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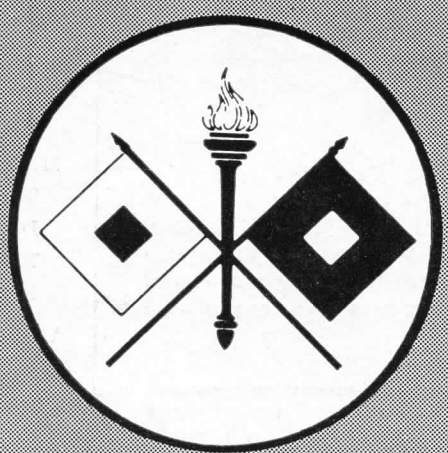
SIGNAL CORPS
Technical Information Letter
OCTOBER · 1944

ARMY SERVICE FORCES · OFFICE OF THE CHIEF SIGNAL OFFICER



SIGNAL CORPS

TECHNICAL INFORMATION LETTER

PURPOSE THE SIGNAL CORPS Technical Information Letter is a monthly publication designed to keep Signal Corps personnel and other military personnel using Signal Corps equipment informed on Signal Corps matters. It provides means for the dissemination and interchange of information of a widely-varied nature, both technical and tactical.

SOURCE THE LETTER is compiled mainly from information available in the divisions and branches of the Office of the Chief Signal Officer. Signal Corps and other communications personnel are invited to submit, through channels, material of general interest. Information on problems encountered and overcome by combat and service communications troops is desired. Such items should reach the Chief Signal Officer (SPSAY) not later than the 15th of each month for inclusion in the letter for the following month.

DISTRIBUTION DISTRIBUTION overseas is made by The Adjutant General on the following basis: Theaters of Operations (25); Armies, Corps, Departments, Island Commands, Air Forces and Base Commands (10); Divisions and AAF Commands (7); AAF Wings and Groups (4); AAF Squadrons (2); Signal Battalions (6); Signal Companies and separate Signal units (2).

Within the continental limits of the United States the Letter is distributed to Signal and other Ground and Service Forces units and installations by the Chief Signal Officer (SPSAY), Washington 25, D. C. Distribution to Army Air Forces units and installations in the continental United States is made by the Commanding General, Army Air Forces (AFMPB), Gravelly Point, Virginia.

Correspondence relative to distribution overseas and to all addresses, except AAF units, in the continental United States should be directed through channels to the Chief Signal Officer (SPSAY), Washington 25, D. C. Air Force units in the continental United States should write to the Commanding General, Army Air Forces (AFMPB), Gravelly Point, Virginia, on this subject.

WARNING THIS publication is issued solely to give proper and speedy dissemination to timely, useful information concerning pertinent trends and developments. Nothing herein is to be construed as necessarily coinciding with United States Army doctrine. Changes in official doctrine, as they become necessary, will be officially published as such by the War Department.

Publication approved by Bureau of the Budget, Executive Office of the President

CONTENTS

THE CAMPAIGN IN ITALY

The Signal Corps Played Its Part in the Drive That Swept the Enemy Out of Rome

DURING THE closing stages of the Sicilian Campaign, plans were being prepared for future Allied operations in the Mediterranean.

By the middle of August 1943, even while the U. S. Seventh Army was racing toward Messina, it was decided that the Fifteenth Army Group, consisting of the Fifth Army and the Eighth Army, would launch an assault into Italy. This operation was to consist of a landing in the Gulf of Salerno by the Fifth Army and an advance across the Straits of Messina by the Eighth Army.

In view of the fact that, as of this writing, no complete operational report has been received from the Allied forces in Italy, it is impossible to describe the Italian campaign in detail. This article will merely summarize operations in Italy from 4 September to 5 June, the day Rome was liberated.

FIFTH ARMY OPERATIONS

The mission given the Fifth Army for its landing at Salerno was to seize Ponte Sele and the airfield at Montecorvino and to secure a beachhead to include ground up to line A B (figure 1); to exploit the initial success by capturing Naples and its surrounding airfields to include the line C D, to join with the British Eighth Army which would be advancing from the south, and to prepare for the conquest of Italy.

The scheme of maneuver called for a simultaneous assault on D-Day on eight beaches in the Gulf of Salerno, in order to capture Naples and the surrounding airfields by D plus 22. To accomplish this mission, the Fifth Army had an over-all strength of about 169,000 officers and men. Of these, approximately 100,000 were British and 69,000 American.

On 5 September the bulk of the U. S. VI Corps (36th Division, reinforced) sailed from Oran and, after spending a day at Bizerte, where it was joined by part of the British X Corps from Tunis, sailed for Salerno. North of Palermo, this force was joined by the remainder of the British X Corps (from Tripoli).

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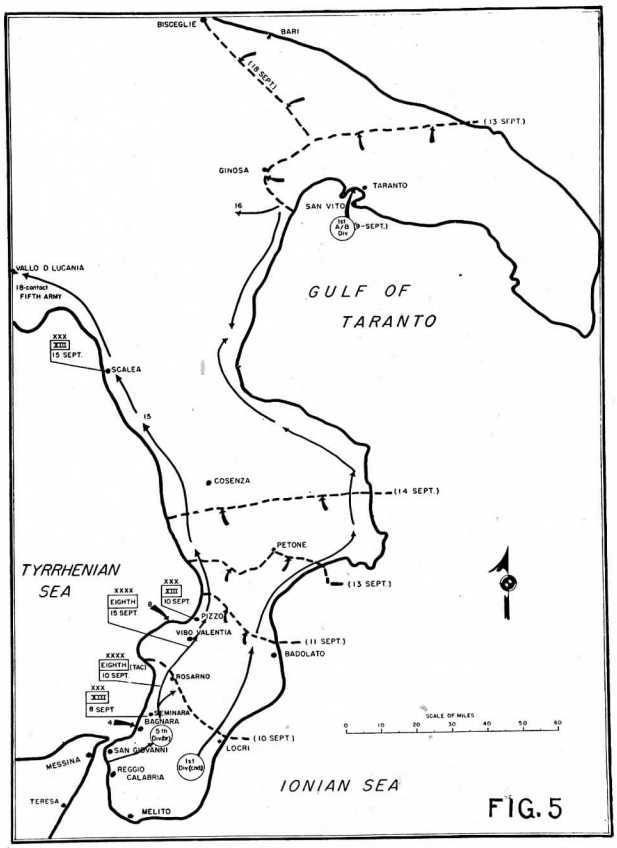
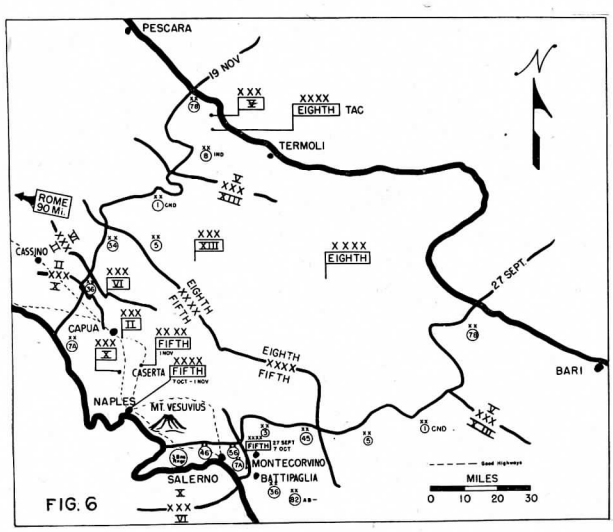
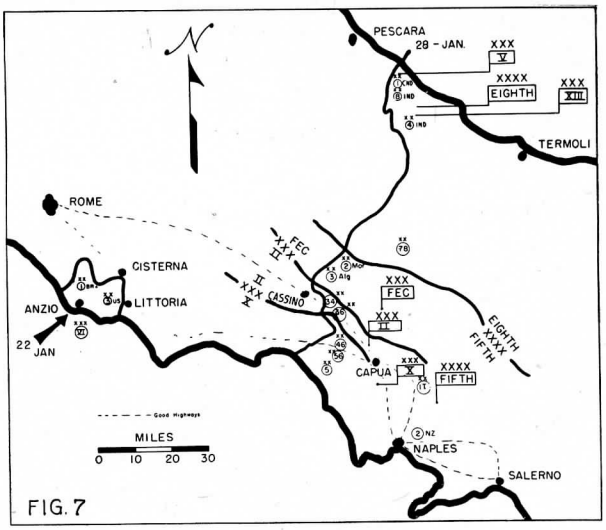


countered. A ferry service was soon put in operation between Teresa and Reggio. By 6 September 35,000 men and almost 7,000 vehicles had been moved across the straits.

In order to speed the assault, landings were made in the rear of enemy lines. These landings increased the speed of the German withdrawal. In connection with one such landing a Naval officer stated "regardless of the arrangement made for





finding the proper beaches in an amphibious operation, there is no guarantee that the landing will be made on the proper beach. The Army's faith in our ability to always land them at the right place and at the right time, in the right order, should be modified accordingly, and they should be prepared for the worst."

On 9 September the British 1st Airborne Division made a seaborne assault on the Italian Naval beach at Taranto. By 10 September the Eighth Army had advanced to the line Rosarno-Locri; and by the 11th, to the line section of Pizzo-Badolato (figure 5).

By 13 September it was obvious that the Eighth Army was needed to assist the Fifth Army. Landing craft were used on both the east and west coast to advance stores, personnel, and vehicles. By the 17th, elements of the 1st Airborne Division and the 1st Canadian Division made contact; and by the 18th, the junction with the Fifth Army was completed.

COMBINED OPERATIONS

With contact established between the two armies, the line gradually pivoted counterclockwise on a point just north of Salerno. By 27 September the Allies reached the line shown on figure 6 and became engaged in mountain warfare for the first time in Italy.

Casualties at this time numbered about 20,000 in the Fifth Army and 600 in the Eighth. Five days before this the enemy had evacuated Sardinia.

Spearheaded by Rangers and the 7th British Army Division, the Fifth Army penetrated the enemy mountain defenses in the south. Naples,

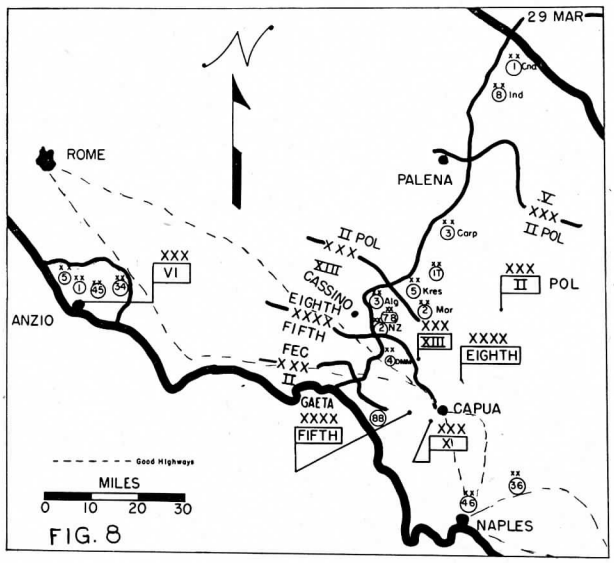


FIG. 8

sown with mines and time-delay bombs, was captured on 1 October. Corsica was cleared of enemy troops on 6 October.

On 19 November the enemy had withdrawn his entire line and was entrenched southeast of the Cassino-Pescara line. The U. S. II Corps had joined the Fifth Army in the line; and, in addition, a French Expeditionary Corps headquarters was in reserve. Bitter fighting continued throughout the next few months, but the line remained stationary before Cassino.

On 22 January 1944 General Clark sent the VI Corps, comprising the 3d U. S. Division and the 1st British Division, in a seaborne landing at Anzio, in the rear of enemy positions. On 28 January the line was as shown in figure 7. The Fifth Army was now composed of the French Expeditionary Corps, the U. S. II Corps, the British X Corps, and the U. S. VI Corps at Anzio. A rearrangement of the line on 29 March extended the Eighth Army sector to include Cassino (figure 8). The X Corps of the Fifth Army was reassigned to the Eighth Army, which now consisted of the V Corps, the II Polish Corps, and the XIII Corps, in addition to the X Corps.

The "big push" began on 11 May. The II Corps, with two French divisions, the 88th and 85th, surged forward. The Eighth Army lunged against Cassino at the same time. After bitter fighting Cassino fell to Polish and British troops the afternoon of 18 May. Contact was established with patrols of the Anzio beachhead 25 May. The enemy withdrew rapidly, and by 5 June our troops were in Rome (figure 9).

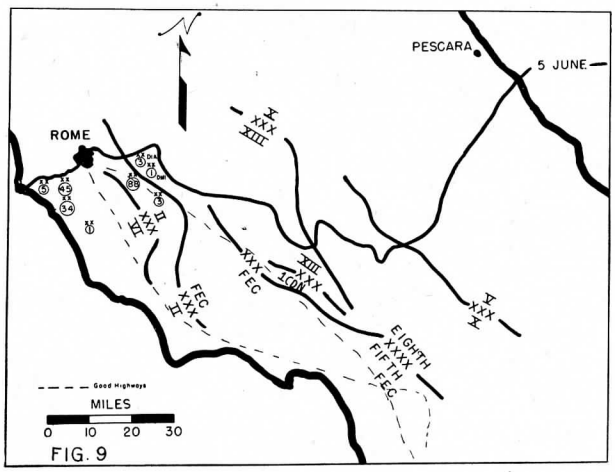


FIG. 9

FIFTH ARMY COMMUNICATIONS

As in other campaigns, the Signal Corps played a leading role in Allied operations in Italy.

Signal communications of the Fifth Army headquarters from 9 September 1943, the day of the Salerno landing, to 5 June 1944, the day Rome was liberated, will be high-lighted.

As shown in figure 10, headquarters ships (now known in joint amphibious operations as flagships) were provided for Fifth Army, X Corps, 46th Division, 56th Division, and 36th Division for the Salerno landing. VI Corps signal communications were not to operate until VI Corps command post was established ashore.

When radio silence was broken on 9 September, Fifth Army had two channels to both the X Corps and the 36th Division, one for tactical traffic, the other for administrative traffic.

Twelve radio sets SCR–399, mounted in

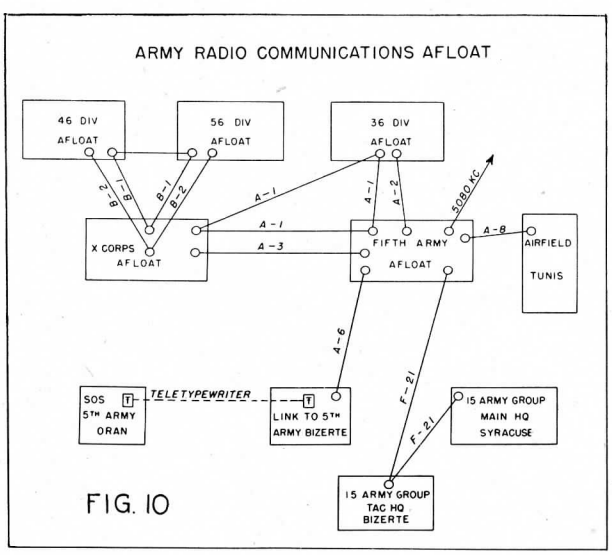


FIG. 10

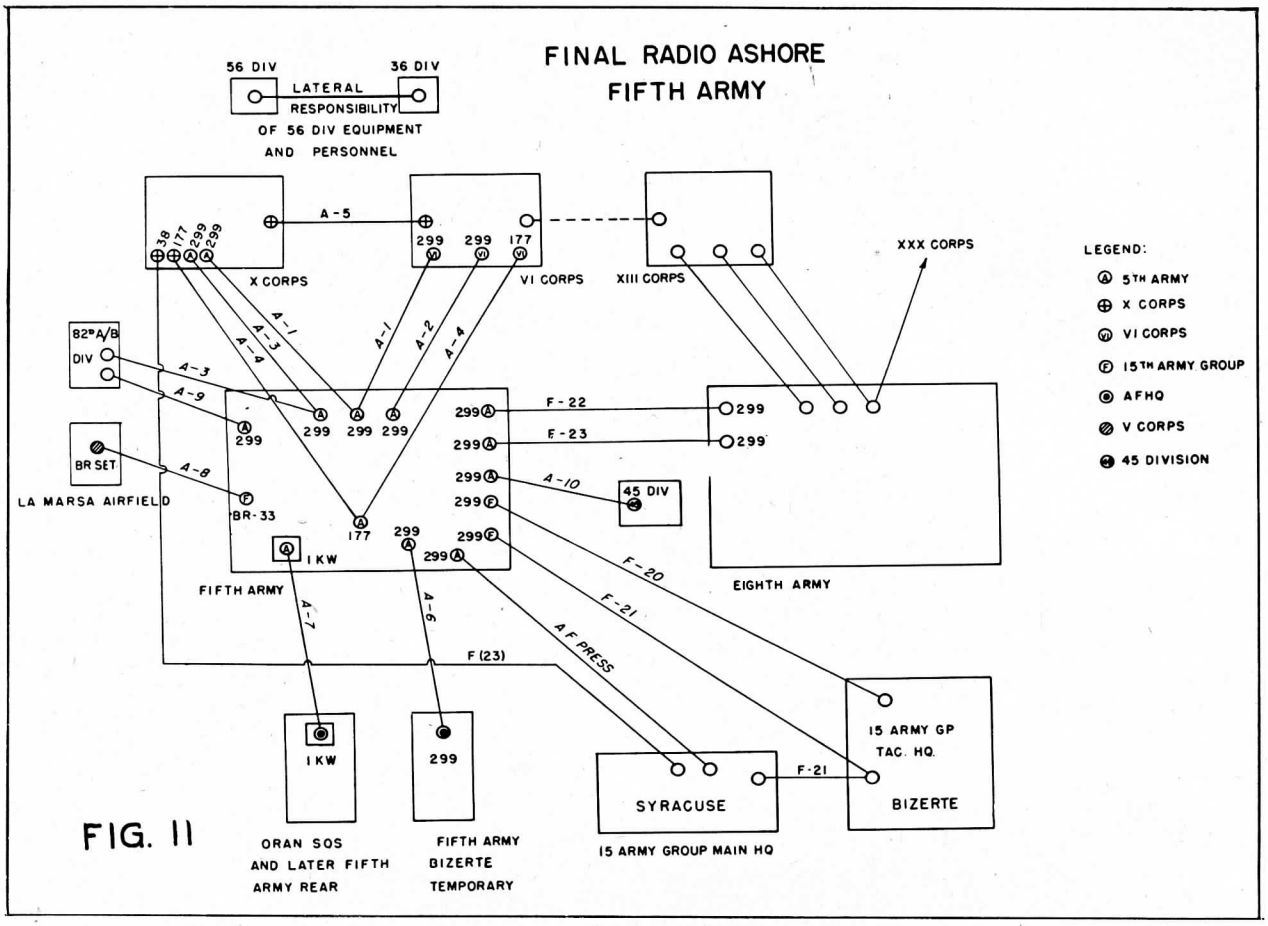


FIG. 11

DUKWS, were used to put high-powered radio sets ashore rapidly. Five of these sets were for Fifth Army headquarters, two for X Corps, one for the 36th Division, and four for VI Corps, for use by its command post on shore.

These sets proved invaluable, and all but one worked well. The set that did not operate was the one assigned to the press. Below Fifth Army, press dispatches were handled by messenger; above Fifth Army, by radio. The DUKW carrying the press set went ashore and came face to face with a German tank, which fired a cannon shell that passed through the radio set without exploding. The driver of the DUKW then turned the vehicle around and drove off to a Signal Corps repair shop.

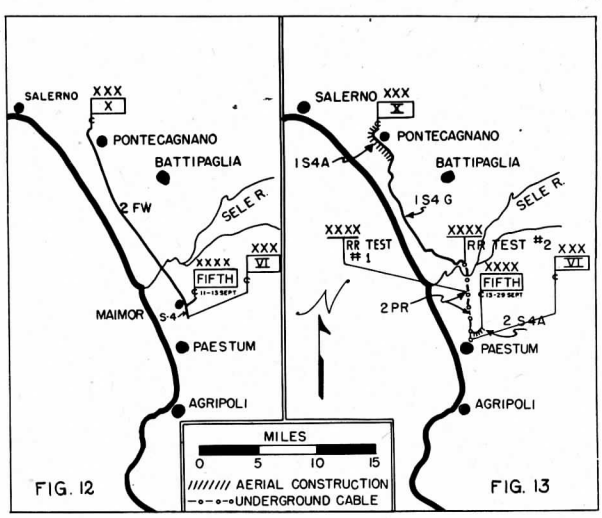


FIG. 12

FIG. 13

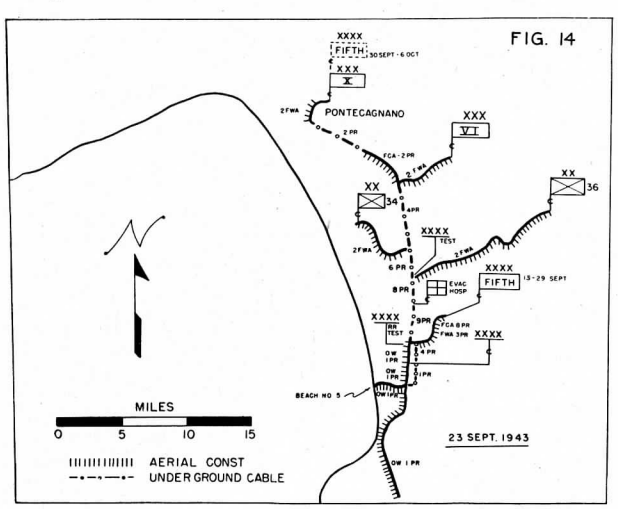
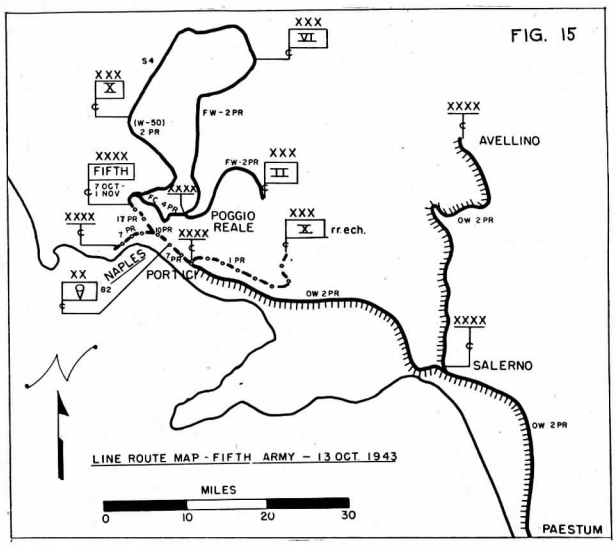


FIG. 14



The final radio nets ashore are shown in figure 11.

The Fifth Army command post remained afloat until 11 September, when it opened at Maimor as shown on figure 12.

The field wire to X Corps was constantly broken by shell fire. Since this section of Italy is very swampy, with few roads, linesmen could seldom use trucks. Maintenance of these circuits was usually difficult.

