LEARNING
THE
Radiotelegraph
CODE

R R L

BASIC
TRAINING
FOR RADIO
OPERATING

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LEARNING
the Radiotelegraph Code

BY
JOHN HUNTOON

Assistant Secretary,
The American Radio Relay League

Foreword

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THROUGHOUT THE NATION the war brought great interest in learning the International Morse radiotelegraph code. Innumerable buzzer classes and radio courses sprung into being and thousands of people went industriously to work mastering the dots and dashes. Many requests were addressed to the American Radio Relay League, the national society of radio amateurs, to produce a piece of training literature that would be a reliable and helpful guide to those who were undertaking to learn this new language. It was to fill that need that this booklet was written.

It did that job well. Now, with amateur radio reopening in a world again at peace, many thousands of persons are given their delayed opportunity to take up one of the world's most fascinating avocations. They will need guidance in learning to send and receive the code, for that is requisite to the attainment of an amateur operator license. This booklet, originally written to help a nation at war, can now be of similar assistance to those who wish to qualify as amateurs.

The author, John Huntoon — at that time the acting communications manager of the League and one of its assistant secretaries, later on leave of absence as a Chief Radioman in the U. S. Coast Guard — is one of the outstanding amateur authorities on the reception and transmission of the code and on its teaching. In amateur circles he is reckoned to have one of the best sending "fists" in the country; and he is the possessor of several trophies for first place in high-speed receiving competitions. It is from this background of long familiarity and experience that there comes the ingenious idea here outlined for learning the code. The emphasis on learning the *sound* of letters rather than the sequence of their dot-and-dash components is strictly in accord with modern thought in this field. It is reminiscent of the way children nowadays learn to read words before they know the individual letters — and make much faster progress than we oldsters did. The applicability of this technique to code learning has been thoroughly tested; it is unquestionably the best way, as is also attested by its employment in the schools of the Army and Navy.

In compiling this booklet the author has borrowed heavily from accumulated amateur knowledge and notes in this field. He is indebted to Commander Everett L. Battey, USNR, the League's assistant communications manager and

himself associated during the war with the Navy's radio training work, for much helpful material taken from his splendid article, "The Secrets of Good Sending," which first appeared in the League's journal, *QST*. To Lieut. Commander Arthur L. Budlong, USCGR, senior assistant ARRL secretary on leave of absence, goes particular credit for collaboration in the first presentation of this method in the code-learning chapter of the League's *Handbook* (defense edition) and for much helpful criticism of the present endeavor. Most of the notes on apparatus for code-learning are from material first presented in *QST* by George Grammer, its technical editor. The lists of words and code groups and clever practice sentences appearing in the chapter on class instruction were compiled by George Hart, formerly acting communications manager and chief operator of the League and now also on leave in the armed forces — originally for distribution in mimeographed form for the help of amateur clubs and study groups.

There is something fundamental, almost universal, about this business of code. Its applicability far transcends radio and wire circuits. It is sent by blinker lights, by heliograph, by wig-wagging a flag. Automobile horns and the whistles of ships and locomotives can be "keyed" to make these signals, understandable to anyone who knows the code, and we have even heard an airplane pilot signaling a letter or two by manipulating his engine throttle. It would be possible to send an SOS on the trigger of a machine gun. An exaggerated example, to be sure, but illustrating the thought that whenever there is any way of turning on and off for varying lengths of time anything that can be heard or seen, those who know this universal code have peculiar and often invaluable ability to communicate. So important is this knowledge, so frequent its benefits, that we have long thought that it should be imparted in the public schools, along with the ability to swim and to administer first aid.

You should know this code. It is the key to the first door of the fascinating hobby of amateur radio, the peacetime avocation of tens of thousands. We hope this booklet gives you the help you need. Good luck!

KENNETH B. WARNER
Managing Secretary, A.R.R.L.

WEST HARTFORD, CONN.
May, 1946

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Learning the Code

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You are about to learn a new language — the language of code.

The radiotelegraph code is essentially a language of sound. As such, it is quite difficult to illustrate in a book, and we shall have to ask that you follow each step closely and pay attention to every detail of learning as outlined in the paragraphs to follow.

One important preliminary: forget completely about "dots" and "dashes." Those terms were invented for the old land-line telegraph system and they have absolutely no place in a modern system of learning radiotelegraph code. Forget, too, about any other code chart or table you may have seen or memorized.

The Continental (International Morse) Code is the one used in all radio work. It consists of various combinations of sounds and spaces, forming letters of the alphabet, numbers, punctuation marks and procedure symbols. The sound usually takes the form of a high-pitched audio tone having a frequency of about 500 cycles per second (approximately C above middle C on the piano), more or less, depending upon the receiving operator's individual preference. Lacking an audio oscillator itself for practice, the best way to simulate the high-pitched sound of code in headphones is to whistle.

● THE MECHANICS OF CODE

To illustrate how closely allied are radio code and human speech, let us liken the mechanics of code to those of our own spoken English language. Human speech is made up of a number of pure sounds, such as "ah," "ee," "oh," and "$\overline{oo}$" (as in "ooze"). We combine these to form other sounds, and those to form words. The sound of the letter I, for example, is not pure but it is made up of two others, "ah" and "ee," spoken in rapid succession.

The radiotelegraph code is similarly constructed, but actually it is much easier to learn since there are but two fundamental sounds. In reality, each sound is the same tone and differs from the other only in length. The first is very short and staccato, the other somewhat longer (three times as long, actually). Since this high-pitched tone or whistling cannot very well be shown in print, for instruction purposes aural terms have been coined which closely duplicate the actual element sounds in code. We speak of the short sound as "dit," of the longer one as "dah." Various combinations of these sounds, properly interspersed with spaces, are used to represent the various letters of the alphabet just as are the sounds in the spoken language.

For purposes of explanation to you and to whomever might assist you, let us say that the sound "dit" is pronounced as "it" with a "d" before it. The sound "dah" is pronounced with "ah" as in "father." The sound "dah" is always stressed or accented — not in a different tone of voice, but slightly drawn out and the least bit louder. The sound "dit" is pronounced as rapidly and sharply as possible; for purposes of easy combination, as a prefix, it is often shortened to "di." When combinations of the sounds appear as one letter, say them smoothly but rapidly, remembering to make the sound "di" staccato, and allowing equal stress to fall on every dah. There should never be a space or hesitation between dits and dahs of the same letter.

These are simply convenient vocal terms to use in duplicating the sound of code. You should never think of a letter as being composed of certain separate sounds, but rather as a complete sound itself. You don't think of the spoken letter U, for example, as being composed of two separate and distinct sounds — yet actually it is made up of the pure sounds "ee" and "$\overline{oo}$," spoken in rapid succession. You learned the spoken letter U as a sound unit itself. Similarly, you should learn code letters as sounds themselves, and not as combinations of other sounds. A skilled operator does not think of dits and dahs when copying, but actually hears the headphones speak words to him. He has mastered this new language. The sound "dah didididit dit" is just as familiar

to him as the sound of the spoken word "the," for which it stands.

In no event should you use the "didah" tables below — or any other such chart — for memorization study. If you do you will have a visual concept of code instead of an aural concept, and when you hear sounds you will have to convert them first into "didah" language and then into letters. If you learn the sounds directly with their letters, however, without using visual reference, you will eliminate this extra step while learning.

