RCA

Communications News

MOBILE, MICROWAVE AND MARINE RADIO

VOLUME 6, NUMBER 1 | CAMDEN, N. J. | SPRING, 1957

El Paso Expands Vast Microwave Network for Pipeline Communications and Control

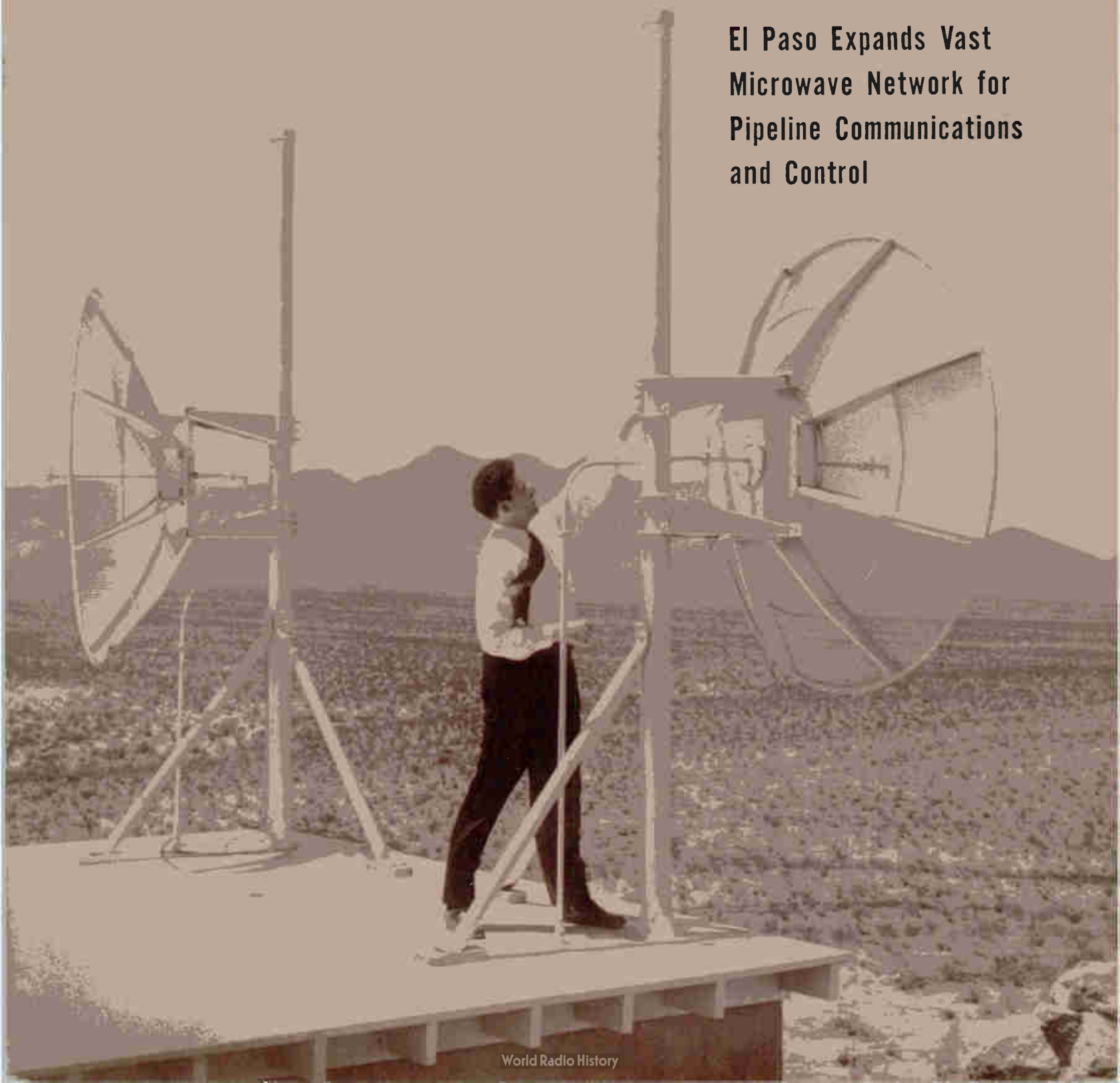


Fig. 1 — At end of production line, warehandler Charles Hobbs stacks cartons of glass containers on trailer for removal to warehouse.

Fig. 2—Enroute from production line to warehouse, tractor operator Robert Adams radios type and amount of ware in transit.

POSITIVE CONTROL OF INVENTORY

How Owens-Illinois Uses RCA Radio to Keep Track of Glassware in Vast Warehousing Operation

THE OWENS-ILLINOIS COMPANY has put RCA 2-way radio to work in its 50 acre Bridgeton, New Jersey, plant in a unique and new way... for a positive, up-to-the-minute record of inventory, stock locations and movement of glassware in its seven huge warehouses. By using this electronic tool almost exclusively for this purpose, the company has solved a problem that has long plagued large warehousing organizations. As in any normal storage function, stock is constantly on the move—being shipped to customers, new stock being received, existing stock being relocated—and an accurate inventory record must be maintained for an efficient, economical operation.

Paperwork System Before Radio

At Owens-Illinois, prior to the installation of the radio system, a voluminous amount of paperwork was required to pinpoint the location of all glassware in stock, and yet, this system proved ineffectual since it required from two to three days after the stock was moved before it was ac-

Communications News

Vol. VI, No. 1 Spring, 1957 Camden, N.J.

In This Issue . . .

Published by Communications Products Department
Radio Corporation of America, Camden, New Jersey, U.S.A.

Address all correspondence to:
Editor, COMMUNICATIONS NEWS
Radio Corporation of America
Camden, New Jersey, Building 15-1

Price . . . . . 50 cents

RCA MOBILE AND MICROWAVE RADIO TERMINOLOGY

"Carfone" is RCA mobile radio equipment designed for 25-54, 148-174 and 450-470 mc operation.
RCA 960 mc Microwave radio equipment is designed for "Short-Haul" application.
RCA 2000 mc Microwave radio equipment is designed for "Long-Haul" application.

Fig. 3 — Operating versatile five-prong lift truck, Henry Morse reports via 2-way radio the exact location of ware being stored.

Fig. 4—Pallet operator Floyd Wright loads glassware on truck for shipment and radios detailed report to inventory control department.

THROUGH 2-WAY RADIO REPORTING

tually recorded on the inventory cards. As a result, when a pallet operator was directed to a specific location to remove a load of bottles for shipment, quite often the ware was not in the proper location and valuable time and manpower was lost searching for the "missing" stock.

The Need For Better Control

Management had long been concerned with the need for a better method of inventory control, and this need became more and more pronounced with the steady growth of the Bridgeton plant. The plant had increased from a five to an eight furnace operation, production was continually climbing, and new warehouses were erected to house the three million glass containers streaming off the production lines daily. After a preliminary survey had justified the need for immediate action, George E. Diament, Work Analyst, and James H. Walsh, Warehouse Supervisor, were tapped by Merle Thompson, Plant Manager, for the job of developing the new system. This combination—a planning expert, and an experienced warehousing man familiar with the problems involved—proved an excellent choice.

Both men were well aware of the shortcomings of the existing inventory control system. They knew that the pallet operators often neglected to submit complete reports of all stock movements; that there was always the possibility of error in preparing these written reports. The most important problem to be overcome, however, was the time lag before stock movements were actually recorded on the inventory cards.

George and Jim were familiar with the 2-way radio system being used in the maintenance department on five vehicles. After carefully analyzing the advantages of radio, they submitted detailed recommendations for a similar 2-way radio system, but one that would be specifically planned for inventory reporting. They were convinced that such a system would give them a positive method of inventory control—would make it possible for pallet operators to radio verbal reports while they were engaged in stock movement and would permit instant posting on the inventory record cards.

Fig. 5—Radio control clerks William Miles, Richard Smithson, and Floyd Price post stock changes as radio reports are received. System enables George Diament, at right, to have up-to-the-minute information on plant inventory.

RCA Radio Chosen for Test Installation

Since the use of 2-way radio for stock control purposes was an entirely new concept, management gave approval for a three month test of the

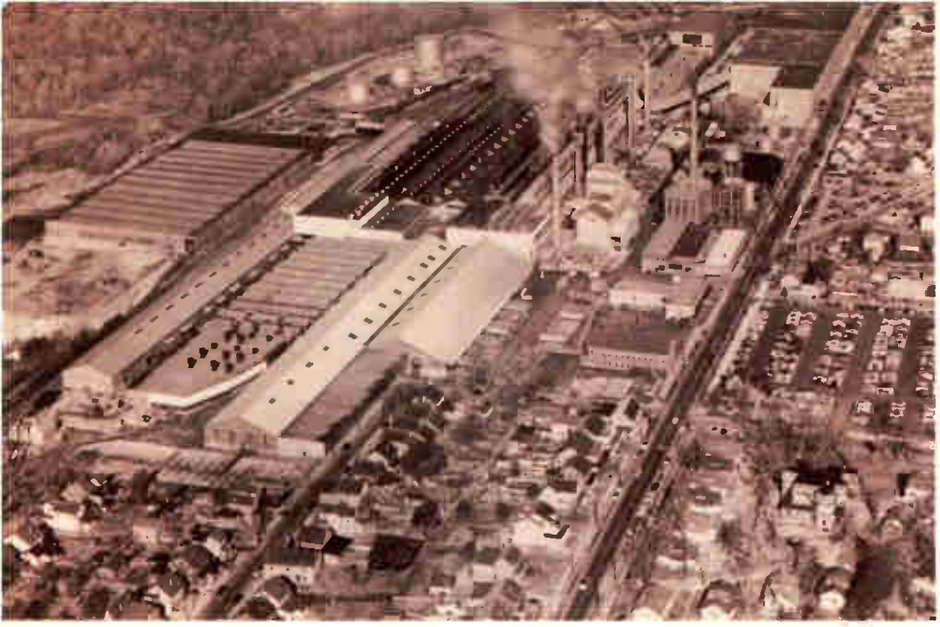


Fig. 6—Entire 50 acre plant of Owens-Illinois is blanketed by the RCA radio reporting system. Largest of seven warehouses (upper right) houses over 30 million glass containers.

Fig. 7—The radio system benefits many plant departments. Here, crew leader Bob Morgan radios urgent request for delivery of glassware to decorating department.

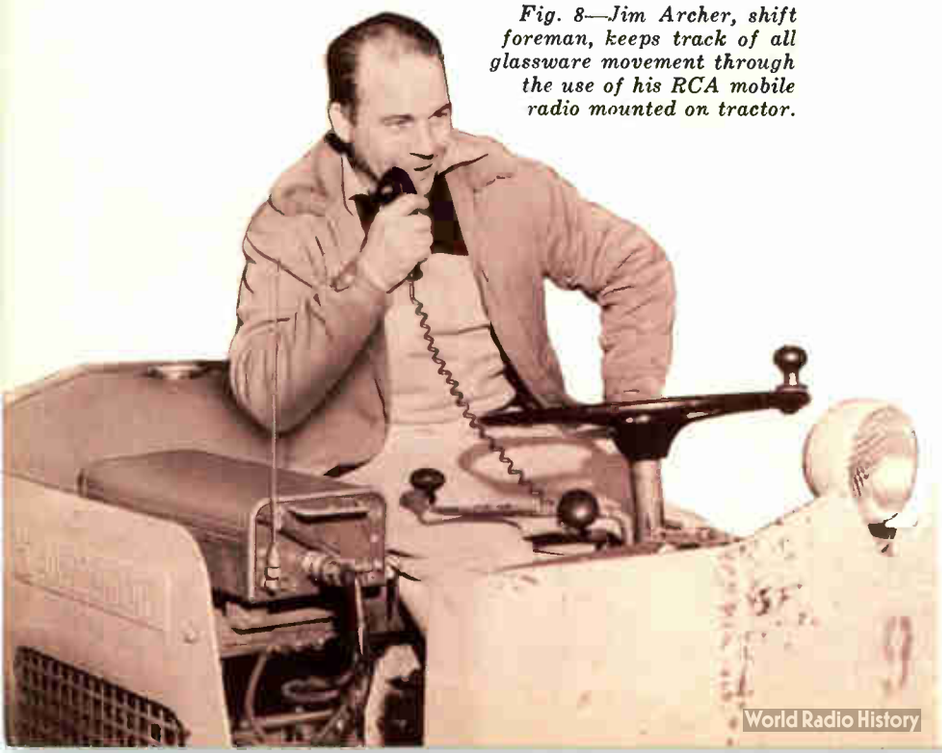


Fig. 8—Jim Archer, shift foreman, keeps track of all glassware movement through the use of his RCA mobile radio mounted on tractor.

system. RCA radio equipment, specifically designed for materials handling vehicles, was selected for the test installation. Working closely with Owens-Illinois in planning the radio system and coordinating the installation was V. J. Keenan, RCA communications specialist.

Early in March, 1956, initial tests of the system were begun. Carfone mobile units were installed on three fork-lift trucks and a fixed station was located in the inventory control office. The immediate results were quite convincing. Now, when a driver removed ware for shipment, he immediately radioed a report of the movement and the necessary notation was made on the inventory cards. No longer was there a delay of several days before the movement of ware was recorded. Management was so impressed with the results of the system that they gave quick approval for the installation of mobile radio units on the entire fleet of 27 fork-lifts and tractors.

How Radio Reporting Works

The radio system is always on the air . . . 24 hours a day, seven days a week. Inventory control begins at the selecting department where glass containers are boxed and stacked on trailers. A tractor operator moves the ware to a specified area in the warehouse and reports, via radio, to the shift dispatcher. The dispatcher, in turn, radios a pallet operator and directs him to the storage location. After the ware has been stored in a numbered bay, the pallet operator radios the inventory control office and reports the storage location and the type and amount of ware stored. A similar reporting procedure is followed when the ware is removed for shipment or relocated in the warehouse. This information is then adjusted on the stock cards, and the inventory group knows the location of every available foot of unoccupied space in all seven warehouses. This facilitates quick selection of storage sites for new ware and completely eliminates the possibility of unused warehousing space.

Radio Provides Better Service to Other Plant Departments

Jim Walsh is enthusiastic about the system. "In addition to improving the efficiency of our shipping and warehousing functions, we are now giving better service to other plant departments."

As an example, Jim cited the fast service offered the decorating department, where glass containers are painted with customer labels and trademarks. Before radio, when the department had an urgent need for a particular type bottle to complete a run, they had to track down the shift foreman to request additional ware. In a warehousing operation of this size, it required considerable legwork and the loss of precious time before the foreman was located. Now, a quick telephone call to the inventory control office, followed by a radioed request for delivery of the stock to the decorating department, gets the job done fast!

The accounting department is directly affected

"Radio has given us a more efficient warehousing operation."

James H. Walsh, Warehouse Supervisor
Bridgeton Plant, Owens-Illinois Company

"Radio keeps our records up to the minute through accurate reporting of bay area storage space by on-the-spot transmission. I believe we will gain even further benefits from this radio reporting system as we gain experience."

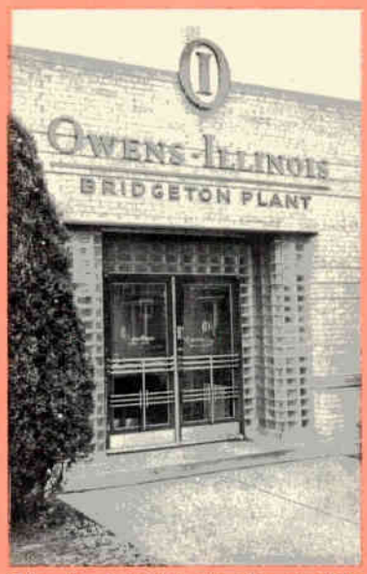


Fig. 9—Located in the world's largest glass producing area, the Bridgeton plant of Owens-Illinois ships over three million glass containers daily.

by the radio system, too. By checking the stock record cards at regular intervals, they have access to production and inventory figures as well as individual production figures on which incentive bonuses are based.

In summarizing the benefits of radio reporting, George Diament says — "With our RCA 2-way radio system, we have reduced paperwork and increased our effective working time 10 to 30 minutes per man per day. More important, however, we now have complete knowledge and control of every piece of glassware in stock."

Pioneers in Materials Handling Developments

The use of 2-way radio reporting is just one of the many materials handling developments Owens-Illinois has introduced. Their perfection of the "grip-fork" loading system was another first in glass container handling. This loading principle involves the use of specially designed five-prong fork-lift trucks, eliminating the need for expensive pallets. The boxes of glass containers are stacked with five channels provided at the bottom of the stack. The forks are inserted into these channels, and when the lift begins, gripping devices extend from the sides of each prong to grip the bottom cartons. The remainder of the load provides its own support during movement and storage. One huge warehouse consisting of 240,000 square feet is used exclusively for this type of handling, and the location and shipment of over 30 million glass containers in this warehouse are controlled by RCA 2-way radio.

