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JUNE

★ V-H-F RAIL RADIO SERVICE IN TUNNELS ★ MOBILE 30–44 MC EQUIPMENT
★ MOBILE SERVICE V-H-F PROPAGATION SURVEYS

1947

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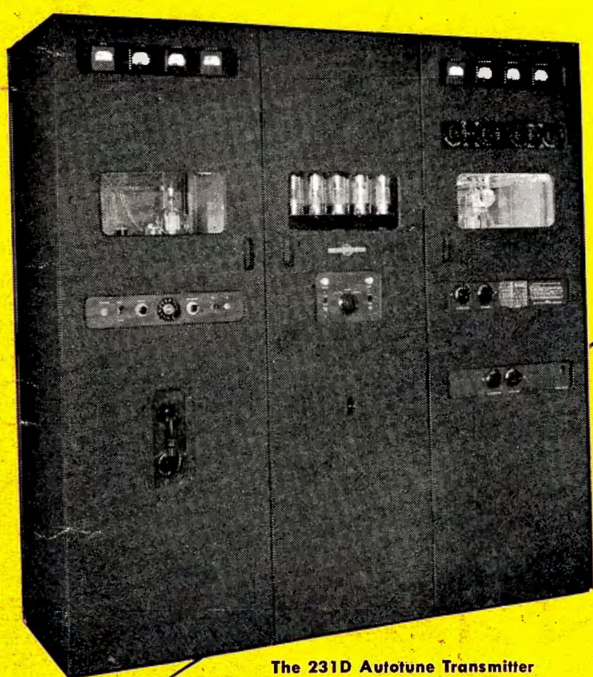

The 231D Autotune Transmitter
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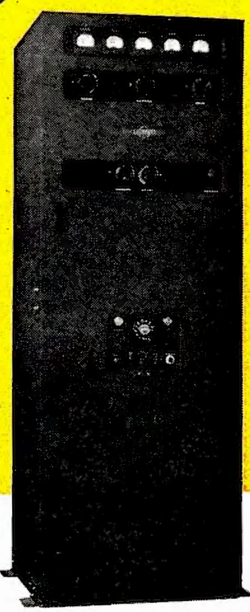

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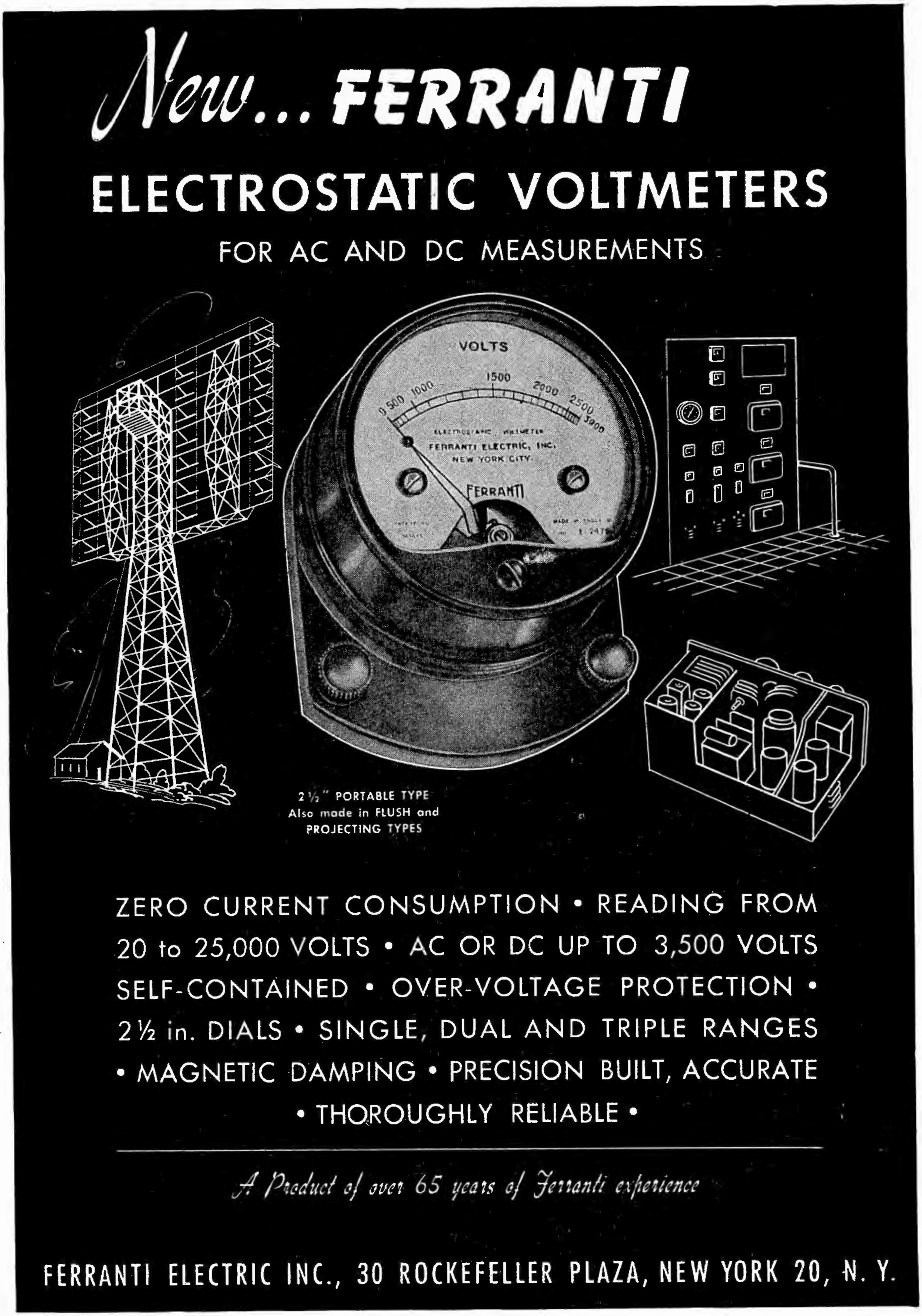
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JUNE, 1947 **VOLUME 27** **NUMBER 6**

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COVER ILLUSTRATION

Field testing 152 to 162-mc mobile radiotelephone system.
(Courtesy Federal Telephone & Radio Corp.)

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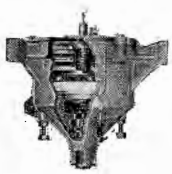

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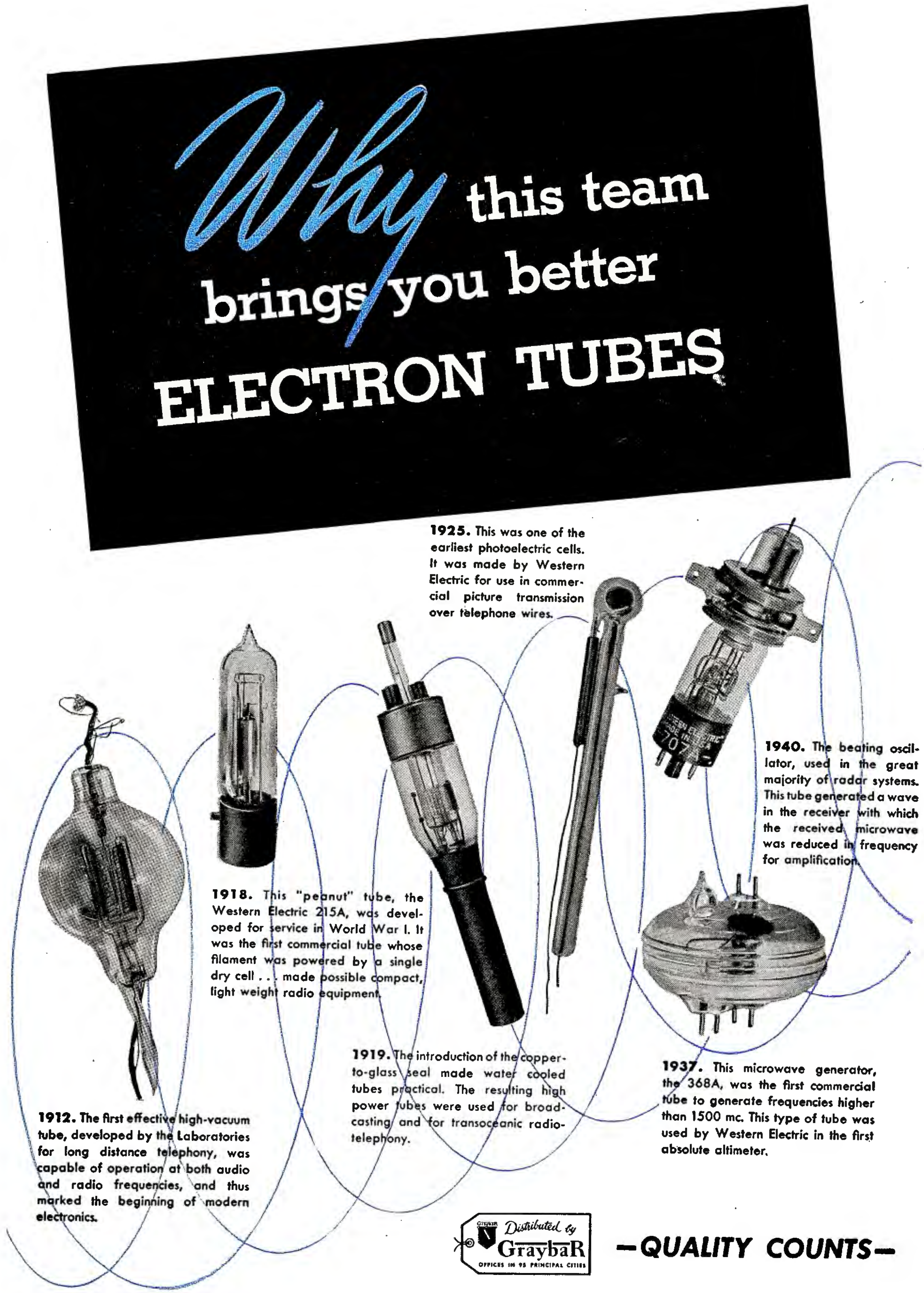
Why this team brings you better
ELECTRON TUBES
1925. This was one of the earliest photoelectric cells. It was made by Western Electric for use in commercial picture transmission over telephone wires.
1940. The beating oscillator, used in the great majority of radar systems. This tube generated a wave in the receiver with which the received microwave was reduced in frequency for amplification.
1918. This "peanut" tube, the Western Electric 215A, was developed for service in World War I. It was the first commercial tube whose filament was powered by a single dry cell . . . made possible compact, light weight radio equipment.
1919. The introduction of the copper-to-glass seal made water cooled tubes practical. The resulting high power tubes were used for broadcasting and for transoceanic radio-telephony.
1937. This microwave generator, the 368A, was the first commercial tube to generate frequencies higher than 1500 mc. This type of tube was used by Western Electric in the first absolute altimeter.
1912. The first effective high-vacuum tube, developed by the Laboratories for long distance telephony, was capable of operation at both audio and radio frequencies, and thus marked the beginning of modern electronics.
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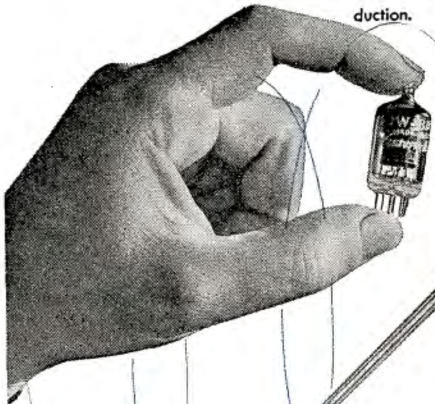
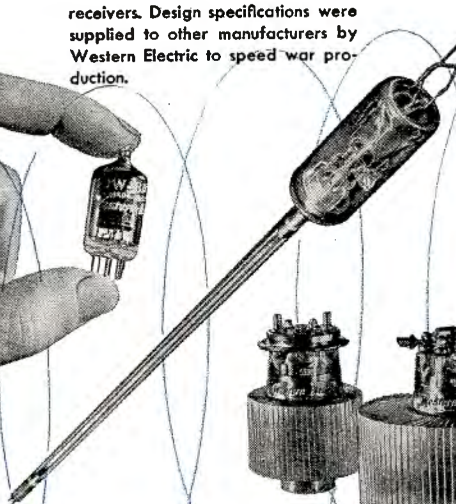
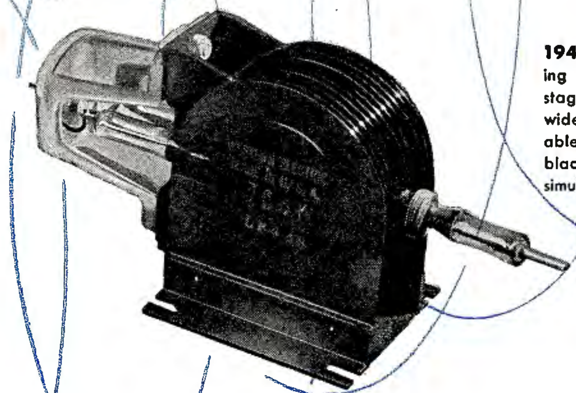
1942. This tiny 6AK5, operating in the vicinity of 400 mc, proved itself invaluable as an amplifier in radar receivers. Design specifications were supplied to other manufacturers by Western Electric to speed war production.





1940. Bell Laboratories produced the first American multicavity pulsed magnetron from a British model. The team of Western Electric and Bell Laboratories developed 75 new and improved magnetron designs by extending operation into the 10 cm, 3 cm and finally the 1 cm bands, and produced over 300,000 of these wonder tubes of World War II.



1945. The Bell Laboratories traveling wave tube, still in the research stage, amplifies over a band 40 times wider than present tubes—may be able to amplify dozens of color or black and white television programs, simultaneously.

TODAY. These new forced air cooled FM transmitting triodes are among the latest in the line of tubes designed by Bell Telephone Laboratories and made by Western Electric. Their thoriated tungsten filaments, rugged construction, flexible terminal arrangements and many other features make them tops in performance in the 88 to 108 mc band.

OVER 34 years ago in the laboratories of Western Electric, De Forest's Audion was improved and developed into the high vacuum tube and put to work for the first time amplifying telephone and radio frequency currents. And *for over 34 years* Western Electric and its research associate Bell Telephone Laboratories have been foremost in designing new and better electron tubes.

Every tube shown here and many developments *basic* to the tube art are examples of that leadership. More than 10 years ago, for instance, Bell Laboratories first used microchemistry to determine what gases were destructive to tube elements, and with Western Electric developed a manufacturing technique to keep these damaging elements out—thus increasing tube life many-fold.

Every one of the more than 300 codes of electron tubes now being made by Western Electric from Bell Laboratories' designs has the same unequalled background of research and manufacturing skill.

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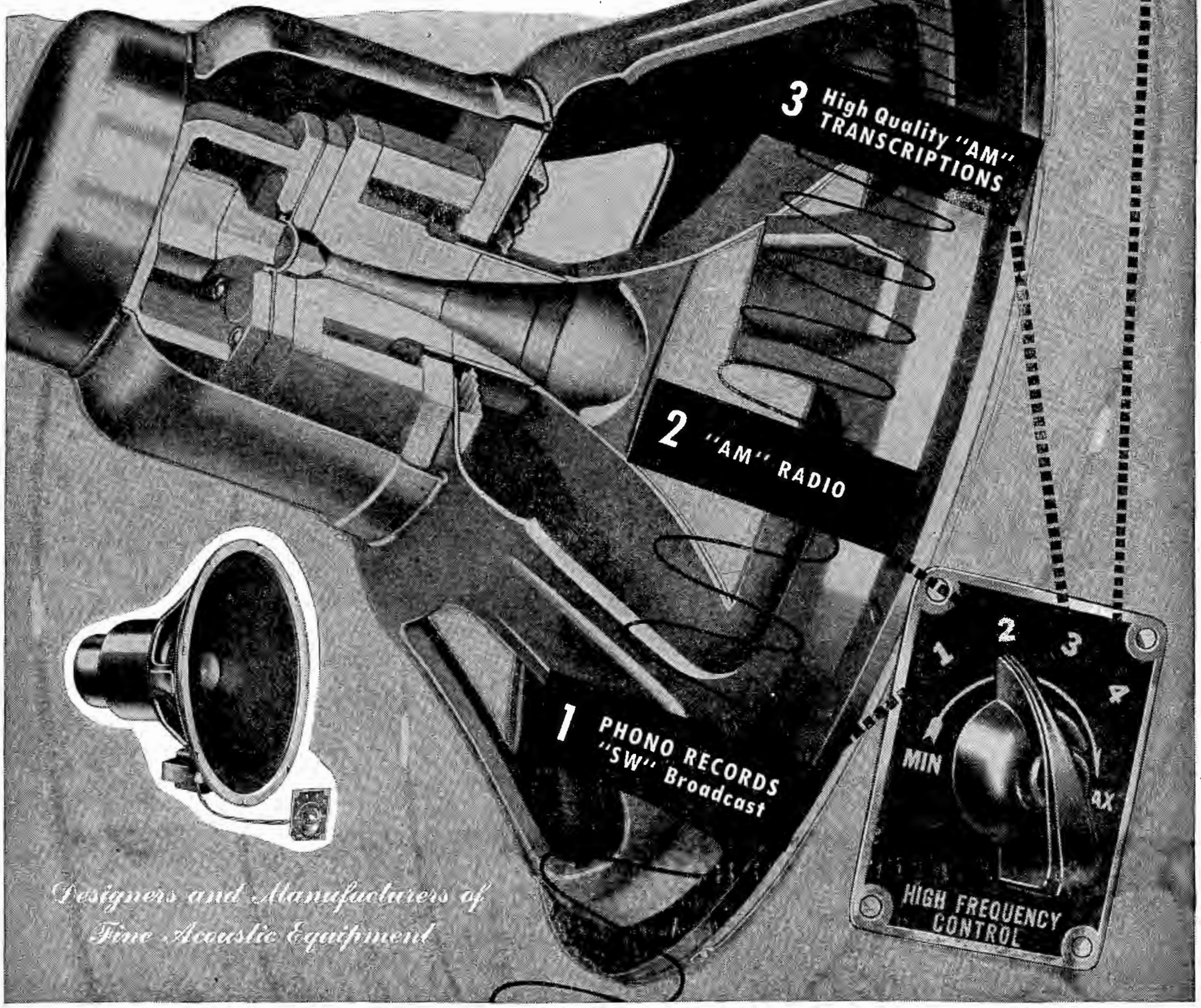