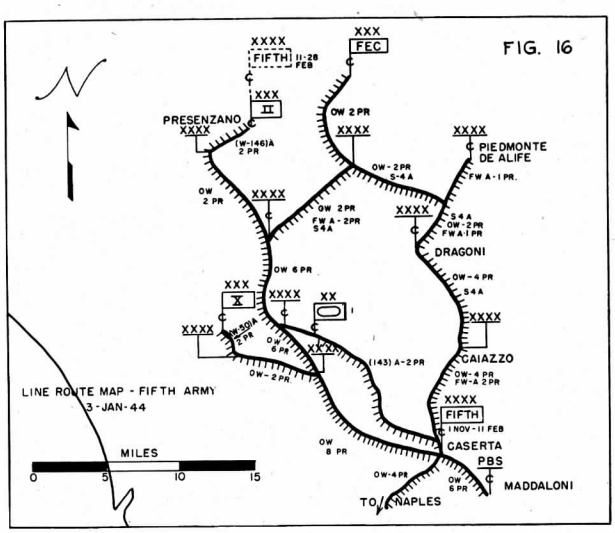
When the Germans launched the counterattack on 13 September, the Fifth Army command post was forced to move to a point northeast of Paestum (figure 13). There it was divided into a tactical headquarters and an administrative headquarters separated about one-half mile. Both installations were strafed several times by enemy planes. At this time use was made of a 23-pair underground railroad cable which ran between Agripoli and Battipaglia. Two pairs were in operation from Fifth Army to the point where field wire completed the circuit to X Corps.

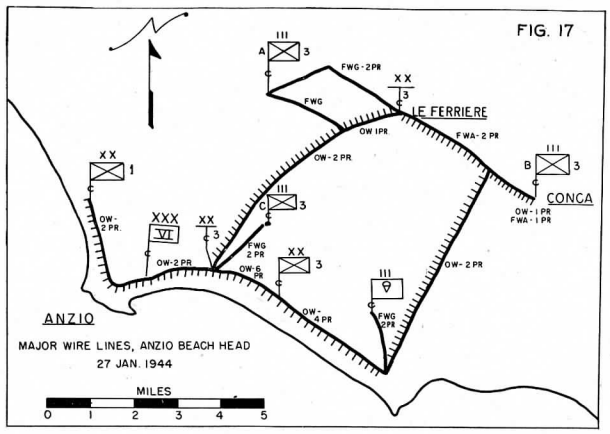
Figure 14 shows two pairs of underground cable in operation just south of Pontecagnano. These two circuits were part of a 70-pair, state-owned, underground cable which ran up the west side of the peninsula. The retreating Germans cut this cable in many places to prevent its use by Allied forces. After the capture of Naples, and the movement of the Fifth Army command post to that city on 7 October, shown on figure 15, 17 pairs of this cable were rehabilitated. A colonel in the British Army, as a telephone engineer during peacetime, had installed this cable for the Italian government. He knew the route and aided in the rehabilitation of the cable.

The command post moved a fifth time, to Caserta, opening there as shown on figure 16, on 1 November. Now the general tactical situation was quite stable and remained so for some time. The Signal Officer of the II Corps stated at this time that in some instances rehabilitation of commercial circuits to his front was impossible, as the enemy cut many poles close to the ground. The rough nature of the terrain and the mine fields left by the enemy made cross-country construction of lines for his units virtually impossible. Consequently, the few roads which existed in his area accumulated more field wire than had ever been encountered in previous operations. It was not uncommon for 150 field wire circuits to be found along a single road in the forward areas. Along highway 6, to the north, wire was supported by trees at about knee height except for overhead crossings. It was difficult to recover this field wire because the wire being recovered was invariably crossed by a multitude of other wires.

The Fifth Army command post moved a sixth time, opening at Presenzano on 11 February. Just prior to this time, the landing was made at Anzio, on 22 January.

For this landing the VI Corps and 1st British Division used headquarters ships. The 3d Division used an LST for its headquarters. Vehicular radio sets SCR–399 and 193, loaded on the top deck of the ship, were used for radio communication to the Fifth Army. Within this Division, the radio set SCR–300 was used for all nets above company level. None of the SCR–300 sets failed because of immersion in salt water.





There was no opposition at the Anzio beach landing. Hence, the officers of the VI Corps staff who would normally have kept their headquarters afloat for several hours, or even days, wanted to come ashore immediately.

Figure 17 shows the VI Corps circuits which were in operation by 28 January. This area, formerly a military training area, was devoid of civilians, hence there was little sabotage. Many of the existing commercial and military wire facilities were still serviceable and provided open wire lines as far down as regimental headquarters.

For approximately one week everything worked smoothly. Enemy opposition was weak, and damage to telephone lines was negligible. Then the storm broke. Enemy bombing attacks and artillery fire not only caused frequent interruptions in wire circuits but threatened to destroy the signal installation of the Corps CP. Most of the open-wire circuits, which at first looked so useful and so easy to maintain, became useless because of the intensity of enemy artillery fire, the frequency of bombings, and our own antiaircraft fire.

Fortunately someone discovered some wine cellars in the area. These wine cellars were interconnected by underground tunnels, so, as shown on figure 18, VI Corps telephone switchboards were installed underground secure from bombs and artillery. It was possible to locate underground for a distance of more than one mile practically all circuits leading to the command post.

Most of the open wire was then abandoned as worthless, and wire communications to divisions was primarily by spiral-four cable underground

COMMUNICATIONS

HOW THE VI Corps maintained its communications, beginning with the breakout from the Anzio beachhead 23 May until Rome was reached, is told in the following extracts from a report on this operation.

The communication problem of the VI Corps during this period was as vicious as could be expected. Though the facilities of the corps signal battalion were strained to the limit for days at a time, the battalion was able to meet each requirement without the necessity of reinforcement.

The breakout from the beachhead was an abrupt change from a completely static situation to a fast-moving situation calling for a quick transition from underground construction to overhead construction. For the operation, corps headquarters was divided into an advance "battle" command post and a "main" command post. Several days prior to the breakout the "battle" command post was set up in an old castle abreast of, or in advance of, all initial division command posts. Most trunk circuits were spiral-four cable ploughed underground to a depth of from 6 to 16 inches, with Cable Plow LC–61. All cable entries and locals in the command post were either buried or sandbagged to protect them from shell fire.

The internal wiring of the "battle" command post was elaborate. The center of activity was the "war room," in which were located G–2 and G–3 duty officers, the air officer, the artillery officer, and a G–4 traffic representative. The air officer had a direct line to his radio station which was in contact with aircraft. The artillery officer had a direct line to the corps artillery S–3. The commanding general and chief of staff were located in an office adjacant to the war room, and their phones were interconnected. All telephones were connected across a monitoring device whereby stenographers could listen in and record all conversations in the journal. Two teletype locals were installed in the G–2/G–3 clerks' room to facilitate transmission and reception of tactical messages.

One development was successfully employed during the campaign. The need for an amplifier which could be switched to any connection had long been felt. It was desired to be able to switch the amplifier on or off whenever a conversation was weak. A device was produced which modified a Telephone Repeater EE–89–( ) so as to operate efficiently from the terminal of a line rather than from the center.

The following radio nets were operated at the

and field wire underground. But even buried wire was subject to interruption. Sometimes a soldier dug a fox hole over a buried circuit and unknowingly cut the telephone lines of his organization.

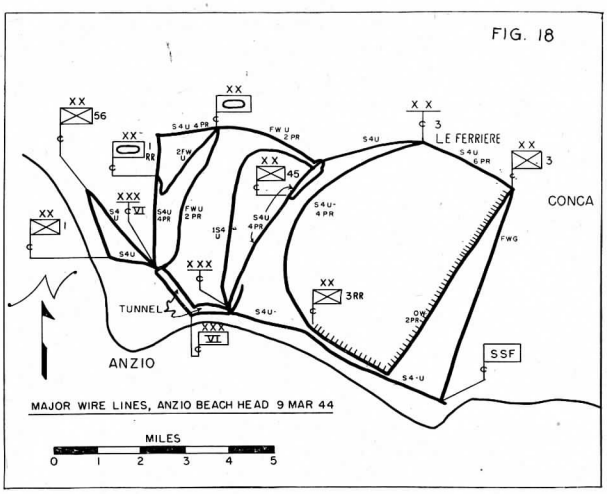
As brought out in the third phase of this article, the great allied offensive on Rome was launched at 2300 on 11 May. Construction elements from six signal battalions were employed in the extension of the main Army open wire axis.

Radio teletype service, direct to the divisions in the Anzio beachhead, was inaugurated through the VI Corps teletype switchboard, employing wire circuits from Corps to divisions.

Eighteen hundred and ten messages were carried by pigeons within Fifth Army during May. There were 28 combat lofts out on tactical assignments, operating from 15 locations, distributed over the entire Army front.

Message center traffic at Fifth Army headquarters for this month averaged 560 messages and 2,600 packets handled per day. Cryptographic traffic averaged 40,000 groups daily.

Signal Corps units operating under Fifth Army were issued 2,020 tons of signal supplies during



the month of May. This included 5,400 miles of assault wire and 14,800 miles of field wire. These figures represent three times the tonnage issued during the month of April. Wire lines moved rapidly during the last two weeks of May. Without these successful communications, Rome would never have been liberated on 5 June 1944.

While fighting still rages in Italy, it is impracticable to cover more recent action.

IN THE VI CORPS

advance command post: 1 link to Fifth Army advance command post, 1 link to VI Corps main command post, 2 command nets to divisions, 1 corps troop net for engineers and other corps troops, and 1 liaison net, consisting of 4 Radio Set SCR-193 in jeeps—1 each for the corps commander, artillery commander, tank destroyer commander. The fourth was for the use of any staff officer on reconnaissance. This net proved most valuable, since it gave the corps commander and his staff close contact with all units at all times.

At VI Corps main command post the following radio nets were operated: 1 link to Fifth Army main command post, 1 link to photo reconnaissance unit, Fifth Army, and 1 link to VI Corps advance command post.

After the southern front joined up with the beachhead forces, one infantry division was taken away from the VI Corps but was replaced by two British divisions. This made a total of six divisions under VI Corps and made it necessary to establish a third command net to divisions. This was done by putting two divisions in each net and proved very satisfactory.

Forty-eight hours after the breakout, enemy resistance on the eastern flank gave way and the movement of division command posts started. By keeping construction teams building ahead of division command posts, lines were in new command posts before the arrival of using units. However, three days after the breakout, the axis of advance was changed about 90 degrees and the advantage of being ahead of troops with wire was lost. New lines were hurriedly constructed along the new axis, and no contact was lost.

With the collapse of German resistance, all units commenced a series of rapid daily movements at an average rate of from 6 to 20 miles per day. Construction of spiral-four lines was speeded up. Where trees were available, cable was suspended overhead; otherwise it was laid like field wire. To save construction, switching centrals were set up at points adjacent to one or more divisions.

On the day Rome fell VI Corps command post was moved up to a point a few miles south of the city. That same night reconnaissance parties crossed north of the Tiber to locate a new command post area. By 1000 the next morning the new area was chosen, and all signal installations were in place and operating by noon.

SIGNAL UNITS DECORATED

THE FIFTH Army plaque and clasp for exceptionally meritorious performance during the month of May 1944 has been awarded 15 Signal Corps organizations in the Mediterranean Theater of Operations. The 15 units and excerpts from the citations awarded each follow:

THE 57TH SIGNAL BATTALION.—This organization carried out to a successful conclusion a mission vital to operations and contributed in no small measure to the success of the Fifth Army. The important communication projects carried out by the 57th Signal Battalion provided a model worthy of emulation.

THE 72D SIGNAL COMPANY.—This unit performed with highest efficiency their special task of providing all communications required to the transportation section. The difficulties of keeping pace with the rapid advance of the Army, although presenting service problems not previously encountered, were rapidly overcome. The perseverance and steadfast devotion to duty shown by members of the 72d Signal Company were reflected in the outstanding record set by this organization.

THE 212TH SIGNAL DEPOT COMPANY.—Demonstrating versatility and skill, this organization has rendered highly valuable services in providing and maintaining high standards of communications. Personnel of this company carried out all assigned tasks with notable efficiency, often under enemy shelling and bombing. Reliance is put upon the 212th Signal Depot Company to maintain its record in the days that lie ahead.

THE 6681ST SIGNAL PIGEON COMPANY (PROVISIONAL).—Members of this unit displayed a high degree of technical skill and courage without regard for personal safety. The 6681st Signal Pigeon Company (Provisional) served all units of Fifth Army and operated in tactical assignments along the entire Army front providing rapid convenient service which contributed materially to successful operations.

THE 6759TH SIGNAL DETACHMENT (PROVISIONAL).—This organization displayed a high degree of skill and perseverance in providing all communication facilities at French Corps Headquarters. In the face of language difficulties and other obstacles, the 6759th Signal Detachment (Provisional) was able to clear accurately all calls and messages, thereby contributing in a large measure to the ultimate success of operations.

THE 63D SIGNAL BATTALION.—This organization displayed superior technical ability in operating and maintaining all types of communication facilities required at the Fifth Army Command Post. Despite the rapid advance and the frequent displacement of the Command Post, the 63d Signal Battalion demonstrated exceptional perseverance in maintaining wire communications for the transmission of highly importance messages.

THE 74TH SIGNAL COMPANY (SPECIAL).—The superior manner and skill with which this organization operated and provided communications at the Anzio beachhead, despite shelling and air attacks, was an outstanding accomplishment. Members of the 74th Signal Company (Special) invariably performed assignments in an excellent manner and without regard to personal sacrifice.

THE 163D SIGNAL PHOTOGRAPHIC COMPANY.—This unit has provided complete motion picture and still camera coverage for Fifth Army in a highly commendable and skillful manner. The members of the 163d Signal Photographic Company demonstrated a high degree of courage and devotion to duty in accompanying infantry patrols in the forward combat areas in order to obtain spot news photographs.

THE 128TH SIGNAL RADIO INTELLIGENCE COMPANY.—The 128th Signal Radio Intelligence Company not only dealt with the traffic load but processed the material in such a superior manner that it was considered among the best sources of intelligence work.

THE 51ST SIGNAL BATTALION.—The eagerness of the members of this unit to adopt practices to speed up the extension of open wire lines . . . was highly valuable to the Fifth Army.

THE 53D SIGNAL BATTALION.—Despite the rapid advance necessitating the frequent displacement caused by the movement of corps command post, the 53d Signal Battalion displayed a high degree of perseverance in maintaining communications for the transmission of highly important messages.

CO. C., 1ST ARMORED SIGNAL BATTALION.—This unit, working long and arduous hours under hazardous conditions accomplished a vital mission in the setting up and maintaining vital lines of communications. The high degree of technical skill and steadfast devotion to duty demonstrated by Company C, 1st Armored Signal Battalion, was in evidence by their exceptional ability to extend communications expeditiously over long distances despite a frequent displacement of command posts.

THE 6738TH SIGNAL INSPECTION AND MAINTENANCE DETACHMENT.—The untiring efforts of the personnel of the unit were always in evidence as shown by the excellent services rendered and their determination to complete an assigned task in a superior manner regardless of the many difficulties encountered.

THE 6737TH SIGNAL INSPECTION AND MAINTENANCE DETACHMENT.—Personnel of this unit have rendered an important service and have contributed materially to the success of communications within the Fifth Army.

THE 229TH SIGNAL OPERATIONS COMPANY.—This organization displayed a high degree of perseverance and a steadfast devotion to duty in handling communications at the Anzio beachhead. Despite the tremendous increase of traffic during the launching of the offensive and the tension created by constant bombing and shelling, the 229th Signal Operation Company performed their services in an exemplary manner.

VEHICULAR ANTENNA SYSTEMS

New Lightweight Mast Bases and Sections Developed for Six-Foot and Nine-Foot Radiators.

MAST BASE AB–15/GR is a lightweight vehicular mast base designed by the Camp Coles Signal Laboratory to support a 6- or 9-foot antenna for use in place of Mast Base MP–48 with Radio Set SCR–508–( ), SCR–510–( ), SCR–608–( ), SCR–610–( ), and similar sets. Mast Base MP–48, now being used with these sets, was designed to support a 15–foot antenna and consequently is larger and stiffer than necessary for proper functioning with either the 6- or the 9-foot antenna required for use with the above-mentioned radio sets.

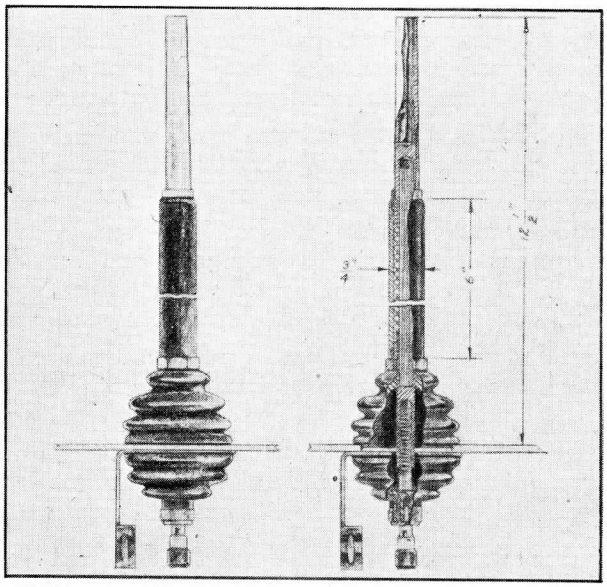
The spring of the new mast base consists of a bundle of piano wires inclosed in a flexible metal sheath. These wires are fastened at one end, while their other ends are held in a race which allows free linear movement as the antenna mast is deflected. With this type of spring, the antenna mast is quickly returned to its normal position after being deflected, and the damping effect is sufficient to prevent the antenna mast from oscillating more than a few times. The flexible metal sheathing, which provides lateral support of the wires, is approximately ¾ inch outside diameter, including a 1/16 inch bonded neoprene covering used as a lubricant retainer and for protection against the elements.

The spring element, consisting of wires and sheath, also serves as the conductor between the terminal end of the mast base and the mast end of the mast base. The insulator at the terminal end consists of two small steatite bowls. This design was adopted to make maximum use of air for a dielectric in order to keep the capacitance at a low figure (less than 9 mmf); steatite was selected because of its low loss factor, low water-absorption factor, and strength. The upper end of the mast base is terminated in a coupling which will accept the male end of a mast section; the lower end is terminated in a fitting which will accept either a binding post for a single-wire connection or a coupling for coaxial cable. A ground strap is furnished for use with coaxial cable. The mast base will fit any standard bracket of 1/8-inch to ¾-inch thickness, having a 2⅛-inch hole.

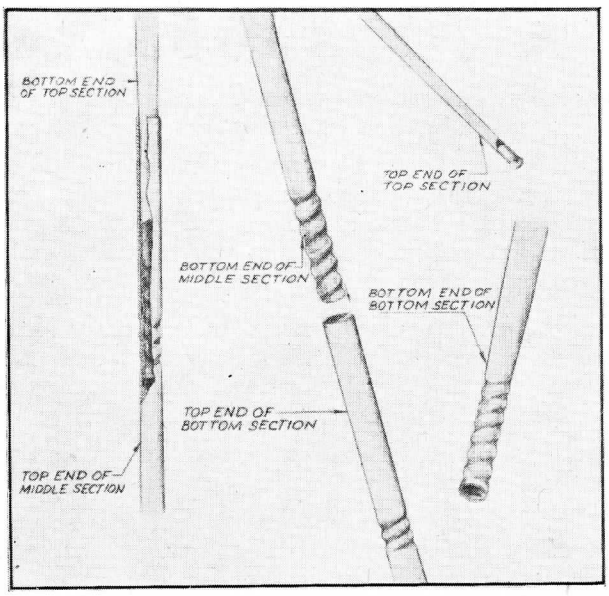
Because of the success of tests on Mast Base AB–15/GR, it was the opinion of the Laboratory that a mast base utilizing similar principles of construction and designed to support a 15-foot antenna should be made available for use with Radio Set SCR–193 series, SCR–245–( ), SCR–284–( ), SCR–506–( ), SCR–694–( ), and similar sets in vehicular installations. As a result, Mast Base MP–65 was designed and constructed. This mast base is somewhat larger than Mast Base AB–15/GR, and its insulators will withstand the higher voltage-differential required.

Mast Section MS–116, MS–117, and MS–118 were designed for use with the two mast bases described above. These sections, each 3 feet long, are made of lightweight tapered steel tubing, copper-plated for surface conductivity, and painted for weather resistance. The mast sections are assembled to each other by means of a rolled thread in the male and female ends of the sections. If a 9-foot antenna is desired for use with Mast Base AB–15/GR, one of each of these sections is used, Mast Sections MS–117 and MS–118 being used for a 6-foot antenna. If a 15-foot antenna is desired, for use with Mast Base MP–65, three each Mast Section MS–116 and one each, Mast Section MS–117 and MS–118, are used.

Mast Base AB–15/GR, together with the neces-



CROSS-SECTION DRAWING OF MAST BASE AB–15 ( )/GR.



SECTIONAL VIEWS OF THE MS–116, MS–117, AND MS–118.

sary mast sections to form a 9-foot antenna, weighs approximately 2 pounds, as compared to 13 pounds for Mast Base MP–48 and associated mast sections. Mast Base MP–65, together with the necessary mast sections to form a 15-foot antenna, weighs less than one-third as much as Mast Base MP–37 and its associated mast sections.

Models of the new mast bases and mast sections were furnished to the Armored Board, the Field Artillery Board, the Infantry Board, and the Tank Destroyer Board for service test. Each of these boards found the new lightweight antenna systems to be preferable to the existing antenna systems and recommended that they be used. In addition to the reduction in weight, the tests showed that the new antenna systems were superior to existing antennas in physical stability. One antenna, consisting of Mast Base AB–15/GR and Mast Section MS–116, MS–117, and MS–118, was continued in operation throughout automotive tests by the Armored Board, covering 3,997 miles, and when removed was undamaged. The new antenna system is easier to assemble, and the joints between the sections are more secure; taping or clamping the sections is not necessary. The insulators are small and hence less vulnerable to small-arms fire. The mast bases are completely sealed against the entrance of moisture. The electrical characteristics are equal to those of the existing antennas.

As a result of the service tests, and with the approvals of Army Ground Forces and Army Service Forces, Mast Bases AB–15–( )/GR and MP–65–( ) and the associated mast sections have been classified "Standard" and Mast Bases MP–37, MP–48, and MP–57 have been classified "Limited Standard."

Action is being taken to change all parts lists for vehicular radio sets to call for the appropriate light-weight antenna systems, including necessary connecting cables and coupling devices. The new antenna systems are now under procurement and will be issued with new radio sets as soon as available. A Technical Bulletin will be issued furnishing information as to items necessary for use with various radio sets, listing accessories necessary for the various installations and furnishing installation instructions.

LUBRICATION ORDERS

WAR DEPARTMENT Lubrication Orders (WDLO's) are now being made available for almost all the equipment of each of the technical services. In the case of items for which the WDLO's are already available but are missing due to loss or damage, they will be found listed in FM 21–6, 1 February 1944. As the new WDLO's become available, they are listed in changes to FM 21–6, which come out once a month.

Distribution of WDLO's is made as automatic as possible. However, when automatic distribution is not possible it will be necessary for using organizations to requisition them. It is mandatory that each piece of equipment be accompanied by its WDLO at all times (see Cir. No. 114, W. D., 1944) and it is the responsibility of the using organizations to comply with this requirement. Addresses to which requisitions for WDLO's must be sent are given on the newer WDLO's and are also listed in Change 4 to FM 21–6, page 46. If possible, use the directions on the WDLO desired, otherwise follow FM 21–6.

WDLO's come in three forms: The rimmed type is a metal-bound card designed to stand up under hard usage, issued for the larger items of equipment such as trucks and gun carriages; the decalcomania is for use on equipment which may be subject to the weather, but which is too small to carry the larger, metal-bound type; the pressboard card is designed for use with smaller equipment such as cameras, portable flame throwers and the like, and is usually attached to the inside of the carrying case.

