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No. 30

RESTRICTED

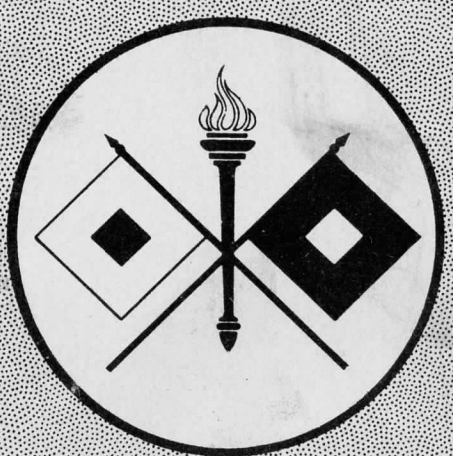
SIGNAL CORPS

TECHNICAL

INFORMATION LETTER

MAY · 1944

ARMY SERVICE FORCES · OFFICE OF THE CHIEF SIGNAL OFFICER



SIGNAL CORPS TECHNICAL
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Number 30 May 1944

RESTRICTED

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WAR DEPARTMENT · ARMY SERVICE FORCES

OFFICE OF THE CHIEF SIGNAL OFFICER

OFFICE SERVICE DIVISION · SPECIAL ACTIVITIES BRANCH

SIGNAL CORPS TECHNICAL
INFORMATION LETTER

PURPOSE The Signal Corps Technical Information Letter is a monthly publication designed to keep personnel informed on Signal Corps matters. It provides means for the general dissemination of information of widely varied nature to Signal Corps officers as a whole, and for the interchange of information among the different Signal Corps organizations and installations.

SOURCE The Letter is compiled mainly from information available in the divisions and branches of the Office of the Chief Signal Officer. All Signal Corps training centers and other agencies are invited to submit items of general interest. Such items should reach the Office of the Chief Signal Officer (SPSAY) not later than the 15th of each month for inclusion in the Letter of the following month.

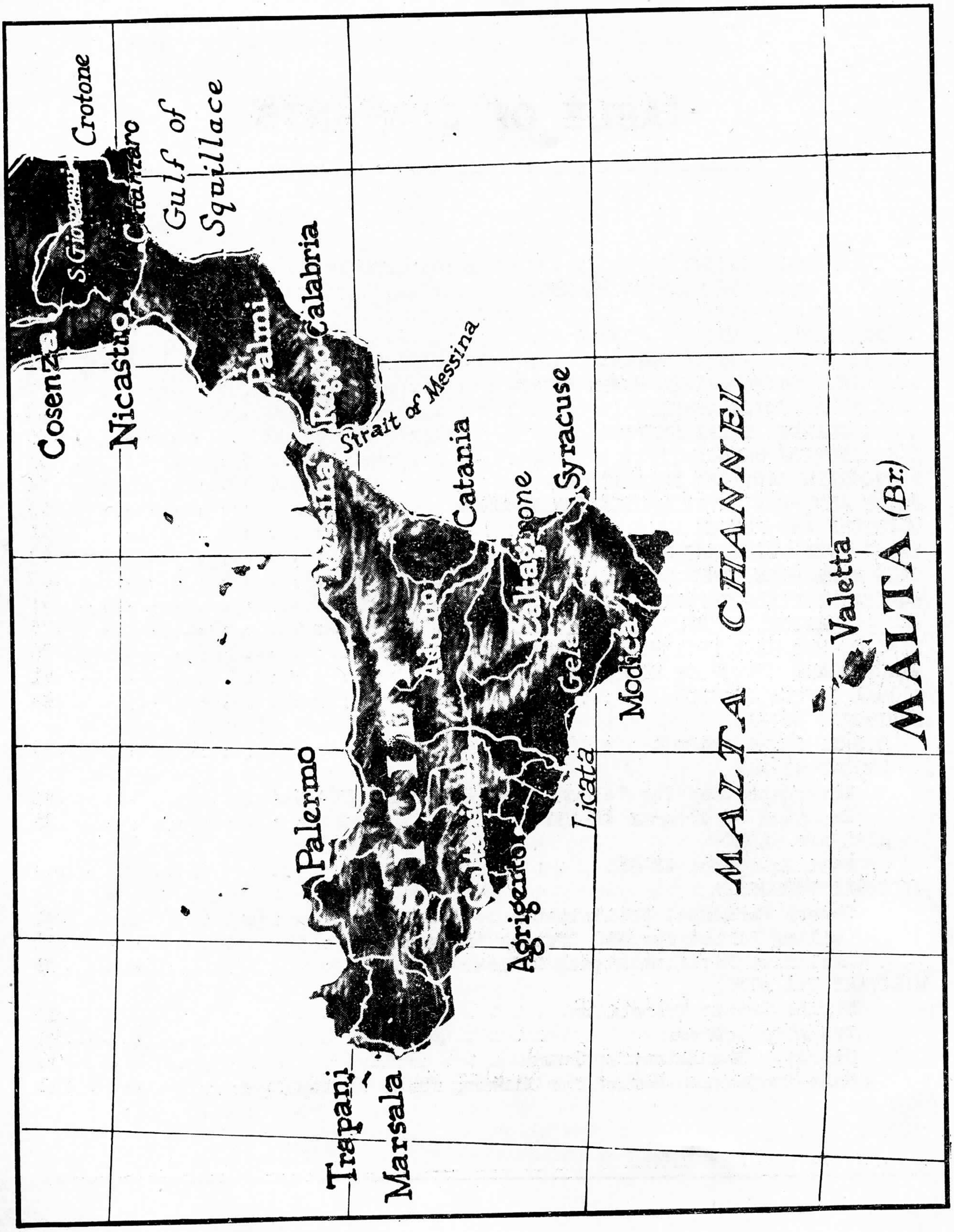
DISTRIBUTION Distribution overseas is made by The Adjutant General on the following basis: Headquarters, Theaters of Operation (25); Armies, Corps, Departments, Base Commands, Island Commands and Air Forces (10); Divisions, Brigades, Battalions 11 and Companies 11 (2).

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) and to air units and installations by Headquarters, Army Air Forces.

To be placed on the mailing list, to receive more or less copies, or to have mailing addresses corrected, requests should be made through channels to the Chief Signal Officer (SPSAY) in the case of overseas units and Signal and other Ground and Service Forces units within the United States, and to the Commanding General, Army Air Forces (Management Control, Reproduction Branch, AAF Annex), Gravelly Point, Virginia, in the case of air units in the United States.

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.

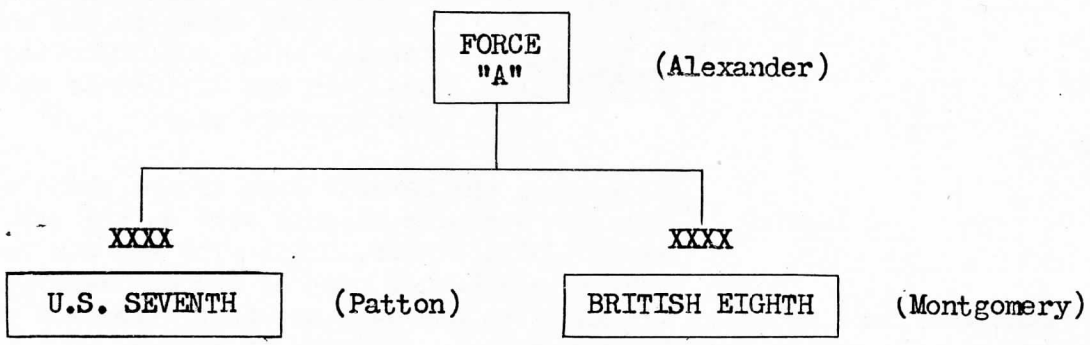
TABLE OF CONTENTS


Cosenza
Nicastro
Crotone
Gulf of Squillace
Palmi
Calabria
Strait of Messina
Catania
Syracuse
Gela
Modica
Licata
Agrigento
Palermo
Trapani
Marsala
MALTA CHANNEL
Valetta
MALTA (Br.)

SEVENTH ARMY PARTICIPATION IN THE SICILIAN CAMPAIGN

The Sicilian Campaign has been acclaimed by some authorities as "the first stage in the liberation of Europe." It has been hailed by others as "the beginning of the end" (for Hitler). Whether these predictions are true or not remains to be seen, but there can be no doubt that the thirty-eight day campaign, which began 10 July 1943 and ended with the capture of Messina, 17 August 1943, was a major triumph for the Allies. A triumph in which signal communications played a leading role. A study of these successful signal communications should help all Signal Corps officers appreciate the problems confronting an Army signal officer during combat.

The combined ground, air and naval forces which invaded Sicily were under the supreme command of General Eisenhower. The combined ground force (labeled Force "A" because of security reasons) was a newly organized 15th Army Group commanded by General Alexander. This combined ground force was further divided as shown below:



To more readily understand the crushing blow dealt the Axis in Sicily from the personal observation of the 7th Army Signal Officer, this article will cover the 7th Army participation in the campaign in four phases.

1. Seventh Army Operations - General: 10 July-17 August 1943.
2. Signal Communications available to Seventh Army Headquarters: 10 July-17 August 1943.
3. Activities of Signal Corps Personnel, I Armored Corps (which became Seventh Army at 0001, 10 July 1943): 21 February-10 July 1943.
4. Lessons learned from the campaign as they apply to signal communications.

SEVENTH ARMY OPERATIONS - GENERAL: 10 JULY-17 AUGUST 1943

The Plan (Figure 1) This was the plan for the invasion of Sicily. On D day the Seventh Army would make landings along the Southwestern coast of Sicily, west of the general line Pozzalo-Vizzini. At the same time the Eighth Army would strike on the right.

The Mission The specific mission for the Seventh Army was to seize the airfields at Ponte Di Olivo, Comiso, Gela and Licata. At the same time to seize and operate the small port at Licata and to prepare for further operations under the direction of the commander, Force "A".

The Scheme of Maneuver The scheme of maneuver for the Seventh Army was to make a simultaneous assault in the Licata-Gela-Scoglitti area in order to capture the airfields and the port of Licata by D plus 2. This action was to be preceded on the night of D minus 1 by the dropping of American parachute troops in the vicinity of Ponte Di Olivo. Then to expand the beachhead to the general line Palma Di Montechano-Mazzarino-Vizzini to include the high ground in the vicinity of Piazza-Amerino-Aidone to prevent hostile interference from the Northwest.

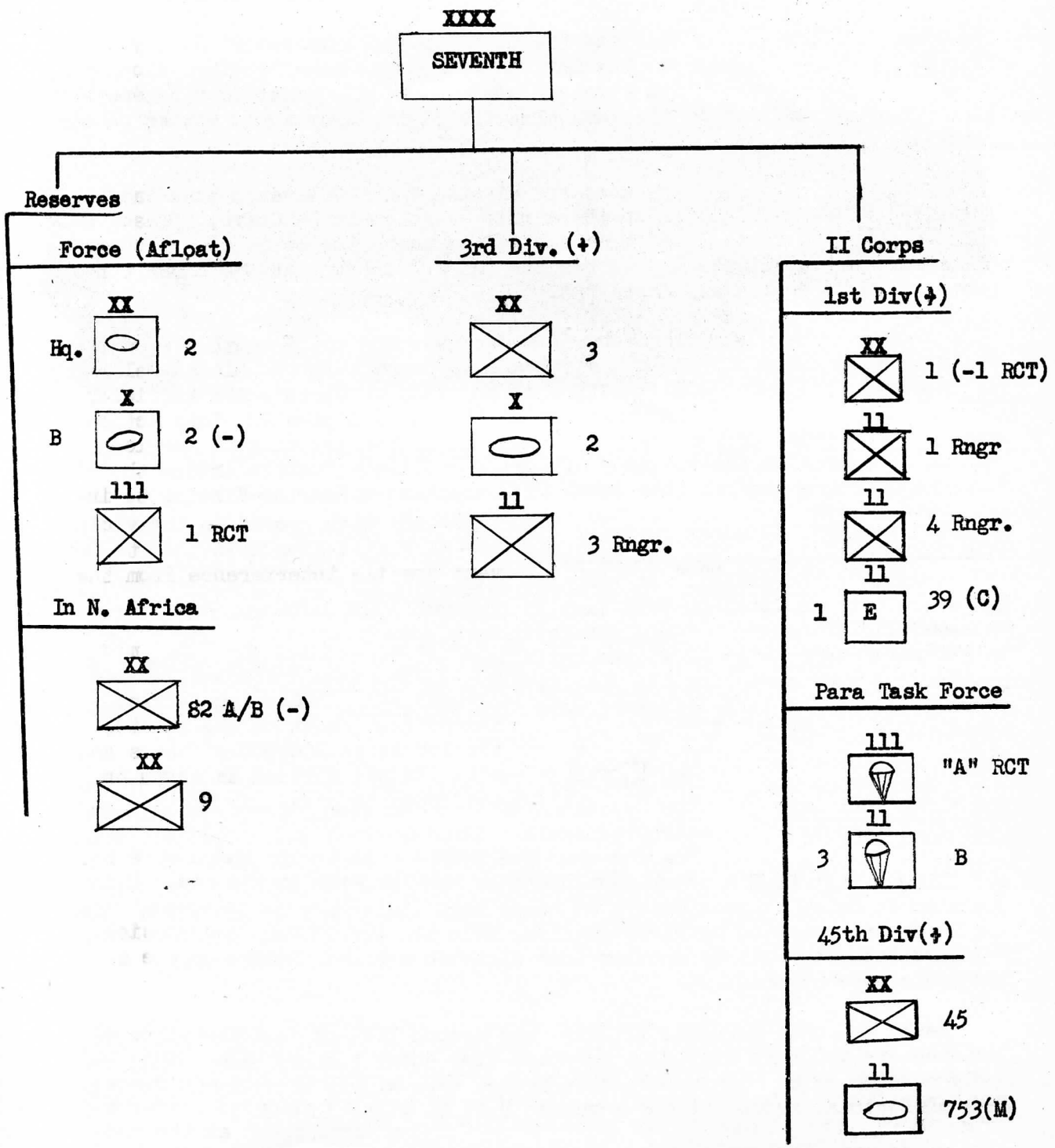
FIG. I

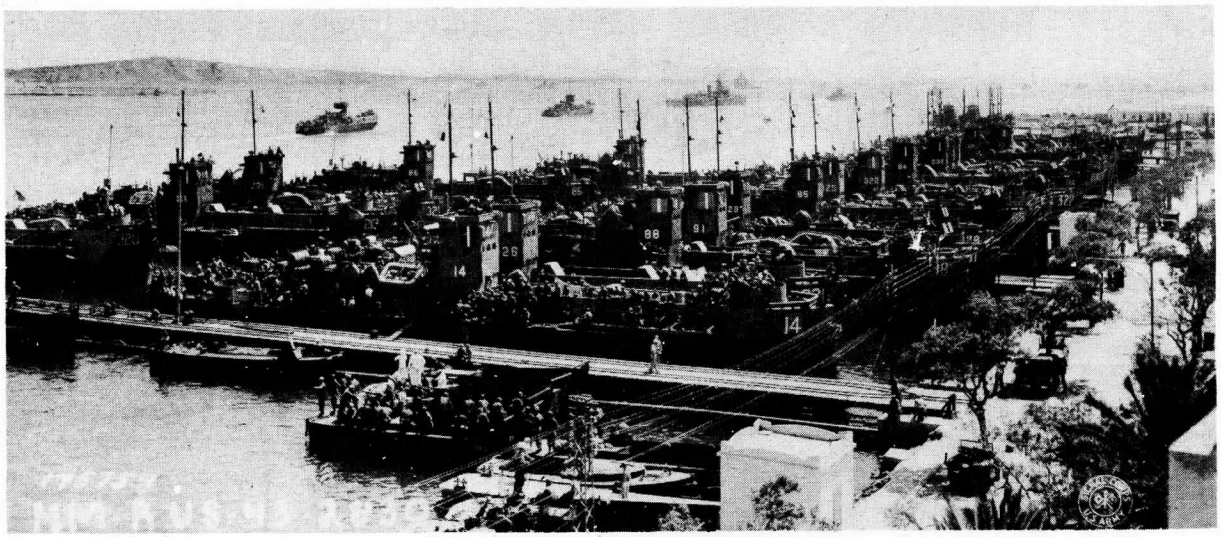
To accomplish the first mission, the overall strength of the Seventh Army, including service troops (not shown on the chart), totaled about 200,000 officers and men. It was divided as shown on the opposite page.

Overwater and Landing Period, 9-10 July On 9 July, the Seventh Army troops which were to make the seaborne assault were on the sea. D day was 10 July; H hour, 0245. The sea was rough. Approximately 60 per cent of the men were seasick. Plans were made to delay the invasion one day, but that afternoon the sea leveled off, so the decision was made to carry on as planned.

Late that evening the para-task force -- about 3,000 parachutists of the 82nd Airborne Division -- boarded air transports in Tunisia. The loaded planes roared away from Africa following a dog leg course that would not pass over Seventh Army transports. Because of this complicated course and cross winds, the planes failed to reach the proper drop zones at the prescribed times (2330 and 2356). Parachutists jumped about 0200-0300, 10 July, and were widely scattered from Ponte Di Olivo to Noto.

Preliminary air and naval bombardment had softened the beach defenses


XXX
SEVENTH
Reserves
Force (Afloat)
XX
Hq. 2
X
B 2 (-)
III
1 RCT
In N. Africa
XX
82 A/B (-)
XX
9
3rd Div. (+)
XX
3
X
2
II
3 Rngr.
II Corps
1st Div(+)
XX
1 (-1 RCT)
II
1 Rngr
II
4 Rngr.
II
1 E 39 (C)
Para Task Force
III
"A" RCT
II
3 B
45th Div(+)
XX
45
II
753(M)



READY TO GO. ASSAULT TROOPS BOARDING LANDING BOATS IN NORTH AFRICA FOR THE INVASION OF SICILY

when Seventh Army landings began at 0245, 10 July (Figure 2). The 3rd Division landed at Licata, the 1st Division at Gela, and the 45th Division in the vicinity of Scoglitti. At the same time, the British struck on the right. In general, these landings were lightly opposed. All landings shown were successfully completed by 0600 and beachheads extending two to four miles inland were secure. By 1200, two battalions of the paratroops had been assembled and were assisting the 45th Division on the right. At 1800 the reserve force afloat landed East of Gela, and was placed in Seventh Army reserve.

The First Four Days
Period 11-15 July

The next day, 11 July, the enemy threatened to push the Seventh Army into the sea. Enemy air attacks directed against landing craft and supply ships unloading over the beaches, began at dawn and continued all day. At 0800 a heavy counterattack was launched against the 1st Division at Gela. Approximately 60 enemy Mark IV tanks were involved. The 1st Division, assisted by Naval gunfire, held its ground, and by 1645 this counterattack, as well as smaller ones directed against the 3rd and 45th Divisions were stopped.

Early the next morning, 12 July, the second lift of the 82nd Airborne Division arrived over Sicily at the same time enemy bombers were making an early morning raid. Again parachute troops were widely scattered. Despite this misfortune, ground troops advanced 8 to 15 miles inland.

By 13 July, the Seventh Army had captured an airfield at Ponte Di Olivo, an airport at Comiso, a glider strip northwest of Gela, and a landing strip 2 miles east of Gela. In addition, a landing strip was prepared at Licata and three P-38's landed late that day. The port of Licata, captured

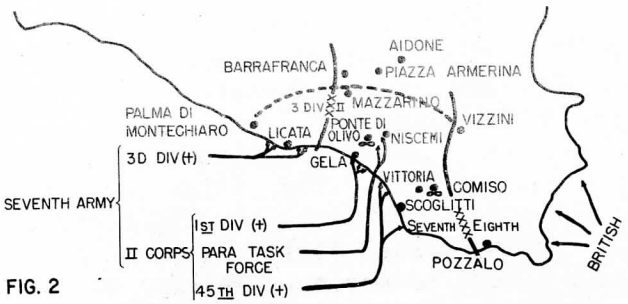


FIG. 2

FIG. 3

on the 10th, was reopened to shipping and a railroad was in operation between the port and Campobello.

All ground up to the line AB was occupied by the 15th (Figure 3). The enemy had been pushed back so far that his long range artillery could not reach the captured airfields. Hence the first mission of the Seventh Army was accomplished.

Approximately 15,000 of the 350,000 enemy troops estimated to be in Sicily, had been captured. This total increased daily and became an acute problem. Italians deserted by the hundreds, either because of inbred hatred of their German comrades or because in some instances the Germans in withdrawing ahead of the Italians, mined the roads and trapped the Italians between the Americans and the minefields.

Advance on Palermo
Period 16-22 July
(Figure 4)

Foreseeing that eventually the Seventh Army would be driving the enemy towards Messina, it was realized that, with Palermo in Allied hands, its port facilities would greatly simplify the supply problem. Accordingly, orders from Headquarters, Force "A", now swung the effort of the Seventh Army toward the north and northwest. A provisional Corps Headquarters was provided and a new Army boundary was established as shown.

By 18 July, the 3rd Division, assisted by Naval gunfire, had captured Agrigento. The 2nd Armored Division was assembling near Campobello. The 82nd Airborne Division was reorganizing near that city preparing to fight on foot.

The troops raced forward, meeting only moderate opposition. By 20 July the dispositions were: 1st Division at Enna; 45th Division north of San Caterina; 3rd Division on the general line Casteltermini - Bivona; 2nd Armored Division north of Sciacca; 82nd Airborne Division at Menfi; and a newly organized task force "X" consisting of two Ranger battalions, a battalion of medium field artillery, and a regimental combat team (part of the 9th Division) brought over from Africa two days before, in position east of Menfi.

The stage was now set for a break-through to the north and northwest

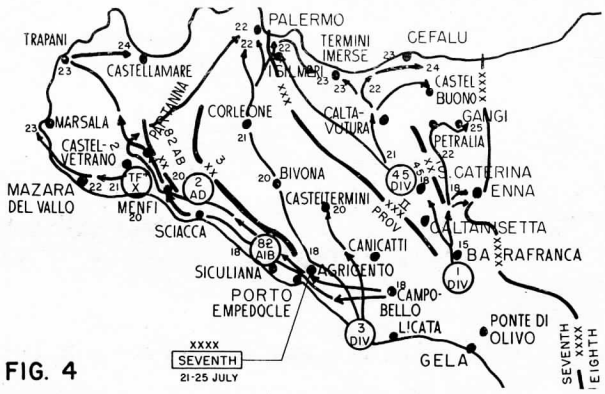


FIG. 4

and a rapid drive on Palermo. The "touchdown play" was called. The 2nd Armored Division, assembled northwest of Castelventrano, which was captured by Task Force "X" on the 21st. Then tanks and armored infantry broke through enemy lines, by-passed Partanna, wheeled right and advanced to Palermo on the 22nd. The 3rd Division, by continuously shuttling infantry battalions forward, drove north and reached Palermo the same day — this advance was made despite the fact that the Division, stripped of all but organic transportation, was required to haul its class I, III, and V (ammunition) supplies from a beach dump at Agrigento.

The 45th Division lunged forward and then separated into 2 columns as shown. The 1st Division stopped just short of Petralia.

As planned, many Axis troops were trapped in the northwestern pocket of Sicily. Then Task Force "X" took Mazara on the 22nd and Marsala on the 23rd; while the 82nd Airborne Division, now operating as an infantry division, seized Partanna on the 22nd, Trapani on the 23rd, and Castellamare on the 24th. The 45th Division advanced as shown while the 1st Division moved to Gangi.

Approximately 45,000 prisoners had been captured by 24 July — as many as 11,000 in one day. Axis dead totaled about 7,000 as compared to 600 for Seventh Army.

Seventh Army service troops had begun the repair of roads, railroads and public utilities on 11 July. Now they intensified this work. Palermo, captured on the 22nd, was not usable as a port. The harbor was dotted with sunken ships and docking facilities were in need of repair.

<u>The Battles for Troina and San Fratello Period 25 July - 8 August (Figure 5)</u>

However, the lack of nearby port facilities did not stop our troops. On 25 July, the advance was directed to the east. Actually, the attacking force was the II Corps. The enemy, employing land mines, mortar fire and heavy artillery concentrations, put up increasingly stiff resistance to further advances. Allied aerial reconnaissance disclosed an increasing flow of reinforcements across the Straits of Messina, and the preparation of defensive positions at Troina and San Fratello. This action indicated that the rapid enemy withdrawal of the previous 15 days had come to an end.

The II Corps smashed forward. Soon the problem of supply was simplified. Palermo harbor was reopened to shipping on 27 July. By 31 July the

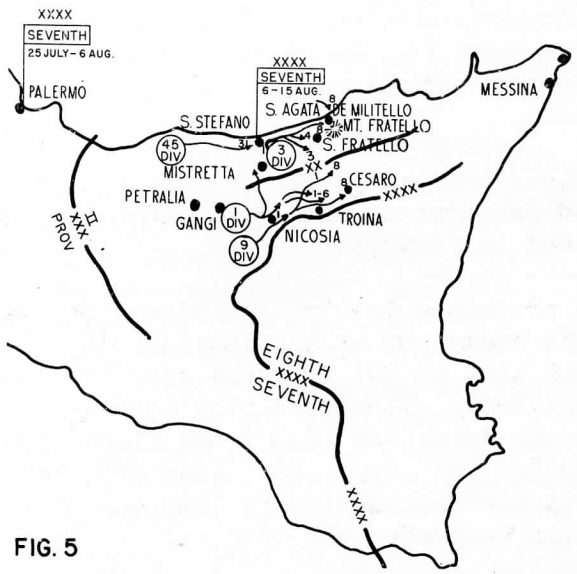


FIG. 5

45th Division captured S. Stefano, whereupon it reverted to provisional corps control and was replaced by the 3rd Division.

On 1 August, the 9th Division, less the RCT used with Task Force "X", arrived at Palermo harbor, was ordered to Nicosia, and placed under II Corps control.

On this same day, 1 August, the Battle of Troina began — the greatest battle of the campaign for the Americans. Troina was a heavily fortified town atop a 3,600-foot peak. To shatter German positions which held fast for 3 days, II Corps brought up additional artillery. The big push began at 1645 on 4 August. Eight and one half battalions of field artillery battered the town with a 50-minute barrage. At the same time 72 A-36 planes, flying in two waves with each plane carrying one 500-pound bomb, bombarded enemy positions. Despite this action the 1st Division was unable to take Troina until 6 August. The 1st Division was then relieved by the 9th.

While the 1st Division was struggling on the right flank, the 3rd Division was having trouble on the left. This Division was engaged in the battle of San Fratello from 4 to 8 August. The 3rd Division pursuit of the enemy was delayed at successive ridge lines by rear guard actions, mines and demolitions. The action that followed gave new life to the Cavalry. To outflank the enemy left required an operation over steep rocky terrain impassable to vehicles. Therefore, a provisional horse cavalry troop was formed. The horses for this reconnaissance troop, as well as mules for an animal pack train, were brought forward in $2\frac{1}{2}$-ton trucks.

Victory in this battle was virtually assured after an amphibious operation in which a battalion of infantry, a tank platoon and 2 armored field artillery batteries landed behind enemy lines near S. Agata at 0400 on 8 August. This action caught the enemy flat-footed, broke his resistance in the vicinity of Mt. Fratello, and started him reeling back to Messina.

By this time, 8 August, captured enemy prisoners totaled about 93,000. However, the problem of handling them was considerably simplified. Instructions had been issued on 27 July, shortly after the downfall of Mussolini, that certain prisoners of war would be eligible for parole. These eligibles were confined to Italian enlisted men whose permanent homes were in that part of Sicily already in Allied hands. This system was put in operation 1 August and eventually some 33,000 Sicilians were paroled.

At Naso, the enemy held again, so the 3rd Division threw another punch

Into Messina - Period 9-17 August (Figure 6)

by completing a second amphibious operation at Brolo, on 11 August, which again caught the enemy off guard. The next day, 12 August, Allied pilots reported that enemy evacuation across the Straits of Messina was under way on a large scale.

On the right flank, the 9th Division, advancing slowly over roads constructed by division personnel, reached Randazzo on the 13th. Here the 1st Division came back into action and headed for Novara.

Poor roads and demolished bridges prevented the 3rd Division from reaching Barcelona until the 15th. There the enemy put up his last display of resistance. Late that night, Seventh Army sent an RCT from the 45th Division to land in rear of enemy positions. The enemy withdrew during darkness. Consequently this force which landed on 16 August at 0230 found itself several miles in the rear of the advancing 3rd Division. Late that day, Seventh Army artillery fired 100 rounds of 155's across the Straits into the Italian mainland. Only light counterbattery fire was returned.

The next morning, 17 August, the 3rd Division entered Messina from three directions and the Sicilian Campaign ended. The Seventh Army had captured 100,000 of an estimated enemy force of 350,000. In addition enemy losses in killed or wounded totaled 12,000. Against this, Seventh Army losses were about 1,200 killed, 4,500 wounded and 1,000 missing. Two days before the end service troops at Caltanisseta uncovered an enemy chemical warfare dump stocked with mustard and other poisonous gasses.

It is obvious that the leapfrogging Seventh Army troops could never have made such rapid progress without efficient signal communications. The Signal Corps' cooperation in furnishing these outstanding signal communications throughout the campaign, highly commended by all commanding officers, is brought out in the second part of this article which follows.

SIGNAL COMMUNICATIONS AVAILABLE TO SEVENTH ARMY HEADQUARTERS 10 JULY - 17 AUGUST

For the invasion of North Africa the Army used Naval warship signal communication facilities during the overwater and landing phases. Army signal communications failed each time the warship became involved in combat due to concussion from heavy gun fire. To prevent this failure in the Sicilian Campaign, headquarters ships were provided for Seventh Army, 3rd Division, 1st Division, II Corps and 45th Division combined; and Army signal communications were operated by Signal Corps personnel. The force afloat and each regiment improvised individual headquarters facilities upon the vessels transporting them. Each headquarters divided its personnel and equipment to provide an alternate command post in the event the headquarters ship was sunk.

Radio channels allotted each headquarters:

	Trans.	Receive.
Seventh Army	5	6
II Corps	4	5
1st Division	6	12
3rd Division	6	12
45th Division	4	10
Each Regtl. Hq.	4	4

USE OF PRIMARY RADIO CHANNELS

	Force "A" Command (F-1)	Seventh Army Command Net (A-1)	A/B Units Net	FM Voice Channels	II Corps Command Net (C-1	Ship Shore Channels	Division Command Nets	Regtl. AM Command Net.	Regtl. FM Command Net.	Engr. Shore Bn. AM Command Net	Engr. Shore Bn. FM Command Net
Seventh Army	X	X	X	X							
3rd Division		X	X	X		X	X				
II Corps		X	X		X						
45th Division				X		X	X				
1st Division			X	X	X	X	X				
Each Regtl. HQ. (including attached Shore Engr. unit.)					—			X	X	X	X

As far as possible the actual radio sets provided on Headquarters ships were Naval equivalents for sets normally used by the Army — the reason being, as stated by the report of the Commanding General, Seventh Army, "because naval radio sets are manufactured with the view of withstanding a salty atmosphere."

Signal personnel aboard the headquarters ships totaled as follows:

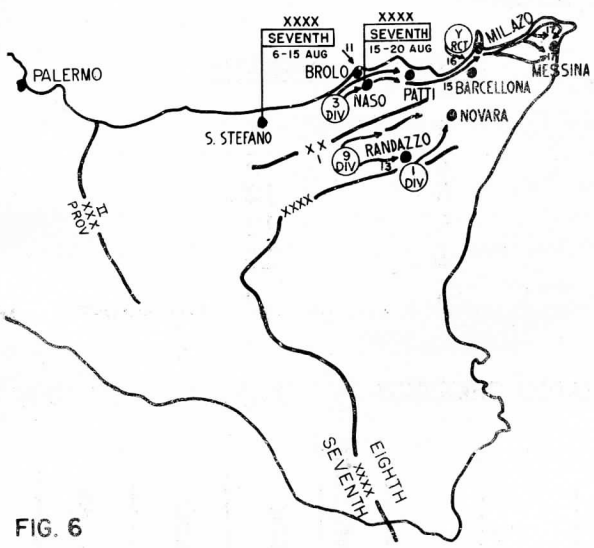


FIG. 6

Seventh Army, 32 officers and 115 enlisted men; II Corps and 45th Division, 24 officers and 112 enlisted men; 1st Division, 18 officers and 56 enlisted men; 3rd Division, 22 officers and 61 enlisted men.

At 0305 on 10 July, 20 minutes after landings began, radio silence was lifted for Seventh Army. The nets shown on Figure 7 (less those eliminated for security reasons) were quickly established. The advance CP on the destroyer was not established. Originally General Patton had intended to prowl along the coast in a destroyer to see how the landings were progressing.

The Seventh Army signal center was soon swamped with messages. Administrative traffic from higher headquarters had accumulated in such volume during the period of radio silence, that to clear it over Seventh Army channels would delay the clearing of tactical traffic. Accordingly, a representative of the Chief of Staff was assigned to approve all outgoing traffic from Seventh Army headquarters and outgoing administrative traffic was eliminated. It was impossible, however, to suspend incoming traffic.

The troops sent ashore at Gela were accompanied by a Signal Corps detachment from Seventh Army headquarters, previously loaded in an LST. Two and a half ton amphibious trucks, DUKWs, mounting the component parts of Radio Set SCR-299-( ) had been provided on the basis of two per task force. These sets were used successfully to establish initial radio communication ashore (Figure 8). Link Sign Procedure was generally used.

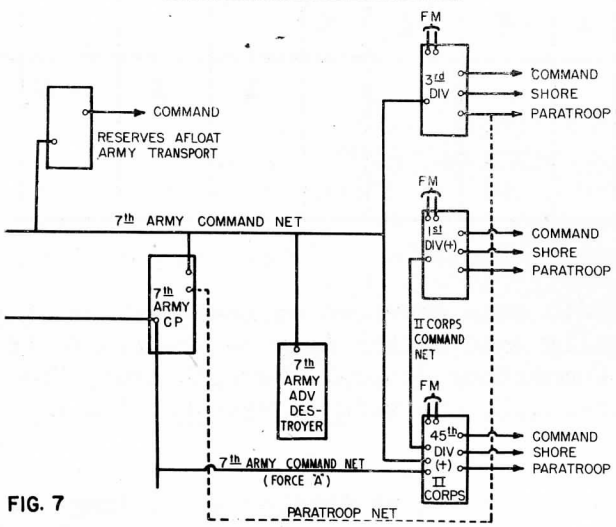


FIG. 7

The final radio nets ashore for Seventh Army are shown in Figure 9. With the exception of the Seventh Army command net and the administrative net between Seventh Army and Force "A" main headquarters, each net operated on a low frequency from 2000 to 0600 and a higher frequency during daylight hours from 0600 to 2000.

At one time the action was so rapid that the Seventh Army operated a set direct in the Corps - Division net.

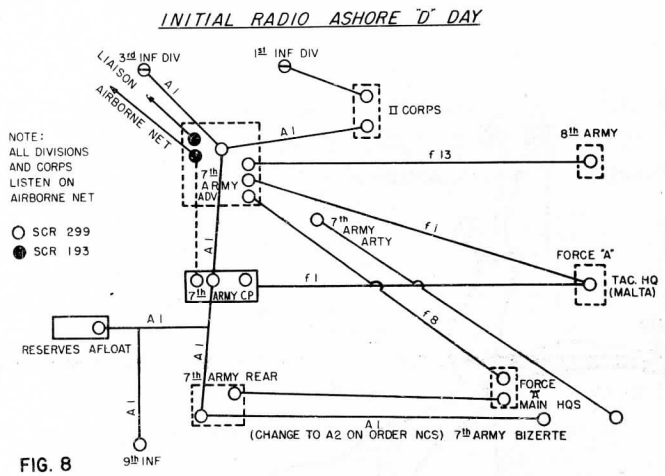


FIG. 8

The Army CP opened at Gela at 1600, 12 July. Two separate command post installations were made -- one to serve the tactical headquarters and one to serve a rear echelon containing the administrative sections. Most unfortunately, the Signal Officer and his staff were placed at the rear echelon, making it difficult for him to provide signal communications for a rapidly moving operation.