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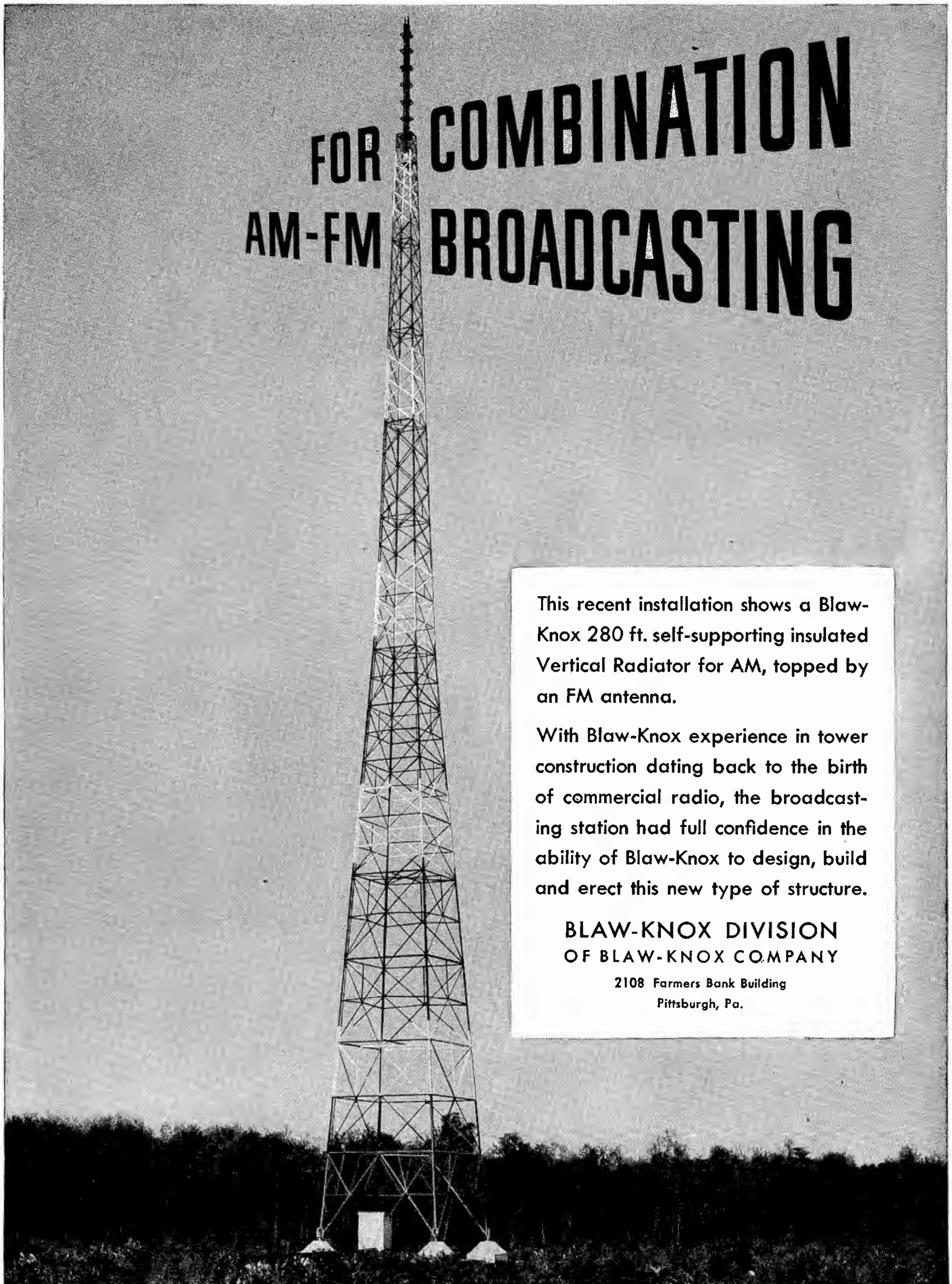

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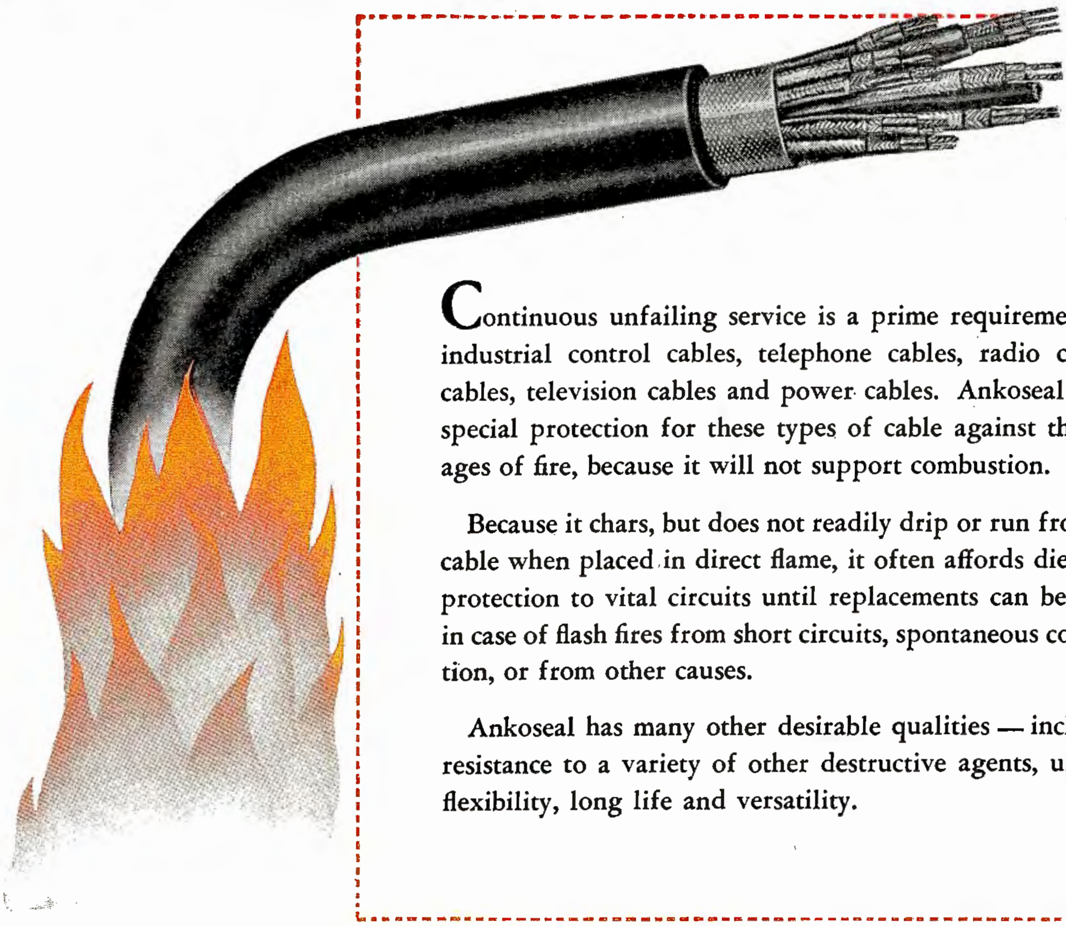

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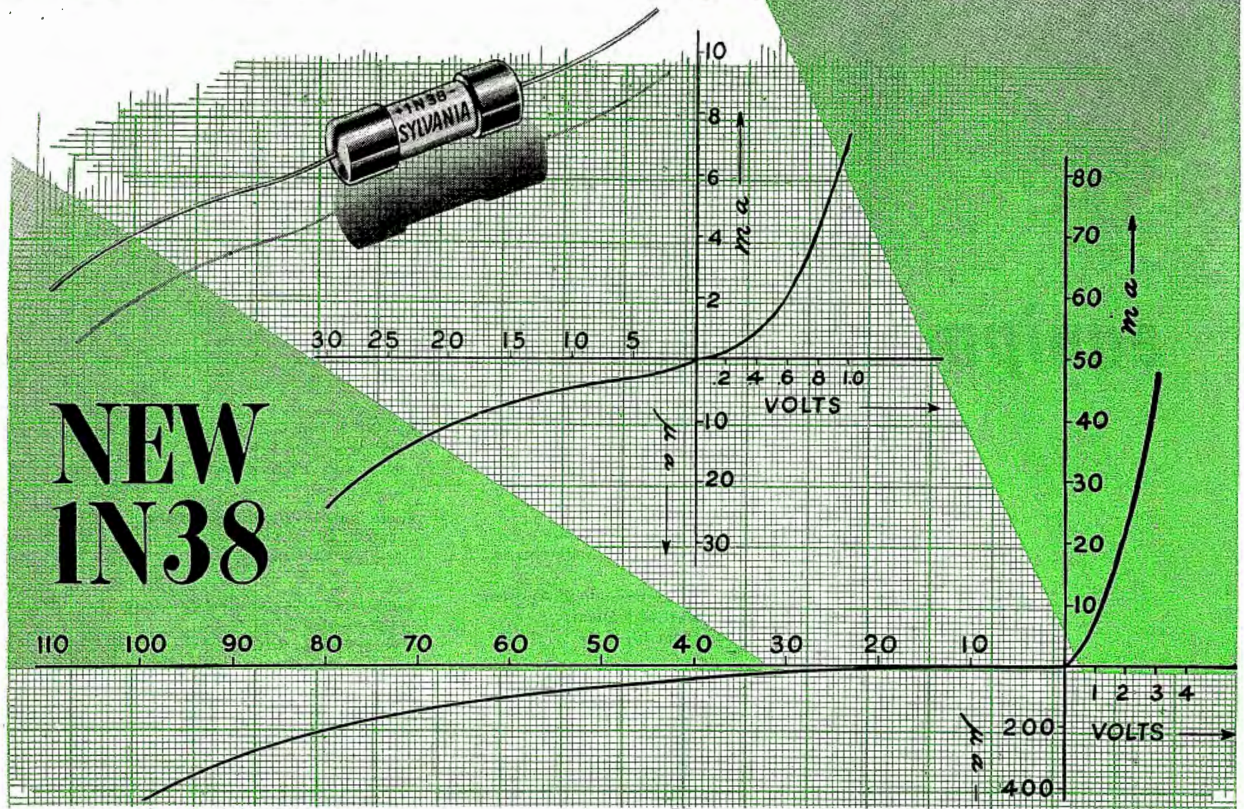

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SYLVANIA ELECTRIC

COMMUNICATIONS

LEWIS WINNER, Editor

JUNE, 1947

V-H-F AND THE CAA

V-H-F COMMUNICATIONS received quite a tribute from CAA Administrator T. P. Wright recently, who during an address before an airport user's conference, declared that the . . . "biggest CAA news is *v-h-f communications.*"

"V-h-f," he said, "will supply a most welcome relief from the aural punishment which pilots have been taking for years."

Stressing the importance of the v-h-f omnidirectional range, he predicted that this method of transmission will change the whole airways picture. For, he said, instead of four legs or courses as now transmitted on the l-f ranges, the v-h-f range will transmit courses in all directions, a course selector being used to select the course to be flown.

Wright said that the v-h-f range will multiply the capacity of our airways for scheduled and non-scheduled flights. The ranges will be placed about 100 miles apart so that their signals will blanket the country and pilots will have a radio course from anywhere to anywhere.

The system will also mean much to the feeder airlines, cited Wright. When all the v-h-f ranges are in, and all operations are shifted from the l-f channels, everybody, including the feeders, he said, will have an airway from everywhere to everywhere.

Wright also emphasized the potential uses of v-h-f distance-measuring equipment; described at the recent IRE meeting in New York City and analyzed in a paper report in the March issue of COMMUNICATIONS. This system provides the pilot with a continuous indication, on a simple dial, of the distance from the point to which he is tuned.

The use of v-h-f and u-h-f for landing guidance in ILS and radar systems will also see wide supplemental application, Wright declared. Airports in Washington, Chicago and New York City have already had radar systems installed and scores of airports are in line for installations.

The use of airborne radar as an aid in flying the rugged coastal route of Alaska was also reported recently by CAA. Installed in a Grumman amphibian, the radar system has made it possible to fly for miles at less than 1,000 feet on instruments. Pilots have reported that the system would make it quite safe to fly in a dense fog or heavy snow with visibility as low as one-eighth of mile.

CAA airways flight inspector chief Arthur E. Jenks has prepared a book on v-h-f aviation communications that's *must* reading. The book, entitled "Flying the Instrument Landing System," is based on more than 3,000 hours of v-h-f test and diagnostic flying.

Looks like quite a v-h-f year!

THE WHITE BILL

SIGNIFICANT CHANGES IN THE COMMUNICATIONS Act of 1934, proposed in the new White-Wolverston Radio Bill, are being scrutinized carefully by industry and government. There are a few sections, in particular, which are receiving the "fine-tooth-comb treatment" . . . sections 4 and 5. Section 4 takes from the President the authority to name the chairman of the FCC. And section 5 states that the FCC shall select, annually, one of its members as chairman. This section also provides for a sub-division of the commission into *broadcast* and *common carrier* divisions.

It's been indicated that the rotating chairmanship would eliminate the effectiveness of the post. And the subdivision idea has not been received too favorably either, it being felt that the change would cause hearing delays and confusion.

The technical facilities of the FCC, stressed in the bill, receive continued authority to regulate equipment standards and control technical operations of stations.

There'll be rows of hearings and then the roll call and all-important vote decision which may come in the early Summer.

IN THE NEWS THIS MONTH

THE P-A SYSTEM has now come to the aid of the baseball umpire at home plate. A gentleman in Philadelphia has received a patent on a system which provides a microphone under the protective mask and contact to an amplifier through metal plates on the shoes.

There'll be a real roar to the strike and ball calls when this system finds its way into the ball parks.

QUITE A COMPREHENSIVE apartment house tv-antenna agreement has been prepared by the TBA, and accepted by several realty groups in New York City.

The agreement, a three-page legal affair, includes complete details on installation provisions, building codes, accident insurance, site selection, use of antenna by one or more tenants, responsibilities assumed by installer and user, and so on.

Yes, it's quite a document, but it solves an important problem and the TBA antenna groups are to be congratulated on gaining this realty acceptance.

TEN MANUFACTURERS HAVE RECEIVED FCC-standards approvals for their f-m transmitters ranging from 250 watts to 50 kw. Three types of frequency and modulation monitors have also been approved.

Incidentally f-m broadcasters have certainly multiplied during the past months. There are now about 215 stations on the air. And FCC says that it won't be long before 500 different communities in 47 states will be served by f-m.

THE 25TH ANNUAL NAB CONVENTION will be held in Atlantic City, September 15-18, in Convention Hall, with quite an equipment exhibition and series of broadcast engineering clinics. COMMUNICATIONS will publish a complete report on the affair. Watch for it.—L. W.

V-H-F Railroad Communications

THE ATTENUATION OF SPACE RADIO SIGNALS within tunnels presents a problem which is not insurmountable, but quite a challenge from an economic and engineering point of view.

In v-h-f band tunnel-transmission tests, it has been found that the masonry or rock walls of railroad tunnels form poor boundaries; if the tunnel were to be considered as a wave guide, masonry performs as a poor dielectric. Repeated reflections from such surfaces soon absorb the signal.

In preliminary tests in an abandoned brick-lined water tunnel, circular in cross section and 8′ in diameter, attenuation of signals in the 156-mc range was found to be 106 db per 200 feet. It was found though that signals could be carried through a tunnel on a transmission line, with the transmission line placed in the crown of the tunnel and arranged so that there would be no coupling into the high-loss tunnel walls, nor an appreciable electrical field within the tunnel. The transmission line had to be designed so that the signal loss was minimized. This was achieved by placing reflector wires above the transmission line in the tunnel crown. Practical means of bringing space radio signals from outside, to trains moving within the tunnel, was achieved by terminating both ends of the transmission line into outside directional antennas.

By the use of such a system, engine-to-caboose communication may be made continuous as the train approaches and actually passes through the tunnel. For instance, when the engine has entered the tunnel, the signal from the caboose, still being outside, is picked up by the antenna at the tunnel mouth and fed directly into the transmission line within the tunnel, thus reradiating the signal to the locomotive. Tests also proved that after both ends of the train were within the tunnel the transmission line effectively served to link locomotive and caboose by reradiation of the signal. Likewise, the locomotive after it had emerged, fed the signals to the antenna at the opposite end by space propagation.

Preliminary Tests

The preliminary field tests in the abandoned water tunnel were conducted in a portion of the tunnel curved on a 500′ radius. A vertically polarized transmitting antenna was mounted just outside the mouth of the water tunnel. A hand-cart using two bicycle wheels was improvised to carry a superheterodyne receiver-type field strength meter. The receiving antenna was a vertical top-loaded quarter-wave type which was worked against a quarter-wave radius rod ground plane. This antenna was mounted on a short mast on the hand-cart which was placed as far away from the operator as possible to minimize the effect of the operator's body on readings. However, due to reflections and the difficulty of maintaining the cart in a level position on the curved floor, voltage readings were considered to be at least 10% inaccurate. The cart was pushed through the tunnel and readings were taken at 25-foot intervals. Using these voltage readings the attenuation in db per unit length of tunnel was calculated for the various transmission lines which were used in the tests. Figure 1 shows the relative positions of the transmission line under test, also the receiving antenna and equipment which was installed on the cart.

Three different transmission lines were tried and for each test 300′ of line was constructed. The physical arrangement of the transmission lines may be seen in Figure 2 (*a*, *b*, *c*). To minimize wall absorption reflecting lines were placed above the transmission line. The arrangement *c* in Figure 2 was used as a prototype similar to the final installation. A record of signal attenuation appears in Table 1, p. 19. These tests showed that the shielding of the transmission line from the tunnel roof by reflecting wires was of major importance.

It was assumed that the relative field strength received from the transmission line would follow the relations governing the fields around an antenna:

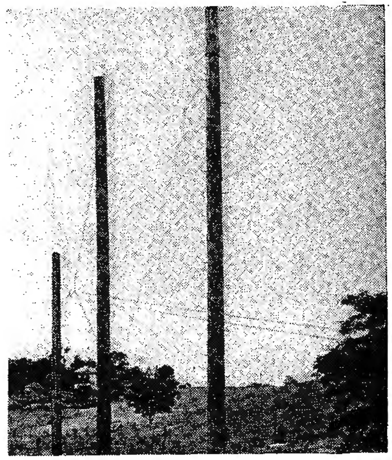
$$E = C\,I_L\left[\frac{2\pi}{d\lambda} - j\frac{1}{d^2}\right] \qquad (1)$$

East portal of the Mt. Airy tunnel showing the radio transmission lines. The double-wire feedline at the upper part of the illustration is connected to the rhombic antenna placed atop of the tunnel.

Overhead catenaries or cross wires supporting the v-h-f redistribution antenna, as seen from the west end of the Mt. Airy Tunnel. Wire runs out of the tunnel roughly paralleling the tracks for a short distance.

IN TUNNELS

Tests on 152 to 162 mc, Conducted in Abandoned Water Tunnel and B. & O. Railroad Tunnel at Mt. Airy, Maryland. Signals Fed Into Transmission Lines Via External Directional Antenna. Reflecting Wires Served to Minimize Signal Loss.



Directional rhombic antenna installed near the east entrance of the Mt. Airy tunnel in Maryland. The *diamond* shaped antenna may be seen faintly supported on either side of the central pole.

by J. P. SHANKLIN

Project Engineer
Bendix Radio, Div. of Bendix Aviation Corp.

where:

E = relative voltage of field
d = distance from the line
λ = wavelength
I_L = line current
C = a constant of proportionality

This equation states that the radiation field, $C\, I_L \frac{2\pi}{d\lambda}$, varies inversely as distance, and the induction field, $C\, I_L \frac{1}{d^2}$, varies inversely as the square of distance and is at 90° phase angle to the radiation field. At $d = \frac{\lambda}{2\pi}$ the two are equal. In the case of the transmission line d was taken to be approximately equal to the distance from a point half way between the high side of the line and the ground plane, and a point at the current center of the antenna. In the case of the top loaded quarter-wave antenna used this would be near the center of the vertical antenna. The constant C will depend on line spacing and was not determined for the water tunnel lines. However, the voltage received was measured at varying distances from the five-wire line C of Figure 2; this is plotted in Figure 3 and compared with a plot of equation (*1*).

Railroad Tunnel Used for Final Tests

After these preliminary tests an installation was next made in the Baltimore and Ohio Railroad tunnel at Mt. Airy, Md. This is a double-track brick-lined tunnel 2,760' long. The line (surge impedance of 324 ohms) used in this installation is shown in Figure 4. The line may be considered to have half the surge impedance of a

Figure 1
Relative positions of the transmission line under test; also the receiving antenna and equipment.