● **ELEMENT SOUNDS**

Before taking up letter-sounds, however, let us observe some of the element sounds. Practice saying to yourself the sound "dididididi . . ." (dits in rapid succession). It should sound like a blast from a machine-gun: staccato, evenly-spaced, precise. To make certain you get correct timing, start tapping the top of a table continuously in smooth, even sequence, like clockwork; if a metronome is available, it will serve admirably. The tapping (or metronome ticks) should be at about 100 per minute, or a bit less than two per second. Synchronize your tonguing of dits at four per metronome beat. Be careful not to say "dididit . . . dididit . . . ," thereby leaving a space after every fourth dit; they should be as even and regular as the metronome beat, but four times as fast. If it will help, slightly accent the dit which coincides with the metronome beat. When you can do this easily, begin repeating "dahdahdahdah-dah . . ." so that the beginning of each *second* dah synchronizes with a metronome tick (or table rap). Let the dahs run smoothly and make them of equal length. Do not let them become choppy; your voice should be almost continuous, broken only for that short instant your tongue cuts off the tone to make the "d" sound.

Now alternate, repeating dits for a moment and then switching to dahs, without stopping to take a breath. This will show you the proper proportion of dits to dahs at this speed, or any speed to which the metronome is set; that is, four dits or two dahs per metronome tick. You should now practice alternating this voice simulation with whistling. Again, make your whistled dits very short and staccato, your whistled dahs smooth and full.

A graphical representation of the relation of the metronome beat to the spoken dits and dahs might be that shown below; the beats are shown by small dots, and the dahs are spelled "dahh" to complete the mechanical relation:

```
dıdıdıdıdıdıdı dıdıdıdıdıdıdıdıdıdıdıdı dıdıdıdıdıdıdıdı
 dahhdahhdahhdahhdahhdahhdahhdahhdahhdahhdahhdahh
dıdıdıdıdıdı dıdahhdahhdahhdahhdahhdı dıdıdıdıdıdıdı
```

Another excellent practice exercise is the al-ternating of single dits and dahs. Practice repeating (and then whistling) "didahdidahdi-dahdidah. . . ," and then "dahdidahdidahdi-dahdi. . . ." Here again the tone should be almost continuous, the dit as short as possible. An hour, in several shorter periods, is not too much time for these exercises. If you can master them, you will have no difficulty in forming the various letter and number sounds.

● **LETTER SOUNDS**

When you have mastered the timing and rhythm exercises explained above, you can begin to combine these groups and form letter sounds. In doing so, remember that this is a new type of spoken language you are learning, not a collection of short and long code symbols taken from a printed page. In fact, it might be better to forget that you are learning "code" and think of it instead as the "didah" language.

This is how you should proceed to learn the letter sounds: If possible, get someone who knows the code to start you off. Or, a member of your family or a friend (preferably not one also wishing to learn code) will suffice if he will study these paragraphs and practice the subsequent voice exercises a short time. Give *him* the book. Then ask him to pronounce the sounds to you, identifying them with the letters for which they stand. Take a few letters at a time, such as in the groups suggested below. As your "instructor" sings out the sounds to you, you should be able to call out the letters, or vice versa. This is excellent practice. It will come harder at first, possibly, than other ways, but you are set for a successful code career if you learn by sound. In other words, after you read this section do not go back and memorize the code tables. Don't even take another look. Get someone to call out the sounds to you, either by "didah" language or whistling, and preferably a combination of both.

Let us take a few letters and numbers to start with, as shown in the following table. Remember that you should look at this table only briefly while reading this text; when you come to study, have someone hold this book and coach you in memorizing the code-sound of each letter.

5	didididididit
∅ (zero)	dahdahdahdahdah
E	dit
T	dah
A	didah
R	didahdit

The "5" should merely be five *staccato* dits in the same sequence and speed you practiced above; the zero should similarly be five dahs. "A" is our first character using both sounds. Make that di very short, the dah the usual length, properly stressed; it should have the same metric swing as does the word "to-day," rapidly spoken and strongly accenting "day." Similarly, the "didahdit" of "R" should have the same metric swing as "repeated," the second syllable strongly stressed, the final one not accented and as short as you can make it.

Spend at least one-half hour on this group; and preferably more, although your practice should then be split up into shorter periods. Take your time and learn the sounds of these letters thoroughly. Repeat them in "didah" language, and then whistle the characters. You will find it interesting to make up some words from this group of letters, such as:

ATE RAT TEAR 5Ø ERA RATE Ø5 ART TARE

You should immediately begin practicing copying down the characters your "instructor" calls out to you in sound. Copy them simulta-

Signal Corps operators learn this method of hand-printing letters, shown above in the groups by which you will learn letter-sounds.

neously speaking the letter, if you like. For the first copying practice it is well to print; in the transmission of non-English text, which you often will be getting for letter-practice, longhand letters are sometimes confused with each other. For example, L is mistaken for E, an uncrossed T for L, etc. The Army Signal Corps requires printing ability by its field operators, since much of the text handled is in code groups and errors would cause much difficulty in reading the actual message. Print until you are able to receive about ten words per minute, above which speed you will want to resort to longhand to keep up with the text.

Learn to print the characters rapidly and without conscious effort; your mental effort must be on reading the code sounds and not on your finger movements. Never look back over your copy when receiving, nor try to guess what word is coming; copy what is sent. If you do not immediately recognize a character, skip it and devote your full attention to the next one; if you try to think back, you doubtless will miss several letters in a row. By checking your written copy with the transmitted text, you can determine what letters are giving you trouble and give special attention to them.

Here is another group of letter-sounds. You are ready to learn them when you can *instantly* call out English letters for code sounds spoken to you, or vice versa. Before beginning their study, have your "instructor" review you on the first group; do not be so eager to learn fast that you forget old sounds! Intersperse learned sounds with new ones when studying this new group:

S	dididit
L	didahdidit
U	dididah
Q	dahdahdidah
J	didahdahdah

The first letter obviously is simply three staccato dits. L is more difficult; its metric swing is like that of "fraternity"; again, make dits rapidly, particularly the final ones, and stress the dah. U is similar to S with the final dit changed to a dah; practice the two letters interchangeably to get the rhythm. Q and J should be smooth; stress each dah equally, make the dit short.

Study these in the same manner as the previous group. You have nearly twice as many letters to remember now, so your progress will be a bit slower. Don't rush; learn each sound thoroughly before proceeding to the next. Speed will come later, and it will come rapidly later if you learn by sound. There are quite a number of words which can be made from the letters so far studied, more examples of which are here given:

SELL REQUEST JAR LURE RUSE STARE
SUET SQUEAL JET QUEER SLATE JUTE
QUART LESSER QUELL JUST TESLA SALES

Practice saying the sounds to yourself, particularly between study sessions. Occasionally you should have an operator who knows code check you on your progress.

Here is a third group, to be taken up only after you have learned the previous eleven characters well:

H	didididit
O	dahdahdah .
N	dahdit
C	dahdidahdit
V	dididdah

The first two letters should give no trouble. Be careful not to have a space in the sound for N; nor to make the dit anything but short. C can best be simulated by remembering our earlier exercise of alternating single dits and dahs; practice that again momentarily, and you should have no trouble.

