Western Electric OSCILLATOR

SEPTEMBER 1944

Radio Fights Its First War

Western Electric's 75th Anniversary

FM Goes to War

Western Electric OSCILLATOR

SEPTEMBER 1944

DEVOTED TO DEVELOPMENTS IN COMMUNICATIONS AND ELECTRONICS

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THE COVER

This painting, done by Paul Rabut, shows a scout car fitted with an SCR-603 FM radio set, used by an artillery battalion commander for receiving range data from ground and air observers, and for passing this information along to the several gun batteries which he commands.

THIS ISSUE

Pick-Ups Yields to *Oscillator*

A vacuum tube is nothing more than a particularly fine exhibit of the delicate craftsmanship of hands and machines in fashioning an object out of glass and metals, until it starts to oscillate. But when the electrons begin to flow, the very pulse and life of the universe are unleashed within its shiny glass canopy. The tube oscillates. That is the fact, the phenomenon upon which the world of electronics rests. It is the *all* of what we know today; it is the promise of things for tomorrow about which we can only dream today.

At the very dawn of electronics Western Electric men played their part in making the vacuum tube oscillate. Who is the man who calls himself an engineer in the field of electronics who hasn't heard the names of Colpitts and Hartley for whom two of the fundamental oscillator circuits are known! And there is Arnold who by developing the *high vacuum* tube brought its oscillations under sharper control. And there are many others.

And so in searching for a new name for the Western Electric publication, *Pick-Ups*, there seemed to be only one name that would carry in one summation the fundamental fact of the vacuum tube and something of the men who have taken that fact and built a new empire around it. That word is OSCILLATOR. Western Electric *Oscillator* takes its bow.

Scientists at Work

This is the war of instruments . . . instruments of great and confusing complexity. Instruments we never dreamed of before the war. They have been developed in the Nation's research laboratories, and because of them this war will be won sooner and at great savings in Allied lives. Perhaps without them the war would not have been won at all. Beginning on page 12 is the story of some of the things one research organization, Bell Telephone Laboratories, has done in this war. Its greatest contributions, however, are not recounted because of security reasons.

Noble

When we look back on this war some years from now we are bound to wonder how it was possible to achieve the tremendous production job on top of just the normal job of living with ten or more million men in the army.

We believe the answer to that, for one profession at least, is to be found in the story, "Radio Fights Its First War," beginning on page 3. In a narrow sense it is the story of how broadcasters have kept their stations on the air in spite of staggering manpower shortages. It is the story of station owners rolling up their pants and scrubbing studio floors; it is the story of little men and big men working day and night, doubling in brass, carrying tremendous loads. It is the story of a great profession fighting its first war, but in its broadest sense it is the story of America's Home Front carrying on. After reading it we were left with a feeling of deep pride for the men and women called *Americans*. Somehow the word *noble* came to our mind.

Seventy-Five Years Young

Four years after the end of the Civil War two young men with little cash but with big ideas began manufacturing electrical devices. They were proud of their small firm — so much so that they lent their own names to it and called it Gray and Barton. They made electric bells, annunciators, telegraph instruments and the like. It wasn't long before more and more business began coming to them. Customers, it seemed, had discovered there was a quality of workmanship and materials in the products of Gray and Barton which matched their pride in their little company. With the invention of the telephone in 1875 by Alexander Graham Bell came still more business, and in 1881 when the American Bell Telephone Company wanted a manufacturing organization, the once little firm of Gray and Barton, now known as the Western Electric Manufacturing Company, was the logical candidate. It became a part of the Telephone Company under its present-day name, The Western Electric Company. Seventy-five years young today the Company maintains unchanged the same pride in quality of workmanship and materials that its founders bequeathed it. Perhaps that is explanation enough for the Company's being today the nation's largest producer of electronic and communications equipment for war.

* * *

There's a lot of war in this first issue of the *Oscillator,* but then there is a lot of war, as we go to press, in France, in the South Pacific, and in the morning paper. There is a lot of war work, too, in the many plants of Western Electric, where equipment for combat is made. It should not be otherwise. Western Electric is in this war with all its might until the war is over. Until then, there is little else to talk about.

He directs War Intelligence Division's Press Section . . . Col. Albert L. Warner, formerly news director, WTOP, one of CBS's crack reporters.

He is at General Eisenhower's headquarters . . . Royal V. Howard, director of engineering for KSFO-KWID, San Francisco, on leave from station.

He died in a heroic attempt to rescue torpedoed seamen . . . Lt. Murray Blum, formerly of WNYC, radio officer in Merchant Marine.

He helped cause the surrender of the Italian Fleet . . . R. Morris Pierce, former chief engineer, WGAR, Cleveland, now in the European theatre.

He fell in action at Pearl Harbor . . . Ensign Tom McClelland, former chief engineer, KLZ, Denver, Broadcasting's first casualty of the war.

He keeps invasion forces in France informed . . . Col. Ed Kirby, formerly of WSM and NAB, now stationed at Gen. Eisenhower's headquarters.

Radio Fights Its First War

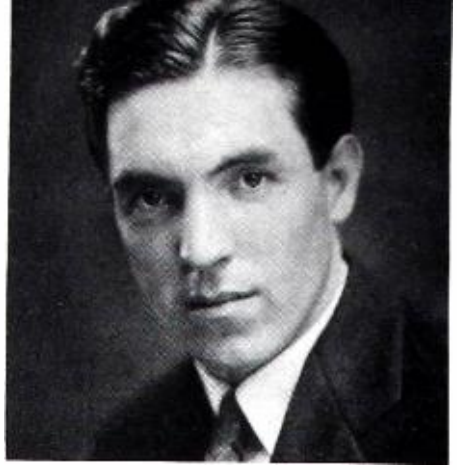
By George de Mare

• • Here is the story of how the men and women of one profession are standing up under their wartime responsibilities. As such, perhaps, it is not unique; it only tells to some degree how all Americans faced with such a responsibility would act. But we believe that this account of the manner in which ordinary people of a great and important profession conduct the heavy, difficult day-to-day jobs that the war has made routine for them, adds up to something profoundly dramatic — to a story of such real courage and achievement that all Americans reading it can reflect on the character of their Nation and be proud • •

"For exceptionally meritorious and distinguished service in a position of great responsibility . . ." is the way the citation for one of America's highest decorations conferred on Major Charles Vanda, formerly of CBS, New York, reads. In many instances this might be the citation for the record of all Broadcasting itself in this — its first war. Radio, in this war, occupies a central position as a communications arm in the coordination of military branches and of military tactics in battle. It holds the center of the stage as a propaganda weapon to transmit our views to the world; and at home the people of the United States depend greatly upon Broadcasting for the news of their fighting men and the dissemination of vital home-front information. Indeed, gasoline rationing which has kept more people at home has turned more people to their radios for entertainment, information and escape from the enormous tiredness of long hours and hard labor. Thus, on Broadcasting, this time, has fallen the burden of supplying technical and fighting men to the armed forces and at the same time operating on a vaster scale than ever before a great and essential industry at home — a prodigious job!

How have broadcasting people measured up to the job? What types of action have broadcasting people seen on the battlefronts of the world? What means have those who were left at home used to carry on under added loads with their best men gone to war? Have women been able to replace men in the engineering and program departments of the various stations? What methods of doubling up on the jobs or rescheduling of programs have worked out best to keep stations operating? In short, what have been the experiences of large stations and small in meeting the difficult problems posed by loss of personnel, increased wartime restrictions and greater wartime responsibilities? These are some of the questions we set out to answer

He saw action in four campaigns as Gen. Eisenhower's Naval Aide . . . CBS's Commander Harry C. Butcher.



He worked on the communications set-up for the Teheran Conference . . . Capt. Glenn Boundy, former chief eng., WWVA.

He supervises OWI's technical facilities throughout the world . . . Chas. L. Jeffers, formerly of Station WOAI.

He serves in Bureau of Ships . . . Comdr. A. B. Chamberlain, former chief engineer, Columbia network

through contacts with the broadcasting industry, interviews with broadcasting men and a nation-wide survey, and the results have been both interesting and impressive.

Broadcasting People at War

Broadcasting men and women — more than seven thousand of them — have seen action on all the battlefronts of the world in all the branches of the Armed Forces. During the Mediterranean campaign, for example, Robert Morris Pierce, formerly chief engineer of WGAR, Cleveland, and recently elected vice-president in charge of engineering, while technical head of the Psychological Warfare Branch Radio Division, gained national recognition for the part he played in the surrender of the Italian Fleet. Prior to Italy's surrender, the Navy was anxious that the Italian Navy which was at sea did not fall into enemy hands. The Navy instructed Psychological Warfare to broadcast surrender terms and instructions to the Italian Fleet. Knowing that the Italian Navy was forbidden to listen to any radio other than its own, Pierce conceived the idea of broadcasting the message to them on the International Distress Channel to which all ships are constantly tuned. When Allied radio in North Africa went off the air at 3 A.M., Pierce began work on an old commercial transmitter. With no tools to gauge his work, he worked for fourteen hours until the equipment was ready to broadcast on the SOS channel. The message was then broadcast to the Italian Navy. The following was taken from testimony before a House Committee:

"Admiral Cunningham, chief of the British Mediterranean Fleet, on seeing the Italian Fleet steam peacefully into Malta turned to an aide in astonishment and said: 'Congratulate the Americans for me. They've accomplished in one day with propaganda what I've been trying to do for three years with my fleet.' "

Pierce is now chief of Continental Radio Operations of the Psychological Warfare Division of SHAEF (Supreme Headquarters Allied Expeditionary Forces), and in that capacity supervised the installation of the first Allied transmitter in Normandy which went into operation July 11, 1944.

Again somewhere in Africa just before the African invasion, Pierce, assisted by Charles Topmiller, former chief engineer of WCKY, Cincinnati, had the difficult job of installing one short wave and four broadcast band transmitters to beam 350 kw of constant United Nations programs and propaganda at the Axis. Lt. Victor Tervola, formerly with NBC, was in charge of design, construction and operation of studio facilities, while Paul von Kunits, formerly chief engineer of WINS, arrived in North Africa with his crew to aid in this project.

In the South Pacific also, broadcasting men were on the spot, doing their vital jobs as our forces moved in. For example, Major Purnell Gould, former manager of WFBR, Baltimore, and his staff had the heartbreaking job of setting up an Armed Forces Radio Service network in jungle that rotted equipment as fast as it could be erected. "Juice ants" constantly ate the insulation around transmitter wiring causing short circuits, and microphones had to be blown out twice daily with bellows because fungus sprouted in them. Ordinary receiving sets for the soldier audience lasted only about four months. Nevertheless, with the introduction of plastic-sprayed sets, use of diesel power and better insulation most of the problems of this vital "Mosquito Network" were solved.

In the invasion of Europe, hundreds of former broadcasting men took part, but only a few of the names are as yet known. They include Col. David Sarnoff, president of RCA and chairman of the NBC board, who, as a Signal Corps officer, had a hand in blueprinting the biggest communications "traffic" job in history; Commander Harry C. Butcher, a vice president of CBS in Washington, Naval Aide to Supreme Commander Gen. Eisenhower — he served with Eisenhower through the African, Sicilian and Italian campaigns. CBS President William S. Paley, now Radio Chief, Psychological Warfare, SHAEF, prepared the first historic invasion announcement.

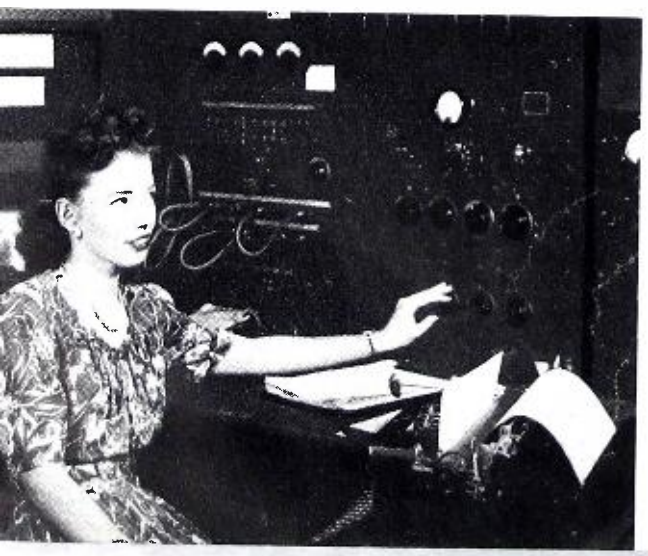
Col. Ed Kirby, formerly of WSM, Nashville, afterward public relations director of NAB and since 1940 chief of the Radio Branch of the War Department Bureau of Public Relations has returned to the European Theatre of Operations to serve in the vital radio role of keeping the U. S. invasion forces in France informed of developments on all war fronts.

Finally with the Allied Military Government forces moving in are Lt. Col. Samuel R. Rosenbaum, who headed WFIL, Philadelphia; Maj. James C. Hanrahan, Scripps-Howard Radio vice president and head of WMPS, Memphis; Capt. Arthur W. Scharfeld, radio attorney; Phil Cohen, former Radio Chief of OWI, now operating ABSIE (American Broadcasting Stations in Europe); and Royal V. Howard, director of engineering of KSFO and its international station, KWID, San Francisco, now chief radio operator for General Eisenhower's headquarters.

But the European invasion is only one operation and these are only an infinitesimal handful of the thousands of broadcasting men in action here and in other great war theatres of the world.

In every campaign, broadcasting men, doing radio work, have set up their equipment and organized their networks immediately behind the advancing lines. Such men as Capt. Albert M. Wharfield, formerly national manager for C. E. Hooper, Inc., Radio Officer of the American Forces Headquarters, Mediterranean Theatre, now Liaison Officer, Radio Branch, Army

She has done a good job for Broadcasting . . . Ruth Gano, of WRUF, Gainesville, Fla., one of the women who help keep stations on the air.



She serves in WAVES . . . Frances Balcom, who left Station WJTN, Jamestown, N. Y., to join Waves.

He helped quell a panic . . . Capt. Rex Howell, director, KXFJ, whose station performed an outstanding service.

He prepared first historic invasion announcement from Britain . . . Wm. S. Paley, CBS president now in ETO.

He has fought in two wars . . . Capt. Tim Sanders, formerly of WLAC, a World War I marine, now in Pacific.

Public Relations; Capt. Charles A. Batson, formerly of WFBC, Greenville, S. C., who succeeded Wharfield in the Mediterranean theatre, also now in Washington; Lt. Col. Gordon Hittenmark, formerly of WRC, Washington; Capt. Hunton L. Downs, formerly of WSLS, Roanoke; Lt. Col. Paul L. Jones of the China-Burma-India Theatre; Lt. Col. Brooks Watson, formerly of WMBD, Peoria, now in the European theatre; Capt. George Schimmel, formerly of WQXR, New York; and Capt. Charles Hunter, former chief engineer of KPRO, Riverside, Calif., who practically single-handed operated two 50 kw short wave transmitters and one five kw short wave transmitter in North Africa, carried Radio's vital military, morale-building and information functions to America's soldiers and to the battlefronts of the world almost before the last enemy sniper could be cleared out. The routine day-by-day labors of men like these are largely responsible for Radio's military successes in this war.

In other branches of the armed forces also, broadcasting men and women made their marks.

In the Air: Lt. Sidney L. Beighley, Jr., formerly of WJAX, Jacksonville, completed fifty missions over Italy, Sicily and Axis-dominated areas, won the Purple Heart and the Air Medal with seven Oak Leaf Clusters for his exploits; and Lt. Thomas L. Moore, formerly of WIBG, Philadelphia, won the Distinguished Flying Cross, Air Medal with two Oak Leaf Clusters for bombing missions over Germany. Lt. William L. Musladin, formerly of KYOS, Merced, Calif., served with the 8th Air Force in the European theatre, participated in more than 30 missions as navigator-bombardier of a Fortress and received the highest air award, the D.F.C. Capt. David Olds, formerly of KRLD, Dallas, was stationed at Pearl Harbor when the Japs attacked. He subsequently became a navigator and was navigator-in-charge of the first flight of American planes to bomb Paramushiro. Lt. Ralph H. Sims, former program director of WJBO, Baton Rouge, completed eleven bombing missions over the continent and recently received the Air Medal, while Lt. Bill Weaver, formerly of KOVC, Valley City, N. D., has also received the Air Medal and two Oak Leaf Clusters for his missions on the German bombing run.

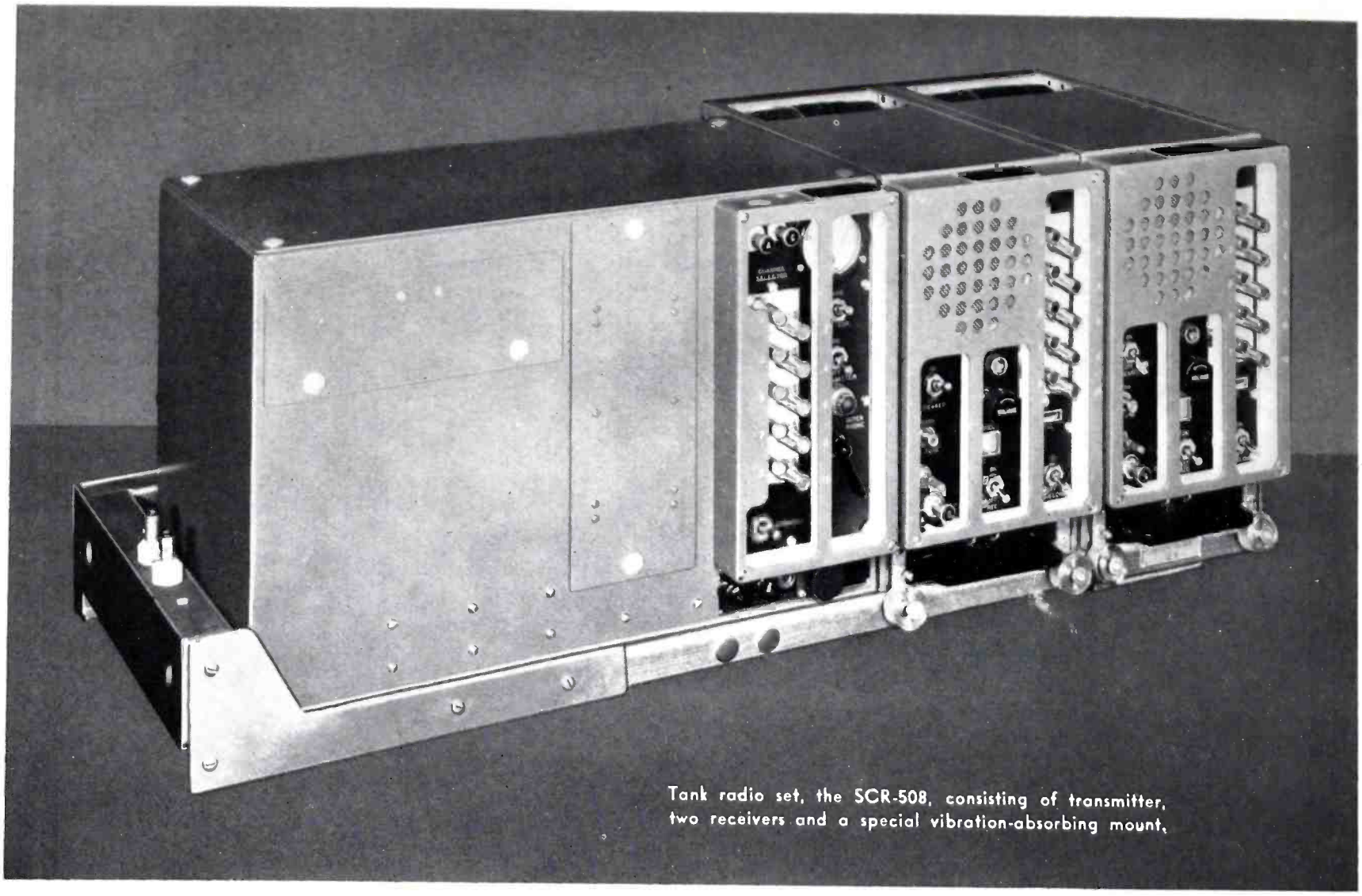
Derby Sprouf of KLZ, Denver, another Air Corps hero, was killed in Africa in 1942, and Lt. Albert Pulver, former chief announcer, WJOB, Hammond, Ind., was lost in action in the Italian campaign in January, 1944. Other broadcasting men in the Air Corps, according to the survey, include Capt. Milton C. Scott, Jr., former chief engineer of WIOD, Miami, now in England; Maj. James McEldowney and Capt. Walter Harrison, Jr., both formerly of KLZ, Denver; Lt. Col. W. Friel Heimlich, formerly of WOSU, Columbus; Col. Luther L. Hill, formerly vice president Iowa Broadcasting Co., now commanding officer of Air Forces Redistribution Station, Miami; Lt. Benton Letson of WJBO, Baton Rouge; Sgt. W. S. Lindsay, formerly of WFBC, Greenville, S. C., now in Africa; Maj. William Harris, former chief engineer of WDAS, Philadelphia; Maj. Louis Wasmer, formerly of KHQ and KGA, Spokane, Wash., now an air communications officer; Lt. (j.g.) H. M. Bitner, Jr., former vice president of WFBM, Indianapolis; Lt. Com. John C. Roberts, former general manager of KXOK, St. Louis, a veteran of World War I; Lt. Hulbert Taft, Jr., former general manager of WKRC, Cincinnati, now in the North African theatre; Capt. Charles Belfi, former manager KABC, San Antonio; Lt. Col. J. Elroy McCaw, former general manager of KELA, Centralia, Wash.; and Robert A. Smith, formerly of KRBM, Bozeman, Mont., who was killed in action while dive-bombing the Japs at Kiska. His Air Medal citation reads: "Subjected to heavy anti-aircraft fire from ship and shore batteries . . . Smith skillfully assisted in persistent dive-bombing and strafing attacks and in the pull-out into the clear at very low altitude. On June 24, 1942, his plane . . . failed to return." Lowell H. Watts, formerly of WLW, Cincinnati, was taken a prisoner of war when his bomber, the *Blitzin' Betsy,* was shot down over Holland on a mission to Germany.

Lt. William Eckman, formerly of WJTN, Jamestown, N. Y., now in England, has received the Air Medal and Oak Leaf Cluster for his heroism in action on the German bombing run, and Lt. Gene D'Accardo, formerly of KTRB, Modesto, Calif., now a bombardier and navigator in New Guinea, was recently decorated for heroism, although details are as yet lacking.