As soon as the roads to Licata and Ragusa had been cleared of enemy troops, work was started on the rehabilitation of two 2-way open wire circuits from Gela. These overhead wires had been damaged by the enemy and considerable work was required. This rehabilitation was delayed considerably by sabotage. Within seven days, over 100 cases of trouble causing circuit interruptions occurred between Gela and Licata. This sabotage plagued the Signal Corps throughout the campaign. However, it was effectively reduced in certain areas by arresting local inhabitants identified as having knowledge of wire construction, operation or maintenance in the area.

Upon learning that future operations would follow along two axes, one north toward Caltanissetta and one northwest towards Agrigento, it was felt that there was not sufficient wire personnel to reconstruct and maintain open wire circuits. Arrangements were made immediately to use messenger and radio only between Army and subordinate headquarters. However, it later developed that Seventh Army was able to maintain wire communication despite the rapid action.

By 20 July (Figure 10) Seventh Army had the following main wire circuits established:

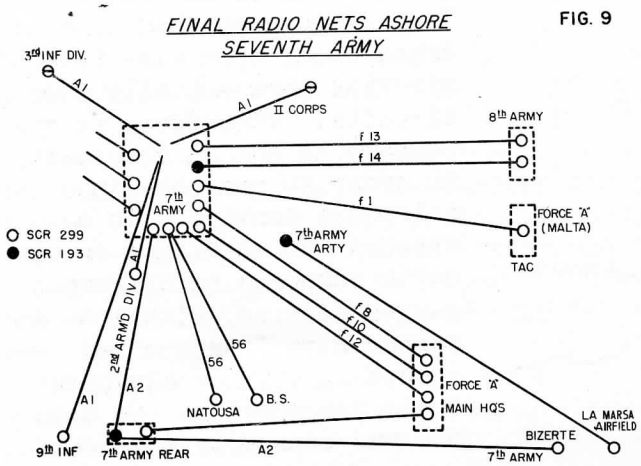


FIG. 9

From Gela east to Ragusa -- open wire to British Army (4 circuits).

From Gela north approximately 25 miles -- Spiral-4 cable to II Corps, 45th Division and 1st Division, and open wire to Barrafranca (2 circuits).

From Gela west to Licata -- two Spiral-4 Cable and two open wire circuits.

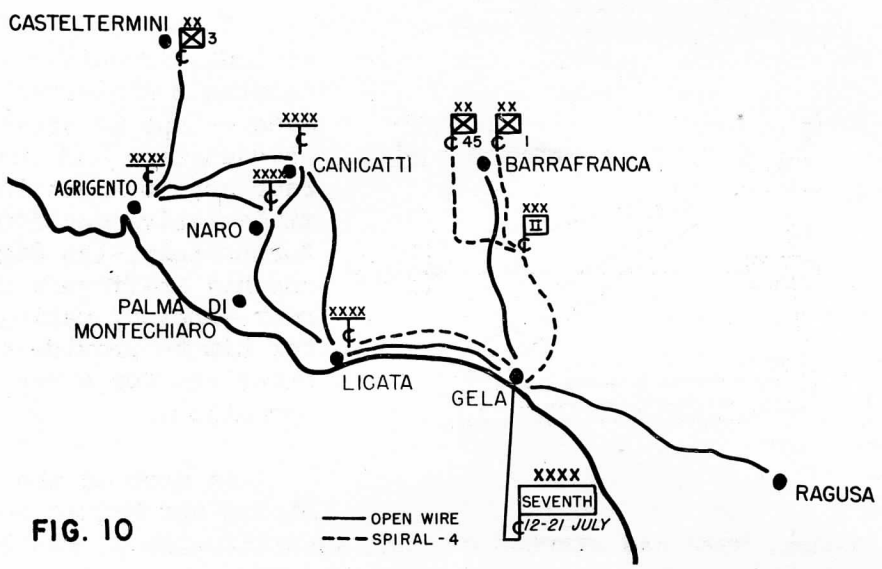


FIG. 10

From Licata north and northwest — open wire to Canicatti, Agrigento and 3rd Division.

During this period, the overclassification and length of messages, together with an insufficient number of radio sets, caused considerable delay in clearing radio traffic.

The advance of the Seventh Army progressed so rapidly that by 18 July moving of the command post was necessary. The city of Agrigento was chosen as the site, signal communication facilities were installed, and the CP opened officially 21 July.

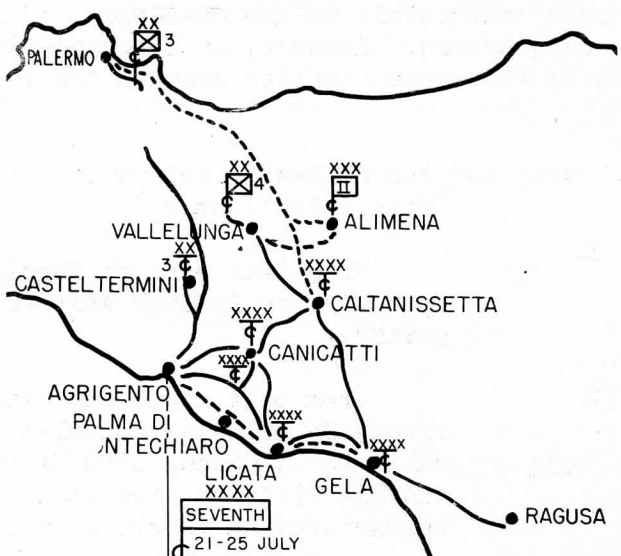


FIG. 11

Again wire crews worked 24 hours daily to keep pace with the advance of the II Corps. They discovered that in some areas local open wire telephone circuits were actually telegraph circuits. Therefore, it was necessary to put in transpositions in order to use the lines for telephone service. In most instances the unbalance on circuits composed of different gauges of wire, with iron and copper wire interspersed, was such that carrier equipment would not operate. So much trouble was caused by this condition

that it was sometimes easier to replace the existing wire plant with new wire.

Sabotage continued. The Spiral-4 Cable between Agrigento and Palma was burned into three times and hacked with an axe five times during one 24-hour period.

Several methods were used to sabotage Spiral-4 cable, such as simply cutting the cable, leaving the ends free, or even cutting the cable and splicing it back incorrectly, to cause cross-circuits. Another method was to hammer the cable between two stones causing breaks in the outer covering and shorts between the conductors. Sometimes when repairmen were sent out at night to make repairs many of them were killed. In some instances orders were issued to shoot any individual found tampering with this cable. One night seven saboteurs were shot.

ITALIAN FIRE DEPARTMENT LADDER HELPS YANKS STRING WIRE

Switching centrals, consisting of one or more Switchboard BD-72 with three operators, were installed at Canicatti, Naro, Licata, Gela and Caltanisetta to give greater flexibility to the wire system.

During the period 21-25 July while the Army command post was at Agrigento, radio communication was extremely difficult due to the poor ground conductivity in the area. Teletype service, established to II Corps and Gela, worked only intermittently, due to the poor grounds, high leakage to ground, and the ever present sabotage.

When Palermo surrendered 22 July it was decided to move the Army CP to that city. Again a dual installation of signal communication facilities was required, one for the tactical headquarters and the other for administrative headquarters. Before the local telephone system could be utilized, considerable rehabilitation was required. The rehabilitation of open wire circuits, which inside the city were mostly placed over the tops of three and four-story buildings, presented a problem. This was solved by the use of the local fire department's extension ladder. Pending completion of the rehabilitation of the open wire leading into the city, a 10-pair rubber covered cable was laid from the main switchboard to the outskirts of Palermo where

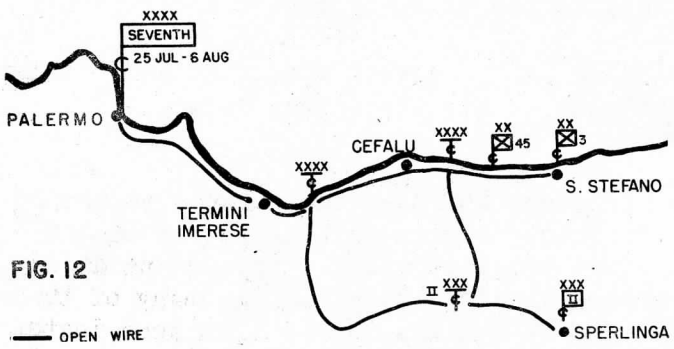


FIG. 12

connections were made to open wire circuits. Through the ingenious use of this expedient by the Signal Corps, efficient signal communications were in operation by 25 July when the Army CP officially opened at Palermo.

During the period 25 July - 6 August signal troops were confronted with a new and more serious handicap in the form of hundreds of land mines (Figure 12). In this area the local wire route, in general, followed the railroad right-of-way. Mines were found along the pole lines and also between railroad ties. Special mine detector crews composed of signal personnel did excellent work in destroying or removing the deadly weapons.

Initially four circuits were reconstructed from Palermo to Cefalu. Signal troops working immediately behind the combat troops then extended two circuits to San Stefano. Laterals to the successive location of II Corps command post were usually open wire circuits. The method of construction shown furnished alternate routes for telephone and teletypewriter service where circuits were interrupted by sabotage or by friendly troops brushing up on their rifle markmanship.

The command post was again moved. This time to San Stefano, where it opened on 6 August. The administrative headquarters remained in Palermo.

Rehabilitation Period 6-15 August (Figure 13)

Rehabilitation of existing circuits continued. By this time several bicycle type railroad hand cars had been converted into motor driven hand cars and they were used to advantage in this rehabilitation. The motors were obtained from captured German motorcycles and installed by personnel of an armored signal battalion.

Laterals to II Corps were in some cases open wire circuits and in other cases Spiral-4 Cable or long range tactical wire. In the rear there were now 8 circuits from Palermo to Cefalu switch --and 6 forward to S. Stefano.

During this period, the Seventh Army had teletypewriter service back to the administrative headquarters at Palermo, to II Corps and to 3rd Division. Scheduled and spe-

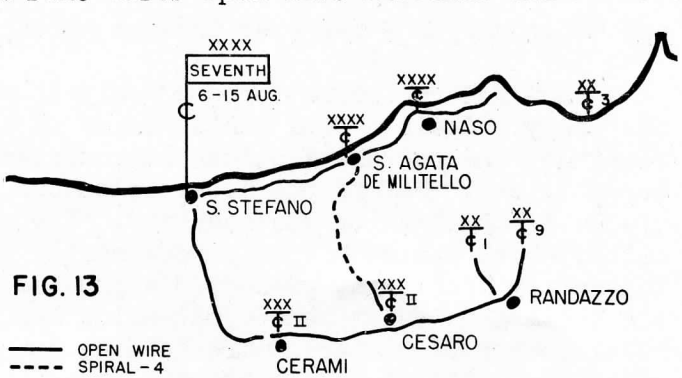


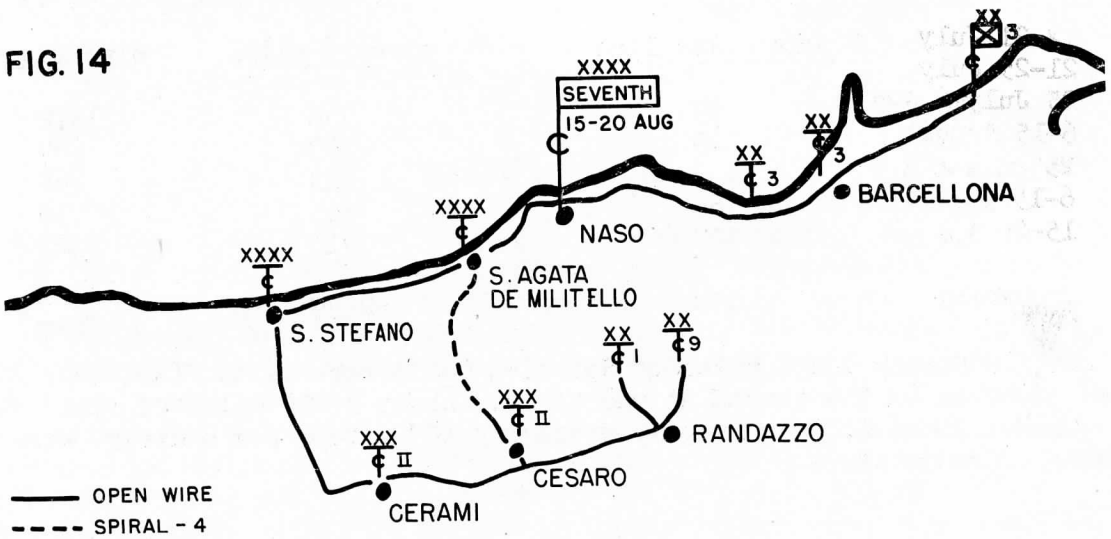
FIG. 13

cial motor messenger service was also available to these units. Special air messenger service, using Cub planes of the artillery section, was established for a period of three days to II Corps, 82nd Airborne Division at Trapani and to Agrigento. Seven radio sets were in operation at the tactical headquarters at San Stefano and eight at the administrative headquarters at Palermo.

During the action at San Fratello when a regiment of the 3rd Division enveloped the enemy left flank, it was necessary to lay 15 miles of wire over rough terrain. The wire was carried forward by pack animal and then laid by linesmen who had to crawl up rocky slopes. When the latter reached the top of the ridges they had to lay an additional 5 miles by hand.

An attempt was made to use Radio Set SCR-284-( ) as a pack set on these land envelopments, but the set proved difficult to carry. Furthermore, metallic deposits in the mountain ranges running perpendicular to the coast often make radio contact across the ridges impossible. Under such conditions a

FIG. 14



series of Radio Set SCR-609-( ) placed on peaks and ridges were used as relay stations. In this unusual action the 3rd Division message center was seldom used to handle tactical messages within the Division. Instead it handled Division administrative traffic and tactical and administrative traffic from higher headquarters. Radio and telephone were used almost to the exclusion of other signal agencies.

For the amphibious operation at San Agata on August 8th, one SCR-299 installed in a DUKW and one Radio Set SCR-193 mounted in a jeep, were used. Since trouble was experienced in getting the DUKW ashore (low railroad underpasses), two SCR-193's installed in jeeps were used in the landing at Brolo on the 11th.

As mentioned previously both of these landings hastened the Axis re-

treat, and the resulting Seventh Army advance required a fifth move of the command post. This time to Naso, opening there at 1200 on 15 August.

Direct Wire to 3rd Division Period 15-17 August (Figure 14)

It is interesting to note that Seventh Army now had a direct wire line to the 3rd Division which was then under II Corps control. When this Division moved so rapidly on the 16th that wire teams could not keep up with the advance, Army sent an SCR-193 to 3rd Division headquarters to provide direct radio communications. When Messina fell on the 17th, the tactical headquarters moved back to Palermo opening there on 20 August.

From statistical information available, the following table shows the accomplishment of ground signal troops (in rehabilitation activities during the Sicilian campaign):

Wire Phase	Rehabilitation in Miles		
	pole miles line	circuit miles	wire miles
12-21 July	189	756	1512
21-25 July	129	283	567
25 July-6 Aug.	143	343	686
6-15 August	166	365	730
15-20 August	323	710	1421
Total	950	2457	4916

Approximately 1,800 miles of Spiral-4 Cable were laid. (Not over 200 miles of cable on the ground at one time). About 3,000 miles of field wire were used. About 8,300 messages, averaging 107 groups per message, were handled by radio alone.

* * * * * * *

Such accomplishments by Signal Corps personnel could never have been attained without the most proficient planning and the intensive specialized training which preceded the actual campaign. This is brought out in the third part of this article, which will be published in the next issue of the Signal Corps Technical Information Letter.

GROUND CONTROL OF FIGHTER PLANES

In order that the most effective tactical use can be made of fighter aircraft it is essential that the pilot be given sufficient navigation and tactical information during a mission to enable him to successfully complete the operation and return to his home base. Since fighter aircraft, due to space and weight limitation, carry only a minimum of radio and navigation equipment, ground equipment must be used to provide this information.

Communication equipment for the ground control of fighter operations provides the following facilities: ground-to-air and air-to-ground radio communication, position fixing, and homing. These facilities together with information received from associated detection equipment provides sufficient information and means by which a ground controller (intercept officer) can direct such operations. Equipments being supplied for this purpose are the following: Control Set SCR-572-( )/SCR-642-( ); Radio Set SCR-573-( )/SCR-643-( ); Radio Set SCR-574-( )/SCR-644-( ); Radio Set SCR-575-( )/SCR-645-( ). The 570 series are mobile sets; the 640 series, fixed.

CONTROL FACILITIES

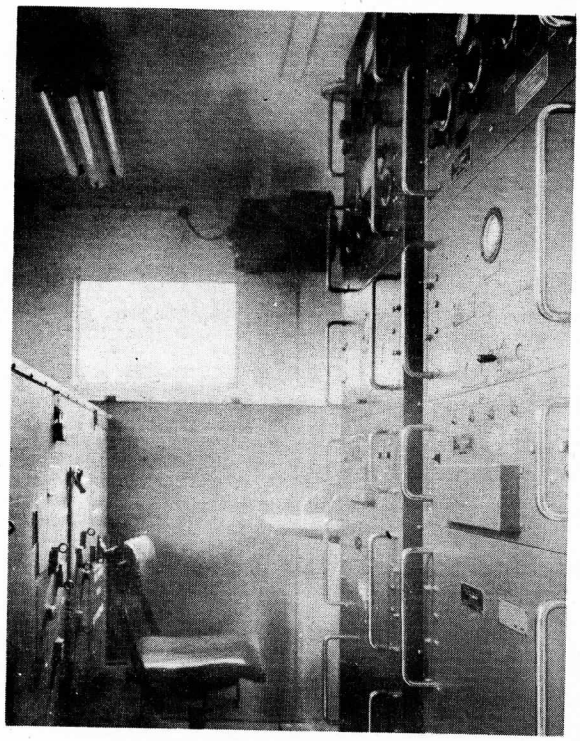
Control Set SCR-572-( )/SCR-642-( ) provides a central control position from which point the intercept officer communicates directly with the aircraft pilot through the use of the transmitters and receivers of the respective stations. Data from the D/F station Radio Set SCR-575-( )/SCR-645-( ), and also from associated detection equipment, is transmitted onto the plotting boards and provides the intercept officer with information as to the location of all friendly and enemy aircraft operating within the area covered by the reporting equipment. Control facilities are also provided in the control set which permits the use of a T-R channel by the homing D/F operator. (This is further described under Radio Set SCR-575-( ).) Three telephone Switchboard BD-72 are used in handling the necessary telephone circuits.

Control Set SCR-572-( ) is transported and operated in Trailer K-55-( ); however, Control Set SCR-642-( ) is intended for fixed installation in shelters not part of the radio set.

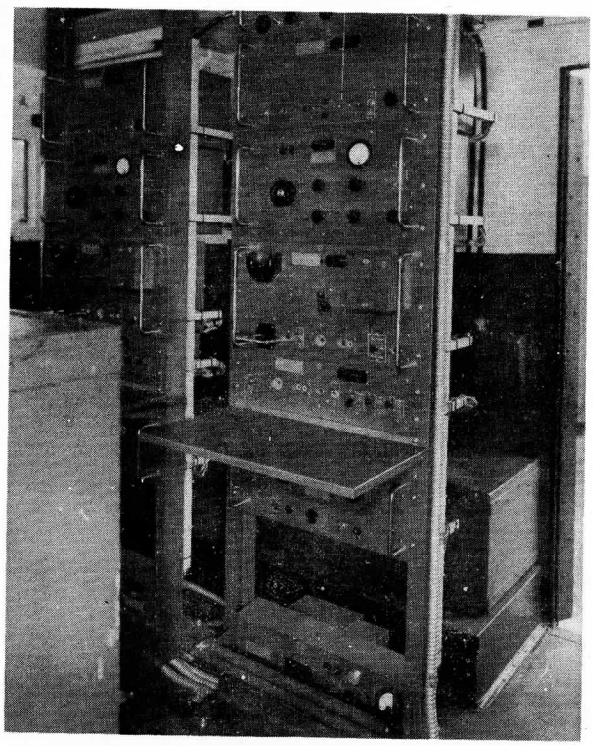
TRANSMITTER EQUIPMENT

Radio Set SCR-573-( )/SCR-643-( ) is the transmitter station providing complete radio transmitting facilities for simultaneous operation on two pre-selected frequencies in the 100-156 mc band. Two Radio Transmitter BC-640-( ) provide these radio channels. The input speech circuits to the transmitter which originate from the control set are connected through the Control Unit RM-27-( ) which permits the local attendant to monitor these

circuits. Facilities are also provided at this control unit for intercommunication. Although only two transmitters are contained in the SCR-573-( )/ SCR-643-( ), the control unit has provisions for patching five incoming lines to any 5 of 6 transmitters. In a normal installation three transmitter sta-



RADIO TRANSMITTERS BC-640 AND EQUIPMENT CABINET OF SCR-573



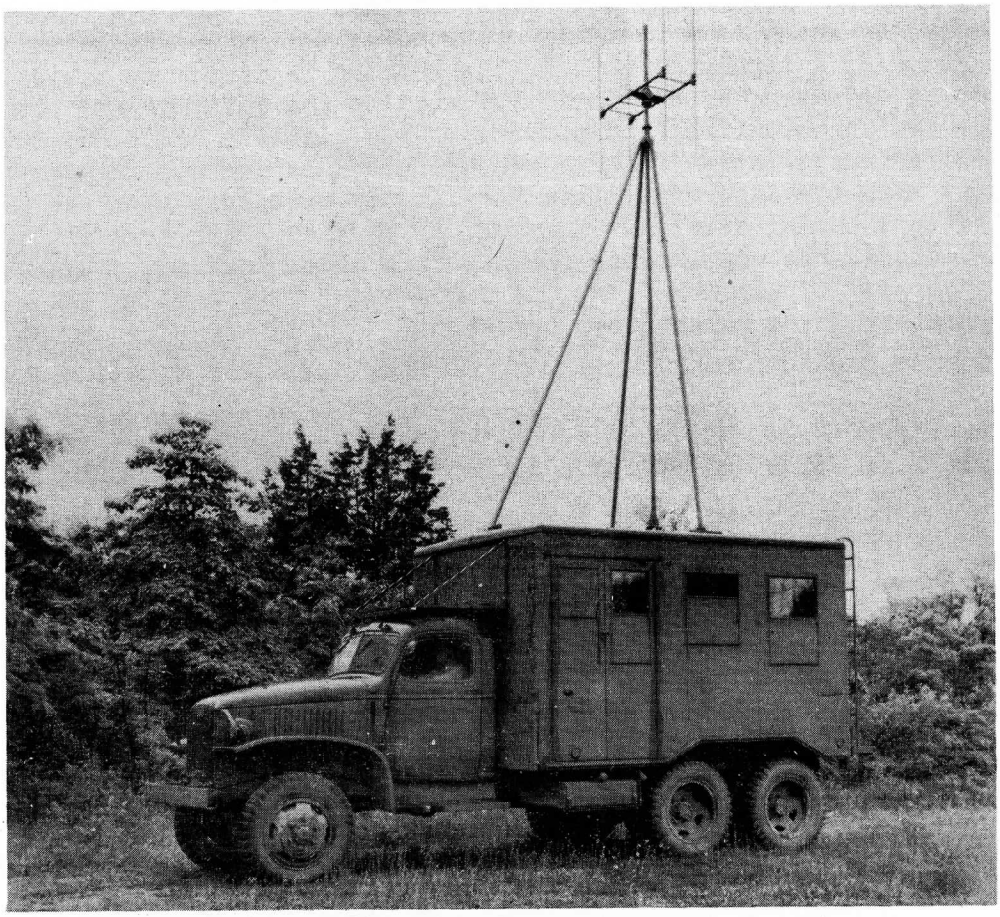
RADIO RECEIVING EQUIPMENT RC-72, PART OF SCR-574

tions are used which provide six radio channels (5 in use, 1 spare). Radio Set SCR-573-( ) is transported and operated in Truck K-53-( ). Shelter for Radio Set SCR-643-( ) is not part of the radio set.

The BC-640-( ) is a crystal controlled single frequency 50-watt transmitter capable of continuous operation on voice or MCW.

RECEIVING STATION

Radio Set SCR-574-( )/SCR-644-( ) is the receiver station providing complete radio receiving facilities for simultaneous operation on two preselected frequencies in the 100-156 mc band. Two Radio Receiver BC-639 are supplied with this set. The BC-639-( ) is a continuously tunable superheterodyne receiver of conventional design, capable of receiving voice modulated or CW signals. Since the receiver is not crystal controlled, a crystal controlled Frequency Meter BC-638-( ) is provided to facilitate accu-



RADIO DIRECTION FINDING STATION SCR-575

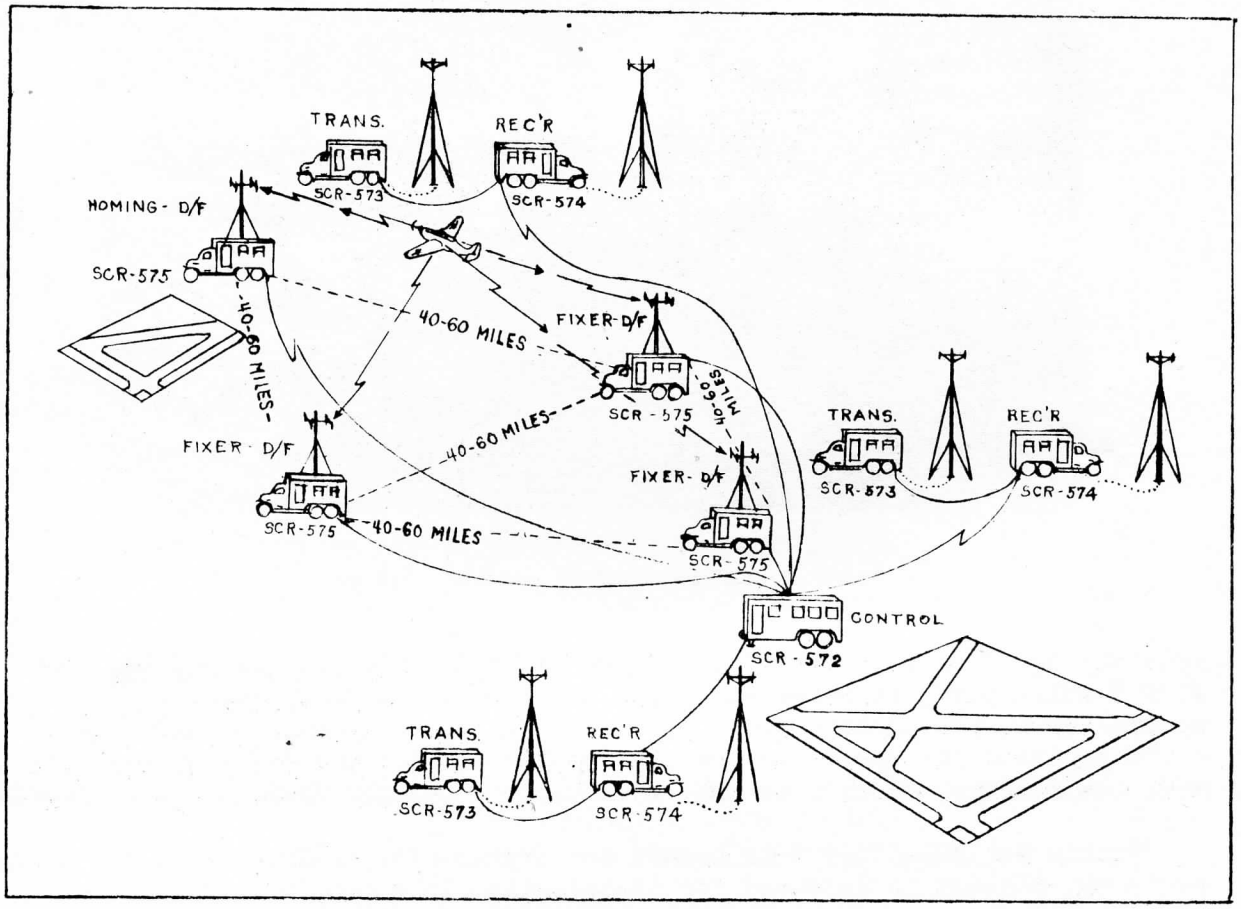
rate tuning. The receiver circuits are connected through Control Unit RM-23-( ) which provides means for local monitoring and intercommunication with controller at the control set. The radio set also provides a local operator's position for operating one transmitter station SCR-573-( )/SCR-643-( ) with the receiver station to make a complete 2 channel Trans-Receiver Station.

Radio Set SCR-574-( ) is housed and transmitted in Truck K-53-( ) while Radio Set SCR-644 is intended for installation in a housing not part of the set.

DIRECTION FINDING

Radio Set SCR-575-( )/SCR-645-( ) is the direction finding station which provides facilities for fixing and homing of VHF-equipped aircraft. A manually rotatable adcock antenna feeding into a Radio Receiver BC-639-( ) provides means for taking azimuth bearings on voice or tone modulated or CW

signals from the aircraft. 180 degree ambiguity of bearings thus taken is eliminated by means of a manually operated switching mechanism which provides means of determining whether the bearing is "true" or reciprocal. When the set is operating as a "fixer" D/F station the bearings are transmitted to control set for plotting. Components of the airborne Radio Set SCR-522-( ) adapted for installation in this set are provided for use in communicating directly with the aircraft. This facility is necessary when the radio set is used as a homing station. However, if the low power transmitter of the SCR-522-( ) is not adequate to provide this communication, a transmitter-receiver channel of the SCR-573-( ) and SCR-574-( ) is made available to the D/F operator by the control set operator.

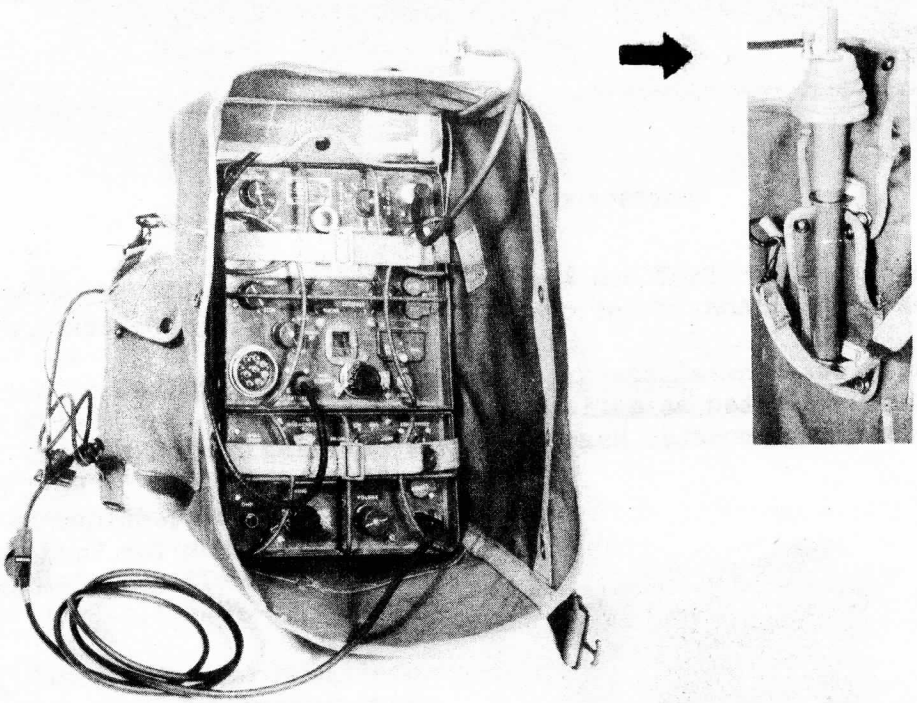


VHF FIGHTER CONTROL SYSTEM

This diagram of a typical VHF fighter control system was originally known as the mobile Control Net System SCS-3. Because of different tactical and geographical considerations that make no two systems alike in the proportion of the components, nomenclature was dropped and the system is now issued in varying quantities of components as required.

RADIO SET SCR-694-( )

Radio Set SCR-694-( ) was developed by the Signal Corps and tested by the Infantry Board, the Airborne Command, the Mountain and Winter Warfare Board and other units as a substitute for Radio Set SCR-284-( ). In July 1943, Radio Set SCR-694-( ) was classified as Standard to replace Radio Set SCR-284-( ) in various uses where weight is at a premium as for Airborne and Mountain units. Tables of organization and equipment have recently been



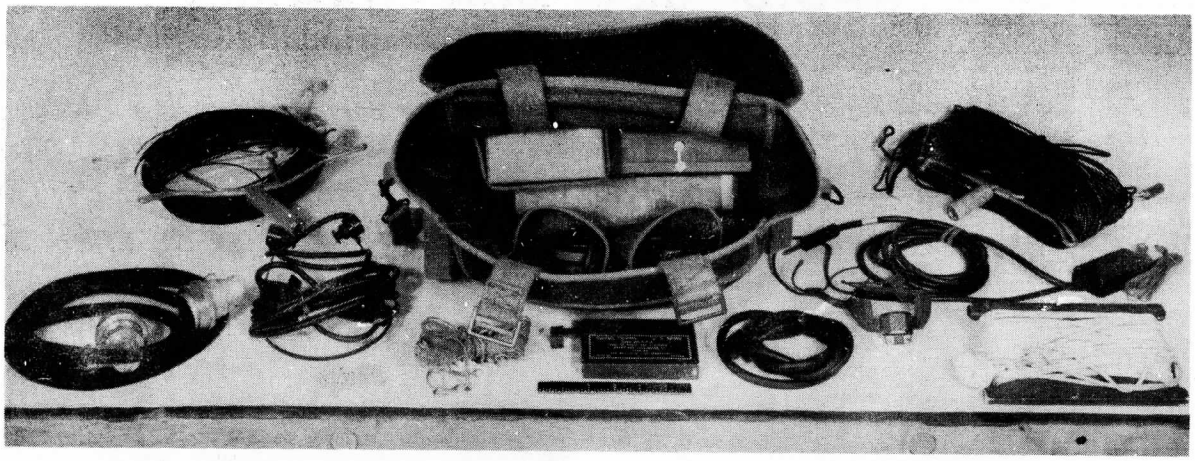
RADIO RECEIVER AND TRANSMITTER BC-1306-( ). NOTE DETAIL OF ANTENNA MOUNTING AT RIGHT

amended to specify Radio Set SCR-694-( ) as the desired equipment and Radio Set SCR-284-( ) as the substitute equipment on all Tables which authorized issue of Radio Set SCR-284-( ). Radio Set SCR-284-( ) has been reclassified as Limited Standard.

The basis of issue of Radio Set SCR-694-( ) appears on T/A and T/O-E as of 1 March 1944 as follows:

> **T/O-E numbers 1-618, 1-987, 6-50-1, 11-7, 44-77, 11-147S and T/A numbers 7-1 and 7-4.**

The components of SCR-694-( ) include various power supplies and necessary accessories for operation as a vehicular station and as a field station.



ACCESSORIES FOR RADIO SET SCR-694-( )

The components for field use are lightweight and capable of being made up into individual loads of not over 30 pounds each for man-pack transportation.

