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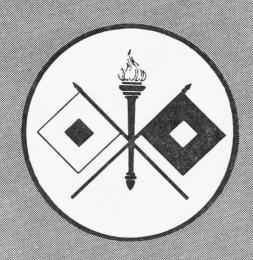
No. 33

RESTRICTED

# SIGNAL CORPS Technical Information Letter

AUGUST · 1944

ARMY SERVICE FORCES · OFFICE OF THE CHIEF SIGNAL OFFICER



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### 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.

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 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.

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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"

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# **VHF CROSS CHANNEL CIRCUIT**

### Radio Relay System Used Operationally Sixty Hours After Allied Landings in France

A RECENT report from the European Theater of Operation, describes the employment of Radio Sets AN/TRC-3 and 4 for cross channel communication between a U. S. Army headquarters in France and a Tactical Air Command headquarters in England.

The requirements were for a cross channel VHF radio circuit to provide facilities for handling traffic between the U. S. Army forces on the beach and a Tactical Air Command 40 miles inland in the UK, with provision for emergency circuits from the headquarters in France to another headquarters in an English town on the channel coast. The most important initial requirement was to

permit transmission of air reconnaissance information and pictures by facsimile from the Tactical Air Command headquarters to the Army troops on the beach.

It was decided that the requirements could be met by the use of AN/TRC-3 terminals at Army and Tactical Air Command headquarters and AN/TRC-4 relay station at a location on the English side of the channel. The headquarters on the Channel coast would be connected by land lines to the relay station.

The time allowed for the planning and initiation of work on the project was 4 hours. Coordination with the British War Office in order

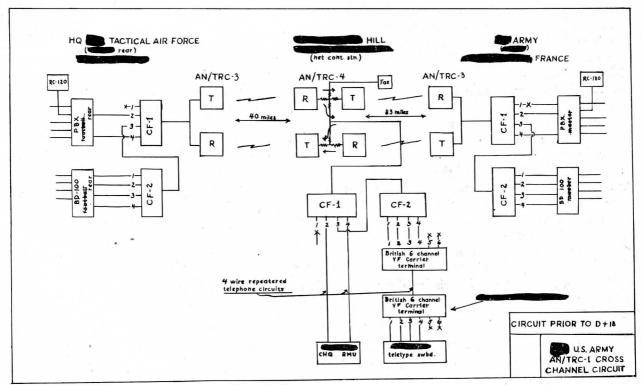
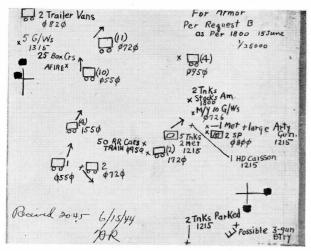


FIG. 1—THIS IS THE VHF CROSS CHANNEL CIRCUIT IN USE FROM 10 JUNE TO 18 JUNE. PRIOR TO 10 JUNE NO CARRIER EQUIPMENT WAS USED; AFTER 18 JUNE, TWO SETS WERE IN OPERATION.



TELEDELTOS RECORDING OF MAP OVERLAY SENT TO AEF

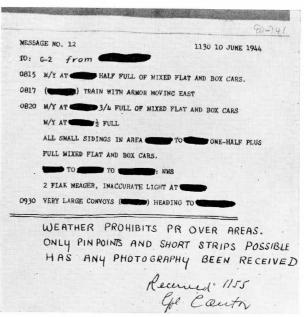
to obtain designations of available sites for the relay station and with the Mutual Interference Committee of the Combined Signal Board to arrange for frequencies free from interference from possible neighboring VHF installations was necessary. An inspection of two sites proposed by the War Office disclosed that a neighboring elevation presented a possibility of serious interference with the inland leg of the system. A further difficulty was presented by the fact that both proposed sites were lower than had been contemplated by about 100 feet. In addition to this the presence of a number of British VHF terminals in the same vicinity raised a question as to whether complete freedom from interference could be attained at these sites.

A hill, with an elevation of 780 feet, about 3 miles from the sites proposed by the War Office, offered a solution to these problems. An abandoned building at the top of the hill provided an excellent operating position. The walls, which were of stone and about 2 feet thick, appeared to provide maximum protection from shrapnel and blast, nothing but a direct hit being likely to cause complete casualty to the equipment. After clearance had been obtained to install an AN/TRC-4 relay station in this building, a field test was made establishing satisfactory communications between the hill and the inland terminus of the system.

A 230 volt, 50-cycle power line running across the hill was tapped to provide power for the installation. Three PE-75 power units were installed nearby for emergency use. In order to provide the emergency circuits from the beachhead to the headquarters on the Channel coast, CF-1 and CF-2 terminals, one of each, were provided at the relay station.

The day after initiation of the project work was started by cleaning and repairing the interior of the building which in recent years had been used only as a shelter by local sheep and cattle. The same day installation of the radio station in the building was begun. It was not possible at this time to erect antennas because of the established security policy which prohibited making any observable installations before H-Hour minus 12. The carrier terminal equipments were not installed at this time, but were mounted in trucks, which were kept away from the site until instructions should be received to complete the installation.

The initial plan contemplated that in order to use the emergency circuits to the Channel coast position the relay station would operate as a terminal, the inland link of the VHF circuit being inoperative for such time as the emergency circuits were in use. Since the land line facilities available along the Channel coast consisted of four-wire repeatered circuits, it was necessary to modify the CF-1 to provide a two-wire to four-wire switching arrangement on the line drop side. The teletype circuits obtained from the CF-2 were



AIR RECONNAISSANCE INFORMATION AS RECORDED ON TELEDELTOS PAPER.



FIG. 2.—AN AERIAL PHOTOGRAPH MONITORED AT THE RELAY STATION AND TAKEN OFF AT THAT POINT WITHOUT DEMODULATING.

extended to the Channel coast position through the use of four channels of a British six-channel voice frequency carrier telegraph system.

In order to permit simultaneous operation of the circuits from the beachhead to the Channel coast position and from the beachhead to the inland station, one additional CF-1 and one additional CF-2 would normally have been used. As these were not available, a bridging arrangement was devised using locally constructed "T" pads. The fabrication of these pads was undertaken during the waiting period before "the balloon went up." The possibilities for circuit routing with this arrangement is shown in figure 1.

At 1645 on 5 June personnel at the relay station were notified that H-Hour would be 0000, 6 June. An indication was given as to the general location of the beachhead and the operating procedure for Signal units. At 0000, 6 June, the AN/TRC-4 receivers went into operation. Tests were conducted with the inland station using the transmitting frequency of the Far Shore station.

Tests proving satisfactory, the receivers on the cross channel link were maintained in a standby status until a signal was received from France.

At 1314, 8 June, the Far Shore station contacted the relay station and was immediately patched through to the inland terminal. Transmission in either direction was excellent and the system went into service on a single channel basis. At 1540 the same day, the first facsimile transmission took place. A Facsimile Equipment RC–120 installed at the relay station was used to monitor the transmissions from the inland station to the Far Shore.

Single channel operation was continued until 1209, 10 June, at which time the Far Shore station shut down to permit moving the equipment inland. During this break the CF-1 and CF-2 equipments at the relay station were connected into the circuit and tested. At 2120 the same day the Far Shore station rejoined the net. Several

(Continued on p. 19)

# HIGH SPEED WIRE COILS

### Method of Production Worked Out Experimentally by Signal Corps Board

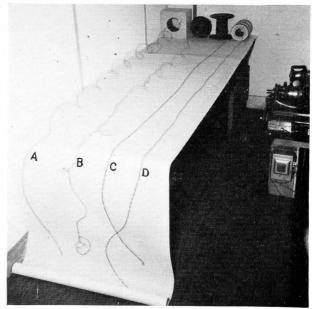
A LONG felt military need for a wire coil capable of being laid at high speeds or at low speeds without mechanical equipment, is close to being met. Investigation, under way for some time by the Signal Corps Board, the Eatontown Signal Laboratory and the Army Air Forces, has resulted in the production of high speed coils on an experimental basis.

Limited tests in laying wire in the form of concentric balls and criss-cross multilayer coils previously had resulted in the approval of military characteristics for assault wire intended for laying from airplanes, rapidly moving vehicles, and fast moving personnel, such as ski-troops. The term "high speed coil" was used to indicate communication wire which is prepared in such a manner that it can be laid during tactical situations at either low or high speeds without the use of reels and reel equipment.

The Signal Corps tested various types of high speed rolls and balls submitted by manufacturers. All were found unsuitable because of handling laying and abrasion difficulties, as well as breakage, twisting, and kinkage when laid at high speeds. An analysis indicated that the difficulties were due to spiralling and lack of turn-to-turn restraint.

The investigation indicated that a suitable coil should embody the following features: a rigid cylindrical coil container; wire to be paid out from the center rather than the outside of the coil; turn-to-turn restraint to prevent the wire from paying out too fast when laid at lower speeds; and pre-twisting during the winding process to prevent kinking during wire laying.

Crux of the problem was a coil-winding machine capable of rewinding wire into the preferred coil form. The Board in collaboration with the Eatontown Signal Laboratory improvised a machine which produced a satisfactory coil. Different types of standard wires were wound into high speed coil form and satisfactory handling and laying performances were obtained. The wire used included: assault Wire W-130 and W-130-A, experimental and braided assault Wire WD-1/TT, and WD-3/TT, single and double conductor field Wire W-110-B and 16-gauge copper-clad wire insulated with a synthetic developed for use in jungle pole line construction.



LACK OF HELICALS AND TURN-TANGLES IN SIGNAL CORPS HIGH SPEED COIL (D) AS COMPARED WITH STANDARD REEL DR-8 (C) AND TWO COMMERCIAL WIRE BALLS (A AND B).

Standard assault wires in high speed form were laid from land and motor vehicles as well as from liaison type airplanes and experiments also conducted with constant communication throughout the laying operation between the personnel stationed at the starting point and the laying crew using sound powered telephones during the laying operations.

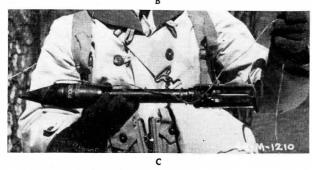
The manual laying of coils of wire was successfully accomplished through the use of shoulder slings and packboards. Tandem laying of three coils was accomplished using a packboard. The laying route chosen was directly cross-country through wooded terrain.

Coils were laid singly and in tandem from jeeps, command cars, trucks and Cargo Carrier M 29C, Amphibian. Coils were hand held or attached to the vehicle as desired.

Airplane laying of assault type wire, at a speed of 115 miles per hour, was accomplished by slinging a steel container equipped with a wire release mechanism under the fuselage of a liaison airplane. The container was built to receive six high speed coils connected in tandem equivalent to four and one-half miles of Wire W-130.







LAYING BY PROJECTILE: A—PROJECTILE HEAD PICKUP LOOP IS SMALL CIRCLE ON RIGHT; LARGE LOOP IS SLIP KNOT FOR TAIL OF PROJECTILE. B—PICKUP LOOPS ATTACHED TO MUZZLE OF BAZOOKA BY TAPE. C—PICKUP AND SLIP LOOP POSITION IS SHOWN IN RECOVERED PROJECTILE.

Assault Wire W-130-A was laid from a high speed coil through the use of an AT Rocket Launcher M1A1 (Bazooka). The bazooka was fired and handled normally, the attachment of the wire to the projectile being accomplished through the use of a loop arrangement attached to the muzzle with rubber tape in such a manner as to be picked up by the projectile as it emerged.

Assault Wire W-130 was laid from high speed coils through the use of a rifle, U. S. Caliber 30 M1 with Launcher Grenade M-7.

Assault Wire W-130 in one-fourth-mile coils was laid from the back of a trained Army dog with excellent results.

Standard field Wire W-110-B was laid from high speed coils from land and amphibious vehicles with excellent results from the standpoint of handling, laying and relative freedom from damage.



METHOD OF LOADING AIRPLANE COIL CONTAINER.

Airplane laying of 1½ mile high speed coils of Wire W-110-B were made at speeds exceeding 150 miles per hour. However, further development is required where several coils in tandem are used.

A brief summary of the Signal Corps Board's conclusions indicate that:

A military need exists for assault and field wires in high speed coils.

A military need exists for winding machinery and trained personnel for the production of satisfactory high speed coils in the field.

A program should be established for the development of machinery suitable for winding high speed coils in field depots and organizations.

The approved recommendations directed that action be initiated to enlarge the present development program on high speed coils of light assault wire. This was to include development of winding machinery, suitable for use in Signal depots and field organizations, for winding light assault wire such as Wire W-130; W-130-A; WD-1/TT and field Wire W-110-B (for man pack) into high speed coils; also the investigation of the possibility of supplementing the issue of field Wire W-110-B on Reels DR-4 and DR-5 by issuing some Wire W-110-B in ½ and 1 mile high speed coils for use in laying from vehicles.

### TMS ON RADIO EQUIPMENT

WITH THE publication of TM E 11–227, German Radio Communication Equipment, the second in this series on radio communication equipment is now available. The first in this series was TM 11–227, Radio Communication Equipment, and dealt with Signal Corps sets. The third, now in preparation, will deal with Japanese equipment.

All TMs are available through Adjutant General channels.

# HIGH SPEED COIL WINDING MACHINERY

THE WINDING machinery employed by the Signal Corps Board consists of 2 Reel Unit RL-31, 1 Reel Unit RL-39, and a small bench lathe plus accessories. An overall view of this equipment appears in figure 1.

One RL-31 is used for winding wire on coil forms which are made from standard reels DR-4, DR-5, and DR-8 (see figure 2). The other RL-31 is used for the pretwisting of wire by rotation of the supply spool around an axis perpendicular to its own as the wire is unreeled. This is shown in figure 3.

Pulleys and ropes are used to belt the 2 Reel Unit RL-31 together to obtain uniform pretwisting of the wire. This amounts to one twist per revolution of the coil being wound.

The lathe, with a fabricated guide attached in place of the cutting tool, is belted to the winding reel unit to provide machine layer feeding of the wire at a turn pitch of 1.25. During winding, the wire is fed through the guide to the point of contact with the coil form. (See figure 4.)

A half-horsepower drill press motor was used by the Signal Corps Board to drive the winding equipment. The machine proved capable of winding approximately 10 miles of wire per 8 hour day.

The high speed wire coil container is made up of a cylindrical core of corrugated cardboard, to be removed before laying wire; two wooden annular rings for the ends, to provide side support; an outer cylindrical cover of sheet metal (see figure 5), to provide mechanical strength in handling and transportation. The outer cover is lined with cardboard to which adhesive tape, wound over the top layer of the wire (figure 6), is glued and is used to prevent the collapse of the outer turns as the wire is paid out.

Rubber cement is used to achieve turn-to-turn restraint.

Recommendations for the best winding techniques are as follows:

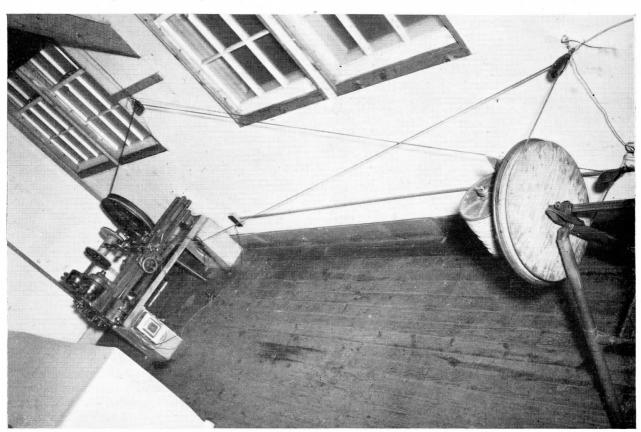


FIG. 1-HIGH SPEED COIL WINDING MACHINERY USED BY SIGNAL CORPS BOARD.

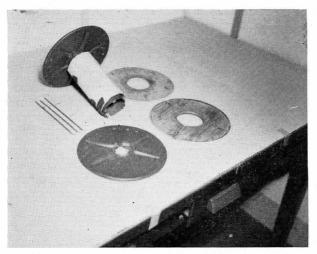


FIG. 2a—COIL WINDING FORM MADE FROM REEL DR-8 AND WOODEN END PIECES.