Sgt. Frank Seth of the Army Air Forces, formerly of WHYN, Holyoke, Mass., participated in the liberation of Morocco, Algeria and Tunisia and was presented with a medal by French Algerian 6th Spahi's Cavalry Regiment in Biskra, as well as a letter of commendation from U. S. Brig. Gen. Atkinson for being one of three instructors who enabled French pilots in North Africa to become acquainted with a vital course of radio procedure. Three air corps men formerly of WFAA, Dallas, are also serving abroad: Maj. Loran Wicker, now of the Army Airways Communications System, is in the Pacific area; Capt. Paul E. Bostaph is in the South Pacific area and Capt. Hal Thompson is in Air Corps Military Intelligence — England. From WWJ, Detroit, Lt. Melvin Wissman, now Special Services

(Continued on page 24)

They help run station as manpower shortage grows at home . . . Patrolmen Britton and McKinley; Sgt. Seitler; WRUL Chief Engineer Persio.



Tank radio set, the SCR-508, consisting of transmitter, two receivers and a special vibration-absorbing mount.

FM Goes to War

. . . helps our mechanized forces in outblitzing the blitzers

By Vance Hilliard

MEET the SCR-508 and SCR-608, two of the basic radios of our Army's motor vehicles — tanks, halftracks, tank destroyers, scout cars and command cars. They're frequency modulated, push button operated, crystal controlled, vibration proof; and they're helping our armored forces and artillery outguess and outmaneuver the inventors of lightning war.

The present great invasion of Hitler's fortress is strictly a repeat performance for these unique two-way radio telephone sets, for they were first tested under fire in North Africa in 1942, then proved in Sicily and Italy in the latter part of 1943. Now that military censorship regarding them has been relaxed, it is possible to reveal details of their operation and how they are used in combat.

The Allied invasion of French North Africa was only minutes old when this new type of FM vehicular radio was embarked on its first important combat assignment. In one of the early assault boats to hit shore was an olive-green U. S. Army car fitted with an SCR-608 radio transmitter-receiver. As the ramp clattered down, the car moved into the hub-deep water and across the beach to a place of concealment. It had barely come to a stop when the soldier seated at the radio in the rear seat began sending a succession of messages which may have sounded something like this: *"Mary-M to Kenneth . . . ready at B . . . will make contacts"; "Mary-M calling Green . . . in position . . . report . . . over"; and "Mary-M relay to Kenneth . . . relay from Green . . . no opposition at four-dash-six . . . over."* As each message ended, the operator stopped only long enough to depress another of the push buttons on the radio in front of him before continuing with the next cryptic message.

Soon this spot and others along the coast were lined with landing craft of every description. From them poured tanks, cars and motorized artillery which formed quickly into groups on the beach and then headed inland on their invasion missions. Some made for the coastal highway; others for airdromes, railway junctions and power plants. Squads of Rangers — Yank commandos — loaded into personnel carriers and headed for French barracks and fortresses. With the attacking forces went FM radios, the various sets adjusted to different frequencies so there would be no interference.

The groups were soon widely scattered, but the plan of attack — timed to the split second — was carried out on schedule. As objectives were reached and won, commanding officers made their reports and received further orders by radio. Focus of all these messages was "Mary-M" — which might have been the code name for the small radio station in the car at the beachhead. Using his FM transmitter-receiver as a relay station, the operator received messages from our forces inland and re-transmitted them to invasion headquarters located in a ship offshore. Whenever a group ran into unexpected opposition, "Mary-M" sent the information to others in the vicinity. When a landing beach was cleared, the signal was passed on by this radio to the assault boats awaiting their turn.

(Continued on page 8)

Technical Details of SCR-508 and 608

The 508 and 608 radio sets are nearly identical in appearance and use similar circuits and component parts. The only major difference is in the frequency range, the 608 artillery set having slightly higher frequencies and more channels. As the lower portion of the 608's band overlaps the higher frequencies used by the 508, the two sets may be adjusted for intercommunication.

The photograph of the SCR-508 on page 6 shows the standard tank set consisting of a transmitter, two receivers and a special vibration-absorbing mount. This is the equipment used in command tanks to provide two-way communication and two open receiving channels. Other tanks within the platoon may have a transmitter and one receiver (coded SCR-528), or a receiver only (SCR-538).

Tanks having a transmitter use its audio frequency amplifier for the interphone system. When a receiver only is installed, a special interphone amplifier is included in the installation. Each crewman has a carbon or magnetic microphone, a headset and a control box for communication within the tank.

A block diagram of the transmitter for the 508 set is shown in Figure 1. While it is standard in some respects, the use of crystal control, the push button frequency selectors and the saturated iron-core modulation coil are unique in a combat radio.

Because hundreds of these transmitters must operate in a relatively small area without interference, crystal control is a decided advantage. Immediately to the left of the control panel on the transmitter is a compartment for inserting the 10 crystals corresponding to the 10 push buttons used for tuning. Beside this is a drawer for holding the crystals not being used in the transmitter. Altogether there are 80 crystals furnished with the tank set and 120 with the artillery set. Both sets work in the medium high frequencies and a crystal is provided for each 100 kc step in the bands. The crystal compartment and storage drawer are shown in Figure 2.

When a push button is depressed, a gang-condenser tuning device (Fig. 3) selects the proper crystal and tunes the circuit to its frequency. The oscillator output frequency (fx) passes through one stage of rf amplification and then, along with the audio frequency signals, is impressed upon a new-type modulation coil. The ninth harmonic of the crystal frequency (9fx) is selected and impressed upon a frequency doubler. The doubler output (18fx) excites a frequency tripler. The tripler output (54fx) drives the power amplifier at the carrier frequency. The proper one of 10 pre-tuned antenna tuning condensers is selected by the gang-tuning control and connected to the antenna.

The modulation coil was designed by Bell Telephone Laboratories especially for these vehicular sets and although small in size it does a big job in simplifying the equipment and furnishing a number of harmonics of the fundamental frequency at essentially equal amplitude. Figure 4 shows a functional diagram of the modulator and rectifier stages of the transmitter.

Several-fold multiplication of the crystal frequency and modulation of the carrier wave by the audio signals are the duties of this new inductor coil. The rf input derived from the first radio frequency amplifier causes a current to flow through the parallel resonant circuit, consisting of a duolateral coil, a modulation coil and a variable condenser operated by the push-button assembly. The modulation coil becomes magnetically saturated at a much lower current than that in the resonant circuit. When the instantaneous rf current exceeds the saturation value there is no appreciable increase of flux density and the inductance of the coil drops to a low value. Consequently, very little voltage appears across it when the instantaneous current through it is higher than the saturation value.

Between the saturation value and zero current the coil has a high inductance and a change in current causes a relatively large change of flux density. Under this condition — when the current passes through the magnetization range of the coil — there is a large change in the magnetic field, and a high counter-voltage is induced across the coil. The current through the modulation coil, therefore, produces sharp voltage peaks each half-cycle as the rf current wave passes through zero. The voltage peaks alternate in polarity each half-cycle and are evenly spaced in time. The peaks have a distorted wave shape and contain many harmonics of the original crystal frequency.

When only rf is flowing through the modula-

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Figure 1. Block diagram for the transmitter of the SCR-508 set. In this set, the use of crystal control, the push button frequency selectors and the saturated iron-core modulation coil are unique.

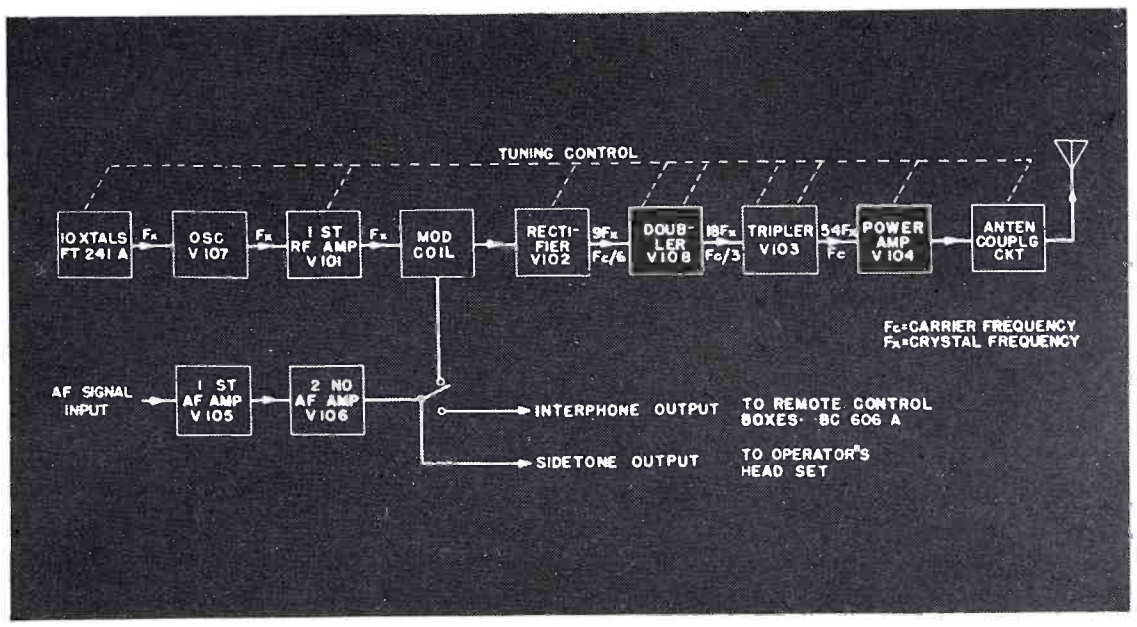


Figure 2. Crystal compartment and storage drawer for crystals not being used in transmitter.

Figure 3. Radio transmitter push button assembly, showing the gang-condenser tuning device.

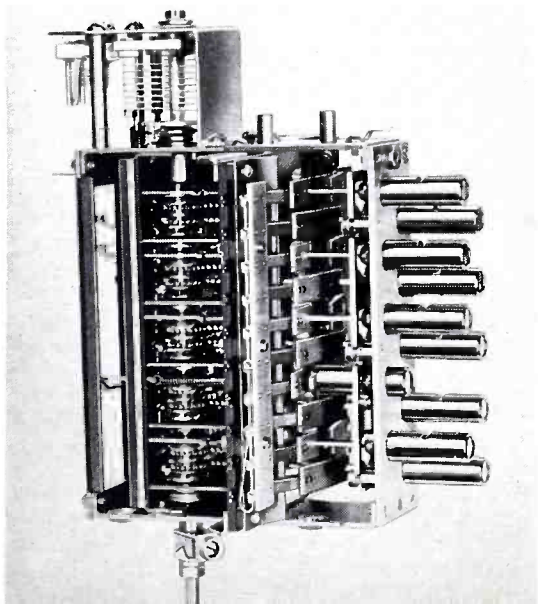
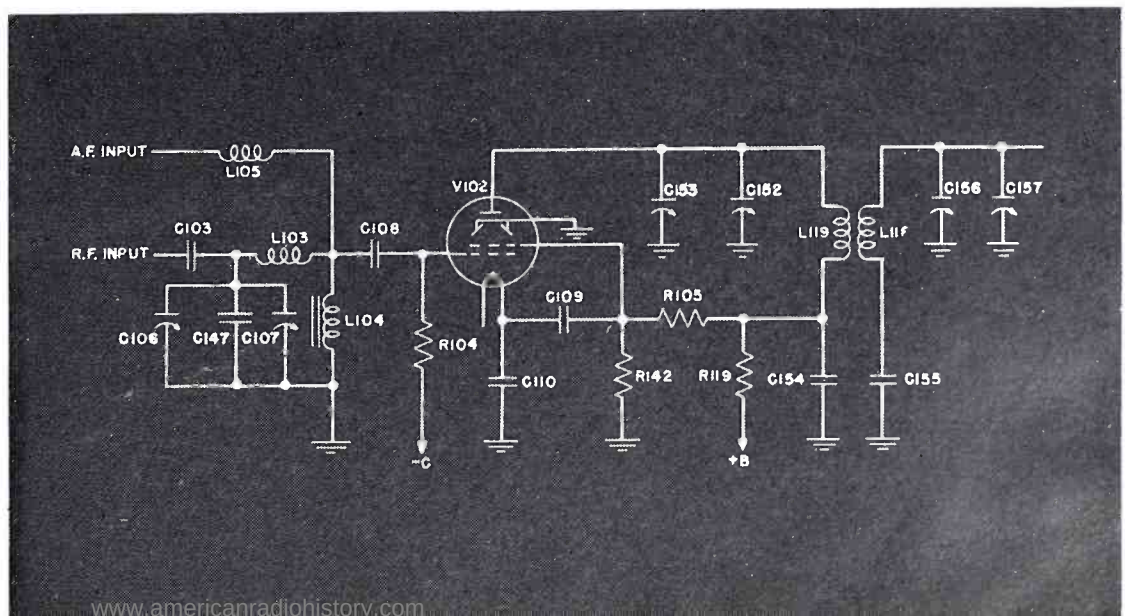


Figure 4. A functional diagram of the modulator and rectifier stages of transmitter of the SCR-508 radio set. L104 is the improved type of modulator coil designed by Bell Labs and described above.



FM Goes to War

(Continued from page 6)

As the invasion gathered momentum messages came thick and fast, but the operator was able to shuttle them back and forth without losing a second of valuable time. The SCR-608 radio he was using required no hairline tuning or tricky adjustments. It was operated by pushing buttons — not by turning dials and knobs — and it worked almost automatically after the power was turned on. This radio set was the "brain child" of engineers at the Bell Telephone Laboratories, designed and developed by them with the assistance of the Army Signal Corps, and manufactured by the Western Electric Company.

Since the first use of Western Electric-made vehicular radios in a major landing engagement, the same story has been repeated many times in many parts of the world. At Salerno and Anzio in Italy, Licata in Sicily, Bernières and Isigny in French Normandy, and on Bougainville, New Britain and Saipan in the Pacific these rugged, compact transmitter-receivers have been in the thick of the fighting and have won high praise from communications officers and men. Today Allied invasion forces are pushing the Nazis back relentlessly in France, paced every foot of the way by our slugging armored columns. In this, the big show, SCR-508 and 608 radio equipment is again making a name for itself by carrying the bulk of the communications load in the armored forces and artillery.

The first type of FM combat radio developed by Bell Laboratories and produced by Western Electric was the SCR-508, often referred to as the tank set. This was so successful that the Signal Corps asked for a similar type of equipment for the field artillery. The result was the SCR-608 artillery set. The names are misleading, however, as both types of radios are found throughout the armored forces and artillery. Together the 508 and 608 account for a sizeable percentage of all radio equipment installed in the vehicles of the U. S. Army — the first military machine in the world to use frequency modulation in its tactical radio sets, according to the Signal Corps.

Radio Net of Armored Command

Radio communication is to our armored divisions what the telephone is to the infantry. In the latter branch each field army has its own vast wire telephone system which reaches from front line observers through numerous field command posts all the way to general staff headquarters. In every armored unit a similar radio network speeds combat information from the most advanced platoon — smallest unit in this command — back as far as corps headquarters.

The platoon leader, with four tanks besides his own under his direction, has both an FM transmitter and an FM receiver, while some of the other tanks in the platoon may have receivers only. Several platoon leaders report to a company commander, who usually has a transmitter and two receivers in his tank.

Company commanders, in turn, report by radio to the battalion commander, whose "office" in the field is a halftrack motor vehicle. He has two complete radio sets — one for FM radio-telephone communication and another for code transmission. With these he issues orders to the battalion's service units, mortar platoon and mobile artillery, and makes his reports to the divisional commander above him.

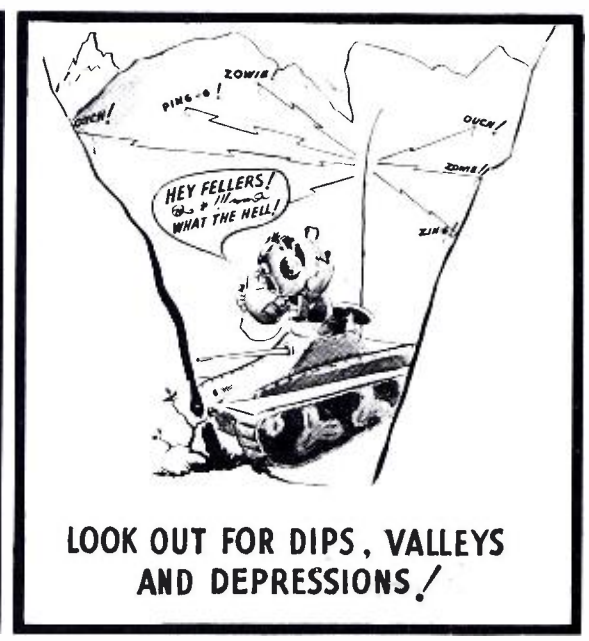
Divisional headquarters, further to the rear, is the highest echelon of the armored command. Here the divisional commander — usually a major general — uses radio to direct the hundreds of tanks and cars in his armored group. He has the same two types of radio equipment used at battalion headquarters, and with these he receives messages from the battalion heads and transmits commands to the division's artillery, reconnaissance units, and supply and maintenance services. By radio he reports to the corps commander above him, who directs all ground fighting in the area.

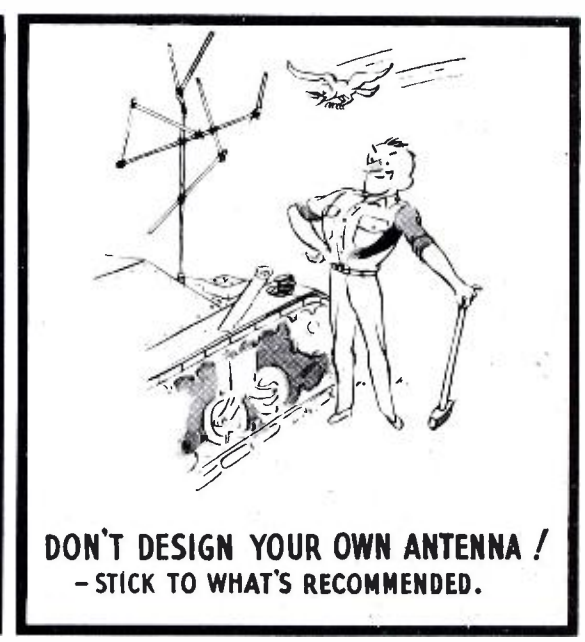
This effective communications system is built around Western Electric's vehicular radios, which form a major part of the 975 sets used by an armored division. The U. S. Army now has thousands of tanks in action and many thousands more in reserve, *and nearly every one of these is equipped with a radio furnished by the Western Electric Company and its subcontractors.*

The field artillery — a branch of our forces respected and feared by every German and Jap fighter — employs FM equipment as another important cog in its fire control system. Ranging far ahead of every rifle and howitzer battery or hovering over it in a "grasshopper" plane is an observer — usually the only member of the artillery team to see the target on which the guns are trained. Through his FM radio he sends back information on the location and range of the enemy-held objective. Battery computors convert this data into degrees of azimuth and elevation, and pass it along to the gun crews by telephone. The first "ranging" shots may be wide of the mark but in a matter of seconds the corrections radioed from the observer put the battery "on target." Then it is often only a matter of loading and firing until the target is destroyed.

The scene on the front cover of this issue of The *Oscillator* shows an SCR-608 in action with an artillery battalion several miles behind the front. The radio car, operator and driver constitute a mobile message

Humorous cartoons such as these in the Army Instruction Manual for tank radio operators teach soldiers what to do and what not to do in handling and using their sets under almost all conditions.





center for the commander of a battalion of twelve 155 mm. "Long Toms", two of which can be seen firing in the background. With the help of a small remote control telephone unit (out of sight on the floor of the car), the operator routes messages back and forth between the battalion commander and his battery commanders, operations posts and forward observers on the ground and in the air. Through this radio also go the messages from the battalion commander to the other artillery battalions in the vicinity.

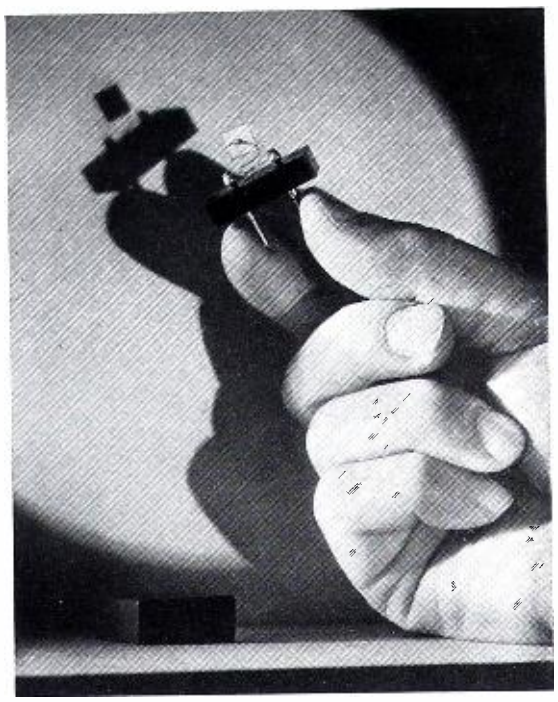
The armored forces and artillery are not the only branches using Western Electric vehicular radios. Reports coming back from battle zones indicate that they are now being used by cavalry, engineer, medical, chemical warfare and quartermaster units. In the chemical warfare branch, they furnish communications for smoke generating companies, and most combat branches use them in anti-aircraft and anti-tank warning control nets.

Radio and telephone communication in the U. S. Army has made rapid strides in the five years since Hitler raised the curtain on World War II. In no branch is the advance more marked than in the armored forces or the artillery, whose latest vehicular radios have just been described. Much of the credit for these powerful communications weapons belongs to the engineers of Bell Telephone Laboratories who conceived and developed the original design in cooperation with the Signal Corps, and to Western Electric and its subcontractors who have manufactured them in quantity. Here is the story of how these organizations cooperated to produce a new and better type of combat radio.

In the latter part of 1940 Bell Laboratories was asked to take on one of the most difficult jobs in the Signal Corps radio development program — vehicular sets for tanks and motorized equipment. The general specifications agreed on were formidable. The set must be small and compact, rugged to the *nth* degree, crystal controlled, push button operated, simple and fool-proof, and practically automatic in operation. Above all, it must be dependable in every respect and under every combat condition. The time schedule drawn up made the engineers involved shudder.

