# ROYAL NEW ZEALAND AIR FORCE.

## EDUCATIONAL SERVICES.

### AIRMEN-PILOTS, AIR-OBSERVERS, AND AIR-GUNNERS.

1234

## *BROADCAST COURSE IN MORSE SIGNALLING.*

WELLINGTON, N.Z.
E. V. PAUL, Government Printer.
—
1941.

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## PREFACE.

SINCE the beginning of June, 1940, men selected for the air crew have been given instruction in Morse signalling concurrently with their preliminary educational training. In every one of the large centres classes in Morse signalling have been established, the instructors in almost every case being officers of the Post and Telegraph Department.

The problem of men in the country was solved with the helpful co-operation of the National Broadcasting Service. A series of lessons in Morse signalling was worked out and the necessary instructions given over the air. At the present time Stations 1ZM, 2YC, and 3YL are being used for the purpose. The course which follows is a course of twenty weeks' duration, and the series of twenty lessons represents the lessons which are broadcast weekly for the benefit of Air Force trainees in country districts. As soon as one course finishes another begins.

This course of lessons has been compiled by the officers of the Post and Telegraph Department who are responsible for the broadcast-signalling instruction. A study of the lessons themselves is sufficient evidence of the thorough and complete manner in which this course has been worked out, and I should like to express my appreciation of the work which has been done in this connection by the officers of the Post and Telegraph Department.

As far as I am aware no similar course of broadcast signalling instruction is in operation anywhere else in the world.

E. CARADUS,
Director of Educational Services.

R.N.Z.A.F. Educational Services,
Private Bag, Wellington C. 1.

CIRCULAR MEMORANDUM:

*Men on Correspondence.*

THIS course has been designed primarily for men on correspondence courses who are unable to attend classes in Morse signalling.

Included in the course is a copy of the Morse code, which you should mount on a sheet of cardboard and memorize immediately on receipt of this pamphlet. Instructions, too, for the construction of a simple key and buzzer are included for the benefit of those trainees who are unable to obtain ready-made instruments. As proficiency without these instruments will be difficult to attain and your rate of progress will be slower, it is stressed that every effort should be made to have some type of key and buzzer for the necessary practice.

You should listen in regularly and practise daily. Send in each test to the Director, Educational Services. They will be marked and sent back to you so that you will be able to gauge your progress and to note any special difficulties.

Though you are listening to the broadcasts and sending in tests you should at the same time, if possible, get in touch with the local Postmaster, who may be able to help you with this work.

Read each lesson through before the actual broadcast, and immediately after, so that the points stressed by the Instructor will be more firmly fixed in your mind. If necessary, mark in your book any sections which are particularly stressed during the broadcast or which may cause you any difficulty.

*Name:* J. E. Mc. Gaughran

*Course:* G. K.

*Stations:* 2YC, 1ZM, 3YA.

*Days of Broadcast:* Wed. Thurs. (17th Sept.)

*Time of Broadcast:* 6.35 — 7 p.m.

Tear off and mount on cardboard for handy reference.

# ROYAL NEW ZEALAND AIR FORCE.
## EDUCATIONAL SERVICES.

# BROADCAST COURSE IN MORSE SIGNALLING.

### LESSON 1.

**Learning the Code.**

When learning the Morse code it is important to distinguish between dots and dashes—that is, a dot or a dash must always be properly characterized. A dash should be three times as long as a dot. Beginners commonly make the mistake of "holding the dots"—not making dots at all, but a series of long and short dashes.

A dot is made by one quick, sharp touch of the key. A dash should never be made longer than the time required to make three quick dots.

The secret of good operating is in the spacing between letters and words but there should be no spacing between dots and dashes which make up an individual letter.

For example, take the letter "A." It consists of a dot and a dash. Phonetically it is pronounced as "Dit-Dah"; dit for the dot and dah for the dash. Thus the letter "A" becomes "Dit-Dah," not "Dot-Dash."

By repeating the phonetic sounds the letters soon become firmly fixed in the mind.

During mental repetition no pause should be made between the "Dit" and the "Dah"; the two must roll smoothly into each other, thus "Ditdah." One of the greatest mistakes made by learners is permitting a pause to come between the "Dit" and the "Dah." As a further illustration take the letter "B," which consists of a dash and three dots. There must be no spacing between the dash and the three dots. It is "Dahditditdit." Now, if a space is permitted to come between the dah and the three dits, the code character will have the form of the letters "TS" instead of "B."

Some learners will adapt themselves more readily than others to this method of signalling and their progress will naturally be rapid. The rate of progress depends entirely upon the degree of application.

**Manipulation of the Key.**

It is most important that the telegraph key be held and manipulated correctly.

In effect, the telegraph key is a metal lever which is pivoted so that pressure on the mushroom-shaped knob causes contact to be made between two contact points. A short contact forms a dot (or dit) and a longer contact a dash (or dah). A Morse key is not absolutely necessary at the commencement of practice. A fairly good substitute will be found in an ordinary

table. While in a comfortable sitting position and using your right hand let the thumb rest lightly under the table top and the tips of the first and second fingers on the top of the table. The third and little fingers will fall into a natural relaxed position. Do not grip the table tightly, but just exert sufficient pressure to prevent your fingers from slipping. For example, apply the same pressure as you would in holding a pen or a pencil. The grip on the key or table-top should always remain light and flexible. The thumb acts more or less as a guide, whilst the first and second figners serve to convey wrist movement to the key. A tight grip becomes very tiring and also prevents the attainment of rhythm and speed. The whole hand and the wrist must remain semi-relaxed at all times.