When learning the sound of V, practice H and then make the final dit a dah; practice the two letters intermittently as you did U and S, repeating in your mind what letter is concerned with each sound. Again, some suggested practice words for the new letters:

COVERLET ALONE CANCEL VOCAL HOVER THE
COLLECT NEVER THAT SHONE LATHE SHEET
THESE CONQUEST THERE NEUTRAL SEVERE
TENET RUNNER ENCLOSE RELUCTANT JOCULAR
JOVE HELEN LUNAR CONCLAVE RECLUSE QUIVER

Here is a fourth group of letter sounds:

I	didit
B	dahdididit
Y	dahdidahdah
P	didahdahdit

By now you should have developed sufficient timing sense and code consciousness that you can pronounce new sounds without difficulty. Simply remember to keep characters smooth, without spaces.

In between practice periods, when convenient, notice street signs and posters containing these letters; when you see one you know, call out its code-sound. Keep this practice principle always in mind and use it a great deal; you will find a goodly amount of idle time you can put to good use — riding back and forth to work, or walking to the corner drugstore. Or even if you are not in the vicinity of signs, there are a number of short words you can practice saying to yourself in

sound language. Make your character formation snappy, leave a recognizable space between letters, plenty of space between words. Use both whistle and voice technique. We want to get you thinking subconsciously of code whenever you see letters and words. This spare-time practice is probably the most important single factor in the progress you make.

Try some words like these to gain familiarity with the new letters:

BOTTLE CORNCOB YESTERYEAR HONEY THIS
POPPY JITTERS BATTERY BAY SISSY
RECONCILIATE COUNCIL BONY PHONE JOIN
SUPPER PAVE SHIP PAY CAPON NYLON COIN
PYRITES COPY BOIL PEBBLE CAVITY VICIOUS

Now, another group:

W	didahdah
K	dahdidah
Z	dahdahdidit
M	dahdah

When these have been thoroughly learned, you may proceed to the final group:

D	dahdidit
X	dahdididah
F	dididahdit
G	dahdahdit

Here are some practice words for the last two groups:

WORK BUZZER ZERO SLOW HARK WARMER KIND
JERK SUZANNA BUMP QUIRK MAKE WINK SIMMER
MAP SKIM MILK TOMORROW WHOLESOME JAM
QUALMS LOWLY WHARVES POMPON WAR MARK
WOMANISH CAUSEWAY KNOW ERSATZ MINK WALTZ

DOCK KIND FINGER DOLORES DEXTEROUS GOLF
KIDDER FIXTURES GOODLY JIGGER JINX FOGGY
STUFFING DOG FLIGHT DRAUGHT FLING FOX GOD
FADDIST GUFFAW DAGGER MEXICAN DODDERING
TEXTILE EXCHANGE PARADOX XYLOGRAPH

You already have learned the two simplest numerals: five and zero. The others are:

1	didahdahdahdah
2	dididahdahdah
3	didididahdah
4	dididididah
6	dahdidididit
7	dahdahdididit
8	dahdahdahdidit
9	dahdahdahdahdit

PRACTICE CIPHER GROUPS

Cipher groups make better practice material than plain English because the student can't foresee the next letter. The groups below, taken from the operator's manual of the Signal Corps, are representative both of the practice material used in military schools and of ciphered messages actually used in the services. Their breakdown into 5-letter units makes it easy for you to determine your approximate speed, figured on the basis of 5 characters to a word.

With someone to send to you, this material of course provides the best possible copying practice. Check back for your errors, concentrate on the letters that are proving difficult for you. If you find yourself memorizing some of the combinations or their order, use each group backwards or start from the bottom of the page. There are plenty of practice possibilities in the following list, even for the experienced operator who is seeking higher speed on the typewriter.

OKICQ	CEMID	9 7 2 Ø 1	ALCRJ	MAIDP	JRNOL
2 4 6 8 Ø	JXEFY	EFXNK	DLZIK	7 6 3 2 1	EWSKM
CKTOG	EFMEY	LCKQH	PHVTX	7 Ø 3 6 5	HZGNA
AXBTR	4 9 2 8 5	OCYAA	HIMAD	OHWIM	SFMCG
Ø 3 7 5 9	JNABD	ZLJBI	CPNZI	VTNEE	FMEMI
CWXCK	JBCYD	8 4 7 Ø 7	JBOAH	HELKF	ZDLYS
DKAKX	PGZUN	KDKNG	GYEVZ	4 7 3 8 2	KTLES
WQYFZ	CTILL	FHFUX	ARJZU	MRFXE	WBPCM
OMIWG	THQVI	NTVMG	DXAQN	4 Ø 3 6 7	SPEJN
HSPCQ	HMOUS	WOHZR	1 1 9 Ø 2	OBRDK	VIODO
XGLDT	TVCPT	IPAQZ	Ø 6 1 4 3	PVFKQ	CUBEZ
8 Ø 7 Ø 1	CPTKO	FNZQJ	CPTKO	RBEFP	AXTRX
RKMOZ	2 Ø 1 8 4	PGMAE	IRAGO	KDIEY	KCNYQ
EKJCD	VNFBH	1 Ø 2 7 3	PZOKA	MDIDH	EIURY
DJHNG	DIEUY	DXNZE	OQUIW	Ø 9 1 6 5	MCNBS
HAHGJ	JCUWH	9 8 2 3 4	MCNUY	QZASU	IHDJI
LDOSJ	8 3 7 4 6	JEHDY	BCNBX	CVFZA	SCQZW
1 2 3 1 Ø	LKDOP	MCNCB	ZAOIZ	ZLKAM	ZJHFG
BAYQT	WEQFQ	PAOKU	3 Ø 2 1 Ø	JDMNF	DKUER
QNBAV	1 7 8 6 3	MDHNH	TQRYW	EIOUW	MXNBG
2 5 8 9 4	MVHVD	UEYTA	ZMNZB	ZXVGX	OIEUQ
JXHGQ	APLKM	QYEUR	NDBGY	UYRHI	LKCCN
9 8 Ø 1 5	NDHBH	QWZXN	KDIOE	DYAFH	LPWCA
MBUDF	JTIOE	MNOPA	CVQAR	1 2 7 5 4	OEVAN
AEIOU	MNLFG	KQZAX	NASTF	PONDL	FAWZX
1 3 5 7 9	YOUMK	LARDO	CFGIL	NPQRT	QWERT
CJRNO	VOIUM	MQECV	CADXA	SNKAD	CUTYR
YOUMK	1 2 7 Ø 9	BEXZB	TTLOR	KOBDZ	RGLBH

Learning to Send

IT IS important that you should learn the correct sound of code letters thoroughly before ever touching a telegraph key. If you do not know how a code letter should sound, no amount of playing with a key will teach you. When you are at the point where you can unhesitatingly call out each letter as your "instructor" pronounces or whistles the sound, you are ready to learn how to handle a key. First, however, you need some device to produce a tone. A buzzer set will serve the purpose, but a much better tone source is the vacuum-tube oscillator since it duplicates the audio-frequency beat note a radio operator hears. Construction data on both types are given near the end of this booklet.

● KEY ADJUSTMENT

A telegraph key is simply an on-off switch in convenient form for rapid manipulation. Pressing the key knob closes the electrical circuit and produces the "mark" or sound; releasing it allows the contact to break, producing the space or no-signal period. Correct key adjustment is that adjustment which fits your particular touch, and it is important that you arrive at the correct adjustment before attempting to use the key. A reliable rule is that there should be a vertical movement of about one-sixteenth inch at the key knob. This is measured from the top surface of the knob. It is set by the rear screw adjustment. When the knob's top surface goes down about one-sixteenth inch upon pressing the key, you have the approximate "average" spacing between the key contacts. In making any key adjustment, be sure to loosen the lock nuts first, so that you do not strip the threads.