After gruelling day-and-night work by a large group of Bell Laboratories radio engineers and scientists, the design was completed and the first handmade FM transmitter and receiver were finished in *three months*. In normal times, at least a year would be required for so complex a piece of apparatus.

After exhaustive tests the Laboratories people were satisfied that the set met specifications, and it was sent to Fort Mon-



Eighty of these tiny quartz crystals are used in each SCR-508 tank set; 120 in the SCR-608.

mouth to be tested by the Signal Corps. From there it traveled to Fort Knox, Kentucky, to be put through its paces by the armored forces. The equipment came through both tests with "flying colors." There was no question about it being accepted; it had performed so well that it was okayed by the military without a single major change. It was a good radio, but the Army needed thousands of sets instead of just one — and in a hurry.

Production Problems

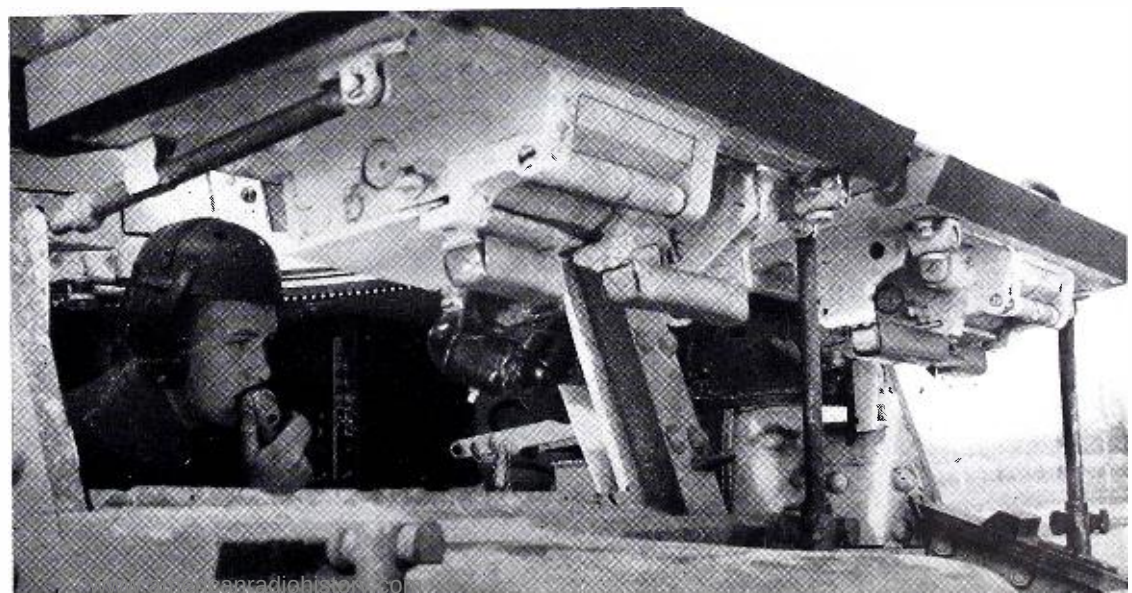
Production in quantity was Western Electric's responsibility, and it lost no time in getting the job underway. Work was started even before a formal contract was signed, and the first goal was reached on October 31, 1941, when several production sets were turned over to the Signal Corps. By December 7th — Pearl Harbor — the equipment was beginning to leave Western Electric's Chicago plant in quantity.

Among the many production problems encountered — and solved — were those in crystal manufacture. To save quartz, the crystals had been designed as small as possible, with the result that a half-dozen will fit on a postage stamp without overlapping. These had to be finished to microscopic accuracy, then the faces silver-plated and the connecting wires and mount attached. Soldering irons were too slow and clumsy so tiny jigs were designed to hold the elements while a minute drop of solder is melted on each face of the wafer by a blast of hot air. Although temperature control of the crystals is provided in the transmitter by heating coils and a thermostat in the crystal compartment, it was the aim from the first to make the crystals themselves immune to extremes of heat and cold. This aim is reflected in one of the tests given the finished crystals, which subjects them to temperatures of —40° F. in a dry ice compartment and +158° F. in a heat chamber. If the frequency of the crystal under test varies by more than .02 per cent, it is rejected.

As America's war industries expanded, shortages of raw materials called for ingenuity in redesigning numerous parts of the equipment without slowing up the program. In spite of this and other manufacturing "headaches," every contract has been completed on schedule. The exact quantity delivered to the Signal Corps since we entered the war is not for publication, but the total number runs into many thousands. Our "blitz buggies" have not had to wait for their radio equipment.

From the beginning, some of each of the principal components of the 508 and 608 vehicular sets have been subcontracted to several selected manufacturers and with the assistance of Western Electric engineers, these subcontractors reached a point where they could handle the entire load. In 1943, with production running smoothly, it was decided that Western Electric should concentrate its efforts on other vital electronic items for the Army and Navy, and the bulk of the manufacturing job for vehicular radios was shifted to the established subcontractors — Belmont Radio Corp., Delco Radio Division of General Motors, Farnsworth Television & Radio Corp., and Philco Corporation. At present, Western Electric serves as prime contractor, producing a few of the more critical items and with the responsibility of assuring the quality of every set before it is turned over to the Signal Corps.

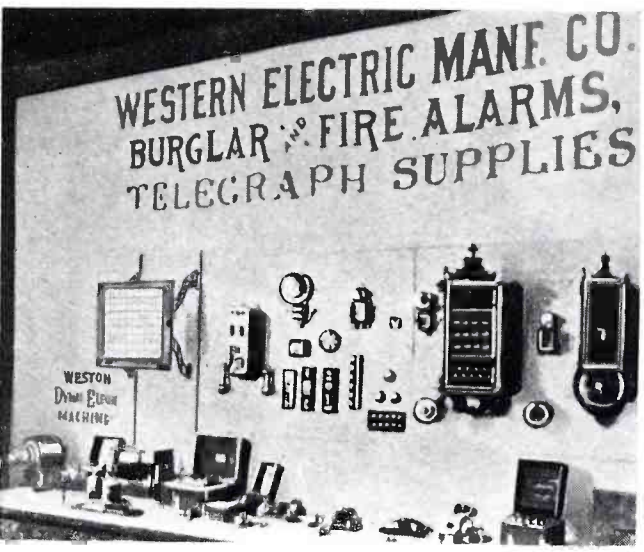
The radio operator of this *"blitz buggy"* talks into the microphone of an SCR-508 radio telephone.



75 Years of Pioneering

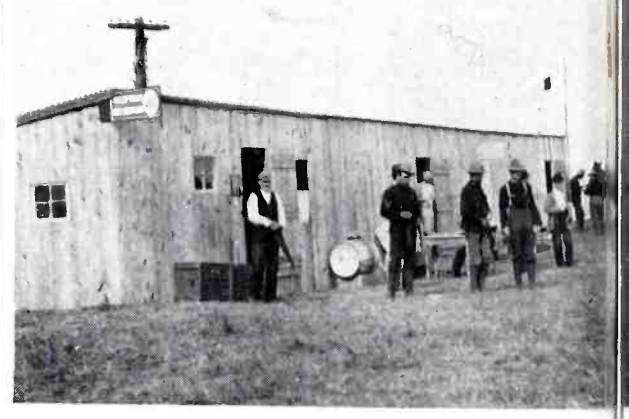
In 1869 in Chicago, this building housed the new partnership of Gray and Barton, electrical manufacturers, founders of Western Electric. The partnership was started with financial aid from Gen. Anson Stager, chief of United States Military Telegraphs in the Civil War and friend of President Lincoln. Enos M. Barton himself was former telegrapher.

In 1870, we see here the entire, though not necessarily fashionable, personnel of Gray and Barton which was in two years to become the Western Electric Manufacturing Company. The gentleman in the beaver hat, Professor Elisha Gray (seated front row center) holds the firm's chief asset, Gray's new printer telegraph, manufactured for Western Union.

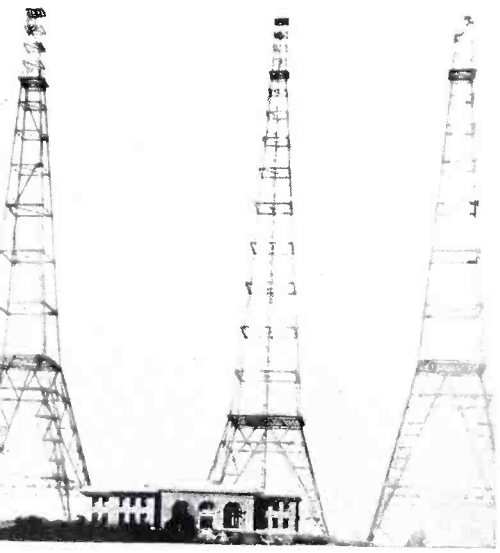


Around 1880, the above were the main products of new company. Business in electrical devices boomed when, in 1871, Chicago fire burned to within two blocks of company. A further stimulus in 1875, Bell invented telephone.

In 1892, Alexander Graham Bell, seventeen years after his historic invention, makes the telephone call which opens the first direct circuit between New York and Chicago. No repeaters were used. It was necessary to speak very loudly and cleorly.



In Spanish American War, 1898, long distance headquarters of Bell Telephone Company is here shown at Camp Wykoff, Montauk Point, New York — a Signal Corps camp. Western Electric mode telephones for camps here and obroad.

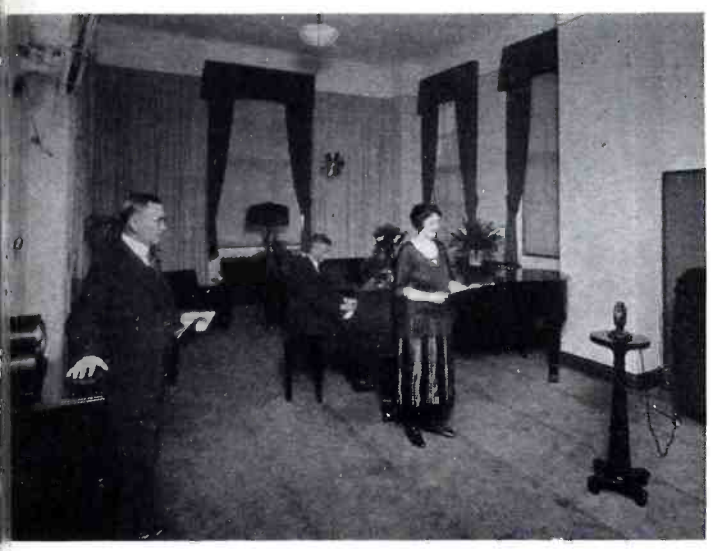


On September 29, 1915, the human voice first spanned the sea by radio, going from Arlington Towers to the Eiffel Tower in Paris. Western Electric did it.

In August 1917 Western Electric engineers made the first radio telephone contact between the ground and a plane in flight. Above is the ground equipment used in the experiment. The demonstration was later repeated for President Wilson on White House lawn.

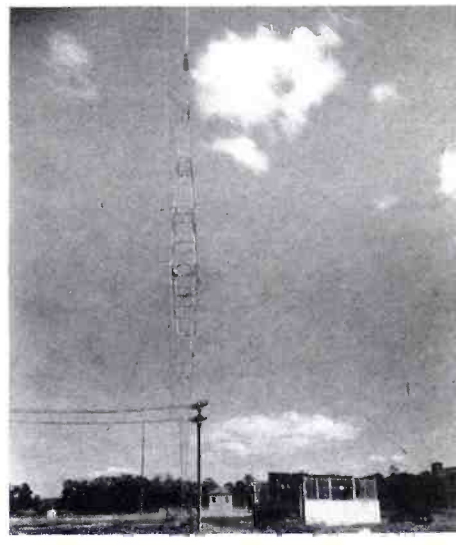
Western Electric public address equipment first played an important role in public affairs by aiding the sale of Victory bonds at this Victory Way on Park Avenue, New York City, soon after the end of World War I. Note the suspended loud speakers.

. . . by Western Electric

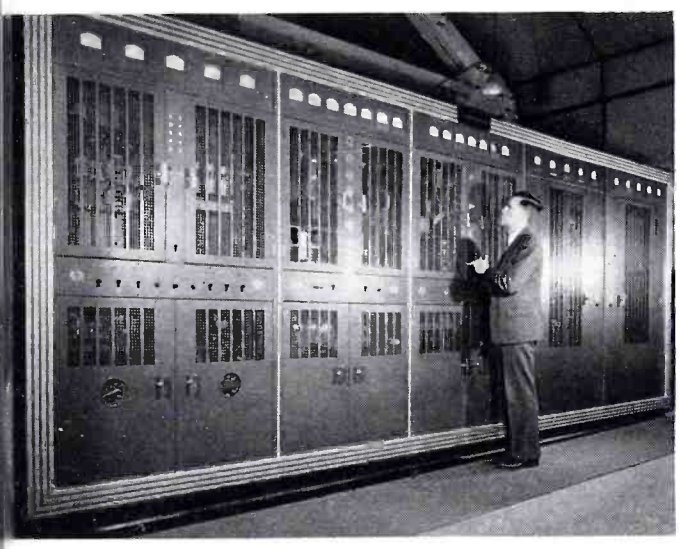


Studio of pioneer commercial station WEAF, built by Western Electric and owned by American Telephone and Telegraph Company. Phonograph at right hints at source of much of the station's program material. First chain broadcast emanated from this station.

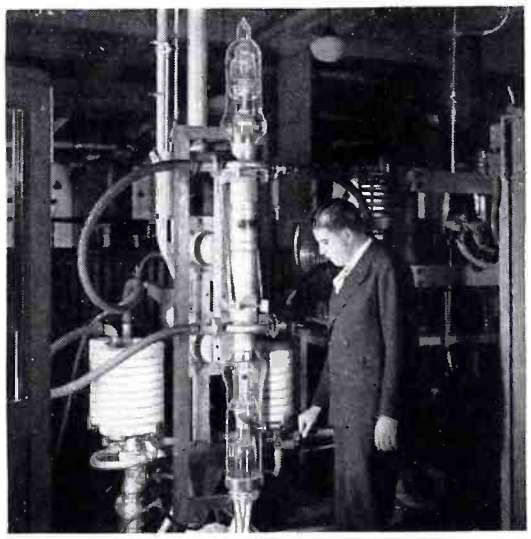
On August 6, 1926, the first commercially acceptable sound picture, "Don Juan," starring John Barrymore, was shown at the Warner Theatre, New York; another first for Bell Laboratories research, and Western Electric manufacturing. Today Western Electric's name symbolizes fine recording.



The half-wave vertical radiator for use in broadcasting was a Bell Telephone Laboratories development. One of the first installations was at WABC in 1931.



Bell Laboratories developed stabilized feedback and applied it to Western Electric radio equipment in early '30's. Another contribution was the high efficiency amplifier. Both were incorporated in the 50 kw transmitter shown in photo.



In 1915 transcontinental telephony became possible through use of vacuum tubes as repeaters. From that date to present Western has pioneered in electronics. Above is largest tube ever made in this country.

Western Electric "bird cage" carbon microphone made radio history, became symbol of broadcasting. The cardioid, developed just prior to war, is the company's latest and best. Many fine mikes came between the two.

Maj. Edwin H. Armstrong, inventor of frequency modulation, makes final adjustment on the one kw Western Electric FM transmitter of Station WBAM, New York City, as Jack Poppele, WOR Chief Engineer, and Alfred J. McCosker, President, look on. An early model, this type of transmitter has been redesigned. Many Western Electric FM sets are in war.

With the coming of war, Western Electric threw its entire resources into the production of war equipment. Today it is the Nation's largest producer of communications and electronic equipment for use by the Allied armies on land, sea, and in the air. Without its long career as maker of Bell Telephone equipment, the job could not have been done.

Bell Telephone Laboratories at War

ONE of the least publicized — because of the confidential nature of the work involved — yet most effective jobs performed in this war has been that of the nation's great research laboratories. Behind a wall of silence, thousands of scientists and engineers have been quietly laboring that our armies may have "secret" weapons to bring surprise and rout upon our enemies and "improved" weapons to give our men military superiority in equipment on the battlefield.

An example of a great technical institution engaged in a vital war undertaking of this type is Bell Telephone Laboratories — world's largest research center for electrical communications. War has made heavy demands upon Bell Laboratories both on the technical staff itself and on the entire personnel. Before the war, this center had 5,000 workers — 1,700 of them members of the technical staff — scientists, engineers and researchers — working on projects that dealt almost entirely with electrical communications. Since the war, even with many Bell scientists called into Government and the armed services for special work, the personnel has been increased to a total of 7,500 men and women — 2,400 of them members of the technical staff — working on projects most of which are confidential and practically all of which are war developments.

The facilities of the Laboratories at the same time have been necessarily vastly expanded. Besides the main laboratories in New York City and Murray Hill, New Jersey, a number of field laboratories for development studies which require large open spaces or typical atmospheric conditions are located at several points in New Jersey, and groups of Bell Laboratories' engineers are further stationed at the main works of the Western Electric Company at Kearny, New Jersey, Point Breeze in Baltimore, Hawthorne in Chicago, as well as at various localities throughout the nation where the Bell System plant provides suitable experimental conditions.

The laboratory objectives posed by the war have been twofold: to apply theoretical knowledge to invent new devices and to utilize engineering and manufacturing "know-how" in the practical production of these devices. One is as important as the other, for new or improved devices are useless unless they can be taken from the laboratory to the battlefield with sufficient speed and in sufficient quantities to give them maximum military effectiveness.

The pursuit of these objectives has had its share of drama, adventure and even physical danger. Now famous is the dream of Dr. Parkinson, a Bell Laboratories scientist, during the early German air operations over England which resulted in one of the great technical developments of the war. In those days when it took thousands of shells to down a plane, Dr. Parkinson dreamed of a mechanism that would ground a plane for every shot fired. So vivid was the dream and so logical that when he awoke he immediately began to put down on paper the circuits that were destined to become the electrical gun director which Gen. L. H. Campbell, Jr., Chief of Ordnance, characterized as "one of the greatest advances in the art of fire control made during the war."

Another dramatic experience involving, this time, actual physical danger was that which came to Paul V. Koos and J. F. Morrison of the Bell Laboratories. The men were aboard a bomber making a flight test of an electronic device. With tests completed, they were ready to land, but for two hours they hovered helplessly over the field while the crew tried to release the jammed landing gear of the plane. Finally, after every expedient had failed and the fuel had run low, the pilot gave the order to bail out. Neither Koos nor Morrison had ever been drilled in the use of a parachute, but they stepped out of the fast-moving plane and came down safely, although one experienced minor injuries. And these new members of the Caterpillar Club flew again, for their job required it.

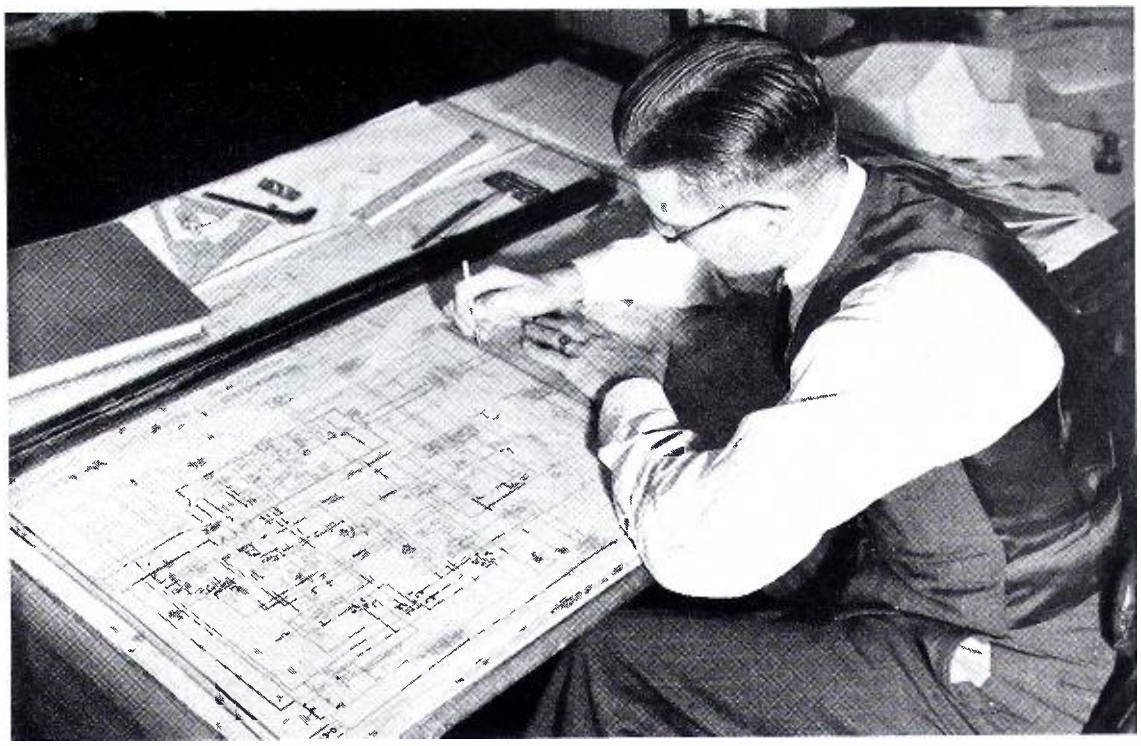
However, it is in the less spectacular but equally vital day-to-day jobs within the laboratories that the bulk of the Laboratories' most effective war contributions are to be found. Over a thousand war projects have been undertaken by Bell Laboratories and at the present date over half of these

View of Bell Laboratories unit at Murray Hill, N. J., completed shortly before war. This and other Bell Laboratories centers are deep in war research.

Photo by Samuel H. Gottscho

have been completed, while more continue to come in. In all about 50 per cent of these projects are for the Army, about 40 per cent for the Navy and 10 per cent for the Office of Scientific Research and Development and other civilian government agencies. Working with the engineers and scientists are 860 draftsmen, more than two and one-half times the normal peacetime number. The output of the draftsman is to a degree a measure of the output of the design engineer. It is interesting to note that the demands call for an average output of over 16,000 blueprints each working day. Furthermore, experimental models must be made of all new devices and an increase in the personnel of the Development Shop from 235 to 850 still fails to meet this demand, so that work is farmed out to no less than 200 outside shops. A glance at a few of these developments will serve to show something of the type of work, the methods and the problems involved in the whole list.

The developments discussed here represent only a portion of the Laboratories' achievements. Many others, for obvious security reasons, cannot be discussed. It can be said, however, that these many products of Laboratories research and Western Electric manufacture are helping to speed victory.