The forearm to the point of the elbow should be in line with and on the same level as the lever of the key with the upper arm held fairly close to the side of the body. The back of the hand should be in a position to allow of unrestricted vertical movement of the wrist. The importance of a vertical wrist action cannot be overemphasized. A diagonal movement of the wrist would cause incorrect formation of the Morse characters.

If the correct position of the hand is observed, vertical wrist movement will result and no difficulty should be experienced in transmitting clear, readable Morse.

Try a little wrist work. Slowly send a succession of dots. Merely move the wrist up and down trying at the same time to exert the same pressure on the key with each downward movement. Remember dots are being sent, not a mixture of dots and dashes. Now try a few more dots a little faster, this time watching your wrist action. Unconsciously you may be gripping the key a little tighter and consequently restricting the movement of the wrist. Relax your grip and carry on with the dots. Endeavour to obtain rhythm. This means that all dots should be of the same relative length and spacing.

Now send a word which is made up of dots only. Write down the word "SISSIE" in block letters.

S is three dots;
I is two dots;
S is three dots;
S is three dots;
I is two dots; and
E is one dot.

It is sent as follows: ditditdit ditdit ditditdit ditditdit ditdit dit. Try sending it a few times and endeavour to correct any little fault you may notice. For instance, you may be sending R for S, or N for I. This is probably due to faulty wrist action and a tight grip. Watch your wrist as you send and try to maintain a uniform up-and-down movement.

Now try a sentence comprised of all dots. "She is his sissie." It is sent as follows:—

"SHE" ditditdit ditditditdit dit
"IS" ditdit ditditdit
"HIS" ditditditdit ditdit ditditdit
"SISSIE" ditditdit ditdit ditditdit ditditdit ditdit dit

This is a good sentence for practice purposes. Send it a few times each day and adapt the speed of your sending to the stage of your advancement. At this stage of your training you must concentrate on quality. The spacing between words should be pronounced.



Now try a few dashes. As pointed out earlier, a dash is three times the length of a dot. This does not mean, however, that you have to press the key with three times the pressure you exert to transmit a dot. The same pressure will do. Should you have a tendency to trip tightly on the downward movement of the wrist, you must endeavour to overcome it.

For further practice on dashes try the letter "M," which is comprised of two dashes.

In this the first lesson an endeavour has been made to illustrate how you should hold and manipulate the Morse key, and it is suggested that you mould your style accordingly. Those who have already commenced practising are recommended to check up on their style, and, if necessary, revise it so as to conform with the method outlined herein.

Receiving practice comprises the remainder of the lesson.

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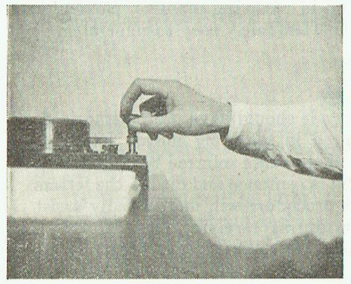
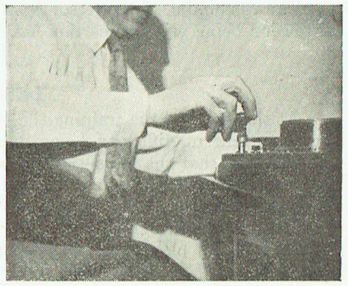
## KEY-MANIPULATION.

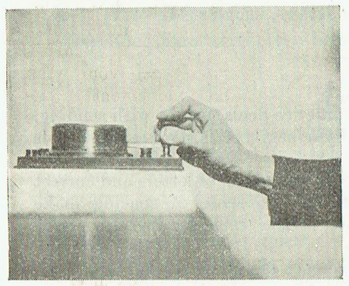
### The Right Way.

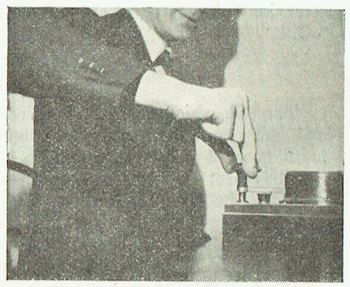




NOTE.—First and second fingers on top of the key; thumb under knob of key; third and fourth fingers in natural relaxed position; arm and wrist on a level with the key-lever.

### The Wrong Way.





NOTE.—Key is gripped—the muscle strain is clearly noticeable. Operating the key from either of the above positions would be extremely awkward and would result not only in a cramped style, but in faulty formation of the Morse characters.

## LESSON 2.

**Lesson 2 is devoted mainly to receiving.**

Those trainees who own short-wave radio receivers should be able to obtain plenty of receiving practice, but for the benefit of the others more and more time will be devoted each session to receiving so that every one will be able to gain a certain amount of receiving practice each day.

It is stressed that the habit should be formed of impressing the sound equivalents of the letters on the mind rather than endeavouring to remember the letters as dots and dashes. As an example, the letter " C " should instinctively come to mind as " dahditdahdit " not as " dashdotdashdot." It is the sound of each letter that should be memorized.