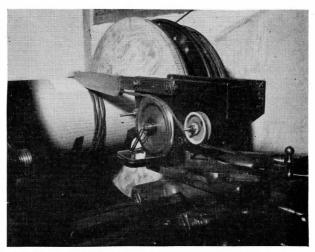


FIG. 4—WIRE GUIDE DETAIL AND METHOD OF APPLYING ADHESIVE.

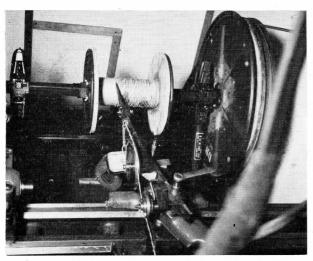


FIG. 2b—COIL WINDING FORM INSTALLED IN MACHINE.

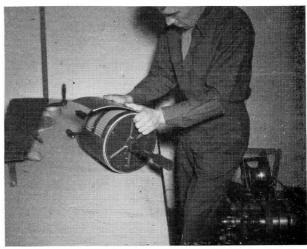


FIG. 5-APPLICATION OF METAL COVER TO COMPLETED COIL.

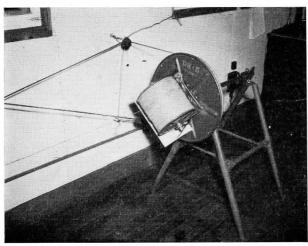


FIG. 3-WIRE SPOOL MOUNTED ON PRETWISTING COMPONENT.

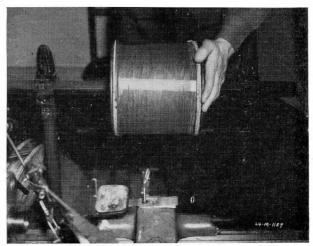
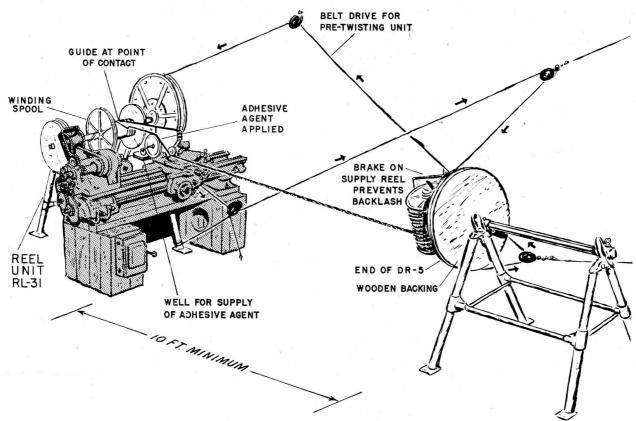


FIG. 6-TAPE TO KEEP OUTER LAYER FROM COLLAPSING.



SCHEMATIC DIAGRAM OF COIL WINDING MACHINERY USED BY SIGNAL CORPS BOARD TO PRODUCE HIGH SPEED WIRE COILS.

Wires should be pretwisted during the winding process in a direction to tighten the lay twist at a rate of one twist per coil revolution. The restraining agent should be selected to suit the specific type of wire being wound so as to prevent solvent-action damage to insulation and to provide the minimum required amount of turn-to-turn restraint needed for manual laying.

The outer cover should be installed before removal of the coil from its winding form, as shown in figure 5. Coils intended for laying at speeds exceeding 60 miles per hour should be constructed from Class A wire. In addition, when wire is to be laid at this speed the end rings of the coil form should be modified so as to provide a removable annular inner ring (whose outside diameter should be approximately 60 percent of the outside diameter of the coil and) which when removed doubles the diameter of the orifice (figure 7). The inner edges of both rings should be rounded to provide a low friction guide for the wire being paid out.

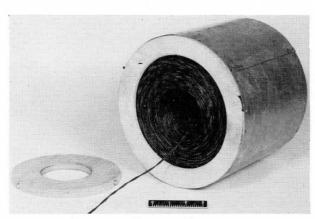
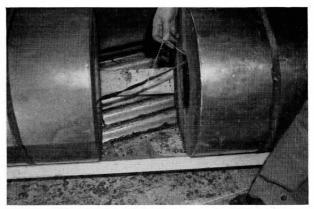


FIG. 7—INNER ANNULAR END RING OF COIL FORM REMOVED TO ALLOW LAYING AT SPEEDS IN EXCESS OF 60 MILES PER HOUR.



COIL TO COIL SPLICE FOR TANDEM AIR LAYING. STRING PRE-VENTS LAYING OF SECOND COIL BEFORE COMPLETE EMPTYING OF FIRST COIL.

### ANZIO COMMUNICATIONS

### Underground Circuits Helped Maintain Communications When the Going Got Rough

THE FOLLOWING information is based on a number of operational reports on the Anzio beachhead. The recommendations appearing in various parts of this article are those of the reporting officers and should not be construed as necessarily reflecting opinions or policies of the Chief Signal Officer.

The initial communication plans for the landing at Anzio were based on experience gained from the landing at Salerno in September of 1943. In this latter operation, an American corps was operating directly under army with a British corps on its left. At Anzio, the U. S. corps operated semi-independently in that all initial supply functions had to be assumed by corps and no wire communications were available to link corps directly with army. The absence of wire made radio of the utmost importance and provided the radio operators of the corps Signal battalion with their first real opportunity to become a vital link in the communication system.

Arrangements were made for one wire team from the construction companies of the Signal battalion to be attached to each division. In addition to this a detail of 30 enlisted men had to be loaned to the Ranger Force for the installation and operation of its Signal center. Two DUKW-mounted SCR-499 radio sets, specially authorized to the battalion to insure immediate radio communication on landing, went ashore about noon on D-Day and contacted the corps CP reconnaissance party late that afternoon.

As soon as the CP site was selected, one radio set was put in operation and communication was established with the headquarters ship and with Fifth Army. Considerable confusion delayed reliable contact because of a change in the prearranged code sign procedure and the interjection of a relay station into the net, both of which changes were unknown to the terminal station ashore. However, early on D+1, the second radio set established direct contact with Fifth Army over a second circuit and thereafter radio contact was never lost either with Fifth Army or the headquarters ship.

The initial Corps message center ashore was established shortly after noon on D+1 utilizing Signal section personnel and improvised equip-

ment. It was impossible to close CP on shipboard and open ashore, despite the desires of the corps staff, until the Signal battalion landed late in the afternoon bringing message center equipment.

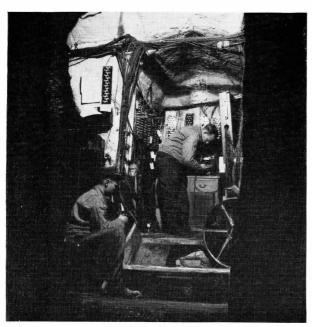
Messenger service was limited to that provided by three motorcycles brought ashore on DUKWs. These 'cycles proved indispensable, not only for messenger use, but in providing speedy transportation for Signal personnel to make the initial contacts necessary to get the communication system started prior to the landing of Signal battalion vehicles. The only personnel from the Signal battalion to land on D-Day were those who could climb aboard the DUKWs. This group consisted mainly of reconnaissance personnel, radio operators and messengers.

### **DIVISION WIRE TEAM USED**

The advance echelon of the corps staff required wire communication to subordinate units the morning of D+1. As none of the battalion equipment was unloaded at this time the immediate problem was solved by borrowing a Switchboard DB-72 and operators from an infantry division and utilizing the battalion wire team which came ashore with that division. The wire teams attached to each division were also delayed in getting ashore due to the precedence they had been given in the unloading plan. It is believed



HALFTRACK EQUIPPED WITH WIRE REEL PREPARING TO ROLL DOWN RAILROAD TAKEN ONLY TWO HOURS PREVIOUSLY.



VI CORPS HEADQUARTERS UNDERGROUND MAIN FRAME INSTALLATION.

and increasing the difficulty of expediting the transmission of high priority messages. Temporary failure of the radio teletype at such periods was serious since 50 percent of all traffic transmitted by electrical means to army was passed over this circuit.

It must be borne in mind the entire area was within range of enemy artillery fire, the flat, open terrain rendered the entire Allied position subject to direct enemy observation, and afforded no wire routes defiladed from artillery fire, the entire area was "combat zone" and therefore a profitable bombing target.

Operation on the beachhead has again proved that sound basic and specialist training is essential to all Signal Corps personnel for the maintenance of efficient communications. It has also proved that a flexibility of operation methods and ability to improvise when necessary to meet a special situation are large contributing factors to the successful accomplishment of the communication mission.

# DESIGN AND STANDARDIZATION OF FORMS

A COMPREHENSIVE program for the control, design and standardization of Signal Corps forms was announced in Memorandum Serial No. 78, Office of the Chief Signal Officer, 25 May 1944, as part of an Army Service Forces program for the conservation of paper and the simplification of paper work and administrative procedures. It is anticipated that substantial savings in expenditures for printed forms will be made and that even greater savings in man hours will be achieved by the speeding up and streamlining of procedures, which will result from the adoption of fewer, simpler and better designed forms.

Although the program has been in effect for little more than a month, considerable progress has already been made. In addition to the Forms Standardization Section, Control Division, OCSigO, seven Forms Standardization Units have been activated in the Office of the Chief Signal Officer and 32 Forms Standardization Units have been activated in field activities under the jurisdiction of the Chief Signal Officer to achieve the objectives of the program. Numerical and functional files of 6,720 active intra-office and intra-Signal Corps forms have been established, 1,975 forms have been discontinued as a result of

the program, and 2,776 forms have been analyzed for simplification and consolidation. A written justification has been obtained for each form retained. A substantial number of forms have been redesigned in accordance with the principles and technique of modern forms design. The quantities of forms authorized for reproduction have been more closely geared to estimate future requirements.

In the weeks immediately ahead emphasis will be placed on the functional analyses of forms and on studies of the underlying procedures for the purpose of effecting consolidation and simplification wherever possible, with attention concentrated on those forms offering opportunities for maximum savings. As the procedures and forms are standardized, greater attention will then be given to the application of the principles and technique of modern forms design. To assist in this part of the program, the Forms Control and Standardization Unit, Office of the Adjutant General, has provided a school for training civilian employees in the standardized technique of forms design and has prepared for publication in the near future a technical manual establishing standards in grades, weights, and colors of paper, colors of ink, and sizes and style technique for all ASF forms.

# ANTI-INTERFERENCE ANTENNAS

### Improvised Antennas for SCR-509/510 and SCR-609/610 Help Reduce Undesired Signals

TESTS HAVE shown that frequency modulated radio systems are vulnerable to interference produced by other radio systems operating within range. Since such interference is to be anticipated in military operations, it is important that plans be made for maintaining communication under adverse conditions.

This article, which is based on tests carried out by the Office of the Chief Signal Officer, Headquarters, ETOUSA, describes a practical means which may be used in the field to permit operation where it would otherwise be impossible. Advantage is taken of the fact that the source of interference is at a location different from that of the desired station; thus a properly installed directional antenna will be able to differentiate between the desired and the undesired signal.

### SCR 509/510

Tests have shown that a practical directional antenna for use with Radio Set SCR-509 and Radio Set SCR-510 may be made with field wire and lance poles as illustrated in Figure 1. The exact dimensions are not critical except that the two antenna wires from the set to the top of the lance poles must be of the same length. This is necessary because the operation depends on equal voltages being produced in the two parts.

The material required for construction is:

Two 25-foot lengths of field Wire W-110-B or equivalent.

Two 14-foot lance poles or equivalent. Rope or other means of supporting poles.

Assault Wire W-130 is an acceptable substitute for field wire. Any practical non-metallic means of supporting the wires may be used in place of lance poles. The wires must, however, be held firmly in place for proper operation.

The 25-foot lengths of wire are first cut to exactly the same length and a knot tied one foot from adjacent ends at one end of the wires. Approximately one and a half inches of insulation are then removed from each wire at this end and all four wires twisted neatly together to facilitate connection to the antenna post.

The lance poles are placed on the ground 24 feet apart and parallel. The wires are fastened to the

lance poles at top and bottom by means of friction tape or short pieces of insulated wire, the common connection at the center is then fastened to the antenna post of the set and the poles are raised to a vertical position, as shown in Figure 1.

With one man holding each pole and using the wire between to maintain correct distance the antenna is rotated about the radio set until the interference is at a minimum and the desired signal is loudest. Due to the characteristics of this type radio set, it is best to move the antenna when both interference and the desired signal are being received, otherwise the correct position is difficult to determine. After the correct position is found, the lance poles are held in position by ropes if available, otherwise by short wood braces at the bottom of the pole. Wire supports will cause trouble under some conditions.

### **Electric Field Reverses**

The operation of the antenna described in this memorandum depends on the fact that at any given time the electric field reverses every half wavelength in the direction of propagation. Thus with two antennas, one of which is one half wave-length closer to the source than the other, the voltages induced are always 180 degrees out of phase. If connected together and to a receiver, cancellation will occur and no signal will be heard. It should be noted that if one antenna produces a greater voltage than the other, complete cancellation will not occur. This is the reason that care must be used to make the two parts identical. Similarly, if the two antennas are an equal distance from the source the voltages will be in phase regardless of the distance between them, and will produce a signal when connected to a receiver. Therefore two vertical antennas separated by a half wavelength will produce a directional system. system will have a maximum response to sources located perpendicular to a line connecting the poles and will have a minimum response to sources located in line with the poles. Therefore when the antenna system is rotated to cut out interference, the position which will give best results will generally be found with the line of poles pointing towards the interfering source.

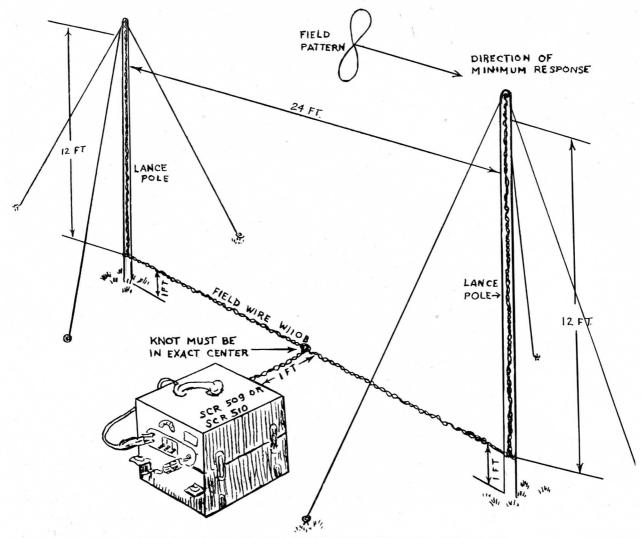


FIGURE 1-DIRECTIONAL ANTENNA FOR RADIO SET SCR-509 AND SCR-510.

Theoretically a half wave-length separation is required between the two antenna poles, however tests have shown that the distance is not too critical and satisfactory operation may be obtained over the complete range of the SCR-509 and SCR-510 with a spacing of 24 feet. It will be noted that on certain frequencies the null does not occur exactly along the line of poles, however this is not important unless it is necessary to locate the direction of the source. The maximum will always occur in approximately the same direction regardless of frequency.

The above discussion has been based on receiver characteristics although the same argument applies to the transmitter. The direction of maximum and minimum transmission is the same as for reception. In other words, if the antenna is properly oriented to receive a given station, it is properly oriented to transmit to that station. Simi-

larly minimum transmission will take place in the direction of minimum reception (along the line of poles).

### SCR 609/610

Antenna Equipment RC-63, which is a vertical half-rhombic antenna originally used with the SCR-194 and SCR-195, may be used with Radio Set SCR-609 or Radio Set SCR-610 where space and weight will permit. This equipment consists of a 30-foot mast (in four sections for transportation), sufficient wire (on reels) for antenna and counterpoise, terminal block with terminating resistor, hammer, stakes, guy ropes and bag.

Where the above equipment is not available, a satisfactory field expedient may be made with field wire and lance poles as illustrated in figure 2. The dimensions are not critical but should be followed as closely as possible.