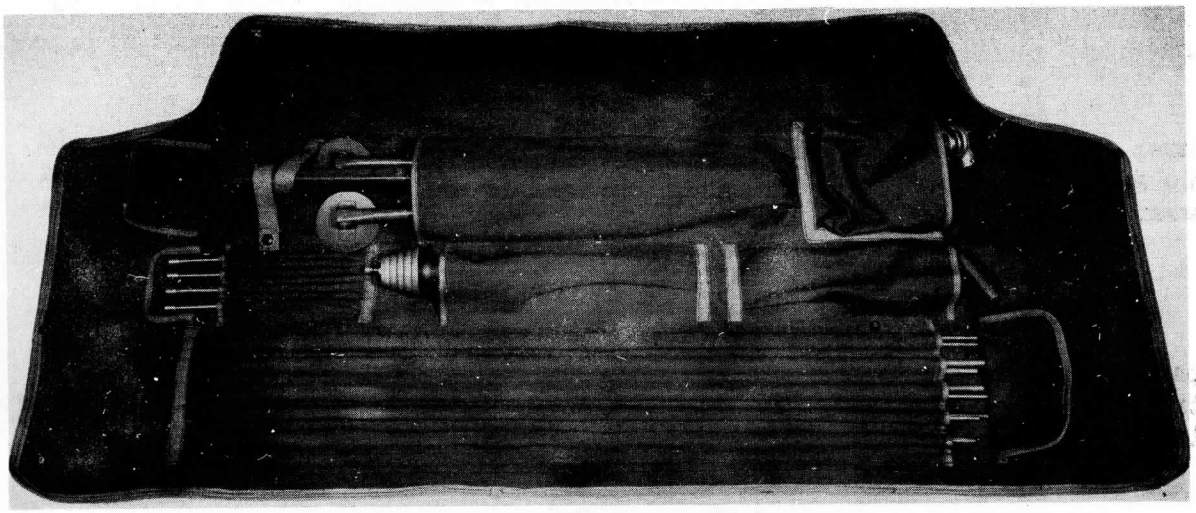
Waterproof canvas bags are provided for carrying the components of SCR-694-( ) when operated as a field station as follows: Bag BG-172 for carrying accessory components, Bag BG-173 for carrying Radio Receiver and Transmitter BC-1306-( ), Roll BG-174 for carrying mast sections as well as legs and crank for hand generator, and Bag BG-175-( ) for carrying Generator GN-58-( ).

BAG BG-173 FOR RADIO RECEIVER AND TRANSMITTER BC-1306-( ). NOTE POCKET FOR HANDSET

Radio Set SCR-694-( ) has a master oscillator and in addition has arrangements for two crystal controlled channels. It is proposed to furnish crystals for SCR-694-( ) in kits separately from the radio sets and two kits are now under consideration, as follows:

1. Crystal Kit MC-535 which is a divisional kit containing ten duplicate crystals on each of 270 channels for operation of Radio Receiver and Transmitter BC-1306-( ) on frequencies 3,800 kc to 6,490 kc with 10 kc separation.

2. Crystal Kit MC-537 which is a training kit containing ten duplicate crystals on each of twenty



MAST SECTIONS AND GENERATOR LEGS AND CRANK, PACKED

selected channels for operation of Radio Receiver and Transmitter BC-1306-( ) on frequencies in the band of 3,800 to 6,490 kilocycles.

The set has the following characteristics:

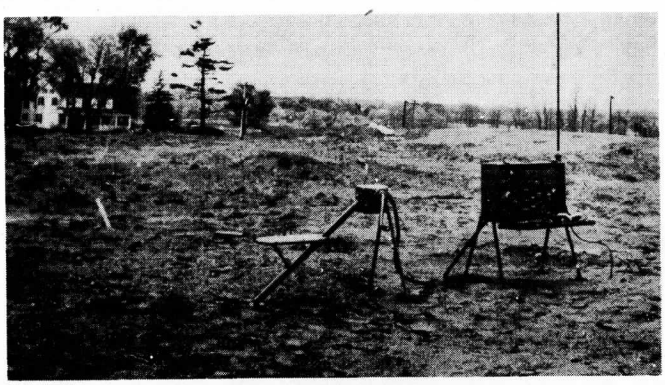
Frequency Range: Continuously variable from 3,800 to 6,500 kc.

Types of Transmission and Reception: Transmits and receives CW, MCW and amplitude modulated voice.

Oscillator: Master oscillator and crystal control, with two preset crystal controlled channels.

Nominal Range: Vehicular operation - 7 miles voice, 15 miles CW; field operation - 15 miles voice, 30 miles CW.

Power Supply: Vibrator Power Supply PE-237-( ) for operation from 6, 12, or 24 volt vehicular battery, for transmitter and receiver; Generator GN-58-( ) for transmitter and receiver, for field use; dry cell batteries for receiver standby, for field use only; portable vibrator power pack for transmitter and receiver, with self-contained 6 volt storage battery, under development.



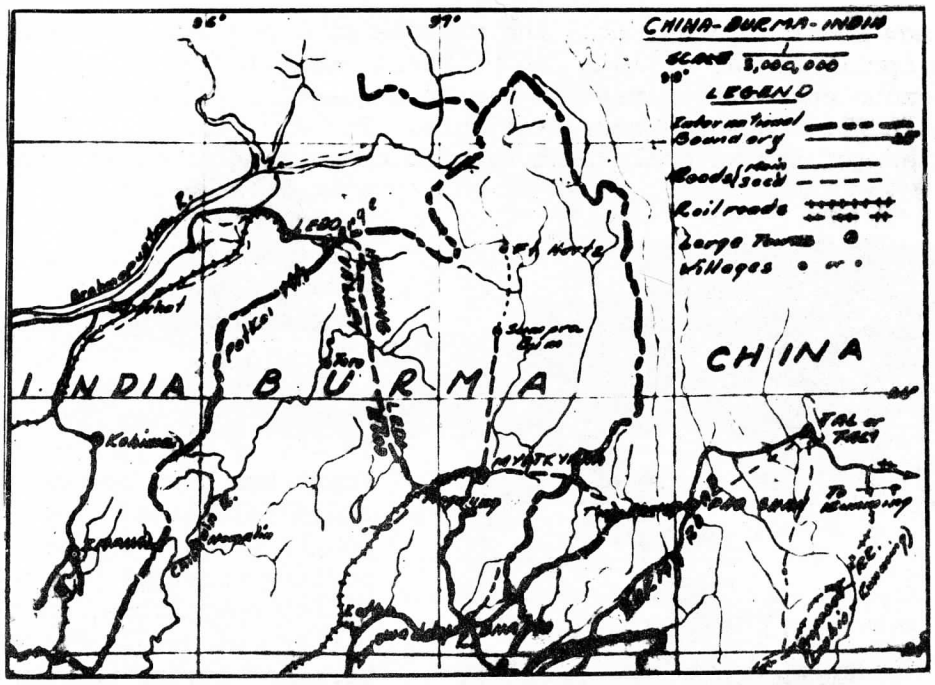
RADIO SET SCR-284 PREPARED FOR FIELD OPERATION

Weight (as Pack Set): Transmitter - receiver, approximately 28 pounds. Generator accessory components (two bags), approximately 30 pounds. Antenna, generator legs, etc., in bag, approximately 18 pounds.

Antenna: Whip antenna for vehicular use; whip antenna for field use; and Antenna AN-160, a long wire antenna for field use, sectionalized to afford various length antennas, requires installation between supports available in field (no masts included).

Power Output: Approximately 30 watts CW, 7 watts modulated.

Special Features: Shock mounting for vehicular installation; panel guard; capable of remote control (equipment not included); components treated for protection against moisture and fungi; sidetone; high-medium-low power control; antenna resonance indicator.



SIGNAL COMMUNICATION - BURMA

As American, British and Chinese troops under General Stillwell move into and through Burma one of their most urgent needs is adequate signal communication.

In considering the signal communication aspects of this campaign it must be remembered that Burma is almost as large as Texas, that there were no motorable roads, railroads or wire communication lines leading from India into Burma before 1943, and that the north Burma terrain over which Allied forces are driving is as wild, mountainous and overgrown as any island in the South Pacific. Until these forces, entering Burma from the west, can establish a line of communication across northern Burma to western China all troops, equipment and supplies must come from India over ancient trading and opium smuggling trails or be shipped in by air.

Radio, then, must provide the initial signal communication channels by which tactical control of these forces is maintained and over which calls for air and ground support, supplies, medical aid and all other requirements must be sent.

Although radio is now the primary means of communication, combat troop units are also installing some tactical field wire nets and an open wire pole line is following the new "Ledo Road" into northern Burma.

RADIO COMMUNICATION IN BURMA

It now seems apparent that the unsuccessful Anglo-Chinese defense of Burma in April and May of 1942 can be attributed, in part, to a shortage of signal communication equipment and an inadequate coordination of the communication facilities which were available. The experiences of the 1942 Burma campaign and of the several South Pacific operations have, at least, provided a basis on which to plan the signal communications for this latest Burma operation and a proving ground for signal equipment in jungle operations.

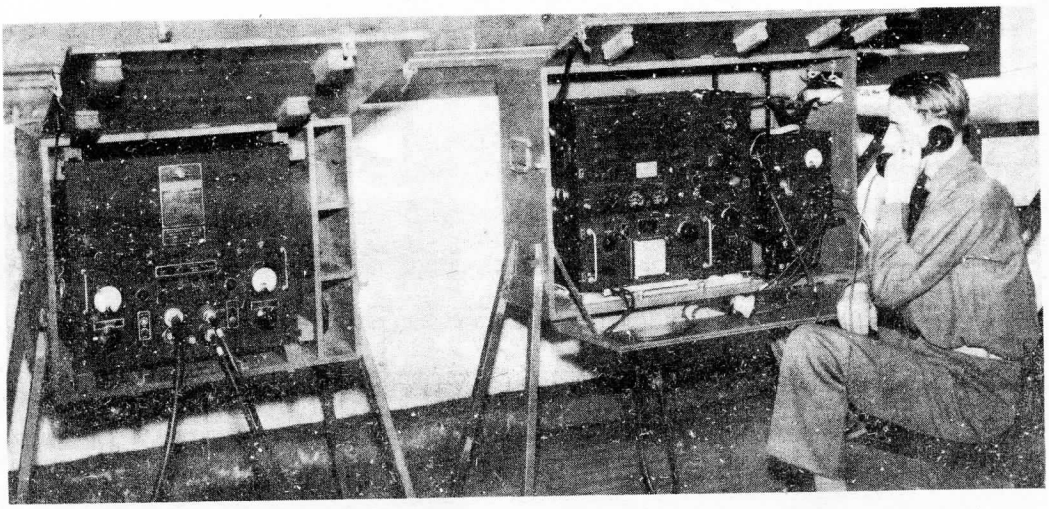
THE ROAD - BACK - 1942

There is, however, one radio problem that has not been solved in any of the jungle operation. There has been no cure for the radio "blackouts" peculiar to jungle areas. One observer, reporting recently on the Hukawng valley operations, describes the pattern of jungle "blackout" determined during the period from November 1943 into January 1944.

"Throughout the day, and in the early part of the evening radio communication between Ledo-Tagap (60 airline miles) and Ledo-Chinglo (75 airline miles) was uniformly good," he said. "At 2300 all readable signals would fade abruptly and for two hours no readable signals could be received at either end of the circuits. At 0100 the signal would begin to return and by 0130 reception would be normal. This cycle continued for three days, with practically no variance in the 'blackout' period.

"On the 4th day the cycle began at 2200 and ended at 0030 and on the 8th, 12th, 16th, 20th and 24th days following the cycle shifted back another hour. When the hour of darkness (1700 - November to January) was reached, there was no fading for 48 hours. At the end of 48 hours the cycles started again, from 2300, and followed the same pattern for the next 24 days. All possible means were tried of regaining communication during these periods but without success."

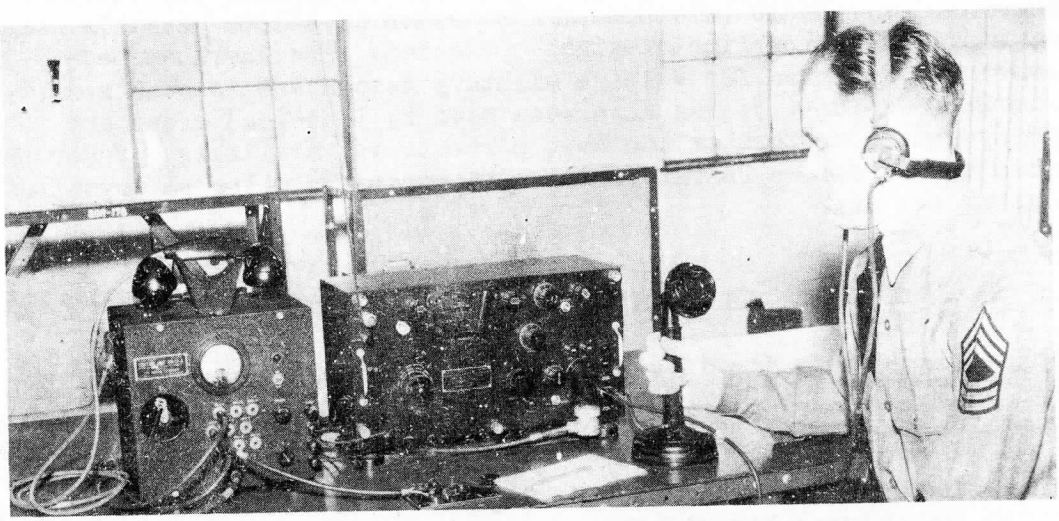
Early in 1943, when U.S. Army Engineer troops began construction of the Ledo Road through the Patkai range on the India-Burma border, radios



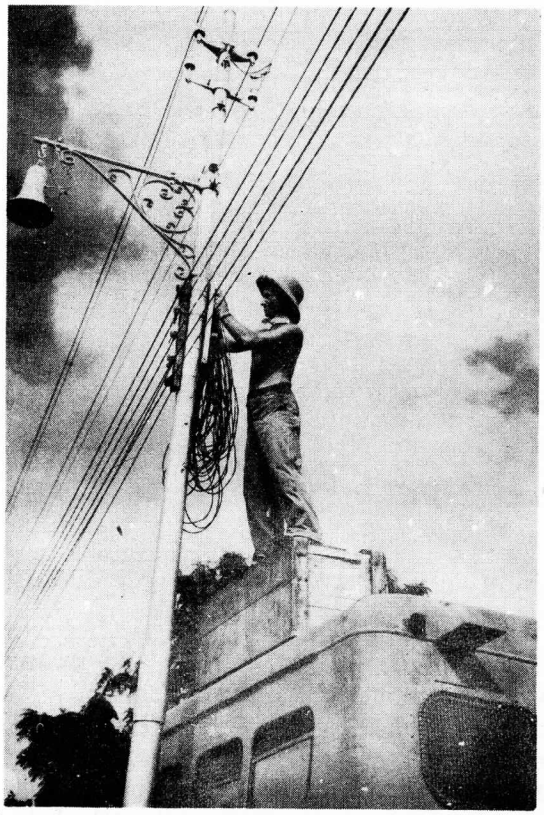
TRANSMITTING POSITION, SCR-188-A

were employed to maintain communication between survey, clearing and construction parties in the forward area, and the headquarters at rear echelon. Man and pack carried sets were employed by forward echelons, and vehicular sets at headquarters echelons. The lessons learned in other jungle areas as to the best means of protecting equipment from dampness during transportation (waterproof bags) were employed here. In selecting sets for each echelon it was necessary to balance the weight of field radios against their power, since there was no point in sending a man packed set forward that was not capable of reaching headquarters, or of attempting to move a vehicular set through overgrown mountain terrain.

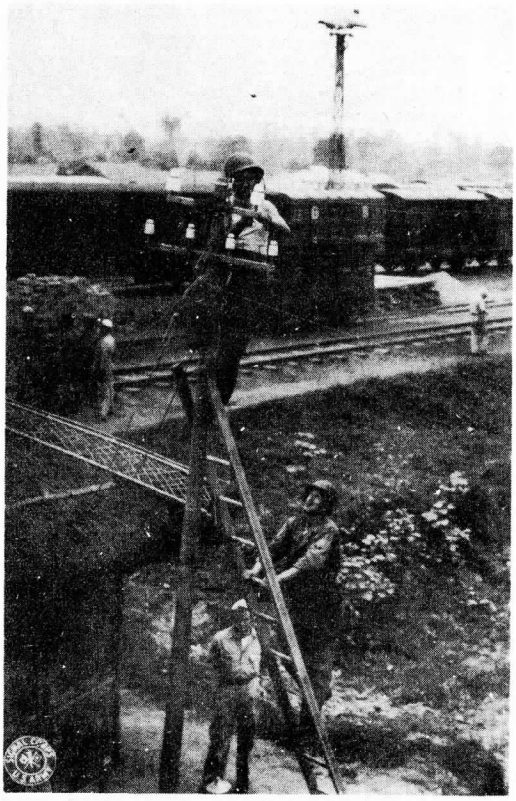
Radio Set SCR-188 is mentioned favorably as a forward echelon set and



RECEIVING POSITION, SCR-188-A



POLE LINE IN THE CBI THEATER



OVERHEAD LINES PARALLEL RAILROAD

Radio Set SCR-299-( ) are used at headquarters to the rear. The whip antennas of both sets are replaced with "end fed" (long wire) antennas to give the sets greater range. Even with this change it is necessary to site the sets on the highest elevation in the vicinity of the bivouacs to obtain good key transmission. Radio telephone transmission is seldom possible, except between stations having line-of-sight operation. The American made V-100 set, which was designed for Chinese military forces and is most nearly similar to Radio Set SCR-284-( ), has also been used by Ledo Road crews and is considered by some operators as the best portable set available. Under the most favorable conditions — in this area — it worked 75 miles on crystal frequencies during the day.

LEDO ROAD OPEN WIRE POLE LINE

This pole line is the first of several which will parallel military highways to be built in Burma as the Japs are driven out, and will tie together military circuits at Chabau, India, and Kunming, China, when completed.

This line is being built by U.S. Signal Construction personnel, aided by British and Chinese technicians, and employing Indian, Chinese and Burmese laborers. At present it provides wire communication for engineering forces

constructing the Ledo Road and for Chinese-American tactical forces driving south through the Hukawng valley.

Recent reports on this communication project indicate that, because of the terrain and climate, much of the pole setting must be done by hand, without the aid of the pole hole digger on Truck K-44-( ) and the derrick on the light construction Truck K-43-( ). Line construction officers report that 6x6 cargo trucks have been able to negotiate steep grade and rice paddies along the right of way equally well and that these trucks — with improvised derricks or "A" frames — must be used when the going becomes too rough for 1½ ton, 4x4 line trucks.

The dense grained hardwood poles used on this line are secured locally through British military channels. Although class 9, 25-30 foot poles are ordered, those received vary greatly in diameter and their weight ranges from 500 to 1000 pounds each. Construction officers hope that native pine logs may be obtained further along the route. The only American poles that have been brought into the area are 60-65 foot antenna masts.

SIGNAL CORPS CRYSTAL UNITS

Crystal units are employed in a large number of Signal Corps equipments. The function of the crystal unit in general terms may be one of the following:

Calibration:	Crystal used as a standard of frequency.
Filter:	Crystal used as a band pass filter, usually in a receiver intermediate frequency stage.
Transmitter Crystal:	Crystal used to directly control or stabilize a transmitter output frequency.
Receiver Crystal:	Crystal used to "spot-tune" a receiver to receive a specific input frequency.
Special:	Miscellaneous applications of crystal units in special circuits to perform unusual operating or test functions.

Signal Corps equipment may specify either a commercial type crystal unit or one of the Signal Corps types. The majority of equipments employ Signal Corps types. The following chart lists the various Signal Corps types of crystal units, the major equipments, the crystal-using components thereof, the general function of the crystal unit, the approximate range of crystal frequencies, the approximate range of channel frequencies and some additional data including the relationships of crystal frequency, F_x, to channel frequency F_c.

It should be understood that as a general rule a different crystal specification prevails for each different equipment and that crystals of the same type are not interchangeable in different equipments. The present exceptions to the rule are as follows:

DC-11, DC-16, DC-26, CR-1 DC-24, CR-2/U, FT-243 in receiver sections of BC-611 and BC-721, FT-243 in BC-620 and R-19/TRC-1, -3, -4.

SIGNAL CORPS CRYSTAL UNITS

APRIL 1944

NOMENCLATURE	USING SCR-	COMPONENT BC-	FUNCTION	XSTAL FREQ Fx	CHANNEL FREQ Fc	ADDITIONAL DATA
DC-4	194	222	CAL. XSTAL	3500 KC		
DC-5	195	322	CAL. XSTAL	5000 KC		
DC-6		312, 342	I.F. FILTER	470 KC		
DC-8	274N	696	CAL. XSTAL	3500 KC		
DC-8	274N	457	CAL. XSTAL	4600 KC		
DC-8	274N	458	CAL. XSTAL	6200 KC		
DC-8	274N	459	CAL. XSTAL	8000 KC		
DC-8	240	338	TRANS. XSTAL	3-8 MC.	3-8 MC.	$Fx = Fc$
DC-8	240	225	RECR. XSTAL	2520-8480 KC	3-8 MC.	$Fx = Fc \pm 480$
DC-8	261	353	TRANS. XSTAL	3-8 MC.	3-8 MC.	$Fx = Fc$
DC-8	261	352	RECR. XSTAL	2520-8480 KC	3-8 MC	$Fx = Fc \pm 480$
DC-8	I-86		CAL. XSTAL	4700 KC	470 MC	$Fx = \frac{Fc}{100}$
DC-8	RC-139	901	TRANS. XSTAL	201, 219 KC	201, 219 KC	$Fx = Fc$
DC-9	211	221	CAL XSTAL	1000 KC		
DC-10	183, 283	C-182, C-184	TRANS. XSTAL	4-5 MC	4-5 MC	$Fx = Fc$
DC-11	522, 542	625	TRANS. XSTAL	5.0-8.7 MC	100-156 MC	$Fx = \frac{Fc}{18}$
DC-11	522, 542	624	RECR. XSTAL	5.0-8.7 MC.	100-156 MC	$Fx = \frac{Fc - 12}{H}$ IN MC, H = 11 TO 18
DC-11	AND VARIOUS	638	CAL. XSTAL	5.0-8.7 MC	100-156 MC	
DC-11	OTHER EQTS.	640	TRANS. XSTAL	5.0-8.7 MC	100-156 MC	$Fx = \frac{Fc}{18}$
DC-12	284	654	CAL. XSTAL	200 KC		
DC-13	241	303	TRANS. XSTAL	201 KC	201 KC	$Fx = Fc$
DC-14	241	303	TRANS. XSTAL	219 KC	219 KC	$Fx = Fc$
DC-15	506	652	CAL. XSTAL	200 KC		
DC-16						SAME AS DC-11 ELECTRICALLY
DC-17	AN/MRN-1	751	TRANS XSTAL	6016-6138 KC	108.3-110.3 MC	$Fx = \frac{Fc}{18}$
DC-17	AN/CRN-2	751	TRANS. XSTAL	6016-6138 KC	108.3-110.3 MC	$Fx = \frac{Fc}{18}$
DC-18	808, 828	923	CAL. XSTAL	1000 KC		USES HEATER
DC-19	808, 828	923	CAL. XSTAL	1000 KC		NO HEATER
DC-20	RC-103	733	RECR XSTAL	5633-5744 KC	108.3-110.3 MC	$Fx = \frac{Fc - 6900}{18}$
DC-21	IE-21	I-161	CAL. XSTAL	245.895 KC		
DC-22	718	788	TRANS. XSTAL	98.356 KC		
DC-23	I-208		CAL. XSTAL	500 KC		
DC-24	284	654	CAL. XSTAL	200 KC		REPLACES DC-12
DC-24	583	1209	CAL. XSTAL	200 KC		
DC-24	694	1306	CAL. XSTAL	200 KC		REPLACES DC-15
DC-24	506	652	CAL. XSTAL	200 KC		
DC-24	AN/TRC-2	1306, RT-12/TRC-2	CAL. XSTAL	200 KC		SAME AS DC-11 ELECTRICALLY
DC-26						
DC-28	518, 618	1028	TRANS. XSTAL	81.968 KC		
DC-30	274	950	TRANS. XSTAL	5556-8667 KC	100-156 MC.	$Fx = \frac{Fc}{18}$
DC-31	274	942	RECR. XSTAL	3879-6213 KC	100-156 MC	$Fx = \frac{Fc - 6900}{24}$ KC
DC-34	543	669	TRANS. XSTAL	1690-4440 KC	1690-4440 KC	$Fx = Fc$
DC-35	543	669	RECR. XSTAL	2075-4055 KC	1690-4440 KC	$Fx = Fc + 385$ UP TO 4050 KC
						$Fx = Fc - 385$ ABOVE 4080 KC
DC-37	694	1306	TRANS XSTAL	1900-3245 KC	3800-6490 KC	$Fx = \frac{Fc}{2}$
CR-1						SAME AS DC-11 ELECTRICALLY
CR-2/U						REPLACES DC-24, DC-23
FT-243	509, 510	620	TRANS. XSTAL	5706.7-8340 KC	20-27.9 MC	$Fx = \frac{Fc - 2880}{3}$ KC
FT-243	609, 610	659	TRANS. XSTAL	5675-8650 KC	27-38.9 MC	$Fx = \frac{Fc - 4300}{4}$ KC.
FT-243	511	745	TRANS. XSTAL	3-6 MC	3-6 MC	$Fx = Fc$
FT-243	511	745	RECR. XSTAL	3455-6385 KC	3-6 MC	$Fx = Fc + 455$ KC
FT-243	536	611	TRANS. XSTAL	3.5-6 MC	3.5-6 MC	$Fx = Fc$
FT-243	536	611	RECR. XSTAL	3955-6450 KC	3.5-6 MC	$Fx = Fc + 455$ KC
FT-243	585	721	TRANS. XSTAL	3995-5500 KC	3995-5500 KC	$Fx = Fc$
FT-243	585	721	RECR. XSTAL	4450-5955 KC	3995-5500 KC	$Fx = Fc + 455$ KC.
FT-243	300	1000	SPECIAL	6815-7300 KC		2 MIXING OSCILLATORS
FT-243	RC-103	733	RECR. XSTAL			SAME AS DC-20
FT-243	ME-13, ME-73	VO-4	SPECIAL	2880-4300 KC		

SIGNAL CORPS CRYSTAL UNITS

APRIL 1944

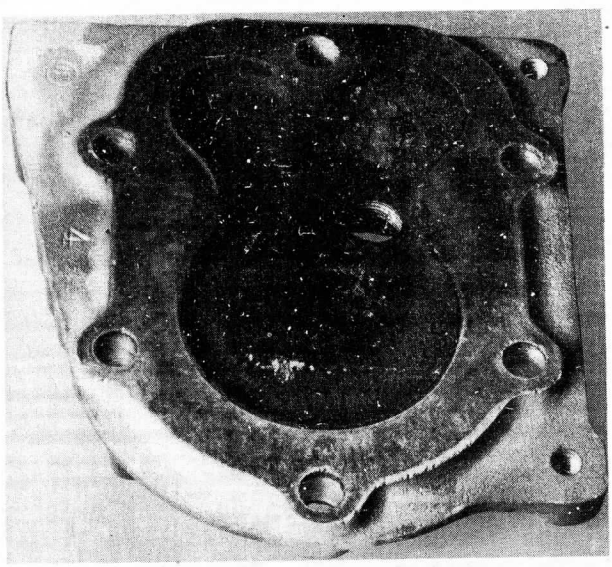
NOMENCLATURE	USING SCR-	COMPONENT BC-	FUNCTION	XSTAL FREQ. F_x	CHANNEL FREQ F_c	ADDITIONAL DATA
FT-243	ME-40	VO-6	SPECIAL	4300 KC		
FT-243	583	1209	TRANS. XSTAL	3000-4030 KC	3000-4030 KC	$F_x = F_c$
FT-243	583	1209	RECR. XSTAL	3455-4485 KC	3000-4030 KC	$F_x = F_c + 455$
FT-243	I-222		CAL. XSTAL	5000 KC.		
FT-243	AN/TRC-1,3,4	R-19/TRC-1,3,4	RECR. XSTAL	6500-7975 KC	70.0 TO 99.9 Mc	$F_x = \frac{F_c - 5000}{10}$ FROM F_c=70-82.5 $F_x = \frac{F_c - 5000}{12}$ FROM F_c=82.6-94 $F_x = F_c$ FROM F_c = 2-4 Mc $F_x = \frac{1}{2} F_c$ FROM F_c=4-12 Mc $F_x = \frac{1}{4} F_c$ FROM F_c=12-18 Mc
FT-171-B	299, 399, 499	610	TRANS. XSTAL	2-4 Mc	2-18 Mc.	
FT-171-B	245	223	TRANS. XSTAL	2210-3510 KC	2210-3510 KC	$F_x = F_c$
FT-171-B	197-F	325-F	TRANS. XSTAL	750-2250 KC	1500-18000 KC	$F_x = \frac{F_c}{2}, \frac{F_c}{4}$ OR $\frac{F_c}{8}$
FT-171-B	293	500	TRANS. XSTAL	625-875 KC	20-28 MC	$F_x = \frac{F_c}{32}$
FT-171-B	293, 294	499	RECR XSTAL	3750-5750 KC	20-28 Mc	$F_x = \frac{F_c - 5000}{4}$ KC
FT-171-B	293, 294	499	I.F OSC.	5456 KC		
FT-171-B	298	LINK 25,35 UFM	TRANS. XSTAL	937.5-1250 KC	30-40 MC	$F_x = \frac{F_c}{32}$
FT-171-B	298	LINK 11-UF	RECR. XSTAL	3125-4375 KC	30-40 Mc	$F_x = \frac{F_c - 5000}{8}$ KC
FT-171-B	298	LINK 11-UF	I.F OSC.	5456 KC		
FT-164		329	TRANS. XSTAL	200-410 KC	200-410 KC	$F_x = F_c$
FT-164		339	TRANS. XSTAL	2-4 Mc	4-26.5 Mc	$F_x = \frac{F_c}{2}, \frac{F_c}{4}, \frac{F_c}{8}$
FT-164		400	TRANS. XSTAL	4166.67 KC	75 Mc	FIXED FREQ. $F_x = \frac{F_c}{18}$
FT-164		447	TRANS. XSTAL	1750-3350 KC	4-13.4 Mc	$F_x = \frac{F_c}{2}, \frac{F_c}{4}$
FT-164		446	TRANS. XSTAL	200-400 KC	200-400 KC	$F_x = F_c$
FT-164		319	TRANS. XSTAL	2-4 Mc	4-13.4 Mc	$F_x = \frac{F_c}{2}, \frac{F_c}{4}$
FT-164		797	TRANS. XSTAL	4666-4889 KC	126-132 Mc	$F_x = \frac{F_c}{27}$
FT-164	RC-52	452	TRANS. XSTAL	1.7-4.5 Mc	1.7-9.0 Mc	$F_x = F_c, \frac{F_c}{2}$
FT-164	RC-139	901	TRANS. XSTAL	201, 219 KC	201, 219 KC	$F_x = F_c$
FT-249	Z81	441	DUAL	1700-2750 KC	1700-2750 KC	$F_x = F_c$ FOR TRANS. XSTAL $F_x = F_c + 385$ BELOW F_c = 2360, $F_c - 385$ ABOVE 2360 FOR RECR XST
FT-249		315	TRANS. XSTAL	2-4.525 Mc	2-18.1 Mc	$F_x = F_c, \frac{F_c}{2}, \frac{F_c}{4}$
FT-249		401	TRANS. XSTAL	1.0-4.525 Mc	2-18.1 Mc	$F_x = \frac{F_c}{2}, \frac{F_c}{4}$
FT-249		460	TRANS. XSTAL	1000-4000 KC	2.0-16 Mc.	$F_x = \frac{F_c}{2}, \frac{F_c}{4}$
FT-241	508, 528	604	TRANS. XSTAL	370-517 KC	20-27.9 Mc	$F_x = \frac{F_c}{54}$
FT-241	608, 628	684	TRANS. XSTAL	375-541 KC	27-389 Mc	$F_x = \frac{F_c}{72}$
FT-241	AN/TRC-1,3,4	F14/TRC-1,3,4	TRANS. XSTAL	730-1040 Kc	70-99.9 Mc	$F_x = \frac{F_c}{96}$
FT-249		642	TRANS. XSTAL	2-5 Mc	4-20 Mc	$F_x = \frac{F_c}{2}, \frac{F_c}{4}$
FT-249		F-4/FRC	TRANS. XSTAL	2-6 Mc	2-18 Mc	$F_x = F_c, \frac{F_c}{2}, \frac{F_c}{3}$
FT-164		328	TRANS. XSTAL	190-400 KC	190-400 KC	$F_x = F_c$
FT-164		330	TRANS. XSTAL	190-400 KC	190-400 KC	$F_x = F_c$
FT-164		340	TRANS. XSTAL	2-4 Mc	4-26.5 Mc	$F_x = \frac{F_c}{2}, \frac{F_c}{4}, \frac{F_c}{8}$

GASOLINE ENGINE DRIVEN POWER UNITS

In general, power units up to and including 2.5 KW in capacity are powered by air cooled engines and those above, by liquid cooled. All engines, with the exception of the "Jeep" engine in the PE-95-( ) and the two-cycle Jacobsen engine used in the PE-214, are commercial models, designed during peacetime, to peacetime standards. Their use was necessary in order to obtain the large production needed at that time by the Army. These engines were designed to operate on the poorer grades of gasoline and, in some cases, were not too conservatively rated.

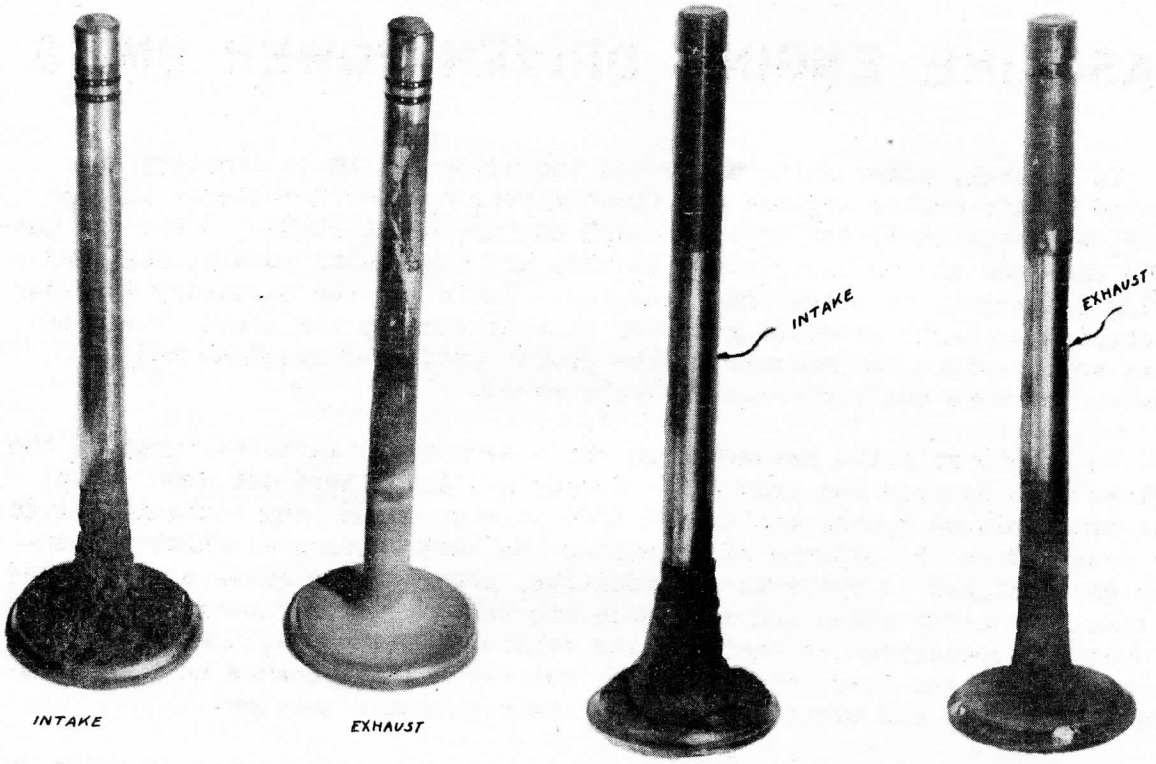
To obtain relative freedom from early mechanical failures, most of the engines were derated for Army use. Speeds and loads were cut down — in most cases piston speeds are around 1200 ft/min — and long mechanical life was obtained at the expense of upsetting the heat balance at which the engine was designed to operate. In addition, power unit engines are operated at nearly constant speed and very moderate velocities of vaporized fuel and products of combustion so that, unlike vehicular engines with wide variations in speed and load, these engines get very little chance to free themselves of carbon and other deposits in the combustion chamber.

