LEADERSHIP

By Brigadier General H. E. Ely, U.S.Army

Leadership is a very peculiar thing. It is hard to define. You may say that it means the ability to induce or to make others follow you, or to make them do what you desire--but there are so many other inherent composites of leadership--esprit de corps, morale, knowledge of human nature, that, to get right down to a concrete definition of the word, in order to show how leadership is to be acquired, is certainly an extremely difficult task.

Our literature dealing with the subject of leadership is rather deficient. We have little in the Army Regulations, Drill Regulations or Field Service Regulations touching upon it. In the French they have some; in the German considerable; in the English little,--but we now have something much better in our schools. Before this war we particularly went to German books when we wanted to find out how great achievements were accomplished--how it was that one organization would succeed where another, evidently under the same circumstances and environments and with practically the same material, would fail. But we now have something better. We have in our own service men who were leaders, and they proved to be just as good leaders as there ever were. We went up against the most powerful and best organized and best taught army in the world,--the German Army. We were associated with the English and French armies, which, next to the Germans, were the best, and we found out that after a short time we did not have much to learn from them, because our people are active and resourceful. General Pershing is now writing a book, I do not know what it is called, but I know that it will be essentially valuable and I am in hopes that others of our great leaders will write books, showing not what Napoleon says about this or that, nor what was done in the campaigns of Alexander, Hannibal, Gustavus Adolphus, Savoy and Frederick the Great--but showing how our own leaders accomplished success, showing what did and how they did it; why they did it that way, why, doing it that way their command successful while the commands on the right and left were not successful.

Leadership can not be attained without intelligence; after intelligence, one who aspires to be a leader must not only be willing to accept responsibility but must seek it. He must look for it--he must want it--else he has no material for leadership. He must also be able to take initiative. Very well organized commands leave to the subordinates a large latitude of initiative. No high commander can handle all detail work and do it efficiently without coordination; and that coordination, so essential to ultimate success, must come up from subordinates, seeking duties to perform and responsibilities to shoulder--and if they do not do this, some of them will find themselves on the outside, and say "Well, I have no command--it has been taken away from me by my superiors."

You will find in the writings of many eminent writers on the subject that "the will to succeed is the road to victory," THE WILL TO WIN. There is a good deal of truth in that. Endurance, staying there longer than the other man, is certainly requisite for success, as is also the qualification of the commander to require of his command to do this--not only require it but through his previous administration and leadership to enfuse into them the desire to stay there, perhaps it may be that their legs want to run away, but the mind is made up to stay. An anecdote is told of Turenne, once before going into battle his legs trembled, he said "Body you tremble, you would tremble more if you only knew where I am going to take you today." And until the mind can overcome the body, you are not going to have leaders nor leaders. This is the prime requisite for success; but willing mind and leader are not enough--the true leader must have the gift of transmitting his supreme energy requisite amongst his subordinates.

No matter how energetic or how courageous or how much of a will to win a leader may have--unless he can enthuse his men, he is not going to be a success and his command is not going to be what is called a successful command. In order to have a good command, the leader must instill into that command, patriotism and love of country; he must instill in them a belief in their cause, good discipline and esprit de corps.

WAR DEPARTMENT
OFFICE OF THE CHIEF SIGNAL OFFICER
WASHINGTON, D. C.

INFORMATION BULLETIN NO. 8. JUNE 1, 1921.

For Signal Officers of the Regular Army, National Guard and Reserve Corps.

qualifications of an officer of the United States Army.

Any officer--and I have seen many and many of them--who never has anything but a word of command or a snarl--for his enlisted man, is never going to be a leader and the United States Army would be better off without them. You have to treat your men like human beings; talk to them; show your sympathy for them; help them in every way that you can; look after their mess; their beds; their billets; encourage recreation; see that they are provided with good reading matter. Always look after the welfare and the comfort of the men. Look forward and plan for the company wherever you may be. If in the field, always send out a detachment and reconnoiter the route and find out something about the roads before you try to make a march. I have seen organizations on the march, way out of their way, with the men dead tired, just because their leaders--so called--had failed to send out reconnaissance parties to show the road--men will never have use for a commanding officer of this type.

Men are very jealous of their prerogatives. Speak to your men about tradition and they will grasp the idea. Tell your men to wear shoulder insignia and fourragere and explain to them what it means. Encourage physical exercises; encourage them to get a few extra dollars for qualification as specialists--this helps their pocketbooks and helps in the furtherance of esprit de corps.

Now (holding Efficiency Report) here is something that you all know something about--it is called the "Efficiency Report." These efficiency reports will be prepared by the officer's immediate military superior. These reports are essential, for they show your military reputation in the service and they will go to your superiors at the War Department. In this connection, I want to repeat what I have told regimental and battalion commanders; these questionnaires must be filled with matters of fact and not matters of opinion. In order to have a brigade with esprit-de-corps, full confidence must repose in every member; and I want that feeling here that everyone will be dealt with justly--perhaps there will be times when injustice will be done but sooner or later you will get your desserts. But should you imagine that injustice has been done, wait calmly--do not growl or whine--for you will get your desserts in the long run, especially in the Army. I know of a Colonel who held a grievance, and evidently lost control of himself, which was manifestly reflected in his regiment; a personal friend of his called his attention to the fact, and like a man he held a stiff upper lip and made the best of it, with the result that there was a manifest change in his regiment and he soon became a Brigadier General. These efficiency reports embody the cardinal characteristics of the officer. I will read a few--"Physical Energy and Endurance"--you have got to have that; you have to keep yourself in physical shape. No man can go to battle as we did on the other side without a good body; if his body is not in good condition, his mind will not work--and you must keep that body in trim, for should you go in action, after you go for three, four or five nights practically without sleep, and you have not kept your body in shape, your mind is not working, you are going to fail, for no matter how much will and determination you have, your mind will not function after the third night and if your mind does not function, you cannot use judgment, so that you can readily see that physical energy and endurance is a prime requisite.

Then comes "Judgment and common sense"--this is another prime factor--a most valuable asset. "Attention to duty"--cultivate the habit of being attentive to your duties--this is an acquired trait. "Intelligence"--I am glad to say that most of you have it; intelligence is what God gave you and can improve it. "Professional Knowledge" and "Leadership". In Professional Knowledge always take into consideration "The survival of the fittest," constant study and application and self-criticism will materially assist you; read all you can on Leadership; on taking up military history, you will be fortifying yourself with matters that are bound to come up constantly in battle. When you have read these matters and talked them over with other officers, when the time comes you know unconsciously and intuitively what to do. "Initiative", "Tact", "Force", "Military bearing and neatness"--all valuable assets and requisites for the officer; then under the other

"Esprit de corps" is very much promoted by the history of the organization--what the organization has achieved in the past--what their predecessors have done--these are basic factors of "Esprit de corps" and in its history this Brigade is particularly fortunate, as both of its regiments have always upheld the prestige, honor and tradition of the Army, and this does not necessarily mean the greater achievements, it means doing efficiently and whole-heartedly every task there is to perform, no matter what it may be--no matter how insignificant or unimportant it may appear, it must be done thoroughly and efficiently--then your organization will be taken notice of, and your men will be proud of their organization,--even if it is only a question of keeping the area neat--the sanitation of their barracks, those are things to be proud of, you may think it is but a small matter, but a little piece of paper on the floor will mar the effect of other things which have been properly done--the proper accomplishment of small duties lends to the proper accomplishment of greater tasks; and when it becomes known that you do things thoroughly and efficiently, your subordinates mould after your acts, and there is where you inculcate true leadership and discipline so essential to the final test in battle--discipline must be inculcated into the enlisted man, the privates, the corporals, the sergeants. It is by discipline that they go when they really desire to stop. Out in the front, your men scatter over many, many kilometers, in shell holes, in trenches, in the wood, out of your sight and out of your control, but if they are imbued with the proper spirit and discipline, they know where you want them to go and they go; the lieutenant, the platoon leader, transmits the wish of the commanding officer and the men go, but without the proper control and without discipline, when a man is in a shell hole and is commanded to go forward, and he does not go, what happens? The whole company is liable to stop where the men are not properly disciplined, the organization stops and it is not stopped by the Division Commander, it is not stopped by the Brigade or Regimental Commander, nor by the Company Company, it is stopped by the Private, because that private did not have the will to go and that WILL TO GO has got to be instilled in him by you officers in time of peace. The Commanding Officer must lead, and not drive. Don't try to instill discipline by the aid of the club--your club may do here on the drill ground; you can put a man in the guard house, you can fine him, you can send him to Leavenworth, but the club is no good in battle--at the time when you make attack after attack, when you are lacking food and water, and for days your men have been without sleep and then you are required to make one more advance--this is the time--that is the supreme test--when your men must go forward, and if you are a real leader, your men will unhesitatingly go. Leadership such as the leadership of Napoleon, Alexander, Caeser, and others, may be born in a man, he may have certain qualities that everybody recognizes, but ordinary leadership is a thing that everybody who has passed the examination to enter as an officer of the United States Army can attain, to a certain extent. The Commanding Officer must know human nature. Human nature is at the bottom of everything. There are times--certain times--when fear or privation and so forth, will overcome a man's training and discipline. "Self-control, self-sacrifice" are cardinal principles to guide the man in the army. These things that I am speaking about do not apply only to the enlisted man--they apply to officers as well. We had in this last war about 200,000 officers. We had, two or three years before the war broke out, about 4,500 officers. You can see how many new ones we had and can figure for yourselves the task confronting them. No one can become a leader without thorough understanding of human nature--without the power and ability to build up such relations of confidence and sympathy as will insure free approach of their men in exigencies, without relaxation of discipline. In order to understand human nature, you have to, in a way, place yourself in the other man's place. Ask yourself how you would like it, if this thing was done to you and you were the enlisted man, how would you like your officer to handle this proposition. These men that we now have, especially the later ones, are a special class of recruits. The American soldier is doubtless the most intelligent soldier in the world. Kipling says "the soldier is human, then treat him as such." He is human; he has the same ideas, the same fear, the same aspirations and ambitions that we have, and you must realize that; and until you realize that fact, you will not embody the prime

which should have been attended to by his subordinates.

It would have been much better for him, his subordinates and his troops, if he had attended to his proper duties and let his subordinates attend to theirs. Then when the time came he would have had that unspent force and this would have enabled him to properly make larger decisions that must be made.

If you look over the list of successful commanders of our forces in Europe, you will invariably find that they are men who have paid particular attention to their physical body; who preserved their energy; who kept a tranquil mind to make the proper decisions with a cheerful face--with determination--and this reflects on his organization. A disgruntled officer may mean disaster. Keep up your spirits--the men are watching your every move--the poor devils watch the officers like a dog watches his master--every little change of expression on the fact of a commander is transmitted to the troops, always repress your personal misgivings, for they may be unjustified, and maintain that WILL TO WIN.

That was a characteristic of Grant. He knew the other fellow was just as scared as he; that he had just as many troubles; but he was going to hang on a little longer--that was his secret--he had abundance of good sence; hard judgment; critical courage and a bull-dog determination to win; and he had a good deal of knowledge of human nature--those were his principal characteristics.