**Revision of Correct Method of Holding the Key.**

Thumb under table-top or knob of key, tops of first and second fingers resting lightly on top of table or key-knob, and, most important of all, a light grip so that the arm-muscles are relaxed.

In order to assist trainees in the formation of the Morse characters for each letter the Instructor will transmit each letter of the alphabet twice.

The remainder of the lesson is taken up in receiving practice, particular attention being given to certain letters which are fairly easy to remember.

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## LESSON 3.

At this stage of the training the Morse code should have been memorized. In the event of difficulty being experienced in receiving certain letters it is suggested that the phonetic method of memorizing referred to in Lesson 2 be persisted in. Take a word or, better still, a sentence and ditdah the letters over in your mind. The adoption of this procedure will undoubtedly assist you in quickly recognizing the characters during receiving practice.

You should be able to set aside ten or fifteen minutes daily for sending practice.

**Summary of Rules for Sending.**

A relaxed grip.
Free vertical wrist action.
Send slowly, concentrating on the correct formation of the letters.

The remainder of the lesson is taken up in receiving practice, particular attention being given to the more difficult letters, such as " L," " F," " X," " Q," " Z," " C," " Y," &c.

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## LESSON 4.

The talk which precedes the receiving practice deals mainly with sending, and one very bad habit easily acquired by a beginner is illustrated. This habit is what is called " Clipping."

The secret of good sending is in the correct formation of letters and correct spacing. Poorly-formed letters together with no sense of spacing make reception not only difficult, but exhausting to the receiving operator. The following four main points are stressed :—

(1) A dot is made with one sharp movement of the key :
(2) A dash is three times as long as a dot :
(3) A space between each letter is the time normally occupied in sending a dot :
(4) A space between each word is the time normally occupied in sending a dash.



In regard to clipping, this is the shortening of dashes, particularly the final one of letters ending in a dash. In other words, the last dash is not given its full value. This is due to a desire to increase speed by getting to the next letter as quickly as possible. This can, in most cases, be traced to the beginner stages where the learner has tried to send at a much greater speed than he is capable of receiving, with the result that the quality of his sending has suffered and bad habits have been acquired. One of these faults, known as " clipping," results in such letters as " O " being sent as " G," " K " as " D," " W " as " R," " Y " as " C," &c. A few instances are then illustrated by the instructor, and it is pointed out that the remedy for this fault is to " *Hold your Dashes.*" It is also mentioned that when receiving from a clipping sender an experienced operator can copy plain language by reading a word or two behind and thus following the sense of the message, but after a time this procedure became tiring. The receiving operator should be able to read the signals subconsciously. In code, however, the receiving operator has no chance whatever of copying correctly from a clipping sender. Should he endeavour to do so, the result will be errors, and this, of course, must be avoided.

The rest of the lesson is taken up in a preliminary practice for the test which takes place during the next lesson, and in receiving practice in plain language.

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## LESSON 5.

The first receiving test is given during this lesson. The test comprises twenty-four groups of five letters, and the following instructions should be followed :—

(1) Writing should be in block letters :
(2) The test will not include figures :
(3) If any letter is not received, the space should be left empty in order that the letters actually received may be entered in the right spaces :
(4) Before sending each line, " Line 1," " Line 2," and so on, will be announced :
(5) Air Force trainees are requested on completion of the test to fill in other details on the test form and post it immediately to the Director, Educational Services, R.N.Z.A.F., Private Bag, Wellington C. 1.

Receiving practice is given before and after the test.

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## LESSON 6.

The talk which precedes the receiving practice deals with another very bad habit easily acquired by a beginner. This habit is known as " rolling "; and, briefly explained, the fault is the result of a squaring or thickening of the second-last dot in certain letters. Thus these dots are given an incorrect value. As an example, instead of sending • • • • for the letter " H," the rolling sender would signal • • ▬ • which, of course, is " F," not " H." Other letters which rolling senders frequently misform are " L " and " S."

It is difficult to explain just how the habit is first formed. Possibly a tight grip is the primary cause, and a tendency to develop a diagonal or swinging movement of the wrist instead of the vertical wrist-action referred to frequently in previous lessons as the correct one.

The position of the hand on the key is most important. If the hand is allowed to roll to either side when sending, a uniform vertical wrist-action cannot be acquired. The back of the hand must remain parallel with the top of the table at all times. The position of the hand should be watched whilst sending. In addition, a loose comfortable key-grip should be cultivated.

**Figures.**

For each figure five characters are used, and these are easy to memorize if the sound equivalents are concentrated upon. First, take the figures 1 to 5. They are—

1 ·————
2 ··———
3 ···——
4 ····—
5 ·····

It will be noticed that the number of dots indicate the figure concerned.

Now the figures 6 to 0—

6 —····
7 ——···
8 ———··
9 ————·
0 —————

It will be seen that the characters for these five figures are exactly the opposite of the first five.

The remainder of the lesson is taken up with receiving practice consisting of jumbled letters, figures, and plain language.

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## LESSON 7.

The talk which precedes the receiving practice deals with two further common faults in sending. These are the faulty formation of letters and the lack of proper spacing between letters.

