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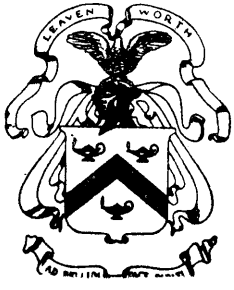
SOUND LIAISON

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The following pamphlet entitled "Sound Liaison" is published for the information of all concerned.

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BY ORDER OF THE SECRETARY OF WAR:

JOHN BIDDLE,
Major General, Acting Chief of Staff.

OFFICIAL:

H. P. McCAIN,
The Adjutant General.

WAR DEPARTMENT,
THE ADJUTANT GENERAL'S OFFICE,
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SOUND LIAISON.

CHAPTER I.

PROVISIONAL INSTRUCTION ON SOUND LIAISON.

INTRODUCTION.

As a result of recent research it has become possible to use sound signals as a means of liaison on the battle field. This process of liaison alone can not claim to have solved the difficult problem of transmission of orders and information, which can only be achieved by combining the chances of success of several methods simultaneously. It deserves, however, to be classed as one of the most valuable forms of liaison.

Investigation has proved that the best signals, as regards clearness and range, are those made by instruments of the *bugle* type. The mechanical bugles employed in sound liaison are special instruments actuated by a pressure of 2 to 3 atmospheres. They emit very loud notes, which carry much farther than those of the ordinary bugle.

In order to increase the value of sound signals a *listening device* is also used. This consists in fact of two *sound trumpets* adjusted to the operator's ears and giving accurately the *direction* of the sound perceived. The listening apparatus are of two models, differing in the size of the trumpets and the details of installation. The largest, which is used by the sound liaison stations in rear of the battle field, makes it possible to hear signals plainly at distances of as much as 2,500 meters, atmospheric conditions notwithstanding, even during heavy cannonading. Under favorable conditions the range may exceed 6 kilometers.

The most important liaison is that between the most advanced infantry units and their command. In each infantry

division a system of sound stations has been established, by means of which liaison may be effected in accordance with the general instructions of the command. This system includes advance stations in the first line battalions, relay stations at the brigade command post, and lastly the divisional station.

The advance sound liaison stations can generally be heard over the entire sector whenever they communicate with the brigade command post. They therefore give the alarm to all other liaison agencies, which should then use every means in their power to forward the signal just heard on to the rear. This is especially necessary when for some reason the brigade command post or the divisional station have not been able to receive the sound signal directly. In this respect advance sound stations are especially valuable.

Sound liaison may also be used in the two following cases:

(1) Mechanical bugles may be installed on the infantry airplane. The airplane may then communicate with its infantry by sending sound signals and observing the visual signals.

(2) In each infantry unit the artillery liaison officer can use a mobile sound station for communicating with his batteries during combat, in which case he uses a special signal code, very similar to that of the radio apparatus used between airplanes and the artillery.

MATERIAL AND ORGANIZATION.

I. SENDING APPARATUS.

There is but one type of sending apparatus. This is an arrangement consisting of two bugles with reeds, joined by a rigid frame and equipped with all the accessories required for their operation. They give the notes mi_3 and sol_3, respectively; these notes are used to establish conventional signals, which will be treated later. The gas used is *liquid* carbonic acid, contained in a bottle provided with a regulator which keeps the issuing gas at a suitable pressure; a flexible tube with interchangeable joints conducts the gas from the regulator to the bugles.

The latter are contained in a box called *sending box*. They are actuated by a handle with two strings by means of which the gas in-takes may be opened at will. Both bugles may be blown simultaneously, with *accordance* of the two notes. The controlling cords may be made any length, so as to enable the

operator to actuate the bugles while remaining under cover if circumstances require.

The sending box may be carried by hand or on the back like a knapsack. There is a socket by means of which the box may be mounted on a tripod for operation. The total weight, with the flexible tube, joint, and regulator, and with the tripod folded and fastened to the box, is 10 kilograms.

The bottles of carbonic gas are of two models—the small, 1-liter bottle, weighing about 5 kilograms and containing enough carbonic gas to give 200 sound notes of 1 second duration, and the large, 10-liter bottle, weighing about 40 kilograms. The latter is only used in *large sound stations.* (See p. 12.)

Figure No. 1 shows a signaler carrying his sending box. Figure No. 2 shows the apparatus in operation.

2. LISTENING APPARATUS.

As has already been said, there are two models of listening apparatus.



FIG. 1.

The large apparatus have sound trumpets in the form of cones, with an opening of 20 degrees, and 1.5 meters in length. They may be dismounted and packed in a special case. When moving over the terrain the case is carried by two men like a stretcher. Its total weight is 50 kilograms, and it can pass through any communication trench. When it is set up the lid when folded back has a cradle, which is used to install the cones. The case itself may be used as a support. A graduation in degrees gives the angle of rotation and enables directions to be determined accurately.

Each cone ends in a rubber tube terminating in a metal earpiece, one end of which is to be placed in the ear.

In cases of emergency, flexible extensions 1 meter long may be adjusted end to end in order to enable the operator to stay

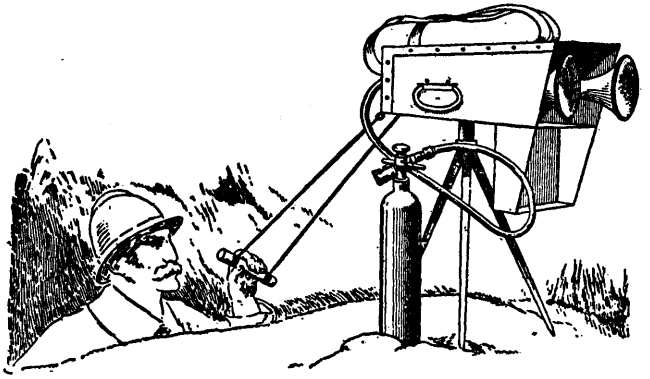


FIG. 2.

under shelter while listening. In addition to the safety it affords, this process enables the listener to be more free from the disturbing noises in the immediate vicinity.

The sound trumpets of the small apparatus are only 75 centimeters long; they have earpieces exactly like those of the large apparatus. The small listening apparatus are carried on the back, and when they are set up they are placed on a tripod similar to that of the sending boxes. Although they do not enlarge sound to the same degree as the large apparatus, they make it possible to interpret as clear signals sounds which the ear would perceive too indistinctly.