The material required for construction is:

One 100-foot length of Field Wire W-110-B. One 88-foot length of Field Wire W-110-B.

Two 14-foot lance poles.

One 500-ohm two-watt resistor.

Three 40-foot length of rope or other means of supporting poles.

Four stakes.

Insulated copper wire may be substituted for Wire W-110-B. Any practical nonmetallic means of support may be used in place of the lance poles provided that a height between 24 feet and 30 feet is attained at the center of the antenna. The resistor should be a non-inductive type and may have a resistance between 400 ohms and 700 ohms. It must be rated at two watts or more and be mechanically suitable for outdoor use.

The two lance poles are placed on the ground end to end with approximately three feet overlapping. At the top and bottom of the overlap they are bound tightly together with rope. The joint should be tested for tightness before proceeding further.

The 88-foot length of wire which is used as a counterpoise is now stretched on the ground in the approximate direction from the radio set that it is desired to receive and transmit. At the end farthest from the radio a stake is driven and the wire fastened.

The assembled pole is laid on the ground perpendicular to the counterpoise with the bottom at the center of the wire, 44 feet from the radio set.

One end of each of the three lengths of rope are securely tied near the center of the pole at the top of the overlapped section.

The 100-foot section of wire which is used as an antenna is next laid on the ground from the radio set to the top of the double lance pole, thence to the stake where the end is fastened. A short piece of wire is used to tie the center of the antenna to the top of the lance pole.

The pole, with antenna attached, is next erected and held in place with the ropes previously attached as guys.

The antenna is connected to the antenna post of the radio set in place of the regular whip antenna.

The counterpoise is connected to the negative lead of the storage battery (or the frame of the vehicle if a vehicular battery is used). When dry batteries are used the counterpoise is connected to the case of the set.

One end of the 500-ohm resistor is connected to the antenna at the end away from the set, and the other end to the counterpoise.

### Field Pattern Important

If the direction of the station with which communication is desired is known, the antenna is set up to operate in that direction. Otherwise the complete structure is moved until satisfactory communication is obtained. A knowledge of the field pattern is helpful in determining the proper place-

(Continued on p. 36)

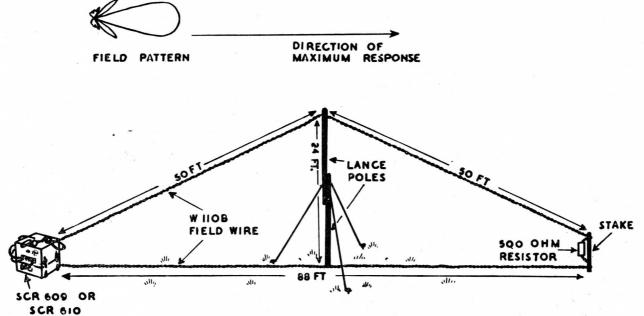


FIGURE 2-DIRECTIONAL ANTENNA FOR RADIO SET SCR-609 AND SCR-610.

# CRYSTAL COMPLEMENTS OF GROUND RADIO SETS

SUPPLY LETTER No. 204, subject "Quartz Crystals," dated 3 December 1943, was issued for the purpose of making it possible that the using arms be provided with all crystals deemed necessary for the proper functioning of certain equipments. This letter was republished in SCTIL No. 27, February 1944.

The following information concerning crystal complements of ground radio sets is published so that necessary steps can be taken by those responsible to eliminate any existing crystal shortages in their equipments:

CRYSTAL COMPLEMENTS OF GROUND RADIO SETS

(Revised 6 June 1944)

Radio set	Xtal type	For	Crystals required (per set)		
			In use or standby	Spare	Remarks
SCR-177 A & B		BC-312 BC-342	0	0 0	One crystal formerly in BC-312 is not now used.
SCR-188 SCR-193 SCR-197-A	DC-6. DC-6. Premier 180GW or=CW	BC-312 BC-325-A	0 5	0 5	Do. Actual quantities supplied with SCR-293, 294, 298, and 197 may be governed by other conditions.
SCR-197-B, C, D, E SCR-197-F	FT-171-B 1	BC-325-B, C, D, E BC-325-F	5 5	5 5	Do. Do.
SCR-197 (all) SCR-211-( )	DC-6	BC-342 BC-221	3	3 0	Do.
SCR-245		BC-223	0	0	Crystals optional; not furnished for transmitter BC-223. One crystal formerly in BC-312 is not now used.
SCR-245 SCR-284 SCR-293	DC-6	BC-312 BC-654 BC-500		0 0 0	Actual quantities supplied with SCR-293, 294, 298, and 197 may be governed by other conditions.
SCR-293 SCR-294-A	FT-171-B <sup>1</sup>	BC-499-A	12 6	0	Do. Do.
SCR-298-C SCR-299, 399, 499	FT-171-B 1	Commercial	3 36	0 36	Do.
SCR-299, 399, 499 SCR-300	DC-6 FT-243 <sup>1</sup>	BC-1000	2	0	
SCR-506 SCR-508	DC-24 or CR-2B/U CR-3/U <sup>2</sup>	BC-652 BC-604	1 80	1 0	SCR-506 can also use DC-15. It is intended that all crystals for BC-620, 659, 604, and 684 accompany the set at all times.
SCR-509 SCR-510	FT-243 1	BC-620	80 80	0	Do. Do.
SCR-511 SCR-528 SCR-536	CR-3/U 2	BC-745 BC-604 BC-611		0 0 0	Do. Radio Set SCR-536 is issued with one transmitting and one r ceiving crystal. Frequency Conversion Kit MC-518 is it cluded in Tables for Infantry Regiments and provides coi and crystals for a total of 50 channels for 72 each Radio SCR-536. It consists of 1 Case CS-113 containing 3 Frequence Conversion Kits MC-534. The latter is intended for use by a Infantry Battaion.
SCR-543	FT-171-B <sup>1</sup>	}BC-669		0	
				0	It is intended that all crystals for BC-620, 659, 604 and 684 accorpany the set at all times.
SCR-609 SCR-610	FT-243 <sup>1</sup> FT-243 <sup>1</sup> CR-3/U <sup>2</sup>	BC-659_ BC-659_ BC-684_	120 120 120	0 0	Do. Do. Do.
SCR-694	CR-3/U 2 {DC-37- DC-24_or CR-2B/U	BC-1306		0	Crystal Kit MC-535 contains crystals for tactical operation Radio Set SCR-694. It consists of 3 Cases CS-140, each ca containing 900 crystals. This provides 10 duplicate crystals of each of 270 channels.
		·			Crystal Kit MC-537 contains crystals for training operation Radio Set SCR-694. It consists of 2 Cases CS-137, each ca containing 100 crystals. This provides 10 duplicate crysta on each of 20 channels.
SCR-808SCR-828	DC-18 or DC-19	BC-923	_ 1		
AN/TRC-1	FT-243 1 CR-4/U 2	R-19/TRC-1 T-14/TRC-1	_ 4	0	
AN/TRC-2	DC-24 or CR-2B/U DC-37	BC-1306 RT-12/TRC-2	34	34	
AN/TRC-3	FT-243 <sup>1</sup>	RT-12/TRC-2 R-19/TRC-1 T-14/TRC-1	32 32	0	
	(ET) 942 1	R_19/TRC=1	48	0	these 900 crystals should be available for use.
AN/TRC-4	$\begin{cases} FT-243 \ ^{1}-\\ CR-4/U \ ^{2}-\\ \end{cases}$	R-19/TRC-1 T-14/TRC-1	48		

<sup>1 &</sup>quot;FT\_" does not actually define a crystal type but merely a crystal holder. For lack of an appropriate "DC" or other no menclature the "FT" designation is used herein but it should be understood that what is meant is "an FT\_( ) crystal holder with crystal" for use in the particular radio set listed.  $^2$  CR\_3/U and CR\_4/U are new nomenclatures for certain crystal units in FT\_241-A holders. All such present units are marked with the FT\_241-A designation. However, it is expected that in the near future the new markings will be applied.

# TANK—INFANTRY COMMUNICATIONS

Radio Set SCR-300, Mounted in a Tank, Seems To Be the Answer to This Important Problem

TO MEET an immediate need for tank-infantry radio communication, it was proposed that existing Signal Corps radio equipment be employed. Since use of the tank set by the infantry was out of the question, due to physical size and weight, it was decided to install the major components of an Infantry set in the tank.

Trial tank installations of Radio Set SCR-300 in Medium Tank M4 and Light Tank M5A1 were made at Fort Knox, Kentucky. Available Signal Corps equipment was used wherever possible. The installation in the M4 Medium Tank was made in the turret just to the right of the loader's seat, using Mounting FT-317. By the use of interphone cordage and Switchbox BC-658-(), the SCR-300 was interconnected with the interphone system of the tank's Radio Set SCR-508-() to permit its operation by either the loader or the tank commander.

Due to space limitations, it was not possible to locate Radio Set SCR-300 in the turret of the M5A1 Light Tank. This installation was made in the right sponson using Mounting FT-250 and, by means of a Switchbox BC-658-(), interconnected to the interphone system of the SCR-508-() so that the co-driver could be on interphone or the SCR-300. In this installation, it is not possible for the tank commander to directly control the SCR-300 because there are insufficient slipring connections and the button switch on the transmitting microphone must control the transmitter.

Various tests were conducted on the installations. The vehicular antenna installations were checked to make sure that they were not overloading the transmitter power amplifier. This was done by inserting a plate milliammeter in the transmitter power amplifier circuit and reading the drain while transmitting. The antenna installations prescribed do not overload the transmitter. The installed sets were operated in a net with a near-by station and with a distant station (3 to 5 miles), to enable comparison of the signals received at the distant station, from the ground station and the installed stations. It was found that the installed radio transmitted a signal which, at the normal range of the set, could not be distinguished from that of an SCR-300 on the ground.

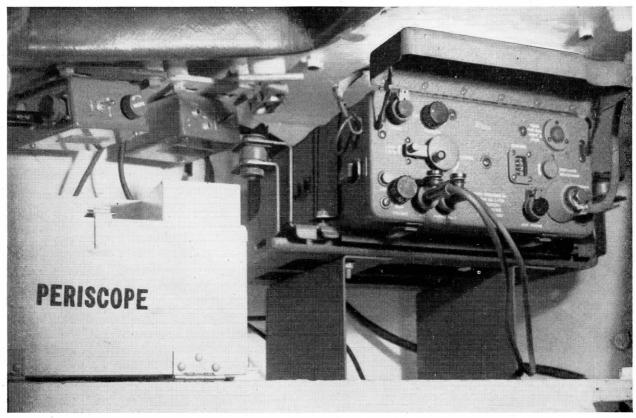
The equipment was operated ground-to-tank with the tank moving, using various microphone and headset combinations at both stations. An intelligibile signal was obtained at both stations at 3 miles, the maximum range used in this part of the test, using any of the microphone-headset combinations tested. Microphone T-45 and Headset HS-30-( ) gave the best results, providing a noise-free signal in either direction. Microphone T-17 and HS-30-( ) were satisfactory, but the signal received on the ground had some tank background noise. Handset TS-15-( ) gave poor results when used in the tanks in that it picked up a great deal of tank noise. Throat Microphone T-30-( ) and Headset HS-18 gave fair results. The transmitted signal was somewhat difficult to understand but not due to tank noise.

The installations were observed while operating the tanks over rough terrain, to determine the damping effect provided by the shock mounts used. The FT-317 and FT-250 are satisfactory shock mounts for the SCR-300. It appears unlikely that any major difficulty will be experienced from vibration.

A net was established and the installed equipment operated while firing the 75 mm gun in the M4 Tank and the 37 mm gun in the M5A1 Tank. This was done to determine what effect the firing



DIRECTING A TANK DURING OPERATIONS AT BOUGAINVILLE.



INSTALLATION OF RADIO SET AN/VRC-3-( ) IN LIGHT TANK OF THE MS SERIES.

might have on the SCR-300 and what difficulties could be expected if it became necessary to operate the radio set while firing the tank guns. The firing appeared to have no effect on the operation of the radios. They were not damaged by concussion. Outgoing transmissions were not interrupted; incoming transmissions were interrupted only to the extent that the noise of the gun caused an occasional word to be missed.

The equipment was operated under simulated tactical conditions using a medium tank platoon in support of a dismounted armored infantry company (less heavy weapons platoon). Four Radio Set SCR-300 were used by the armored infantry company; one by the company commander and one by each of three platoon leaders. One SCR-300 was used in the Platoon Leader's tank of the medium tank platoon, and one was used as a monitor station by observing personnel. The infantry company advanced over a hilly, partially wooded sector with the tanks in flat "V" formation at 50 to 150 yards behind the leading infantrymen, the distance dependent upon the terrain. The SCR-300 was used by the infantry commander to notify the tank platoon leader of the location of "enemy" machine gun nests and anti-tank positions on which fire was desired.

Initially in the platoon leader's tank the SCR-300 was monitored by the loader, who would



RADIO SET AN/VRC-3-( ) IS MOUNTED IN THE TURRET OF AN M4 MEDIUM TANK.

notify the platoon leader over the interphone, when a call was received. This was found to introduce too much delay; therefore, the tank platoon leader remained in the SCR-300 net while the loader monitored the SCR-528. This system provided very satisfactory communication between infantry and supporting tanks.

In addition, it was apparent that when tanks are operating in support of infantry, control of operations must be with the infantry. Since it has not been possible satisfactorily to locate the SCR-300 in the turret of the M5A1 Light Tank, it will be necessary for the assistant driver in the tank platoon leader's tank to relay any tank-infantry radio traffic.

The results of the tests were so successful that the tank installation of the basic components of Radio Set SCR-300 has been assigned the nomenclature Radio Set AN/VRC-3-( ) and has been classified by the Signal Corps Technical Committee as Required Type, Adopted Type, Substitute Standard Article. Radio Set AN/VRC-3-( ) will be battery powered and will not be operable from the vehicular electrical system for the time being. Development of a vibrator power supply suitable for the operation of the set from a vehicular electrical system has been initiated and,

upon the successful completion of this development, it is anticipated that this power supply will be added to the parts list for the radio set.

Seven Radio Set AN/VRC-3-( ) have been placed on T/O and E 17-17, Light Tank Company, and 17-27, Medium Tank Company, Tank Battalion, and will be issued one per company head-quarters, mounted in the command tank and two per tank platoon, one mounted in tank No. 1 and one mounted in tank No. 4, to be considered spare.

In connection with the described test installations, installation instructions, drawings, and parts lists have been prepared for installations in Light Tank, M5 Series; Medium Tanks, M4 Series, 75 mm Gun, dry; Medium Tanks, M4 Series, 76 mm Gun, Wet; Medium Tanks, M4 Series, 76 mm Gun, Wet; Medium Tanks, M4 Series, 105 mm Howitzer; Light Tank, T-24; Medium Tank, T-23; Medium Tank, T25E1; and Medium Tank, T26.

The aforementioned data will be prepared in the near future for the installation of Radio Set AN/VRC-3-() in 3-inch Gun Motor Carriage, M10; 76 mm Gun Motor Carriage, M36; Landing Vehicle, Tracked, Armored, Mark I; and Landing Vehicle, Tracked, Armored, Mark IV.

### **CROSS CHANNEL CIRCUIT**

(Continued from p. 3)

hours later the entire circuit went into carrier operation.

At 1820, 14 June, the Signal Officer of the headquarters on the beachhead requested a connection to the Channel coast station. Four minutes later the commanding generals of the two headquarters involved, one in France the other in England, were carrying on a conversation. Excellent transmission was obtained in both directions.

Although the original plan for this circuit contemplated its use only during the first stages of Army operations in France, continuing heavy traffic justified its retention beyond the originally proposed maximum period. The bridged CF-1 terminal was replaced with the more standard arrangement of two CF-1s. This was the circuit arrangement in effect as of 2 July, the date of the report.