Illustrating the correct position of the hand and fingers for the operation of a telegraph key.

Tighten all lock nuts when you complete the adjustment. The contact points should be perfectly aligned by means of the side screws. There should be a very slight degree of side play, between the two side screws. These screws should be tightened, then loosened just a bit so that the key moves freely and does not bind. Re-check the contacts after this adjustment to be sure they are true, making any slight readjustment necessary.

Although the "one-sixteenth inch" rule is a good one to follow for first adjustment, the amount of vertical movement can later be changed to suit your particular "fist." The spring tension, likewise, must be set for the individual operator. Some prefer a heavier spring than others. The primary consideration is to send *good code;* how you have your key adjusted to do this depends on what you find best for you. However, it should be remembered that too heavy a spring tends to make your sending "choppy," causing you to "clip" your dahs and dits as well as being tiring for long periods of sending. Similarly, too light a spring tends to cause you to run characters together, there being insufficient control of the key. Remember, *you* are making the characters, the key isn't! Generally speaking, a somewhat heavy spring allows better control, particularly of dots. With a spring of "featherweight" tension, the dits are likely to run away from you and you will find yourself slurring them. No treatise on key adjustment ever can solve the individual's problems in this line. Only by personal use can you find the correct adjustment for yourself.

There is a definite sending posture which should be observed. Sit upright in your chair, square with the operating table, with your arm on a line with the key. The key knob should be about eighteen inches from the front edge of the operating table, allowing room for the elbow to rest on the table. The muscle of the forearm should support the weight, and the wrist should be off the table. A table about thirty inches in height is best. The key may be fastened by means of wood screws directly to the table if one is available for permanent use. Otherwise, it may be fastened to a rectangular piece of thin board such as three-ply veneer, about six inches wide and two feet long.

The manner of grasping a key knob is also the choice of the individual operator. When learning, place the thumb against the left edge

of the key knob, the first finger on top of the knob at the rear and lapping over the rear edge just a bit; and the second finger against the right edge of the knob, about in the center or slightly to the rear of center. In no event should the grip be tense. The first and second fingers should be slightly arched, not held out straight. The third and fourth fingers should be permitted to curl naturally toward the palm of the hand, but they should not be tightly clenched. Keep the fingers, hand and wrist relaxed at all times.

Now that you are all set, you can begin sending practice. Before taking up letter-sounds, it is best to achieve smoothness and facility with element sounds, as we did in learning by voice. Begin by making a series of dits — ten or more in a row. Make them evenly spaced, precise, a bit slower than the speed at which you learned the voice-sounds. Work on both dits and dahs, and then alternate, just as you did in voice work. Here again a metronome, or a substitute such as someone rapping on the table for you, will be a valuable timing guide. Remember to synchronize your sending at four dits, or two dahs, per beat. Make the beats about 60 per minute — one per second — as compared to the 100 in receiving practice. Synchronize your sending with the spoken sounds, if you wish. Keep your wrist flexible; allow it to bob up and down with your sending. If you find that your fingers or whole arm are doing the work, stop, and start over again. Be particularly careful to make dahs smooth and full; the tone should be almost continuous, broken only for that tiny instant the key contacts open.

● FORMING CHARACTERS

Once the rhythms of dits and dahs have been mastered, we can proceed to the consideration of the correct formation of each character. This is an important consideration, for if we do not make every letter and numeral correctly we shall never send good code. There can be no characters sent incorrectly. It is one thing to know how we want a character to sound but another thing to make it sound that way! Let's analyze the correct manner in which to make each character. Starting with the basic letters, E and T, practically every character is composed of combination of other characters. A study of the correct rhythm for each character (how it sounds when sent correctly) discloses that certain groups of letters and numerals are associated. It is urged that you practice the characters in accordance with the following plan. The letters listed in each group are more or less associated and it is recommended that practice be "by groups," with each letter mastered in the order given within each group. Keep your speed at the level at which you make a minimum number of errors. Accuracy and perfection come first — speed will come with

practice. Here again, it is well to have someone skilled in code check your progress occasionally.

Group No. 1: The characters E, I, S, H, and 5. With the correct dit-rhythm mastered, you can
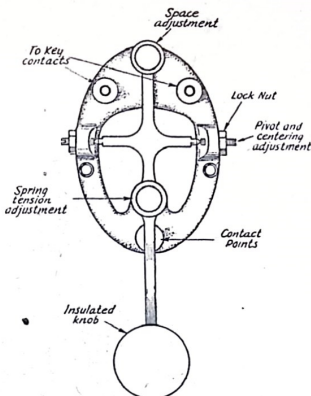
The essential features of a simple telegraph key.

send all of these dit characters. If you experience any difficulty, go back and send a series of evenly-spaced dots (dididididididi, etc.). When your wrist responds, send a 5, using the same rhythm as for the longer series . . . send an H likewise, etc. This same dit-rhythm carries over into other characters which are made up of didah combinations.

Group No. 2: The characters T, M, O and Ø. These were covered under the subject of correct dah-rhythm. Little difficulty is usually encountered in making dah-characters, If, however, you find yourself sending them jerkily, go back and practice the dah-series exercise (dahdahdah dahdahdahdahdah, etc.) until you regain the feel of this action.

Group No. 3: The characters A, R, L, W, J, 1 and P. These all have as their groundwork the letter A (didah). First master that letter by sending several times a smooth didah, didah, didah, keeping the space between the di and dah equal only to one di. Then send an R (didahdi), which is actually the letters AE sent together as one character. Always bear in mind that the space between any parts of a character is the same length as a di. Next try an L (didahdidi), which is actually $\overline{AI}$ sent as one character. Next send W (didahdah), thinking of it as $\overline{AT}$ sent together. If you can send A successfully, you can send R, L and W similarly. The letter J (didahdahdah) should be thought of as $\overline{WT}$ sent together.

The numeral 1 (didahdahdahdah) should be considered as $\overline{JT}$ sent as a single character. It will be noticed that these combinations give a smooth continuity for each character. The letter P (didahdahdi) should be considered as $\overline{WE}$ sent as one smooth character. Care must be taken in sending each of these characters that no additional space is left between the two letters making up the complete character. For example: although P is $\overline{WE}$, take care that you do not leave more than one dit-length between the W and E. The overscore indicates that the two letters are sent rhythmically as *one* sound (didahdahdi).

Group No. 4: The characters U, F, 2, V, 3 and 4. Master first the letter U (dididah). Do not think of U as any combination of letters; think of it only as dididah sent smoothly. (A dangerous misconception is to think of U as the letters IT; avoid this, or your character is apt to sound jerky.) Think only of the sound dididah. Next, tackle the letter F (dididahdi), using the basic

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TABLE OF CORRECT SOUND-COMBINATIONS
For Sending Practice

Consider each letter as its individual rhythmic sound-combination. If you have difficulty forming certain letters, to make them sound right, try the letter-combinations suggested, mastering the first letter, then adding the second unit, sending the whole as one character.