Figures 3 and 4 show the small apparatus during transportation and in operation.

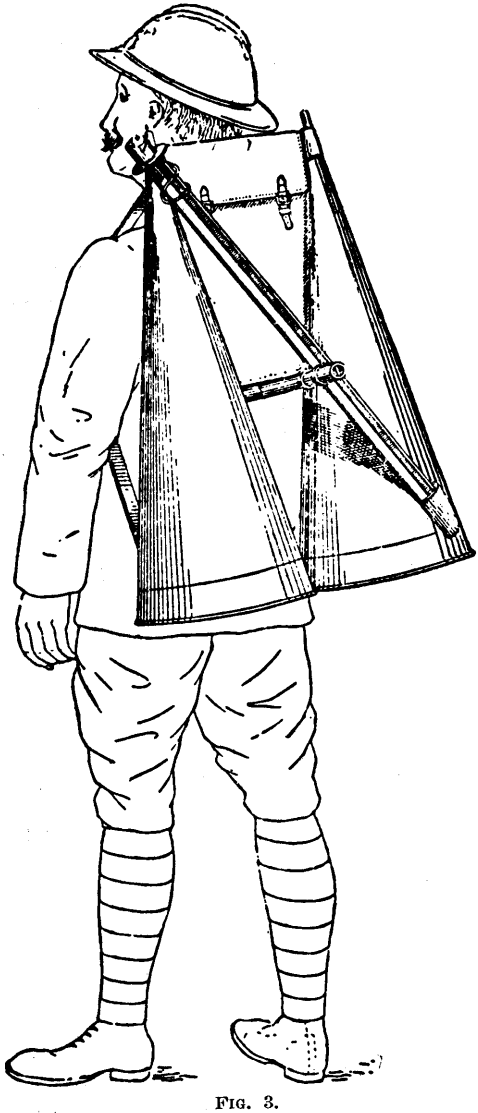


FIG. 3.

3. ORGANIZATION.

The personnel of every sound liaison station consists of specialists provided with sending and listening apparatus and a certain quantity of carbonic acid gas. *Large stations* are established in rear of the lines and *small stations* in the advanced elements. The stationary and mobile stations of the division form a sound system, which usually includes a large station and a number of small stations, depending on the plan of attack.

As a general rule two mobile stations are allotted to each infantry regiment, one mobile station to each brigade, and a large station to each division.

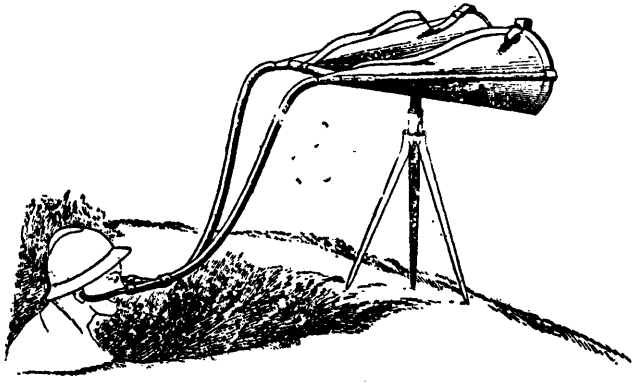


FIG. 4.

ORGANIZATION OF A LARGE STATION.

A large station consists of the following material:

For sending.—A sending box with tripod, a 10-liter bottle of carbonic acid gas, and one extra bottle of the same size.

For listening.—A listening box containing the material of the large listening apparatus.

The total weight of the material of a large sound station is about 160 kilograms. This material is only carried by hand in exceptional cases and for short distances.

The personnel of the divisional station is selected from the telegraph personnel of the division. It consists of one station chief, one operator, and two listeners, making a total of *four men.*

ORGANIZATION OF A SMALL STATION.

A small station consists of a sending apparatus absolutely like that of the large station, and a small listening apparatus. The total quantity of carbonic acid allotted to it is four bottles, which may be replaced from a reserve of six bottles carried by the combat train of the regiment.

The personnel consists of a station chief, who carries two bottles of carbonic acid, an operator carrying the sending apparatus, a listener carrying the listening apparatus, and an assistant carrying two bottles of carbonic acid. It is of great advantage for the latter to be a *bugler*, for in certain cases an ordinary bugle may be used as a sending apparatus. The material of a small sound station also consists of a "periscope" bugle, which can be blown while the operator remains in a shelter. It can be heard three kilometers away with the large listeners.

The total of four men; that is to say, eight to a regiment, is selected from the signalers of the regiment. It is dependent on the telephone officer.

4. INSTRUCTION.

If the maximum of efficiency is to be obtained from sound liaison, a well-trained personnel is indispensable. The following are a few suggestions on the subject of this instruction:

(1) The personnel should be well trained in mounting and operating the material and installing it under the most favorable conditions (visibility, facility for shelter, etc.).

(2) The personnel must know how to find their bearings on the terrain. *The sounds must be directed toward their objectives, and the listening cones must also be oriented with some accuracy toward the corresponding stations.*

(3) The men must be familiar with the cocks and valves of the bottles of carbonic acid, the handling of which requires a certain amount of practice. For instance, the plug of a bottle which has no regulator should never be unscrewed, it might become impossible to close it on account of the formation of icicles, and nothing could be done to prevent the entire contents from escaping.

(4) It should also be remembered that sound requires considerable time to travel from one station to another. The

answer to a call will take from 15 to 20 seconds to arrive if the two stations in communication are 2 kilometers apart.

(5) The men must be perfectly acquainted with the identification signs of stations and lines.

(6) Lastly, the signalers must not forget that the carbonic gas must be used sparingly. While giving each note its full power, each station must use their apparatus with great care and economy. They must also remember that they are not the only correspondents, and that a multiplicity of signals would quickly cause confusion.

RULES OF TRANSMISSION AND CONVENTIONAL SIGNALS.

1. USE OF MATERIAL.

Sending box.—The following operations are necessary to put the sending box in working order:

(1) Put up the tripod and place the box on it, fitting the tripod into the socket. Let down the lid so as to uncover the mouths of the bugles *completely.*

(2) Connect the bottle of carbonic gas to the bugles. The bottle, whether held by the operator or placed on the ground, must be practically vertical.