In spite of the coordination of frequencies which was completed before installation of the components of the system, interference was ex-

perienced from time to time at the relay station from shipborne VHF installations. A change of frequency eliminated this difficulty. During the period of standby operations from 0000, 6 June, until 1314, 8 June, when the signal from France was received, a listening watch with two receivers was maintained on the Far Shore transmitting frequency. One of the receivers was coupled to the standard horizontal dipole-reflector director array while the other was connected to a vertical rhombic antenna. Two similar arrays were erected for the transmitter in order to be able to match immediately whichever type antenna might be put into service on the Far Shore. It was originally expected that the vertical rhombic antenna would be more satisfactory but when the first signal was received from France it was found that the dipole-reflector-director array gave satisfactory service even though the Far Shore antenna height was only 100 feet above sea level and the station 83 miles away. The antennas used for the inland link at the relay station were horizontal rhombics approximately 15 feet above ground.

No fading was experienced on the land link except for one or two instances and fading in these instances was only momentary. The cross channel circuit was subject to fading at times near dawn and dusk. The characteristics of this circuit compare very favorable with British cross channel VHF circuits.

Facsimile transmissions from the Tactical Air Command to the Far Shore station were monitored at the relay station. During the period of single channel facsimile operation the records of monitored transmissions were, of course, quite normal in character. When the carrier equipment was placed in operation it was found possible to monitor the facsimile channel without demodulating. Copy was received of typewritten material, line drawings and aerial photographs (figure 2). During periods where no traffic was being transmitted over other channels, recordings were as good as if received on basic speech channels, but where the other channels were in used interference resulted. The report suggests that a tuned coupling transformer giving a choice of three frequencies would provide sufficient discraimination to avoid this interference.

All recording in the relay station was made with the Teledeltos method. The Far Shore recordings of photographs were done on film or bromide paper. Photo recordings were, of course, better from the standpoint of clarity and detail. It was necessary in making the Teledeltos recordings to employ an unusually low contract range since heavy recording currents caused serious arcing at the stylus. The arcing would be picked up by the radio receivers, creating a "sputter" in the received audio signal. This would record on the paper resulting in a blurred appearance of the reproduction. Although the effects of the blurred reproduction were not serious at the relay station it was felt desirable to avoid introducing this "sputter" in the retransmitted signal to the Far Shore, especially since further disturbances might be present there.

The facsimile transmission at 1540 on 8 June, 63 hours after H-Hour, was the first instance of facsimile transmission to U. S. forces in France. From that time on the value of this circuit in getting the results of air reconnaissance into the hands of the troops on the beachhead in the shortest possible time is obvious. The advantage of the additional channels for intelligence and support purposes are also obvious.

The report also states that equipment of the same type is in use within the U. S. Army forces in France, from Army to Corps headquarters and between Corps, with notable success.

# INFORMATION ROOM FOR MESSENGERS

A ROYAL Signals Training Memorandum published in February 1944, contains a description of a Dispatch Rider's Information Room, which has proven extremely useful at headquarters where messengers are used. It is felt that this information will prove similarly useful to parallel American installations:

The object of the Messenger Information Room is:

To provide information, rapidly, clearly, and accurately.

To insure the satisfactory briefing of messengers.

To arouse the interest of messengers and improve their efficiency.

A typical Messenger Information Room should have the following equipment:

Large and small scale maps giving available information with reference to routes and locations.

Plans of main and rear headquarters areas.

Messenger roster giving details of the messengers
on runs.

Messengers' route schedules. Directory service or station list.

Messenger record containing details of individual messengers' work, i. e., information as to messengers' capabilities, vehicles he can drive, and similar information including file of messengers' reports.

The room should be supervised by an officer or senior NCO, who should see that each messenger is briefed on the following points before he leaves:

Destination.

Route.

Probable moves of the headquarters concerned. Any special information that is required.

In the field, a tent may be found more adaptable than a room, since the layout of a tent can be standardized. Miscellaneous equipment may be added; a suggested addition might be briefing boards with maps mounted on them. However, additional records should be kept to a minimum and be as brief as possible.

# VISUAL SIGNALLING IN SWPA

Panels, Smoke, and Flares Come in Handy During Operations in the Pacific Areas

ALTHOUGH REPORTS from jungle operations indicate that wire and radio provide the primary means of communication, the following extracts from one report of operations in the Southwest Pacific Area outline several interesting occurrences involving visual signalling methods.

Early instances of the use of panels, smoke or similar visual means of target designation and/or marking of friendly front lines occurred among Australian troops. These troops had seen extensive service in the Near East and in Africa. They were familiar with the nature, value, and capabilities of such visual methods; they had confidence in the use of such signals and had the will and ability to try them and make them work.

At Shaggy Ridge, New Guinea, red flares from planes indicated the end of the air attack and red flares from ground mortars indicated the end of the artillery preparation. Both were successful.

At Cape Gloucester the Navy used a star shell to indicate the termination of the naval bombardment and as a signal for the air strafing to begin.

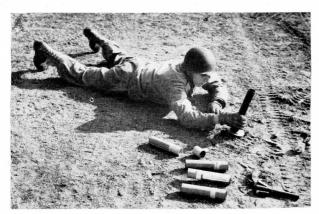
It is reported that at Munda flame throwers were used in an attempt to mark front lines. This had limited success.

An interesting instance involving the use of visual communications occurred at Shaggy Ridge in January 1944. Ground troops, advancing along a knife-ridge, were stopped by Japs. Air support was requested and set up. It included low-level (tree-top) strafing by a group (four squadrons) of strafers. Because of the extremely narrow target, the attack was delivered in a column of single planes.

The briefing was conducted by the group commander. Target designation included: terrain description; marked photographs; lead-in by a reconnaissance plane; and a ground panel in the



WHITE PHOSPHOROUS SMOKE SHELLS BEING LAID ON A HILLSIDE FOR REGISTERING ON TARGET.



FIRING A FLARE BY MEANS OF A GROUND PROJECTOR.

front lines—the target area to begin 600 feet beyond the panel. Pyrotechnic signals that might be encountered were: white—to indicate own troops; green—to indicate the target.

Although the air-ground signal code then in effect prescribed: white—"you are hitting near own troops"; green—"present position foremost friendly troops," some confusion resulted before a copy of the prescribed code could be located and this discrepancy cleared up.

Visibility was poor in the target area, due to mist and showers. The change of formation to column of planes took considerable time, the resulting column (36 planes) being an estimated 70 miles long.

After the return, interrogation of the nine pilots and crews of one squadron developed the following interesting data. Two did not remember seeing any panels at all. The other seven saw the panels. They described the panels, and their descriptions showed that two saw the correct panels, and the other five apparently mistook tents for panels. (These pilots were not used to panels.) All pilots saw "flares" (actually Very pistol signals). Some, but not all, saw red flares. Likewise some, but not all, saw green and white flares, but they were in doubt in many cases whether they were green or white. None was certain where the flares had been fired from. Several were in doubt whether the flares were our own or the enemy's. One was sure that he saw red flares fired from the enemy area (possibly ricochet tracers).

Later reports from the ground indicated that some red flares were fired to attract the attention of the pilots to the location of the panels. If so, it was an error because no such signal appeared in 'the SOI and Air had not been informed of any such plan. The flares rose above the level of the planes, and possibly attracted the pilots' attention away from the ground. Ground did not acknowledge firing any green or white flares, but admitted that some soldiers may have done so "on their own," either through fear or exuberance.

There are a few instances of the use by ground troops of panel arrows to designate targets. In the early stages of the New Guinea operations near Wegi on the Kokoda Trail the opposing forces faced each other across a kunai patch on a narrow steep ridge. The twisting nature of the trail and other complications made positive designation of the target difficult. Under cover of darkness an improvised panel arrow was placed on the open patch, pointing toward the enemy. A bomb line was marked with smoke grenades. The planes located the arrow and effectively attacked the enemy. The Japs found out about the arrow panel in no-man's-land and sent patrols to destroy it. During the succeeding days the panel served as a bait, and many Japs were killed while attempting its destruction.

In October 1943 north of Dumpu, troops of an Australian division pocketed some Japs in a side valley or ravine. Maps were poor, and the area contained many similar valleys with little to distinguish one from the other. An arrow panel was improvised pointing into the mouth of the ravine and a bomb line marked with mortar smoke upon approach of the planes. The planes easily identified the correct ravine through the arrow, and attacked.



A VERY PISTOL FLARE IS FIRED BY A GROUND SOLDIER.

### HOW TO HOLD MICROPHONE T-17

For Maximum Intelligibility the Microphone Should Be as Close to the Mouth as Possible

WHEN THE surrounding noise level is high, as it is in military aircraft, how should Microphone T-17 be held to insure maximum intelligibility over the interphone and radio-telephone?

Microphone T-17 is used widely in Army Air Forces training planes and to some extent in combat planes. It is also used by Army Ground Forces. Its proper placement before the mouth is of considerable importance.

The Voice Communication Laboratory at Waco Army Air Field, sponsored jointly by Office of the Chief Signal Officer and Headquarters, Army Air Forces, has conducted tests to determine the best way to hold this microphone. Six positions of varying angles and distances from the mouth were chosen for experimental study. These positions have all been seen in use by pilots and other air crew members, and all of them have been recommended at various times by flight instructors.

Two of the positions with the microphone held at an angle to the mouth, are very commonly recommended. Many flight instructors insist that the microphone should be held at an angle. The commonly given reason for their insistence is that if you speak into the microphone at an angle, the



MICROPHONE IS PLACED SQUARELY OVER MOUTH, LIGHTLY TOUCHING LIPS OF SPEAKER.

breath doesn't get inside and make a hissing sound. Another position that is often recommended by Army Air Forces instructors is the one in which

the thumb encircles the rim of the microphone. The thumb is supposed to keep out part of the air-

plane noise.

The results showed that the flush position as illustrated, and the one with thumb encircling the rim, were superior to the other four. The least satisfactory positions were those in which the microphone was held away from the mouth. There was a 12 to 15 percent difference between the least intelligible position and the most intelligible ones.

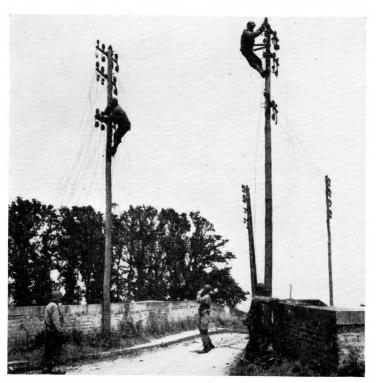
There was little to choose between the two recommended positions. Nothing significant was gained in intelligibility by having the thumb encircle the rim of the microphone. In fact, some of the listeners thought that the noise in the circuit seemed to be somewhat increased by the thumb encircling position. In any event, as the results demonstrated, the best way to hold Microphone T-17 is to place it squarely over the mouth where it will be very close to the lips if not actually touching them lightly.

The worst positions are those in which the microphone is held away from the lips. The farther away it is, the poorer the intelligibility will be. When the instrument is held at an angle, the resulting intelligibility falls between the best and the poorest.

To evaluate the merits of the six positions, the Voice Communication Laboratory used cadet pilots during the first four weeks of their basic flying course. The cadets had not used either interphone or radio-telephone before coming to the basic school. They reported to the laboratory in groups of from twenty to twenty-four. There were eight groups. Two members of each group were chosen to be speakers, while the remaining members served as listeners. In all, there were 16 speakers and about 150 listeners.

The speakers talked over an interphone network composed of standard Signal Corps equipment, including a BC-347-C amplifier and its associated dynamotor. Twenty-two HS-23 headsets were connected in parallel across the amplifier's output. The circuit was fed from the Microphone T-17.

# SIGNAL CORPS MEN AND EQUI



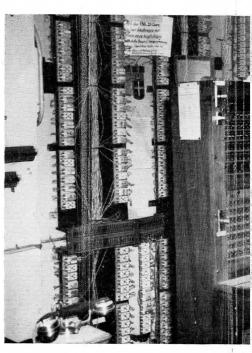
LINES, DESTROYED BY RETREATING GERMANS, BEING REPAIRED BY SIGNAL CORPS WIREMEN.



RADIO AND WIRE ARE INTEGRATED IN A CLEARING "SOMEWHERE IN FRANCE".



COMMUNICATIONS MEN OF A SH UP "SHOP" ON A BEA

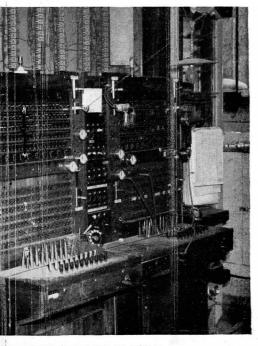


A FRENCH COMMERCIAL SWITCHB

# JIPMENT IN ACTION IN FRANCE



A SHORE FIRE CONTROL PARTY SET BEACH IN NORMANDY.



TCHBOARD TAKEN OVER BY SIGNAL ATING PERSONNEL.



PUTTING IN A LEAD ON A FRENCH POLE LINE AS AN ARTILLERY TANK RUMBLES UP TO THE FRONT.



A SIGNAL WIRE TEAM RESTORES LINES IN THE ONCE PEACEFUL NORMANDY TOWN OF TREVIERES.

# **USE OF TACTICAL PERSONNEL**

### When No Other Personnel Is Available Combat Signal Men Must Put in LOC Communications

DURING THE transitory period between the final peace in French Morocco and the organization of the Atlantic Base Section, it was necessary for tactical Signal troops to be used by the base section. The following paragraphs show some of the jobs that fell to the lot of a corps Signal battalion operating in such a situation.

Existing communications were entirely inadequate to meet the demands of communication zone activity and had to be reconstructed by the use of tactical troops since no other qualified personnel were available.

Radio communication was provided immediately to points throughout the base section using Radio Set SCR-193. Long-range communication to AFHQ and Mediterranean Base Section was established by the use of tactical Radio Set SCR-299.

Equipment and operating personnel were available from fixed station units to cover these nets but no adequate Signal personnel had been provided to set up and rig the rhombic antennas required. The necessary butt-treated 80-foot cedar poles arrived on ships from the United States and were unloaded, transported to the site, set and rigged by a construction company from a corps Signal battalion. Due to the danger involved, small crews of about twenty men did this work but personnel were rotated so that all had a chance at it. The NCO, in direct charge, was in civil life a power line contractor.

An immediate attempt was made to establish wire communication by means of the French open wire system. This proved to be unsatisfactory due to line losses and unbalance. A survey was made and it was found that a thorough police of all wire lines was necessary. This project was turned over to the second construction company in the battalion. Due to a shortage of materials and the character of personnel available to work the lines before the arrival of the U.S. troops, all circuits were in very poor condition. In a 20-wire lead as high as 8 to 10 splices were counted in a single span. None of the splices were soldered and practically all were loose. Where the sag was satisfactory, these splices were cleaned with acid and soldered. In many sections the wire had to be resagged and retied. This wire "police," combined with a thorough cleaning and adjusting of terminal equipment, gave usable circuits.

Wire lines established over difficult terrain for the use of radar stations in reporting were placed in the air and reconstructed by wire teams from the Signal battalion to give satisfactory circuits.

Further difficulty was encountered in obtaining sufficient circuits to give flexibility to communications required by headquarters established in cities. Investigation showed that large numbers of circuits were not usable due to poor maintenance. Cable splicers and equipment from the Signal battalion were furnished the base section. The splicers were put to work tracing out and repairing cable. All splices were opened, checked, thoroughly dried and closed. In many cases, water was found both in the splices and well back in the cable. None of this damage was due to battle but all due to poor maintenance.

The large numbers of troops and supplies being unloaded at the principal port made it necessary for staging areas and supply dumps to be brought into the base section communication system. This was accomplished by use of field wire and 5-pair rubber covered cable placed overhead by crews furnished from the Signal battalion.

The principal port had been set up for civilian use and did not have sufficient communication for military needs. A small number of operating personnel was available to the port, but two field wire teams were attached to the port from the signal battalion to install and maintain the port wire system.

During this entire period, schools and demonstrations were held for French military personnel in order to familiarize them with the American equipment.

It is to be noted that in all of the above operations, neither the battalion nor the companies functioned as a unit but rather individual teams were working upon specific missions coordinated by higher headquarters. Experiences, such as these, led to the formation of teams under T/O and E 11–500—teams that are hand-tailored to the needs of a given job.



