those minutes between the time service breaks down and the time the lights go on again means lower costs and better satisfied customers.

Maintaining communications between service crews and the central office to reduce blackouts is a major problem during any emergency. The use of the telephone system cannot be relied on, because as Dan Haefling, superintendent of operations and service for Lexington, points out:

"We are always hampered by the fact that telephone communications systems are exposed to the same dangers from the elements as electric systems. Time and again storms that cause power line breakdowns also knock out the phone system."

Tests have shown that a radio system can provide that reliable service so necessary in our type of work. We selected a 2-way[1] f-m service[2] which provides a link between four service and two line trucks, and a fixed station.

[1]G.E.

[2]Robert S. White, electrical communications engineer of Radio Engineering and Maintenance Corporation, Lexington, in charge of installation.

[3]Although the f-m antenna of WQOB, of the Fayette County Police Department, is also located atop the bank building, there has been no interference reported.

Figure 2

Mrs. Helen Evans of Kentucky Utilities at the controls of a remote unit in the dispatcher's office. The fixed station transmitter and receiver, two blocks away, are operated from this unit.

Antenna Sites

The roof of the 210′ First National Bank building[3] was chosen as the site for the fixed station antenna. One of the highest spots in Fayette County, of which Lexington is the largest city, the ground on which the building stands is 1,000 feet above sea level. A 34′ mast weighing 1,500 pounds supports the antenna atop the building which places the antenna 212′ above the average elevation of the surrounding terrain.

The power company's regular Lexington line crew, under the supervision of T. R. McCoy, superintendent of construction, installed the tower.

The transmitter and receiver combination is housed in the penthouse atop the building, and is operated by a remote control unit in the dispatcher's office in the utility company's district building two blocks away.

Training Program

Three classes were held to acquaint company personnel with the operation of the equipment and to prepare employees for the operating licenses re-

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Lexington, in Plateau Area of Central Kentucky, Served by Mobile F-M System on 31.46 mc. Two-Way Contact Available Between Six Line and Service Trucks with 30-Watt Mobile and 60-Watt Fixed Transmitters.

quired by the FCC. Eleven persons now hold permits for operating the station transmitter.

Effective range of the system[1] has been found to be 25 miles.

Soon after the system was put into operation last October 6 its value was demonstrated when line crews connected a neutral wire to the transmission line between the hydro-generating station at Dix Dam, Ky., and Lexington. One crew was stationed at each side of the Kentucky River, which was too wide at that point for a man on one bank to hear his fellow workers on the opposite bank. The procedure which utility crews have used over the years was to shuttle a man in a rowboat back and forth delivering messages. Frequently, work would have to stop while the men on one shore waited for the boat to bring back a report on conditions on the other shore.

With the new radio setup, trucks on each bank kept the two crews in constant communication with one another and with the fixed station in Lexington, and the job was finished in short order.

When 65-mile-an-hour winds struck Lexington on the night of March 24, disrupting electric service in and around the city, the radio system got its first real test.

Lines were torn down by the high winds; trees were broken and branches were hurled through the wires strung along the city's streets and the county roads. Within moments after the first gusts struck the city, service interruption calls were pouring into our switchboard.

All during the storm the six trucks with radio equipment moved from trouble point to trouble point restoring electric service.

Officials estimate that calls were made and service restored, either permanently or temporarily, in half the time that would have been required had the radio not been in use.

Each crew was able to keep in direct contact with the main office and to operate in nearby areas without ever being out of touch with headquarters. Furthermore, the crews, moving from one job to another, were able to report trouble that was not even known to headquarters, enabling other crews to be routed to the scene, and giving the service department a better overall picture of the storm damage.

"Despite the greatest windstorm ever recorded in Lexington," Mr.

[1]Call letters of fixed station are WCLI; mobile stations, WCLK.

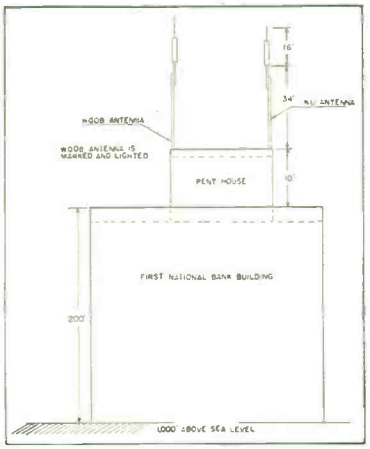
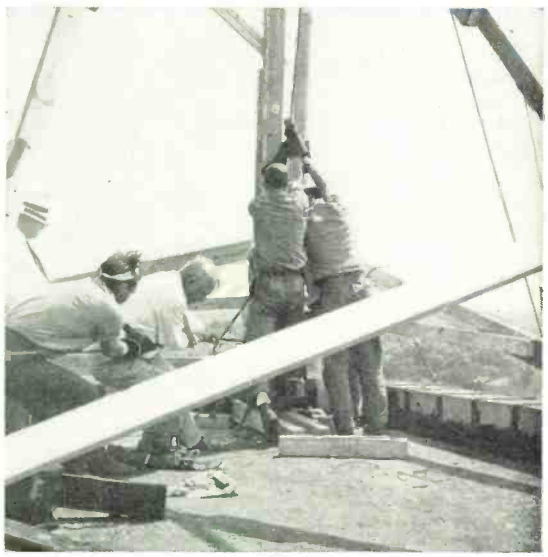


Figure 5
Diagram of fixed-station antenna location.

Figures 3 (left) and 4 (right)
Hoisting the antenna support tower to position atop the 17-story office building in Lexington, Kentucky.



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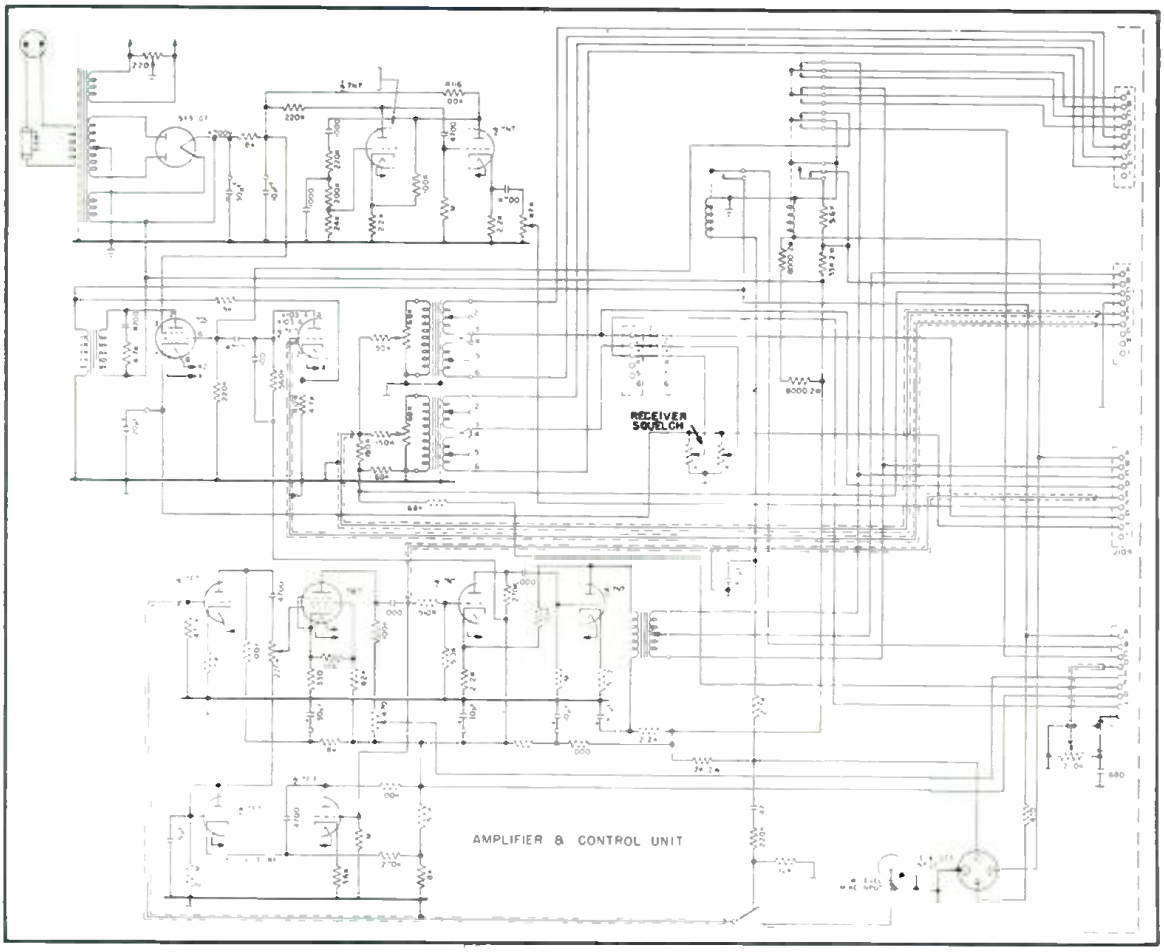

Figure 6
Schematic of remote control unit.

Haefling recalls, "we were able, by radio, to keep on top of the situation at all times. I am literally unable to estimate the time saved that night through the use of two-way radio. As an investment in maintaining and restoring service, these radio-equipped trucks paid our Lexington customers tremendous dividends during that storm."

Man-Hours Saved

Mr. Haefling has kept close records of man-hours and mileage on service calls. His figures show that the radio-equipped crews have handled 20 per cent more calls with no increase in truck mileage during the first nine months the radio equipment was in operation.

A monthly routine checkup on each piece of equipment, as preventive maintenance, is conducted by the installers of the equipment.

Switchboard Setup

The PBX switchboard, located 25' from the dispatcher's remote control unit, is connected with a microphone and a cut-in switch to enable the telephone operator to use the radio system when the regular radio operator is not on duty.

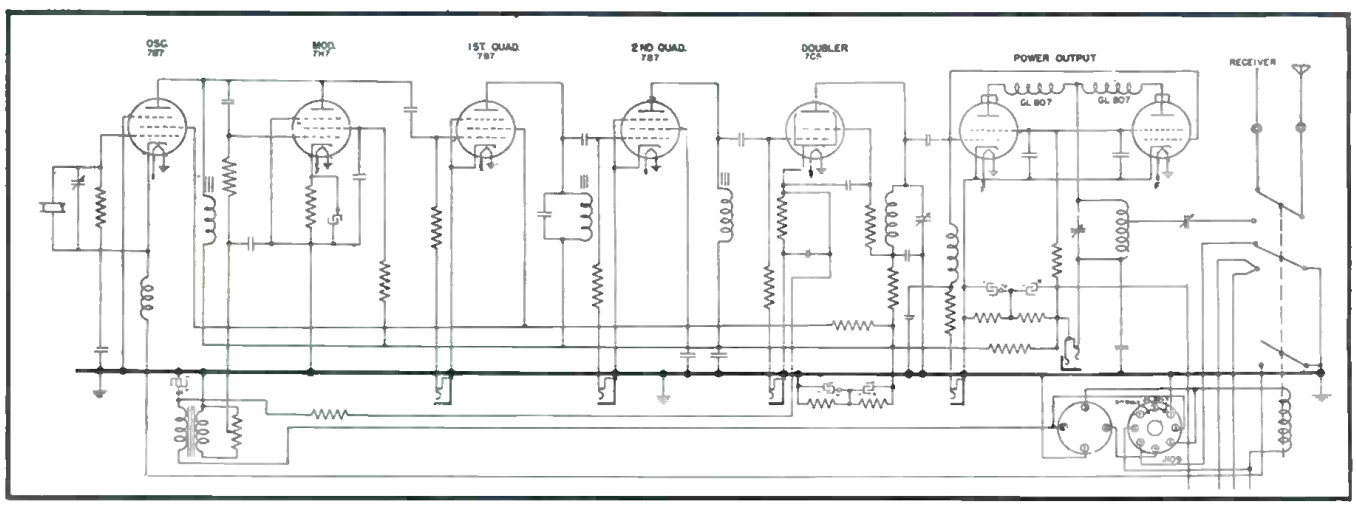

Figure 7
Transmitter schematic.

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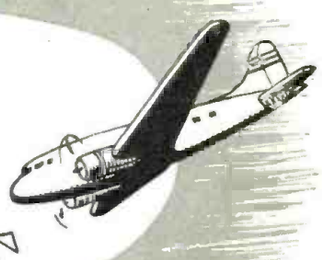
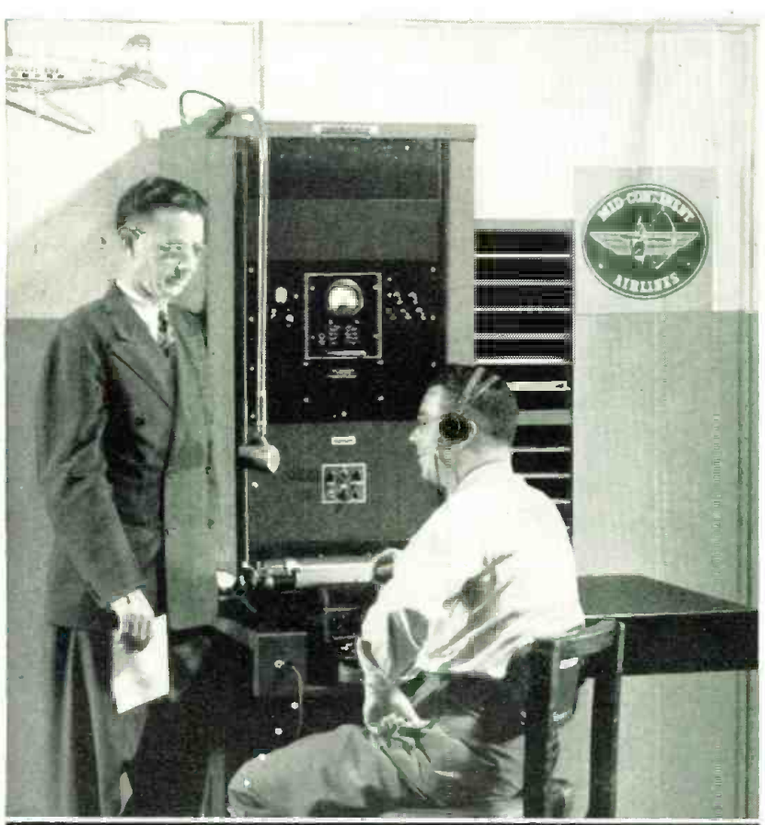
WILCOX... First Choice of MID-CONTINENT AIR LINES



MID-CONTINENT EQUIPS GROUND STATIONS WITH NEW...



WILCOX VHF
Transmitters and Receivers

NEW FEATURES OFFERED IN FIXED FREQUENCY EQUIPMENT FOR 118-136 Mc. BAND

- **Design Simplicity Simplifies Service**
  Simple, conventional circuits minimize the number and types of tubes, and require no special training or test equipment for adjustment.
- **Co-Axial Transmission Line Relay Allows Common Antenna**
  An automatic transfer relay with co-axial connections permits operation of transmitter and receiver from same antenna.
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  A newly developed crystal eliminates need for thermostatic temperature controls and ovens.
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  With noise 33 times as strong as desired signal, the receiver output is perfectly intelligible.
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  Straight sided, flat topped selectivity response curve assures a minimum of interference from adjacent channel transmitters.

Write Today for complete information on this compact, high performance equipment

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TELEVISION RECEIVER Production Test Equipment

Concluding Installment of Discussion on 22-Rack 13-Channel Video and Sound Test Setup at Camden, With Details on Head-End Alignment, H-F Distribution System, F-M Sound Transmitter, Combined Sound and Picture Transmitter and Future Equipment

by JOHN A. BAUER

Supervisor, Test and Measuring Equipment Engineering
RCA Victor Division, RCA

IN LAST MONTH'S DISCUSSION of our tv-receiver production test setup appeared a general review of equipment used, as well as details on the composite video-generator apparatus, sound and video i-f alignment units, low-frequency distribution system, and highlights of the head-end alignment procedure.

In the discussion of head-end alignment, it was pointed out that a thirteen-channel head-end r-f sweep was employed for the alignment of the thirteen-channel head-end tuner unit. This unit provides an r-f sweep of approximately 10-mc width for visual alignment of each of the assigned television channels. Marker signals for the picture and sound carrier points are superimposed for each channel. These markers are produced by two crystal-controlled oscillators, producing a series of appropriate harmonics. The harmonics are, in turn, mixed with a single frequency for each channel which is produced by a self-excited oscillator. Sound and picture carrier frequencies spaced 4.5 mc apart are thus produced for marker purposes.

This unit has a maximum available output of .3 volt or better into a 300-ohm line balanced to ground.