Millions of Bottles Every Year

Located in an area that produces the world's largest tonnage of glass products, the Bridgeton plant of Owens-Illinois employs over 2300 men and women helping to manufacture millions of Duraglass bottles every year. A wide variety of other glass products is also produced by the company, including glass television bulbs manufactured for RCA at the Columbus, Ohio, plant of the Kimble Glass Company, a subsidiary of Owens-Illinois. The Bridgeton plant started operations in 1880 in a two-room dwelling, and has progressed to a major industry and the employees have developed into skilled craftsmen. A pioneer in both industrial and community relations throughout its existence, Owens-Illinois has molded an employee-management team that is considered one of the finest in the glass industry.

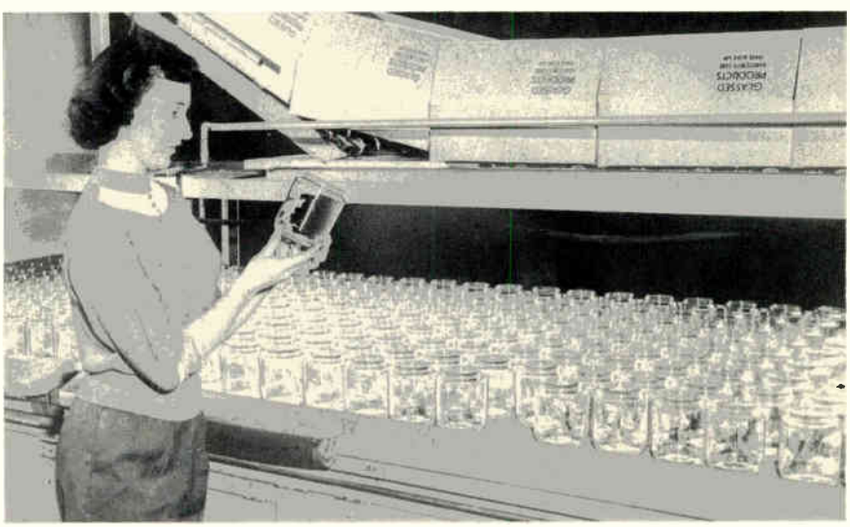


Fig. 10—At selecting end of production line, glass containers are inspected before being cartoned for storage in warehouse.

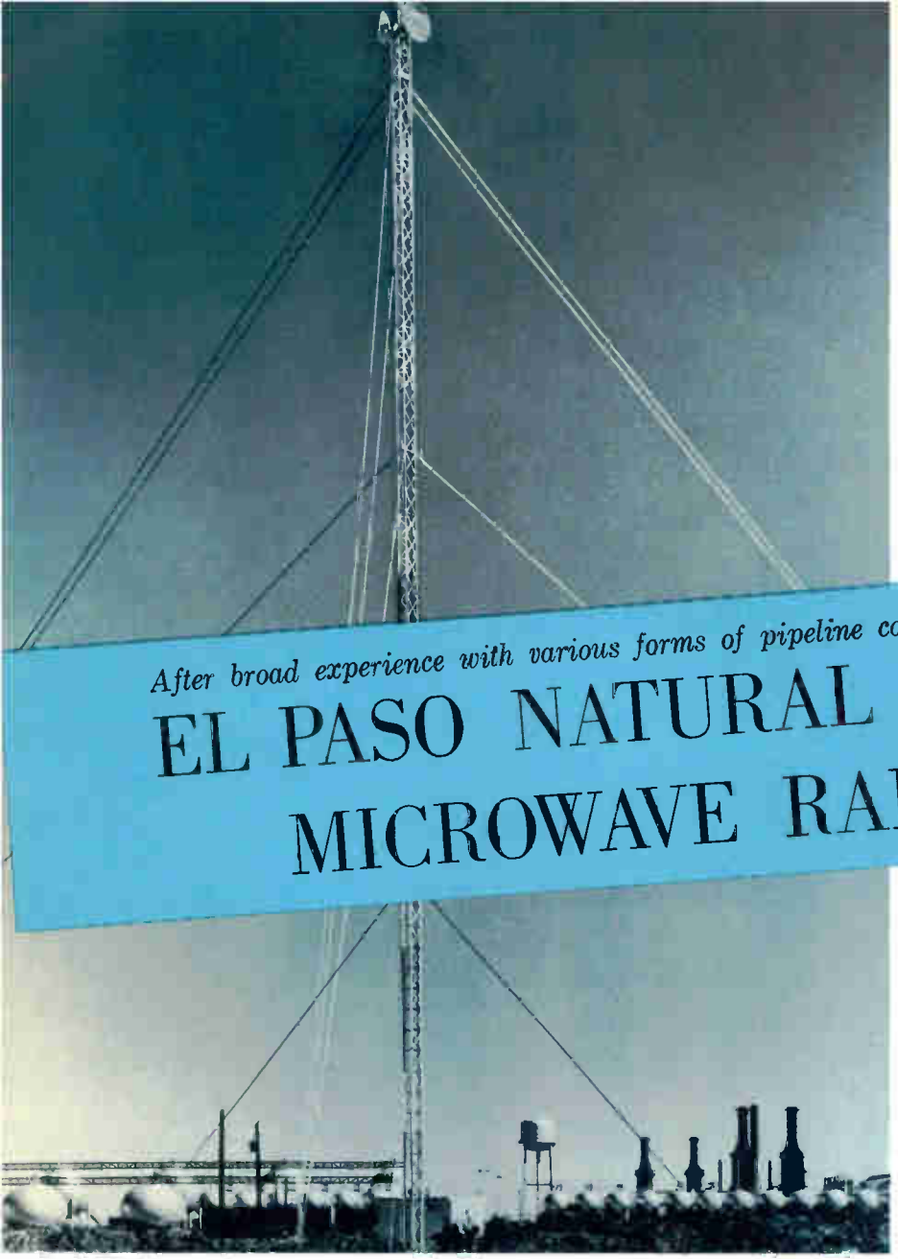


Fig. 1—Microwave repeater station towers over El Paso Natural Gas Company's storage and refining facilities in the Permian Division.

Fig. 2—Company built its own access roads to mountain top locations, such as this station on Thoreau Mountain in the San Juan Division.

After broad experience with various forms of pipeline communications media

EL PASO NATURAL GAS EXPANDS MICROWAVE RADIO SYSTEM

OPERATING the most extensive communications system in western United States, El Paso Natural Gas Company is now engaged in an expansion and modernization program of its microwave system. New facilities are being installed to form a connecting link with existing microwave systems in the Permian Basin and the North Permian system. With the addition of this new link, microwave will cover more than 900 miles of the company's 1334 mile communications system.

El Paso is the prime supplier of natural gas for California, and the sole supplier for Arizona, most of New Mexico and parts of west Texas. To meet the demand of these fuel-hungry areas, the company must operate its pipeline system at near capacity around the clock. Although the average U. S. pipeline operates at an approximate 70 per cent average, El Paso's system has an average load factor of 91 per cent. To operate at this peak the company needs an efficient pipeline—and a communications system that can be counted on at all times. It has both.

Communications between all points must be instantaneous when a high-pressure, long distance line is operating at maximum efficiency. Dispatchers, for example, must be notified of any change which will affect pipeline pressures. On the El Paso Natural system, contact between all points is maintained through a vast communications network that is an efficient amalgamation of microwave and both private and lease wireline circuits. This network stretches over 1334 miles of pipeline right-of-way from Topock and Ehrenberg, Arizona, at the California-Arizona border, to Midway Lane in El Paso's west Texas production fields. Through this combination of microwave and wireline, dispatchers in El Paso can keep in constant touch with any point on any part of the company's lines. Hub of the communications network is located at the company's El Paso City Gate Station, a few miles from the headquarters building in downtown El Paso.

974 Mile Microwave System Serves Pipeline

The El Paso pipeline network is made up of two separate sets of lines running from gas producing fields in west Texas, New Mexico and Colorado to the Arizona-California border. The southern system — oldest of the two routes — brings gas from the Permian Basin to California.

The northern route carries gas from the rich San Juan basin to Topock. Two separate types of communications systems serve these two pipeline routes. The southern system is served by leased wirelines, running from El Paso to Ehrenberg, then northward into California and back into Arizona to Topock. The northern route which runs through endless miles of remote wilderness where there are no telephone lines is served by private wireline and microwave.

The company's pipeline right-of-way runs over some hazardous country. Turbulent air on the desert and mountain areas of Arizona and New Mexico—which plagues wirelines—has just the opposite effect on microwave. When the pipeline went in, the construction of private wirelines was ruled out because of heavy winter snows in the Arizona mountains. Also, no common carrier lines were strung in many of the places where they were needed for vital communications. Therefore, microwave was, and is, the answer for many of the company's new installations.

System Aids Dispatchers

The entire system is designed primarily for voice communications, but also carries teletype and telemetering channels. The dispatching department makes extensive use of party line tone off-on teletype for pressure reports and operating orders. The Permian division, for example, has complex operating problems caused by the large number of gas sources. One of the primary functions, therefore, of the microwave system is the telemetering of these gas flows to division dispatchers at Jal, N. M.

This communications system was designed and is operated primarily for use of the dispatchers for the movement of gas. Naturally, it is also used for other company business. But the dispatcher has first priority, and several channels of the system are reserved for the exclusive use of the dispatching department.

The microwave system operates at 1855-1895 MC. All multiplex carriers have a 1 KC guard band. Voice channels provided are of the single sideband, suppressed carrier type and terminate on switchboards. Unlike normal switchboard circuits which have two-wire termination, the El Paso installation uses four-wire tones with carrier and strapping-over provisions. Conventional dispatching channels could not be used because of the greater number of specialized instruments which would have been necessary.

Company Had Early Experience With Microwave

El Paso's first venture into communications began in 1928, when it installed a private wireline from its headquarters to Jal, N. M. paralleling a then new 16-in. OD pipeline.

El Paso installed its first microwave system in 1951. The first link connected the company's San Juan river plant (N. M.) with Topock, Arizona. This link provided communications between Topock, Flagstaff and Navajo station, Arizona; and San Juan river plant and Farmington, N. M. In 1953, the company installed a microwave system in its Permian division, and a year later equipped its North Permian division with a microwave link from El Paso to Farmington, N. M.

Permian System Adds Microwave

El Paso has recently rebuilt much of its microwave system. The Permian division system, originally installed in 1953, has been modified and expanded to meet increased traffic requirements. This Permian network is made up of 13 stations; 8 voice and one TWX channel, originating at Jal. It runs the route of 223.9 miles of El Paso pipeline southeastward to Midway Lane in Crockett County, Texas. Longest jump on the system is 29.1 miles between Jal, N. M. and the TXL field near Notrees Plant in west Texas. Shortest hop is 7.8 miles between TXL and Goldsmith, Texas. At present, the Permian microwave system is tied-

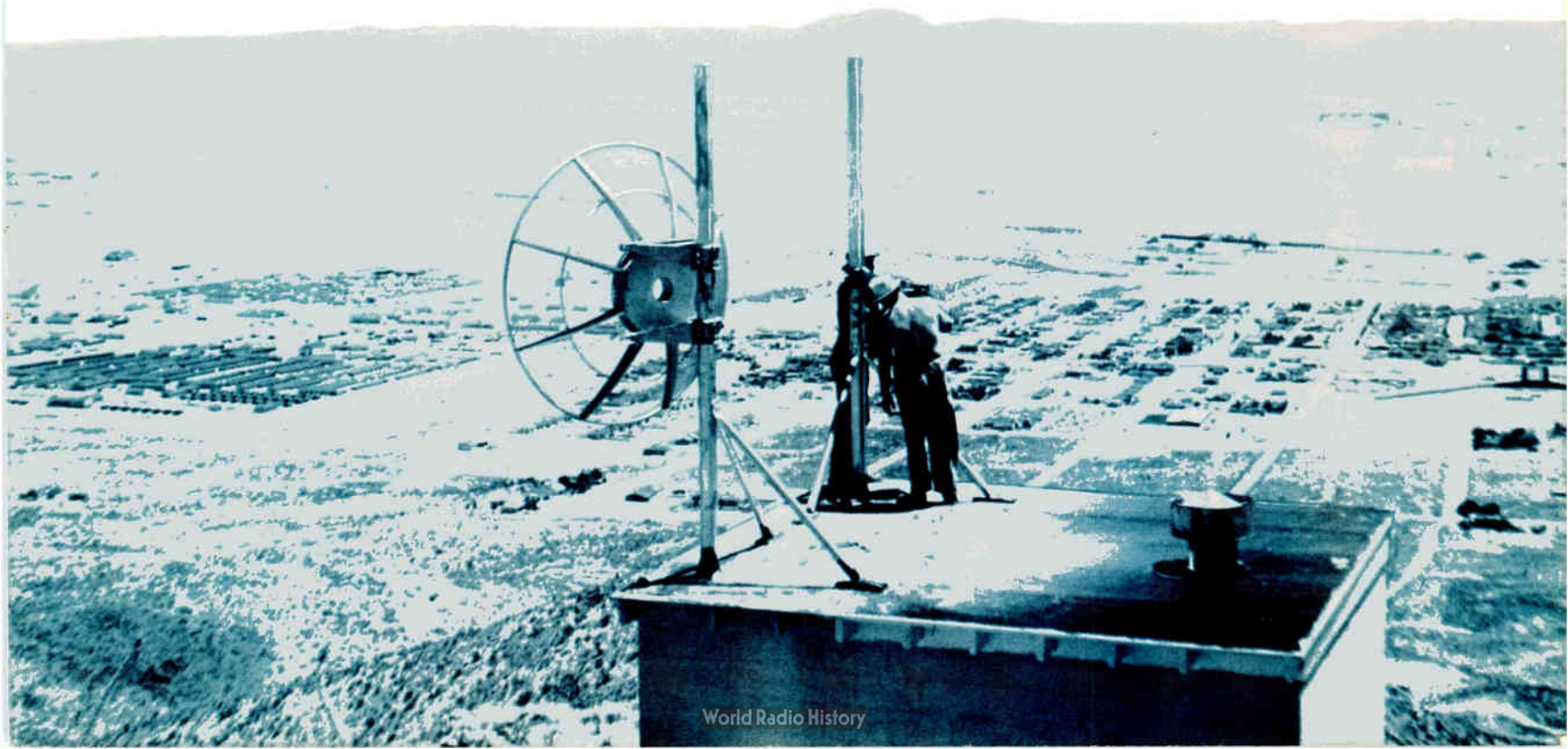


Fig. 3—Technicians install microwave antennas on roof of repeater station located on Sugar Loaf Mountain overlooking El Paso.

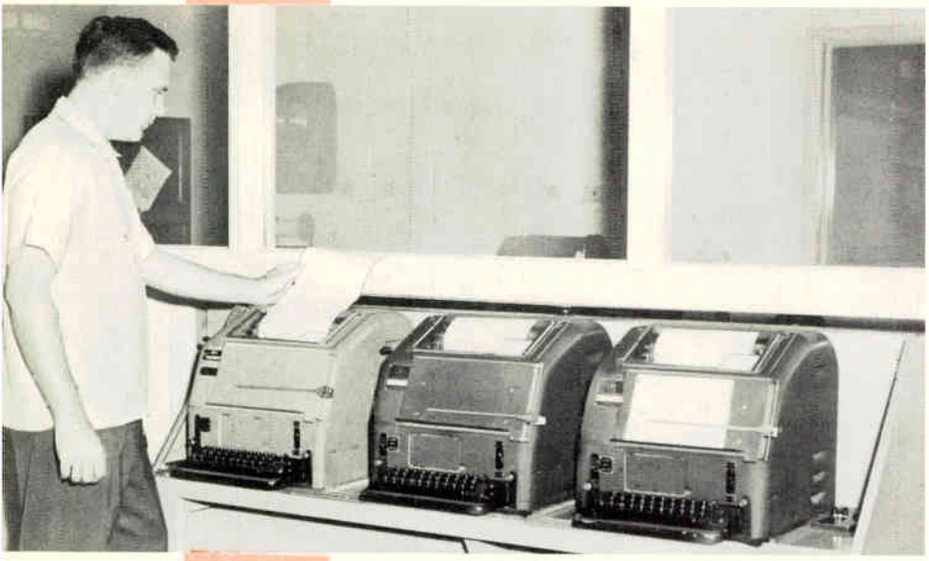


Fig. 4—Mainline depot dispatcher Doyle Gibson receives teletype report at the El Paso office. Unit at left operates on microwave system.

Fig. 7—Dispatcher Roger Smith checks CAA weather maps which are printed at regular intervals on a facsimile circuit of the microwave system.