As a result of these conditions, lead, bromine, and carbon deposits in the top of the cylinders and head, after a period of time, either short the spark plug or cause one of the valves, usually the exhaust valve, to stick and burn, thus producing an engine failure.



CYLINDER HEAD AFTER 153 HOURS OF OPERATION ON 80 OCTANE GASOLINE

EXHAUST VALVE AFTER 488 HOURS RUN ON 80 OCTANE GASOLINE



HARDENED STEEL VALVES AFTER 3,610 HOURS RUN ON NON-LEADED GASOLINE

STELLITE VALVES AFTER 1200 HOURS RUN ON 80 OCTANE GASOLINE

This problem is being vigorously attacked in a number of ways. However, only those ways which involve engine modifications will be dealt with here, the others being indicated under the "Fuel and Lubricant" discussion.

It was found early in the testing of engines for power units that the sticking and burning of the exhaust valves was the most frequent and earliest occurring fault in the average engine. Increasing the tension of the valve spring, so that it would hit the seat hard and displace any deposit that might have formed on the seat, sometimes enabled the running of the engine nearly twice as long between overhauls. Thus, increasing the valve spring tension to prevent the exploding mixture passing through the leaking exhaust valve should be one of the first field changes attempted. New power units will incorporate the stronger springs as well as longer valve travel which also has been found to be important in obtaining longer engine operating periods between stoppages.

New engines will also incorporate Stellite exhaust valves and seats as rapidly as the stelliting facilities of the U.S. can be expanded to meet production needs. In addition, Stellite replacement valves and seats will be made available to the field as rapidly as possible. With Stellite, the operating time between overhauls is appreciably raised — sometimes up to 250 percent of that previously obtained. With the exhaust valve alone stellited and not the seat a large percentage of this improvement is obtained. These

data on increased engine operating time apply to engine failures caused by valve failure. As will be shown, other causes can operate as quickly, if less permanently, to cause engine failure.

Thus, on the new power units to be supplied, stronger valve springs, greatest valve lift, and Stellite exhaust valves and seats will be provided. On engines already in the field the stronger valve springs and the Stellite exhaust valves and seats should be installed as soon as possible after they become available.

Since a large number of power units will not be reached in time by this procedure, the only relief against random engine failures in most cases will be a well organized program of "preventative maintenance." Every Signal Corps power unit is now being run at the Signal Corps laboratories and periodically examined to determine what should be done, and when, so that proper attention at the right time will take the place of unexpected failure. This program is still underway but in the meantime the following schedules for the care of engines based on operating time is recommended:

Small 2 cycle engines:

a. Clean plugs once every 24 hours
b. Inspect intake and exhaust ports every 24 hours and clean as required

Small 4 cycle engines:

a. Inspect plugs every 24 hours
b. Inspect plugs, valves and brush out carbon accumulation every 48 hours

Medium sized water-cooled engines, such as PE-95:

a. Inspect plugs every 100 hours
b. Remove heads and brush out carbon every 250 hours

As soon as the more detailed maintenance program is available it will be widely disseminated and should do a good deal to insure reliable communications.

FUELS AND LUBRICANTS

As indicated above, most of the engines used in power units were intended to operate from the poorer grades of gasoline. At present all power units in the field, other than a few in the Zone of Interior, are being operated on 80 octane gasoline which contains up to 3 c.c. of tetraethyl lead. At the constant speeds and low temperatures of power unit engines, not only is the lead not consumed, but the bromine compounds put into the gasoline to insure combustion of the lead appear as deposits in the combustion chamber. These deposits stick the valves so they burn and, being metallic in nature, also short the spark plug preventing ignition in the cylinder. This is attended by knocking and loss of power.

If it is possible to obtain gasoline of lower octane rating than the 80 octane with 3 c.c. of lead in the field this should be used. Gasolines with octane ratings down to 60 will operate power unit engines satisfactorily providing the lower octane rating is obtained by omitting the tetraethyl lead and not by putting the same amount of lead in a poorer base stock. White gasoline, unleaded gasoline or less highly leaded gasoline than the 80 octane, is available if the theater commander will requisition it.

Some theaters refuse to allow white gas in the field because they fear the problems and confusion which might result if two types of gasoline have to be handled, as well as the fact that white gasoline used in combat vehicles might seriously handicap them. In this case, the maintenance procedure suggested above with frequent cleaning of the spark plugs is the key to successful operation.

The Signal Corps Laboratories have worked for some time on deleading devices to remove the lead from the fuel just before it is used in the unit. Individual units attached directly to the engine and larger plants capable of handling the fuel for a group of units have been developed. Although several of these deleading units have been capable of removing the tetraethyl lead they have almost invariably done so much harm to the fuel in some other way, such as greatly increasing the gum content, that the over-all result was no better than with the lead. Others required so much time and work and involved so much waste that they were obviously impractical.

PISTON CARBON FORMATION AND RING-STICKING CAUSED BY GUM

Efforts to obtain more satisfactory, less heavily leaded fuels of lower octane rating, coupled with preventive maintenance and the engine changes indicated above, will have to be relied upon to produce the desired results. Incidentally, it appears that the storage of fuels for long periods of time increases its gum content many times and makes it even more difficult to obtain proper engine operation than with fresh stocks. An investigation is now being made to determine the importance of this action of stored fuels and specifications have been changed to procure fuels with a lower initial gum content.

The detergent type oils now used as lubricants by the Army employ metallic compounds as inhibitors. While these compounds do a great deal of good in the crankcase, they cause a good deal of harm when they pass leaking

piston rings and burn in the engine head. This is particularly true in the case of two cycle engines where the oil is deliberately added to the fuel and thus must burn. The only remedies are to keep the rings from leaking by careful maintenance, getting oils without detergent compounds from our Allies, or periodic cleaning as previously indicated. The British have distributed both white gasoline and non-detergent type oils in the past. Our gas is better for vehicles but theirs is best for power units.

CONCLUSIONS

To obtain the most satisfactory operation from gasoline driven power units, field units should:

1. Use the tentative preventive maintenance schedule suggested under engines until the more detailed information becomes available.
2. Incorporate the suggested engine modifications -- stronger valve springs and Stellite exhaust valves and seats -- during the first overhaul after the parts are made available.
3. Obtain the more satisfactory fuels discussed under "Fuels and Lubricants." If they are not available, clean up the deposits they leave before they can cause a random shut down when you can least tolerate it.

The Signal Corps Laboratories and a large number of commercial laboratories, engine builders, and oil companies are now doing everything possible to solve the problems involved in keeping power units running. Even partial solutions will be publicized to the field as soon as they become available. Until these solutions are available, however, the program suggested above will help to insure power unit operation. Reports of field failures in sufficient detail to guide the development program will help to produce an early solution.

INTERPHONE VOICE LEVEL

In military aircraft, where the noise level is very high, how loud should interphone speech be for maximum intelligibility?

To answer this question, the Voice Communication Laboratory, Waco Army Air Field, Texas, had groups of aviation cadets read standard word lists (intelligibility tests) over interphone equipment at four different levels of loudness. The four levels were about equally spaced, with conversational speech and shouting at the two extremes. V.U. meters were employed in controlling the loudness levels.

Separate experiments were carried out for each of three different combinations of headphone equipment. Headset HS-23 (Receiver R-14 earphones) was used with both the earphone Cushion MC-162 (large, sponge-rubber type) and the earphone Cushion MC-162-A (small, close-fitting, black-rubber, pad type). The HS-33 headsets (ANB-H-1 earphones) were used only with the MC-162-A cushions. Interphone Amplifier BC-347-C was employed (one with each twelve headsets) to provide a typical interphone set-up.

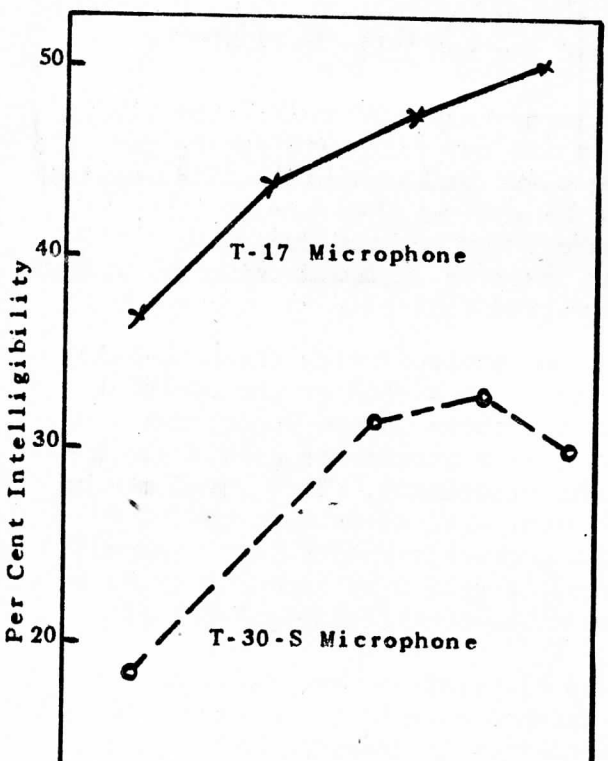


Figure 1. HS-23 Headset in MC-162 Earphone Cushion

In each experiment, the talkers used both the hand-held Microphone T-17 and the throat Microphone T-30-S, while the groups of listeners used one of the above combinations of headset and earphone cushion. Both the talkers and listeners were in the presence of a loud (110 db average level) synthetic airplane noise.

The results of the experiments are shown in the graphs of Figures 1, 2, and 3. In these figures, degrees of intelligibility are shown on the vertical axes and degrees of loudness on the horizontal axes. As seen from the curves, voice intelligibility increased in all cases through the third level of loudness. Two of the three curves for the hand-held microphone indicate a slight increase for the fourth or shouted loudness level.

Most of the planes used in basic pilot training and in naviga-

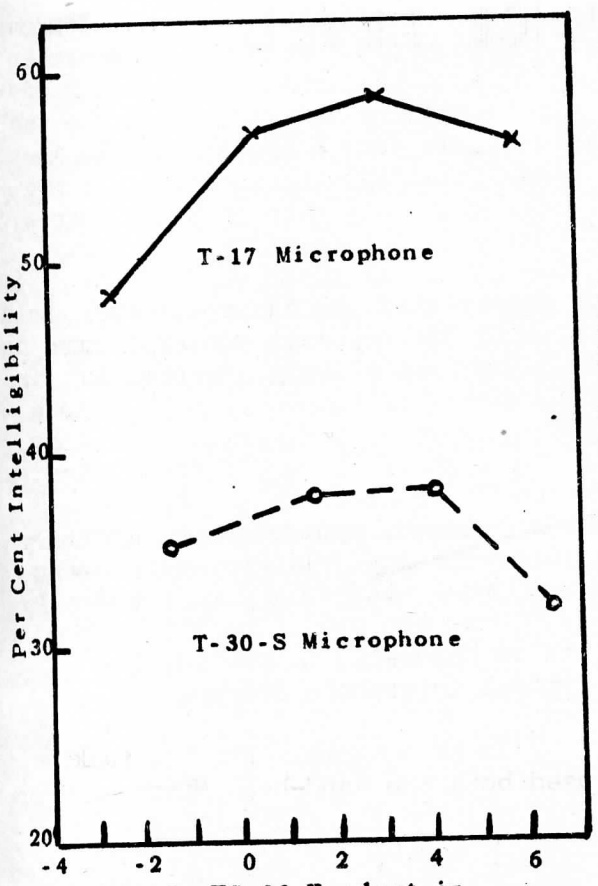


Figure 2. HS-23 Headset in MC-162-A Earphone Cushion

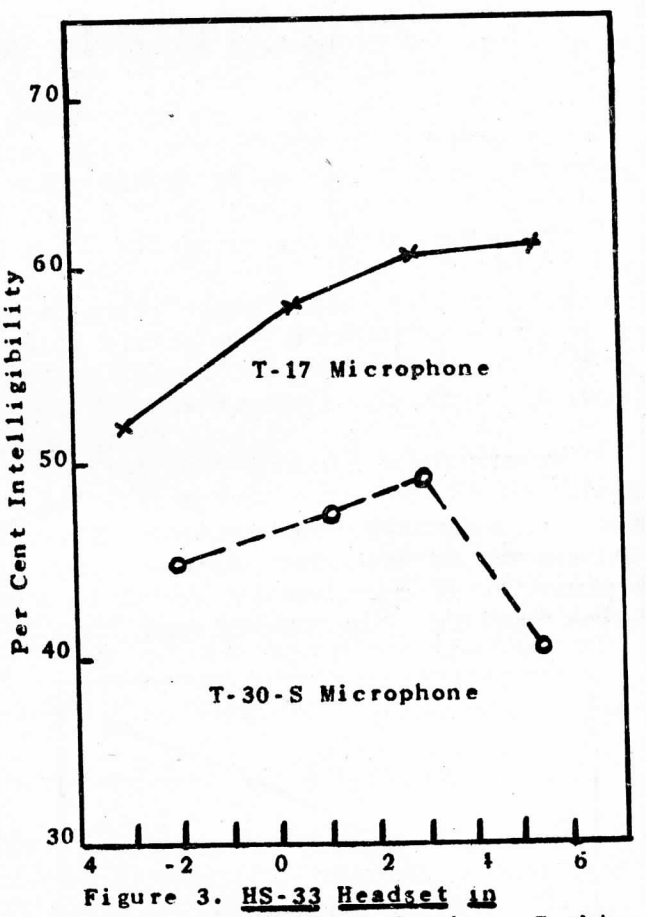


Figure 3. HS-33 Headset in MC-162-A Earphone Cushion

tor and bombardier training programs are now equipped with the hand-held microphone and the HS-23 headset with either the MC-162 or the MC-162-A cushions. This condition is most adequately shown in the upper curves of Figures 1 and 2. With this equipment, a talker should use a loudness approximating that of the third level of the experiment. This level may be described as the loudest that can be produced without extreme effort or noticeable strain. Other training planes currently employ the HS-23 and the throat microphone. In this case, also, a person is most likely to be understood if he talks as loud as he can without straining his voice.

It is expected that, before long, in all training and tactical airplanes, the listener will wear ANB-H-1 earphones, either in Headset HS-33 or in the helmet Headset HS-38. This condition is described in Figure 3. Although the curve for the T-17 microphone shows an increase in intelligibility for the fourth (shouted) level, the increase is too small to be accepted with confidence. Therefore, the recommendation for the HS-33 headset, with either the throat or hand-held microphone, is for a level approximating that of the third level of the experiment, as loud as possible without strain.

INTERPHONE VOICE LEVEL

Training literature and instructors' remarks often refer to the loudness of voice for interphone by using general expressions such as "be conversational," or "be comfortable." It has been found that the best training procedure is not to use such expressions but to require the speaker to use the side-tone in his receiver to gauge his loudness. Every speaker should acquire the habit of using enough voice power, when talking in noise, to produce a "good loud side-tone," a much louder side-tone than is heard when a conversational level is used.

The most intelligible voice is not necessarily the one a listener would judge to be the most pleasant. In fact, with the resonant earphones used in Headset HS-23, some listeners may find the most intelligible voices definitely distasteful. Because of this dislike, these listeners may well believe that they are hearing less well. Actually, however, the results show they hear better.

In summary, the findings of the Voice Communication Laboratory clearly demonstrate that when maximum intelligibility in airplane interphone communication is required a loud voice, substantially louder than that typically recommended, must be employed.

MULTI-CHANNEL RELAY SYSTEM

The multi-channel radio relay communication system was developed in anticipating a need for equipment to supplant or supplement spiral-four cable and repeaters in the Signal Corps multi-channel tactical carrier telephone system where warranted by circumstances. When a survey of existing military radio equipments disclosed no set which met the necessary requirements, Camp Coles Signal Laboratory of the Signal Corps Ground Signal Agency was directed to develop frequency modulated radio sets which would be suitable for use in this system. Figure 1 illustrates the basic wire and radio systems involved and a few of the possible combinations thereof.

The necessity of such a system becomes apparent when the types of tactical operations now in progress are investigated. A few of the types encountered are:

1. Jungle warfare where it is very difficult to lay and maintain wire.
2. Island warfare where it is impossible to install wire between islands.
3. Mountain warfare where the situation dictates a minimum of miles of wire.
4. Rapidly moving situations where the time for installation of communication facilities is at a minimum.
5. River crossings that would create a serious installation and maintenance problem in a wire system.
6. Overwater operations which require that a minimum bulk of equipment be transported because of the premium placed on shipping space and the weight which can be transported, and where conditions permit the use of this system.

The radio relay system is normally composed of two groups of carrier terminal equipment, two radio terminal stations, and three radio relay or "repeater" stations. Each system ordinarily utilizes one Telephone Terminal Set TC-21-( ), one Telegraph Terminal Set TC-22-( ) and two Ringer Set TC-24-( ) at each terminal, and up to five miles of spiral four cable to connect the carrier terminal setup to the radio terminal equipment. The radio portion of the system is composed of two Radio Terminal Set AN/TRC-3-( ) and a number of the Radio Relay Set AN/TRC-4-( ) (the actual number of AN/TRC-4's varies depending on the distance to be covered and the terrain). Figure 2 shows a representative system.

The radio sets AN/TRC-3-( ) and AN/TRC-4-( ) both use as their basic components the Radio Receiver R-19-( )/TRC-1, the Radio Transmitter T-14-( )/TRC-1 and Antenna System AS-19-( )/TRC-1. The difference in the sets lies in the quantity of each component supplied and the spare parts kits and accessories. Table 1 shows the component parts lists of these radio sets.

The Radio Receiver R-19-( )/TRC-1 is a 16-tube crystal controlled superheterodyne receiver designed for the reception of frequency modulated signals generated by Radio Transmitter T-14-( )/TRC-1. Its more important characteristics are:

RELAY SYSTEM

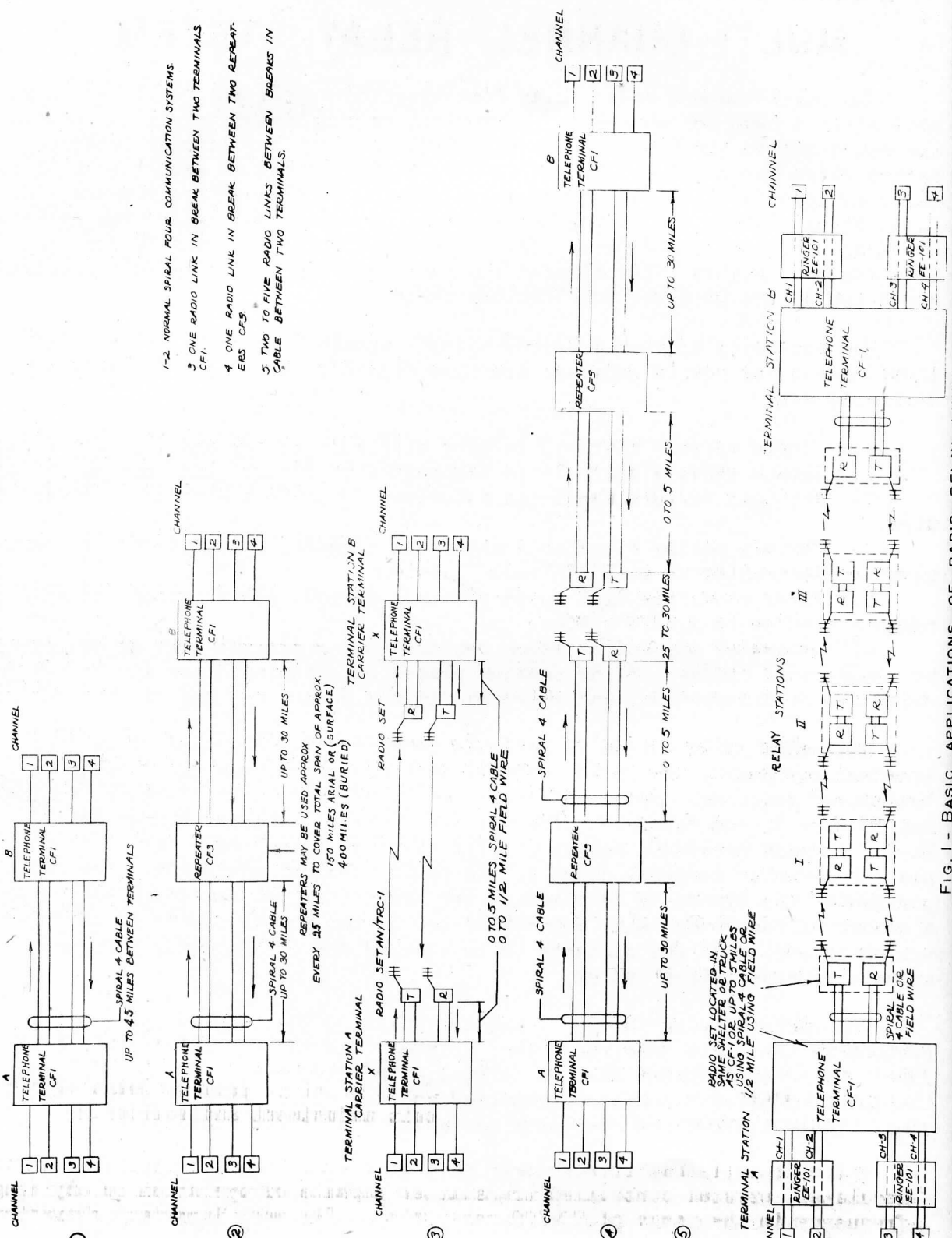


FIG. 1 - BASIC APPLICATIONS OF RADIO RELAY LINKS

RELAY SYSTEM

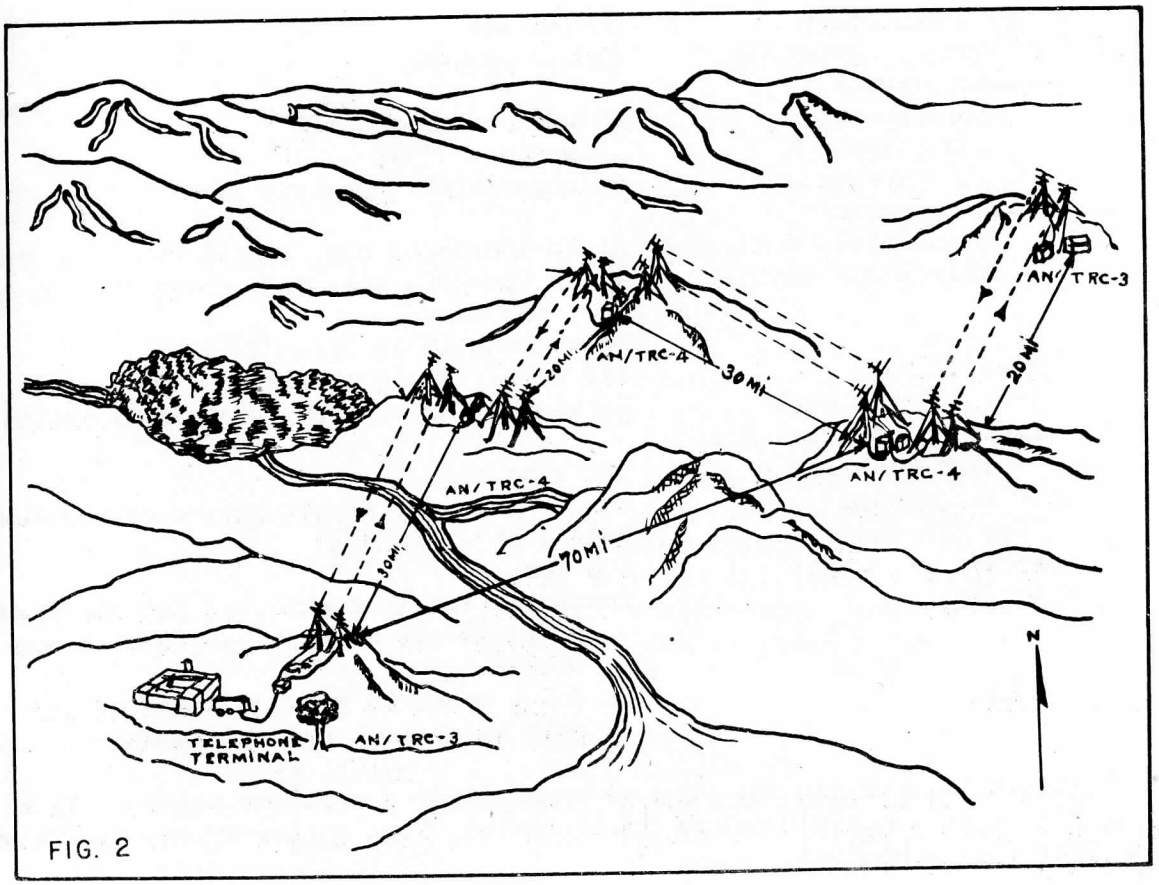


FIG. 2

Frequency range	70-100 megacycles
Frequency deviation	±30 kcs max.
Audio response	High fidelity circuit, ±1 db 200-12000 cps, and low fidelity circuit, ±1 db 200-2500 cps
Mounting	Shock mounted in Case CY-18/TRC-1
Power input	115 volts, 50-60 cycles AC 100 watts
Output impedance	500 ohms
Output level	500 ohm line, 0 dbm normal ±20 dbm max.
Loud speaker	1 watt max.
Size (in case)	22½" x 16" x 17-3/4"
Weight (in case)	95 lbs.
Cooling	Thermostatically controlled fan circulates filtered air when temperature exceeds 75-85° F.
Meter	On front panel to provide means of circuit adjustment and monitoring

The Radio Transmitter T-14-( )/TRC-1 is an 11 tube, 50 watt, frequency-modulated, crystal controlled transmitter capable of operation on any single frequency in the range of 70-100 megacycles. Its more important characteristics are:

FIG. 1 - BASIC APPLICATIONS OF RADIO RELAY LINKS

RELAY SYSTEM

Frequency range	70-100 mcs
Frequency deviation	±30 kc maximum
Power output:	
Full power	50 watts nominal, and
Low power	12 watts nominal
Output impedance	50 ohms into concentric line
Audio response:	
High fidelity channel	±1 db 500-12000 cps, and -3 db at 200 cps
Microphone channel	±1 db 250-2500 cps, and -30 db at 3000 cps and above
Mounting	Shock mounted in Case CY-17/TRC-1
Power input	115 volts, 50-60 cycles AC (300 watts)
Audio input level	Between 0 and -12 dbm for 9 kc deviation
Audio input impedance:	
High fidelity	500 ohms and
Microphone	30-50 ohms for single button carbon microphone
Size (in case)	22½" x 16" x 17-3/4"
Weight (in case)	108 lbs.
Cooling	Thermostatically controlled fan circulates filtered air when temperature exceeds 75-85° F.
Meter	On front panel to provide means of circuit adjustment and maintenance

Figure 3 illustrates one type of transmitter - receiver set-up. This photograph shows a radio terminal installation, less engine-driven generator, completely interconnected.

The Antenna System AS-19-( )/TRC-1 contains all the equipment necessary to erect a three element, horizontally polarized, directional array for use

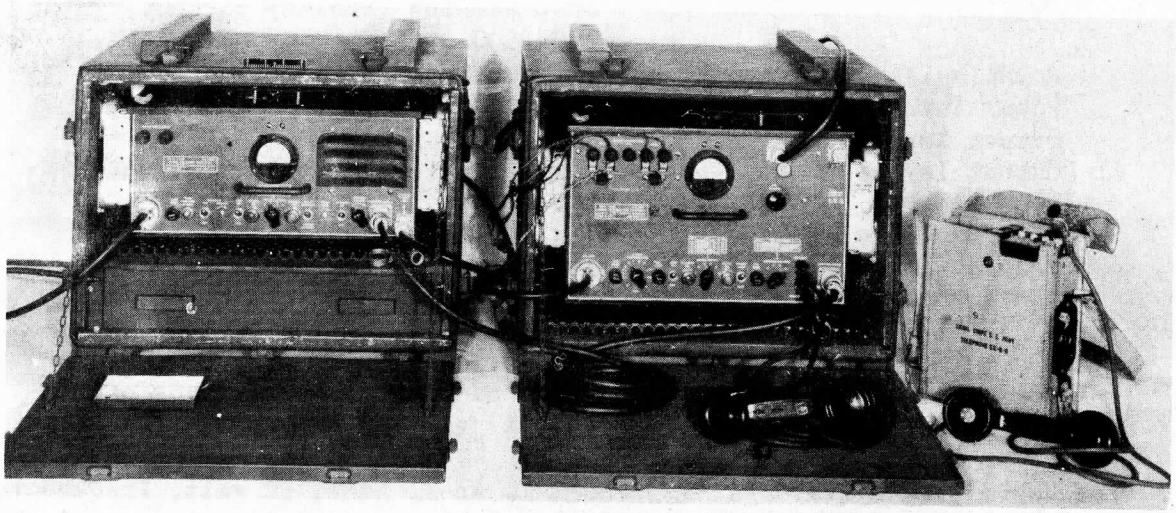


FIG. 3 - TERMINAL INSTALLATION OF RECEIVER AND TRANSMITTER

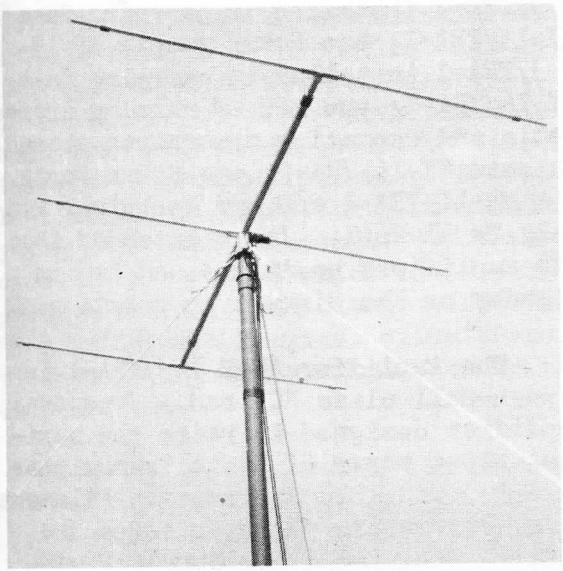


FIG. 4 - ANTENNA ASSEMBLY SHOWING METHOD OF SUPPORTING CABLE

with either the Radio Transmitter T-14-( )/TRC-1 or the Radio Receiver R-19-( )/TRC-1. It includes the adjustable antenna array AS-20/TRC-1, mast, and transmission line with all installation equipment and aids. The complete antenna system is packed in two wooden carrying chests, Case CY-29/TRC-1 and Case CY-30/TRC-1. The mast height is 40 feet. All elements of the antenna are adjustable for resonance at any frequency within the band 70 to 100 megacycles. A table of settings is incorporated in the Technical Manual TM 11-2601. Figure 4 shows the antenna in operating position while Figure 5 shows the radiation pattern of the antenna in the horizontal plane. The packed weight of the two cases is 350 pounds.

Four Amplifier Equipment AN/TRA-1-( ) are supplied with each radio relay communications system. These amplifiers are not used unless a circuit is encountered where the signal strength using only the T-19-( )/TRC-1 is too low to give reliable communication.

Each Amplifier Equipment AN/TRA-1-( ) consists of one Amplifier AM-8-

QUANTITY		DESCRIPTION
AN/TRC-3-( )	AN/TRC-4-( )	
2	3	Radio Receiver R-19-( )/TRC-1 inst'd in Case CY-18/TRC-1
2	3	Radio Transmitter T-14-( )/TRC-1 inst'd in Case CY-17/TRC-1
2	4	Antenna System AS-19-( )/TRC-1
-	1	Control Box C-21-( )/TRC-1 (pkd with Maint. Eqmt. MK-6/TRC-4
2	3	Running spares, tools and operating components
3	3	Power Units PE-75-( )
1	-	Maintenance Equipment MK-5/TRC-3
-	1	Maintenance Equipment MK-6/TRC-4
1	-	Case CY-44/TRC-3 containing 300 rec'ing and 600 trans'ing crystals
3	3	Telephone EE-8-B
1	1	Cord CD-711
1	1	Junction Box JB-110
2	2	Technical Manual TM 11-2601 for AN/TRC-1, 3, 4-( ), AN/TRA-1-( )
6	6	Technical Manual TM-11-900 for PE-75-( )
3	3	Technical Manual for EE-8-B
1	1	Test Set I-56-( )

TABLE I - COMPONENTS PARTS LIST

RELAY SYSTEM

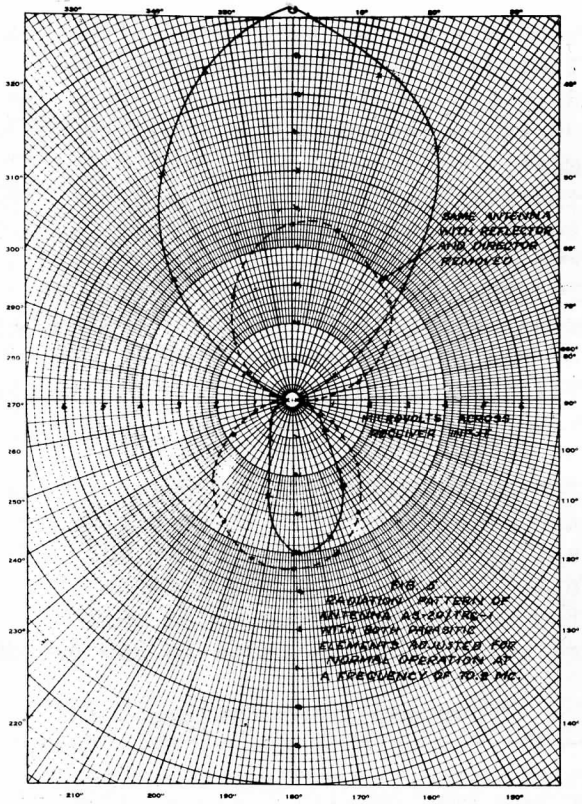


FIG. 4
RADIATION PATTERN OF ANTENNA AS-201/TRC WITH BOTH PARASITIC ELEMENTS ADJUSTED FOR NORMAL OPERATION AT A FREQUENCY OF 70.2 MC.

( )/TRA-1 installed in carrying Case CY-15/TRA-1; one Power Supply PP-13-( )/TRA-1 installed in carrying Case CY-16/TRA-1; one set of running spares, tools and operating components stored in case CY-16/TRA-1; one Spare Parts Kit MK-11/TRA-1 and two Technical Manuals TM 11-2601. It is intended that two amplifiers be in use and two in standby on the circuit in question.

The Amplifier AM-8-( )/TRA-1 is a push-pull class "C" radio frequency amplifier designed to raise the maximum output power of Radio Transmitter T-14-( )/TRC-1 to 250 watts. Filament, bias, screen and plate voltages are furnished by the Power Supply PP-13-( )/TRA-1. The power input is 115 volts, 50-60 cycles AC, 800 watts.

