COMMUNICATIONS

INCLUDING "RADIO ENGINEERING" AND "TELEVISION ENGINEERING"

DECEMBER

* TWO-WAY TAXICAB-RADIO SYSTEMS * ANNUAL INDEX
* DEATH VALLEY V-H-F RADIOTELEPHONE LINK

1947

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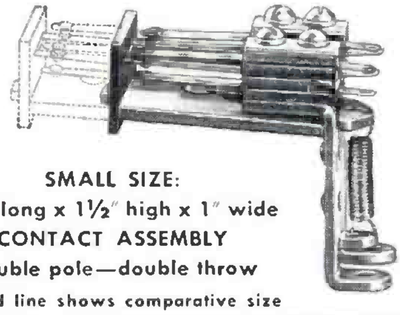
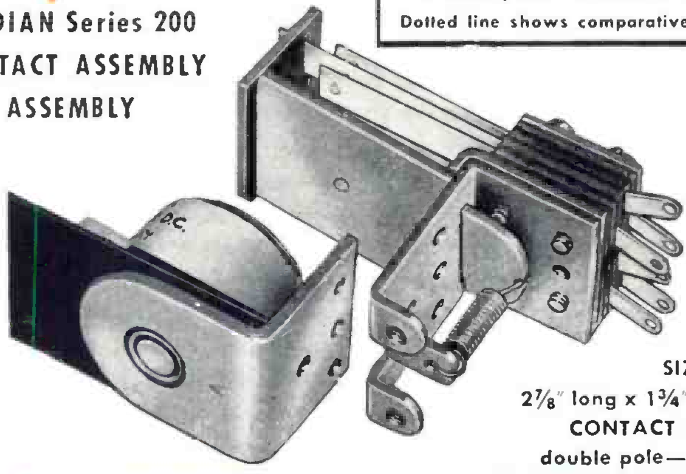
STANDARD CONTACT ASSEMBLY
AND COIL ASSEMBLY

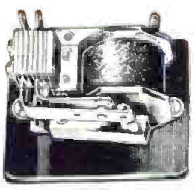


SMALL SIZE:
$1\frac{5}{8}$" long x $1\frac{1}{2}$" high x 1" wide
CONTACT ASSEMBLY
double pole—double throw
Dotted line shows comparative size

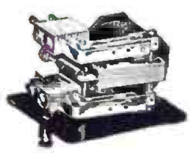


SIZE
$2\frac{7}{8}$" long x $1\frac{3}{4}$" high x 1" wide
CONTACT ASSEMBLY
double pole—double throw

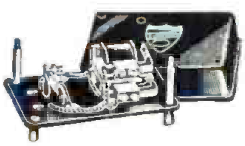
Popular RADIO RELAYS in the GUARDIAN line:



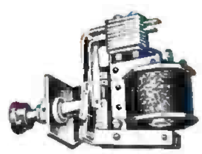
K-100 Keying Relay For low voltage control of high voltage transmission. Guardian Series K-100 Relay will follow key or bug at highest WPM rate attainable. High speed response, strong magnet and return spring give clean make and break, produce best CW note. Coils: 5 to 16 v., A.C.; coils for other voltages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



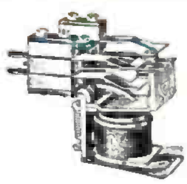
B-100 Break-In Relay For break-in operation on amateur transmitters. The Guardian B-100 Relay has laminated field piece and armature. Fine ¼" silver DPDT contacts, capacity to 1500 watts, 60 c., non-inductive A.C., and in A.C. primary circuit of any inductive power supply delivering up to 1 KW, inclusively.



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



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



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

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COVER ILLUSTRATION

Inspector Francis A. Burns, acting superintendent of telegraph for the Brooklyn (N. Y.) Police Department, at the controls of a dispatch console in Brooklyn Police Headquarters, which feeds into a 250-watt f-m transmitter operating on 39.58 mc. Mobile units, of which there are 150, operate on two frequencies; 37.22 mc for the eastern portion of the borough and 39.38 for the western portion of the borough. *(Courtesy RCA)*

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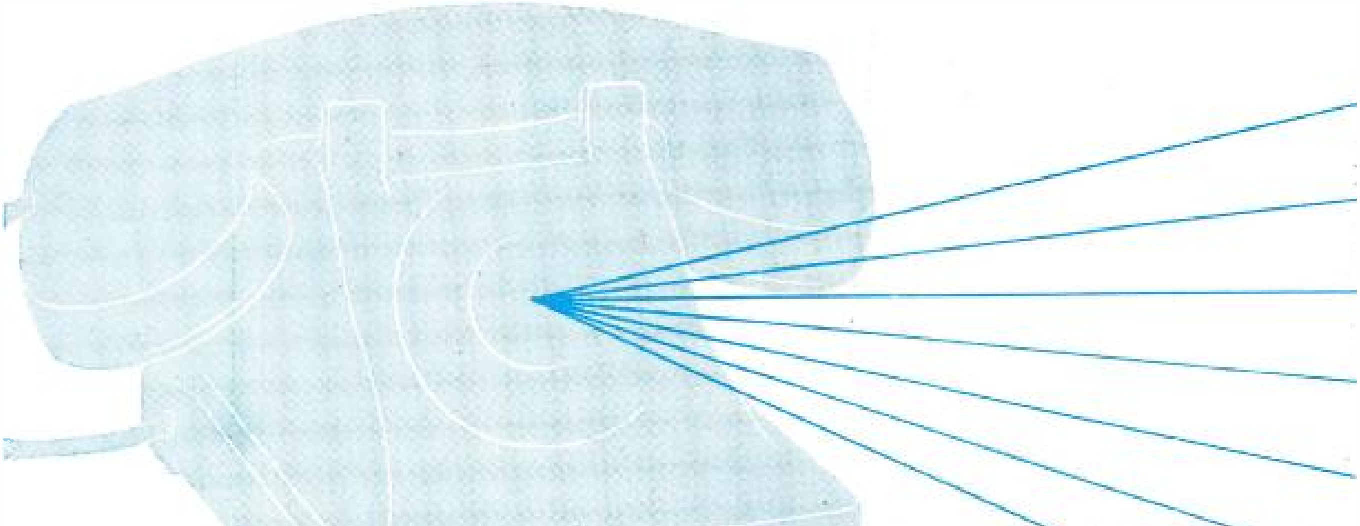
Why this team



RESEARCH in telephony has given birth to many of the important advances in the transmission, amplification and reproduction of sound. Out of the telephone transmitter came the first successful commercial microphone in 1920...out of the receiver came the loudspeaker in 1919 ...out of the vacuum tube repeater—developed for telephony in 1913—the modern science of electronics.

It is only natural that Bell Laboratories scientists and Western Electric engineers, working as a team to improve telephony, have pioneered in the design and manufacture of equipment in all of these fields which have sprung from the telephone.

Whether you are interested in radio broadcasting, mobile radio, sound motion pictures, sound systems, radar, hearing aids or radio telephony, you'll find it wise to look to equipment designed and manufactured to fill your needs by the Bell Telephone Laboratories-Western Electric team.

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"The National Debt and You,"

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SOUND EQUIPMENT

COMMUNICATIONS

LEWIS WINNER, Editor

DECEMBER, 1947

F-M Design Factors

Selectivity has always been a particularly important factor in receiver and transmitter development, usually serving as a focal point of consideration.

Ease of tuning, fidelity, channel separation, transmitter location and power, represent a few of the factors involved in the problem of selectivity, a problem that becomes quite acute at the higher frequencies. At these frequencies, the relationship of tuned circuits and channel separation must be probed carefully. Analyzing this point in a paper on i-f selectivity considerations in f-m receivers, at the recent Rochester Fall Meeting, R. B. Dome, of G. E., said that the i-f gain of a two-transformer receiver, from the converter grid to the limiter grid, may be as high as 3,600 if the receiver is to be used in areas where channels are spaced no closer than .8 mc.

This interesting study also disclosed that the i-f gain of a three-transformer receiver, from the converter grid to the limiter grid, may be as high as 5,600 if the receiver is to be used in an area where the channels are spaced no closer than .6 mc.

The study of a six tuned-circuit receiver revealed that the signal ratio should not exceed 2,000 to 1 at the converter grid. This ratio may, however, rise up to 10,000 to 1 if the limiting is good and propagation vagaries do not prevail.

The gain data presented by Dome were based on a practical design chart, which provided i-f selectivity for two to fourteen tuned circuits with frequency spacings of from .2 to 2 mc.

The channel separation problem was also the basis of an FCC study about a year ago when it was learned that some f-m receivers did not adequately discriminate against moderately strong f-m signals 400 kc away. This prompted the FCC to reallocate class *B* (high power regional) stations to provide an 800-kc separation between stations in the same service area

Probing further into this selectivity problem, Hazeltine engineers found that practical grid-bias limiter systems are not as satisfactory in regard to adjacent-channel interference as, for instance, ratio detectors and systems employing a dynamic limiter in cascade with a ratio detector.

Reporting on this investigation, at the Rochester Fall Meeting, B. D. Loughlin, of Hazeltine, said that the combination of dynamic limiter and ratio detector provided a system which is better able to cope with simultaneously applied signals than the ratio detector alone.

Loughlin reported that a fast acting avc to effect a-m reduction was also studied. It was found, however, that the a-m reduction fails at some high a-m frequency and may or may not have a modulation rise at some higher frequency, depending upon the amplitude and phase characteristics of the feedback loop.

The study indicated, therefore, that it is necessary to probe carefully the relationship of f-m detectors and selectivity since the type of detector considerably influences the susceptibility of the receiver to interfering signals.

TV Progress

The year 1947 has been quite a grand one for tv. Operating stations have tripled. Stations in 12 cities are now on the air, reaching approximately 25% of the population of the country. Fifty-four stations have been authorized to start telecasting soon, and forty-three have applied for tv building permits. Coax and radio relays have linked New York to Syracuse, New York to Philadelphia to Washington, and Chicago to South Bend. The Boston to New York relay link has become available. Relays to other cities are now being completed and will be open for business in '48.

Microwave relays operating in the 2,000- to 4,000-mc bands have played quite a role in the transmission expansion, providing the all-important coverage flexibility, a flexibility that will be improved on in '48 through the use of such facilities as trucks with microwave equipment beamed to centrally located buildings.

The viewing audience has grown from a few thousand to over a million and as Jack Poppele of WOR and TBA said recently, many millions will be looking on in '48.

A bright stage was set for tv in '47, and there'll be more pace-making progress in '48.

Books of '47

U-h-f and s-h-f techniques, mathematics, acoustics, tv and radar were covered quite thoroughly in books released during 1947.

The all-important subject of ultrahigh frequency was analyzed by Nathan Marchand in his book on "Ultra-High Frequency Transmission and Radiation" (*John Wiley*).

Arthur B. Bronwell and Robert E. Beam discussed "Theory and Application of Microwaves" in their new book (*McGraw-Hill*). Harvard University Radio Research Labs released a two-volume presentation on "Very High Frequency Techniques" (*McGraw-Hill*).

Television books of '47 included the comprehensive *RCA Labs Technical Book* series, Volumes III and IV, covering the periods of '38 to '41 and '42 to '46.

An extremely useful text on mathematics was published by *Pitman*; "Mathematics and Radio Engineers" by Leonard Mautner.

Books on radar included the MIT Radiation Lab series covering "Radar System Engineering" and "Radar Aids to Navigation" (*McGraw-Hill*). The Radar School of MIT also released a book on the "Principles of Radar," containing lectures presented at the MIT Radar School (*McGraw-Hill*).

Two excellent revised editions also appeared in '47: "Radio Engineering" (third edition) by F. E. Terman (*McGraw-Hill*) and "Elements of Acoustical Engineering" (second edition) by Harry F. Olson (*Van Nostrand*). The subject of acoustics was also effectively discussed in a book by Michael Rettinger entitled "Applied Architectural Acoustics" (*Chemical Pub. Co.*)

"Patent Notes for Engineers," a very handy little book, also appeared in '47. It was published by the *RCA Review* department of RCA Labs Division.—L. W.

(Above)
Central station control console used by city cabs in Pulaski, Virginia (*Courtesy Doolittle Radio and Leonard Electric Supply Co.*)

(Left)
Miami Beach Yellow Cab with a 15-watt transmitter and 16-tube receiver which has a ½ microvolt sensitivity. (*Courtesy Communications Co.*)

Two-Way Taxicab Radio Systems

THE ADOPTION AND SUCCESSFUL utilization of two-way radio in the taxicab field already exceed the most optimistic prophesies of radio and taxicab experts. The growth of the taxi radio systems has substantiated the testimony offered at FCC hearings by the American Taxicab Association, the National Association of Taxicab Owners and the Cab Research Bureau.

When the now famous FCC Docket No. 6651 assigned frequencies in the 152 to 162-mc band for new land transportation services on May 25, 1945, it was expected that taxicabs would be one of the smallest of mobile radio services. This feeling was based on the overall number of taxicabs in existence as compared to the number of truck, bus and railroad vehicles. The FCC allocations gave railroads 60 channels and all highway radio services a total of 24 channels.[1] Taxicabs were given one channel (two frequencies in the case of duplex operation) out of the twenty-four reserved for highway radio services. Already, there are more taxicab radio installations operating on a single channel than exist for all railroads, trucks and buses in the United States on the other 83 channels.

At the time the allocations were made, there were less than 50,000 taxicabs in the United States. Since that time, returning veterans becoming available as drivers and fleet owners, and the resumption of taxicab production has greatly increased the number of vehicles for hire. Today, according to A. Weisinger, editor of *Taxi Weekly*, there are about 90,000 taxicabs in service of which about 75,000 taxicabs are destined to be equipped with two-way radio.

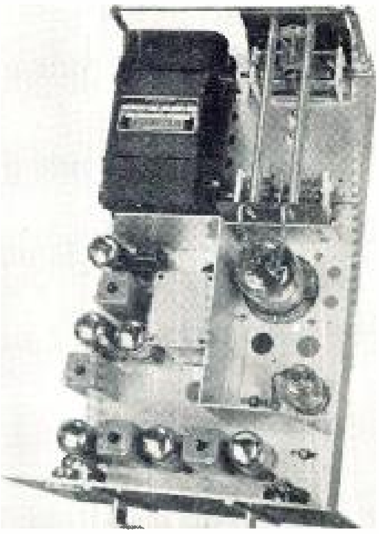
Despite the short elapsed period of time, experimental licenses for initial service and the inability of the radio industry to cope with the equipment demand, over a third of these 75,000 cabs are now either equipped, licensed to be equipped or orders have been placed for the equipment.

As of October 1947, the FCC land transportation section advised the writer that over 600 taxicab fleets have been licensed to use two-way

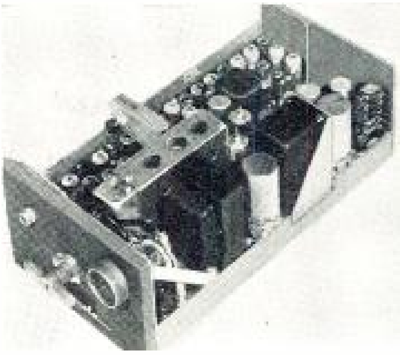
[1]Each channel is 60-kc wide.

Front view of model 210-D of *Communications Company*.

Interior top chassis view of 30-watt *Temco* model 30-FMT transmitter.