### SUPPRESSING INTERFERENCE

The Effect of Spark Can Be Reduced by First Echelon Personnel. Here Is How It Can Be Done

REPORTS HAVE been received that some radio men, on hearing noise on a receiver installed in a vehicle, have removed the unit and returned it to a higher echelon for repair. In numerous cases, when such units were tested at the maintenance depot, nothing was wrong. Evidently the difficulty in such cases lies with the vehicle, rather than the radio set. Any interference created by a vehicle can be reduced, and it is a waste of time and effort to immediately condemn the radio when such interference is experienced. An effort should be made to locate and remedy the trouble right on the job.

For years, engineers and technicians have attempted to eliminate radio interference produced by vehicles. Vehicular radio interference is controllable, and every vehicle and power unit has been, or will be, treated to reduce the interference to a negligible point.

Such radio-interference-suppression systems must be maintained in good condition in order that they function satisfactorily. Strictly speaking, the maintenance of a vehicle and its parts is an Ordnance problem, but in the field were the first and second echelon take over, it becomes a problem for the organization mechanic, and he has to have the help of the radio operator in order to do a good job. Certainly, it is the operator's headache if there is noise, and he should have no objection to helping get rid of it. Every communication officer should make certain that his operating and maintenance personnel is familiar with the suppression of vehicular radio interference so they will know what to do when the occasion demands.

There is nothing mysterious about vehicular radio interference or its suppression. As is well known, when a spark occurs in a circuit, oscillating currents are created that surge back and forth and radiate into space, where they are picked up by the receiving antenna, producing noise in the receiver. The problem is not so much to eliminate the spark, as to eliminate the radiating currents that result from the spark.

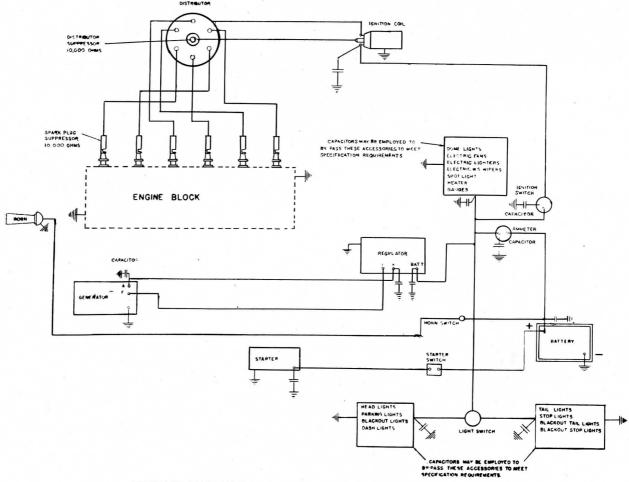
### TWO METHODS IN USE

There are two systems in general use, the shielded system and the resistor-suppressor system. In the shielded system, usually only used in tanks, all wiring is shielded with metal hose or solid metal conduit. Some filters are used to prevent interfering radio currents from flowing in conductors. Capacitors are used in such places as turret-traversing motors and controls, gyrostabilizer controls, and so forth.

In the resistor-suppressor system, resistors of approximately 10,000 ohms are used in each spark plug to distributor lead, and in the high-tension

ignition coil to distributor lead. Filters or capacitors are used to suppress interference from the generator and regulator. The hood and side panels, etc., are bonded either by bond straps or toothed lockwashers. Bonds are used over engine mountings, on fenders, and elsewhere on the vehicle as is necessary to eliminate static discharge and to form as much of the vehicle as possible into a shield around the interference-producing points on the engine.

Simple low-pass filters are used, consisting of a few turns of heavy wire with a capacitor at each end to ground (frame of the vehicle). The coil and capacitors are inclosed in a sealed container with the necessary terminals for attaching the circuit wiring. Such units are used in series with the generator to regulator circuit, regulator to battery circuit, and primary ignition circuit. They are usually mounted on the firewall. The capacitors are non-inductive, with a metal container equipped with a mounting bracket and pro-



SCHEMATIC DIAGRAM OF A TYPICAL VEHICULAR RADIO SUPPRESSION SYSTEM.

vided with a lead having a suitable lug for attaching to the offending noise source terminal.

To be completely effective in bypassing interfering high frequency currents to ground, the connecting lead of the capacitor must not be too long. Therefore, all capacitors are mounted in such a position that the lead is as short as possible.

The theory of filters and bypass capacitors is known to most radio men. What they should know is whether the vehicle is causing noise, and what to do about it. It is a simple matter to ascertain whether the vehicle is causing any noise heard in the receiver. If noise is heard when the engine (or other device) is operating, but not when it is stopped, then the electrical system of the engine (or other device) is causing the trouble. The receiver should be tuned to the frequency on which the most noise was observed. (These tests cannot be made if "static" is strong or in a location where man-made noise is high.) The driver should operate the engine at a speed of approximately 35 miles an hour and then turn off the ignition while at the speed. By listening closely, it is possible to determine which part of the vehicle is causing trouble. The following table will be helpful:

Noise Heard

Regular clicking with the number of clicks varying with the engine speed and which ceases the instant the ignition is cut.

Irregular clicking that continues with ignition switch "off" as long as the engine is rotating (with sufficient speed to cause the ammeter to indicate "charge").

A regular whine or buzz that changes in pitch as the engine speed varies and which continues with ignition "off" as long as the engine is rotating (with sufficient speed to cause the ammeter to indicate "charge").

Any noise when a particular The motor or circuit device, such as, turret-traversing of the device in operamotor, blower, windshield wiper, tion. etc., is operated.

When the circuit causing the difficulty has been determined, an examination of the particular device will usually disclose the cause. The following table lists the most likely causes:

Type of Noise

Probable Cause

Circuit or Device

Causing Trouble

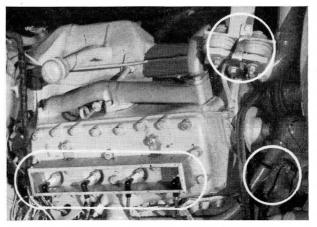
Ignition Circuits

Regulator

Generator

Ignition

Poor adjustment or poor condition of breaker or spark plugs.



CLOSE-UP OF SUPPRESSION METHODS IN ENGINE BLOCK.

Type of Noise

Regulator

Generator

ated

Noise from turret-tra-

versing motor

Probable Cause

loose connections, loose bond straps, broken or scorched suppressor, loose shielding, defective filter or capacitor.

Loose connections, loose mounting bolts or screws, defective filter or capacitor.

Loose connections, worn brushes or commutator, loose mounting, loose bond straps, defective filter or capacitor.

Any noise when a de-Loose connections, loose vice or circuit is oper- mounting bolts or screws, detive capacitor.

> Poor grounding of motor, loose brushes, loose connections, dirty slip rings, poor wiring connections at springs.

The remedy for any of the above conditions is obvious. Connections should be tight and clean. Worn bonds, broken or questionable suppressors, defective condensers should be replaced. Numerous points are bonded by tooth-type lockwashers which bite through the metal. These must be tight. In replacing any capacitor, filter, or bond, a toothed-type lockwasher should be placed under the head of the mounting bolt. The mounting bolt or screws and lockwashers must be plated to prevent corrosion.

Common sense must be used when "shooting" trouble on a noise-suppression system. It should not be expected that the interference can be reduced to a point where it cannot be heard on a radio receiver with the volume control wide open and no signal coming in; rather, the interference should be reduced so that it does not interfere with the weakest signal that can be heard above the background noise of the receiver.

The one most important point to remember in connection with a suppression system is: keep all connections and mountings clean and tight. If the combined efforts of Ordnance and communications men do not reduce the interference to a reasonable amount, a higher maintenance echelon should be contacted for help and instructions.

The description of suppression systems in the foregoing paragraphs are of necessity brief and general in nature. The type of vehicle and manufacturing variations determine the suppression components needed for satisfactory suppression. Because a suppression component is used at a certain point on one type of vehicle, the lack of the component at a similar point on another type

vehicle, or a change from a filter to capacitor on a different vehicle of the same type, should not be considered as an oversight or makeshift.

The general trend in the production of vehicles today is away from multitudinous filters and extensive shielding. Changes are being effected in production to use capacitors to replace both filters and complete shielding. Thus, one vehicle may be encountered with filters in the charging circuits, while in a later vehicle of the same type, the filters will be replaced by capacitors. Similarly, in one armored car, a completely shielded system may be found, while in a later model the resistor-suppressor system will be employed with all shielding removed.

# NOTES ON VHF PROPAGATION

THE SIMPLEST siting on mountainous terrain is obtained when two sites are selected between which there is an unbostructed transmission path. Under this condition the greatest signal strength is usually secured when the direct ray has good clearance over surrounding terrain.

On the other hand, if one site is low and the other is on a hill toward which the ground slopes gradually, so that the direct ray is in a "grazing" relation to the intervening ground, the signal strength may be considerably impaired. In such a situation relocating the lower station on a hillside may result in improvement of signal, even if this new site increases the distance between the two stations. Often a small hill suffices. While the height of the hill is of prime importance, the slope of the ground for some little distance around the set "looking" in the direction of the distant station should be considered. Tests have shown that signal strength usually increases with the steepness of the slope.

Contrary to the popular concept, a hill intervening in the transmission path does not necessarily reduce the signal strength over that which would obtain if no hill intervened. In fact, if proper siting precautions are taken, the signal strength may be increased because of the intervening hill. This is based on the following:

As a general procedure, the distance between two stations should be calculated on the basis of a path with no obstacle intervening. Then, within the limit of this distance the two stations should be sited with a view to obtaining the smallest angle of diffraction over any intervening obstacle. When the sites have been determined, and the equipment set up, receiving antenna should be moved to various positions, usually within a radius of a hundred feet or so, until the strongest signal is received. This inthis indicates that a point has been found where the dominant multipath rays are nearest in phase.

It is to be noted that when a series of hills intervene between two stations only an extremely rare combination of circumstances would provide signal strength comparable to that obtained if the stations were operating over an unobstructed path.

In wooded areas, if it is not possible to select a site where the antenna is well above the level of the tree tops, the next best location is in a clearing with a radius in the order of ten or twelve wavelengths. If the antenna is omnidirectional, it should be placed as close to the center of the clearing as possible, so as to be equidistant from the surrounding trees. If however, a directional antenna is used, it should be placed as close as possible to a point in the clearing farthest from the receiving station, but as equidistant as possible from the sides of the clearing.

# **GOING OVERSEAS?**

### A Good Signal Officer Must Be on His Toes—Always

SEVERAL MONTHS ago an Allied Force Headquarters Signal officer addressed a conference of Signal Corps officers at Fort Monmouth. He repeated there a talk he had given some 60 U. S. Signal Corps officers who arrived in the North African Theater 6 months previously. He also added some specific comments on Signal operations for the information of the officers attending the conference. The following is an extract of that address.

I have brought you together here for a little informal talk first to extend a welcome to you, secondly to answer some of the questions which you undoubtedly have in your minds and thirdly to try to advise you about some of those things which we consider most important . . . I want to emphasize first that a great deal of the information which you will have from time to time is of a highly secret nature and cannot be discussed with persons of whose identity you are not certain . . . Many Signal officers have access to information which many staff officers do not sometimes have. We have had excellent luck in this Theater so far in signal security matters, not only with our officers, but with our enlisted men and with the Wacs, all of whom handle this highly secret subject matter every day.

We want all Signal officers here at all times, on whatever assignment they may be, to try to keep up to date with the general strategical or tactical situation, and to be fully informed on the local or special situation. This means that you must take the initiative to keep yourselves informed by reading the daily news bulletins and, whenever possible, attend the many conferences at which the daily situation reports are discussed. . . .

I should like all of you to realize the great difference between "essential" military communications and "desirable" communications. Each of you, as you go to your various assignments, must think of this always if you are to be a real help in insuring good military communications. You must keep in mind that most of the British and U. S. commanders and the staffs in this Theater have recently come from the United Kingdom or the United States where they have been used to a superior type of communications. Their demands

at home have usually been met promptly and in such a way that they were not overly restricted in the use of such communications. Again, it must be obvious to you as you look at the map and remember what you have seen in the past few days, that the civil system in North Africa cannot possibly support any such demands. We know definitely from the "scorched earth" of the Germans in Italy that the civil system there, even when fully restored, will not permit a fulfillment of such demands.

The reality of all this becomes evident when we see the local Signal officer, who may in his area have a reasonably good supply of wire, poles, switchboards, etc., acquiese to demands for the building up of a very generous or lavish Signal installation in his area. Such an officer has overlooked the fact that those supplies, particularly if they were in a Signal dump under his control, were probably placed there to support a plan covering a much bigger operation than that of his particular area. He may or may not have been advised in advance that such was the case, but the principle of "essential" communications rather than "desirable" communications again should be the guide, at least until he is assured by higher authority or the authority controlling projects that he is not using supplies or equipment intended for some other purpose.

Another current example of the necessity for rigid control of the Signal projects is the one in which Signal officers in a particular operation have submitted a comprehensive and elaborate plan which if approved would wipe out all the materials which have been ordered for two other very large projects. It must be borne in mind that the Signal Planning Section made an estimate of the essential military requirements several months ago for the various areas, that that plan was the basis upon which supplies were requisitioned from the States or the United Kingdom, that the over-all plans of the various sectors must be fitted into the general framework of the estimate or we would very quickly have failures in certain areas.

Keep these things in mind as you make estimates for your requirements, as you are called upon to examine projects submitted to you, and when you are called upon to advise commanders and staffs as to whether or not certain Signal installations should be made.

The Signal Corps standards in this Theater are very high. You are expected to be good soldiers as well as good technicians. Everybody realizes by this time that Signal Corps personnel are as much a part of the active combat team as the fighting troops themselves. Our men with combat units operate under difficult and trying conditions; they have their share of casualties. You should also remember that by being a good soldier you immediately have better access to the commanders and their staffs, who naturally are prone to listen to and be guided by the military individual rather than one who seems to be proud of the fact that he is a specialist and not a soldier.

Over a period of a year we have learned that there are certain characteristics which every good Signal officer must have. I just want to run over them with you so that you may think about them as you perform your various duties. They may help you personally to make better showings, while we know that they will result in producing good Signal communications to the various units and installations.

A good Signal officer must be resourceful . . . thorough . . . dependable . . . tactful . . . adaptable . . . foresighted . . . flexible of mind . . .

Based upon experiences in the Tunisian, Sicilian and Italian campaigns, here are some facts for you gentlemen here in the U. S.

Signal annexes are seldom used except on an initial operation. Paragraph 5 of the field order usually contains special changes of SOI or SOP to meet the particular situation.

Signal operating instructions, backed up by well developed SOP's for the various units, are extensively used.

Signal orders in divisions and corps are usually fragmentary in form and it is found advantageous in many cases as a coordination measure to follow them promptly by brief written instructions, possibly in letter form.

Message Centers.—Division and corps message centers carry heavy cryptographic loads. There must be an officer on duty at the corps cryptographic office at all times. In our theater wherever practicable, we include a provision in the

signal plan for the use of Cub planes for corps to division message center. We have made a concentrated effort to train staffs to "tone down" the classification of messages as to security in order that they may be transmitted in the clear over those teletypewriter circuits which are classified higher than unrestricted. Wherever practicable, we provided for complete SIGABA installations in trucks, preferably of a type such as the small arms repair or the SCR-299 panel job. We have learned, and I think this applies in any theater, that preparations must be made to exploit the use of pigeons. This includes the necessary coordination for delivery of birds to units and the necessary arrangements to insure prompt delivery of messages from corps or army lofts.

Radio.—Expect to operate additional nets and stations to those normally shown in the charts. (Liaison, special mission, air, ground, etc.) Transmitters are usually remoted to a distance of half a mile or so. VI Corps used "Radio Control Center" with teletypewriter to command post proper. Take positive action, through command channels when necessary, to enforce radio discipline and radio security. Provide in your radio plan for necessary monitoring. Try always to provide practice code equipment for radio operators. Try to have operators over and above your T/O in training.