**Incorrect Formation of Letters.**

The most common letters sent incorrectly are "L," "C," "Y," and "K." The correct formation of the letter "L" is illustrated. The manner in which it is often incorrectly signalled is shown, and the result of the incorrect formation is the transmission of the letters "AI" for "L." Similarly, "C" badly spaced becomes "NN" and "Y," "TW." Many other letters are split in this manner, and the fault is one which frequently leads to errors. In nearly all cases the pause or split in the formation of the letter is made when a dot follows a dash. The cause of this pause is due to the fact that it is necessary to bring the wrist to the upward position to send the dot. If a slow-motion picture were made of the wrist-action of a good morse sender it would be noticed that each character of every letter is made with the wrist descending. Taking the letter "L" as an example—there is a sharp movement of the wrist to form the dot, after which the wrist returns to the original position; then follows a downward movement to form the dash, which is held by the fingers as the wrist recovers to make the necessary two sharp movements to complete the letter. More often than not split letters occur as a result of the dash not being held with the fingers.



**Incorrect Spacing.**

The other fault is the lack of spacing between letters. As an instance consider the word "And." The omission of the proper spacing between the letters which make up this word often results in the signalling of "PD." Further examples, the word "Troops" is often sent as "Coops," and the word "True" as "CF." Many further instances could be illustrated. The fault is an endeavour to obtain speed. Speed should not be tried for in this manner; it will come of its own accord.

The remainder of the lesson is taken up with receiving practice consisting of jumbled letters, figures, and plain language.

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## LESSON 8.

**Revision of Correct Method of Holding the Key.**

While in a comfortable sitting position, and using the right hand, let the thumb rest lightly under the knob of the key and place the tips of the first and second fingers on the key-knob.

Don't grip the key, just exert sufficient pressure to prevent the fingers from slipping.

The forearm to the point of the elbow should be in line with and on the same level as the lever of the key.

The upper arm should be fairly close to the side of the body.

The back of the hand should be in a position to allow of an unrestricted vertical movement of the wrist.

It should be remembered that in order to ensure that the arm-muscles are in a relaxed position a light key grip must be employed.

*Remember:* You should practise sending for at least fifteen minutes daily.

The rest of the lesson is taken up in receiving, practice being given in jumbled letters, figures, and plain language.

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## LESSON 9.

**Difficult Letters.**

At this stage there are probably some trainees who are finding difficulty in recognizing certain letters, particularly "J," "Q," "X," "F," "L," "C," "Y," and "Z." You should ditdah these letters over in the mind at every available opportunity, like this:

Q dahdahditdah, F ditditdahdit.

This phonetic method of memorizing was stressed in earlier lessons, and it should be kept on with; even going so far as to include phrases in the procedure.

The speed of sending at this stage will be increased slightly, the reason being that it is only by endeavouring to read signals a little faster than one can comfortably receive that increased speed will come.

The rest of the lesson is taken up in a preliminary practice for the second test, which will take place during the next lesson.

In addition practice is given in jumbled letters, figures, and plain language.

## LESSON 10.

**Second Test.**

The test comprises twenty-four groups of five letters, and the following instructions should be noted :—

(1) Writing should be in block letters :
(2) The test will not include figures :
(3) If any letter is not received the space should be left empty in order that the letters actually received may be entered in the right spaces :
(4) Before sending each line, " Line 1," " Line 2," and so on, will be announced :
(5) Air Force trainees are requested on completion of the test to fill in other details on their test form and post the form immediately to the Director, Educational Services, R.N.Z.A.F., Private Bag, Wellington C. 1.

Receiving practice is given before and after the test.

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## LESSON 11.

As personal supervision of the progress of the trainees in sending cannot be given it is not possible for little faults which may be developing to be corrected. Trainees should keep rigidly to the methods outlined in previous lessons. Most important of all, the correct keying position must be maintained at all times.

**Here are some DON'TS :**

Don't grip the key—just use a light pressure.
Don't let your fingers wander all over the knob of the key.
Don't run your letters or words together.
Don't clip the last dashes of letters.
Don't split the characters of a letter.
Don't try to send too fast.

**Here are some points to REMEMBER :**

Always keep your forearm at the same level as the key-lever.
Try at all times to keep your arm-muscles relaxed.
Endeavour to develop rhythm.
A free vertical wrist action is essential.

Receiving practice in jumbled letters, figures, and plain language comprises the remainder of the lesson.

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## LESSON 12.

Trainees have now reached the stage where a good style in sending should have been developed. Remember the necessity of adopting the correct keying position, of relaxing, and of observing a vertical action of the wrist and the forming of good Morse characters.

You are advised to concentrate on style and quality and to correct any faults that may be noticed in your method of keying.

This lesson is devoted mainly to receiving, practice being given in figures, jumbled letters, and plain language.



## LESSON 13.

**Wrist Fatigue.**

Before commencing sending, a trial should be made of moving the hand backwards and forwards with a circular motion for a minute or two. This action should help to loosen up the muscles. Remember that, while sending, the forearm should be on a plane approximately parallel with the table so that the arm is neither above nor below the level. The arm should at all times be held fairly close to the side of the body. The keeping of the muscles relaxed will also help to overcome any fatigue.

The remainder of the lesson is taken up in receiving practice.

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## LESSON 14.

You should not become disheartened about the progress in operating that you are making. The only way to attain speed is to practise assiduously, and it is dependent upon your becoming familiar with the sound of each individual letter. Certain letters such as " C," " Z," " Y," " Q," &c., are somewhat difficult to the beginner, and as each letter has its own distinctive sound you should try to associate the particular sound with the letter it represents. No doubt you are already able to pick out small words such as " the," " in," " and," &c., from some of the slower transmissions heard on short-wave receivers. This is due to your becoming more conversant with what may be regarded as a new language.