A — di-dah (not ET)
B — dah-di-di-di (not TS)
C — dah-di-dah-di, or $\overline{KE}$ (not TR or NN)
D — dah-di-di (not TI)
E — di
F — di-di-dah-di, or $\overline{UE}$ (not IN)
G — dah-dah-di, or $\overline{ME}$ (not TN or TTE)
H — di-di-di-di
I — di-di
J — di-dah-dah-dah, or $\overline{WT}$ (not EO or AM)
K — dah-di-dah (not TA or NT)
L — di-dah-di-di, or $\overline{AI}$ (not ED)
M — dah-dah
N — dah-di (not TE)
O — dah-dah-dah (not TTT)
P — di-dah-dah-di, or $\overline{WE}$ (not EG or AN)
Q — dah-dah-di-dah, or $\overline{MA}$ (not GT)
R — di-dah-di, or $\overline{AE}$ (not EN)
S — di-di-di
T — dah
U — di-di-dah (not IT)
V — di-di-di-dah (not ST)
W — di-dah-dah, or $\overline{AT}$ (not EM)
X — dah-di-di-dah (not DT or TU)
Y — dah-di-dah-dah, or $\overline{KT}$ (not TW or NM)
Z — dah-dah-di-di, or $\overline{MI}$

1 — di-dah-dah-dah-dah, or $\overline{JT}$
2 — di-di-dah-dah-dah, or $\overline{UM}$ (not IO)
3 — di-di-di-dah-dah, or $\overline{VT}$ (not SM)
4 — di-di-di-di-dah
5 — di-di-di-di-di
6 — dah-di-di-di-di (not TII)
7 — dah-dah-di-di-di (not MS)
8 — dah-dah-dah-di-di, or $\overline{MD}$ (not OI)
9 — dah-dah-dah-dah-di
Ø — dah-dah-dah-dah-dah

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letter U as a foundation. F is actually $\overline{UE}$ sent as one character. If you can send U, you can send F. The numeral 2 (dididahdahdah) is made up of the letters $\overline{UM}$ sent together; think of it this way and you will get a smooth 2. The letter V (didididah) must not be considered as any combination of letters. (A common fault is to consider V as ST, resulting in a jerky character.) Think of V only as the sound-combination dididdah. Practice, this, using the dit-rhythm, until you send a smooth letter V. One of the most difficult characters for many operators is the numeral 3 (dididdahdah); it is too often sent jerkily (as SM). To send a smooth numeral 3, think of it as $\overline{VT}$ sent together; there you will have the smooth continuity of a correct 3. Conquer the letter V and you will have no trouble making 3. The numeral 4 must be considered only as the sound-combination dididididah. Do not attempt to consider the 4 as composed of any letter-combinations (as HT), or you will get a jerky character. In sending the 4, use the same dit-rhythm as you do for the 5, making the last unit a dah instead of a di (dididid*idah*).

Group No. 5: The characters N, D, B, 6, 8, 9 and X. The N, of course, is merely a reversal of A. Practice the N (dahdi) by sending several times a smooth dahdi, dahdi, dahdi, keeping the space between the dah and di equal only to one di. In making a D (dahdidi), avoid making it sound jerky (as TI). Think of it only as the combination of sounds dahdidi, sent evenly. Likewise, the letter B (dahdididi) must be thought of only as the combination dahdididi. (It is a mistake to think of B as a letter-combination, such as TS; this results in a jerky character.) The numeral 6 calls for the same rhythm as a numeral 5, except that our first unit is a dah rather than a di. Think of 6 only as the smooth sound-combination dahdidididi, evenly spaced. The numeral 8 (dahdahdahdidi) must not be considered as the combination OI; this results in jerkiness. It is best to think of it only as the rhythmic combination dahdahdahdidi, dahdidididah, dahdididah. However, the combination $\overline{MD}$, with care taken not to leave additional space between M and D, will give you a correct 8. The numeral 9 (dahdahdahdahdi) calls for the same dah-rhythm as does the numeral Ø, with the exception that the last unit is a di instead of a dah. The letter X (dahdididah) should be considered only as the combination dahdididah. (Avoid thinking of it as letter-combinations, such as DT or TU; these tend to result in a jerky character.) In practicing X, think only of the rhythmic dahdididah, dahdididah, dahdididah.

Group No. 6: The characters G, Q, Z, 7, K, C and Y. Consider the letter G (dahdahdi) as the sound-combination dahdahdi. With care to keep the spacing correct it might be thought of as ME sent together, but it should never be thought of as TN. (This usually results in an uneven character.) Next, send a Q (dahdahdidah), considering it

as $\overline{MA}$ sent as one character. (Avoid thinking of Q as GT, which makes for jerkiness.) The letter Z (dahdahdidi) may be considered as $\overline{TD}$ sent together smoothly, although it is better to consider it only as the sound dahdahdidi. The numeral 7 (dahdahdididi) can safely be considered only as the sound-combination dahdahdididi, sent evenly. (A common mistake is to think of 7 as MS, a jerky combination.) The letter K (dahdidah) must be thought of only as the sound dahdidah, smoothly executed. (Do not think of K as any letter-combinations, as TA or NT, both resulting in unevenness.)

Probably the most troublesome of all letters is C (dahdidahdi). In order to get a smooth character C it is recommended that it be thought of as the combination $\overline{KE}$ sent as one character. Here you will find a smooth rhythm, as opposed to the combination TR or NN, which are almost sure to result in jerkiness. In actual practice many operators have found the $\overline{KE}$ combination their answer to correct formation for the letter C. Similarly, the letter Y (dahdidahdah) should be considered as $\overline{KT}$, sent together smoothly, as opposed to TW or NM. $\overline{KT}$ will give you a rhythmic Y. Master the letter K and you will have no trouble with C or Y.

In all of the above examples, it should be emphasized that the overscored letter-combinations represent one sound-combination, not the *two* sounds of each individual letter concerned. For example: KT stands for dahdidahdah (Y), one rhythmic sound; *not* dahdidah space dah, two separate letter-sounds. In practicing all characters, repeat the sound of them aloud to yourself. (Example: In practicing B, repeat to yourself dahdididi, dahdididi, dahdididi, etc.)

Determine your difficult characters and practice them until you master them. With the correct formation of each character as a basis we can proceed to combine them into words, giving consideration to correct spacing between characters and between words. With incorrect formation of even one character, our sending will lack that

"something" which distinguishes between the perfect sender and the run-of-the-mill. That is why we must first consider each character separately and practice each separately until we master them all. Then, and then only, should we start sending words.

● ADVANCED PRACTICE

To become expert in transmitting good code, after you have thoroughly learned each letter and numeral and can both send and copy letters without hesitation, your best practice is to listen to commercial automatic tape stations. Perfectly-sent code can be accomplished only by a machine, and you want to get fixed in your mind, indelibly, the correct formation of each and every code character and in particular the associated spaces. Notice the formation of each letter, the spaces left between letters and words, and the proportion in length of dits to dahs.

One of the best methods for deriving this association is to find a commercial or other tape station sending at about your maximum receiving speed. A few schedules of press transmissions which will be helpful in practice are given on an adjoining page. Listen to the transmissions as you would at a musical concert, concentrating on assimilating every detail.

The spaces between words may seem exaggerated, simply because you have probably been running yours together. A score of other details where the automatic transmission is different than yours will very likely show up in the same text. From all this you will learn where your own faults lie and be able to correct them.