(3) Turn the bugles in the direction of the receiving station. This is particularly important in the case of brigade stations, which may have to send signals in two opposite directions. The signals may then be sent.

Listening apparatus.—For the large apparatus, remove the entire contents from the case and turn back the lid according to the adjusting marks indicated. Assemble the parts of each cone and place both cones on the cradle, fasten them with their key, and place their traversal attachment in position. Adjust the earpieces, with or without the extensions, remembering that the earpiece for the right ear and that for the left ear are not interchangeable. Care must be taken that the flexible tubes are of the same length, in order to avoid great errors in the estimation of the direction of sound. Turn the apparatus toward the sector of observation.

The small apparatus is placed on the tripod and the earpieces are adjusted.

2. SIGNALS.

It has been agreed that the *dash* of the Morse code shall be represented by the low note of the bugles and the dot by the high note. A dot or dash correspond to an *emission* of about one second duration. A *signal* is a series of emissions separated by silences of about one-half second; a telegram consists

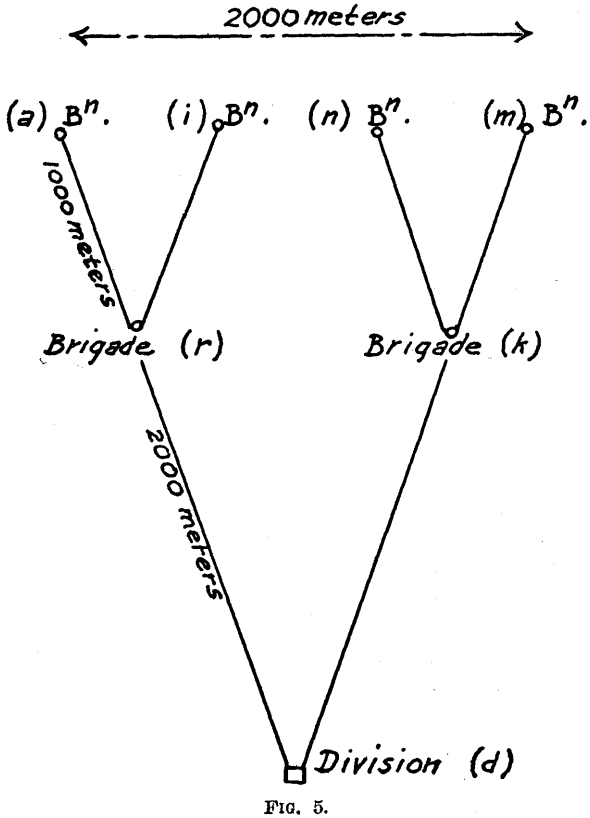


FIG. 5.

of one or more signals separated by longer silences (two seconds).

Signals may consist of words or figures of the Morse code, but only in *very exceptional* cases. As a general rule, all the signals used are conventional signals, requiring *very few* emis-

sions. Before the transmission of any Morse letters or figures the correspondent must be warned by a special signal mentioned above.

In the division system there should be no signaling between two battalion stations nor between the two brigade stations. The diagram (fig. 5) shows the liaison established in a division which has one regiment of each brigade in line. The distances are only given for illustration.

3. SERVICE RULES.

Identification signals.—Each sound station has an identification signal. These signals are determined by order of the division for each operation and must be chosen from the letters with two emissions, such as:

a . —	n — .
i . .	m — —

and from the following letters with three emissions:

r . — .	g — — .
u . . —	d — . .
w . — —	k — . —

Conventional signals.—The only three general signals agreed upon are the following:

o — — —	"Request for artillery fire."
h	"Lengthen the artillery fire."
y — . — —	"Send ammunition."

Service signals.—These signals are generally those used in military telegraphy. They will not have to be used often.

It is advisable to supplement them as follows:

d d — . . — . .	"We are moving the station."
o s — — — . . .	"We are going to send Morse."

(See above.)

Transmission of a telegram.—The case under consideration is that of the transmission by an Infantry station of a conventional telegram concerning operations.

The mobile station first attracts attention by a loud signal made by blowing both bugles simultaneously for *two* seconds.

The mobile station then sends out *calls*. A call consists of the identification signal of the calling station followed by that

of the station called. The latter answers by the same signal, which signifies "Ready to receive."

The mobile station then sends the telegram.

The object of a telegram is to call for a definite operation for the benefit of a given unit. For instance: "Barrage fire for battalion (*i*)." It must therefore mention two things—the *unit concerned* and the *operation* called for. Consequently it consists of two successive signals—the *identification signal* of the unit making the request and the *conventional* signal of the operation called for.

The corresponding station repeats the telegram received. Both stations then exchange a dot, and the transmission is ended.

Example I.

Battalion station (*i*): Both bugles together for two seconds, then—

. . . — . "I am battalion (*i*), I want brigade (*r*)."

Brigade station (*r*):

. . . — . "I am listening."

Station (*i*):

. . — — — "Barrage fire for battalion (*i*)."

Station (*r*):

. . — — — "Barrage fire for battalion (*i*)."

Station (*i*):

. "Understood."

Station (*r*):

. "Understood."

Example II.

Brigade station (*r*): Both bugles blown simultaneously for two or three seconds, then—

. — . — . . "I am brigade (*i*) and I want division (*d*)."

Division station (*d*):

. — . — . . "I am listening."

Station (*r*):

. . — — — "Barrage fire for battalion (*i*)."

Station (*d*):

. . — — — "Barrage fire for battalion (*i*)."

Station (*r*):

. "Understood."

Station (*d*):

. "Understood."

4. INCIDENTS DURING TRANSMISSION.

The above case, which is the most favorable, is that in which all signals have been heard and understood on both sides. Measures should be taken to insure transmission even under less favorable conditions. The less favorable cases are enumerated below:

(1) The sending station does not hear the answers made to its calls by the correspondent. After repeating the calls several times, the telegram is sent notwithstanding.

(2) The receiving station does not understand. It sends the signal:

. . — — . . "Don't understand."

and the sending station repeats the telegram.

(3) The sending station notices that the receiving station is repeating the telegram incorrectly. A *long dash* is sent and the telegram is repeated.