COMBINED PROCEDURES

Combined Operating Signals is Based on Joint as Well as Intraservice Usage

DURING EARLY stages of World War II difficulties were encountered in communication between U. S. and British armed forces and, to a lesser extent, in communication between U. S. Army and U. S. Navy forces. Some of the difficulties, at least were due to differences in communication procedures and could be eliminated by the adoption of a single procedure for all the services concerned. The task of formulating such a procedure was referred to the methods and procedures committee of the Combined Communications Board, a committee composed of representatives of each of the three British services and the two U. S. services.

It was realized from the start by members of the committee that a "universal" procedure was not entirely practicable, because of basic differences influencing the communication problems of the two nations and of each of the services.

The basic mission of the combined committee is to formulate procedures for combined use; however, in considering an item for combined adoption, one of the factors considered is its applicability for joint and intraservice use. An attempt is made to insure that the combined item will have the widest possible application in order to obviate the necessity for extensive joint and intraservice procedures, which might differ widely from the combined item, and to avoid as far as possible the element of confusion which might arise, for example, in a U. S. Army unit having communication links to a combined headquarters, a British headquarters, a U. S. Navy headquarters, and a higher U. S. Army headquarters.

In order to insure consistency between the combined procedure and joint procedure, the committee is so constituted that the American members of the combined committee make up the joint committee. This is true in general of all the committees and of the Combined and Joint Communications Boards as well.

The procedures formulated by the methods and procedures committee, after adoption, are published under CCBP short titles. The combined publications formulated by the methods and procedures committee are:

Short title	*Name of publication*
CCBP 1	Combined Radiotelegraph (W/T) Procedure.
CCBP 2–2	Combined Operating Signals (Second Edition).
CCBP 3	Combined Radiotelephone (R/T) Procedure.
CCBP 4	Combined Teletypewriter (Teleprinter) Procedure.
CCBP 5	Combined Visual (V/S) Procedure.
CCBP 6	Combined Visual (V/S) Procedure (Abridged Version for Radiotelegraph (W/T) Operators).
CCBP 7	Combined Communications Instructions.

Each of the above publications has been, or soon will be, translated and published, under the direction of the methods and procedures committee, in the following languages:

French.	Czech.	Chinese.
Polish.	Greek.	Portuguese.
Dutch.	Turkish.	Spanish.
Norwegian.	Russian.	Italian.

Of particular interest to signal personnel is the development of Combined Operating Signals. The first edition of Combined Operating Signals carried the short title "CCBP 2." Perhaps the most startling feature of this publication to U. S. Army personnel was the adoption of "Q" signals in place of the signals which the U. S. Army had used for years. The decision to change to "Q" signals was influenced by the widespread commercial use of international "Q" signals and by the fact that some commercial stations outside the U. S. have three-letter call signs beginning with "Z."

Since the publication of CCBP 2, operational experience has indicated that some changes were desirable. These changes have been embodied in CCBP 2–2, the second edition of Combined Operating Signals, and in Change No. 1 thereto. In addition to the changes in content, the new edition employs a different index system and is printed on paper of better water-resistant qualities than that employed in the previous edition.

As in the case of CCBP 2, the current publication includes all signals for joint, intraservice, limited combined, and unlimited combined use, as well as a number of signals to be used only between holders

Communication

SIGNAL	QUESTION	ANSWER OR ADVICE	NOTES
QZC	Are you in radio communication with ____ (On ____ kc/s)?	I am in radio communication with ____ (on ____ kc/s).	AIR.
QYC	Are you (or is ____) in communication with ____ (by ____)?	I am (or ____ is) in communication with ____ (by ____).	ARMY.
QSO	Can you communicate with ____ direct (or through the medium of ____)?	I can communicate with ____ direct (or through the medium of ____).	AIR. INL.
QVC		Report when you are in radio communication with ____.	AIR.
QWC	Did you (or ____) hear ____ (at ____)?	I have (or ____ has) been unable to communicate with ____ (since ____).	AIR. ARMY.
QXC	When was I (or ____) last heard?	Nothing heard from you (or ____) (since ____).	AIR. ARMY.
QAP	Must I continue to listen for you (or for ____) (on ____ kc/s)?	Continue to listen for me (or for ____) (on ____ kc/s).	AIR. INL.
QSX	Will you listen for ____ (Call Sign) on ____ kc/s?	I am listening for ____ (Call Sign) on ____ kc/s.	AIR. INL.
QIC		Establish radio communication with ____ on ____ kc/s now (or at ____).	
QQF	On what frequency do you hear me best?	I hear you best on ____ kc/s.	ARMY.
QXS	Will you transmit by simultaneous keying on ____ and ____ kc/s?	I will transmit by simultaneous keying on ____ and ____ kc/s.	
QMX		I must shift to work another station (or ____).	US. US AIR.
*QMC			BR.
QGJ		Reduce your communications to the strict minimum. I have to communicate with other aircraft.	AIR. INL.
QKC	Shall I send by ____ (1. Direct (R) Method; 2. Broadcast (F) Method; 3. Intercept (I) Method (with ____) 4. Repeat back (G) Method)?	Send by ____ (1. Direct (R) Method; 2. Broadcast (F) Method; 3. Intercept (I) Method (with ____); 4. Repeat back (G) Method).	AIR. ARMY.
QOG		Assume W/T (radiotelegraph) organization ____ forthwith (or at ____).	ARMY.
QNG		Resume normal W/T (radiotelegraph) communication now (or at ____).	AIR. ARMY.
QNV	Was there any traffic addressed to me on ____ broadcast schedule between serial numbers ____ and ____?	Following traffic was addressed to you on ____ broadcast schedule between serial numbers ____ and ____.	US.

FIG. 1—SAMPLE OF COMBINED OPERATING SIGNALS (SECOND EDITION).

of the complete publication, and a series (QEA through QEZ) to which no meanings are assigned and which are available to theater commanders for assignment of meanings, where need exists within the respective theater for operating signals not provided by CCBP 2–2.

The signals appearing in CCBP 2–2 are also published in various extracts. Entries in the "Notes" column of CCBP 2–2 indicate for each signal the extracts, if any, in which the signal appears. If the signal is included in the International "Q" Code, that fact is also noted in the "Notes" column by the notation "INL."

In the figure 1 shown here, signals QWC, QXC, QKC, and QNG also appear in both U. S. and British Army and Air Extracts,* as indicated by the notation "AIR ARMY," and may be used between any two stations, U. S. or British, each of which holds any one of the publications, CCBP 2–2, Army Extracts of Combined Operating Signals, or Air Extracts of Combined Operating Signals. QZC, QSO, QVC, QAP, QSX, and QGJ appear in the Air Extracts and may be used between any two stations, U. S. or British, each of which holds either an Air Extract or the complete CCBP 2–2. Of these six signals, QSO, QAP, QSX, and QGJ are drawn from the International "Q" Code, as indicated by the notation "INL," and may be used by U. S. or British holders of CCBP 2–2 or of an Air Extract in communication with merchant ships or commercial airports or aircraft. QYC, QQF, and QOG appear in the Army Extracts and may be used between two stations, U. S. or British, each of which holds either CCBP 2–2 or an Army Extract. QIC and QXS which appear blank under "Notes," are combined signals and may be used between all U. S. holders of CCBP 2–2 and between U. S. and British holders of CCBP 2–2.

(*Continued on p. 38.*)

*U. S. Extracts: **FM 24–12** (Army), **FM 24–13** (Air).

IMPROVISING HYBRID COILS

A Combination of Commercial or Signal Corps Repeating Coils Can be Made in the Field

REPORTS RECEIVED in the Office of the Chief Signal Officer from time to time indicate a limited need for a hybrid coil for use in converting a 4-wire voice frequency telephone circuit to a 2-wire circuit and vice versa for certain specialized or stopgap applications. Carrier Hybrid CF–7 is designed to accomplish conversion between spiral-four cable carrier systems and open wire carrier systems. However, use of this rather costly hybrid for applications other than that for which it was originally designed is not encouraged. Reports from the field indicate that hybrid coils have been successfully improvised by using a combination of two repeating coils of commercial or Signal Corps types which are now available in the field.

It is the purpose of this article to describe some of the improvisations which have been successfully used by field organizations. This information is intended only for emergency or stopgap utilization, since, as is the case in most improvisations, certain shortcomings—impedance mismatch, poor balance in some early production repeating coils, difficulty in improvising a really good but simple network, etc.—exist. Caution should be exercised, from the security standpoint, in adapting telephone circuits to radio relay circuits by improvised hybrid coils. Indiscriminate combination of such facilities would permit inadvertent violation of security measures normally controlled by prescribed radio operating procedure.

Figure 1a shows a schematic diagram of typical commercial telephone repeating coils, such as the Western Electric 74, 75, 76, 77, 83, 91, and 93 series. Coils of these series with a suffix letter "A," with exception of series 83, have a 1:1 ratio; 83–B is a 1:1 coil. Only repeating coils with a 1:1 ratio should be used in improvising hybrid coils. These repeating coils are wound so that if an even-numbered terminal of one winding is connected to an odd-numbered terminal of another winding, the windings are in series aiding. Conversely, by connecting even-to-even or odd- to-odd terminals, the windings will be in series opposing. Two such coils are needed to improvise a hybrid coil. These coils as nearly as possible should be electrically matched.

Figure 1b shows the schematic diagram of Signal Corps Coil C–161, Coil C–75, or Coil C–288. Two each of any one type are required to improvise a hybrid coil. The two halves of each line winding of these coils should be electrically balanced if successful hybrid operation is to be obtained. This balance may be checked by use of Test Set I–61 or two Telephones EE–8 as described in Technical Bulletin TB SIG–29, "Impedance Unbalance Tests for Coils C–161 and C–288," dated 21 April 1944. If the specifications cannot be met, other coils should be tried until two are selected which meet the requirements of balance.

If commercial type coils are used, they should be connected as shown in figure 2a or 2b. If a simplex leg is required in addition, the method shown in 2b should be used, otherwise either of the two methods will give satisfactory operation. The method shown in figure 2b is the same as that used in Telephone Repeater EE–99. In the system of connection shown in figure 2a, either "E" or "F" wiring may be necessary, depending upon the "poling" of the type coil used. If Signal Corps type coils are used, they should be connected as shown in figure 2c. Further information on the theory and operation of hybrid coils is given in Technical Manual TM 11–457, paragraphs 68 through 72.

CHECK FOR BALANCE

After the combination of coils has been wired, it should be checked for internal balance. This may be done as follows: short the terminals indicated in the diagrams as "2-wire line" and short the terminals indicated as "balancing network." Connect a tone source, such as Test Set I–61, to the terminals indicated as "input." Connect a volume indicator or measuring device, such as the receiving side of I–61, to the terminals indicated as "output." The transmission loss between the input and output terminals in this condition should be greater than 25 db, but losses as great as 50 db are reported to be easily obtainable with matched coils. The higher the transmission loss between these terminals, the more successful the operation of the hybrid coil will be. If no transmission meas-

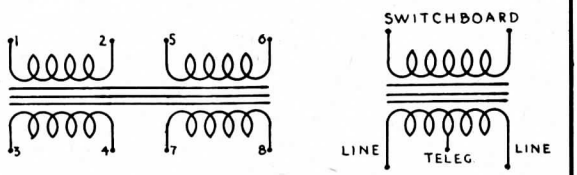


FIG. 1

uring equipment is available, a check may be made of the loss by connecting separate telephones to the input and output terminals and attempting conversation between the two telephones. The loss should be so great that conversation is not possible (conversation through a loss of 35 db is just barely possible). After checking internal balance, the transmission measuring set or testing telephones should remain connected while the over-all balance of the combination is checked. This may be accomplished as follows: connect the 2-wire line to the terminals of the hybrid so marked. The distant end of the 2-wire line should be terminated in an impedance which will be normally used with the circuit under operating conditions. If the distant end of the 2-wire line is a switchboard, the usual method is to connect the one end of the switchboard cord to the 2-wire circuit and the other end of the cord to one of the telephones connected to the switchboard. If it is a common battery system, the receiver is removed from the hook.

A network should be connected to the terminals of the hybrid so marked. For ordinary field conditions, a satisfactory network will consist of a 1,000-ohm variable resistance and variable or tapped capacitance with maximum capacity of 4 mfd. In individual cases, a more elaborate network may be required, but the one described will probably give a satisfactory balance in most cases encountered in the field. The loss between the input and output terminals should now be measured and adjustments made to the balancing network until the attenuation between the input and output terminals is as great as can be obtained with the circuit used. The adjustment of the network is quite critical and changes should be made in small steps to find the point of maximum loss. After the maximum loss has been obtained across the combination, the output terminals should be connected to the transmitting pair of the 4-wire circuit used and the input terminals should be connected to the receiving pair. A final readjustment of the balancing network should be made to ensure maximum operating balance. This final trimming is necessary because the 4-wire circuit gain frequency characteristics will, in the case of radio circuits, probably be peaked at the high-frequency end and, if the balance is not adjusted at the peak frequency, some readjustment will undoubtedly be required.

The signal level fed into the input circuit should be adjusted to a point which will give satisfactory operation without causing the circuit to "sing." The impedance of wire lines or apparatus connected to the hybrid should be matched as closely as possible to the terminating impedance of the improvised hybrid. The difficulty of impedance matching with the repeating coils available in the field is probably the greatest shortcoming to be

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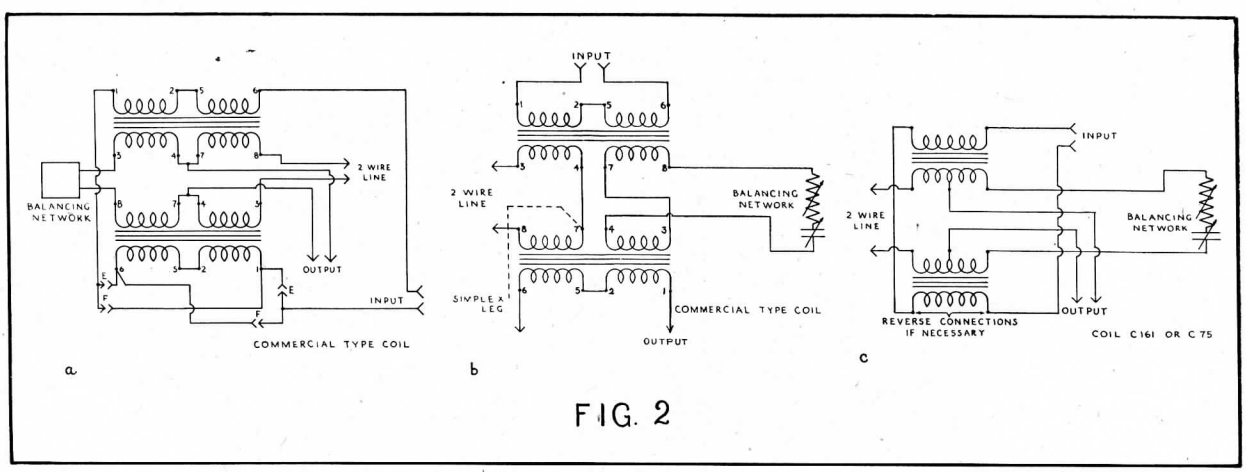

FIG. 2

WORK SIMPLIFICATION

Step-By-Step Analysis Results in More Efficient Utilization of Manpower and Boosts Personnel Output

THE NATIONAL manpower shortage has made it imperative that Signal Corps activities be carried on with a minimum of personnel and a maximum of efficiency. It is incumbent upon all supervisors to see that everything be done to gain maximum utilization of all personnel.

Two methods used widely by management in industry by which to effect better utilization are at present being employed by the Signal Corps. These methods are known as: work measurement procedures and work simplification programs.

Work measurement is a method of determining the effectiveness of a working organization by a comparison of actual man-hours expended in performing a given volume of work with the standard man-hours which should be required. This program assumes the setting of "standards" for all operations within an activity.

Work simplification, on the other hand, is the critical study of an operating procedure by the employment of certain tested techniques to discover ways of doing a job more simply, with less time and effort. It is not a speed-up process and it is not a means of getting personnel to work harder. In fact, when simplification takes place the job is made easier for the doer.

It is the purpose of this article to discuss briefly the work simplification program within the Signal Corps.

Application of the work simplification program throughout the Signal Corps makes use of five developed techniques (figure 1). A brief description of each of these techniques follows:

Process chart.—The step-by-step detail of a job process is expressed graphically by using four symbols representing operation, transportation, storage, and inspection. This graphic outline is then analyzed by challenging each successive step of the operation with six questions—WHY? WHAT? WHEN? WHERE? WHO? and HOW? This technique is both the most frequently used and the most productive of accomplishment, since it results in rearranging the flow of work and eliminating wasteful and superfluous steps.

Gang process chart.—This consists of an individual process chart for each member of a gang, the symbols of the actions of each member being arranged to represent action performed simultaneously by each member of a group with every change in the job process. This technique was developed primarily for use in the field of materials-handling operations. Attention is focused upon the balance of the gang being used to perform the job under study; i. e., can the job be done better by a four-man gang than a six-man gang, etc.

Operation study.—This is a graphic study of the motions of the individual operator with a view to reducing waste

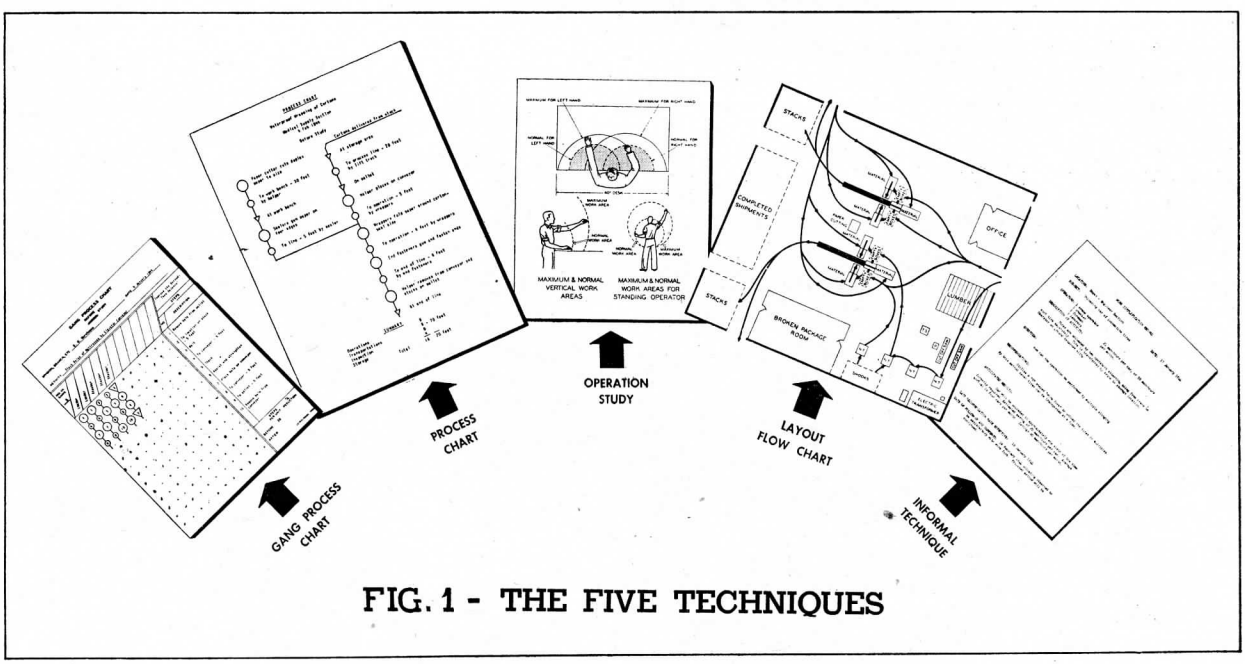

FIG. 1 - THE FIVE TECHNIQUES

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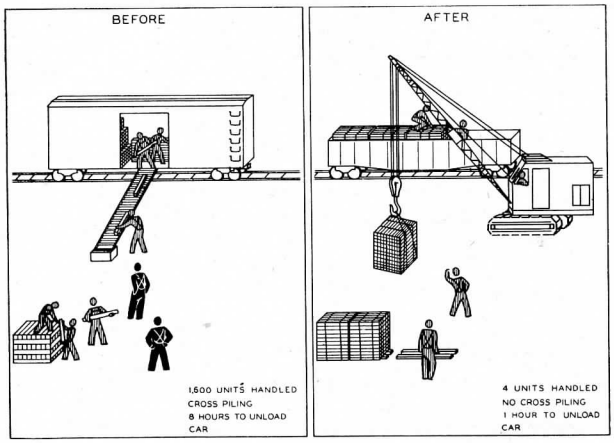


FIG. 2

effort by examining the simultaneous motions (e. g., by each of the hands) of a worker who is performing a task within a limited working area.

Layout studies.—Layout studies are of two types:

Flow charts are used to record the flow of material or movement of operators through a particular area. This involves the use of flow plans drawn to scale with all movements plotted thereon for the purpose of rearranging what is found necessary after study.

Space charts are graphic studies, by use of appropriate keys such as coloring or cross hatching, of the allotment of various portions of available space by type of commodity, etc., and are utilized to evaluate and improve space assignments to achieve the most effective movement of materials or workers.

Informal.—Any technique other than those listed above by which work simplification is accomplished is considered to be informal. The most common informal technique is accomplished by critical visual observation of a work process, recognition of opportunities to improve the process and the taking of steps to accomplish the improvement on the spot or very soon thereafter.

The work simplification program of the Signal Corps was begun early in 1943 and was confined exclusively to studies of clerical operations during that year. During that period, about 9 months, 99 surveys covering the work of 9,700 operating personnel were made, resulting in manpower savings equivalent to 1,570 people, or 16 percent of the operating personnel surveyed.

Extension of this program to the field of materials-handling operations took place early in 1944 to help relieve the acute manpower situation which then was present in all depots.

Although survey coverage for the first 8 months of 1944 is small, covering only an additional 3,900 operating personnel, savings have been realized which are equivalent to 1,280 full-time Signal Corps employees, representing 32.7 percent of the number surveyed!

Savings brought about by the program to date are productive enough to warrant increased attention on the part of all supervisors. Work simplification techniques constitute a tool which is available to help all supervisors fulfill their responsibilities for making methods improvement.

The fields of activities within the Signal Corps covered to date by the program are many and are wide in scope. Surveys covering the clerical field have ranged from filing to a new procedure for processing a vendors' shipping document; and in the field of materials-handling activities, the range has been from spotting freight cars to a device for testing capacitors.

Results of several of these completed surveys have been selected for discussion in the following paragraphs, in the belief that they are of fairly wide general interest and may suggest to the reader opportunities for applying the techniques to some aspect of his own job.

DEPOT OPERATIONS

Assembly of Teletype Repair Kits

Before the study it was the practice to place boxes containing the 130 items comprising the kit assembly, in order, on tables about the room. Women with empty kit boxes and hand carts passed by each table and selected the items of the kit assembly. The maximum number of kits assembled in 1 day by this method was 200, and resulted in extreme fatigue on the part of the workers.

As a result of time and motion studies, the procedure was radically changed. Tables were arranged in a horseshoe manner; parts were placed on them in a logical sequence; and the operators were seated comfortably within work range of several different items. Empty kits were started at one end of the line and each operator placed therein items within her work range before passing the box on to the next operating position. This system increased to 325 the number of sets assembled in an 8-hour period and materially reduced the fatigue factor.