If you can locate a tape station sending double (repeating each word) you can get excellent rhythm practice. Set up an audio oscillator alongside your short-wave receiver so you can hear both simultaneously. As each word comes through the receiver fix it in your mind; then, as the tape repeats it, send the same word on your oscillator simultaneously with the tape, as closely to perfect synchronism as possible. Perhaps you will find yourself leaving too much or too little

dit	■	1	
dah	▬	3	*Time duration ratio, relative to "dit" as 1*
element space	□	1	
character space	▭	3	
word space	▭	7	
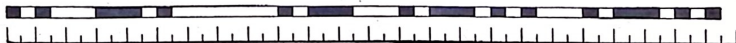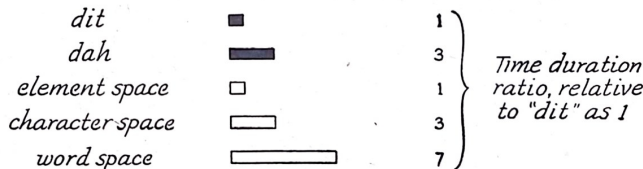
This chart shows the mechanical relations between code element-sounds, letter-sounds and word-sounds.

space between characters, or making certain dahs too long — these are the most common errors. Remember that all inaccuracies are yours, and profit accordingly. By such constant practice you will learn the proper rhythm and precision of perfect code. It's bound to work itself, subconsciously, into your sending.

Probably the most important single factor in sending ability is this sense of proper spacing. While it can be much more easily obtained by listening to tape than by visual study, the student should understand the mechanical relation of the various marks and spaces, as shown in the chart on page 13.

● **SPECIAL SYMBOLS**

In transmitting text there of course is a need for code symbols for punctuation marks, and some special procedure signals to facilitate rapid transmission. The important ones are:

Period	didahdidahdidah
Comma	dahdahdididahdah
Question mark	dididahdahdidit
Double dash	dahdidididah
End of message	didahdidahdit
End of work	didididahdidah
Wait	didahdididit
Invitation to transmit	dahdidah

Others which you might encounter in future code work, and which you therefore should learn after you become reasonably proficient with the previous characters, are:

Hyphen	dahdidididahdidah
Parentheses	dahdidahdahdidah
Colon	dahdahdahdididit
Semicolon	dahdidahdidahdit
Quotes	didahdididahdit
Error	dididididididit
Apostrophe	didahdahdahdahdit
Fraction bar	dahdididahdit
Dollar sign	didahdididahdidit
Underscore	dididahdahdidah
Percent	didahdahdidahdidahdit
Understood	didididahdit
Attention	dahdidahdidah
Separation [1]	didahdididah

Special foreign-language characters:

ä	didahdidah	ch	dahdahdahdah
á, å	didahdahdidah	ñ	dahdahdidahdah
é	dididahdidit	ö	dahdahdahdit
	ü	dididahdah	

[1] This signal is used in transmitting number text, to separate whole numbers from fractions. With the text "1½," for example, the operator would transmit "1 didahdididah ½," so the receiving operator would not copy "½."

High-Speed Operation

COPYING BY TYPEWRITER — BUG SENDING — AUTOMATIC EQUIPMENT

In high-speed copying a new principle is involved. It is one you will reach automatically if you progress sufficiently far in your practice, but it is worth explanation here.

When one first learns the code by sound, he learns letters first. (In some cases, students studying visually learn *parts* of letters first, but we have tried to obviate that error by teaching code sounds in letter-units.) With a good deal of practice, one may slowly increase his speed of copying until he reaches a certain point — differing with various individuals — which is the maximum speed at which he can copy individual letters without having them seem to run together or blur in his mental thought. The average is around 28 words per minute.

● WORD SOUNDS

Progress beyond that point must be on a new principle of copying, then. It is simply the process of copying by *word*-sounds instead of letter-sounds. An operator capable of receiving, say, 25 words per minute, can listen to 35 or 40 w.p.m. text and easily pick out the shorter, more common words such as "the," "and," "but," and so on. He can do so only because he is copying *word*-sounds and not letter-sounds. A skilled operator does not hear letters, but actual syllables and words. The code sound "didit dahdit dahdahdit" (the familiar suffix "ing"), for example, is mentally heard by the skilled operator as a complete sound and not as three different letters; again, it is as if someone had pronounced the syllable to him.

However, there is no secret to the attainment of this ability, except continued practice. You can help yourself, though, by having someone send to you rapidly (about 10 w.p.m. above your normal receiving speed) the common words and syllables such as *and*, *of*, *the*, and so on. However, nothing can equal the practice obtainable by copying commercial tape transmissions.

It should be pointed out that one important prerequisite to high-speed copying is ability to spell. Since you do not hear letters, but entire word-sounds, spelling of a word on the typewriter is up to you. True, it was sent only one way, but since you did not hear individual letters you do not know exactly which were sent; you know only what the word sounded like to you. You must know the spelling of words before you can recognize them from their code

sounds and be able to transcribe them correctly to the typewritten page.

● COPYING BY TYPEWRITER

The mark of a good receiving operator is ability to make perfect copy at high speeds on the typewriter. Ability to read rapid code "in your head" means little; what counts is what you can transcribe to paper correctly. Since the limit of handwriting ability is about 30 words per minute, one must resort to a "mill" for copy at higher speeds. This necessitates skill as a touch typist; no "hunt-and-peck" typist ever became a really good operator.

The first step, then, is to acquire that ability — by home study in a standard course, getting someone to tutor you if possible, or by attendance at some school such as an evening public school. Your typing should be nearly faultless in accuracy before you attempt code copy, although a high speed is not necessary immediately. For practice, your typewriter should be placed on a table separate from that supporting the code practice oscillator or receiver, as the case may be. A portable typewriter table, on roller casters, is excellent. Sponge-rubber pads under the typewriter feet will help eliminate vibration.

Use standard letter-size paper, and double-space between lines. Do not try to capitalize any letters at first; all lower-case type will suffice until you become proficient. Do not attempt to copy from a loudspeaker, for even with the so-

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These common English words and syllables, if sent to you by a good operator at high speeds, make excellent practice for acquiring the ability to grasp word-sounds in code.

THE	ONS	ITS	THAT	WHICH
ING	ESS	WHO	HAVE	THEIR
AND	AVE	HIM	WITH	THERE
ION	PER	MAY	FROM	WOULD
ENT	BUT	OUT	WERE	THESE
HER	NOT	OUR	THEY	SHALL
TER	DAY	ANT	WILL	GREAT
COM	INE	NOW	THIS	OTHER
ALL	ONE	YET	WHAT	ABOUT
CON	SUB	TWO	MORE	THOSE
MAN	WAS	OWN	UPON	COULD
EST	YOU	OLD	LIKE	FIRST
FOR	HIS	NEW	SUCH	MIGHT
ATE	HER	CAN	INTO	AFTER
ERS	SHE	ANY	TIME	TRANS
NCE	HAS	TED	VERY	RADIO

A student at the Enlisted Men's School at the Signal Corps' Fort Monmouth, N. J., Enlisted Men's Division gets slip-reading practice at a high-speed operating position transcribing inked tape on a typewriter.

called noiseless variety of "mill" its racket will be interference to the code sounds. Use 'phones. For sustained periods of practice, a set of sponge-rubber earphone pads will be found comfortable. If you find the headset cord getting in your way, bring the leads off the back instead of the front of your body.