A built-in monitor detector allows the output to be observed any time. With the aid of the coarse and fine attenuator controls the output may be reduced to 1 millivolt. Sensitivity may thus be checked when calibrations are made with a standard.

Horizontal deflection voltage for the associated oscilloscope is available from the front of the panel. Blanking may be switched on when required.

Having aligned the antenna and other r-f circuits ahead of the first detector in the head-end unit of the receiver, it remains only to align the local oscillator frequencies. This is done by means of thirteen crystal-controlled frequency-modulated sound carrier signals set for ±25-kc swing. These signals originate in the central signal cage and are obtained from a high-frequency signal selector and attenuator panel near the test operator.

By this time every adjustment in the receiver has already been made and the chassis test may now be considered finished. After assembly in a cabinet the receiver may be *put on the air* and checked for overall operation.

The remainder of this article will describe how signals for two combined video and sound transmitters are generated and transmitted together with necessary f-m sound signals.

High-Frequency Distribution System

The thirteen frequency-modulated carriers at sound carrier frequencies, already mentioned, and two complete television channels with combined picture and sound carriers are transmitted over five separate coaxial lines. These are single-ended, 50-ohm lines. The signal on each line is fed to the various positions through a cascaded arrangement of high-frequency transformers. A block diagram showing the cascading series arrangement and a photograph showing a typical installation of *high-frequency distribution transformers,*[12] are shown in Figure 12. One of the six lines seen in the photo is a spare.

This transformer matches a single 50-ohm line to four 50-ohm lines or terminations in parallel, 50 to 12.5 ohms. The voltage step down is 2 to 1 per transformer. Losses at the low-frequency end are negligible while they run roughly 30 per cent at the high-frequency end. Reflection from every transformer is tested and adjusted to run below 10 per cent over

(*Continued on page 44*)

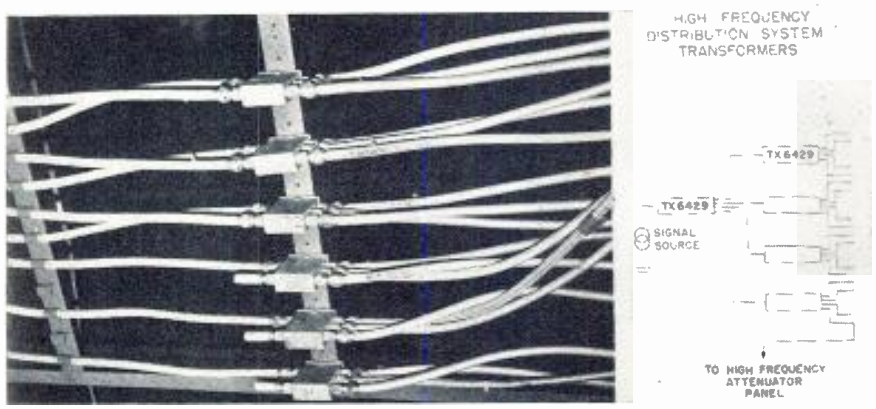

Figure 12
High-frequency distribution system transformers.

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NOW - A SIXTY-FIVE WATT

- *Hard Glass*
- *Non-Emitting Grids*
- *Instant Heating Filament*
- *Low Drive*
- *Low Voltage*
- *Low Feed-Thru Capacitance*
- *Low Cost*

$14.50

TYPE 4-65A

ELECTRICAL CHARACTERISTICS

Filament: Thoriated tungsten		
Voltage	6.0	v
Current	3.5	amp
Grid-Screen Amp. Factor (Av.)	5	
Direct Inter-Electrode Capacitances (average)		
Grid-Plate	0.08	μμf
Input	8.0	μμf
Output	2.1	μμf

TYPICAL OPERATION

Class C Telegraphy or FM Telephony
(Key Down Conditions, 1 Tube)

D-C Plate voltage	400	1000	2000	v
D-C Screen voltage	250	250	250	v
D-C Grid voltage	−40	−50	−70	v
D-C Plate current	100	125	125	ma
D-C Screen current	40	37	35	ma
D-C Grid current	13	16	16	ma
Peak R-F grid input voltage	135	155	180	v
Driving power (approx)	1.8	2.5	2.9	w
Screen dissipation	10.0	9.2	8.8	w
Plate power input	40	125	250	w
Plate dissipation	12	30	50	w
Plate power output	28	95	200	w

THE ANSWER TO THE TRANSMITTER-MAN'S PRAYER

Available now, type 4-65A is a small radiation cooled, instant heating tetrode. Devoid of internal insulating hardware, the 4-65A was designed as a transmitting tube . . . not a blown-up receiving tube. This rugged new Eimac tetrode really performs at low voltage, and its instant heating thoriated tungsten filament makes it ideally suited for mobile installations. The 4-65A operates well into the VHF, beyond the 160-Mc. band, and is capable of delivering relatively high-power with a plate voltage range from 400 to 3000 volts. As do other Eimac tetrodes, type 4-65A embodies the inherent characteristics of low grid drive, low feed-thru capacitance, and general stability of operation.

Type 4-65A's versatility of operation is demonstrated in the adjacent data showing typical operation at 400, 1000, and 2000 volts. Additional data on the 4-65A are now available, write direct.

EITEL-McCULLOUGH, Inc.
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Follow the Leaders to Eimac TUBES *The Power of R-F*

EXPORT AGENTS: FRAZAR AND HANSEN, 301 CLAY STREET
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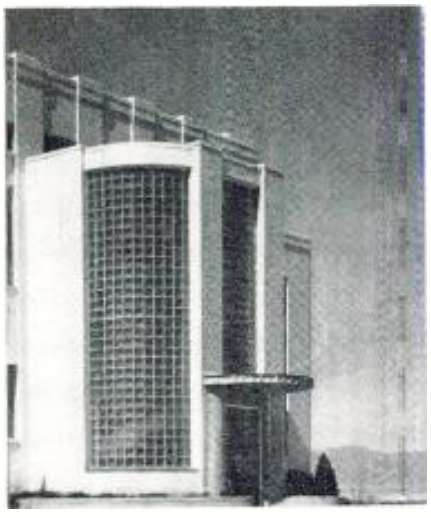
F-M and A-M BROADCAST Transmitter Buildings

Major Factors To Be Considered in Laying Out the Building and Choosing a Building Site.

The 5 kw a-m island location of WQID, Miami, Florida. This type of installation provides excellent ground conductivity.

Home of KSL 50 kw a-m transmitter at Salt Lake City, Utah



IN BUILDING A HOME for a broadcast transmitter, six factors should receive major consideration: Preliminary planning, site selection, building layout, technical accessories, building services and the style of the building.

Site Selection[1]

One of the most important of these problems is *site selection*. There is a simple, yet effective formula which can be used for site selection; signal strength and coverage versus cost of land, construction and operation.

Adequate coverage is the first necessity for the success of any broadcast station.

Factors in Site Selection

Zoning restrictions: Your municipal or county government should be visited to learn what building restrictions, if any, apply to the site.

Roadways: Will you need additional roadways? How much will they cost?

Water: Is fresh water available? Must you sink a well to unknown depth in search of water, with possible very high costs?

Sewage: What provision must be made for sewage disposal?

Power: Will primary power be easy or difficult to bring in? What about an alternate source of primary power?

Program circuits: What is necessary to bring in program circuits?

Drainage: Unless your building is specifically adapted to a marshy site, does the land drain properly with the heaviest precipitation to be expected?

Soil and foundation conditions: Are there any unusual conditions that will make construction difficult and costly? Will soil give the ground screen reasonable efficiency?

Transmission line: Are there any problems in the proposed transmission line run, such as steep grades or soft ground?

Towers: Is there a convenient location for the erection of your antenna towers? The Civil Aeronautics Authority must be checked for any restrictions on antenna height at the site being considered.

Accessibility: Will the site have unusual construction and operation costs because of inaccessibility?

Amount of Land Needed

F-M stations will fit on a small tract of land because they do not require acreage for an antenna ground system. Little more than the building plot, with parking area and appropriate landscaping, will accommodate the majority of f-m stations, provided the antenna tower can be erected on or near the building. However, it must be remembered that it is desirable to exercise control over property in the immediate vicinity of the tower to avoid the possibility of future erection of a tall structure which might adversely affect the propagation of your f-m signal.

A-M stations must have land for the antenna grounding area: one to five acres for non-directional antennas, forty or fifty acres for directional arrays involving two or more towers. The tract of ground should be large enough for an array even though your single radiator may require only a part of the total.

Marshy and Over-Water Sites

Marshy or over-water sites give increased radiation efficiency for a-m

[1] *From a survey and study of broadcast transmitter building design and construction by the* "Western Electric Oscillator." *Collaborating in the program were Royal V. Howard, NAB director of engineering; A. B. Chamberlain, CBS chief engineer; J. I. Middlebrooks, ABC chief facilities engineer, and J. R. Poppele, vice president and chief engineer of WOR.*

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stations, but generally make the building more expensive.

The improved radiation characteristics of an a-m installation on marshy ground or over water are attractive, but competent estimates of the cost of construction should be on hand before you can be sure that such a site will *pay off*. Building on marshy ground often involves very expensive underpinning. Building over water will also require special construction methods.

The ideal site is one on which the transmitter building can be put up on a waterfront plot by conventional methods, with a short transmission run to the tower system in an adjoining sheltered body of water.

Mid-City Buildings As Transmitter Sites

The excellent coverage and operating convenience of f-m installations in tall city buildings must be weighed against several factors:

Are there any zoning restrictions or building ordinances against installation of the transmitter in the building, or the antenna on top of it?

Will the building support the antenna? Will the transmitter overload the floor at the chosen location? A preliminary study by competent engineers on these points is good insurance against unforeseen expense. Structural alterations on modern skyscrapers can be very expensive.

Can you get the transmission line to the roof without interference with other tenants? A top-floor installation makes this easy but is not always available.

Is the power cabling to the transmitter floor large enough? Will there be large variations in the power consumed by other tenants, causing irregular supply voltage? A separate power run to the top floor of a tall building is another expensive item.

What about building services such as heat and elevator service during your after-midnight operation?

Transmitters on Mountain Tops

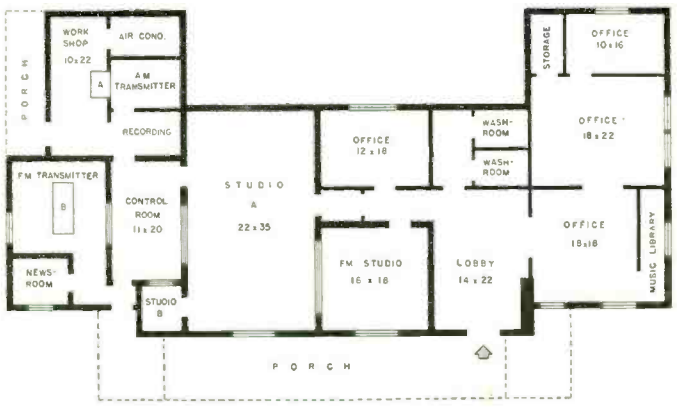
F-m and television are "going to the mountains" for antenna height. Obviously a mountain top is in general a very inaccessible site. Its usual advantage, besides coverage, is low land cost. There are quite a few items which offset these advantages.

Water, roadways, power and program lines are often difficult and expensive to bring in.

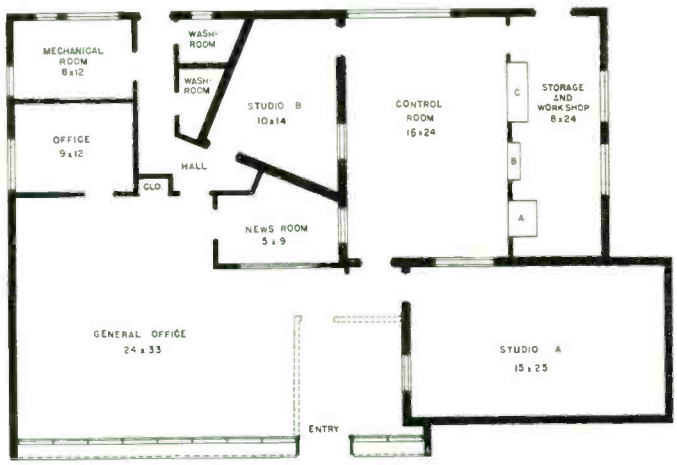
The building will cost more, because of the distance both labor and materials must travel.

Severe weather conditions may require special weatherproofing. A study must

(*Continued on page 36*)

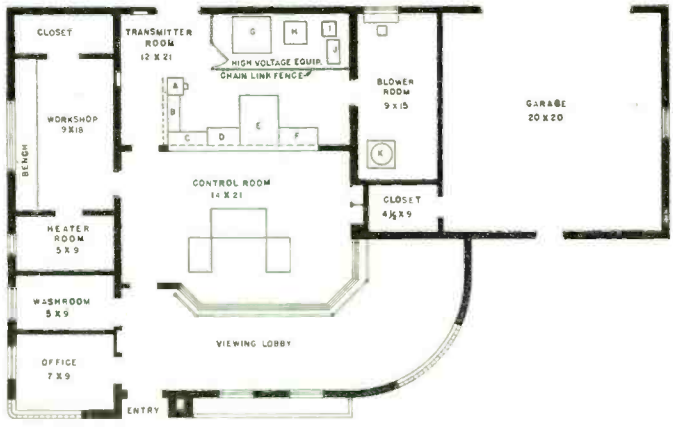


Floor layout for 250 watt a-m (*A*) and 3 kw f-m (*B*) transmitter at KGBS, Harlingen, Texas. W. O. Porter is chief engineer at this station.



Layout for 1 kw a-m (*A*) and 1 kw f-m (*C*) system. In *B* of this layout we have the rooms for audio and test equipment. This is a setup used at KSJO, San Jose, Calif., where John G. Bauriedel is engineering director and Larry King is chief engineer.

The floor plan for the 5 kw a-m station of KTAR, Phoenix, Arizona. At *A* is the automatic voltage regulator; *B*, power distribution cabinet; *C*, control unit; *D*, oscillator amplifier; *E*, power amplifier; *F*, antenna control equipment; *G*, rectifier; *H*, high-voltage transformer; *I*, retardation coil; *J*, filter capacitor and *K*, water storage tank. Arthur C. Anderson is chief engineer of this station.



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V-H-F AIRBORNE Communications System

by S. A. MEACHAM
Wilcox Electric Company, Inc.

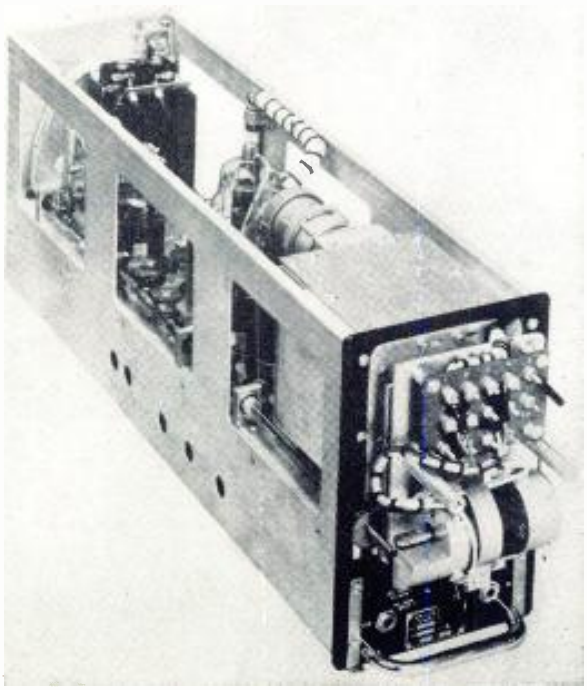
Setup for 118 to 132-mc Band Includes Transmitter, Receiver, Power Supply, Equipment Mount and Frequency-Selector Switching Unit. Transmitter Uses One Oscillator and Three Multiplier Stages to Drive 829B Final Amplifier to 50-Watts Output. Seventy-Channel Coverage Provided by Crystal-Switching Arrangement in Both Receiver and Transmitter.

BETWEEN 1925 AND 1930, the airline industry began, on a reasonably large scale, to equip their planes with radio equipment. This was, of course, a natural turn of events since it was, and is, the only known way location of aircraft in flight can be determined. At first these installations consisted of 10- to 25-watt transmitters, with higher power equipment on the ground. For a long time c-w was used since it simplified the transmitter construction and allowed longer distance transmission for a given power output. As the complexity and speed of aircraft increased it became apparent that each individual operation performed by the pilot must be simplified as much as was practicable. Obviously voice modulation was the next step and was accomplished over a rather short development period.