Again, the attainment of knowledge is a valuable asset. Many of the officers in the service now were emergency officers--some of these officers have not had more than three or four years' service and are now in command of companies and even battalions--all these officers must continually endeavor to improve their military knowledge. Any officer who does not spend three nights a week studying military subjects is not fulfilling his obligation to the Government. As the division commander stated the other day, we are "not working by the day"--our military duty and profession is our LIFE work; and right here in this Division in these few months past and the few months to come, during this reorganization, no matter what a man's previous military history may have been, no matter what his success in the past, right now his military record is being made that will follow him right through his military career. If he is attentive to his duties, if he is willing to work and applies himself and uses intelligence and judgment and is considerate to his men and treats them with justice, that man is going to be considered as their leader, and they are going to follow him and do his will, everybody will see that he doing his duty and he will become a marked man--on the other hand, if, through lack of concentration or lack of desire, or even, in a few cases, lack of intelligence, they cannot come up to the average standard, they are gone. They won't stay. This division and this brigade are "going" institutions. They have a high standard. We assume that you are all interested; that you are going to work hard and these are matters that I wanted to impress upon you. I want to prevail upon you gentlemen when you have any duty to perform, no matter what it is, do it with an intensity of purpose and with all your might--do it thoroughly and strive to make your military reputation in this way--the man who achieves success is the one who does things and the man who does things is the man who attracts attention and thus he makes his mark and the officer who does things thoroughly need never fear for his military reputation. It is the duty of the superior officers to assist his subordinate officers. Perhaps some officers who were placed on Class B, if they had been accosted by their superior officers and had been told that they were not performing their duties in accordance with their desire and in the proper spirit--perhaps those Class B officers would have reformed themselves. The commanding officer must give instructions to his subordinates as to the methods he desires his subordinates to adopt, and perhaps this would preclude adverse opinion of the subordinate officer and I request you--request you because I cannot order you to do this, but, in a way, you should carry out my desires in my brigade--I request you to be just in making out the efficiency reports--don't fill them with adverse opinion until you have told your subordinate

subheads come: "handling of men" (greatest of all); "Performance of field duties"--the excellence of an organization is judged by its field efficiency; then come the other subheads, which are equally as valuable. What I earnestly want to impress upon you, gentlemen, is the fact that these ratings stay with you while in the service and follow you after you are out of the service, so strive at all times to get the best rating possible--do not forget that these cards are read by General Staff officers who are selecting men with special qualifications--those who excel finally receive their rewards--also remember that these efficiency cards are read by boards who are selecting men for Class "B".

Looking after the care and comfort of your men is a thing that you must do, in order that you may win their respect and love. Preserve the feeling of pride and enthusiasm amongst your men--make them feel proud of their organization--and there are so many ways that have been selected to attain these characteristics--for instance, competition is the best thing amongst men in companies--rivalry--to see who is the best shot--boxing--wrestling--and all these kind of things; then there is another indispensable factor--the dispensing of justice to your men--this is a matter that lies within your power. Some officers, every time a man does something he should not do, irrespective of information or instruction as to his duties, have him tried, put him in the guardhouse--that certainly is not the proper procedure. The summery court officer can regulate these things; he can take cognizance that a certain company is sending an unusual number of men for trial and speak to the commanding officer with the view to ameliorating conditions. Gentlemen, talk to your men when they come into the service; tell them what desertion means; explain to them what "Absence without leave" means; tell them why they should salute and how to salute; inform them that this is a military courtesy and that the officer at all times returns the salute, and when you return the salute, do it properly. At all times be a model to your men,--when one officer passes another render the prescribed salute in a military manner--for the men are watching you, and if they do not see this military courtesy amongst officers properly executed, they naturally cannot see the necessity for saluting you or anyone else.

In addition to the dispensing of justice, the human element must come in with the desire to avoid making what is called a "jail-bird" out of a man. As soon as you put a man in the guardhouse, he loses a certain amount of self-respect, so before you send a man to the guardhouse, talk to him,--get his ideas--why he came into the service,--explain to him why he should be punished for what he has committed and then give him another chance--of course, common judgment must be exercised as there are deeds that demand strict measures,--but as a general rule the first offense can be dealt with lightly.

Whatever you do, do it thoroughly, with your whole heart and soul and do these things with a view to producing results and always reserve your energy for the higher task that confronts you, for the bigger things. I was talking the other day with an officer who handled a division in France; he was telling me about one of his regimental officers, a man supposed to be a pretty good man; they were in the field and there was this regimental commander haggling over every little detail in his organization and when his outfit was to go into the most trying part of the engagement, he was what you might call "all in." He had exhausted his nervous force,--his energy. His division commander called him and said "Colonel, your regiment will attack tomorrow" then told him what the objective would be. The Colonel answered "My regiment cannot do it--they are done for,--we have had tremendous losses and they have not had sleep and cannot do it." The General knew human nature; he also knew the command and its ability, and told the Colonel: "Colonel, your regiment has less to do than the other regiments and your regiment will attack tomorrow. If you feel that you are all in I will put someone else in command of that regiment." At this the Colonel decided that his regiment was in condition and they went in and did very creditable work--but imagine what would have been accomplished if the commanding officer had properly conserved his energy. He did not have very much of it to start with--he had wasted it in attending to little details

WAR DEPARTMENT
THE SIGNAL CORPS SCHOOL
Camp Alfred Vail, N. J.

May 3, 1921

From: The Director, Signal Corps School.

To: The Commandant, Signal Corps School.

Subject: Historical Data.

1. I enclose herewith, with recommendation that copy be sent for file to the Chief Signal Officer, data which has resulted from correspondence with Lieut. Colonel Parker Hitt, formerly Colonel, Signal Corps, and Chief Signal Officer for the 1st Army, A. E. F.

2. This data pertains to an old French station wagon which was used as a telephone exchange by the 1st Army just prior to the St. Mihiel Offensive. Copies of this photostat are to be framed and placed in the tractor which is now on hand in the Signal Corps School.

ROBERT DAVIS
Major, Signal Corps.

1st Ind.

Hq. Camp Alfred Vail, New Jersey, May 6, 1921, To: The Chief Signal Officer of the Army, Washington, D.C.

Forwarded. It is proposed to have this French Station wagon painted and restored to its original condition and on special occasions placed on exhibition on the Camp grounds.

J. E. HEMPHILL
Lt.Col., Signal Corps
Commanding.

- -

HISTORY OF THIS TELEPHONE TRAILER
March - October, 1918

This old French bus, with French military telephone switchboard installed, was the first A.E.F. attempt at the construction of a rolling telephone office. It was assembled by the Research and Inspection Division, Signal Corps, A.E.F., at the Paris shop in the Spring and Summer of 1918. The bus was used because it was impossible to get hold of any other kind of trailer. The entire electrical equipment of the bus was French because no equivalent American equipment was then available. The trailer was completed in July or August, 1918, and it was towed behind a truck from PARIS to LIGNY-en-BARROIS where it arrived late in August, 1918.

LIGNY-en-BARROIS was the Battle Headquarters, First Army, for the St. Mihiel operation. This bus was installed as an emergency exchange under a tree in a stone-walled garden in rear of the building where we installed the First Army Telephone Exchange. It was hooked up to our terminal board in the exchange by the long red cables which are part of the equipment of the wagon. It was not used during the St. Mihiel operation as our main exchange functioned perfectly. This sketch shows the location of the wagon at LIGNY.

that he is not satisfactory--until you have tried to make him satisfactory--until you have explained to him how he could do these things to your satisfaction--until you have done this you are not "doing your job." And with subordinates, your job is not only to do a thing well--your job is to please your commanding officer; if you are a lieutenant you must please your captain, if you are a captain you must please your major, if you are a major you must please your colonel, the colonel must please his brigade commander and the brigade commander must please the division commander.

Commanding officers are put in command by proper authority. They are put there by the United States Government through the War Department. They are there by virtue of their proper appointments. The division commander is put there because he had special qualifications; his will governs; no matter what his subordinates think about it; the brigade, regimental, battalion and company commanders similarly. You may have a way of accomplishing results, practically as well as his way, but when he wants a thing done in his way, it is up to you to do it his way--if he leaves it to your discretion, then do it your way, but do it thoroughly and properly--at times the commander will give you a method to accomplish certain results and when he gives you the method you must use that method--you may not like it--you may not believe it is the best, but it is incumbent on you to do it that particular way, although it may be a "beastly way", as the Englishman says.

Some of you may have observed the results of target practice at Camp Benning, where they had, I think, 585 officers who were sent through the course of target practice. Out of that number, as I remember it, 60 or 65 per cent qualified as expert riflemen; three-fourths of the others qualified as sharp-shooters, and only 2½ or 3 per cent did not qualify at all. That is out of 585 officers, and we would like for every officer in this brigade to qualify, if he can, as expert; if he cannot, as sharpshooter; qualify as something, anyhow. Target practice should be undertaken at every opportunity possible; learn to shoot; show your men that you can shoot; firing on Class B range is materially important. Show your soldiers how to shoot. If your soldier cannot shoot straight there is no use to teach him how to march and how to drill, for if he cannot shoot and hit the other fellow, he had better be behind, for he will simply be in the way. Develop the intelligence and character of your men--these are qualities that help to make leaders--good noncommissioned men--good soldiers--good officers.

We are in a period of reorganization. We have new recruits--intelligent recruits--that in the course of a few months will make good soldiers in every sense of the word. Teach them the traditions of their organization; teach them love of country; teach them to venerate the past for the good there is in it; teach them to honor the flag; instill in them the proper spirit in order that they may show the greatest respect and take pride in the National Flag, the National Anthem and the uniform.

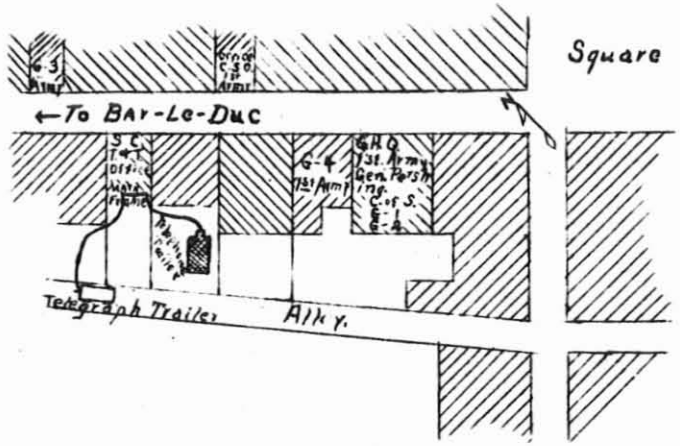
(THE INFANTRY JOURNAL)

TABLE 408 P & W
SIGNAL SPROT, CAVALRY DIVISION
(Peace & War Strength)

Road space ..... 559 yds.
Tonnage:
Animal drawn ..... 2½ tons
M ..... 19½ tons

February 4, 1921

1	2	3	4	5	6	7	8	9	10
UNITS	Specialists Rating (Class)	Symbol Number	Headquarters	OPERATION PLATOON: Message Center Section	Radio Section	Telegraph & Telephone Section	TOTAL	Construction Platoon	Total W. S.
Captain			1h						1
1st Lieutenant				1h			1		1
2nd Lieutenant								1h	1
Total Commissioned			1	1			1	1	3
Master Sergeant, incl.			1						1
Electr'n, Radio & Telep.			(1h)						
Tech al Sergeants, incl.					1		1	1	2
Construction foreman								(1h)	
Radio traffic chief					(1)				
Staff Sergeants, incl.			2			1	1		3
Acting 1st Sergeant			(1h)						
Divn. & Co. Supply			(1)						
Wire chief						(1h)			
Sergeant, incl.			2	1	1	1	3	1	6
Linemen								(1h)	
Maintenance (As't Wire Chf)						(1h)			
Mess			(1)						
Message Center				(1h)					
Radio					(1)				
Stable			(1h)						
Corpor , incl.			2	1	1	2	4	2	8
Clerk			(1)						
Linemen								(2h)	
Message Center				(1h)					



When the Battle Headquarters of the First Army moved to SOUILLY for the Meuse-Argonne operation, the telephone plant at LIGNY, including this trailer, was left for the use of the rear echelon and was finally, in October, 1918, turned over to the Advance Section, S.O.S. The old bus thus passed out of my control, without ever having been actually used in combat.

"THEY ALSO SERVE WHO ONLY STAND AND WAIT".