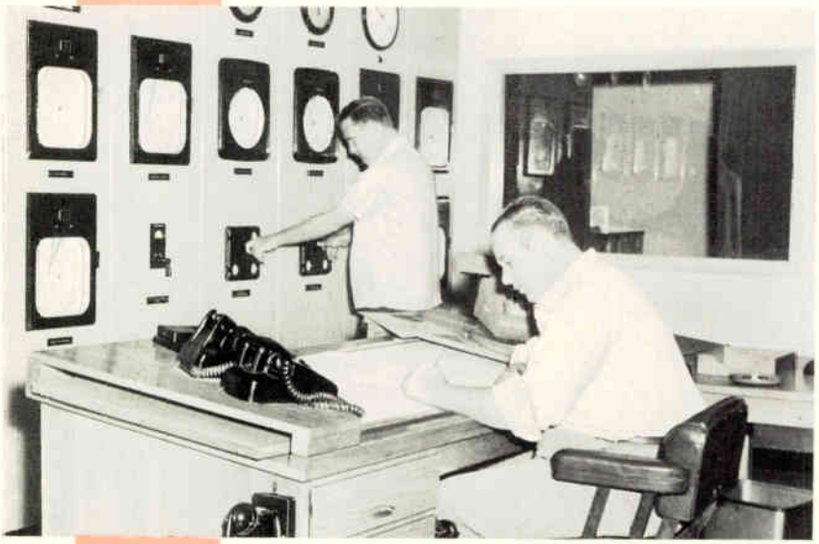


Fig. 5—This battery of telemetering instruments provide mainline dispatchers with essential pressure and differential data.

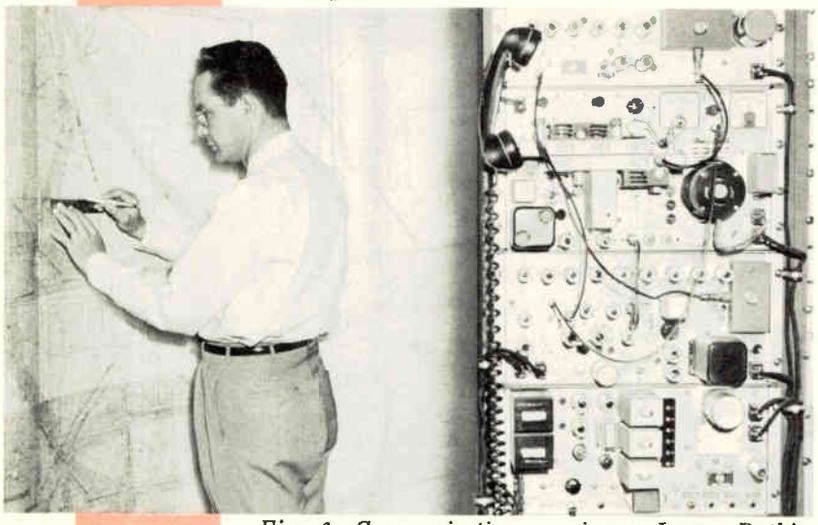


Fig. 6—Communications engineer, Larry Duthie, checks transmission paths on wall map showing company operations.

in to the rest of the system by wireline from Jal to El Paso. It soon will tie-in with a new RCA microwave link now being installed and running from Jal to Tecolote, N. M. where it will join existing microwave facilities. This new link will be made up of nine new stations, and will be designed along the same lines as the present North Permian division.

North Permian System Includes 12 Stations

The North Permian division microwave system joins El Paso's headquarters with its processing plants in Farmington, N. M. It stretches over 430 miles of rugged territory and is made up of 12 stations, starting at the El Paso City Gate. The longest hop between any of the company's repeater stations is found on this system, 83 miles between Grants, N. M. and Mountainair, N. M. The North Permian system carries seven voice channels, a service channel, three TWX channels and a fault alarm channel to the Farmington terminal, where they are multiplexed. A tie-in at Wingate station, N. M. joins the North Permian system with the San Juan division system, and furnishes a through path to the Arizona-California border sales station at Topock, Arizona.

San Juan Division System Spans Rugged Terrain

The San Juan division microwave system has been undergoing a modernization program, too. Some of the original equipment has been moved to other locations, and the sites of some of the original repeater stations have been changed.

Nine repeater stations beam the microwave along the route of the pipeline. The beams carry a service channel, a dispatcher's voice channel, and three fault alarm channels. These fault alarm channels are used to report any malfunction at individual microwave repeater stations.

El Paso's San Juan division microwave system is unique in many ways. Instead of using the

customary steel towers (found elsewhere on the company system), the microwave dishes are mounted on 40 ft. wooden poles. Stations are located on mountain peaks, hence the high towers were not needed. These high mountains also make possible several long hops between repeater stations—81 miles between Dilkon and Mt. Eldon repeater stations in Arizona, and 70 miles between Mt. Floyd and Hualpai Peak, Arizona.

Two company-operated VHF base stations are tied-in to the microwave system in the San Juan division. These are at Topock Camp and at Williams, Arizona. This makes it possible for personnel at El Paso, or any other point along the communications system, to carry on a conversation with mobile equipment operating within the range of these two VHF stations.

Company Installed Own Facilities

El Paso's Communications Department, headed by L. G. Wainman, Superintendent of Electrolysis and Communications, designs and installs all of its own facilities. Whenever a repeater station is located at a company compressor installation or other company facility, it is incorporated into the buildings. However, many of the repeater stations, mainly in the remote areas of the Arizona mountains, are unattended. These unattended stations are constructed of cement block, and house the microwave equipment, standby power equipment, and emergency replacement supplies, such as tubes and other components.

Standby power facilities are provided at all microwave stations. Prime power is furnished by the company's own compressor stations whenever possible. When company-generated power is not available, El Paso buys from REA, or a public utility. At several stations on the San Juan system with no available power, El Paso makes its own, using single cylinder diesel engines belted to 5 kw generators. Standby gasoline engines and Onan generators are set to cut in automatically if the prime source should fail.

Microwave Provides Added Protection

In its early years of operation, El Paso built its own private wire lines into remote areas. But, maintenance was a definite problem. Another hazard was the weather. In 1948, a heavy winter snow storm knocked out 23 miles of the private wire line between El Paso and Jal, N. M. The line was out for three days, and El Paso dispatchers got a thorough education in operating a pipeline by guesswork.

Now, the chances of a three-day outage between any points on the line are practically nil. El Paso and Jal, for example, are still connected by a private wireline. But a new microwave link soon will be built from Jal to Tecolote, N. M. where it will connect with existing microwave facilities. When this link is completed, all points on the system will be protected. If a wireline should go out, calls can be easily rerouted over the new microwave link and be received through the back door, so to speak. This should make the system almost 100 per cent foolproof.

Fig. 8—L. G. Wainman, Superintendent of Communications, contacts distant microwave station on service channel handset.

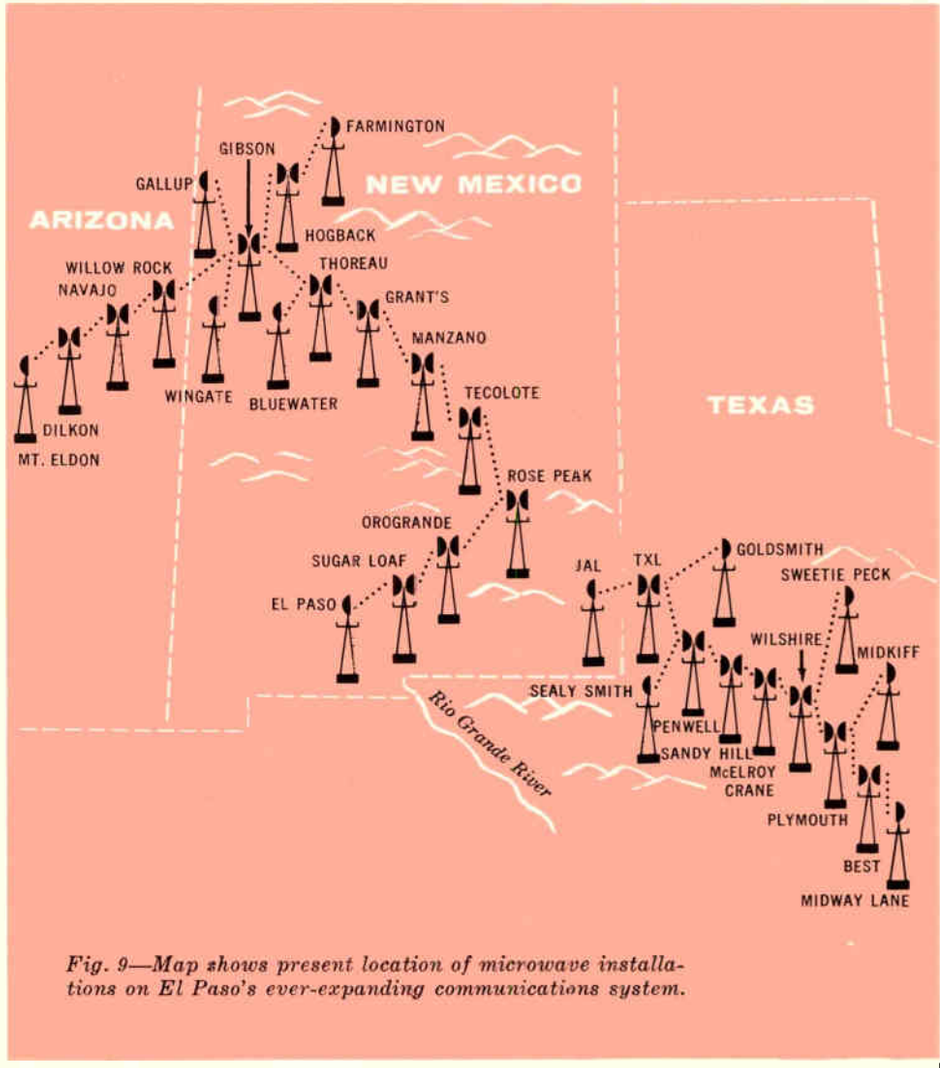


Fig. 9—Map shows present location of microwave installations on El Paso's ever-expanding communications system.

Fig. 1—Superintendent radios report from building site. RCA 2-way radio furnishes vital communications link necessary to coordinate construction activities at three projects.

RCA RADIO HELPS HOMEBUILDER BEAT CONSTRUCTION SCHEDULES

FOR the Larwin Company, top-rated builders of planned home communities in the highly competitive Southern California market, an RCA mobile radio system employing a unique four-base-station operation is the communications messenger that delivers a constant flow of information, orders and top level decisions between the firm's Beverly Hills main offices, executive and maintenance personnel on the road, and three spread-out home construction tracts in Northridge, Buena Park and Norwalk.

"To meet rigid completion dates," reports William Weinberg, Larwin Vice President, "we must keep a constant flow of information on everything from escrows to day-to-day construction schedules moving between our home office and our project sites, often fifty miles apart. Our RCA radio system is the answer. It cuts time-consuming phone calls, it eliminates trips, it facilitates important decisions—and it saves us money!"

With more than 5,000 homes built in some fifty tracts by the eight-year-old firm, and more going up daily at three current construction sites, "all Larwin activities are coordinated by our RCA radio system," continued Mr. Weinberg. "We know exactly where our key men are at all times and can act at a moment's notice."

Radio Cuts Phone Bill $500 a Month

Installed in 1955, the RCA radio system has released the company from former dependence upon regular telephone for communications in their widespread operation.

"The use of land-line phones presented two major problems," explained Vice President Weinberg, who was instrumental in the selection of the RCA system to speed communications. "First, we had difficulty obtaining phones in new building locations. Second, these locations were sometimes located in areas where toll calls were necessary."

"It takes more time to put a call through an operator—and we found that lines were frequently busy. The RCA equipment has done away with these problems. We save from five minutes to an hour in contacting personnel. And our phone bill has been cut by at least $500 a month."

50 Mile Coverage with UHF Radio

Larwin's Carfone installation consists of four 15 watt base stations (plus three remote control units) and six 15 watt mobile units, operating on

Fig. 2—Bill Holden, superintendent of El Dorado project, radios request for lumber from desk station in field office.

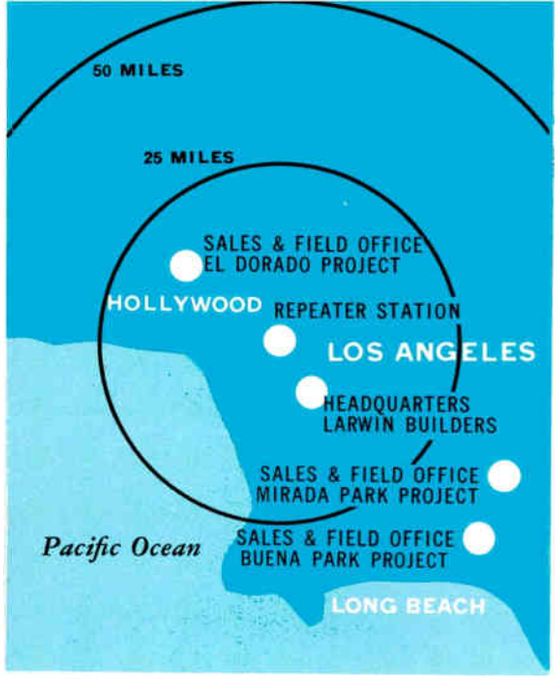


Fig. 3—Map shows location of Larwin headquarters and three building projects. Repeater station in Hollywood Hills boosts radio signal to cover 50 mile area.

Fig. 4—Field supervisor Buck Lemons uses RCA remote control unit to contact headquarters from El Dorado construction shack as field clerk Tom Drake looks on.

a Citizens Band frequency allocation shared by a few other firms in the area.

The master station is at the Larwin Company main offices at 8692 Wilshire Blvd., Beverly Hills, where seven extension handset-type microphones (turned on throughout the working day) serve company executives. An attractive receptionist-telephone operator monitors radio calls, alerts persons called, and dispatches incoming phone messages via radio to the field.

An Andrews 4002 antenna, mounted on the main offices roof, and a repeater station with a Mark Products high gain antenna, located in nearby Hollywood Hills at a 1,600 foot elevation, give Larwin a strong and consistent fifty mile signal range.

Three other stations are located at the field sales offices in the Northridge, California, "El Dorado" project; the Norwalk "Mirada Park" site, and the Buena Park tract. Remote control units at each of the tracts are on duty in field construction shacks, keeping construction supervisors in touch with headquarters and each other.

Five passenger cars and a roving company maintenance truck are equipped with two-way radio. At Larwin Company, described in HOUSE & HOME (October, 1955) as "keen merchandisers," the RCA radio system plays a key role in executive coordination.

To Vice President William Weinberg, overall construction boss, who schedules two field trips a week to check all housing sites, the radio system means uninterrupted contact with all phases of operations, with radio at his fingertips in both office and on the road in his radio-equipped car.

Radio Speeds Completion Dates

Purchasing Agent Bernard H. Moore, one of the main users of radio at the home office, says, "Radio helps me get each day off to a flying start." Arriving at 7 A.M., Moore contacts the tract superintendents for a standard early morning discussion of material shipments and labor schedules as they plan the day's activities before craftsmen report for duty and routine work begins.

"By operating in this manner," Moore continues, "we greatly facilitate our overall schedule, which speeds up completion dates. During the day the radio is in constant use. Construction supervisors or salesmen with problems call the home office or executives in their cars, and important decisions are made immediately."

"And in our business the unforeseen is fairly common. When problems arise, the RCA radio is an all-important tool. For instance, there have been times when certain materials have not arrived on schedule. As soon as I know there will be a delay, I call the project superintendent con-

Fig. 5—Two efficient members of Larwin's main office team are Mrs. Judith Crane and Carfone 450 desk station transmitter/receiver.

1 *Fig. 6 — Maintenance superintendent Ed Meibos acknowledges radioed request for adhesive urgently needed at Mirada Park.*

2 *Fig. 7 — Within minutes after originating radioed request, Fred Vanier gets delivery of adhesive from Meibos.*

3 *Fig. 8 — Using remote control radio unit in construction shack, Meibos reports completion of delivery and receives further instructions.*

cerned and he can change his plans to put men to work on another job. This fast action cuts idle time and labor expenses."

Radio Saves Company $50,000 in Few Hours

Citing an example where the RCA radio system was "worth its weight in gold," Moore remembered a rain storm early in 1956. The Los Angeles basin was drenched with a downpour of seven inches of rain in twelve hours. Storm drains were overflowed, streets were blocked and powerlines were knocked down.

Larwin was building a tract in Norwalk. As the storm hit, it was apparent that every home in the 250-house tract was in danger. It was impossible to get in or out of the area by car, and the phone lines were out.

"The crew at the Norwalk tract called on radio and informed us of the seriousness of the situation," said Moore. "They explained exactly what we were up against, and we in the home office were able to direct emergency operations. Keeping in touch at all times via the radio, we had the crew throw in sand bags and dig drainage ditches. We saved the homes."