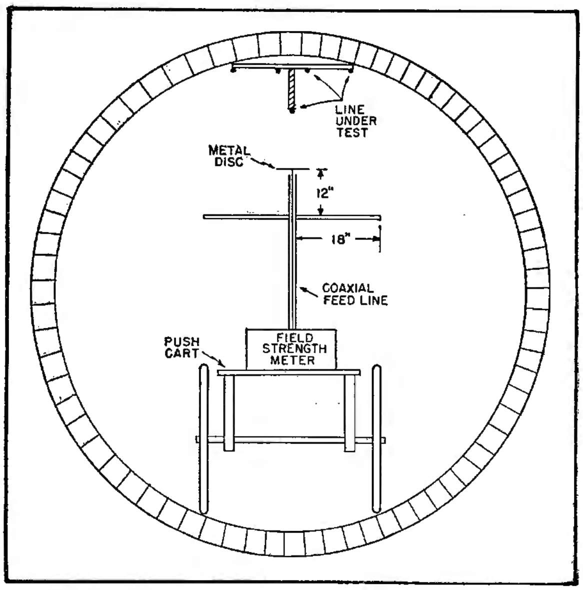
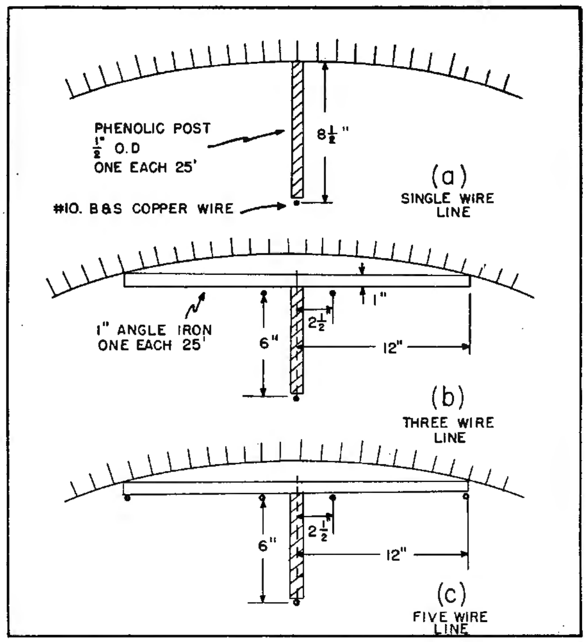


Figure 2
Physical arrangement of the transmission lines. Arrangement in C was used in final setup.



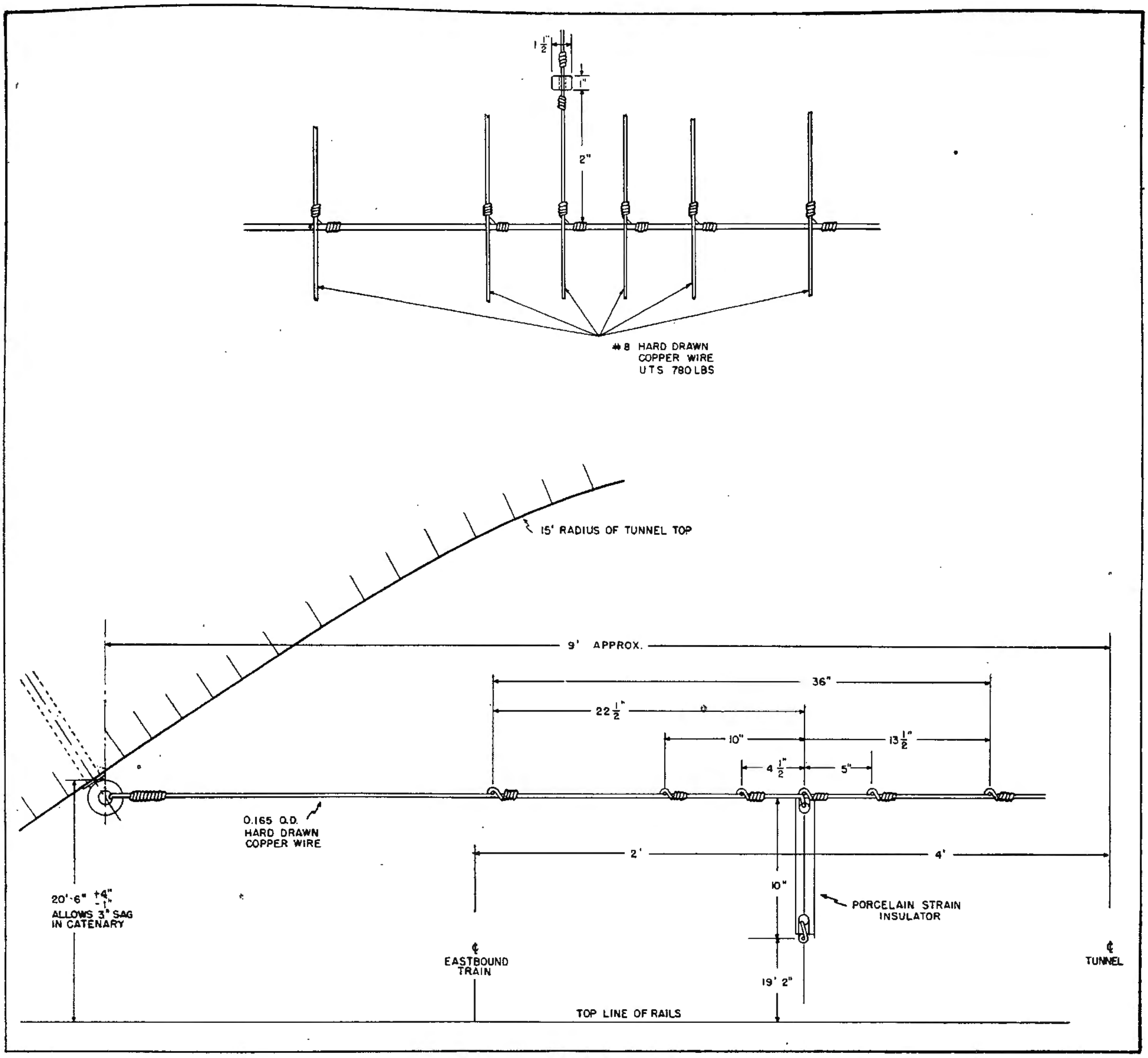


Figure 4
Installation setup in B. & O. tunnel at Mt. Airy, Md.; a double-track-lined tunnel 2,760′ long.

balanced line with twice the spacing between the insulated wire and the ground plane, as the ground plane supplants the virtual ground plane which exists through the center plane of a balanced line. This unbalanced line was transferred to a balanced line at the tunnel entrances by drawing the ground plane wires gradually together to a point (Figure 5). The balanced line (575 ohms surge impedance) was then fed into a rhombic antenna located on top of the tunnel out at either tunnel mouth (Figure 5). These rhombics, with a theoretical gain of 15 db, were directed at the track one mile distant from the tunnel.

For test purposes two 10-watt output transmitters were located along the tracks; one .7 mile from the west portal of the tunnel and one 1.2 miles from the east portal of the tunnel. These fed vertical coaxial dipoles mounted at the same distance above rail tops, as though mounted on a train.

The match between the rhombic antennas and the balanced feed lines, and the feed lines and tunnel line, was investigated by measuring the standing wave on the lines with a probe antenna connected to the field strength meter. To investigate the matches at the east end of the tunnel the west-end transmitter was turned on and then the process was repeated to investigate the match at the west-end. The signal would then be coming out of the tunnel at the end under investigation and standing waves would be created by a mismatch. In no case was the voltage standing-wave ratio greater than 2 to 1 and as this would result in losses in the order of only 1 db, no artificial matching in was necessary.

The field strength meter was then mounted on a scaffold car which had been used in construction of the tunnel line and readings taken at 100-foot intervals through the tunnel. Only the four center wires of the six-wire ground plane were installed at first. This line showed a total attenuation of 32 db. The two center ground plane wires were then installed and the attenuation dropped to 15.6 db. Of this loss, 3 db was due to a slight curve 1,000′ inside the tunnel at the east end. The theoretical loss of the copper line was 1.01 db per 1,000′ or 2.8 for 2,760′. The remaining 12.8 db was probably due mostly to tunnel wall absorption. Reflection at the insulators was so slight that it produced no measureable standing wave.

To meet the clearance requirements demanded by the railroad it was necessary to have a five-foot gap between the trainboard antenna and the lower wire of the tunnel line. This resulted in a 31.3 db drop from the total signal actually present on the transmission line and that picked up on the train.

The space drops in the propagation distances outside the tunnel were the largest involved. These were 85.8 db for the .7 mile at the west-end and 99.1 db for the 1.2 miles at the east-end. Neither path of propagation was line-of-sight. However, had dipole antennas been used instead of the rhombic type, the additional drop would have been approximately 15 db.

Using a 10-watt transmitter and taking 2 vu on a 50-ohm impedance cable as a minimum commercially usable signal, a total drop of 141 db may be tolerated.

The various drops encountered in the railroad tunnel tests were:

.7 mile of space at west end..	85.8 db
.5 mile of tunnel line.........	15.6 db
4′ tunnel line to train.........	31.3 db
1.2 mile—total attenuation.....	132.7 db
1.2 mile of space at east end....	99.1 db
.5 mile of tunnel line.........	15.6 db
4′ tunnel line to train.........	31.3 db
1.7 mile—total attenuation......	146.0 db

Type of Transmission Line	Attenuation db per 100′
None	35.4
a.......1 wire	26.0
b.......3 wire	4.4
c.......5 wire	Negligible

Table 1
Record of signal attenuation

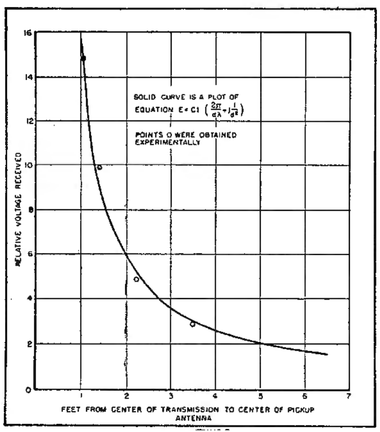
The above attenuations were measured as a total and as separate drops with substantial agreement between the single total and the sum of the separate drops.

The last total attenuation exceeds the allowable attenuation. However, few freight trains are as much as a 1.7 miles long. Also had the tunnel line been extended some distance down the tracks outside the tunnel the space drop could have been greatly decreased with the addition of a small amount of line attenuation. Such an out-of-the-tunnel line need be only a two-wire balanced line as no shielding from high loss material is necessary outside the tunnel.

The installation as demonstrated in these tests was considered to be satisfactory from a practical railroading point of view. It was proved that space radio communication can be maintained on trains operating in tunnels.

The tests indicated that a careful selection of wire used for transmission lines is imperative. These tests made use of copper wire for the transmission line. However it is known that few metals will withstand the corrosive stack gases of a steam engine. However, some of the stainless steels have proved useful in tests run by the Baltimore and Ohio Railroad, the wire being virtually unaffected by combustion gases. It is also of interest to note that these steel alloys are not magnetic and while their electrical resistance is about 6.5 times that of a similar copper conductor at v-h-f frequencies, it would still seem to be practical to build a tunnel line of stainless steel. The major part of the 15-db line attenuation in the Mt. Airy tunnel was due to tunnel-wall absorption. If such a line were constructed of stainless steel using No. 0-B&S gauge for the insulated strand and No. 15 B&S gauge for the six-ground plane wires, a line of approximately 30 db total attenuation in the transmission would have resulted.

Figure 3 (Below)
Plot of voltage received at varying distances from the five-wire line of *C* in Figure 2.



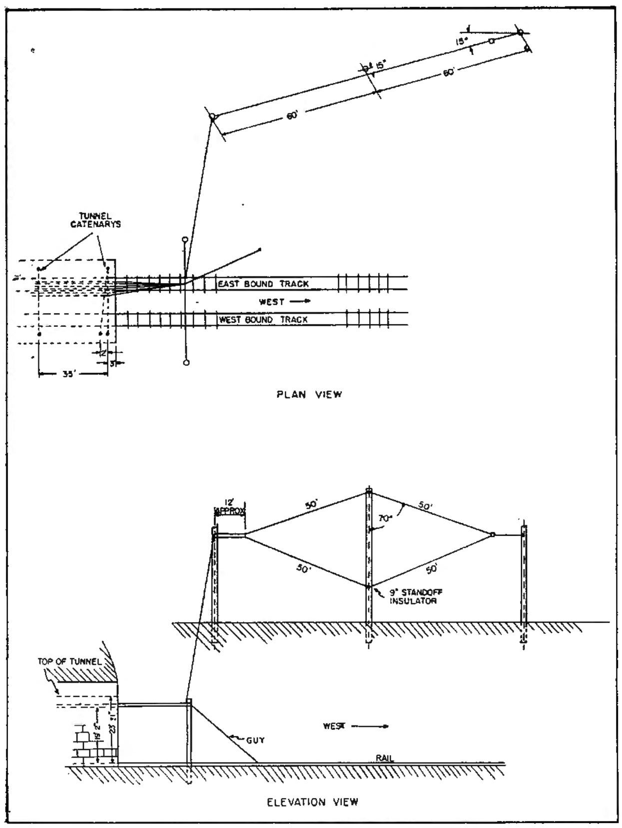
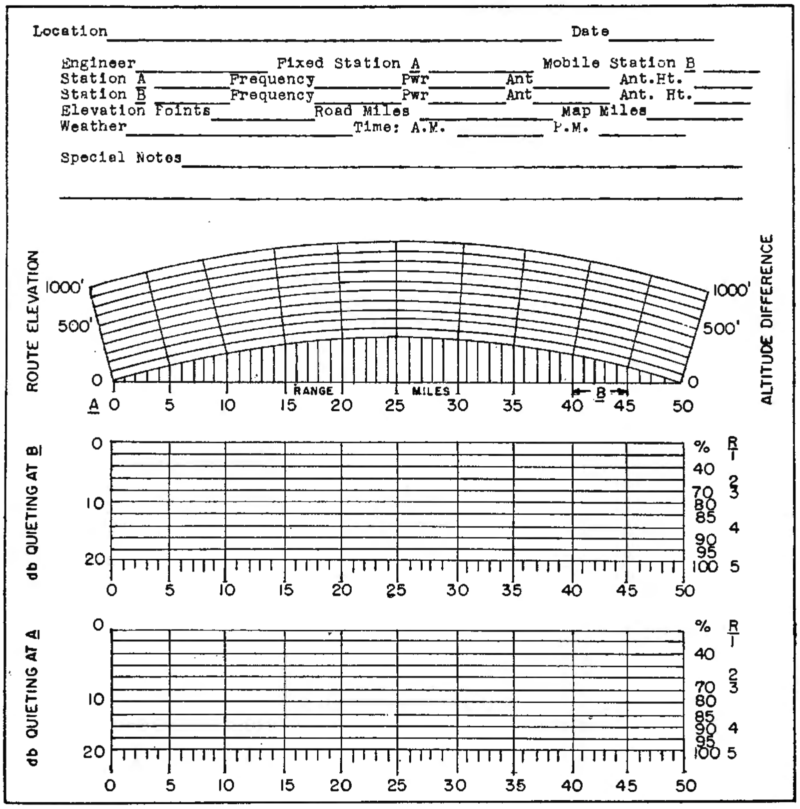


Figure 5
Layout of rhombic-antenna system located on top of the tunnel at either tunnel mouth. Rhombics had a theoretical gain of 15 db.

V-H-F Propagation Surveys FOR MOBILE SERVICES



Field test data sheet.

A Study[1] of the Various Pieces of Equipment Required for the Tests, and an Analysis of the Methods Applied During the Surveys.

by RALPH G. PETERS

THE SITE OF OPERATION has always been an important factor in communications and in the v-h-f bands it is even more important because of the optical-path requirements. Accordingly it has been necessary to conduct substantial field surveys of the areas, with critical analyses of the propagation characteristics.

Making Field Surveys

The signal plus noise divided by noise ratio at the outer limit of the range method has been a very practical way of determining useful range and *dead* areas. The greater this ratio, $(S + N)/N$, for a particular combination, the greater the range because a usable percentage of intelligibility is generally limited to about 6 db of equivalent noise ratio, carrier on to carrier off, rather than any value of microvolts per meter.

To conduct a survey in terms of db ratio of equivalent $(S + N)/N$, only a few pieces of equipment are required. Items include a one- to two-thousand-ohm potentiometer, preferably wire wound or relative high wattage of 2 to 5 watts, one 500-line to 3-ohm voice-coil matching transformer, and one db meter with at least a 20-db range on one scale (or an output meter with minimum scale down 20 db or more from the maximum reading of about 1.75 to 2 volts).

In application, the db meter (or output meter reading volts) is arbitrarily set to zero (or some reference value in case of a different meter) with no carrier and squelch set for maximum noise. When a carrier is received on without modulation the noise will be reduced to some value, about 20 db for best results and 100% intelligibility. The amount of this reduction in noise by an unmodulated carrier is a measure of the usefulness of the system at that point in the field measured, and with the local existing noise level present.

The range or contour map can then be plotted in terms of db ratio of noise, carrier off to carrier on, for no modulation; noise is measured with carrier off and squelch set for full noise, this being used as a zero reference level. The reduction in output noise is then measured with carrier on and no modulation.

If a remote console standard db meter is used the level of full noise would be set at +6 db, so that the noise reduction due to carrier could be read down to –10 and estimated to –15 or so. This means that a reduction of +6 to –15 or –21 db could be easily determined.

An accurate signal-generator is quite handy in these tests, too, providing actual microvolts corresponding to various values of microammeter test readings on meter test positions. Microvolts for a given db noise quieting may be determined.

Checking Optical Path From Geodetic Survey Maps

There are cases where the transmission path is not obvious or where distance is near the critical limit, and it is helpful to plot the elevation contours

[1]*Data courtesy Motorola, Chicago.*

Farnsworth

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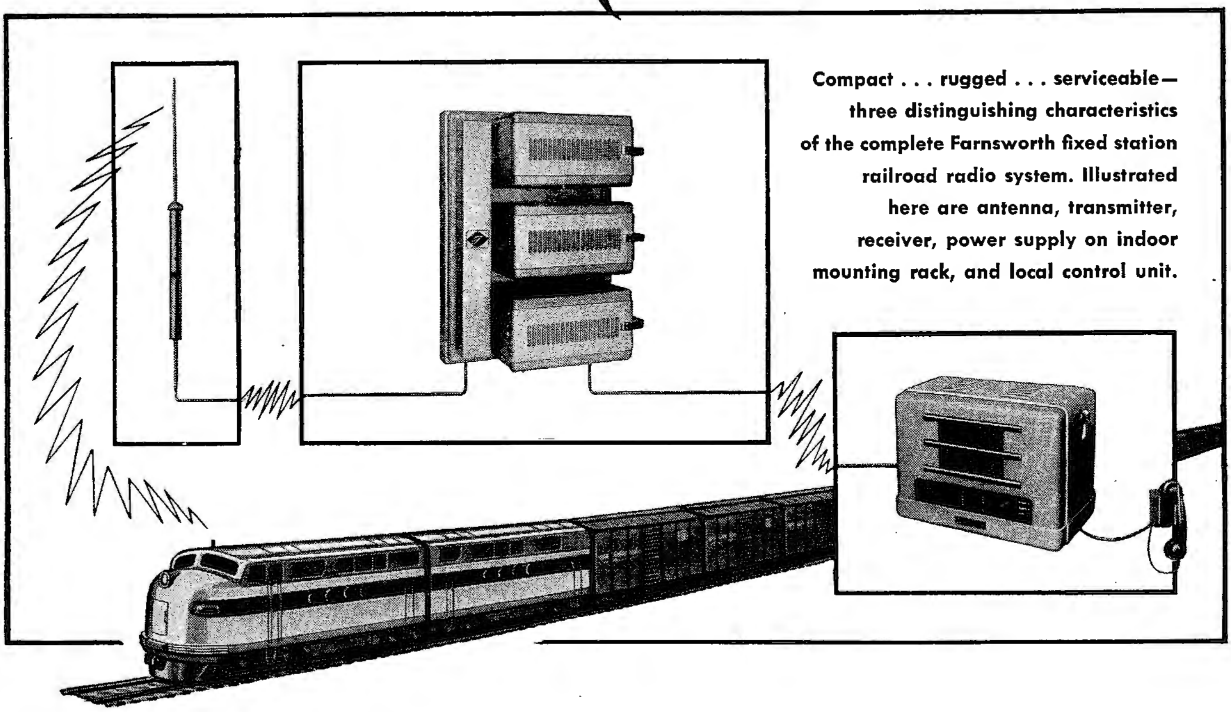

Progressive railroads have waited many years for railroad radio communications equipment in which they could invest with confidence.