The size of the Amplifier AM-8-( )/TRA-1 in its case is 22½" x 16" x 17-3/4" and the weight in the case is 88 pounds. The size of the Power Supply PP-13-( )/TRA-1 in its case is 46" x 16" x 13½" and its weight in the case is 194 pounds.

The radio relay system with the carrier equipment furnished is capable of simultaneously carrying four duplex teletype circuits and three two-way voice circuits. One or more of the voice circuits may be converted to facsimile service without modification of the equipment. The four teletype circuits are carried on one voice channel of the CF-1-( ) (part of TC-21-( )) while the other three circuits are carried on the remaining three-voice channels. It is usual to carry the teletype on Channel No. 3 because of the necessity for a very low noise level. Since Channel No. 1 transmits voice without inversion it is the only one available without the introduction of extra equipment for communicating with the intervening radio stations of the system. Channel No. 1 is, therefore, ordinarily used for an "order wire" to maintain the necessary routine adjustment and command of personnel. Each radio transmitter and receiver is equipped with filters to prevent interference between this Channel and Channels Nos. 2, 3, and 4. Both the radio terminal stations and the radio relay stations are provided with a handset for use in system adjustment and control. Channel No. 1 is available for general use when the load on the system demands.

IT IS TO BE STRONGLY EMPHASIZED THAT SINCE RADIO IS USED AS A MEDIUM OF TRANSMISSION, THERE IS NO SECRECY AS SUCH ON ANY CHANNEL OF THE SYSTEM; THEREFORE, ANY TRANSMISSION REQUIRING A CLASSIFICATION OF OTHER THAN UNRESTRICTED MUST NOT BE TRANSMITTED OVER THE SYSTEM IN CLEAR TEXT BUT MUST BE ENCODED BEFORE TRANSMISSION.

The military characteristics of the system require that the radio equipment be capable of producing high level communication over a distance of twenty-five miles between stations. It is stressed, however, that there will be topographical considerations which will make possible the use of the equipment over greater distances in some instances while in others it will be necessary to materially reduce the spacing between installations below the nominal design distance. Figure 6 shows profiles of two of the several circuits which have been investigated. Tests made show that Steely's Hill-Neshanic circuit (Figure 6a) which is essentially line of sight gives excellent results under all conditions. The Camp Coles - Fort Dix circuit (Figure 6b) is considered a marginal circuit and, therefore, one in which it would be advisable to install an amplifier on the transmitter located at each end of this circuit.

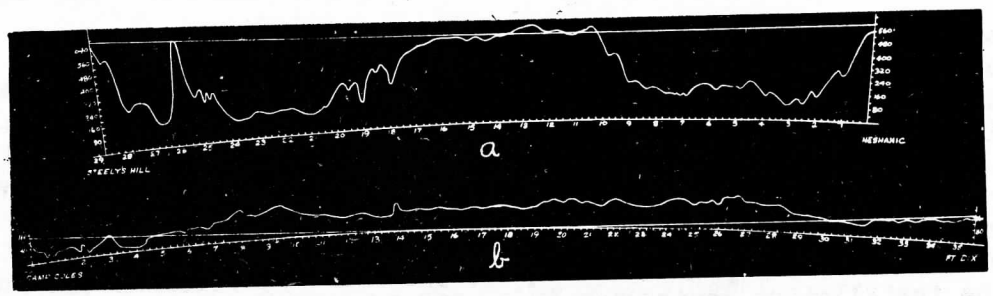


FIG-6 - PROFILES OF TWO CIRCUITS

When a system installation is being planned there are a few considerations which should be kept in mind. These considerations are:

1. Determine from a map study the approximate route of the system and the number of radio installations needed. The route is selected with regard to the advantageous locations for the radio sets, no regard being given to the straight line connecting the two terminals. Since the frequency range of the radio sets falls within the VHF band, the radiation tends to act similar to light. It is, therefore, advisable when possible to have radio line of sight (4/3 optical line of sight distance) between the transmitting and receiving antennas. It is to be pointed out, however, that slight interruptions in the line of sight such as hill tops will not prevent the successful operation of the equipment. A useful formula for the quick estimation of a proposed circuit is $D = \sqrt{2H_t} - \sqrt{2H_r}$ where D is the distance between transmitter and receiver in miles; H_t and H_r are the respective heights in feet of the transmitter and receiver antennas above sea level.

2. Each terminal of the radio relay system is equipped with five miles of spiral four cable to permit installation, wherever practicable, of carrier terminal equipment near the telephone central at the same time permitting the Radio Terminal Set AN/TRC-3-( ) to be located advantageously with regard to propagation sites, and as remote as possible from sources of man-made electrical interference.

3. Select operating frequencies for each leg of the circuit which do not interfere with each other and with those used on other legs of the sys-

tem. The charts furnished in the back of TM-11-2601 were prepared to aid in this frequency assignment.

The system operating team commander should select the actual sites for the radio stations. This is done in accordance with the wishes of the Signal Officer as to the general areas. He should make a map reconnaissance and draw profiles of the circuit if time and equipment are available. Again, if time is available, a ground reconnaissance should be made to select the actual locations, the routes of supply, covered avenues of approach, natural cover for camouflage, space for the erection of antennas, space for quarters, tents, etc. In the case of either a relay or terminal installation the matters of tentage, personal baggage, machine guns, carbines, ammunition, rations, fuel, camouflage nets and finally operating personnel must all be considered in the transportation problem in addition to the radio equipment.

The necessary operating personnel to keep a system in continuous operation includes a minimum team of six FM repairmen for each carrier terminal. In addition, there are two officers assigned to each team. These officers are trained, one in the expert usage and maintenance of the radio equipment and the other trained likewise on the carrier equipment. Totalling the personnel requirements it is seen that 42 enlisted specialists and two officers are required to keep a system in operation 24 hours per day. This minimum of personnel allows man power to adequately handle and assemble the equipment during the installation period and then provides a maximum of two men per watch to adjust, maintain and repair the equipment during the system operation. The matter of supply to the relay stations must be closely coordinated since they will be in positions remote to main traveled roads where possible because of radio noise considerations and will have no officer personnel stationed with them. The terminal stations on the other hand will be near populated areas and will have an officer stationed thereat.

Due to the nature of communications carried by a system with the capability of the one under discussion, extreme reliability is required. For this reason the system has incorporated therein spare units as well as spare components, i.e., a spare transmitter, a spare receiver and a spare engine driven generator are located at every operating point of the radio system. The design of the system is such that when failure occurs, the standby equipment is immediately placed in operation and the operating personnel, who are trained and equipped to perform 3rd echelon maintenance, repair the faulty equipment and place it in standby readiness. The operating personnel, during their watch follow a fixed schedule of adjustment and preventive maintenance.

Tests on several systems indicate that extreme reliability is to be expected. Due to the employment of FM the effect of atmospheric disturbances on the system is minimum. Teletype has been carried without error through a heavy thunderstorm appearing over a terminal as well as over relay stations. Facsimile records under the same conditions are perfectly legible though showing small dots of interference. Telephone conversations carried over the system during atmospheric disturbances are not interfered with to a

noticeable extent.

The complete radio relay system packed for overseas shipment occupies 180 boxes, totalling 1650 cubic feet and weighs approximately 23 tons.

A few systems are now in the hands of troops and others are coming off the production lines in sufficient quantity to take care of the immediate needs and future anticipated requirements.

SCTIL DISTRIBUTION CHANGE

Beginning with this issue, the Signal Corps Technical Information Letter will be distributed overseas by The Adjutant General and for all air units within the continental limits of the United States by Headquarters, Army Air Forces. Signal and other Ground and Service Forces units now on the mailing list still in the United States will continue to receive the SCTIL directly from the Office of the Chief Signal Officer.

Overseas distribution has been authorized as follows:

Headquarters, Theaters of Operation	(25)
Armies	(10)
Corps	(10)
Departments and Base Commands	(10)
Island Commands	(10)
Air Forces	(10)
Divisions	(2)
Brigades	(2)
Battalions 11	(2)
Companies 11	(2)

Overseas organizations which desire to be placed on the mailing list or wish to have distribution changed in any way should request such changes through channels to the Chief Signal Officer (SPSAY).

Air units within the United States should address their request to the Commanding General, Army Air Forces (Management Control, Reproduction Branch, AAF Annex), Gravelly Point, Va.

All other organizations within the United States may continue to send requests direct to the Chief Signal Officer (SPSAY).

PHOTOGRAPH CAPTIONS THAT STICK

It has been found that the typing of captions on paper which is to be pasted on the back of still picture prints with the information indicated by directive from the Chief Signal Officer has resulted in much typing, trimming, and pasting. Often the last copies typed are not very distinct, and adhesive material has dried and the captions do not remain on the print.

In order to overcome these difficulties, the Photographic Branch, Port Signal Office, San Francisco Port of Embarkation, uses a small hand-operated ditto machine. Using a standard typewriter with the ribbon lever set for "stencil" and a sheet of ditto carbon paper between two sheets of white paper, the caption is typed and transferred to the ditto machine, where the caption is transferred not only to the negative preserver, but also to the back of every print requiring that caption.

Much time has been saved using this method, and the appearance of the captions are improved for they are now part of the prints and cannot be separated therefrom. Also the master sheets can be filed away and used again whenever additional prints are needed.

This system is also being used in the Still Pictures Library Section of the Army Pictorial Service, OCSigO; the European Theater of Operations, and the South Pacific Area of the Pacific Theater of Operations. No general instructions for the use of this method have been issued due to procurement and supply problems in furnishing the ditto machines.

JOINT ARMY-NAVY STANDARDIZATION PROGRAM

Before entering the conflict, the Army and Navy each had its own systems of tube nomenclature, but they were quite unsuited to the desirable qualities of interchangeability, common stockpiles, joint inspection, and general efficiency.

Early in 1942, work was begun to prepare a joint Army-Navy specification for tubes which would be based upon the use of RMA and commercial type numbers. By the latter part of 1943, the Joint Army-Navy Specification JAN-1A for Radio Electron Tubes was in use, and mandatory for all Signal Corps and Navy tube contracts.

The JAN Committee, comprised of the Army Service Forces and Naval Office of Procurement and Material, has authorized the JAN-1 Tube Subcommittee to handle the tube specification. The Service organizations represented on this Subcommittee are:

1. The Navy - Bureau of Ships.
2. The Signal Corps Aircraft Signal Agency.
3. The Signal Corps Ground Signal Agency.
4. The Signal Corps Standards Agency.

The official duties of the JAN-1 Tube Subcommittee as supplied by the JAN Committee are as follows:

1. To prepare and establish standard tube specifications.
2. To review, revise and correct these specifications, as required by technical improvements, changes in Service requirements, etc.
3. To coordinate tube specification matters with the Services and industry.
4. To supervise the distribution of the specifications to all concerned.

In addition to these duties, which apply directly to the JAN-1A Specification, the members of the Subcommittee have additional duties as follows:

1. The consideration of proposed tests to determine if the resulting tubes are equivalent to those which meet tests required by the JAN-1A Specification.
2. The issuance of tube type approvals under the JAN-1A Specification.
3. The compiling and revising of the Army-Navy Preferred Lists of Vacuum Tubes.
4. The recommending of security classifications for vacuum tubes.
5. Coordination with Canadian Armed Services in their use of the JAN-1A Specification.

6. Coordination with the RMA on tube numbering and tests methods.

Some of these duties will be described in detail, in order to indicate their scope and method of handling.

It may seem reasonable that the Services which use the tubes should write the specifications to insure that the tubes will meet Service needs. This is not wholly satisfactory however, for the tube manufacturers must also have an opportunity to comment in order to insure that the specification can be met, through its being in accordance with good production and engineering design and practice -- even though this may not allow the Services to make as "tight" a specification as they might prefer. In other words, it is sometimes necessary to sacrifice the ultimate in desired performance in order that the tube can be produced with reasonable efficiency and by more than one manufacturer. After complete coordination with all concerned, the resulting specification is written to insure the best possible operation of the tube in the equipments using it, with the minimum of requirements which would cause excessive production difficulties.

Because improved design and production techniques and changed equipment requirements may involve specification changes, the Subcommittee's duties include that of reviewing and correcting specifications as necessary. Coordination with the tube manufacturers affected is secured, as in the case of a new specification.

SPECIFICATION AVAILABLE

The JAN-1A Specification is available to any contractor or Government organization which requires it. Requests for copies may be sent either to the Signal Corps Standards Agency or the Bureau of Ships.

It is well to point out that the JAN-1A Specification is still incomplete in that all tube characteristics are not necessarily controlled by the required tests. Therefore, any tube application which requires the control of less frequently used tube characteristics should be checked against the specification to insure that it provides tests to control those characteristics. For example, the triode and suppressor cut-off characteristics of pentodes are not usually controlled by the specification, but if a particular equipment requires that these characteristics be controlled, the matter should be brought before the JAN-1 Tube Subcommittee, together with data to enable the formulation of a suitable test. The Subcommittee will then do all possible to arrange for specification revisions to accomplish the desired result.

At this point attention is called to the fact that special tube selection is extremely undesirable. Directives from the headquarters of both the Bureau of Ships and the Signal Corps state that special selection of tubes will not be permitted, but that equipments must meet performance requirements with any and all tubes which pass the JAN tests for the types involved. When a tube requires replacement in the field, any tube of the correct type which is in stock must work satisfactorily.

Fortunately the majority of radio engineers recognize the evils of special tube selection and are doing all possible to eliminate it by proper equipment and circuit design, but continued attention to this is necessary. The preceding remarks to the effect that care should be taken to insure that the JAN-1A Specification controls all important tube characteristics are, therefore, particularly applicable to the prevention of special tube selection.

The JAN-1A Specification provides for type approval of each tube type produced by each tube manufacturer, since this provides a check on his ability to produce those tubes satisfactorily, and allows the Services to check the accuracy and capabilities of his test equipment as well as the suitability of the tube for use by the Armed Services. Thus when the contracting officer places a contract with a manufacturer holding type approval for the required types, he knows that the contractor can actually make and test those types satisfactorily. Complete information regarding the obtaining of tube type approval is contained in Form TAI-1 which may be secured from either the Bureau of Ships or the Signal Corps Standards Agency.

WAIVERS HANDLED BY COMMITTEE

An important function of the JAN-1 Tube Subcommittee is the handling of requests for waivers to the JAN-1A Specification. A tube manufacturer may find that he cannot make a required test due to lack of equipment; an equipment contractor may encounter a long delay in securing a particular type, if all JAN tests are complied with, but can secure quick delivery of that type if it is tested to broader limits which still permit it to give proper operation in the particular equipment concerned. Such situations often arise. If they are referred to the Bureau of Ships, the Signal Corps Standards Agency, or the Signal Corps laboratory concerned, the JAN-1 Tube Subcommittee will consider them and decide whether the tube will meet the requirements of the JAN-1A Specification. Decisions required to keep up production may be secured within a few hours by telephone and telegraph concurrence of the JAN-1 Tube Subcommittee members.

Over a year ago, the Army and Navy jointly issued a Preferred List of Vacuum Tubes. The present revision, dated 15 February 1944 includes both confidential and unclassified listings. The object of these Preferred Lists, which must be aimed for in all developments, is to reduce the number of types used by the Services. With fewer types required, there are important savings to the Services in space and manpower for handling stock. Also, tube manufacturers can, by concentrating on the production of these types, achieve greater production efficiency, higher quality, and lower shrinkage. The JAN-1 Tube Subcommittee members revise these Preferred Lists from time to time on the basis of each type's wideness of application, ease of production and available production capacity. If a development requires tube characteristics which can be shown to be lacking in any of the preferred types, a waiver of the Preferred Lists may be requested from either

the Bureau of Ships or Signal Corps Standards Agency. Thus, the fact that the use of the Army-Navy Preferred List of Vacuum Tubes is mandatory does not serve as an obstacle to new developments in tubes and equipments.

SECURITY CLASSIFICATIONS

The JAN-1 Tube Subcommittee members are, by virtue of their close contact with personnel concerned with tube work for the government, fully cognizant of the tube features which should be withheld for reasons of security, so are called upon to recommend types for classification, or for removal from their security classification, after there is no longer need for restricting information concerning them.

Although the RMA continues to assign type numbers for new tubes, the JAN-1 Tube Subcommittee members work in cooperation with RMA regarding arrangements and plans for handling this work.

CANADIANS USE JAN-1A SPECIFICATION

The most recent addition to the work of the Subcommittee is that concerned with the use of the JAN-1A Specification by Canada. The Canadian Services now require the use of this specification in their contracts using tubes and will administer the specification through a joint industry-government committee. They will coordinate their actions with the JAN-1 Tube Subcommittee in order to assure a yet broader standardization of tubes.

Thus has been achieved a single specification for use with all tubes procured by the U. S. Signal Corps, the U. S. Navy, and the Canadian Armed Services. After the transition stage, during which existing tube stocks will be used up, all tubes purchased and stocked by the organizations just named will be fully interchangeable.

By pooling their requirements in the JAN-1A Specification, the Army and Navy have been able to improve the quality of many of their tubes.

Through the use of preferred types, the tube manufacturer is aided by the opportunity to specialize on a few types.

Lastly, the Services are working more closely with tube manufacturers than ever before, and there is greater mutual understanding of each other's problems.

In closing, it is interesting to quote from a report on lessons in signal operation from Burma. "American tubes are superior because they are (1) sturdier and (2) standardized and interchangeable."

ARMY-NAVY RADIO ELECTRON TUBE SECURITY CLASSIFICATION

10 March 1944

NOTE: This list supercedes the ARMY-NAVY RADIO ELECTRON TUBE SECURITY CLASSIFICATION list of 15 February 1944.

To Those Concerned with the Use and Dissemination of Information Concerning Classified Electron Tubes:

1. The following list sets forth certain electron tubes used by the Radio Division, Bureau of Ships, Navy Department, and the Signal Corps, Army Service Forces, together with the security classification of same. The purpose of this list is to insure uniformity in the security classification of electron tubes and electron tube information used by the aforementioned Services.

2. THE OMISSION OF A TUBE FROM THIS LIST DOES NOT NECESSARILY INDICATE THAT THE TUBE IS UNCLASSIFIED.

3. Technical data and information concerning electron tubes under development, or already developed but not in production, which would be of great advantage to a foreign nation by virtue of:

a. Disclosure of wavelengths or operational frequency, or
b. Disclosure of novel design and constructional features, or
c. Disclosure as to application,

MUST BE CLASSIFIED AS SECRET.

4. Technical data and information for electron tubes not included in paragraph 3 above shall be classified CONFIDENTIAL when:

a. The data or information directly or indirectly reveals pulse modulation ratings, or

b. The data or information directly or indirectly reveals specific operations frequencies within or above the ultra high frequency spectrum. Photographs or drawings of frequency determining elements of tubes are included in this category.

5. Tubes for which technical data have been published and generally distributed prior to this data will not be classified in the future unless reasons of National Security necessitate such classification; in which event the recipients of this list will be notified.

6. The type number of a classified tube may be listed in an unclassified document when such listing does not disclose either wavelengths, basic principles, or technical details of the tube.

7. The publication of characteristics of unclassified tubes which may disclose application information pertaining to classified equipment is not permitted except by authority of the Services.

The following tubes are classified as "CONFIDENTIAL".

J-1 Series
K-0 Series
1P23(729A)
1B24
1E26
1B27
1P24(936, ZJ-564)
1P25
D-2 Series
GY-2
2B24(QF-197)
2C27(QF-200C)
2C28(SA-780)
2D29(SA-782B)
2E27(QF-206)
2E28(HY-145ZT)
2E29(SA-781A)
2J21 THRU 2J34
2J36 THRU 2J62
2JB51
2K22 THRU 2K29
2KB72
3BX
4AP10
4C27(CV92)
4C28
4J21 THRU 4J30
5J21 THRU 5J30
7C22
HK7
K-7 Series
REL-7
8D
REL-21
CV58
CV92
HY-145YT
HY-145ZT
VT-158
QF-197
QF-200 Series
QF-202
QF-206
QF-213
QF-214
QF-215
417
417A
419A
421AA
WL-441 Series
WL-442
WL-443 Series
GL-484
GL-485
GL-486
GL-488
ZG-489
ZJ-564
ZG-530
GL-531(ZG-531)
WL-538
GL-541(ZG-541)
ZP579
700 Series
706 Series
707A, B
714 Series
718 Series
720 Series
721A
723A
723A/B
724A
725A
726A,B,C,
728 Series
729A
730A
SA780
SA781 Series
SA782 Series
933
936
NU-976
1280CT5
1380M
1636
8026

UNCLASSIFIED TUBES PREVIOUSLY CONSIDERED CLASSIFIED

C1B
1B22
1B25
1N21, A, B
1N22
1N23, B
1N24
1N26
1N27
1N28
1N29
2C26
2C44
2E22
3B24
3BP1
3CP1
3CP1-S1
3DP1
3DP1-S1
3DP1-S2
3E29
3FP1
3FP7
3HP7
GA-4
C5B
CA-5
GA-5A
5BP1
5BP4
5CP1
5CP4
5CP7
5D21
5EP1
5EP7
5FP7
5GP1
5JP1
5JP7
5LP1
5LP7
5NP1
REL-5
6C21
7BP7
8C21
9EP1
9EP7
9FP1
9GP7
9HP7
9MP7
12DP7
12FP7
12GP7
12HP7
15E
15R
H-45
EF50
53A
TS-70
72R
73R
VR78
VT-90(Br.)
98R
VT-98(Br.)
100R
100TH
100TS
X102B
HY114B
VT-114
VT-127, A
VCR139A
QF-196
HK-227
227A
RX233
274B
304TH
313CC
316A
326A
327A, B
371A, B
393A
410
434A
446A, B
447A
ZP-449
450TH
451
GL-455
455/9LP7
464A
GL471A
GL-515
GL-522
527
WL-530
530A
ZG-532
WL-532A
GL-532A
559
HY615
701A
702A
703A
704A
705A
708A
709A
710A
713A
715A, B
716A
717A
719A
722A
727A
732A
829A
829B
832
953B
1000UHF
1630
1810-P1
1860
1960
1961
WX3074
7193
8011
8012
8013A
8014A
8016
8020
8021
8023

Chief of the Bureau of Ships.
Navy Department.

Office of the Chief Signal Officer,
Headquarters, Army Service Forces,
War Department.

24-76274ABCD-3M

ARMY-NAVY PREFERRED LIST OF RADIO ELECTRON TUBES
15 February 1944

NOTE:- THIS PREFERRED LIST SUPERSEDES THE ARMY-NAVY PREFERRED LIST OF VACUUM TUBES, DATED MARCH 1, 1943

TO THOSE CONCERNED WITH THE DESIGN AND MANUFACTURE OF ARMY OR NAVY EQUIPMENT UTILIZING RADIO ELECTRON TUBES:

1. The following Army-Navy Preferred List of Radio Electron Tubes sets up a group of unclassified general purpose tubes selected jointly by the Signal Corps and the Bureau of Ships. The purpose of this list is to effect an eventual reduction in the variety of tubes used in Service Equipment.

2. IT IS MANDATORY THAT ALL UNCLASSIFIED TUBES TO BE USED IN ALL FUTURE DESIGNS OF NEW EQUIPMENTS UNDER THE JURISDICTION OF THE SIGNAL CORPS LABORATORIES OR THE RADIO DIVISION OF THE BUREAU OF SHIPS BE CHOSEN FROM THIS LIST. EXCEPTIONS TO THIS RULE ARE HEREINAFTER NOTED.

3. The term "new equipments", as mentioned in Paragraph 2 above, is taken to include:

a. Equipments basically new in electrical design, with no similar prototypes.
b. Equipments having a similar prototype but completely redesigned as to electrical characteristics.
c. New test equipment for operational field use.

4. The term "new equipments", as mentioned in Paragraph 2 above, does not include:

a. Equipments either basically new or redesigned, that are likely to be manufactured in very small quantity, such as laboratory measuring instruments.
b. Equipments that are solely mechanical redesigns of existing prototypes.
c. Equipments that are reorders without change of existing models.
d. Equipments in the design stage before the effective date of adoption of this Preferred List.

Note: The foregoing statements in Paragraphs 3 and 4 above are explanatory in nature and are not intended to be all-inclusive.

5. In the event that it is believed that a tube other than one of those included in this Preferred List should be used in the design of new equipments for either the Signal Corps or Navy, specific approval of the Service concerned must be obtained. Such approval, when Signal Corps equipment is concerned, is to be requested from the Signal Corps Laboratory concerned with such equipment; the said Laboratory will then make known its recommendations in the matter to the Signal Corps Standards Agency where the final decision will be made and returned to the laboratory for transmittal to the party requesting the exception. When Navy equipment is concerned, the request for exception shall be addressed to the Radio Division, Bureau of Ships, Code 930-A, Navy Department.

6. The publication of this list is in no way intended to hamper or restrict development work in the field of radio electron tube or radio electron tube applications.

7. This list is to take effect immediately.

Chief of the Bureau of Ships,
Navy Department.

Office of the Chief Signal Officer,
Headquarters, Army Service Forces,
War Department.

ARMY-NAVY PREFERRED LIST OF RADIO ELECTRON TUBES
15 FEBRUARY 1944.

RECEIVING

FILAMENT VOLTAGE	DIODES	DIODE TRIODES	TRIODES	TWIN TRIODES	PENTODES REMOTE	PENTODES SHARP	CONVERTERS	POWER OUTPUT	INDICATORS	RECTIFIERS	MISCELLANEOUS
1.4	*1A3*	1LH4	1LE3	*3A5* 3B7/1291	*1T4*	*1L4* 1LN5 *1S5*	1LC6 *1R5*	*3A4* 3D6/1299 *3S4*			CRYSTALS 1N21B 1N23 1N27
5.0										5U4G 5Y3GT	
6.3	*6AL5* 6H6* 559 *9006*	*6AQ6* 6SQ7* 6SR7*	2C22 2C26 *6C4* *6J4* 6J5* 7E5/1201 *9002*	*6J6* 6SL7GT 6SN7GT	6SG7* 6SK7* *9003*	6AC7* *6AG5* 6AG7* *6AK5* 6SH7* 6SJ7* *7W7* *9001*	6SA7*	6G6G 6L6GA 6N7GT/G 6V6GT/G 6Y6G	6E5	6X5GT/G 1005	PHOTOTUBES 918 927
12.6	12H6*	12SQ7* 12SR7*	12J5GT	12SL7GT 12SN7GT	12SG7* 12SK7*	12SH7* 12SJ7*	12SA7*	12A6*	1629		VOLTAGE REGULATORS OB3/VR-90 OC3/VR-105 OD3/VR-150
25 and above								25L6GT/G 28D7	991	25Z6GT/G	

TRANSMITTING

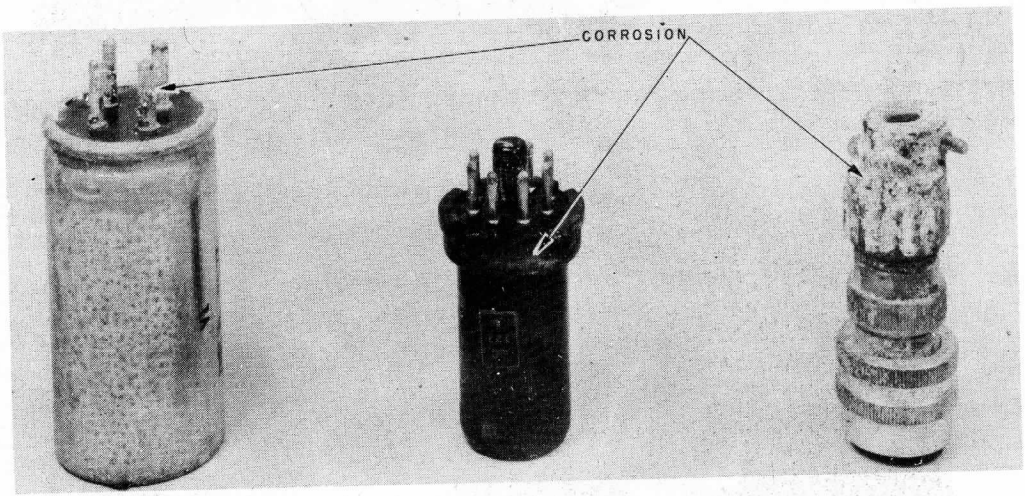
TRIODES		TETRODES	TWIN TETRODES	PENTODES	RECTIFIERS VACUUM	RECTIFIERS GAS	RECTIFIERS GRID CONTROL	CLIPPER TUBES	GAS SWITCHING	CATHODE RAY
2C26	801A	5D21	3E29	2E22	2X2	4B25	3C23	73	1B32/532A	2AP1
2C44	809	715B	815	803	3B24	83	3C31/C1B	719A	471A	3BP1
6C21	811	807	829B	837	5R4GY	866A/866	C5B		532	3DP1
15E	826	813	832A		371B	872A/872	884			3FP7
VT127A	833A	814			705A		2050			5CP1
3278	838	1625			836					5CP7
434A	1626				1616					5FP7
446A	8005				8016					5JP1
527	8014A				8020					7BP7
530	8025									12DP7
										12GP7

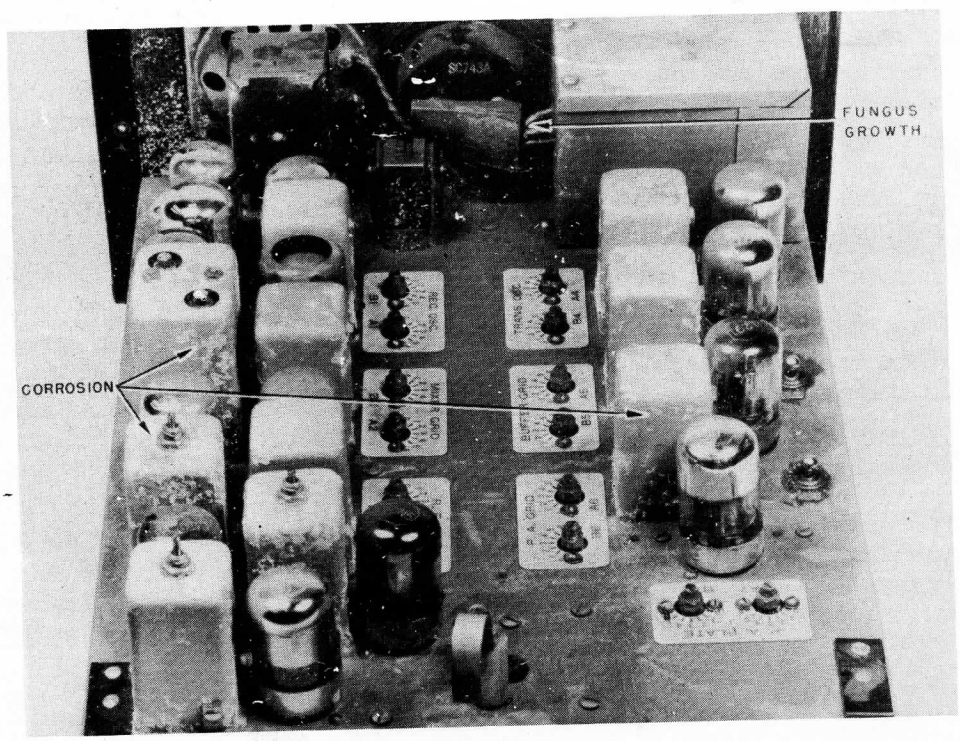
MISCELLANEOUS

**Where direct interchangeability is assured "GT" and "L" counterparts of the preferred metal tubes may be used.*

Miniature tubes (shown in Italics) shall be used only when essential to Service requirements.

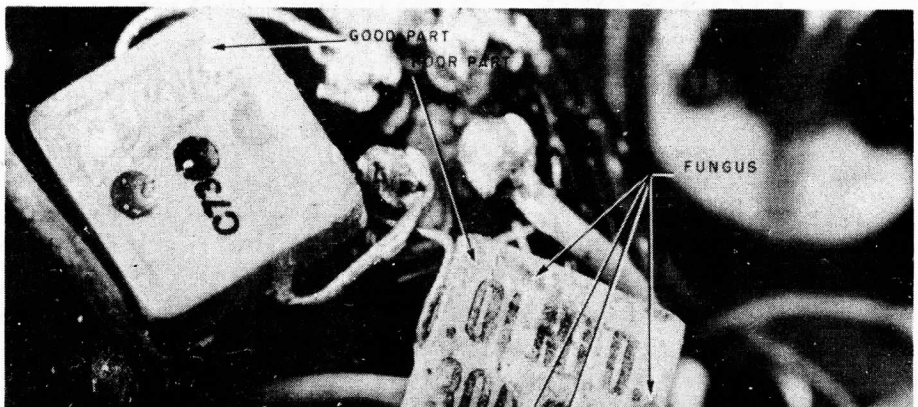
MOISTURE AND FUNGUS

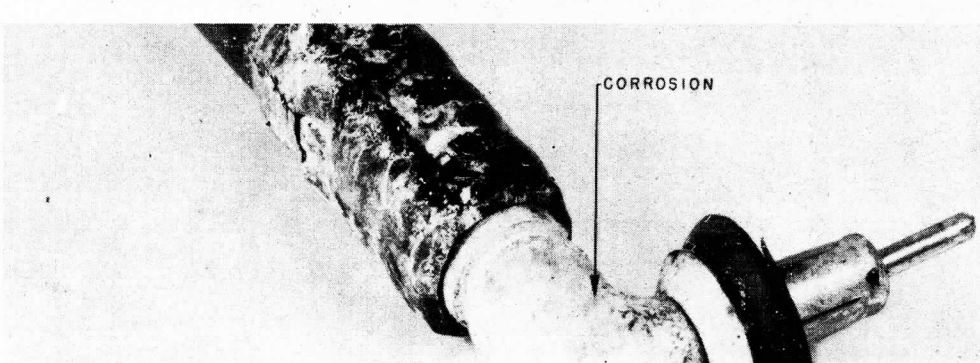




Better than a thousand words, the pictures above show the effects of moisture and fungus on untreated signal equipment. Study them carefully and keep that spray gun or brush busy! Shown on this page are vibrator pins, tube base, and cable connector, in the top picture; and IF and RF transformer shield cans, in the bottom picture.

MOISTURE AND FUNGUS





Pictured on this page, in descending order, are bypass condensers and bakelite terminal strip, twisted pair braided wire, and cable termination.

ENEMY FIELD WIRE AND CABLE

During the past two years, numerous samples of enemy telephone wire and cable have been received by the Enemy Equipment Identification Service and examined by the Signal Corps laboratories and, in some cases, analysis has been made by commercial firms as well at the request of the Signal Corps. In general, it may be stated that both the Germans and Japanese are now using field wire which is well-made and suitable for the uses intended.

Samples of Japanese wire found so far show no evidence of shortages of critical materials. However, reports from China-Burma-India Theater indicate that the Japanese are very careful about recovering all wire when they move, even though it may mean abandoning what would seem to be more valuable equipment. This may simply indicate a serious shortage of supply locally.

German wire indicates an economic pinch to a greater degree. Long ago the Germans were obliged to forego the use of natural rubber insulation, and lately they have substituted aluminum conductors for copper. Like the Signal Corps, they also use polyvinyl chloride instead of rubber in some instances. Strangely enough, some samples of their PVC insulated wire show markedly inferior electrical and physical properties when compared against the product of American cable manufacturers. This is not what would be expected of the German chemists, and seems to indicate a growing shortage of critical materials which may necessitate a lowering of inspection standards to enable the continuous supply.

The Germans use single conductor field wire with ground return, twisted pair field wire, and spiral-four rubber jacketed cable, depending upon the tactical situation. They use more types of field wire than are standard in the Signal Corps, but these types are designed for special conditions whereas our wires are suitable for use in any part of the world.