PARKER HITT
Lieut. Col., General Staff
late Colonel, Signal Corps
C.S.O., First Army, A.E.F.

THE INFANTRY JOURNAL

The attention of Signal Corps Reserve officers is invited to the Infantry Journal, which is one of the leading military magazines of the country. The Journal is published monthly and contains many excellent articles that are of interest to the Reserve Officer. A reserve officers' department is a feature of the magazine which will help you to keep abreast of the times. The subscription is $3.00 per year. A letter addressed as follows will bring particulars:

THE INFANTRY JOURNAL
UNION TRUST BUILDING
WASHINGTON, D. C.

1	2	3	4	5	6	7	8	9	10
UNITS	Specialists Ratings (Class)	Symbol Number	Headquarters	OPERATIONS PLATOON: Message Center Section	Radio Section	Telegraph & Telephone Section	Total	Construction Platoon	Total Troop
Operators, radio					1				
Operator, telegraph						(1h)			
Pigeoneer			(1)						
Supervisor, telep. swbd.						(1h)			
Privates 1cl & Pvts., incl.			14	2	7	12	21	20	(a)55
Chauffeurs	5th		(2)			(1)		(1)	
Chauffeurs	6th		(5)		(1)	(1)		(2)	
Clerk	6th			(1h)					
Cook	4th		(1)						
Cook	5th		(1)						
Draftsman	3rd		(1)						
Horseshoer	4th		(1h)						
Lineman	6th							(4h)	
Mechanic, auto	3rd		(1)						
Mechanic	6th		(1)						
Motorcyclist	6th				(1)			(2)	
Operators, radio	6th				(2)				
Operators, swbd.	6th					(2h)			
Operators, telegraph	6th					(1)			
Saddler	5th		(1h)						
Troubleman	4th					(1)			
Wagoners	6th							(5)	
Troubleman	6th					(1h)			
Unclassified:									
Clerk				(1h)					
Linemen								(6 4h)	
Operators, radio					(3)				

1	2	3	4	5	6	7	8	9	10
UNITS	Specialists Ratings (Class)	Symbol Number	Headquarters	OPERATION PLATOON: Message Center Sect.	Radio Sect.	Telegraph & Telephone Section	TOTAL	Construction Platoon	Total Troop
Operators, swbd.						(4)			
Troublemen						(1h)			
Total enlisted			21	4	10	16	30	24	75
AGGREGATE			22	5	10	16	31	25	78
Horses, riding			6	5		8	13	13	32
Horses, draft								12	12
Carts, wire, two-horse								4	4
Wagon, escort, combat								1	1
Car, motor, 5-pass.			1						1
Motorcycles with side cars			2		1	2	3	2	7
Truck, 3/4-ton, cargo			1			1	1	1	3
Truck, 1½-ton, cargo			5			1	1	2	8
Truck, radio, army					1		1		1
Trailer, storage battery					1		1		1
Trailer, kitchen			1						1
Trailer, ration, ¼-ton			1						1
Trailer, tank, 300 gallon			1						1
Pistols			22	5	10	16	31	25	73

REMARKS:

(h) mounted on horse

(a) Includes:
18 pvts. 1st cl.
37 privates

Summary of Specialists ratings:

3rd class	2		
4th class	3		
5th class	6		
6th class	29	Total	40

TABLE 408 PAW - SIGNAL TROOP CAVALRY DIVISION (1)

SIGNAL EQUIPMENT

Article	A War set for field & garrison service: Operation Platoon: Headquarters	Message Center Section	Radio Section	Telephone & Telegraph Section	Construction Platoon	Total Company	B Additional for use at posts & camps of a relatively permanent nature	Remarks
Ammeters, radio frequency, portable, 0-1.5 amps.							1	Substitute Ammeter, radio freq. 5-2.5 amps until stock is exhausted
Ammeters, radio frequency, portable, 0-3 amps.							1	Substitute Ammeter, radio freq. 5-2.5 amps. until stock is exhausted
Arresters, Protector, telephone, sub-station							10	
Antenna, phantom, Type A-52							1	
Q Axes, hand, lineman's, 5½" cut			2			2		
Bars, tool service, complete				1	1	2		
Bakelite, 1/8" thick, sheets 36"x40"							1	
Bakelite, ¼" thick, sheets 36"x40"							1	
Q Bars, crow & digging, 1-1/8" x 7 octagonal tool steel					3	3		
Batteries, Type BA-1	80	2	3	47	28	160		
Batteries, Type BA-2	20			5		25		
Batteries, Type BA-4	2		2			4		
Batteries, Type BA-9	12			6	6	24		
Batteries, Type BA-10	74			24		98		
Batteries, Type BA-12 (gravity)							10	
Batteries, Type BA-14(Edison Type V)							10	
Q Batteries for flashlights	47	3	3	9	12	74		
Q Bells, vibrating (iron box) 2½" gong				10		10		

Article	A War set for field and garrison service: Operation Platoon: Headquarters	Message Center Section	Radio Section	Telephone & Telegraph Sect.	Construction Platoon	Total Company	B Additional for use at posts & camps of a relatively permanent nature.	Remarks
Binding posts, assorted							25	
Blocks, connecting, one pr.							10	
Blocks, connecting, 11 pr.							10	
Bluestone, lbs (copper sulphate)							25	
Q Bolts, carriage, 3/8" x 4½"							40	
Q Bolts, cross-arm, 5/8" x 10"							10	
Q Bolts, cross-arm, 5/8" x 12"							10	
Book, field message with lead pencils	50	10	10	10	20	100		
Braces, cross-arm, G.I., 26"							20	
Braces, cross-arm, G.I., 30"							20	
Brackets, oak							100	
Brackets, standard transposition, 1 point, drop, G.I., W.E.#9251							6	
Brackets, standard phantom transposition, 2 piece, W.E. #9275							4	
Bridges, dial, Wheatstone							1	
Q Bulbs, flashlight	37					37		
Q Buttons, push, bronze case, screw cap, diameter 2-3/8"				10		10		
Buzzers, service			1	5	12	18		
Cable, 20pr. swbd. #22 B&S gauge, ft.				100		100		
Cable, 25pr. #22 B&S gauge, paper insulated, lead covered, ft.							150	
Q Candles, lantern, tallow, 7/8" or 1-1/8" diameter	12	12	12	36	48	120		
Carts, wire, Type N, complete					4	4		
Cases, battery, Type CS-8	1					1		

Article	A War set for field and garrison service: Operation Platoon: Headquarters	Message Center Section	Radio Section	Telephone & Telegraph Sect.	Construction Platoon	Total Company	B Additional for use at posts & camps of a relatively permanent nature	Remarks
Condensers,variable,air,0.001 mfd.							1	
Condensers,variable,air,0.006 mfd.							1	
Coppers,battery,for 5" x 7" jar							10	
Q Cord,lamp,twisted pr. #16 B&S,ft.			100	200		300		
Q Cord,sash, 5/16", ft.				50	150	200		
Cord, for radio receivers			3			3		
Cord,switchboard,camp type, 5 ft.	8					8		
Cord [illegible]chboard,monocord type	20					20		
Cord,telephone,for telephone Type EE-4	18					18		
Cord,telephone,for telephone Type EE-5	6					6		
Cord, #311, for switchboard operator's head sets	3					3		
Cross-arms,wooden,for 1½" pins, 6-pin							10	
Cross-arms,wooden,for 1½" pins, [illegible] 10-pin							10	
Decremeter, Type SCR-87			1			1		
Desk,field company (for division message center stationery)		1				1		
Dynamotor, Type DM-1, with case							1	
E Drafting Equipment, (Company)	1					1		
Electrolyte, in 12 gal. carboys	1					1		
Flar[illegible]ghts	10	3	3	9	12	37		
Fuses,monocord switchboard				8	24	32		
Fuses, for camp switchboard				40		40		

Article	A War set for field and garrison service: Operation Platoon: Headquarters	Message Center Section	Radio Section	Telephone & Telegraph Sect.	Construction Platoon	Total Company	B Additional for use at posts & camps of a relatively permanent nature	Remarks
Q Cases,map,carrying, Type CS-9	6	2	2	2	3	15		
Q Chairs, folding		3				3		
Chests, cable splicer's, complete with contents (Equipment Type TE-16)							1	
Chests,tool mechanics No. 1 complete (Equipment Type TE-6)	1					1		
Chests,tool mechanics No.2 complete (Equipment Type TE-11)	1					1		
Chests,telephone repair parts, complete (Equipment Type TE-34)	1					1		
Chests, packing, Type EC-5	6	1	1	3	3	14		
Cipher device		4	2			6		Cipher disk supplied for the present
Clamps, guy,2 bolt							6	
Clamps,hard fibre,double groove 13/32" x 3/4" groove 1/8" x 1/8"							100	
Clips, test, Frankel, #2521			24	24	24	72		
Cloth, insulating, Empire, lbs.							2	
Coils,induction,for camp telep.							3	
Coils,induction,common battery							3	
Coils,retardation, F.E. #12-A							3	
E Compass, prismatic, with case	2	1	1		2	6		
E Compass, watch	6	2	2	4	3	17		
[illegible]pers, Type CA-8							1	
[illegible]pers, Type CA-9							1	
Condensers,telephone, 2 mfd.							3	

Article	A War set for field and garrison service: Headquarters	Operation Platoon: Message Center Section	Operation Platoon: Radio Section	Operation Platoon: Telephone & Telegraph Sect	Operation Platoon: Construction Platoon	Total Company	B Additional for use at posts & camps or a relatively permanent nature	Remarks
Insulators, pony, porcelain, [illegible] single groove							500	
Insulators, porcelain knob, No. 5½ split							100	
Insulators, porcelain knob, No. 5½ solid							200	
Insulators, wooden knob, Type IN-33							1000	
Keys, ringing and listening, for camp switchboard Type BD-14							3	
Keys, telegraph, CC, legless							5	
Keys, telegraph, vibroplex				2		2	2	
Kit, inspector's pocket, complete	2		3	6	4	15		
Kits, soldering, complete	1		1	1		3		
Knives, electrician's	22	5	10	16	25	78		
Q Ladders, extension, 30 ft. complete with hoisting gear					1	1		
Q Lanterns, candle, folding, #3	2	2	2	6	8	20		
Line jacks, for switchboard Type BD-14							3	
Lineman's Equipment Type TE-21			1	4	10	15		
Magnetos, for telephone, Type EE-4							3	
Meters, audibility							1	
Mil-ammeters, portable, D.C., scale 50-0-50							1	Substitute mil-ammeter D.C., scale 175-0-175 until stock is exhaus'd
Q Nails, 6 d., common wire, lbs.							5	
Q Nails, 16 d., common wire, lbs.							100	
Q Nails, 20 d., common wire, lbs.							100	
Q Nails, 40 d., common wire, lbs.							100	

Article	A War set for field and garrison service: Headquarters	Operation Platoon: Message Center Section	Operation Platoon: Radio Section	Operation Platoon: Telephone & Telegraph Sect	Operation Platoon: Construction Platoon	Total Company	Additional for use at posts & camps of a relatively permanent nature	Remarks
Glasses, field Type EE	4	2	2	2	3	13		
Gloves, leather, lineman, prs.			1	4	10	15		
Gloves, rubber, light, No.11, prs.			2			2		
Q Gloves, rubber, heavy, No.11, prs.				1		1		
Q Grinders, hand, with vitrified carborundum wheel, 6" x 11"	1					1		
Grips, Buffalo, with pulleys, prs.				2	2	4		
Grips, Haven					2	2		
Groundman's Equipment Type TE-23				2	6	8		
Ground rods, Type GP-16			8	12	8	28		
Hand sets, for telephone Type EE-4	6					6		
Hand sets, for telephone Type EE-5	3					3		
Hangers, cable, Bonita, 1⅜"							100	
Hangers, messenger, wood pole, Hubbard #8911							5	
Hand sets, telephone, complete, receiver Type R-9 with cord #311							3	
Head sets, radio, Type P-11			2			2		
Q Hooks, brush					4	4		
Q Hydrometers, Type HY-2			5			5		
Inductances, variable, variometer type, .060 to .500 mil. h.							1	
Inductances, variable, variometer type, .450 to 4.00 mil.h.							1	
Inductances, variable, variometer type, 3.6 to 30.00 mil.h.							1	
Insulators, electrose, Type IE-2							20	
Insulators, pony, porcelain, double groove							50	