Now Farnsworth engineers and designers—the same men who pioneered the adaptation of radio to rail communications—have developed practical, reliable, *guaranteed** railroad radio communications equipment which merits capital investments.

Farnsworth systems are *thoroughly engineered* to meet the unique and exacting standards of railway operation . . . *carefully designed* to provide maximum usefulness and flexibility . . . *comprehensively planned* to comply with regulations of the FCC and ICC, and the specifications of the AAR . . . *exhaustively field-engineered* over a period of years to guarantee simplified, low-cost maintenance. Developed systematically and without haste in one of the world's great electronic laboratories, Farnsworth systems represent the best equipment designed and produced for this highly important service.

Write Dept. C-6, Farnsworth Television & Radio Corporation, Fort Wayne 1, Indiana.

* *Farnsworth guarantees this equipment for a period of one year* against defective design, material and workmanship, and agrees to remedy any such defect in any railway electronic unit of its manufacture, provided that the unit is returned intact, bearing original serial number with all transportation paid, for Farnsworth's examination at its Fort Wayne, Indiana, factory within one year and thirty days from date of purchase. This warranty does not, however, extend to tubes or moving parts (components which carry the guarantee of the manufacturers thereof).

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STATION........ OPERATOR.............. DATE........ PAGE......

Time	Test No.	Position, Notes, Landmarks	Readability R	Quieting audio (db)	Meter—R-F sensitivity Position No.		Mileage	Speed	Miles out	Air miles	Microvolts		
					With carrier	No carrier							

Survey log form.

between the two radio contact points. From these elevation contours it is much easier to determine whether or not a particular proposed circuit may be feasible.

To conduct those studies geodetic survey maps[2] of states and territories are quite handy.

In making an elevation contour, the state or territory maps with scales of 8 or 16 miles to the inch should first be secured. These state maps are good for general layout of the transmission paths from point to point. To give closer details, these maps are sectionalized into squares or quadrangles which are coded by numbers on the large scale state map. If the transmission path falls across two or more of the blocks which have been surveyed, it is much easier to secure copies of these particular blocks or rectangles to a more detailed scale of 1 to 2 miles per inch. From the large scale state maps, it can be easily determined where the radio path enters and leaves the sectionalized or rectangular blocks, and a straight line can be drawn across these rectangles, representing the radio path. The contour intervals generally run 25′ to 50′ per contour line so that the vertical elevations can be read from the more detailed rectangular blocks quite easily at all points along the radio or optical path. From the scale of the map these points can be transferred to the elevation contour drawing being developed.

To develop the contour drawing it is usually most convenient to take a radius of 15″ and draw a heavy arc representing the surface of the earth at sea level. The elevation above this earth surface line should be for the radius used here, exactly 500′ per inch. Additional arcs should be drawn above the earth's service at inch or half-inch intervals, depending upon how accurate the contour is required. For very hilly terrain 500′ intervals, an arc at each inch will be sufficient; for terrain which is not hilly these arcs should probably be drawn at one-half and one-quarter inch intervals, always remembering that the vertical scale is 500′ to the inch. The two radio points at either end of the path should be drawn in at their respective altitudes above sea level as determined from the contour maps. From the scale given on each map, it is easy to measure the distance from either end of the radio path by the use of a compass or ordinary ruler, so that each contour interval can be measured with respect to its distance from the radio contact station at the end of the circuit and laid off on a line drawn between the ends of the radio circuit. The easiest way to do this, although not strictly accurate, is to find two points on the arc representative of the two ends of the radio circuit to the scale selected for the map. A chord may be drawn between these two points to the scale in inches per mile desired. The distance from either station to the particular contour whose elevation is being determined and plotted may be then measured on this chord and transferred up to the elevation arc on a straight line through the center at the point used to strike off 15″ earth's surface arc.

Certain factors affecting transmission at the higher frequencies should be noted when endeavoring to determine the best radio path for general or relay transmissions:

(*1*) It is obvious that the best path is always optical and for certain safety factors should be somewhat above optical, for relay applications in general.

(*2*) Locations near busy highways where ignition or r-f noises may be present should always be avoided.

(*3*) Signals will generally be better at a greater distance if the more distant station is always out in the clear and not shadowed by hills, buildings or other obstructions.

(*4*) If it is necessary that the radio path pass over hills, it is then best that these hills be far from both stations; that is, out near the center of the radio path if possible.

(*5*) If it is desired to transmit or control different locations with frequencies close together, then it is quite often necessary to use directors or reflectors or directive arrays. Directive arrays may also aid in increasing signal strength at times to get over some hills or other obstructions.

(*6*) The use of a larger than normal coaxial line for long r-f antenna runs is always helpful where higher towers are required to get over intervening hills.

(*7*) It is quite important to stay away from large and tall steel framed brick buildings because of their reflecting and absorption properties.

(*8*) Quite often a lower elevation or lower antenna location off to one side of a hill is appreciably better than a higher one directly in line with some nearby reflecting hill.

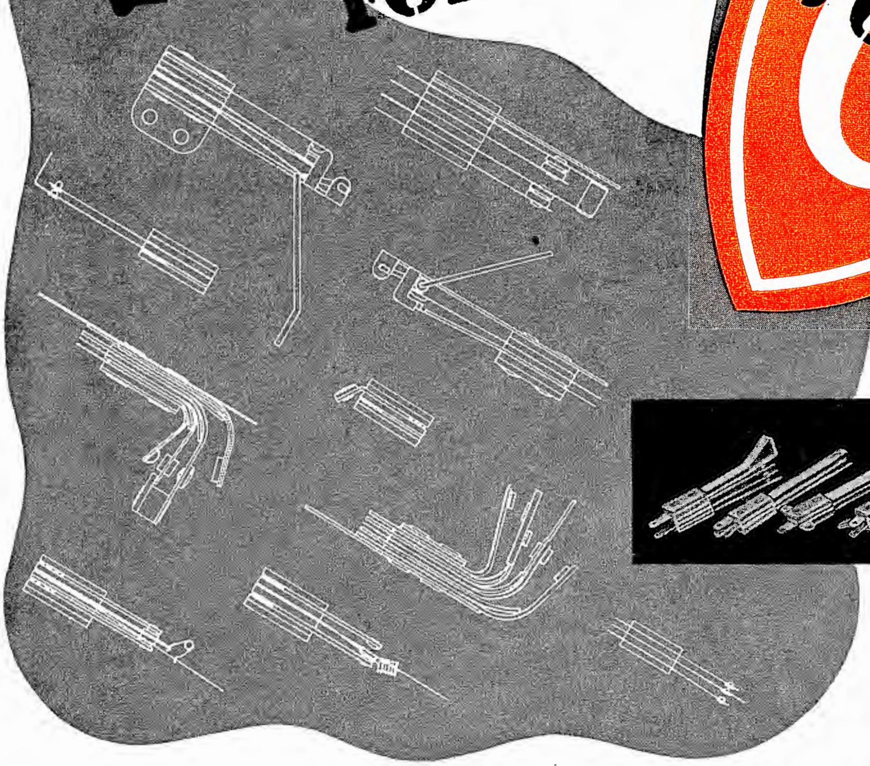
(*9*) Receiving locations should always be placed away from manufacturing plants, welders, motors, diathermy equipment, radio-frequency heaters, etc.

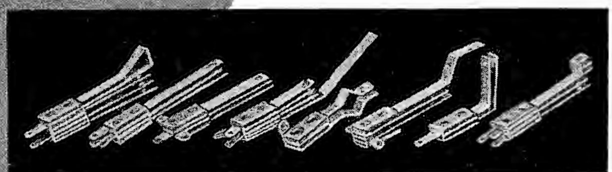
(*10*) It is best to determine the location where the ground will slope down from the station level towards the other end of the radio link rather than to have rising ground in front of either station. This is especially bad if there is rising ground for several

(*Continued on page* 41)

[2]May be secured, generally for 10 cents each, from the Director of U. S. Geological Survey, U. S. Dept. of Interior, Washington, D. C. In Canada, maps may be secured from the Surveyor General, Department of Mines and Resources, Ottawa, Ontario.

Switches OF TOMORROW FOR DESIGNS OF TODAY





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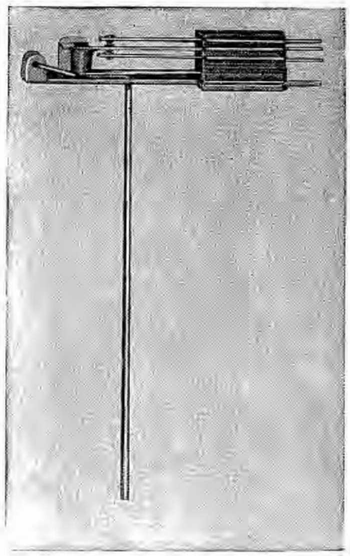

GUARDIAN FEATHERUB SWITCH

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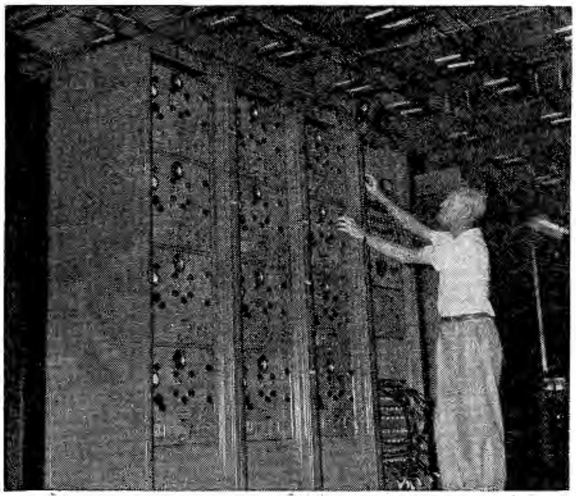
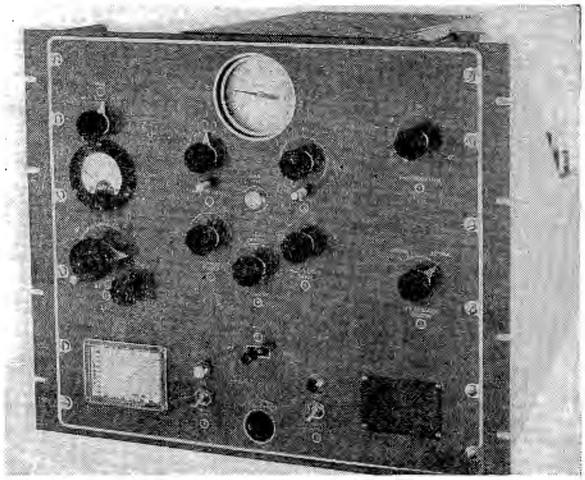
A COMPLETE LINE OF RELAYS SERVING AMERICAN INDUSTRY



Transmitting frequency-shift keying units with a control bay at a typical international airline station.
(*Courtesy Press Wireless*)



Close-up of high-frequency transmitting frequency-shift keyer.
(*Courtesy Press Wireless*)

International Commercial Aviation RADIOTELETYPE SYSTEMS

THE RADIOTELETYPE SYSTEM of transmission offers many unique advantages. For instance, it is possible to standardize methods of actual transmission and apparatus. Conventional message tapes, punched by perforators, can be interchanged at will between land line (such as CAA weather circuits) and radio transmission circuits. No transcription or changeover process involving two different types of transmission (such as manual radiotelegraph to teleprinter circuits) is required. Ordinarily all material incoming on the circuits is punched on tape by reperforators, and the section containing the required text (such as certain weather collections) is torn off from this tape and transmitted on the radio or landline circuit.

Speed of transmission is another feature. Automatic (in place of keyboard) transmission is used on all modern radioteletype circuits, insuring a speed of from 60 to 100 groups per minute. Long tapes can be inserted in the *TD* (transmitter-distributor) of the sending equipment and left unattended until transmission is completed. One operator can thus handle several outgoing circuits. (For this reason, many installations group all transmitting circuits, *TD's*, together, attended by one or more operators.)

Although radioteletype transmission was used years ago by the CAA and other agencies, and developed extensively by the military during World War II, commercial installations are only now adopting this service for domestic circuits.

Hypothetical Installation

The system also has excellent possibilities for international airways control. To illustrate let us assume that an installation were made in a centrally-located seacoast country like Turkey.

This system could be used for both international and domestic traffic.

Weather traffic, as well as aircraft movement messages, *notams*,[2] etc., could be handled by Ankara with Cairo, Rome, Athens, Beyrouth, Teheran and all other stations on air routes entering Turkey. It would also be possible to take advantage of already existing facilities, originally installed by the AACS and AAF at Payne Field (Cairo), Rome, etc. Inasmuch as typing equipment at Ankara would be identical to those of other ex-military installations, activation of new circuits would be comparatively easy.

Weather would constitute by far the greatest percentage of traffic handled by both the international and domestic systems. It is assumed that Ankara would have continuous schedules with key stations in other countries, and would, on schedule, transmit and receive forecasts, synoptic data, and *notams*.

Broadcast Transmission Method

To save point-to-point circuit time, the broadcast method of transmission could be used wherever possible. For instance, Ankara would receive (simultaneously with several other control stations in other countries) an hourly report of synoptic weather broadcast from Rome. In addition to Ankara, Athens, Budapest and Cairo might simultaneously intercept this broadcast.

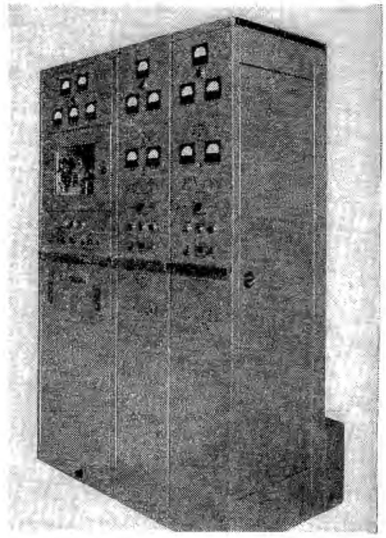
The international Ankara weather broadcast would consist of a resume or collection of all reports from its satel-

[2]Notices to airmen.

Analysis of Centralized-Network Systems Which Expedite Control of Air Traffic, and Transmission of Reservation, Administrative and Airmen Notices.

by F. VINTON LONG[1]

Communications Consultant
Intercontinent Engineering Corp.



A 3-kw multi-channel h-f a-m transmitter for teletype, telegraph and telephone use.

(*Courtesy Westinghouse Electric International Corp.*)

lite stations, plus Ankara local weather. All of these transmissions would take place on one net operating frequency that is common to the eastern division of Turkey. Simultaneously, stations of the western division (airways system arbitrarily divided into eastern and western divisions to lighten the traffic load on each net frequency) would transmit their data to Ankara.

Ankara would record (by cutting tapes) these transmissions by means of typing reperforators. After reception from all satellite stations is completed, Ankara would add its own local weather data (punched out on a manual tape-cutting machine immediately upon receipt from the weather observer) and place the entire collection of cut tape on an international transmitting circuit.

Transmission of the Turkish data collection, plus certain portions of the international circuit data received from abroad, would be broadcast each hour on Ankara's domestic transmitters. During this broadcast, eastern and western division transmitters would be locked together to one *TD* so that each intercept satellite station would receive the entire collection for both eastern and western points. It should be noted that no receipts are indicated for reception. Blind transmission employed in all instances, is arbitrarily assumed to have been received.

It might appear that the broadcast type of transmission would be unreliable, but experience has proven that speedy dissemination of a large mass of weather information with an average of 90% or better reception is more useful than the slower method of transmitting all weather data point-to-point, with a receipt for each individual message. If urgently required, any unreceived sections could be filled in (by request) on the regular point-to-point circuits.

It will be noted that each satellite would receive its own weather back from Ankara during the broadcast. Inasmuch as the percentage of this particular portion of the entire resume is small compared to the whole, no great disadvantage would result.

It would seem that the foregoing functions would tie up the radioteletype circuits exclusively for weather transmission. Fortunately, this is not the case on the majority of circuits. On the contrary, weather transmission would require only one-half or less of the total available circuit time, leaving the balance for aircraft movement, operational, passenger reservation, and administrative traffic with priority in the order named. The majority of aircraft departure, arrival and position report messages require less than 30 seconds each, and passenger reservations, if properly coded, about the same. Administrative traffic would be handled during spare circuit time, especially at night.

Although aircraft movement and weather messages customarily have about equal priority, experience has shown that weather should be handled by radioteletype strictly on a schedule basis and routine aircraft movement messages as rapidly thereafter as possible. Emergencies, of course, could be handled via radiotelephone (airway stations), manual radiotelegraph, and also via radioteletype after appropriate warning bell signals have been sent out over the system.

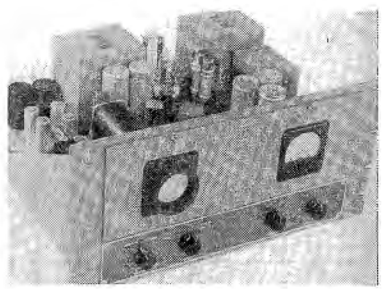
Ankara and possibly other points could combine radioteletype and A-3 (voice) or A-2 (modulated tone) broadcasts on the same frequency with the same transmitters by employing frequency shift radioteletype transmission, while modulating the carrier with A-3 or A-2 intelligence. This system is practicable at any location at which the transmitters are assigned clear channels and the carriers stay on continuously.

With this method voice and tone telegraphy can be used to broadcast local weather data, plus condensed portions of the collection available from other points.

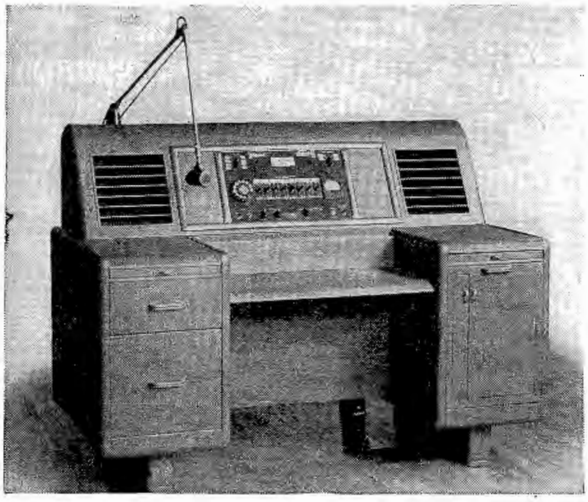
The f-s method is somewhat similar to frequency modulation used in broadcasting in that the carrier is ***shifted*** from one frequency to another by some form of external modulating signal; dissimilarly, however, the amount of shift is relatively very small and is always a fixed, pre-set value. As in f-m, the signal-to-noise ratio is considerably increased with f-s operation but

H-f frequency-shift receiver converter.

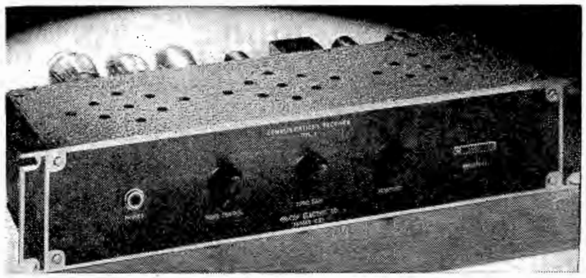
(*Courtesy Press Wireless*)



[1]Managing Director, Empresas Ilimitadas, Caracas, Venezuela.