(4) The sending station does not hear the signals of the receiving station. After repeating the telegram several times, it sends the signal:

SO . . . — — —

which signifies: "If you have understood, send rockets."

The receiving station then sends one or more rockets until the sending station sends a dot.

5. PRIVATE TELEGRAMS.

In order to simplify sound transmission and thereby increase its chances of success, only three general signals for operations have been agreed upon. It is evident, however, that in special situations, special signals may be agreed upon concerning them. All signals should be preceded by the suitable identification signals, and their number should be reduced to the minimum.

6. MEASUREMENT OF DISTANCE.

When an advanced station has moved, the command post may estimate approximately the new distance from its correspondent by measuring the time which elapses between the sending of a dot and the immediate return of the same signal by the corresponding station.

In this case the command post sends the conventional telegram:

k k e — . — — . — .

with an interval of three seconds between *k k* and *e*. This signifies "measure of distance"—"Send a dot after receiving my dot."

The mobile station obeys the order received. By means of a second watch or a stop watch the stationary station observes exactly the time which elapses between the signal sent and the return.

Sound may be considered as traveling at an average of 340 meters in one second. From the rough result, 100 meters should be deducted to allow for the time required to operate the apparatus.

For instance: If 20 seconds elapse between the departure and arrival of the dot, the distance sought for is practically 3,300 meters.

7. RECORDS.

In each sound station a record is kept of the telegrams sent and received. This book is of the regulation type book of arrivals of military telegraphy.

The concordance between the records of two stations is shown by the time.

When the record books are completed they are turned in to the stationary station of the division.

NOTE I.

USE OF SOUND LIAISON BY THE ARTILLERY OBSERVATION OFFICER.

The artillery observation officer who is following the advance of an infantry unit may find it of advantage to communicate with his batteries by sound signals.

An allotment of two mobile stations might be made to an artillery battalion; one station to follow the observation officer and the other to remain at the command post of the battalion.

The following signals are given as an example:

(1) "We have encountered an obstacle and are checked, observer at 305 (square of sketch distributed before the attack) requests fire on 307."

"identification signal" 305 o o 307.

(2) "I am sending you the position of your fire in relation to my line of sight target observer."

"identification signal" 305 r r 307.

(3) Ten seconds later:

"too short": . . . .

or "over" — — — — —

(4) Ten seconds later:

"too far to the right" . . . . . .

or "too far to the left" — — — — — —

(send long emissions).

(5) "On target; continue firing":

"identification signal" b b 307.

(6) "Extend fire on this objective; we are going to advance":

"identification signal" h h 307.

(7) "We have temporarily stopped our advance. Prepare to protect us by your barrage fire. Regiment occupies front 315–18.

"identification signal" s t 315 . 318.

NOTE II.

USE OF SOUND LIAISON APPARATUS ON INFANTRY AIRPLANES.

The infantry airplane may communicate with the advanced infantry elements and the command posts of the rear by means of sound or visual signals, the combined use of which appears able to render quite important services.

As regards visual signals, the airplane may send rockets, and, on the other hand, may observe the identification panels of the units with which it is in communication, and take photographs for them.

As regards sound signals, the airplane acts only as a sending station, using mechanical bugles.

These bugles may be mounted on airplanes very easily and very satisfactorily. A frame is secured to the bottom of the cockpit to hold the bugles, and the latter are turned downward with the mouths barely emerging from two holes, so that when the airplane is flying the bugles are vertical. The levers by which the bugles are actuated are placed within reach of the observer. Two bottles of carbonic acid with flexible tube and

joints are placed in the cockpit in a vertical position. The *total* weight of the apparatus is 15 kilograms.

TO CALL AN INFANTRY UNIT.

In order to attract the attention of the infantry units with which it is to communicate, the airplane must fly above these units and first blow both bugles simultaneously. The identification signal of the regiment called for is then sent.

On account of the medium altitude at which it is flying the airplane will be able to attract the attention of the line without fail, even if it has not been seen and if the motor has not been heard. The experiments conducted in this direction have been very satisfactory.

SIGNALS SENT BY AN AIRPLANE TO THE INFANTRY.

(1) Identification signals of the various regiments: **d u r k.**
(2) . . . . . "Where are you?"

(On receiving this signal the troops put up the various identification panels.)

(3) . . . "Understood."
(4) — . . . — — "Have you something to ask?"

On certain important occasions the airplane may also transmit *orders* to its infantry by means of sound signals previously determined for each particular case.

VISUAL SIGNALS FROM THE INFANTRY TO THE AIRPLANE.

These include all the signals mentioned on pages 10–11 of the "Provisional Regulations" of April 17, 1916. The regulation methods are used. The new methods may also be used, for instance, groups of simultaneous signals (groups of panels), which are perhaps preferable to the series of signals or rockets, successive in time (as in the case of Morse signals).

SOUND SIGNALS FROM THE AIRPLANE TO THE COMMAND POST.

After having observed the requests of the infantry the airplane may transmit them to the command post by means of the bugles.

Telegrams on the order of the following may be sent:

"Such and such a regiment asks for extension of artillery fire."

CHAPTER II.

PROVISIONAL NOTE ON MATERIAL FOR SOUND LIAISON.

The method of sound liaison is nothing more than a *means of signaling.* It permits the establishment, in accordance with the instruction on liaison, of a *stationary center of information,* to which information is sent from *mobile advanced stations*, and from which signals may be sent to the latter.



FIG. 6.

Every sound liaison station consists of sending and receiving apparatus.

There are *large stations* and *small stations.*

Sending.—The thorough study of various practical instruments (whistles, sirens, horns, etc.) has shown that the best signals, both as regards clearness and range, are produced by instruments of the bugle type. These bugles include, principally—

(1) *The ordinary bugle* (preferably in the form of a *periscope bugle,* which can be blown while remaining under cover—fig. 1).—This is the most simple type of small station. Its signals may

be easily recognized 3 kilometers away by the large listening apparatus described on page 37.

(2) *Mechanical bugles.*—These instruments are nothing more than bugles with reeds operated by a pressure of two or three atmospheres.

(NOTE.—Among other mechanical bugles is the "Strombos" apparatus, which is used to signal gas attacks.)