"Without our RCA radio equipment," he said, "we probably would have lost most of our houses. Therefore, I would say that the radio saved us conservatively $50,000 in a few hours."

One of the Larwin project superintendents is Bill Holden. He is now in charge of construction of a tract going up in the San Fernando Valley.

Holden pointed up the advantages of the RCA radio equipment in providing him with a broad picture of operations and policy.

Fig. 9—Key people at all job sites are in radio contact with firm's main office. Here, superintendent reports progress on grading operation at Mirada Park.

Radio Pushes Production Up— Idle Time Down

"Larwin Company is completely departmentalized. By listening to the radio in my office, I can keep track of sales, finance, construction in other tracts, real estate buying, movements of the maintenance man and executives, and many other activities. Eventually all of this information falls into a pattern. Then, when I have a decision to make, I know exactly what to do or whom to contact for an immediate answer."

"Of course," he added, "my job is mainly concerned with construction—materials, equipment, labor schedules and completion dates. And I have found that the radio system helps me cut idle time in many ways."

"For instance, if I have an immediate need for materials or equipment that I do not have on hand, I put the word out to the other construction

superintendents and purchasing, knowing that they will help me out as soon as possible."

"Also," he concluded, "Larwin has established a good name with labor through the use of radio. There have been occasions when top-notch carpenters, or other skilled craftsmen, have come to me requesting work. If I don't need a man on my project, I radio the other superintendents to see if they can use him. Workers appreciate the fast action."

Radio Lets One Maintenance Man Do Work of Two

Another employee who constantly uses the radio is Ed Meibos, the maintenance man now servicing five Larwin-built tracts. His job begins when a tract is completed—for the next thirty days to a year, or longer, he rides herd on plumbing leaks, electrical difficulties and structural problems that require fast service.

Because he stays in constant touch with all Larwin offices and personnel through the radio in his truck, he saves at least an hour a day and some fifteen to twenty-five miles on the road.

A large portion of his work consists of coping with emergencies. One afternoon a frantic homeowner called a Larwin salesman saying that a connection to his water heater had broken and the house was about to be flooded with water.

The salesman immediately got through to Meibos on radio—and the leak was repaired within a half hour.

Vice President Weinberg confirmed that "the radio system helps direct the maintenance man to the proper place at the proper time."

He said that "without the RCA radio, Larwin would have to employ two maintenance men."

"Efficiency up 100%"

To Larwin Director of Sales Sidney Cagan, who spends eighty per cent of his time and 4,000 miles per month on the road between tract sites, the radio system is "terrific."

"The two-way radio has increased my efficiency by 100%," said Mr. Cagan. "While driving from one point to another I can handle a tremendous amount of vital communications. Using radio we can keep information flowing on escrow clearances, loan approvals, dates that homes will be ready for occupancy—and a hundred and one other details."

"As an integral part of our sales operation, radio has developed good will and saved us hundreds of hours per month in dealing with home buyers alone," Cagan points out.

In Los Angeles, Larwin Company has been honored by having one of its homes selected for a place in the permanent "Hall of Fame" established by the National Association of Home Builders.

The home, designed by Larwin President Lawrence Weinberg, was one of fifty-six selected from throughout the nation as an example of the finest in design, construction and functionalism.

In communications, too, Larwin Company has insisted on the finest: RCA radio equipment.

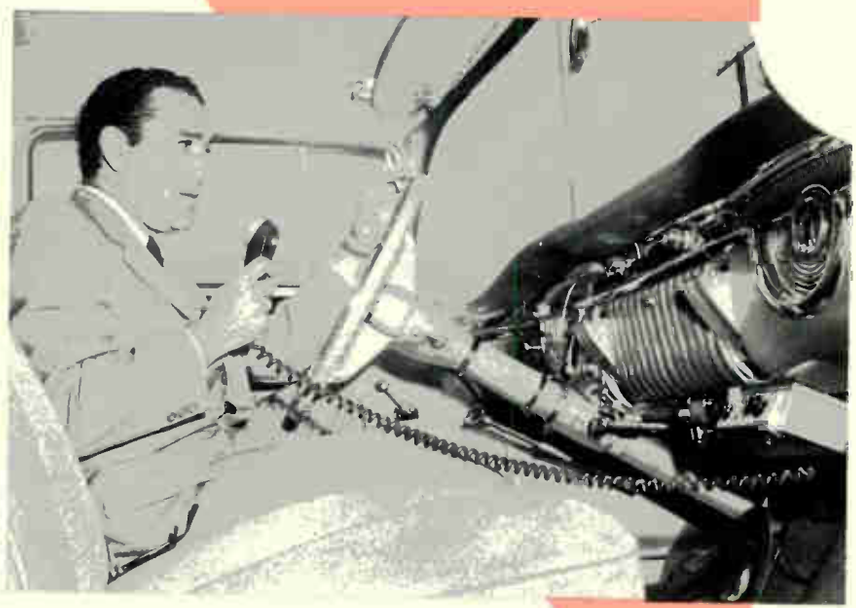


Fig. 10—Larwin land acquisition official Harry Stanley talks to company office from his radio equipped car. Note radio control panel mounted within easy reach on dashboard.

Fig. 11—President Lawrence Weinberg keeps track of all construction and sales activities through means of remote control unit in his office.

Fig. 12—Douglas Gifford, assistant sales manager at the Mirada Park sales office, receives information on prospective customer relayed from main office.

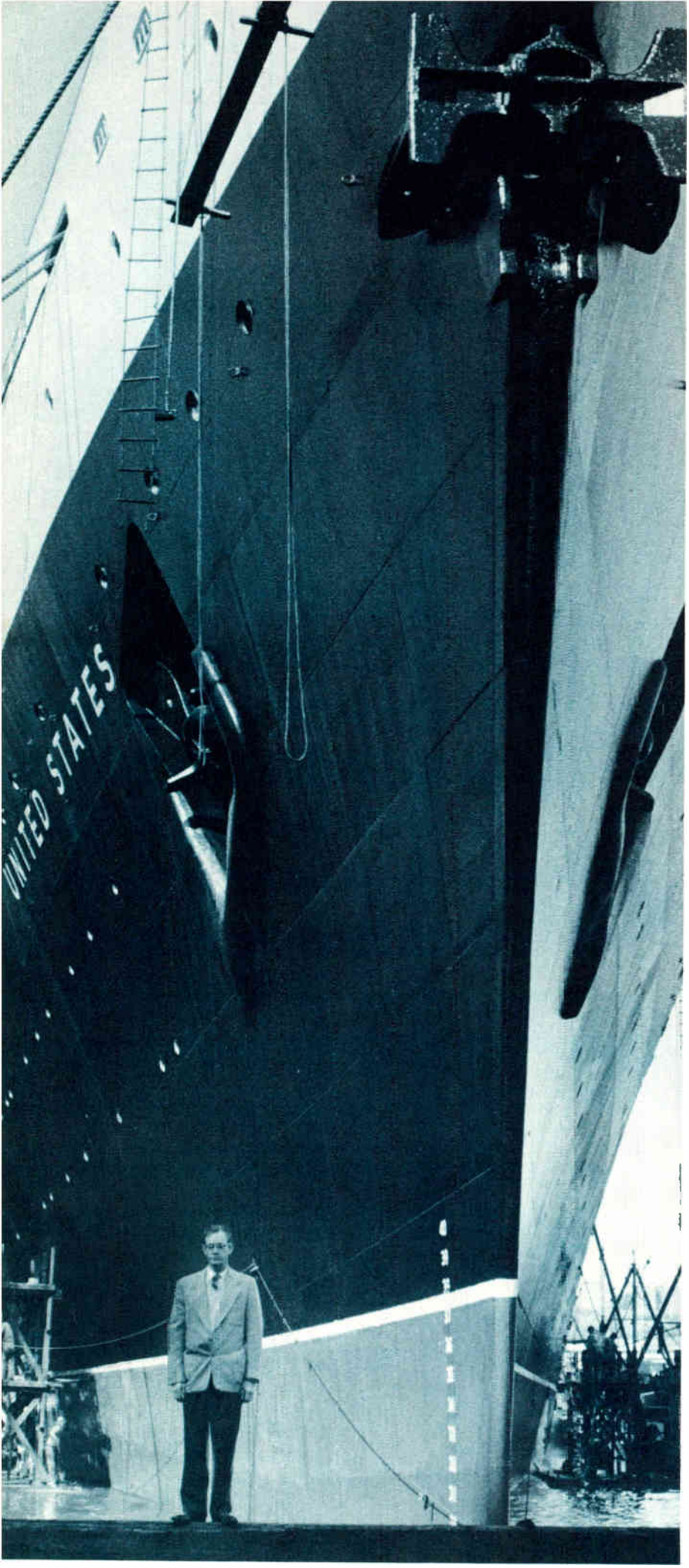


Fig. 1—One of the finest ships afloat, the luxury liner SS UNITED STATES is serviced through the New York Radiomarine Service Port. Technician E. L. McCarthey is dwarfed by the giant passenger liner berthed at the United States Lines Pier.

NO MORE, THE ANCIENT MARINER!

Modern Mariners Rely On RCA Radiomarine Service For Equipment Protection

MEET A *Radiomarine* Service technician and you'll likely find a nautical "four-letter" man—a seasoned sailor; an electronic specialist; a customer servicing expert; an RCA career man.

Take a group of men with these attributes, give them the ever-looming responsibility of completing service by sailing time, be positive that they're well schooled in the traditions and parlance of the mariner, if they are to maintain a hard-won position of respect, and they'll knit you an efficient unit comparable to today's *Radiomarine* Service organization.

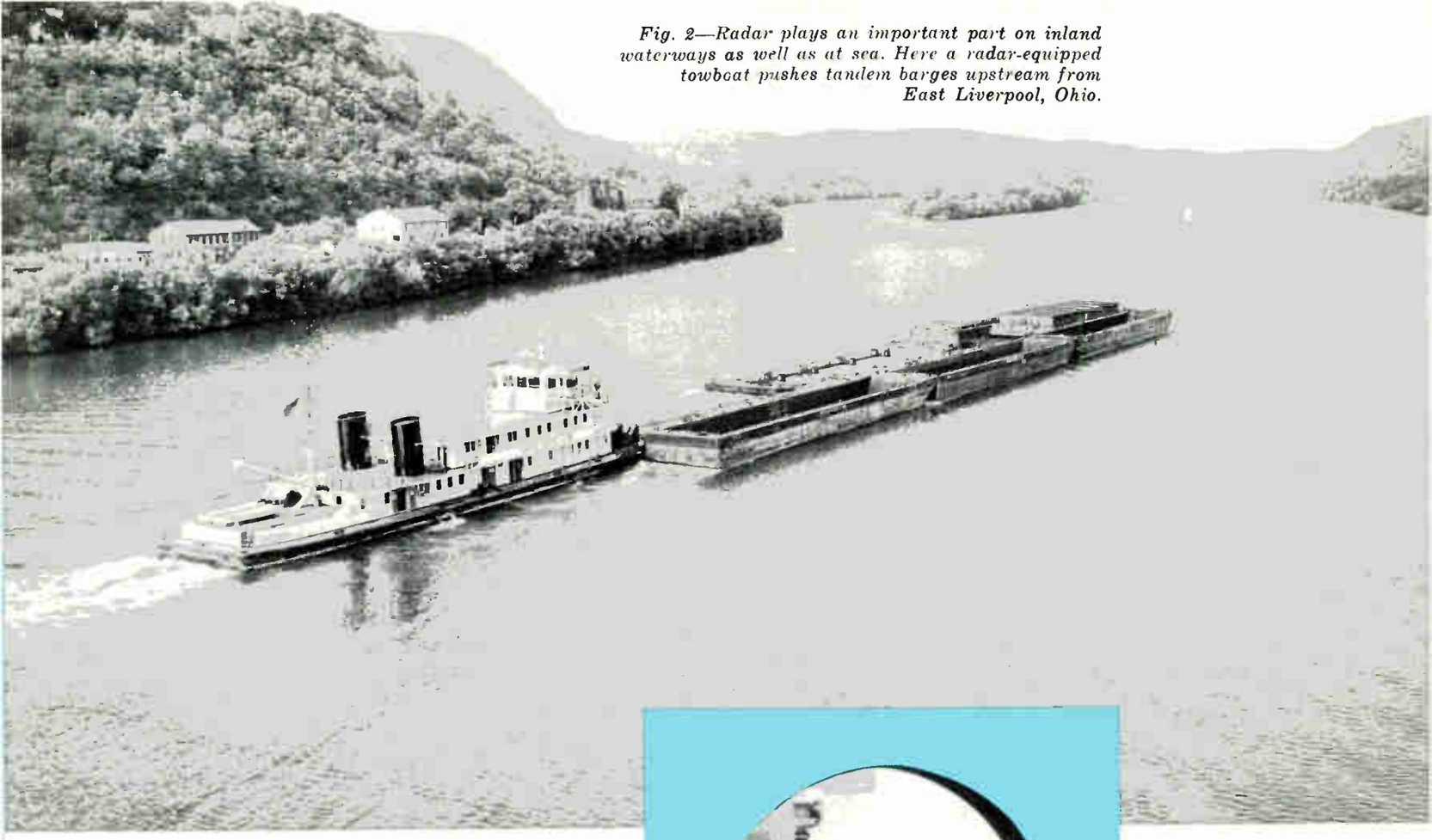
Personal comfort has become secondary for these men. They'll leave warm homes on treacherous winter nights to service all manner of craft along bone-chilling waterfronts. They'll climb aboard outbound ships on an hour's notice, perhaps to be gone for weeks, secure in the knowledge that their job is part of the tradition of men who rule the seas.

30 Years of Radiomarine Service

In 1919 arrangements were made to acquire the assets of the Marconi Wireless Telegraph Company and shortly thereafter Radio Corporation of America commenced its activities in the field of marine and international radio communications. As the radio communications service of RCA expanded, there grew a need for a separate operation for marine activity. On December 31, 1927, *Radiomarine Corporation of America* was formed.

Included in the operations of *Radiomarine* was a communication service with a dual role; operation of a radiotelegraph and radio communications system for contact with ships in all parts of the world; and a function providing maintenance, repair and installation service and annual FCC inspection on all types of marine radio communications equipment and electronic navigational devices.

Fig. 2—Radar plays an important part on inland waterways as well as at sea. Here a radar-equipped towboat pushes tandem barges upstream from East Liverpool, Ohio.



This latter service is now a function of RCA Service Company's *Radiomarine* Service.

The Job of RCA Service Company

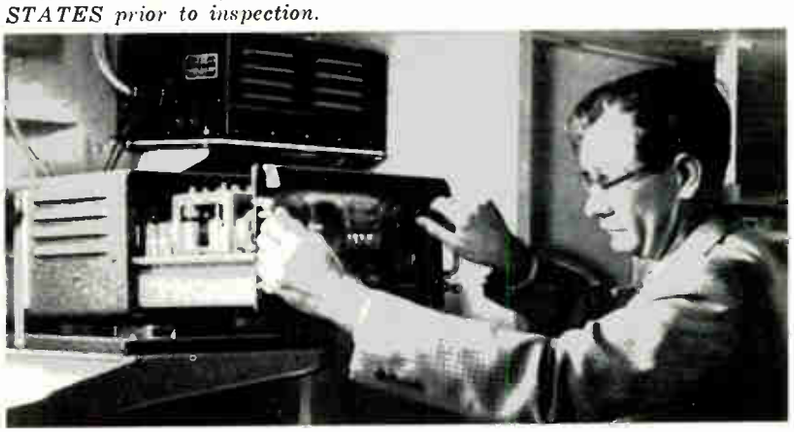
RCA Service Company, which services electronic equipment for RCA customers, is composed of three departments: Technical Products Service Department, Consumer Products Service Department and Government Service Department. *Radiomarine* Service, because of the type equipment involved, is included in the Technical Products Department, which is responsible for the maintenance on all industrial, scientific, mobile and microwave communications, theatre sound and broadcast equipment. *Radiomarine* service technicians now have the added engineering facilities and knowledge of this department at their disposal to carry out this service.

The Consumer Products Department handles television receivers, air conditioners and home appliances, and the Government Service Department services Armed Forces electronic equipment, including Radar, Guided Missiles and other field support activity.

It is the responsibility of *Radiomarine* Service to keep electronic equipment aboard merchant craft in first class operating condition. *Radiomarine* service personnel operate from more than 25 coastal and inland ports, under the direction of Field Managers who generally combine service contract and equipment sales-mindedness with marine savvy and technical experience. In foreign ports, ships with RCA maintenance contracts are assured the same efficient attention from associated companies and agencies overseas as they receive in principal U. S. ports.

Fig. 3—Framed by porthole, Technician E. C. Lashus inspects superstructure where radar antenna will be located aboard newly designed tanker.

Fig. 4—As an aid to navigation, Loran is constantly relied upon by skippers. Technician E. E. McCarthey removes chassis of unit aboard SS UNITED STATES prior to inspection.