Working with the engineers and scientists are the draftsmen — over 800 of them in the Bell Laboratories. Wartime demands call for an average output of 16,000 blueprints each working day.

Airborne Radio: Radio command sets for airplanes, so called in the Army because one of their functions is to transmit commands from the leader to his squadron, have been produced in greater unit volume than any other electronic device used in fighting this war. The value of this equipment delivered by the Western Electric Company and its subcontractors since 1941 totals 250 million dollars. The job — and one in which the Bell Laboratories' scientists and the Western Electric Company's manufacturing engineers played a principal role — was that of "manufacturing planning" required before the set could be put into production. This job was enormous. For example, the SCR-274 radio command set, the one most commonly used, required 2,300 drawings. An average installation of this set (three receivers, two transmitters, one modulator, one antenna relay, mountings, racks, plugs, cords, three dynamotors, two control boxes) contains between four and five thousand parts, many of them intricate and difficult to manufacture, requiring the most exacting engineering work.

Materials must stand up under grueling punishment of war . . . Testing vacuum tubes for radio.

Tank and Field Artillery Radio: Tank radios are dealt with in a separate article on page 6, but the development problem involved is of interest here. Over a year before Pearl Harbor the Signal Corps requested the immediate designing of communications systems for tanks and other armored vehicles. They needed, in effect, a private branch radio telephone exchange to provide communication among tanks, scout cars, artillery units and anti-tank vehicles. The answer was a multi-frequency FM radio communication system.

Electrical Gun Director: This device has already been mentioned and extensively publicized. Although the basic ideas of the gun director stemmed from brilliant individual inventiveness, development to the point of manufacture as a precise weapon able to stand the battering of war required the experience of over 400 Laboratories engineers who often worked day and night. Including 3,300 different parts, it required the preparation of 1,100 specifications and 5,000 different drawings involving 66 man-years of drafting time; a maintenance manual of five volumes, an instruction manual, spare parts lists, and the design of many special maintenance tools and circuits. In addition, it was necessary to prepare textbook material and conduct classes for training a group of 350 army personnel in its principles, operations and maintenance so that they in turn could train the many groups that would later be responsible for the apparatus in the field.

Some idea of the improvement in fire control represented by this device may be suggested by the fact that in World War I it was possible to hit, but not knock down, a plane for every 17,000 rounds fired. With the electrical gun director, anti-aircraft fire has actually made as many as 16 hits out of 48 shots on a plane-trailer sleeve-target — one out of three hit the target. This represents an economy in shells fired in a ratio of 17,000 to 3 in that instance. The electrical gun director is now performing on the battle front.

Wire and Cable: The problem here was to develop wire and cable that could be readily and quickly strung on the battlefield and yet could provide multiple voice channels. The answer was the Spiral-Four Cable carrier telephone and telegraph system, based on spiral-4 cable. The cable, about the diameter of a fountain pen cap, contains four wires wound together. It is made in quarter-mile lengths thrown on the ground from wire-laying trucks or plowed under the soil to be safe from pulverizing tanks and can be laid faster than

Electronic developments touch many fields . . . Sun spots which disturb short waves are studied.

men march, its weatherproof connectors allowing sections to be snapped together without splicing. With repeaters and terminal apparatus, spiral-4 provides three first-class telephone channels and eight fast carrier-telegraph channels.

Military Telephone Instruments: Transmitters and receivers, microphones and headsets — all required extensive development to be useful for combat purposes. Among interesting developments should be mentioned the adaptation of headphones for military use similar to the audiphone (hearing aid) type that is so compact that it can be worn under a steel helmet; a transmitter — the throat microphone — which is worn strapped to the throat, freeing the hands; and finally the lip microphone which supplants the throat microphone in certain uses. Another development is the sound powered telephone — an instrument that requires no external energy save that of the human voice for transmission purposes. It was developed from Bell's basic telephone, uses a powerful electromagnet and works efficiently entirely without batteries. It is particularly valuable where there is unusual danger of power failure and is now serving special purposes on ships of the merchant marine as well as in the Navy and Army. All of these instruments must be not only rugged but highly efficient. Instances such as the one that occurred in North Africa must be avoided where a message was received from an observer saying "There are three *battalions* coming over the hill." What the observer actually said into the transmitter was: "There are three *Italians* coming over the hill." As a result the entire outfit got ready to go out and whip three Italians — all because of a garbled message. No doubt the three Italians were overwhelmed but everyone else was disgusted.

Crystals: The research problem involved in providing the crystals which keep war radios (and of course, practically all modern radios) on the beam and that play such an important part in electronic devices is that of breaking down skilled manufacturing operations into operations simple enough to put on an assembly line. The manufacture of quartz crystals from the mother crystal to the thin mounted wafer combines several fields of applied science including crystallography, precision grinding, vacuum techniques and high-frequency electrical measurements. Dimensions of the finished crystal must be extremely accurate, yet the work must be done on a vast scale. Careful planning turned this highly skilled, intricate manufacturing job into one that could be done by semi-skilled labor and with a minimum of experience. The Western Electric Company alone, aided by this type of engineering research, has produced over nine million crystals since the war began.

Packaging for War: Extending throughout the picture of war development has been the problem of packaging equipment for war. Those who used to build broadcast receivers in the early days were duly impressed when the radio industry compressed the originally bulky broadcast receiver into a compact box which could be taken from room to room or to a picnic on the beach. Such streamlining of equipment is a "must" in these days of mobile armies. Telephone and radio equipment originally designed to be securely anchored in one location under a protecting roof has had to be packaged for travel with armies at war. Intricate electrical systems have been squeezed into spaces not previously considered feasible and built to withstand the hazards of climate and wartime transportation. Apparatus is severely tested on "shake-machines" specially developed to simulate the expected shock conditions on ground, on shipboard or on aircraft.

Materials: The diverse chemical and physical studies necessary to insure that materials and finishes will stand up in war equipment can only be touched on here. Exposed materials must withstand the destructive action of salt spray, arctic cold, the soaking humidity of the jungle with its attendant fungus growth, as well as gunfire shock. Microphones to work in the reduced air density at high altitudes or hydrophones to work under the sea to detect submarines, require the solution of numerous special problems. Materials under severe electrical stresses, such as capacitor dielectrics, must operate without failure at high temperatures which are often fatal to paper capacitors not designed to meet this condition.

Not least is the over-all problem of making one material serve for another which the war has made unavailable. For example, in the handset or the combined telephone set which stands on office desks, it has been necessary to provide a different material for almost every material previously used.

Special Electronic Devices: Finally the largest single group, approximately half of all war projects undertaken by the Bell Laboratories, is concerned with special electronic devices, the field in which the Laboratories had already begun to work before the war. Almost all types of this

(Continued on page 35)

One of the new weapons of this war — The M-10 Electric Gun Director — conceived in a dream by a Bell Laboratories scientist, has been called "one of this war's greatest advances in fire control."

You Can't Win a War without Radio

and Western Electric Provides the Circuits for Victory from GHQ to GI Joe Out Front

FROM the pint-sized airplane command set whose transmitter and receiver units will go into a small suitcase to the powerful 50 kw broadcast transmitters, Western Electric radio communications equipment is at work throughout the world carrying military messages for Army, Navy, Marines and Coast Guard and psychological warfare broadcasts for the Office of War Information. Dozens of types of transmitters and receivers, studio equipment from switches to speech input consoles, microphones, headsets, tubes, crystals, testing and maintenance apparatus — all these and more go to make up the list of radio communications instruments being turned out in unprecedented quantities at 30-odd manufacturing locations. While many of the items are of a restricted nature, it is possible to give a general, over-all picture of the wartime radio products being produced by Western Electric and how they are employed in this "three dimensional" conflict.

To crewmen of our Army and Navy planes — and particularly to the radio operators — Western Electric airborne radio sets are as familiar as their parachutes or flak suits.

For the Army Air Forces, Western Electric has furnished four types of command sets — so called because they are used mainly for transmitting commands between planes, and from planes to nearby ground stations. These are low-powered two-way telephone sets, generally made up of two transmitters and three receivers so the operator will have several open channels. A modulator unit, antenna relay and control boxes complete the installation. Transmission bands used are in the high and very high frequencies and because of the transmitter's low power output, the enemy is less apt to intercept messages.

The famous SCR-274 Western Electric made Command set here being operated in a B-26 bomber.

Western Electric has made Army command sets in huge quantities — figured, not in thousands, but in *hundreds of thousands* — and a large percentage of all Army planes from single-seat fighters to the heaviest bombers have them aboard.

In the carrier and land-based planes of our Navy, Western Electric radio equipment is nearly as well known. Of the several types of aircraft sets manufactured for Navy use, one is similar to the Army command set, one is an adaptation of a Western Electric commercial radio telephone, and others have been developed by Bell Telephone Laboratories for the Naval air arm since the war started. The newer sets embody many improvements which provide easier operation and greater dependability in combat, such as 100 per cent crystal control and a greater number of transmission channels.

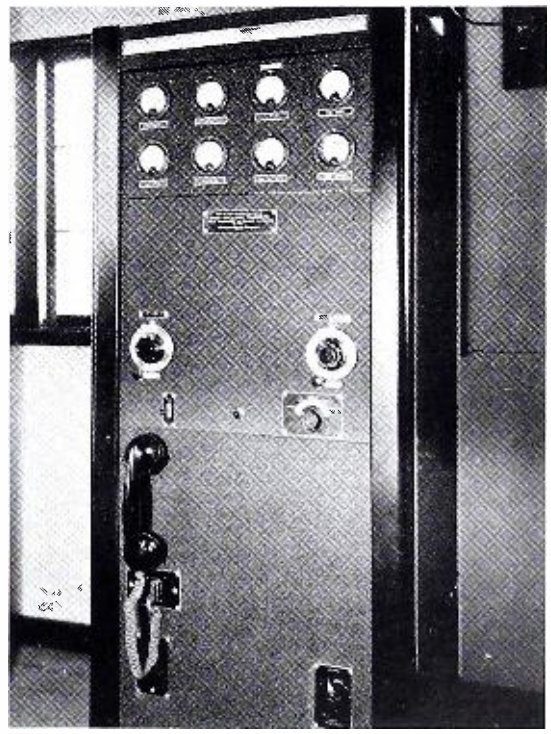
One particular Navy airborne radio set was designed by Bell Laboratories and put into production recently by Western Electric on a rush basis at the request of the Navy Bureau of Aeronautics. The need was urgent and long hours of hard work finished the design job on schedule. Rear Admiral DeWitt C. Ramsey, Chief of the Bureau, sent the following message to those working on the project: "The men and women who participated in the development and production . . . are to be congratulated upon the initial month's delivery of this important new radio. Principles embodied in this equipment will be of value to the planes and carriers of the United States Fleet in maintaining adequate communications in the vital Pacific offensive."

A special type of airborne radio is carried by our combat planes to help pilots locate their bases and fly back to them unerringly in any kind of weather. Once the base is reached another type of set guides the plane in to a safe landing, even though a dense fog obscures the runway. Western Electric has made many thousands of these instruments for guarding the safety of our airmen.

In addition to the radios that go aloft other, more powerful Western Electric transmitters stay on the ground at Army air fields. They are used for communication with planes in flight, as part of the radio net connecting several air fields with each other and with headquarters, and for general point-to-point communications. These transmitters have a power of 350 watts and provide operation on two pretuned channels, either of which may be selected from a remote operating point. The types of transmission employed are telephone, continuous wave telegraph and two-tone telegraph. The equipment is so constructed that it can be disconnected, rushed forward to a new air field in a small truck and put in operation again in the shortest possible time.

On the ground, radio equipment divides into strategic and tactical, depending on its use. Strategic radio equipment comes into use in the planning of campaigns and long-range military and political movements — tactical radio sets are employed in carrying out this advance planning in specific engagements against the enemy. The world-wide radio networks maintained by both Army and Navy and focused on Washington make up the strategic radio systems. Smaller mobile, vehicular and portable radio sets are the tactical equipment used in the field.

In the strategic radio systems of Army and Navy, Western Electric single sideband transoceanic transmitters and receivers are used extensively. These are high-powered directional installations used to beam teletype messages from this country across the Atlantic and Pacific to the capi-



Special type of transmitter contacts Pan Am's transport planes carrying high-priority cargoes.

At Ain-El-Turck, Algeria, Corporal Ray Jozaitis, at the controls of a 23C speech input console at one of the AEF stations, rebroadcasts a program from the States.

In the OWI radio center studios in New York, a modified 23C speech input console handles one of the many overseas programs in our psychological warfare.

tals of the Allied Nations and to theatres of military and naval operations. It was a transmitter of this type that carried the words of Col. Ernest Dupuy on the morning of June 6 when he made his official announcement to the United States that the invasion of Europe had begun. Three single sideband receivers for the Signal Corps are shown being wired and assembled in the color photograph on page 19.

Powerful broadcasting transmitters, of a type furnished by Western Electric, are used to feed reports to the Army's strategic network. Following closely behind our advancing troops, Signal Corps technicians set up complete broadcasting stations to handle the rush of military messages necessary to a force in the field. Radio communication plans for a major invasion might call for the establishment of a 1 kw transmitter in the occupied territory 10 days after the start of the operation. At the end of a month a 5 kw transmitter might be installed. Two months after invasion day plans might call for a 10 or 15 kw transmitter. Ultimately the Signal Corps would have radio transmitters powerful enough to reach half way around the world.

Several other types of long-range radio telephone and radio teletype equipment are being made in quantity by Western Electric. One of these is an ultra-high frequency radio communications link using highly directional transmission. Another is a teletype system for use over comparatively short distances, capable of handling 36 messages simultaneously between one transmitter and one receiver. Still another teletype system, known as the "two-tone telegraph" has been developed by the Army Communications Service of the Signal Corps, and has proved highly successful. Some components of the system were built by the Western Electric Company. This system is used extensively to provide long-haul communications in situations where only 60-speed channel is required.

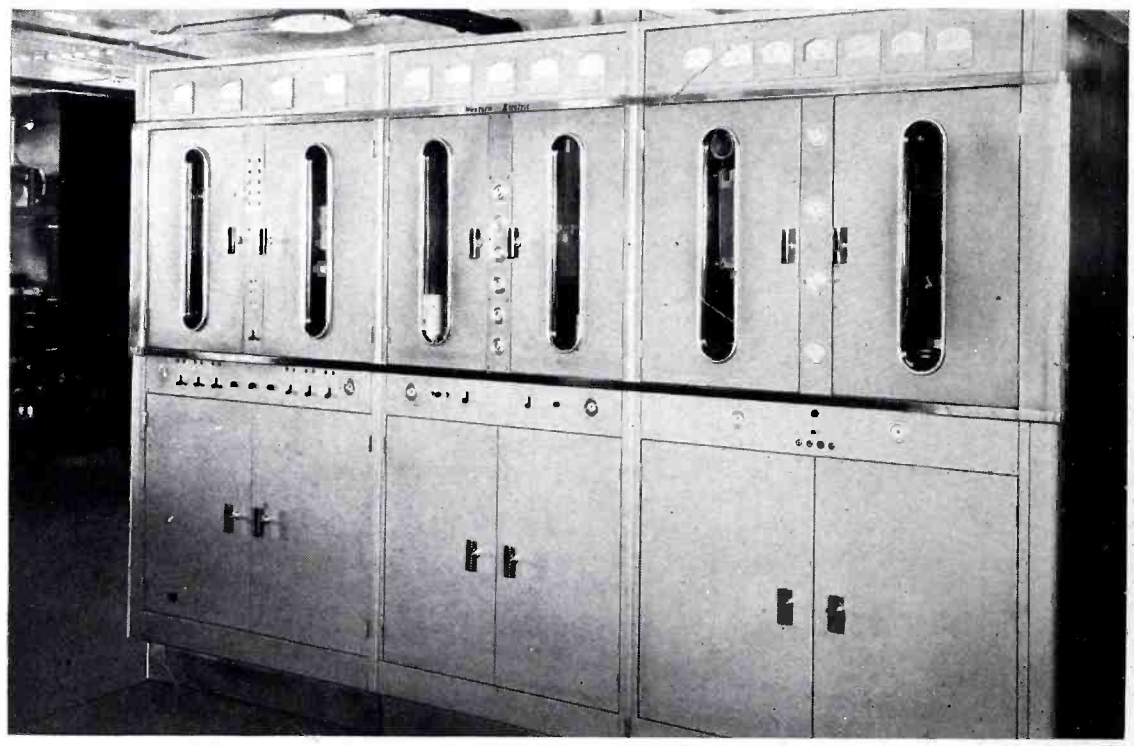
Recently released for publication by the War Department is the story of the installation of six long wave radio stations linking the U. S. with Newfoundland, Labrador, Greenland, Iceland and Great Britain. The stations were installed by the Army Communications Service of the Signal Corps "on the double" to speed plane traffic over this northern route to Europe when it was found that electrical disturbances peculiar to the area played havoc with short wave transmission. The system was engineered and installed with breath-taking speed in order to finish before the Arctic winter set in, and so fast was the pace that the entire construction job was completed in 28 days. Technicians trained in all phases of radio station construction were gathered from virtually the four corners of the globe and flown to the northern points and the equipment was likewise transported largely by air. It is estimated that the engineering of these six stations in their remote locations would have taken about a year, had they been installed under normal operating procedures in peacetime.

The radio net completed under such trying conditions is now in operation and is providing dependable radio communication along the short route to Europe.

Radio teletype equipment for the project was made by Western Electric and its subsidiary, Teletype Corporation, and Western also supplied special radio teletype terminal apparatus.

In the field, radio equipment from Western Electric is used in most of our Army's tanks and in large quantities in other vehicles. These FM tank and field

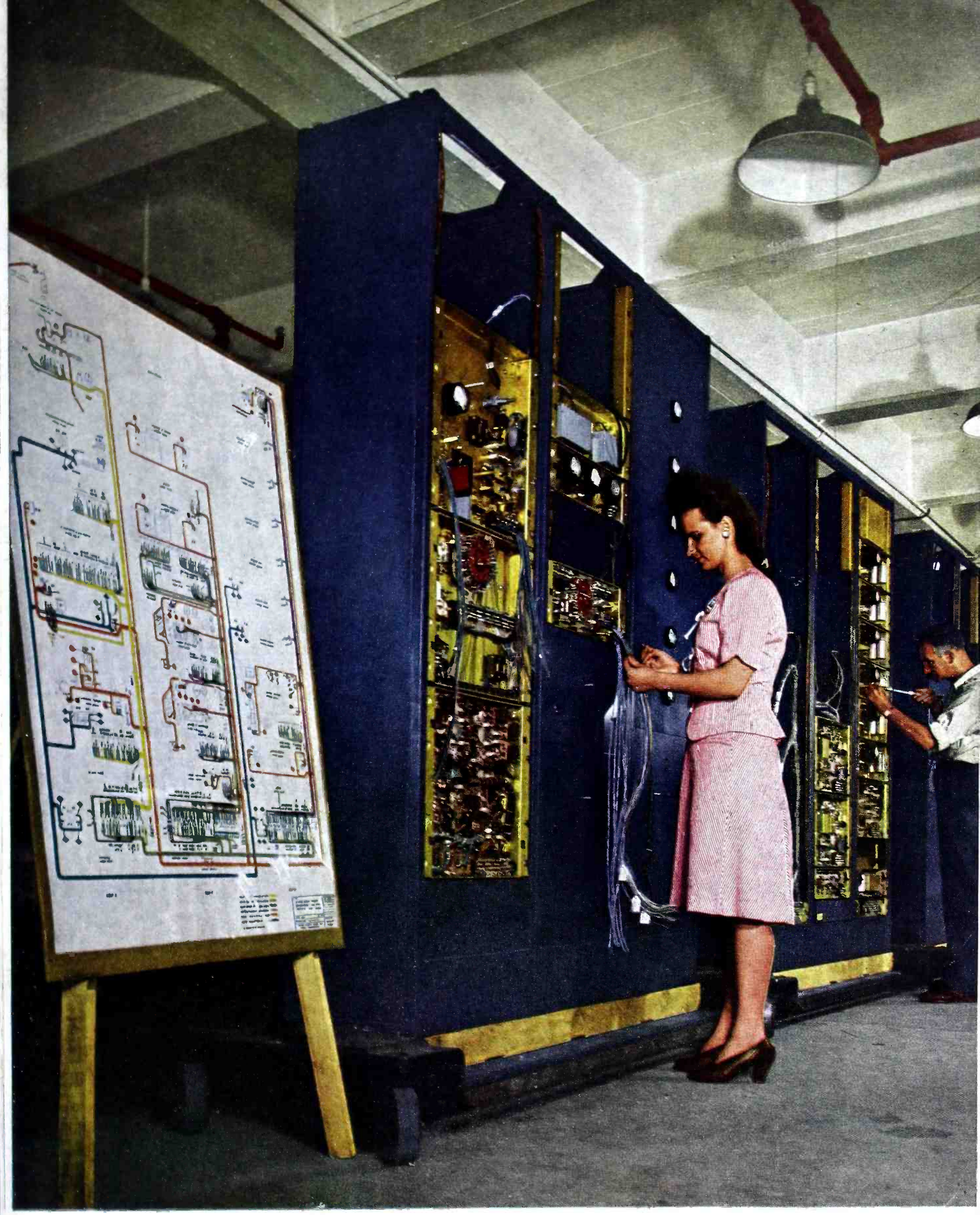
(Continued on page 23)



Western Electric 5 kw transmitter just before shipment to OWI for use overseas in psychological warfare. Large numbers of Western transmitters from 250 watts to 50 kw are used by the OWI throughout the world.

In the New York radio center of OWI, these Western Electric program amplifiers, power amplifiers and driving amplifiers — 46 in all — serve the 14 high fidelity transcription recording lathes.