Unloading Telephone Cross Arms

Telephone cross arms were being unloaded from freight cars at a Signal Corps depot in a manner that required an 8-man gang 8 hours per car. The method used was to unload the cross arms singly

o o o

by hand from the boxcar and cross-pile them on the ground adjacent to the car (figure 2), roller conveyors being used to transport arms from the car to the ground. Critical examination of this method resulted in changing the method of shipment by strapping the cross arms in bundles of 400; employment of gondola cars instead of box cars; and the use of a crane for unloading. Unloading is now accomplished by a 5-man crew at a rate of 1 hour per car. The same saving is realized in the reshipment of telephone cross arms from the depot to a port of embarkation and in the subsequent unloading at the port.

REPAIR SHOP PROCEDURES

Painting Empty Cable Reels

In a depot repair shop a study was made of cleaning and repairing empty cable reels for paint spraying. Prior to the study, all reels were individually cleaned by hand brushing and washing which took an average of 17 minutes per reel for preparation. A machine, equipped with a square rotating axle, was developed which accommodated two reels at a time (figure 3). This equipment cut the time for preparing each reel to 6 minutes and permitted better cleaning as more pressure could be applied with a wire brush to the rotating reel.

This speed-up led to a bottleneck in the paint spraying of the reels. The old system included the insertion of an axle in the reel, placing the reel on a fork, and hand-rotating while spraying. Improvements consisted of a pair of rollers, arranged to form a cradle to permit insertion and rotation of the reel while spraying, installed in a frame with foot pedal attachment to remove reel from rack. The equipment was also supplied with a pan to catch excess paint heretofore wasted. This equipment reduced time of paint spraying to three minutes per reel.

Sorting and Testing Capacitors

To test and sort capacitors within a tolerance range of 5 percent, a commercial tester was previously used, necessitating individual testing and handling of each capacitor for each range of capacity. This method required 60 operators to test and sort approximately 225,000 capacitors in 1 month.

A horizontal rotating wheel was developed (figure 4) having 30 chucks arranged so that capacitors can be inserted as the wheel rotates. The capacitors are tested and sorted by stock number (capacity) by a series of electronic bridges located around the wheel.

With this device, a capacitor is handled but once, i. e., when the operator inserts it in the chuck, the capacitor is automatically tested and sorted within a tolerance of 0.5 percent. Five people now test and sort 225,000 capacitors in 1 month's time with a higher degree of accuracy than before. This has resulted in a saving of 55 operators on this job alone.

LABORATORY METHODS

Internal Security Measures

A large Signal Corps laboratory made a study of its internal security procedures and the resulting improvements included raising the guard booths at vital points, expanding and utilizing the existing lighting systems; installing telephones in a number of the guard booths; and installing radio sets in outlying areas. These refinements permitted a reduction of guard personnel from 812 to 579 with an accompanying increase in security.

At another Signal Corps installation, a study of internal security led to a recommendation that was put into effect whereby walking of posts was substituted for stationary posts which also resulted in increased security and decreased guard personnel.

SIGNAL OFFICE ACTIVITIES

Message Center Operations

A far-reaching program of work simplification was started in the Southwest Pacific Area by first tackling message center procedures. This selection

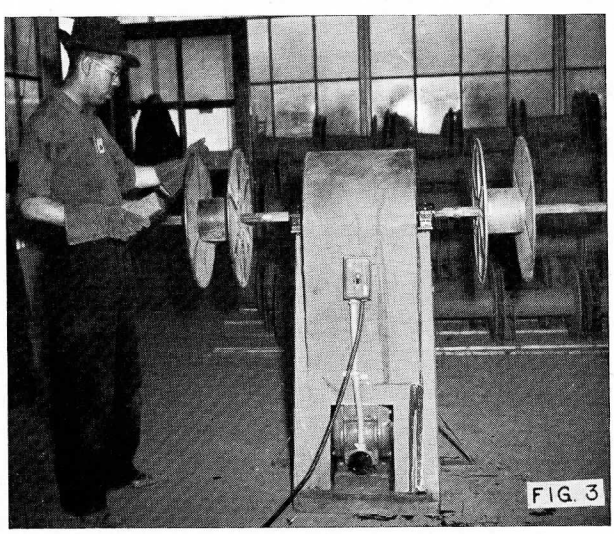
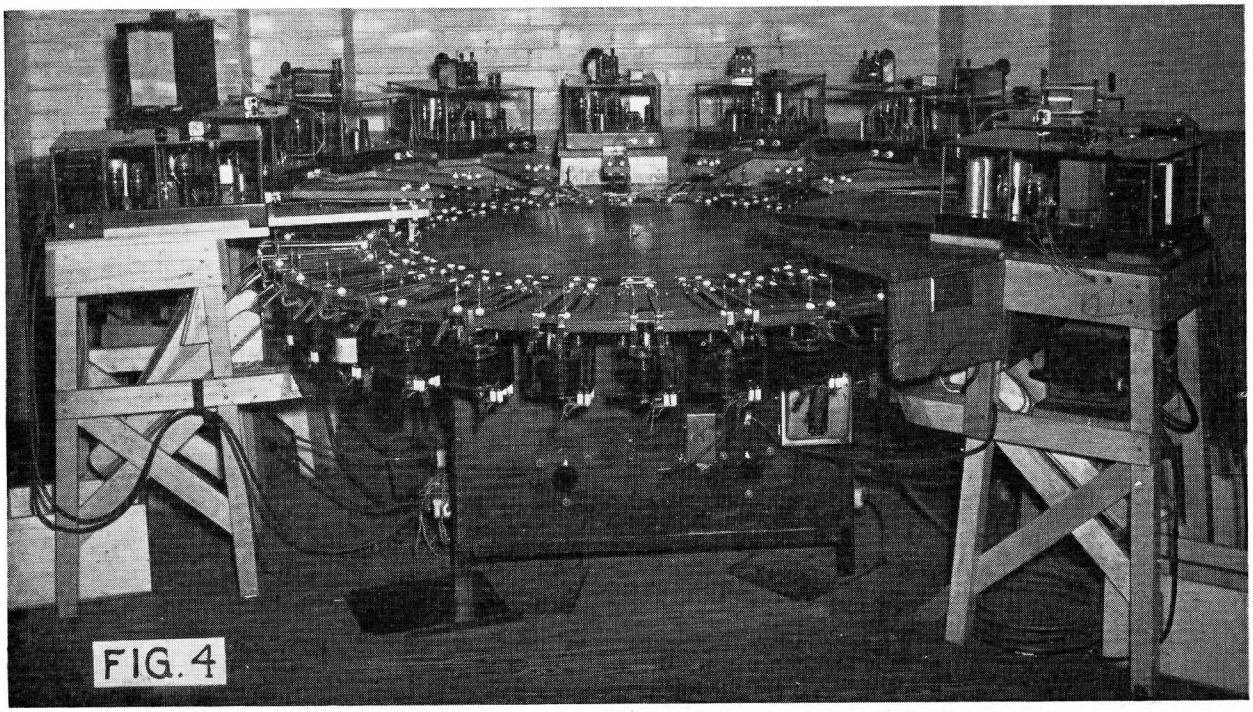


FIG. 3



was made partly because of the extremely high standards of speed and accuracy that must be maintained by message centers.

The results of those initial efforts were very encouraging both in view of the savings realized, over 10 percent, and because the simpler methods resulting maintained the high standards of speed and accuracy under difficult conditions. That experience served as a springboard for extension of the program to all phases of operations in this theater, as well as in the adjacent China-Burma-India Theater.

Communications Systems

In one East Coast area telephone service for Signal Corps installations was furnished by means of 23 separate telephone systems using a total of 42 switchboard operating positions, staffed by 148 telephone operators. In a comprehensive survey of these systems, recommendations for consolidation and intergration were made, including elimination of certain systems by removal to another existing area; elimination of other systems by provision for off-premises extensions to pertinent areas from the nearest, larger, separate telephone system and absorption by the larger telephone system, and elimination of certain tours of duty with only night service connections to be used.

These recommendations were effected over a period of several months and have resulted in the elimination of 14 separate telephone systems, 17 switchboard positions, and 67 telephone operators, with the possibility of still further savings to be realized.

SCTIL DISTRIBUTION

Overseas distribution of the Signal Corps Technical Information Letter was formulated on the basis of past requests from theaters, armies, air units, ground and service organizations, signal battalions and companies, and standard AG publication distribution figures. It is recognized that this symbol distribution may not meet the needs of many field organizations; therefore suggestions for changes in or additions to current distribution should be addressed to The Chief Signal Officer (SPSAY), Washington 25, D. C.

SPIRAL-FOUR CARRIER SYSTEMS

THE FOLLOWING information has been obtained from several sources bearing on the overseas experience of signal organizations in the use of spiral-four carrier systems. For reasons of security, names and places have been omitted.

Spiral-four carrier systems are being used in theaters of operations not only to increase the talking range but also to provide additional channels of communication. This cable was especially designed for use with carrier equipment and contains two pairs in spiral arrangement, each having a 6-millihenry loading coil at quarter-mile intervals. The carrier system will operate at distances up to 150 miles when spiral-four is used as an aerial cable or laid on the ground, and approximately 400 miles when it is buried underground. Some organizations prefer to have an additional speech channel rather than to sacrifice it for teletypewriter channels provided by the Telegraph Terminal CF–2A. For systems using two or more intermediate repeaters it has been found desirable to use the cable either underground or as aerial construction with average repeater spacing of approximately 25 miles. Reports indicate that the Telephone Terminal CF–1A requires little adjustment once installed. The gains of the telephone terminals and repeaters, if adjusted properly when first installed, require only periodic changes thereafter to compensate for variations in attenuation caused by changes in temperature. Experience has shown that daily inspections and a weekly line-up of the system is usually sufficient, except when there is a radical change in temperature. Routine tests are made when the traffic is low. The alignment of the channels remains fairly constant and very little adjustment is required at the time the checks are made.

A report from one theater states that spiral-four cable provides the most satisfactory means of communication for carrier systems. Its installation requires less man-hours than the construction of an equivalent amount of open wire line. Experience has proved that spiral-four installations must be protected from friendly vehicles as well as from the weather and enemy action. It has been found preferable to hang the cable from trees parallel to the road, using messenger wire only when needed because of excessive spans. Placing the poles prominently along the inner shoulders of the highway makes their mortality from military traffic high.

A spiral-four carrier system in England has been in continuous operation since the first week in May with 60 miles of cable suspended from poles. This system uses Telephone Terminal CF–1A, Telegraph Terminal CF–2A and Repeater CF–3A and auxiliary equipment. Three telephone, four teletypewriter and two d-c ground return simplex circuit are provided. The repeaters are spaced approximately 20 miles from the terminals and located in private buildings. In order to facilitate maintenance, an alarm and signaling circuit operating over one of the simplex circuits is used for signaling between the carrier terminals and intermediate repeaters. Since this carrier system was first installed it has given excellent service with only a 2-minute interruption in service caused by a tube burning out.

The spiral-four cable is hung unsupported between poles except at highway crossings and through some towns where the cable is supported by messenger wire. Spans of less than 100 feet are obtained by 20-foot, 4 by 4 poles at the midpoint of each span of the permanent lead. The cable is fastened to the poles by means of open helix spring hangers which are placed on drive hooks. At road crossings, corners and vertical pole runs, the Kearney Clamp is used and also hung on the drive hooks. (This appears to be in accordance with the procedure outlined in TM 11–369 "Spiral-Four Cable."). The method has been useful since when a pole is struck by a vehicle the spring hanger jumps off the hook, allowing the pole to fall free of the cable. This has happened in two cases and only necessitated replacing the pole. Recently several bombs were dropped in the immediate vicinity of the pole line and although open wire lines on the same pole were damaged and put out of service, the spiral-four cable was found to be undamaged.

Maintenance discipline is as important as personal discipline. A poor soldier endangers his buddies' lives. Poor maintenance endangers everyone's life by causing the breakdown of needed equipment often at the time of crisis.

DIVISION OPERATION PROCEDURES

THE OPERATION memoranda printed below were issued by an infantry division of the Third U. S. Army. They are reprinted here as a matter of information. The paragraphs that have been deleted in this reprinting are those of purely local application.

HEADQUARTERS_____INFANTRY DIVISION

OFFICE OF THE COMMANDING GENERAL

APO—, U. S. ARMY

OPERATION MEMORANDUM NUMBER_____10 } 7 JUNE 1944.

WIRE CONSTRUCTION AND OPERATION

1. *Wire Construction:*

a. Wire communications will be established as fast as possible even though it may mean only one circuit of a temporary nature.

b. Minimum circuits will be established as follows:

(1) *Signal Company* will lay a minimum of two (2) circuits to each front line Regiment, Division Artillery Headquarters, and each Infantry Battalion operating under Division control; (4) four circuits between the Division Command Post and the rear echelon; one (1) circuit to QM Co, Sig Co, Ord Co, Engr Bn, Med Bn, Traffic Control Stations, Division reserve, and attached units.

(2) Infantry Regiments will provide a minimum of two (2) circuits to each front line battalion.

(3) The Division Artillery Commander will prescribe the minimum requirements for the Division Artillery.

c. The Signal Company and Infantry Regiments, upon completion of initial installations, will push wireheads or trunks forward along the prescribed axis of communication in anticipation of a forward displacement.

d. Wire construction teams of the Signal Company will operate from a wirehead established some distance from the Division CP's. Regiments and the Division Artillery will operate in the same manner when possible.

e. The lowest numbered circuit between Division and the following units will be simplexed for telegraph:

Regiments.
Division Artillery.

f. All trunk lines laid by the Signal Company between the Division rear echelon, Division CP and regiments in the front lines will be loaded.

g. * * *

h. * * *

i. *Enemy Wire:*

(1) Overhead wire and cable circuits will be completely disrupted at a convenient pole, bunched and grounded on the side nearest the enemy.

(2) Underground circuits will be disconnected, bunched and grounded at the test frame or cross-connecting point nearest the enemy. Underground cable will not be cut.

(3) Enemy field wire will be cut and grounded on the side nearest the enemy.

(4) No enemy or commercial wire will be used without approval of this headquarters.

j. Field wire will be recovered whenever possible.

(1) A thorough check will be made before recovery to make certain that circuits are not in use or intended for use.

(2) Recovered field wire will be serviced and used by units recovering same.

k. *Wire Routes:*

(1) In laying field wire congested areas and crowded roads will be avoided. Wire will be laid cross country whenever possible.

(2) When laying wire along roads, Field Artillery units will use the left of the road facing the enemy or to the flanks. Signal Company and Infantry Regiments will use the right side of the road.

(3 All trunk lines will be patrolled to facilitate clearing of trouble on the lines.

l. Complete records of all wire laid will be kept. Communication officers of Infantry Regiments and Hq Division Artillery will forward circuit diagrams and line route maps to the Division Signal Officer as of Ø8ØØ each day.

2. *Wire Operation:*

a. Teletype communication will be established between the Division Rear Echelon and the Command Post. Telegraph will be substituted in event teletype fails.

(1) Procedure will be that prescribed in FM 24–8.

b. Telegraph communication will be established between the Division and each Infantry Regiment and between Division and Division Artillery when CP's are not adjacent, between Regiments and their Battalions and between the Division Radio Stations and Message Centers.

(1) * * *

(2) Headquarters Code Signs will be used for telegraphic Call Signs.

(3) When telegraph is available radio will not be used.

c. *Telephone Communication:*

(1) Telephone Code Names are assigned to all Division Units and are published in the Division SOI. These Code Names afford no security but serve to facilitate handling of telephone calls. They will not be used in radio transmissions. Local telephone numbers will be assigned in accordance with paragraph 265, FM 24–5.

(2) Telephone Operating Procedure:

(a) Procedure prescribed in FM 24–5 will be used.

(b) Telephone Priorities: Telephone calls will be handled in accordance with their precedence over the Division wire system.

(1) *Urgent* ("Clear the line"). This precedence will be used by the Division Commander, Asst to Division Commander, Artillery Commander, Artillery Ex O and Commanding Officers of Infantry Regiments and Chief of Staff, only. Operators will interrupt any calls of a lower precedence for calls of this type.

(2) *Operational Priority.* This precedence will be used by officers authorized to make urgent calls and by G–2 and G–3 and corresponding staff officers in Division Artillery and Infantry Regiments, only. Operators will interrupt any calls of a lower precedence after a one (1) minute notice for the placing of operational priority calls.

(3) *Priority.* This precedence will be used by officers authorized to make urgent and operational priority calls, G–1, G–4, Asst G–4, S–4's of Div Arty and Inf Regts, Engr Officer and Div Signal Officer only. Operators will interrupt all calls of a lower precedence after one (1) minute notice for the placing of priority calls.

(4) Routine (Normal). This precedence will be used by all persons other than those mentioned above. Operators will handle these calls in the order received.

(c) *Flash Warning.* See operation memorandum on General Communications.

(d) Commanders of Division Units will prescribe priorities for use over their own communication systems.

HEADQUARTERS _____ INFANTRY DIVISION

OFFICE OF THE COMMANDING GENERAL

APO —, U. S. ARMY

OPERATION MEMORANDUM NUMBER_____9 — 7 JUNE 1944.

MESSAGE CENTER OPERATION

1. *Message Center:*

a. Message Center Operation will follow the provisions of FM 24–5.

b. All Message Centers will have some means available for quick destruction of all cryptographic papers and devices.[1]

c. When heavy traffic can be foreseen, advance notice will be given the Message Center by the issuing section concerned.

d. When a message is delivered by a messenger to a Message Center and the clerk who receives it is doubtful of the authenticity of the bearer, the following action will be taken:

(1) The identification of the bearer will be carefully examined.

(2) The bearer will be detained until his message is delivered to and read by the addressee who will be informed by the Message Center of the circumstances in which they received the message.

(3) The addressee will inform the Message Center whether or not in his opinion, the message is genuine. If there is any doubt, the bearer will be delivered into the custody of G–2 or S–2 for disposition.

(4) Having properly identified the messenger beyond doubt, the receiving Message Center will notify the originator that his message has been received.

e. Message Center procedure is a means for orderly and expeditious handling of traffic. It will not be permitted to become so cumbersome that it no longer serves its purpose. Message Center personnel are authorized to eliminate all "Procedure" in favor of getting a tactical message out of the Message Center in one minute or less, except where cryptographing is required.

f. Message Center is the official time agency for the Division. All Message Centers will synchronize time at least twice daily with its next higher headquarters. When there is no contact with next higher headquarters, the time will be checked with the BBC. See SOI Item 42–( ), this headquarters, for frequency and schedule of broadcast.

g. Message Center records will be turned over to G–2 or S–2 at the end of each week. G–2 or S–2 will inspect same for any required statistical data and then destroy them.

2. *Messenger Service:*

a. Establishment of scheduled and special messenger service will be habitual by all units in this command.

b. The departure of messengers will be confirmed if possible by a message between Message Centers concerned. The arrival of a messenger will likewise be confirmed.

c. A unit that changes the location of its Command Post will dispatch messengers to its next higher and lower Command Posts in order to keep the Message Centers informed as to the exact location of the new Command Post.

d. Airplane Messenger Service will be established in emergencies by the Division Artillery.

3. *Codes and Ciphers:*

a. Only codes and ciphers issued by this headquarters will be used.

4. *Preparation and Processing of Messages:*

a. All messages except telephone will be authenticated. Message Centers will perform this work. See SOI Item 61–( ) this headquarters.

b. All messages to be transmitted by electrical means will be cryptographed except those that fall in the category listed below:

(1) Messages of less than a Secret classification.

(2) Messages authorized to be sent in the clear over the signature of an officer having authority to do so (list of officers authorized to send messages in the clear will be furnished unit Message Centers).

c. *Flash Warning* messages will have priority over all messages and will be sent immediately to G–2 or S–2.

[1] In general, paragraphs of SOPs dealing with destruction of crytographic matériel include detailed instructions rather than the general statement given in paragraph 1b of the example.

". . . an all-time traffic record over a manual circuit was handled for this headquarters on September 2, 1944 . . . (between AFHQ and Seventh Army). A total of 15,228 words was handled, due to the fine coordination and cooperation of the operators on duty at both ends of this important radio link."—From a letter to General Ingles from the Deputy Chief Signal Officer, AFHQ.