Top chassis view of taxicab 7 to 10-watt transmitter-receiver: *Motorola Dispatcher*.



A Report on the Technical and Economic Aspects of the Mobile F-M Service, Which Is Now Being Used by Over 600 Fleets Operating Some 20,000 Cabs.

by SAMUEL FREEDMAN

Author of "Two-Way Radio"

San Francisco Yellow Cab with a two-way taxi-talkie which has a 25-watt output. *(Courtesy Mobile Communications)*

radio, and that new applications were coming in at the rate of 100 cab fleets per month. As of November, 1947, one manufacturer had sold equipment to over 350 taxi fleets in the United States. Another manufacturer has completed contractual negotiations to install radio systems in 1,600 taxicabs in Chicago (for the Yellow Cab fleet alone), 1,000 in Los Angeles, 600 in San Francisco and various numbers between five and over eighty in the California cities of Long Beach, Visalia, Tulare, Hanford, Fresno, Sacramento, Wilmington, San Luis Obispo, San Diego, El Monte, East Los Angeles, Pomona and other points throughout the United States. Comparable experiences have been reported by several other manufacturers either on a national basis or on a zone basis.

The taxicab fleet owners have been well pleased with cab-radio which has resulted in more business and an increase in percentage of profit. Two-way radio in the taxi field is selling itself, and at this moment there appears to be business available to every firm able to make deliveries. The general expectation is that before the taxicab field is saturated, the trucking field will open up with an even greater demand since there are forty times more trucks than taxicabs in the United States.

Economic Advantages of Systems

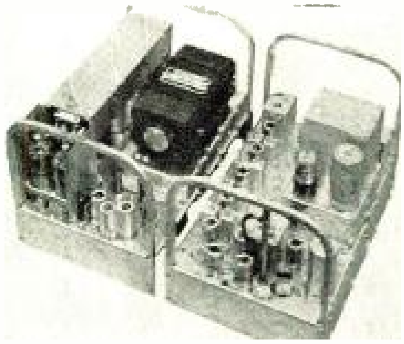
Typical reports, based on actual experiences, indicate that cab radio service costs are self-liquidating in a short period of time:

(1) One major fleet reports that every radio-equipped cab is equivalent to as many as three non-radio cabs in parallel service.

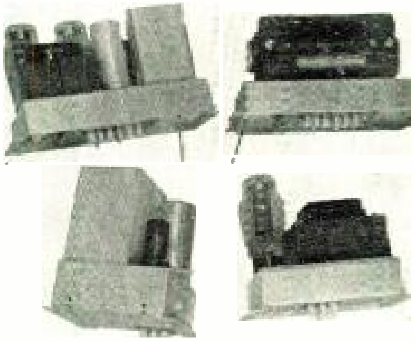
(2) Another reports that every radio-equipped cab can gross at least $5 more per cab per eight-hour shift.

(3) Another claims that radio-equipped cabs can average up to 25% more revenue per mile traveled than can non-radio mabs.

(4) All claim that there is a marked reduction in dead or cruising (non-farepaying) mileage. It aver-



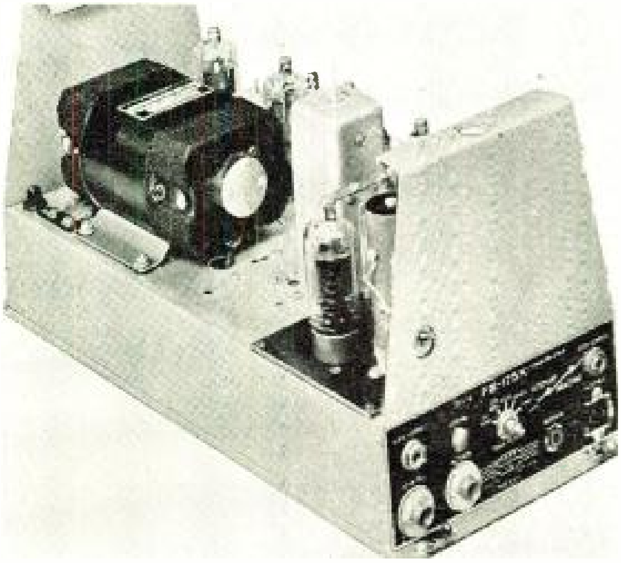
Top chassis view of *Harvey Radio* transmitter and receiver; transmitter has 30-watt output.



(Right)
Four types of power supplies which can be used with *Harvey Radio* equipment. At upper left, a-c transmitter power supply; upper right, d-c transmitter power supply; lower left, d-c receiver power supply; lower right, a-c receiver power supply.

(Right)
The 20-watt instantaneous heating *Kaar* transmitter: FM 175X.

FTR taxi receiver, a 14-tube double conversion model.



ages about 50%, varying between 25% and 75%, depending on circumstances and location of the taxicabs in the citywide area.

(5) The service has prompted new business and made it feasible and profitable to handle. Return loads become much more common when a radio-cab discharges a passenger in an outlying or *poor business* area. The business hitherto ignored on side streets or in outlying areas becomes as convenient to accept and handle as the business on the main thoroughfares or the midtown area.

(6) The radio-cab has made every home, business or other telephone equivalent to a taxicab telephone stand.

Results of Recent Installations

Pulaski, Virginia: In an analysis of a fleet of seven cabs with and without radio, in a city of 12,500 population, with a total of seventy-five cabs, among several fleets, the following data were compiled:

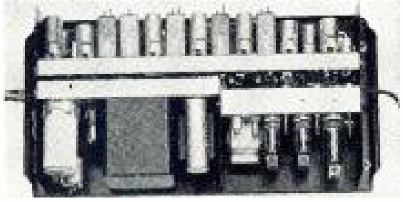
	January 1947 (*Without radio*)	*May* 1947 (*With radio*)
Number of cabs	7	7
Miles traveled	25,644	32,952
Gross income	$3,485.30	$5,382.70
Income per mile	13.59c	16.34c

Odell G. Mayberry, manager of the City-Cab fleet, involved in the foregoing study, stated that January has always been an-above-average month, whereas May is an average month because of weather conditions. There is more taxicab patronage in the winter months when exposure outdoors is less comfortable. Despite this, two-way radio can take a less favorable month and make it substantially exceed the best month without radio.

Plainfield, N. J.: Fleet owner reported that the adoption of two-way radio immediately raised the revenue from 22 to 35 cents per mile.

High Point, N. C.: A report by FCC, covering carefully-observed tests for a ten-day period, with four radio cabs versus six non-radio cabs, showed that the four radio cabs averaged 1,300 miles, 425 fares and $350 revenue each: the six non-radio cabs averaged 1,000 miles, 200 fares and only $150 each.

Chicago, Ill.: A *Radio Flash* taxicab driver reported that he is grossing 200 miles per day as compared to 120 miles for non-radio cabs. When he is in the downtown area or near terminals, he usually finds his own fare-paying passengers with little effort. When he is in other zones, he relies on the central station dispatcher to find him a passenger in his proximity. The tendency is increasing for the dispatcher to more and more assume the responsibility of providing passengers, while the driver concerns himself largely with the operation of the vehicle.


The 2½ watt transmitter-receiver unit of *Bendix*: model RTR-2.

Two-way radio always is important to the driver. It is important to the taxicab fleet owner only when the driver is employed by them, normally on commission. In most cities the commission paid the driver is 42½% of the fare registered on the taximeter. It varies in city to city as follows:

In Los Angeles, drivers are paid 47½% commission with an $8 per day minimum guaranteed wage, exclusive of tips. Yellow Cab holds an exclusive franchise with 1,000 cabs except for about 100 veteran cabs established since the end of the war. The city has the largest geographical area in the United States (452 square miles). It has relatively few cabs for the size of the overall population because a greater percentage of the population and visitors operate their own private automobiles. Taxicabs are therefore spread out more thinly and they are often hard to find at locations removed from principal thoroughfares and terminals. The danger of making a long trip back without a fare after discharging a passenger is unusually great. Two-way radio is destined to revolutionize their taxicab revenues and service to the public. During an inspection of a telephone-operated main dispatching office in this city at the 5 P. M. rush hour, two persons were steadily receiving telephone requests for taxicab service, while fifteen dispatchers were hard pressed trying 150 taxicab stands by telephone to find the necessary taxicabs to fill these requests. Their percentage of hits (finding a cab by that method) was discouragingly small, as well as very trying to the dispatcher and annoying to the impatient passenger waiting somewhere. Many cabs, cruising without passengers, would have liked to have known of these opportunities in their area.

RCA transmitter-receiver installed in trunk rack.

Incidentally each operating cab in the 1,000-cab fleet is expected to average $20 per shift, or approximately $40,000 per day.

In Chicago the major fleets pay their drivers 42½% commission, with no minimum guaranteed wage. In the case of independents, a driver owns or leases a taxicab. In some cases an enterprising individual may own several cabs which are rented out. If radio-equipped, such a cab may rent for $10 to $12 per shift. If the cab is owned by the driver without radio, the radio equipment may be rented for $20 per month. This cost includes maintenance and central dispatching service from an organization, such as *Tower Cabs*. Since one central station is serving many independent drivers, chaos is minimized by the central station who first determines which cab or cabs desire to handle a passenger needing a cab. The procedure is to first broadcast (without specific call to any particular cab) the general location where a cab is needed, such as "Clark and Division" Streets. Any driver hearing it may offer to take the call. The dispatcher then gives the volunteering or selected taxicab the complete address. If no one volunteers and the need is important, further removed taxicabs can volunteer.

In Philadelphia, Yellow Cab has begun to equip their 1,500-cab fleet with two-way radio. Non-radio drivers report about 25% dead mileage.

In Washington, D. C., the largest organization, *Diamond Taxicab*, is currently negotiating for two-way radio in 2,000 taxicabs. The *Airport Taxi Service*, who have the franchise for hauling passengers from the Washington National Airport to the city, have equipped some of their cars with Bell system toll radio facilities. Passengers ordering an airport taxi in the city proper pay an extra charge for the service of being picked up at points other than the Hotel Statler.

Right: Data on eight models of mobile equipment used for taxi service.

[To Be Continued]

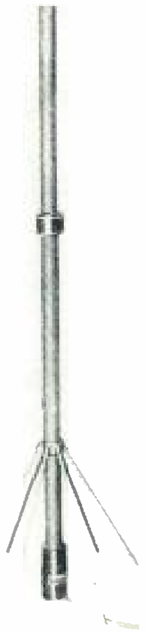
Detail	RCA	Doolittle (PVY-PFY)	Kaar	Western Electric (238)	Motorola (Dispatcher)	Motorola (Standard) (FMTU-30D)	General Electric (4 ES)	Mobile Communications (MFM 25)
Number of Tubes (Receiver)	15	14	12	15	16	16	14	14
Number of Tubes (Transmitter)	12	9	10	11	9	9	8	8
Number of Tubes (Total)	27	23	22	26	25	25	22	22
Receiver Tube Lineup	R-F Amplifier, 6AK5 1st Detector, 6AK5 2nd Detector, SH7 1st I-F, 6SH7 2nd I-F, 6SH7 Discriminator, 6H6 1st Limiter, 6SH7 2nd Limiter, 6SH7 1st Multiplier, 6SH7 2nd Multiplier, 6AG5 Oscillator, 6SH7 Noise Rectifier, 6H6 1st Audio and Squelch Amplifier, 6SL7GT 2nd Audio, 6SH7 Audio Output 1635 [*CT-2*]	R-F, 6AK5 Mixer, 6AK5 Multiplier, 6AK5 Oscillator, 6AK6 1st I-F, 6SH7 2nd Mixer, 6SA7 2nd I-F, 6SH7 1st Limiter, 6SJ7 2nd Limiter, 6SJ7 Discriminator, 6H6 1st Audio-Squelch, 6SL7 Noise Amplifier Rectifier, 7A6 Audio Output, 6V6GT Vibrator Rectifier, 6X5	1st R-F, 9003 2nd R-F, 9003 1st Mixer, 9003 Crystal Oscillator, 6G6G Quadrupler, 9003 5300-5700 kc I-F, 7C7 2nd Mixer, 7C7 455 kc Amplifier and Semi-Limiter, 7C7 2nd Limiter, 7C7 Noise Amplifier, 7C7 Noise Rectifier and 1st Audio, 6SZ7 Power Output, 6G6G [*Model* 10X]	H F Oscillator, 6AK5 Harmonic Amplifier, 6AK5 R-F Amplifier, 6AK5 1st Mixer, 6AK5 2nd Mixer, 9001 L-F Oscillator, 9001 1st L-F I-F, 9001 2nd L-F I-F, 9001 1st Limiter, 9001 2nd Limiter, 9001 1st Audio, 9001 Noise Amplifier, 9001 Discriminator, 6AL5 Audio Output, 6AK5 Rectifier, 6X5G	1st R-F, 6BH6 2nd R-F, 6BH6 1st Mixer, 6BJ6 Oscillator-Multiplier, 6BJ6 Oscillator, 6BJ6 1st I-F, 6BJ6 2nd Mixer, 6BJ6 2nd I-F, 6BJ6 1st Limiter, 6BJ6 2nd Limiter, 6BJ6 Discriminator, 6AL5 Noise Amplifier, 6BH6 Noise Rectifier, 6AL5 1st Audio, 12AU7 Output, 6AQ5	1st R-F, 6AK5 2nd R-F, 6AK5 Mixer-Amplifier, 6AK5 Multiplier-Amplifier, 6AK5 Oscillator, 7H7 1st I-F, 7C7 Mixer, 7C7 2nd I-F, 7C7 1st Limiter, 7C7 2nd Limiter, 7C7 Discriminator, 7A6 Squelch and Audio, 7F7 Noise Amplifier, 7C7 Voltage Doubler-Noise Rectifier, 7A6 Audio Output, 7C5	R-F, 6AK5 1st Mixer, 6AK5 Oscillator 1st Tripler, 6AK5 2nd-3rd Triplers, 6J6 1st I-F, 6AK5 2nd Mixer, 6AK5 Low I-F, 6AK5 1st Limiter, 6AK5 2nd Limiter, 6AK5 Discriminator-Noise Amplifier, 6AQ7 Audio Amplifier-D-C Amplifier, 6SL7 Noise Rectifier, 6AL5 Synchro-Cycle Control, 6J6 Audio Power amp., 6AQ5	R-F Amp, 6AK5 1st Mixer, 6AK5 I-F, 6AK5 2nd Mixer, 1R5 1st L-F I-F, 1T4 2nd L-F I-F, 1T4 1st Limiter, 1L4 2nd Limiter, 1L4 Noise Amplifier and Rectifier, 1S5 Audio Amplifier, 1S5 Output Audio, 6AK6 Rectifier, 6X5 Oscillator-Tripler, 6V6 Harmonic Amplifier, 6AK6
Transmitter Tube Lineup	Audio Amplifier, 6SG7 Limiter, 6SL7 Oscillator, 6SJ7 Phase Modulator, 6SJ7 1st Doubler, 6SJ7 2nd Doubler, 6SJ7 3rd Doubler, 2E24 4th Doubler, 2E24 Tripler { 2E24 / 2E24 } Power Amplifier { 2E24 / 2E24 } [*CM-3B*]	Oscillator, 6C4 Modulator { 6BE7 / 6BE7 } Quadrupler, 6AK6 1st Doubler, 6AK6 2nd Doubler, 6AK6 3rd Doubler-Driver, 2E24 Power Amplifier { 2E24 / 2E24 }	Oscillator 2E25 Phase Modulator { 2E25 / 2E25 } Amplitude Modulator, 2E25 1st Quadrupler, 2E25 2nd Quadrupler, 2E25 Doubler, 2E25 Driver, 2E25 Final Amplifier and Doubler { 5516 / 5516 } [*Model* 175X]	Oscillator, 2E24 Buffer Amplifier, 2E24 Modulator, 2E24 Doubler, 2E24 Tripler, 2E24 Doubler, 2E24 PP Tripler { 2E24 / 2E24 } PP Amplifier { 2E24 / 2E24 } Voltmeter, 9001	Oscillator, 6AK5 Modulator { 6BE6 / 6BE6 } Quadrupler, 6AK5 Tripler, 6AK5 Doubler, 6AK5 Double-Driver, 2E26 Output Amplifier, 2E26 Rectifier, 0Z4	Oscillator, 7C7 Modulator { 7A8 / 7A8 } Quadrupler, 7C5 Tripler, 7C5 Doubler, 7C5 Driver-Doubler, 2E24 P. P. Final Amplifier { 2E24 / 2E24 }	Oscillator, 6AG5 Modulator, 6AG5 Quadrupler, 6AG5 1st Doubler, 6AG5 Tripler, 2E30 2nd Doubler, 2E30 P-P Power Amplifier { 2E24 / 2E24 }	Oscillator, 6AK6 Balanced Modulation { 6BE6 / 6BE6 } Quadrupler-Tripler, 6J6 Doubler, 6AK6 Doubler, 6AK6 Doubler, 6AK6 Power Amplifier, 832A
Transmitter Power Output	20-25 watts	30 watts	20 watts	20 watts	7-10 watts	30 watts	15 watts	25 watts
Maximum Load During Transmission (6-Volt Storage Battery)	40 amperes	35 amperes	52 amperes	57 amperes	21 amperes	39 amperes	25 amperes	26 amperes
Steady Load During Receiver Standby	7.4 amperes, vibrator, or 9.4 amperes, dynamotor plus 1.8 amperes for transmitter filaments	7.5 amperes, plus 1½ standby for transmitter	5.8 amperes (transmitter is zero)	8 amperes (13 while listening)	9½ amperes total	6 amperes plus 2.4 for transmitter filaments	10 amperes total	4.6 amperes
Multiplication of Transmitter Crystal Frequency	2 × 2 × 2 × 2 × 3 = 48 times	4 × 2 × 2 × 2 = 32 times	4 × 4 × 2 × 2 = 64 times	2 × 3 × 2 × 3 = 36 times	4 × 3 × 2 × 2 = 48 times	4 × 3 × 2 × 2 = 48 times	4 × 2 × 3 × 2 = 48 times	4 × 3 × 2 × 2 × 2 = 96 times
Receiver Sensitivity For 20-db Signal-to-Noise Ratio	1 microvolt with 50-ohm series resistor	.8 microvolt	1 microvolt	1 microvolt	1 microvolt	1 microvolt	1½ microvolts for 20 db voice-coil quieting	1 microvolt for 500-milliwatt output
Receiver Selectivity	60 kc, down 20 db. Alternate channel 120 kc, down 60 db	6 db down at 25 kc. 60 db at 120 kc from resonant frequency	5 lb down 15 kc. 60 db down 60 kc	50 db down 60 kc, from midband	Alternate channel rejection 120 kc away in excess of 85 db	Nearly same as Dispatcher	120 kc, 60 db down	50 db down, 60 kc from midband
Receiver Audio Output	3-4 watts	1½ watts at less than 10% distortion	1 watt at below 10% distortion	50 milliwatts to 100 ohms with 1600 cps modulation. Also 250 milliwatts to internal selector	1½ watts at less than 15% distortion. Has 3 preset levels, high—medium—low	1 watt	1 watt at less than 10% distortion	500 milliwatts at 400 cps to 50-ohm speaker
Squelch Operating Voltage	Adjustable 0.4 to 1.5 microvolts	Adjustable from .1 to 2 microvolts	½ microvolt, adjustable 0 to 10 microvolts; automatically silences noise. Receiver loudspeaker is silenced rather than operated by noise.	½ microvolt, adjustable ¼ to 10 microvolts	Opens only when signal is strong enough to reduce noise 2 db	Adjustable from .1 to 1.5 microvolts	½ microvolt	Selective lockout.