Left: Airways operating console.
(Courtesy Wilcox Electric)



A fixed-frequency crystal controlled h-f receiver.
(Courtesy Wilcox Electric)

since the amount of actual carrier shift is small, the bandwith required is no greater than that required for moderate speeds of practical make-and-break keying. Further, it has been observed that inherent transients, key clicks, spurious side bands, etc., extend the bandwidth requirements of high-speed amplitude keying considerably beyond those required for frequency-shift transmission at the same keying rate.

The trend of modern communication systems to accelerate keying speeds reaches a point of saturation in amplitude keying under any but the most favorable atmospheric conditions during certain hours of the day and season. As keying speeds increase in make-and-break operation an increment of transient disturbances is encountered with acceleration of the rise and decay of the radiated wave form. Employing f-s circuits, the increment of these transient disturbances is effectively minimized. Further, the reduction of transients permits closer channel spacing. It is, therefore, apparently possible and practical to operate a greater number of high-speed f-s circuits within a given portion of the spectrum than is regularly required for high-speed amplitude keying.

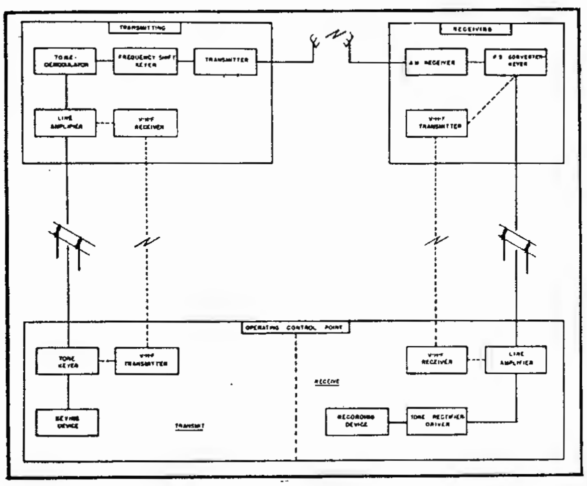
Above 3,000 kc carrier frequency, to transmit mark and space by the f-s method, the amount of carrier shift above and below the hypothetical center frequency is 300 cycles per second, as conveniently employed in some present-day applications for radioteleprinter and Morse radiotelegraphy. The transmitter, always delivering its full output power to the antenna, usually is adjusted to rest on the space frequency. This, however, is entirely arbitrary and depends on the exact type of mechanical equipment involved.

As an example, a keyed transmitter assigned to 10,000 kilocycles will, by means of carrier shift, successively shift the carrier signal between two frequencies, one at 9,999.7 kc and the other at 10,000.3 kc. The f-s receiving equipment differentiates between these two frequencies by means of discriminating circuits and delivers corresponding mark-and-space pulses to the teleprinter or telegraph recorder and relative black and white signals for facsimile recording.

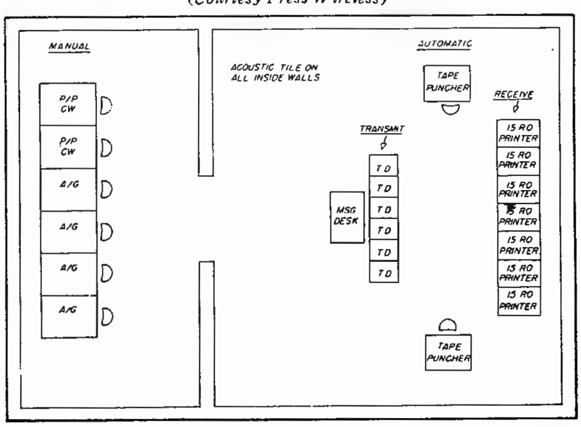
A near approach to *something for nothing* is effected by the foregoing broadcast plan since no additional frequencies, antenna or transmitters are necessary; merely the addition of modulators to existing f-s transmitters would provide complete weather reception. If desired, A-2 radiotelegraph transmission could be accomplished by using tapes cut into continental-code characters with an automatic wheatstone perforator set. Conventional teletype No. *14* typing reperforators could be used to prepare tape for the radioteletype broadcasts.

Choice of transmitting equipment for any civic airways would result from a compromise between high power and consequent higher installation and maintenance cost, and low power units involving lower cost and easier main-

(Continued on page 42)



Left: A typical frequency shift radioteleprinter system.
(Courtesy Press Wireless)



Suggested airways radio operating room; P/P, point-to-point c-w; A/G, air-ground; T.D., transmitter-distribution; and R.O., receiver only.

MOBILE F-M COMMUNICATIONS Equipment For 30 to 44-mc

Small-Sized Radiotelephone Units, Featuring Selective Calling, and Providing Two-Way Communications, Designed for Police, Fire and Ambulance Departments, Forest Patrols, Taxicab Dispatching, Ferry Services, Construction Projects, Etc.

by R. B. HOFFMAN and E. W. MARKOW

Radio Equipment Division
Federal Telephone and Radio Corp.

WITH THE ADVENT of long-life miniature tubes and highly efficient v-h-f f-m circuits it has become possible to design compact mobile-fixed transmitter-receiver systems with many unique features. For the 30- to 44-mc band, for instance, a small 2-way unit providing selective calling is now available. This *calling* feature permits contacting any one of four groups of mobile stations without energizing any of the others.

The mobile unit, shown in Figure 1, consists of a 25- or 50-watt transmitter,[1] receiver[2] (both on separate plug-in chassis which are inserted in the housing), control box which is normally mounted on the auto dashboard, loudspeaker, microphone, microphone hook-switch and whip-style antenna.

Operation of equipment is accomplished by lifting microphone off the hook-switch, depressing the microphone switch, which turns on the transmitter, and speaking. Controls provide *carrier, monitor* or *selective-calling.*

In the *carrier* position the receiver audio circuit is silenced by a squelch circuit which maintains control until an on-frequency carrier is received. This removes annoying receiver noises during stand-by periods and makes the receiver operative when a call is sent out by a transmitter on the assigned channel. The squelch circuit turns on audio system with signals producing 6 db of noise quieting.

The *monitor* position is used only for the reception of very weak or fading signals or for checking the operation of the receiver. In this position, the squelch circuit is inoperative, and therefore the operator hears hissing and rushing sounds along with the message. This is characteristic of the impulse and receiver noise characteristics of high-gain receivers in the absence of a signal sufficiently strong to produce quieting.

In the *selective-calling* position a frequency selective decoding circuit is introduced. This renders the receiver audio system operative only in response to the proper calling signal from the central station.

1, 2Power is derived from standard 6-volt automobile battery; current drain during stand-by periods is 7.12 amperes, and 33.2 amperes or 50.5 amperes during on-call periods, depending upon whether 25- or 50-watt transmitter is used.

3Measured in accordance with RMA procedure.

The Receiver

The receiver, Figure 2, is a conventional double-conversion crystal-controlled superheterodyne circuit. Overall receiver sensitivity is such that a 0.5 μ v r-f signal will provide 20 db of thermal noise quieting.[3]

The first r-f stage uses a 6AK5; mixer, 6BE6; oscillator, 6AK5; 10.7-mc i-f, 6AK5; converter, 6BE6; 1.7-mc l-f, 6AK5; first limiter, 6AK5; second limiter, 6AK5; discriminator, 6AL5; selective-call switch tube, 2D21; decoder amplifier, 6AK5; first audio

Figure 2
Block diagram of the mobile receiver.

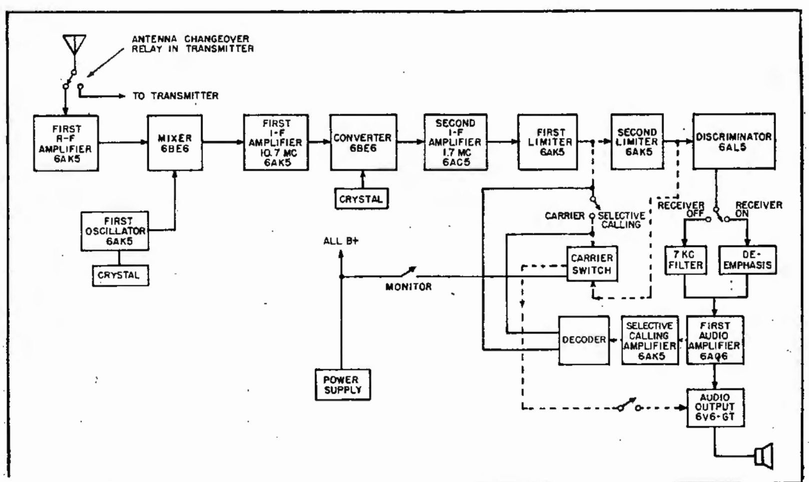
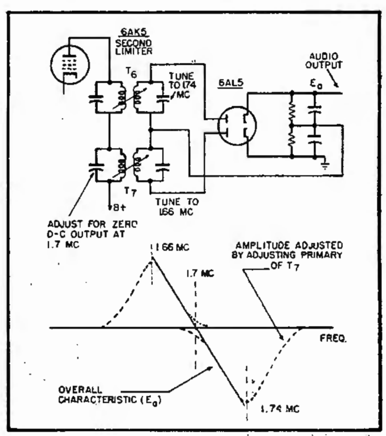


Figure 3
F-m mobile receiver discriminator and plot of discriminator action.



amp, 6AQ6; power amp, 6V6-GT; and power rectifier, OZ4A or 6X5-GT.

The first local oscillator uses a crystal which resonates at the third mode of its fundamental frequency; no fundamental crystal frequency is present in this oscillator.

The discriminator circuit, Figure 3, is a double-tuned dual transformer type. The transformers are tuned 80-kc apart (1.7 mc ± 40 kc), and the output so phased that the linear portion of the pass-band curve between the transformer peaks can be utilized as an f-m discriminator. (Adjusting T_7 adjusts the amplitude of the signal in the secondary winding and permits center frequency zero adjustment.)

The *selective-calling* system makes use of a frequency-selective decoder. The decoder is essentially a spst normally open switch which closes only when an audio signal of suitable frequency is impressed across the driving coil. The receiver circuit is arranged so that when in the *select* position, the audio amplifier stage is inoperative until the decoder contacts close. When the decoder is energized by the proper audio signal, the receiver is *turned on* and the audio system made operative. Once the receiver has been turned on and the r-f carrier *remains* present, the receiver will stay on. If the carrier is removed, the receiver shuts off and cannot be turned on unless the carrier *with proper decoding signal* is again present to turn on the receiver audio circuits. A carrier alone, or a carrier with any other type of modulation, will not turn on the receiver. The operator at the fixed station may call any particular mobile installation by selecting and transmitting the audio tone to which the desired mobile receiver will respond. No other receiver, when in *select* position, and equipped with decoders tuned to any other frequency, will respond.

The audio frequencies to which the decoders are sensitive lie between 150 and 442 cycles. Direct phase modulation of the r-f carrier with frequencies as low as 150 to 440 cycles can be accomplished only with very low deviations, and is therefore not practical. Instead, a sub-carrier system is used in which the low-frequency audio signal amplitude modulates a 7,000-cycle sub-carrier which, in turn, frequency modulates the r-f carrier. In this 7,000-cycle range no frequency-modulation difficulties with respect to deviation are encountered. The station equipment transmits the r-f carrier, frequency modulated by the amplitude-modulated 7,000-cycle sub-carrier, and all receivers in the system receive the signal. The signal is reconverted into an amplitude modulated 7,000-cycle audio signal by the receiver discriminator. The envelope is then high-passed, detected, passed through a low-pass filter network, and the low-frequency 150- to 440-cycle energizing signal impressed on the decoder coil. If the impressed frequency is the same as the decoder-resonant frequency, the decoder contacts will close and turn on the audio circuit. The fixed station equipment is equipped with four low-frequency audio oscillator circuits permitting the selection of four separate groups of receivers.

Briefly the *selective-calling* chain of action is: When calling a mobile unit the station operator chooses the audio channel corresponding to the one with which the mobile unit he desires is provided. The audio signal amplitude-modulates a 7,000-cycle signal, and the audio-modulated 7,000-cycle signal modulates the r-f carrier. The *select* tone is transmitted at the *beginning* of the fixed-station transmission only. The station equipment automatically provides the proper time duration of about one second by use of a delayed action relay. Reception of the *select call* signal energizes the audit circuit in the mobile receiver which is silenced, when no carrier is present, by the removal of screen voltage from the 6V6 power tube.

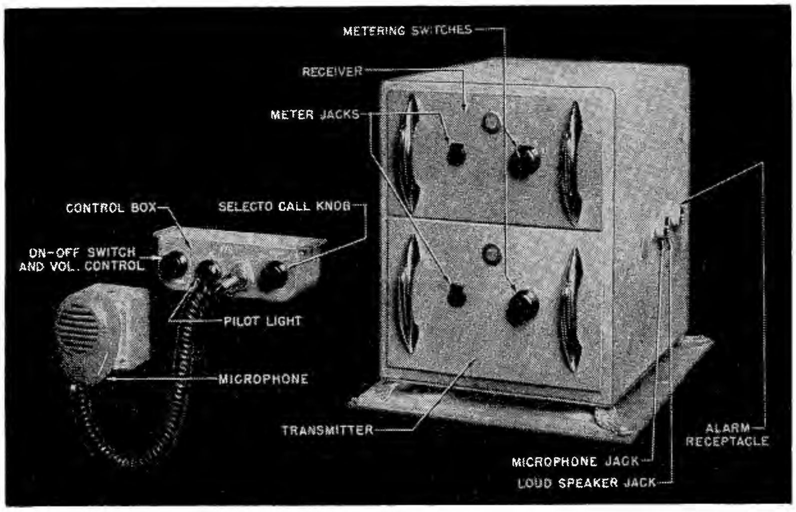


Figure 1
The 30 to 40-mc equipment developed for mobile applications.

Squelch Circuit

In this circuit, Figure 4, a switching relay, which turns the receiver

(*Continued on page 40*)

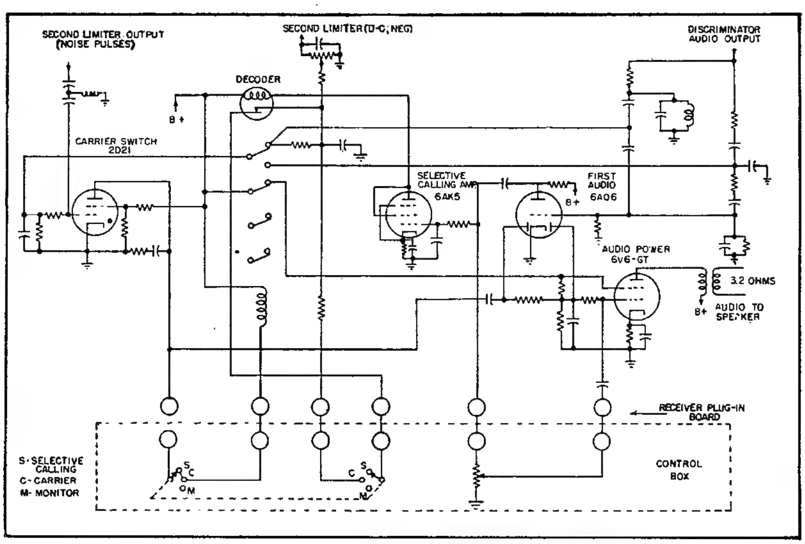


Figure 4
Schematic of the squelch and selective-calling circuits of the **receiver.**

VETERAN WIRELESS OPERATORS ASSOCIATION NEWS

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

MANY VETERAN VWOA MEMBERS attended the Spring Meeting in New York on June 5th, in the Marine Room of the Fireplace Inn. Among those present were W. J. McGonigle, G. H. Clark, William C. Simon, T. H. Ellis, R. H. Pheysey, R. K. Davis, Eric Bisbee, Roger Lum, Ben Beckerman, J. L. Savick, Sam Schneider, Roy Chipp, H. T. Hayden, W. A. Paul, R. J. Iversen, H. H. Parker and C. D. Guthrie. . . . Life member Iversen revealed that he has just designed two new 1-kw c-w transmitters for the New York Times radio station. The station, WHD, transmits comprehensive news summaries for isolated world outposts twice daily. The daytime broadcast are on 16.72 mc, and nighttime are on 8.36 mc. About 45 minutes of copy at 25 words per minuate are transmitted at 1900 gmt and 0500 gmt. Iversen said that he would very much like to have reliability reports from operators hearing the station. The transmitter features automatic electronic keying. Signals are fed into stub-mast one-half wave doublets, located atop the New York Times Building at W. 43rd Street in New York City, 350 feet above the street level. . . . W. A. Paul, now with the Mackay engineering department, revealed that he is doing field engineering on South-American station installations. WAP, who has been in radio since 1926, has sailed many tankers and freighters. From 1926 to 1928, he was with the Independent Wireless Co. In 1928, he joined Tropical Radio and for two years was in the tropics. From 1930 to 1933, he was in New Orleans and in 1933 he went to Miami at WAX. From 1942 to 1945, WAP was in the Navy as a radio electrician, assigned to the Third Fleet in the Aleutians. . . . Rodney Chipp, now a radio-facilities engineer for ABC, told the boys that he is now planning installation of prospective ABC f-m and television stations and a 50 kw a-m transmitter at KGO in San Francisco. RC, who has recently been elected treasurer of the New York Section of the IRE, was quite

VWOA assistant president, George W. Bailey, third from left, at the recent RMA annual spring meeting dinner in Syracuse, N. Y. Left to right: S. P. Taylor, Western Electric, chairman of RMA's transmitter section; F. R. Lack, vice president and manager of Western Electric's radio division; Dr. W. R. G. Baker, vice president of General Electric; George W. Bailey; and J. J. Farrell of the G. E. transmitter department.

active during the war, serving the U. S. Navy as a lieutenant commander. He received the commendation ribbon for his work in radar design. . . . Roger Lum, veteran of the early broadcast days, told the boys that he began pounding brass in 1918. He was with WJZ in 1922 and then went to WRC in 1923. In 1924, he went to WNYC and in 1926 he joined WDAE. In 1931, he was at WGST, and then he decided to enter the business world and join the Chain and Gear Corp., manufacturers of chain drives and flexible couplings. He says that he still yearns to go back into broadcasting and would like to become, believe it or not, a disc jockey. . . . Samuel Schneider revealed that he is now with Oscar Radio, 176 Greenwich Street, N. Y. C., handling radio sales in the marine division. SS was a chief code instructor with the Chamberlain Technical School during the war. He also served with the OWI and was in charge of the radiophoto division. . . . T. H. Ellis reported that he is now actively engaged in aircraft development work and is concentrating on the *Lanac* system of safety control at the Hazeltine Corp. TE has been in radio since 1925 and served on many ships. In 1931, he was instrumental in establishing radio communications from Belize, British Honduras, which was devastated by a hurricane. He received a commendation for his work from the Governor of British Honduras and Captain F. Muller. Before joining Hazeltine, Tom served with Tropical Radio for 13 years as a radio operator and radio inspector. During the war, Tom acted as a field engineer for Hazeltine, installing radar and IFF equipment for the U. S. Navy. . . . Robert H. Pheysey, who received the VWOA award in 1930 for his prompt and efficient handling of an SOS, is still quite active with United Fruit Co., with whom he has been associated for 18 years. During this period he has been marine radio operator, inspector and chief of accounting. During World War II, RHP served as a chief operator on an ammunition carrier and transport, making several trips to France and England. . . . R. K. Davis reported that he has returned to his former position as chief inspector at Tropical Radio. . . . Henry T. Hayden is quite active these days on his ham transmitter, W2FO, which operates on 7050 kc. HTH says that he would like to contact other VWOA members. . . . Eric L. Bisbee told the boys at the VWOA dinner that he'll soon become a father-in-law. ELB is with the N. Y. Police Dept., operating the f-m police station, WJIJ, in Jamaica. The frequency of the station is 39.9 mc. . . . J. L. Savick, now with the N. Y. Telephone Co., automatic dial system division, recalled his early days as a marine operator. JLS began his brass-pounding days in 1919 and for quite a few years served on such ships as the West Lake, Eastern Crown and Allison. JLS is on the air with his ham rig on 7150 kc. His call letters are W2KQE. . . . We learned that Arthur J. Costigan, vice president in charge of traffic of Radiomarine, is down at Atlantic City covering the International Allocations Conference. . . . Harry Cornell, radio supervisor of the Standard Oil Company of N. J. is also covering the Allocations Conference in Atlantic City. . . . We learned, too, that Arthur Lynch is vacationing in Florida and it appears as if he may establish a permanent residence there.