Article	A War set for field and garrison service						B Additional for use at posts & camps of a relatively permanent nature	Remarks
		Operation Platoon						
	Headquarters	Message Center Section	Radio Sect.	Telephone & Telegraph Section	Construction Platoon	Total Company		
Needles, poised, magnetic							1	
Panels, Cavalry Division, Set, Type AP-2			1			1		
Paraffine, lbs.							15	
Pike poles, standard heavy, 10,12 & 14 ft. long							6	
Pikes, wire					12	12		
Pins, insulator, locust, 1¼" x 9"							175	
Pins, insulator, G.I. ⅜" x 5" (for transposition brackets)							20	
Q Pliers, diagonal cutting, rounded nose, 5"				6	4	10		
Q Pliers, long oval nose, 5"				6	4	10		
Q Pliers, side cutting, 6"	22	6	10	16	25	78		
Poles, telephone, 25'							5	
Receivers, telephone, hand							3	
Reel carts, pack, Type RL-16					2	2		
Reels, breast, Type RL-9				2	2	4		
Reels, pay-out, on barrow					2	2		
Relays, telephone switchboard, W.E. #44-C							3	
Renewals for Type BA-14 batteries							10	
Resistance, Type RS-1							1	
Resistance, Type RS-2							1	
Resistance, Type RS-3							1	
Resonator, telegraph				2		2	5	
Rheostat, porcelain base, 10ohms							1	
Ringers, complete for camp telephone Type EE-4							6	
Rings, bridle, 1½" eye							25	
Q Rope, 1", Manila, ft.	300					300		

Article	A War set for field and garrison service						B Additional for use at posts & camps of a relatively permanent nature	Remarks
		Operation Platoon						
	Headquarters	Message Center Section	Radio Section	Telephone & Telegraph Sect	Construction Platoon	Total Company		
Q Saws, cross-cut, 3½ ft.					1	1		
Q Saws, hand, cross-cut, 8 point, 26"				1	2	3		
Q Screwdrivers, cabinet style, 6" blade				6	4	10		
Q Screws, fetter drive, ¼" x 2½"							20	
Q Screws, F.H.B., 3/4" No. 6, gross							1	
Q Screws, F.H.B., 1¼" No. 8, gross							1	
Q Screws, F.H.B., 1½" No. 10, gross							1	
Q Screws, R.H.B., 1" No. 6, gross							1	
Q Screws, R.H.B., 1½" No. 8, gross							1	
Q Screws, R.H.B., 2" No. 8, gross							1	
Q Screws, R.H.B., 2½" No. 8, gross							1	
Q Screws, iron, flat head, 2½", No. 10, gross							1	
Set, buzzer instruction, Type EE-14							2	
Set, monocord oper's, Type EE-64				2	4	6		
Set, simplex telegraph, Type EE-76				2		2		
Set, test, cableman's tone							2	
Set, test, Universal, Type EE-65				2		2		
Set, low frequency amplifier, Type SCR-121 or BC-101			1			1	1	
Set, battery charging, Type SCR-82			1			1		
Set, radio receiving, Type SCR-54-A			1			1		
Set, ... short range radio telephone & telegraph, Type SCR-109-A							1	
Set, U.W. radio telegraph, Type SCR-130			1			1		
Q Shovels, short handle, round point					3	3		
Q Shovels, round point, best steel, 8'					3	3		
Signal Lamp, Type EE-6							3	
Signal Lamp, Type EE-7							2	

Article	A War set for field and garrison service						B Additional for use at posts & camps of a relatively permanent nature	Remarks
		Operation Platoon						
	Headquarters	Message Center Section	Radio Section	Telephone & Telegraph Sect.	Construction Platoon	Total Company		
Signal, supervisory, camp swbd., complete							3	
Sleeves, splicing, paper, 3/16"x3"							2000	
Sleeving, lead, 1½" diameter, ft.							50	
Sockets, Type SO-2 (for tube type VT-1)							10	
Sockets, Type SO-3 (for tube type VT-2)							10	
Q Solder, half and half, lbs.	10					10		
Q Solder, wiping, lbs.							10	
Sounders, telegraph, 4-ohm							5	
Q Speed indicator							1	
Spoons, regular, shovel, best steel, 8 ft.					3	3		
Stationery, message center, set		1				1		
Stationery, radio, set			1			1		
Stationery, telegraph, set				2		2		
Strips, terminal, 10 pr.				12	8	20		
Switches, hook, wall telephone							3	
Switches, snap, 4-point, 5 amps.							2	
Switches, knife, D.P.S.T., 15 amps. porcelain base							2	
Switches, knife, D.P.D.T., 15 amps. porcelain base							2	
Switches, knife, D.P.S.T., 25 amps. porcelain base							1	
Switches, knife, SPST, 15 amps., porcelain base							2	
Switches, knife, D.P.D.T., 15 amps. porcelain base							2	
Switchboards, telegraph, 4-line				2		2		
Switchboards, telegraph, 8-line							1	
Switchboards, local battery, model cross section							1	
Switchboards, monocord, 4-line, type BD-9				4		4		
Switchboard, monocord, 12-line Type BD-11					4	4		

Article	A War set for field and garrison service						B Additional for use at posts & camps of a relatively permanent nature	Remarks
		Operation Platoon						
	Headquarters	Message Center Section	Radio Section	Telephone & Telegraph Sect.	Construction Platoon	Total Company		
Switchboard, Camp, Type BD-14				2		2		
Switchboard Units, Type EE-2	5					5		
Q Tables, folding		3				3		
Tacks, milonite, #18	250			250		500		
Q Tape, friction, ¼ lb. rolls, lbs.	20		4	8	12	44		
Q Tape, rubber, ¼ lb. rolls, lbs.	10		2	4	6	22		
Telephones, camp, Type EE-4-A	1	2	1	32		36		
Telephones, Type EE-5				4	4	8		
Tools, line construction, set							1	
Trailer, storage battery			1			1		
Transformers, Type C-21							3	
Transmitters, breast, set							3	
Transmitters, telephone, for standard magneto telephone, flush mounting							3	
Q Trimmers, tree					1	1		
Truck, radio, army, Type SCR-97 (chassis Q)		•	1			1		
Tubes, porcelain, standard, 9/16" outside x 4"							20	
Tubes, porcelain, 13/16" outside x 9"							10	
Tubes, vacuum, Type VT-1	80		20			100		
Tubes, vacuum, Type VT-2	90		10			100		
Tubes, vacuum, Type VT-4	20		5			25		
Tubes, vacuum, Type VT-5	80					80		
Tubes, vacuum, Type VT-10			6			6		
Q Typewriters, telegraph, caps only		1	1	2		4		
Volt-ammeter, battery, 0-[illegible] amps., 0-11 volts			1	1		2		
Volt-ammeter, Weston Type 280, scale 150-15-3 volts, 30-15-3 amps	1					1		
Q Washers, round, ¾" hold, G.I.							40	
Q Watches, pocket, 15 to 21 jewel	1		1			2		For issue in time of war

Circular
No. 139

WAR DEPARTMENT
Washington, May 28, 1921

APPOINTMENT OF OFFICERS IN THE REGULAR ARMY

1. A final examination for appointment of lieutnants of the Regular Army under the provisions of AR 605-5 will be held throughout the United States and in the Philippine Department, Hawaiian Department, Panama Canal Department, and with the American Forces in Germany, beginning August 22, 1921.

2. Preliminary examinations will be started at once and continued until August 13, 1921. Facilities for conducting preliminary examinations at educational institutions prior to graduation will be provided by department and corps area commanders, boards being composed of one officer of the line and one medical examiner when necessary. The provisions of paragraph 18, AR 605-5 are suspended accordingly.

3. The number of vacancies in the various branches of the service for which this examination will be held will be announced later. There will be vacancies in all branches covered by AR 605-5 except the Finance Department and the Judge Advocate General's Department.

4. Information relative the scope and details of examination is contained in AR 605-5 and may be obtained at any military post or station. Applications may be submitted at any military post or station or at the headquarters of the department or corps area in which the candidate resides.

(210121, A.G.O.)

By order of the Secretary of War:

PEYTON C. MARCH
Major General, Chief of Staff

Official:
P.C. HARRIS
The Adjutant General

INTERNATIONAL COMMUNICATION CONFERENCE

When the International Communication Conference met at Washington some months ago some matters of a technical nature were left for later settlement. For that purpose a technical committee composed of representatives of the countries that were parties to the Conference will meet at Paris early this summer. The United States will send delegates to the technical committee from the Army, Navy, Department of Commerce (Bureau of Standards), and Post Office Department. Major General George O. Squier, Chief Signal Officer; Major Joseph O. Mauborgne, of the Signal Corps, and Dr. Louis Cohen, a civilian expert attached to the Signal Office, will represent the Army. Rear Admiral William W.G. Bullard, head of the Naval Communications Service, and two or three other officers will represent the Navy. Among the subjects to be considered by the Committee are apportionment of wave lengths to various countries for high power stations and determination and definition of various kinds of transmitters and classification thereof.

(ARMY & NAVY REGISTER)

Article	A War set for field and garrison service: Headquarters	Operation Platoon: Message Center Section	Operation Platoon: Radio Section	Operation Platoon: Telephone & Telegraph Sect	Construction Platoon	Total Company B	Additional for use at posts & camps of a relatively permanent nature	Remarks
Watches,wrist,7jewel,luminous dial, with wristlet	7	5	6	8	4	30		For issue in time of war
Watches,wrist,7 jewel,luminous dial, with wristlet		3	3	8	4	18		For issue in time of peace
Wavemeters, Type SCR-61							1	
Wire, antenna, Type W-29, ft.							1000	
Wire,bridle,51 mils,Type W-37,ft.							1000	
Wire,counterpoise, Type W-30, ft.							1000	
Wire,field,11-strand,miles	30				30	60		
Wire,G.I. No. 9, B.W.G., Miles							1	
Wire,G.I., No.14,B.W.G., miles							8	
Wire,house,tw.pr.,Type W-33,ft.				1000		1000		
Wire,magnet,#20(31.9 mils)DCC,lbs.							2	
Wire,magnet,#24(20.1 mils)DCC,lbs							1	
Wire,magnet,#28(12.6 mils)DCC,lbs							1	
Wire,magnet,#32 (8 mils) DCC, lbs							1	
Wire,climax #18, B&S, lbs.							1	
Wire,climax #22, B&S, lbs.							1	
Wire,messenger strand,5/16",ft.							300	
Wire,outpost,light tw.pr.,miles				2	2	4		
Wire,outpost, tw.pr., miles	10			5	10	25		
Wire,outside distributing, #17 B&S,tw.pr., miles							2	
Wire,pothead,36 mils,Type W-34,ft							400	
Zincs,crowfoot,battery, for 5" x 7" jar							10	

B - Purchased by the Engineer Corps
O - Purchased by the Ordnance Dept.
Q - Purchased by the Quartermaster Corps

The small condenser indicated strongly the presence of high frequency oscillations in the plate circuit, and I thought about it a great deal without being able to account for their presence there in any satisfactory manner. During the summer vacation that year, an idea was suggested by the fundamental axiom of radio, "wherever there are high frequency oscillations tune the circuit," and the idea was to see what would happen if the plate circuit of an audion detector should be tuned by means of an inductance.