VERTICALLY POLARIZED V-H-F ANTENNA Design Factors

Broad-Band Antenna With Gain of 2.6 DB Developed for Airline 122 to 136-mc Band and 152 to 162-mc Railroad Radio-Taxicab Band.

by J. P. SHANKLIN

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



A view of the 152- to 162-mc antenna.

To fill the requirement of an antenna with appreciable vertical gain and sufficiently broad band to cover the airline communication range of 122 mc to 136 mc or the railroad radio and taxicab range of 152 mc to 162 mc, many unique design factors must be considered. Relationship of length and radiation are among the initial points requiring study.

If the length of a center-fed antenna, shown in Figure 1, is varied the radiation pattern for any length may be calculated by:

$$e = \frac{\text{Cos}\,(2\pi l/\lambda) - \cos\,(2\pi l/\lambda \sin\theta)}{\text{Cos}\,\theta} \qquad (1)$$

Where: e = relative voltage radiated in direction θ.
θ = vertical angle; the antenna is assumed to be vertical.
l = half length of antenna.

At l λ equal to ⅝ λ, radiation in the horizontal, or θ equal zero plane, is a maximum. The variation of gain with length as compared to a λ/2 dipole is shown by the dashed line in Figure 2. At l λ equal to ⅝ λ the theoretical gain is 3 db over a λ/2 dipole. The corresponding radiation pattern is shown by the dashed line of Figure 3.

To cover the required frequency ranges it was known that relatively large-diameter radiating members would be required. To investigate the effect of increasing the diameter of antenna on the radiation pattern the antenna of Figure 4 was constructed. This antenna was mounted horizontally so that its radiation pattern could be easily taken.

Patterns were taken with various antenna lengths at a frequency of 480

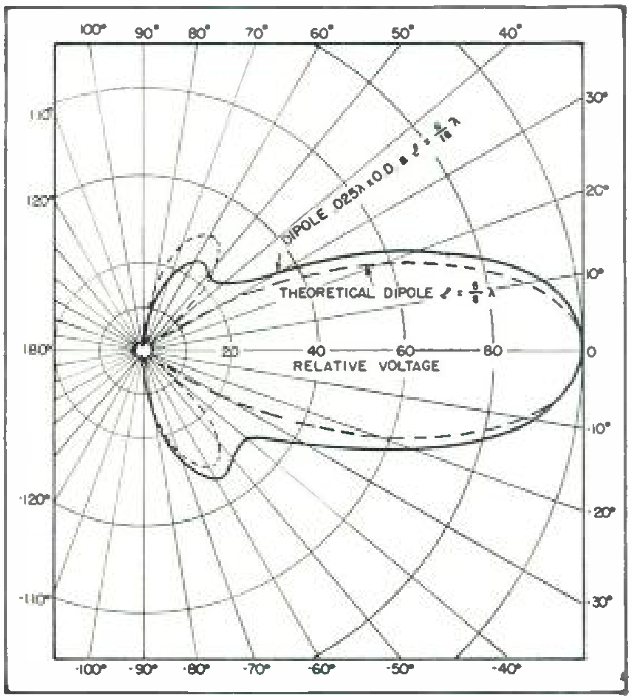
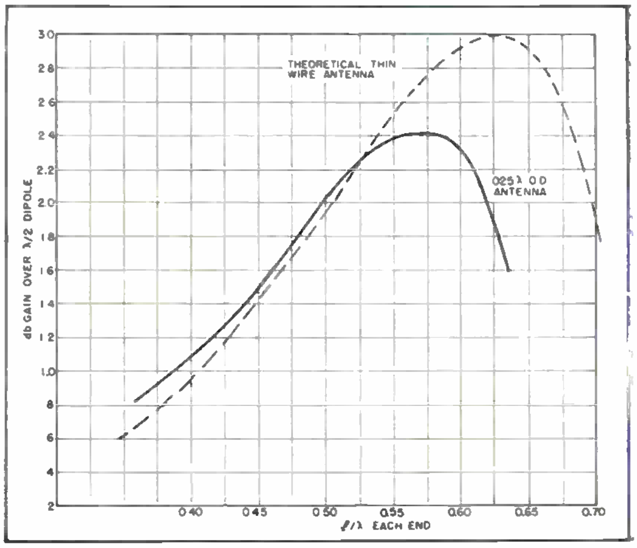


Figure 3 (left)
Radiation patterns of a theoretical thin wire and .025 λ o.d. experimental dipole.

Figure 2
Plot of gain versus length of a dipole. The dashed line shows the variation of gain with length as compared to a half-wave dipole. The solid line shows the db gain versus length at 480 mc for the antenna illustrated in Figure 4.



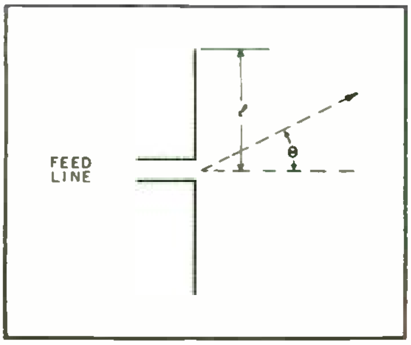


Figure 1
Layout of simple dipole, illustrating the length of the center fed line and its relationship to radiation.

mc and the corresponding gains calculated. The plot of db gain versus length is shown by the solid line in Figure 2. The length for maximum gain was found to be l/λ equal to $9/16\ \lambda$. The radiation pattern obtained at this length is shown as a solid line in Figure 3.

The model shown in Figure 5 was then constructed. This antenna is essentially a coaxially fed version of the model shown in Figure 4. The radiation pattern of this antenna at 480 mc is shown in Figure 6. It will be noted that this pattern agrees closely with

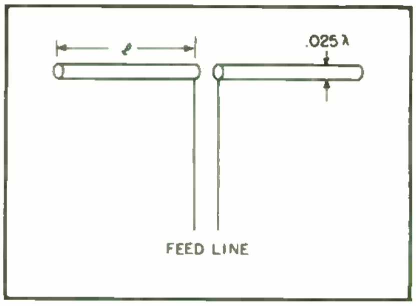
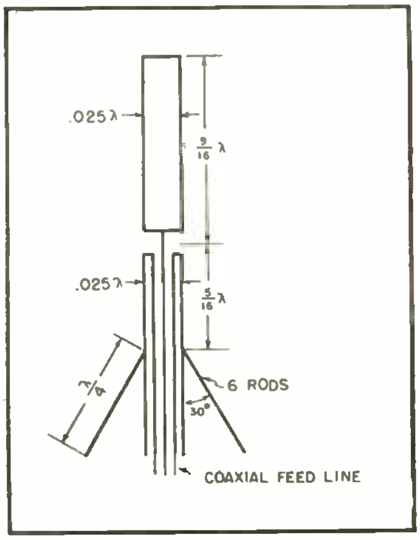


Figure 4
Antenna designed to study the effect of increasing diameters of antennas on radiation. A frequency of 480 mc was considered in this design.

Figure 5
Coaxial fed version of Figure 4.



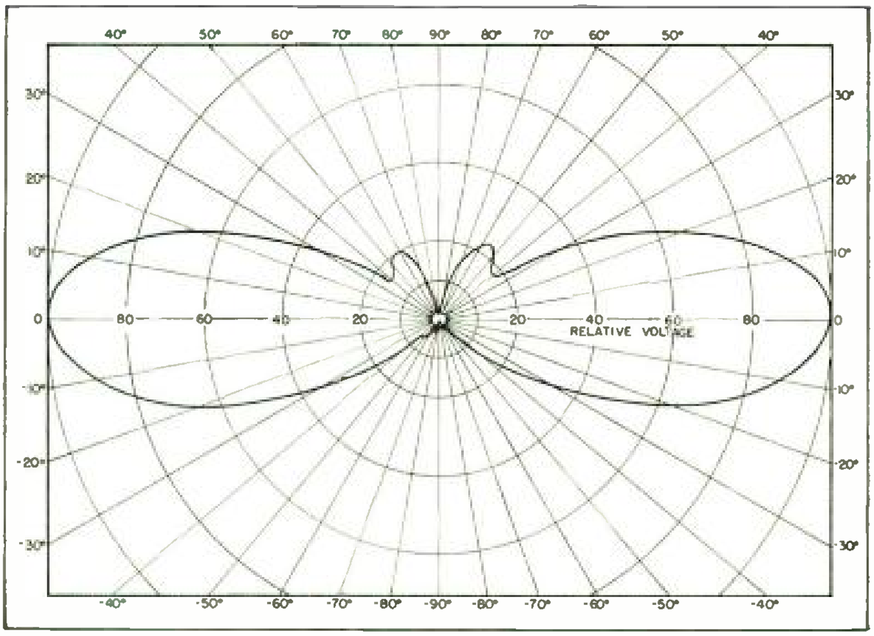


Figure 6
A vertical radiation pattern of the Figure 5 antenna at 480 mc.

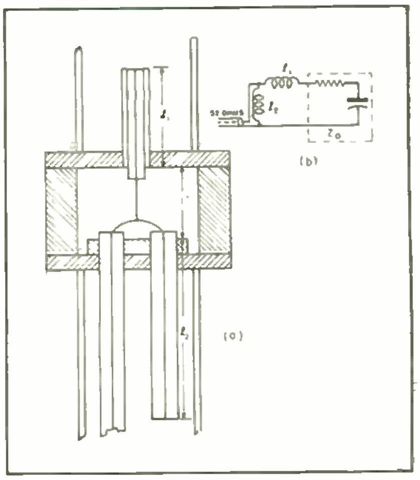
the balanced-feed antenna pattern in Figure 3. The gain calculated from the pattern of Figure 6 was 2.36 db. Patterns taken at 454 mc and 506 mc yielded gains of 2.25 and 2.30 db, respectively, showing that the patterns remained relatively stable over a range comparable to 122 to 136 mc.