You may be experiencing trouble with figures, but remember that the transmission of these did not commence until Lesson 6 and consequently you have not had much practice with them. Each figure, as with each letter, has its own distinctive sound, and that sound has to be associated with the particular figure immediately it is heard.

A preliminary practice is given for the test which takes place during the next lesson. Receiving practice in figures and plain language is given also.

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## LESSON 15.

**Third Test.**

The test comprises twenty-four groups of five letters, and the following instructions should be noted :—

(1) Writing should be in block letters :
(2) The test does not include figures :
(3) If any letter is not received the space should be left empty in order that the letters actually received may be entered in the correct spaces :
(4) Before sending each line, " Line 1," " Line 2," and so on, will be announced :
(5) Air Force trainees are requested on completion of the test to fill in other details on their test form and post the form immediately to the Director, Educational Services, R.N.Z.A.F., Private Bag, Wellington C. 1.

Receiving practice is given before and after the test.

## LESSON 16.

In previous lessons an endeavour has been made to give instruction in regard to the correct manner of holding the key, how to send correctly, and what faults to avoid. As it is not possible under the radio-broadcasting method of tuition for Instructors to personally watch trainees sending and correct faults, it is necessary to repeat again the method of sending which is regarded by the Instructors as the correct one. This is as follows :—

Sit slightly to the left of the key so that the hand will fall naturally on to the key knob. Rest the first and second fingers lightly on the knob of the key with the thumb pressing lightly on the inside of the knob. The third and fourth fingers will fall into a naturally relaxed position. The forearm should be in line with the key-lever and level with the knob of the key. The upper arm should be at an angle of 45 degrees with the body, and the elbow about 6 in. from the side of the body. The first and second fingers should be bent at the knuckles forming a convex figure. These fingers must never be lifted from the key-knob when sending ; otherwise a tapping style of operating will result, causing poorly formed dots and a loss of rhythm.

**Just a few " DON'TS."**

Don't grip the key. Always practise with the arm, wrist, and hand muscles relaxed. If the arm tires quickly (say, after sending for five or ten minutes), then something is wrong with the method of holding the key and it should be corrected.

Don't send fast until capable of doing so. Fast sending in the early stages of learning only tends to develop bad habits, such as clipping, stumbling, and bad spacing.

Don't rest the elbow on the table, as this tends to reduce the flexibility of the wrist and forearm.

In order to overcome any difficulty that may be experienced in spacing uniformly between words the following procedure is suggested. Try removing the hand from the key and lightly touching the table beside the key after each word is sent. This procedure will give uniform spacing between words and may be of assistance.

The remainder of the lesson is taken up in receiving practice, jumbled letters, figures, and plain language being transmitted.

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## LESSON 17.

In the last few lessons plenty of receiving practice has been given because this is the only way in which reception speed will be increased. More practice than is given by the weekly broadcasts is required and you should obtain another half-hour at least daily.

If possible trainees should practise together. An ideal method of increasing speed is to copy some of the slower transmissions heard on radio receivers, and although a little difficulty may be experienced at first in reading these signals the results later on will be well worth while. Endeavour to pick out a station which is sending slightly faster than you are able to receive comfortably. Although many letters or even groups of two or three words may be missed at first, do not become disheartened. Keep at it, and eventually it will be found that the whole of the transmissions can be copied. When this stage is reached select another station which is sending a little faster, and so on.



There is, of course, the other method mentioned in earlier lessons of ditdahing words over in the mind on every opportunity by spelling off as Morse symbols the letters appearing on advertisement hoardings, &c. If this is done constantly the alphabetical signs will very quickly become groups of phonetic sounds.

By working towards the rapid and rhythmic conversion of letters into the Morse sound equivalents you should find that your speed in transmission and reception will increase daily. Consistent practice is, however, essential. Don't do two hours practice on one day, one hour the next day, and call it three hours for the week. It is much better to spread the three hours' practice over six daily practices.

Write legibly, using block letters. Practise writing any letter which is being transcribed in an ambiguous or slovenly manner. Remember, time is wasted and delay is caused when doubtful writing has to be referred back for amplification.

Receiving practice comprises the remainder of the lesson.

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## LESSON 18.

You may have observed that in the last three lessons the speed of the transmission has in many cases exceeded eight words a minute, and this was done with a definite purpose, as it is only by receiving slightly faster than is comfortable that your speed can be gradually increased. Again, owing to nervousness, which is usually apparent when a test is undertaken, one cannot always give of his best in such circumstances, and consequently if the maximum speed transmitted during the lessons had only been eight words a minute the chances of success in a test at that speed would be problematical. In a desire to give confidence transmissions in the last few lessons have varied between ten and twelve words a minute, and for the last two lessons prior to the final test this speed will be maintained. It is hoped that you will endeavour to read the signals at this speed, because if you can receive reasonably well at the speed of ten or twelve words a minute during these practice transmissions your success in the final test at eight words a minute will be assured.

The remainder of the lesson is taken up in receiving practice, jumbled letters, figures, and plain language being transmitted at a speed of ten to twelve words a minute.