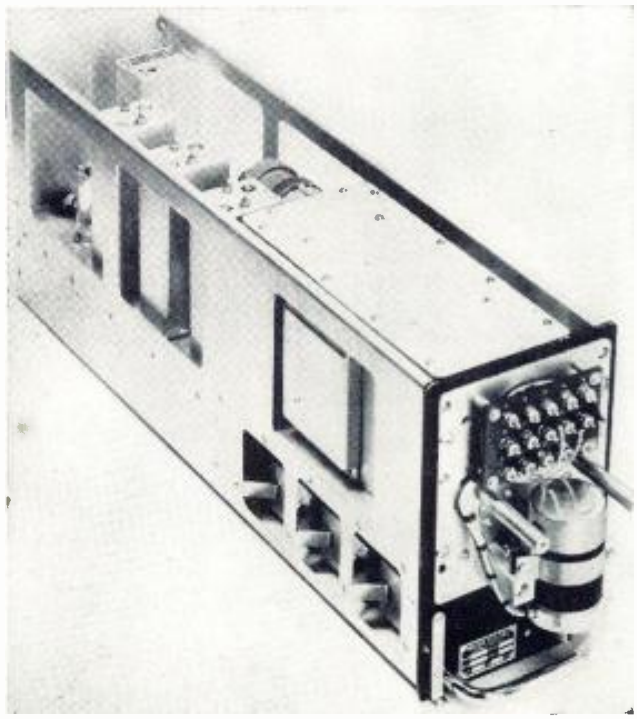
At this point of development all the basic fundamentals of an aircraft communications system had been incorporated in its design. The state of the art limited the refinements possible and the original units, by present-day standards, would be considered very crude. To repeat, however, all the basic fundamentals of an aircraft communications system had been incorporated.

All frequencies were within the 2- to 20-mc range. Evolution took the single frequency, large size and heavy

The transmitter. Note the switching arrangement for crystal control on the front panel.



The receiver.



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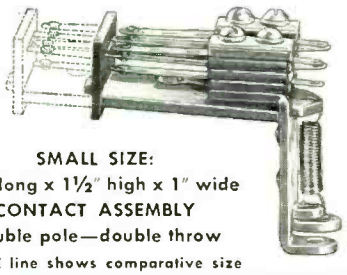
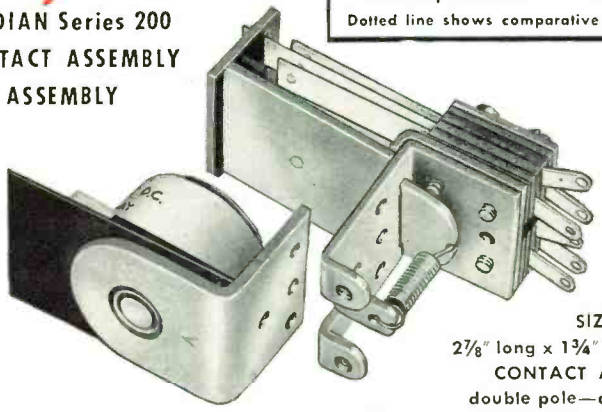
a new MIDGET
CONTACT ASSEMBLY
Interchangeable
with the GUARDIAN Series 200
STANDARD CONTACT ASSEMBLY
AND COIL ASSEMBLY

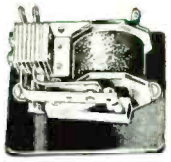


SMALL SIZE:
1⅝" long x 1½" high x 1" wide
CONTACT ASSEMBLY
double pole—double throw
Dotted line shows comparative size



SIZE
2⅞" long x 1¾" high x 1" wide
CONTACT ASSEMBLY
double pole—double throw

Popular RADIO RELAYS in the GUARDIAN line:

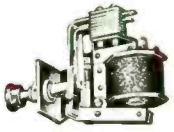


K-100 Keying Relay For low voltage control of high voltage transmission. Guardian Series K-100 Relay will follow key or bug at highest WPM rate attainable. High speed response, strong magnet and return spring give clean make and break, produce best CW note. Coils: 5 to 16 v., A.C.; coils for other voltages on specifications.

B-100 Break-in Relay For break-in operation on amateur transmitters. The Guardian B-100 Relay has laminated field piece and armature. Fine ¼" silver DPDT contacts, capacity to 1500 watts, 60 c., non-inductive A.C., and in A.C. primary circuit of any inductive power supply delivering up to 1 KW, inclusively.

T-100 Time Delay Relay In radio transmitter circuits, Guardian's T-100 Time Delay Relay prevents damage of rectifiers and tube filaments by preventing plate current before filaments are sufficiently heated. Laminated field piece and armature. Mounted in dust-proof metal box.

L-250 Overload Relay Provides accurate, fixed overload protection against current surges and continuous overloads. Guardian's L-250 Relay replaces expensive, time-wasting fuses. Attracts armature on 250 mils. Max. drop across coil—10 v. Guardian's L-500 Relay attracts armature at 500 mils. Max. drop across coil—5 volts. Ideal for experimenters on new circuits.



A-100 Antenna Relay A low loss AlSiMag insuloted relay. For single wire fed installations specify the A-100-C, SPDT unit. Two A-100-C in place of one A-100 in open wire line systems will avoid possible impedance mismatch. A very popular relay with radio amateurs.

SEE THESE AND OTHER GUARDIAN RELAYS AT YOUR JOBBER — OR WRITE FOR BULLETIN R-6.

Ask your jobber for the new midget contact switch assembly which is interchangeable with the Guardian Series 200 coil assembly. Your jobber carries a complete line of Guardian radio relays.

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1610-L W. WALNUT STREET CHICAGO 12, ILLINOIS

A COMPLETE LINE OF RELAYS SERVING AMERICAN INDUSTRY

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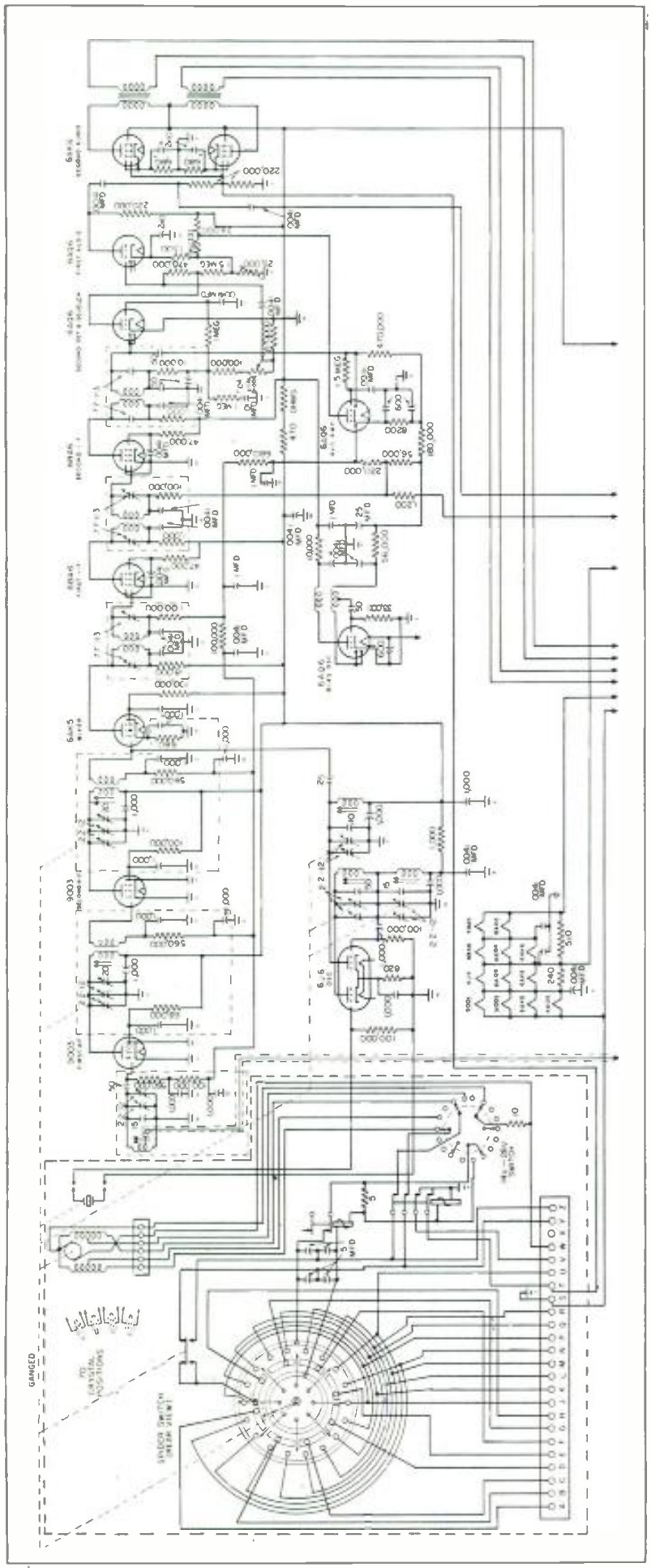

Schematic of the receiver.

units to smaller sizes, higher power, multiple frequencies and much more efficient operation. Initially transmitters, receivers and sometimes even the power supplies were large separate units. As the state of the art improved and the industry demanded these were condensed into a single compact cabinet housing a complete two-way communications system which required only primary voltage input, control wire, and an antenna externally located.

These communications equipment developments were very rapid and an integral part of the extremely fast airline-industry enlargement program. The airline communication engineers began to realize, as early as 1938 and 1939, that they were rapidly reaching the saturation point in the number of messages that could be transmitted over the comparatively limited number of frequencies available.

Ground Stations

To insure reliable communications high-power transmitters had been installed in ground stations. The reliability was obtained, but an undesirable result also was realized. If a ground station in New York sent a message to an aircraft only 75 or 100 miles west of New York, the frequency was then saturated as far west as Chicago or Kansas City. Any message in Kansas City, Chicago or stations east would have to wait until New York was through. The obvious answer would be to find a method of retaining the desired reliability and still allow many stations to communicate with ships in their vicinity on the same frequency and without interference.

No solution was found in the medium high frequency portion of the spectrum. Some experimental work was done in the v-h-f range above 100 mc and the results seemed to be more than satisfactory. Much experimental work was carried on by the airlines, government agencies and manufacturers. Just as the initial test work began the war broke out and forced the airlines to do their job with the available facilities. Early in the war, the military services drew not only on the wealth of knowledge gained from their own v-h-f experimental work, but on that recorded by the various aeronautical groups.

Operational tests, initiated in 1940 and 1941, but never completed, were made possible under more complex conditions and on a considerably larger scale by the military services throughout the war. Almost all the problems

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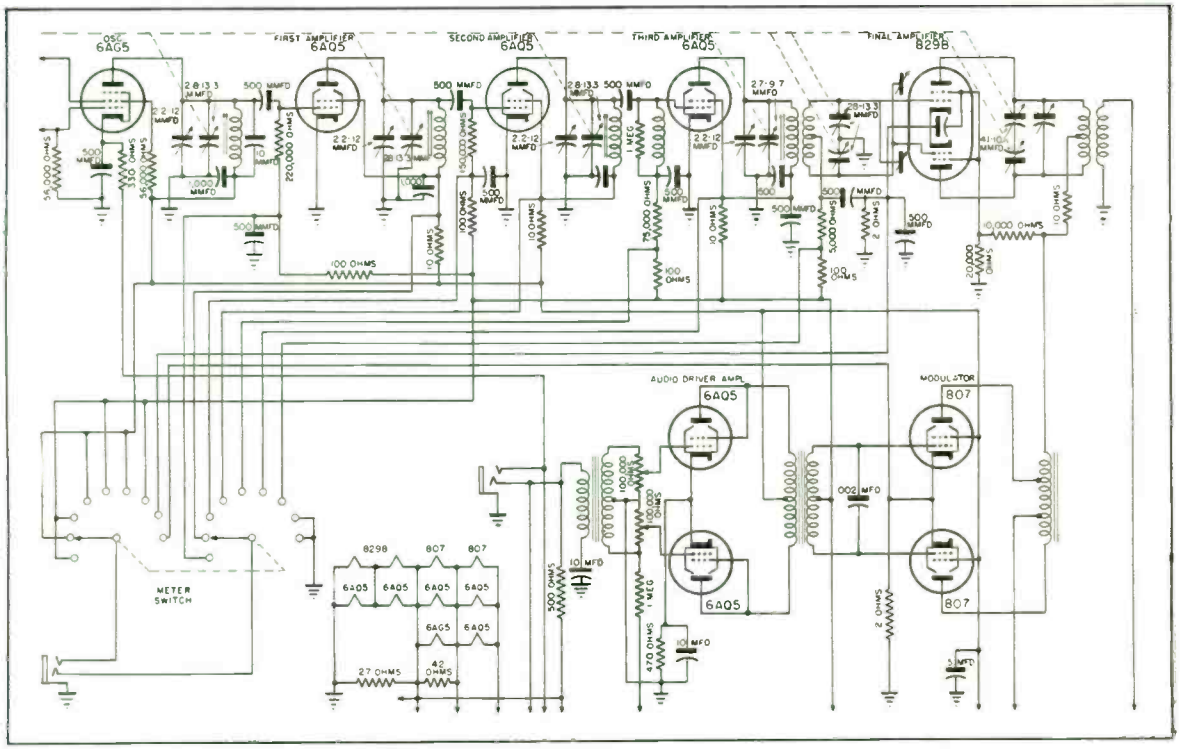

Schematic of the v-h-f transmitter. Crystal switching unit similar to that shown on the receiver diagram is used in this transmitter.

encountered by the airlines were solved by use of v-h-f, with one additional advantage. Atmospheric and other types of undesirable noise was almost completely eliminated, allowing reliable communications during periods that had previously almost completely prevented communications.

At the end of the war, in 1945, the airline communications engineers resumed their active pursuit of the installation of v-h-f systems. Two obstacles were directly in their path. The first was definite frequency allocation. FCC solved this quite quickly. The second problem was equipment that would meet all the requirements shown necessary by wartime and civil aircraft operational tests.

In the final frequency allocations aeronautical services were grouped in the 108- to 132-mc range, with navigational aids and instrument landing systems occupying the lower end of this band, from 108 mc to 118 mc. The various communications requirements received the balance of the allocation from 118 to 132 mc.

We undertook the elimination of the second obstacle and developed a two-way v-h-f airborne communications system.[1]

Many problems were considered. Standard considerations of a general nature were first specified. Since aeronautical communications systems always approach and sometimes actually are emergency facilities, reliability is of prime importance. Components were all selected with two major prerequisites; they must be of high quality by reputation and experience, and they must be operated below their maximum operating level as recommended by the manufacturer. Accessibility of components was another important factor to be considered. We applied a general *rule of thumb* principle which allows ten minutes to remove any component and insists that no component shall cover a second requiring removal of the first component to gain access to the second.

There are five items in our v-h-f airborne communications system: transmitter, receiver, power supply, equipment mount, and frequency selector switch.

Transmitter

The transmitter[2] is self-contained, except for its power supply, and is housed in a cabinet which complies with joint Army-Navy Specification Jan-C-172. Standard circuits are employed throughout the equipment.

Various crystal-saver circuits were tried experimentally and in each case discarded since they required more tubes than a straight-forward oscillator. Since a mechanical switching unit would be required under any circumstances it was decided to slightly increase its complexity and thereby reduce the number of tubes necessary.

In the finished equipment one oscillator stage and three multiplier stages are used to drive an 829B final amplifier to 50 watts output over the range of 118 to 132 mc. Two push-pull stages are in the audio system. When using any of the standard carbon microphones, adequate output power is realized to fully modulate a 50-watt carrier.

Frequency changing is accomplished by means of a separate unit. This unit is so mounted that it becomes an integral part of the transmitter but is easily dismounted for maintenance and inspection. After an extensive survey to determine how many frequencies should be available within this unit it was found that seventy channels would be ample to satisfy all current needs and allow room for predicted expansion that would occur within the next five or six years. A crystal is used for each frequency. The small, hermeti-

(*Continued on page 36*)

[1] Type 361A.

[2] Type 319A.