Pick a station on your receiver sending at a speed you can comfortably copy, or, if you are using a code machine, set its speed accordingly. Do not expect your first hour or so of practice to be encouraging; you have to learn coördination between typing and the mental processes of copying, and that takes time. It is like the old trick of trying to pat one's head and rub one's stomach simultaneously — it's not so easy as it sounds.

In practicing, do not listen and then type ferociously for a second . . . and listen . . . and type hurriedly again. Your typing must be dissociated, consciously, from your code reception. After you are able to handle this first speed, pick stations sending a bit faster (or step up the code machine), so that you get about 90 per cent of the text; when you copy solid, again step up the speed.

● "BUG" SENDING

The complement of high-speed receiving is of course high-speed sending. You should never let your sending speed outstrip your receiving speed, however; if that does happen, it simply means that your conception of the code is mechanical rather than in terms of sound. A *semi-automatic* key, or "*bug*," can be used for speeds higher than obtainable on a "straight"

key, but in no event should a student attempt to handle a bug until he has mastered the regular key. The semi-automatic key is a mechanical device which produces a series of dits (when the proper lever is tripped) by means of a vibrating contact. Dahs are made in the usual manner, although the operating knobs work in a horizontal instead of a vertical motion. Relieved of the fatigue of tense motions involved in making rapid dits, the fingers are able to tap out code of much higher speed.

The position of the bug should be similar to that of the straight key. The arm again should be relaxed, and the right side of the hand should rest on the table immediately in front of the key. To the left of the control paddle is the thumb, which when moved to the right trips the dit vibrator; to the right of the paddle are the index and second fingers (some operators prefer to use only one), which when moved to the left operate the dah contact, similar to a straight key set on edge.

Operating motions consist of an easy roll of the wrist and hand from one side to the other. With the key connected to a tone source, practice sending a series of dits, then of dahs, then of alternating single sounds — just as we did in learning voice sounds. Take letter-sounds in that sequence, as well. Before attempting to use a bug in actual operating, you should become proficient with it through practice with an audio oscillator and headphones.

● AUTOMATIC EQUIPMENT

Government radiocommunications stations and commercial companies with a great deal of message traffic use intricate machines to speed up the flow of text from origin to destination. At the transmitting end is a Kleinschmidt or similar *perforator*, which has the appearance of an oversized typewriter. Actually, it punches holes in a paper tape in a certain pattern depending upon the keyboard letters that are struck. This tape is then run through a "keying head," a gadget with electrical contacts which operate through the punched holes and transform the punched patterns into the dits and dahs of code letters. The tape may be run through so rapidly that the keying of the transmitter is at speeds beyond the capability of a receiving operator to copy by ear — sometimes as high as 150 or 200 words per minute, while the limit of aural reception is about 70 w.p.m.

For reception of this high-speed material, a *tape recorder* is used. This device consists, basically, of an ink-fed pen at the end of a lever
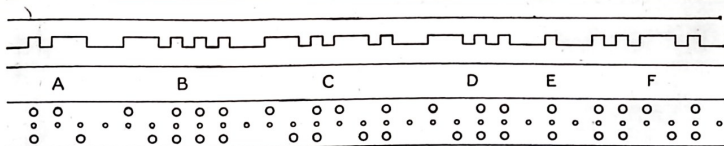
At the top, above the corresponding text letters, is shown the appearance of inked slip as it comes from the recorder. The same text is shown below in the representation of Wheatstone perforated transmitting tape. The latter is distorted in length to make it coincide with the slip text. The center line of small perforations fits the driving-wheel gear teeth. Of the larger holes, the top row operates a "make" contact relay; the bottom row a "break" contact relay.

activated by an incoming signal. The pen rests lightly on a moving paper tape and makes a representation of the dits and dahs in outline form, somewhat like the adjoining illustration. This tape, pulled by a small motor, is passed across the front of the receiving operator's typewriter, and its content is read and copied on the "mill" by the operator. It is seldom that the average student gets opportunity to practice with such a system unless he purchases one of the moderate-priced amateur recorders that have been available on the market; but fortunately it does not take a great deal of practice to become proficient in "reading slip" if one is already a skilled sound operator.

In such high-speed stations an operator is often required to be familiar with the teletype machine. This has a keyboard generally similar to a typewriter, although some rows of letters are slightly offset. With a few minutes' practice a skilled typist can adjust himself quickly to the new key locations. Of principal importance in teletypewriter operation is a precise, even manipulation; each key should be sharply struck in smooth, even sequence.

● **THE SUBCONSCIOUS MIND**

A person just learning to drive a car has no time for conversation; his every mental and physical effort is bent toward operating the car. Yet

after a few months' experience he can carry on a conversation, occasionally watch the scenery, smoke a cigarette, etc. — because he has learned to drive automatically, subconsciously. A good high-speed operator reacts instinctively, subconsciously, to incoming code — just as a good typist automatically taps out words without thinking of the position of the individual letter-keys.

This may hurt, but the reader may as well know the truth: the ability is accomplished principally by practice and more practice. Think in code, talk in code, visualize code in place of street signs; make it second-nature, just as is the use of the English language.

Psychologists tell us we can help develop our subconscious minds by mentally concentrating on one subject and physically engaging in another. For example, we might try reciting Lincoln's Gettysburg address while simultaneously writing the Lord's Prayer — or better, while copying it on a typewriter. Practice copying code, to typewriter or in longhand, while carrying on a conversation with someone in the room. Send code with "bug" or straight key, while also engaged in conversation on another subject. This sort of mental exercise will help you separate your conscious thought from your subconscious reactions so that the latter may devote themselves to code copying.

Operating On the Air

THE radiotelegraph code is used for *record* communication. Aside from ability to copy at high speeds, then, a good operator is noted for his neatness and accuracy of copy. It is evident that an operator should copy what is sent, and if there is any doubt about a letter or word he should query the transmitting operator about it.

An operator with a clean-cut, slow, steady method of sending has a big advantage over the poor operator. Good sending is a matter of practice, but patience and judgment are just as important qualities of an operator as a good fist. Very often, transmission at moderate speeds moves traffic more quickly than faster but erratic sending. In hand operating, unusual words should be sent twice, the word repeated following transmission of "?". A transmitting operator who is notified of interference on his frequency, either static or man-made, should adjust this speed of sending to require the least number of "fills." Every transmitting operator should have facilities for monitoring to check the accuracy of his sending. Accuracy comes *first*.