TELEPHONE SWITCHBOARDS—

Switchboard	BD-9	BD-11	BD-14	BD-54	BD-71	BD-72	BD-74	BD-80
Stock No	4C9909	4C9911	4C99145 W. E. Co. 4C99146 Str. Carl	4C9954	4C9971	4C9972	4C9974	4C9980
Part of	CE-1							TC-1
Used for	Field wire systems	Field wire systems	Division	Training	Field wire systems	Field wire systems	Fire control	Army
Classification as of 2 August 1944	Obsolete (6-1-43)	Obsolete (6-1-43)	Limited standard	Limited standard	Standard	Standard	Standard	Limited standard
Type	Magneto (monocord)	Magneto (monocord)	Magneto	Common batt.	Magneto (monocord)	Magneto (monocord)	Common batt. magneto	Common batt. magneto
Equipment—lines—magneto	4	12	40		6	12	Per specification	30
Lines—common battery							Per specification	60
Lines—outgoing				2				
Lines—through								60
Multiple jacks (magneto)								120
Multiple jacks (common battery)								3
Trunks—manual								3
Trunks—dial			8	1			25 (patching)	15
Cord circuits—conn								Yes
Cord dial								10
Conference ckt. (number of jacks)								Yes (BE-72)
Test circuit								Yes
Grouping key								ME-4, TE-44
Associated maintenance equipment								600w
Maximum ext. loop (C. B. lines)								10,000w
Minimum ins. res. (C. B. lines)								(See BD-101)
Simplex coils					2	4		
Power equipment, number dry cells			2 BA-17		6 BA-30	6 BA-30		
Power panel								BD-90
Voltage								40-56
Number storage battery cells								24
Ringing equipment hand generator	Yes ④	Yes ④	Yes		Yes	Yes		Yes
Telering	No	No	No		No	No		Yes
Battery converter	No	No	No		No	No		Yes
Main distributing frame or protection panel.	Integral	Integral	Integral		Integral	Integral		FM-19
Protection	Fuses spark gap	Fuses spark gap	Fuses carbons		Spark gap	Spark gap		Heat coils carbons
Number of terminals (pairs)	4	12	40		6	12		100
Number of protectors (pairs)	4	12	40		6	12		100
Dimensions in inches (Swbd.)	10½ x 5½ x 6¼	17½ x 10½ x 5½	21 x 26 x 15		18½ x 10¼ x 15	27 x 10¼ x 15	84 x 24 x 11	77½ x 26½ x 37⅞
Weight pounds, switchboard only:								
Packed	20	30	185	115	52	74	800	1215
Unpacked	10	20	185	95	52	74	666	739
Weight, complete unit								(TC-1) 7900 ③
Technical manual or instruction book	FM 24-5	FM 24-5	TM 11-331		TM-11-330	TM-11-330		TM-11-335
Specification number	Dwg. 101D16	Dwg. 15001D1	578	71-301	71-686	71-686	71-681-B	71-1015-A
REMARKS	Replaced by BD-71 Generator is part of operator's telephone set EE-8-( ) ④	Replaced by BD-72 Generator is part of operator's telephone set EE-8-( ) ④	Replaced by TC-4	(Model cross-section) For instructional purposes only	Replaces BD-9	Replaces BD-11	Used by coast artillery	Limited standard TC-1 consists of three sections BD-80 ③

COMPARATIVE DATA CHART

BD-89-G*	BD-91	BD-95	BD-96	BD-101	BD-105	BD-110	BD-120 □Ø	SB-5( )/PT	SB-18/GT*
4C9989	4C9991	4C9995.4	4C9996.6	3F4480-101	4C10105.2	4C10110	4C10120	4C9905-5	4C9905-18
TC-2	TC-12	----------	TC-4	See footnote remarks	----------	TC-10	TC-20	----------	----------
Corps	Air forces groups or squadrons	Harbor defense	Division	Army	Harbor defense	Army	Army	Field wire systems	Field wire systems
Standard	Standard	Standard	Standard	Standard	Standard	Substitute standard	Standard	Limited procurement	Standard
Common batt. magneto	Magneto	Magneto (cordless)	Magneto	----------	Magneto (cordless)	Common batt. magneto	Common batt. magneto	Magneto monocord	Magneto
20	20	20	40	----------	12	30	30	6	6
40*	----------	----------	----------	----------	----------	60	30	----------	----------
3	----------	----------	----------	100 (test)	----------	----------	----------	----------	----------
2	----------	----------	----------	----------	----------	60	60	----------	----------
----------	----------	----------	----------	----------	----------	120	60	----------	----------
4* ①	4 ①	----------	4 ①	10 (test)	----------	4 ①	8 ①	----------	----------
*	----------	----------	----------	----------	----------	----------	----------	----------	----------
13	8	5 (key)	12	20 (patching)	5 (key)	15	15	----------	----------
Yes	Yes	----------	Yes	----------	----------	Yes	Yes	----------	----------
5	4	----------	6	----------	----------	10	10	----------	----------
Yes	----------	----------	----------	Yes	----------	Yes (BE-72)	See BD-101	----------	----------
Yes	Yes	----------	Yes	----------	----------	Yes	Yes	----------	----------
ME-6, TE-44	ME-30	----------	ME-11	TE-44	----------	ME-4, TE-44	ME-63, TE-44	----------	----------
300w	----------	----------	----------	----------	----------	600w	600w	----------	----------
10,000w	----------	----------	----------	----------	----------	10, 000w (See BD-101)	10. 000w (See BD-101)	----------	----------
12 (BE-79)	4	----------	8 (BD-97)	40	----------	----------	----------	----------	----------
----------	8	----------	6	48 (test batt.)	----------	----------	----------	----------	----------
BD-98	----------	----------	----------	----------	----------	BD-90	BD-132*	----------	----------
22-30	----------	----------	----------	----------	----------	40-56	48	----------	----------
12	----------	----------	----------	----------	----------	24	24	----------	----------
Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No ④	No ④
Yes	Yes	----------	Yes	----------	----------	Yes	Yes	No	----------
Yes	Yes	----------	Yes	----------	----------	Yes	Yes	No	----------
BE-79	Integral	----------	BD-97	Assoc. TC equip.	----------	----------	FM-64	Integral	----------
----------	----------	----------	----------	----------	----------	----------	----------	----------	----------
Heat coils	Fuses	----------	Fuses	----------	----------	----------	----------	Spark gap	----------
carbons	carbons	----------	carbons	----------	----------	----------	68	6	----------
80	24	----------	44	210	----------	----------	75	6	----------
80	24	----------	44	----------	----------	----------	----------	----------	----------
22½ x 35½ x 47¼	17¼ x 17⅜ x 25⅜	23 x 13 x 14	15 x 22 x 25	58 x 25¾ x 21¾	----------	72 x 26½ x 36¾	57 1/16 x 26 7/16 x 32 1/16	7 x 8 x 10	1¼ x 2 x 10 (est.)
400	215	160	230	600	141	850	675	11½	1½ (est.)
400	215	----------	200	600	----------	850	675	11½	1½ (est.)
(TC-2) 2900	(TC-12) 325	----------	(TC-4) 673	----------	----------	(TC-10) 6550	(TC-20) 5500	----------	----------
TM-11-340	TM-11-336	----------	TM-11-332	----------	----------	TM-11-338	----------	Tentative TM-11-2016	TB Sig 61
71-995	71-1312	Commercial	71-1007	71-1311	Commercial	71-1015-A	71-1611	71-3059	----------

① Trunks are universal
*BD-89-A, B, C, D, E and F have 37 common battery lines, with 2 C. B. trunks and 1 dial trunk

Five TC-12 are required per division if used instead of TC-4
① Trunks are universal

Commercial item

Three TC-4 are required per division
① Trunks are universal

Test board BD-101 is used with but not part of TC-1, TC-10, TC-20. For lines to BD-80, BD-110, and BD-120.

No more BD-105 to be procured. However, BD-95 with 12-line equipped and 20-wired for shall be procured in lieu of BD-105

① Trunks are universal

① Has cord splitting feature with EE-8 telephone; the second operator has 7 cords
Ø SWBD, power frame, and M. D. F., all same height
*Panel BD-132 is universal for TC-1, TC-10, TC-20

① Trunks are universal

④ Generator is part of operators telephone set EE-8-( ). Two, three, or four SB-5-( )/pt may be operated together for providing capacity up to 24 lines

④ Generator is part of operators telephone set EE-8-( )
*Emergency switching unit using 7-adaptor plug U-4/GT with mounting block and carrying case

TELETYPEWRITER MOTOR SPEEDS

How to Use the Tuning Fork and Stroboscopic Target to Adjust Individual Machines

THE MOTORS which operate teletypewriter apparatus are equipped with a speed measuring device which consists of a stroboscopic target having alternate black and white spots. This target is viewed through a special tuning fork and when the motor speed is correct the target spots appear stationary.

Occasionally difficulty is experienced since there are other incorrect motor speeds at which the target spots will appear stationary. To alleviate this difficulty some motors are equipped with two targets and it is not always clear which target should be used.

Also occasionally due to rather special circumstances it is necessary to change the motor speed of transmitter-distributors, teletypewriters, or other teletype equipment from the standard speed. This, of course, should not be done except when the necessity is clearly indicated, such as in the case when American machines operate on a network having both American and British teletypewriters. This paper gives some information concerning methods of computing motor speeds and records some computations of available speeds.

The standard American teletypewriter tuning fork vibrates 87.6 times per second and is equipped with slotted shutters so that the target on the motor shaft is viewed 175 times per second (2×87.6). In the case of a motor with a 10 black spot target and a speed of 35 revolutions per second, the number of black spots passing a given point in a second will be 350. This is divisible by 175 and therefore during the interval of time between views of the target exactly two spots would pass a given point and the spots would appear stationary. If the motor speed were 17.5 revolutions per second every spot would be viewed. If, however, the target had 20 black spots instead of 10 and every spot was viewed, the motor speed would be half of 17.5 revolutions per minute. From this discussion it will be fairly clear that:

$$\frac{\text{R.P.S.}\times N}{175}=I \text{ (whole number 1, 2, 3, 4, etc.)}$$

$$\text{R.P.S.}=\frac{175I}{N}$$

$$\text{R.P.M.}=\frac{60\times175I}{N}=\frac{10{,}500I}{N}$$

R.P.S. = Revolutions per second of motor
N = Number of Black Spots on Target.
I = An integer.

A tuning fork which vibrates at the rate of 96.19 cycles per second is also available. This fork was designed for use with teletypewriters which operate at 404 operations per minute and coordinate with British machines. This fork gives speeds which are about 10 percent higher than the standard 87.6-cycle fork.

Tables A, B, and C record computations of speeds obtainable with various targets and various tuning forks.

Targets with a large number of spots have the disadvantage that there are several speeds at which the target will appear stationary and hence the speed may be adjusted to the incorrect value.

TABLE A.—*Motor speeds obtainable with targets having a certain number of black spots*

Target	*Motor speed (revolutions per minute)*		*Target*	*Motor speed (revolutions per minute)*	
	87.6 Fork	**96.19 Fork**		**87.6 Fork**	**96.19 Fork**
7, 14, 21, 28, 35	1502	1649	31	2035	2234
34	1546	1698	35, 30, 25, 20, 15, 10, 5	2102	2308
27	1557	1710	34	2164	2376
20	1577	1732	29	2175	2388
33	1593	1749	24	2190	2405
13, 26	1617	1776	19	2213	2430
32	1642	1803	33	2230	2449
19	1660	1823	14, 28	2252	2472
25	1682	1847	23	2285	2508
31	1695	1861	32	2300	2525
6, 12, 18, 24, 30	1752	1923	9, 18, 27	2336	2565
35	1802	1978	31	2374	2605
29	1812	1989	22	2389	2623
23	1828	2007	35	2403	2638
17, 34	1855	2036	13, 26	2426	2664
28	1877	2061	30	2453	2693
11, 22, 33	1911	2098	17, 34	2473	2715
27	1947	2138	21	2503	2748
16, 32	1971	2164	25	2523	2772
21	2002	2198	29	2537	2785
26	2021	2219	33	2548	2798
			4, 8, 12, 16, 20, 24, 28, 32	2628	2886

TABLE B.—*Motor speeds obtainable with targets having a certain number of black spots and 87.6-cycle fork*

Target (number of black spots)	Motor speed (revolutions per minute)							
	(1)							
4	2628							
5	2102							
6	1752							
7	1502	(2)						
8		2628						
9		2336						
10		2102						
11		1911	(3)					
12		1752	2628					
13		1617	2426					
14		1502	2252					
15			2102	(4)				
16			1971	2628				
17			1855	2473				
18			1752	2336				
19			1660	2213	(5)			
20			1577	2102	2628			
21			1502	2002	2503			
22				1911	2390			
23				1828	2285	(6)		
24				1752	2190	2628		
25				1682	2102	2523		
26				1617	2021	2426		
27				1557	1947	2336	(7)	
28				1502	1877	2253	2628	
29					1812	2175	2537	
30					1752	2102	2453	
31					1695	2035	2374	(8)
32					1642	1971	2300	2628
33					1593	1911	2230	2548
34					1546	1855	2164	2473
35					1502	1802	2102	2403

(2) Indicates every second spot is viewed, etc.

TABLE C.—*Motor speeds obtainable with targets having a certain number of black spots and 96.19-cycle fork*

Target (number of black spots)	Motor speed (revolutions per minute)							
	(1)							
4	2886							
5	2308							
6	1923							
7	1649	(2)						
8		2886						
9		2565						
10		2308						
11		2098	(3)					
12		1923	2886					
13		1776	2664					
14		1649	2472					
15			2308	(4)				
16			2164	2886				
17			2036	2715				
18			1923	2565				
19			1823	2430	(5)			
20			1732	2308	2886			
21			1649	2198	2748			
22				2098	2623			
23				2007	2508	(6)		
24				1923	2405	2886		
25				1847	2308	2772		
26				1776	2219	2664		
27				1710	2138	2565	(7)	
28				1649	2061	2472	2886	
29					1989	2388	2785	
30					1923	2308	2693	
31					1861	2234	2605	(8)
32					1803	2164	2525	2886
33					1749	2098	2449	2798
34					1698	2036	2376	2715
35					1649	1978	2308	2638

(2) Indicates every second spot is viewed, etc.

When the motor speed is fast it will be noted that the target spots appear to travel in the direction of rotation and when the motor speed is slow the target spots appear to travel opposite to the direction of rotaton. The amount of speed deviation in any case can be estimated as in the following example: If a motor operated at a speed of about 35 revolutions per second and was equipped with a 10-spot target, 350 black spots would pass a given point in a second. If 351 black spots passed a given point the spots would appear to progress at the rate of 1 per second. Therefore, the actual speed would be:

$$\frac{351}{350} = 1.00286 = 0.286 \text{ percent fast}$$

In case the motor speed desired is in doubt, various methods may be used to determine the one to use. One method which is very useful on such machines as tape distributors is to measure the length of tape passed through the distributor in 1 minute. The tape is perforated with 10 characters per inch so if, for example, 368 characters were desired 36.8 inches of tape should pass through the gate in 1 minute. When the motor speed is about correct as determined in this manner, it may be adjusted more accurately by means of the tuning fork and target.

The ratio of the gears used in transmitter-distributors is occasionally in doubt. For example, it may be known that the gear ratio is either 7:40 or 9:44. One method of determining which gears are installed is to turn the motor over by hand. If 7:40 gears are installed, it will be found that the motor must be turned 40 revolutions for the brush arm to return to its starting point, while if

9:44 gears are installed it will be necessary to turn the motor 44 revolutions.

It is convenient to be able to remember some of the constants such as the rates of vibrations of the tuning forks. The speed of the standard American tuning fork can be remembered fairly easily by noting that the first number is 8 and the next 2 numbers are obtained by subtracting 1 from each preceding number (87.6).

The 96.19 fork is 10 percent higher, less about 2 parts in a thousand. This case, perhaps, is like the old story of the man who counted the number of cows in a field from a fast train by adding the number of horns and dividing by 2.

WINTER-WISING GI'S

THE ARMY is furnishing the material needed to operate vehicles at temperatures ranging from 0°F to -65°F. This material consists of winterization equipment and supplies for the vehicles and printed aids, such as manuals and technical bulletins.

Number one on the list of printed material is the new technical bulletin, TB ORD 126, "Cold Weather Lubrication and Service of Combat and Transport Matériel." It contains all the latest information on cold-weather operation—the use of winter-grade gasoline, a gasoline "designed to reduce cold-weather starting difficulties," with information on storing it. This is important to know, because there are a number of little accidents that can happen to a tank of gasoline in low temperatures.

There are also pointers in TB ORD 126 on care of mechanical features. Electrical equipment must be kept free of ice, connections must be tightened, wiring cleaned. Batteries require special care. Cooling systems need extra attention, especially in keeping antifreeze solutions at proper strength. The tendency of brakes to freeze must be avoided as much as possible by releasing them when vehicles are parked. And even simple items like nuts and screws must get extra attention, because metal is affected by low temperatures.

After a perusal of TB ORD 126, publications that should be referred to include War Department Supply Bulletin, SB 9–16, which lists authorized winterization equipment for automotive matériel, TB ORD 67, "Storage Batteries," and, of course, technical manuals and War Department lubrication orders for specific vehicles.

BATTERIES AND TUBES

THE FOLLOWING tables give the consumption of batteries and vacuum tubes for Radio Set SCR–300 as reported by four divisions of the Fifth Army. In addition, the total monthly issue of Battery BA–70 and BA–80 is shown, together with the total sets in use each month in the Fifth Army to the end of June 1944.

In general, during offensive operations involving an attack against prepared positions or enemy delaying forces, the consumption of Battery BA–70 was approximately 10 per set per month in the units actually in combat. The life of fresh batteries for sets in constant use was approximately 20 hours. On sets operating intermittently, the total life was approximately 30 hours with battery changes approximately every 3½ days. The over-all monthly average consumption for all sets in use did not exceed 7½ batteries per set per month for normal intermittent operation.

Total battery issues to Fifth Army Units

Month	December	January	February	March	April	May	June
Sets estimated in use	120	120	208	550	650	947	400
Sets on hand	138	138	226	790	958	1,055	774
Battery BA-70	545	329	882	2,475	2,171	6,730	2,340
Battery BA-80	260	30	428	699	315	1,419	873
Average batteries of BA-70 type/mo/set	5.5	3	5.3	5.1	3.5	7.9	7
Type of operation	Offensive	Static	Attack and defensive	Generally static	Static and attack	Attack	Attack and pursuit

Battery and tube consumption by divisions

Month (Unit)	April 34th Div.	April 88th Div.	February 3d Div.	February 45th Div.
Number of sets in use—Average	121	111	120 [1]	88
Type of action	Attack	Holding	Holding (Anzio) attack	Holding
Number of batteries used:				
BA-70	1,185	806	813	694
BA-80	71	114	40	50
Average required BA-70/mo/set	10	7.7	7.3	8
Number tubes replaced:				
Tube 2T171 (1R5)	5	13	4	
Tube 2T172 (1S5)	14	7	1	6
Tube 2T173 (1T4)	7	21	5	8
Tube 2V1A3 (1A3)	11	10	3	2
Tube 2V114 (1L4)	18	32	15	1
Tube 2V3A4 (3A4)	13	11	7	

[1] Approximately 15 sets used Power Packs.

ENEMY RADIOSONDES

GERMAN AND Japanese radiosondes make use of techniques and measuring elements similar to those used in American radiosondes, but differ in the types of such elements employed, and in the method of varying the transmitted signal.

GERMAN EQUIPMENT

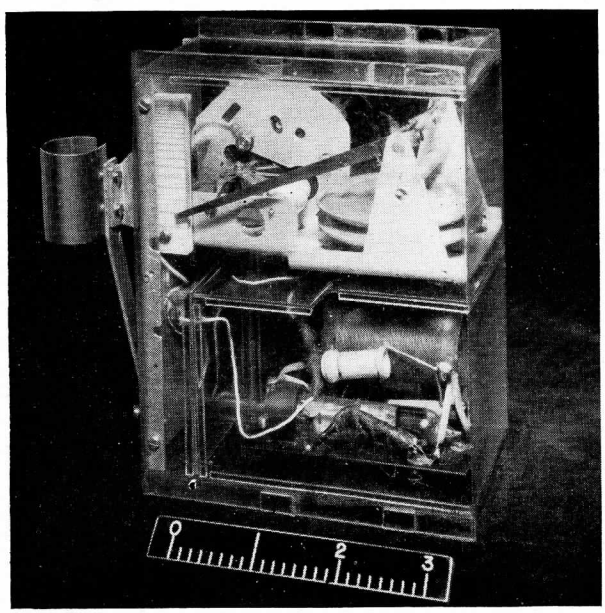
The Germans have two types of radiosondes in general use. The first type employs wet and dry bulb mercury in glass thermometers for measuring temperature and relative humidity, and a mercury filled glass manometer for the determination of pressure. These glass tubes have metallic coils on the outside distributed through the operating length of the mercury columns within the glass tubes. Two transmitters are used in this radiosonde. The dry bulb thermometer varies the radio frequency of one transmitter while the wet bulb thermometer and mercury manometer vary the frequency of the second. The number of coils below the top of the mercury column determines the conductance of the resonant circuit of the transmitters which in turn varies the radio frequency of the transmitted signal. The variations of frequency caused by the wet bulb thermometer are relatively large as compared to the variations of frequency caused by the manometer, thus enabling the observer to differentiate between the signals produced by the wet bulb thermometer and the mercury manometer. It can thus be seen that two radio frequencies and two antennas are required for this system. It is probable that constant tracking of the signals at the ground station is required to operate this set.

The Germans also use chronometric radiosondes that employ bimetallic elements to measure temperature, and hair hygrometers to measure humidity. Changes in temperature and humidity cause a variation in the time of contact between a pointer and a metallic helix embedded in a circular clock-driven wheel; this wheel is made of an insulating material. Temperature contacts are made twice a minute, humidity contacts once a minute. An aneroid pressure capsule moves a pointer across a commutator made up of metallic strips separated by an insulating material. These metallic strips, about 15 in number, are so spaced that contact is made at equal divisions of elevation. When contact is made, the plate of the transmitter tube is shorted, causing the signal to be interrupted. By keeping count of the interruptions, the pressures and therefore the heights of the instrument can be determined. German radiosondes use a frequency of 6 to 12 megacycles.

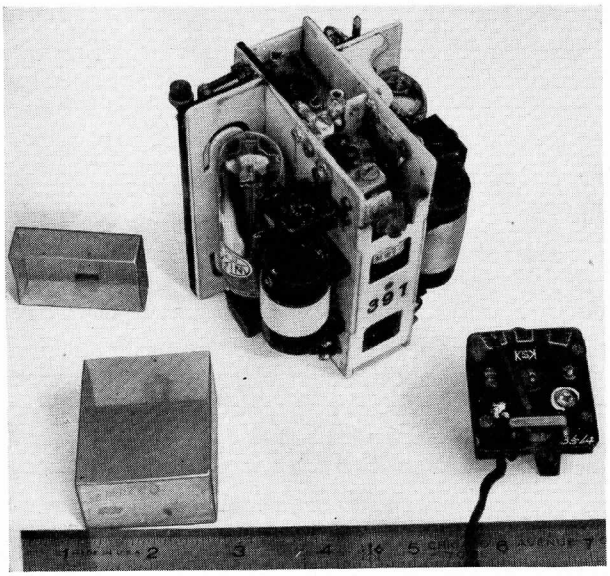
JAPANESE INSTRUMENT

The Japanese use radiosondes very similar to the German. Their temperature element is a thallium amalgam-in-glass thermometer partially encased by a metal tube. Changes in the height of this column vary the tank capacity of a transmitter and thus cause variations in the transmitting frequency. A hair hygrometer is used as the humidity element, whose movements vary the plates of a variable condenser and thus change the tank capacity of another transmitter. Pressure is determined in a manner similar to that of the German chronometric radiosonde mentioned above; however, there are only seven contacts. Japanese radiosondes like the German radiosondes also operate on two radio frequencies, requiring two transmitters, two antennas, and constant tracking at the ground station.

The American radiosonde operates with one transmitter. The carrier frequency is audio modulated and variation in audio modulation can be translated into meteorological data. The signal is received and graphically recorded on a chart.



GERMAN RADIOSONDE IN TRANSPARENT CASE.



COMPONENTS OF A JAPANESE RADIOSONDE.

The temperature element is a ceramic resistor whose resistance varies with temperature. The humidity element is a polystyrene slide covered with a hygroscopic salt solution whose resistance varies with the amount of moisture absorbed or evaporated. These changes in resistance vary the audio modulation of the carrier wave. A pressure capsule moves a contact over a commutator that switches a temperature, humidity or reference resistor into the audio modulating circuit in a definite sequence. The number of contacts can be counted and the pressure and therefore the elevation determined. Some American radiosondes have 80 contacts; others, 95. All three countries use a battery for their radiosonde power supply. The foreign radiosonds use vibrators and transformers to obtain desired voltages and alternating currents. American radiosondes use batteries with the correct plate voltage and tap only certain components of the battery for the correct filament voltages.

German and Japanese radiosondes give fewer readings than American radiosondes and therefore are less accurate. They are well built and well designed, are smaller in size, and lighter in weight than American instruments. Japanese instruments and German instruments using mercury thermometers and manometers are not well suited for mass production, since certain component parts must be hand-made, and at least two precalibrations are necessary. American radiosondes were designed for mass production.

FITCAL

THE SIGNAL Corps has "coined" a new word, and if you have anything to do with maintenance of communications equipment, especially radios, it's a word you should know about. The word is "FITCAL," and it's made up of the first letters of "Feel, Inspect, Tighten, Clean, Adjust, Lubricate." These preventive maintenance services are vitally important in radio maintenance. If performed regularly and carefully, they will enable maintenance personnel to keep equipment in good working order at all times with a minimum of effort.

The system is described in detail in TM 11–1424, a relatively recent Signal Corps preventive maintenance manual (SCR–584). It is intended mainly for second echelon personnel, since the first echelon, particularly in radio maintenance, is confined to operations which do not require access to interiors of sets. Briefly, the services involve the following.

FEEL.—Feel for overheating and lose connections. If bearing housings or trunnions on rotating machinery become too hot to the touch in less than 10 seconds something is wrong. Terminals and connections which overheat indicate poor contact or poor soldering. Remember to take precautions against electric shock and corrosive acids before you start to work.

INSPECT.—Look for mildew, discoloration, excessive moisture, blistering, bulging, leakage, oxidation of contact surfaces, dirt, corrosion, fungus growth, loose clamping rings and connections, cracked or charred insulators, broken or loose wires, loose mounting bolts or screws. Touch parts gently so you don't displace them. Be thorough!

TIGHTEN.—Tighten vacuum tube shields, fastenings, cable connectors, fuses and other parts. Handling and transit may jar them loose, and firm mountings and connections are extremely important to successful operation of communications equipment. Be especially careful not to jiggle vacuum tubes in their sockets to find out whether or not they are loose. Instead, press them straight down in their sockets. Jiggling may crack their seals. Be careful not to overtighten other parts. You're apt to damage them or cause misalignment.