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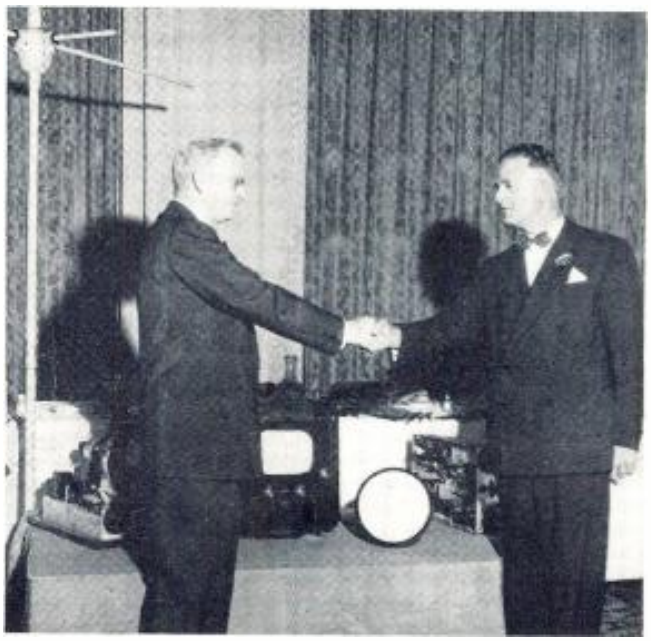
VETERAN WIRELESS OPERATORS ASSOCIATION NEWS

W. J. McGONIGLE, President RCA BUILDING, 30 Rockefeller Plaza, New York, N. Y. GEORGE H. CLARK, Secretary

VWOA LIFE MEMBER E. A. Nicholas president of Farnsworth Television and Radio Corp., offered quite an effective analysis of the future of television recently during a new tv-model dealer-distributor meeting at the Hotel Astor in N. Y. City. He said:

"I have been in this television business a long time. I have been a television booster practically as long as there has been all-electronic television—a matter of some twenty years. For a considerable part of that time I have been one of the individuals seeing it just around the corner. Until this year, I must confess that my enthusiasm has been what we might call premature. But this much is certain: I had rather be seeing commercial television just around the corner and doing something to get it there than continually be saying it is impossible and doing nothing about it. Television has turned that corner."



VWOA life member E. A. Nicholas, president of Farnsworth Television and Radio Corp., and VWOA life member J. R. Poppele, vice president and chief engineer of WOR and president of TBA, at a recent meeting in the Hotel Astor in New York, during which the new Farnsworth television receivers were introduced.

Commenting on the advantages of moderately-priced sets, EAN stated that to the television broadcaster the lower-priced set was important because it means more circulation, widening distribution of receivers in more and more homes and public places.

"The economic progress of the broadcaster depends in large part upon this circulation," he said. "Broadcaster progress means more and better programs, and this in turn, of course, stimulates still wider public interest in television—and television receivers.

"Obviously television is not a *vicious circle* as some would have us believe. As a matter of fact, it is just the opposite. It is a *chain reaction of progress*, with each part of the industry complementing each other toward an assured and rapid expansion into a great new national service.

"Telecasters in New York, Philadelphia, and other parts of the country, have shown real courage and confidence. So, too, have the farsighted companies sponsoring commercial programs. They have moved ahead in the telecasting of programs, with true pioneer spirit, and with the firm belief that the public demand for receivers would be met as rapidly as manufacturers could efficiently do so. And they are *not* going to be disappointed.

"We who have pioneered in the production of equipment have faced our problems of heavy costs and investments, too. But we have shared their faith, and the historic results are now clearly in evidence. The accelerating advance brought about by the faith of the true television pioneers is shown in these facts:

"There are now *80* regular sponsors of television programs. This is an increase of *70%* over the number in only March of this year. And the list is mounting daily.

"Eleven commercial stations are on the air, and a number of others are within a few months of going on the air.

"Construction permits for 56 stations have been granted by the FCC."

EAN reported that there'll soon be around 100,000 sets in operation.

"Assuming, conservatively, that five persons view programs over each home receiver, and this does not include the large audiences in public places," he said, "it is obvious that the viewing audience will total *at least a million persons by the end of this year.* With that viewing audience of one million, television will have gone a long way toward attaining its economic maturity.

"All this, in effect, is a mere start. To all practical intents, the curtain is just now being raised on the commercial debut of the television industry.

"Technically, television has truly and fully arrived. Economically and artistically, the age of television is firmly under way. With good home receivers at prices millions can afford now beginning to reach the public in quantity, the final impetus needed to assure television's economic success has been given. This is the final and indisputable answer to critics who have said it could not be done.

"Television is on the right path. It needs no artificial schemes to make it click. It needs no subsidies that are now a part of the tradition of broadcasting as established by radio. It needs only to continue to grow as it is growing. It needs only more receivers in more homes and more telecasters in more cities, and that is exactly what it is getting.

"No other new or potential industry

(*Continued on page* 43)

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NEW

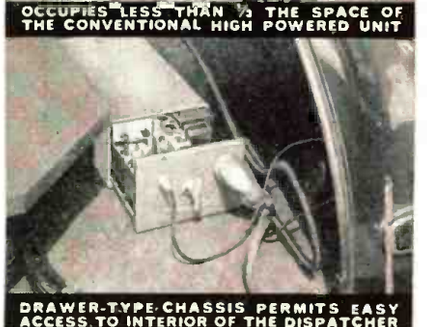
LOW COST—NOISE FREE
2-WAY RADIOTELEPHONE FOR URBAN AREAS

Motorola FM DISPATCHER

WITH P.S. "PRECISION" SELECTIVITY

$397.50 COMPLETE *plus tax*


OCCUPIES LESS THAN ⅓ THE SPACE OF THE CONVENTIONAL HIGH POWERED UNIT


DRAWER-TYPE CHASSIS PERMITS EASY ACCESS TO INTERIOR OF THE DISPATCHER

The DISPATCHER-Another FIRST for Motorola

The Motorola DISPATCHER is a compact, single-unit mobile radiotelephone transmitter and receiver specifically designed for use in noisy urban areas. Easy to install and maintain, with exceptionally low battery drain and highest sensitivity, the Motorola DISPATCHER is the FIRST radiotelephone unit especially and effectively designed for urban communications. The DISPATCHER comes to you as a tried and proved communications tool—after two years of design and field performance testing. It's a Motorola masterpiece!

P. S. . . . "Precision" Selectivity

Now your conversations can be conducted without interference from other radiotelephones, ignition noise, sparking trolley contacts or any other electrical noises radiated in urban areas. P.S. does it—"PRECISION" SELECTIVITY—the sensational Motorola development that gives you the absolute maximum of protection against off-channel interference of *all types*.

GET THE COMPLETE STORY

WRITE for illustrated, descriptive brochure giving you all the many features and specifications of the new Motorola DISPATCHER—WRITE TODAY.

The Motorola FM HANDIE-TALKIE IS HERE!

Now you can have instant, constant communications wherever a man can go. Smaller than a brief case, easily carried in the hand, the Motorola FM HANDIE TALKIE is the eagerly awaited answer to hundreds of communications problems. *Send for descriptive booklet.*

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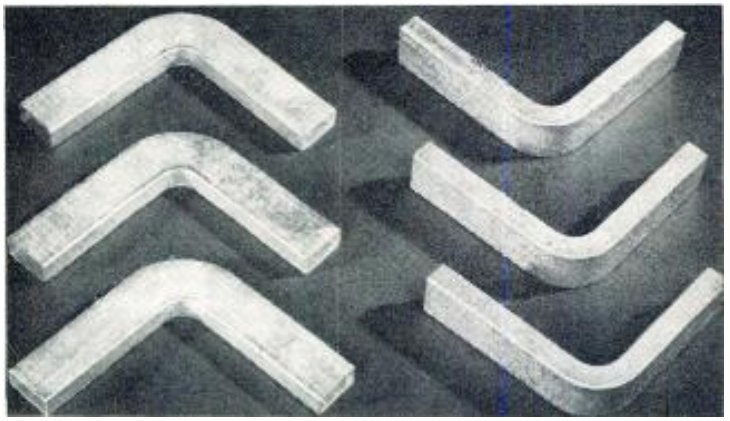

Figure 1
Rectangular aluminum waveguide tubes. 1" x ½" x .05".

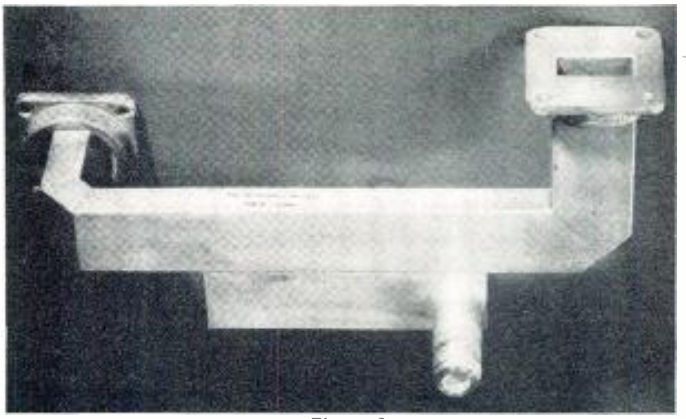

Figure 2
Aluminum waveguides brazed with Alcoa brazing rod (#716) and flux (#33). Note the clean and neat fillets which can be obtained with this method of brazing.

ALUMINUM WAVEGUIDES

For Lightweight Communications Equipment

Lightweight Waveguides For Aeronautical, Mobile and Personal Applications Employ New Techniques in Bending, Brazing and Plating.

by ROBERT SHERMAN

Project Engineer
De Mornay-Budd, Inc.

THE POSTWAR FREQUENCY ALLOCATIONS of the FCC, allocating all frequencies up to 30,000 megacycles and beyond, authorize extensive or unlimited use for practically all forms of radio communications such as governmental, commercial or private fixed and mobile applications. The most interesting are the mobile and relay services whose expansion and potentialities depend on the utilization of additional spectrum only existent in the microwave region.

The use of microwaves immediately involves new concepts. These concepts are necessitated by the following circumstances:

(*a*) — Inductive reactance rises to infinite values as the frequency is increased to reach the microwave spectrum.

(*b*) — Capacitive reactance declines to infinitesimal values as the frequency is increased to reach the microwave spectrum.

(*c*)—Physical dimensions decline to the point that small spacings or separations between conductors or conducting surfaces become appreciable, with respect to the wavelength, to behave like free space for microwave energy.

The most marked of these new concepts is the utilization of waveguides for the transmission of radio energy. With minor modifications, waveguides may also be used for the control, measurement, transformation, isolation, coupling, tuning and propagation of microwave energy. This becomes physically as well as electrically feasible when the frequencies exceed 2,000 megacycles or the wavelengths are shorter than 15 centimeters.

A waveguide is the equivalent of a coaxial cable with the central conductor and supporting internal insulation spacing removed so that only a hollow pipe remains. In practice, waveguides are hollow pipes, normally rectangular or cylindrical. They are fabricated out of material having surfaces (either natural or plated) with good electrical conductivity.

These waveguides become increasingly necessary and finally indispensable for the transmission and propagation of r-f energy as the wavelength dimension is reduced to inches or even a fraction of an inch. This is particularly true when the lateral distance from the central conductor to the inner sheath of a coaxial cable approaches a dimension appreciable with respect to a quarter wavelength. At that limit, a coaxial cable becomes either impossible or unpredictable in actual practice. The energy then tries in whole or in part to follow lateral or semi-lateral paths, as if the central conductor were the earth and the conducting inner sheath wall of the coaxial cable were an ionspheric reflecting layer.

A waveguide on microwaves is an artificial and correctly dimensioned substitute for the earth and the ionosphere. It can be a conveniently small diameter pipe because it is being used with an extremely short wavelength. The two opposite wider wall dimensions (called *a* dimension) simulate the ionosphere and the earth. Microwave energy travels longitudinally down the waveguide by reflections between those two walls exactly like lower frequency (sky wave) energy travels between the earth and the Kennelly-Heaviside layer. The two narrower wall dimensions (called *b* dimension) need only be there to posi-

(*Continued on page* 30)

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TRANSMITTING AND SPECIAL PURPOSE

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AT PRICES THAT SEEM UNBELIEVABLE!

Check this list of Transmitting and Special Purpose Tubes! Then check our prices! Never before — and perhaps NEVER AGAIN — will you have such an opportunity to get exactly what you need at such prices. Every tube BRAND NEW — IN ORIGINAL FACTORY PACKAGES AS PURCHASED BY THE U.S. GOVERNMENT. Manufactured by WESTINGHOUSE, WESTERN ELECTRIC, GENERAL ELECTRIC, R.C.A., EIMAC, H. & K., others equally reliable. We repeat

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2AP1	$ 1.95 ea.
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2J32	$15.95 ea.
2J38	$15.95 ea.
2J48	$15.95 ea.
3CP1	$ 1.95 ea.
4J26	$15.95 ea.
5AP1	$ 2.95 ea.
5D21	$ 9.95 ea.
5JP2	$ 3.95 ea.
5J23	$15.95 ea.
5J29	$15.95 ea.
6J6	$ .49 ea.

24G ..... **$ .69 ea.**
Type H.F. Triode; Max. power output 90W. Max. operating freq. 300 M.C. A rare bargain.

V.T.25A (10 spec.)	$ .69 ea.
V.T.52 (45 spec.)	$ .69 ea.
V.T.158A	$ 4.90 ea.
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371A	$ 1.47 ea.
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715B	$ 3.95 ea.
723A-B	$ 2.95 ea.
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726A	$ 4.75 ea.
803	$ 4.90 ea.
804	$ 3.75 ea.

832A ..... **$ 1.47 ea.**
Type Push-Pull R.F. Beam Power Amplifier. Max. Power Output 26W.

841 ..... $ .69 ea.

WL869B ..... **$29.95 ea.**
Mercury Vapor Rectifier. Inverse Peak Volts, 20,000. Peak Amps, 10.

954	$ .49 ea.
1616	$ 1.47 ea.
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JAMES MILLEN MFG. CO., INC.

MAIN OFFICE AND FACTORY
MALDEN
MASSACHUSETTS

Waveguides

(*Continued from page 28*)

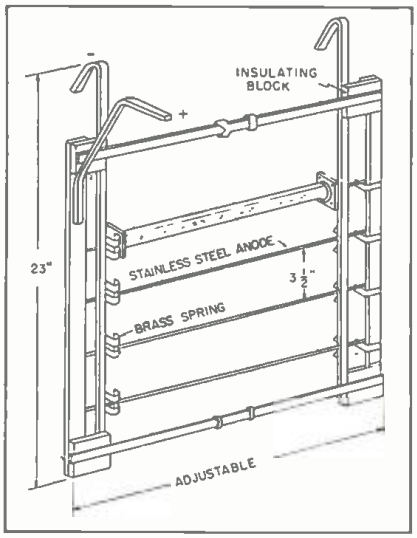
tion the *a* dimension surfaces and uniformly as well as correctly, support it in place. The *b* dimension walls are attached to the *a* dimension walls at points of zero electric field. The method of introducing the energy into a waveguide together with the shape and dimension of the waveguide, in addition to the operating frequency or wavelength, are very important in determining the distribution of the electric and magnetic fields which will exist when microwave energy is present in the waveguide.

The material used most commonly today for waveguides is cold drawn rectangular brass tubing. A red brass alloy of approximately 90% copper and 10% zinc is preferred for reasons of strength and corrosion resistance. It has been found suitable to use brass because of its good machinability, ease of fabrication, mechanical strength and ease of electro-plating.

It now appears that an urgent need exists for lightweight communication equipment for aeronautical, mobile and personalized applications. Our thoughts immediately turn to aluminum, magnesium and plastics as the possible materials. This is so because of the obvious difference in weight as well as an eventual reduction in cost. The foregoing materials have been considered and the following conclusions have been reached.

Aluminum tubing has been suggested for use as waveguides because its weight is less than ⅓ that of the corresponding brass tubing. Pure aluminum weighs only .098 pound per cubic inch, has a specific gravity of 2.71 as compared with 8.8 for copper, and its electrical resistivity at 20° C equals 2.688 microhms per cubic centimeter. It has a high electrical conductivity. This property is lowered by the addition of other metals. Practically pure aluminum (2S) has a volume conductivity in excess of 64% of the international annealed copper standard, but because of its low specific gravity, the mass conductivity is even higher; 2S was found to be the grade aluminum best suited to waveguide use because of its electrical conductivity, machinability, bendability, brazing characteristics and ease of plating.

Figure 3
Adjustable plating rack which makes use of a center anode of stainless steel and can be used to obtain satisfactory interior plating of straight waveguide sections.



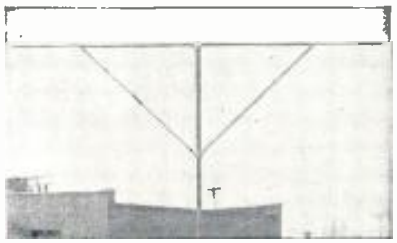
Machining

Satisfactory results in machining aluminum and its alloys may be obtained by using tools ordinarily used for steel, provided they are sharp and in good condition. Aluminum and most of its alloys have familiar machining characteristics.

Bending

2S aluminum rectangular tubing 1" x ½" x .05" can be satisfactorily

PREMAX



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bent at ½" radius using the mandrel method of bending. Good bends can be obtained on both the flat side and edge of the tube; Figure 1. This method consists of inserting flexible steel strips inside the tube before bending.