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## LESSON 19.

**Sending.**

In previous lessons every effort has been made to explain the correct method of holding and manipulating the key. In addition, the correct and incorrect methods of holding the key have been shown in photographs (p. 9). Study these photographs again and endeavour to remember what you have been told. You should not try to send at too fast a speed. If it is found in sending that stumbling occurs in the transmission of certain letters or that rhythm is lost or frequent mistakes made, the trouble is most probably due to the speed of sending being greater than your capabilities. In such cases the speed should be slowed down and transmission continued at a steady rate.

In the event of some one adversely criticizing your sending you should not get upset, but should just analyse the criticism, because there must be a reason for it. Then endeavour to correct the faults which have been discovered. In order to avoid the clipping of the final dashes of letters speed should be reduced and, if anything, the final dashes should be over-accentuated until the tendency to clip has disappeared. It should always be borne in mind that there is some one copying the messages. A difficult time may be experienced in reading the signals owing to static or some other form of interference, and all the consideration possible should be given to the receiver by transmitting the best Morse possible.

A preliminary practice for the final test which takes place during the following lesson is given, as well as receiving practice in figures and plain language.

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## LESSON 20.

This is the last lesson of the series, and the final test for men taking this particular course will be given.

To those who feel so inclined, a continuation of practice is recommended with the object of increasing the speed of transmission and reception up to twenty or twenty-five words a minute. Such a speed will always prove an asset and never a liability.

A preliminary practice for the test is followed by the test itself.

After the test further practice in receiving is given in figures and plain language.

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## SUMMARY.

### Points for Air Force Trainees to REMEMBER.

1. Practise daily. A few minutes' practice daily is more valuable than a longer period once a week.
2. Learn the code by the " dit-dah " method.
3. Constantly practise key manipulation in the correct way :—
   (*a*) Thumb lightly under knob of key ; tips of the first and second fingers on the key knob :
   (*b*) Just sufficient pressure should be exerted to prevent the fingers from slipping :
   (*c*) Upper arm should be fairly close to the side of the body :
   (*d*) Unrestricted vertical movement of the wrist :
   (*e*) A light grip must be employed to ensure that the arm muscles are in a relaxed position.
4. Avoid " clipping " the last dashes of letters and incorrect spacing between letters.
5. Concentrate on letters causing difficulty.
6. Endeavour to cultivate rhythm.
7. Practise with a friend or obtain help from the local Postmaster if possible.
8. Practise receiving slightly faster than is comfortable.
9. Writing should be in block letters.
10. Send in tests regularly.
11. When you have completed your course, you must **continue with your practice** until you go to Levin. Otherwise your speed will quickly fall off.



### Some DON'TS.

1. Don't grip the key—just use a light pressure.
2. Don't let your fingers wander all over the knob of the key.
3. Don't run your letters or words together.
4. Don't clip the last dashes of letters.
5. Don't split the characters of letters.
6. Don't try to send too fast.

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## DIRECTIONS FOR MAKING A SIMPLE DOUBLE-ACTION MORSE KEY.

A double-action key is one which has two sets of make-and-break contacts. Such a key is of a universal type and allows the operator to feel and hear the formation of the dots and dashes much more readily than a key with only one set of contacts. It might be said that an operator should be able to send without such indication, and while this is true in so far as the experienced operator is concerned it is not so with the learner, to whom a double-action key is of very great assistance.

For example, take a pencil and place a pin under one end as shown in Fig. 1, place one finger on the end numbered 1 and hold the end numbered 2 in the same way as you would a Morse key, and send a few dots and dashes. Change the position of the pin as illustrated in Fig. 2 and send a few more dots and dashes. This is the equivalent of the double-action key and will be generally preferred to the principle outlined in Fig. 1.

If you observe carefully the following instructions, the construction of a cheap and double-action Morse key should present no difficulty.

The necessary parts which may be found in almost every home are as follows :—

A 3 in. nail :

Two small wood screws :

A boot-tack :

Two $\frac{1}{8}$ in. metal screws with two nuts each :

A piece of clock-spring approximately 2 in. long :

A base-board 3 in. by 6 in. long and $\frac{1}{2}$ in. thick :

A piece of clean tin about 8 in. long and 3 in. wide folded about six times to eventually form a rigid strip approximately $\frac{1}{8}$ in. thick, $\frac{1}{2}$ in. wide, and 8 in. long.

Take the baseboard and drill two holes as shown at A, A of Fig. 3. They should be drilled to a depth of $\frac{3}{8}$ in. and equal in diameter to that of the nail chosen. Cut two pieces off the nail each $\frac{11}{16}$ in. long and drive them into the holes until $\frac{5}{16}$ in. still remains above the board. The protruding ends should be filed flat as they are to serve as the two contacts. Between these two contacts drill another very small hole in which to insert one of the small wood screws when carrying out the final assembly.

Fig 1.

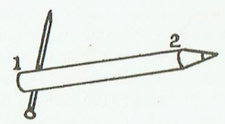



Fig 2.

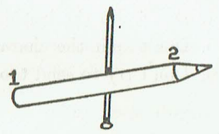



Fig 3.