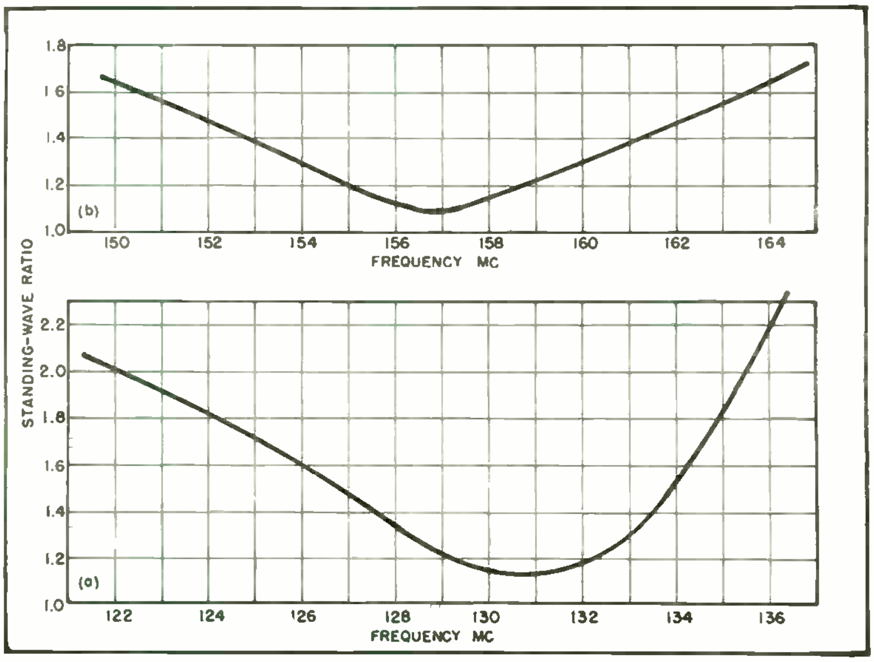
As experience had shown that mast radiation may be serious in coaxially-

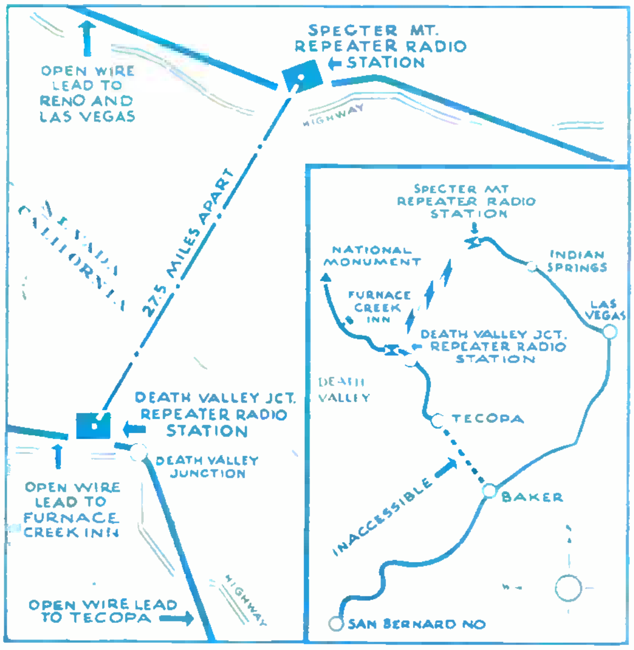
(*Continued on page* 33)

Figures 8 *a* and *b* (right)
In *a* appears internal feed system of dipole. In *b* we have the equivalent circuit for a combination of the shorted stubs l_1 and l_2 of 75 ohms (RG-11 U).

Figure 9 *a* and *b*
Curves of standing-wave ratios. In *a* we have a plot for the 122 to 136-mc range (*Bendix MS 171A*) and in *b* we have a 152 to 162-mc range plot (*Bendix MS 171B*).







Death Valley

The general and specific locations of the radio link of the Death Valley telephone system. Inset at lower right shows telephone lines which serve Death Valley and the inaccessible section that made the radio link necessary. Drawing at left shows the radio path across the state line from the Specter Mt. repeater station to the newly constructed station near Death Valley Junction.

CHRISTMAS OF 1849 saw the first white men ever to reach what the Indians called Tomesha (*ground afire*), struggling for survival in that barren wasteland which now is known as Death Valley. Forty days later some of these emigrants found their way across the Mojave Desert to the fertile San Francisquito Ranch, near the present Newhall. A few remained in Death Valley forever.

These pioneers were followed by gold and silver hunters, but the real wealth of the region was in borax. Some years after its discovery, large scale production in the region started, and 1882 saw communications with the outside world carried on through the now legendary twenty-mule-team freighters which hauled tons of the white borax crystals to railheads to the south.

By 1907, mule teams had given way to the establishment of the Tonopah and Tidewater Railroad, changing the region in a small degree from its previous near-isolation.

Early Telephone and Telegraph Service to Death Valley

The years following the establishment of the Tonopah and Tidewater Railroad, eventually saw telephone and telegraph messages carried from the Death Valley region over a pole line stretching some 110 miles from Furnace Creek Inn to Baker, where telephone connection was made to a backbone open wire line between Las Vegas and San Bernardino. The line carried one copper pair and one iron wire, and in some sections was accessible for maintenance only because its route followed the right-of-way of the Tonopah and Tidewater Railroad.

Requirements for Additional Circuits

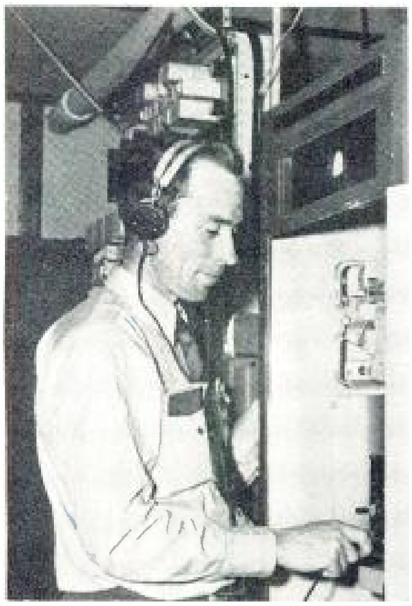
The years of World War II saw further increase in the number of telephone instruments on the heavily-loaded circuit. The pole line proper, which was owned by the Pacific Coast Borax Company, did not offer the opportunity of additional suitable circuits without excessive expenditures in manpower and strategic materials. By the end of the war, the in-season traffic load was far too great for a single circuit, and technical problems had arisen from the large number of instruments on the line.

Traffic studies disclosed two additional telephone circuits would be required initially to relieve the situation.

Radio As a Relief Measure

Several plans for providing these telephone circuits were studied. These took two general forms, namely, use of new open-wire construction, or radio transmission.

The Tonopah & Tidewater Railroad had ceased operation in 1940, with rails being removed a few years later. The 37 miles of the pole line between Silver Lake, site of a CAA air station,



(Left)

Monitoring one of the transmitters in the Death Valley Junction station.

Portable antenna used with test radio car during site testing.

V-H-F Radiotelephone Link

Two-Way 152-162 mc Phase-Modulated System Bridges Inaccessible Areas, Providing a 27½ Mile Link Between Specter Mt. and Death Valley Junction For Service to San Bernardino and Las Vegas. Three-Element Antennas, Mounted on 65′ Poles, Having Gain of 6 db, Provide Signal Level of About 108 db Below 1 Watt.

by CARL KOERNER

Engineer, Transmission Department
Pacific Telephone and Telegraph Company
Southern California Area

and Tecopa to the North over a mountain range, had become practically inaccessible for maintenance. It, therefore, was deemed reasonable to plan on abandoning this section. New circuits to the region would be required for routing via Las Vegas, Nevada, and a repeater station on Specter Mountain on the warborn *Jackrabbit* open-wire lead east of the Sierra Nevadas between Reno and Las Vegas. New construction would be required to connect this lead with the Death Valley wire lead at Death Valley Junction near the east rim of the valley.

Cost studies indicated radio to be an attractive method of reaching Death Valley. In addition, a radio installation would provide desired experience in the use of this facility in this type of application and, therefore, enable a more experienced approach in considering future applications.

It was thereupon agreed that tests should be undertaken for the purpose of verifying that telephone circuits, which offered the possibility of meeting the high standards required for inclusion in the national telephone network, could be established over this route by means of radio.

Telephone Circuit Performance Requirements

A considerable difference exists between a circuit link, or section, which apparently *talks* satisfactorily from terminal to terminal (such as from radio station to radio station) and one which meets the exacting requirements necessary for inclusion in a national telephone network.

One reason for this is that a given built-up telephone connection may consist of as many as four or more circuits. Each circuit in turn may consist of a variety of facilities, such as voice frequency or carrier transmission systems on open wire, cable or radio. Noise, however, is cumulative and unless each facility contributes only its proper share, the over-all circuit noise will be excessive.

Radio Transmission Tests

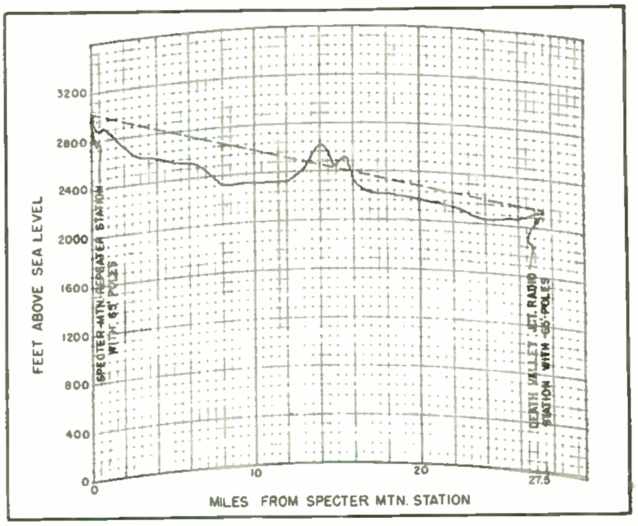
To secure sites which would provide maximum point-to-point transmission r-f path-loss measurement tests were initiated.[1]

Path-loss measurements consist of radiating a test signal from a transmitter at one terminal location and measuring the received signal intensity at the other terminal by substituting an equivalent signal from a calibrated signal generator for the signal from the distant station. The power equivalent to this level is then calculated and expressed in db relative to 1 watt. Subtracting the latter from the transmitter power output, also expressed in db relative to 1 watt, and taking into account antenna gains and transmission line losses, the loss for each path studied may be determined.

With the results of path-loss measurements, it is possible to compute the

(*Continued on page* 31)

[1]Previous to the tests, path-loss calculations were made with profile contours plotted from U. S. Geological Survey Topographic Maps. These served as a guide in the selection of sites at which it would be most reasonable to test.



(Right) Graph illustrating the elevations of the terrain between the two points in the Death Valley link. It will be noted that the path is not strictly *line-of-sight* since an intervening mountain peak protrudes several hundred feet into the path.

The repeater station setup at Specter Mt., Nevada, showing the *J* carrier open-wire lead and the v-h-f antennas.

V-H-F AIRBORNE Communications System

Part II,[1] Offering a Discussion of the Receiver, Equipment Mount, Power Supply and Remote Frequency Control Setup.

by S. A. MEACHAM

Wilcox Electric Company, Inc.

THE V-H-F RECEIVER[2] of the airborne system is constructed as a complete self-contained unit in a fashion similar to the transmitter. Again, the power supply is an external unit. Mechanically, the receiver is identical in size with the transmitter and all electrical connections are made through an aircraft-type plug located on the rear of the chassis. The frequency change problems and reduction of the number of tubes were solved exactly as in the transmitters. A frequency changing unit similar to that used in the transmitter was devised. The size and general configuration was changed to accommodate the slightly different space requirements of the receiver but the major electrical and mechanical components remained identical. Designed as a complete, self-contained unit it mounts as an integral part of the receiver with all external electrical connections accomplished by means of an interconnect plug.

Seventy channels may be set up in a manner similar to the transmitter. They are limited only to the same extent as the transmitter.

All v-h-f resonant circuits are kept in proper tune across the band by means of tuning control driven by the same motor which shifts crystals for frequency change. This is an exact repetition of the transmitter operation and again the resonant circuits are kept in synchronism with the crystal drum. This similarity between transmitter and receiver has been maintained throughout the system to minimize the maintenance education and to minimize the spare parts required.

[1]Initial installment appeared in October COMMUNICATIONS.

[2]Type 308B.

Power Supply

The power supply,[3] Figure 1, supplies the high voltage requirements of the transmitter and receiver. The outside dimensions are exactly the same as the transmitter and receiver and all external connections are made through a plug mounted on the rear of the chassis. Again, by proper wiring of the receptacle into which this rear chassis connector plugs, either 14- or 28-volt operation is obtainable. As will be noticed in Figure 1, the dynamotors are equipped with connectors to allow them to be plugged into the chassis. When changing from 14 to 28 volts or the reverse it is necessary to install the proper dynamotor designed with the appropriate primary voltage

[3]Type 321A.

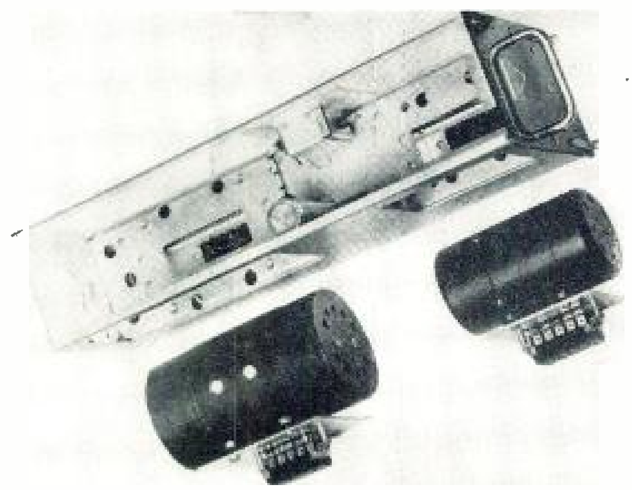


Figure 1
The power supply.

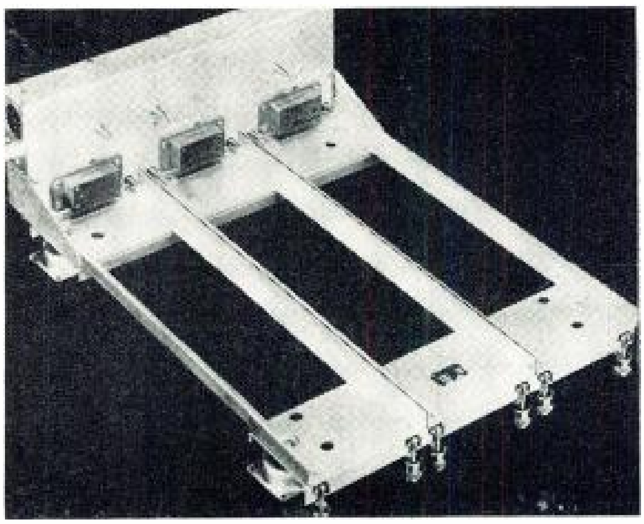


Figure 2
Equipment mount. Six stainless steel thumb screws and steel cup washers hang on a threaded and hinged rod. Cup washers are pulled down tight on stainless-steel hooks on the front side of the transmitter-receiver and power supply.

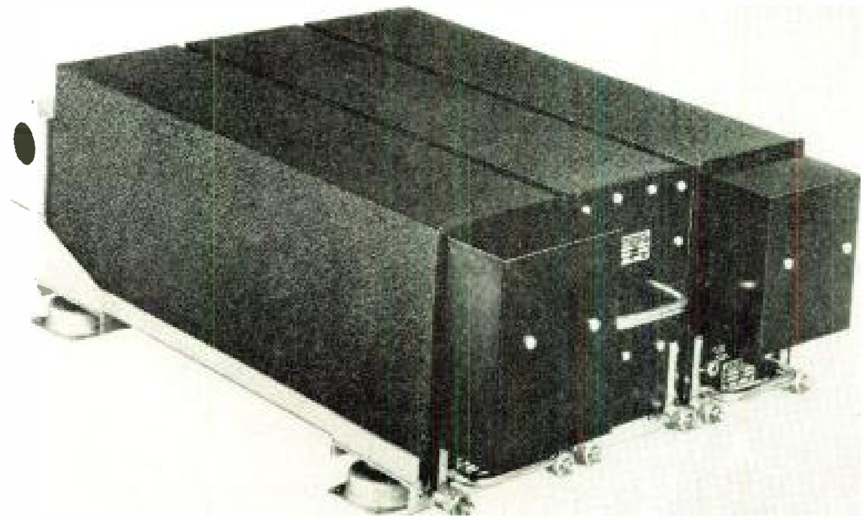


Figure 3
Five units which comprise the v-h-f airborne communications system.

windings. Connections between dynamotor and plug are such that if a 14-volt supply is installed in a 28-volt position the dynamotors will not be damaged.