Brazing

Brazing is considered the best method of joining aluminum because of the neat joints obtained and minimum finishing requirements. Again, parts which are too thin to be welded may be satisfactorily brazed. The brazing method best suited to wave-guide use is the torch method. In this method the heat is applied locally to the joint with a welding torch. Oxy-hydrogen, oxyacetylene, or oxynatural gas flames can be used. It is advisable to use one of the first two gases as they produce smoother and cleaner joints and are faster than the third gas. The thickness of the parts determine the choice of torch tip. This can easily be determined by trial. It has been found that best results can be obtained with a reducing flame. In our work[1] we have used an oxyacetylene flame and a No. 3 torch tip. For best results, the aluminum parts to be brazed must be absolutely clean, free of all dirt, grit, grease, oil film, etc. The brazing filler alloy must have a sufficiently low melting temperature to provide a practicable range at which brazing can be done. Specifically recommended is Alcoa No. 716 brazing rod, ⅛" thick. The brazing flux used is of great importance. It is used as a guide to produce a flow of filler metal. Recommended is Alcoa brazing flux No. 33, a low melting point flux (1,100° F or below). It is the most active chemically and produces maximum flow of filler metal. Figure 2 shows the many clean and neat fillets which can be obtained by following the proper brazing procedure.

Plating

The electrical properties of a wave-guide may be considerably improved by the type of finish applied. It has been found, at microwave frequencies, that if one metal is plated on another to a depth of 1,000 of an inch, all of the current will flow in the plated surface. It then follows that the guide

(Continued on page 34)

[1] Data appears in booklet prepared for Signal Corps.

MODEL P-52HF

TRU SONIC

Separate 2-Way Speaker System

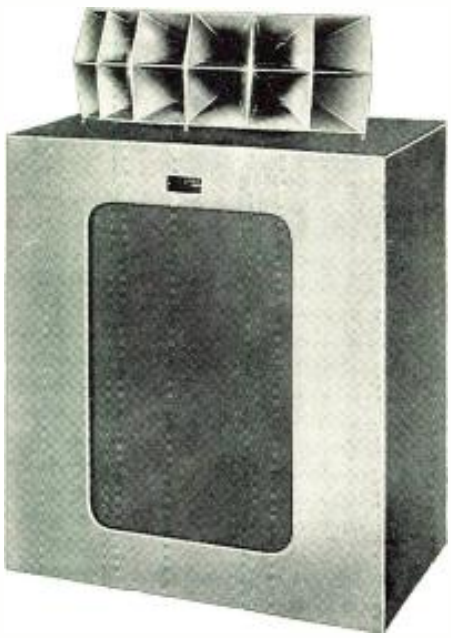
Required FOR FM

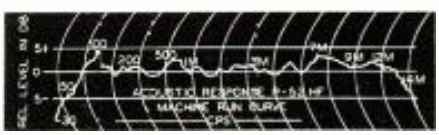
BROADCAST MONITORING

Illustrated on the right is the complete fulfillment of the broadcasters requirements for adequate monitoring of the extended range FM signal. Features of the P-52HF Tru-Sonic separate 2-way speaker system include low 800 cycle crossover to relieve the low frequency driver cone of high frequencies—6 cubic foot phase-inverted reflex cabinet for adequate bass support—120°x 40° high frequency dispersing horns—over 6 pounds of Alnico 5 magnet for high flux density in the gaps—efficiency over 50%—high frequency attenuation control to balance room acoustics—least inter-modulation, and fewest transients of any comparable speaker.

Shown in the Model 52U utility cabinet. Available also in exquisite furniture of period design in either bleached blond or mahogany, with components totally enclosed.

Model P-52HF with 2x6 horn, as shown, *$345.00 list.* With 2x5 horn, *$332.50 list.* With 2x4 horn, *$320.00 list.*



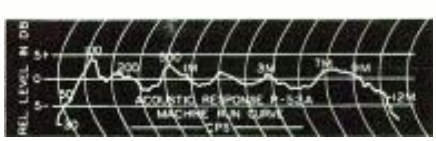


P-52A Coaxial 2-Way System

For Home Reception

The Model P-52A Coaxial 2-way speaker system embodies the same fine engineering and construction exemplified in the P-52HF Separate 2-way system shown above, *plus* the added feature of space saving design. 1200 cycle crossover — 80°x 40° dispersion through 8 cellular horns—heavy, 6 pound Alnico 5 magnet for high flux density—16 ohm, 20 watt input—15" cone diameter. Price *$205.00 list.*

Normal trade discounts prevail. Write for 16 page bulletin describing Tru-Sonic speaker systems.



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The Industry Offers

RCA DUO-CONE MONITOR SPEAKER

A 20-watt duo-cone monitor loudspeaker, type LC-1A, has been developed by Dr. H. F. Olson of the RCA Laboratories. Its range is said to be 30 cycles to 15,000 cycles.

Speaker consists of a 15" p-m type mechanism. Cones are of the direct radiator type and consist of high and low frequency units mounted together coaxially and sharing the same axis and cone periphery angle.

High-frequency unit is a 2" cone with an aluminum wire-wound voice coil.

Low-frequency cone employs a 15" diaphragm with a high-mass voice coil to produce low-distortion factor, a wide angle (120° at 15,000 cycles), and a low fundamental resonant frequency, which is said to be approximately 35 cycles. Above this frequency the reluctance, due to the mechanical compliance of the cone suspension system, does not appreciably retard the movement of the cone.

The speaker cabinet has an open bass reflex port. For a low-frequency response, the port may be closed by a manual control.

Has control panel with volume control, compensator and channel selector. Channel selector switch may be employed to connect the speaker to any one of 10 high-level audio busses. When this method of bridging is desired, a 15-ohm power attenuator can be used and mounted on the control panel.

• • •

G.E. TV PROGRAM CONSOLE

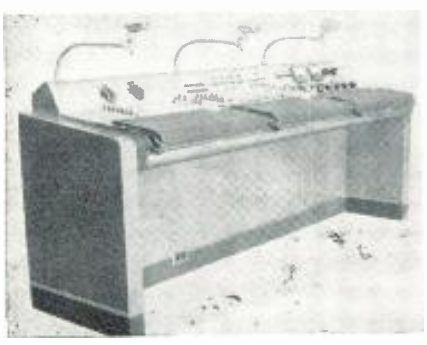
A desk-like television program console, TC-6-A, has been developed by the transmitter division of the G. E. electronics department.

Console, divided into three sections for the program director, video operator and audio operator, is designed for use in the control room where, with the aid of a camera control desk, any channel may be selected for the program line.

Visual portion of unit provides switching, mixing, fading of any of six channels; interlocking lever operation for lap-dissolves; switches to bypass camera channels to line; signal lights to indicate conditions in all channels; and film projector controls.

In the program audio section of the console are five mixer positions; two program busses with master gain controls and vu meters; monitor speaker control; cue amplifier (to talk-back system) control; and studio-speaker control.

Tube complement: Three 6AC7s; one 6SN7; one 6AG7; one 6H6, and one OD3/VR150.



G-R CAPACITANCE BRIDGE

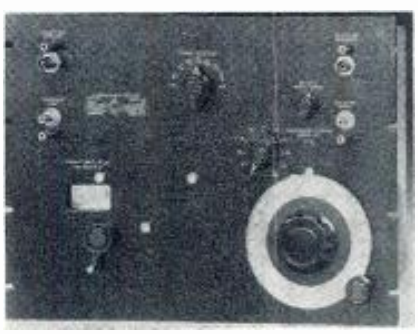
A capacitance bridge, type 716C, to measure capacitance and dissipation at all frequencies between 30 cycles and 300 kc, has been developed by the General Radio Company, 275 Massachusetts Avenue, Cambridge 39, Mass.

Instrument's uses include measurement of dielectric constant and dissipation factor of dielectric materials as a function of frequency. The frequency range covered is said to be sufficient to show the effects of interfacial polarization at low a-f and of dipole dipolarization in polymers. The effect of surface water films on insulators can be measured, as can the Boella effect in resistors.

Circuit is a conventional Schering bridge, using a G-R precision capacitor as the standard capacitance. A newly designed shielded input transformer with polystyrene tape insulation makes possible the extended upper frequency limit of operation.

The direct-reading capacitance range is 100 mmfd to 1 mfd at 1,000 cycles and 100 to 1,100 mmfd at other frequencies. Using the substitution method of measurement, the range is from 0.1 to 1,000 mmfd. Dissipation factor range is from 0.00002 to 0.56.

Accuracy is ±0.2% for capacitance; ±2.0% for dissipation factor.



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RAYTHEON PORTABLE CONSOLETTE

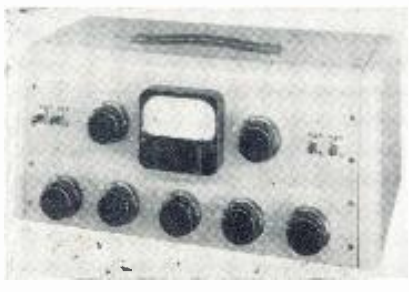
A portable consolette, type RPC-40, with four input channels, for microphone or turntable, which feed into four individual pre-amplifiers and terminate in one mixer has been announced by Raytheon Manufacturing Co., Waltham 54, Mass. Output stage can be switched into either of two output lines.

Selective headset monitoring of either output line is obtained by switching. A terminal is bridged across the output of the final stage for connection of a monitor amplifier for loudspeaker output, and a telephone handset may be switched into either line for cues or other communication.

Input impedance: 600, 250, or 50 ohms, by changing transformer taps. Output impedance: 600 or 150 ohms, selected by a switch.

Output level, +25 vu maximum; bridge output level, 30 db below output level. Frequency response, down 1.5 db at 30 and 15,000 cycles (1,000-cycle reference). Distortion, less than 1% from 100 to 15,000 cycles; less than 1.5% from 30 to 100 cycles. Signal-to-noise ratio, better than 60 db with 80 db gain. +20 vu output. Overall gain, 95 db maximum.

Tube complement, six 6J7s, one 6SN7, two 6G6s.



SYLVANIA THERMISTOR BRIDGES

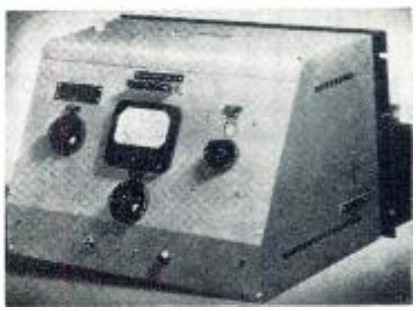
Two thermistor bridges, TBX-7SE and TBX-6SE, providing r-f power measurement up to two milliwatts at frequencies up to the shorter microwave regions have been announced by the electronics division, Sylvania Electric Products, Inc., 500 Fifth Avenue, New York 18, N. Y.

Type TBX-7SE is for continuous duty at normal laboratory ambient temperatures where measurement in S, X and K microwave bands may be made accurately with suitable r-f measuring heads. The bridge is independent of frequency, but should be used with appropriate thermistor mount. Two milliwatt scale sensitivity is essentially linear but a calibration curve is required for each r-f head used.

Tube complement includes one 6X5GT/G, two VR-105 and one VR-150.

Type TBX-6SE thermistor bridge, which requires external oven and thermistor mount, contains a Wheatstone bridge circuit with three precision resistor arms and externally mounted thermistor; a stabilized 2,000-cycle source for the bridge; stable d-c source for substitution measurement of r-f power; and an amplifier. It is independent of frequency and can be used as a balanced or unbalanced bridge providing accurate full scale meter readings from 25 microwatts to 2 milliwatts.

Tube complement includes seven 12J5s, three 6Y6Gs, two 5U4Gs, three 12SH7s and two VR-90s.



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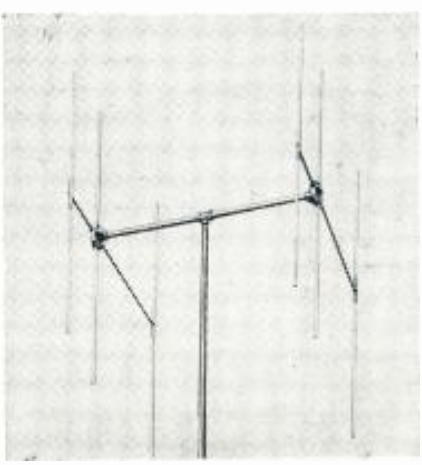
WORKSHOP ASSOCIATES ANTENNAS

High-gain directional antennas for each of the three communication bands, 152-162 mc, 72-76 mc, and 30-40 mc, have been announced by The Workshop Associates, Inc., 66 Needham Street, Newton Highlands 61, Mass.

Antennas are 6-element arrays with two driven elements. Two bays use reflector and director principle. Half wave spacing between the bays are fed in phase.

The gain is said to be 7.6 db.



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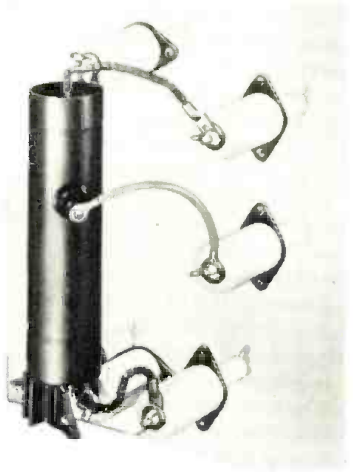
AMPHENOL TUBE MOUNT

A steatite mounting bracket of compact design, available with or without feed-through steatite bushing which permits back of supporting panel wiring, for direct mounting of metal industrial tubes, similar to 172 thyratron, has been announced by American Phenolic Corporation, Chicago 50, Illinois.

Terminal screw sizes of 3/8" or 1/4" are available.

Surface electrical creepage distances are said to be held at about 2" enabling use at high voltages.

Exterior of stand-off is glazed and metal parts plated.



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TRIG TOWERS

Triangular, tapered towers for a-m, f-m and tv, *Trig Towers*, fabricated of 61 S-T aluminum alloy, have been announced by the Rostan Corporation, 202 East 44th St., N. Y. 17, N. Y.

There are three sizes: 30', 20', in 10' sections, as well as a complete 10' unit. The tapered lines permit nesting of sections.

Tower is self-supporting and has been tested to hold 200 pounds of gear, with a projected area equal to 5 square feet of flat surface in a 90-mile-an-hour wind.

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W. E. RELAYS

Relays, types 275 and 276, using mercury wetted contact surfaces in a hermetically-sealed switch, have been announced by Western Electric. A development of Bell Telephone Labs, the switch is said to provide almost instantaneous break of contacts with consequently high current-handling capacity. The mercury provides extremely low contact resistance, serves to dampen undesirable modes of vibration, and eliminates chatter. The continuous replenishment of contact surfaces prevents deterioration of the underlying metal. Because this switch unit is sealed in a gas-filled glass envelope, it requires no maintenance.

* * *

MILLEN FREQUENCY CALIBRATION UNITS

Two frequency-calibration units, 90515 and 90511, for checking transmitter carrier frequencies and other high-frequency signals against WWV, have been announced by the James Millen Manufacturing Company, Malden, Mass. Model 90515 calibration unit combines the functions of the secondary frequency standard model 90505 and the high-frequency multiple and mixer unit, model 90511. The 90511 is available separately for those already having secondary frequency standard 90505.

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Pickup Models QT-508, QT-510 and FP-QT, with standard mounting centers, may be used for reproduction of 10" and 12" Records. Transcription Models QT-400 and HP-QT may be used for reproduction of all lateral transcriptions. Needle pressure with all models is but one ounce.

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Waveguides

(Continued from page 31)

losses will depend upon the surface metal used. Therefore, it has been found advantageous in some cases to silverplate aluminum waveguides. Silver has an exceptionally high conductivity which is also coupled with good corrosive resistance. The corrosive resistance can be even further improved and the electrical properties unchanged if the silver is flash plated with rhodium or palladium.

Studies have been made of methods for electroplating aluminum for the past 30 years with many patents being issued over this period. However, satisfactory plating of aluminum has only occurred during the past five years.

Aluminum must be properly treated prior to plating. We use the *Alumon* process,[2] which consists of the following steps:

(1)—Clean with enthone emulson cleaner or vapor degreaser.
(2)—Rinse in running cold water.
(3)—Etch in hot alkali solution.
(4)—Rinse in running water.
(5)—Scratch brush.
(6)—Dip in strong nitric or nitric hydrofluoric acid solution.
(7)—Rinse in running water.
(8)—Immerse in *Alumon* solution.
(9)—Rinse in running water.
(10)—Copper plate.

It has been found that when an aluminum waveguide is immersed in a copper-plating solution, plating occurs more rapidly on the outside of the guide than on the interior surface. This explains the fact that the interior plating is not as good as desired. The effect of the prior treatment of the aluminum has worn off before the interior plating takes place and thus the lack of good plating quality on the interior surface. This, plus the fact that the nature of the plating solution is such that the throwing power is not good enough to be recommended for sections over 12" in length, made it necessary for us to design an adjustable plating rack. Figure 3, which makes use of a center anode of stainless steel and can be used to obtain satisfactory interior plating of straight waveguide sections. When using this rack, plating occurs simultaneously on the inside and outside of the tube. Thus the effect of the prior treatment of the aluminum is utilized on the interior surface of the guide and the throwing power of the plating solution is not a limiting factor. A uniform

[2] Recommended by Enthone, Inc., New Haven, Conn.