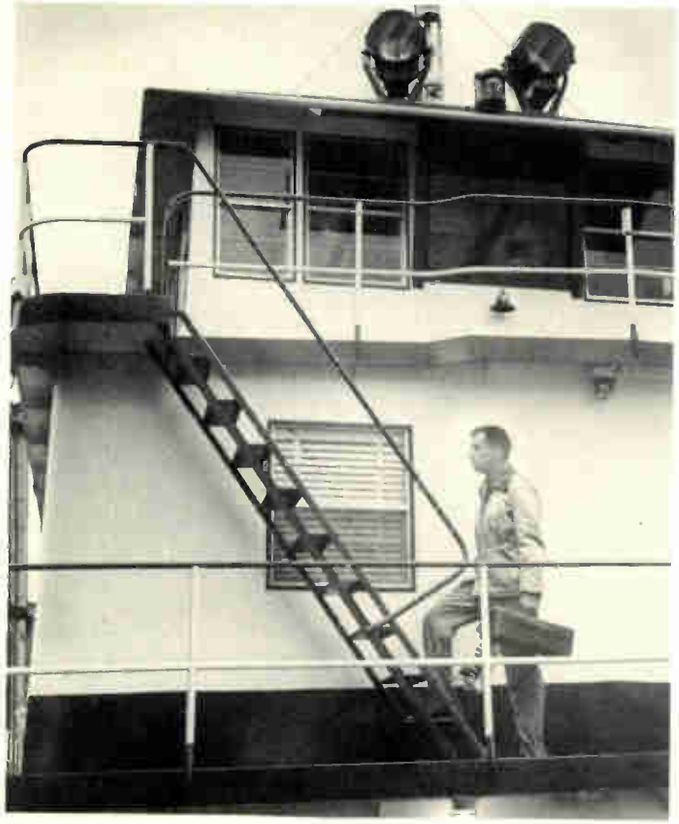
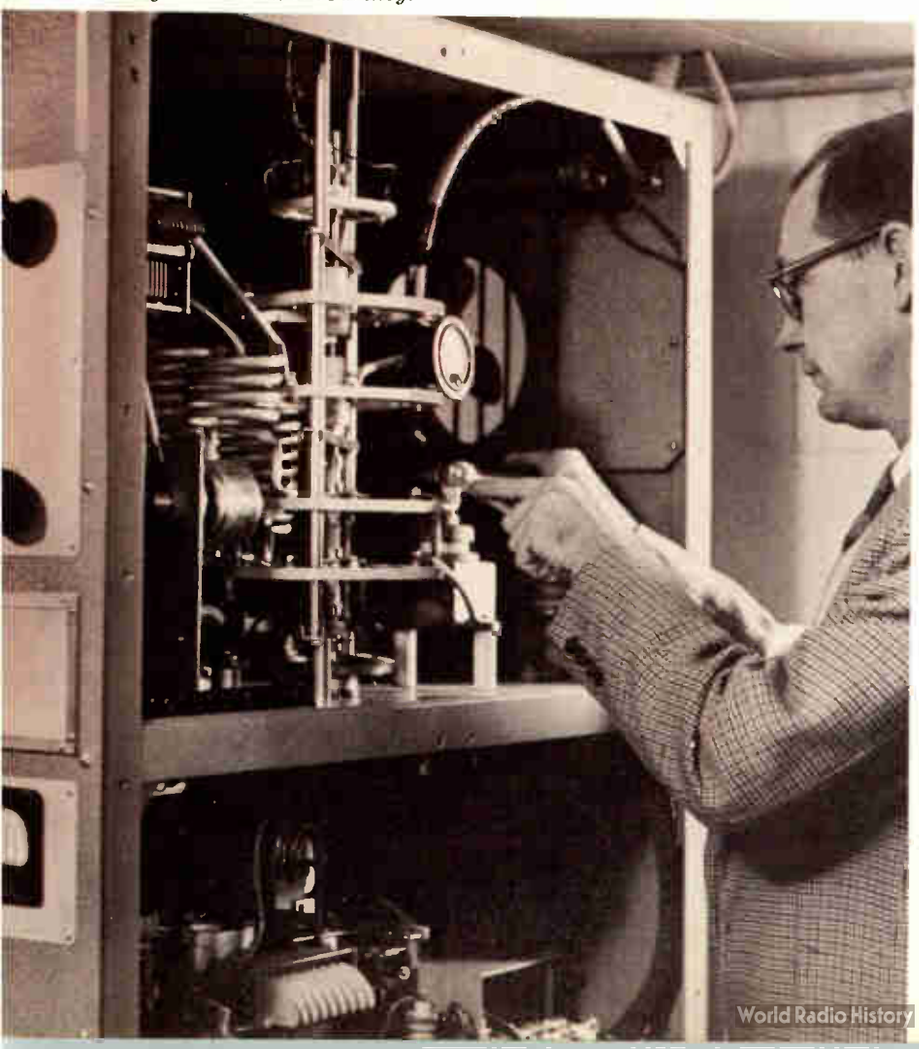


Fig. 5—St. Louis Technician E. R. Stone boards towboat at St. Louis for inspection of RCA Radar. Mississippi-borne towboats rely on radar as well as other electronic equipment to ply their way on treacherous inland waters.

Fig. 6—High frequency transmitter aboard the SS UNITED STATES receives preliminary checkout for possible outages by Technician McCarthey.



Radiomarine service is a 24-hour-call type of operation. But it pays off. One veteran captain was so impressed with the new Loran unit aboard his ship that he used it to check the position readings periodically against sun sights. When the two points coincided exactly, he would invariably turn to his navigator and remark, "Well, the sun is in the right place."

Winning plaudits from experienced seafarers with precision electronic equipment is no easy task, especially when you consider that just short decades ago huge ocean liners criss-crossed the Atlantic with not much more navigational and safety equipment than Columbus used almost 500 years before!

Today's modern mariner has Radar to sweep the horizon, enabling "vision" through black night or fog. The helmsman guides the ship over a true course electrically with the aid of a gyro compass repeater. High frequency sound waves emitted by *Radiomarine's* depth sounding system bounce off the ocean's floor to accurately measure depth. And to locate the ship's exact position Loran is called upon to give an accurate position in minutes by radio.

You will also find unanimous judgment of the spirit of *Radiomarine* service from the sailing men whose lives and livelihoods depend so heavily on it. Summed up one service expert, "We find that electronics has proved so useful to commercial shipping that people now pay it the supreme compliment of almost taking it for granted."

Service at the Drop of a Hook

Before electronics was applied to navigation, visual observation was limited to the lookout's view of the horizon. Helmsmen steered by the often temperamental magnetic compass. Soundings were made with the historic lead-weighted lines, and an accurate fix of the ship's position depended on a sextant and chronometer.

Contrast the operation with today's modern ocean liner. On the bridge of the SS United States, for example, you'll find equipment operating that is a marvel of electronic efficiency. How is it actually done? The problem rests with the *Radiomarine* service port personnel in the harbor as soon as the ship anchors, regardless of the time of day.

Take a large port such as New York harbor, covered for service by Field Manager L. D. Jameson's port technicians. The bustling ship traffic in this port sends technicians out each morning servicing all types of craft, from tankers to freighters to luxury liners and tugs.

Field Manager Larry Jameson will tell you his marine service has undergone a basic service operation change since World War II. During the 1920's when he joined RCA, until just after the war, about 90 per cent of the servicing business centered about telegraph. Since that time, the marine service broadened — matching the increased pace of the usage of electronic equipment generally — and now his technicians perform

skilled service on Radar, Loran and VHF communications equipment.

Typical of the service technicians is Eldon E. McCarthey, a competent RCA specialist able to handle any type of electronic equipment afloat.

Formerly self-employed with his radio repair business, "Mac" served in the Merchant Marine during World War II. Runs like the one to Murmansk found him minus two ships on as many different occasions. Once due to enemy U-boats, another due to enemy planes. A resident of Paramus, New Jersey, any weekday morning finds Mac reporting in at the port office to pick up his assignments for the day from W. H. Courtney, dispatching chief technician.

The jobs he might tackle in any week could consist of checking a radio-telegraph console circuit breaker aboard a passenger liner; performing routine maintenance on a freighter's Radar or locating and correcting a "short" in a tug's mobile ship-to-shore radiotelephone.

But even this "equipment-hopscotching" talent fails to fully demonstrate his versatility. He knows the ins and outs of the lightweight portable radio direction finder used on outboard pleasure cruisers and sailboats. He knows the workings of the radio direction finder and he can tell you how to get the best operating efficiency out of a depth sounder.

His operation might have been duplicated in any major port in the United States by *Radiomarine* technicians.

Inland Waterways are Served

By way of contrast, and no less vital to the marine servicing fraternity, is the *Radiomarine* service technician climbing the ladder to the pilothouse of a less glamorous but work-horse powered Mississippi towboat.

Generally absent from the limelight of the sleek luxury liners and cargo ships are the dependable towboats, barges and other river craft transporting every conceivable type of cargo over thousands of miles on the nation's vast inland waterways system. Here too, the press and tempo of modern business has wrought sweeping changes and electronic equipment is as familiar to the inland sailor as to his ocean-going counterpart. Here too, speed and schedules are equally important watchwords.

If technicians are working heavily traveled inland ports, they'll be equally adept at solving problems involving river towboat radar and communications gear. Or if men are assigned the Great Lakes area, they'll know ore-carriers, while a West Gulf area technician is expert on tanker traffic.

The scenes may change from crowded waterfront piers thronged with passengers and cargo to the broad sweep of mighty rivers and lakes. The service port may differ in its specialty, depending on the heaviest type of ship traffic. But regardless of the port location, you'll note the one strong, common link . . . the spirit of *Radiomarine* service!

Fig. 7—Technician E. R. Stone inspects antenna of CR104A radar on towboat KANSAS CITY.

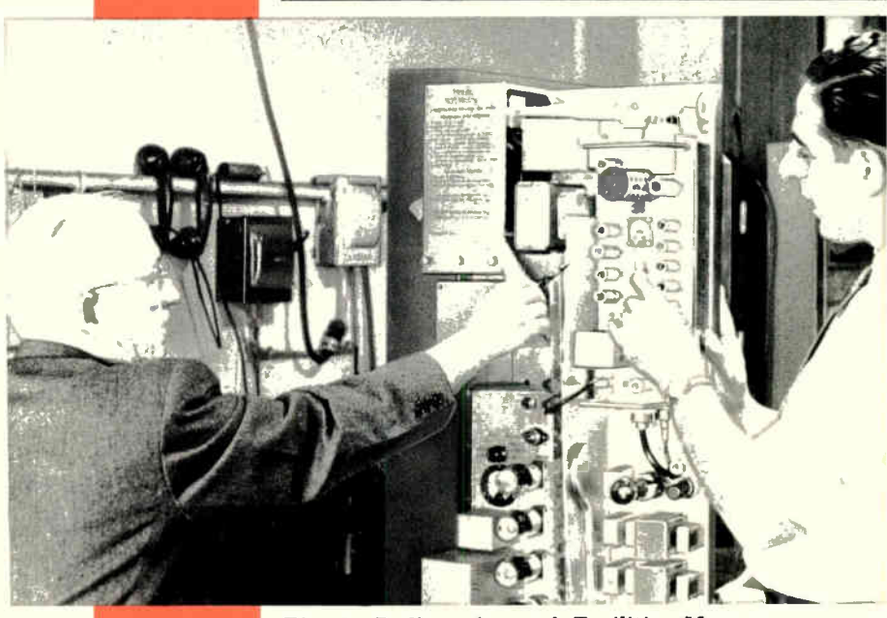
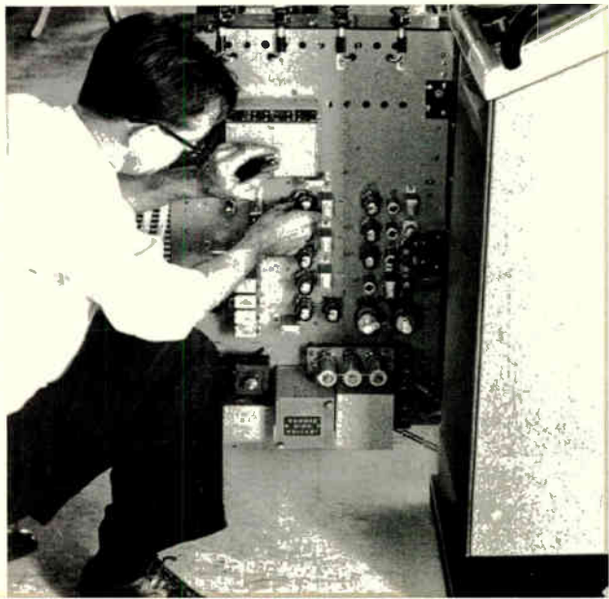
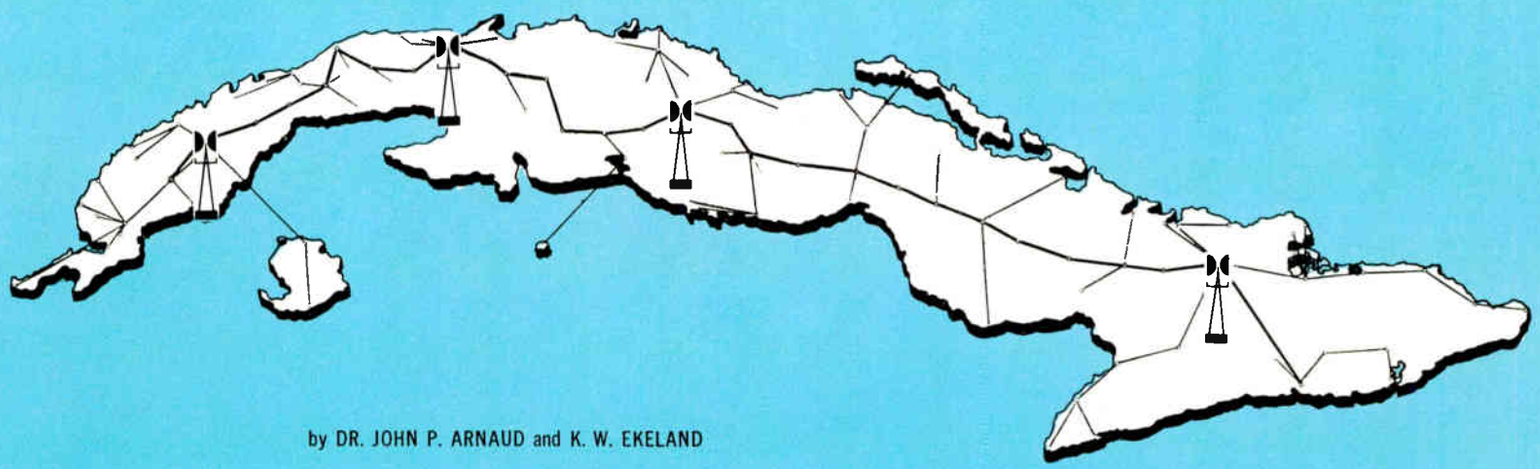


Fig. 8—Radiomarine and Facilities Manager F. H. Illingsworth determines components needed for replacement, with Technician C. Anzilone, right.

Fig. 9—Freighters as well as luxury liners require constant inspection. Here, E. L. McCarthey services Radar on bridge of freighter SS SANTA BARBARA.



NATIONWIDE MICROWAVE NET AIDS CUBA'S GOVERNMENT, AGRICULTURE AND INDUSTRY



by DR. JOHN P. ARNAUD and K. W. EKELAND

PROGRESS through communications is the story in Cuba, where telephone and telegraph services throughout the country are being streamlined by electronics. Under the direction of President Fulgencio Batista the nation is taking a giant stride forward in communications, with a microwave telecommunications system that is among the most modern in the world. Its design insures stability and flexibility with a minimum of high frequency interference for maximum efficiency during normal use of channels.

Printed and voiced messages are already being transmitted every day over parts of the new microwave system. This system is built up of 30 microwave stations which form a "back bone" running down the middle of the island. Locations not directly served by the microwave trunk are connected to it by sidelegs consisting of 82 VHF stations. The system is supplemented by mobile units, mobile radar, and mobile microwave.

Hardly a year since the first link in President Batista's program was completed, an expansion has begun which will extend the system further with the addition of 40 more stations. This modernization program provides better service for all branches of the government, and is an important asset to Cuba's vital agricultural interests and her growing industrial centers.

RCA International Division, which is engineering the system for the Cuban government, first conducted a terrain survey to determine suitable sites for relay stations. With the assistance of Cuban engineers, RCA engineers mapped out a network to provide maximum service with the smallest number of relay stations. The survey work required three months.