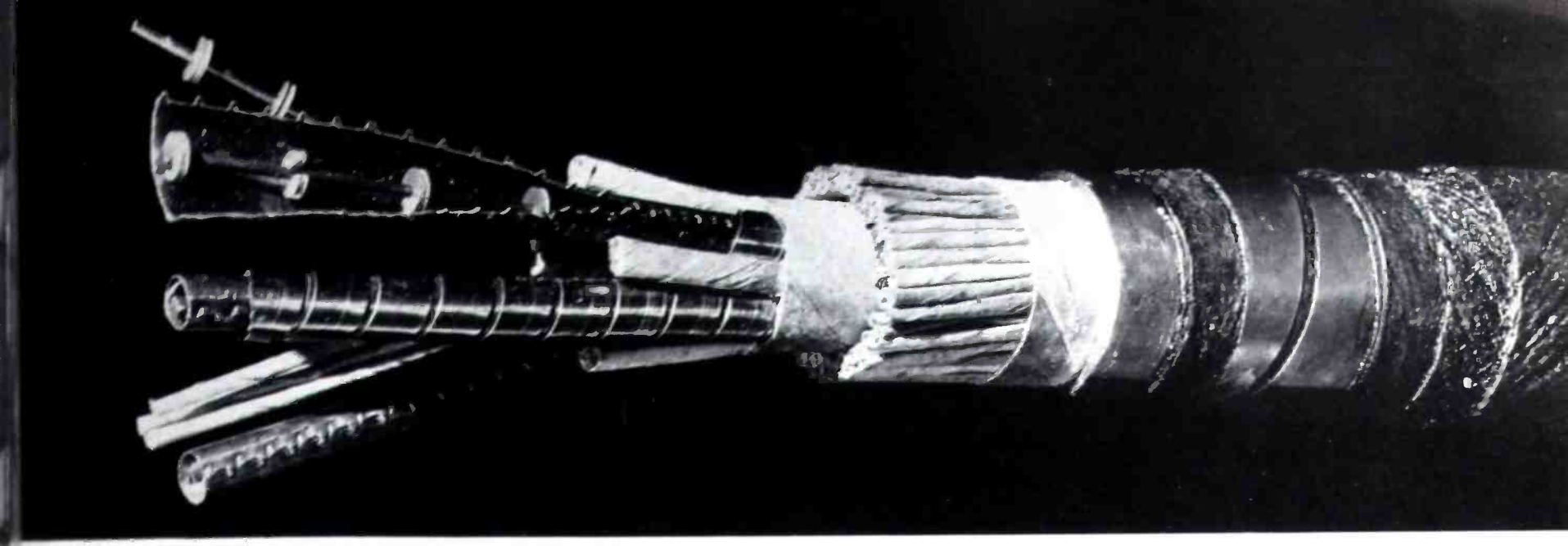
War workers at a Western Electric plant add the finishing touches to a line of 1 kw broadcasting transmitters to be used in the United States Government's overseas psychological warfare program.



Wiring transoceanic radio receivers of single sideband type is an intricate job. These three Western Electric receivers are destined for the use of U. S. Army Communications Service at home or overseas.

War messages from Signal Corps message centers in this country are flashed to Allied capitals and to war theatres throughout the world over Western Electric transoceanic radio equipment.

Checking a piece of radio equipment after it has been submitted to a temperature of 30 degrees below zero in the stratosphere chamber of the Western Electric Type-Test Laboratory.



Coaxial cable has been much in the news lately. Here is fanned out view of latest type Western Electric cable which can carry television circuits.

A. T. & T. Plans for Television

PLANS for placing television on a nation-wide network basis, comparable to that of modern sound broadcasting, received practical impetus recently with American Telephone and Telegraph's announcement of a construction program involving two projects of significance to those interested in broad-band transmission. They are (1) a trial repeatered radio system; and (2) a nation-wide coaxial cable program of 6,000 to 7,000 route miles, which is expected to be completed within five or six years.

The repeatered radio system to be constructed between New York and Boston will determine what can be done now with a system of this type in comparison with wire methods of transmission. It is intended to make trials of both multiplex telephone transmission and television transmission.

The first steps have already been taken. Application has been granted by the FCC to begin construction of two Class-2 (experimental) stations in New York and Boston to be terminal points of the proposed wide-band, point-to-point radio repeater circuit. The time of operation authorized for these stations was unlimited. The stations are to have 10 watts of power and twelve bands of frequencies, each ranging from 11 to 23 megacycles in width in the ultra-high and super-high frequency range as follows:

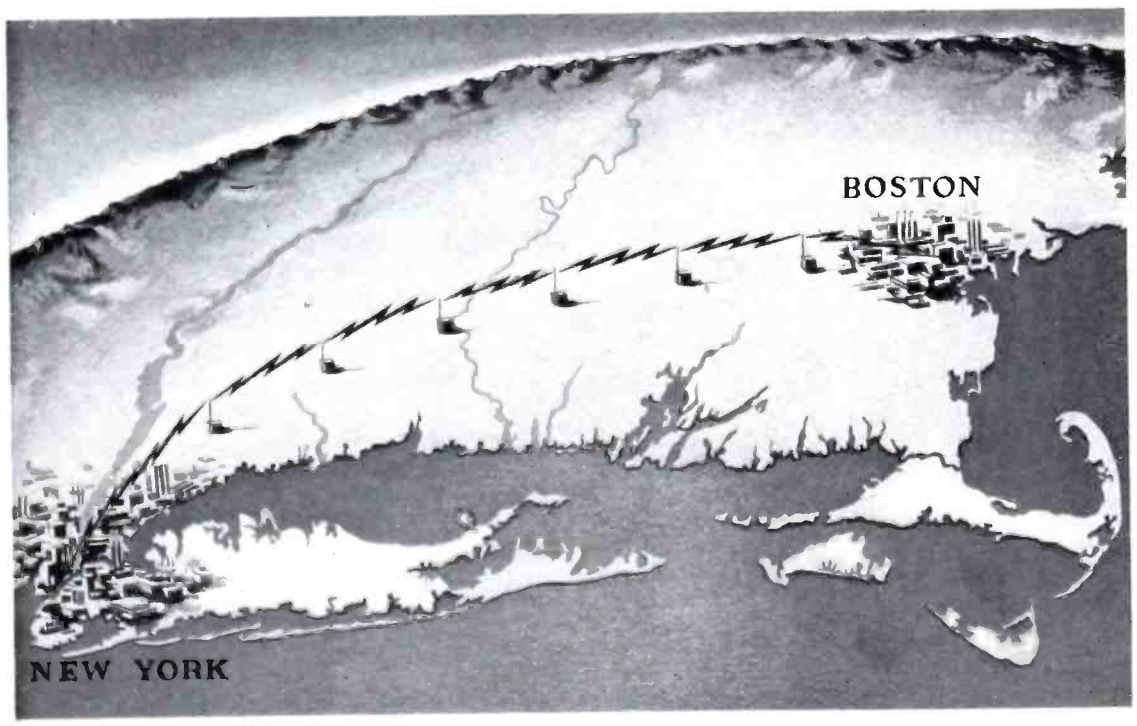
1,914,040 kc to	1,925,960 kc inc.
1,974,010 kc to	1,985,990 kc inc.
2,193,900 kc to	2,206,100 kc inc.
2,253,870 kc to	2,266,130 kc inc.
3,993,000 kc to	4,007,000 kc inc.
4,052,970 kc to	4,067,030 kc inc.
4,292,850 kc to	4,307,150 kc inc.
4,352,820 kc to	4,367,188 kc inc.
11,489,250 kc to	11,510,750 kc inc.
11,689,150 kc to	11,710,850 kc inc.
12,288,850 kc to	12,311,150 kc inc.
12,488,750 kc to	12,511,250 kc inc.

The whole project is expected to require two years to complete; it will cost about $2,000,000, and the work will proceed as rapidly as the war situation permits. At present engineers of Bell Telephone Laboratories essential to technical phases of the undertaking are engaged in war work. See article on page 12.

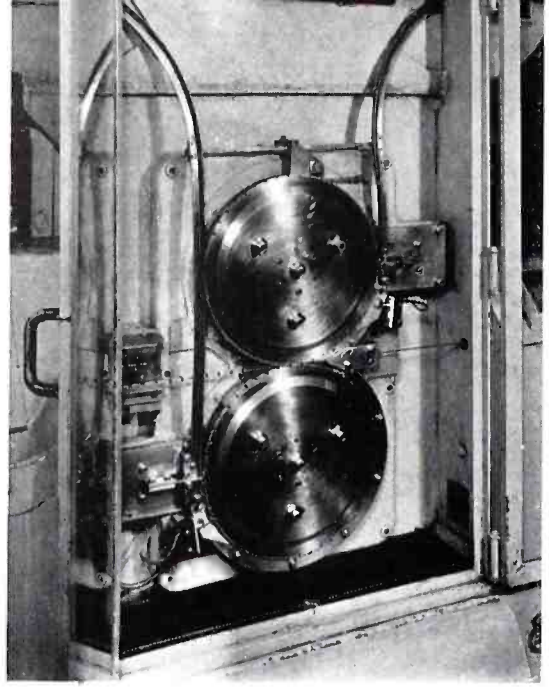
The repeatered radio system is of a type which was under development by Bell Laboratories prior to the war. It applies to communication by radio some of the techniques which have played an important part in the development of long distance telephone circuits and network sound broadcasting transmission. Directed radio beams at ultra-high frequencies will operate simultaneously in both directions and these will be relayed at stations spaced at an average of about 30 miles throughout the route.

This experimental short-wave system, which will use micro-waves, represents another step in efforts to harness and control shorter and shorter wave lengths, an essential development for the successful transmission of television. Overseas commercial radio telephony to England initiated by the Bell System in 1927 used very long waves. Soon afterwards transoceanic telephony employed shorter waves, and just before the war, a radio telephone service, using waves only two or three meters long which do not travel much beyond the horizon, was established between Norfolk and Cape Charles across Chesapeake Bay and between Boston and Cape Cod across Massachusetts Bay.

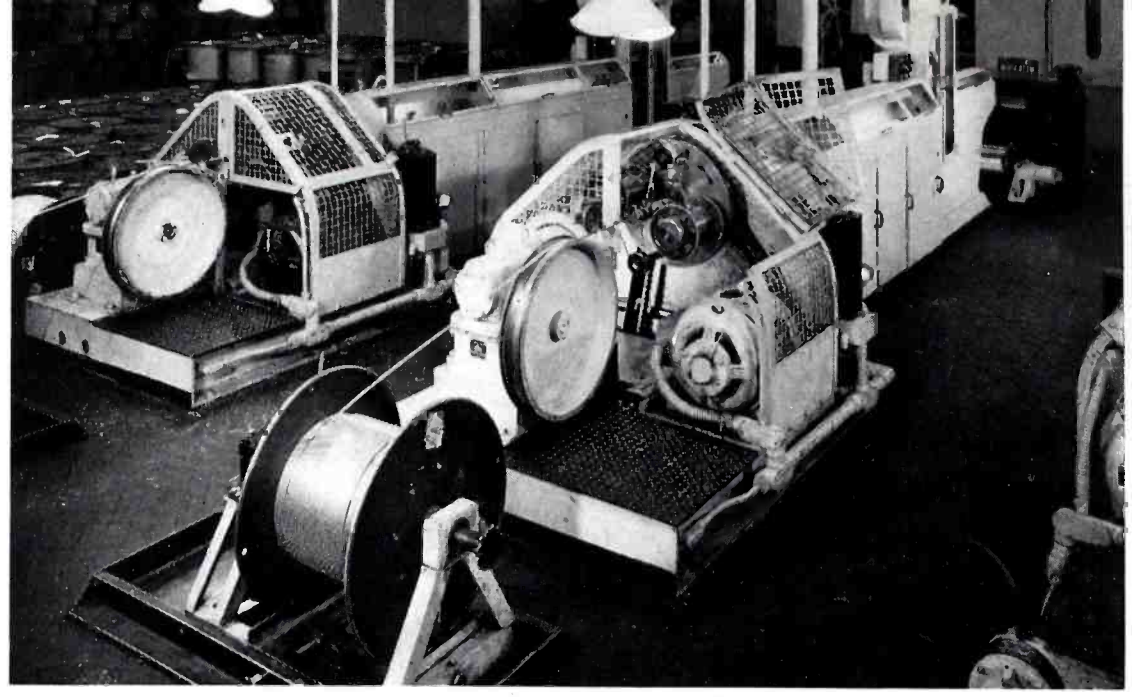
This first series of short-wave stations, it is hoped, will determine by practical operation the relative merits of the whole repeatered radio method for television transmission as compared with transmission by coaxial cable.



Sketch of suggested experimental repeatered radio system. It shows graphically how New York and Boston may be linked by long distance facilities which may also provide for television band transmission.



In manufacture of coaxial cable, applicating wheels force insulating disks on center wire.



One operation in manufacture of coaxial cable — machines apply double wrapping of steel tape to coaxial unit before unit is wound on takeup reel. Tape protects against electrical interference.

Regardless of how this repeatered radio experiment works out, however, the success of broad-band transmission has already been proved, and so a second and much larger undertaking of importance to television under this proposed Bell System program is the construction of approximately 6,000 to 7,000 route miles of coaxial cable facilities within the next five or six years to meet expected increasing demands for long distance telephone service. The significance of this to television lies in the fact that the "coaxial"— a copper tube with a single wire in its center — can carry signals of the required quality, quantity and speed for television. Television's transmission requirements are stiff. The equipment must carry a complete description of about thirty different visual images per second. Since this is accomplished in effect by dividing each image into 200,000 or more different parts and sending a signal to the distant point indicating the density or degree of brightness of each part, together with its relation to other parts of the image, the transmission of television requires facilities capable of transmitting and carrying six million or more different signals per second. Equipment as now developed for use with coaxial cables — a product of years of research in Bell Laboratories — provide television channels of 2.7 megacycles (2,700,000 cycles) in width by the exclusive use of a single coaxial unit or pipe.

A rough idea of the capacity of such a frequency band can be had from the fact that 480 telephone circuits can be provided over a single pair of coaxials with present amplifying equipment. The trials which have been made over existing coaxial cable routes have indicated that such a channel will allow the transmission of very satisfactory television pictures. Further technical improvements are expected to make possible television channels of 4 megacycles, or broader if required by the television industry. Simultaneous use of the same coaxial for television and for a large number of telephone messages is indicated.

Experiments with coaxial as a means of transmitting many telephone messages simultaneously over two pairs of conductors began more than a decade ago. The New York-Philadelphia cable, containing two coaxials, was installed in 1936 for further experiment. Its use for transmitting visual images for television was first demonstrated in 1937. The cable recently has been providing telephone circuits.

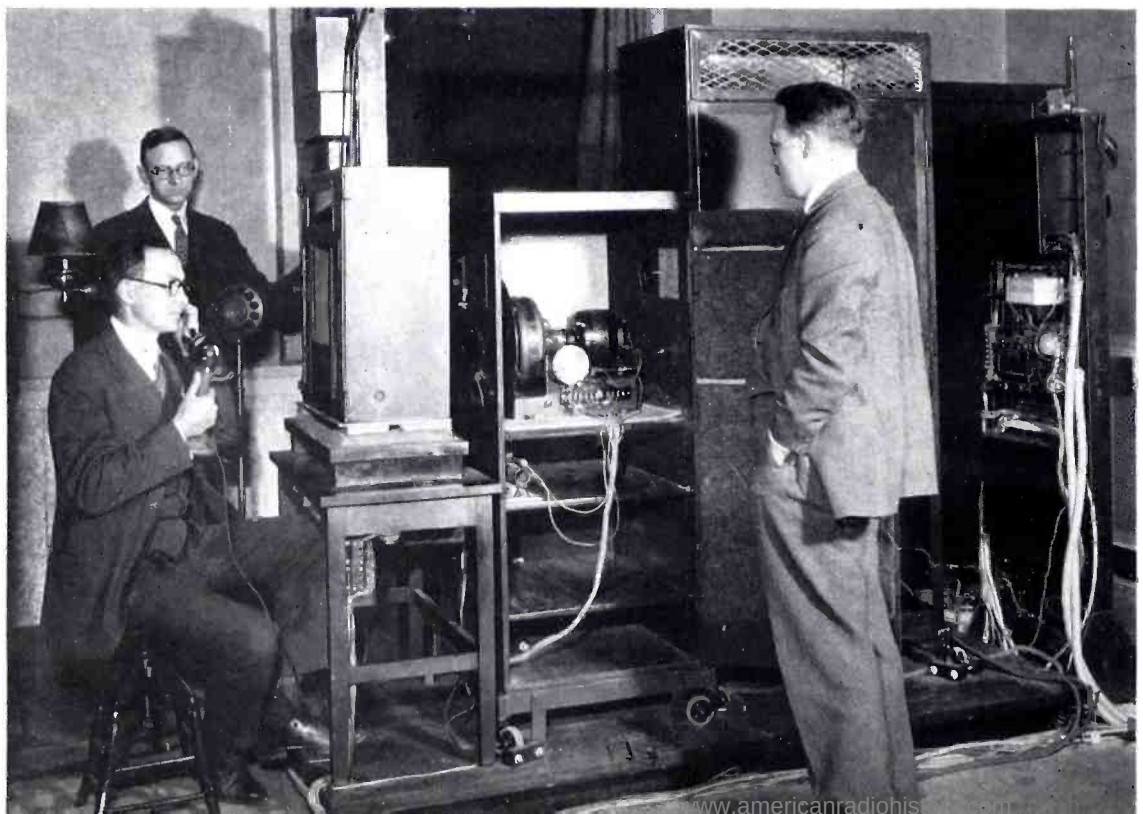
The first commercial installation was the Stevens Point-Minneapolis cable, containing four coaxials (two in regular use and two in "stand-by" use). This is capable of providing 480 telephone circuits with its present amplifiers.

One of the cables now in use between Philadelphia and Baltimore and another between Baltimore and Washington contain coaxials. The former contains six coaxials and the latter four. Construction of the 295-mile Atlanta to Jacksonville route is now underway.

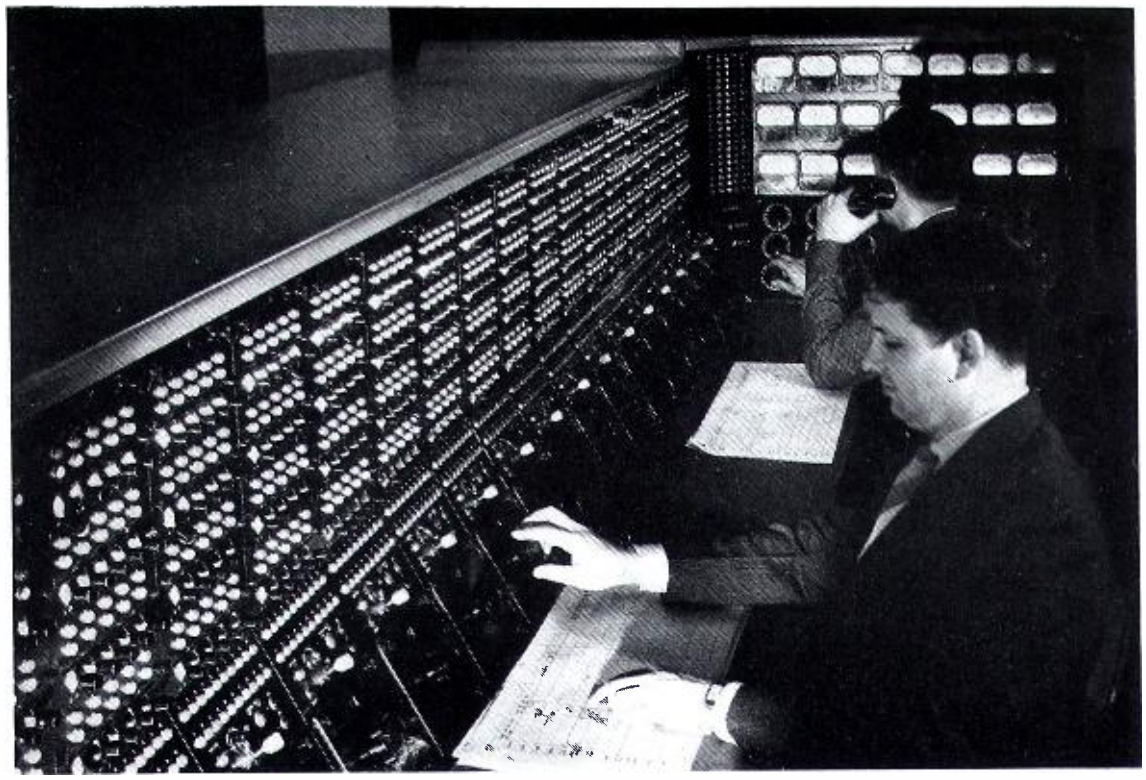
The new construction program calls for an enormous expansion of the coaxial routes within the next five or six years, representing an investment by the Bell Sys-

(Continued on page 35)

Equipment over which the Bell Laboratories sent black and white images in its first public demonstration of television in 1927. The Laboratories and Western Electric were television pioneers.



First public demonstration of color television held in 1929 by Bell Telephone Laboratories.



Master control desk in New York studios — center of the OWI's radio activities in this country. Specially designed, it has 1,500 relays, 1,600 lamps, 600 switches furnished by Western Electric.

Ship-to-shore radio telephones are a vital part of the Coast Guard's hard-hitting "sub-chasers."

You Can't Win a War without Radio

(Continued from page 16)

artillery radios are described in detail in an article beginning on page 6.

Perhaps of greater personal interest to GI Joe than either the strategic or tactical radio nets of the Army is his own special radio system — the Armed Forces Radio Service. These are broadcast stations operating in many sections of the world where Joe is stationed and their sole purpose is to give his morale a boost by bringing him news, music and entertainment, wherever he may be. Operated by the Morale Service Division of the Army Service Forces, this "network" of local GI radio stations is another military customer for Western Electric radio equipment.

Among other radio items made by Western for war use are mobile, truck-mounted radio stations for communication in the field over relatively long distances, and radio telephone sets for Coast Guard boats.

Distinct from the military services of the country but an active and powerful force directed against our enemies is the Office of War Information. One of the OWI's major functions is to originate and transmit radio programs in many languages to every corner of the globe, and its efforts are now largely in the direction of psychological warfare, in which field it cooperates closely with Allied armed forces. From the U. S. it sends a steady stream of broadcasts to South American, European and Pacific areas, and this broad coverage is augmented by regional stations operating overseas.

Western Electric broadcast band transmitters used by OWI at overseas points range from 250 watts to 50 kw. The color photograph on page 18 shows some of the 1 kw transmitters now being assembled by Western Electric for the OWI.

Center of OWI radio activities in this country are its studios in New York, which are as modern as present-day engineering knowledge and facilities can make them. Into the huge master control desk, designed by OWI engineers, went 1,500 relays, 1,600 lamps and 600 switches furnished by Western Electric. In the equipment racks which line one wall of the master control room are nearly 10,000 Western Electric jacks, four 1126 compressing amplifiers used to reduce level

Naval aircraft radio, adapted from Western Electric commercial aviation radio telephone.

peaks particularly predominant in certain foreign-language broadcasts and four type 118 monitoring amplifiers.