Equipment Mount

The equipment mount,[1] Figure 2, was designed to facilitate mounting electrical interconnection between the three units and shock protection for the three units.

Interconnection between external circuits and the three units, as was previously mentioned, is accomplished by means of aircraft type connectors mounted on a junction box at the rear of the equipment mount. Inside this junction box is a terminal strip by means of which all interconnection between these three units is made, as well as all external control, audio and power circuit. On one end of the junction box will be noted an open hole and a coaxial connector. This open hole is standard size for aircraft flexible conduit fittings and the coaxial connector for the antenna feeder line. On each side of the interconnecting receptacle will be seen a taper pin. This is a spring loaded stainless steel fitting which matches two holes in the rear of each chassis. These two pins serve as alignment guides for proper mesh of the rear chassis plug and the junction box receptacle, and for holding down pins to keep the unit solid on the mount. Above each receptacle is a third stainless steel pin. Each of these are mounted in a different mechanical relationship with their corresponding receptacle. The holes in the back of each unit which fit the various positions on the mount are located to fit its own particular key, thereby eliminating the possibility of installing the transmitter in the power supply or receiver position, the power supply in the transmitter or receiver position or the receiver in the transmitter or power supply position.

Often it is desirable to install this equipment mount with the back end close to the skin of an airplane or a bulkhead without allowing room for access to the internal terminal strip. To facilitate this the junction box has been made removable from the front, so that by this removal process it may be inspected and serviced from the front side.

Four shock mounts are included on the equipment mount. These serve to soften any sudden shock the aircraft might encounter and to decrease the amplitude of constant vibration experienced when in flight.

Remote Control

The remote control switch for frequency selection presented a rather unusual problem. Two independently-operated wafers of a standard multiple position rotary selector switch, one having eight positions and the other nine, are required. The final design incorporated these two switches, one behind the other, with the rear section driven by a shaft inside that which operates the front switch section. A dual knob is then mounted on these two shafts. One knob has eight plastic-filled holes drilled parallel to the shaft and on a circle concentric with the outer diameter. Numbers from one to eight are engraved in these holes and light is transmitted through, one at a time. The second section of the knob is constructed in the same fashion except that it has nine holes and is numbered from one through nine, the second section being mounted concentric wtih the first section. By using the outer number as the first digit and the inner number as the second digit seventy-two combinations are possible, beginning with eleven and ending with eighty-nine. Number eleven and number eighty-nine are off positions, with the balance of the combinations being channel numbers with frequency determination controlled by crystal frequency installed in each position.

[1]Type 325A.

Control Box

No standard control box has been designed for the equipment since most airplane cockpits are severely crowded and the change-over from h-f to v-h-f is being made slowly under a combined operation process. In addition to the frequency-change switch, there is required a primary on-off switch, a receiver sensitivity control and an audio control for each of two output channels. All these items are comparatively small and may be situated in more usable positions than would be possible if they were tied together in a standard control box.

Channel Coverage

Present plans for use of this portion of the spectrum intend transmission and reception to be on the same frequency at all times. Future speculation indicates the probability of transmission and reception on different frequencies. The equipment is sufficiently flexible to accommodate changes that may be necessary for other types of operation which may be required. The present one-channel operation requires nineteen wires between equipment and frequency change switch, one wire for sensitivity, one wire for the warning light, and four wires for the two audio lines, for a total of twenty-five wires. Changing to cross-channel operation will require the addition of two wires and a toggle switch which allows selection of transmitter frequency and receiver frequency independently by operating the toggle switch from one position to the second. This cross-band frequency change process has one possible disadvantage. If a transmitter frequency is selected, the toggle switch changed to receiver position, and then a receiver frequency selected, there is no indication of the transmitter frequency selected.

Additional Selector Switch

The complexity of modern aircraft is such that many times it would be hazardous to require the pilot to remember details of this type. A possible and practical solution would be installation of a second frequency selector switch instead of the toggle switch. No additional wires would be required over the number made necessary by the addition of the toggle switch, and the toggle switch may be removed.

Although the discussion indicated location of these units on the equipment mount, each unit, which is complete and self-contained, can be mounted separately in different parts of the plane, as space permits.

Wide-Band Superhet A-M TUNER

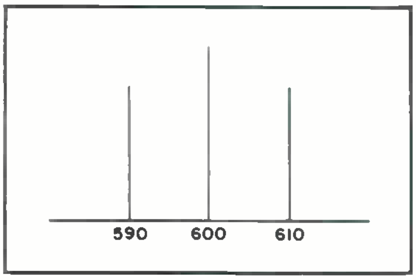
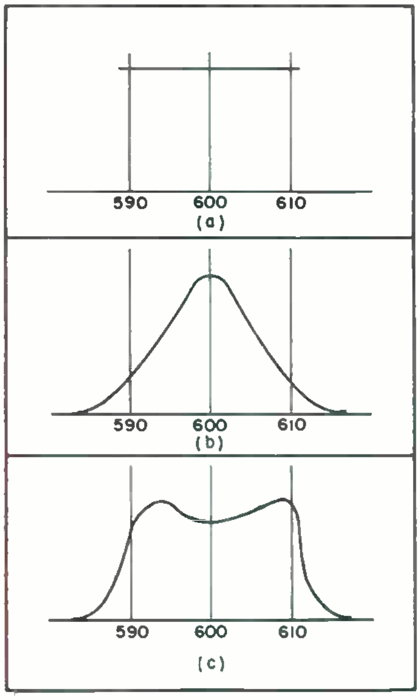
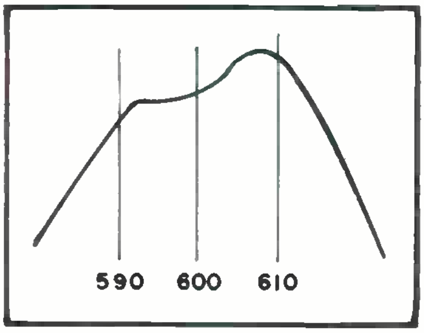


Figure 2
Plot illustrating how a steady state 10-kc note modulating a 600-kc carrier produces sideband signals, displaced 10 kc on each side of the carrier frequency.



Figures 3*a*, *b*, *c* and *d* (below).
In *a* appears an ideal bandpass characteristic. In *b* we have a narrower pass band. The sidebands corresponding to 10-kc modulation would not be heard when receiver is exactly tuned to the carrier. In *c* and *d* appear tuning effects when one or more single-tuned resonant circuits are used.



There has been continuing interest among broadcast and commercial communications men in wide-band receivers. Improved 2-way speaker systems (coaxial, etc.), improved microphones and recording and reproducing techniques have stimulated this interest.

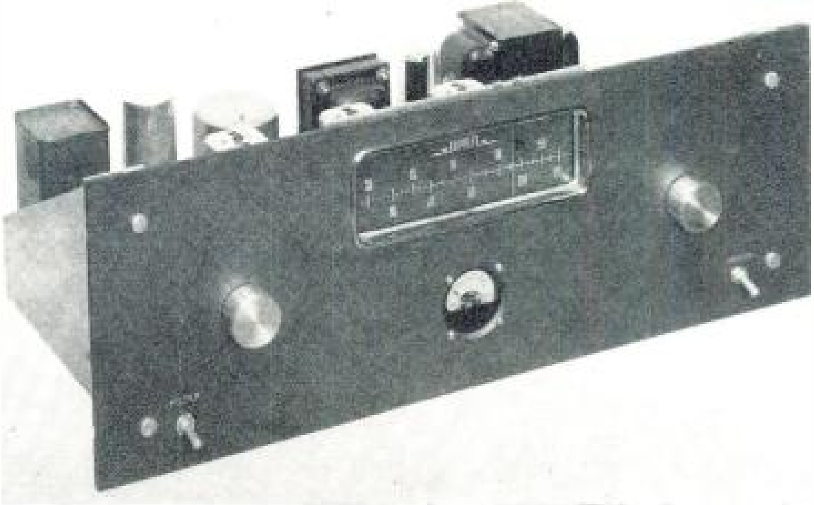
Although frequency assignments are made at 10-kc intervals in the broadcast band, broadcast stations in some non-interfering areas use a wider band. In addition, it is common practice to equalize the program lines from the studio to the transmitter to have good response up to at least 10 kc. For example, at least three broadcast stations in the Los Angeles area have line equalizers with a slight rise between 12 and 14 kc. This means that for good air check recording and good critical listening, at least to programs originating in the local studio, substantially flat response to at least 10 kc is needed.

Bandwidth Requirements

When amplitude modulation takes place, modulation side bands occupy positions which are actually on each side of the carrier by the amount of the modulating frequency. For example, a steady state 10-kc note 100% modulating a 600-kc carrier, would produce side band signals displaced 10 kc each side of the carrier frequency, as shown in Figure 2. If a very sharp receiver is tuned across such a modulated carrier, each side band may be heard separately. The 10-kc output will go through a maximum, fade out, become loud again and fade out again.

The ideal band-pass characteristic for hearing such a signal and excluding noise and extraneous interference would be that shown in Figure 3*a*. If the pass band were narrower (as in Figure 3*b*), the side bands corresponding to the 10-kc modulation would not be heard when the receiver is exactly tuned to the carrier, and only the lower audio notes would ever reach the speaker. If the pass band of 3*b* were adjusted to one side of the carrier frequency, the side bands on that side of the carrier would be amplified satisfactorily. The effect would also be noted if the overall shape of the pass band were as shown in 3c or 3*d*. However, if the modulation were music or speech, which was not a symmetrical wave in the first place, the reproduced wave would have only the shape of that side band and sound distorted. If the pass band were tuned off far enough that the carrier frequency falls down on the side of the pass curve, insufficient carrier voltage would be generated at the second detector, and side band components of high percentages of modulation would be in a larger ratio

Figure 1
View of the wide-band amplifier.



Unit Features a Balanced Mixer With Germanium Diodes, Broad Band I-F, Infinite-Impedance Second Detector, Tuning Meter, Cathode Follower Circuit and 10-kc Filter.

by M. O. KAPPLER

The Kappler Company
Los Angeles, California

to the carrier voltage present than they were in the original modulated carrier, resulting in over-modulation at the detector and attendant distortion.

If one or more single-tuned resonant circuits were used, the result would be a curve like that shown in Figure 3*b*, in which only a very narrow portion at the top is anywhere near flat. The width in cycles of this portion is a percentage of the carrier frequency which is determined by the *Q* of the circuit, becoming sharper as the *Q* is increased. Unfortunately, however, if the *Q* is decreased to accomplish a greater bandwith, the rejection outside of the desired bandwidth becomes much poorer. At relatively high frequencies, a single-tuned circuit could include a pass band of 20 kc, since the same percentage of the higher carrier frequency would be a larger number of cycles; however, for practical *Q*'s this is not the case anywhere in the broadcast band. With complicated configurations, consisting of multiple resonant circuits, a fixed 20-kc bandwidth in the broadcast band can be accomplished, in the same way that almost any configuration of band-pass filter may be accomplished in the audio-frequency spectrum. However, if such a bandwidth is to be adjusted to various frequencies, as in a tuned r-f tuner, the problem becomes more complicated, since the adjustment for the resonant circuits used must be gauged mechanically. A possible solution is the use of overcoupled resonant circuits. By the proper selection of *Q* and the coefficient of coupling, double-tuned circuits, similar to those shown in Figures 4*a* and 4*b*, may be made to have the required bandwidth in the broadcast band, providing a shape like that shown in Figure 4*c*.

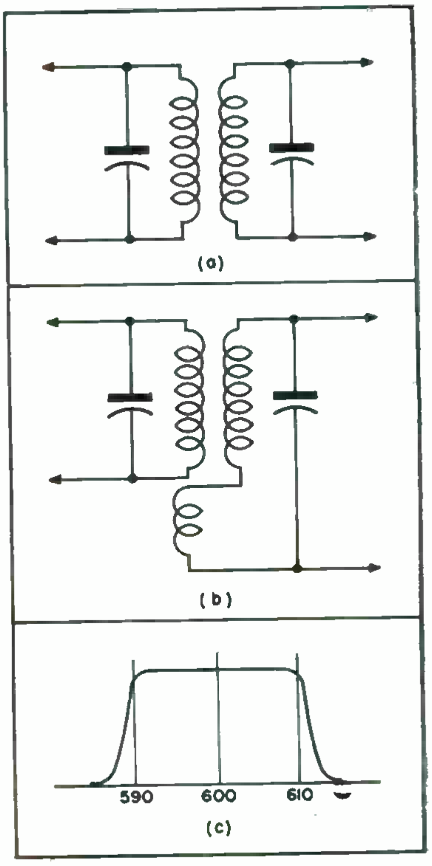
However, in order to secure sufficient gain, it is desirable to have three or four stages of amplification. If each of these were coupled to the adjacent stage by one of the types of double-tuned circuits, which are necessary to secure the band-pass characteristic, it would involve a six- or eight-gang tuning capacitor, which is quite impractical. Reducing it even to the simplest possible arrangement, and taking a considerable sacrifice in sensitivity to do this, a four-gang unit would be required. Even assuming the reasonable availability of such a capacitor, another difficulty would present itself, namely, that of having the four-gang unit track over the desired frequency spectrum. Experience has shown that even by bending the plates, only a rough approximation of a symmetrical curve can be accomplished over the whole broadcast band. Failure to do this causes overmodulation distortion. Furthermore, since the width of the top of the curve is a function of the *Q*, which varies with frequency, it is usually necessary to vary the coefficient of coupling through the band to compensate for this effect and maintain the same bandwidth.

Advantages of Superhet

The i-f section of the superhet circuit could be aligned once and for all and each capacitor or tuning slug adjusted individually without attendant mechanical ganging problems. Several stages could be included in order to provide the necessary gain. However, several difficulties appear in the application of this type of circuit.