All the old timers remember C.C. later known as M.C.C. and M.C.C., the Marconi press station at Wellfleet, Mass. This station was the one hundred percent reliable testing standby of all experimenters, and on M.C.C. the first test was made. A standard audion detector system was set up and tuned in, and a tuning inductance introduced into the place circuit of the audion. Then various things began to happen. As the plate inductance was increased, the signals were boosted in strength to an intensity unbelievable for those days, the more inductance the louder the signal, until suddenly the characteristic tone of M.C.C.--the tone which any of the old timers, if they heard it on Judgment Morn would recognize instantly--disappeared, and in its place was a loud hissing tone, undeniably the same station, but recognizable only by the characteristic swing and the messages transmitted. A slight reduction of the plate inductance and the old tone was back again,--and then the placing of the hand NEAR a tuning condenser and the hissing tone reappeared. It required no particular mental effort to realize that here was a fundamentally new phenomenon, as obscure as the principle of the operation of the audion itself, but which opened up an entirely new field practical operation.

Here the element of luck ended and it became simply a case of a lot of hard work, digging out the meaning of the various phenomena. A long series of experiments was carried out on different wave lengths and with various circuit modifications, and it became possible on a small amateur antenna to receive readable signals from the navy shore stations on the Pacific coast, the Manoas and Porto Vehlo stations in Brazil and the Marconi transatlantic station at Clifden, Ireland, with regularity every night, a performance which a few months before was undreamed of. But while the method of producing these results was known, many of the phenomena involved were as obscure as ever. The most striking of the various phenomena was, of course, the change of tone and the investigation centered on this. A number of things contributed to the suspicion that the hissing state was due to the production of local oscillations by the system. With this idea and the aid of some instruments borrowed from one of the university laboratories, it was a relatively simple matter to determine that this was actually the case. Once it was apparent that the system was capable of generating oscillations, the explanation of another phenomenon became plain. I had observed on a number of occasions during the course of listening to various stations, that a whistling note would frequently appear in the telephones, which could be varied by adjustment of the receiving apparatus. I observed this particularly in the course of listening to a wireless telephone station. After the discovery of the generating feature of the system, the explanation of the change in tone became apparent--the system was acting as a heterodyne receiver. A series of tests confirmed this explanation.

That is briefly the story of how the invention of the feedback circuit came about, and how its properties of acting as a generator and a self-heterodyne were discovered. Since that time a vast amount of work has been carried out in investigating in detail the precise manner in which the various phenomena occur and in determining quantitatively the amplification given by the circuit in both the non-oscillating and oscillating state.

THE REGENERATIVE CIRCUIT

(Edwin H. Armstrong)

Note: Edwin H. Armstrong's contribution to the radio art, particularly the vacuum tube radio art, is epoch making. No one who has employed his feedback or regenerative circuit can fail to appreciate its eminent value, and inexhaustible possibilities. Armstrong made his invention when he was about 21 years of age and before he graduated in the Department of Electrical Engineering at Columbia University in 1913. Altho the original discovery was more or less accidental, Armstrong soon appreciated the real meaning of it and applied it to the construction of the vacuum tube oscillator, which is more easily and accurately controllable than any other oscillator in existence. The regenerative receiver and the regenerative oscillator will always figure among the classical inventions and will occupy a foremost position in the research laboratory, as well as in the commercial wireless service. It entitles Armstrong to a very high place among electrical inventors.

When I was in Paris in the Spring of 1919 I met General Ferrie, the Chief of the Signal Corps of the Allied Armies. Armstrong was working under him. The general paid me several well meant compliments which I refused to accept on the ground that I had done so little for his Signal Corps. "Ah, Monsieur le Professeur" exclaimed he, "but have you not given us Armstrong."

PROF. M. I. PUPIN

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The question as to how the invention of the regenerative or feed back circuit came about can best be answered by the statement that it was the result of a streak of luck--and the kind of luck that comes once in a lifetime. For, all things considered, the operation of the regenerative circuit involves too many new phenomena, inextricably woven together with the operation of the audion, a device whose action was clouded in the mystery of the DeForest gas ionization theory at the time the invention was made, for any one seriously to lay claim to a mental pre-conception of the operation of the feed back method of amplification and oscillation.

The invention was the result of an idea--the kind of idea which may be best expressed in the form "what would happen if" certain additions should be made to existing apparatus. The resulting trial of these additions uncovered a series of new phenomena based on a new principle. The discovery came out of a desire to find out exactly how the audion detector detected--not an easy thing to do in the dark ages of '11 and '12 when the very scanty literature on the subject explained (without explaining) that the action was due to ionized gas, and the audion was known to the art simply as a detector of high frequency oscillations.

To find out exactly what went on in the tube, I started an investigation. This was carried on under considerable difficulty, since my main object in life just then was supposed to be the obtaining of the degree of Electrical Engineer at Columbia University, and the professors could not be relied upon for the necessary charity mark of 6 unless a certain so-called reasonable amount of time was devoted to their particular courses.

However, during this investigation it was observed that a condenser placed across the telephone receivers in a simple audion receiver sometimes gave an increase in signal strength; not much of an increase, but nevertheless a very definite increase, and with only a small value of capacity. Now I had tried a condenser across the phones many times before (what amateur has not, when graduating to the audion from the crystal detector stage, where telephone shunt condensers originated) but never before had there been any observable change in signal strength *

QUARTZ CRYSTAL WAVEMETER

By Lieut. J. T. Filgate, SC

1. The attention of radio engineers has recently been attracted to the possibility of utilizing a quartz crystal as a standard of frequency and the consequent development of a quartz crystal wavemeter.

2. THEORY

(a) The utilization of a quartz crystal as a means of determining frequency is based on the well known "Piezo-Electric Effect" which is displayed in such a crystal. When a mechanical stress is imposed upon a quartz crystal along one of its axes, an electrical strain is produced in a direction perpendicular to such axis, the magnitude of the strain depending upon the magnitude of stress to which the crystal is subjected. The converse of this is also true, that is, if a crystal is subjected to an electrical stress a mechanical strain will be produced in a direction perpendicular to that in which the electrical stress is directed. It is this characteristic, possessed by quartz crystals, which enables their utilization as a standard of frequency.

3. In experimental apparatus in use at the present time a small quartz crystal is supported in such a way that it is free to vibrate about the pivot on which it is mounted, such pivot being placed where a node occurs in the natural vibration of the crystal. When the crystal is mounted in this way it is connected across the terminals of a condenser in a receiving set, and the capacity of such condenser is varied until the receiving set is tuned to that of some generating set. The crystal will then be set into longitudinal vibration, provided the frequency imposed on the receiving set is the same as the natural frequency of vibration of the crystal. The maintenance of such vibration will consume a certain amount of energy and there will be a drop in the deflection of the galvanometer forming part of the receiving circuit. If the natural frequency of the crystal is known the frequency of the imposed wave is established. The natural frequency of a crystal is originally determined by putting the crystal in a circuit as described above and determining with a standard wavemeter the wave length at which the change in galvanometer deflection occurs. After determining the natural frequency of a crystal, the crystal itself may be used as an indicator of such frequency. It is however, necessary to have a number of crystals having a definite range of natural frequencies in order to use such a device as a wavemeter. This is true because of the fact that one crystal may be used only to determine the wave length to which it is naturally resonant.

4. ACCURACY

(a) As regards the accuracy in the determination of wave lengths obtainable with such a device, it is estimated that the wave lengths may be determined to within ten meters in twenty thousand.

5. RESEARCH

A further study of these phenomena is being made, some the outstanding problems being the following:

Without considering the actual mechanism of the operation of the system let us consider the physical results accomplished in practice. Consider first the results in the non-oscillating state. Measurements of the signal energy in the telephone receivers show that an amplification of from 100 to 1000 results from the regenerative action, the value depending on the strength of the incoming signals, the greater amplification being obtained on the weaker signals. By reason of the nature of the amplification, which is of the negative resistance type, the selectivity of the system is greatly increased, the gain in selectivity becoming more pronounced the lower the damping of the incoming wave. Three distinct operations are therefore carried on simultaneously in the non-oscillating state. 1--the high frequency currents are regeneratively amplified; 2--the selectivity of the system is increased; 3--the amplified high-freqqency currents are rectified and converted into currents of telephonic frequency.

When the amplification is increased beyond a certain limit the system passes into the oscillating state and generates, in radio circuits, high-frequency currents. In this state it is applicable to the uses of any generator, and because of its simplicity and reliability it is particularly applicable to the heterodyne receiving system. By far the most interesting application is that of the "self-heterodyne" in which the same circuit and tube perform simultaneously the functions of generator of the local frequency, amplifier of the incoming high frequency and rectifier of the beat current to produce currents of audible frequency in the telephones, at the same time giving the increase in selectivity inherent in regenerative amplification. All these operations go on simultaneously in the same system with a single tube and out of it all comes a signal 5000 times as strong as the signal given by a simple audion circuit with a chopper, and far less subject to the disturbing influence of static and interfering signals.

On account of the very fortunate combination of sensitiveness and simplicity, its effect on the art was immediate. The amplifying feature made possible trans-oceanic signaling. The self-heterodyne feature contributed very largely to the change from spark to continuous wave systems. The generating feature has been responsible for the development of carrier wave or wired wireless signaling. And this progress can be attributed, not to any carefully preconceived ideas, but to the versatile properties of the regenerative circuit and the luck that led to its discovery.

* * * * *

* The reason for the increase in signal strength obtained when the telephone receivers in the simple audion circuit are shunted by a condenser, remained unknown for a number of years. The explanation is an interesting one--the ordinary audion circuit is not a neutral device as regards reaction between the plate and grid circuits. There is a reaction which is in the opposite sense to the regenerative reaction; that is, the plate circuit robs the grid circuit of energy. This is because of the capacity reactance of the telephone receivers. When this is decreased by a parallel condenser the signal strength increases.

(THE ELECTRIC JOURNAL)

wire, however, loses in talking range where it gains in portability, since the limit of good transmission with field telephones is from 7 to 9 miles as compared with 12 to 15 miles for the twisted field wire. The expedient of converting an isolated circuit which has become extended beyond these limits into a ground return circuit results in a doubling or even tripling of the effective range of transmission. In this case both sides of the pair are used as a single metallic path. A non-stranded copper-clad steel sted pair, known as "Outside Distributing 17-2" was used in great quantis during the World War by American signalmen, and will in all probability be again used in any large future operations because of its extensive manufacture for commercial use. In spite of its lower tensile strength and greater weight, this wire was popular with former commercial linemen because splices could be made more easily than with the stranded field or outpost types.

5. Numerous connectors and knots have been tried with the stranded wire since the springiness of the steel wires will not permit of a satisfactory "Western Union" splice. The most satisfactory of these splices is made by stripping the ends for about 2 inches and tying these bare ends in a square knot. This knot should then be seized with a piece of soft copper wire, #18 or #20 about 6 inches long, and then covered with rubber and friction tape. Splices in a twisted pair should of course be staggered. This splice has the advantage of being small enough to go neatly on a reel and offers no loop which will catch on projections or entangle men or horses. Its tensile strength is nearly that of the wire. When circumstances demand the omission of the soft copper wire wrapping, then great care must be taken to make a tight knot and wrap it securely with the tape, because of the springy character of the steel strands.

6. Effort is being made to develop a suitable extra light twisted pair. This wire will be designed to meet the needs of combat battalions and should weigh not more than the "cable leger" of French manufacture which is familiar to signalmen who served in France. It should have sufficiently transmission qualities to permit conversation up to three miles and ld have sufficient insulation to withstand adverse weather conditions for several hours.

7. The proper placing of a line along the road is a matter of experience and common sense. As is well known a twisted pair which is allowed to lie on or across a well traveled road will develop trouble in a few minutes. The great amount of traffic which is to be found on and near a main axial road during a drive makes it imperative that wires must be laid well away from this road or else lifted up so as to clear vehicles.