Telephone and Teletypewriter.—Some typical difficulties and their solutions were: The problem of maintaining communications to units out of the normal talking range of spiral-four cable was solved by making use of carrier equipment, CF-1. The anticipated problem of providing adequate cover for the large amount of terminal equipment associated with corps and army switching centrals, including that added thru the use of carrier equipment, was solved by moving the switching central to a point outside the CP and making use of available buildings in the area. In a few cases the chief operator reported a circuit in trouble to the wire chief when actually the telephone or switchboard had been removed from the end of the circuit with This caused no notification to our operators. needless work on the part of maintenance personnel and used up crews that might be needed for actual troubles. This problem has been solved by having our operators in their hourly line checks tell the subordinate operators to call in before leaving.

# SUPPLY DURING OPERATIONS

### Maintenance Allowances Must Be High in Combat, Especially in Amphibious Actions

THE FOLLOWING is an extract of a talk given to a group of ETOUSA Signal officers four months ago by a Mediterranean Area Signal officer. The full talk was printed in the June issue of the ETOUSA "Current Information Letter."

Communication equipment arrives at a salvage condition for a number of reasons. In every landing operation we have found you must figure on a loss of about 100 radio sets in the first two days. That is over and above your normal maintenance factor allowance for every division. Most of these will be 536s, but there will be a proportion of 511s, 510s, 284s and all the others.

I have put all these losses which must be anticipated in a folder called "Replacement Data" and I believe every Signal officer who has to do with Signal plans should read it. I feel that the data which we have learned in our five little missions in Africa, Tunis, Sicily, Salerno and Anzio can be useful to you. If you will look at my figures, you will see exactly where the War Department and its maintenance allowance of 200 sets per division are not so far out.

The critical items varied. At one time it was mine detectors, at another time field wire.

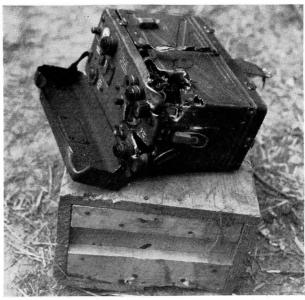
In Tunis, when the Germans were using tremendous quantities of metallic mines and when we were running into mine work for the first time, everyone from AFHQ, G-3, down, demanded a report on every mine detector in the Theater every day, and if that mine detector report was an hour late in reaching Algiers, the Chief Signal Officer heard about it, and we heard about it! The SCR-625 is excellent and the supply is satisfactory.

A division will scream for mine detectors until it has at least 140 or 150. You can tell them that their allotment is 20 if you want to; they will tell you that they have lost them and the next day they will come again for another 20, and so on. If, however, you will be practical and reasonable and give them 150 realizing that they have to have them, you will save yourself and them a great deal of trouble. There have been many instances of men abandoning their rifles and mess kits, but in Tunis you never heard of a man abandoning his mine detector. It was considered much more important to have a mine detector than a mess kit.

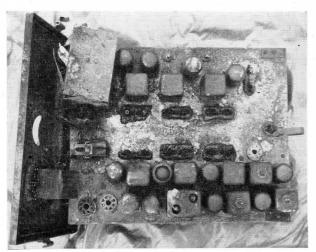
The Fifth Army recently drew 20,000 miles of field wire in less than three weeks, so I really was quite perturbed about where the W-110 issues were to come from. A division is authorized about 450 miles and they will use during an action 200-250 miles per day, but only for a very short time. The position has eased, but when the Anzio show was being prepared the Fifth Army drew from our depots in Naples 14,000 tons of Signal supplies in less than two weeks. That is, the depot stocks of Signal supplies in Naples decreased 14,000 tons in one week's report. I had 7,000 tons left, which was less than a week's supply at the rate they were drawing it, and I have a feeling that we were actually down to 2,000 tons at one time.

Running out of field wire is to a Signal officer what being out of field rations is to a Quarter-master officer.

Concerning the relationship to replacement factors already established, i. e. communication zone, you will have to get from your G-3 the number of troops which you are going to support, and the number of units, because as you know, one reconnaissance company has more communications than an AB division. You get, therefore, from your G-3 a list of the troops which you are going to support, you make a list of the total numbers of each type of equipment you are going to support,

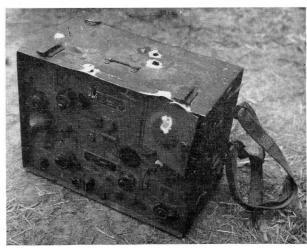


FLYING STEEL CAUSED THIS TO RADIO SET SCR-300.



EFFECTS OF SALT SPRAY ON A SIGNAL CORPS RADIO SET.

you take the number of months' supply, e. g. one month's, two months', 75 days', etc., go in to the War Department list of maintenance figures for the numbers of these equipments and you get quite plainly and simply the storage which you should have in a depot. Add the 100 percent for the first



THE BC-654-A DAMAGED BY ENEMY RIFLE FIRE.

assault, and providing you have enough people, you will average out.

You can figure out almost exactly what you are going to need and providing the time is sufficient to smooth out the extent of your losses you will be all right.

# **BC-610-() TRANSFORMER REPAIRS**

MODIFICATION WORK Orders MWO SIG 11–280–4, dated 21 June 1944, and MWO SIG 11–281–4, dated 21 July 1944, describe the installation of the improved rectifier filament transformer T–2, used in Radio Transmitter BC–610–( ), part of Radio Set SCR–299/399/499. Although the mounting dimensions are the same for both transformers, the terminal arrangement for the new type is entirely different than the old type.

Due to a critical shortage of the new transformers for replacement purposes, a large proportion of the requisitions for this transformer cannot be filled at this time.

In order to keep the transmitter in operation, emergency repairs of the old type transformer are sometimes required. Reports received from the theaters indicate that failures of this transformer are due largely to high voltage flash-overs between the high voltage secondary center-tap and the transformer casing. Although increasing the clearance can be accomplished by cutting away a portion of the lip of the casing (see MWO SIG 11–280–3 or MWO SIG 11–281–3), this does not always cure the trouble.

Reports received from the Pacific and European Theaters of Operations indicate that an emergency cure may be obtained by insulating the entire transformer from the chassis by means of a piece of bakelite or plexiglass, or by mounting the transformer on Isolantite stand-off insulators. This repair places a high voltage on the transformer case. Therefore, when the above repair is made, a warning notice should be placed on top of the transformer.

### SERVICE GROUP FORMATION APPROVED

THE WAR Department recently approved the constitution and activation of two Headquarters and Headquarters Companies, Signal Service Group, for one of the theaters of operation. This action represents the first official recognition by the War Department of the necessity for a Signal headquarters to control a large number of Signal Corps units associated in the installation, operation and maintenance of Line of Communication facilities. These Signal Service Group Headquarters will each control two or more Signal service battalions and from 10 to 20 varied Signal service or tactical companies, sections and detachments.

Although Column AD of T/O and E 11–500 has been approved and published for more than one year, this was the first theater request to be approved by the War Department.

# AGING OF QUARTZ CRYSTALS

### Soap and Water Scrubbing Will Help, But Etching Results in a Crystal That Does Not Age

DURING THE summer and early fall of 1943 it became apparent that large numbers of crystals for VHF sets were either completely inactive or the activity was of such a low order as to render them useless for use in the SCR-522 and similar

Army Air Forces crystal banks immediately instituted the practice of testing all VHF crystals prior to shipment, and the Signal Corps began testing all stocks of similar crystals in depots. This testing showed that inactivity was most noticeable in crystals of a frequency of about 8 megacycles or higher; that the products of certain manufacturers were worse than others in this respect, and that this low activity was also a function of time. A spotcheck of Army Ground Forces depot stocks indicated that the effect, while present, was so small in total quantity as to be negligible for three probable causes:

The relatively small number of crystals higher than approximately 8 megacycles in frequency.

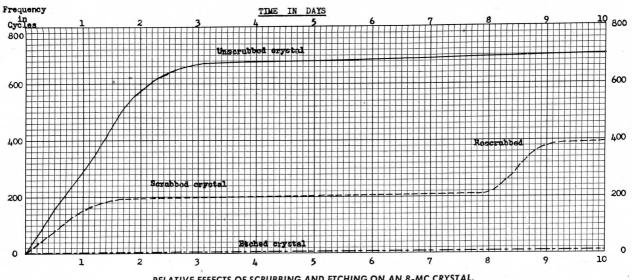
Moderate activity requirements of most Army Ground Forces sets.

A comparatively large safety factor in the specifications. A high percentage of crystals failed to meet specifications, but still operated the sets in a satisfactory manner.

Shipments of the products of certain manufacturers were halted from both depots and plants, pending completion of stock testing and the institution of remedial practices in the plants. Concurrently, a technique to achieve cleanliness was instituted by Aircraft Radio Laboratory. This technique consists of vigorously scrubbing the oscillator plate with a toothbrush and soapy water until no further frequency change is evident. It was discovered that this also constituted a means of reducing the effect of aging to a reasonable minimum, and the process was installed in all affected plants as a temporary expedient, until the results of fundamental investigations were known and could be put into practice. The Dayton Signal Corps Supply Agency successfully undertook the salvaging of defective units.

As a result of an extensive investigation at Camp Coles Signal Laboratory and with the cooperation of personnel from the Quartz Crystal Section of the Engineering and Technical Service, Office of the Chief Signal Officer, it was found that the aging phenomenon could be roughly divided into two separate phases:

An initial phase, characterized by changes in frequency and/or activity of considerable magnitude in a relatively short time (48 hours) after final finishing when such finishing is done by ordinary (abrasive) methods. A substantial part of this phase is eliminated by the vigorous scrubbing technique. This scrubbing reduces the effect of aging to a reasonable minimum but does not afford a permanent cure.



RELATIVE EFFECTS OF SCRUBBING AND ETCHING ON AN 8-MC CRYSTAL.

The second phase is characterized by the comparatively gradual increases in frequency and/or decreases in activity.

Exposure of the plate to severe conditions of heat and humidity often results in a repetition of the aging cycle. The accompanying graph illustrates the two phases and the effects of scrubbing insofar as frequency is concerned.

### MOISTURE AGGRAVATES CONDITION

It has been determined by X-ray methods that laping leaves a disoriented layer on the surface and it is the sloughing off of this layer that causes the increase in frequency; retention of the material results in a decrease in activity. Water vapor tends to aggravate the disintegration of the surfaces and it was thought at first that treatment of these surfaces with silicon-carbon compounds having hydrophobic properties would afford a cure, but thorough investigation showed the results of such treatment to be unsatisfactory. Complete removal, however, of the material in the disoriented layer by etching and the resultant exposure of fresh undisturbed surface results in an oscillator plate which does not age; that is, plates so processed show no increase in frequency or decrease in activity after exposure to relatively high temperature and humidity for substantial lengths of time. In fact, a very slight but consistent decrease in frequency is noted where plates so exposed are mounted in phenolic holders. It is thought that this decrease may be due to loading of the plate by substances derived from the phenolic and driven off by exposure to elevated temperature; a silicon salt produced by the aging process also loads the surface of the plate. It appears that for blanks lapped with 800 mesh abrasive the removal by etching of a minimum of one-third of a micron of material is necessary at eight mc to expose a fresh undisturbed surface. This represents a frequency change of about 15 kc. Oscillator plates so finished should not show any of the effects of aging.

The realization of the part that water vapor played in the aging problem resulted in a wide-spread investigation of the problem of crystal holders and the properties of the materials ordinarily used in their fabrication. It has been found that most phenolic compounds which are widely used in the manufacture of holders are relatively permeable and afford little or no protection to the plate and its associated electrodes. The development of hermetically sealed holders has therefore been vigorously pursued with favorable results at an early date anticipated.

Steps have been taken recently to require etching to frequency of virtually all Signal Corps crystals higher that five mc in frequency. Holders containing crystals so treated will be identified by a white dot, about one thirty-second of an inch in diameter, placed just below the nomenclature appearing on the unit. In cases where the markings are other than white in color, the dot will be of the some color as the other markings.

# ANTI-INTERFERENCE ANTENNAS

(Continued from p. 15)

ment. It is generally best to move the complete antenna about the radio set as a center using two men for this operation. One man supports and moves the composite pole and the other man supports and moves the far end including the terminating resistor and stake. The approximate shape of the antenna should be maintained while moving, otherwise tests should be made every twenty or thirty degrees to determine whether the desired signal is being received and the interference eliminated.

The approximate shape of the field pattern is also given in Figure 2. Field measurements made of an antenna constructed as described have shown that the width of the pattern is in excess of 40 degrees in all cases, therefore satisfactory com-

munication can be assured if the angle of the antenna is correct within 20 degrees. Under some conditions the total angle of satisfactory operation will be as much as 90 degrees. This generally occurs at the lower frequencies. The antenna is normally unidirectional but transmission and reception can be obtained from two directions (180 degrees apart) by removing the terminating resistor at the far end. It should be noted that this resistor affects neither the strength of the signal nor the field distribution in the forward direction. Its only function is to decrease the radiation, and reception, from the reverse direction when it is connected. This feature makes it posible to change to a bidirectional antenna at will when interference or jamming does not occur in the reverse direction.

# **EQUIPMENT NOTES**

#### SIGNAL CORPS BOARD

#### CASES APPROVED BY THE CHIEF SIGNAL OFFICER

Case No. 523, Supplement 1—Service Test of Improved Loop Assembly AS-4/GR

THE SIGNAL Corps Board was directed to conduct a service test of an improved Loop Assembly AS-4/GR, comparing it with Radio Set SCR-206, SCR-503 and similar loop type direction finders. This assembly is not in itself a complete direction finder. It is designed for attachment to an ordinary radio receiver within the frequency range of 1.5 to 18.0 megacycles. The equipment consists of a combined indicating and power unit, a set of four interchangeable loops and associated cables. A 12-volt direct current source of power is required for its operation.

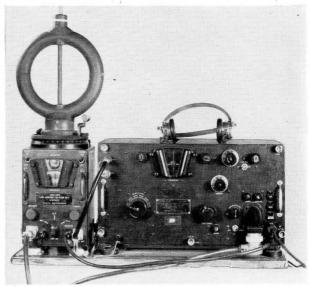
Radio Set SCR-206 is now in use as a portable loop-type direction finder. It is of the aural null type and its size and weight are serious disadvantages for mobile operation. This set has been classified as limited standard and is being replaced by Radio Set SCR-503.

Radio Set SCR-503 has been standardized but is not entirely satisfactory for mobile use due to its size and weight. Also two complete units are needed to cover the frequency range from 0.1 to 3.0 megacycles.

The Signal Corps Board conducted field tests using frequencies from 1.7 to 18 megacycles at distances of 2½ to 15 miles, both day and night. Measurements of bearings and sensitivity were made which indicated that the Loop Assembly AS-4/GR when used with a suitable receiver such as the BC-312D is nearly as accurate as the Radio Set SCR-206 and is more accurate than the SCR-503 at the frequencies tested.

It was concluded that the Loop Assembly can be used to meet a requirement for a small portable adapter to be used with a suitable receiver as a direction finder, homing device, or anti-jamming device.

The approved recommendations include the initiation of action to coordinate with the using arms military characteristics for Loop Assembly AS-4/GR based upon those submitted by the Signal Corps Board; to present the Loop Assembly AS-4/GR to the Signal Corps Technical Committee



LOOP ASSEMBLY AS-4/GR SETUP FOR OPERATION.

for necessary classification as to type; and to continue any subsequent development of the Loop Assembly AS-4/GR under the project for the Radio Set AN/VRD-1.

# Case No. 561—Service Test of Hood, Field, M—1943—OQMG—282

The Signal Corps Board was directed to service test Hood, Field, M–1943, to determine its adaptability to Signal Corps needs when worn over headsets. The tests were to be conducted under field conditions in accordance with an outline submitted by the Office of the Quartermaster General. The hood is water repellent and designed to be worn with Jacket, Field, M–1943 or Overcoat, Field, Officers' (trench coat type).

Tests were conducted in a cold chamber at Fort Monmouth Signal Laboratory at a temperature of approximately 15 degrees Fahrenheit. Men were fitted with the hood and related clothing and remained in the chamber for about an hour. During that time the men installed a telephone Switchboard BD-71 and made a field splice in the installation. After completing the switchboard installation, a Radio Set SCR-284 with hand generator was installed.