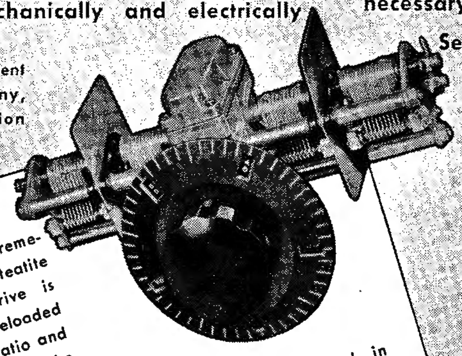
Tolerance is Important...

. . . Especially when it comes to radio parts. That's why National parts are precision-made with tolerances measured as close as .0002".

Operational results justify this close attention to detail for every National precision condenser is mechanically and electrically interchangeable and can be depended upon to fit the specifications called for. Production flows smoothly when you use National parts because their closely-tooled tolerances and sturdy construction make replacements unnecessary . . .

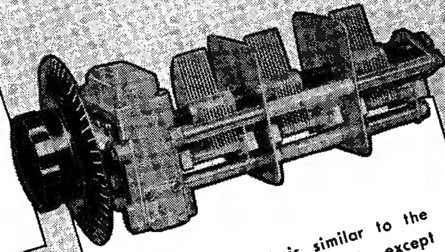
Send for your copy of the new National catalog containing over 600 parts today.

Please write to Department ☐, National Company, for further information

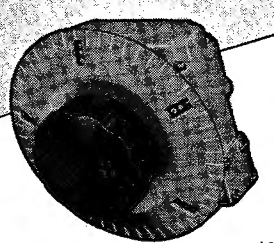


This PW Condenser is of extremely rigid construction with Steatite stator insulation. The drive is through an enclosed preloaded worm gear with 20 to 1 ratio and the rotor shaft is parallel to the panel. Plate shape is straight-line frequency when the frequency range is 2:1.

PW Condensers are available in 2, 3, or 4 sections in either 160 or 225 mmf per section. A single-section PW Condenser with grounded rotor is supplied in capacities of 150, 200, 350 and 500 mmf, single spaced, and capacities up to 125 mmf, double spaced.

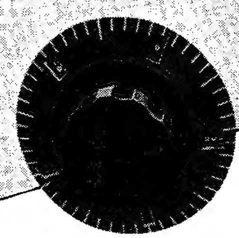


The NPW model is similar to the other PW Condenser models, except that the rotor shaft is perpendicular to the panel. Three sections . . . each 225 mmf.



NPW-O uses parts similar to the NPW Condenser. Drive shaft perpendicular to panel. One TX-9 coupling supplied.

The PW-O uses parts similar to the PW Condenser. Drive shaft parallel to panel. Two TX-9 couplings supplied.



The PW-D micrometer dial can be read direct to one part in 500. It revolves ten times in covering the complete range and fits a $\frac{5}{16}$" diameter shaft.

National EST. 1914

National Company, Inc.
Malden, Mass.

MAKERS OF LIFETIME RADIO EQUIPMENT

A V-H-F/U-H-F Noise and Field Intensity Meter

Instrument, with 88 to 400-mc Range, Measures Radiated, Conductive and Inductive Amplitude of Noise in Microvolts and Decibels. Unit, Which Also Measures Field Intensities in Microvolts per Meter, Uses Butterfly Circuit Elements.

by LEWIS W. MARTIN

One of the most disturbing elements in transmission and reception is noise. The problem, particularly acute in the v-h-f and u-h-f bands, can be attacked with ultra-sensitive receiving or noise-measuring equipment, such instruments also providing a check on field intensities. With one unit,[1] recently developed, it has become possible to measure the amplitude of noise and field intensity in microvolts per meter.

In operation, r-f energy or signal is picked up on an adjustable dipole antenna and its location determined by the antenna position. When a close approximation of the source of the signal has been obtained, the dipole antenna is then replaced with a small loop probe antenna.

[1]Stoddard Aircraft Radio Co. NMA-4 (100 to 400 mc) and NMA-5 (88 to 400 mc).

The voltage existing across the terminals of the probe antenna is then fed through a 95-ohm balanced transmission line to the input of the instrument.

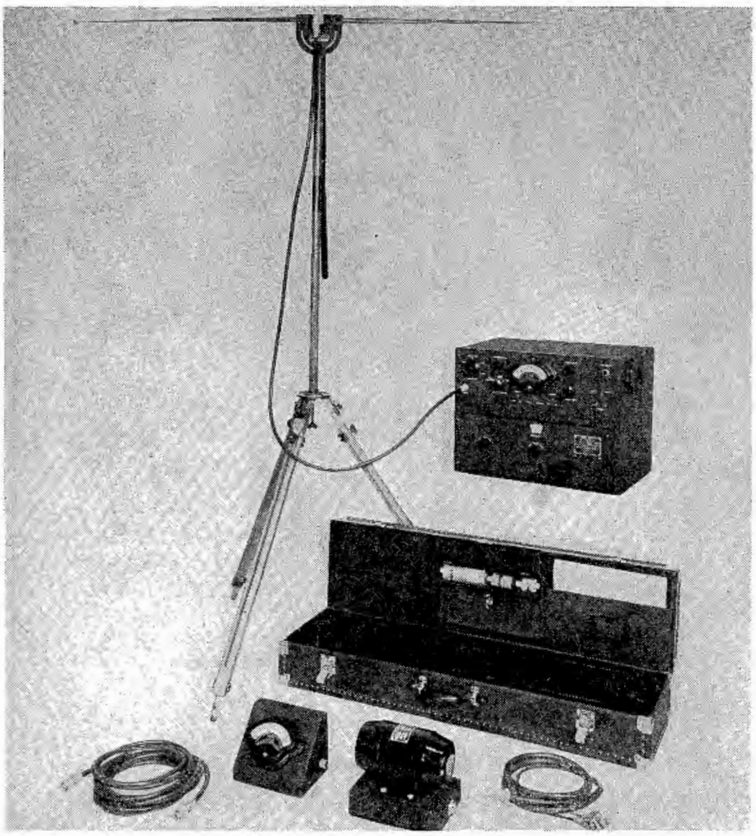
The voltage can then be attenuated with a resistive-type constant impedance balanced *H* network, which provides for multiplying the indicating meter scale reading by 1, 10, 100, or 1,000.

Voltage at the output of the attenuator is fed through another 95-ohm balanced transmission line to a r-f tuning unit, where it is amplified, selected, and then mixed with the local oscillator to produce an i-f signal. This signal is then fed to an i-f amplifier through a low-capacity coaxial line.

The voltage, after i-f amplification, is then rectified by a diode, the output being fed to an *RC* network which has a voltage charge and discharge timing constant. The resulting voltage is impressed on the input of a vacuum-tube voltmeter. The magnitude of this voltage is proportional to, and is indicated by, a deflection of the pointer of an indicating meter. The indication of the meter is a measure of the voltage existing across the terminals of the antenna.

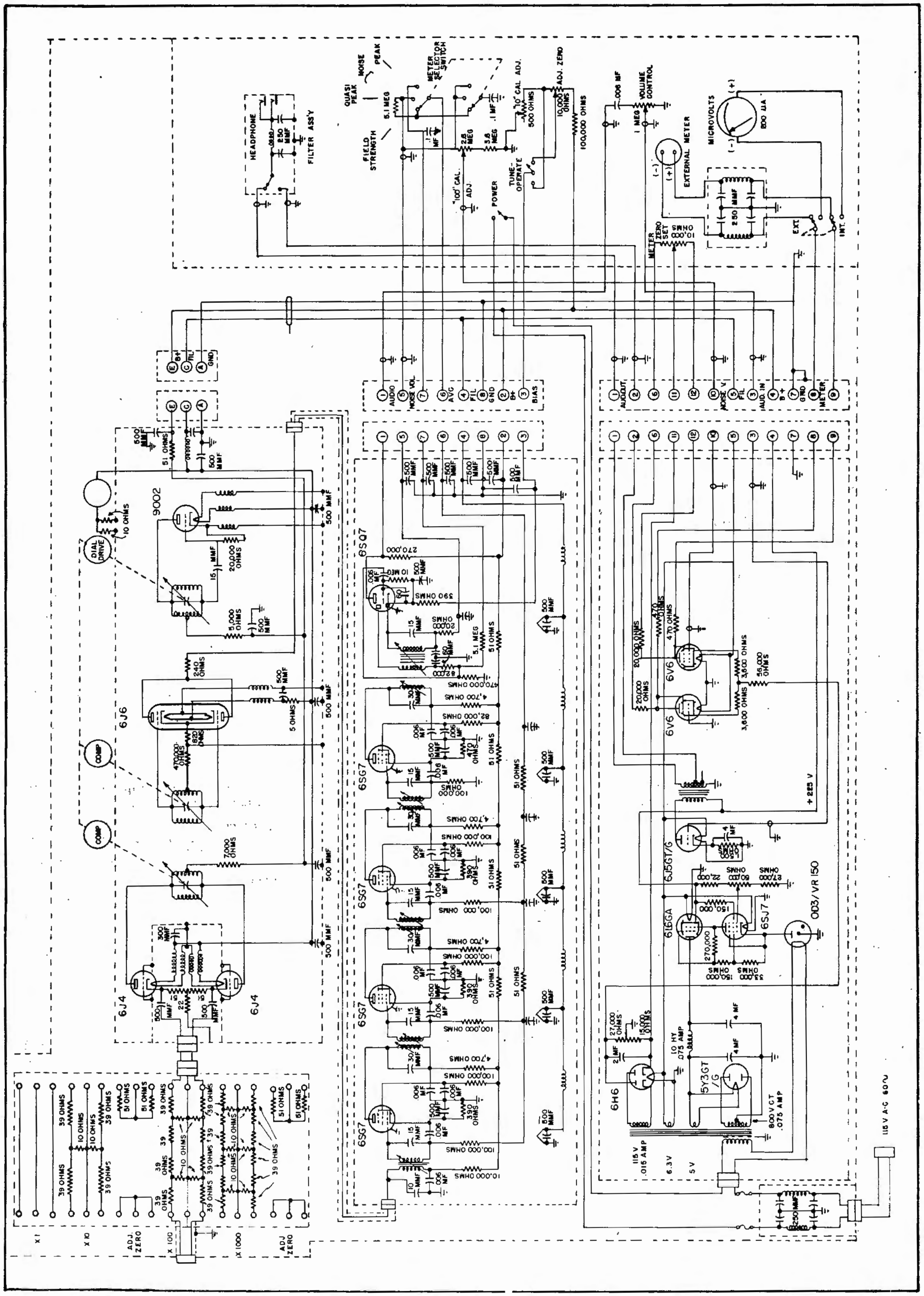
The instrument features a three-position meter switch marked *field strength, quasi-peak noise* and *peak noise,* provides for logarithmic indication of carrier wave *field strength;* logarithmic indication of the *quasi peak* value of radio noise or a modulated carrier wave; and indication, with a linear deflection, of the *peak* value of radio noise.

The logarithmic meter scale indication is produced by means of avc voltage applied to the i-f amplifier. In the first position of the switch, the avc voltage is proportional to the carrier value of the signal and modulation products are filtered out and the vacuum-tube voltmeter input, in ef-

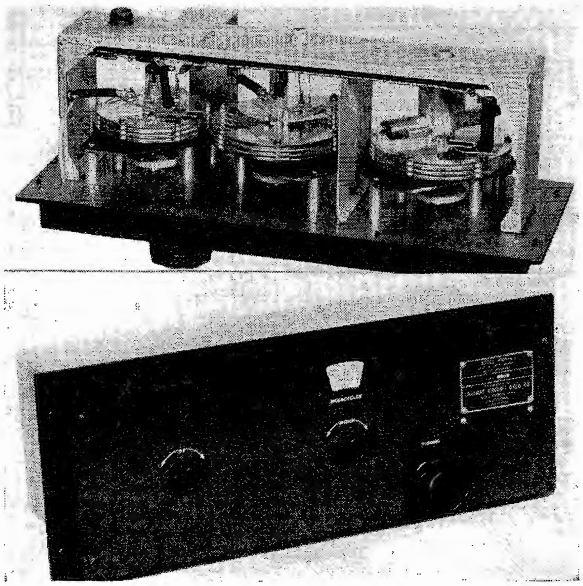


Noise and field intensity meter equipment, and accessories.

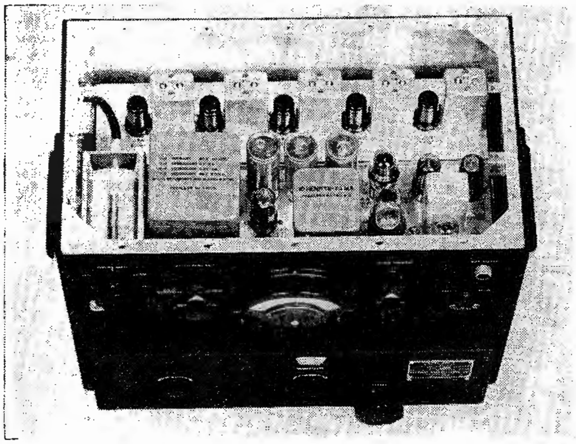
Right: Circuit of the noise-field intensity meter.


HEADPHONE
FILTER ASS'Y
FIELD STRENGTH
QUASI PEAK
NOISE PEAK
METER SELECTOR SWITCH
"100" CAL. ADJ
"10" CAL. ADJ.
ADJ. ZERO
POWER
TUNE-OPERATE
VOLUME CONTROL
EXTERNAL METER
MICROVOLTS
200 UA
METER ZERO SET
EXT.
INT.
DIAL DRIVE
COMP
9002
6J6
6J4
6SQ7
6SG7
6V6
6J5GT/G
6L6GA
6SJ7
OD3/VR 150
6H6
5Y3GT/G
+225 V
115 V A-C 60~
AUDIO
NOISE VOL.
AVC
FIL
GND
B+
BIAS
AUD. OUT
NOISE V
AUD. IN
METER
X 1
X 10
X 100
X 1000
ADJ. ZERO

Interior and external views of the r-f amplifier.



Top view of noise-field intensity meter.



fect, is connected so as to indicate this voltage.

In the second position, the avc voltage is obtained directly from the RC network and is proportional to the *quasi-peak* value of the impressed wave and for steep wave fronts, it rises to values quite high, reducing the i-f gain.

In the third position the avc voltage is obtained from a separate diode rectifier in the i-f amplifier and is filtered by a network having a large and equal charge and discharge time constant so that only the carrier value of the impressed wave is applied as avc voltage. In addition, the vacuum-tube voltmeter is connected to the diode and *RC* network, thereby indicating the *peak* value of the impressed wave. The indication is thereby substantially linear for noise pulses and equal to their *peak* value because the avc voltage assumes the equivalent carrier to reduce the i-f gain and thereby reduce the indication obtained.

The *peak* position provides for an indication of audio output which may be employed for comparison purposes. For example, the calibration of an audio frequency noise meter may be compared. Incidentally the indicating meter *is not calibrated for noise voltages in the peak position.*

Because the *peak* position provides a linear indication of the *peak* value of an impressed wave, it may be used to also indicate the percentage of modulation of a carrier wave, i.e., doubling the linear angular deflection of the indication is proportional to 100% modulation. This modulation indication is valid only for modulation frequencies approximating 100 cps or pulse lengths not less than .01 second.

Calibration

The instrument is logarithmically calibrated, in terms of microvolts and decibels, by means of an unmodulated sine wave signal obtained from a standard signal generator. The calibration includes the losses in a six-foot length of AN RG-22/U cable (which is negligible) and is made with the meter selector in the *quasi-peak* position.

The stability of calibration is determined by means of the *shot noise* developed in the plate circuit of the r-f amplifier. This *shot noise* is amplified and indicated by a deflection of the indicating meter pointer similar to that which is produced by an impressed signal. The deflection is dependent upon the overall amplification of the instrument and is therefore a direct indication of the stability of the calibration.

This *shot noise* indication is produced each time the instrument is tuned for maximum sensitivity at the desired operating frequency.

Since the *shot noise* acts on the instrument as a signal, provision has been made for balancing out its indication so that the meter reads zero during operation prior to measuring an impressed signal.

The magnitude of *shot noise* varies with the operating frequency and unless balanced out, would effect the avc operating point of the i-f ampifier, altering the logarithmic calibration of the indicating meter.

Radio-Frequency Tuning Unit

The r-f tuning unit includes an r-f stage, mixer stage and an oscillator; their associated tuned circuits (which are the butterfly type), tuning dial and tuning mechanism.

The r-f amplifier stage is of the grounded grid type and comprises a pair of 6J4 tubes in push-pull for operation with a balanced transmission line input.

Since the input impedance of the grounded grid amplifier is inherently low, direct connection to the transmission line input is possible, and the impedance is so chosen as to provide a precise termination for the line. This eliminates the necessity of employing a coupling coil for terminating the line which causes difficulties when operated over a wide band of frequencies.

The push-pull plates of the grounded grid amplifier are connected to the butterfly-tuned circuit. This type of tuned circuit leads itself to push-pull operation because it is geometrically arranged for balanced connections. It is tunable over a wide range, provides high Q values and produces a substantially constant value of resonant impedance.

The mixer stage consists of a 6J6 dual triode with the grids connected in push-pull and the plates connected in parallel. The grids are connected to another butterfly-tuned circuit and the parallel plates are connected to a coaxial plug for connection to the i-f amplifier.

The oscillator also employs a butterfly circuit. A 9002 triode is connected in a Colpitts type of circuit wherein the proper feedback voltages are obtained through the inter-electrode capacities. Its operating frequency is 30-mc higher than the r-f or mixer stage.

The r-f butterfly circuit is inductively coupled to the mixer butterfly circuit. The oscillator butterfly circuit is also inductively coupled to the mixer butterfly circuit. These circuits are quite closely coupled so that the oscillator voltage induced in the mixer circuit is many times that of the signal, providing the mixer with good linearity and high conversion gain.

Because the oscillator operates 30 mc higher than the signal frequency, the i-f frequency produced in the plate circuit of the mixer is 30 mc. This difference frequency being relatively high, reduces the tendency of pull-in between the mixer and oscillator circuits and provides desirable image rejection. The use of an r-f stage further improves the resulting image rejection ratio.

The r-f, mixer, and oscillator butterfly-tuned circuits are ganged together for single dial operation. The tuning drive comprises a large spur gear train, one gear for each tuned circuit.

I-F Amplifier

Four 30-mc band-pass stages, employing 6SG7s, are used in the i-f. Each stage has relatively low gain to produce good stability.

The first three i-f tubes have avc voltage applied to their grids. It is through the exponential control characteristics of these tubes that the logarithmic scale calibration of the indicating meter is obtained. The fourth i-f stage has fixed bias and functions as an avc amplifier, improving the logarithmic action.

The i-f amplifier is connected through a low-capacity coaxial line to the r-f tuning unit. Each of the i-f stages are individually filtered, including the filament leads. Button type capacitors are used to bypass the output and power leads.