8. Experiences with enemy shell fire have also shown the necessity of avoiding main roads and important road junctions. The establishment of alternate routes and the spreading apart of circuits to reduce the liability of having all channels destroyed by one shell have come to be general practice.

9. Cables from observation balloons which are being towed while in the air are the enemies of overhead cross-overs and the tanks with their tendency to leave the regular roads and molest wire communications which have been laid across the open field must be reckoned with by the signal officer. He will do well to familiarize himself with the intentions of these units and learn the routes over which they expect to advance.

10. As conditions of stabilization occur and continue, the wire system of a unit is gradually developed from its original installation to a more permanent and lasting one. The hastily laid field wire lines are uted where necessary and according to the degree of stabilization, the owing methods of construction are adopted in the forward areas:

On short stakes
In special wire trenches
In communication trenches
In buried cable trenches.

(a) The determination of the significance of certain properties of quartz crystal as regards their natural frequencies.

From the data available no definite relationship has been found to exist between the size of the crystal and its natural period of vibration or between the relative direction of the longitudinal geometric axis of crystal as used in this set and its optical axis. The modulus of elasticity of the crystal of course has a definite significance.

(b) The detection of the existence of harmonics for a given crystal so as to permit the utilization of a single crystal as a standard for several different wave lengths.

To date the existence of harmonics has not been satisfactorily determined.

6. In general the use of quartz crystals as standards of frequencies has become quite possible, and with a little better understanding of the inherent phenomena this possibility will be greatly enhanced.

WIRE AXIS INSTALLATION AND MAINTENANCE WITHIN THE DIVISION

(Familiarity with "Signal Communications for All Arms" is assumed)

1. In the division during an advance, the efficiency of wire communications and the economy of wire and labor demand a system of installation and maintenance by which the maximum use may be obtained from each line laid before it is discarded or salvaged.

2. From the standpoint of installation this means that each line must be so physically constructed that it will be protected from damage, caused by either the enemy or friendly forces, as well as time and conditions will permit. It must be properly tagged for identification and equipped for test and supervision. The route of the line must be so chosen that as a circuit its usefulness will not terminate with its first assignment. If located with an eye to future needs, many circuits or parts of them may be reassigned and used during each successive step of the advance, until the lines can be rebuilt in a more permanent manner during a period of stabilization or "back area" conditions.

3. From the standpoint of maintenance the line must be kept in repair, and an up-to-date record of it must be available to each signal officer to whom it is, or may some day be, of interest.

Construction Methods within the Division

4. The universal demand for the telephone, the introduction of the telephone intercept apparatus into modern warfare, and the poor service afforded by grounded circuits have made complete metallic circuits over twisted pair wire the standard construction for divisional troops during an advance. Twisted pair field wire (wire Type W-43)with each conductor composed of ten steel wires, 12 mils in diameter, twisted about one copper wire, 28 mils in diameter, and covered with rubber insulation and cotton braid weighs 180 lbs. to the circuit mile. Its high tensile strength makes it ideal for laying from a wire cart or from an improvised reel mounted on a motor truck, trailer or horsedrawn vehicle. A lighter wire, twisted pair outpost (wire type W-44) with each conductor made of three steel wires and two bronze wires, 13 mils in diameter, twisted around one bronze wire, 14 mils in diameter, and covered with rubber insulation and paraffined cotton braid weighs 125 lbs. to the circuit mile. It is more suitable for construction where the wire must be brought forward by signalmen [illegible] and without the aid of animal or motor drawn transportation. The outpost

Orders

16. Instructions and orders for the technical and tactical application of signal communications are discussed in "Signal Communications for [illegible]." It will not be necessary at this time to go into the details of the plan of signal communications, or those paragraphs in the field order which apply to signal troops and axes of signal communications.

17. In the operations order of the signal unit, however, is found the means by which coordination of our technical details is secured. The part of the order referring to wire communications is usually given verbally by the signal officer to his chiefs of construction and operation and to the signal officers of subordinate units. When time and circumstances permit, a conference is called, since in this conference many small details may be arranged between the various officers. Prior to the conference, the signal officer of the unit has made a study of the situation from the field orders, the map, and if possible a reconnaissance. He may be obliged to gain his knowledge of actual conditions of the terrain from the subordinates when they report for the conference.

18. Although his orders may be verbal, yet they will invariably be supplemented by such maps and diagrams as will make them clear. Two types of maps or sketches are designed for this and copies of them should be distributed or else the officers permitted to make their copies from the original. One of these is the Line Route Map. (Fig. 2). This map shows the geographic disposition of the various headquarters marked upon a military map of suitable scale. It also shows the axes of the units concerned, the geographic routing of the lines existing and proposed, and the location of such test stations as the unit signal officer deems advisable to prescribe. The number of circuits along each route is shown by a figure on the map. The other is the Circuit Diagram. (Fig. 3). This is a conventional or schematic sketch showing the individual circuits and their connections at each test station and switchboard frame.

19. To avoid confusion the divisional axis is ordinarily divided into geographic sections. A section is of such length that it can be assigned as a task for a construction party with a view to the same party remaining in charge of maintenance of their section. A section begins and terminates with a switchboard frame or test station. Sections are numbered from rear to front in serial order, "Section Zero", "Section One,", etc. The circuits within each section will bear numbers, the hundreds corresponding to that section, thus the circuit in Section Two might be given a circuit number "No. 209", and the same circuit continued in Section Three, "No. 309", and so on. By means of these circuit numbers proper reports can easily be made by each chief of construction party or maintenance party with reference to completion of a line, and maintenance work. If the circuits are properly tagged this assignment of numbers will be of material aid to the linemen in seeking and reporting trouble.

Test Stations and Test Points

20. TEST STATIONS are stations placed along [illegible] for the purpose of making line tests and such cross connections as are ordered or necessary. These stations effect the temporary protection of the line in case of failure of one or more circuits. Such stations [illegible] a test frame which expands into a cross connecting frame without any tearing down or duplication of effort when a tactical central moves in and occupies the location. Test stations are located not only at the ends of sections but at such other points as are deemed advisable by the chief of constructing personnel. Such additional points might be determined with reference to their possible and probable availability as future command posts or their necessity with reference to patching through of damaged circuits.

21. The matter of line construction lies within the scope of another Wire communication pamphlet which will deal particularly with that subject. Mention of the methods employed is made here in order to lead up to the tactical and technical phases of the wire axis problem.

Telephone Service in the Division

12. The command telephone system within the division may be considered in general by the signal personnel as a means by which each commander and his staff may talk to superior, subordinate, supporting, and adjacent commanders and their staffs. The system extends down to and including battalions. Switchboards at each headquarters handle local traffic between the various offices, and also switch calls over trunks to the boards of other units. Special boards, such as at forward communication centers, not at a headquarters, serve as trunk switching points. Other service is demanded in addition to the locals and trunks above outlined. Maintenance of the system necessitates a local to the wire chief at each board. The message center and the radio station are entitled to service when conditions will permit. The observation post or posts pertaining to the headquarters must usually be connected before the headquarters begins to function at that particular locality. Such posts are often at a distance from the switchboard. The special needs for continuous service in the Artillery between the observers, the battalions, the batteries, and, in some cases, the individual guns, have given rise to a special system known as the Artillery Battalion Fire-Control System. This system is distinct from the command system but where the two overlap the same agencies are usually employed for both systems.

13. The greatest problems for the signal personnel arise when the division advances. Each headquarters moves forward and in moving demands a new local installation, as well as an uninterrupted trunk service. Trunks which have been so located as to pass through, or near the new command posts, need not be discarded but may be utilized without delay. This is one illustration of the fact, set forth in Paragraph 2, that lines should be so located that the circuits or part of them may be reassigned and used during each step of the advance.

Wire Axis of Signal Communications

14. The route of advance of a command post is designated as its "axis of signal communications." Each successive location of a forward post can not definitely be located at the beginning of an operation, but if the route of advance be known to the signal officer, he can follow it as he extends his lines toward the front. Further than this, the general layout of the lines of each subordinate unit should be so directed that they build into the general scheme of their superior unit. This means close coordination between signal officers of all units in the division.

15. This works out within the division in the following way: The division signal officer advances his lines to the brigade along the divisional axis. He will establish a forward communication center or switching point in the vicinity of the brigades in case they are adjacent and use that point as a center from which to give division-to-brigade, and brigade-to-brigade service. In contemplating an advance he will run his lines forward along his axis as far as practicable, and often to another forward communication central in the vicinity of the regiments. In many cases the axis of the division coincides from time to time with that of one or the other of its brigade. This permits further cooperation in the work and cuts down the expenditure of wire and labor. The relation between the brigade and its regiments is similar to that outlined above between the division and its brigades.

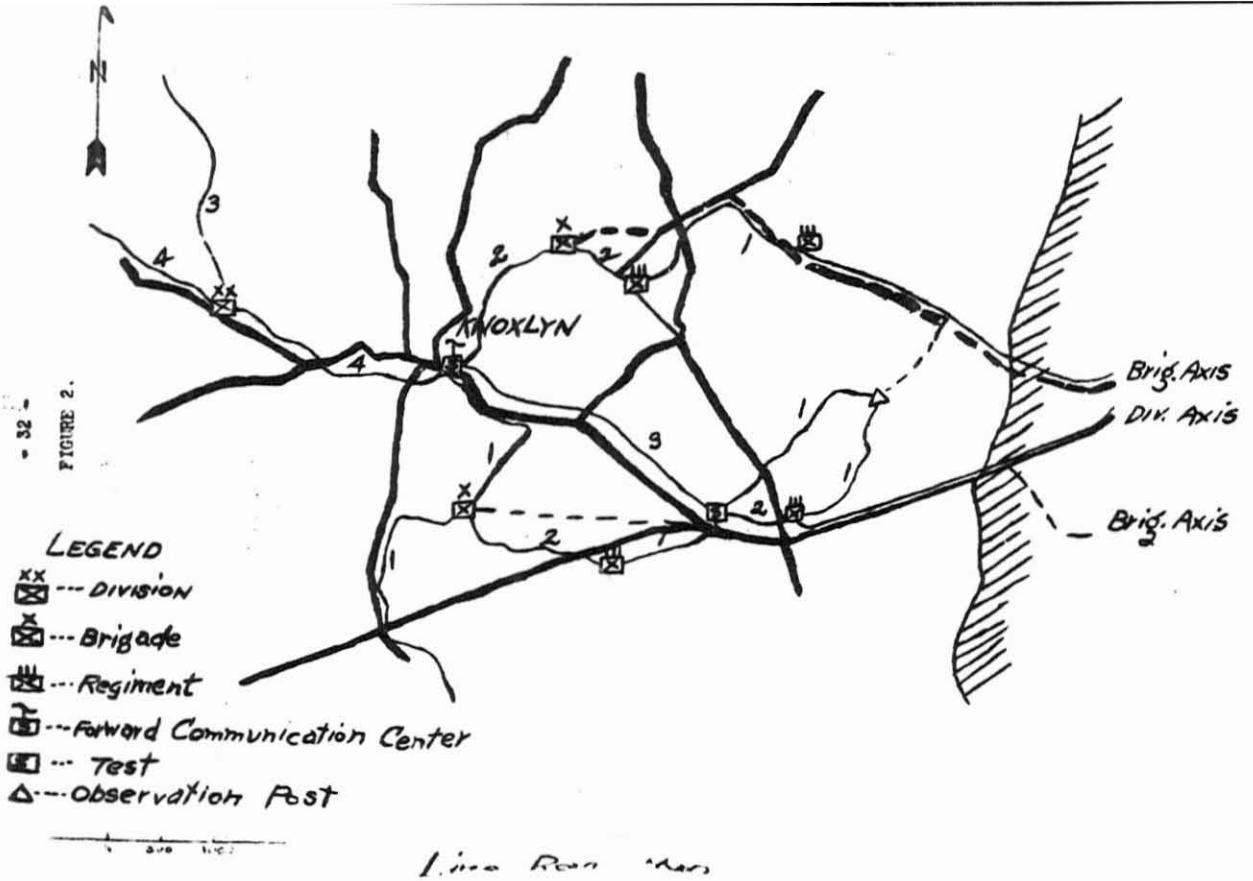

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FIGURE 2.