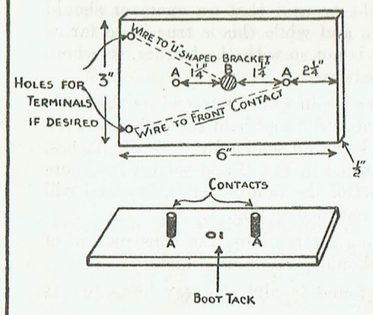
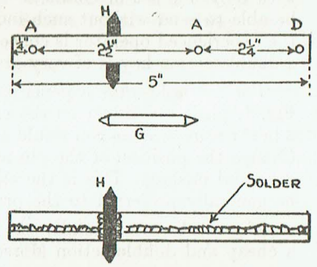



Fig 4.



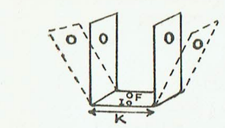
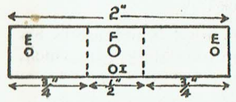




Fig 5.



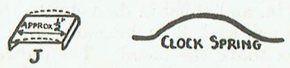
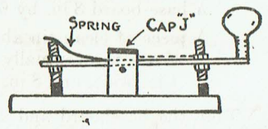




Fig 6






Next take the piece of clean tin, cut off 3 in. and fold the remainder lengthwise until it makes a strip 5 in. long, about $\frac{1}{2}$ in. wide, and $\frac{1}{8}$ in. thick. To do this it will probably be necessary to start the first fold about $\frac{5}{16}$ in. from the starting edge and hammer the metal flat after each fold. In the writer's model the last fold was soldered in order to make a neater finish. Drill holes at A, A and D of Fig. 4. The ones A, A are for the two metal screws and nuts to serve as the top adjustable contacts and the one at D for the other small wood screw to which to attach the knob. Cut another piece of nail, G, about $\frac{3}{4}$ in. long, point both ends as evenly as possible, and solder to the bottom of the strip exactly half-way between A, A as shown at H of Fig. 4.

Now take the remaining piece of tin, fold it about four times and hammer it flat until it eventually forms a strip about $\frac{3}{4}$ in. wide. Cut it to a length of 2 in. as shown in Fig. 5 and drill holes at E, E, F, and I, those at E, E being to hold the pivot H. They should be about two-thirds the diameter of the nail and those at F and I are drilled to fit the other wood screw and boot-tack respectively. The purpose of the boot-tack is to serve as a lock to stop any side movement of the key. Bend this strip to the shape shown by the dotted lines in preparation for the final assembly of the key, when it will be further bent to the shape shown by the straight lines.

Take the piece of metal that is left and bend it over about $\frac{1}{16}$ in. from each end in order to form a cap J a little over $\frac{1}{2}$ in. long, but not much longer than the outside measurement K. This cap will eventually be fitted and soldered on top of the U-shaped bracket shown in Fig. 5, and by slightly bending or arching as shown it will serve to adjust the side-play of the pivot H and also to hold the tension spring in place.

The tension spring, which is a piece of clock-spring, is placed under the cap and over the end screw or back contact.

Now the parts are all ready for the assembly. Take the base-board complete with the contacts A, A as shown in Fig. 3 and screw on to it the U-shaped bracket of Fig. 5. Next take the rocker arm of Fig. 4, attach a knob D, fit the pivot H into the holes E of the bracket; close the bracket from the shape shown by the dotted lines to that shown by the solid lines and fit and solder the cap J. The front and back contact screws may now be fitted, and any side play in the key may be taken up by squeezing and arching the cap as shown in Fig. 5. Should the cap be made to hold the pivot too tightly a very slight tap on the cap with a hammer will loosen it.

The final construction is to fit the tension spring under the cap and over the top of the back contact, tension being adjusted by raising the back contact screw and decreasing the gap between contacts by adjusting the front screw.

If it is desired to work a buzzer or oscillator with this key it will be necessary to connect a wire to the U-shaped bracket and another one to the front bottom contact.

## DIRECTIONS FOR MAKING A CHEAP AND SIMPLE BUZZER.

This buzzer should not cost more than a couple of shillings. Figures 7 and 8 are drawn full size, with dotted lines showing how the interior work is laid out, or parts underneath a certain object—*e.g.*, E is the top of the iron core of the magnet shown through the reed or trembler arm F, F as in Fig. 8. Following is the key to the lettered diagrams, together with the instructions :—

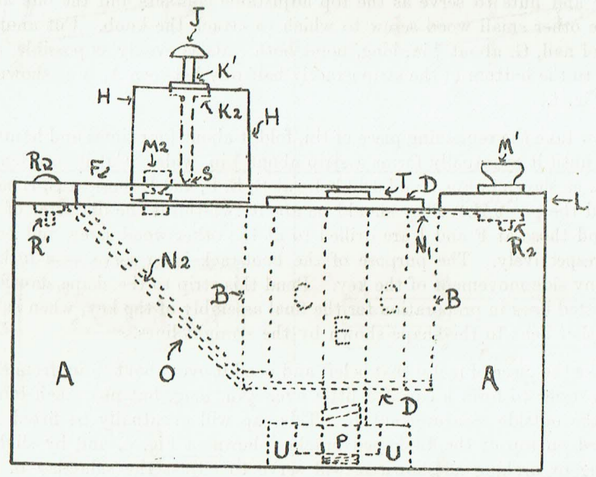



Fig. 7.

A, A is a block of wood $3\frac{1}{2}$ in. by 3 in. by $1\frac{3}{4}$ in. approx.