CLEAN.—Keep parts clean but remember that the less they are handled the less chance there is that they'll be loosened or bent or thrown out of line. Don't wash and wipe equipment unless it needs to be cleaned.

ADJUST.—Adjustments must be made by first echelon personnel only in emergencies, or when they are authorized to do so. Don't make adjustments just because you like to "tinker."

LUBRICATE.—Lubricate only in accordance with log sheets and War Department Lubrication Orders. Lubricate faithfully. Don't lubricate too much or too often.

EQUIPMENT NOTES

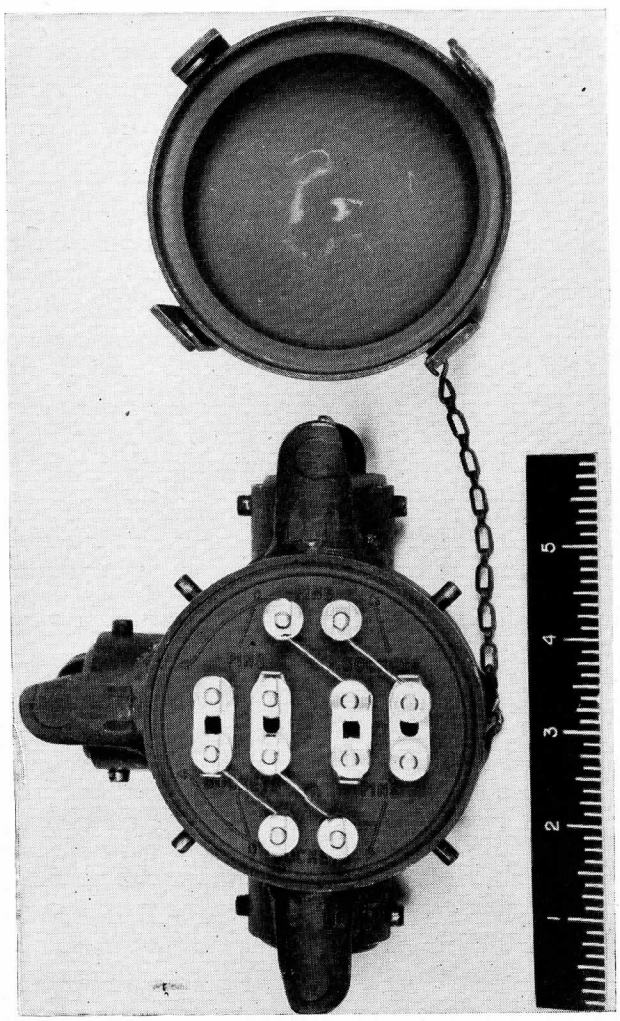
SIGNAL CORPS BOARD

APPROVED BY THE CHIEF SIGNAL OFFICER

Case No. 559—Service Test of Bridging, Access, and Test Terminal for Spiral-Four Cable

THE SIGNAL Corps Board in this case tested a Bridging, Access, and Test Terminal developed by Eatontown Signal Laboratory for use in spiral-four cable assembly facilities.

The device is a 3-way, 4-conductor test block for permanent insertion in the line at any assembly connection point convenient for bridging or test purposes. When the cover is removed access is provided for test purposes to each of the conductors connected to the terminal without interference with the metallic circuit through the remainder. The 3-way feature also provides a convenient method of bridging a through circuit without breaking the connections on the operating facility. The third socket is closed by a waterproof plug when not in use.



BRIDGING, ACCESS, AND TEST TERMINAL FOR SPIRAL–4.

Extensive tests of this device were made in connection with the installation of spiral-four facilities near Camp Murphy. The Signal Corps Board found that the Bridging, Access, and Test Terminal, when properly connected to spiral-four assemblies, satisfactorily performs the electrical and mechanical functions for which it was designed, is waterproof, and sufficiently rugged for field use.

Minor modifications were suggested by the Board, including a chain for attaching the waterproof end plug to the main device, an improved cover fastening arrangement and means for attaching the terminal to a pole or other fiixture.

The Board concluded that the terminal, when modified as suggested, constitutes a satisfactory device for providing test points and circuit bridging points on spiral-four cable facilities.

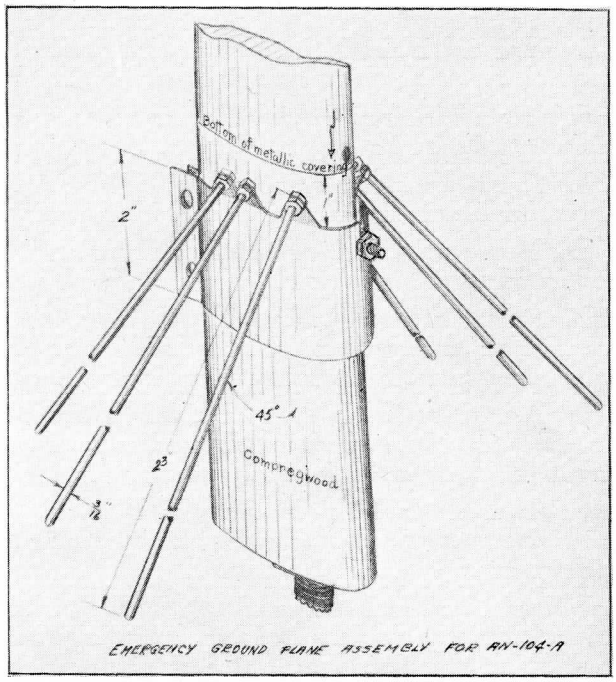
The recommendations of the Board provided for the modifications of the Bridging, Access, and Test Terminal, its submission to the Signal Corps Technical Committee for classification, and the initiation of action toward the development of a portable test plug capable of being used by Signal Corps linemen for making rapid tests on any pair of the four-conductor cable.

AIRCRAFT RADIO

VHF EMERGENCY ANTENNA

The following is a means of providing an emergency antenna when normal coaxial or J-type is not available for ground VHF stations in the 100 to 156 mcs range:

Aircraft stub Antenna Mast AN–104–A or similar type can be used by providing a ground plane. This is done by mounting an annular ring around the insulating portion of the mast at the ground connection and fastening copper wires in a downward position 45° from the vertical. These wires should be about six in number and spaced around the circumference of the ring. They should be 23 inches in length and sufficiently stiff



to maintain their relative position without further support except at their point of fastening.

GROUND SIGNAL

SCR–543–( ) CRYSTAL KIT

Radio Set SCR–543–( ), which is designed for use as a field station or as a vehicular set, has six crystal-controlled frequencies within its operating-frequency range. These frequencies may be preset and instantly selected for both reception and transmission.

Two sets of crystals, one in use and one spare, have been issued in the past with Radio Set SCR–543–( ), each set consisting of six transmitting and six receiving crystals. The receiver crystal frequencies differ from the corresponding transmitter crystal frequencies by 385 kc, the receiver intermediate frequency.

A need for additional channels has been expressed by the using arms and as a result 100 extra channels were assigned. These channels are spaced throughout the frequency range of Radio Set SCR–543–( ) and are in addition to the six channels originally provided. Chest CH–219 has been designed to carry the additional crystals. Crystal Unit DC–34 and DC–35 are used in place of Crystal Holder FT–171–B for the added frequency channels.

Procurement of the additional crystals and carrying chest has been initiated and the chests

CHEST WITH ADDITIONAL CRYSTALS FOR SCR–543.

with crystals are now available for issue to users of Radio Set SCR–543–( ) in the field when not previously supplied. The additional crystals and carrying chest have been added to the parts list for Radio Set SCR–543–( ) to take care of future issue of the set.

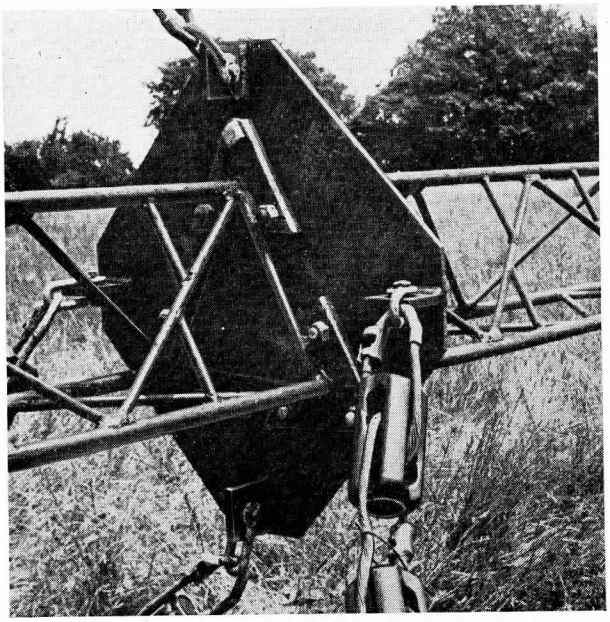
Stock Number 2X18.1–1 has been assigned to the crystal kit which includes Chest CH–219 with 100 Crystal Unit DC–34 and 100 Crystal Unit DC–35. This stock number should be used when requisitioning the kit. Supply Bulletin SB 11–29, Crystal Kits for Radio Receiver and Transmitter BC–669, published this month, gives requisitioning data.

Before Crystal Unit DC–34 and DC–35 are installed in Radio Set SCR–543–( ) in the field, the set should be modified in accordance with War Department Modification Work Order MWO Sig 11–625–4, dated 22 July 1944, subject: "Modification of Crystal Circuit-Radio Sets SCR–543–A, B, and C." The purpose of this modification is to reduce the possibility of fracture of Crystal Unit DC–34 and DC–35 due to excessive r-f currents. Use of these crystal units in unmodified sets may result in fracture of the crystals.

AN–158 GUY PLATE

When Antenna AN–158, the 200-foot steel tower described in Signal Corps Technical Information Letter No. 20, July 1943, is erected with the "falling gin pole" method, temporary side guys are required to prevent buckling during erection.

A 4-guy plate has been devised as a field modification to convert the three sets of guys spaced 120° around the base of AN–158 to four sets of guys



FOUR-GUY PLATE HELPS IN ERECTION OF AN–158.

spaced 90° apart. Use of 4-guy plates eliminates the need for temporary side guys, since two of the four sets of guys are permanent side guys adjusted to proper length before erection to prevent side sway during the elevation of the antenna.

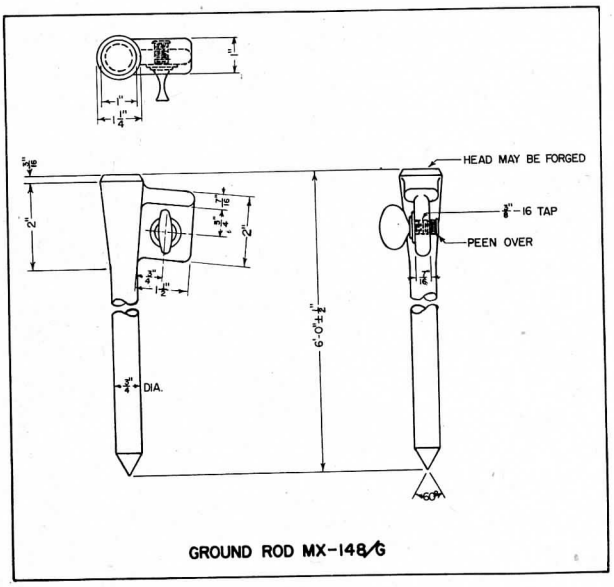
Field experience with the 4-guy plate, illustrated herewith, has demonstrated that its use simplifies erection of AN–158 and reduces the danger of tower sections buckling.

Modifications required, such as change in radial distance of anchors from antenna base and addition of gin pole section, will be specified in a technical bulletin being prepared for distribution to organizations which use the AN–158.

GROUND ROD MX–148/G

Ground Rod MX–148/G, a 6-foot long, ¾-inch diameter, galvanized steel rod, weighing approximately 10 pounds, will replace Ground Rod GP–29, a 3-foot by 1.3-inch ground pipe weighing approximately 8 pounds, in all applications when the present stock of the latter is exhausted.

The new Ground Rod MX–148/G was designed to incorporate all the characteristics which have been found to be desirable in a ground rod. Studies at the laboratory and experience gained in the field have proven that ground rod diameter should be determined solely by weight limitations and the stiffness required for driving in hard packed soil. Decrease in ground resistance gained by increasing the diameter of the rod is negligible, but such resistance is inversely proportional to the length of the rod. Six feet was found to be a suitable length, providing reasonably low resistance, yet not requiring special driving equipment.



GROUND ROD MX–148/G

A rod of large diameter is difficult to drive and to recover, since it displaces a large volume of earth as it is forced into the ground. Such a rod is frequently damaged during recovery. A thin rod is far easier to drive and to recover, but if too thin will bend when driven into hard packed soil. A diameter of three-fourths inch was found to provide sufficient rigidity for the 6-foot solid Ground Rod MX–148/G; hollow tubing was used in GP–29.

The connection to which the ground lead is attached has also been improved in Ground Rod MX–148/G. This rod has a swedged head with a heavy integral guard so positioned as to prevent accidental damage to the wire clamp while the rod is being driven. The clamp is a large wing bolt, providing secure clamping without the use of tools; it is securely staked to prevent loss in shipment or in use.

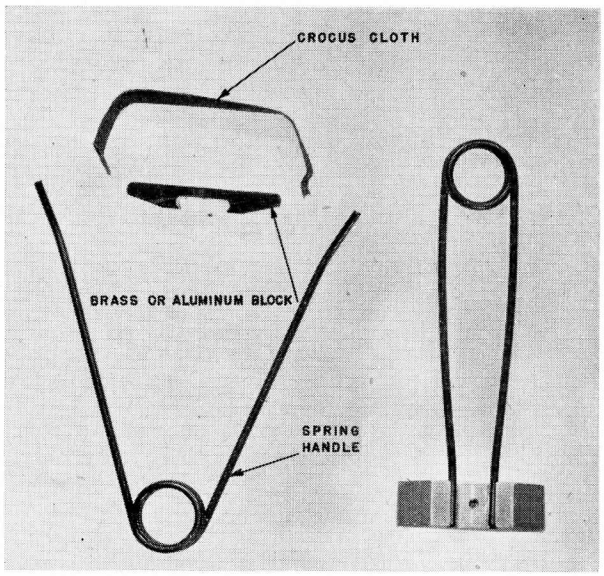
Further information relative to grounding procedure may be found in War Department Technical Bulletin TB Sig 37, dated 11 May 1944.

ARMY PICTORIAL

NEW COMBAT HELMET

Personnel of Army Pictorial Service, recently returned from the Italian front, reported that there was a definite need for a modified helmet for operation of cameras in combat areas. Regulation

MODIFIED COMBAT HELMET FOR COMBAT PHOTOGRAPHERS.



APERTURE PLATE CLEANER FOR SIGNAL CAMERAMEN.

helmets worn in the field extend so far over the wearer's forehead, they said, that the eyepiece of the camera cannot be held in proper viewing position unless the helmet is removed.

Investigations conducted at Pictorial Engineering and Research Laboratory, Signal Corps Photographic Center, resulted in a modification of the regulation helmet which will allow cameramen to operate their photographic equipment with normal protection.

Two regulation helmets were used to effect this modification. One helmet was cut out in front for use as the basic helmet; the front of the second was cut out for use as a visor and hinged to the basic helmet by means of screws on either end. The visor is locked in its open and closed positions by catches pressing into stop-clicks by the spring tension of the visor. In the raised position the visor clears the forehead so that the camera can be operated; at all other times the visor is worn in the lowered position to afford protection. A sponge-rubber gasket is cemented to the helmet to seal it and make it watertight in the lowered position.

One hundred of these helmets have been shipped to the Continent for trial by combat personnel before issuance in greater quantities.

APERTURE PLATE CLEANER

To facilitate the field maintenance of the aperture plates of Camera PH–330–( ) and PH–430 series, a cleaner, used successfully by civilian newsreel men, was tested at Pictorial Engineering and Research Laboratory and recommended for use. The cleaner consists of a small, flat block of aluminum or brass, grooved in the center. One strip of crocus cloth is folded around the flat side and into the groove. A spring handle inserted into the groove holds the crocus cloth in place and acts as a handle.

Formerly, cleaning the aperture plate of grit, dust, lint, and emulsion was too specialized for lower echelons as it necessitated the complete removal of the aperture plate. With this recommended cleaner, the aperture plate can be cleaned in its normal camera position by the camerman.

These cleaners have already been issued to field units and reports show that they are proving a necessary and useful tool.

ARMY PIGEON

PIGEON VEST PG–106/CB

As the result of the tactical development of airborne troops and the increasing requirements for pigeon communication with airborne operations, a new item of pigeon equipment was developed. This equipment, known as Pigeon Vest PG–106/CB, provides a means whereby paratroopers can carry pigeons on their chest or side during descent without sustaining injury to paratrooper or pigeon and in turn, provide a means of communication immediately available.

The initial stages of developing and testing were conducted cooperatively by the Post Pigeon Officer, Fort Benning, Ga., and Communications

PIGEON VEST LACED AND STRAPPED TO PARATROOPER.

and Riggers Division, The Parachute School, Airborne Command, Fort Benning, Ga. Tests conducted revealed that the size and weight of equipment to be used is of paramount importance, therefore cotton insect netting and cotton webbing were used for construction.

> Pigeon Vest PG–106/CB, Stock No. 9A1886–106, has been standardized with an allowance of 600 each per signal pigeon company, the basis of issue being 50 each per combat section. The following nomenclature has been assigned:
>
> Pigeon Vest PG–106/CB (shaped to form a pigeon's body, permitting head, neck, wing tips, tail and feet to protrude, made of porous fabric and has strap for carrying pigeon on parachute jumper's chest, adjustable to any size pigeon).

Pigeon Vest PG–106/CB was primarily designed to be carried by paratroopers, but it is equally adaptable for use with scouts on patrols, mountain climbing troops, pathfinding units, reconnaissance patrols, mounted troops, or units employed in amphibious operations.

The vest is so designed that it is to be worn on the left side under the arm or on the chest. When on foot, however, it may be adjusted so as to permit the pigeon to be carried on the back. One pigeon per man is believed to be the best method of deploying pigeons during airborne operations.

COMBAT WIRE CONSUMPTION

A REPORT from a Corps Signal officer in the Italian Campaign has been received which includes a table of consumption of field and assault wire by two divisions duing combat operations. The figures furnish a typical expected replacement requirement needed to bring quantities of wire on hand up to authorized allowances in the field.

	Division "A" Italy					Division "B" Italy				
		Total mi.		Daily avg.			Total mi.		Daily avg.	
	Days	W110	W130	W110	W130	Days	W110	W130	W110	W130
Attack against a defensive position	58	2,165	1,522	37	26	------	------	------	----	----
Attack against enemy delaying action	------	------	------	----	----	------	------	------	----	----
Defense of a position	38	1,445	1,190	38	31	29	1,316	627	45	22
Six months' operation including above	180	3,610	2,712	20	15	[1] 180	4,411	2,061	24	11
	Division "A" Sicily									
Attack	58	1,730	950	30	16	------	------	------	----	----

[1] Includes: 113 days—Attack against defensive position.
Attack against enemy delaying action.
31 days—Defense of a position.
36 days—Rest and refitting.

The estimated requirements of field Wire W–110 per day in combat expressed in miles as given in paragraph 127, FM 11–5, provides an interesting comparison with the combined actual total of assault and field wire.

	FM 11–5 miles/day	Div. A miles/day	Div. B miles/day
Attack of a position:			
Field Wire W–110	102	37	----------
Assault Wire W–130	----------	26	----------
Total	102	63	----------
Defense of a position:			
Field Wire W–110	74	38	45
Assault Wire W–130	----------	31	22
Total	74	69	67

The manual contains no data on the estimated requirements of assault wire so that a direct comparison is impracticable. The comparative table indicates that the combined daily average consumption of wire in an attack is considerably less than had been expected, while for a defensive action the actual consumption compares more closely with the field manual.

MILITARY PERSONNEL

PARTIAL DEMOBILIZATION PLANS

ON 7 SEPTEMBER, newspaper stories first outlined broad policies under which partial demobilization would be accomplished after Germany is defeated. Winning the war in the Pacific is to have first priority. Limiting the number of men to be released immediately.

Within those broad policies, the Chief Signal Officer has perfected a plan for expediting separation from the service of qualified individuals as well as the prompt reassignment of those deemed essential with continuation of the Japanese conflict. Problems involved are intensified by specialized training characteristics of Signal Corps activities and the need for careful selection of personnel for most assignments.

Signal Corps units rendered surplus in the various overseas theaters will be sent to disposition centers, operated by ports of embarkation within the continental United States. Casual groups are to be included as overstrength in units returned. Personnel records will be forwarded in advance by air courier to permit examination and necessary action prior to the arrival of the men concerned. Thus, all unnecessary delay will be avoided.

Surplus units returned from overseas will be inactivated or disbanded at disposition centers, in accordance with directives issued by the War Department and under the supervision of the port commander. All personnel will be sent to personnel centers (combination of reception station and separation center) located in geographical relationship to the individual's home address.

Enlisted Men

Enlisted men will be declared eligible for separation on the basis of War Department "service credit" computations involving the following factors:

Number of months in the Army since 16 September 1940.
Number of months served overseas.
Number of decorations and bronze service stars.
Number of children under 18 years of age.

Those eligible for separation will be processed immediately. Final type physical examinations, explanation of all rights and duties of veterans, property accountability, settlement of fiscal matters, transportation arrangements, and all similar activities will be conducted by trained personnel to speed up the separation process and yet give the individual every opportunity to fully settle his affairs.

Enlisted men essential for the prosecution of the Pacific war, based upon their technical skill and previous military experience, who are returned to continental United States, will receive a 21-day furlough prior to a new assignment. A study of signal requirements is continuous and every effort will be made to place men in assignments where they can be of greatest benefit to the war effort.

Officer Personnel

Officers will not be released on the "service credit" basis. Instead they must be declared "surplus" by commanding generals of theaters or major commands on the basis of the need for their services. Records of those returned to the United States on this basis will be examined by the Chief Signal Officer's Review Board to determine those essential to the continuation of the Japanese conflict in another assignment. Continued service in the Army after cessation of all hostilities will be considered at that time. Orders for those selected will be awaiting them at the personnel center and those from overseas will report to their new assignment after a 21-day leave.

Officers returned by theater commanders as "surplus" and not reassigned by the Chief Signal Officer, will be separated from the service immediately and processing facilities, similar to those described for enlisted men, will be available to expedite that action.

The readjustment of personnel at the conclusion of the European phase of our war effort will be a responsibility in which all echelons of command must share. Signal Corps planning has been completed early to insure effective continuation of the war effort and yet provide for prompt separation of those individuals not considered essential to the Pacific effort.

RELIEF OF OFFICERS OVER 38

Since 12 January 1944, all officers (except Regular Army) having reached their thirty-eighth birthday have been eligible for relief from active duty, if no suitable assignment existed. Officers in that category are not to be declared "surplus" by

their commanding officers in the event a vacancy, suitable to their grade and experience, will be open in the relatively near future or if the officer is qualified for another type of assignment.

Publication of War Department Circular No. 341, dated 19 August 1944, modified the original policy to the extent that the officer can no longer request his own release. Instead, recommendation must be made by his commanding officer, adding a statement to the effect that the officer is not at that time assigned to a position commensurate with his grade and qualifications and that no suitable vacancy to which he might be assigned is expected within the near future.