Field tests were also conducted to determine whether the hood provided adequate protection from weather, adequate depth from top of head to



RADIO HEADSET WORN OVER THE FIELD HOOD M-1943.

back of neck, and a correctly proportioned "face opening." Additional tests were made to determine whether the hood interfered with the operation of radio and telephone headsets worn either over or under the hood.

The Signal Corps Board found that the Hood, Field, M-1943, when attached to Jacket, Field, M-1943, is suitable for Signal Corps use in cold climates. It was also found that the hood may be worn over or under headsets and over or under the field helmet. The hood possesses the disadvantages of restricting the movement of the head of the wearer when looking upward and its proper attachment to Overcoat, Field, Officers', requires an additional button on the latter.

The Board concluded that when the proper modifications have been made to remove these difficulties the hood will be satisfactory for use by Signal personnel.

The approved recommendations in this case provided for action to inform the Quatermaster General that the Hood, Field, M-1943, should be modified to allow the wearer greater freedom in movement of the head and that consideration should be given to placing an additional button on Overcoat, Field, Officers', in order to adapt it more adequately for use with the hood.

## Case No. 556—Tactical Submarine Cables

The Signal Corps Board was directed to make a study and submit a report with recommendations on the suitability of standard field cables for use as tactical submarine wire facilities. Specific consideration was directed toward the development of

methods of installation, modification or reinforcement of Cable WC-534 (5-pair), WC-535 (10-pair) and WC-548 (spiral-four) which would make them more resistant to tension, abrasion, and insulation breakdown due to the action of waves, tides and currents when laid in fresh or salt water.

The Board made several installations across Shark River Inlet, near Belmar, New Jersey. This inlet is about 230 feet wide and is said to have a tidel current of approximately 10 miles per hour. The Board determined that the cables should be laid in the bottom so that they would not be susceptible to the motion of the waves and currents. The additional weight to accomplish this was obtained by lashing a wire W-115 (6M Messenger) to the cable at 3-foot intervals. The messenger and communication cable of sufficient length to cross the channel were laid out on the shore of the inlet and pulled across the inlet with a winch line and dropped into the water.

Other installations, using two spiral-four, one 5-pair, and one 10-pair cables, were made from a point near Spermaceti Cove on Sandy Hook to a point on the mainland near Atlantic Highlands, New Jersey. This crossing is about 1½ miles wide with gradually sloped sandy beaches on both banks. No special reinforcements were considered necessary at the Atlantic Highlands end as the beach at this point is fairly well protected by a breakwater. The only precautions taken were to bury the cable from the low tide waterline to a point well above the high tide waterline.

The beach near Spermaceti Cove is not so well

protected. At this end, one of the spiral-four cables was buried in the manner just described.



LAYING OPERATION DURING UNDERWATER TESTS.

The other three cables were each reinforced with 6M Messengers to a point offshore about 200 feet where the water was 15 feet deep. The offshore ends of the messengers were attached to 100-pound rock anchors. The shore ends were attached to log anchors buried well above the high tide mark. The messenger-cable combinations were buried between the low tide mark and the log anchors.

The first spiral-four cable (without messenger reinforcement near Spermaceti Cove) was laid by means of Reel RL-31 mounted on the afterdeck of a 26-foot Mine Yawl. Connectors were joined applying rubber cement and taped with both DR and friction tape as the operation proceeded. A second yawl was available, and when a connector was reached, it was handed over to the men in the second yawl for connection, so that the first yawl could proceed with the laying. One Cargo Carrier M 29C, Amphibian, and one Truck, Amphibian, ½-ton 4 x 4, were available to assist in making the shore approaches as the yawls required about 4 feet of water.

The other three cables were all laid from large reels mounted in Truck, Amphibian, 2½-ton, 6 x 6. The capacity of the reels employed was sufficient to permit making all splices before the actual laying commenced. Taped connectors were employed in the case of the spiral-four cable; expedient splices were used in the 5-pair cable; and standard (vulcanized) splices were used in the 10-pair cable. All of these installations were successful and no electrical troubles were encountered.

The Board concluded that Cable WC-453 (5-pair); WC-535 (10-pair), and WC-548 (spiral-four) will be suitable for tactical submarine cable use in fresh or salt water.

Cable WC-548 (spiral-four) will, no doubt, normally be used in the form of Cable Assembly CC-358. This is considered feasible from an underwater standpoint provided the connectors are adequately taped. It appears, therefore, that no special considerations are involved in the choice of the type of cable for a given job, but rather that the choice may be based upon the usual considerations of circuit requirements, transmission requirements and available terminal apparatus. In this connection, it should be pointed out that loading of tactical submarine cables, other than that built into Cable Assembly CC-358, is not considered feasible. The most suitable standard vehicle for use in laying tactical submarine connection

cables of appreciable length is the Truck,  $2\frac{1}{2}$ -ton,  $6 \times 6$ , Amphibian.

Indications are that the use of Buna S compounds in outer covers or as insulation will not preclude their underwater use provided the cables are otherwise satisfactory for normal tactical use.

Underwater splices in tactical cables should be avoided whenever possible, but when necessary, they constitute the most important single factor involved in the project, and if not made with great care, will be the main source of failures. Time and care in their making will pay dividends and they should be made under the direct supervision of a responsible officer. All splices should be made on shore before laying operations commence, insofar as possible.

Tension bridges at splices and connectors are not considered necessary in submarine cable work, and are undesirable because of difficulties they are apt to cause as the cable is being payed out.

The approved recommendations included the preparation of training literature on laying underwater field cable facilities and the procurement of Trucks, 2½-ton, 6 x 6, Amphibian, for use by Signal Corps organizations for such purposes. It was also recommended that the Signal Corps Board continue the further investigation and study of improved methods of installation with special emphasis on the protection of cables on approaches to shores where rocks, coral formations, and beach traffic are important problems.

#### GROUND SIGNAL

#### TELEPHONE TP-9-( )

Telephone TP-9-T1 and TP-9-T2 (two developmental models of a field telephone incoporating built-in transmitting and receiving amplifiers) were briefly mentioned in the March issue of the SCTIL No. 28, in an article on Signal Corps Board Case No. 530. A third model known as TP-9-T3 has since been produced and standardization based on this model, was approved by the Army Service Forces on 23 March 1944. Production of Telephone TP-9() is now underway. Initial deliveries are scheduled to begin in September 1944.

Telephone TP-9-( ) is intended for use on point-to-point magneto line circuits on which the transmission loss or depreciation in quality is so great as to be objectionable; it is also intended for use at the end of long magneto loops radiating from a switchboard to effectively move the tele-



LOCATION OF OPERATING CONTROLS IS SHOWN IN THIS PHOTO OF THE TELEPHONE TP-9-( ).

phones nearer to the switchboard from a transmission standpoint, thus providing improved communication over connections built up through the switchboard. TP-9-( ) differs from TP-9-T2 in that components are mechanically rearranged, a silent signaling device for alternate use has been added and an aluminum housing for protection against damage from immersion has been employed in place of the plywood case used for TP-9-T2. TP-9-( ) and TP-9-T2 do not differ materially in electrical characteristics.

Salient features of Telephone TP-9-( ) are as follows:

Fixed-gain (23 db) transmitting amplier is capable of providing a maximum power output of 15 db above one milliwatt.

Gain of receiving amplifier is variable up to a maximum of 60 db. A single gain control knob enables adjustment of receiver volume suitable to each operator.

Single-tube transmitting amplifier; two tube receiving amplifier JAN3Q5GT used throughout.

"Push-to-Talk" switch on handset controls direction of amplification by use of relay.

"Breaking" other party is possible by giving ringing signal.

When handset is on the cradle, telephone is converted to equivalent of Telephone EE-8-B. Cradle

switch may be locked in this position if desired, otherwise removal of handset from cradle turns on the amplifiers.

Two-position switch (operated by knob) is used to select internal Ringer MC-131 or silent signaling device located in the upper left hand corner of handset compartment.

Terminal impedance at 1,000 cycles is approximately 600 ohms with telephone in either transmitting or receiving condition.

Uses one Battery BA-27; one Battery BA-65; and three Battery BA-2. Battery life is dependent on usage: one week for continuous operation; two weeks under normal service conditions.

When used on both ends of circuit, it is capable of tripling the maximum range possible with Telephone EE-8() on non-repeatered circuits.

Approximate dimensions are 10½ inches high, 115% inches wide and 7½ inches deep. Approximate weight, equipped with batteries, is 25 pounds.

In general, the operating procedure for this telephone is as follows:

Connect telephone line to the "line" terminals. Release the cradle snap lock and ring on the circuit using the built-in Generator GN-38. When communication is established, adjust "gain control" knob until the received level is satisfactory. The handset switch must be operated for each transmission and must be released for each reception as Telephone TP-9-( ) is a "push-to-talk" set.

To use Telephone TP-9-( ) without transmitting and receiving gain, depress the cradle switch and lock in place with snap lock. Telephone TP-9-( ) will then function in the same manner as Telephone EE-8-( ), except that common battery operation is not provided for.

## FOLDED DOUBLET ANTENNAS

Folded doublet antennas may be used to advantage to match open wire transmission lines when concentric or twisted pair lines are not available or desirable.

The methods of construction and dimensions of folded doublet antennas are shown in the accompanying figure.

The feed point impedance of the two-wire antenna is approximately 400 ohms, and that of the three-wire antenna approximately 800 ohms. The resonance curve of the multi-wire antennas is much broader than that of a single wire doublet and both types of multi-wire antennas may be used with a

600-ohm feeder line without appreciable standing waves on the line.

The dimensions of 400, 500 and 600-ohm two-wire lines for various wire sizes are given in the following table:

Wire size B & S or AWG	Spacing in inches between wires—		
	400 ohms	500 ohms	600 ohms
6	21/4	5½ 4½ 3½	1178 938 738 6
0 2			

#### NOMOGRAM HELPS ASCERTAIN RANGE OF AN/TRC-1, 3 AND 4

The communication range over an unobstructed path of Radio Set AN/TRC-1, Radio Terminal Set AN/TRC-3, or Radio Relay Set AN/TRC-4 can be quickly estimated without mathematical computations, through the use of the nomogram published herewith.

The following data, as explained in greater detail below, must be known in order to make use of the nomogram:

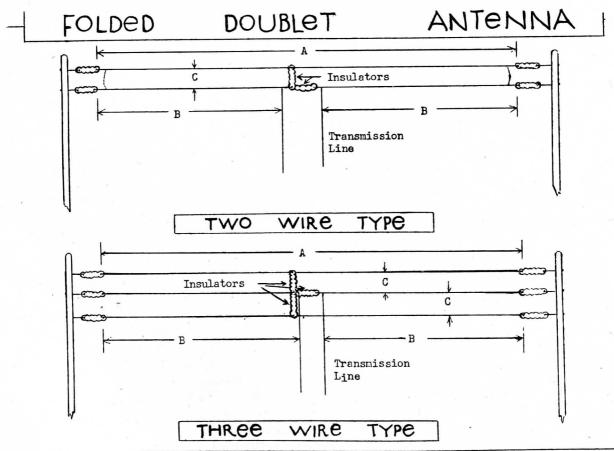
Height in feet of both transmitting and receiving antennas above average level of intervening

Type of transmitting and receiving antennas being used.

Radio frequency power output of transmitter.

When these factors have been determined, proceed as follows:

To determine the expected range, a straight edge should be placed between the point on the transmitting antenna height scale, H<sub>T</sub>, and the point on the receiver antenna height scale, H<sub>R</sub>, corresponding to the transmitter and receiver antenna heights respectively. Hold a pencil or other sharp object at the point of intersection of the straight edge with scale A. The straight edge should then be placed between this point on scale A and the point

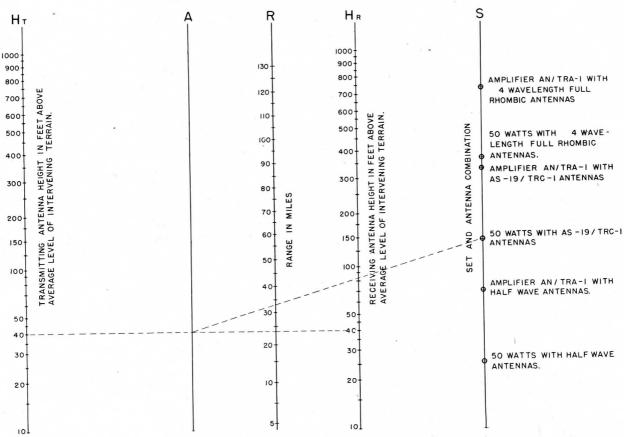


Dimensi ons

A -  $\frac{1}{2}$  Wavelength less 5% B -  $\frac{1}{4}$  Wavelength less 5% C - 6 to 8 inches

The plane of the antenna wires may be either horizontal or vertical

# ESTIMATED RANGE OF RADIO TERMINAL SET AN/TRC-3 AND RADIO RELAY SET AN/TRC-4



on the "Set and Antenna Combination" scale, "S," corresponding to the existing set and antenna combinations. The set may or may not include Amplifier AN/TRA-1. The expected range is then read off the range scale, "R," at its point of intersection with the straight edge. It will be noted that scale "S" assumes that similar antennas are used for transmitting and receiving.

The example shown by the broken lines on the chart illustrates its use for the following situation:

Transmitting Antenna Height, 40 ft. Receiving Antenna Height, 40 ft. Transmitter Power, 50 watts Transmitting Antenna, AS-19/TRC-1 Receiving Antenna, AS-19/TRC-1 Range, 34 miles (approx.)

Explanation of the scales:

Antenna Height ( $H_T$  and  $H_R$ ).—For transmission paths over flat or gently rolling terrain or over sea water, the values of antenna heights used should be the height of the center of the antenna

above the average level of the intervening terrain. If the transmitting or receiving antenna is located on top of a high hill with comparatively flat low land in the transmission path, the elevation of the hill above the average terrain level should be added to the height of the antenna mast. The chart will not give accurate results for transmission paths over very high hills or mountains; however, reasonable approximations may be made by making a judicious selection of the antenna height reference level considering the height of the intervening hills and their proximity to the transmitting and receiving locations. Attention in this respect is called to the article on VHF Propagation appearing elsewhere in this issue.

Set an Antenna Combination Scale (S).—The value of power used has been calculated as power in watts delivered to the antenna, multiplied by the transmitter antenna gain, multiplied by the receiver antenna gain and is based on signal strength required for multichannel operation.

#### **MAINTENANCE**

#### VARISTORS FOR CARRIER EQUIPMENT

Numerous reports have been received from the field regarding the failure to obtain replacement varistors for field maintenance of the EE-101-A. This failure may be due to requisitions going through improper channels or the use of erroneous or incomplete nomenclature or stock numbers.

Requisitions should be processed through regular channels for the required varistors.

The proper nomenclature and stock numbers are as follows:

3H4956–1 Rectifier, Silenium, W. E. Co., KS–8642 (varistor, D. C. output .07 ampere, 38 volts, input 44 volts, 10 ampere. 3'' x  $17'_8$ " x 1" overall, 2 mtg brackets for EE–101–A) unit ea.

3H4956–2 Rectifier, Silenium, W. E. Co., KS–8636 (varistor, full wave, output, .06 ampere, 150 volt D. C., input 200 volt, .09 ampere AC,  $1^{\prime\prime}$  x  $4\frac{1}{16}^{\prime\prime}$  x  $1\frac{7}{8}^{\prime\prime}$  for EE–101–A) unit ea.

#### SIMPLE TESTER FOR CHECKING SPIRAL FOUR

Reports from organizations in the field reveal that some spiral four Cable Assembly CC-358 on Reel DR-15 is inoperative due to shorts, opens, and/or grounds. It is believed that this is primarily due to the enormous amount of handling required in the shipment of this cable from the manufacturer to Signal depots. Obviously further handling is necessary in order to get this cable into the hands of the using units and organizations.

In order to avoid the issue of defective cable by Signal Corps depots, a simple tester has been designed by Maintenance Branch, Signal Supply Division, Headquarters, ETOUSA, which could be constructed from materials readily available and by personnel of third and fourth echelon repair units. A number of Signal Corps depots in ETO are using these testers and find it a satisfactory means for testing the cable.