They emit much more powerful notes than the ordinary bugles, and should, therefore, be used whenever possible as the main sending apparatus of sound liaison stations.

The equipment then used consists of (fig. 2) *two bugles* with reeds, each giving a different note (mi_3 and sol_3, respectively), the low representing the "dash" and the high representing the "dot" of the Morse code.

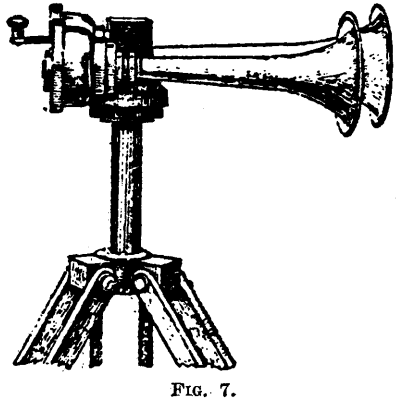


FIG. 7.

These bugles are held together by a rigid frame and are contained in a box called *sending box*, which protects them, and which can be carried on the back like an ordinary knapsack (figs. 3 and 4).

The apparatus may be mounted on an iron-pointed stick (small station) or on a tripod (large station) by means of a socket projecting from the box. A *handle* which may be turned through an opening in the sending box acts as a discharge key to blow either the low or high bugle.

The gas required to actuate the bugles is provided by *bottles of carbonic acid* or *bottles of compressed air.* Small stations are supplied with bottles of carbonic gas. Compressed air is preferable in large stations *when there are air compressors in the district.*

A *regulator*, screwed to the bottle, maintains the gas at a suitable pressure. A flexible tube with interchangeable joints conducts the gas from the regulator to the sending box.

The bottles are of three kinds, and may contain 200 grams, 1 kilogram, or 10 kilograms, respectively, of carbonic acid. The latter are only used in the large stations, and may be replaced by bottles of compressed air when circumstances allow.

The supply of carbonic gas allotted to small stations consists of five bottles of 200 grams, which are carried by the man in charge of the sending box, and of a reserve of 1 kilogram, kept by the man in charge of the receiving apparatus.

The load carried by the first of the two men is distributed as follows:

(1) *One bottle* (the one to be used) is hung on his left side (fig. 4) by means of the regulator to which the bottle is screwed. The regulator is contained in a leather case, which is slung onto his belt.

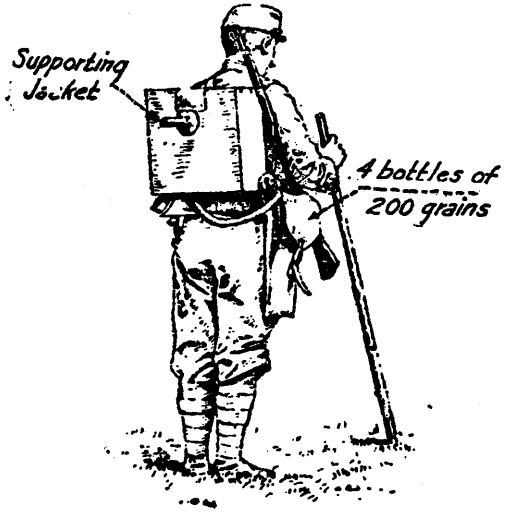


FIG. 8.

(2) *The four other bottles* are placed in a special case (fig. 3) which is carried on the right side by means of a strap passing over the left shoulder.

(3) On his back, the sending box.

(4) In his hand *the supporting stick.*

The total weight of the sending material of a small station is less than 15 kilograms.

The extra gas is carried in a case similar to that containing the four bottles of 200 grams (see fig. 5). The total weight is about 7 kilograms.

Use of pumps.—Mechanical bugles may also be actuated by means of the *pumps* which are furnished with the *Brandt* or

Boileau-Debladis pneumatic howitzers. A *reservoir regulator* is then required. This reservoir is only included in the station material.

Receiving.—The means of receiving consist of:

(1) *The naked ear*, which can not recognize the sound of an ordinary bugle beyond distances exceeding 700 to 1,000 meters and can recognize the sound of a compressed gas bugle at distances three times as great. The ear may therefore be used if listening apparatus are lacking.

(2) *A listening apparatus*, which acts as a *sound magnifier.* This apparatus will generally consist of two large sound trumpets, each adjusted to one of the listener's ears. He perceives the sound on the right or left, as with the naked ear, and can thus determine the direction of the call by turning the apparatus as if he were turning his head in the direction of a person speaking to him.

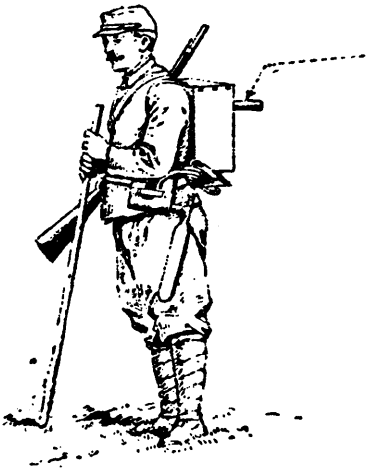


FIG. 9.

In the listening apparatus of the *small station* the two trumpets are connected by a rigid frame. The total weight is less than 4 kilograms. The apparatus may be carried on the back by means of shoulder straps (fig. 5).

The listening apparatus is fitted with a socket, by means of which it may be mounted on an iron pointed stick (fig. 7).

The trumpets used in large stations are demountable and may be packed in a case which can be carried by two men like a stretcher. It can pass through any communication trench.

NOTE 1.—When it is possible to obtain *Sagnac* interferential sound magnifiers, these instruments may be used to great advantage in the large stations. As regards the determination of the direction of the sound perceived, it should be observed that with these magnifiers the sensation of right and left can not be recognized, but that the sound perceived is louder when they are turned in the right direction.

The weight (case included) is about 80 kilograms.

NOTE 2.—This weight will later be reduced to about 50 kilograms.

The lid of the case, when turned back, is fitted with a socket, in which the trumpet support may be adjusted. The apparatus may be easily turned on this axle. A graduation in mils gives the angles of rotation.

MATERIAL OF THE STATIONS.