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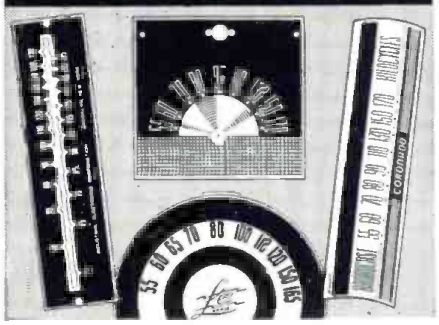

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adherent plate can be obtained.

It has also been found that the electromagnetic waves of the wavelength encountered in microwave work have a depth of penetration very much greater than the thickness of the oxide coating inherent to unplated aluminum or its alloys. The attenuation of aluminum waveguides will not be materially increased as a result of this oxide coating. Therefore, it may be desirable, in some cases, to use unplated aluminum waveguides.

Magnesium as well as various plastics are now under investigation as possible waveguide material. Briefly, our investigation of these materials has indicated that:

(*1*)—Magnesium can be successfully plated by a new process.

(*2*)—Oxyacetylene welding can be used to join successfully magnesium of the same thickness. However, when different thicknesses are to be joined (such as $\frac{1}{16}$" and $\frac{1}{4}$") the thin section melts before the thick section reaches its welding temperature.

(*3*)—Arc welding which would use an inert gas in place of a flux would eliminate corrosion due to flux.

(*4*)—Various factors must be considered before selecting a plastic material to be used for waveguide fabrication, namely, strength, moisture absorption, chemical resistance, electrical requirements, thermal and arc-resisting properties, dimensional stability, hardness, plating characteristics and cost.

(*5*)—Plastics can be satisfactorily plated by various methods.

(*6*)—Plastics can also be metallized (tubes larger than 1" x ½" x .05") by directly spraying metal on plastic.

(*7*)—Plastic material can be easily formed into rectangular waveguide tubes. The i-d can be held to a ±.003" and the wall thickness to a ±.005".

Due to new developments mentioned, these lightweight materials will have a tremendous influence in the design of new communication equipment; weight advantage is gained at no sacrifice in electrical conductivity, ease of fabrication and resistance to corrosion or cost, which will be lowered as these new materials come into popular use in the communications field.

Factory View

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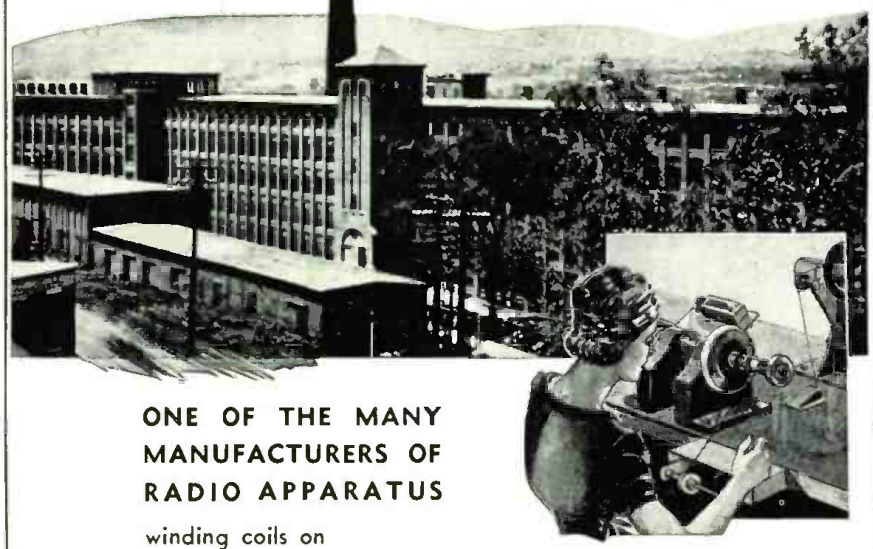

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RH-51 — RH-241

The wide range of Reeves-Hoffman crystal activities includes such crystal units as RH-51 a hermetically sealed, 1000 kc. crystal unit designed for frequency meters and secondary standards. The metal tube holder has a standard octal base.

In still another field of crystal applications is the RH-241 crystal unit designed for FM transmitters and receivers. This is a plated, 200-1000 kc., wire mounted, sealed unit which is also suitable for use in frequency meters and filters.

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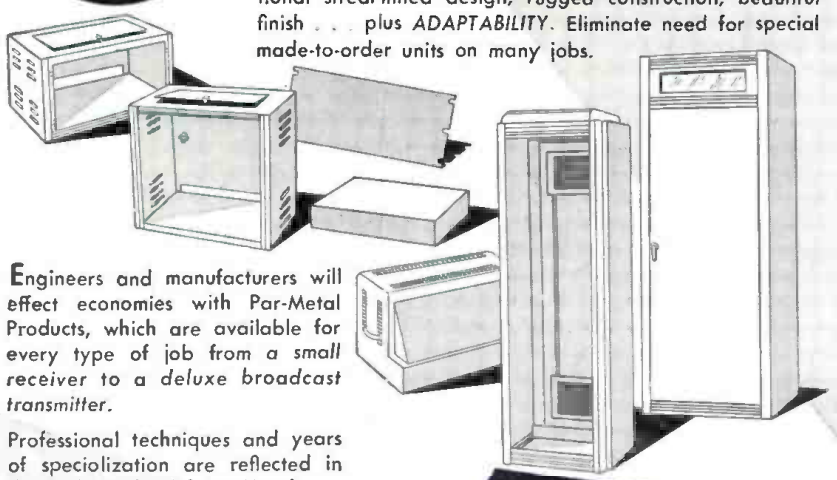

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V-H-F Airborne

(*Continued from page* 25)

cally sealed, crystal unit developed during the war lends itself to this use, in a very desirable manner. Its dimensions are approximately ¼" x ½" x ½", and when packaged just inside a metal drum with its contacts protruding it is unusually small and compact; the crystal drum is approximately 3½" in diameter and 2½" long. The drum is moved in 5° steps by means of a geneva mechanism which is, in turn, driven by a motor (visible on the front panel of p. 22 view). The crystals are mounted in the drum in such a manner that each successive position is slightly higher in frequency. The same drive motor also drives a shaft which extends the length of the transmitter and moves the capacitors in each of the resonant circuits. This resonant circuit change is synchronized with the crystal position change and thus the transmitter is kept in tune throughout the band.

External connections are all made to the transmitter through an aircraft type connector located in the rear of the chassis. This connector is so wired that the unit may be operated on either 14 or 28 volts. A coaxial connector is included as an integral part of the rear plug for antenna connection. An antenna relay is located within the transmitter to transfer the antenna from the transmitter to the receiver.

[*To Be Concluded in December*]

Transmitter Buildings

(*Continued from page* 21)

be made of the maximum wind velocities and rainfall at the proposed site, to be sure that the building will be water-tight, especially around doors and windows.

Cost of operation will be higher because of the inaccessibility. Complete living facilities for personnel will be necessary, particularly in areas where "snowing in" can be expected.

The ideal high-frequency site would be a mountain top in or near a city, with consequent short roadways, water, power and signal runs.

Building Layout

The layout of the building is another important transmitter construction problem. It is necessary, for instance, to consider whether it is better to combine or separate studios and transmitters.

The combination of transmitter and studios will effect certain economies in the cost of building. However, if studios near the business center are desired, separation is often necessary with larger

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a-m transmitters, which must go to the country for land of reasonable cost. Mountain-top f-m and television transmitters must also usually be separated from the studios.

Combined studio and transmitter installations are advisable for f-m and television stations in tall city buildings, or a-m stations in smaller cities where cost of land for the radiation system is not prohibitive. Many new stations, particularly of low and medium power, have found that a combined installation in a suburban district is practical and economical.

Separate locations for studio and transmitter are usually necessary with mountain-top sites for f-m and television, and a-m stations finding "breathing room" for their antenna systems by going into the country.

Whether the transmitter building should be a show-place or just an enclosure for transmitter and operators is another problem to solve.

If the building is to be in a remote location, seldom seen by any persons excepting the operating force, it is obvious that no extra money should be spent merely to give it public appeal. Careful planning and sound architecture, however, do pay off heavily, even in remote locations. The difficulties of the site make it even more important and prudent to think carefully in advance, to coordinate the planning of persons involved in the building, and to put up a permanently satisfactory building that will be easy to maintain, with all the facilities necessary for the efficiency of the operating force.

On the other hand, if the transmitter building is seen regularly by a large number of people in your community, the buildings becomes a permanent advertisement for your station, establishing in the minds of listeners the character of the organization. The minimum response to this situation should be a building with a clean, well balanced exterior appearance, well-kept approaches, architecture neither pretentious nor dowdy. This kind of clean, smart looking building need not cost substantially more than a cluttered, ugly, ramshackle type of building.

Management must make a decision, based on its resources and the probable benefits in good will to be obtained, as to just how far it wants to go beyond this minimum toward a more elaborate use of the transmitter building in the public relations scheme of the station. Many arrangements are possible, ranging from the use of glass wall on the control area, a fairly inexpensive and often most effective way of *showing the works* to the public, up to fountained gardens, beautifully furnished visitors' lounges, raised viewing lobbies that circle the whole transmitter area.

Units of Buildings

Architecturally speaking, a transmitter building can be divided into unit functions and features: essential, desirable and optional, depending on requirements.

Planning of interior layout can be based on the selection of the building units or rooms to take care of your particular needs and problems.

The transmitter room and control room are the heart of any transmitter building,

(*Continued on page* 38)

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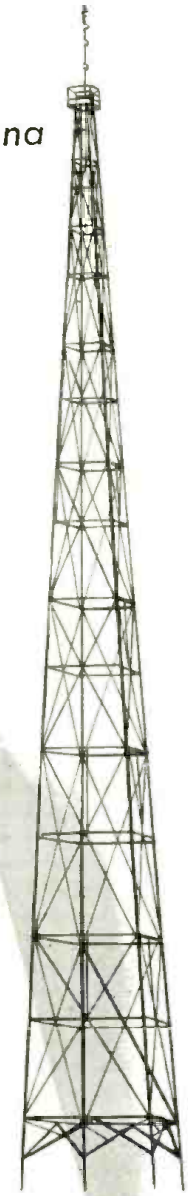

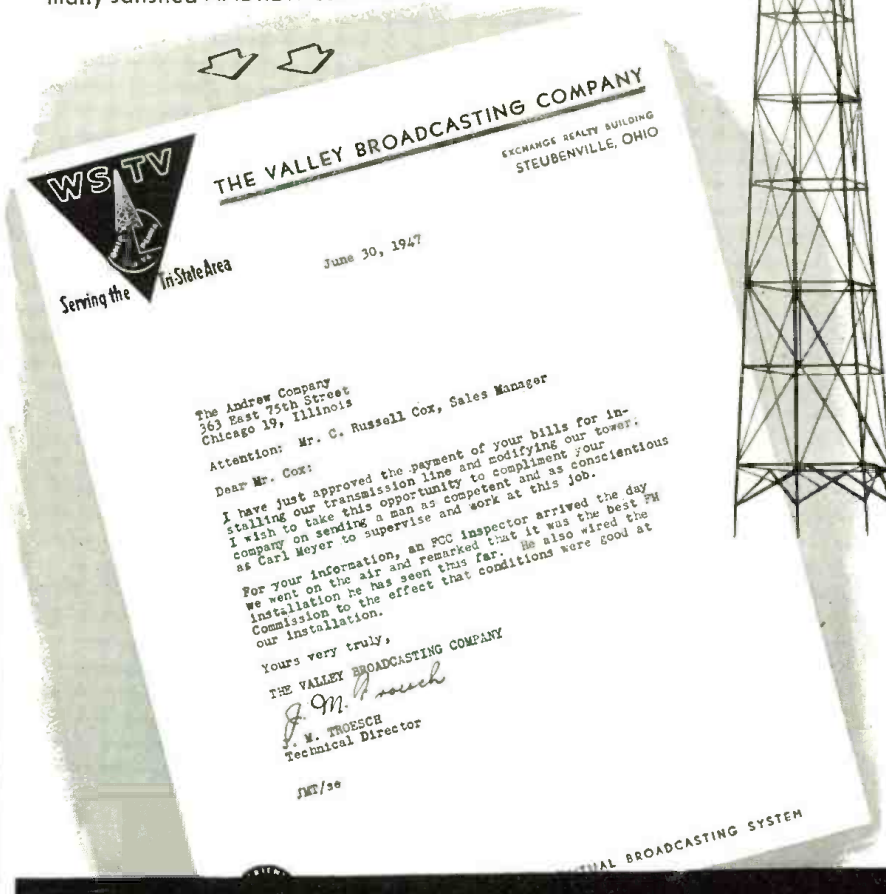

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Write for Reproducer Bulletin D 5

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- **HUM PROOF**
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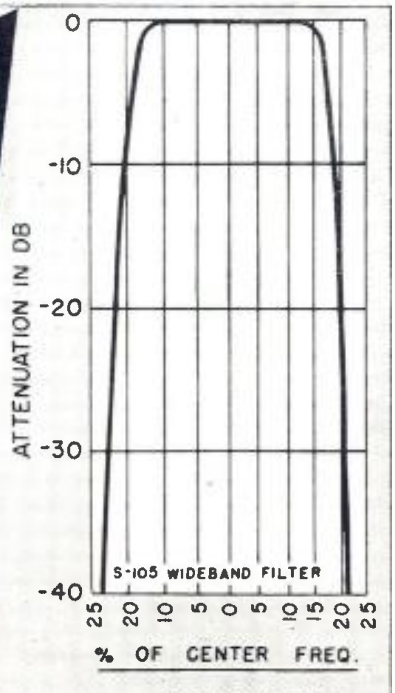

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(*Continued from page 37*)

and they should be designed first, to accommodate the transmitter and to provide for installation of the services necessary for operation and maintenance. Choice of the other building units or rooms required for the installation can then be made. These additional rooms should be added around the transmitter and control rooms to provide proper and efficient operating flow to the various parts of the building.

In the *transmitter room* the floor space should be sufficient for the transmitter itself, and in addition must provide room completely around it for easy servicing. This means that in back of the transmitter, there must be room to open any swinging doors, plus additional room to allow the operator, with portable test equipment or small power tools, to pass the opened doors. The front of the transmitter will face into the control room or area.

The larger transmitters, which include auxiliary high voltage or cooling apparatus in separate units, will ordinarily have recommended transmitter room layout plans supplied by the manufacturer. Layout of a transmitter room with a number of auxiliary units is based on: (*1*) short interunit connections; (*2*) separation of equipment that must be attended in operation, from dangerous high voltage equipment; and (*3*) provision of proper insulation and separation for high-voltage wiring runs.

The enclosure of high-voltage equipment in separate rooms with *interlock* switches on all entry doors which cut off the power automatically when the door is opened should be planned in accordance with FCC and underwriters' regulations.

The ceiling height in the transmitter room must include a margin of several feet over the standing height of the transmitter itself. A minimum over-all ceiling height of 10′ for a-m and 12′ for f-m transmitters is advisable. This is to allow for:

(*1*) Access space for servicing meters and other equipment near the top of the transmitter.

(*2*) Room for discharge of heat from the tops of small and medium size transmitters.

(*3*) For f-m transmitters, room for transmission line and harmonic shunt line stubs installed on or near the top of the transmitter. If harmonic shunts are contemplated, careful consideration should be given to the maximum length of stub that would be required, and vertical space allowed accordingly.

After scaling the room and preliminary placing of the main transmitter units on paper, the plan should be studied from the point of view of the operator:

Can he reach control points quickly and easily? Is there room for all normal maintenance, testing and service? Are the doors to the transmitter room large enough for the largest unit of apparatus to be installed?

In the layout of the transmitter room, as in every feature of a transmitter building, the anticipation of probable expansion is one of the surest forms of long-range economy. All experts agree that every person going into the broadcast business should take a hard look ahead at his future and lay definite plans in the transmitter building for the changes he hopes to make.