The purpose of this filtering is to provide stability by preventing any regenerative effects occurring in the i-f amplifier. In addition, the filtering prevents any harmonics of the i-f output from being conducted through the external wiring to the input of the r-f tuning unit. This eliminates regeneration from occurring when the

(*Continued on page* 44)

The Industry Offers

DUMONT VOLTAGE CALIBRATOR

A voltage calibrator, 264-A, for use with all models of cathode-ray oscillographs has been announced by Allen B. Du Mont Laboratories, Inc., Passaic, N. J. Instrument provides a convenient method for measuring the peak-to-peak voltage of any signal being viewed on the oscillograph screen.

Output of calibrator is essentially a square wave the amplitude of which is continuously variable from 0 to 100 volts. This continuously variable output is obtained from a linear potentiometer with a direct-reading calibrated dial divided into 100 divisions. Connected in parallel with the output potentiometer is a conventional four-step decade output attenuator, providing four ranges of voltage readings, namely, 0-0.1, 0-1, 0-10 and 0-100 volts. Overall accuracy of the output voltage is said to be within ± 5% of each range.

* * *

FREED VACUUM-TUBE VOLTMETER

A vacuum-tube voltmeter, 1060, which can be used at audio and supersonic frequencies, and also as a null detector in d-c bridge measurements, has been developed by Freed Transformer Company, Inc., 72 Spring Street, New York 12, New York.

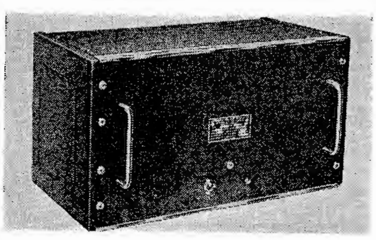
Input impedance is 50 megohms shunted by 15 mmfd. Voltmeter has a frequency range from 10 cycles to 1.6 mc, with a .5 db variation. Voltage ranges of .001 to 100 volts in five ranges; .01, .1, 1, 10, 100 volts, full scale. Logarithmic voltage scale calibrated for 1 to 10 and a linear decibel scale calibrated from 0 to 20 db.

* * *

SUPERIOR ELECTRIC VOLTAGE REGULATOR

An instantaneous-electronic type voltage regulator, Stabiline type IE series, has been announced by Superior Electric Co., 54 Laurel St., Bristol, Conn.

With the first model in production, type IE5101, the output voltage is said to be held to within ± 0.1 volt of any nominal value in the settable output range between 110 and 120 volts for an input line voltage change from 135 to 95 volts. Although the time for recovery varies, depending upon line voltage, load current, load power factor and other conditions, it usually is in the order of 3 to 6 cycles. Device is said to be independent of any load power factor change from a lagging .5 to a leading .9.



WESTON ELECTRONIC ANALYZER

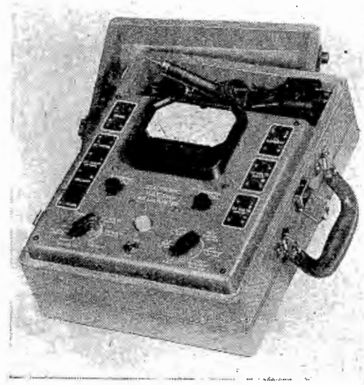
An electronic analyzer, model 769, has been announced by the Weston Electrical Instrument Corporation, Newark 11, N. J.

Instrument features a h-f vacuum-tube voltmeter for measurements on frequencies up to 300 mc, electronic voltohmmeter, and a 10,000-ohm-per-volt d-c and 1000-ohm-per-volt a-c multimeter. Uses a unity gain d-c amplifier, incorporating both regeneration and degeneration.

The v-t-v-m accuracy is said to be 5% to 150 mc, and 12% from 150 to 300 mc, direct reading; use of a corrective curve reduces this to 8% on 150 to 300 mc. Has a 3½" and ¾" diameter r-f probe.

The electronic voltohmmeter covers ranges from 3 to 1200 volts, and 2000 ohms to 2000 megohms full scale. Electronic zero balance is said to be unaffected by zero adjustments to the ohmmeter.

Analyzer section has six 10,000-ohms-per-volt voltage ranges, six rectifier-type a-c voltage ranges to 1200 volts, three ohmmeter ranges to 200,000 ohms, and six d-c ranges to 600 milliamperes.



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RAYTHEON TETRODE

A 450-watt plate-dissipation tetrode, RK-6D22, has been announced by the power-tube division of the Raytheon Manufacturing Company, Waltham, Mass.

When tetrode-connected, can be used as class C amplifier. When triode-connected (screen grid and control grid tied together) the tube can be used as a zero-bias class B audio amplifier.

Tetrode-connected, tube delivers 1000 watts output with about 22 watts of drive.

As a zero-bias class B triode, a pair of tubes will deliver 2400 watts of audio with 45 watts drive.

Under class C conditions, the tube is rated for a maximum plate voltage of 3500 volts; while as a zero-bias class B triode, it is rated for a maximum of 5000 volts.

* * *

GRAY PLAYBACK ARM

A playback arm made to accommodate low-mass highly compliant cartridges has been announced by Gray Research & Development Company, Inc., Elmsford, Westchester County, New York.

Has an adjustable scale for optimum stylus pressure and a self-levelling base.

UNITED ELECTRONICS VACUUM CAPACITOR

A 50-mmfd vacuum capacitor, Cap 50/-60/-30, has been announced by United Electronics Company, Newark, New Jersey.

The capacitance is said to be within a tolerance of ± 2% or ± 1 mmfd. Peak potential is 30 kv. Features include large periphery glass-to-copper seals, end caps gold plated to minimize oxidation and maintain low-contact resistance. Overall dimensions, 2½" x 6½".

* * *

RCA 5-KW TV TRANSMITTER

A 5-kw tv transmitter, TT-5A, featuring a new power tube, the 8D21, in the aural and visual sections, has been announced by the RCA engineering products department.

Tube, a dual-tetrode, is said to have inherent stability, achieved by built-in neutralization; wide bandwidth at high efficiency, achieved by low output capacity; and minimum current loss to grids and shields, accomplished by electron optics.

The tube is designed in such a way that the screen grid is bypassed to the cathode within the tube, and the small feed through capacitance is essentially reduced to zero by means of small neutralizing tabs within the tube.

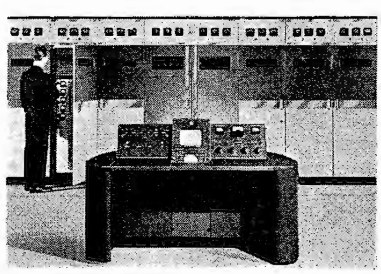
By the use of efficient high level modulation, only one stage of broadband r-f has to be tuned—the power amplifier output circuit of the picture transmitter. Low power stages are tuned in the conventional manner.

The two transmitter units, visual and aural, are almost identical. The primary difference is the type and method of modulating the two transmitters. The f-m sound transmitter employs a standard RCA f-m exciter at the head of an r-f chain, while the picture r-f chain begins with a conventional crystal oscillator. All driver stages employ narrow band circuits and are operated class C with the characteristic high efficiency.

Both the picture and sound sections of the transmitter are operated from power supplies which are entirely isolated from each other.

The video section employs three electronically regulated power supplies.

Dual unit reflectometers in both the sound and the picture output circuits perform three main functions: indication of the power output of the transmitters; measurement of the standing-wave ratio on the transmission line; and



operation as an r-f over-load output, instantly removing plate power, protecting the transmission line against damage from power arc resulting from lightning follow through, in the event of a lightning stroke.

A vestigial side-band filter is said to eliminate the lower side-bands and makes compliance with the FCC regulations positive, by methods independent of operating adjustments. It is constructed of low-loss coaxial transmission lines and is complete assembled and adjuted at the factory for a given assigned channel.

Superturnstile antenna is used with transmitter. Because of the broad-band properties of the antenna, only three antennas of this type (54-66 megacycles, 66-88 megacycles, and 174-216 megacycles) are needed to cover the twelve metropolitan television channels. Antenna gains of 3.8 to 9.3, depending on the channel, are obtained.

The superturnstile can be used for triplex operation. For this purpose, a triplexing unit located in the transmitter building introduces an independent f-m carrier in addition to television picture sight and sound signals. The triplexer enables the same antenna to radiate a television program along with a separate f-m program simultaneously with absolutely **no** interference from either.

The first production-line model of the transmitter was recently delivered to WNBW, in Washington, D. C., to operate on channel four.

* * *

ST. LOUIS OUTDOOR MICROPHONE

An outdoor type dynamic microphone, which, it is claimed, can be dropped successively without failures, has been announced by The St. Louis Microphone Co., Inc., 2726-28 Brentwood Blvd., St. Louis 17, Missouri.

Range is said to be 40-9,000 cycles. Uses Alnico-V magnet. Variable impedance output adjustable to low, 200, 500 or high.

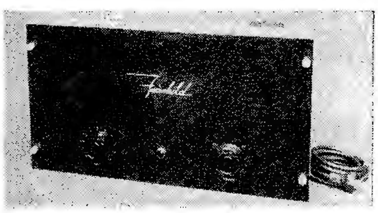
* * *

FAIRCHILD UNITIZED AMPLIFIER SYSTEM

A unitized amplifier system, featuring a dozen units, has been announced by the Fairchild Camera & Instrument Corp., 88-06 Van Wyck Blvd., Jamaica 1, N. Y.

Thus far, a 35-watt power amplifier (No. 620) and a microphone pre-amplifier (No. 621) have been processed for delivery. Additional units to come out shortly are pre-amplifiers and boosters for pickup and line; output switch panel with volume indicator and monitor take-off; input switch panel; N.A.B. and variable equalizers; mixer; volume indicator panel; bridging device; and auxiliary power supply.

The 620 power amplifier is said to have a frequency response of 30 to 15,000 cycles, ± 1 db; noise level, —40 db maximum. Output impedance is 500 ohms, isolated, and there is a second low-impedance winding for monitoring; 2, 4, 8, 14 and 20 ohms. Input impedance is 600 ohms, isolated.



* * *

COLLINS R-F EXCITER UNITS

Three new r-f exciter units for amateurs have been developed by the Collins Radio Company, Cedar Rapids, Iowa.

One, the 310B exciter utilizes a permeability tuned oscillator for its frequency control. Calibration is directly in frequency and accuracy is said to be within .015%. Rated at 15 watts output on all bands under 32 mc.

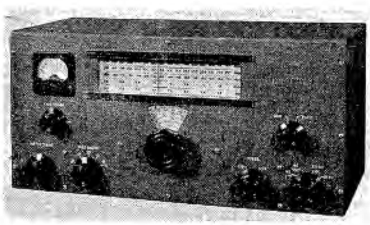
Another, the 310C, provides all the frequency control advantages of the 310B exciter but is designed as a crystal replacement unit. Has an r-f output of 80 volts rms, and a frequency range of 3.2-4 mc. The output can be plugged into an 80 meter or 40 meter crystal socket. The third, 310C-2, is similar to the 310C-1

(*Continued on page* 38)

The Industry Offers

(*Continued from page 37*)

exciter with the added advantage of a self-contained power supply.



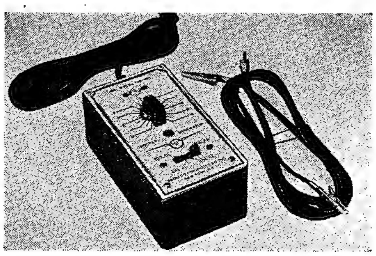
310B exciter

* * *

RCP SIGNAL GENERATOR

A pocket-size supplementary signal generator, 710, has been developed by Radio City Products Co., Inc., 127 West 26th Street, New York 1, N. Y.

Broadcast band alignment is provided for by fixed frequencies of 1500 and 550 kc; intermediate frequency alignment, by fixed frequencies of 456 and 465 kc. Suitable trimmers are provided for recalibrating.



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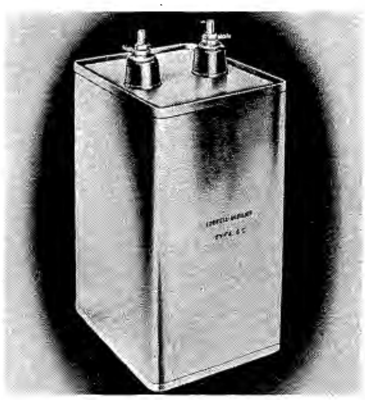
C-D TV CAPACITORS

A series of television receiver capacitors has been announced by the Cornell-Dubilier Electric Corp., South Plainfield, New Jersey. Impregnated and filled with Dykanol and hermetically sealed. Type GC1A00 is shown in illustration.



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G. E. EMERGENCY COMMUNICATIONS UNITS

A 60-watt f-m transmitter-receiver combination, SC-9, for fixed station use by police, power, forestry and public utility groups, has been developed by the transmitter division of G.E.

Incorporating one or two receivers, the combination is designed to permit remote operation over a single-pair telephone line. A preamplifier, tone oscillator and local remote control adapter may be plugged into the rack-mounted control panel.

* * *

BROWNING AMATEUR FREQUENCY METER

An amateur frequency meter, MJ-9, designed for checking the frequencies of f-m or a-m amateur transmitters operating in the 3.5 to 148 mc bands has been announced by Browning Laboratories, Inc., Winchester, Mass. Bands covered are 3.5-4 mc, 7-7.3 mc, 14-14.4 mc, 20.5-21.5 mc, 28-29.7 mc, 50-54 mc, and 144-148 mc.

Meter is direct reading for all bands with separate coils for all bands except the 144 to 148-mc range, this being covered by harmonics of the 20.5 to 21.5 mc band. A 500 kc crystal controlled oscillator is used as a reference standard. Overall accuracy of the unit is said to be .05% at all frequencies.

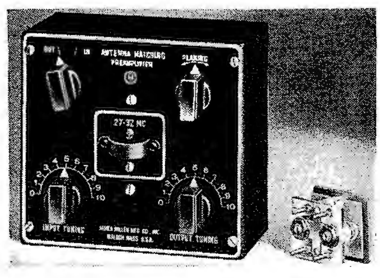
* * *

MILLEN ANTENNA-MATCHING PREAMPLIFIER

An impedance-matching device and a broadband preamplifier combined into a single unit, No. 92,101, the result of the engineering efforts of G. E. and James Millen Mfg. Co., has been announced by Millen.

Coils are available for the 6-, 10- and 20-meter bands.

A 6AK5 miniature tube serves as a broadband r-f amplifier to provide an additional gain of about 30 db.



* * *

AMPERITE STUDIO RIBBON MICROPHONES

A ribbon microphone, which, it is said, will not become boomy on close talking, has been announced by the Amperite Company, 561 Broadway, New York 12, N. Y.

Frequency range is said to be from 40 to 1400 cps; output —56 db.

Wide pick-up angle of 120° front and back; feedback said to be unusually low since the microphone has no peaks.

* * *

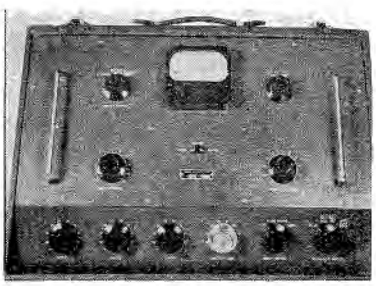
PRESTO AMPLIFIER

A portable recording amplifier, 90-A, that is said to contain all the facilities necessary for operation on remote assignments, is available from Presto Recording Corp., 242 W. 55th Street, N. Y. City. Consists of three preamplifiers, mixer, master gain control and recording amplifier.

Selector provides the NAB 33⅓ rpm recording and playback characteristics, 78 rpm recording characteristic and a flat response, 20 to 15,000 cps ± 1 db. The flat response can be modified by variable bass and treble controls, giving emphasis up to 20 db at 100 and 7,500 cps or 20 db deemphasis at 7,200 cps.

Noise is 60 db below recording level and distortion at maximum output is less than 1½%.

Recording level is monitored by means of a Weston type 30 VU indicator with illuminated scale.

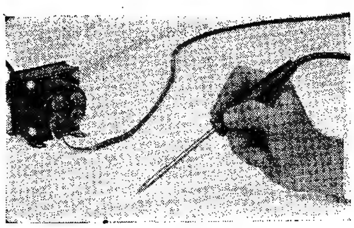


* * *

G. E. CALROD MIDGET SOLDERING IRON

A lightweight calrod soldering iron available with ¼" and ⅛" diameter tips, has been announced by the industrial heating division of G.E.

Iron is 8" long and weighs 1¾ ounces without the cord. Rated 25 watts, 6 volts, and is used with a 115/-volt insulating transformer.



30-44 MC F-M

(*Continued from page 29*)

audio on or off, is held closed by the plate current flowing through a 2D21 thyratron when the receiver is in standby condition. The relay will open, energizing the receiver audio system through a set of relay contacts when plate current through the thyratron is *stopped*. The method of controlling the flow of the thyratron plate current is the key to the entire operation of the squelch circuit. Control grid bias, which controls the flow of plate current, is applied to the thyratron oscillator, from (*1*), the second limiter grid bias resistor and (*2*), the output of the second limiter plate. The second limiter grid bias voltage is always saturated on either noise or *on-frequency* signals and is negative. The voltage from the second limiter plate when no signal is present, on the other hand, consists of continuous noise pulses, the positive peaks of which exceed the steady negative voltage derived from the second limiter grid, changing the instantaneous grid voltage to a positive value and permitting the 2D21 tube to fire, draw plate current, and close the plate relay. The thyratron is extinguished after the first cycle of oscillation, and fires again when another noise pulse is applied to the grid, the random effect keeping the receiver audio off.

Two effects occur, one with on-frequency signals, and the other with near frequency strong signals. When an on-frequency signal is received there is no change in second limiter grid voltage, but the level of the positive peaks of noise is reduced and cannot keep the thyratron in operation. Therefore the plate relay opens and turns on the audio tube.

When an adjacent channel or other signal of sufficient strength is present, the early r-f and i-f stages of the receiver tend to saturate and reduce the noise signal on the limiter grids. With sufficient input signal the second limiter grid bias will go to zero, and at the same time the discriminator output voltage is reduced to zero because of absence of noise signal. The thyratron bias is continuously zero thus permitting the tube to remain fired at all times. In this way the audio stages are caused to remain off. This effect is compensating for all values of adjacent channel or near frequency input signal. However, as in any receiver, interference with an incoming on-frequency signal may be present if the interfering signal is of sufficient strength.

The receiver audio system utilizes a 6V6, driven by a 6AQ6 amplifier. A maximum of 1½ watts output is obtained; about 1 watt with 10% harmonic distortion.

The overall receiver battery drain, when in mobile service, is about 6 amperes when standing by, and 7 amperes when audio is turned on. A power supply, using 6X5-GT rectifier is used for 6-volt d-c operation. This is replaced by a conventional full-wave rectifier using a 5Y3-GT when in fixed station 117-volt a-c use.

[To Be Continued]

V-H-F Survey

(*Continued from page* 22)

miles in front of each end of the radio lane.

Survey Equipment

In conducting these tests, it is essential that a variety of supplementary equipment and components be available. For instance, an altimeter is a required piece of equipment to determine the characteristics of test-territory terrain.

Quite often results of a test may be interpreted entirely differently if something is known of the terrain character. Careful checks must be made when driving at high speed, with windows open. Altimeters are greatly affected by speed of the car and the resultant windage.

In preparing the antenna setup, it is necessary to provide for support pipe clamps, *U* bolts, spare fixed-station antenna whips, coaxial coupling materials and appropriate connectors if the antenna does not use copper coaxial. All cabling for mobile units or any special remote setups must be carefully checked. If the cable involves any special features that might be subject to breakage or damage, spares should be included.

Checking Before Tests

Before raising the antenna, it is quite important to check the leakage resistance of the coaxial line from the center conductor to the outer conductor. It is also advisable to check the center conductor continuity from end to end. This may be done by shorting top antenna whip to the outer casing and measuring with an ohmmeter, on a low resistance scale, between the center conductor and outer conductor at the transmitter end of the antenna lead-out cable.