A. *Small station.*—A small station includes:

For calling, an ordinary bugle (preferably a periscope bugle), a sending box, an iron-pointed stick, 5 bottles, each containing

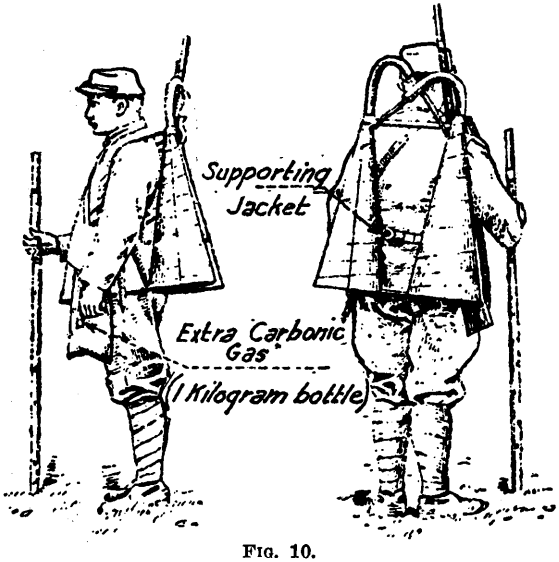


FIG. 10.

200 grams of carbonic acid, a reserve of 1,000 grams of the same gas, and a steelyard for measuring the quantity of carbonic acid remaining in a bottle.

NOTE 1.—These two kilograms of carbonic acid enable an expert operator to send about 1,000 emissions.

For listening, two trumpets with tubes to be adjusted to the ears, and an iron-pointed stick.

In addition to these essential parts, which may easily be carried by two men without leaving their gun, it is a good plan to

have an air compressor with reservoir. These accessories necessitates the assignment of two extra men to a station.

Figures 6 and 7 each show one of the apparatus of a small station; the sender (carbonic acid) and the receiver, during operation.

B. *Large station.*—A large station includes:

For calling, a sending box with tripod, a 10-kilogram bottle of carbonic acid, and a similar bottle in reserve.

NOTE 2.—A 10-kilogram bottle will supply about 5,000 emissions. The amount assigned to a large station will therefore supply about 10,000 emissions.

For listening, a listening case containing the trumpets and accompanying material, and device for measuring the angles.

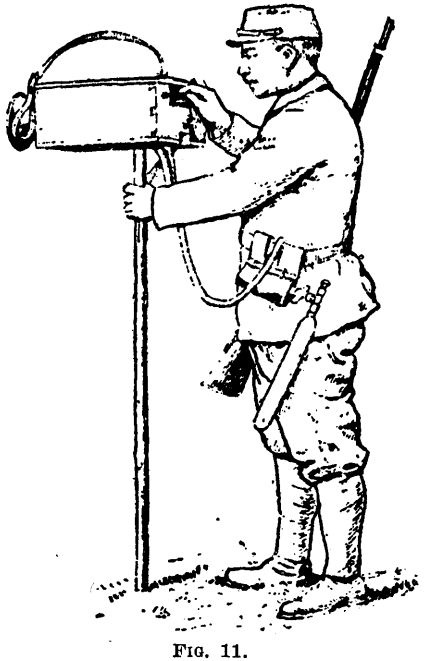


FIG. 11.

GENERAL REMARKS ON THE DIRECTIONS FOR USING SOUND LIAISON APPARATUS.

Sending.—(1) *Always turn* the bugle or sending box *toward* the district in which you wish to be heard.

(2) When calling a station 4 or 5 kilometers away, *do not forget that sound requires about 30 seconds to go and return.* In order to avoid confusion in your own listening apparatus by the deafening sounds emitted it is best to proceed as follows:

Send the signal required, consisting of four to six "dots" or "dashes." *Wait about one-half minute,* then *repeat* the signal which, in this way, will have a chance of being received (the first signal having attracted attention).

Wait two minutes in order to give the signal "understood" or any other signal time to arrive, and *to enable the carbonic acid to warm again.* Then begin again, if necessary, in the same way.

Do not send more than six consecutive sounds (each of one second duration with an interval of one second). Then wait about one-half minute before repeating the signal. After a group of two or three signals spaced in this way, wait several minutes,



FIG. 12.

if possible. Do not rely *entirely* on the cock of the box, but *close the cock of the bottle carefully after each signal.* In short, give each sound its full strength, but at the same time *use the carbonic acid sparingly.* (If the emissions are too rapid, the carbonic acid will congeal and a long rest will be required.) The steelyard makes it possible to determine within about 50 grams the quantity of carbonic acid remaining in a bottle.

Receiving.—The immediate vicinity of the listening apparatus must be kept as quiet as circumstances will allow. In the neigh-

borhood of a large apparatus, especially if a call is sent from a distance of more than 5 or 6 kilometers is to be perceived, avoid all talking, and, as far as practicable, all stray noises. When listening, assume as comfortable a position as possible; when a man is not comfortable he can not hear so well.

When circumstances permit, *elevate the listening apparatus.* Sounds increase in intensity when they are higher from the ground.

NOTE.—A listening apparatus in a captive balloon appears able to give good results.

Supply.—Supplies are furnished by the army engineer parks, to which material is sent from the central establishment of special engineer material, 39, rue de Bellechasse, Paris.

Empty carbonic-acid bottles will be returned to the above establishment to be refilled unless there is a local supply.

CHAPTER III.

INSTRUCTION ON MATERIAL FOR SOUND SIGNALING.

[Plan.]

The sound-signaling apparatus (S. A. apparatus) makes it possible to send sound signals strong enough to be heard at fairly great distances, in spite of the noise of guns, on the battle field.

The distance at which these signals can be heard varies with the atmospheric conditions; the minimum, however great may be the noise of the battle, appears to be 500 meters.

I. DESCRIPTION OF MATERIAL S. A., MODEL B.

The S. A., model B, apparatus is an assemblage of two mechanical bugles, a bottle of liquid carbonic acid used to operate the trumpets, and certain accessories consisting of cocks and valves.

Bugles.—The mechanical bugles are instruments with circular, vibrating reeds, which are operated by carbonic-acid gas under a pressure of 2.5 kilograms. The dimensions of the reeds and mouths are so regulated that the bugles give the notes sol_3 and si_3, respectively. These two notes are utilized in the organization of sound signals, the study of which will be taken up later.