The basic telecommunications system is a trunk network which links all the principal cities and extends across all of Cuba's provinces, which are rich in history and in natural resources. The system also features smaller relay stations which, when combined with the trunk network, permit modern communications facilities to all parts of the country. The network supplies independent telecommunications circuits, including telephone, telegraph and facsimile, among all the main stations in the system.

Among Cuba's principal cities connected by the system, with direct telephone and telegraph connections with the nation's capital, are: San Julian, Pinar del Rio, Havana, Matanzas, Santa Clara, Cienfuegos, Camaguey, Holguin, Santiago de Cuba and Guantanamo.

ABOUT THE AUTHORS:

DR. JOHN P. ARNAUD was Professor of Electrical Engineering at La Plata University in Argentina. He has had ample field experience, including communications development and installation for the Argentine Army.

K. W. EKELAND came to RCA International Division after serving in communications with the Norwegian Department of Defense. He was associated with research and development for the Norwegian Armed Forces.

Each of the main stations in the network has available a transmitter and corresponding receiver for communication with patrol cars. These circuits serve as local services only. They are not connected directly with the main microwave network. In the system are 265 mobile units.

The first link in the system was inaugurated in special ceremonies early in 1956. Major General Fulgencio Batista, President of the Republic of Cuba, personally put into operation the initial link between Campo Batista, an important Air Base, and Ciudad Militar, located in Havana and headquarters of the Cuban General Staff. A. F.

Fig. 1—Inaugurating System—Major General Fulgencio Batista, President of Cuba, inaugurates first link of national communications system at Campo Batista. From left: Julian Lastra Humara, Dr. John P. Arnaud, Albert F. Watters, Vice President of Radio Corporation of America and Operations Manager, RCA International Division, President Batista, G. A. S. Roberts, Hector Magno, J. H. Marsh.

Fig. 2—Hurricane Proof Tower—This 300-ft. antenna tower was constructed to withstand hurricane winds up to 200 miles per hour, and it has stood off the big winds.

Watters, Vice President of Radio Corporation of America and Operations Manager, RCA International Division, headed a group of RCA representatives attending the inaugural ceremonies, attended also by RCA's distributors in Cuba, Humara y Lastra.

The project is administered by Ramón Vasconcelos, Minister of Communications. Coordinating for the military and other services are: Sr. Juan Payret y Veitia, Sr. Octavio Marti, Brigadier General Eulogio Cantillo, Lieutenant Colonel Jose A. Fernandez, Lieutenant Colonel Carlos San Martin, and Captain Eloy Rubio Baro.

The microwave system was planned by engineers from Systems Engineering and Marketing of RCA International Division, in close cooperation with engineers from CEP Communications Engineering of RCA, in Camden, N. J., and engineers from RCA Service Company. The job is a good example of how different engineering organizations within RCA can work together as an efficient team in order to get a big task done.

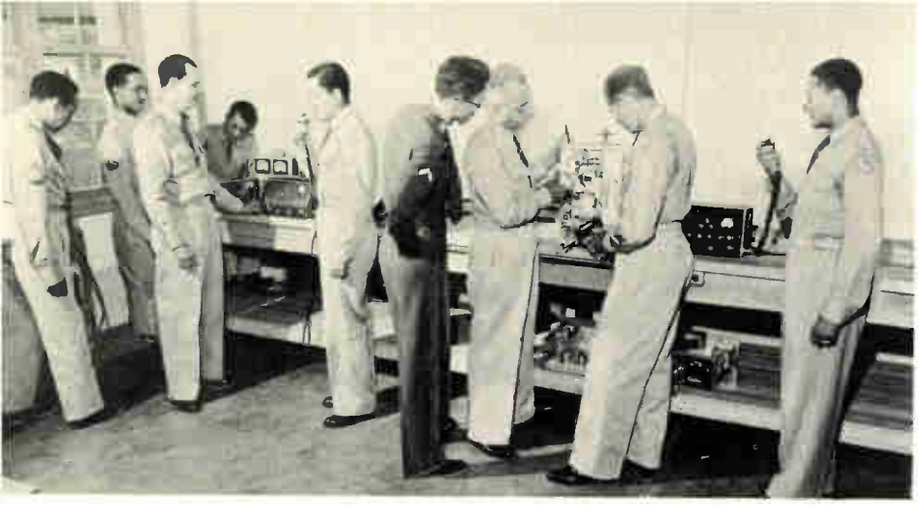


Fig. 3—Communications Classroom—Personnel from Cuban Armed Forces go to school for new communications techniques. School is operated by RCA International Division, helping to expand Cuba's electronic manpower.

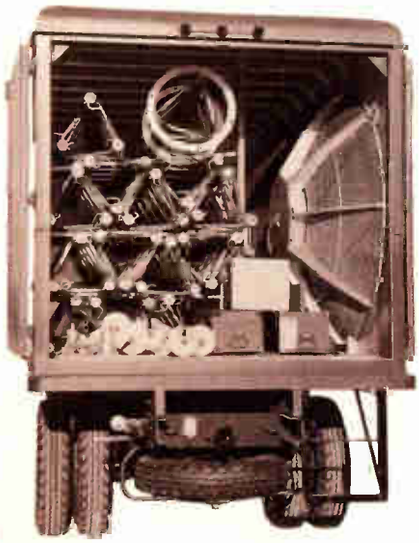
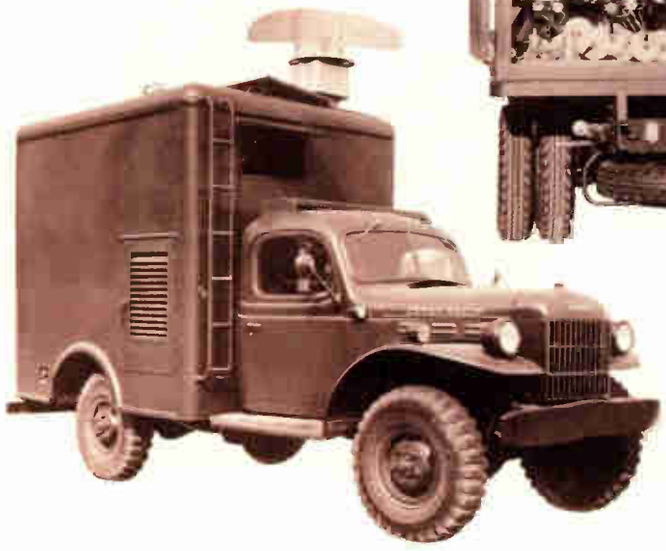


Fig. 4—Modern "Package" for Modern Nation—Interior of mobile microwave unit showing efficient set-up for equipment that can move in any direction and set up in a matter of minutes.

Fig. 5—Radar Truck—One of mobile units which supplement the fixed Microwave system.



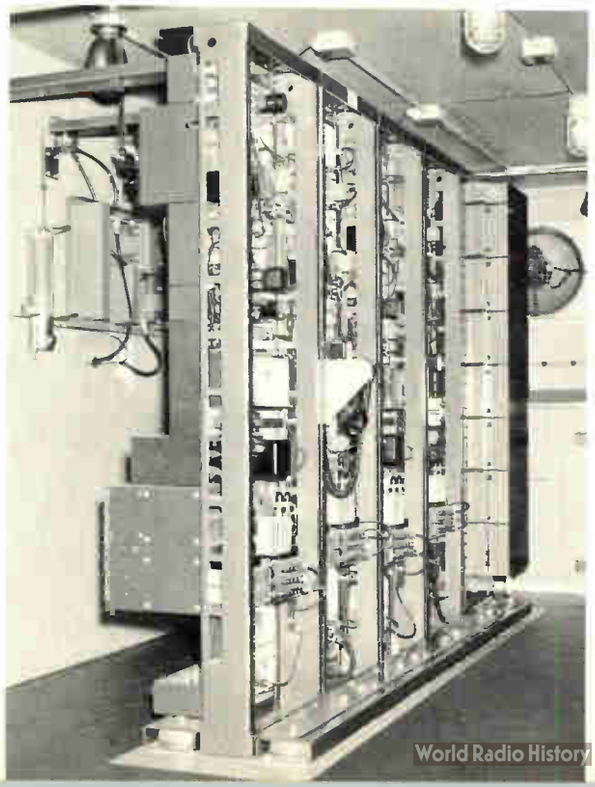


Fig. 6—Rack mounted equipment rests on shock mounts to withstand vibration in transit. This mobile microwave equipment can be moved to any part of the island where communications are needed.

Julian Lastra Humara, Miguel Humara Maderne, Carlos Rom Serra, directors of Humara y Lastra, RCA distributor for Cuba, and Antonio Zamorano, engineer for Humara y Lastra, helped to coordinate work on the historic system.

RCA Microwave equipment in the Cuban system operates on frequencies around 2000 megacycles for the basic trunk network. VHF stations serving as interconnecting links with the trunk network operate on 150 to 174 MC/S.

Because of Cuba's geographical location—in the path of tropical storms—the system required special engineering on antenna towers throughout the system. All towers are constructed to resist winds of hurricane force, up to 200 kilometers per hour. Those erected in zones bounded by Matanzas and Pinar del Rio have been reinforced to withstand winds up to 300 kilometers per hour.

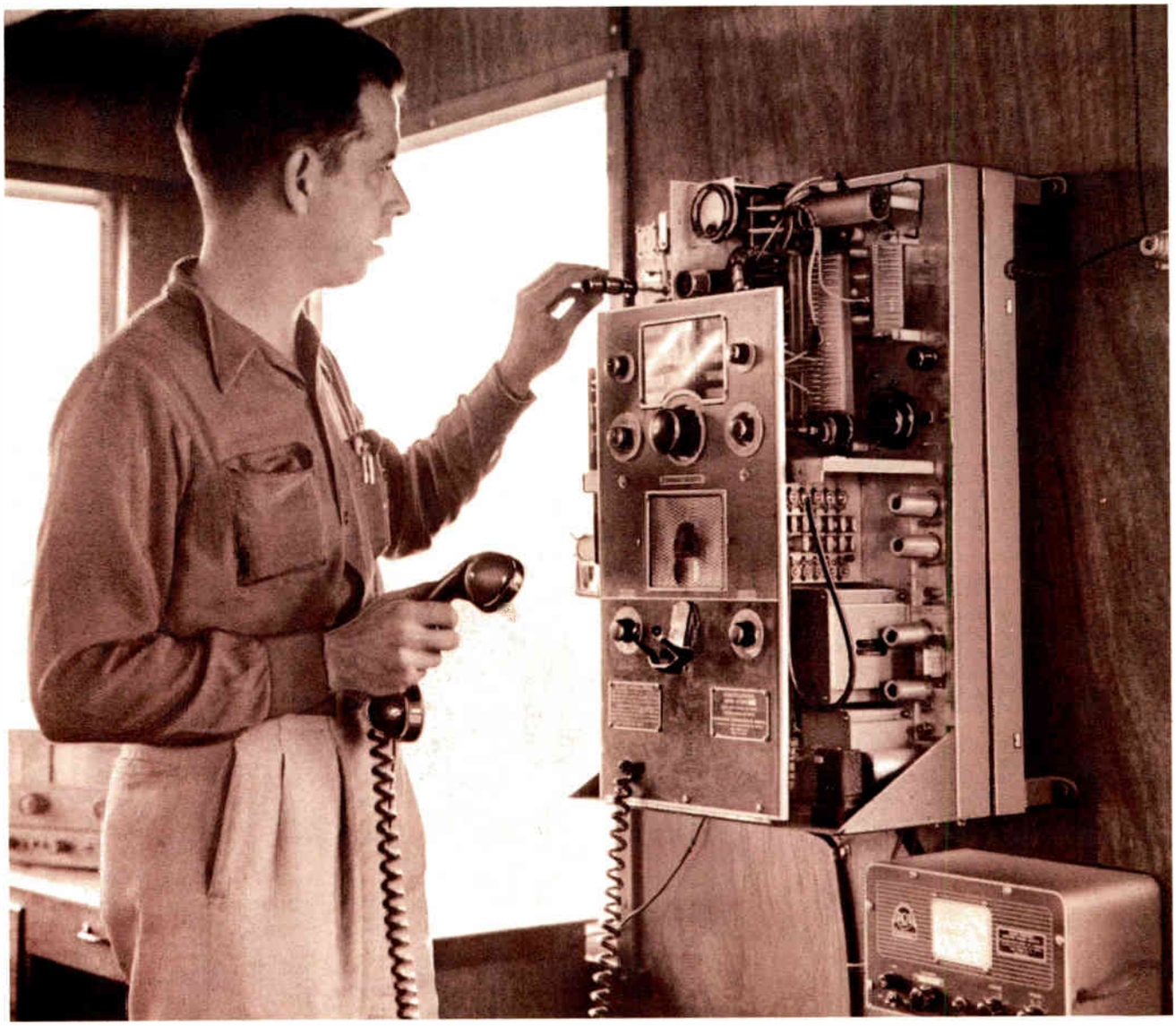
The trunk network of the system has also been designed with the idea of facilitating its enlargement without changes of equipment or interruptions of communications. Of the 40 new stations being added to the original system, nine will be used to extend the Ministry of Communications teleprinter service for the Havana area, 18 will provide teleprinter service for the Ministry of Communications at localities throughout the country which were not served by the original system. Ten of the stations will bring high speed communications to sugar mills, tobacco, hemp and other agricultural locations, mining and industrial centers. The remaining three will extend the Armed Forces Communications network.

Coinciding with the increase in facilities, a new technical school will be inaugurated in which communications personnel will be trained by RCA International Division engineers for the Ministry of Communications. It will give Cuba needed manpower in telecommunications and open up career opportunities in this essential service.

Before the initial link of the Cuban system was inaugurated, RCA International Division conducted a technical school at Campo Batista. It was established primarily to train personnel to operate the system. Attended largely by members of the armed forces, this school will continue to hold classes for six-month periods.

When the first class of 38 students was graduated in November, 1955, Cuban officials called the ceremonies a milestone in communications in their country. The first school was held under the direction of Hector Magno, RCA International Division Engineer.

The communication system will provide 19,000 kilometers of telephone circuits for conferences among government offices and for official service. More than 29,000 kilometers of radiotelegraphy and teletype circuits will give a rapid and efficient service to the public and 1,300 kilometers of facsimile circuits will permit instantaneous transmission of photographs and other material.



Equipment reliability protected by RCA Radiomarine Service!

Smart skippers know they can work more profitably . . . fair weather or foul . . . when their marine electronic equipment performs reliably.

In every major American harbor, on sea, lakes or rivers, the ships that sail the seas find RCA Radiomarine Service on the job from 0001 to 2400. 'Round the clock service in an industry where time and tide wait for no man . . . or ship.

Tugs or trawlers, liners or lighters . . . protect *your* Radar, Sonar, Radiotelephone and other navigation and communications equipment. For Marine electronic equipment protection by experienced engineers, turn to RCA Radiomarine Service for your fleet or individual vessel requirements . . . Now!

RCA SERVICE COMPANY, INC.

A Radio Corporation of America Subsidiary

Camden, N. J.

RCA Service Company, Inc., Technical Products Department
Bldg. 203-3, Cherry Hill, Camden 8, N.J.

Please send me complete information on your marine service and the name of my nearest representative. No obligation, I understand.

Name_____ Title_____

Company_____

Address_____

City_____ Zone____ State_____

RCA DEVELOPS FIRST POCKET-SIZE FM RADIO RECEIVER FOR MOBILE COMMUNICATIONS USE

ACTUAL SIZE ▲

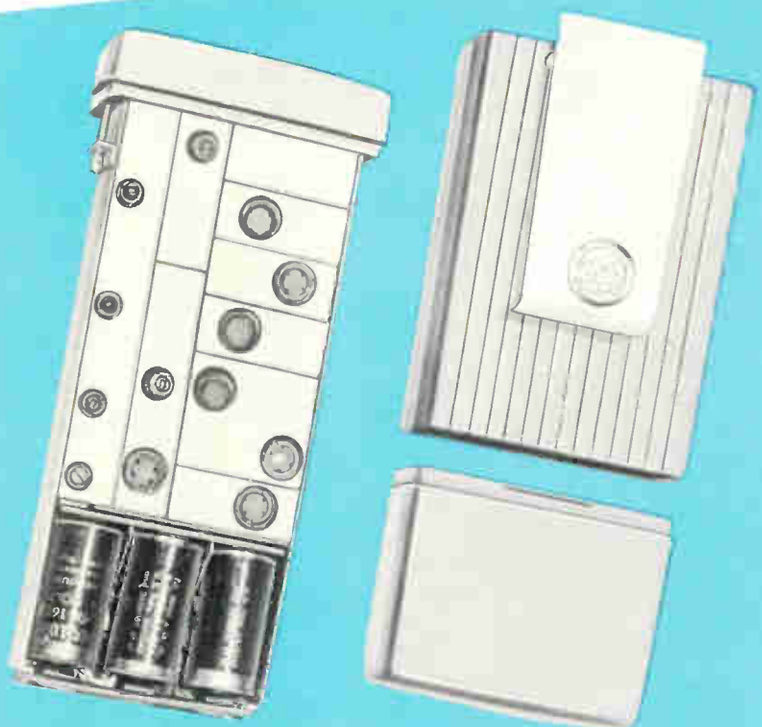


Fig. 1—Pointing the way to a new era in personalized radio communications, the pocket-size receiver is fully transistorized, weighs only 10 ounces, and may be used with any 2-way radio system now operating in the 150 MC band.