In the recording room, 46 Western Electric amplifiers are used with the transcription recording lathes (see color photograph on page 17). The 18 studios at the radio center use modified Western Electric 23C speech input consoles, and a 25A two channel speech input is installed in a new recording truck to be used for making high quality on-the-spot transcriptions for rebroadcast.

Smaller than the studios in New York but very nearly as complete are those used by the OWI in San Francisco. The programs broadcast from there are similar to the ones aired from New York but are beamed westward to cover Japan and Jap-occupied territories. Western Electric studio equipment is well represented in this West Coast installation.

Working in close cooperation with the OWI is the Psychological Warfare Branch of the Army, organized in London just before the invasion of North Africa. One of its noteworthy contributions to the Allied cause is the North Africa radio installation which sends a continuous barrage of long and short wave programs to Italy, Germany and occupied and unoccupied countries of Europe. Transmitters, speech input consoles and other radio apparatus made by Western Electric and turned over to the Psychological Warfare Branch by the OWI were used in this unusual installation. One of the transmitters is of French manufacture and was left intact by the retreating Germans except for broken tubes and sockets. Four Western Electric 298A's were sent from the States and used as replacements in the final amplifier stage.

The foregoing, of course, has not dealt with many other Western Electric communications and electronic devices which are playing important war roles. Ask the GI, the general, the seaman or the admiral, and each will tell you that wherever he serves — be it on land, at sea, under the sea, or in the air — Western Electric equipment helps to fight his battles.

Radio Fights Its First War

(Continued from page 5)

attached to Army Air Forces, is in Honolulu. Lt. Francis Kearney, formerly of WRUF, Gainesville, Fla., was killed in action in the Aleutians, and from the same station, Lt. William Carey became a prisoner of war in Germany. Lt. D. L. Allen, formerly chief engineer of KGIW, Alamosa, Colo., served 17 months in England and flew with the English in the Battle of Britain. He is now stationed in the United States; and Captain N. J. Rifkin, formerly of KRSC, Seattle, has served in the 8th Bomber command in England now for 19 months. At least one Air Wac is reported: Virginia Vermillion, formerly of KLZ, Denver.

In the Navy: Many of Broadcasting's best men also went into the Navy. Ensign Tom McClelland, formerly chief engineer of KLZ, Denver, was aboard the battleship *Arizona* and fell in action at Pearl Harbor, December 7, 1941 — Broadcasting's first casualty of war. On November 28, 1943, the destroyer escort vessel, *U.S.S. McClelland,* was launched honoring this hero. Lt. C. G. "Chick" Morris, formerly of WBZ, Boston, served as radio officer aboard the heavy cruiser *Helena* for 13 months prior to her sinking by the Japs at Kula Gulf in July, 1943, and lived to tell the tale. From WLAC, Nashville, Tim J. Sanders, a marine in World War I, was recommissioned shortly after Pearl Harbor and is now a captain serving in the South Pacific. From WTOP, Washington, D. C., Lt. Comdr. Lloyd W. Dennis, Jr., is now serving with the 7th Amphibious Force, Southwest Pacific, and Lt. J. P. Moore, who saw service on a mine sweeper, is now a communications officer stationed in the U. S. Station managers and chief engineers now in the Navy from

He has served more than two years in the Signal Corps . . . Lt. Col. W. E Groves, formerly of KSL.

He is a prisoner of war in a Japanese prison camp . . . Earl Guye, formerly of Station KFRO.

some of Broadcasting's more than 900 standard stations are Lt. Comdr. Gifford Grange, former engineer of WJAX, Jacksonville, who is serving as Communications Officer on the *U.S.S. Ticonderoga;* and of the same station Ed. L. Dugger, a marine, who took part in major offensives on Bougainville, Guadalcanal and Tarawa; Lt. (j.g.) J. Gordon Keyworth, former chief engineer of WELI, New Haven; Comdr. Ralph Kiibler, formerly of WISE, Asheville, N. C., now in Hawaii; Lt. Comdr. George B. Storer, formerly president of the Fort Industry stations; CPO Anthony Michaels, former chief engineer of WLLH, Lowell, Mass., now in Central Pacific area; Lt. Comdr. B. A. Carlisle, formerly of WDAF, Kansas City; and Ensign Paul H. Lee, former chief engineer of WWNY, Watertown, N. Y. Ensign Lee had the special job of installing radio transmitters on ships. He had done extensive work with radar and secret war equipment. His first job with the Navy was at the Western Electric Co. on military communications installations. From WEED, Rocky Mount, N. C., former chief engineer, Ike Murphrey, joined the Navy and is now serving in the Arctic theatre, and former chief engineer Fletcher Ball of WBIR, Knoxville, is now serving in the Navy as a radio man. Lt. (j.g.) J. M. Griffith, formerly manager of KADA, Ada, Okla., is now a communication officer aboard a tanker. Lt. Comdr. Clement W. Young, formerly of KOWH, Omaha, up from an apprentice seaman in two years to a lieutenant commander, has the job of assigning gunners aboard freighters, tankers and transports, and Lt. Comdr. Wendell G. Osborn, formerly of WWJ, Detroit, served as the gunnery officer on the *U.S.S. Juneau* and died in action on his ship. Now serving in the Bureau of Ships are Comdr. A. B. Chamberlain, former chief engineer CBS, Lt. Comdr. Carl Meyers of WGN, and Lt. Comdr. Paul De Mars, formerly vice president of the Yankee Network. Lt. Comdr. Robert Lewis, former chief engineer of KMYR, Denver, was last reported deck officer aboard an aircraft carrier in the South Pacific, and among the women who left for the Navy are Barbara Key, formerly of KADA, Ada, Okla., now reported a Yoeman 3/c, WAVES; Frances Balcom, formerly of WJTN, Jamestown, N. Y., also a WAVE, and Eileen Johansen, formerly of KGY, Olympia, Wash., who entered the Marines.

The Coast Guard claimed John E. Boren, former chief engineer of KYOS, Merced, Calif., and Jay Graves, formerly of KMYR, Denver, now serving in the Far Eastern theatre.

In the Army: Finally, thousands of Radio Broadcasting's finest went into this service in all of its numerous branches. One of the most interesting jobs reported was that of Captain Glenn G. Boundy of the Signal Corps, formerly chief engineer of WWVA, Wheeling, West Virginia, who is now supervising the Army Communications network in Persia. Assigned to Teheran, Captain Boundy worked on the communications setup for the famous Teheran Conference and was largely responsible for the success of the Teheran broadcasts. WWVA production manager, Paul J. Miller, reports:

"Captain Boundy is in a rugged section of the world. Men are not sent out on details alone because of the Arabs. One soldier sent out by Captain Boundy returned without his jeep and without his clothes — the Arabs had stolen them. Fishing is apparently good as Captain Boundy reports his men use the whip antennas for fishing poles."

From the same station is Maj. William L. Thomas, now in Alaska, where he recently completed a school program of Army Legal Training conducted in the

He is chief of the OWI Bureau of Communications Facilities . . . James Weldon, radio engineer.

unusual setting of Quonset huts at sub-zero temperatures. Col. Albert Warner, formerly news director of WTOP, Washington, one of Columbia's crack news commentators, is now Chief, War Intelligence Division, Press Section, War Department, and has the key job of passing on military information for the press. Capt. Jack Reilly, former general manager of KOY, Phoenix, is now overseas with the Civil Affairs Personnel Pool and it is our understanding that he is pointed for the German Army of Occupation, while Lt. Col. Jack Harris, formerly of WSM, Nashville, is now acting chief, Radio Branch, War Department Bureau of Public Relations. Sgt. Claude Harris, Jr., formerly chief engineer of WAOV, Vincennes, Ind., received intensive training in radar and radio and is now in China for the U. S. Army constructing radar and radio stations for communications. Lt. Gilbert R. Schoener, formerly of KFAM, St. Cloud, Minn., was one of America's heroes who fell in action at Cassino and Pvt. Thomas Williams, formerly of WLS, Chicago, another American hero, died at a field hospital of wounds he received in action on Biak Island. Among broadcasting men in the Army who were formerly managers or engineers of the Nation's stations are Maj. Edward Hopper, former chief engineering supervisor of WHN, New York, now in the Troop Carrier Command; Maj. W. S. Swartley, formerly general manager of WBZ, Boston, now in the Ordnance Branch; Lt. Col. W. E. Groves, former chief engineer of KSL, Salt Lake City, now in the Signal Corps; Capt. Gordon Gray, former president of WSJS, Winston Salem; Maj. John A. Smithson, former chief engineer of KFVD, now stationed in Hawaii; Capt. Francis Ries, former chief engineer of KCKN, Kansas City, who served in the South Pacific campaigns;

He was torpedoed at sea . . . Ensign Philo Stevens, radioman, formerly of station WBEN, Buffalo, N.Y.

She is serving her country as an Air Wac . . . Virginia Vermillion, formerly of KLZ, Denver.

I. E. Dickenson, former chief engineer of KMJ, Fresno, Calif.; Maj. Francis Biltz, former chief engineer of WLB now in the Army Service Forces; Troy Carlton Wooddell, formerly of KTRH, Houston; Pfc. Rudolph Luukinen, former chief engineer of WDSN, Superior, Wis., now technical operator of a new Army broadcasting station in the South Pacific; Lt. Col. E. W. Peak, former chief engineer of KFJB, Marshalltown, Iowa; Col. Joe Nickell, formerly of WIBW, Topeka, now in Alaska; and Lt. Col. H. T. Gray, former president of WCED, Du Bois, Pa., now in the Adjutant General's office.

One of the men formerly from KFRO, Longview, Texas, Earl Guye, was stationed in the Philippines when the Japs came and is now a prisoner of war reported to be at the Mukden Prison Camp in Manchukuo; and Lt. R. Lee Black, formerly of KIT, Yakima, Wash., is now reported to be in charge of setting up broadcasting stations in the China-Burma-India area. Lt. Col. Ralph Watson, formerly of WMBD, Peoria, is now in the Army Special Services Division and stationed in England. Also in the Army are John L. Booth, president and general manager of WJLB, Detroit, and his chief engineer, E. H. Clark; Sherrell Zimmerman, former chief engineer of KWAT, Watertown, S. D.; Capt. J. Russell Knowland, former president of KLX, Oakland, Calif., now stationed in Washington, D. C.; Maj. Lester W. Lindow, former general manager of WFBM, Indianapolis; Maj. Kenneth M. Meredith, former chief engineer WMBS, Uniontown, Pa.; Lt. Col. H. O. Brickson, former chief engineer of WLBL, Stevens Point, Wis., now in Signal Corps in England; and Charles H. Singer, former technical supervisor of WOR-WBAM transmitters, now chief of the Maintenance Section of the Signal Corps' Operational Research Branch with the job of supervising all operating procedures, preventive and service maintenance of U. S. Army radio equipment.

An amusing sidelight is the experience of Sgt. James Sims, former chief engineer WHLN, Harlan, Ky., who received his induction notice two years after he had been in the Army, and Cpl. Carl Edgar Whikehart from the same station had been in the Army eight months when he received a classification from his draft board of 1C(h).

One phase of total war in which broadcasting men have done a superlative job is that of war reporting. The names of the great network correspondents are so well known to the listening public that they need no mention here. However, a number of outstanding correspondents were drawn from the management and technical fields of broadcasting. Among these may be mentioned Gene Rider, former chief engineer of WQAM, Miami, who made one of the first tape recordings of the landings in Normandy, as a technician-correspondent for CBS; E. R. Vadeboncoeur, vice president of WSYR, Syracuse, who spent six months at General MacArthur's headquarters and flew combat missions in B-25 squadrons on raids on Wake Island; H. R. Ekins, from the same station; and Wilson K. Foster, former general manager of KFAR, Fairbanks, Alaska, now a correspondent for NBC in the North Pacific War Theatre.

In the Merchant Marine: Perhaps no service has played a greater part in this war than the Merchant Marine, and many broadcasting men saw action with these vital carriers in America's lifeline. Philo Stevens, formerly of WBEN, Buffalo, served as a wireless operator, was torpedoed on his first run in the Mediterranean area and was adrift for several hours before being rescued. Ainslie Pryor, formerly of WELI, New Haven, traveled

He serves two stations . . . Louie L. Lewis, of WOI, Ames, Iowa, who also serves KFGQ.

37,000 miles in an around-the-world trip during his service in the Merchant Marine, and the experiences of two other WELI men in this branch are typical: W. Richard Carlson's ship was torpedoed on a return trip from Italy, while aboard another ship in the same convoy was Arthur Tuttle, former WELI engineer. Finally, another Broadcasting man, Murray Blum, formerly of WNYC, a radio operator on the *S.S. Leonidas Polk* after a heroic attempt to rescue seamen of a sinking Dutch vessel, was reported "missing at sea." Lt. Blum had made nine convoy trips and had four ships sunk under him during three and a half years in the service. For the heroism beyond the line of duty, which cost him his life, he was awarded posthumously the rare Merchant Marine Distinguished Service Medal of which fewer than 20 have been given during this war.

Now in the Seabees are Bill Beard, formerly of WLBJ, Bowling Green, Ky., who has seen action at Guadalcanal and New Guinea; Charles M. Stone, formerly of WMBR, Jacksonville; and Harry Adams, formerly of WWNY, Watertown, N. Y., who is now stationed in Hawaii.

General Manager Leslie Joy of KYW, Philadelphia, comments on a very pleasant and unusual coincidence:

"In view of the millions of men in the service, a unique incident occurred recently when four of our KYW members in the armed forces met and had dinner together 'somewhere in North Africa.' The group consisted of a major in the engineers (and former engineer of KYW), two Army lieutenants (one formerly an announcer and one general service supervisor) and a WAC corporal (formerly senior mail clerk)."

In War Agencies and Industries: In concluding these reports of Broadcasting people now seeing action outside of the profession, mention should be made of the profession's many men called into Government agencies and war plants where their special skills are doing a great job for the Nation's war effort. Of these many entered the Office of War Information. Charles L. Jeffers, OWI's chief radio engineer, with headquarters in Washington, was formerly technical director of WOAI, San Antonio. He now has the responsibility of supervising the technical operations of OWI's radio facilities throughout the world. Assisting him in this formidable position is Meredith L. Koerner, formerly radio engineer of WSBT, South Bend. Burton Paulu, former general manager of WLB, Minneapolis, is now in charge of the radio stockpile for OWI overseas in London, and from KROO, Tulsa, L. W. Stinson, former chief engineer, is serving as technical adviser to the OWI Overseas Branch in the Mediterranean area. George W. Herrick, former chief engineer of the Hearst Radio Stations, now has the important job of chief engineer of the OWI New York radio center, while Charles H. Phillips, formerly recording engineer from the West Coast, now supervises recording activities of these studios. Frederick Blackburn, former chief studio engineer of WFLA, who specialized in recording work, was sent to Africa by OWI where he is doing technical work in a short-wave station in Algeria. Jim Weldon, radio engineer, is now chief of OWI Bureau of Communications which has the job of providing the Overseas Operations Branch of OWI with a world-wide communications network, and Jack E. Bannon, former chief engineer of WLOK, Lima, O. and C. W. Heller from the same station are now also members of the OWI team. Other broadcasting men who entered this agency are Earl M. Key, former general manager and owner of WKEY, Covington, Va., and Edward Klauber, before the war a vice president of the Columbia Broadcasting System.

He made the first broadcast to the French people in the North African invasion . . . Major Andre Baruch, former network announcer, standing at the mike in a "Salute to the States" program from N. Africa.

On the National Defense Research Council are such radio broadcasting people as Orrin Towner, former technical supervisor of WHAS, Louisville; D. W. Gellerup, former technical supervisor, WTMJ, Milwaukee; W. L. Everett, former radio professor, University of Ohio; and F. E. Terman, formerly professor of electrical engineering, Stanford University; Neville Miller, former president of National Association of Broadcasters, once mayor of St. Louis, is now Balkan director of the United Nations Relief and Rehabilitation Admnistration. George B. Bairey, former general manager, KFAM, St. Cloud, Minn., is now serving with the Government Monitoring Service in New York, and Les Biederman, former manager and chief engineer, WTCM, Traverse City, Mich., is serving as consultant and adviser to the Chief Signal Officer and has been since 1942 a member of the Operational Research Branch; Roy M. Flynn, chief engineer of KRLD, Dallas, and Ray Collins, WFAA, Dallas, are on leave to the Government doing work in the Radio Research Laboratories of Harvard University as liaison men between the laboratories and the manufacturers, while Earl Cullum, former consulting engineer, has also left his business to do similar government work at Harvard.

In industry, many Broadcasting people have been given leave of absence from their stations to undertake important radar and electronic assignments in great war plants. In the Western Electric Company alone, William Hutton, WGAR, allocations engineer, and Robert Fox, WGAR field engineer, are both on leave from their station for war work; as are John Buning, former chief engineer of WSPB, Sarasota, Fla.; Bob Thompson, former chief engineer of KOY, Phoenix; Francis J. Reilly, former engineer of KRLD, Dallas; Vern Fulton, formerly of WLS, Chicago, and Anthony Elia, former chief engineer of WJPA, Washington, Pa., who went to Western Electric Radar School. Two important social agencies also claimed Broadcasting men: C. M. Chapman, formerly of WFBC, Greenville, S. C., a Quaker, joined the Friends Society and went to the Burma Road. He is now presumed to be a prisoner. Wallace Husted, former general manager of WLOL, Minneapolis, is now somewhere in England in the foreign service of the American Red Cross.

These are, of course, but a few of the most dramatic experiences of the estimated 7,000 Broadcasting men and women in the armed forces and on the battle fronts of the world as gleaned from our nationwide

survey. So far, over a hundred Americans from this industry have been reported killed in action and at least sixteen have been reported prisoners of war. Thus, it can safely be said that no other profession has contributed more than has Broadcasting of its best men and women to the far-flung war fronts of the world.

Broadcasting at Home

But what of Broadcasting at home?

Few stations, the survey shows, escaped the immense manpower drain or the great increase in broadcasting load. Out of all the reports we received, only one station, WSFA, of Montgomery, Ala., was fortunate enough to have kept its original key staff intact. President Howard E. Pill reported this unique situation as follows:

"Our general manager, assistant general manager, the local sales manager, the program and traffic manager and the chief engineer — the five key men of our station — started here on the same 'team' away back in 1930, fourteen years ago, when this station opened. We fought out the Depression together — and we're still together carrying on through these war days. Two of us are now 37 and the others over-age. None of the five of us has ever held a position in radio elsewhere."

This was certainly not typical of the conditions prevailing in any of the other stations surveyed or throughout the whole industry. Replies to questionnaires showed that all stations canvassed lost at least one important man, that 78 per cent of the Nation's stations lost their chief engineer or general manager, and that a typical station has lost an average of 30 per cent of its technical force. In many of the smaller stations which felt the burden of manpower losses most heavily, practically the entire staff went into the services, leaving perhaps one or two people struggling to keep the station open.

It is not difficult, therefore, to appreciate the problems of Broadcasting at home under these conditions and the amazing thing is that the job has been so well done.

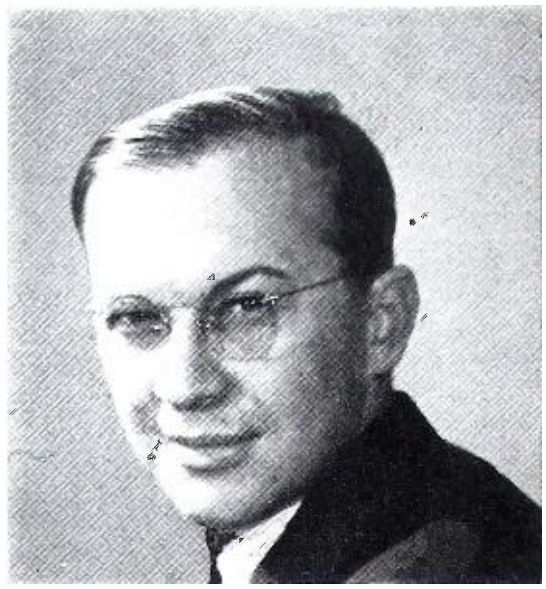
He served in the Troop Carrier Command in England . . . Major Edward Hopper, formerly of WHN.

Station Manpower Losses: Typical of station manpower losses on the home front, for example, is the case of WOR. This 50 kw station lost 16 technical men, 10 program men to the armed forces and 13 other engineers to special services. Two supervisory engineers are on leave of absence, one in the Operations Research Section of the War Department, the other in radar work with Western Electric Company. In addition, two engineers are working in radiation laboratories, two in The National Development Research Commission, four in the OWI and two in the U. S. Treasury Department. Yet this station has continued operation at a peak level of quality and efficiency.

Another example is WFBC, Greenville, S. C. Manager B. T. Whitmire reports that this 5 kw station has lost 23 men out of a staff of 23 — 100 per cent — plus 3 of the men they hired to replace those gone to war. The station is now operated entirely by draft-exempt men and women. Another 5 kw station, KXOK, St. Louis — Neil Norman, public relations director, tells us — lost a total of 34 men to the armed forces, 10 of them technical men. Yet owing to the organizational and directive job done by Station Manager Chester L. Thomas, the station has been able to continue operating with a full staff and at top proficiency. Managing Director Stanton T. Kettler of the 5 kw station WMMN, Fairmount, W. Va., reported that at one time they operated their transmitter on an 18-hour day basis for four months with only two transmitter engineers.

But it is the smaller stations which have really felt the weight of manpower losses. Where a larger station can lose six and seven men and still have a good proportion of its staff, a smaller station losing only three or four technical men has lost practically its entire engineering force. Take the cases of KSUB, Cedar City, Utah; WLAG, La Grange, Ga., and KASA, Elk City, Okla. — all 250 watt stations. Hurschell G. Urie, general manager of KSUB, reports that they lost four men and have not been able to replace three. Thus during the last year, Manager Urie has worked regularly two shifts — including such odd jobs around the station as "janitor, shipping agent, line man, etc...." "It's quite a life!" he comments.

Manager Edwin Mullinax of WLAG is now operating with a staff of four people out of the seven he used to have. His duties at present are described as follows: "Station manager in addition to handling all executive duties does all the selling, copywriting, program directing, announces and



He works a twelve to fourteen-hour day . . . Chief Engineer John H. Stenger, Jr., Station WBAX.

stands transmitter watch seven hours daily." This station, in spite of these difficulties, has not shortened its broadcasting day and is on the air daily for 16 hours, and 17 hours on Sundays.