Bottle of carbonic acid.—The carbonic-acid bottle is made of steel. With its plug cock it weighs 2.8 kilograms when empty. It is delivered with 1 kilogram of carbonic acid; this quantity is sufficient to send 200 sound notes of one second duration.

The plug is very easily operated. There is a special hood to protect the cock, so that it will not open by accident during transportation.

Accessories.—In order to reduce the carbonic-acid gas to the pressure of 2.5 kilograms it is made to pass through a regulator as soon as it is let out of the bottle. A flexible rubber tube passes the gas from the regulator to the trumpets; the intakes are closed by two metal valves.

The bugles are operated either by moving the valve levers by hand or by using the *controlling cords*, which may be made as long as desired, in order to enable the signaller to *get under cover* or even to stay *in a shelter*. Both bugles may be operated simultaneously.

Details of assemblage.—The frame-work of the apparatus consists of a wooden box of practically the same shape and dimensions as a knapsack. The bugles are fastened to the inside of this box. The bottle is held in a *circular support* of aluminum which is fastened to the left side of the box by a rod around which it can turn. The regulator is screwed to the bottle by a special *wing screw*. The two ends of the flexible tube are permanently attached to the regulator and to the bugles. The box has four aluminum legs which are used to set it up on the ground for operation. When it is carried, the legs are folded back on the box; the bottle is placed lengthwise on the box and is held in place by securing the regulator in a *regulator holder* which is fastened to the front lid of the box. There are handles by which the box may be carried by hand, and two knapsack straps by which it may be carried on the back. The total weight of the signalling apparatus with a full bottle is 10 kilograms.

Bottle carrier.—The sound signalling material includes, in addition to the apparatus described above, a *bottle carrier* arranged to carry two extra bottles of carbonic acid.

Bottle carrier, model B, consists of a frame with holders for two bottles and a small bag of heavy canvas. Like the S. A. apparatus it is provided with a handle and two knapsack straps. Its total weight with two full bottles is 9.5 kilograms.

Fig. 1 shows a signaller carrying his signalling apparatus; fig. 2 shows the apparatus while in operation, and fig. 3 shows the bottle carrier.

II. MOUNTING, DISMOUNTING, AND OPERATION.

Signallers should be trained to the *following:*

TO ADJUST THE APPARATUS FOR OPERATION.

This should be done in a few seconds, as there are no extra parts to be put in place.

Unfold the legs and place the apparatus on the ground, *turning* it carefully in the direction of the correspondent.

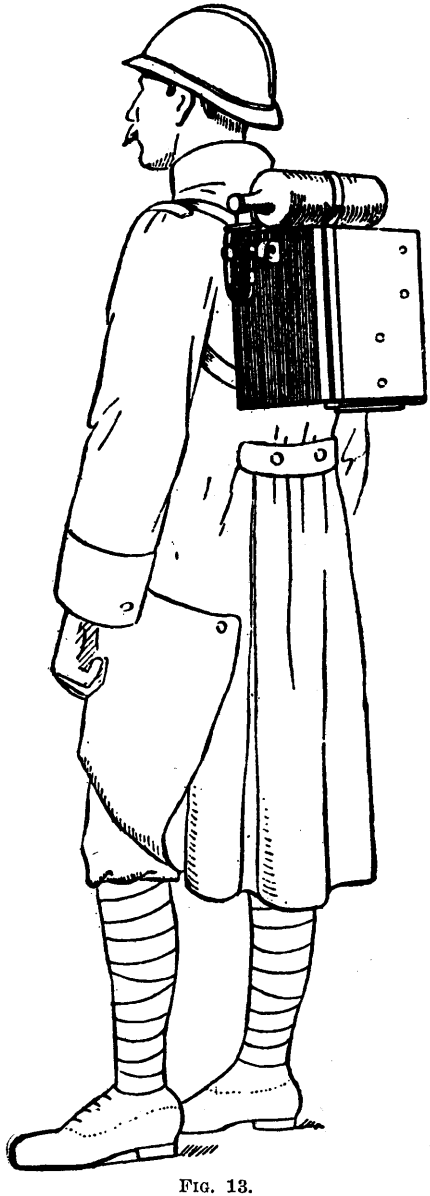


FIG. 13.

Unscrew slightly the tightening screw of the *regulator holder*, and turn the bottle up until it is practically vertical.

Let the front lid of the box down so as to completely uncover the mouths of the bugles.

Open the back lid of the box and take out the controlling cords.

The signals may then be sent. For this purpose slightly unscrew the plug and operate the bugles.

When the signals have been sent, never forget to screw the plug back tight.

TO PREPARE THE APPARATUS FOR TRANSPORTATION.

See that the plug of the bottle is screwed tight; put the little cover over the cock.

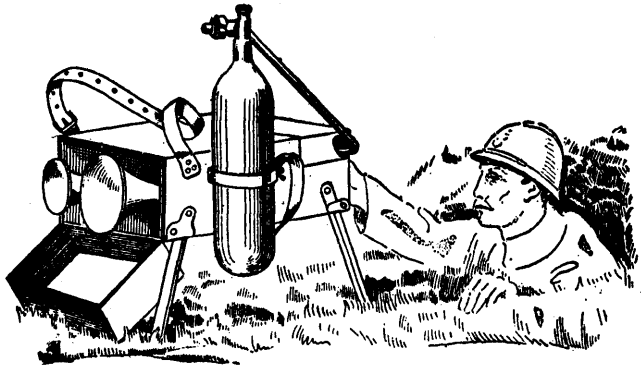


FIG. 14.

Close the front and back lids of the box after having put the cords and the lever in place.

Turn the bottle, place the arm of the regulator in the regulator holder and tighten the screw of the latter.

Fold back the legs of the box.

TO REMOVE THE BOTTLE OF CARBONIC ACID.

Set the box up on its legs and place the bottle in a vertical position.

Separate the ⊔-shaped end of the rubber tube from the regulator by unscrewing the joint which holds them together.

Separate the regulator from the bottle by turning the regulator itself rather than the wing screw.

Open the bottle-support by turning the pivot-clamping screw which holds the bottle.

TO SET UP A BOTTLE OF CARBONIC ACID.