Random Noise

The first of these is random noise originating in the front end of the receiver. The importance of reducing the noise generated is even greater here than in a conventional receiver since the noise output of any system is proportional to the bandwidth. Since



Figures 4*a*, *b* and *c*
Double-tuned circuits are shown in *a* and *b*, and the resultant bandwidth appears in *c*.

the required bandwidth for this use is at least twice that of the conventional receiver, the noise output would be twice as great, all other things being equal. Assuming that the sensitivity of the set is insufficient to reach the level of thermal noise for the input impedance and bandwidth under consideration, there remain two sources of noise in a superheterodyne receiver; noise generated in the mixer itself, and random noise demodulated from any local oscillator signal which is accidentally transmitted through the i-f channel. Both of these effects have the best opportunity to operate to a disadvantage in a conventional super design. First, in any multi-element tube, whether mixer or amplifier stage, there is a tendency for each grid to act as a virtual cathode and thereby to become a new noise source. In heptode-mixer circuits, there are five of these new noise sources all contributing to the noise in the output. Second, the local oscillators in superhets always contain a certain amount of random noise modulation. This may be minimized by maintaining stable oscillation and by being sure that no form of superregeneration is taking place. However, at best a good deal of this noise modulation is present. It is true that the i-f

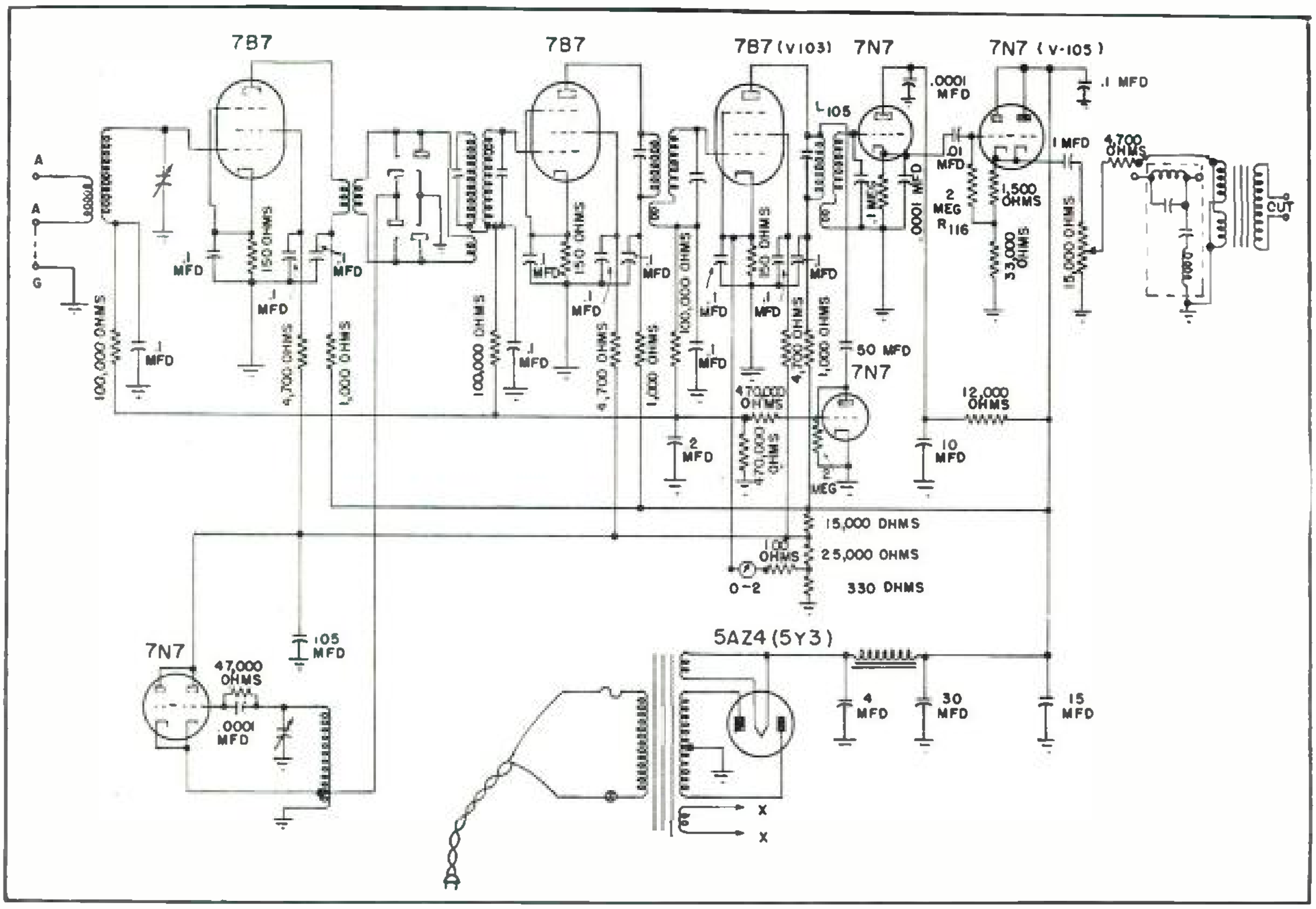


Figure 5
Circuit of the wide-band superhet a-m tuner.

pass band may be 80 or 100 db down at the oscillator frequency, but it must be remembered that the oscillator signal amplitude is also 80 to 100 db greater than the desired signal amplitude.

During the war when this same problem presented itself to the designers of radar receivers in which the bandwidth had to be very wide, the compromise of conversion gain versus noise had to be reconsidered and a decision was made to use diodes for mixers. Since the problem here was very similar, it seemed logical to consider them for this use. Upon consideration of the necessary circuit, another advantage presented itself. If use were made of the germanium or other crystal diodes which were developed for the purpose for radar receivers, there would be less objection to a more complicated configuration such as a bridge. In the bridge circuit, the local oscillator signal could be applied in such a way that it was balanced as far as transmission into and through the i-f was concerned. This led to the circuit shown in Figure 5, in which the local oscillator signal is balanced out of the input of the i-f amplifier.

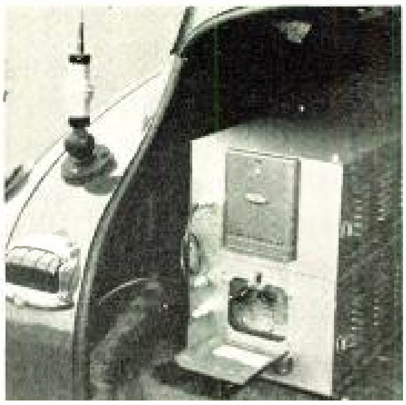
Another advantage of the balanced mixer is that a good many second order modulation products are cancelled out, with subsequent reduction in *birdies*, which might otherwise be objectionable because of the small amount of preselection possible with this circuit. The effectiveness of this balance may easily be demonstrated by upsetting it with a shunted resistor or additional crystal across any of the elements and noting the increase in noise. An *A-B* comparison of this circuit with an i-f amplifier similar to that in Figure 5 and a 6SA7 mixer has also been made and an improvement of approximately 30 db observed. The design of a suitable input i-f transformer to couple out of this bridge circuit gave considerable trouble until the configuration shown was evolved. The two tuned windings were overcoupled to give the double-humped band-pass characteristic needed to accomplish the necessary bandwidth. Then the low-impedance primary coming from the crystal bridge was loosely coupled so that the strong resistive component of the bridge would not spoil the band-pass characteristic of the transformer.

To avoid cross modulation, at least one stage of tuned r-f amplification is necessary. However, this single-tuned stage would have a rather sharp band-pass characteristic, similar to that shown in Figure 3*b*. To compensate for this, the band-pass characteristic of the i-f was made broader than necessary and with a slight overall sag in the middle. The addition, then, of the single-tuned r-f stage brought the middle of the pass curve back up to level. Two adjustments are provided on the coil and capacitor, which comprise the r-f amplifier tuned circuit, in order that this tuned circuit may be made to track accurately, since any detuning here is likely to leave one side-band higher than the other, or at least leave a hole in the middle with the resultant previously described distortion caused by overmodulation at the second detector.

The second detector in this circuit must also be well designed, since with a flat pass band there is no attenuation of the side bands with a consequent reduction of percentage of modulation at the high frequencies. The detector must be capable of handling 100% modulation clear up to 10 kc. The infinite-impedance detector chosen is inherently slightly modulation losing, which helps in this respect. But the most important design factor in pro-

(*Continued on page 38*)

The Industry Offers



PHILCO THREE-WAY RADIOTELEPHONES

Radiotelephone equipment permitting three way conversations between a patrol car, control station and other patrol cars has been developed by Philco and is being supplied to the State of Colorado.

Equipment features a *frequency-saving* circuit. Mobile transmitters are designed for two-frequency operation within the 30-44 mc band. The *advanced f-m circuit* is also used in the receiver.

* * *

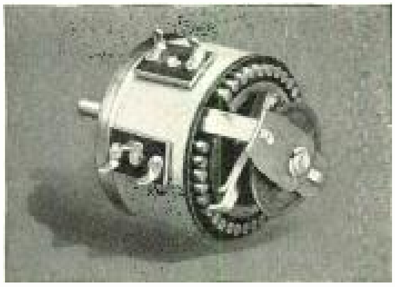
SHALLCROSS CUEING ATTENUATORS

A line of cueing attenuators has been announced by the Shallcross Manufacturing Co., Collingsdale, Pa.

Units feature a switching mechanism to transfer attenuator input to a pair of separate output terminals for cueing purposes.

Standard Shallcross ladders, bridged T, straight T, or potentiometer may be equipped for cueing action, including units as small 1¼" in diameter. Controls are available for mounting by means of a single-hole ⅜" 32 thread bushing or two 6-32 or 8-32 screws on 1¼" or 1½" (except 1¼ diameter units) centers.

Cueing position is at the extreme counter clockwise position, following the attenuator **off** position. Unit may be equipped with detent action for the off position, the cueing position, or both, if desired.



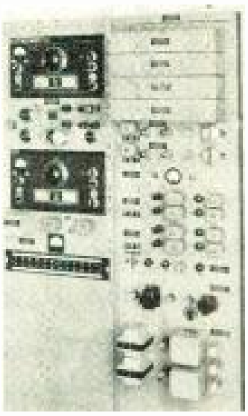
* * *

RCA P-M SPEAKERS

A line of p-m speakers for general replacement and sound-systems work has been announced by the renewal sales section of the RCA tube department.

The line includes a *controlled-resonance* 12" speaker, a 4" and 5" speaker, a 4" x 6" elliptical speaker, and a 2" x 3" elliptical speaker.

Rated at 12 watts power-handling capacity, the 12" speaker has a unique filter to filter needle scratch and other objectionable high-frequency noises. Also has an adjustable voice-coil mounting for alignment of the cone.



HEINTZ AND KAUFMAN FREQUENCY-SHIFT RECEIVER TERMINAL

A dual-diversity receiver terminal, type A-4601, has been added to the line of frequency-shift equipment being produced by the communications equipment division of Heintz and Kaufman Ltd., 50 Drumm Street, San Francisco.

Unit accepts a frequency shifted signal from two communications receivers and converts it either to tone, neutral or polar d-c, keyed in accordance with telegraphic intelligence. Recording device may be radiotype, teletype, or a high speed telegraph tape recorder.

Has a crystal oscillator and bfo unit.

Input filters have a range of 1850 to 3250 cycles. The response is down 70 db at 1700 cycles, and 60 db at 3400 cycles. A frequency shift between 600 and 900 cycles may be used.

A three stage limiter amplifier has a constant output with inputs in excess of ten microwatts. All amplitude modulation is removed in these limiter stages.

Discriminator filters are essentially channel filters, separately passing the high and low audio frequencies which correspond to mark and space frequencies.

Mark and space frequencies are separately amplified, rectified, and added differentially in the discriminator amplifier-rectifier unit.

The d-c output of discriminator-rectifiers is mixed in double diodes so connected that the cleanest signal is used for keying, and the poorer signal rejected.

A wave-shaping amplifier is provided in the terminal. Oscillator furnishes an 1800-cycle tone.

Gain of the system over a single channel makebreak system approximates 22 db.

* * *

CLARKSTAN MAGNETIC PICKUP

Magnetic reproducers, with removable sapphire .003" ball point stylus, have been announced by the Clarkstan Corporation, 11927 West Pico Boulevard, Los Angeles 34, California.

The needle, which weighs 31 mg, is the armature and is the only moving part. High impedance is standard, but the pickup can be had in impedances of 5, 50, 250, and 500 ohms.

Needle force is 20 grams optimum for commercial pressings. Unit is said to be exactly velocity responsive to 15,000 cps. Output, 60 millivolts at 1000 cps with lateral displacement of .001". Inductance of 350 millihenries at 1000 cps. Has a Q of 1.05.

BROWNING SCOPE

A five-inch scope, model OL-15A, has been announced by Browning Laboratories, Inc., Winchester, Massachusetts.

Response curve of the vertical amplifier is linear and without positive slope from 10 cycles to 4 mc. The horizontal amplifier response extends linearly from 10 cycles to 1 mc. Sawtooth sweep range is from 5 cycles to 500 kc with synchronizing sensitivity permitting synching and viewing 10-mc r-f sine waves.

Triggered sweeps of 0.2, 0.5, 1, 5, 20, and 200 microseconds per inch are available with an internal trigger generator or by external pulses. Sweeps and internally generated trigger are phasable with respect to each other.

* * *

EIMAC TETRODES

A 400 watt tetrode, type 4-400A, has been announced by Eitel-McCullough, Inc., 189 San Mateo Ave., San Bruno, California.

Has short low-inductance leads, processed non emitting grids, thoriated tungsten filament and plate of new Eimac material, Pyrovac.

Radiation cooled. Suggested for use in the Eimac socket and air duct which provides maximum cooling from a small amount of air. Two 4-400A tetrodes said to provide over 1-kw output power at 4000 plate volts on the 88-108 mc f-m band.

* * *

McMURDO SILVER F-M AND TV SWEEP GENERATOR

An f-m and tv sweep generator, model 909, has been announced by McMurdo Silver Co., Inc., 1240 Main Street, Hartford, Connecticut.

Covers a center-frequency range of 2 to 226 mc in three bands, without band switching. Frequency modulation (sweep) is adjustable from 40 kc to over 9 mc by a panel control. Output is adjustable from zero to ½ volt maximum. Synchronization of the scope, used to visually trace alignment, is at power line frequency, selected multiple or sub-multiple, or by saw-tooth synchronizing voltage provided in generator at twice power frequency.

(Continued on page 34)

VETERAN WIRELESS OPERATORS ASSOCIATION NEWS

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

VWOA honorary member William A. Ready, president of the National Company, at the controls of National's communications receiver, NC-173

THE HEROISM OF VETERAN OPERATOR, Henry F. Wiehr, during the recent Ft. Dearborn tanker disaster in the Pacific, has been revealed in a collection of notes and clippings sent in by VWOA member Lt. Commander Leroy Brenmer.

With his equipment smashed and water-soaked, and the tanker snapping apart in mid-ocean, Wiehr, despite the additional handicap of only one arm and splintered glasses, rigged up an emergency transmitter in the charte house and sent out the SOS's which saved the lives of nine crew members.

Wiehr, with the aid of Chief Steward Sanford Rogers, carried the transmitter up to the chart room and connected it to batteries which were being used with a direction finder. An antena lead was run out of the door and up through a speaking tube to the bridge, where it was connected to a convoy signal-light fixture.

VWOA salutes you, H. F. Wiehr, for your courage and foresight.

VETERAN MEMBER C. W. HORN is now down in Mexico at station XEW. His address is Calle Rincon del Bosque No. 2 (Apt. 5), Colonia Anzures, Mexico, D.F. . . . Walter J. Simon is still at his Standard Oil Co. of New Jersey post. . . . H. David Buyman is with the Radiomarine Corp. of America, in Savannah, Georgia. . . . R. D. Chipp, radio facilities engineer of the American Broadcasting Co., can be reached at 30 Rockefeller Plaza, Room 1442. . . . Jack Poppele recently addressed a G.E. group at Syracuse on the future of television. He predicted that by 1949 we will have close to two million tv receivers in use, and that three-quarters of a billion dollars will be spent for this equipment.