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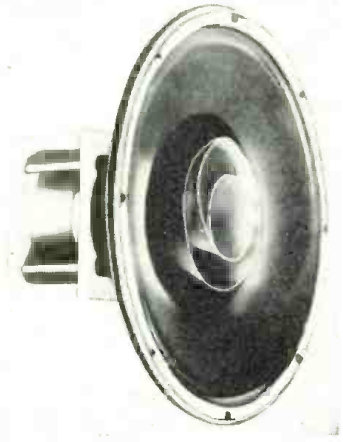
ON VIEW AT THE SAN FRANCISCO WCEMA SHOW

Above: Intercommunication unit developed by Dalmo Victor Co., San Carlos, Calif. These units, for receiving and listening, are self-contained masters which can be hooked up to a link of units for multiple operation. Below: Direction finder, type D-24, now being made by Kaar Engineering Co., of Palo Alto, Calif. Unit has three-range coverage; 130 to 400 kc, 540 to 1740 kc and 1740 to 5600 kc. Uses a 6SK7 r-f; 6SA7 oscillator and mixer; 6SK7 i-f; 7F7 infinite impedance detector and amplifier; 7F7 null tube and h-f oscillator; 6V6 audio-output beam-power amplifier; 6B8 amplified ave and 6B5 tuning eye.

Below: Co-spiral model P-52FR, using a single voice coil for a 40 to 14,000-cps range announced by the Stephens Mfg. Company of Los Angeles. Stephens also displayed a Tru-Sonic 2-way speaker with a 10 cell h-f horn and 40-watt driver complemented by a woofer horn with a bass phase-inverted acoustical labyrinth, utilizing two 20-watt 15" l-f drivers.



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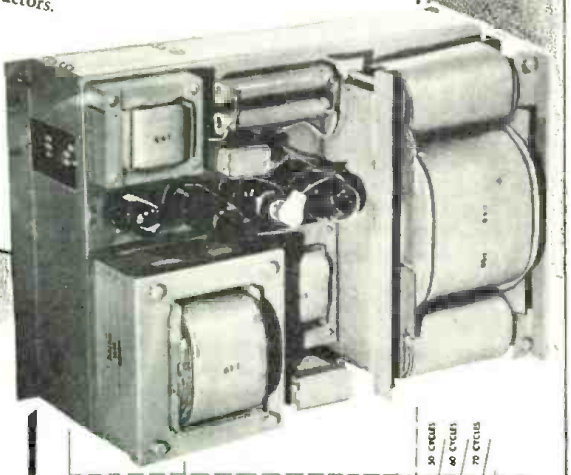
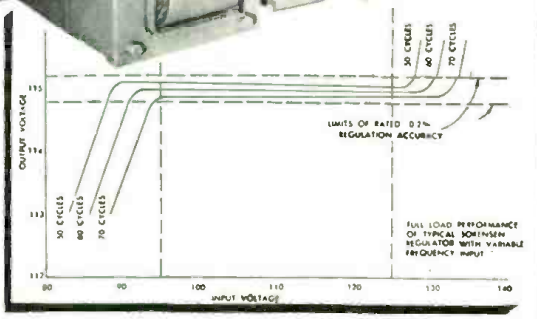
Input voltage range	95-125
Adjustable output between	110-120
Load range	200-2000 VA
Regulation accuracy	0.2%
Harmonic distortion	2% max.
Recovery time	6 cycles
Input frequency range	55-65 cycles





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135-20J	135-40	135-42J
135-22	135-40J	135-44
135-22J		135-50

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News Briefs

PERSONALS

W. H. Wells has been named sales and service manager of the Red Bank division of Bendix Aviation Corp.

Wells was formerly with the radio division of Western Electric.

Paul Tartak is now president of Tartak Speakers, Inc., on the Pacific Coast. **Al Dresner** is vice president and general manager of the company which has a complete line of speakers for manufacturers and jobbers, including 3," 4", 5", 6", 8", 10" and 12" speakers, both p-m and e-m.

* * *

Dr. W. L. Barrow has been appointed chief engineer of the Sperry Gyroscope Company, Inc.

* * *

M. W. Scheldorf, coinventor of the circular loop antenna, has joined Andrew Co., 363 E. 75th St., Chicago, 19, as head of the engineering research department.

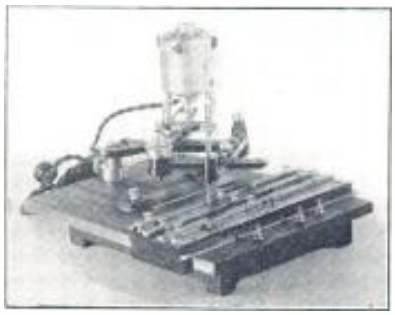
* * *

Bayard H. Clark, advertising and sales promotion manager for Jensen Manufacturing Company, Chicago, has received his Master's degree in Business Administration from the University of Chicago.

* * *

Grenville R. Holden, vice president of Sylvania Electric Products, Inc., has been elected to the board of directors of Electronics Tubes Ltd. of London, British tube manufacturing affiliate of Sylvania Electric.

—MICO— ENGRAVER



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RELAYS

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Guardian SPST Norm Open, 40 ohms, 6 v = R31	.39
Alln Bradly Solenoid, SPST Norm Open, 200 ohms, 24 v, 50-a contacts = R33	.79
Ward Leonard SPDT, 5-a contacts 110v 50-60 c. = R56	1.25
Pottr Brmfld SPST Norm Clsd, 5000 ohms 10 ma	.75
G-M 4PDT, 240 ohms 24 v = R57	.75
G.E. SPDT, 50 ohms 12 v = R58	.29
G.E. SPST Norm Open, Solenoid, 50 ohms 24 v, 300 a contacts double break = R59	.90
Allied DPDT, 230 ohms 24v Types BOX66 or BO6D35 or BO13D35	.35
Leach SPST, Norm Open Solenoid, 40 ohms, 12v 50-a contacts = R60	.75
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Rudolf Feldt has become head of the cathode-ray oscillograph manufacturing department of Allen B. DuMont Labs., Inc., at the Clifton plant.

Dr. C. B. Jolliffe, executive vice president in charge of RCA Laboratories division, has been elected to the board of directors of RCA.

L. F. Randolph, of RCA equipment tube sales, died recently.

* * *

LITERATURE

Selenium Corporation of America, 2160 East Imperial Highway, El Segundo, California, has released a 12-page brochure on self-generating photoelectric cells. Included are characteristics, applications and design factors.

The Daven Company, 191 Central Avenue, Newark, N. J., have published a 4-page bulletin with data on mixer circuits showing circuit diagrams and applications.

Also included are a table showing impedance vs. decibel loss, with values calculated for impedance mismatch, minimum "P" loss, and bridging pad loss.

International Resistance Co., 401 N. Broad St., Phila. 8, Pa., have released a 4-page bulletin, G-1, with data on type MV high-voltage resistors, 2 to 90 watts, 8 terminal types.

Phillips Control Corporation, 612 North Michigan Ave., Chicago 11, Illinois, have prepared a 12-page catalog, No. 7, covering relays designed for electronic and industrial control, signal and traffic control, etc.

Coil characteristics, contact assemblies, operating and release times and dimensional drawings of each relay are included.

Waldom Electronics, Inc., 911 North Larrabee Street, Chicago 10, Illinois, have published a catalog, No. 48, listing replacement cone assemblies and universal field coil replacements.

The RCA sound-products section have published a 288-page book "The Architects Manual of Engineered Sound Systems," describing acoustics, studio and control rooms, microphones, speakers, amplifiers, speakers, etc.

Manual contains 49 floor plans, 32 charts, tables and photographs, 24 sketches and wiring diagrams.

Priced at $5.00.

General Ceramics and Steatite Corporation, Keasbey, New Jersey, have published a 32-page booklet covering dielectric ceramics and their application in communications.

Allen B. DuMont Laboratories, Inc., Clifton, New Jersey, have prepared a 32-page booklet describing the image orthicon chain, which includes the camera, pickup auxiliaries, low-voltage supplies, monitor units, sync generator, distribution amplifier, mixer amplifier, etc.

Transmitter Equipment Manufacturing Company, Inc., 345 Hudson Street, New York 14, N. Y., have released a series of bulletins describing basic units for the series RA transmitter, which include a narrow-band f-m exciter unit and variable-frequency and crystal-controlled oscillator.

Cornish Wire Company, Inc., 15 Park Row, New York 7, N. Y., have prepared a 4-page leaflet covering antenna wire, p-a cables, shielded leadin, etc.

Jensen Manufacturing Co., 6601 S. Laramie Avenue, Chicago 38, Ill., have prepared a 24-page catalog, No. 1010, covering standard and concert speakers, extended range single radiators, coaxials, bass-reflex reproducers and cabinets.

Mathematics for Radio Engineers by Leonard Mautner, research engineer of Allen B. DuMont Labs, has been published by the Pitman Publishing Corp. Price of book is $5.00.

Nathan Marchand's book on **Ultrahigh Frequency Transmission and Radiation** has been published by John Wiley and Sons, Inc. Price of book is $4.50.

The concluding installment of R. C. Cheek's paper on ***Power-Line Carrier Communications*** *will appear in December,* COMMUNICATIONS.

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The Finest Money Can Build or Buy!

Wherever quality is called for, Bendix-Scintilla* Electrical Connectors are the logical choice. These precision-built connectors set a new standard of efficiency with their remarkable simplicity and low electrical resistance. The secret is Scinflex—a new Bendix-Scintilla-developed dielectric material. It lessens the tendency towards flash-over and creepage, and makes possible efficient performance from −67° F. to +300° F. Dielectric strength is not less than 300 volts per mil. The contacts, made of the finest materials, carry maximum currents with the lowest voltage drop known to the industry. *TRADEMARK

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- Available in all Standard A-N Contact Configurations

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H17 CRYSTAL FOR AIRLINES AND VHF EQUIPMENT

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*BUILDERS OF QUALITY RADIO INDUCTANCES SINCE 1924

Two-Way Taxi Radio

(*Continued from page* 13)

telephone dispatcher in that area in quest of a telephone order or *wire*.

If an order is available, it is appended to the radio tickets and returned to the radio dispatcher for transmission to that radio cab for filling. The radio dispatcher then places a small *w* in the upper right corner of the ticket to show that the cab has been assigned a job. The driver repeats the wire back to the dispatcher to show that he has received it correctly. If the repeat-back is correct no acknowledgment is made by the dispatcher, but if the driver fails to repeat the order or repeats it incorrectly the dispatcher repeats the entire order or the portion which has been incorrectly repeated.

Having arrived at the address given on the order and learned the destination of his fare the driver reports his destination to the radio dispatcher who records it on the ticket of that cab number. Five minutes before arriving at his destination, the driver again reports to the dispatcher by means of an operating signal. The dispatcher then sends the ticket bearing his cab number and destination to the telephone dispatcher for the area of his destination for another order. If one is then available it is transmitted to the driver while he is still enroute with his passenger. If not, the ticket is returned to the control board until the driver has discharged his passenger and reported *empty*, when it is again returned to the dispatcher for that area for an order. If an order is still unavailable the driver is instructed by means of an operating signal to *proceed independently* or *hold* at the nearest busiest intersection, at the discretion of the radio dispatcher.

If instructed to *proceed independently* the driver periodically reports his changing position until he has obtained a fare or been furnished a *wire*. This procedure is followed throughout each shift.

The radio taxicab quickly demonstrated its practicability in taxicab operation. There are many cases on record of patrons' being astounded by the rapidity with which their telephone call for a cab has been filled. On several occasions cabs discharging passengers in front of office buildings and apartments have been held at their positions to fill calls received from the same apartment or office building. Dispatching cabs within the same

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square in which they have discharged their passengers is not uncommon. The reduction in *dead* mileage and quality of service in such cases is readily apparent.

In addition to the radio-equipped cabs one tow truck has been equipped with two-way radio to provide rapid servicing of disabled cabs. This service has eliminated considerable backtracking.

Fifteen supervisor cars also have been equipped with receivers to provide a *paging* and information service to supervisory personnel. This service has provided a rapid means of contacting supervisors on routine duties or covering special events, who might otherwise be unavailable for protracted periods of time. In addition, it is possible to keep them informed of traffic conditions in the area for which they are responsible. It further enables a supervisor to station himself in a busy cab lane and divert empty cabs to needed points.

The many uses to which radio may be effectively applied to the taxicab industry appear to be limited only by the frequencies available. Radio cabs may be used for many purposes such as effectively *clocking* proposed cab stands, providing an accurate check of cab requirements; obtain service for other non-radio cabs requiring service, for covering special events, and many other purposes.

On occasions radio-equipped cabs provide a measure of security.

The circuit load on the taxicab frequency is tremendous and growing every day as equipment becomes more plentiful. It is estimated that more than $16,000,000 has already been invested by the industry in taxicab radio equipment to which only one channel has, so far, been allotted.

It is to be hoped that at least 20 additional channels soon will be made available for taxicab use by the FCC.

•

VWOA

(Continued from page 26)

on the business horizon today equals the tremendous possibilities offered by television. It is a *new* industry. It does not strive to replace anything else. It is an added service which joins with the many other modern conveniences enjoyed by our people to further enhance the American way of life.

"It is fast becoming a *big* industry. With the expanding employment of hundreds of thousands in the various phases of television work, I believe it is bound to have a very stimulating effect on our national economy."

NEW TECH-LAB DEVELOPMENT

For RAPID MEASUREMENT OF AUDIO FREQUENCY GAIN or LOSS

TYPE 1A TRANSMISSION MEASURING SET

Completely Self-Contained

PORTABLE • AC OPERATED

With this instrument it is possible to quickly and accurately analyze and service equipment in different locations without fuss in time consuming demounting and transportation of apparatus. It will thus pay for itself in a short time and no modern radio station can afford to be without it. It can also be used to good advantage in factory checking and inspection of audio equipment.

The set combines in a modern efficient manner an accurate vacuum tube voltmeter, an audio oscillator with four fixed frequencies and a precision attenuator all mounted in a handy cabinet easily carried by the operator.

SPECIFICATIONS

- GAIN: Up to 80 db.
- LOSS: 60 db. maximum.
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- AUDIO OSCILLATOR: Freq. Range; 100 to 10,000.
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TV Set Production

(*Continued from page* 18)

the band of 40 to 220 mc. This has proven satisfactory in practice.

When the lines are brought down to the test position where they will be used they are connected to the various points on the selector switch of a television r-f attenuator selector panel,[13] Figure 13. This selector switch properly terminates and allows selection from eight different 50-ohm, single-ended coaxial lines. Reflection looking into this panel is below 15 per cent over the 40- to 220-mc band on any setting of controls. All lines coming into the panels are always terminated. Neither open nor short circuited conditions appear during switching intervals. This has been found important since such serious reflections are otherwise set up as to make test impossible in adjacent positions. Total attenuation provided is 120 db. A short length of 50-ohm cable connects the output of the panel to a transformer going from 50-ohms, single-ended, to the 300-ohms balanced line input required by the receivers under test.

F-M Sound Transmitters

A quantity of thirteen *standard f-m exciters,*[14] such as were primarily designed for broadcast transmitter service, may have been readily used to generate the f-m signals required for aligning the local oscillator frequencies and checking sound channel sensitivities of the receivers. Two reasons, however, precluded their use: First, the standard f-m exciters produced a signal of far better quality than required; second, a saving could be realized by designing and constructing a simpler *tone-modulated f-m exciter,*[16] and its companion piece, and an *r-f tripler* and *power amplifier.*[19]

These two panels are illustrated in Figure 14. The lower panel and chassis actually contains two transmitters capable of delivering f-m sound carrier signals on any of the lower six channels.

From an examination of Figure 15, which is the rack assembly of television f-m sound carrier signal generators as used in Camden, it can be seen that the first cabinet contains three of these dual transmitters. Together with the *standard power supplies,*[17] this rack supplies f-m sound carrier signals for all the lower six channels.

All of these signals are fed to the factory floor over a single-ended 50-ohm coaxial line. Each transmitter contains its own audio oscillator, and channels are identified from one to six by tones of 1,000, 1,200, 1,400, 1,000, 1,200 and 1,400 cycles respectively. These tones are readily identified on the factory floor. The frequency excursion of each transmitter is adjusted to be ±25 kc.

These f-m signals are controlled by

[13] RCA TX-6429.
[14] RCA TX-6382.
[15] RCA MI-7016.
[16] RCA TX-6412.
[19] RCA TX-6413.
[17] RCA 580-C.