Supervisor F. E. Mayhew of KASA, notes:

"Our station has become known as the 'one-man radio station' due to the fact that during the time the armed services were taking engineers right and left, it became necessary for the supervisor to make a hurried trip to Dallas and take an engineer's examination. He made it, and since then, Sept. 1942, no engineers have put in their appearance at KASA. I am still chief engineer, supervisor and manager operating the station with a skeleton crew so that at times it does resemble a one-man radio station."

Similarly Manager Ken Given of WLBJ, Bowling Green, Ky., who lost 12 men to the armed forces reports, "I am now doing the work of four people in peacetime operation. For instance, I write practically all continuity, do all the selling, work a regular announcing shift, handle all remote broadcasts, particularly sports and special events. This keeps me going from early morning till late at night."

But perhaps the experience of WKBZ, Muskegon, Mich., sums up the difficulties of the small station. President Grant F. Ashbacker reported: "I have only eight of our oldtime employees left from a staff of 30. Hired 104 in past two years to keep 18 others on staff."

These have been the experiences of station after station throughout the country since war began.

What expedients, then, have been most successful in meeting this shortage? And what methods of keeping stations on the air have been undertaken where the manpower shortage cannot be made up? There have been several answers to these dilem-

mas. One attempt at solving the first problem has been the hiring of women to replace men gone to war.

Women in Broadcasting: Of the stations canvassed our survey shows that 48 per cent have replaced men who have left with women, both in the technical and program departments and a substantial majority, 66 per cent were enthusiastic about them. Smaller stations of 1 kw or less used women to a greater extent. A little over half of these reported that they employed women as replacements, while about 45 per cent of those over 5 kw reported use of women as replacements. More than 65 per cent of the smaller stations reported women very satisfactory while 20 per cent reported them unsatisfactory; and 68 per cent of the larger stations reported them excellent, while 25 per cent reported them unsatisfactory.

Typical comments were:

"In control room work, we find women as good and frequently better than men."

"Women have worked out excellently and are doing a wonderful job. As a matter of fact, as a whole, they pay stricter attention to details than men."

And General Manager Leslie Joy of KYM noted:

"In the fall of 1943, we selected six women whose backgrounds were peculiarly adapted to technical operation. We gave them three months' extensive training course, after which we placed them on our operating schedule. These women have worked out remarkably and we have been highly pleased with the results of our experiment."

Other comments:

"We have had a first-class woman operator at our transmitter for a year, and she's been very beneficial in more ways than one. The appearance of the engineers has been enhanced a good deal; the floor is scrubbed without threats, and equipment seems to be kept in better condition."

"Splendidly — we employ three women holding 3rd class tickets. They are diligent — more observant of detail than men — interested in work — studying for first class licenses."

A survey made under the auspices of Station WLBJ, Bowling Green, Ky., found that women were acceptable as announcers to both the station's clients and listeners, and Program Director Mary Mangold of KBUR, Burlington, makes a further interesting observation on this subject: "Since women make up the greater percentage of the listening audience, it seems natural a woman should program a radio station."

One station, having lost all its technical men, now has perhaps the only all-woman engineering staff in the United States, and the station's president comments: "While these girls have proved more efficient than men, we will of course give the jobs back to returning boys." And another comment: "Women have worked out splendidly and we will always want one or two on our staff. As far as mechanical control room operation is concerned, they appear more alert, conscientious and capable. Totally satisfactory."

Chief Engineer H. J. Lovell of WKY, Oklahoma City, a station whose three girls make up 33⅓ per cent of the staff reports:

"We're completely satisfied with our girls. They're well trained and are doing a swell job. These girls work in regular shifts, alternating hours, working together whenever transcriptions are made. They take care of all duties that entail straight studio operation. Minor adjustments can be made by any one of the three and it's a matter of record that nothing has happened

She is a peach who has made a real success in Broadcasting . . . Patty Roberts, station WKY.

so far at WKY while any of the girls has been on duty that she hasn't been able to handle. They can balance and arrange radio setups for anything from a three-piece corn band to a symphony orchestra. And there is plenty of big league studio production going on here. The three have also had a hand in the construction of the new 915-foot antenna that is being built, doing some of the surveying, laying of ground wires and miscellaneous jobs around."

And again:

"Quite satisfactorily. We have been fortunate in keeping our chief engineer who has taken over all major technical work. But women have been trained very successfully to operate the transmitter on FCC permits." But here is the final tribute:

"They worked out very well — I didn't believe it was possible."

On the other hand the battle of the sexes is never ended. Of those managers who expressed dissatisfaction with women, most found them inadequate in the technical department, although one or two found them unacceptable to their listeners as announcers. Of the more thoughtful comments these may represent the feeling of a majority of managers canvassed who replied unfavorably:

"Our principal objections to women in technical positions are their inflexibility, their emotional nature, and they do not seem to be as dependable or punctual as men. Furthermore, they do not readily accept responsibility."

And another from a 50 kw station:

"Where only routine control work is required, we have found that women work with some degree of satisfaction. However, it has been our experience that their value as general radio or maintenance workers is limited. There also seems to be a psychological factor involved which appears to limit their efficiency."

There was the case of the woman who resigned because "work made her nervous." One manager, apparently a hopeless misogynist, replied:

"Women in radio — a joke. They are always too tired, too lazy or too something to do a good job. If the pitching gets hard, they either hide behind their skirts or their tears. We tried and gave up in disgust."

And another station vice president concluded:

"Women do not work out any too well. We employed one woman who had just gotten a radio telephone license. She called in one afternoon to say she was going to Texas to marry her boy friend in the Army. Left within the hour, no notice, no farewell! QED: Woman's place is not in the control room!"

Finally, the manager of a 5 kw station remarked laconically: "The place looks like the casting department of the Ziegfield Follies," and further on in the space where the survey requested human interest stories, there is the single startling word "CENSORED!"

From the foregoing reports and as in the case of men, therefore, our only conclusion can be that the usefulness of women in the technical and program departments of radio seems to depend entirely on the woman, but the fact remains that they are doing a wonderful job for the industry and many stations would be forced to go off the air without them.

One of the most interesting letters we have received in the course of this survey was from Miss Lois Crawford, manager of KFGQ of Boone, Iowa — practically an all-woman station with the exception of the chief engineer. In many ways she exemplifies the spirit that has been shown by Broadcasting people everywhere — both men and women — during this war period.

"Our chief engineer is Louis Lewis,

He was known as "a silent fellow" — is now an announcer . . . Charles Sjostrom of KOVC.

Ames, Iowa, WOI. He checks, repairs and constructs. Regular operation is done by Anne Reiffenstein and myself, both licensed operators. We also run an Old People's Home, a Children's Home, a farm, an interdenominational church. The 25 children take part in programs, help with dishes, on the farm, etc. The elderly people help in many ways. People of the church volunteer help on farm. Anne has a large victory garden and a large strawberry patch. I drive the truck — going places for things to eat — potatoes, onions, fruit. I am hoping to drive to Illinois for 100 bushels of peaches (if I can get a bargain) and to Michigan for black, sweet cherries! I wish Vermont maple sugar was closer! Tractor work on farm is done by a man of 73. A woman (75) runs the milking machine. A man of 62 does most of the dairy work with the assistance of small boys. The contralto mows the grass! Our soloist helps cook. Anne can cook also. You should taste her strawberry pie!"

And, as the survey shows, other broadcasting people are also doing this kind of a job both for Broadcasting and for their communities.

High School Boys and Girls in Broadcasting: Another method of licking the manpower shortage and one which many stations, particularly the low-powered ones in which the manpower shortage is most acute, report as having surprisingly good results is the use of high school and college boys and girls, and boys and girls under 17, part-time workers and technicians and helpers outside the industry. Eleven of the smaller stations reported the use of high school students and boys and girls under 18 and were extremely enthusiastic about them.

Comments were: C. W. Neeld, manager of WCBS, Springfield, Ill.:

"We have replaced several of our former employees with inexperienced help, using students from high schools and colleges as announcers and men from some of the defense plants as part-time technicians, and in every case they have adapted themselves nicely. Have two theological students from Concordia Seminary as part-time announcers and our president, Harold L. Dewing, a licensed engineer, has taken over as chief engineer and supervisor of maintenance."

Manager Mel Marshall of KYOS, Merced, Calif., reports that he has had "unusually satisfactory" experience with young men in the 16-18 age bracket holding restricted licenses, and General Manager Joseph D. Mackin of WMAM, Marinette, Wis., remarks:

"WMAM's rapid progress in the past two years demanded an increase in personnel. Training of high ranking high school seniors in announcing and in basic engineering was undertaken — holding night classes two evenings each week. The results were excellent with several other stations taking some of the overflow. WMAM was able to meet the crisis satisfactorily and has been looked up to by the community as a place of excellent opportunity for outstanding young men to progress in the radio field."

General Manager R. T. Mason of WMRN, Marion, Ohio, and Manager D. J. Poynor of WMBH, Joplin, Mo., also report using high school students until drafted or ready to leave for college. Director Garland Powell of WRUF, Gainesville, Fla., informs us:

"The majority of the members of my staff are students of the University of Florida, who desire to follow radio as a life's vocation. They are learning while they are earning and getting practical experience as well. They are tremendously interested in their work."

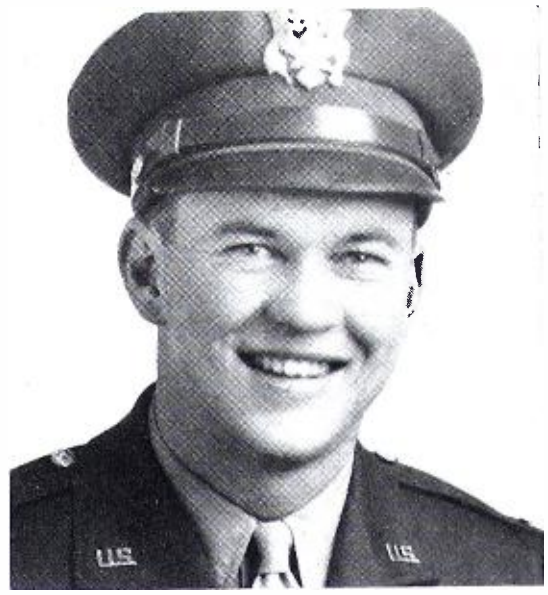
KVFD President Edward Breen of Fort Dodge, Iowa, reported:

"We are using part-time engineers — one a high school teacher, another a motion picture projector operator. We are using part-time announcers, ministers and high school people mostly."

General Manager B. A. Laurie of KNET, Palestine, Texas, with his wife practically runs the station single-handed but what other assistance he does have comes principally from high school people. He reported:

"The manager is president, chief engineer, announcer, salesman, news editor, continuity writer and my wife is secretary-treasurer, traffic, program director, bookkeeper. We have 3 R.P.'s (Restricted Phone Operators). One is a high school student, another principal of Palestine High School."

And Vice President Roy Dabadie of



He is a prisoner of war in a German prison camp . . . Lt. Lowell H. Watts, WLW, Cincinnati.

WJBO, Baton Rouge, La., comments:

"We have also hired several students and people who are physically handicapped, but who are capable of doing jobs in which the physical handicap is not a hindrance."

At KOVC, Valley City, N. D., Manager Robert E. Ingstad reports:

"A 16-year-old student we have — George L. Brooks — has developed into such a capable announcer and all-around man that in this short time he has gained a good knowledge of radio from A to Z. All we are worried about now is losing him when it comes his turn to register. Frankly, he is that valuable to us — believe it or not."

President Robert J. Dean of KOBH, Rapid City, S. D., notes:

"When our former chief engineer went into the Army, we immediately employed National Youth Administration instructor M. J. Jones who is now in war work in Berkeley, Calif. The assistants we employ in the engineering and operation fields we get from the student body of the State School of Minnesota. In the production field, we hire men with 4F status. The salesmen have 2H and of course the women employees do not have any worry about status. We feel we have been very fortunate. The Rapid City Army Air Base furnishes us with men who are in service here when we need a man for a special assignment."

Help from Other Quarters: Besides high school boys and girls and boys and girls under 18, assistance for hard-pressed stations from outside the industry has come from a great number of unusual and unexpected quarters. Already mentioned have been such sources as part-time men from war plants, ministers and teachers, and handicapped people. But the survey uncovered some other surprising sources:

Manager George E. Joy of WRAK,

He operates American Broadcasting Stations in Europe . . . Phil Cohen, former OWI radio chief.

Williamsport, Pa., informs us he is using policemen as operators of the station under the supervision of the chief engineer.

General Manager J. B. Conley, WOWO-WGL, Fort Wayne, Indiana, informs us:

"An arrangement has been worked out with an Army Air Base located in Fort Wayne to use one of our former announcers at night when he is needed and is available."

And this has also been the case with KFFA, Helena, Ark., where Program Director Doris Trainer notes:

"We have been able to use instructors from an air base part-time on our station. These instructors were former radio men."

President Harold H. Thoms of WISE, Asheville, N. C., reports:

"We use servicemen from Naval and Army hospitals on part-time basis. Helps rehabilitate men and pulls the station through manpower problem. Mostly these boys have worked in radio and have some experience, particularly in announcing field."

Chief Engineer B. C. O'Brien of WHEC, Rochester, notes:

"We have been able to use part-time men evenings from local radio warplants," and Miss Winifred Ross, program director of KSWO, Lawton, Okla., informs us that her station hired a 1st Class engineer who works also at the telephone company and uses a restricted licensee to do the actual operation."

Older Men and 4F's: The main burden of keeping stations operating, however, fell on the men in 4F, over-age men and the old timers, men whom one station manager calls "the Old Warhorses" — and these people have done a heroic job in this industry. As the president of one 1 kw station sums it up:

"We use 4F's mostly -- one has a bad arm, one has bad legs, one has arthritis and some are women."

A composite picture of a typical wartime station staff shows 25 per cent over-age men, 40 per cent 4F men, 20 per cent women and 15 per cent men deferred for dependency reasons. Half of the typical station's staff has come to the station since Pearl Harbor, and all of these people are doing a 20 to 50 per cent bigger job.

In practically all stations, the load is far heavier than ever before. There are more emergencies of all types — news flashes, special broadcasts, mechanical failure of one type or another owing to difficulty in keeping maintenance up to par during the materials shortage, extra machinery to carry out war bond campaigns, scrap drives, blood bank volunteer projects and other community programs.

But what happens when — asked to carry this load — stations find that all of these expediencies for gaining manpower fail? The answer may be dealt with briefly under four categories: "Longer hours and harder work," "doubling up," joining the major networks (in the case of smaller stations), and "mechanical reorganization" to enable one man to do two, three and four men's jobs.

"Longer Hours and Harder Work": In the reports of station after station the words "longer hours and harder work" appear again and again.

Manager L. A. Schamblin of KPMC, Bakersfield, Calif., commented that the overtime operation of his staff averages 56 to 65 hours per week. Manager C. Earl Williams of KFAB-KFOR, Lincoln, reports:

"We have never been overstaffed, and to operate efficiently we need about the number of people we have always carried on our payroll. The departments most difficult to replace have been, first, the engineer-technicians, and next, the accounting department. . . . We always have a weather eye out for a likely-looking prospect. This has been one of the most complex set-ups in radio in the United States: our engineers do the switching for the networks and also for three radio stations, and we have kept the books for three stations, so we have been quite busy. Everyone is, of course, working much harder than they were three years ago. We have also been unable to hire first-class announcers because of the low salary ceiling allowed us by WLB. Our engineers themselves are now, most of them, working 44 hours and more per week."

Manager Joe Spring of WASK, Lafayette, Ind., reported:

"Where we used to enjoy 8 A.M. to 6 P.M. hours, now they are 5 A.M. to 11 P.M. and sometimes later — *seven days a week!*" Manager Hugh M. Gray of WJLB, Detroit, has put his technical employees on a 48-hour week and Vice President P. J. Stanton of WDAS, Philadelphia, maintains a working schedule of 10 to 12 hours a day himself at his station, at the same time holding a commission of lieutenant (j.g.) in the Voluntary Port Security unit of the Coast Guard Reserve to which he devotes an added 30 hours per week. These have been the experiences of men in many larger stations as well as practically all smaller stations throughout the country. Manager Plowman of KWAT, Watertown, S. D., remarks:

"Work harder, longer hours, no vacations. Believe me, it is plenty tough going, but we will make out OK." And Director W. I. Griffith of WOI, Ames, Iowa, echoes: "Longer hours for those of us who are left with no vacations in sight." Manager Elmer G. Beehler of KGEK, Sterling, Colo., dryly reported, "I just put in 16 hours a day, as I am also engineer and service man for police radio station KESY. Besides that, run my own station when I have nothing else to do!"

From KTRB, Modesta, Calif., President William H. Bates, Jr., informs us:

"Before the war we were a daytime station 250 watts — shortly after war started completed our 1 kw full time. We all work longer hours, do more things, cut out most frills. Have two Class 3 operators and as owner of station and an old licensed operator and technician, I have been able to hold ends together by working seven days a week."

Manager Martin B. Avery of WLNH, Laconia, N. H., remarks:

"We have had to suspend service on all but the most essential things. Our main idea has been to stay on the air. This is accomplished mostly by working long hours overtime."

Finally, Manager Drew McClay of WTCM, Traverse City, Mich., reports: "Our transmitter operator works 70 hours a week!"

But General Manager William E. Ware of KWFC, Hot Springs, Ark., sums it all up when he says: "We just work like hell and love it!"

"Doubling Up" to Save Men: The second method of keeping stations operating in spite of everything may be described under the heading "doubling up." This consists of using one man for two or more jobs around the station. For example, announcers formerly did only "mike" work. Now under FCC Order 91-C they can also stand transmitter watch. Practically all the smaller stations have been forced to use this method of doubling up and in the larger stations in many instances departments overlap and help in all emergencies. Examples are as follows:

Manager Joe Chytil of KELA, Cen-

tralia, Wash.: "We still have two 1st-class engineers and a second-class operator. One of our operators also sells and services accounts. Hired an older man with newspaper and agency experience to edit and gather news and program writing."

Station WHYN, Holyoke, Mass.: "Now operating with 11 less employees. Have met this exigency by doubling up executive positions, training technical employees for routine operation, procurement of restricted radio telephone permits by announcers permitting them to act in a dual capacity. Adherence to strict maintenance schedule to minimize possibility of equipment failure."

Program Director Edna Brautigam of WLOL, Minneapolis: "Executive technical men actually taking shifts. Incorporation of program director's work with that of the traffic manager."

Chief Engineer John H. Stenger, Jr., of WBAX, Wilkes-Barre, reports that he has taken over, in addition to his own job, the work of four control operators and has a 12 to 14-hour day. At WHBL, Sheboygan, Wis., Business Manager H. Born notes that the announcers handle the control board during off-peak hours, and at KWFC, Hot Springs, Ark., the engineers announce, pull and replace transcriptions; the manager and sales manager sell and collect, carry on the merchandising service; the bookkeeper and receptionist divide the program and traffic manager's work, and, as General Manager Ware adds: *"Everybody* announces."

At KBUR, Burlington, Iowa, the two jobs of program and traffic director are now being handled by one girl. Manager Ingstad of KOVC, Valley City, N. D., reports: "General manager does practically everything — operates transmitter, announces, sells, does advertising, writes copy, directs programs — almost a one-man station. Chuck Sjostrom, chief engineer, known as the most silent fellow ever in station's employ, has been transformed into a very capable sports and news announcer besides his duties as chief."

General Manager Glenn Shaw of KLX, Oakland, notes:

"In some instances here, departments are doing double duty in order to get the work out. The program director will take a shift on the air or relieve for one reason or another; the commercial department has taken over some of the program department work where interviews on new programs are needed, auditions, etc., that are pertinent to the functioning of an independently owned station."

At WNYC, New York City, in the program department, according to the report of News Editor Mitchell Jablons, tours have been made overlapping so that news,

He was awarded the Distinguished Flying Cross . . . Lt. Thomas L. Moore, formerly of WIBG.

publicity, programming and continuity departments function as a unit. "This means that the personnel of these departments can fill in on any of the other assignments. Specialization is out for the duration, and generalization is now the spirit of the times."

And finally the manager of WFLA at Tampa, Fla., reports:

"We have discontinued the practice of having studio control operators, as these men have the highest turnover in the military forces. We now train our program men to double in brass and take care of control room. Our chief engineer comes in and makes such repairs as may be necessary."

One amusing sidelight which may fall under this method of "doubling up" emphasizes the manpower shortage. At least two stations noted this difficulty and solved it. Here is station KXO's, El Centro, Calif., report:

"We have dispensed with a janitor. The opening announcer and technician each morning share the clean-up chores. This has saved manpower and is working out OK."

At WOWO-WGL, Fort Wayne, the

He served as a communications officer in North Africa . . . Capt. Charles H. Batson of WFBC.

general manager notes:

"During the early part of 1943 we were in dire need of janitors but none were available. The floors in our studios and reception rooms were in a deplorable condition. Then, one evening, the auditor and program manager appeared at the station in their old clothes, assembled the necessary equipment, scrubbed and waxed the floors until they were brightly polished. This act, purely voluntary, depicts the fine spirit of cooperation of all members of our staff in 'getting the job done'."

As already noted, a third method of keeping small stations operating on a peak schedule was joining a network, which took a great load from the program departments. Four small independent stations of those canvassed reported using this method.

Mechanical Labor-Saving Techniques: But perhaps one of the most important ways of solving the manpower shortage besides those of longer hours and harder work and "doubling up" was the various mechanical techniques for increasing a station's efficiency with fewer operators which may be characterized under the heading "mechanical reorganization."

These mechanical techniques may be such simple things as moving reproducers to the transmitter, or a complicated reorganization involving installing all control room equipment in duplicate in each studio and tying all to a master control room with relays. Here are a few of the methods reported:

Station WTMC, Traverse City, Mich.: "Installation of studio facilities at transmitter has saved an average of 101 man-hours per week — announcers doing own control operating, where possible, has saved average of 20 man-hours per week."

Station KUTA, Salt Lake City: "Production has been maintained by intensive use of recordings made and played back both at studio and transmitter."

Station KLX, Oakland: "We have increased our recorded library so that it may amply take the place of increased shortages in the field."

Station KTSW, Emporia, Kan. (General Manager J. Nelson Rupard): "Operators play transcribed station breaks at the transmitter two and a half hours daily. No remote operator used on one mike remotes."

Station KVAK, Atchison, Kan. (Assistant Manager Dottie Taylor): "Record playing equipment moved to transmitter building and announcers are now announcer-operators. Only one man on duty at a time."