Line Plan

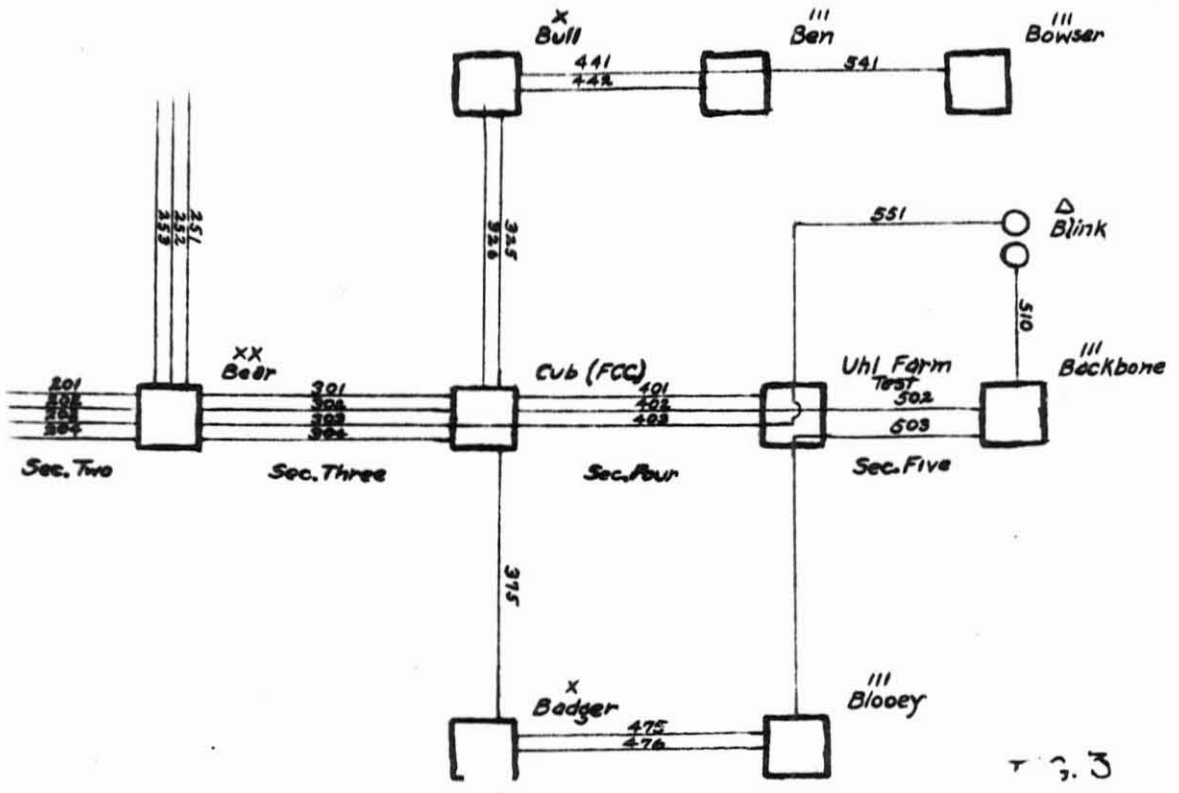

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FIGURE 3

FIG. 3

CIRCUIT DIAGRAM

26. The chief of the party should always be furnished with a line route map and a circuit diagram or such extracts as will be necessary to him [illegible]w work. The line route map does not in any kind him so as to prevent [illegible]g slight deviations for the purpose of securing protection for the personnel or the line.

27. The location of test points is usually left to the discretion of the chief of this construction party, since rapid location of trouble and economy of his men are his personal responsibility. In constructing an entirely new section, the party will start by placing a test frame and leaving the test party in charge. At the end of the section, if no test station has already been established, another frame will be installed. As soon as the circuits have been tested through, the chief of the party will immediately report to the signal officer of his unit the completion of his task and the numbers of the circuits. He will in return receive orders for the connections and assignments of these circuits if such have not already been made verbally or indicated in a circuit diagram.

Operating Detail

28. Each operating detail, whether they represent a tactical headquarters switchboard or a Forward Communication Center, are so equipped that they can either make the original installation of a frame board with terminal strips for the incoming line or enlarge and extend the frame of a test station so as to take care of their circuits from local phones. Extra frame boards are added above or below the original board whenever necessary.

29. When a central is installed, the jurisdiction of the construc- personnel terminates with the incoming trunk lines. Local phones and [illegible]its are installed and maintained by the operating detail.

30. The wire chief of each switchboard should possess such portions of the Plan of Signal Communications as relate to telephone code, etc., and a circuit diagram including all circuits within his part of the sector. The switchboard must be furnished with a local directory, Telephone Code and a Traffic Diagram. The TRAFFIC DIAGRAM (Fig. 9) is a schematic showing switching points by their code names and the number of channels between them.

1. Reports and Instructions

31. A daily communications report is made by the signal officer or noncommissioned officer of each unit to his technical superior. This report is ordinarily telephoned but where changes in route or complicated changes in circuits are made, this verbal report should be supplemented by line route maps (or tracings) and circuit diagrams sent in by courier.

32. The daily report covers radio, courier, visual, pigeon and pyrotechnic services; supply, traffic, interruptions, etc., as well as a report on the wire system.

33. The part of the report concerning the wire system should cover the following:

(a) Construction - Progress of lines under construction, Lines completed last 24 hours, giving circuit numbers.
(b) Assignments - Changes in circuits. Traffic loads.
(c) Interruptions- Cause and time out of service.
Equipment & Supplies - Expenditures and requisitions.

21. Test stations are usually known by the name of the town or locality, but for the sake of clearness a code name may be given a test station provided such code name is known throughout the signal command. This code name designates a geographic point and not the detachment which makes or maintains the installation. Every test station is marked with a Signal Corps flag to help couriers and advance parties from tactical headquarters to find it. The original installation at a test station consists of a frame board to which is attached one or more terminal strips, Type TM-[illegible], along its right hand edge. The board must be of such a size as to accommodate the anticipated number of circuits. Circuits under construction are brought into binding posts on the terminal strip and as outgoing circuits in continuation of the line are again connected at another pair of posts on the same strip. Connections are made to the test phone by means of cords with clips fastened to the binding posts of the block. Its normal connection is on the circuit designated as the Control Circuit, but if this circuit is also used for traffic, answers are made only to three short rings of the calling bell. In case of patching through i.e., temporarily reassigning certain channels, jumpers for making the desired connection are inserted and the loops between the incoming and corresponding outgoing circuit are cut away.

22. Switchboards are made up with a one hundred foot cable joining the line terminals to a connector block. Upon arrival of a switchboard for installation at a point where a test station exists, the switchboard's connector block is fastened to the left side of the frame board and cross connections are made with the right side before the jumpers which have been used to make through circuits are removed. After the switchboard has been placed in working order the test station party continue to keep their test phone on the control circuit but make no reply to calls unless three short rings are given. Ordinarily trouble information is referred to them by the local wire chief or chief operator.

23. When the tactical central again moves forward, the jumpers or through connections between circuits on the right hand side of the board are replaced, the cross connections are cut away, and the terminal strips belonging to the switchboard are then removed. The frame then reverts to its former status and name as a test station. When the necessity for a test station in a given locality is passed, the signal officer of the unit concerned may direct that the test station be abandoned. Corresponding circuits are then spliced through and the test frame is entirely removed.

24. TEST POINTS are intermediate points located along the axis with a view to rapidly localizing and repairing line trouble. They are sometimes placed no more than a half-mile apart. At a test point there are a few men with a telephone. The latter can be bridged across one of the circuits by the use of Frankel clips. Test points are designated "Test Point A," "Test Point B", etc. from rear to front. The chief of construction work will ordinarily assign a series of test letters to each section. Supervisory personnel at intermediate test points and test stations habitually keep their test phones on the lowest numbered circuit, or such other circuit as may be designated as the control circuit. In case this circuit has been assigned to traffic duty, they only answer to calls of three short rings.

Construction Parties

25. The chief of the construction party is assigned a section to construct, maintain, or construct and maintain. The principle here involved is that it is best to allow a party to maintain the circuits which they have constructed and to take charge over all of the circuits between two given geographic points. When the necessity for special maintenance of a given section has passed, then the party assigned to this section may be moved forward by the leap frog method and assigned an entirely new section to maintain or to construct and maintain. Sections which have become comparatively "quiet" are turned over to the operations personnel for maintenance.

34. The superior signal officer should in turn keep each subordinate informed of changes in circuit assignments, traffic, and line routings which may affect him. The division signal officer should frequently issue a mimeographed or hectographid circuit diagram to the various signal chiefs throughout the division as well as a traffic diagram for all switchboards.

SIGNAL CORPS PAMPHLETS

The following pamphlets dealing with Signal Corps subjects have either already been printed or are now in the hands of the public printer, and will soon be available for issue:

ELEMENTARY ELECTRICITY - TRAINING PAMPHLET NO. 1 (3rd Edition)

This pamphlet, written by Captain Leon H. Richmond, Training Section, Office of the Chief Signal Officer, is replete with sketches, analogies and diagrams, is written in terms of simple English, and without a doubt is the best yet written on the subject that can be used for the purpose of instructing the Signal Corps soldier. "Elementary Electricity", Training Pamphlet No. 1, has been distributed to all officers of the Regular Army, National Guard and Reserve Corps. Additional copies may be secured from the Superintendent of Documents, Government Printing Office, Washington, D.C., for 15 cents per copy.

TRAINING PAMPHLET NO. 10- "WIRE AXIS INSTALLATION AND MAINTENANCE WITHIN A DIVISION."

This will soon be available. The major portion of this pamphlet appears under the above title in this issue of the Information Bulletin. The subject matter should be of great interest to all Signal Corps officers because it crystalizes the Signal Corps doctrine with regard to installing and maintaining wire communication within a division.

RADIO PAMPHLET NO. 40 - "THE PRINCIPLES UNDERLYING RADIO COMMUNICATION".

A new edition completely revised with much new matter added thereto is soon to go to press. This pamphlet has indeed been a boon to beginners by reason of the very thorough manner in which it explains the radio art.

LINE RADIO COMMUNICATION

In line radio communication electric oscillations are generated and modulated by the methods employed in radio. These oscillations, instead of being led to an antenna to be radiated as Hertzian waves, are impressed on a conducting line which extends to the receiving station. This line guides the waves to the receiving station where they are detected by radio methods and apparatus of radio type, no receiving antenna, however, being necessary. The fundamental difference between radio and line radio is in the fact that in the former electric waves are radiated in space, while in the latter they are guided by a conducting line used for that purpose. The conducting line does not destroy, nor, to any extent, distort the modulated form of the oscillations which are impressed upon it. Thus both telephony and telegrapny are possible by this method. The names "Guided Wave Telephony and Telegraphy", "High Frequency Telephony and Telegraphy", "Carrier Current Telephony and Telegraphy", "Wired Radio", "Wired Wireless" and others have all been applied to this new art of communication.