B, B is a $1\frac{1}{4}$ in. hole drilled in the block to a depth of $1\frac{1}{4}$ in. to accommodate the coil C, C.

D, D are 1-in.-diameter pieces of ebonite, cardboard, or thin wood for ends of coil.

E is a $\frac{5}{16}$ in. iron carriage bolt with the head cut off. This is the core of the magnet.

F, F is reed or trembler arm, made from a piece of old hack-saw blade. (Note shape of fastened end of reed.)

X, X, G, G Small piece of wood or ebonite, to which reed F is fastened.

H, H piece of hoop iron bent to the shape shown in Fig. 10.

J contact and adjusting screw. (Note pointed end S.)

$K^1$ and $K_2$ lock nuts.

L, L piece of ebonite or wood on which terminal $M^1$ is mounted.

$M^1$ and $M_2$ Terminal $M_2$ is connected directly to the hoop iron loop H, H.

$N_1$ is wire from the outside of coil to terminal $M^1$. The wire $N_2$ passes through a hole drilled in block as shown in dotted lines at O.



$R$ and $R^1$ Wire connected to screw R by nut $R^1$.

P is nut of carriage bolt.

U Cut hole U in bottom of block large enough to have end of bolt and nut out of sight.

Q, Q, Q, Q, Q are fastening-down screws.

T is gap between trembler arm and head of magnet.

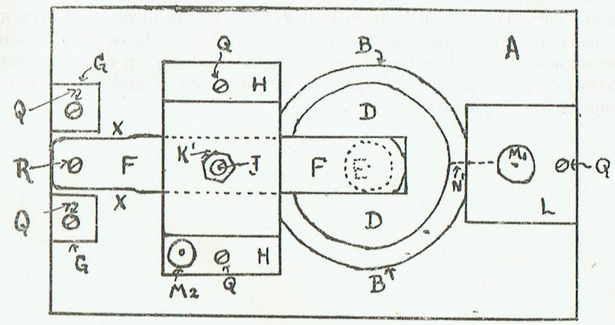



Fig. 8.

### Constructional Details.

Cut out block of wood, drill holes, &c. Give good coating with shellac. Drill holes in hoop iron, then bend to shape. Attach terminal. Shape reed. Use end of hack-saw blade that has hole in it. Make anchoring-block for reed and block for terminal Q.

*To make Magnet.*—Drill $\frac{5}{16}$ in. holes in end pieces D, D. Drill small holes at T, T (Fig. 9) for fastening wire. Fasten to bolt with balsa-cement. Inside space between ends, $1\frac{1}{8}$ in., wind a thin layer of brown paper round the bolt at E in Fig. 7. Now carefully wind on about 85 ft. of either 26, 28, or 30 enamelled copper wire. Procure a reel of wire. Wind the layers evenly up and down. Leave sufficient wire at each end for connecting-purposes. Inside wire of coil goes to end of reed at $R^1$ (Fig. 7). Outside wire to bottom of terminal $M^1$ shown in Fig. 7 at $R_2$. Hoop-iron bridge H goes over the top of reed F, but must not touch reed. Contact point S of screw J is the only metal part other than the anchoring screw R that must touch reed. To test, connect $4\frac{1}{2}$ volt battery to terminals. Screw adjusting-screw J until a clear note is made by trembler arm.

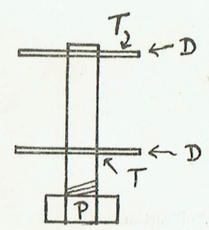



Fig. 9.

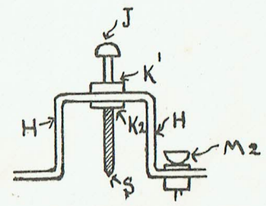
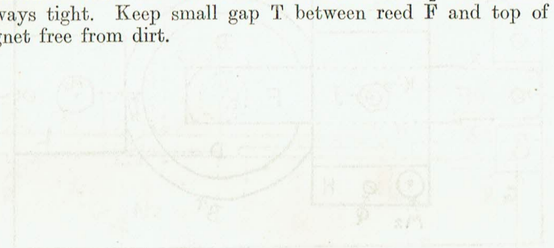
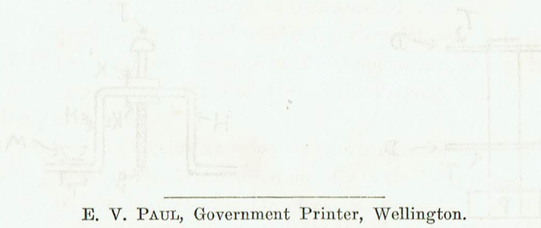



Fig. 10.

*General Hints.*—Don't use more than 4½ volts. A bigger voltage does not seem to give as good a note. Don't have any more metal than you can possibly help at the top end of the magnet. Unnecessary metal decreases the strength of the magnet. Try slightly different positions for the contact screw J by moving it nearer or further from the coil. On the whole, the position shown seems the best.

*To connect with Morse Key.*—One wire from battery goes to one terminal on Morse key, the other wire from battery goes to the buzzer. A wire goes from other terminal of buzzer to other terminal of key. Give contact joint J an occasional clean. See that lock screws $K^1$ and $K_2$ on contact screw J are always tight. Keep small gap T between reed F and top of core E of magnet free from dirt.





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