Both the Germans and Japanese employ single-conductor assault wire somewhat similar to Wire W-130-A. However, these enemy types are constructed without rubber, or synthetic resin conductor insulation, and thus have inferior transmission characteristics when wet.

Table No. 1 provides a comparison of German spiral-four cable and Cable WC-548. The German cable is of good construction and material and shows evidence of excellent manufacturing procedure. Other data not shown in the chart indicates that the mutual capacitance of the German spiral-four is higher than that of WC-548, being sometimes as much as 50 per cent greater. The power factor also is greater, approaching three times the value of WC-548. The German cable is stable in capacitance and power factor with respect to wetting and drying. The capacity unbalances are low and about equal for both pairs of conductors. Side-to-side and phantom-to-side unbalances are also

PHYSICAL AND ELECTRICAL CHARAC-

TABLE NO. 2

		#3		
Origin	Germany	Germany	Germany	Germany
Use	Rub.Jac.Tw.Fld.Wire	Tw. pr. field wire	Sing.cond.field wire	Sing.cond.field wire
Conductors				
No. and Comp.	.0237" tinned solid copper conductors (2)	9 strands - 6 steel, 3 copper	9 strands - 8 steel, 1 copper	9 strands - 8 steel, 1 aluminum
Diameter		6 steel - .013" 2 cu. - .013" 1 cu. - .021"	8 steel - .015" 1 cu. - .028"	8 steel - .015" 1 alum. - .028"
Construction		Concentric - 6 steel and 2 cu.wound arnd. .021" cu.	Concentric - 8 steel wound arnd. 1 cu.	Concentric - 8 steel wound arnd. 1 alum.
Insulation Material	Rubber-Probably 30% Buna S type	Rubber - syn. or natural	Thrpl. of polyvinyl chl. comp.	Thrpl. of polyvinyl chl. comp.
Color	1 Black, 1 White	White	Red	Red
Thickness	Black - .014" White - .015"	.027"	.035"	.035"
Diameter	.052", .054"	.093"	.128"	.128"
Covering Material	Outer Rubber-like Jacket .05" thick - Over the two twisted conductors	Blk.braid	None	None
Thickness		.011"		
Overall Diam.	Min. .157", Max. .172"	.115"	.128"	.128"
Physical Chara.				
Weight	19.6 lbs/1000 ft. sing. cond.	20.5 lbs/1000 loop feet.	12.9 lbs/1000 ft. sing. cond.	11.8 lbs./1000 ft. sing. cond.
Tensile Str.	16 lbs. sing. cond.	275 lbs.	400 lbs.	400 lbs.
Insul. Chara.				
Tensile Str.		167 lbs/sq.in.	871 lbs/sq.in.	871 lbs/sq.in.
Set		.25 in.	.50 in.	.625 in.
Modulus		87.5 lbs/sq.in.	804 lbs/sq.in.	804 lbs/sq.in.
Elongation		7.25 in.	2.50 in.	2.50 in.
Compr. Str.				
(1) Rm.Temp.		340 lbs.	Cr.No brks. under load of 2000 lbs.	Cr. No brks. under load of 2000 lbs.
(2) 70°C		165 lbs.	565 lbs.	565 lbs.
Abrasion Res.	58 cycles to insul. 173 cycles to cond.	360 cycles to cond.	360 cycles to cond.	
Cold bend(-40°C)	Failed	Satisfactory	Failed	Failed
Impact (-40°C)	Failed	Satisfactory	Failed	Failed
Heat Deformation @ 100°C		2.15%	8.6%	8.6%
Elec.Chara.				
D-C Res./1000'	19 ohms sing.cond.	25.9 ohms sing.cond.	11.6 ohms sing.cond.	16.9 ohms sing.cond.
S.I.C. - 50°C				
1 hr.imm.		1.80	3.90	4.35
24 hr.imm.		2.98	6.27	6.84
3 day imm.		3.18	6.75	7.91
7 day imm.		3.36	7.30	9.24
S.I.C.-Rm.Temp.				
1 hr.imm.			4.00	4.63
24 hr.imm.			4.73	5.79
P.F. - Rm.Temp. in Hg.			7.5%	9.4%
P.F. - 50°C				
Oven dried	1.04%	.664%		
Wet	4.90%	5.11%		
Moist.Absorb. 50°C				
Ini.-1hr.imm.	.0432 mfd/1000'	.034 mfd/1000'	.083 mfd/1000'	.083 mfd/1000'
24 hrs.	.0452 mfd/1000'	.056 mfd/1000'	.134 mfd/1000'	.146 mfd/1000'
% Rise		64.7%	61.5%	57.0%
3 days	.0498 mfd/1000'	.060 mfd/1000'	.144 mfd/1000'	.169 mfd/1000'
% Rise		76.5%	73.5%	81.7%
7 days		.063 mfd/1000'	.156 mfd/1000'	.197 mfd/1000'
% Rise		85.3%	88.0%	101.4%
Trans. Tests @1000 cps.				
Attenuation Dry @ Rm.Temp.		1.84 db/mile		
Attenuation Wet @ Rm.Temp.				
Attenuation Dry @ 50°C	2.68 db/mile	2.54 db/mile		
Attenuation Wet @ 50°C	3.52 db/mile	2.97 db/mile		

TERISTICS OF CAPTURED ENEMY WIRE

Germany Sing.cond.field wire	Japan Sing.cond.field wire	Germany Sing.cond.aslt.wire	Germany Sing.cond.fld.wire	W-110-B Tw.pr.field wire	W-130-A Tw.pr.aslt.wire
7 alum. strands	7 strands - 4 steel, 3 copper	7 strands - 6 steel, 1 copper	9 strs. - 8 steel 1 copper	7 strs. - 4 steel, 3 copper	7 strs. - 6 steel, 1 copper
.016"	4 steel - .0125" 3 cu. - .0125"	steel - .008" cu. - .010"	8 steel - .015" 1 copper - .0275"	steel - .013" 2 cu. - .013" 1 cu. - .014"	6 steel - .0095" 1 cu. - .010"
Concentric - 6 strs. wound arnd. a cu.str.	Concentric - 4 steel and 2 cu. wound arnd. 1 cu.	Concentric - 6 steel wound arnd. 1 cu.		Parallel or Concentric	Concentric - 6 steel wound arnd. 1 cu.
Thrpl. of polyvinyl chl. comp.	Rubber - syn. or nat.	A wrap of celophane-like material, 1 serving of cotton helically wrapped	Rubber - synthetic or natural	30% Rubber	Vinylite
Yellow	Black	Celephane-like wrap blue	Black	Black	Black
.042"	.023"	Blue wrap - .002", width - 1/8" cotton wrap - .003"	.028"	.031"	
.130"	.083"		.115"		.060"
None	Yellow silk brd. with lacquer finish	Cotton brd. with finishing comp.	16 carrier cotton braid, wax impregnated	Impreg. cotton brd. - black	None
	.007"	.015"			
.130"	.096"	.055"	.135"	.145"	.060"
9.2 lbs/1000 ft. sing. cond.	6.93 lbs/1000 ft. sing. cond. 170 lbs.	2.5 lbs./1000 ft. sing. cond.		11.8 lbs/1000 ft. sing. cond. 145 lbs. sing.cond.	3.27 lbs/1000 ft. sing. cond. 55 lbs. sing. cond.
				1523 lbs/sq.in. .219 in. 355 lbs/sq.in. 9.75 in.	2626 lbs/sq.in. 3.3 in.
	718 lbs.			587 lbs.	936 lbs.
	497 lbs. 24 cys.to insul. 151 cys. to cond.			427 lbs.	256 lbs. 190 cys. to cond.
	Satisfactory Fld.on 2nd impact			Satisfactory Satisfactory	
	1.9%			14%	
51.4 ohms sing.cond.	20.6 ohms sing.cond.	83.5 ohms sing.cond.		18.2 ohms sing.cond.	66.3 ohms sing.cond.
4.90	3.70			3.96	7.25
7.45	5.10			4.65	7.35
8.55	5.75			4.68	7.83
8.70	7.05			4.71	7.72
11.4%	11.42%				
				1.27%	8.1%
				2.31%	9.8%
.083 mfd/1000'	.058 mfd/1000'			.0701 mfd/1000'	.159 mfd/1000'
.126 mfd/1000'	.088 mfd/1000'			.0824 mfd/1000'	.161 mfd/1000'
51.8%	51.8%			17.5%	1.3%
.145 mfd/1000'	.100 mfd/1000'			.0830 mfd/1000'	.170 mfd/1000'
74.7%	72.4%			18.3%	7%
.147 mfd/1000'	.122 mfd/1000'			.0834 mfd/1000'	.173 mfd/1000'
77.1%	101.0%			18.9%	9%
				1.7 db/mile	4.5 db/mile
				2.7 db/mile	5.7 db/mile
				1.73 db/mile	4.39 db/mile
				3.03 db/mile	8.64 db/mile

S.I.C. is Specific Inductive Capacity.

P.F. is Power Factor.

Length of sample for "set" and "elongation" varied.

NO. 2

low. Complete capacitance stability up to 30 kc exists.

Table No. 2 provides a comparison of principal enemy field wires and Wires W-110-B and W-130-A. Many other types of wire and cable have been captured, but those listed in the table represent the ones most commonly encountered to date.

Experience has shown that, for voice frequencies, appropriate types of enemy wires may be substituted for our own with excellent results. Stocks of captured wire should therefore be salvaged whenever possible to supplement the supply of wires W-110-B and W-130-A, WC-548, etc.

Table No. 1

COMPARISON OF GERMAN SPIRAL-4 CABLE AND CABLE WC-548

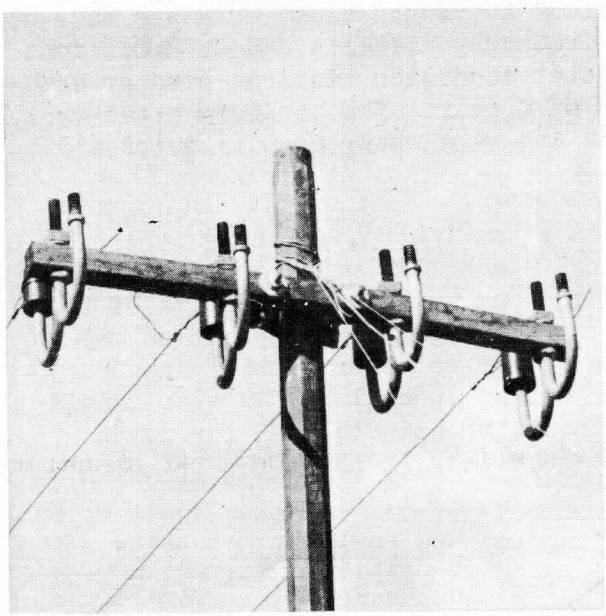
Characteristic	German Cable	Cable WC-548
ELECTRICAL:		
Conductors	19 copper strands 0.0127" diameter (equiv. #15 AWG)	7 copper strands 0.0152" diameter (equiv. #18 AWG)
Resistance	6.8 ohms/1000 loop feet	14 ohms/1000 loop feet
Mutual Capacity	0.0212 mf/1000 feet	0.020 mf/1000 feet
Shield	Tinsel tape on sample #1 No shield on sample #2	Metal foil shielding tape
Braid	None	Steel braid
Size (O.D.)	0.430" for sample #2 0.45" for sample #1	0.42"
Jacket	Rubber	Neoprene
Loading	10 mh coil - spacing undetermined	6 mh coil - spacing ½ mile
PHYSICAL:		
Weight of Cable	670 lbs/mile	528 lbs/mile
Breaking Strength	510 lbs. approx.	500 lbs. approx.
3 foot cable stub equipped with connector:		
Weight	1.5 lbs. (without loading coil)	1.3 lbs. (with loading coil)
Overall diameter	3 5/16"	2 1/8"
Length including molded rubber section	14"	7"
Loading Coil Assembly:	Separate assembly	Included in connector
Weight	3.04 lbs.	
Overall diameter	3 5/16"	
Overall length	6 3/4"	
Weight - 2 connectors with loading coils	6.04 lbs.	2.6 lbs.

OPEN WIRE POLE LINES

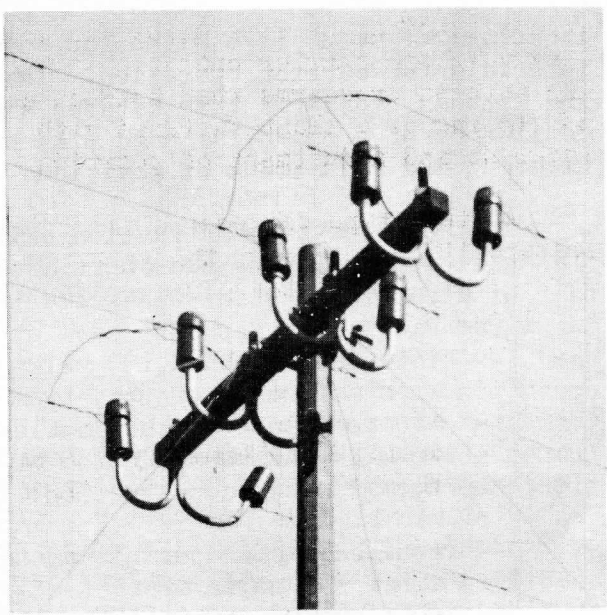
The Signal Corps is concerned with the building of new pole lines, and the rehabilitation of existing pole lines in every theater of operations. New pole lines are required either because no commercial pole lines exist or because the original lines have been destroyed by artillery fire, bombings, sabotage, and enemy demolition to such an extent that rehabilitation cannot be attempted. Conditions encountered in the various theaters have been reported on and the curricula of the Signal Corps unit training centers and the Eastern Signal Corps Schools changed to include information regarding these conditions. The Eastern Signal Corps Unit Training Center has obtained examples of pole line hardware and materials and has set up short demonstration units of three types of pole line; namely, British Multi-airline (MAL), French Postes Telephonique et Telegraphique (PTT), and United States Signal Corps tactical open wire line (TOWL). A short description of each type follows.

BRITISH MULTI-AIRLINE

This type of pole line is essentially a very light type of tactical pole line designed to provide open wire facilities which can be erected more quickly than a commercial type of line. The support for the line is a tapered pole, either round or octagonal in cross section, and 16 feet in length. It is similar in appearance to Lance Pole PO-2, although lacking



BRITISH MAL- DEAD-END STRUCTURE



BRITISH MAL-POINT TRANSPOSITION ON DOUBLE "J" INSULATOR SPINDLE

BRITISH MAL-EXTENSION POLE WITH WIND STAYS

the insulator adapter at the top, and two feet longer. Two lengths of crossarm are available for use on the line; one is 30 inches long, with four holes for insulator pins spaced nine inches apart, and the other is 15 inches long, with two holes for insulator pins spaced 12 inches apart. Insulators provided with a screw cap are used and mounted on steel pins fastened to the crossarms. The screw cap of the insulator covers a slot into which the line wire is laid. The line wire is wrapped with a flat, cadmium-copper tape, laid in the slot and the cap screwed down upon the wire. The line wire is 70 pound cadmium copper, about No. 17 B and S gauge, and weighs approximately 70 pounds to the mile. Transpositions are arranged differently from those in the TOWL construction and the use of carrier systems on the two outside pairs of a line is not contemplated. The most regularly transposed pair, No. 5-6, is suitable for the operations of carrier frequencies up to about 150 kc.

In certain regions, the British have erected pole lines using two pairs, one above the other on short crossarms. Transpositions to reduce cross-talk are made at intervals of about five miles for voice frequency circuits and at 3,000 foot intervals for carrier operation. The latter condition requires greater spacing between crossarms than between wires of a pair. The crossarm attachment, consisting of a clamp fastened with bolts and wing nuts, permits quick attachment and adjustment of position.

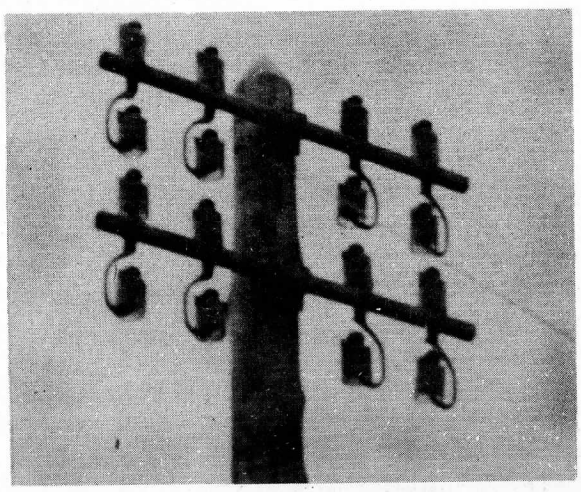
Another type of construction utilizes a continuous, rotating type of transposition employing two short crossarms spaced 12 inches apart. Each pair of wires is rotated 90 degrees in each span and a pair consists of the two wires diagonally opposite each other. This type of transposition may be used for distances of about 100 miles for either voice or carrier frequency operation. An advantage of this type is that no special hardware or insulators are required, such as the double-J insulator spindle used for point transpositions in MAL construction or the Insulator IN-128, (TW) Transposition, employed in TOWL construction.

MAL requires a considerable amount of "staying" or guying to afford stability since the poles are set only two feet in the ground. Stays are attached to "pickets" driven into the ground with mauls. When strong prevailing winds are encountered, it is often necessary to provide each structure with either two or four stays.

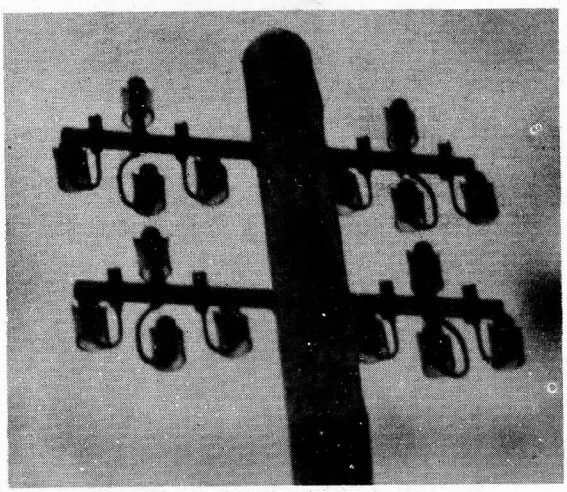
FRENCH PTT

The pole lines found in NATOUSA were PTT lines, the property of the commercial, government-controlled utility which furnished telephone service in French North African territory. These lines are supported upon either wood or steel poles, often braced with a similar pole, or built into H-fixtures. The structures are additionally strengthened by means of ornamental iron scrollwork.

Special hardware is required because of the wire spacing and the type of transpositions used. The wires are arranged in quads taking the form of a square, two wires being above the crossarm and two below. The wires on the opposite ends of the diagonals of the square form the pairs. Transpositions are made by turning the quad through 90 degrees in the two spans ad-



FRENCH PTT: GUYED DEAD-END STRUCTURE SHOWING NORMAL INSULATOR ARRANGEMENT

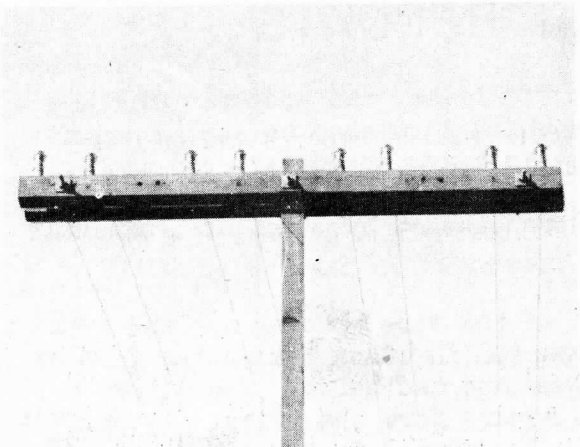


FRENCH PTT- ROLLING TRANSPOSITION SHOWING INSULATOR ARRANGEMENT

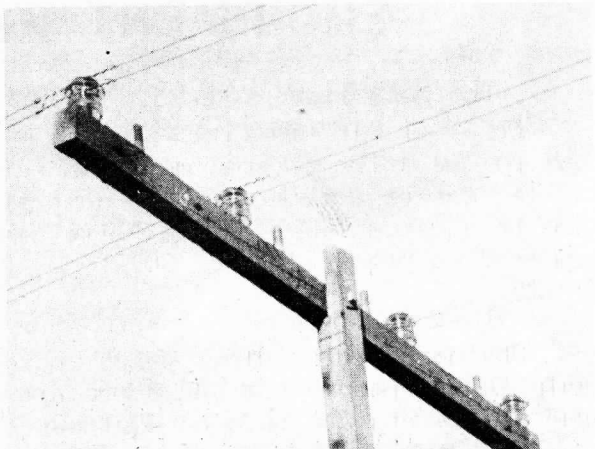
jacent to the fifth pole. Another transposition system uses a 180 degree twist in four spans. Insulator brackets are provided in two types, one for use on crossarms and the other for use directly on the pole.

UNITED STATES TOWL

Technical Manual 11-368, "Tactical Open Wire Line Construction," describes open wire pole line construction suitable for new lines having from two to eight pairs of wires. The construction resolves itself into several types which are intended to provide lines which will withstand the typical wind and ice loading encountered in any particular area. The loading data is based upon data obtained by commercial telephone systems over many years of observation and are generally designated as light, medium and heavy loading. An "extra heavy" loading is recognized in TM 11-368 and provides for



U.S. SIGNAL CORP TOWL - GUYED DEAD-END STRUCTURE. 4" X 4" SUPPORT IS USED ONLY FOR LIGHT LOADING



U.S. SIGNAL CORPS TOWL - ROLLING TRANSPOSITION MADE ON INSULATOR IN-128

the same type of construction used in heavy loading areas but with closer pole spacing, and with additional storm guying.

The TOWL construction system provides for the minimum of types of hardware and pole line materials and for the use of such supporting structures as will permit the sturdiest construction commensurate with the conditions imposed by the storm loading in the area traversed by the line and the transportation facilities available.

The transposition system employed is simple and provides for voice and carrier frequency operation over long distances. All pairs on an eight pair line may be used for carrier operation at frequencies up to 35 kc, over lengths up to about 1,000 miles. Carrier frequencies up to 150 kc may be employed over the most regular pair in the line, No. 7-8.

It may be necessary to use U.S. TOWL construction to fill in gaps in an existing pole line, and may involve connecting together pairs of wires having different spacing or wires having different conductivity or gauge and different transposition systems. The TOWL transposition system can be arranged to permit termination at either an S pole, or at the end of a complete short transposition section, and to terminate the foreign construction at a "balance point." This procedure is fully described in TM 11-486.

EQUIPMENT FIELD REPORTS

Observers in the field and Signal officers making reports on unsatisfactory operation of equipment can save themselves much time and trouble, and get faster action on their complaints, by confining their correspondence to equipments which are "live" and by following the suggestions which appeared on pages 24-47 of SCTIL No. 27 as corrected on page 56 of SCTIL No. 28.

Obviously, complaints which indicate the need for specific improvements in equipments now under procurement are highly valuable. However, when complaints are made on equipments classified as Obsolete, no action can be taken, and the observer has merely wasted time and effort in reporting them. For example, the fact that "The ___th Signal Battalion reports that pulleys (of field wire Boom Equipment LC-60) are too narrow, and recommends that the pulleys be made $\frac{1}{4}$-inch wider to permit free passage of splices," is of academic interest only, since field wire Boom Equipment LC-60 is Obsolete.

Similarly, when complaints are made on Limited Standard equipments, no factory corrections can normally be made since it is highly unlikely that further procurements of the equipment or its major components will be made. However, complaints of defects on which field correction is possible are of great value, especially if practical suggestions are made to accomplish such field corrections, for such corrections may make it possible to keep in use equipment which would otherwise have to be "junked." As an instance, reports recommending the use of a sturdier relay in a certain circuit of Radio Set SCR-284-( ) now classified as Limited Standard, would be of value, for such relays could be supplied for installation in the field. On the other hand, a recommendation that the set be divided into smaller and more portable components is of little value, since this would necessitate changes in factory production, and no further procurement of this set is contemplated.

LIMITED STANDARD AND OBSOLETE LIST ATTACHED

A list of representative ground signal equipments which have been classified as Obsolete, and another of those classified as Limited Standard, from February 1942 to March 1944 is appended for the guidance of observers and Signal officers in reporting equipment failures. A check of these lists and a knowledge of what can and what can not be done, as stated above, should assist reporting officers in minimizing the time and work devoted to reporting equipment failures.

An inspection of the following lists will reveal the reason why completeness and accuracy are essential in reporting on defective equipments. It will be noted that Test Set I-56 is classified as Obsolete; but every officer doubtless knows that certain of the later issues -- particularly Test

Set I-56-K -- are widely distributed and extremely active. In the same way, Wire W-110 is Obsolete, while Wire W-110-B is Standard. If a complaint is made of faulty performance of "Test Set I-56," it will naturally receive little attention, for the equipment is obsolete -- yet a careless report may mention "I-56" when the equipment in question is actually Test Set I-56-K.

The following lists are for information only, and are published with the intent that they may aid reporting officers and expedite the correction of equipment defects:

GROUND SIGNAL EQUIPMENT CLASSIFIED AS OF 3 APRIL 1944

Obsolete

Panel AL-119
Panel AL-120
Switchboard BD-9 (Telephone)
Switchboard BD-11 (Telephone)
Switchboard BD-50
Switchboard BD-51
Switchboard BD-52
Switchboard BD-53
Coil C-334
Cable Assembly CC-355 (See Note 1)
Pack Equipment CE-4
Pack Equipment CE-5
Pack Equipment CE-6
Pack Equipment CE-7
Pack Equipment CE-8
Pack Equipment CE-10
Wire Thrower RL-37-( )
Telephone EE-3
Telephone EE-3-A
Telephone EE-4
Telephone EE-4-A
Telephone EE-5
Telephone EE-66
Telephone EE-67
Telegraph Set EE-76
Ground Listening Set GR-1
Test Set I-56 (See Note 2)
Insulator IN-62
Insulator IN-63
Power Unit PE-AA-49
Power Unit PE-49-A
Power Unit PE-49-B
Power Unit PE-75-A (See Note 3)
Flashlight TL-95
Pack Equipment CE-9
Power Unit PE-75-B (See Note 3)
Basket PG-1
Cover PG-31
Blower PG-62
Oscillator Equipment RC-12
Oscillator Equipment RC-12-A
Recording Equipment RC-18
Interphone Equipment RC-38
Interphone Equipment RC-44
Interphone Equipment RC-48
Interphone Equipment RC-60
Interphone Equipment RC-61
Reel RL-17 (See Note 4)
Wire W-110 (See Note 5)
Radio Set SCR-131
Radio Set SCR-161
Radio Set SCR-162
Radio Set SCR-171
Radio Set SCR-172
Radio Set SCR-173
Radio Set SCR-174
Radio Set SCR-175
Radio Set SCR-176
Radio Set SCR-178
Radio Set SCR-179
Radio Set SCR-( )-185
Radio Set SCR-189
Radio Set SCR-195
Radio Set SCR-199
Radio Set SCR-213
Radio Set SCR-243
Radio Set SCR-272
Signal Lamp Equipment EE-10
Signal Lamp Equipment EE-10-A
Wire Thrower RL-37-( )
Telephone EE-3-B

Limited Standard

Radio Set AN/GRR-3-( )
Switchboard BD-14
Cable Assembly CC-345 (See Note 6)
Cable Assembly CC-355-A (See Note 7)
Pouch CS-34
Pouch CS-35
Switchboard Unit EE-2
Signal Lamp Equipment EE-6
Signal Lamp Equipment EE-10-B
Sounder EE-11
Test Set EE-65-( )
Code Practice Equipment EE-81
Code Practice Equipment EE-81-A
Code Practice Equipment EE-81-B
Signal Lamp Equipment EE-84
Ringing Equipment EE-100-A (Voice Frequency)
Sleeve FT-86
Sleeve FT-87
Sleeve FT-88
Sleeve FT-89
Sleeve FT-95
Sleeve Stock No. 6N5606
Sleeve Stock No. 6N5610
Ground Rod GP-29
Head and Chest Set HS-17
Head and Chest Set HS-17-A
Headset HS-18
Head and Chest Set HS-19
Headset HS-22-( )
Headset HS-23
Head and Chest Set HS-27-( )
Test Meter Unit I-87-( )
Key J-2
Key J-12
Key J-15
Key J-30
Key J-33
Key J-34
Key J-35
Key J-38
Key J-41
Bar LC-2 (See Note 8)
Knife LC-14-B
Wire Pike MC-1
Stamp Set MC-65
Recorder MC-311 (Sound Dual)
Transcriber MC-312 (Sound)
Shaver MC-313 (Wax Cylinder)
Headset P-18
Headset P-19
Headset P-20
Headset P-23
Public Address Set PA-6-( )
Power Unit PE-52-( )
Power Unit PE-53
Power Equipment PE-92-( )
Message Holder PG-14
Loft PG-45
Pigeon Equipment PG-60
Receiver R-2
Receiver R-2-A
Rectifier RA-36-( )
Recording Equipment RC-17 (Sound)
Interphone Equipment RC-53
Interphone Equipment RC-53-A
Antenna Equipment RC-67 (Vehicular)
Reel Cart RL-16
Radio Set SCR-194
Radio Set SCR-197-( )
Radio Set SCR-203
Radio Set SCR-206 (Direction Finding)
Radio Set SCR-209
Radio Set SCR-210
Radio Set SCR-255 (Direction Finding)
Radio Set SCR-284-( )
Radio Set SCR-293-( )
Radio Set SCR-294-( )
Radio Set SCR-299-( )
Telephone Central Office Set TC-1 (Army)
Auxiliary Telephone Central Equipment TC-5
Telephone Repeater Set TC-29-( ) (Voice Frequency, 4 wire)
Tool Equipment TE-50 (See Note 9)
Vulcanizing Equipment TE-54
Vulcanizing Equipment TE-54-A
Code Transmitter and Recorder TG-8
Perforator Set TG-11
Reperforator Set TG-13
Teletypewriter Set TG-15

Teletypewriter Set TG-17
Flashlight TL-194
Telephone Set TP-4
Wire W-73
Wire W-75
Wire W-76

Wire Stock #1A75A
Wire Stock #1A806
Wire Stock #1A810.1
Wire Stock #1A812
Wire Stock #1A812.2
Wire Stock #1A814

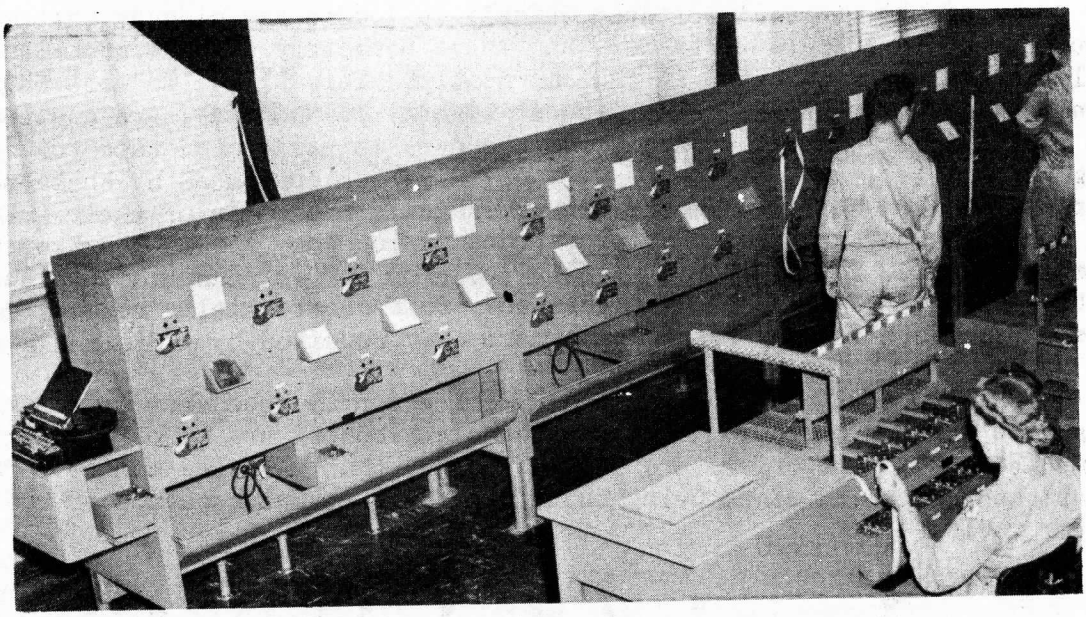
Reference Notes

Note 1. Also see "Limited Standard" list.
Note 2. I-56-A, etc. are "Standard".
Note 3. Recalled from the field, but not officially reclassified to "Obsolete." Note that PE-75-C and later are "Standard."
Note 4. But all RL-17-( ) are "Standard."
Note 5. But W-110-B is "Standard."
Note 6. Only the 1000' and $\frac{1}{2}$-mile lengths are "Limited Standard;" 100', 200' and 500' lengths are "Standard."
Note 7. Only the 1000' lengths are "Limited Standard;" 100', 200' and 500' lengths are "Standard."
Note 8. But LC-2-A is "Standard."
Note 9. But TE-50-A is "Standard."

MECHANIZATION OF "WAR"

The traffic load in WAR, keeping pace with the increasing magnitude and acceleration of world-wide military operations, has quadrupled within twelve months. It was early apparent that only by use of the most efficient methods could this immensely large volume of important message traffic be handled satisfactorily. The ordinary methods of direct teletypewriter operation of circuits would be wasteful of time, personnel and equipment.

A program for mechanizing operations in WAR through use of modern tape-relay equipment was begun in July 1943 and was virtually finished in January 1944 when semi-automatic telegraph facilities were installed for the termination of both domestic wire and overseas radio circuits. Identical means are



RECEIVING PANELS ARE A STEP FROM TRANSMITTER-DISTRIBUTORS, IN RIGHT FOREGROUND

thus provided for the operation of wire and radio circuits providing fastest and most dependable service for both, with more efficient use of personnel.

SEMI-AUTOMATIC SYSTEM

This is a tape-relay system which employs typing reperforators for receiving, and transmitter-distributors for sending. Associated with the latter are means for automatically numbering outgoing messages and making copies of all such messages on perforated tapes.

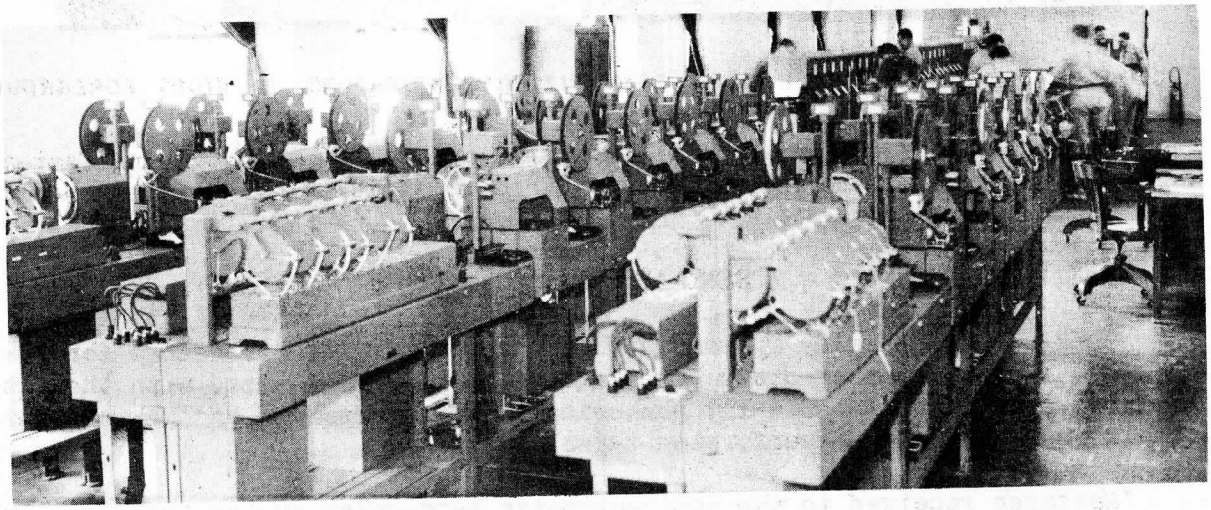
Messages received in the semi-automatic tape-relay system are normally

sent through the associated transmitters, including messages intended for local tributary stations. A special procedure is followed, however, for messages of more than 500 words. Such messages would be unnecessarily delayed if it were necessary to wait until they are completely received before their retransmission begins. In order to avoid such delay, an individual transmitter is associated with each bank of typing reperforators in such manner as to permit long messages to be sent simultaneously with their reception. The result is that long messages are at their points of destination within a few seconds after the completion of their reception at WAR.