Micro-Miniature Instrument, Scheduled for Market After Nationwide Field Tests Later This Year, is Forerunner of Revolutionary Line of Personalized Two-Way Radio Equipment

DEVELOPMENT of the first commercial pocket-size FM radio receiver for mobile communication service was announced on February 28 by Arthur L. Malcarney, Vice-President and General Manager, Radio Corporation of America, Commercial Electronic Products.

"This micro-miniature receiver is the forerunner of a complete line of revolutionary RCA personalized receivers and transmitters for commercial communications," Mr. Malcarney said. "It is a fully transistorized, 10-ounce instrument designed to provide extensions of several miles for radio systems now operating on the 150-megacycle band. It will become available commercially later this year, following nationwide field tests."

The field tests will be made in conjunction with various organizations representing a broad range of communications applications, including various municipal police and fire departments, Government agencies, and users of low-power communications equipment in the industrial field.

Coincident with the field testing of the 150-megacycle FM receiver, research and engineering on additional personalized two-way radio equipment will be carried forward at RCA's communications equipment engineering laboratories in Camden, N. J.

The research program is concentrated on the development of a complete line of RCA micro-miniature receivers and transmitters for operation in the three commercial two-way radio bands, 50, 150 and 450 megacycles. Subsequent models of RCA personalized radio instruments for all communication bands will incorporate such features as person-to-person private communication, absentee notification of messages received, and novel battery-saving operation.

"RCA's pocket-size 150 megacycle FM receiver and the instruments for other radio bands nearing fruition in our laboratories," Mr. Malcarney said, "point the way to a new era of truly personalized radio communication. The fantasy of the comic strip has achieved reality. The day of the pocket-size and even wrist-watch two-way radio is already marked on the laboratory calendar. It is possible to foresee clearly the availability in the not too distant future of personalized radio systems for the general public as well as for the commercial user.

"With the introduction of the first commercial models of RCA's personalized radio communications equipment, we anticipate a significant extension of commercial communication services. The availability for the first time of unobtrusive, far-ranging pocket receivers and transmitters will place new values on commercial radio as an effective medium for traffic control surveillance, emergency paging, military operations, and a wide range of industrial and business services, such as remote inventory recording, construction projects, remote direction of production operations, and so on. There is virtually no limit to applications made possible by two-way radio systems that can be carried in a pocket."

C. M. Lewis, Manager of RCA's Communications Products Department which engineered the 150-megacycle personalized receiver, said that the pocket-size instrument is a single-channel device designed for operation on any frequency in the 148-to-174 megacycle band. This is the popularly called 150-band which has been assigned by the Federal Communications Commission for communications applications by such services as police and fire departments, industries, utilities, and Government agencies, including law enforcement organizations and the forestry service.

Fully transistorized and featuring printed circuitry, the pocket-size double superheterodyne FM receiver incorporates its own antenna and loudspeaker, obviating need for a separate ear piece, and can be directly contacted by the sending station without need of additional equipment.

It measures only 2¾ inches wide, 1 inch thick, and 6½ inches high; weighs approximately 10 ounces; and operates with self-contained flashlight-type mercury batteries. It operates on a fraction of a watt of power.

Mr. Lewis said that the pocket-size receiver is designed to extend existing 150-megacycle radio systems and can be used to take direct or relayed transmission from both fixed and mobile stations.

In operation, he explained, the experimental receiver is carried in the pocket in an "on" position, enabling the carrier to hear all messages transmitted by the sending station on its 150-megacycle frequency. The receiver can be factory-adjusted for reception on any VHF channel in the 150-megacycle band. The receiver's exceptionally low power requirements, resulting from the low power drain characteristic of transistors, makes possible efficient "on" operation of the unit over extended periods of time.

Fig. 2—Arthur L. Malcarney (left), Vice-President and General Manager, RCA Commercial Electronic Products, discusses operation of miniature FM receiver with C. M. Lewis, Manager, RCA Communications Products Department, which engineered the revolutionary new device.

RELIABILITY STUDY OF THE 2C39A IN MICROWAVE USE

L. E. PETERSON,
RCA Communications, Inc., Rocky Point, L.I.

N. C. COLBY,
RCA Commercial Electronic Products, Camden, N.J.

TABLE I

Heater Voltage	5.5 to 6.3 volts
Heater Current	1 amp.
Amplification factor	100
Transconductance I_b=70 ma, E_b=600 V)	22,000 micromhos
Plate dissipation (forced air cooling)	100 watts

WHEN the development of RCA's current line of 2000 mc radio relaying equipment, known as type CW-20, was begun, the 2C39A was chosen after a thorough investigation of several possibilities as the most economically and technically satisfactory for use in the UHF circuits.

The 2C39 is the outgrowth of some intensive development work during the early years of World War II to find a successful ultra high frequency tube design. The design originally marketed, and much refined since, was a planar triode carrying the developmental number ZP572. The shape of the tube, which was one of a family, resulted in their being called "light house" tubes (at times they were even called "oil-can" tubes). A planar tube is one in which the electrode (in a triode the cathode, grid, and anode) are parallel planes. In the 2C39's as now manufactured the spacing between the planes of the cathode and grid is 0.005 inches and between the grid and anode it is 0.0225 inches. The intended use for the 2C39 when it was first developed was in countermeasures equipment of medium power and wide tuning range. Its application was studied quite extensively in many of the radar and countermeasures laboratories operating during World War II. Its application during the war and in many designs since has been in expendable equipment not intended for long life. The necessity of improving the characteristics responsible for long life was not felt strongly until its use became more widespread in radio relay equipment where long life and unattended operation of station equipment are of paramount importance.

The tube, as available now from a number of manufacturers in the U. S., appears under type number 2C39A if glass insulators separate the electrodes, and 2C39B when ceramic insulators are used. A ruggedized version manufactured under specially controlled conditions is available as a 2C39WA. Only type 2C39A life data is included here as some of the later types were only recently installed.

There are yet other versions available only in sample quantities bearing X numbers of the particular manufacturer.

The "tube characteristics" of the 2C39A, 2C39B and 2C39WA are very nearly the same. The nominal values of the more important characteristics are given in table I. Generally speaking the tubes from the various manufacturers are interchangeable in a given equipment design.

The 2C39A, B, and WA are used today in a wide variety of military and commercial equipment manufactured in the U. S. and several foreign countries, notably France and Germany. It is used in equipment operating over the entire frequency spectrum from 400 mc to 3000 mc. It is used in both pulsed and CW service. The characteristics that make it popular with equipment designers working in the UHF range are its small size, relatively large plate dissipation, rugged construction, and its nearly ideal geometry which allows it to be used in either coaxial, cylindrical or waveguide cavities.

The CW-20 equipment uses three 2C39A's (2C39B, or 2C39WA) in the transmitter—one as an oscillator, one as a high-level mixer, and one as an RF power amplifier. In MM-26 microwave radio relay systems the 2C39B is used predominantly. The circuits, of which the tubes are an intimate part, are of the waveguide cavity type. The use of the waveguide type of cavity resulted in three important circuit advantages. It resulted in circuits with a wide tuning-range, a convenient physical size, and a structure in which it was possible to provide good circulation of air around all parts of the tubes and yet enable one to change the tubes quickly without tools of any kind. The tube operating

currents and voltages were chosen so that under no circumstances of recommended operations does the plate dissipation exceed one half the manufacturer's rating. Under the most usual operating conditions found to be satisfactory by users, the dissipation is one third or less of the maximum rated value. The heater voltage was chosen to obtain a compromise between long life and stable operation. The combination of excellent ventilation, low anode dissipation and optimum heater voltage is important in obtaining the long life that has been recorded.

The 2C39A tube life obtained in the New York City to Riverhead system operated by RCA Communications, Inc., is especially interesting because of the accurate and thorough methods employed in keeping tube life records. This system consists of a Terminal at New York City, a Thru Repeater at Dix Hills, a Drop Repeater at Rocky Point and another Terminal at Riverhead, Long Island. The company's principal overseas shortwave transmitting station is located at Rocky Point, Long Island. The principal receiving station is at Riverhead. The microwave radio relay equipment employed is the RCA type CW-20. To obtain maximum reliability, needed for the common carrier traffic service, parallel radio beams are used. The system is operated under circumstances that are ideal for getting significant tube life data. All tubes are in service continuously. There are no tubes in rarely used standby equipment included in the samples. Voice multiplexing facilities are provided for each of the independent parallel radio circuits. The traffic carried is chiefly teletype signals and program channels. The same information is transmitted over the parallel circuits simultaneously, with the best circuit being automatically selected at the terminal making use of the information. No tube failures have resulted in the simultaneous loss of both circuits between New York City and Riverhead in a period of 2½ years.

Figure 1 shows the equipment housing at Rocky Point. Figure 2 shows a portion of the equipment at the New York City Terminal. Figure 3 shows a portion of the terminal facilities at Rocky Point.

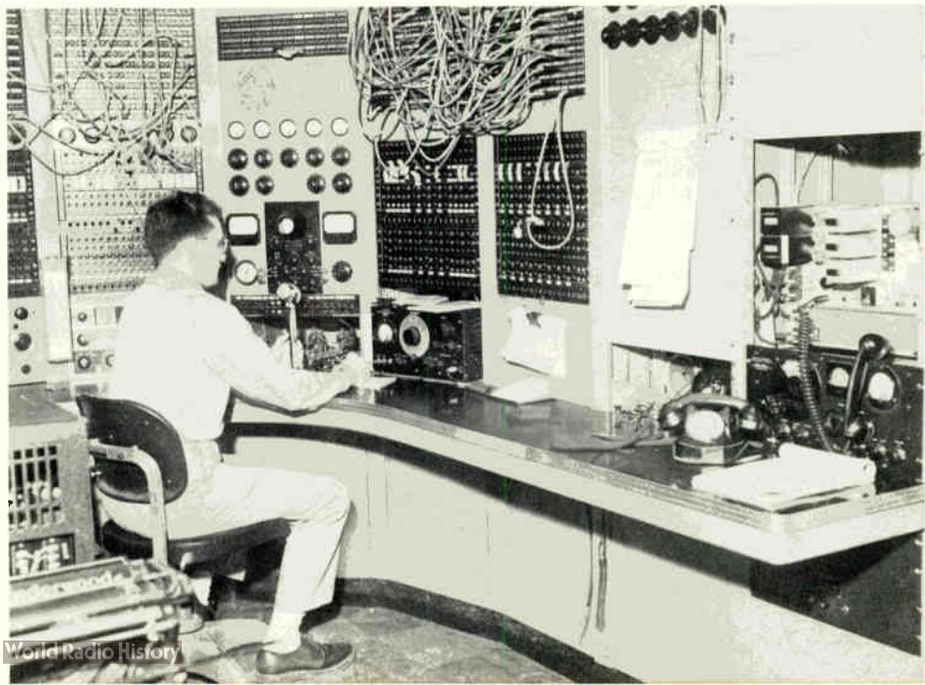
The means of keeping records used by RCA Communications will be described in some detail since they have resulted in the accumulation of much valuable tube life data.

To obtain accurate tube life history, a means of identifying individual tubes is essential. Fortunately this problem is easily solved since all 2C39A, B, and WA tubes are given a serial number by the manufacturer. A convenient printed form on which to record data is a second essential. Figure 4 shows the form currently in use. A form is filled out for each transmitter each month. As indicated by the column headings, the socket number, tube types, tube serial numbers, and type of service is recorded. The "type of service" may be oscillator, mixer, amplifier, etc. The day of the month and the running time meter reading when a tube failure occurs are recorded in the appropriate column. The serial number of the re-

Fig. 1—The Rocky Point microwave equipment is housed in this shelter against a background of overseas transmitting towers.

Fig. 2—The 2C39A tubes serve the microwave transmitter (fourth panel down from top) in this typical CW-20 microwave installation.

Fig. 3—A portion of the Rocky Point terminal facilities are located in the station control room.



placement tube is recorded along with the date and running time meter reading. Thus a continuous record for each socket is available. The periodic readings taken which indicate failure or incipient failure are not recorded on these forms.

It is unfortunate (for the purpose of determining tube life) that all failures are not catastrophic. Unless a filament burns out or a seal breaks, some more or less arbitrary performance criterion must be applied to determine whether or not a tube is unfit for service. Each user will develop performance limits based on his particular system requirements and operating experience. Except in cases of outright failure the criteria used by RCA Communication maintenance men are the value of maximum obtainable cathode current or relative power output measured with the metering facilities built into the transmitter. An analysis of the tube life data obtained is given in the following paragraphs.

The system has thirty-six 2C39 tube sockets. The records from which data are taken covers a period of approximately 22,400 hours. Figure 5 shows graphically the history of each transmitter socket in the system. The crosses mark the points in time at which a tube replacement was made. Of the original thirty-six tubes ten are still in service in the same socket. To date, reclamation (for example, using a tube as an amplifier after it will no longer serve as an oscillator) has not been practiced although it is intended to do so in the near future. During the period covered by this report 52 tubes have been removed from service either during routine maintenance or at the time of failure. Calculations based on the life data of the 52 tubes that have been removed and the life data of those original tubes still in service show an average life of 10,241 hours and a median life, or the life which 50% of the tubes exceeded, of 8,600 hours. These figures are pessimistic because in making the calculation it was assumed that all of the 10 original tubes still in service had failed at 22,400 hours. Accurate average and median life figures can only be calculated from data obtained from systems that are in "statistical equilibrium."

Studies of tube failure data indicate that the failure rate after the first 500 or 1000 hours is proportional to the number of tubes still in service. Figure 6 is a plot of the number of the original tubes still in service against the number of hours of service. With the number of tubes plotted on a logarithmic scale a straight line function is obtained. This substantiates the proportionality relation previously stated. An extrapolation of this line indicates that at the end of 40,000 hours 3 of the original tubes will still be in service.

The slope of this curve indicates that one-half of an initial set of tubes can be expected to remain in service for 13,000 hours (the median life). If experience continues to follow the extrapolation the computed average life will be 15,000 hours.

It can be concluded that careful conservative equipment design is an important factor in achieving long tube life, and in order to know what tube life is being actually obtained, accurate records are essential.

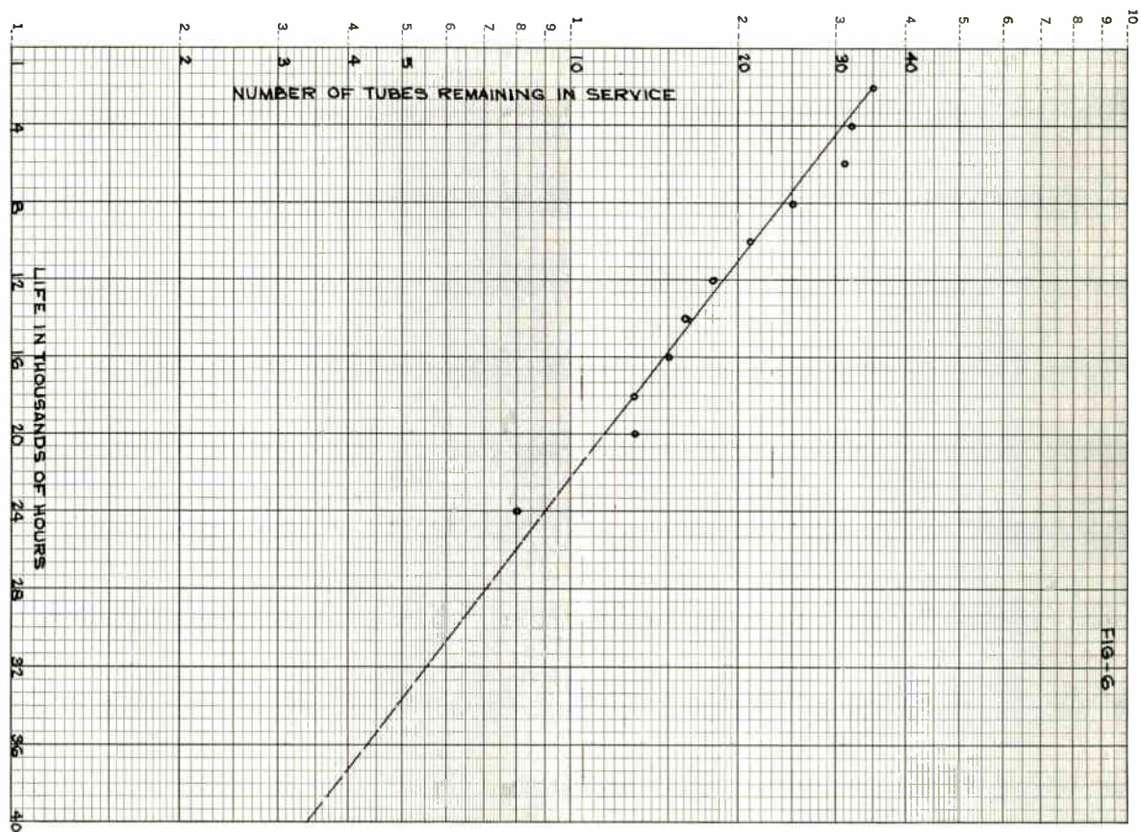


Fig. 4—A plot of the number of tubes in use against number of hours in service.