Under the terms of the new regulation, the officer is notified by his commander at the time he is declared surplus in that command and is afforded the opportunity to include any remarks which he might wish to make concerning the action at the time the recommendation is forwarded to the next higher headquarters.

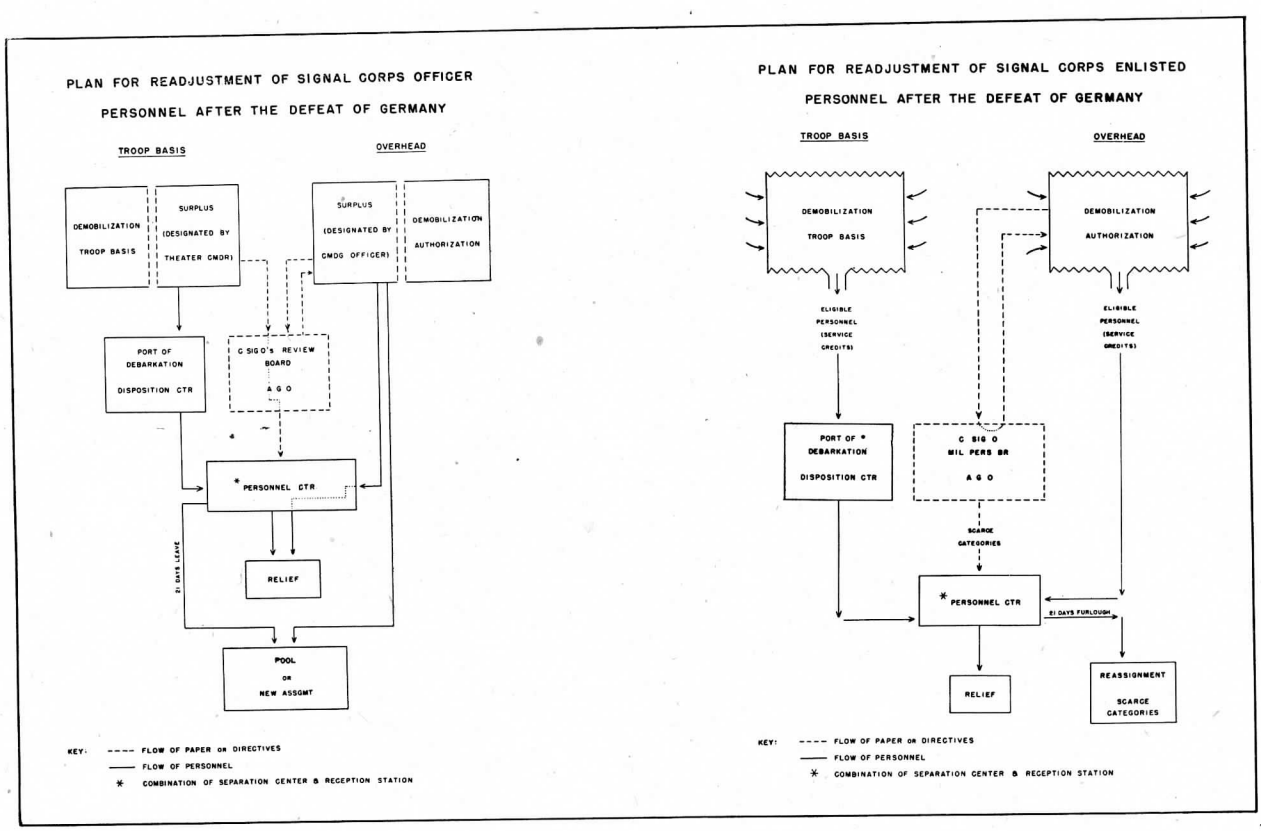
Recommendations involving Signal Corps officers must be approved by the Chief Signal Officer and then are forwarded to The Adjutant General for review by representatives of the three major commands and the other technical services to determine whether suitable vacancies exist in their command. If a vacancy is found, the officer is detailed in the arm or service having jurisdiction over the assignment; otherwise, relief from active duty is effected.

The Signal Corps has been fortunate in securing the services of many technically qualified officers released by other arms and services. At the same time, a small number of officers in the Signal Corps, originally ordered to active duty in connection with special purpose assignments, have now completed their work and, under the provisions of this circular, may be recommended for relief from duty.

FIELD INSTRUCTORS' DETACHMENT

The Chief Signal Officer has authorized the establishment of a field instructors' detachment consisting of specially selected officers and enlisted men who are to function under direct Signal Corps supervision. The chief mission of the group will be to introduce new items of radar and radio equipment to using organizations in theaters of operation, and instruct in methods of operation and possible applications.

A portion of the group are to function under the jurisdiction of the Engineering and Techni-



cal Service in connection with equipment developed in Signal Corps laboratories. The remainder will specialize in cryptographic devices and countermeasure equipment which are the responsibility of the Army Communications Service.

Both officers and enlisted men receive extensive training on the equipment project to which they are assigned prior to departure to the theater in which they are to function. The training is given in the Signal Corps schools and is supplemented with work at the laboratories and "briefing" by headquarters groups in Washington.

The project assures prompt introduction and most efficient usage of all new electronic equipment developed and, at the same time, affords a medium through which shortcomings of such equipment operated under combat conditions can be transmitted to the Chief Signal Officer for further action.

Teams are sent to the theaters on temporary duty and while there they operate under the direction of the theater commander. Methods vary. Some theater commanders prefer to establish schools and bring key personnel to a central point for instruction. Others prefer to send the teams to the organizations concerned. When their mission is accomplished the teams are to be returned to this country for assignment to another piece of equipment.

BASE DEPOT GROUPS

The need for personnel and equipment suitable for performing fifth echelon maintenance on Signal Corps equipment in theaters of operations resulted in the recent formation of base depot groups, consisting of a headquarters and headquarters company plus one or more base depot companies and one or more base maintenance companies.

The headquarters and headquarters company (T/O 11–592) includes administrative, control, and engineering personnel for the staff supervision of functions to be performed by the maintenance or depot companies, making up the depot group.

The base depot company (T/O 11–597) provides for the receipt, storage, and issue of all items of signal equipment, as well as the maintenance of stock levels, follow up of requisitions, and other signal supply functions that are characteristic of depot companies in existence and at one time under T/O 11–107.

The base maintenance company (T/O 11–587) is an entirely new unit intended to provide fifth echelon maintenance for signal equipment. All repair functions have been withdrawn from the base depot company.

The tables of organization mentioned in the paragraphs above specify many technical specialties not ordinarily found in T/O's developed for troop units, in order that fifth echelon maintenance can be performed. Formation of the base depot groups provides for a definite organization to accomplish that which heretofore has been done by any personnel which the theater commander could make available for the purpose.

COMBINED PROCEDURES

(*Continued from p. 14.*)

They are not printed in extracts of that publication. The remaining two signals QMX and QNV are U. S. signals only; QMX is used only between U. S. holders of either the U. S. Air Extract or CCBP 2–2. QNV is limited to U. S. stations holding the complete publication. British joint signals are identified by an entry "BR", "BR AIR," or "BR ARMY" in the "Notes" column. Such signals are never used by any U. S. station.

Distribution of CCBP 2–2 includes warships and fixed stations; of the Air Extract, all aircraft; of the Army Extract, all ground force units, down to and including Infantry companies.

HYBRID COILS

(*Continued from p. 16.*)

overcome in such a field improvisation. This improvisation is not limited to radio circuits, but may be used in any case where conversion between 2-wire and 4-wire operation is necessary without mutual interference between the sending and receiving pairs of the 4-wire circuit.

SPARE PARTS CATALOGS
CORRECTION

The number of the War Department circular referred to in the item on Spare Parts Catalogs, page 44, SCTIL No. 34, September 1944, was wrong. The correct WD circular is No. 227, 7 June 1944.

MILITARY TRAINING

TESTING SWITCHBOARD OPERATORS

IN THE Eastern Signal Corps Unit Training Center, the Performance Test Laboratory at Camp Charles Wood evaluates by means of standardized tests the proficiency of telephone switchboard operators (650) as defined in TM 12–427. To increase the validity of testing, realism is made the keynote in both the performance and written phases of the examination.

The Performance Laboratory's job specification calls for "telephone service of a uniformly high standard with the least possible delay, confusion or annoyance to telephone users. The competent operator must be thoroughly familiar with all the aspects of his job, know exactly what is expected of him and perform his functions with courtesy, accuracy and speed." That, briefly, sums up the technical and practical requirements covered by the test itself. "The competent operator must be thoroughly familiar with *all* the aspects of his job * * *" in order to provide for emergencies, or in the case of limited available personnel, a situation frequently encountered overseas, the above stipulation is possibly the most important in the training of telephone switchboard operators.

To assure that these standards are met, the tests that are given to each switchboard operator before he leaves the Unit Training Center cover all the essential requirements of the job. The major requirements of the job specification, which make up the performance test, are as follows:

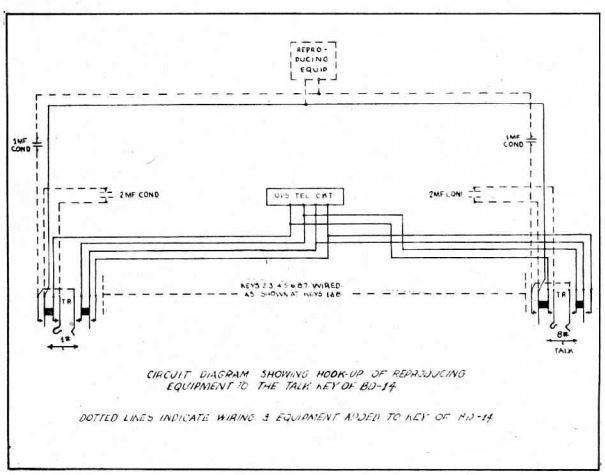
Installation of Switchboard.
Maintenance of Station Log.
Knowledge of Diagrams.
Pole Climbing.
Operation of Local Battery Switchboard.
Operation of Common Battery Switchboard.
Knowledge of Switchboard Procedure.

The Test Laboratory includes a room especially designed for the testing of switchboard operators. This room is equipped with two Switchboard BD–71, four Switchboard BD–72, and one common battery board arranged to simulate a typical wire net. Six terminal strips are mounted at different points in the room. Each terminal strip has five or more pairs of conductors connected to it. Some of these lines are used to represent trunk connections, while others represent local lines. All lines, both local and trunk, terminate at a control board (BD–14), operated by the test administrator, which is located in an adjoining room.

The testee, in the first part of the performance test, is given a circuit diagram of a typical wire net and is assigned one of the headquarters switchboards, which he is to install and operate. He then makes the installation of the switchboard to the trunk and local lines, following the circuit diagram provided. After he has completed the installation and made the required tests, his work is checked by the NCO administering the test.

As soon as the installation has been checked, the testee is required to draw a traffic diagram on the back of the station log for use with his switchboard. To maintain the station log completely, the testee must consider himself the chief operator as well as the regular operator.

Knowledge of switchboard procedure is the most important single part of the performance test, since the job of routing calls through a switchboard is the one most generally expected of telephone switchboard operators. The test administrator in charge of this part of the test operates the control board, individually testing the procedure and operation of each man located at either the BD–71's or BD–72's. Each man is examined for the manner and rapidity with which he puts through such possible calls as urgent, conference, local and outgoing trunk. He is required to follow the proper procedure in responding to supervisory signals involving a ring-off; recall—wrong number; recall—new number wanted. Instances of



CIRCUIT DIAGRAM SHOWING HOOK-UP OF REPRODUCING EQUIPMENT TO THE TALK KEY OF BD-14

DOTTED LINES INDICATE WIRING & EQUIPMENT ADDED TO KEY OF BD-14

called lines being busy, the called party not answering or not being able to understand a number, are also introduced as a standard part of the procedure and operation test.

To maintain the realism of the test situation and to facilitate the testing, traffic is maintained on the local and trunk lines, as required, by means of a 16-inch phonograph disk on which have been recorded several tactical telephone conversations. The recording equipment, which is attached to the control board (see diagram), operates in the following manner:

When the test administrator calls one of the men he is testing and requests a number, he also answers the call, since all of the local and trunk lines terminate at his control board. If the testee, when supervising the connection, heard no conversation and challenged on the line, he would assume that both parties had hung up and disconnect the circuit. When testing a half-dozen or more men, the test administrator puts the recorded conversation on the lines which are busy, thus providing a continuous flow of traffic through the wire net. A testee, hearing this conversation while supervising a connection, would leave the circuit intact. The record thus makes it possible for the test administrator to set up a number of calls with the assurance that all will remain intact until he is able to return to them in order to continue the test.

The final job in the performance test is climbing a pole. To meet the requirements for this test, the man must merely demonstrate his ability to climb properly.

In addition to the performance test, switchboard operators are given a one and one-half hour practical, "down to earth" written test. Knowledge and skills which do not lend themselves readily to performance testing are covered by the written test. A break-down of the switchboard operator's written test by subject follows:

Army Organization.
Installation of Field Circuits and Telephones.
Maps, Diagrams, and Records.
Local Battery Switchboard Installation.
Common Battery Switchboard Installation.
Switchboard Operation (General).
Switchboard Operation—Local Battery.
Switchboard Operation—Common Battery.
Storage Battery Maintenance.

To qualify as a telephone switchboard operator (650), men being tested must successfully pass each of the major job requirements in the performance test and attain a passing grade in the written test. A failure in any one of the major portions of the performance test or failure to pass the written test will disqualify the operator. He will be required to retake that portion of the test he failed before he is considered to be qualified in his specialty.

Both performance and written records indicating the state of training of each man are forwarded to the unit commander and to the director of training for use in planning and directing current training programs. The status of training is determined by periodic reports submitted by the standards and control section and indicating each unit's individual training progress. If the test was conducted for classification purposes, results of the test are forwarded to the classification section of the personnel branch. From these tests, this section determines the qualification of the enlisted man in his specialty or reclassifies him if he is found to possess insufficient background and experience for his specialty.

To date, hundreds of telephone switchboard operators have been successfully graded through the performance and written tests, which approximate the hard, practical problems encountered in the field under combat conditions.

DISSIPATION LINE

The Enlisted Men's School, Fort Monmouth, was recently faced with the problem of dissipating and preventing radiation of the radiofrequency output of high-power transmitters (10 and 15 kilowatts) used in its course of instruction.

The requirements for use of such a device were as follows:

It should be capable of safely dissipating a minimum of 20 kilowatt of radio frequency power.

It should reflect a load on the output circuit of the transmitter to which it is connected, closely resembling that of radiating antennas normally used in fixed-station installations.

The reflected load should be adjustable to provide maximum flexibility in student training on antenna-tuning procedure.

A large number of experiments on power dissipation devices of all sorts, such as lamp banks, resistance banks, and salt-water barrels were carried out. None of these was found to satisfy all of the three requirements stated above. Lamp banks and resistor banks exhibited undesirable reactance

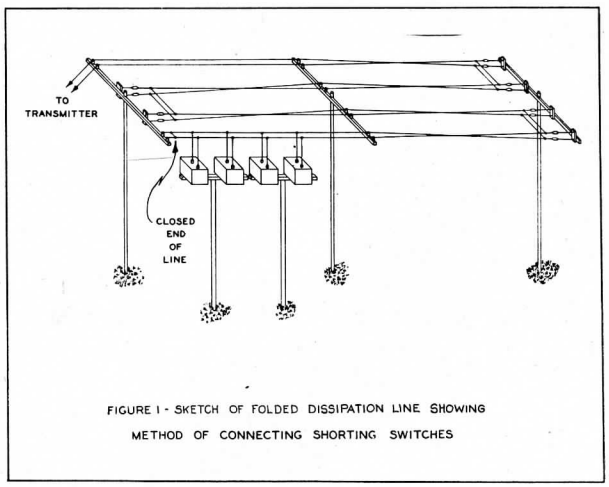


FIGURE 1 - SKETCH OF FOLDED DISSIPATION LINE SHOWING METHOD OF CONNECTING SHORTING SWITCHES

characteristics due to self-inductance and distributed capacity; the load was not distributed evenly throughout the bank, causing "hot spots" and consequent failures; the load did not simulate normal antenna characteristics; adjustment was difficult, and last but not least, both lamp and resistor banks radiated so much heat that working conditions in their vicinity were almost unbearable.

Salt-water barrels, as dissipation devices for large quantities of power, particularly at radio frequencies, suffer from the fact that it is particularly difficult to adjust them to present balanced loads to the transmitters which they terminate. Evaporation of the water, and electrolysis, cause the terminal resistance of the device to vary considerably during a day's operation, and the requirement for repeatedly adding quantities of water and salt to the solution makes the maintenance of the device a decided nuisance.

The solution ultimately decided upon after all these experiments was the construction of a dissipation line patterned on the type used for terminating rhombic transmitting antennas used in high-power fixed-station installations. Essentially, the action of this type of dissipation line approaches that of a two-wire infinite line with a characteristic or surge impedance of approximately 600 ohms. Physically, the line is 1,000 feet in over-all length, consists of two No. 10 galvanized iron wires spaced 9 inches apart, and is closed on one end and fed on the other. The closed end of the line is grounded. To reduce the space requirements of this array it is folded back on itself three times, so that the over-all length of the completed line is 250 feet. To insure the best possible balance of the line, the wires are frequently transposed throughout its length. Figure 1, illustrates these constructional features.

Extreme care was used in constructing the line, particularly in the precise sagging of the wires to keep the capacitances of each wire to ground as nearly equal as possible. This care in construction was found to pay dividends when the line was tried out, as the balance, indicated by a standing-wave ratio very close to unity, was good.

In making field-strength measurements on the line at the assigned operating frequency, it was found that a shorting bar placed approximately 60 feet from the closed end of the line produced the best possible balance and minimum radiation. Field-strength measurements made by the Camp Coles Laboratory of the Signal Corps Ground Signal Agency indicated that the relative radiation from this line was comparable to that of a half-wave, nondirectional, vertically polarized antenna fed with a little over 1 watt of power. The findings of the laboratory are presented in the following table.

FIELD STRENGTH MEASUREMENTS ON 17 KW DISSIPATING LINE

Transmitting Power: 17 kw into dissipating line.
Transmitting Frequency: 5.02 mc.
Measuring Equipment: Ferris 32A Field Strength Meter, Serial No. 616.

Distance (miles)	*North (microvolts per meter)*	*West (microvolts per meter)*
1	1500	4600
2	200	400
3	50	260
4	84	100
5	46	150
6	36	130
7	20	70
8	18	64
9	—	38
10	—	40
12	—	24

Effective Radiated Power: 0.12 watt North; 1.07 watts West.

Stainless steel wire is normally used for the construction of "infinite" lines of termination of rhombic antennae because of the requirement for an essentially resistive termination. These lines, however, are not readily adjustable to present varying impedances and reactances to the transmitter. It was decided, therefore, to construct the line from galvanized iron wire which, because of its lower resistance, would produce a line of greater

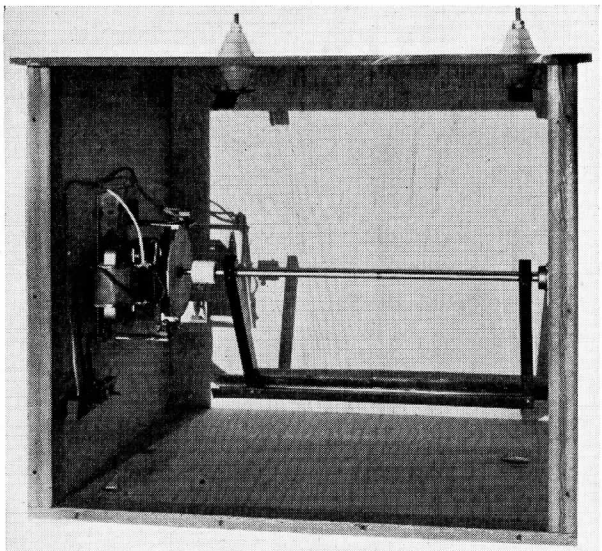


FIGURE 2

flexibility. Small changes in the position of a shorting bar across a stainless steel wire line would have had little effect on the effective impedance at the transmitter output terminals, since the power would have been almost completely dissipated by the line before it reached the shorting bar. In the case of the galvanized iron wire line, however, only part of the power is dissipated when the current reaches the shorting bar. Consequently, moving the shorting bar a short distance will have a relatively large effect on the characteristics of the line as seen by the transmitter, thereby satisfying the design requirements for variable impedance and reactance.

It has been found by experiment that the dissipation factor of the line using galvanized iron wire is sufficiently high that the effective radiation is only slightly increased by small changes in shorting-bar position.

In order to provide conveniently selected, predetermined shorting-bar positions, four rotary line-shorting switches were designed and built (figure 2). The rotary arm of the switch is driven by a small motor and speed-reducing gear train salvaged from a confiscated pinball machine. Heavy wiping contacts are provided on the rotary arm and on the two stand-off insulators at the bakelite top of the box so that positive, low-resistance contact is made when the switch is in the shorting position. A slotted disk on the shaft of the motor, together with a contact assembly, is used to turn the motor off when it reaches the closed or open positions, according to the sequence of operation.

Figure 3 is a schematic diagram showing the method of operation of the four rotary switches, and the remote control circuit used to actuate them. An interlock circuit is provided between the remote control circuit and a door on the final amplifier of the transmitter, so that this door must be opened, shutting off the power to the final amplifier of the transmitter, before the control circuit can be operated. This prevents damage to the shorting switch which would occur if it were operated with power applied to the line.

The four shorting-switch boxes, suitably weatherproofed, are mounted on the cross arms of two stub poles placed underneath the end section of the line as illustrated in figure 1.

These shorting switches provide a great deal of flexibility in the use of this line. Their positions can be chosen so that the line will present an optimum load to the transmitter for several different operating frequencies. The shorting switch position which presents an optimum load for one frequency can also be used to present a different antenna-tuning condition when the transmitter is operating on another frequency. Thus, antenna-tuning circuit exercises can be run under conditions which will simulate those of several different radiating antennae.

It has been found that in rainy weather the characteristics of this line will change somewhat, due to the decrease in ground resistance. The shorting-bar switches have proven extremely valuable in correcting this condition.

In summary, this dissipation line has proved itself to be an extremely useful design. It has proven

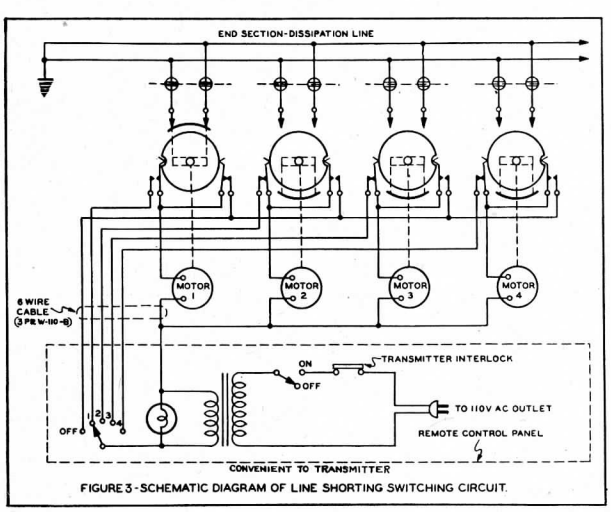


FIGURE 3 - SCHEMATIC DIAGRAM OF LINE SHORTING SWITCHING CIRCUIT.

to be capable of dissipating 22 kilowatts of radio frequency power without undue heating. Its relative radiation is far lower than the expected figure. Because of its construction, it loads up in a manner very closely approximating that of a radiating antenna. The four operating positions provided in the remotely controlled shorting-switching circuit provide four different conditions of load at the output terminals of the transmitter for each operating frequency, simulating tuning conditions of four different antennae, and providing the desired flexibility in instruction on antenna-tuning procedure.