Manual functions have been eliminated to the fullest extent. Outgoing messages are automatically numbered at the time tapes are inserted in the message transmitters. The sending operators are thus relieved of what otherwise would be a tedious and time-consuming operation.

It is of the utmost importance quickly to locate any message that may be questioned by a distant station, and where necessary to make such message available for retransmission in the shortest possible time. To meet this requirement, all circuits, except the most lightly loaded ones, are equipped with typing reperforators arranged to reproduce in perforated tape form everything transmitted, including message numbers. Tapes produced by these monitor reperforators are stored on motor-driven reels in the order of their transmission and when they are required for retransmission they are torn out of the reels and carried to the proper sending position for retransmission without the necessity of being manually processed. This substantially reduces delays to telegrams that for any reason are improperly received by a distant station.

In radio operations, where it is more frequently necessary to rerun messages than in wire operation, transmitter-distributors are associated with the monitor typing reperforators in such manner that messages can be rerun without the necessity of removing them from their normal sequence on the monitor reels.



AUTOMATIC NUMBERING TRANSMITTERS, IN FOREGROUND, ARE TIME-SAVERS

PROCESSING OF ORIGINATING AND TERMINATING MESSAGES

Local tributary stations with sufficient traffic to warrant such facilities are equipped with teletypewriters for transmitting messages directly into the typing reperforators of the semi-automatic system. Other tributary stations send their messages into the Signal Center in page form where they must be processed into tape form by Signal Center operators.

The means employed in the Signal Center for processing originating messages into tape form consist of perforators, associated with especially designed pneumatic tubes through which the perforated tapes are transferred to the sending banks of the wire and radio semi-automatic operating sections. Tubes used for this purpose require no carriers — tapes are simply folded and inserted as soon as the processing is finished. This arrangement results in minimum use of personnel and expensive and critical operating equipment, and at the same time provides excellent service.

Telegrams received in either the wire or radio semi-automatic operating sections are inserted into pneumatic tape tubes through which they are drawn to the part of the operating room where an assembly of transmitters and page printers are located for the purpose of processing messages received in tape form into page copies for physical delivery.

PROCESSING OF BOOK MESSAGES

Upwards of 400 multiple address and book messages are received daily from distant stations both domestic and overseas. These messages ordinarily consist of an action or information copy for delivery in Washington, plus copies for other domestic or overseas stations or both. Tapes containing messages of this kind are separated from the others at the terminating message processing department. In this department, in addition to the transmitters and printers used for processing single copy messages, there is located a page printer, two transmitter-distributors, and eight typing reperforators. Perforated tapes received from distant stations are immediately run through one of the transmitters for production on the page printer of a copy for local delivery, and while this copy is being made, suitable headings are prepared in perforated tape form for re-transmission of the message to each of the other stations to which copies must be sent. These headings are successively transmitted into typing reperforators while the local copy is still being prepared on the printer, and when the separate headings are properly set up, all of the typing reperforators involved in the operation are connected by switches to receive the body of the message simultaneously. Tapes so prepared are then sent through pneumatic tape tubes to the wire and radio sections for transmission to distant stations in the usual manner.

Book and multiple address messages presented to the Signal Center in page form are handled in the manner described above except that the tapes containing the text of the message are perforated locally.

WORKING AT AUTOMATIC NUMBERING APPARATUS

MANNING RECEIVING STATIONS AND TRANSMITTER-DISTRIBUTOR EQUIPMENT

OPERATING RESULTS

The total processing time of originating and terminating messages in WAR Signal Center is approximately 9 minutes from the time messages are received in the Signal Center until they are transmitted to distant stations or sent out for delivery. Relayed messages are completely processed through the Signal Center in approximately $4\frac{1}{2}$ minutes each. The average length of messages handled through the Signal Center is about 90 words.

The new equipment, processing methods and procedure refinements have combined to increase the message-operator ratio from approximately 300 to 1 in July to more than 500 to 1 at the present time. This advance was of inestimable value to War Department communications inasmuch as it permitted the handling of the greatly increased, and still increasing, traffic of the Army Command and Administrative Network and World-Wide Communications System without proportionate increase in skilled personnel, which could not be obtained during this interval.

TIPS ON HOT WEATHER VEHICLE OPERATION

About the only thing most car owners do when summer comes boiling around the corner is to have radiators flushed, oil changed, and the "old bus" lubricated. But in the Army, things are different. Hot weather operation calls for repeated attention to numerous preventive maintenance services in order to insure reliable vehicle performance at all times.

The more important of these services have been listed by Maintenance Division, A.S.F., for special emphasis by all concerned in the hot months ahead, and they will probably be incorporated into a poster to be distributed to posts, camps and stations. They comprise the following points.

Batteries must be serviced more frequently in summer because they operate at higher temperatures. This causes the electrolyte to "boil," or evaporate, faster. However, care must be exercised not to put too much water in battery cells because it will "bubble" out of the vents and accelerate corrosion of cables, terminals and clamps.

Tires should be inflated in the morning when they are cool. Pressures will normally increase during the day due to the sun and heat generated by the flexing action of tire sidewalls. When tire pressures are checked during the day and are found to be high, they should not be reduced, or "bled," because the pressures will return to normal as soon as the tires cool off.

Cooling systems require special care. They should be flushed out thoroughly. The thermostat should be checked, and the various hose connections should be inspected and replaced if necessary. Clean, "soft" water should be used in the cooling system and, when the technical manual for the vehicle calls for it, rust preventive should be added. The water pump must be in good condition, and the fan belt should be inspected frequently and its tension correctly adjusted.

CHECK IGNITION TIMING

The ignition timing should be carefully checked. Late timing, particularly, can be a contributing cause to overheating of the engine.

Accumulated grease on the under side of the crankcase tends to "insulate" it, and prevents the oil from efficiently dissipating its heat. For this reason, it is important that grease be scraped off.

Careful driving is also an important means of preventing overheating. Slow speeds in high gear, especially on hard, cross-country or up-hill pulls, must be avoided. When the vehicle and fan are both operating at reduced speed, an insufficient amount of cooling air flows through the radiator. By shifting to a lower gear, the fan will speed up and provide adequate cooling.

HOT WEATHER VEHICLE OPERATION

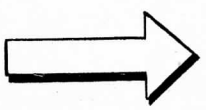
In this connection, nearly all drivers are conscious of the increased "pinging" of engines on hills that has come with the lower octane numbers of wartime gasoline. This destructive detonation, to be avoided at all times, is particularly harmful in summer when a laboring motor is always an overheating motor.

Sand and dust are generally more prevalent in the summer due to the drying effect of the sun. This makes it necessary to wash air cleaners more frequently, and, under extreme conditions, to replace oil filter elements more often.

Special attention to these summer-time preventive maintenance services will enable drivers to keep their vehicles running smoothly despite the extra stresses put on them by torrid weather. In the meantime, don't forget to keep a weather eye on the temperature gage. At the first sign of trouble, take necessary corrective action. Only in this way can the serious damage that results from overheating be avoided.

Investigation has shown that equipment is shipped from the United States with two copies of technical manuals, which are not received by using units. This indicates that the books are taken from shipments during the period between arrival in the theater and arrival at the point of use. While the desire to build up a personal library of instructional literature is understandable, it is essential that using units receive the technical manuals with the equipment.

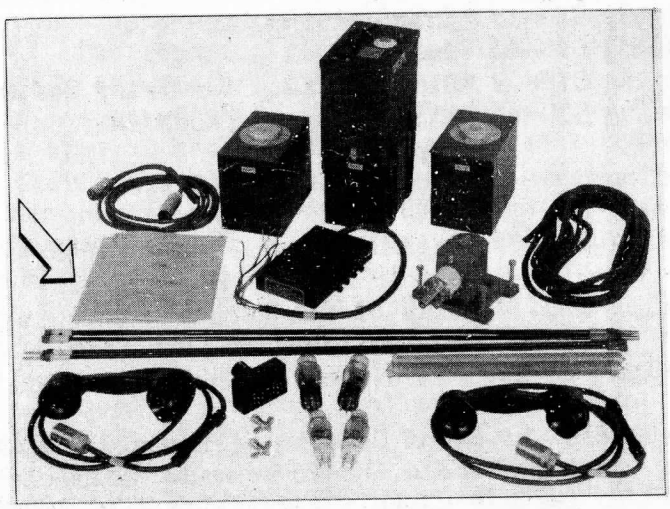
Theater Signal officers may wish to take appropriate action within the various theaters to eliminate the practice of port and depot personnel removing instructional material from Signal Corps equipment.



MANUALS ARE "PART" OF EQUIPMENT

Complaints are occasionally received from the field that "No instruction books for use with these radio sets have reached this unit." Even more frequent are statements by observers and Signal officers to the effect that "The equipment did not have the range given in military characteristics; this is attributed to the fact that technical manuals were lacking, and personnel did not operate the equipment correctly," or "Damage was caused by improper operation, due to the lack of instruction books."

As a general rule, every major item of signal equipment includes two or more copies of the applicable technical manual or instruction book. In some cases, separate manuals are issued for the major components of an equipment. If the equipment is issued without these manuals, the officer accepting it is receipting for equipment which he is not actually receiving. He is not getting a vital part of the equipment which he expects to use.



Even when the instruction manuals are originally issued with the equipment, they are sometimes lost due to being separated from the apparatus and not kept in the possession of some responsible person who is always accessible.

There are three good rules to observe in regard to manuals. They are:

1. When equipment is received, make sure that it contains necessary technical manuals for its operation. If it does not, these should be requisitioned immediately from the AGO depot serving the area.

2. In the case of vehicular, fixed and transportable equipments, always keep at least one copy of the manual actually with the set.

3. In the case of portable equipments, have at least one copy of the technical manual always available at 2nd echelon or other accessible point, and inform using personnel as to where this technical manual may be found.

If these three simple rules are followed, it is virtually certain that improved equipment performance will result, and that any failures which may be repaired by 1st echelon will be corrected more rapidly and effectively.

SIGNAL SUPPLY CATALOG

Under ASF Circular No. 121, dated 17 November 1943, future editions of the Signal Corps Catalog will be known as the Army Service Forces Signal Supply Catalog, divided into the following sections:

Army Service Forces Catalog SIG- 1 "Introduction."
Army Service Forces Catalog SIG- 2 "Index."
Army Service Forces Catalog SIG- 3 "List of Items for Troop Issue."
Army Service Forces Catalog SIG- 4 "Allowances of Expendable Supplies."
Army Service Forces Catalog SIG- 5 "Stock List of all Items."
Army Service Forces Catalog SIG- 6 "Sets."
Army Service Forces Catalog SIG- 7 "Organizational Spare Parts."
Army Service Forces Catalog SIG- 8 "Higher Echelon Spare Parts."
Army Service Forces Catalog SIG- 9 "List of all Parts." (Not to be published at this time.)
Army Service Forces Catalog SIG-10 "Fixed Plant Maintenance List."

The first edition of SIG-5 replaces the Stock Section of the old Signal Corps General Catalog and contains items available, or to be made available for supply purposes. It is planned to issue a monthly cumulative supplement to this Section and then to publish quarterly a complete new SIG-5 Catalog. Work is in progress to include in succeeding publications a more complete index and sub-sections, such as an index by manufacturer's part number, index by alphabetical listing, and a list of interchangeable and substitute items.

With the issuance and distribution of SIG-5, together with its supplements and sub-sections, the need for the present 3 x 5 catalog supplement cards will cease to exist; it is, therefore, planned to stop their present wide distribution.

EQUIPMENT NOTES

SIGNAL CORPS BOARD

SIGNAL CORPS BOARD CASES APPROVED BY THE CHIEF SIGNAL OFFICER

Case No. 537 - Investigation of Linemen's Safety Straps

The Signal Corps Board in Case No. 537 investigated certain changes in the design of Linemen's Belt LC-23. Belt LC-23-B, the current standard linemen's belt consists of a body belt and a detachable safety strap equipped with snap hooks. The purpose of the safety strap is to hold the lineman in position on the pole, leaving both hands free for the performance of his work. The study originated because of complaints from the field relating to difficulties experienced with a new type "recessed" snap hook used on some safety straps. Linemen had reported that there was a tendency for this type of hook to break at the point where the tip fitted into a slot in the spring-operated device which closes the hook. This gave a feeling of insecurity on the part of the lineman and led to requests for replacement of the new type hook by the reliable solid tongue snap hook previously used. No complaints had been received on the latter type which usually outlasted the strap to which it was attached.

While the investigation of the snap hooks was being conducted the procurement of high grade leather required for the manufacture of Belt LC-23-B became so critical that a suitable substitute had to be found. The Fort Monmouth Signal Laboratory conducted an investigation of the various proposed substitutes for leather and found that a woven fabric belting treated with impregnating material was superior to leather in tensile strength and in resistance to the effects of weather and abrasion (see "Leather Substitutions" SCTIL No. 29). This change in material necessitated a change in the hardware components of the belt.

The Signal Corps Board collaborated with the Signal Corps Ground Signal Agency in the development and service tests of a new sample Lineman's Belt LC-23-C consisting of a three-ply fabric body belt and safety strap impregnated with a suitable compound highly resistant to the effects of weather, moisture and abrasion and having a satisfactory degree of pliability. The model belt is fitted with hook snaps and grommets only as required by the change in materials. The solid-tongue snap hook which had proved satisfactory in the past was specified on the safety strap.

The Signal Corps Board in the final report in this case recommended that the production of the fabric Belt LC-23-C be permitted to go forward at the earliest practicable date; that the approved sample with minor modifications be used as a guide in the preparation of appropriate Signal Corps specifications and drawings for fabric Belt LC-23-C; that the development

of a tongue type buckle and suitable grommets to be used on the fabric body belt be continued and that no further consideration be given to the procurement of the recessed type snap hook for fabric or leather safety straps.

GROUND SIGNAL

ALTERNATE USES FOR TELEPHONE REPEATER SET TC-29-A

Information received in the Office of the Chief Signal Officer indicates that full use is not being made of the Telephone Repeater Set TC-29-A now distributed to the field, primarily because of the necessity for laying two pairs of field wire to obtain a single telephone circuit on which these repeaters can be used. It is also understood that attempts have been made with more or less success, to modify this repeater set in the field for other types of application.

Since Telephone Repeater EE-89-A has been standardized and is now being used to fill many of the requirements for which Telephone Repeater Set TC-29-A was originally procured, a small surplus of TC-29-A exists, in addition to those in the field which are reported to be not fully utilized.

The following information is presented to facilitate possible alternate uses of this repeater set.

Substitute for Telephone TP-9-( )

Telephone Repeater Set TC-29-A may be used as a partial substitute for Telephone TP-9-( ) (pending its availability) by the addition of a suitable double-pole double-throw switch connected externally between a two-wire line and the repeater. When so used, the talking range of field wire will be doubled. Procedure for making the conversion is as follows:

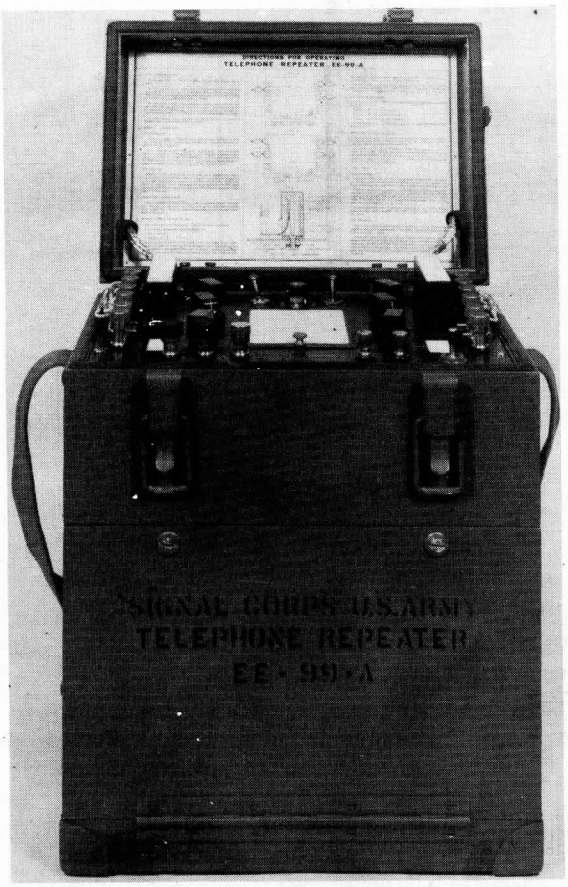
1. Connect the line to the movable contacts of the rapid-acting double-pole double-throw switch (line switch).
2. Connect one of the pairs of fixed contacts to the AB OUT terminals and the other pair to the BA IN terminals of Telephone Repeater EE-99-A.
3. Connect Telephone EE-8 to the A TERM terminals of the repeater.
4. Set the A TERM-THRU switch to A TERM and the B TERM-THRU switch to THRU.
5. Set EQ AB switch to 1, EQ BA switch to 2, GAIN AB to 5, and GAIN BA to 8.
6. Throw the line switch to AB OUT, turn on the repeater, and operate the telephone handset. Upon talking, observe that the volume indicator lamp flashes when the VOL IND switch is thrown to AB.
7. Throw the line switch to BA IN and adjust GAIN BA for satisfac-

tory volume when receiving speech from the distant terminal. EQUALIZER BA may be adjusted to give the most intelligible speech. It should usually be set on position 2 or 3, depending on the length of the circuit.

8. Connect another Telephone EE-8 across the line to permit ringing on the circuit and to allow break-in operation by ringing.

9. Push-to-talk operation of the repeater is accomplished by throwing the line switch to connect the line to AB OUT when talking and to BA IN when listening.

Telephone Repeater Set TC-29-A may be used as an emergency replacement for telephone Repeater Set TC-23-( ). For this application the "roof filters" contained in Telephone Repeater EE-99-A must be removed from the amplifier circuits by disconnecting Capacitors C9A and C9B from ground. Tests made at the Eatontown Signal Laboratory indicate that the power handling capacity and frequency characteristics of the repeater will then be adequate for emergency carrier repeater service. Monitoring and talking may be done by connecting Telephone EE-8 to the TEL binding posts (Nos. 9 and 10) and operating in the usual manner. It should be noted that the talk-monitor switch on the repeater should remain in the MON position to prevent interference with the carrier channels when talking. A more desirable monitoring and talking arrangement which also provides means for signaling the terminals may be obtained by connecting Telephone Unit EE-105-( ) (when it becomes available) in place of Telephone EE-8.



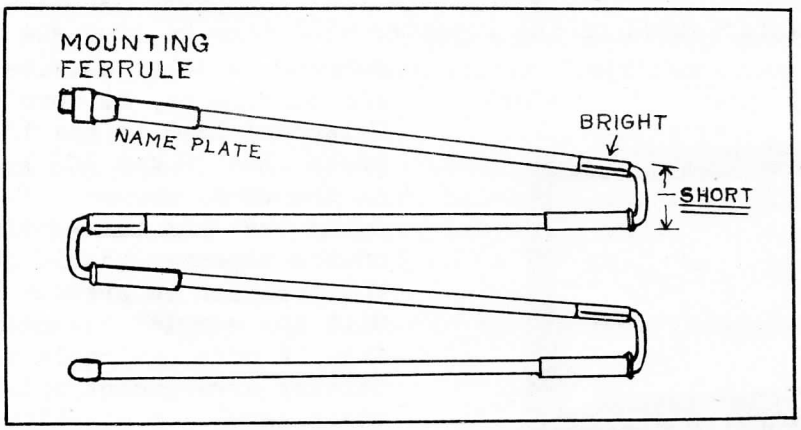
TELEPHONE REPEATER EE-99-A, PART OF REPEATER SET TC-29-( )

Telephone Repeater Set TC-29-A may be used to fill requirements for a high-gain audio-frequency amplifier for intercepting ground-return telephone circuits, by connecting the two amplifiers contained in Telephone Repeater EE-99-A in tandem. This connection is most easily made by setting the A TERM-THRU switch to A TERM and the B TERM-THRU switch to THRU. Terminals BA IN and AB OUT become the input and output connections to the amplifier respectively. The maximum gain of the amplifier in this condition is 60 db at 1000 cycles when the equalizers are set on position 1.

ERECTION OF ANTENNA AN-131-A

Numerous unsatisfactory reports have been received by the Chief Signal Officer concerning Antenna AN-131-A, part of Radio Set SCR-300-A. These reports usually refer to failure of the "automatic erection" feature of the antenna because of cable breakage or stretched springs.

The so-called "automatic erection" feature of Antenna AN-131-A has been referred to (in TM 11-242) as the standard method of erecting the antenna for use. It is, as a matter of fact, only an incidental feature of the antenna construction, and it is unfortunate that it has received undue emphasis. Action is under way to revise TM 11-242 in this respect, and it is felt that



the following information will serve as a guide for users of Antenna AN-131-A with Radio Set SCR-300-A pending distribution of the revised technical manual.

Three primary objectives motivated the present design of Antenna AN-131-A. First, the telescoping type of antenna was considered unsatisfactory because of tell-tale reflections from shiny surfaces which revealed the operator's position to the enemy. Several methods of dulling the surface of telescoping antennas were attempted, but because of the necessity for sliding action in telescoping the sections none proved entirely satisfactory. The use of a jointed antenna with OD-painted sections was resorted to as the best solution of the problem. Tapered sections were used to gain maximum strength with minimum weight.

A jointed, sectional antenna with non-interchangeable sections brought up the question of color-coding or numbering to provide easy and rapid assembly. This could meet the problem, but then what about antenna assembly at night in a blackout?

The use of the cable and spring-type of assembly adequately answered this question.

One further consideration was the necessity of providing some means for preventing loss of antenna sections. The operation of Radio Set SCR-300-A is dependent upon a critical antenna length for optimum performance with a minimum of equipment failure. Use of Radio Set SCR-300-A with one or more sections of AN-131-A missing would result in overload of the PA stage of the transmitter, with a consequent reduction in range, increased tube failures and shorter battery life.

Again the spring and cable idea provided a simple means for insuring that the correct number of antenna sections would be utilized, and precluded accidental loss of sections.

Note that nowhere was an automatic means of erection considered a required design feature.

With reference to Section 11-c-(2) of TM 11-242, the SECOND paragraph of this section, describing the erection of the antenna by unfolding it, section by section, and fitting the sections together, by hand, should be construed to be the standard method of assembly. The automatic erection feature should be taken advantage of only as an emergency means of "unfurling" the antenna in instances where time is short.

AIRCRAFT RADIO

TEST EQUIPMENT IE-36

Test Equipment IE-36 is used to make field tests of Radio Sets SCR-522-A and SCR-542-A. It can also be used for the SCR-624-A and AN/CRC-1. This item is now in production for the purpose of issue, together with Test Set I-139-A, as a partial replacement for the larger Test Equipment IE-19-A. The IE-36 is particularly designed to fill the need for a small, readily portable test unit which can be used at the point-of-installation. It provides a means for making trouble shooting tests and tuning adjustments on the above radio equipments as outlined in the following paragraphs. Although the IE-36 is usually used with and contains mounting space in the chest for the meter I-139-A, this meter is issued as a separate item. A composite view of this equipment is shown in Figure 1.

The main application for the IE-36 is in airplane squadrons where a check of the SCR-522-A installation and/or a change in channel frequencies can be made in the airplane in a minimum of time and without the necessity of using large, heavy test equipment. Each squadron equipped with the SCR-522-A radio set is to be normally supplied with three each IE-36 and I-139-A, together with one IE-19-A. At the present time the IE-19-A is the only special equipment furnished to squadrons for use with the SCR-522-A radio. Since the combination of IE-36 and meter I-139-A is small and convenient to stow, it is readily adapted for use in conjunction with the SCR-624-A, AN/

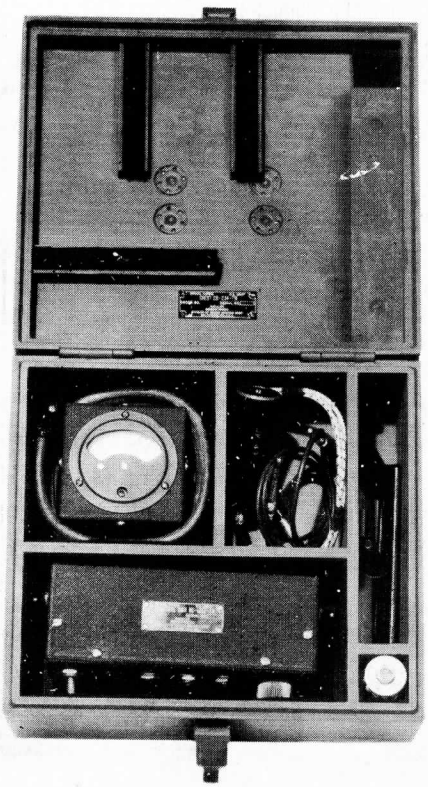


FIG. 1 - TEST EQUIPMENT IE-36 COMPLETE WITH TEST SET I-39-A

CRC-1, or ground installation of radio transmitter/receiver SCR-522-A, which may be so situated that larger test equipment could not ordinarily be carried.

The IE-36 is made up of the following items:

Chest CH-234 is a wooden chest 10" x 9-7/8" x 4" with suitable compartments for transportation of the components. It is provided with a metal carrying handle.

Control Unit BC-1303 shown in Figure 2 is the major item. When performing tests it is arranged to mount directly on the 18-pin Socket 417 of the SCR-522-A rack. It provides a channel selection switch, carbon/magnetic microphone and headset jacks, a buzzer with on-off switch for use in tuning the receiver, a "Contactor On-Off" switch, and a "Transmit-Receive-Remote" switch. The d-c voltage for operation of the buzzer and the convenience light on the bottom of the unit is obtained from the 14-volt circuits through the 18-pin socket.

Phantom Antenna A-29 consists of 12 resistors, each 820 ohms, and a pilot lamp, all connected in parallel on a coaxial fitting which plugs into Socket SO-153 of the radio set. The A-29 can be used properly for test purposes only. For transmitter channel tuning, the airplane or ground installation antenna should be used in order that proper tuning and adequate power output will be obtained.

FIG. 2 - CONTROL UNIT BC-1303

In order to provide means for connecting magnetic Microphones T-34-( ) and T-44-( ) with their special type plug, adapter Cord CD-1169 is included. It is made up of four wires connecting Jack JK-49 and two Plugs PL-55.

Cord CD-1170 is three feet long with an alligator clip and a pin probe fastened to opposite ends. It is used to couple the r-f output of the buzzer in Control Unit BC-1303 to the antenna socket on the SCR-522-A.

The spanner wrench is continuously adjustable to adequately fit the various plugs found in radio sets SCR-522-A, SCR-542-A, SCR-624-A, and AN/

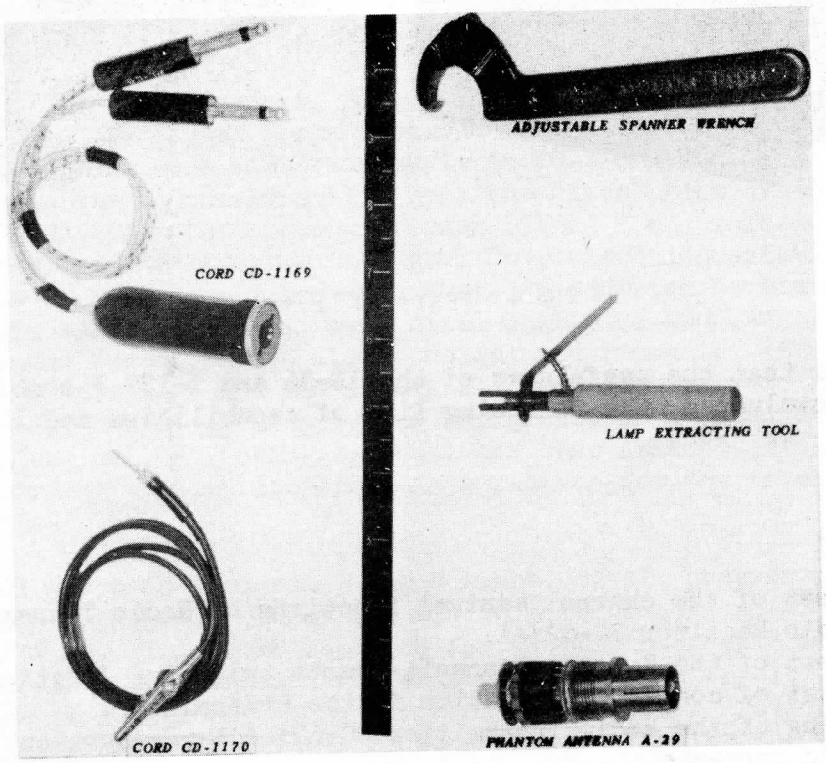


FIG. 3 - TOOLS AND ACCESSORIES FOR TEST EQUIPMENT IE-36

CRC-1. The lamp extractor is the same as used in Test Equipment IE-12-A and is for removal of lamps in Radio Control Box BC-602-A or BC-602-B.

These five items are shown in Figure 3.

Since the Test Set I-139-A is to be in most instances issued as a companion item to the IE-36, and can be stowed in the Chest CH-234, a brief description is included. This test set is a 0-1 milliampere direct current meter and is also used in Test Equipment IE-19-A. Figure 4 illustrates this item. It is used in the normal way as described in tuning instructions for the Radio Transmitter BC-625-A.

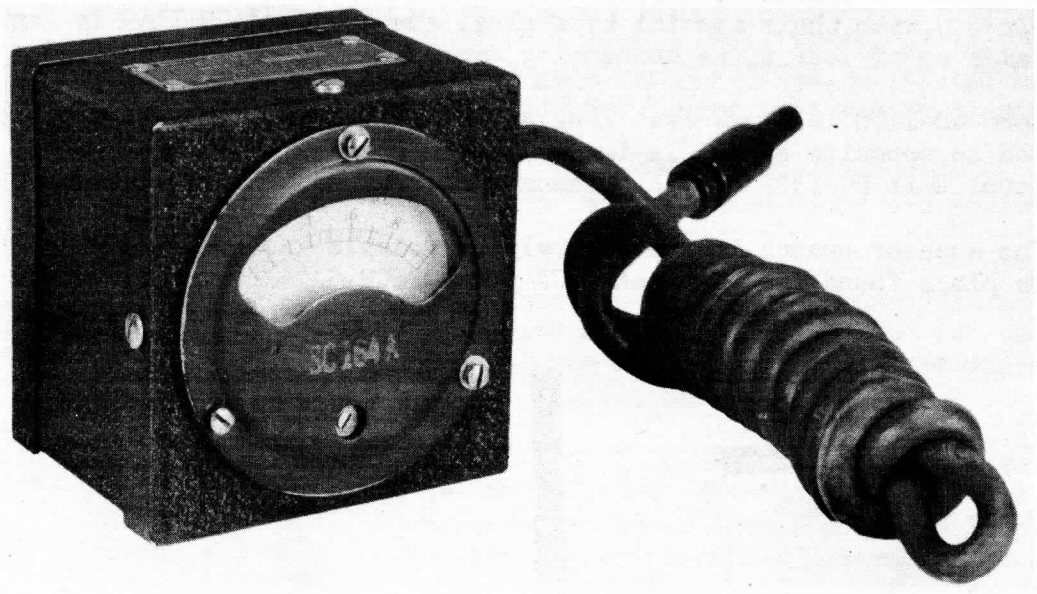


FIG. 4 - TEST SET I-139-A

In order that the usefulness of the IE-36 and I-139-A combination can be properly evaluated, the following list of capabilities and limitations is given:

Capabilities:

1. A test of the channel control functions of Radio Transmitter BC-625-A and Radio Receiver BC-624-A.
2. A test of the Receive-Transmit-Remote switching functions.
3. A test of contactor operation in the transmitter.
4. Tuning of the Radio Transmitter BC-625-A by measurement of various plate and grid currents.
5. A test of relative sensitivity between the four channels of Radio Receiver BC-624-A. Test Equipment IE-36 may also be used for channel tuning in Radio Receiver BC-624-A. However, use of test equipment IE-19-A may result in more accurate adjustments being obtained.

Limitations:

1. Test Equipment IE-36 will not give an indication of field strength produced by the transmitter.
2. It will give only relative power output as indicated by the brightness of the lamp of Phantom Antenna A-29.
3. It will give only a relative index of modulation, not the actual percentage. Again the phantom antenna lamp shows the modulation as the lamp varies in brilliance.

MILITARY PERSONNEL

RECENT PERSONNEL ACQUISITIONS

The Signal Corps Service Units that are being activated on the 1944 Troop Basis will have enlisted personnel procured from a number of different special sources, rather than as in the past being made up of reception center personnel brought in through Signal Corps replacement training centers and schools. This is because inductions into the Army have not been sufficient to meet the needs for signal personnel and as a consequence it has been necessary to negotiate for certain bulk transfers to fill up units called for early this year.

One of the primary sources of personnel has been the Army Specialized Training Program. The Signal Corps received several thousand former Signal Corps enlisted men who were withdrawn early in 1944 before their ASTP courses were completed. Subsequently, upon the dissolution of the program in March 1944 additional thousands of former Signal Corps personnel and electrical engineers were transferred to Signal Corps training establishments. The dissolution of ASTP itself provided that, in addition to electrical engineers, certain basic engineers, mechanical engineers and linguists were to come to the Signal Corps to meet its technical requirements. More than 93 per cent of this personnel are now in Signal Corps schools receiving specialist training. Because of their previous background in communications work and electrical engineering, this personnel has been able to complete enlisted courses in a minimum of time and serve as a nucleus for the technical cadres of service units.

The Signal Corps is also receiving a number of air crew or aviation cadets who were transferred out of the Air Corps back to Army Ground and Army Service Forces. This personnel, as far as possible, will be the ex-Signal Corps enlisted personnel who applied for air crew or air cadet training and are now no longer needed by the Army Air Forces. Previous training received by this group will also be of substantial value to the Signal Corps and will raise the standards of excellence required for technical units.

There have been, and will be, several bulk transfers of enlisted men, either reservists, or those with communications SSN's, from the Army Ground and Army Service Forces to Signal Corps units.

Another source of personnel has been the Reassignment Centers which were recently established by the War Department to effect the reclassification and reassignment of surplus personnel. Some 1,500 of this personnel were transferred to the Signal Corps to serve as fillers for ASF Signal units.

It will be seen from these bulk transfers that the Signal Corps has been fortunate in receiving high grade and qualified communications personnel at a time when inductions were inadequate, and the need for skilled personnel was great.

CEILING LIFTED FOR WAC OFFICER ASSIGNMENTS

In authorizing personnel for overhead installations under the jurisdiction of the Chief Signal Officer, Army Service Forces has removed any numerical limitation on the assignment of WAC officers. This means that there is no limit to the number of WAC officers who may be assigned to field installations, except that the number of Wacs cannot exceed the total authorized number of commissioned officers.