THE RECENT VWOA FALL MEETING in New York City brought many old-timers together. Among those at the meeting was VWOA life member A. F. Van Dyck. Looking over our records, we found quite a few interesting facts about AFD. He's a genuine old-timer, having begun as an amateur in 1907. He joined the ranks of the commercial operators in 1910 with the United Wireless Company. Served during World War I as an Expert Radio Aide with the U. S. Navy. In World War II he held the rank of Commander and was assigned to the office of the Chief of Naval Operations. Since 1919 his civilian activities have included continuous service with RCA in numerous capacities and is now consultant to the executive vice president of RCA Laboratories. A past president of the Institute of Radio Engineers, Commander Van Dyck was one of a small group of technical experts who served as observers at the atom bomb tests at Bikini. . . . Life member Louis G. Pacent, president of the Pacent Engineering Corporation, is engaged in a wide variety of electronic projects. . . . V. P. Villandre, a former treasurer of VWOA was also at the Fall get-together. "Vic" started in commercial radio in 1917 aboard the SS Limon. (Seems as though many of our members served aboard that vessel.) He has been with RMCA for many years. . . . R. K. Davis, chief inspector for Tropical Radio in New York, began his radio career in 1922 at Olancho *UL*. . . . Arthur F. Rehbein, who first tapped a key commercially in September 1911 aboard the SS City of Everett, serviced by the United Wireless Telegraph Company, served with Marconi Wireless until 1914, then to Panama Railroad Steamship Company, is now radio supervisor of the American Hawaiian Steamship Company. . . . George F. Duvall, another oldtimer who attended the fall meeting, also has had quite a varied experience. He was with Merritt Chapman in 1910, and subsequently with the Ward Line, Ocean Steamship Company (the good old Savannah Line), Bull Line, United Fruit, Lamport and Holt, aship and ashore from 1910 until 1921. He has been local and national president of the Radio Servicemen of America and an outstanding television technician since 1938. Now has his own business in Brooklyn specializing in tv.

Listen! IT'S A Jensen SPEAKER

Jensen *Speech Master* REPRODUCERS NOW WITH ALNICO 5 PM DESIGN

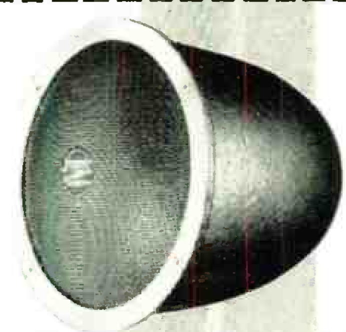
JENSEN Speech Master Reproducers have long been widely used in moderate-level intercom, paging and P. A. systems. Now, in ALNICO 5 design, they are once more available for all applications where clear, crisp, intelligible speech and good "talk-back" performance are required. Ideal for amateur, commercial, police and aviation phone communication as separate units or integral equipment. In amateur CW they aid selectivity, help signals override QRM and QRN. The husky voice coil withstands keying transients.

JENSEN MANUFACTURING CO.
6603 S. LARAMIE AVE., CHICAGO 38, ILL.
In Canada: Copper Wire Products, Ltd.
11 King Street W., Toronto 1

MODEL AP-10 SPEECH MASTER (Desk Type)

ALNICO 5-PM design. Complete with swivel base and tilt adjustment. Double dustproofed, fully enclosed and protected. Internal mounting bracket for ½ x ½" transformer. Power rating 5 watts. Height 6¾", depth 5⅛", diameter 5". Attractive hammered gray finish with satin chrome trim. 36" RC cord. Shipping weight 5¼ lbs.

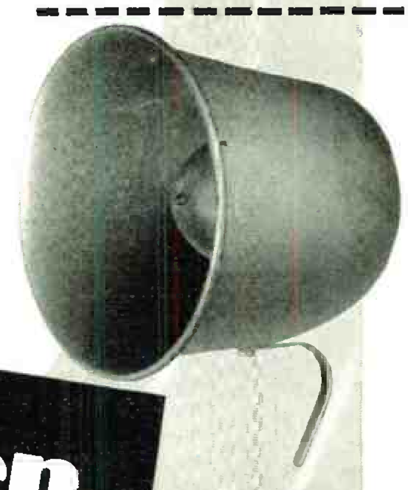
	List Price
AP-10 (ST-590) with 3-4 ohm voice coil	$13.90
AP-10 (ST-591) with 45-50 ohm voice coil	14.50



MODEL AP-11 SPEECH MASTER (Panel Type)

Similar to AP-10 but without swivel base. Clearance eyelets for mounting screws. Mounts in 4-27/64" cutout. Depth from front panel 4½". Power rating 5 watts. Screws and drilling template furnished. Shipping weight 3¼ lbs.

	List Price
AP-11 (ST-592) with 3-4 ohm voice coil	$11.30
AP-11 (ST-593) with 45-50 ohm voice coil	11.90



MODEL AR-10 REFLEX SPEECH MASTER REPRODUCER

Specially designed reflex horn increases efficiency in mid-range, giving added effectiveness and punch to speech quality when used for paging, intercom and call systems operated at moderate levels. Reflex construction prevents direct access of snow or rain to speaker diaphragm. Power rating 6 watts. Space within case provided for mounting ½ x ½" transformer. Over-all diameter 10", depth 8". Complete with bracket for wall or post mounting.

	List Price
AR-10 (ST-643) with 3-4 ohm voice coil	$20.00
AR-10 (ST-644) with 45-50 ohm voice coil	20.75

Jensen SPEAKERS WITH ALNICO 5

Designers and Manufacturers of Fine Acoustic Equipment

Index, COMMUNICATIONS, 1947

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V-H-F Link

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received-signal intensity to be expected at the various sites for the transmitted power, antenna gains and heights and transmission lines proposed to be used in the actual installation. By applying this figure to so-called *quieting curves*, which correlate received signal intensities and tone-to-noise or speech-to-noise ratios, it is possible to predict the noise performance of a radio link with a fairly satisfactory degree of accuracy.

To conduct the tests two station wagons were equipped with low-power 150-mc band transmitters and receivers and test equipment. A gas engine generator installed in each station wagon provided 110 volts a-c.

As various antenna heights were to be tried, a collapsible multi-section mast supporting a three-element directional antenna was hinged to the rear of each car. Thus one or two men could quickly raise as much as 25 or more feet of mast with little effort. In the course of the tests, antenna horizontal radiation patterns were plotted, which aided in determining the spacings of the antennas.

The tests were carried out in June 1946, perhaps not actually the hottest, but, in the experience of the test personnel, certainly appearing to be the hottest month of the season in this region. Temperatures as high as 112° F inside the ventilated station wagons were sometimes noted. However, service was required for the winter 1946-7 season and time was at a premium. Consequently, the personnel consumed large quantities of water and salt tablets and consoled themselves with the fact that it was generally some 15° hotter on the floor of Death Valley proper. In any case, the equipment performed well despite many miles of rough travel over desert and mountain roads and sometimes off the roads, too.

The test results led to the conclusion that telephone-circuit technical-performance requirements could be met satisfactorily with a radio facility bridging the gap between a repeater station on Specter Mountain and a point two miles west of the town of Death Valley Junction. A new building would be required at this point, situated near the wire lead and the highway to Furnace Creek Inn and Death Valley proper.

Application was thereupon made to the FCC for permission to operate two v-h-f phase modulation transmitters at the Specter Mountain and Death Val-

(*Continued on page 32*)

V-H-F Link

(*Continued from page* 31)

ley Junction points to provide public toll telephone service to the Death Valley region.

The Commercial Installation

Construction permits were granted in the fall of 1946 for two 35-watt phase modulated transmitters[2] at each terminal of the link to operate as class 2 stations in an experimental service. Two frequencies in the 152 and 162-mc band were assigned at Death Valley and two at Specter Mountain to permit two *four-wire* (two-way) circuits to be established.

The required transmitter-receiver-[3] terminal equipment building of quonset hut two-room construction, was erected in September two miles west of Death Valley Junction.

Commercial power being unavailable, a three-unit gasoline-driven engine generator supply of 1.5-kw capacity was installed to provide 60-cycle a-c at 110 v.

The east terminals of the radio circuits, at the Specter Mountain repeater station, are approximately 65 miles north of Las Vegas. The same transmitting and receiving equipment, as was installed at the Death Valley Junction station, was provided here. Motor-generator sets of 1-kw capacity provide 60-cycle a-c at 110 v.

The transmission path between these stations is 27.5 miles, with an intervening mountain range near the center projecting into the path.

With three-element antennas, having a gain of about 6 db mounted on 65′ poles, a signal level of approximately 108 db below 1 watt has been measured at the receiver inputs.

The Telephone Circuits

Upon completion of construction and the necessary tests on the radio links, two telephone circuits were established over these radio facilities and connecting wire lines, terminating in a toll switchboard at San Bernardino. Both circuits utilized carrier channels[4] to Las Vegas and open wire facilities to

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[2]W.E. 542A. Frequency stability, ±.003%. Considering 1000 cps as reference frequency, the response is down not more than 2 db at 250 and 4000 cps.

[3]W.E. 40A. Stability, ±0.001%. Sensitivity (r f input to give 1-milliwatt output and 20 db signal to noise ratio), 1 microvolt. A-f characteristics: 1000 cps. 0 db (reference): 250 cps. —4 to 0 db; 4000 cps. − 3 to 0 db.

[4]W.E. type C.

Specter Mountain. After the *hop* to the Junction radio station over the v-h-f links, one circuit was extended on a type *H* carrier system to telephone instruments at Furnace Creek Inn, while the second utilized a few miles of open wire to terminate on instruments at the Armargosa Hotel at Death Valley Junction. More recently, the circuit extensions have been rearranged and additional public telephone stations added.

Conclusion

These radio systems are believed to be the first v-h-f phase modulated radio systems forming a point-to-point link in the national telephone network.[5] Class 2 experimental licenses are now held by The Pacific Telephone and Telegraph Company and the Bell Telephone Company of Nevada, respectively, for the operation of these transmitters.

The transmission performance of the radio systems has thus far been very good. Further experience will aid in more fully evaluating the proper place in the telephone network of such radio systems operating in the general v-h-f range.

[5] First commercial traffic handled on November 28, 1946.

V-H-F Antenna

(*Continued from page* 15)

fed vertical antennas, a disc of metal $\lambda/2$ in radius was placed on the mast at various distances below the antenna so as to resonate the mast. It was found possible to produce only minor variations in the radiation pattern.

Antenna Matching

To match the antenna a 52-ohm feed cable, full scale models were constructed for study. The antenna impedance is capacitive and its resistive component is approximately twice the feed-line impedance. Shorted stubs, l_1 and l_2 in Figure 8*a*, are $\lambda/8$ or less in length and so are inductive. The two in combination, resonate the antenna and furnish a 52-ohm feed point; equivalent circuit is shown in Figure 8*b*.

The curves of standing-wave ratio on the feed cable versus frequency appear in Figure 9.

The Industry Offers

(Continued from page 23)

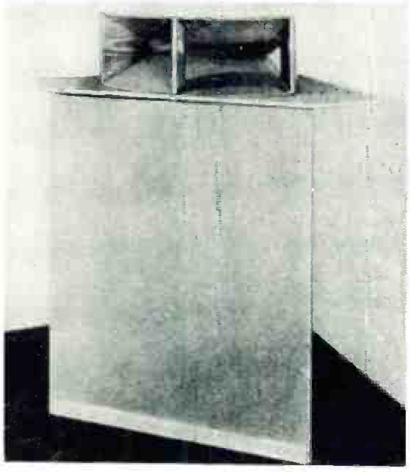
KLIPSCH SPEAKER SYSTEM

A 2-way Klipsch speaker system has been announced by the Brociner Electronics Laboratory, 1546 Second Avenue, New York 28, N. Y.

The Klipsch low-frequency horn is a folded unit, and uses the corner of the room as an integral part of the acoustic system. High and low-frequency speakers are coupled to horns.

High-frequency horn is said to provide a 90° horizontal distribution pattern of frequencies above 500 cycles, to match the dispersion of the low-frequency horn.

The dividing network is a constant-resistance, parallel type, providing 12 db per octave attenuation, and has a crossover frequency of 500 cycles. An L-pad permits adjustment of balance to suit individual conditions. Air-core inductors are used. Model 1A illustrated is rated at 20 watts.



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AMPERITE VELOCITY MICROPHONE

A velocity microphone which, it is said, will give high-fidelity reproduction on either close talking or distant pickup, has been announced by the Amperite Co., Inc., 561 Broadway, New York 12, N. Y.

The harmonic distortion is said to be less than 1%. The ribbon itself has a peak of 10 cps; above that, it is said to be practically flat. The entire microphone is said to have a frequency response of 50 to 11,000 cps $\pm$ 2 db; output is —62 db.

Discrimination, with angle from 60 to 10,000 cps, is said to be less than 5%.

Available in two models: model RBHG (high impedance); model RBLG, 50-200 ohms.

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FAIRCHILD CONSOLE RECORDER

A console model recorder, type 539, featuring a synchronous drive for direct lateral recording on disks up to 17¼" at 33.3 and 78 rpm, has been announced by Fairchild Camera and Instrument Corporation.

Noise level is said to be 44 db below standard recording level of 2.5" per second stylus velocity at 1000 cycles per second. Cutterhead feed is stationary overhead lathe type.

Pitch, 96, 112, 120 and 136 lines per inch. Direction of cut, *in-out and out-in.*

• • •

FURST ELECTRONICS WOW METER

A wow meter, model 115, with frequency response of the amplifier and vtvm extended to permit measurement of wow at 33 1/3 rpm, has been announced by Furst Electronics, 800 W. North Avenue, Chicago 22, Illinois.

Meter reading is said to vary less than 3 db with frequencies of the frequency variations of the signal between .3 and 120 cps. Meter reading is independent of the amplitude of the input signal between .1 volt and 250 volts between 950 and 1,050 cps.

The vtvm measures ½ peak-to-peak values of the frequency deviations and is calibrated to express them directly as a percentage of the average signal frequency.

• • •

UNIVERSAL RECORDING FREQUENCY RECORDS

Vinylite lateral frequency standard records for 78 and 33 1/3 rpm, double sided, have been produced by Universal Recording Corporation, 20 North Wacker Drive, Chicago 6, Illinois.

Voice announcements identify each of the frequencies, which include 1000-cycles reference: 10, 9, 8, 7, 6, 5, 4, 3, 2 kc; 1500, 1000, 700, 500, 300, 200, 100, 70 and 50 cycles, with an additional 10-kc band at the innermost useful groove diameter for checking reproducer tracking loss.

• • •

ELECTRODYNE PULSE GENERATOR

A pulse generator, type 471, with pulses internally triggered for continuous operation from ½ to 1000 cps, has been announced by The Electrodyne Company, 899 Boylston Street, Boston 15, Massachusetts. Provision is made for the use of an external triggering device.

Continuously variable pulse duration is available from 25 to 950 microseconds.

Maximum output obtainable into a 10,000-ohm load is 50 volts, and 5 and 1-volt ranges are provided.

Output impedance of the 50-volt range is approximately 1500 ohms. Approximate output impedances of the 5-volt and 1-volt ranges are 250 and 50 ohms respectively.

• • •

MILLEN VERNIER DIAL

A midget vernier multi-scale instrument dial, measuring 3¼" x 4", and with a vernier ratio of 8 to 1, has been announced by the James Millen Manufacturing Company, Malden, Mass.

• • •

SORENSEN 350-AMPERE NOBATRON

A d-c 350-ampere 28 volt Nobatron, E-28-350, has been constructed by Sorensen & Company, Inc.

The unit will operate from either three phase delta or wye lines.