DETECTOR DEMONSTRATOR BOARD

As a lecture aid in teaching the subject of detectors, a demonstration board, combining the advantages of a schematic diagram and an operating circuit, has been devised. Used in conjunction with an oscilloscope, this demonstrator has given favorable results. While blackboard diagrams have always been adequate in teaching, they have the disadvantage of not giving any practical experience to the students. The use of a prewired demonstration board fails to show the evolution of a radio circuit; besides, several boards are necessary to show the different types of detectors. The solution for this problem seemed to be a board containing the component parts needed to construct an operating circuit, but this would merely present a maze of elements to the student and would necessitate the use of a separate schematic diagram which would have to be consulted constantly.

After considering these factors, it was decided to construct an operating demonstration board that would overcome these disadvantages. The resultant product is shown in figure 1.

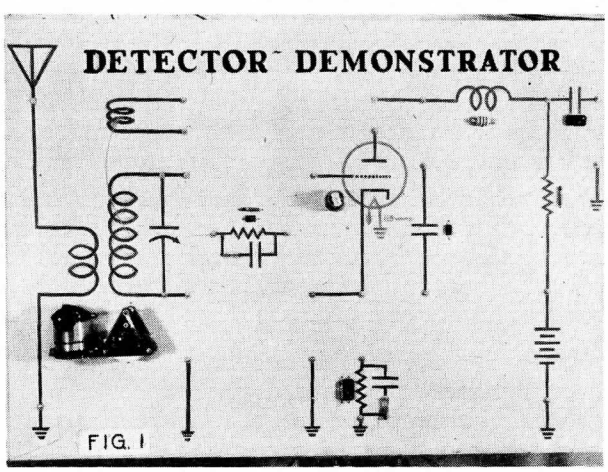


FIG. 1

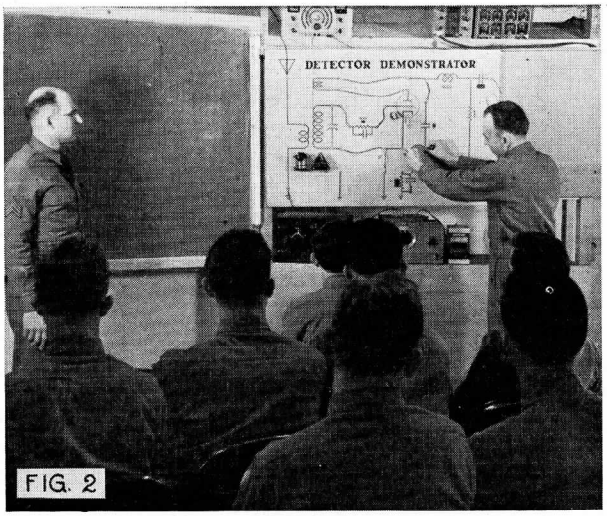


FIG. 2

The board was made 3 feet 10 inches long and 2 feet 6 inches wide, to give visibility from a large angle. All parts are visibly mounted so as not to obstruct the full view of the circuit symbols on the panel. No prewiring is used except for those circuits not directly pertaining to this lesson, such as the tuned circuit, plate load circuit, and common grounds. All this wiring is done on the rear of the board. Nu-way snaps and connectors are placed so that the connecting wires complete the operating circuit and also give a schematic diagram of the particular circuit being wired (figure 2). When the wiring is changed to a different type of detector, the new placement of leads automatically changes the schematic representation. Therefore one board can be used to show several circuits. This aids in maintaining a simple clear appearance and allows a more thorough understanding of the particular circuit under consideration. The connecting wire snaps allow several wires to be connected to one point at the same time. There are three standard lengths used as connecting leads.

An octal socket is mounted in the center of the panel allowing the tubes to be inserted from the front of the board. The base is wired to accommodate a 6H6 (VT–90) and a 6J5 (VT–94). One of the plate pins of the VT–90 is common with the control grid pin of the 6J5. The cathodes are located on the same pin in both tubes. All socket pins terminate in snaps on the face of the board.

When demonstrating a diode detector, a card with the symbol of a diode is placed over the triode symbol painted on the panel.

To keep the exposed nonessential parts to a minimum, a 45-volt B battery is connected behind the board to terminals that terminate at the painted symbol on the demonstrator. Heater power is obtained from a separate amplifier which is used to boost the detection to speaker level. A three-circuit tuner and a variable capacitor are used for tuning in broadcast stations. A resistor and capacitor mounted between the tuned circuit and the tube serve as the diode load and filter and also as the grid leak resistor and filter. A plate capacitor and radio frequency choke act as the plate filter for all circuits except the diode detector. The plate load resistor is permanently connected to the battery terminal and choke to facilitate wiring. To supply the needed bias for a plate detector, a resistor and capacitor are mounted beneath the tube. The tickler section of the three-circuit tuner is used to demonstrate regenerative grid detectors. An oscilloscope is used in conjunction with all demonstrations to add interest and to give a visual indication of all operations.

In use, one student connects the circuit on the board while the rest of the class watch for errors and give helpful suggestions. When properly completed the power is applied and the characteristics and functions of the circuit can be clearly shown.

This board has proven valuable in many ways—it can be used to demonstrate heterodyne action, oscillator principles, development of automatic volume control, self-biasing methods, and at the same time provide actual practice for the student in hooking up circuits.

The component parts that are mounted on the board include one 3-circuit tuner, one tuning capacitor, one 2-megohm resistor, one 20,000-ohm resistor, one 50,000-ohm resistor, two 0.00025 capacitors, one 0.01 capacitor, one 1.0 mfd capacitor, one VT–90, and one VT–94.

RADIO ELEMENTS AND SYMBOLS

At the Eastern Signal Corps School it was found that quite frequently students did not understand radio terminology. Given a radio part, they could not name it. Given its name they could not describe the part. Given the part name and the part, they could not draw the symbol. The elements and symbol display board was developed to answer this need.

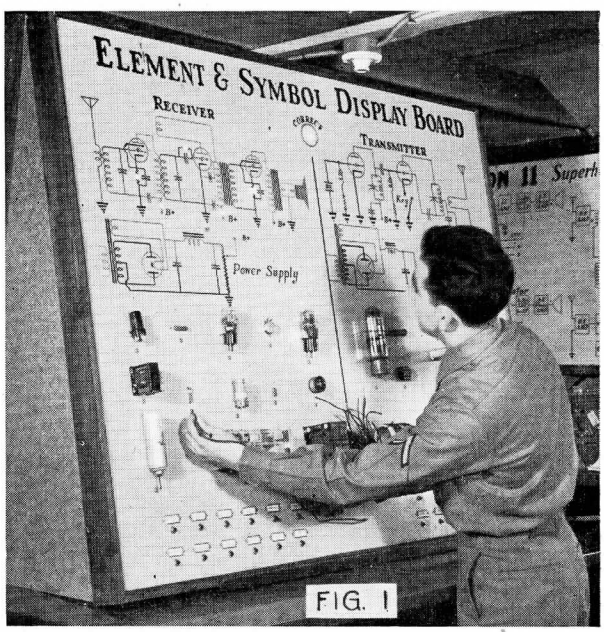


FIG. 1

At the top of the board (figure 1) are circuit diagrams of a receiver and a transmitter with small light bulbs mounted in the center of some of the circuit element symbols. Below the two diagrams are mounted many of the component parts found in radio circuits, each part having an electrical contact plate beneath it. The lower section of the board has two rows of nameplates with small push-button switches mounted beneath them. Each nameplate gives the name of one of the mounted parts, and the push button is connected in the bulb circuit belonging to this part. In the bottom center of the board is a lead and a prod which is used as a probe. In the top center of the board is a bulb which is marked "correct."

In operation, the prod is placed on one of the contacts underneath a part, the student then reads the nameplates and if he depresses the proper switch a series of bulbs will light. These bulbs show the symbol used to designate that part of a circuit diagram and also show how and where this part is used. The "correct" bulb indicates that he has associated the proper name with the selected part. If the student selects the wrong button, none of the bulbs will light. In this manner, the student is able to select the part, properly identify it by name, and see the symbol and the portion of the circuit where it is used.

Figure 2 shows the wiring diagram of one of the selector circuits. Two transformers are used to provide the voltage necessary to light the bulbs

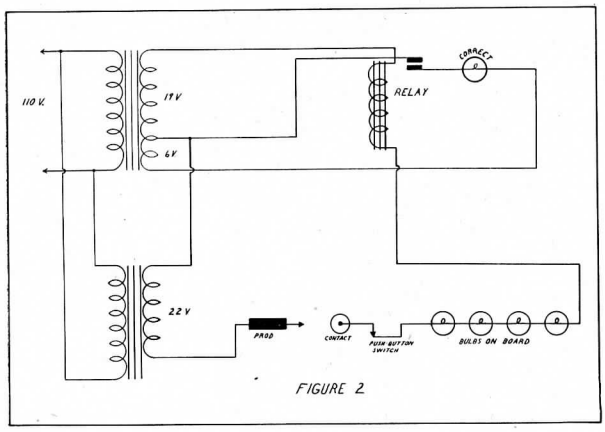


FIGURE 2

and to operate the relay coil. The relay contacts connect the "correct" bulb to a 6-volt tap on one of the secondaries so that the bulb will light when the proper selection has been made. Contrary to expectations, it is not possible to connect this bulb in the circuit with the bulbs on the diagram due to the variation in the number of bulbs in each circuit. Such a connection would result in a varying degree of brilliancy for each different circuit selected.

Since the number of bulbs in a circuit varies between one and five, two types of 6-volt panel lamps are used, the T–41–6.3V–.150A–Brown bead, and the T–46, 6.3V–.250A–Blue bead. Thus, regardless of the number of bulbs in the circuit selected, they all attain the same amount of brilliancy with the same voltage drop across the entire circuit. Following is a list of the six possible series and parallel bulb combinations:

No bulb in circuit. This may be used in cases where the part mounted has no symbol in the diagram. The "correct" bulb will indicate that the right switch button has been depressed.

One bulb in circuit. Use one T–41 bulb through symbol on board, with a T–46 bulb in parallel, mounted behind the board.

Two bulbs in circuit. One T–41 and one T–46 bulb in parallel, both through symbol on board.

Three bulbs in circuit. Three T–46 bulbs in series.

Four bulbs in circuit. Four T–46 in series.

Five bulbs in circuit. Five T–41 in series.

In the circuits above, it is assumed that the relay coil will be in the circuit at all times.

The transformers, bulbs, sockets, wires, relays, etc., used in this board were obtained from salvage material and pin ball machines. Two types of transformers were used, both having tapped secondaries. This permits the adjustment of the secondary voltage to the correct value of 41 volts. Under various circuit conditions the voltage across the individual bulbs does not vary more than plus or minus one volt.

Students operating this board have shown considerable interest in it. It develops a spirit of competition in the sense that each student tries to select all circuit elements without an error. As an introductory laboratory experiment, the board is interest-arousing, attention-arresting, self-teaching, simple in operation, and effective in achievement.

WATERPROOFING THE SCR-625

All Detector Set SCR–625 equipments now being made are fully waterproofed and tropicalized. However, the first 6,500 of these mine detectors were not waterproofed, and were subject to failure during prolonged and heavy rain, due to the entry of water into Control Box BC–1140 and Amplifier BC–1141. These early models can readily be identified by the absence of a rubber cap over the toggle switch in Control Box BC–1140 and by the use of Bag BC–151–A, B, C, D, or E.

Based on the laboratory tests the following corrective measures were adopted in production after the first 6,500 SCR–625 sets had been delivered to the Signal Corps:

A more waterproof bag, BG 151–F, was designed for Amplifier BC–1141.

The toggle switch on Control Box BC–1140 was waterproofed by adding two neophrene washers and a rubber cap on the arm and shank of the switch.

The lucite window and rubber packing ring were firmly cemented with Fairprene cement.

Waterpump grease was applied to the threaded spindles of the fine R and fine X compensators.

All gasketed surfaces on Control Box BC–1140 and all external mounting screws were coated with permatex.

Sufficient waterproofing kits, Signal Corps Stock No. 2S625/K2, containing instructions and materials for waterproofing Detector Set SCR–625 have been procured for the 6,500 nonwaterproofed sets in the field. A majority of these kits have been distributed to the various theaters of operation in proportion to the nonwaterproofed sets that have been issued in each area.

All nonwaterproofed sets should be waterproofed utilizing these kits. If the kits cannot be obtained through local requisition, they may be obtained through regular channels by requisition to the Lexington Signal Depot, Lexington, Kentucky.

IONOSPHERIC DATA IN USE

Proper Utilization of Forecasts Has Helped Better Combat Communications in SWPA

A SQUADRON leader of the Royal Australian Air Force wrote the following article. In it he tells some of the experiences with wave propagation usage that have taken place in the Southwest Pacific.

No sane man would finance the building of a railroad system and permit the expenditure of millions of dollars on stations without first ascertaining what difficulties were likely to be encountered in putting down the track, and by what routes the various stations would be linked. He would rightly hesitate to act before he knew a good deal concerning the nature of the country through which the line was to run. Nor would any careful pilot take off on a long oversea journey without first ascertaining the likely behavior of the medium through which he was to fly his ship.

Yet it seems to be a rather common belief that one has only to set up transmitters and associated receivers, covering some aribtrarily selected frequency range, to guarantee communication between any two points, any time of the day or night. It can be definitely stated from operational experience that millions have been spent on radio equipment which has done only half the work it was designed to do. One can see and operate transmitters and receivers, but one cannot understand the nature of the connecting medium without considerable abstract study, and it is this fact which causes some otherwise reliable communications officers to neglect the medium and hope for the best.

This habit of hoping for the best is not good enough, since it has been abundantly clear for a number of years that a high frequency communication system can be just as carefully engineered as a railroad, that the behavior of the medium through which the radio waves are to travel can be predicted more accurately than ordinary weather, and contact thus ensured between any two points day and night throughout the year.

It is hoped to dispel the habit of trusting to luck, and by citing a number of applications of ionospheric data—the key to the situation—in the Southwest Pacific Area from 1940 on, to persuade responsible communications officers not already seized with the importance of the problem that there is a better method that there should, in fact be more widespread use of wave propagation data.

POINT-TO-POINT SERVICES

In peacetime, delays in establishing telephonic or radio communication between any two points can be tolerated to some degree since the consequences of short period failures do not in general affect more than a handful of people. In wartime, however, delays of 10 minutes or so may make all the difference between the success or failure of an important operation.

A survey of Australian communications was made in 1939 with a view to assessing their suitability to withstand the strain of war. There were at that time relatively few radio point-to-point circuits, and the services had then primarily to use already loaded carrier telephone channels. These channels existed only in the more heavily populated areas to the east, southeast, and west of the continent. Communications with New Guinea were rudimentary.

The situation, was, in fact, serious, and some means of enabling rapid communication to be maintained between all important bases had to be established in a minimum of time. Moreover, because of limited equipment and personnel, resources had of necessity to be employed with the utmost economy of effort.

To meet the situation, it was decided to establish a comprehensive radio point-to-point system, and, since it had been laid down by the operational staff that communication was essential 24 hours of the day, 365 days of the year, it was obvious that guesswork was not good enough. An appeal was therefore made to various scientific organizations which cooperated to the fullest degree in supplying wave propagation data based on earlier researches into the characteristics of the ionosphere. The success achieved in maintaining communication over point-to-point links encouraged the Australian services to expand the organization responsible for supplying predictions of wave propagation conditions.

Subsequent experience has shown that, provided frequency allocations are based on adequate knowledge of the ionosphere, communication is, for all practical purposes, as reliable as that over land lines. The network of point-to-point services in Australia has grown more than fiftyfold since 1939, and all operated with clock-work regularity.

AIR TO GROUND

The planning of air operations depends in a large measure on knowledge of enemy activities and thus regular reconnaissance flights are necessary. It is important that communication be possible of establishment between base and aircraft at any time during the flight, since sighting reports must be made without delay back to base to enable appropriate offensive action to be taken against the enemy.

Prior to the application of ionospheric predictions to RAAF operations in the southwest Pacific Area, communication failures were frequent, in particular near the dawn period, but also quite often at other times of the day. It had been customary to employ frequencies in the region of 6 megacycles on which channels partial success had been achieved. At dawn, however, these frequencies were much too high, having skips of the order of a thousand miles or more, and at midday, having short distance ranges, due to high absorption. The selection of frequencies based on ionospheric predictions completely eliminated practically all difficulties in communicating with aircraft; so much so that pilots came to look on operators who could not establish communication as being inefficient.

On strike missions planes may have to travel more than a thousand miles to their target. Schedules of frequencies and times of operation on each must therefore be carefully worked out in advance so that continuous communication may be ensured. The same care must be taken in selecting frequencies for communication between aircraft sent to protect convoys and both base and ships in the convoy.

SHIP-TO-SHORE AND SHORE-TO-SHIP

The need for fighter cover to protect battleships against enemy dive-bombers may arise. If the commander cannot signal base in time due to delays following the employment of incorrect frequencies, serious losses may result. There is evidence to indicate that inadequate knowledge of wave propagation was an important contributing factor to one or two earlier heavy losses.

Warnings must also be conveyed to ships if there is a likelihood of attacks by submarines or other vessels, and it has been found that unless frequencies are carefully chosen, some areas will be skipped altogether. Broadcast warning systems must therefore be carefully planned and ionospheric data used to assist in the selection of frequencies ensuring reliable passing of information from shore to ship at all times.

METEOROLOGICAL SERVICES

In an Australian theater, there exists a network of widely separated key meteorological stations. Each of these interchanges information with all of the others so that each may prepare synoptic charts of the area. Each must then inform all airfields within its area of meteorological conditions existing and predicted. A radio network has been set up to meet this need. The frequencies used and their time of use are all planned on the basis of ionospheric predictions; thus no failure now arises. At first the equipment in use could not reach sufficiently low frequencies; later, equipment of satisfactory range was installed, completely eliminating any difficulties in maintaining contact between stations.

HIGH FREQUENCY DIRECTION FINDING

In the Southwest Pacific Area high frequency direction finding is used as a navigational aid to aircraft. An instance of the need for ionospheric information to obviate the failure of such a system is given by the loss some 2 years ago, in one theater of war, of more than 40 aircraft returning from a mission, due to the selection of the wrong frequency, resulting in the aircraft being in the skip zone, and thus being unable to obtain navigational assistance.

In the Southwest Pacific no such heavy losses have been experienced due to the fact that the area has been divided into zones, time tables carefully drawn up and selected frequencies laid down for each zone, thus ensuring that no aircraft shall be within skip of the DF station at any time of the day or night. No failures have arisen except where instructions have been disobeyed and frequencies used involving skip.

An example of this arose when a Hudson aircraft with a crew of five and five passengers aboard proceeded from a station to the north of Australia

to an east coast Australian city on a combined reconnaissance and travel mission, arriving at that city about 6 p. m. in bad weather. The aircraft called for bearings on an unsuitable frequency, and although the DF station advised the ground station, which was maintaining difficult communication with the aircraft, to change to a lower frequency, the ground station feared loss of communication and would not accept the advice given. No bearing of the plane could be given, and it finally crashed into the sea, 100 miles south of its destination, with total loss of life. An examination of ionospheric graphs at the subsequent inquiry showed that the skip on the frequency in use by the aircraft varied from 300 to 600 miles during the time it was endeavoring to obtain bearings.

OPERATIONAL CHANNELS

Just prior to the Coral Sea battle, a meeting was hastily called at General MacArthur's Headquarters to decide ways and means of ensuring communication between ground stations, ships, aircraft, and organizations vitally concerned with obtaining information which would enable them to follow the course of the anticipated battle and take appropriate action. Because of the number and disposition of the forces concerned, both in the South and Southwest Pacific Areas, the system had of necessity to be as simple as possible. Some communications officers at the conference therefore advocated the use of a single frequency. It was pointed out, by reference to ionospheric predictions, that if this plan was adopted, communication failures would inevitably result. The more scientific approach was finally agreed upon, and additional frequencies were selected, the hours of operation on each being specified in advance. The plan was completely successful, and as far as is known, there was not a single hitch during the battle due to a communication failure.

Since the time of the Coral Sea battle reconnaissance, strike, convoy and broadcast frequency allocations in the Southwest Pacific Area have been based on ionospheric data, and the success achieved has amply justified the comparatively small expenditure of effort in this direction.

SIGNAL INTELLIGENCE

Ionospheric information has proved of considerable value to Signal Intelligence units. Taking the negative aspect first, past experience indicates that operations rooms may be unnecessarily alarmed by reports of strong signals picked up by nearby receivers, leading to the conclusion that an attack is imminent. A ship was, in fact, sent out on one occasion to endeavor to intercept a submarine which was finally proved to be some 10,000 miles distant at the time. Had reference been made to ionospheric data, it would have been clear that considerable skip distances were involved, and one could have predicted with certainty that the signal in question could not have come from a point closer than 2,000 miles from the receiver.

As a further example, in 1942 one of the services believed a spy to be operating a transmitter in one of the mountainous regions of New South Wales. The frequency, on which strong signals were picked up, was in the neighborhood of 11 megacycles. It was also noted that signals were exceptionally strong and steady by night. After considerable time and effort had been spent searching the area, a request was made for the supply of mobile direction finding equipment, thus bringing those familiar with the application of ionospheric data into the picture. It was then made clear that the transmitter was at least 2,000 miles away, and that errors in plotting the bearings, due to the use of rhumb lines instead of great circle bearings had caused incorrect inferences to be drawn. Further observations made by DF stations more appropriately placed proved conclusively that the transmitter in question, although operated by the Japanese, was located in the Netherlands Indies.

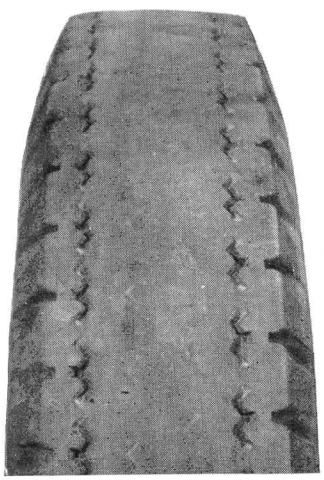
Prior to the more widespread use of ionospheric data in the Southwest Pacific Area, a sudden increase in the number of signals being received by radio intercept units led to the impression on one or two occasions, that attacks were impending, and hurried preparations made to meet them. When nothing eventuated, there was, of course, some criticism of those responsible for the unnecessary alarm which had been caused. Investigation showed, however, that the sudden increase in traffic was due to improved propagation conditions on lower frequencies, due to the onset of an ionospheric storm, thus giving the impression that the enemy was more than usually active. Ionosphere forecasts, coupled with regular monthly predictions are now in general use, and thus cause and effect can be more readily determined, and unnecessary warnings eliminated.

U. S. GOVERNMENT PRINTING OFFICE: 1944

YOU can help stretch our tire supply by removing tires at exactly the right time for reconditioning.

TOO SOON—Tread is raised slightly near center. Run farther before you remove for reconditioning.

TOO LATE—This is gross negligence. Tire is worn beyond repair. Instructions in TM 31–200 ignored.



TIRES WORN JUST RIGHT FOR RECONDITIONING

Note how the tread designs are worn down smoothly in the center and are just beginning to disappear. This is exactly the right time to remove these tires to have new treads put on.

double, double, boil and bubble
cook up a code and get in trouble,
unless the armys' experts back it—
the enemy is sure to crack it!

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