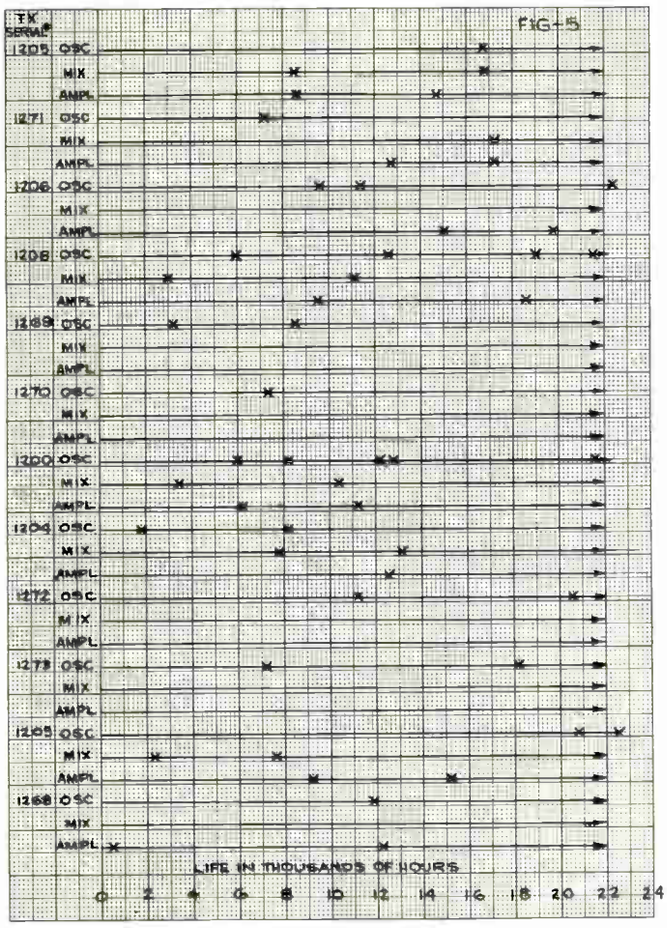


Fig. 5—This chart shows graphically the history of each 2C39A.

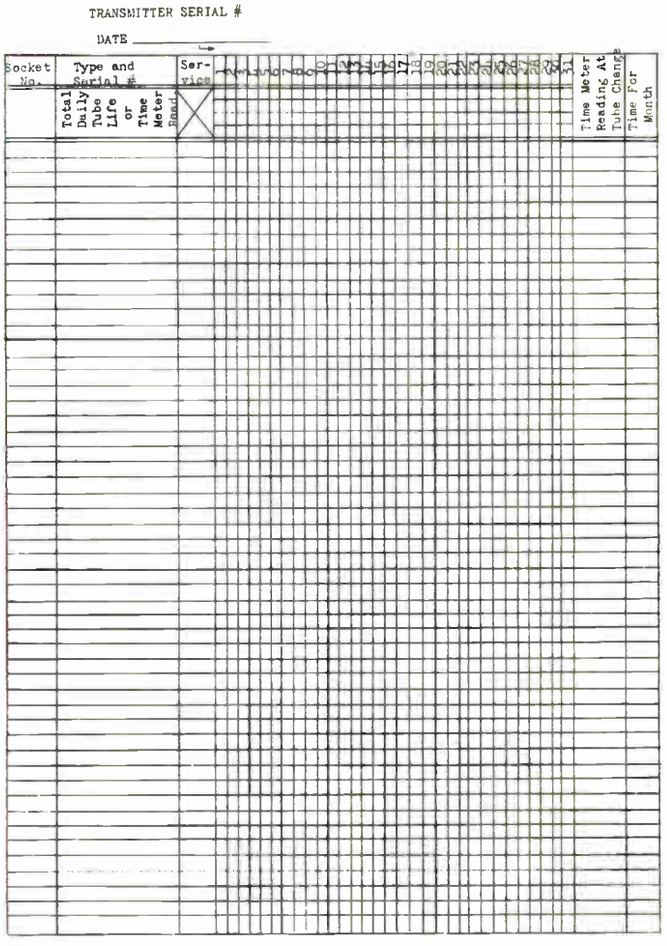


Fig. 6—A form such as this is filled out every month for each transmitter in use.

About the Authors

LLOYD E. PETERSON, Tube Engineer, Rocky Point laboratory of the RCA Communications Company, received his B.S. degree in Electrical Engineering from Iowa State College. Upon graduating in June 1926, he joined the General Electric Co., Schenectady, New York, where he did research on power vacuum tubes. In November, 1927, he was transferred to RCA Communications Inc. at Rocky Point, New York. Ever since then he has specialized in vacuum tube engineering.

He is presently responsible for testing and reporting on the life test of new tube designs for use throughout the company.

Mr. Peterson is married and the father of three sons, all graduate engineers. He is a member of I.R.E., and Lambda Chi Alpha.

NORMAN C. COLBY, Leader, Design and Development, Communications Engineering, received the B.S. degree in Engineering Physics in 1940, and the M.S. degree in Nuclear Physics in 1942 from the University of Illinois. He has done graduate work in Electrical Engineering at Massachusetts Institute of Technology and the University of Pennsylvania.

From 1940-42 Mr. Colby was graduate assistant on Cyclotron design at the University of Illinois; from 1942-46 he worked on research and development of Microwave Components at the Radiation Laboratory of Massachusetts Institute of Technology. He joined RCA in 1946 to work on Communications Receiver development. Since 1947 to the present he has been working on commercial microwave communications equipment design, with emphasis on transmitter design.

Mr. Colby is a member of I.R.E., the American Institute of Physics, Sigma Xi, Tau Beta Pi, and Phi Eta Sigma. His hobbies are reading, wood-working, gardening and photography.

9:01 A.M. WELLPOINT GENERATOR AT WOODMERE IS REPORTED BURNED.

9:02 A.M. FIELD REPAIRMAN IS ALERTED.

DOWNTIME'S BEEN CUT AT HENDRICKSON BROS.

THANKS TO RCA 2-WAY RADIO

Whether it's replacing a burned-out pump generator, repairing a tire, or resplicing a cable, the radio-equipped maintenance department of Hendrickson Bros., Inc., Valley Stream, L.I., swings into action FAST! Field repair trucks fitted with replacement parts, tools, and 2-way radio tour the jobs continually. They're in touch with the office at all times and can talk to one another on the road. If it's a shop job that's needed, the equipment can be towed in for prompt repair. "Fast, efficient, effective," is the way they describe their operation with radio.

9:15 A.M. SPARE GENERATOR IS ON THE JOB.

RCA 2-WAY RADIO FOR CONSTRUCTION USE is specially designed to "take it," with sturdy drawer-type case design, elliptical loud speaker providing 3 times more acoustical power than the ordinary type, greater range and better signal at any distance. Built-in 6-12-volt convertibility. New Improved "Red Head" microphone, transistorized or regular, now available. Mail coupon.

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☐ Have RCA Communications Specialist make a FREE radio survey of my operation.

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RADIO CORPORATION OF AMERICA

COMMUNICATIONS PRODUCTS

CAMDEN, N. J.

In Canada: RCA VICTOR Company, Limited, Montreal

Radio-equipped diesel locomotive uses
RCA Power Tube for reliable communications

RCA Power Tubes give top performance

at Allegheny Ludlum Steel Corp.

Reports Miller Torrence, Manager, Transportation Yards, of the Brackenridge Works: "In the 21 mobile transmitters of our 2-way radio system, RCA Power Tubes operate with remarkable dependability. We install them—and forget them."

To meet industrial demands for reliable mobile radio communication when the going is tough, RCA designs and builds tubes that "take it" under the punishing conditions of road shock, vibration and changing voltage. That is why you see RCA Power Tubes specified by most mobile radio equipment manufacturers.

For quick service in obtaining RCA Power Tubes—call your nearby RCA Industrial Tube Distributor. He handles a complete line of RCA tubes for communications.

RCA-6146 Power Tube—famous for reliable radio communication

TUBES FOR COMMUNICATIONS

Radio Corporation of America Tube Division Harrison, N. J.

NEW

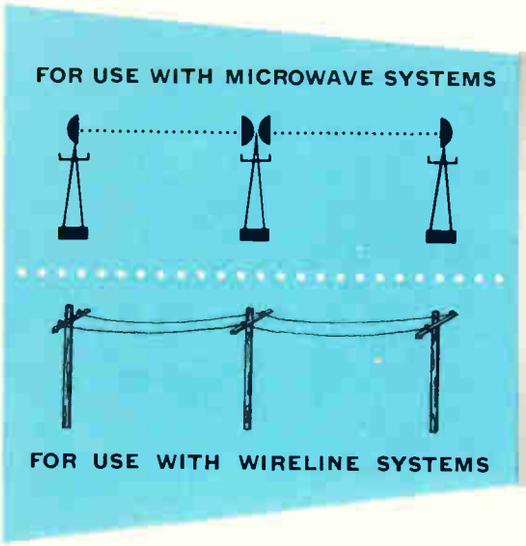
MP-3A AND MP-4A SERIES

TRANSISTORIZED TONE UNITS

Provide High-Speed Protection of Utility Power Lines

FEATURES:

- All Transistorized
- Fail-Safe Circuitry
- Minimum Signaling Speed— 7 Milliseconds
- Battery or Power Supply Operation
- Modularized Design



• *APPLICATION:*

These transistorized High-Speed Tone Units have been designed specifically for use in protective relaying systems for the electric utility industry and other critical applications which require high signaling speeds with fail-safe features.

When used in conjunction with the appropriate relays, these units provide high speed fail-safe protection for high tension transmission lines. Time delay between the initiation of a tripping cycle and the closing of the tripping relay in a remote receiver can be as short as seven milliseconds. Maximum reliability is provided by using frequency shift signaling in which the transmission of one of two precise tones causes the desired function to take place. The presence of both tones, or absence of both tones causes fail-safe protection circuits within the receiver units to function and prevent false tripping. A dual tone channel may be used for each function to provide maximum protection and to facilitate maintenance.

These units offer the largest channel capacity and highest signaling speed of any protective devices now available and require a minimum of power. They may be operated from a battery source. A completely transistorized tone transmitter or receiver unit occupies only 3½" on a standard 19" width relay rack. Only ten transistors, all interchangeable and of the same type, are needed for a complete control channel.

Radio-equipped diesel locomotive uses
RCA Power Tube for reliable communications

RCA Power Tubes give top performance

at Allegheny Ludlum Steel Corp.

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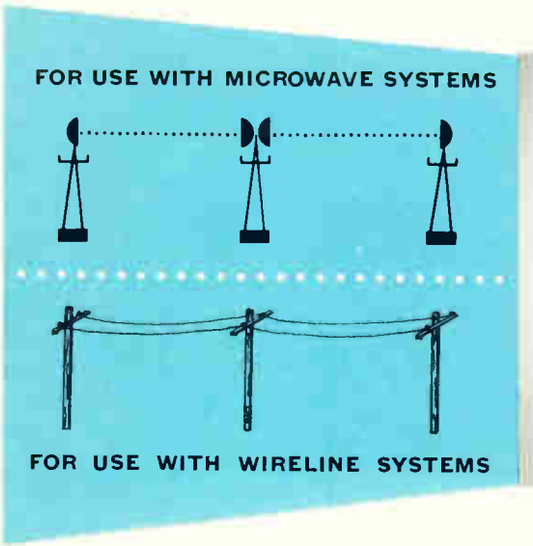

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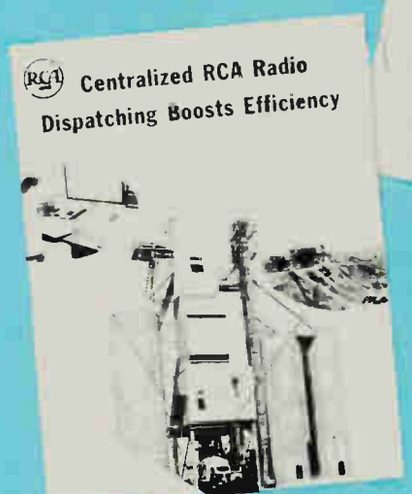
Send for these Free Bulletins

they tell you how to use Radio Communications more effectively



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Cleveland 15, Ohio, 1600 Keith Bldg. Cherry 1-3450
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Hollywood 28, Cal., 1560 N. Vine Street Hollywood 9-2154
Kansas City 6, Mo., 1006 Grand Avenue Harrison 1-6480
New York 20, N. Y., 36 W. 49th Street Judson 6-3800
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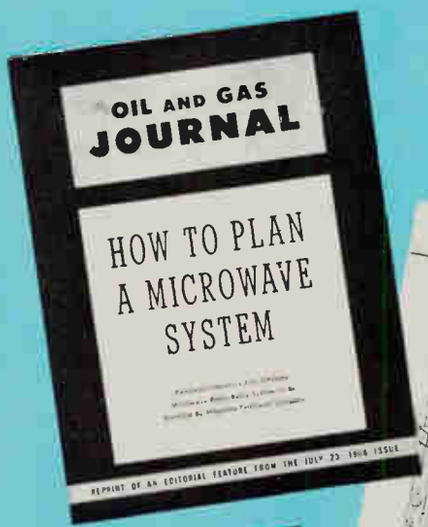
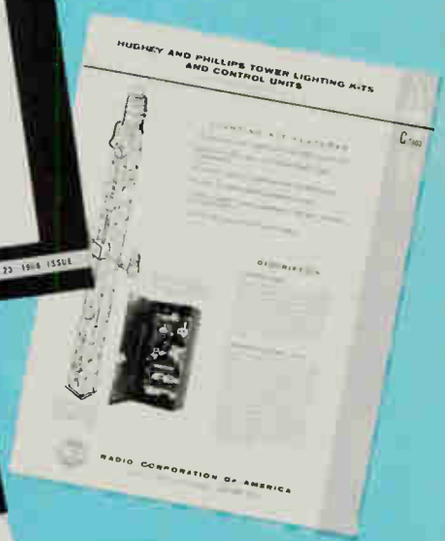
Seattle 4, Wash., 2250 First Avenue, South Main 8350
Washington 6, D. C., 1625 K Street, N. W. District 7-1260





The *Finisterre* (above) is equipped with an RCA "Golden Guide" Radio Direction Finder (right).

How to "home in" on any port ...with an RCA Radio Direction Finder!

In winning this year's Newport-to-Bermuda yachting classic, the 38-foot yawl *Finisterre* carried an RCA Radio Direction Finder aboard. Because of overcast, navigation was extremely difficult during the entire course and *Finisterre* navigated the final 75 miles by Bermuda radio. Said skipper-owner Carleton Mitchell, "The RCA Direction Finder was instrumental in our victory, providing a series of accurate running fixes in poor visibility during the crucial approach to the finish."

An RCA Radio Direction Finder helps the boating enthusiast navigate safely in adverse weather. Priced to the sailor's pocketbook, simple to operate and extremely portable, it is found aboard hundreds of pleasure craft doing triple duty as a high quality direction finder, a marine radiotelephone receiver and a broadcast receiver.

Equally popular among boating owners is RCA's complete line of radiotelephones, the Golden Courier, Golden Sentry and Golden Herald . . . all quality electronic instruments designed specifically for pleasure craft of every kind.

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RCA "Golden Herald" Radiotelephone— provides 8 channels in 2000-3000 KC range covering standard harbor telephone and inter-ship facilities. Easy-to-read front panel meter; separate power supply for either 12-32-115 V. D.C. or 115 V. A.C. operation.

RCA "Golden Sentry" Radiotelephone— priced for pleasure craft! Self contained, compact 2-way Radiotelephone and Broadcast Radio with built-in 6 or 12 volt D.C. power supply. 5 crystal controlled transmitting and receiving channels plus broadcast band for entertainment.

RCA "Golden Courier" Radiotelephone— another popular priced, space saving transmitter-receiver. Occupies less than 6/10ths of a cubic foot! Combination 2-way Radiotelephone and Broadcast Radio with 5 crystal controlled channels and separate power supply for 6-12-32 V. D.C. or 115 V. A.C. operation.

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