Station WFLA, Tampa, Fla.: "When it became apparent we would not be able to keep studio technicians, we devised a plan

He is chief, Maintenance Section, Army Operational Research Branch . . . Chas. Singer, WOR.

of installing all control room devices in duplicate on separate consollette all tied to master control room with relays. To further simplify the problem of switching, etc., a plan was drawn up to use relays driven by batteries, so that the announcer on duty could handle everything from a so-called 'driver's seat.' . . . In this way we have been able to run our studios with the least possible amount of help during these manpower shortages."

Station WFAS, White Plains, N. Y., has a special report on an outstanding maintenance record and outlines a procedure which does credit to Managing Director Frank A. Seitz's skill and care:

"We are proud of the operational record WFAS — Western Electric equipped from pickups to antenna — has chalked up: well over 4,500 consecutive program hours on the air without even a second lost due to equipment trouble. We attribute this to *a rigid system of maintenance*. One full evening each week is given over to a thorough-going cleaning, adjustment and general check-up of the equipment. The routine starts at sign-off time, 7:30 P.M., and continues till well after midnight, ending with the weekly test of WFAS' 100-watt auxiliary. Tests include frequency runs on audio equipment and transmitters, modulation pattern checks on cathode-ray oscillograph, etc. . . ."

Finally, this report from Station WJR, Detroit, furnishes a striking example of the ingenuity of a remarkably talented technical staff. The station manager described their achievements as follows:

"The inventive genius of WJR engineers has given birth to a number of devices and processes that have overcome wartime handicaps. Chief Control Engineer Freddy Friedenthal designed and made a gadget for renovating damaged microphone plugs and by use of it we have kept plugs in good condition and salvaged a number that apparently were ready for discard. Merrill R. Mitchell, chief transmitter engineer for WJR, devised a scheme for cutting down heating fuel by using the hot water from the tube cooling system. In addition, Mitchell built a pressure cooker which staff members used last fall for canning.

"To maintain equipment (most of it impossible of replacement) at its peak efficiency, Mitchell conceived the idea of applying x-ray technique to examining tubes, an idea that is producing such good results it might well be adopted by stations throughout the country. The object was to discover when tubes are about to burn out, thus preventing interruption of service through unexpected failure. With practice, the x-ray plates can be read in the same way a dentist reads plates and one can actually see that a filament is wearing down. In addition, x-ray was found particularly effective in the examination of condensers."

Training New Men: From the foregoing studies and reports on the manpower shortage, "longer hours and harder work," "doubling up," and mechanical reorganization, it can be plainly seen that one of the industry's most pressing problems is the desperate need for "trained" people. Thus one of its major jobs has been training. All through these reports, the theme of training has recurred again and again, and the necessity for constant training of new men has in some instances worked hardships. Small organizations complained that larger stations were "pirating" their men as soon as they had been trained. One manager remarked that his station had virtually become a recruiting center for nearby large network outfits. Another 250-watt station lost 10 men to larger organizations. However, in general, all stations and organizations had to undertake extensive training programs.

Typical of the experiences and methods of smaller stations in promoting this fundamental activity of building their organizations are those of stations KODL, WWDC and WOMI.

Local Manager Glenn Howell of KODL, The Dalles, Ore., reported:

"For the past two years we have been more like a school than a radio station because none of the help has had sufficient commercial radio experience. We teach announcers how to announce, operators how to operate, bookkeepers how to keep books."

Chief Engineer Beville of WWDC, Washington, D. C., notes:

"Standards as to qualifications for employment have been lowered and to overcome this, training programs in both the program and engineering departments have been set up to train people with little experience or previous training so that they may qualify for these positions."

His hours are 5 A.M. to 11 P.M. and sometimes later . . . Manager Joe Spring of WASK.

Manager Hugh O. Potter of WOMI, Owensboro, Ky., informs us:

"In order to make certain we would have a staff of first-class licensed operators, we encouraged a former radio repairman, H. C. Sanders, who was teaching a war department radio class in Owensboro to brush up and take an examination for a first-class ticket. This he did and is now a full-time operator. Believing that the shortage of operators might become acute, the manager began the study of radio theory and learned to operate the controls. After more than 18 months of night and spare-time study, he passed the examination required for a first-class license. This he did by steps, getting a third-class ticket first; a second-class next and then, being ready for 'Element Four', got the first-class license one year ago. WOMI, as a result, has three first-class operators."

Station WAOV, Vincennes, Ind., which is doing a remarkable training job, uses these measures, according to Manager Victor H. Lund's report:

"We are conducting a school for radio technicians, hoping to provide sufficient knowledge among the students to allow them to undertake successfully FCC engineering examinations for licenses. We have had the licenses of several members of the Vincennes Police Force who are familiar with the Force's two-way radio communications endorsed to permit them to operate commercial radio stations. In that way, we have filled some of the voids in the transmitter engineer schedule. Also we have been training several 16- and 17-year-old boys, both as technicians and announcers. This is in addition to the regular technical courses that we are conducting. Promising students attending these courses are sent to Chicago *at station's expense* to take FCC examinations."

And Manager Martin of WWNY,

Watertown, N. Y., notes:

"We have a system worked out by chief engineer to encourage and instruct control operators to study for first-class licenses. Under this system we already have gained two control engineers who have third-class licenses and one control operator who made his first-class license and is now working full time at transmitter."

Chief engineer Lloyd R. Amoo, of KSJB, Jamestown, N. D., reported:

"At an early date we could see that we would need replacements and probably could not obtain them unless we set up a training course. Such a course was started and has continued, with the result that we have been able to make our own replacements and provide personnel for several other stations."

Chief Engineer Blair K. Thron of WFPG, Atlantic City, N. J., noted that they have spent much time training inexperienced men to fill positions as announcers and operators and Manager James M. Brown of KONO, San Antonio, informed us that out of a school of seven "green" men, five made the grade and four are still with him — an average proportion.

Finally, WRUF, Gainesville, Fla., furnishes one of the best examples of a station with a really impressive training program. Director Garland Powell comments:

"The rule was to employ students of the University of Florida who needed financial help to aid them in obtaining an education, and also students who desired to follow radio as a life's vocation. Such men as Red Barber, George Gunn, Jimmy Walton, Jimmy Sirmons, Dan Riss, Orville Anderson and other well-known names in radio had their start at WRUF. The policy has been to give them actual experience while learning and it has been a very successful one. Such men as Wayne Mason of the FCC, F. Banks Duncan, formerly with the FCC, now with the Coast Guard, and others high in the technical field likewise obtained their real start and training at WRUF."

Returning Veterans: One of the pleasantest disclosures noted in the reports of the survey is that a number of the 60,000 veterans given medical discharges from the armed forces each month are finding their way back into the Radio Broadcasting profession. Five per cent of the stations which reported in the survey mentioned returned veterans among their staff. These include such men as Bob Shelley, chief announcer at WLOK, Lima, Ohio, a former marine who fought at Guadalcanal and received the Silver Star, the Purple Heart and other decorations. He was discharged from service because of chronic malaria. Then there is Arthur W. Mallory, now at WELI, New Haven, who received the Purple Heart for injuries received in the sinking of the *S.S. Gregory* in the South Pacific, and Francis L. Sherwood, former transmitter supervisor of WHEC, Rochester, who saw duty in the Atlantic, Arctic and Pacific oceans. He was cited by the Navy Bureau of Ships for technical advances in radio equipment while in the Pacific. He was wounded in the South Pacific, given a medical discharge and is now back on the job. Other veterans back on the job are Marvin Behrens of WBZ, Boston, now a news commentator with first-hand war experience, and George Floyd, at present an engineer on the staff of WINX, Washington, D. C. He was a 3/c Radioman with the Navy, stationed at Pearl Harbor when the Japs pulled their sneak attack. In an attempt to carry his transmitter to a point of safety, Floyd was machine-gunned by a low flying Zero. Finally, there is Ernest Simon, now announcing at WINX. Simon spent 17 months overseas with the British 8th Army. As a leftenant in Intelligence, he participated in the British drive across Africa and later in landings on Sicily and Italy. He learned to speak fluent Arabic and French, and was often sent behind enemy lines. At one time he was reported missing; twice he was wounded when the jeep he was driving set off a mine planted beneath the road. He is still being treated for shell fragments and gangrene infection in his thigh. Despite this fact, Simon carries an 8-hour shift as chief announcer and presents his own "platter with chatter" show across the board at 7:15.

Contributions to Community and Nation's War Activity: Finally, however, no analysis of the Broadcasting profession would be complete without mention of perhaps the profession's most important job of all — its contributions to the Nation's war efforts and to the war jobs of the communities of which it is a part. Since the day Station KGU, Honolulu, flashed the news of the Jap "stab in the back" to the world on the morning of December 7th, shortly after a bomb had landed within 40 or 50 feet of the KGU station tower itself, and Station Manager M. A. Mulrony had made the first announcement of the attack in a two-minute report over NBC, American broadcasting stations have been giving war announcements, war demands, war requirements and anything, no matter how remote, that has to do with furthering the war effort, undisputed first priority. It is difficult to estimate fully many of these contributions. Mention has already been made of its morale-building work at this time and its importance as one of the major agencies for dissemination of vital home-front information. The *Broadcasting Yearbook* has estimated that the industry, through its networks alone, has spent well over $100,000,000 a year of time and talent on OWI war information broadcasts. And this does not include of course the enormous amount of free time and effort put in by individual stations or for other governmental agencies. Nor does it give any indication of the type of jobs that are being done by the various stations through their own communities for the Nation — jobs that tie the community more closely into the total war effort. Besides the war loan campaigns, the recruiting campaigns for the armed forces and the Wacs, Waves and Women Marines; the recruiting campaigns for nurses and war workers, the V-mail and "Letters to Soldiers" campaigns, the informative campaigns to stimulate growing of Victory Gardens, saving of scrap and other projects, there are the numberless achievements of individual stations in special and unexpected ways. These examples gleaned from reports in our survey are typical of the jobs done both for the war effort and for communities of the home front by both large and small stations throughout the land.

He has worked regularly two shifts to keep his station going . . . Mgr. H. G. Urie, KSUB.

Program Director Vann Campbell of WDEF, Chattanooga, informs us:

"Our engineers are switching from one station to another filling in where necessary until new men can be trained. Some of them are even working part-time in small towns nearby. One of them, Burford Young, is putting in time at Dalton, Ga., about 35 miles south of Chattanooga. He attended Army Radio School, received a medical discharge and is now putting in much overtime, as the others are doing, to keep the radio sets of the staff serviced. I know of five sets he has taken in hand and put into excellent working order. Our present chief engineer has just completed teaching a class in radio engineering at the University of Chattanooga. Most of our engineers spend a lot of time repairing radio sets, doing a good job of it."

He has put his skill to work for the Navy . . . Lt. Comdr. Paul De Mars, of Yankee Network.

He runs almost a "one-man station" . . . Gen. Mgr. Robert E. Ingstad of KOVC, Valley City.

His station gave many broadcasting people their start . . . Major Garland Powell, director of WRUF.

Station WRVA, Richmond, which has received three *Variety* Plaque awards, two of which have been received consecutively during wartime for making radio a vital cog in civic enterprise, has become distinguished for its programs designed as contributions to military-civilian understanding. For example, the station anticipated the need for entertainment and solace to returned wounded veterans and early in December, 1943, before the idea had taken hold in radio, launched a "Smokes for Our Wounded" drive. As the report on this project notes:

"From listeners in many states, from schools, colleges, clubs, church societies and from individuals of all walks of life, the cartons and packs have poured in and continue to pour in to the studios in Richmond and Norfolk. Joe Brown, emcee of 'Smokes for Our Wounded,' and himself a hard worker in behalf of servicemen and War Bond Drives, also records an "Okay America" show from one of the wards of Government hospitals in the Old Dominion, and brings a group of entertainers — pretty girls to sing and dance, comedians to bring the laughs — for a half-hour performance before the broadcast."

Variety remarked of this station's community activities: "WRVA not only became a radio station, it became an integral part of Richmond."

In San Francisco, Program Director Ted Lenz of KSAN, who served as radio and telegraph signaling instructor at U. S. Maritime Training School until receiving a medical discharge, set a radio endurance record in behalf of the 4th War Loan Drive of 53 hours and 16 minutes of *continuous* broadcasting at the mike for bonds. The drive was an enormous community success, as the campaign far exceeded its quota. Over 4,000 telephone calls were received. During this period, Lenz played 915 phonograph records, emceed 159 programs for two days and two nights without a break, delivered 41 newscasts of 15 minutes each, spoke 224,401 words in all and conducted 19 interviews with bond salesmen and others. Nine engineers assisted him.

Another typical outstanding community service program is that presented by KQW, San Francisco, entitled "G. I. Legal Aid," which furnishes legal assistance to servicemen and their families. Four lawyers speaking for the California State Bar Association answer questions on family allotments, servicemen's debts, insurance problems, rents, leases, Army and Navy relief benefits and other problems which harass the hard-pressed families of those in the armed forces in that state, and this program has thus performed a real public service to its community.

Finally, Auditor Charles Howell of KFXJ, Grand Junction, Colo., highlights Radio Broadcasting's great and unique importance to the community in an emergency, in the following report of one of the most dramatic and unusual home-front incidents of the war:

"When two carloads of explosives caught fire in the Grand Junction railroad yards in the early morning hours of June 27th, 1943, the residents were greatly alarmed, as shells began screaming over the city and shrapnel fell over a wide area. The force of the explosion rocked the lower end of town. For over three hours the bombardment continued, several persons were injured by flying shrapnel as crowds surged into the streets. The telephone company was hopelessly swamped by calls, and the Police Department was deluged with inquiries. Some people mistook the fire sirens and sound of fire apparatus rushing to the scene of the explosions to be the signal for an air-raid alert, and near panic resulted.

"Rex Howell, station manager of KFXJ, Mutual affiliate, telephoned the Army Public Relations office in Denver and received permission to broadcast detailed explanation of the explosions. At about 3:30 A.M. the station went on the air explaining their cause and cooperating with the Police and Civilian Defense agencies, requesting people to remain under shelter in their homes, and to refrain from using the telephone. Within half an hour after the broadcast started, the telephone traffic was cut by over 70 per cent, and police were able to handle street traffic satisfactorily.

"Countless distant listeners also heard the broadcasts, which were accompanied by the sounds of the explosions, the screaming shells, and the noise of falling shrapnel. While Rex Howell broadcasted the reports from a suburban studio, Eph Towne, chief engineer of KFXJ, went to the station's downtown studio, just three blocks from the scene of the explosions, and recorded the sound of the 'attack.' From this point it sounded like a battle line at the front. Shrapnel fell all around the studio, and one large shell tore through the roof of a cafe across the street. The result is, KFXJ's library now contains all the battlefront sound effects they need!

"The station received commendation from military and civilian authorities for the manner in which it had served to restore order among the population. Press reports were filed which made top headlines coast to coast, most of which gave liberal credit to KFXJ for its job of public service."

From reports like this and the compendium of information gathered in this survey, it can be seen that — in war, as in peace; on the home front as on the battle field — the Radio Broadcasting Profession and Radio Broadcasting men and women everywhere are meeting their wartime problems with conspicuous courage and remarkable success. This is a real picture, through one industry, of America at War.

A. T. & T. Plans for Television

(Continued from page 22)

tem in the neighborhood of $100,000,000. As many as six or eight coaxials are likely to be built into some of the new cables. In a six coaxial cable, for example, with the present amplifying equipment, two coaxials could be used to provide 480 telephone circuits, another two could provide two one-way television channels and the other two would serve as equipped stand-by circuits to protect both services.

For the future, there are two methods of utilizing coaxials for the combined job of providing long distance telephone and television service:

1. Use some of the coaxials in the cable for telephone messages exclusively, and some for television.
2. Expand the frequency band width, so that both telephone and television transmission can be handled through the same coaxial.

The present schedule and approximate dates at which television transmission facilities over coaxial cable routes might be made available if demand justifies their provision and manufactured cable and equipment can be secured are as follows:

1945

New York — Washington

1946

New York — Boston
Washington — Charlotte
Chicago — Terre Haute — St. Louis
Los Angeles — Phoenix

1947

Chicago — Toledo — Cleveland — Buffalo
Southern Transcontinental Route (a large part) will include Charlotte — Columbia — Atlanta — Birmingham — Jackson — Dallas — El Paso — Tucson — Phoenix

1948-1950

Southern Transcontinental (complete)
Washington — Pittsburgh — Cleveland
St. Louis — Memphis — New Orleans
Kansas City — Omaha
Des Moines — Minneapolis
Atlanta — Jacksonville — Miami
Los Angeles — San Francisco

The routes indicated are subject to review prior to the time construction would be started. The list does not include additional sections which might be advanced into this period should important television requirements arise which would warrant routes or sections being installed well ahead of telephone requirements.

Technical Details of SCR-508 and 608

(Continued from page 7)

tion coil the peaks or pulses produced occur at regular intervals. However, by introducing a low frequency current flow through the coil in addition to the rf, the position of the peaks may be changed with respect to each other to cause phase modulation. Essentially what occurs is that the point of zero instantaneous current — which is the position in time at which the coil is not saturated — is moved along the rf wave. The positive and negative pulses, if radiated, would interfere with each other, and for this reason the output of the modulation coil is passed through a rectifier which eliminates the negative pulses and produces phase modulated odd-order harmonics at its output. In the 508 set the ninth harmonic is chosen and multiplied from there to get a frequency 54 times the original crystal frequency.

The transmitter delivers a carrier power of approximately 30 watts to the antenna system. This gives the set a *normal* range of about 10 miles and under favorable conditions a *maximum* range of 20 to 25 miles. The carrier wave has a *peak* frequency swing of plus or minus 80 kc, but the *average* frequency swing is considerably less. The power supply is obtained from either a 12-volt or 24-volt vehicular battery, converted to approximately 625 volts by the proper dynamotor.

The superheterodyne receiver (Figure 5) uses push button frequency selection in the same manner as the transmitter, although it is not crystal controlled. The high frequency circuits include one stage of tuned rf amplification, a modulator and an rf oscillator. The intermediate frequency amplifier comprises two stages, the second providing the necessary limiting action. The detector, or discriminator, is followed by two stages of audio frequency amplification. An intermediate frequency oscillator permits checking the receiver tuning. A single dual-purpose tube provides delayed automatic volume control and "squelch," which suppresses noise by "disabling" the receiver output when no signal is being received.

The receiver delivers an output of approximately two watts to a speaker mounted behind a metal grille at the top of the unit, or about 200 milliwatts to the headset circuit. Normally a headset is used for receiving all signals when the tank is in motion and the speaker is put in operation only when the tank is stopped and the operator is not at the set.

Bell Laboratories at War

(Continued from page 14)

specialized equipment come under the wartime activities of the Laboratories' program. The Bell Laboratories is the largest development center for these electronic devices in the Nation. These projects are, of course, of a confidential nature but when the story is told, it will be one of the most dramatic in the history of research.

The above brief glances which have been cast at the types of jobs a war research organization is called on to perform do not, of course, include the routine jobs that are at the same time expected of a great communications laboratories — such jobs as emergency telephone repair development to find ways of providing swifter repair methods and materials for overtaxed communications facilities in the midst of a materials famine, or setting up Air Warning Systems, or even the special job of establishing a School for War Training to teach fighting men how to use and maintain their new weapons.

Bell Telephone Laboratories is just one of the nation's great research centers working ceaselessly under the direction of the National Defense Research Council and in cooperation with other laboratory and industrial organizations here and in the British Isles to bring Science to the service of America's and the United Nations' war program. Its tireless efforts and the miracles which it has been able to perform typify the scientific work being carried on by the best of America's laboratories now engaged in war research.

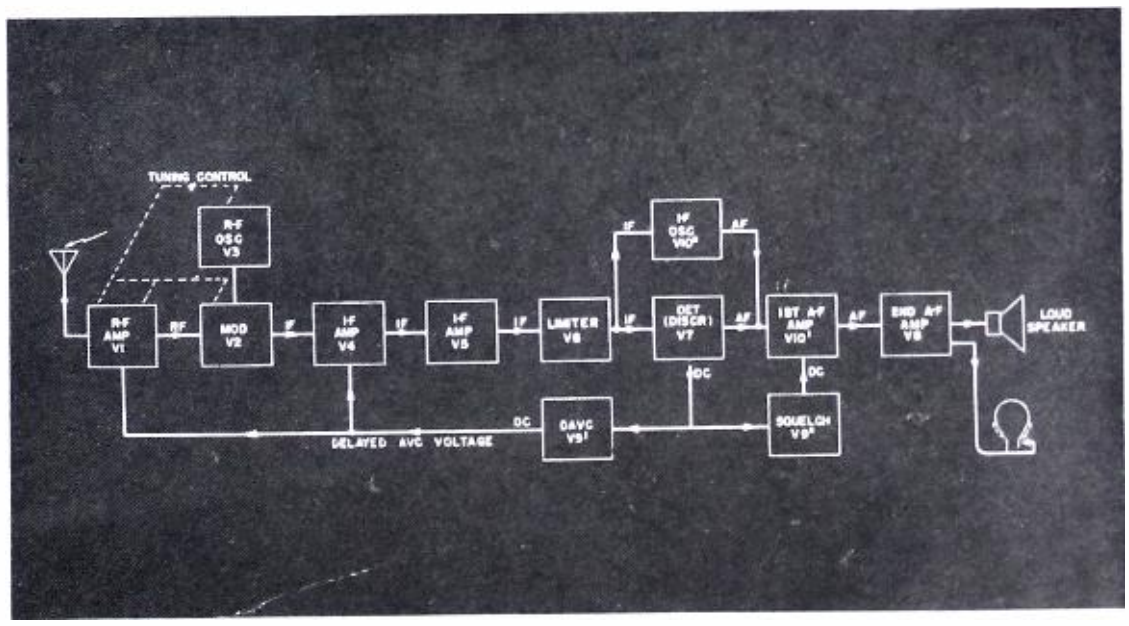


Figure 5. Block diagram of receiver used with the SCR-508 radio set. When a receiver alone is installed, a special interphone amplifier is included in the installation for interphone system.

Quartz crystals are put through stiff tests before they are accepted for use in armed forces' communications equipment. Here a Western Electric worker operates an automatic temperature-run test set. Without human assistance, this complex apparatus gives a laboratory examination of three critical qualities of each of 44 crystals, while it carries them from 60° below zero fahrenheit to near boiling point of water.

Western Electric

nation's largest producer of electronic and communications equipment for war