The tester is housed in a small box made from ¼-inch or ½-inch plywood approximately 4¼" wide and 5½" long and 6" deep. This size will accommodate the two Battery BA-2 (3A2) required to energize the 45-volt lamp (4C1973). The two Battery BA-2 will provide energizing current for the lamp for approximately 60 hours, as the maximum current is less than 20 ma.

The parts required to construct this tester are as follows:

- 1—Box made from ¼" or ½" plywood, approximately 4¼" wide and 5½" long and 6" deep.
- 1—Panel, bakelite, hard rubber or plywood  $4\frac{1}{4}$ " x  $5\frac{1}{2}$ " or equal.
- 2—Battery BA-2 (Stock #3A2) or equal (See diagrams) B-1.
- 1—Lamp, jewel green (Stock #4C1972) or equal (See diagrams) L-1.
- 1—Lamp, jack (Stock #4C1973) or equal (See diagrams) J-1.
- 1—Switch, toggle (SW-110) (Stock #3Z8110) or equal (See diagrams) S-2.
- 2—Switch, rotary (SW-137) (Stock #3Z8138) or equal (See diagrams) S-3.
- $2--\mathrm{CC-356}$  Cable, spiral four stub CC-356 (1B1456) or equal.

Necessary wood screws for securing panel to box.

Preliminary check of test equipment should be performed on each occasion that the test equipment is to be put into use, and also when the equipment has indicated that four consecutive reels of cable are defective.

Plug connection (A) of figure 1 into connector (B). Set switch A of test equipment in Position 1.

Rotate switch B through its five positions: 1, 2, 3, 4 and 5. The lamp in the test equipment should light on one, and only one, of these positions; if this does not occur the test equipment is defective and should be repaired by an authorized repairman.

Repeat the above for remaining positions (2, 3, 4, and 5) of switch A.

To test reels of Spiral Four cable, plug the terminals of the reel of Spiral Four Cable to be tested into connectors (A) and (B) of test equipment.

Set Switch A of test equipment in postion 1.

Rotate switch B through its five positions: 1, 2, 3, 4, and 5. The lamp in the test equipment should light on

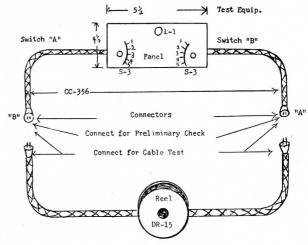


FIG. 1-SKETCH OF SPIRAL FOUR CABLE TESTER.

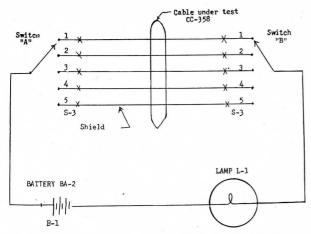


FIG. 2-DIAGRAM OF TEST EQUIPMENT AND CABLE.

one, and only one of these positions; if this does not occur the length of cable under test is defective and should be tagged and sent to the nearest Signal Corps repair shop.

Repeat the above for remaining positions (2, 3, 4, and 5) of switch A.

Due to the nature of the terminal connectors on Spiral Four cable the functional diagram (figure 2) of the test equipment cannot be taken too literally; that is, switch position 1 of switch A is not necessarily connected by the cable under test to position 1 of switch B.

Consequently conclusions should not be drawn that a particular conductor of the cable is open merely because the test equipment lamp does not light when switches A and B are turned to the same numbered positions.

If the lamp glows on one, and only one, position of switch B for each position of Switch A it can safely be assumed that the cable conductors are continuous and without shorts.

#### CHECKING COMMON BATTERY TELEPHONE (302 DESK SET) WITH BATTERY BA-2

The use of Battery BA-2 for testing the 302 Desk Set Telephone was found to be very helpful when no other current supply is available. The 302 is connected to a BD-71 switchboard or EE-8-A telephone, and the BA-2 is then placed in series with the 302 on this line. This method provides for sidetone, ringing, and transmission tests.

The BD-71 is more advantageous that the EE-8-A, in that the respective drop on the board will operate when the hookswitch is released, thus testing the signal operation of the desk set.

#### CHECKING POWER CABLES OF SCR-509, 510 AND SCR-609, 610

It has been found in repairing SCR-509, 510 and SCR-609, 610 that a great deal of trouble occurs in the power cables of the Plate Supply Units FE-97 and PE-117; and battery Case CS-79.

By use of the test unit shown in figure 3 a dummy load can be induced in the unit to be tested thus showing any deficiency in the unit or cable.

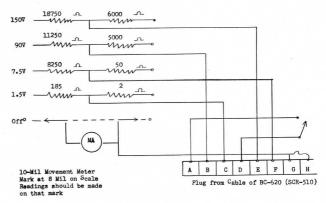


FIG. 3-CHECKING POWER CABLES OF PLATE SUPPLY UNITS.

#### RADIO COMPASS LOOP TROUBLES

Information from the field indicates that a large part of the failures of Loop LP-21, used with Radio Compass SCR-269-( ) and \*AN/ARN-7, is due to moisture. In order to reduce the amount of moisture in the loop housings and assembly used in Loop LP-21-( ), all air entering or leaving the interior of the loop, due to the breathing action caused by the various levels at which the aircraft must operate, passes through the dehydrator unit and is dried. This means that the dehydrator hose and connections and all joints and seals in the loop assembly must be air tight. Required maintenance procedure is described in Technical Order No. 08-5-53.

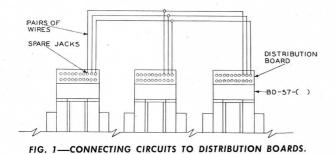
# MILITARY TRAINING

#### RADIO PROCEDURE TABLE NET EXERCISES

INSTRUCTION IN radio procedure at the Officers' School, ESCS, Fort Monmouth, N. J., for the Radio Communication Course is of an advanced nature.

Several methods are used to make this instruction more effective. The first method involves the use of a small public address system such as the Reproducing Equipment MC-364-( ). It is used to simulate a four station radio-telephone net. Four students operate the net, one at each microphone. They are required to open the net, handle traffic, and close the net. The remainder of the class listens to the net traffic and, under the supervision of the instructor, offers corrections of any procedure errors. Students are rotated in this assignment during the period until all have had an opportunity to participate.

In the standard code room installed and wired according to TM 11-432, 2 February 1942, it is only possible to set up "table nets" of various students at the same code table. Such an arrangement facilitates instruction because all stations in the same "table net" are easily supervised. However, for more advanced instruction it was desired that the "table net" conditions and arrangements be less stereotyped and actual radio net conditions be more accurately simulated to the extent that the identity of the persons in other stations of the net be unknown and that the stations be more widely separated. This was accomplished by use of simple "table link" circuits added to the distribution board mounted above the Switchboard BD-57-( ). These "table link" circuits were wired into unused jacks on this distribution board in the manner shown in figure 1. Patching of various "table nets" together is accomplished in the same manner as through the regular Switchboard BD-



NET "A"

FIG. 2-POSSIBLE TABLE NET ARRANGEMENTS.

57-( ). A diagram of some of the possibilities of "table net" arrangements is shown in figure 2. When "table nets" are set up using this arrangement students are given their net problem with only the call signs of the other stations in their net as a basis of establishing communication and are required to complete the net problem without further aid from the instructor except in unusual cases of equipment trouble. The volume controls normally associated with the jacks used were left in place on the Switchboard BD-57-( ) but were disconnected from the circuit to avoid shunting the "table link" circuit.

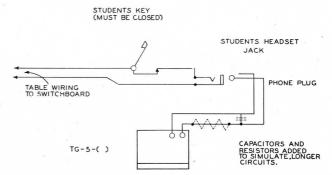


FIG. 3—CONNECTING TG-5 FOR USE IN CODE TABLE NET.

As an aid to preliminary instruction in the adjustment and operation of the Telegraph Set TG–5–( ) these instruments are used in the code room connected into "table nets" by use of a simple plug connection placed into the same jack as the student headset at each position of the code table. Figure 3 shows the arrangement in this case. This arrangement does not require any alteration or additions to the standard code room wiring system and the "table nets" may be established by the same methods as used for regular tone "table nets." An additional problem can be introduced by the use of capacitors and resistors to simulate a long circuit of reasonable length.

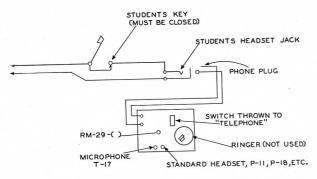


FIG. 4-REMOTE CONTROL CONNECTION FOR R/T TABLE NET.

Individual R/T nets are simulated by the use of several Remote Control Unit RM-29-() connected in the same manner as described above for the transmitter table is transferred to corresponduse of the remote control units permits a number of voice procedure nets to be conducted at the same time in the classroom. As the student wears headphones, interference from other students nearby is reduced somewhat but not entirely, thus simulating some interference during the conduct of these nets.

It should be noted that both the telegraph nets and simulated R/T nets previously described can also be interconnected by the "table link" circuits in the same manner as the regular tone "table nets."

## DIRECTION-FINDING DEMONSTRATOR TABLES

Keeping track of a fighter squadron in the air from the time it leaves the airport until the enemy planes are intercepted is the job of an elaborate direction-finding system in the VHF Fighter Control Net Systems. The process of direction-finding is large in scope. It requires a good deal of equipment, 15,000 square miles of ground area, and sufficient sky space in which to maneuver a squad-For that reason, the VHF Section EM School, Fort Monmouth, found it necessary to simplify the subject through the use of training aids. The solution to the problem came in the form of four small, electrically-operated, dynamic demonstrator tables on which the whole operation of direction-finding can be shown clearly and dramatically in just a few square feet of floor space.

This is how direction-finding is achieved in the field, and taught in the classroom.

In the field, a signal from an airborne transmitter is picked up by the directional antennas of three direction-finding stations. These stations are usually 40 to 60 miles apart and are located in such a manner that each station constitutes an apex of a giant equilateral triangle. In any one station the operator searches for the signal by rotating a handwheel which is attached to the antenna shaft. When he finds the signal, he rotates the antenna until he receives a null indication in his headset. Above the handwheel are two important instruments. One is a drum calibrated in degrees, (azimuth scale), 0 to 360, which informs the operator of the direction of the plane in relation to his station. The other is a sense switch which enables the operator to determine whether he has the correct null. As the transmitter in the plane sends out a signal, the three operators in widely separated stations take the bearings. If lines were drawn from each directional antenna to the source of the signal, and the three lines were applied to a map of the area which the plane is flying, the point of intersection of the three lines would indicate the position of the plane.

In the classroom, the role of the plane and its airborne transmitter is performed by a transmitter table (see figure 1). The operations of the three widely-separated direction-finding stations are demonstrated by three small direction-finding tables standing side by side. These tables, one

which is shown in figure 2, contain the handwheel assemblies like the ones used by the operators in the field.

The transmitter table is a "bird's-eye" view of the direction-finding system. It is a table-mounted map of an area on which is located one whole direction-finding system and a toy plane on which bearings are to be taken. It shows the triangular arrangement of the direction-finding station as they would appear in the field. It shows the airplane and indicates the paths of the signal from the plane to each of the three ground stations by three metal rods.

The transmitter table simulates the transmission of the signal which is ordinarily supplied by the airborne transmitter. The operation necessary for the reception of the signal is shown by the use of the three D/F tables. The simulated radio signal is transferred from the transmitter table to the three D/F tables by a special wiring circuit. The signal in this case is a 1,000-cycle tone emitted by an audio generator. The wiring is such that the simulated direction-finding stations, X, Y and Z on the transmitter table feed their signals to D/F tables, 1, 2, and 3. The tables are so designed that as the toy plane is moved on the transmitter table a modified selsyn motor

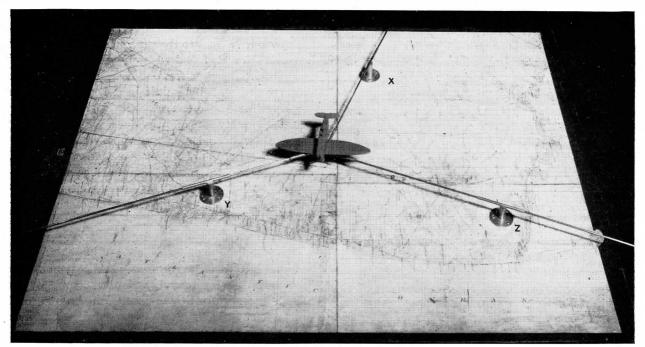


FIGURE 1—TRANSMITTER TABLE, SIMULATING AN AIRBORNE TRANSMITTER, USED IN TEACHING DE OPERATION.

mounted under each of the stations, X, Y and Z, (see figure 3) transfers any voltage or voltage change to a similar motor on one of the D/F tables. Since, under normal conditions, the three direction-finding stations receive their signals together, the voltage on the three D/F tables change according to the distance and the direction in which the plane was moved. Thus it is necessary to rotate the handwheel until a new null indicates the azimuth readings of each new position of the plane.

The motors which make the operation of the tables possible are a modified form of the selsyn, or self-sychronized, motor. Each of the motors is made up of four coils mounted in the same plane—

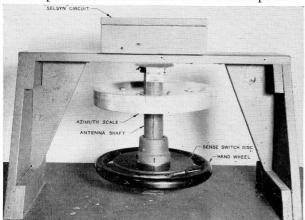


FIG. 2-A DF RECEIVING TABLE SIMULATING A DF STATION.

three stationary and one rotary. The three stationary coils, 1, 2 and 3 which are arranged in a

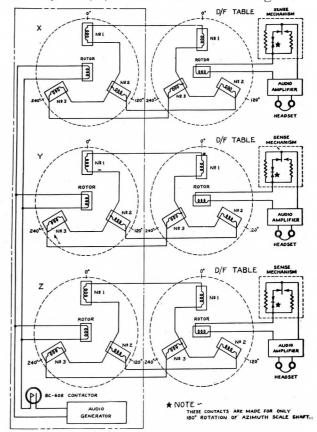


FIG. 3-SCHEMATIC DIAGRAM OF THE SYNTHETIC DF TABLES.

circular pattern are 120 degrees apart. The amount of coupling which exists between the rotary coil and each of the stationary coils at any instant determines the amount of voltage in the stationary coils.

The voltage induced in the stationary coils on the transmitter table is transferred to corresponding stationary coils on the direction-finding tables. As the rotary coil on any receiver table is rotated by the handwheel, the stationary coils are coupled to the rotary coil in such a manner that a null is indicated in the operator's headset.

To determine whether he has the correct null, the operator rotates the handwheel 20 degrees off the null point and presses the sense switch disk. A decrease in signal indicates the correct null. An increase in signal intensity signifies that the null which he has found is the reciprocal of the true null.

## BC-687-A DYNAMIC DEMONSTRATOR BOARD

VHF Control Net Systems employ a band of very high frequencies which are characterized by line-of-sight transmission. Consequently, the Control Net System would normally lose contact with a pilot unless an advance relay station equipped with transmitters and receivers is set up beyond the horizon. This station is operated by remote

control through a unit known as the BC-687-A. This unit controls the distant relay station by sending over wire lines to the station, Morse code audio signals S or R, followed by a "channel-selection" code of from two to five dots. When the signal is interpreted as S by a unit in the relay station, a transmitter is automatically set up. On receipt of an R, the relay station provides a receiver.

The dynamic demonstrator board was built at the EM school, Fort Monmouth, to simplify the functions, operation, and maintenance of the BC-687-A. It is designed to show the electrical circuits and the sequence of operation of the relays. To facilitate circuit reading, the actual circuit diagram is enlarged to four times its original size. The schematic wiring is shown by color-coded lines. The actual wiring is behind the panel. The sequence of relay operation is dramatized by the flashing on and off of a small light bulb as each relay is energized. Each relay is identified by a number so that the student can observe and remember the sequence in which the relays energize for "receive" and "send."

An unusual feature of the dynamic demonstrator board is the fact that troubles can be introduced into the circuits during lectures. Thus, the student has the opportunity to discuss the probable causes of the breakdown, then trouble-shoot the actual circuit.