When the bottle has been placed in a vertical position, first join the regulator to the bottle by giving four turns to the wing screw without turning the regulator itself; then turn the latter as far as it will go into its screw. Then try turning the wing screw in order to obtain the following result: When the regulator has been screwed tight the disk of the regulator will be in a vertical position, and if the bottle is held in the left hand, with the regulator to the right, the small exterior hexagonal nut will be facing you (see fig. 4).

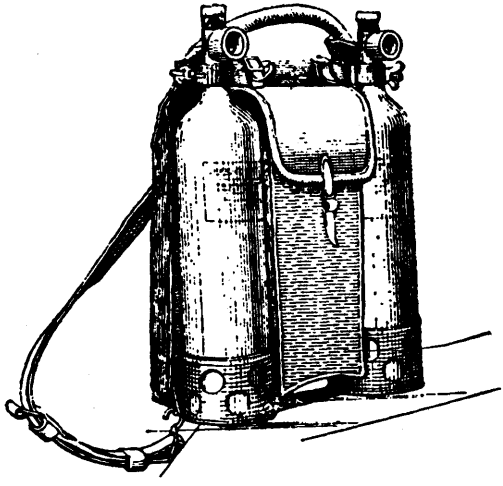


FIG. 15.

Place the bottle in the open bottle support and slide it in until the arm of the regulator can be placed in the regulator holder. Then tighten the pivot screw of the bottle support, that of the regulator holder, and join the ⊔-shaped end of the flexible tube to the regulator.

TO ASCERTAIN THE AMOUNT OF CARBONIC ACID CONTAINED IN A BOTTLE.

It is very necessary to be able to know at a given time whether a bottle is empty, or what weight of carbonic acid it still contains. In order to know whether a bottle still contains gas, do not unscrew the plug unless it has a regulator. You would run the risk of not being able to close it again on account of the formation of small icicles, and the entire contents would escape. The bag of the bottle carrier contains a specially graduated scale. By using these scales it is possible to ascertain almost exactly the quantity of carbonic acid contained in a bottle at a given time. The exact weight of each empty bottle is engraved on a copper plate soldered to the bottle itself.

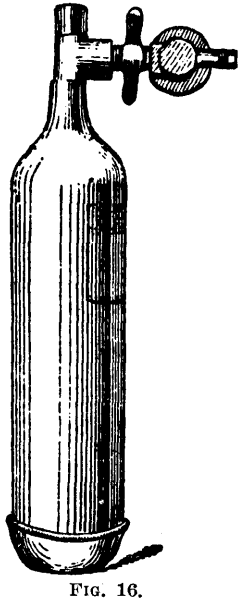


FIG. 16.

III. SENDING OF SIGNALS.

Sound signals are exclusively conventional signals consisting of letters and figures of the Morse code. It has been agreed that the *dash* of the Morse code should be represented by the *low* note of the S. A. apparatus and the *dot* by the *high*. A dot or a dash are therefore of the same duration—about one second. Each signal is a series of sounds separated by silences of about half a second; a telegram consists of one or more signals separated by longer silences (two seconds).

A sound-signalling station consists of two men, one carrying the signalling apparatus, the other the bottle carrier. These men must be familiar with the operation, setting up, and taking down of their material and with the special service rules concerning sound signalling. The service rules for the system of sound stations of a division are given hereafter. During operations, the most important things to be sent are telegrams from the advanced line, giving brief information about the advance, or containing extremely urgent requests concerning the artillery.

Whatever arrangements are made in each case, the signallers must always observe the following general rules:

GENERAL RULES.

(1) Each telegram must be repeated three times at least, with intervals of at least 20 seconds.

(2) A sound station must repeat accurately toward the rear any telegram heard from the front.

(3) If the signalman carrying the S. A. apparatus is put out of commission, his comrade leaves the bottle carrier, takes charge of the apparatus, and goes on with the service, after having replaced the bottle of carbonic acid, if necessary.

IV. ORGANIZATION OF SOUND LIAISON IN A DIVISION DURING OPERATIONS.

As a general rule, signal material is not allotted to units permanently. Material may be distributed by a special order from headquarters to the divisions which are to take part in the operations.

The parties of signalers are, generally speaking, the agents of the regiment; their minimum number is four per regiment, with two men to a party. Each regimental commander must make use of his sound stations during the advance, so as to maintain liaison with the most advanced line. A certain number of stations will thus be assigned as relay stations, the distance of one station from its correspondent not exceeding 500 meters.

V. SERVICE RULES.

As a general rule each regiment has an identification signal. In cases of emergency identification signals may be given to smaller units which have been intrusted with special missions. In any case, the identification signals should be chosen among the Morse letters of two or three sounds, such as:

a . — n — . d — . . r . — .
u . . — k — . — , etc.

It is essential for the identification signals to contain at the same time at least one dot and one dash so that the ear may clearly distinguish the two sounds during the message which is to follow.

These identification signals are determined by the order of operations.

The conventional signals to be used are generally the following:

O — — —	"Request for artillery fire."
H	"Extend the fire; we are going to advance."
S . . .	"Extend the fire; our artillery is firing on us."
Y — . — —	"Send ammunition."
Z — — . .	"Objective reached."

In the troops all the officers and noncommissioned officers must be informed of their identification signal and the operation signals. They must be able to recognize them by ear.

TRANSMISSION OF A TELEGRAM.

The signaler first attracts attention by sending a long loud call operating both bugles simultaneously.

He then sends the telegram.

The object of a telegram is to call for a definite operation for the benefit of a given unit or to make known that this unit has reached a given objective. Example: "Barrage fire for battalion D;" "Regiment U has reached second objective."

Consequently the telegram will contain: (1) The identification signal of the unit concerned; (2) the conventional signal required; (3) in the case of the signal "Objective reached," the number of the objective should be added.

Examples.

"Barrage fire for battalion D"	**D O.**
"Regiment U has reached second objective"	**U Z 2.**

Whenever a sound station begins to operate it gives warning to all the liaison agencies in its vicinity. The latter must forward the information (or the request) they have heard to the rear by every means in their power.

LARGE LISTENING APPARATUS.

Powerful listening horns may be installed at the rear, with listeners *sheltered* and provided with telephone communication. When this installation is possible signals from the front may be received at a distance of several kilometers and may thus be utilized without delay.

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