FIGURE 9

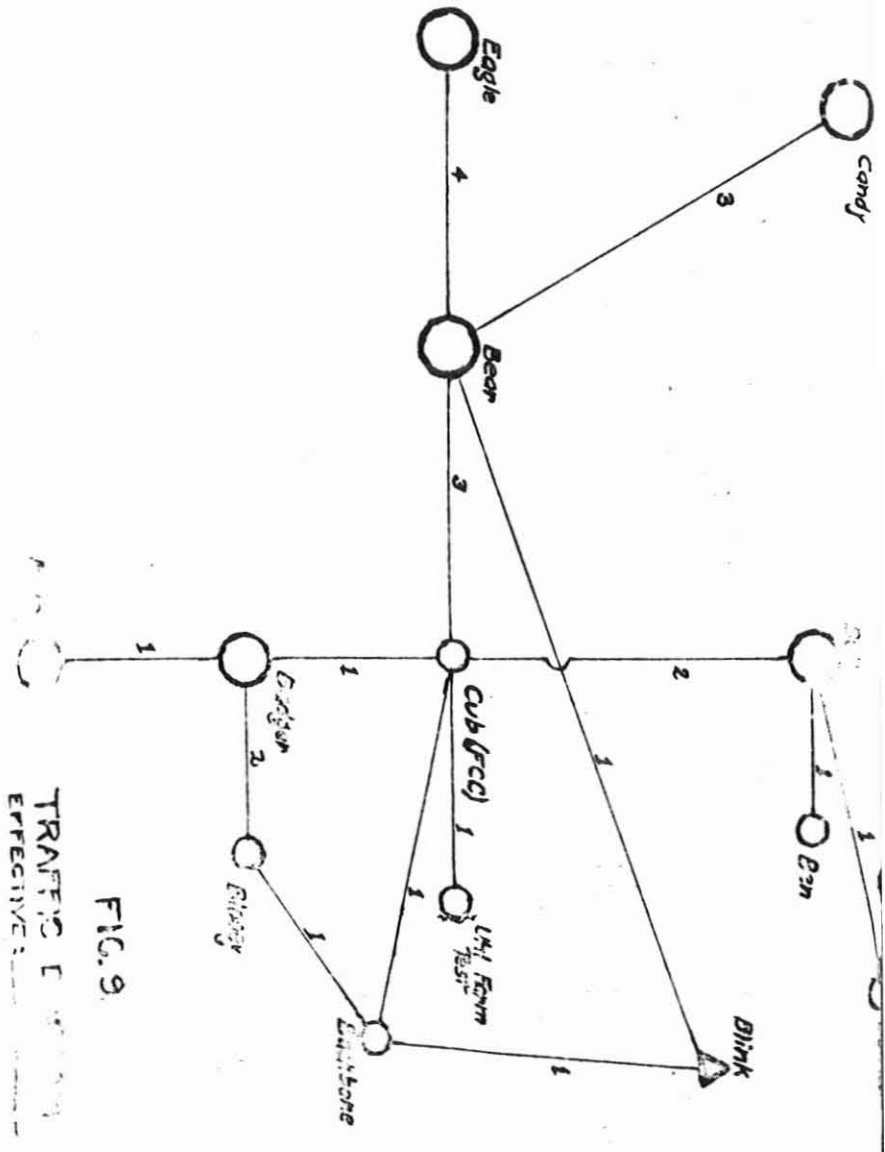

FIG. 9

TRAFFIC [illegible]
EFFECTIVE [illegible]

Oscillations of different frequencies may be impressed simultaneously at either or both ends of a wire which will carry them without destroying the characteristics of any frequency impressed. This fact makes it possible to use the same wire to transmit simultaneously a large number of two-way messages, either telephonic or telegraphic, or both. The number is limited, in telegraphy, only by the selectivity of the receiving apparatus. Oscillations differing by five per cent in frequency can readily be separated. As there is a large range of frequencies available, a large number of telegraphic messages can be carried over one wire. In line radio telephony the number of messages is limited by the same restriction and by the fact that the frequency used in one message must differ from the next higher or lower frequency by at least 2000. This is because the range of effective frequencies of the human voice lies within the limits, 200 - 2000. An oscillation of radio frequency modulated by the voice becomes, in reality, a complex oscillation in which are present the original frequency plus and minus the frequencies of the voice. Thus in addition to the original frequency there are present side bands of frequencies, one side band being the original frequency plus the speech frequencies, the other side band being the original frequency minus the speech frequencies. In order to reproduce speech one of these side bands must act upon a detector; therefore in order to permit the simultaneous transmission of more than one telephone conversation without interference, the original unmodulated frequencies must differ by at least 2000 in order to allow for the side band.

In addition to the great advantage of multiplexing explained in the preceding paragraphs, line radio telephony gives a more exact reproduction of the original voice than does ordinary telephony. In ordinary telephony the electric waves transmitted have the frequencies of the speech wave consisting of a fundamental and its harmonics or overtones. The range of frequencies of speech is, as noted above, considered to be contained within the limits, 200 - 2000. These waves in the transmission along the line are attenuated, (damped out) the attenuation on any particular line depending upon the frequency, being greater for higher frequencies. Thus in ordinary telephony the higher frequencies suffer a greater attenuation than the lower frequencies. This results in speech distortion. In line radio telephony the attenuation for all the frequencies of the speech wave is nearly the same as the ratio of the highest frequency of the speech wave plus the frequency of the unmodulated oscillation, to the lowest frequency of the speech wave plus the frequency of the unmodulated oscillation is nearly unity. For instance, if a voice has a fundamental of 250 vibrations per second and one of the overtones is 1250 vibrations per second, the frequency of the component of the current corresponding to the latter is, in ordinary telephony, five times that of the former. With the same voice transmitted by line radio, using a frequency of 150,000 the ratio of the frequency due to this particular overtone (151,250) to the frequency due to the fundamental (150,250) is 1,006. The ratio, in each case, indicates the relative magnitude of the attenuation of the frequencies considered. It is seen therefore that speech distortion due to unequal attenuation of the component frequencies of the voice is practically absent in line radio telephony.

Line radio has many other advantages besides the possibilities of multiplexing and the reproduction of distortionless speech. A conducting line used for any other purpose can also be used at the same time for line radio without any interference arising. Power lines, as well as telephone lines, may be used simultaneously for line radio. Except where a cable is used as the conducting line, the power required to communicate between two points by line radio is, even without the aid of repeaters, much less than that required in ordinary radio. It is of course entirely practicable to use repeaters in a line radio system, thus further reducing the power required.

Line radio systems are already in commercial use in the United States, Canada, England, Japan and Germany. Line radio is being used on many of the commercial long distance telephone lines in the United States.

In Germany and Japan power lines are being utilized as the conducting lines. Line radio communication has given a great impetus to the development of vacuum tube and circuits used with it. Some progress has been made in inventing methods by which a vacuum tube will generate oscillations only when actuated by the voice. Progress has also been made in developing circuits which permit the use of the same vacuum tube as a detector and a generator without requiring any switching arrangement. Also circuits containing no switches have been designed which permit of sending and receiving at the same station, different vacuum tubes being used in each case. New methods of separating frequencies and bands of frequencies have also been developed.

Line radio apparatus may be bridged across a metallic circuit or it may be used on a line having a ground return. In the latter case line radio telephony is not subject to the interfering noises met with in an ordinary ground return telephone line. This is because the line radio frequencies to which the circuits are tuned are much greater than the frequencies of the currents that usually cause disturbing noises. One of the methods of connecting line radio apparatus to a circuit, used by General Squier in his original work, is as follows: The oscillations are generated and modulated by radio methods and impressed upon the oscillation transformer. The secondary of the oscillation transformer is bridged across the line. In addition to the secondary of the transformer there are also in this bridging circuit a variable inductance ( ) and a variable capacity ( ) which are the tuning elements of the ( ) system. It has been found that suitable adjustment of the inductance-capacity value for a given frequency increases several fold the current input to the line. At the receiving station a similar arrangement is made and the strength of the oscillations received are increased by proper tuning.

R.O.T.C. SUMMER CAMP

About four hundred American college men are expected to arrive at Camp Alfred Vail, New Jersey, on June 23 for the annual R.O.T.C. Summer Camp of the Signal Corps. These men hail from ten different colleges where Units of the Signal Corps R.O.T.C. are maintained. Many of the students were at camp last year, and their return to camp this year is an evidence of the pleasure and benefit which they have found the camp has to offer.

During the six weeks' camp the latest developments in signal communications will be studied as well as tactical principles and practical Signal Corps work. Special lecturers are being imported from the General Service Schools at Fort Leavenworth, Kansas, to give instruction in the tactics and technique of the various arms of the service and their special needs with regard to signal communications. One of the most prominent code and cipher experts in the country will be in camp for a few days to give a short series of lectures.

About thirty regular officers of the Signal Corps will be detailed to this camp as instructors. Quite a large number of these were instructors at last year's camp and are well known to the men of the R.O.T.C.

Plans are already under way for the formation of a company baseball league and for the organization of various field sports.

SETS USED IN THE ARMY RADIO NET COVERING THE UNITED STATES

There are soon to be installed at various selected posts throughout the United States, powerful vacuum tube transmitting radio sets Type SCR-140or SCR-141. These sets, together with existing stations, will form a radio net covering the entire United States. The two sets differ in that one of them is used where a direct current source of power is available and the other is used where an alternating current source of power is available. They are very similar to the transmitting part of the Set Type SCR-97, the main difference being that the latter is mounted on a truck, while the SCR-140 or SCR-141 form fixed stations. These sets are arranged for radio telephony and buzzer modulated radio telegraphy, in addition to undamped wave radio telegraphy.

In these sets the main vacuum tubes used are six pliotron tubes, Type VT-10. In undamped wave radio telegraphy, these six tubes are employed as generators. In buzzer modulated telegraphy and in radio telephony three of these tubes are used as generators and the other three are used as modulators. In telephony there is also another tube (Type VT-16) used as a speech amplifier. This also is used to amplify the variation in current produced by the buzzer in buzzer modulated radio telegraphy. This tube amplifies the voice currents before they act upon the modulating tubes. Two ballast lamps Type L-3 are used in the filament circuit to maintain constant conditions therein. The power for the SCR-140 or SCR-141 sets is derived in most cases from commercial power lines, and by means of a motor generator or similar type of machine, converted into currents of the proper voltages needed for the plate and also for the filament.

The antennae for these sets should have a capacity of .0012 microfarads and should be at least 100 ft. high. The Navy Type receiver (S.E. 1420-B), with an amplifier (Type EC-103) and heterodyne (Type EC-104) form the regular receiving apparatus to be used with these sets. The amplifier has three stages of radio frequency amplification and two stages of audio frequency amplification. With such an antenna and receiving apparatus, it is expected that the undamped wave radio telegraph range of these sets will be 1000 miles. The buzzer modulated and radio telephony range will be from 100 to 200 miles. The transmitting wave lengths are from 860 to 1200 meters; from 1700 to 2300 meters and from 2600 to 3400 meters.

When these sets are used for telephony, arrangements are made for remote telephone control. This permits, for example, the commanding officer at Jefferson Barracks to call his radio station on his desk phone and ask for the commanding officer at Fort Omaha. The radio operators establish radio communication between the two posts and thereafter the two officers will be able to converse using their desk telephones. An important feature of this remote control is the control of the transmit-receive switch by means of an alternating current impulse which is sent over the telephone line and throws the transmit-receive switch to either of the positions desired.

It is expected that by the first of November of this year these sets will have been installed at the following posts:

Fort Wood, New York, in the 2nd Corps Area
Fort Howard, Maryland, in the 3rd Corps Area
Fort McPherson, Georgia, in the 4th Corps Area
Fort Benjamin Harrison, Indiana, in the 5th Corps Area
Fort Sheridan, Illinois, in the 6th Corps Area
Fort Omaha, Nebraska and Jefferson Bks. in the 7th Corps Area
The Presidio of San Francisco, Fort Douglass, Utah, and
Fort D.A. Russel, Wyoming, in the 8th Corps Area.