These tests, made just preceding the raising of the antenna, must also be

(*Continued on page* 45)

Radioteletype Systems

(*Continued from page* 26)

tenance by unskilled personnel. Above all, flexibility should be paramount in the plan, as the system should stand unlimited expansion without obsolescence of equipment. Standardization of equipment for replacement and maintenance purposes is an important item.

Often transmitting equipment are divided into two categories: 400-500-watt output for domestic circuits, and 3 kw for international use. The smaller transmitters combine radioteletype r-f channels with A-3 voice r-f channels in a common cabinet with common power supply. Two radioteletype r-f channels (for day and night frequencies) and two voice r-f units might constitute one complete transmitter.

Common Frequencies

Common frequencies could be used for satellites within a net. Because the carrier is turned on and off constantly as stations transmit and receive, simultaneous use of A-3 (voice) and f-s keying on the same channel is impractical. Thus satellites would use simplex operation between themselves and full duplex between each *individual* satellite and the control station. This might be called half-duplex or shared-time duplex operation. Traffic between divisions would be relayed by Ankara. Because the r-f carriers of both eastern and western divisions transmitters at Ankara would stay on continuously, operation of combined A3/A1 and f-s telegraph transmission would be feasible.

Rhombic directional transmitting antennas would be beamed from each satellite towards Ankara, to provide better reception from the low-power transmitters. Ankara on the other hand, would have to transmit in all directions; 3-kw transmitters would be required to give sufficient power to the non-directional antennas.

There would be no distinction between the domestic and international transmitters. Three 3-kw output transmitters of 4 r-f channels each would be arbitrarily set up with frequencies corresponding to the circuits desired. From two to four r-f units could be operated simultaneously on each transmitter, which insures sufficient channels available for all services.

The base station would ordinarily use at least two and occasionally three or four r-f channels (frequencies) simultaneously on both domestic and international weather broadcasts. In fact, for conventional domestic point-to-point transmission, both day and night channels would be keyed simultaneously from one *TD*. This would enable nearby and distant satellites to choose the frequency best received.

Dual-Diversity Uses

Dual-diversity reception would be required for the international circuit and also on the sub-international circuits. Purely domestic short-haul circuits can use non-diversity receiving equipment.

It is hoped that international commercial aviation may some day acquire that degree of standardization of communications so vital to safeguarding our airways.

[3]Data on frequency-shift principles of operation, courtesy of Press Wireless Manufacturing Corp.

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AT TEXAS CITY DISASTER

Harvey Radio 30 to 40-mc band mobile equipment in use during the recent Texas City disaster. Radio equipped car was used inside restricted area as a command post communications unit. A three-way communications setup at the police station provided additional coverage of the disaster area. Equipment had a power output of 40 to 70 watts.

Noise-Field Meter

(Continued from page 35)

operating frequency is harmonically related to the i-f frequency.

Vacuum-Tube Voltmeter

The vacuum-tube voltmeter is a bridge circuit having one triode connected 6V6 or 6V6GT/G in each of the two adjacent bridge arms. The indicating meter is connected across the bridge between the plates of the tubes. The noise output voltage is applied between grid and ground of one voltmeter tube, while the grid of the other voltmeter tube is directly grounded.

With no signal, the plates of the two tubes are at the same potential, and no current flows in the indicating meter circuit. With the d-c component of the noise voltage applied to the grid of its voltmeter tube, the plate resistance of this tube is changed and the bridge is unbalanced, causing a current to flow in the indicating meter. The heaters of the two voltmeter tubes are connected in parallel, so that changes in initial velocity of electron emission occurring because of fluctuations of cathode temperature with line voltage change appears equally in both sides of the bridge circuit, and, because they are balanced out, do not appear on the indicating instrument.

The triode section of a 6SQ7 (located in the i-f amplifier) serves as the first stage of the audio amplifier. A 6J5GT/G tube (located in the power supply) serves as the second audio amplifier stage.

The input signal to the 6J5GT/G is adjusted by means of a potentiometer volume control. The audio output is carried through a tapped output transformer having output impedance of 4,000 and 300 ohms selected by a switch.

A balanced *H* attenuator of 100 ohms impedance serves to reduce the input signal voltage before application to the r-f amplifier by factors of 1.0, 0.1, 0.01, 0.001, to permit limiting the r-f amplifier drive under conditions of high input signal.

The attenuator assembly consists of four separate attenuators of equal physical dimensions mounted on a turret and successively substituted in the input transmission line to give the desired loss.

Instrument has a bandwidth of approximately 210 kc at 6 db down. At twice the i-f, plus the incoming signal frequency, the attenuation is not less than 60 db over the operating frequency range.

V-H-F Survey

(*Continued from page* 41)

made immediately after the raising of the antenna. The center-conductor continuity test may be a bit difficult unless the antenna is near enough to some roof or building to permit placement of a bare wire around the antenna whip to the skirt so that the upper end can be shortened.

Connectors

Connectors are an important field-test equipment item. Three or four type u-h-f connectors are usually sufficient. These are used to connect RG-8/U cable sections as may be here required. In some cases, a special connector may be used on the antenna, or it may be necessary to connect from flexible RG-8/U cable to a ⅞" coax or a special antenna. It may be found at the test location that additional lengths of antenna cable are required.

Three lengths of RG-8/U flexible r-f cable with connectors, 50', 100', and 200', are also *must* items.

Miscellaneous Items

It is often advisable to have available an assortment of mica capacitors of about 100, 500, 2,000 and 5,000 mmfd, half a dozen mica metal-enclosed toothpick-type capacitors, a few spikes for use in blocking up antennas for fastening guy ropes, zippers if it is necessary to put an antenna into a couple of cars, spare mobile antenna or complement of parts if it is necessary to put an antenna on a car as in the case of the 160-mc equipment, several hanks of sash cord, an extra pair of long-nose pliers and side cutters, extra tuning tools or real small screwdrivers with insulated handles, a small ¼" x 1" neon pilot lamp tube, plenty of solder, a good flashlight, a good soldering iron, etc.

Spare tubes are quite essential, too. They should be very carefully checked for all units.

Dummy loads should always be available at the test location; a small bulb and connector for the mobile units and a larger bulb with short connection or flexible cable for quarter kilowatt units.

A standard 50-microampere test meter kit is also necessary. A voltohmmeter[1] or equivalent should also be available. If data are to be taken on mobile runs a db or noise meter is required for determining noise reduction by carrier.

[1]Simpson 260 voltohmmeter.

News Briefs

INDUSTRY ACTIVITIES

Ground-breaking ceremonies for the 460-kw f-m transmitter of KMPC were conducted recently at San Gabriel Peak, near Los Angeles.

San Gabriel Peak has an altitude of 6,156 feet. Because of its inaccessibility, KMPC will construct an inclined tramway of 1,200 feet, extending from Mt. Wilson Road to the crest of San Gabriel Peak. Living quarters for radio technicians, as well as the transmitter's own electrical power plant of 200,000 watts, will be erected on this site.

Loyd Sigmon is chief engineer of KMPC-FM.

Motorola, Inc., is the new name of the Galvin Manufacturing Corporation.

The Sound Apparatus Company has opened a plant in Stirling, New Jersey. Research laboratories are in Millington, N. J., Main offices are at 233 Broadway, N. Y. City.

Raytheon Manufacturing Co., Waltham, Mass., has formed a commercial products division, which will consist of the broadcast equipment division, recently transferred from Chicago to Waltham.

Frank S. Horning has been appointed sales manager of the new division, and **William A. Gray** is assistant sales manager.

David D. Coffin will be chief engineer, and **James N. Nye** will be engineer in charge of broadcast transmitter equipment. **Everett G. Fraim** has been appointed engineer in charge of speech input equipment, microwave applications, and engineering service and installation supervision on broadcast and microwave equipment.

Electro-Voice, Inc., recently held a microphone sales clinic with the sales staff of Newark Electric in Chicago. The clinic was conducted by Web Soules, sales manager.

The A. T. & T. have announced that on August 1 it would make intercity video transmitting facilities available to broadcasters on a commercial bass. Tariffs covering rates to become effective on that date have been filed with the FCC.

Intercity video channels for television broadcasts will be provided over both coaxial cable and radio relay facilities. Four thousand miles of coaxial cables have now been placed for use in furnishing telephone service. It is expected that this mileage will grow to 6,500 by the end of 1947 and to more than 9,000 miles by the end of 1948.

Two additional one-way video channels will become available along the New York-Washington route by the middle of 1948.

Experimental radio-relay facilities, with television possibilities, will be available in both directions between New York and Boston in the latter part of 1947. Another radio relay system, to link New York and Chicago, is projected.

For occasional, or part time, service an interexchange video channel (a transmission link between cities) will cost $1.25 per circuit mile for the first hour of use, and one-quarter of that amount for each additional consecutive 15 minutes of use. In addition, there is, for each city, a monthy station connection charge of $250, plus $15 for each hour of use.

For monthly service the charge will be $40 a month per circuit mile for eight consecutive hours daily, plus $2 a month for each additional consecutive hour. For each station connected on a monthly basis the charge will be $750 a month for eight consecutive hours daily and $50 a month for each additional consecutive hour.

The St. Louis Microphone Co. has been incorporated. The company moved into a new building at 2726-28 Brentwood Blvd., St. Louis 17, Missouri.

Capitol Radio Engineering Institute, Washington, D. C., celebrated its 20th anniversary recently. An anniversary dinner was held at Hotel Mayflower, during which CREI president E. H. Rietzke was honored for his work as an engineering educator.

The Brush Development Co., Cleveland, exhibited their magnetic type recorders and allied equipment at the recent Mid-America Exposition in the Public Hall, Cleveland, Ohio.

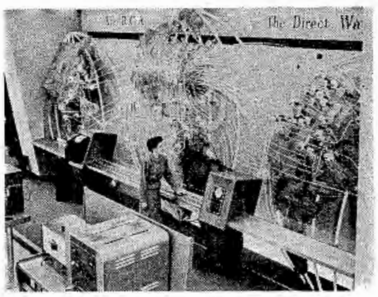
The Sola Electric Company plants have been moved to a new building at 4633 West 16th Street, Chicago 50, Illinois.

Selenium Corporation of America, an affiliate of Vickers Incorporated, manufacturers of selenium rectifiers, and photoelectric cells, have moved to a new plant at 2160 East Imperial Highway, El Segundo, Cal.

The RCA Exhibition Hall, 36 W. 49th St., N. Y. C., was opened recently.

The Exhibition Hall features a television display, where visitors may be televised and simultaneously see their own televised images.

On view are giant models of various tubes containing miniatures of radio and television receivers, transmitters, and other electronic equipment. On exhibition, too, are tv receivers, home receivers and portable and personal radio sets. On-the-spot demonstrations include the vibration pickup and electronic metal-detectors and computing devices.



WGN will install a 5-kw G. E. tv transmitter this summer.

The station, to be known as WGNA, expects to have a test pattern on the air by late October and to be ready for limited commercial operation by January. Carl J. Meyers is director of engineering.

PERSONALS

George L. Beers, assistant director of engineering, RCA Victor, recently received the honorary degree of Doctor of Science from Gettysburg College, Gettysburg, Pa.

Mr. Beers graduated from Gettysburg College in 1921, when he received a B.S. degree in electrical engineering.

D. M. Allgood is now a vice president of the Farnsworth Television & Radio Corporation.

Robert F. Davis has been appointed as a communications field engineer for Motorola, Inc., with headquarters in Denver. His territory will cover the states of Colorado and Kansas.

A. F. Wild has been appointed sales manager of television equipment in the G. E. transmitter division at Syracuse, N. Y.

Jack M. Williams has been named advertising manager of the RCA home instrument department.

Mr. Williams was formerly advertising manager of the RCA Victor record department.

Henry C. L. Johnson, formerly advertising manager of the Sylvania Electric Products, Inc., radio, electronics and international divisions, has been appointed advertising manager of Rheem Manufacturing Company, 570 Lexington Ave., N. Y. City.

James D. McLean, formerly manager of sales of G. E. transmitters, has been appointed commercial manager of Philco tv station WPTZ.

George F. Metcalf, manager of General Electric's Electronics Laboratory at Syracuse, N. Y., was decorated in Washington, D. C., recently by Lord Inverchapel, British Ambassador, for his wartime contributions to airborne radar. Metcalf was appointed an Honorary Officer of the Military Division of the Most Excellent Order of the British Empire, conferred by King George VI.

Metcalf headed the Aircraft Radar Laboratories at Wright Field, Ohio, while he was in the service.

E. J. Pool has been elected vice president and a member of the board of directors of Cinch Manufacturing Corporation, Chicago.

Edward M. Tuft has been appointed director of personnel of the RCA Victor Division.

A. D. Heller has been appointed chief mechanical engineer of the United States Television Manufacturing Corp.

Philip G. Caldwell has been appointed manager of sales of the G. E. transmitter division at Syracuse, N. Y.

Mr. Caldwell formerly was sales manager of television equipment for the division.

WHEN YOU CHANGE YOUR ADDRESS

Be sure to notify the Subscription Department of COMMUNICATIONS, 52 Vanderbilt Avenue, New York 17, N. Y., giving the old as well as the new address, and do this at least four weeks in advance. The Post Office Department does not forward magazines unless you pay additional postage, and we cannot duplicate copies mailed to the old address. We ask your cooperation.

Major General Harry C. Ingles, who served as Chief Signal Officer of the United States Army from July, 1943, to March, 1947, has been elected president and a director of RCA Institutes, Inc.

Gen. H. C. Ingles

James F. White has been appointed assistant sales manager of Andrew Co., Chicago, Illinois.

James F. White

Sidney Karr is now advertising and publicity manager for the Amplifier Corp. of America.

Harry F. Mickel, formerly manager of the communications equipment section of RCA in Camden, N. J., has been appointed engineering sales manager of the radio engineering products division of Raymond Rosen & Company.

Edward F. Weston is now chairman of the board of the Weston Electrical Instrument Corp.; **Caxton Brown** is chairman of the executive committee; **Earl R. Mellen,** president; **H. Leigh Gerstenberger,** vice president in charge of sales; **Reginald R. Lambe,** vice president in charge of manufacturing; **John H. Miller,** vice president and chief engineer.

Andrew A. Foley, Walnut Street, Philadelphia, Penn., has been named Astatic representative in the Philadelphia territory.

Walter Carruthers has been named chief engineer in charge of the Don Lee Broadcasting System. Carruthers was formerly director of development and research.

Carl V. Hansen, Jr., has been elected vice president and treasurer of the St. Louis Microphone Company, Inc.

LITERATURE

The Lenz Electric Mfg. Co., 1751 N. Western Avenue, Chicago 47, Ill., have prepared a 16-page bulletin describing and illustrating radio and instrument hook-up wire, radio leadin and ground wire, shielded cables, shielded jacketed microphone cables, cotton-braided extension cables, crystal microphone cables, phono and musical instrument pickup cordage, tinned copper shielding and bonding braids, and p-a and intercommunications cables.

Two volumes of an index to RCA technical papers has been released by the **RCA Laboratories Division,** Princeton, N. J. The indexes are available without charge.

The General Radio Experimenter for April describes a wide-frequency-range capacitance bridge, Type 716-C.

Clarostat Mfg. Co., Inc., 130 Clinton St., Brooklyn 2, N. Y., have released a bulletin "Why Cement-Coated Power Resistors?". Simple tests to determine overload capacity, heat-shock immunity, through-coating leakage, corrosion elimination and other advantages of cold-setting cement coating, are illustrated and described.

Cornell-Dubilier Electric Corporation, South Plainfield, New Jersey, have published a 208-page book by W. C. King, sales engineer, entitled "Power Factor in Your Plant."

The book is based on actual experience in answering the questions of maintenance engineers. Book, priced at $3.00, can be ordered from Cornell-Dubilier.

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COMMUNICATIONS—JUNE, 1947

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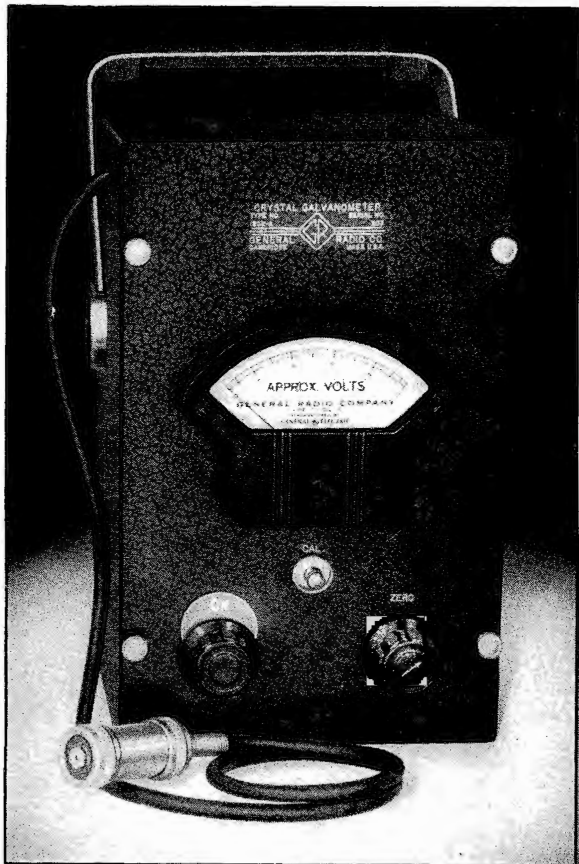

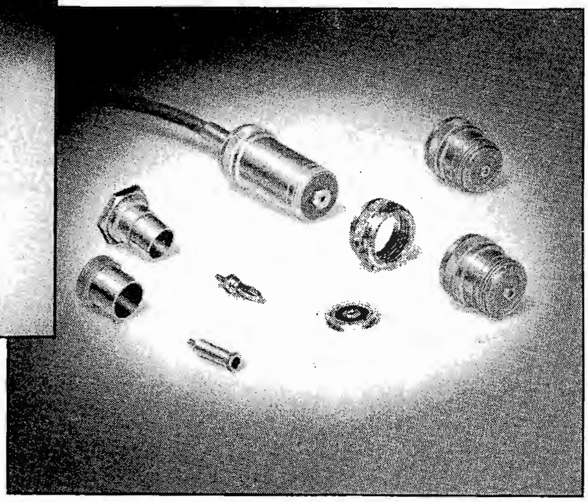

The Type 1802-A Crystal Galvanometer (a "galvanometer" rather than a "voltmeter" because it does not have the high accuracy of most other G-R instruments) measures voltages from 30 to 1,000 Mc, and is useful up to 4,000 Mc. It is direct-reading from 0.1 volt to 100 volts and is finding considerable utility in u-h-f measurements.

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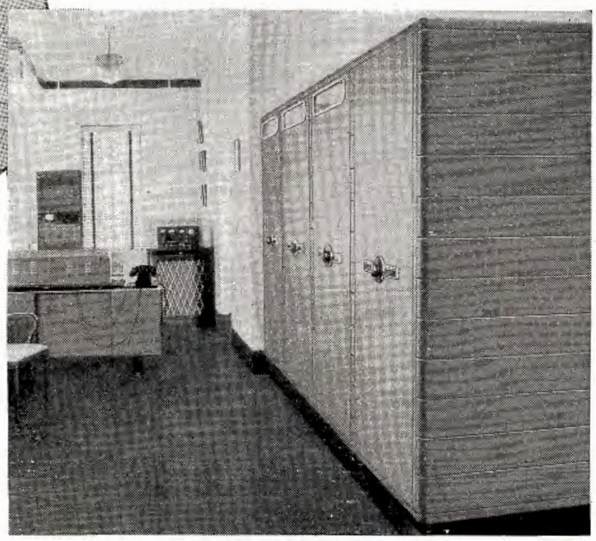

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