• • •

AMERICAN PHENOLIC TUBE SOCKET

Molded bakelite sockets, type 146-116, for tubes requiring the RMA super jumbo tube base, as well as industrial 411 and 412 tube bases which have the same pin arrangement but with smaller shell diameter, have been announced by American Phenolic Corporation, Chicago 50, Illinois.

Features incorporated are above or below horizontal panel mounting, screw-type terminals, and long-surface creepage distances for high voltage applications.

• • •

SHURE BROTHERS WIRE-RECORDING HEADS

A line of wire-recording heads has been announced by Shure Brothers, Inc., Chicago. Mechanical construction permits a variety of shielding and mounting arrangements.

Impedances and internal connections may be varied to suit individual needs. Has a controlled groove contour.

News Briefs

INDUSTRY ACTIVITIES

WAA has announced that sales of surplus electronic equipment through distributors will be terminated March 1, 1948.

The Weston Electrical Instrument Corporation has moved into its new engineering and administration building on the plant grounds at Newark, N. J.

General Electric will supply television transmitting equipment to WNAC, key station of the Yankee Network in Boston.

The station, with transmitting facilities in Medford, Massachusetts, is scheduled to go on the air early next year.

Kay Electric Company, manufacturers of the Mega-Sweep sweeping oscillator and Mega-Match, has moved to Maple Ave., Pine Brook, New Jersey. Telephone is CAldwell 6-3710. E. L. Beaudry, Jr., is president of the company.

The News Syndicate Co., Inc., publishers of the New York *Daily News*, have purchased an RCA 5-kw tv transmitter.

The station, WLTV, will be located in the Daily News Building, 220 E. 42nd Street, and will operate in channel 11 (198-204 mc). WLTV is expected to go on the air with test patterns early next spring.

The Capacitron Company, Inc., of Chicago has been purchased by Jefferson Electric Company, Bellwood, Illinois. Plans have been made to continue the production of capacitors in the present Capacitron Company plant.

Altec Service Company held a tenth-anniversary celebration recently at the Waldorf-Astoria in New York City. G. L. Carrington, president, was host.

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PERSONALS

Jay Sullivan has been elected president and treasurer of Airadio, Inc., succeeding J. B. Cobrain who has sold his interest in the company to Mr. Sullivan and others.

Benjamin E. Shackelford has been elected president of the IRE for 1948, and Reginald L. Smith-Rose, of England, vice president.

Dr. Shackelford, a fellow of the IRE since 1938, is manager of the license department of RCA international division, New York, N. Y. Dr. Smith-Rose, a Fellow of the IRE since 1944, is superintendent of the radio division, National Physical Laboratory, Teddington, Middlesex, England.

B. E. Shackelford

R. L. Smith-Rose

Captain L. B. Blaylock, U. S. N. (ret.), has been appointed director of the radio division of FTR.

Capt. L. B. Blaylock

L. G. Burnell has joined Burnell & Company, Yonkers, New York, as a partner and chief engineer.

Mr. Burnell was formerly chief engineer of United Transformer Corporation.

Robert P. Lamons has been appointed Eastern sales representative for the Andrew Corporation, Chicago.

* * *

Hugo Sundberg has been appointed sales manager of the jobber and industrial divisions of the Utah Radio Products, division of International Detrola Corporation, Huntington, Indiana.

* * *

Wm. H. Knowles, chief engineer of IRC, has been named head of the *IRC Resistor Analysis Council*.

The council operates as a consultant to engineers and designers, providing confidential analysis of resistor requirements.

* * *

George Wiley, formerly of McGraw-Hill Book Company, has been named manager of the technical and business book division of Murray Hill Books, Inc. (a subsidiary of Rinehart and Company), New York.

John V. L. Hogan received the Armstrong medal during the thirty-eighth anniversary banquet of the Radio Club of America, held recently at the Advertising Club of New York. The presentation was made by Professor Alan Hazeltine, who is president of R. C. of A.

A posthumous award of the Armstrong medal was made to Charles S. Ballantine.

Frank Horning, sales manager of the Commercial Products Division, Raytheon Mfg. Co., one of radio's real old-timers, died suddenly on Nov. 11, while on business in Cleveland.

LITERATURE

The RCA commercial engineering section tube department have prepared a new edition of the *Receiving Tube Manual*, RC-15.

Manual features sections on tube and circuit theory, a quick-reference receiving-tube chart, formulas and examples for the calculation of power output, load resistance, and distortion for A1, AB-1, AB-2, and B classes of service, and application data on ratio detectors, discriminators, limiters, and multivibrators.

Price, thirty-five cents.

Premier Crystal Laboratories, Inc., 53-63 Park Row, New York 7, N. Y., have released a 4-page bulletin describing the model 117 crystal-controlled high-frequency mini-signal generator.

The National Bureau of Standards have published a 43-page booklet on *Printed Circuit Techniques*, by Drs. Cledo Brunetti and R. M. Curtis. Available from the Superintendent of Documents, U. S. Government Printing Office, Washington 25, D. C., at twenty-five cents per copy.

Bardwell & McAlister, Inc., P. O. Box 1310, Hollywood 28, Calif., have released a catalog describing a line of commercial amplifiers, public-address systems, and sound and recording equipment.

Wide-Band Tuner

(Continued from page 22)

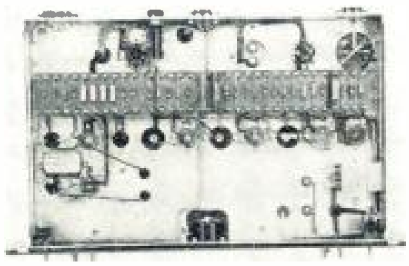
viding a high degree of modulation capability is the ratio of the a-c to d-c load impedance presented to the cathode of the infinite-impedance detector. If R_{116} in Figure 5 went directly to ground, the ratio of a-c to d-c load impedance for modulation frequencies would be .95, which would limit the detector to 95% modulation. However, since R_{116} is returned to a point part way down on the cathode load of V_{106}, it tends to follow the cathode up and down, becoming effectively a much greater impedance to the modulation voltage. The actual a-c impedance measured with such a circuit is about 40 megohms with subsequent improvement in modulation capability. The remainder of the audio frequency amplifier merely provides a balanced output, gain control, and 10-kc filter. Precautions were taken to keep the hum in the audio stage more than 70 db below the signal to take full advantage of the high signal-to-noise ratio in the rest of the tuner.

The avc circuit is so arranged that an rms signal of approximately 7 volts will be applied to the infinite-impedance detector with a resultant 7 volts of audio at the output of a cathode follower. This provides one volt of audio across the 500-ohm output terminals for a 100% modulated signal.

Tuning Meter

Tuning a broad receiver is likely to be difficult. A meter was therefore provided, arranged in a bridge so that deflection to the right indicates increased carrier strength. Experiments showed that if the diode supplying bias to the tube, which operates this meter, were connected at a point where the response was flat across the pass band, tuning was still somewhat difficult, since, for a considerable rotation of the tuning knob no change in meter reading was observed and it was necessary to interpolate between the points where the response began to fall off. This was solved by deriving the avc voltage from the primary of L_{105}. In any double-tuned circuit such as this, in which the effective primary Q is lower than the secondary Q (caused by the shunting of the plate resistance of V_{103}), the primary voltage is not an image of the secondary voltage but shows much more of a double-humped characteristic, which appears in the meter readings. Thus, when the set is tuned, it should be adjusted for the small minimum on the meter corresponding to the mid point in the pass band. Meter readings of 5 correspond to the rms signal of 7 volts which is necessary for full output.

Figures 6 and 7
In Figure 6 (top) appears an interior view of the amplifier and in Figure 6 (below) an underside view. Resistors and mixer crystals are mounted on a terminal strip. The bypass and individual decoupling filters are of the bathtub type and located under the strip, so that the leads from the decoupling resistors pass the terminals of the capacitors and go to the tube sockets without including more than 1" of wire.



The bandwidth of the receiver has been measured by several different methods. A calibrated f-m oscillator is used for the production alignment procedure, and the bandwidth of each unit is checked during that test. Another method of testing the bandwidth is to introduce two oscillator signals into the antenna terminals, one signal being approximately five times greater than the other. The receiver then serves as the detector in a beat-frequency oscillator system and the amplitude of audio output is proportional to the amplitude of the smaller of the two signals. If the small signal is left fixed in frequency and the larger one varied, an overall a-f curve can be plotted at the output winding. Another method is to modulate a fixed r-f oscillator with a variable a-f signal. However, for this test, it is necessary to be certain that the bandwidth of the test oscillator tuned circuit is sufficient to give the same degree of modulation for all of the audio frequencies under consideration.

The last and most convincing test of the band-pass characteristic of the receiver is a setup within reach of the signal line between the broadcasting studio and transmitter. If a good speaker system and bridging amplifier are then provided, a comparison of the direct audio frequency modulating voltage and the output of the tuner can be made. This test has been made several times with the tuner and considerable difficulty is experienced, even by practiced listeners, in determining which is the direct signal and which has gone out to the transmitter and back. A series of half-octave filters may be inserted to give a subjective indication of the bandwidth. All of the measurements described indicate that the over-all response of the receiver is not down more than 3 db at 10-kc each side of the carrier.

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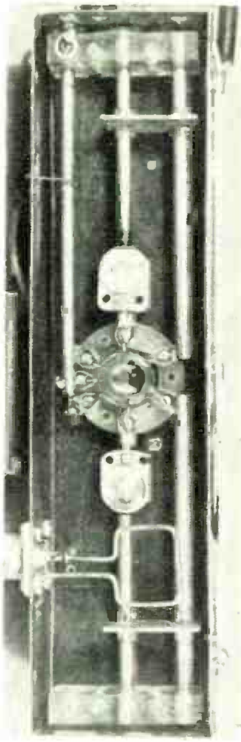
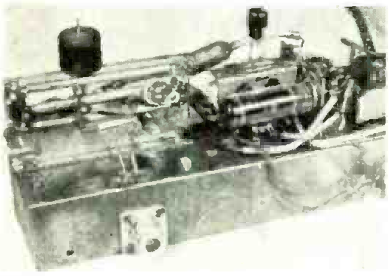
Citizens Radio Equipment



Above and below: Citizen's Radio transmitter-receiver described by R. E. Samuelson of Hallicrafters at the recent National Electronics Conference in Chicago.[1] Transmitter has a plate-modulated oscillator using a 6S4 acorn triode in the center of an effective half-wave line with both ends short circuited. Receiver, with a self-quenched superregen detector, uses a 605-A miniature triode. Common a-f amplifier is used for transmitter and receiver.



[1]See report on paper in November, 1947, COMMUNICATIONS.

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CORRECTION

THE REGULATION ACCURACY of the Sorensen voltage regulator, discussed in the Helterline article on *Voltage Regulation in Broadcasting Stations*, which appeared in the November issue of COMMUNICATIONS, is ½ of 1%.

ADVERTISERS IN THIS ISSUE

COMMUNICATIONS INDEX

DECEMBER, 1947

for DISTORTION and BRIDGE MEASUREMENTS at 2 to 15,000 Cycles

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- **EXCEPTIONALLY PURE WAVEFORM**—Distortion not more than following percentages: with 5,000-ohm output 0.1% from 40 to 7,500 cycles; 0.15% at other frequencies. With 600-ohm output 0.1% from 40 to 7,500 cycles; 0.25% from 20 to 40 cycles and 0.15% above 7,500 cycles.
- **HIGH STABILITY**—Frequency is not affected by changes in load or plate supply voltage. Drift less than 0.02% per hour after few minutes operation.
- **ACCURATE FREQUENCY CALIBRATION**—Adjusted to within 1½% ±0.1 cycle.
- **NO TEMPERATURE OR HUMIDITY EFFECTS**—In ordinary climatic changes, operation is unaffected.

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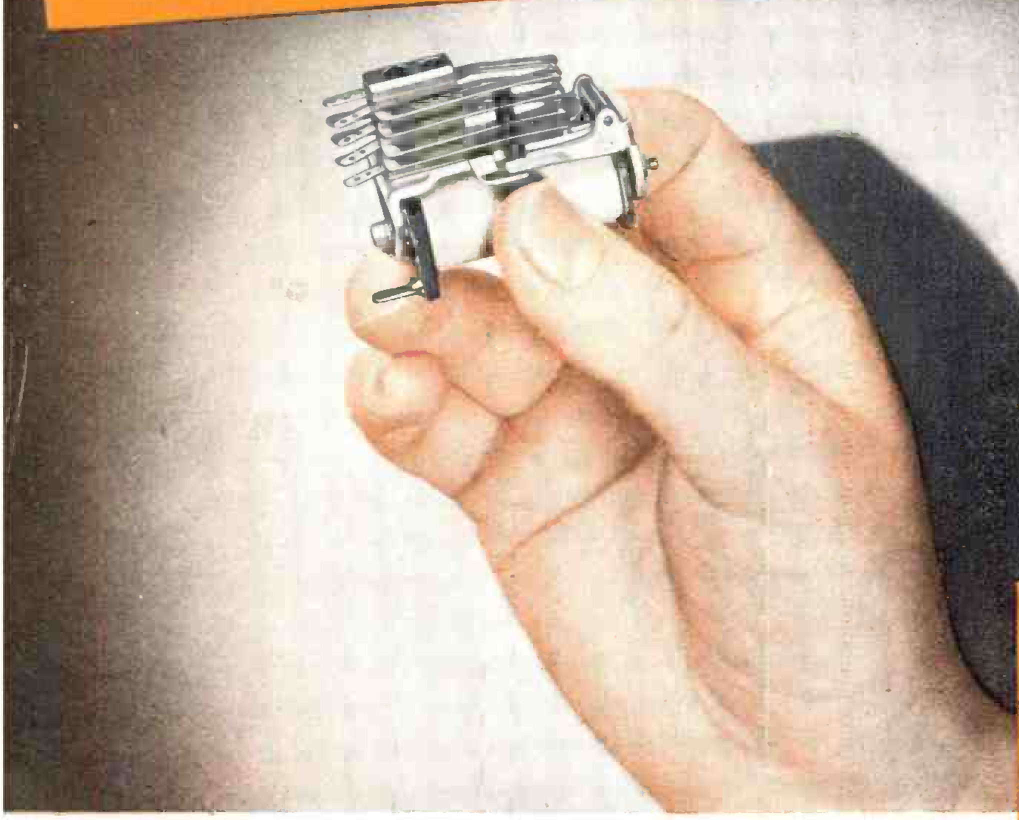

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Exclusive design of the CLARE Type "J" d.c. Relay allows the twin contacts to operate independently of each other so that one contact is sure to close even when the other may be blocked by presence of dirt or grit.

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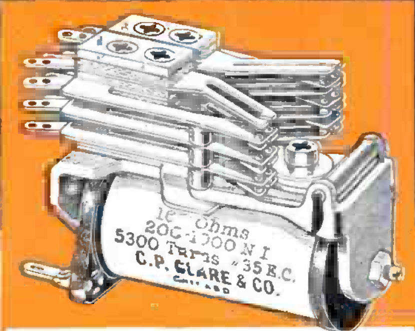

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Independent Spring Contacts. Dome shaped contacts on movable springs; flat discs on fixed springs.

High Current-Carrying Capacity. Twin contact points of palladium. Rated current-carrying capacity: 4 amperes, 150 watts.

New Design Large Armature Bearing Area. Hinge type armature has new design bearing providing largest possible bearing surface. Pivot pin turns in cylinder of different metal which is full width of heelpiece.

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