CABINET 1	CABINET 2	CABINET 3	CABINET 4
TWO-CHANNEL F-M R-F EXCITER[1]	TWO-CHANNEL R-F TRIPLER AND POWER AMPLIFIER[3]	TWO-CHANNEL R-F TRIPLER AND POWER AMPLIFIER[3]	FREQUENCY MONITOR
POWER SUPPLY[2]	TWO-CHANNEL F-M R-F EXCITER[1]	TWO-CHANNEL F-M R-F EXCITER[1]	
TWO-CHANNEL F-M R-F EXCITER[1]	POWER SUPPLY[2]	POWER SUPPLY[2]	FREQUENCY MONITOR CONVERTER
POWER SUPPLY[2]	TWO-CHANNEL R-F TRIPLER AND POWER AMPLIFIER[3]	TWO-CHANNEL R-F TRIPLER AND POWER AMPLIFIER[3]	BLANK
TWO-CHANNEL F-M R-F EXCITER[1]	TWO-CHANNEL F-M R-F EXCITER[1]	TWO-CHANNEL F-M R-F EXCITER[1]	SPARE TWO-CHANNEL R-F TRIPLER AND POWER AMPLIFIER[3]
POWER SUPPLY[2]	POWER SUPPLY[2]	POWER SUPPLY[2]	SPARE TWO-CHANNEL F-M R-F EXCITER[1]
BLANK	HIGH VOLTAGE POWER SUPPLY[4]	HIGH VOLTAGE POWER SUPPLY[4]	SPARE POWER SUPPLY[2]
SPARE POWER SUPPLY[2]			SPARE HIGH VOLTAGE POWER SUPPLY[4]

Figure 15
Setup of the rack assembly of the television f-m sound carrier signal generator; type TX6383. Equipment in *1* is a TX-6412; *2*, 580C; *3*, TX-6413; *4*, TX-6332.

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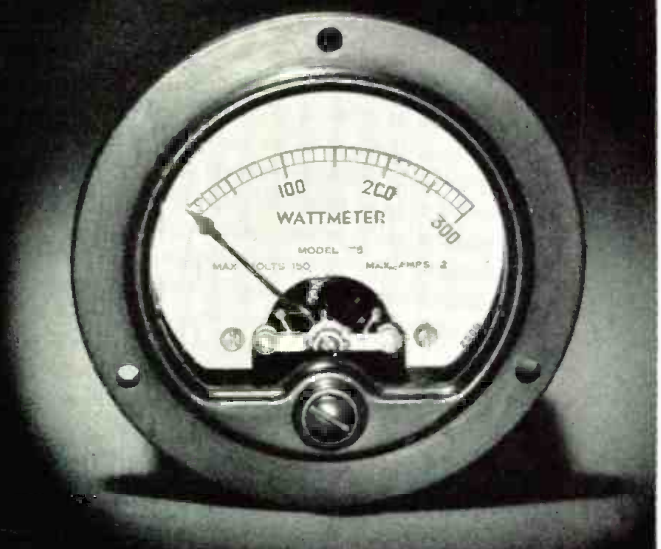

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and derived directly from a crystal. Figure 16 (p. 46) shows how they are obtained primarily, from a phase modulation circuit. A crystal-controlled oscillator at medium frequency feeds the No. *1* grid of one 6SA7 directly while the other is fed through a 90° phase-shift network. The No. *3* grids of the 6SA7s are then supplied with the modulating tone frequency in push-pull. Phase modulated r-f appears across the load impedance tying the two 6SA7 plates in parallel. This phase modulated r-f is multiplied by three successive triplers and results in a useful fixed tone modulated f-m signal.

Cabinets *2* and *3* contain the two dual f-m transmitters, plus two dual r-f triplers and power amplifiers. These tripler amplifiers are of conventional design and serve simply to extend the frequency range of the dual

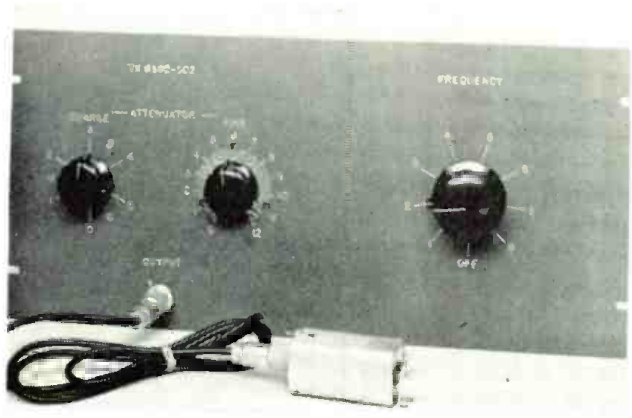
[9]RCA TX-6382.

transmitters into the higher seven channels. Actually, cabinets *2* and *3* will deliver eight signals where only seven are required, thus providing a spare. Of these seven higher frequencies the first four are transmitted over one line while the remaining three are fed to the factory on another line. Besides identification by line numbers or selector switch positions of *attenuator panel*," modulation of different tones

(*Continued on page* 46)

Figure 13
The television r-f attenuator selector panel.

Figure 14 (right)
The lower two-channel f-m r-f exciter.



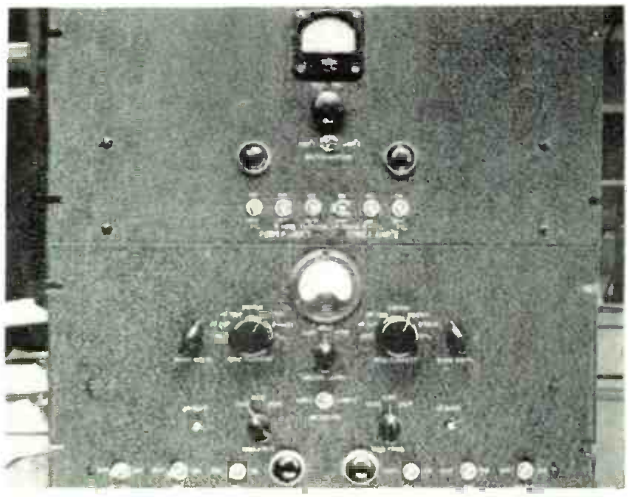


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Figure 16
Phase-modulation circuit in which f-m signals are controlled by and derived directly from a crystal.

(*Continued from page 45*)

is applied to aid signal identification on the factory floor.

Cabinet 4 contains a standard frequency monitor plus a converter so that constant check may be had on the frequency excursion of all carriers. The remainder of this cabinet is fitted with spare equipment sufficient for any emergency.

Combined Sound and Picture Transmitters

Figure 17 illustrates the assembly of racks required to produce and monitor the combined sound and picture transmitters. The right-hand rack contains monitoring and measuring equipment for making band width and distortion measurements on the f-m sound transmitters housed in the center cabinet. This measuring equipment consists of standard commercial items which are described elsewhere.

The f-m transmitters for the sound carriers consist of two standard *broadcast transmitter f-m exciters*,[19] and associated *power supplies*.[20] These are high quality exciters capable of music modulation with very low distortion. One unit is aligned for channel *1*, while the other is aligned to channel *6*. Because the normal upper limit of these f-m exciters is 50 mc, the channel-*6* exciter is followed by an *f-m sound amplifier* and *frequency multiplier*.[21]

The output of the two f-m exciters is fed over to the upper panel of the left-hand rack. This panel is a diplexer which combines the f-m sound carriers with the picture-modulated carriers obtained from two *television test transmitters*.[22] Mounted in the same rack are the associated filament

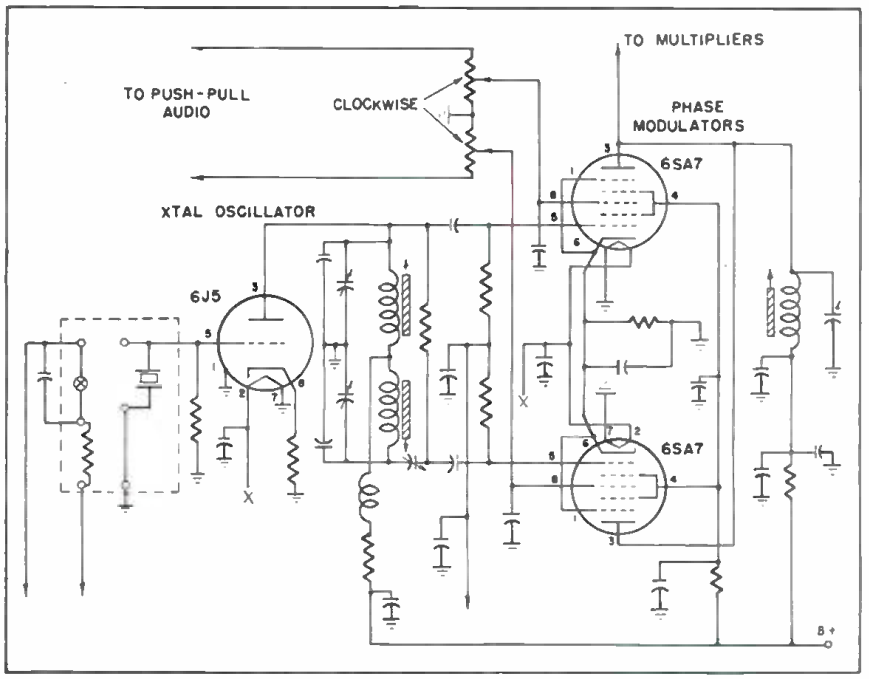
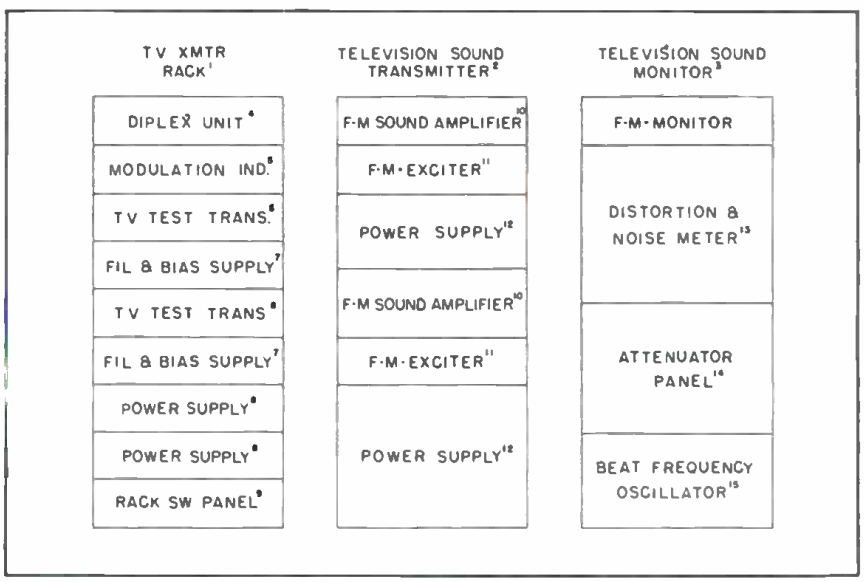


Figure 17
Rack assembly for the combined sound and picture transmitters. In *1*, we have a TX-6419 unit; *2*, TX-6427; *3*, TX-6426; *4*, TX-6444; *5*, TX-6443; *6*, TX-6441 or TX-6446; *7*, TX-6442; *8*, 580-C; *9*, K-399951; *10*, TX-6433; *11*, MI-7016; *12*, MI-7017; *13*, 69-C; *14*, 89-C, and *15*, 68-B.



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and bias supplies and standard plate power supplies.

The design of the television transmitter is suitable for any of the lower six channels. As set up, a monoscope-modulated picture carrier is combined with music modulated sound carrier and fed to the factory floor on one 50-ohm line. Another line carries a grating or bar-modulated picture carrier combined with audio sweep, modulated sound carrier. Two channels, *1* and *6*, are used for overall test in final test positions.

The television transmitters were designed to be as simple as possible. Since the character of the picture modulation is fixed, either monoscope or grating, d-c restoration was omitted. Vestigial side band filters were also omitted and both sidebands generated out to approximately seven megacycles. This was done on the basis that a receiver with standard selectivity will receive either standard transmission, upper sideband and carrier, or double sideband transmission with equal facility. This was proved in practice before the War. In fact, two advantages may be cited by omission of a vestigial sideband filter: First, the lower sideband can be considered an effective interfering signal on the next lower channel against which the receiver should discriminate; second, no questionable conditions such as phase or amplitude distortions in the vicinity of the carrier frequency are introduced.

Overall Considerations

The test facilities outlined here are deemed sufficient for a rate of production up to 500 television receivers per day. Approximately twenty-two racks of equipment including spares, audio and music modulation sources and monitor equipment are represented. Upwards of twenty kilowatts are drawn by the *central signal cage* alone in operation. It has been found highly desirable to maintain line regulation of ±1 volt in 117 to maintain constant test signal levels from the *central signal cage*.

Future Equipment

This test equipment was used for initial production. In most cases additional equipment will be required. One or two combined sound and picture modulated transmitters would certainly be desirable on the upper seven channels. This would immediately cut down the number of type tests now necessary.

Additional types of video modulation should be on hand to provide regular changes of scene from mostly white to mostly black. This would serve both to check operation of d-c restoration in the receivers and the performance of sync-separator circuits.

Acknowledgments

The best efforts of a number of men made this project a success. Without them mass production of commercial television receivers would have been a great deal more difficult. B. L. Brady, R. A. McDermody, A. J. Grange, H. Hay, R. S. McKinney, B. L. Adler, G. Musil, L. C. Smith and M. J. Ackerman shouldered the burden of the design work involved. H. L. Morrison of the *television-terminal section* gave valuable assistance. A. D. Bridges supervised all of the construction. N. M. Brooks persevered in being responsible for the activities of the entire group.

[1]RCA MI-7016.
[2]RCA MI-7017.
[3]RCA TX-6433.
[4]RCA TX-6441.

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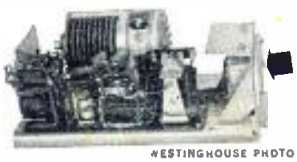

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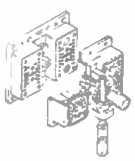

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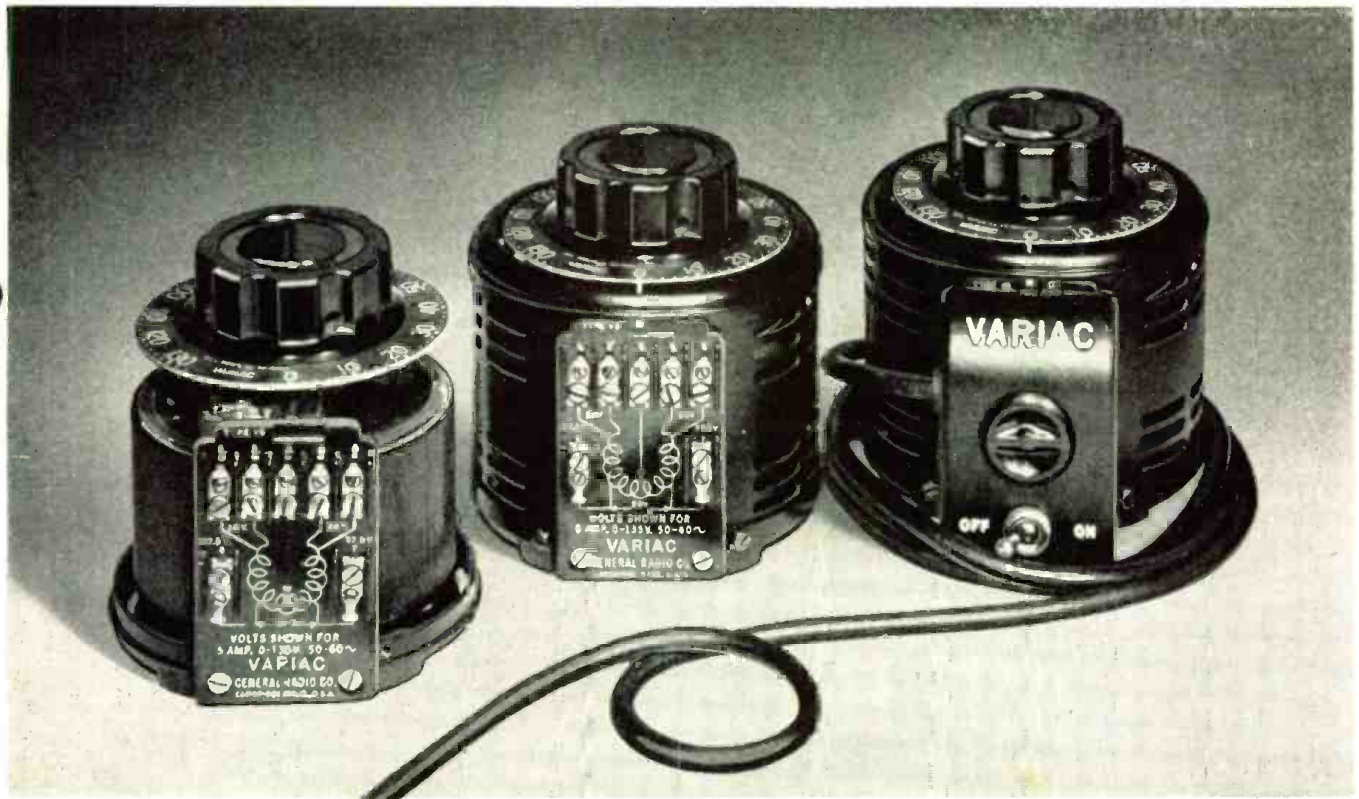

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