Originally WAC officers were assigned according to Manning Tables to administer WAC personnel only. Later, the only authorization for the Office of the Chief Signal Officer was that for a WAC Staff Director. Still later, when it was decided that WAC officers could replace male commissioned officers in overhead positions, it was necessary to make specific requests for such a conversion of the personnel authorization. Under the new ruling, there is no ceiling on the number of WAC officers an installation may use, other than that they must release male officers or fill officer position vacancies which have already been authorized. A definite personnel authorization is still required for enlisted Wacs, however, as the number which can be accommodated by an installation is dependent upon several factors which must be considered, such as housing, administration, supplies and other facilities necessary because of the fact that the WAC is a women's organization.

More and more emphasis is being placed upon the replacement of combat-fit officers by Wacs and field installations have been requested to survey the possibilities of utilizing such personnel to the greatest extent possible.

ASSISTANT DIVISION SIGNAL OFFICER

A revision of T/O 11-7 for a Division Signal Company was made by Change No. 1, 25 March 1944, which added the position of Major for duty as Assistant Division Signal Officer. Formerly T/O 11-7 called for a Lieutenant Colonel as Division Signal Officer and a Captain to act as Commanding Officer of the Signal Company. Under the new T/O, the Assistant Division Signal Officer will perform the duties of a staff officer and will probably act as Division Signal Officer while that officer is off on reconnaissance, is establishing a new command post, or is performing other duties necessitating his absence from headquarters. The newly authorized Assistant D.S.O. will also handle paper work such as making up Signal Operating Instructions, and will no doubt supervise divisional communications and units, carrying part of the responsibility for handling instructions for personnel. When future operational planning requires the D.S.O. to be away from his organization for any length of time, his duties will fall upon the Assistant D.S.O. The grade for this new position provides for a training stage for prospective Division Signal Officers, thus assuring that each D.S.O. has an understudy who will be able to carry on in an emergency.

MILITARY TRAINING

SIGNAL CENTER TRANSITION

The Signal Center of a large static headquarters is normally somewhat like a mass production assembly line. Traffic flows in and out in an endless stream. Speed and accuracy are best accomplished by specialized workmen in the routing, processing and Code Room work.

The day comes when the headquarters loses its importance; traffic begins to slow down. Suddenly, personnel are transferred and the Signal Center suddenly finds that specialists are actually holding them back. The need is for individuals with complete Message Center and Code Room ability, capable of carrying a message through the complete processing.

The moment traffic permits, a training program should be immediately introduced, that not only teaches men the complete system in use, but also provides for rotation of personnel in the various jobs. The change is then easily made from mass production with specialists to the smaller installation requiring personnel with general knowledge.

This procedure has proven its value at the Signal Center, Atlantic Base Sector.

A similar program is in effect at Allied Force Headquarters and, since 30 January 1944, has been augmented by classroom work for the entire midnight shift.

During the early morning hours, message traffic is light and time for such a program, therefore, is available. At the suggestion of duty officers in Traffic Control, arrangements were completed to use the office of the OIC, Signal Center, for a classroom where facilities, adequate room and a blackboard were available. Duty officers prepared the outlines, programs, training schedules and lectures.

The purpose is to broaden the general knowledge of all personnel to the extent that each individual will be familiar with every assignment in his section. Classes are held on CCBP-1 and CCBP-4 procedure headings, and special procedure covering Cable handling, and procedures necessary for efficient use of automatic enciphering equipment. The operation of each position in Traffic Control is explained in detail by the Duty Officer and the Crew Chiefs of the respective positions.

THIS ARTICLE APPEARED IN THE MARCH 1944 ISSUE OF THE MONTHLY BULLETIN, PUBLISHED BY THE CHIEF SIGNAL OFFICER, ALLIED FORCE HEADQUARTERS, NORTH AFRICA.

As each position is discussed, the operation and procedure is compared with that of another large fixed station, such as WAR, and with a repre-

sentative small station such as ___ or ___. Here is taught the difference in procedure and traffic control as employed by both British and American stations, large and small. Further comparison with this station gives the individual a much clearer picture of the "why's" and "wherefor's" of local procedure and regulations.

Classes, conducted five nights a week, consist of two periods of one hour each. The section is equally divided between the two classes and the Duty Officers alternate in conducting them. Experience gained by both Duty Officers in their previous assignments is thus utilized for the benefit of all.

The results of the first week of classes have been good. Inasmuch as the student personnel has been acquainted with phrases of operation and procedure heretofore unfamiliar to them. At present, they are encouraged to participate in open discussion on their newly acquired information and are definitely gaining a much better picture of Army communications. While thrashing out some of their problems, they are learning, too, to handle their individual assignments more efficiently.

TRAINING COURSES

Since December of last year, the following courses for officers and enlisted men have been added, discontinued, or have had the course-lengths changed. For further information on the purpose, scope, and other details of each course, see SCTIL #25, December 1943.

Officers' Training

Electrical Fundamentals Course (Present Course Length - 9 Weeks)

Administration and Supply Course (Present Course Length - 9 Weeks)

Motor Transport Course (Discontinued)

Division Field Wire Systems (Proposed to discontinue as of 1 May 1944)

Advanced Officers Course (Present Course Length - 17 Weeks)

Signal Depot Supply Course (Present Course Length - 4 Weeks at Camp Lee, Va., and 8 Weeks at Holabird Signal Depot School)

Enlisted Men's Training

SSN 231 - Switchboard Installer, Tp and Tg, Dial (Discontinued)

SSN 206 (formerly SSN 042 b) - Projector Repairman Course (17 Weeks)

SSN 115 - Automatic Switchboard Maintenance Course (8 Weeks)
Prerequisite: AGCT score of 95 or more; experience in work requiring the use of small tools; must not be color blind. Taught at Automatic Electric Company, Chicago, Illinois.

SSN 150 - Crystal Grinders Course (8 Weeks)
Prerequisite: AGCT score of 95 or more; high school education desirable; experienced in the use of small tools. Taught at Holabird Signal Depot, Baltimore, Maryland.

SSN 648 (Modified) - Radio Repairman Course, Modified (15.5 Weeks)
Prerequisite: AGCT score of 110 or more; if experienced in the manufacture or repair of radio equipment, the AGCT score may be as low as 95; must not be color blind. Taught at Eastern and Central Signal Corps Schools. Note:-This course replaces SSN 174 for preliminary training for such courses as SSN 649, 792, etc.

SSN 384 - Installer Toll, Tp and Tg Courge (22.9 Weeks)
Prerequisite: AGCT score of 110 or Otis General Intelligence Test score of 37, or General Electrical Intelligence Test score of 30. Taught at Eastern and Western Signal Corps Schools.

SSN 506 - Portable Power Generator Repairman Course (8 Weeks)
Prerequisite: AGCT score of 90 or more; high school education desirable; experience in the automotive field. Taught at Holabird Signal Depot School, Baltimore, Maryland.

SSN 538 - Voice Intercepter, Designated Language (4 weeks - g)
6 weeks - j)
Prerequisite: Must have excellent understanding of the spoken language; must be a good translator; must be cleared in accordance with Conf. AG letter, 250.1 Loyalty (22 Jan 44) OB-S-B-M, 26 Jan. 44. Taught at classified installation.

SSN 078 - Electrician (Discontinued)

SSN 709 - Traffic Analyst (Radio) Course (6 Weeks - g)
9 Weeks - j)
Prerequisite: Knowledge of language desirable; also some knowledge of cryptography and cryptanalysis; ability as radio operator, particularly military radio operation experience; must be familiar with radio call signs and procedure; must have some training in mathematics and statistics; knowledge in concept of world geography desirable. Taught at classified installation.

SSN 792 - Radio Repairman, Single Channel Teletype System (17 Weeks)
Prerequisite: Must be qualified Radio Repairman (SSN 174); if not, an additional training time to complete the SSN 648 Modified Course, of 15.5 Weeks would be required. Taught at Eastern Signal Corps School.

VIBRATOR DEMONSTRATION BOARD

The vibrator power supply, because of its light weight, compactness and efficiency, has found its way into Army equipment. Although the vibrator action is very basic, it does appear more complicated than that of many of the other components of radio equipment. This is perhaps because of the mechanical action in contrast to the almost purely electrical function of most of the other parts.

A working knowledge of vibrators is therefore essential to be able to service vibrator power supplies. The vibrator demonstration board was devel-

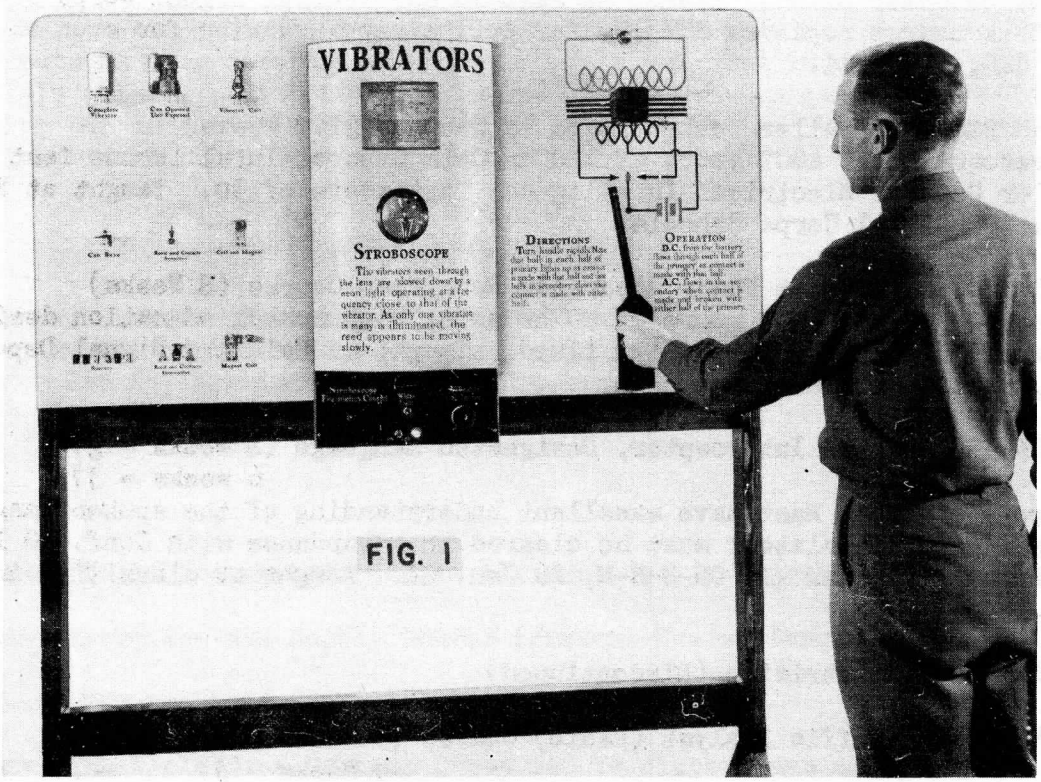


FIG. 1

oped to enable the student to acquire this knowledge quickly and efficiently. It is large enough and attractive enough in appearance to interest the student immediately. Being able to see the mechanical as well as the electrical action arouses his enthusiasm with the result he understands and remembers more.

The demonstration board is two and a half feet high, five feet long, and one foot deep. It is set on two legs bringing its total height to six and a half feet (Figure 1).

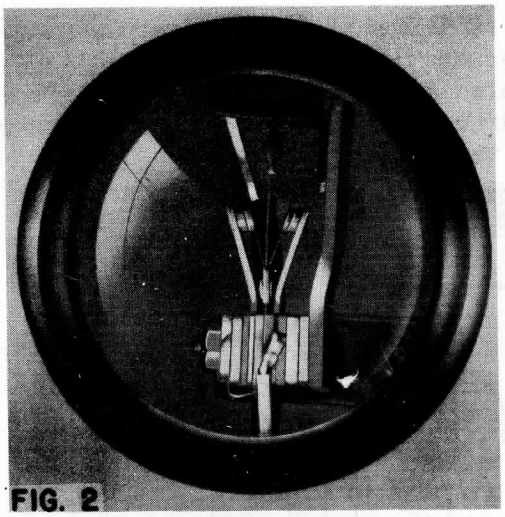


FIG. 2

Vibrator Viewing Mechanism The stroboscopically lighted slow motion action of the vibrator is seen through a four and a half inch viewing window mounted in the center of the board (Figure 2). This window magnifies the size of the vibrator several times, making it easier to see the individual parts. Directly below this window is the panel on which are mounted the controls for the viewing mechanism, as follows, from left to right:

Stroboscope Frequency Control - enables the light pulses to be synchronized with the vibrator action.

White Light Button - permits the vibrator to be seen under conventional lighting.

On-Off Power Switch - with its panel indicator lamp, controls all the power supplied to the board.

Vibrator Selector - enables the student or lecturer to select any one of four vibrators and place it in operation in the viewing chamber.

Directly above the viewing window is the illuminated diagram window. Each time a different vibrator is turned into the viewing position by the vibrator selector knob, a schematic diagram appears in this window. The instructor uses this schematic diagram to explain how the electromagnet is switched on and off by the contacts on the reed. Defects that the vibrator possesses are shown greatly enlarged.

Simulated Vibrator Mechanism The simulated vibrator mechanism with its power supply circuit consists of a four and a half volt battery, a mechanically simulated vibrator, a vibrator transformer with panel lamps connected in series in both legs of its primary circuit and a neon lamp connected across its secondary. The actual parts are mounted on their respective symbols in such a manner that the student readily associates the symbol with the part. Operational directions and descriptions of the circuit action are printed beside the simulated vibrator mechanism.

Vibrator Display The vibrator construction display on the left side of the board consists of three vibrators in progressive stages of disassembly. The one mounted in the top left corner (the point which reading habits have taught one's eyes to notice first) is completely assembled. This impresses upon the student the physical size, shape and appearance of the complete unit. Beside this vibrator is another with its cover split open. Here can be seen the internal

mechanism as well as the method used to support it in the can. A sponge rubber liner cap grips the stack end of the vibrator, supporting it freely above the plug base thus preventing the transmission of the vibratory movement to the external mounting. The entire can and the liner cap have been removed in the next unit of the display. This makes it easier to trace the lead circuits and study the stack construction. Below these vibrators are displayed the various components. The reed and its contacts are shown assembled and

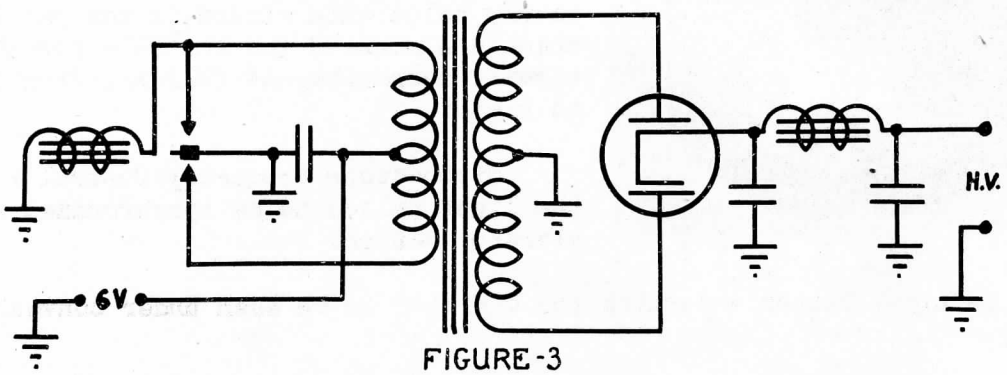


FIGURE-3

also completely disassembled. The coil is shown mounted on its pole piece and also completely knocked down. The can base and the various spacers used in the construction of the vibrators are also shown on this display.

How the Vibrator Demonstration Board Operates

To put the Demonstration Board into operation, plug the line cord into a source of 115 volt AC current. Turn the power switch to the ON position and the vibrator selector knob to bring the good non-synchronous vibrator into view. Adjust the frequency control while watching the vibrator through the viewing window, until the vibrator appears to be moving very slowly.

Notice the distance through which the reed swings and the action of the contacts as they close and open. As the vibrator reed lazily swings from side to side, first one and then the other set of contacts close so firmly and surely that they appear to stick together. Because of this contact action only a very small spark accompanies each make and break of the circuit.

Depressing the white light button on the control panel, bathes the vibrator in a strong white light. This shows the vibrator action as it would appear to the eye unaided by special lighting.

We have seen the vibrator opening and closing the two sets of contacts at high speed. This same action may be duplicated at a very low speed on the simulated vibrator power supply circuit.

Turning the handle of the mechanism causes the simulated vibrator reed to connect first one, then the other half of the primary to the DC power source. The small bulb, in series with each leg of the transformer primary,

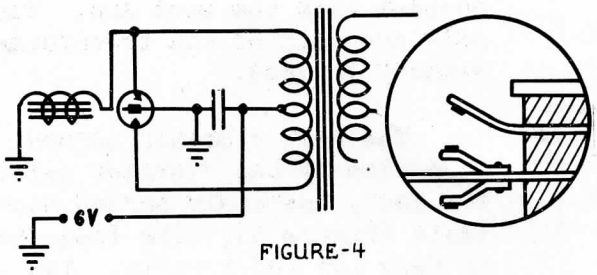


FIGURE-4

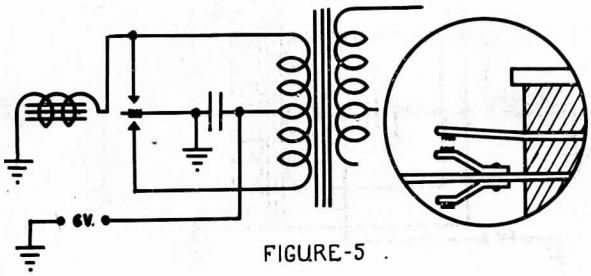


FIGURE-5

lights as contact is made. Thus current flow in each part of the circuit is indicated.

As the reed touches one contact, current flows through that leg of the primary, building up a magnetic field around the transformer. The flux, in cutting the secondary winding, induces a voltage which causes one electrode of the neon lamp, connected across the secondary, to glow momentarily.

When contact is broken, the magnetic field collapses, inducing a voltage of opposite polarity into the secondary, causing the other electrode of the neon lamp to glow.

When the reed swings to the other contact, that half of the primary is connected to the power source. The resulting current flow induces a voltage into the secondary of the same polarity as was induced by the preceding collapsing field. The neon lamp glows again on the same electrode.

As the handle on the simulated vibrator mechanism is turned, each electrode flashes twice in succession. Thus when the handle is turned rapidly these two successive flashes on each electrode blend into one. The flashes alternating from one electrode to the other give a true impression of an AC voltage in the secondary.

We have seen, in slow motion, the simulated vibrator and power transformer changing a low voltage DC current into a high voltage AC current. We have seen the actual vibrator through the viewing window with the aid of the stroboscopic light, rapidly making and breaking first one circuit then another. If we imagine this actual vibrator replacing the simulated vibrator, then this process of changing low voltage DC to high voltage AC will take place at high speed and automatically.

The vibrator circuit described above is, of course, very simple. A schematic diagram of the typical circuit in which this vibrator will be found (as appears in the illuminated diagram above the viewing window) is reproduced in Figure 3. The vibrator selector knob is now turned to the next position, bringing into view a vibrator with one contact arm bent out of place (Figure 4). The stroboscope frequency control may have to be changed slightly to match the different frequency of this vibrator. One is immediately impressed by the smaller reed movement and the tendency of the reed to jerk toward and away from the good contact. In this case the reed does not make

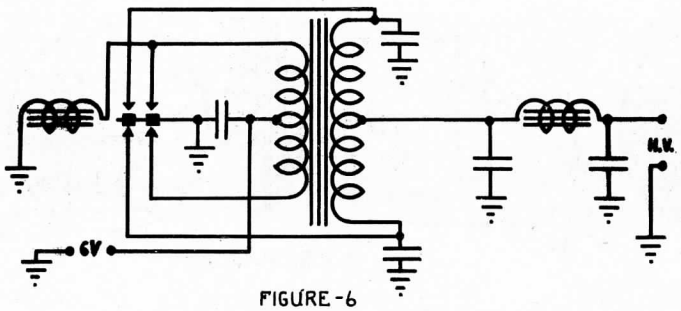


FIGURE-6

contact with the bent arm. Thus, only one half of the transformer primary is used.

The next vibrator turned into view by the vibrator selector knob, has badly burned contacts (Figure 5). Its frequency is very low and erratic. The movement of the reed is so small that it appears to be standing in its resting position and "shaking" rather than bowing smoothly to and from each contact as the good vibrator appears to do. Large sparks accompany each make and break action of the contacts.

The synchronous vibrator is the last to be turned into the viewing position (Figure 6). Its reed movement is smaller than that of the good non-synchronous vibrater because of a different type reed, yet its frequency, as noted by the pitch of vibration, is about the same. Very little sparking exists at the contacts.

Troubles in the Construction of the Demonstration Board

One of the first problems encountered was that of securing proper vibrator action. Connecting the vibrator in the usual manner, that is, with the coil in shunt with the contacts, was undesirable because of the amount of current drawn from the power supply. In order to overcome this difficulty, the circuit connections were rearranged so that the coil would be in series with one set of contacts. A small DC current, limited by a resistor, flows through the other contacts to duplicate the normal sparking.

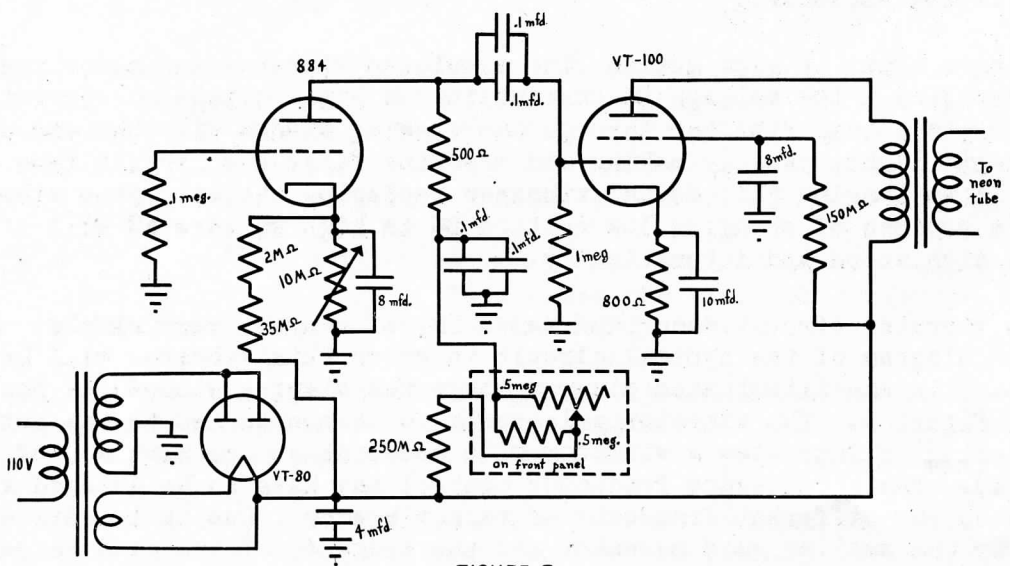


FIGURE-7

Another problem was that of lighting the vibrator. It had to be a type of light that could be flashed on and off very rapidly; it had to be bright enough to make the vibrator parts stand out distinctly.

The ordinary round neon bulb was tried in a time constant oscillator circuit but its light output was too small. It was also quite difficult to get it to oscillate at the proper frequency.

A fluorescent lamp was tried but the retentivity of the coating was too great. The light could not be flashed on and off rapidly enough to stop the action of the vibrator.

Finally, a long neon tube was tried. A class C amplifier with its fre-

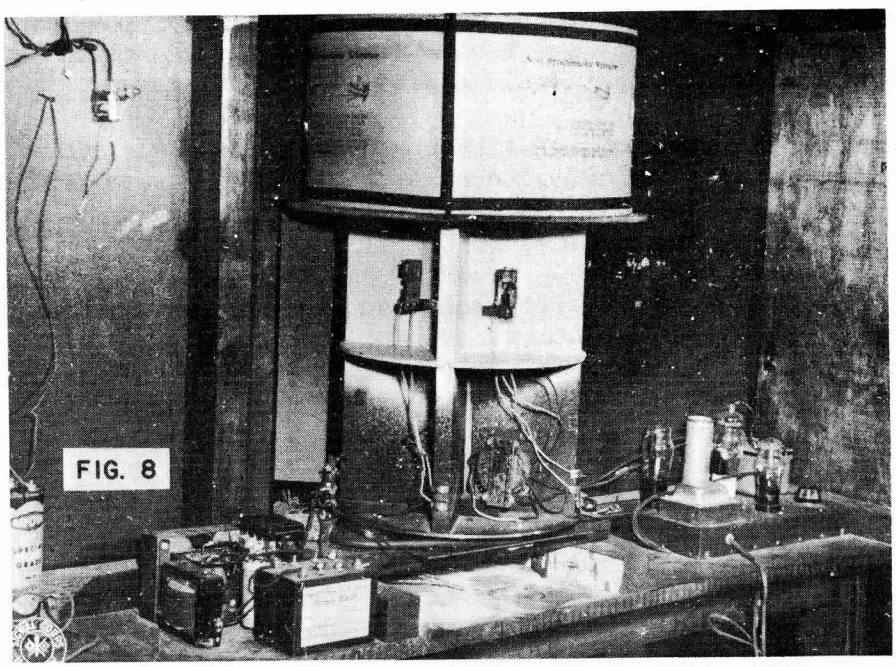


FIG. 8

quency controlled by a thyratron tube furnished power. This worked satisfactorily. The neon tube was bent into the shape of a large U and mounted behind the front panel, in front of the vibrator, to light it evenly. Figure 7 is the schematic diagram of the pulse generator and the amplifier used to light the neon tube.

Then there was the problem of displaying the various vibrators. Many arrangements were checked, including mounting the vibrators in a row and displaying them one at a time by means of a sliding window. This idea was discarded in favor of the present system because of the difficulty of lighting the individual vibrators.

The vibrators are mounted on a large rotatable drum controlled by the vibrator selector knob on the control panel. Turning this knob rotates the

drum and brings the desired vibrator into position behind the viewing window (Figure 8). This solved the problem of displaying the vibrators but their mechanism was still too small to be conveniently studied. The lens of a four and a half inch reading glass was then mounted in the window. This magnified the vibrator sufficiently to make the individual parts stand out distinctly.

It was also desired to show the vibrator in action under normal lighting conditions. Lights were placed along side the neon tube and were controlled by a push button on the control panel. These lights could not be made strong enough to completely counteract the stroboscopic effect of the neon light. Finally, a pin ball lamp with its lens was used to throw a bright spot of light on the vibrator. This one spot of light creates hard shadows, sharply defining the different parts.

A switching arrangement was also placed on the drum so that the vibrator would have to be properly positioned behind the viewing window before the stroboscopic light or white light would operate.

Even though the contacts of the vibrators were burned and pitted, they didn't spark badly enough. In order to make this sparking very obvious, the contacts were connected directly across the 110 volt winding of a power transformer and low voltage AC was applied to the filament winding.

Designing the simulated vibrator mechanism was not very difficult. It was mainly a matter of changing rotary movement to a reciprocal movement. This was accomplished by fastening a wheel to the handle of the mechanism. A pin on this wheel moves back and forth in a slot on the reed arm. Thus, as the wheel revolves, the pin moves the simulated reed from side to side touching first one contact, then the other.

The unusual action of a vibrator compared with the theory and application studied by the student of radio servicing, indicated a definite need for such a demonstration board. Besides making the vibrator power supply easier to understand, it has proven to be an interest builder, adding spice to a subject which some students may consider dry at times.

REAR-PROJECTION METHOD FOR SHOWING FILMS IN DAYLIGHT

A method for showing films out of doors in daylight, or indoors in daylighted rooms, which has been successfully used by certain units of the Air Forces, Signal Corps, and other branches of the armed forces, is briefly described here for the benefit of officers who may be able to adapt it to their needs during the coming summer months.

The ordinary method of projecting training films and film strips depends on projecting a light image on a screen in a darkened room. Darkening the room in mess halls or similar buildings used as army classrooms, results in poor ventilation. Accompanied by crowded conditions, this causes a ten-

dency to doze or let the attention wander — particularly in warm weather.

By taking advantage of optical laws, it is possible to show films in outdoor shaded areas or indoors in properly ventilated rooms. The rear-projection method creates an image on a screen placed between the audience and the projector in the line of vision from the light source. Thus the audience looks at the source of light instead of at a mere reflection as in the ordinary method. This gives a good screen image in spite of the additional outside light falling on the screen, provided that outside light does not create more than ten-foot candles of reflected light from the screen surface.

The rear-projection method (commercially known as "translux") uses any standard 16mm film projector. The projector is directed at a mirror which

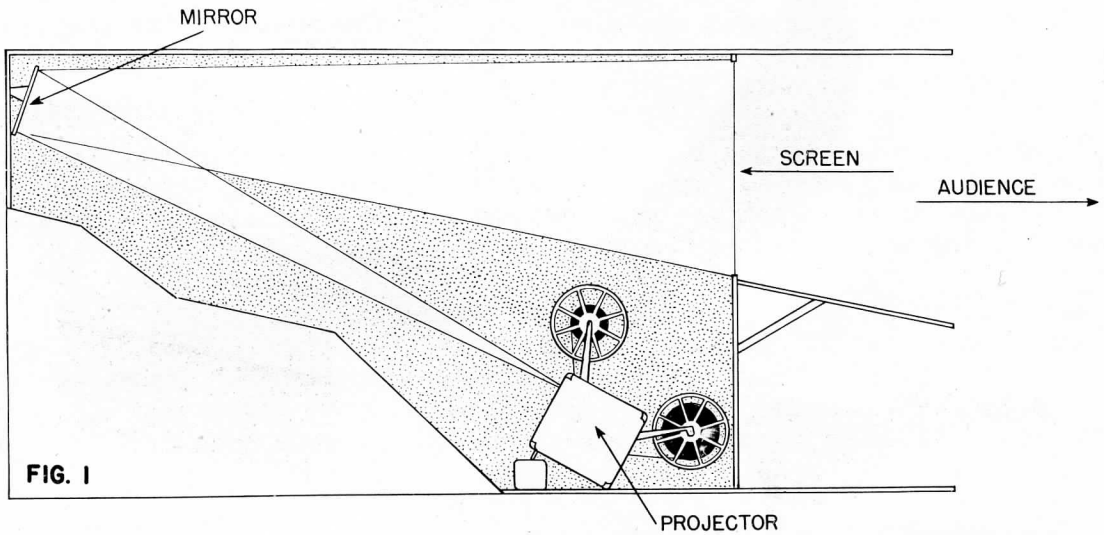


FIG. 1

reflects the image to a screen from the rear of the screen (Figure 1). The mirror serves not only to decrease the total distance from projector to screen, but also to reverse the image from right to left, so that the audience seated in front of the screen sees the image correctly. The mirror, projector lens, and back of the screen must be in the dark, and the front of the screen must be shielded from direct light by a shadow box. One practical method for obtaining this darkened space is to use the back of a 1½ or 2½ ton truck (Figure 2) or a portable booth can be built.

When used away from commercial electric power, any 110-120 volt, a.c. 60-cycle army power unit capable of delivering 1,000 watts, can be used as a source of power for the projector.

The screen may be any translucent material rough on the image side and smooth on the front side. Map overlay plastics or paper, tracing cloth, or regular "translux" screens available from commercial sources can be used.

When outdoor daylight showings are planned, the location must be selected away from distracting action or noise, and the audience must face north to avoid glare from the sun. It is also extremely desirable to have enough foliage around the area to shield both the screen and the audience from the direct light of open sky near the horizon. This is even more detrimental to the screen image than sunlight.

The truck installation has the added advantage of extreme portability, so that many showings can be made at different locations over a short space

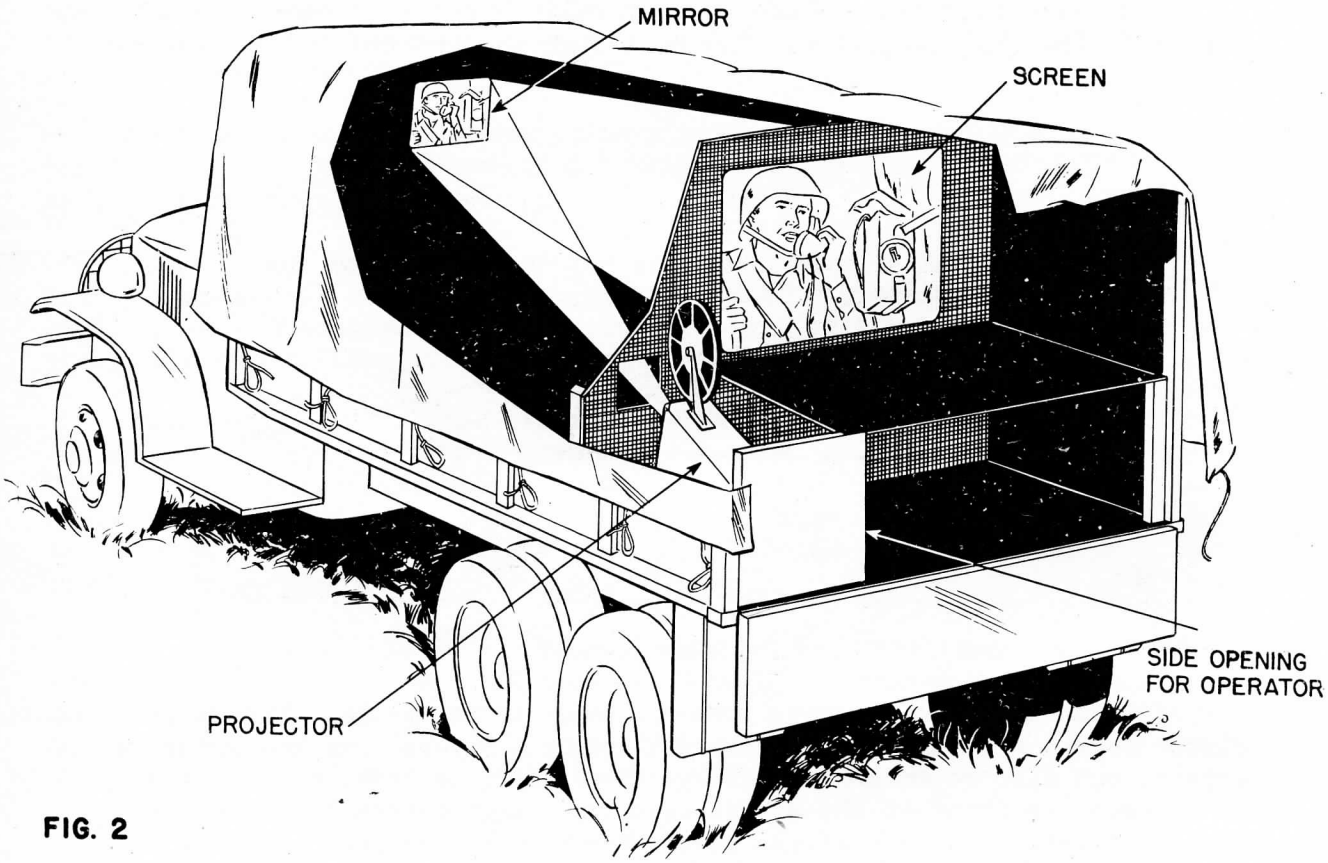


FIG. 2

of time, and training films and film strips can be brought directly to men on bivouac.

The largest practical image obtainable from the usual 750 watt bulb in government issue projectors is 30 by 40 inches, but this is large enough for an audience of 100 people -- although a smaller number is desirable for efficiency in using the training film or film strip in army instruction. A table of screen image sizes, and distances from projector to screen for lenses of various focal lengths, is included in TM 11-401, Training Film and Film Strip Projection.

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