To this end, an operator copying in long-hand should use extreme care in writing, so there will be no chance of confusing an "l" with an "e", and the like. On a typewriter, best practice is always to double-space between lines, write ten words to a line with an extra space or two after the fifth word in each line, triple-space between lines every fifth line. This is for the purpose of rapidly determining the number of words in a message as it is sent. As one gains mill-copying skill, he will be able to typewrite subconsciously in this pattern, an example of which is here shown as a portion of text:

● ABBREVIATIONS

To speed up radiotelegraph communication, a number of standard and special abbreviations have been devised. As time is a factor, uniform practices in operating are necessary to insure a ready understanding by both operators, so proficiency in the commonly-used abbreviations is to be desired. Some of those prescribed by the regulations attached to the International Telecommunications Convention for all radio services follow:

C	Yes
N	No
W	Word(s)
AA	All after (used after a question mark to request a repetition)
AB	All before (similarly)
AL	All that has just been sent (similarly)
BN	All between (similarly)
BQ	Announcement of reply to a request for rectification
CL	I am closing my station
GA	Go ahead (or resume sending)
JM	If I may send make a series of dashes. To stop my transmission make a series of dots
MN	Minute(s) (to indicate duration of a wait)
NW	I resume transmission
OK	We are in agreement
RQ	Announcement of a request for rectification
UA	Do you agree
WA	Word after (to be used after a question mark to request a repetition)
WB	Word before (similarly)
ADR	Address (similarly)
PBL	Preamble (similarly)
SIG	Signature (similarly)
TXT	Text (similarly)
XS	Atmospherics
YS	See your service advice
ABV	Use abbreviations
CFM	Confirm or I confirm

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IN FULL FORCE STOP THE    ATTACK WILL BE SUPPORTED BY
BOMBARDMENT AVIATION WITH LIGHT AND  MEDIUM TANKS IMMEDIATELY PRECEDING THE
ARTILLERY UNITS STOP ATTACHED TO   EACH DIVISION WILL BE UNITS
OF THE SIGNAL CORPS FROM  FORTMONMOUTH NEWJERSEY UNDER COMMAND OF
MAJOR J WORTHINGTON SMITH WHOSE   DUTIES WILL BE SUPPLYING POINT

TO POINT COMMUNICATION FOR STAFF   HEADQUARTERS STOP THIRTY FIVE HIGH
SPEED OPERATORS WILL BE REQUIRED   BY EACH STAFF HEADQUARTERS FOR
THE VOLUME OF TRAFFIC EXPECTED   DURING THESE
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ITP	The punctuation counts
MSG	Prefix to radio telegram
REF	Refer to or referring to
RPT	Repeat or I repeat (to be used to ask or to give repetition of such traffic as is indicated after the abbreviation)
SVC	Prefix to service message
TFC	Traffic
P	Indicator of private telegram in the mobile service (to be used as a prefix)
NIL	I have nothing for you

XXX XXX XXX DE..., urgent signal indicating message to follow regarding safety of mobile station or persons in sight therefrom (PAN is similarly used by aircraft); TTT TTT TTT DE . . ., safety signal sent before meteorological warning messages and those concerning safety of navigation; SOS SOS SOS DE . . ., distress signal sent only by mobile stations in grave danger when requesting assistance (MAYDAY is the radiophone distress call similarly used).

There are also a number of abbreviations used by amateurs and to some extent by commercial operators. They originate with the old press codes in some cases; in others they have been concocted by individual operators and subsequently have found their way into universal use. We list below some of the more frequently-encountered ones. While some are purely arbitrary, it will be noted that others are simple phonetic spellings, some are the first and last letters of a word, some simply eliminate vowels, others use the letter X to replace part of a word, etc.:

ABT	About
AMP	Ampere
BCL	Broadcast listener
BK	Break
BN	Been, all between
BUG	Semi-automatic key
CK	Check
CL-CLD	Closing station; call; called
CUD	Could
CUL	See you later
CW	Continuous wave
DLD-DLVD	Delivered
DX	Distance
FB	Fine business, excellent
FREQ	Frequency
GA	Get answer, Go ahead
GB	Good-bye
GBA	Give better address
GE	Good evening
GG	Going
GM	Good morning
GN	Gone, good night
GND	Ground
HI	Laughter, high
HR	Here, hear
HV	Have
HW	How
LID	"Lid," a poor operator
MG	Motor-generator
MILS	Milliamperes
ND	Nothing doing
NIL	Nothing
NR	Number, near
OPN	Operation
OP-OPR	Operator
OT	Old timer, old top
PSE	Please
R	Are, all right, O.K.
RAC	Rectified alternating current
RCD	Received
RCVR	Receiver

RI	Radio Inspector
SED	Said
SEZ	Says
SIG-SG	Signature
SIGS	Signals
SINE	Sign, personal initials, signatur
SKED	Schedule
TU-TNX	Thanks
TNG	Things
TMW	Tomorrow
UR-S	Your, you're, yours
VY	Very
WD-S	Word, words
WKD	Worked
WKG	Working
WL	Will
WAT	What
WUD	Would
WX	Weather
XMTR	Transmitter
YL	Young lady
73	Best regards
88	Love and kisses

In the text of a message, however, no words should be abbreviated by the operator unless they are so written by the sender. If the text includes punctuation, it should be spelled out in English.

● MESSAGE FORM

Each radio communication service — commercial, amateur, military — prescribes its own message form, but basically all are generally similar to the example given below. A message is broadly divided into four parts: (1) the preamble; (2) the address; (3) the text; (4) the signature. More specifically, a typical message contains the following elements:

> a) Number (of this message)
> b) Station of origin
> c) Check (number of words in text)
> d) Place of origin
> e) Time filed
> f) Date
> g) Address
> h) Text
> i) Signature

Therefore, it might look like this:

NR 34 WLTK JH 13

CHICAGO ILL 450 PM MAY 12 1942

CAPT WM MONTGOMERY
MUNITIONS BLDG
WASHINGTON DC
SIXTH CORPS AREA HAS 68
MEN AVAILABLE FOR ACTIVE DUTY
FIXED SERVICE REGARDS
HUNTER WLTK

This is obviously the 34th message (of that day or that month, as the policy of the station prescribes) from station WLTK. The "JH 13" is the "sine" of the operator plus the number of words in the message text. All operators designate themselves with a personal sine to be used on message traffic and on the air; in most cases it consists of the operator's initials.

As an example of what procedure would be followed in the transmission of a commercial message, let us assume that a passenger aboard the S.S. *Coastwise* wishes to notify a friend of his arrival. Station WKCZ aboard the ship calls a shore station (WSC) and the following ensues:

WSC WSC WSC DE WKCZ WKCZ P $\overline{\text{AR}}$ K

WKCZ WKCZ WKCZ DE WSC ANS 700 K

WSC WSC WSC DE WKCZ P 1 CK12 SS COAST-WISE 0827 MAY 10 BT MISS JANET SHANNON 18 LAMBERT STREET BOSTON BT ARRIVE PIER 18 TONIGHT LOVE BT JOHN $\overline{\text{AR}}$ K

WKCZ DE WSC R 1 K

WSC DE WKCZ QRU $\overline{\text{SK}}$

WKCZ DE WSC R $\overline{\text{SK}}$

Many other designations are used in the preamble to indicate the type of message. The above message uses a P (paid) before the number. Other radiotelegram designations are as follows:

MSG	Ship's business, or master's service
P	Paid
QSP MSG	Free relay
CDE	Code
PRESSE	Press
ST	Paid service
SVC	Service
NRT	Night
TM	Multiple address
DH	Deadhead
EMPDH	Employee deadhead
FLOWER	Flower
GTG	Greetings
CODH	Company deadhead
OPRDH	Operator's deadhead
PDH	Paid deadhead
D	Urgent
MEDICO	Medical
HYDRO	Hydrographic
PIER	Special "Pier"
PC	Radiotelegram with acknowledgment of delivery by telegraph
GFT	Gift
GOVT	Government
OBS	Meteorological
RMP	Paid relay
POSTE	Radiotelegram to be delivered by mail
PAV	Radiotelegram to be delivered by air mail
SLT	Sea letter (ordinary mail)
SLTPAV	Sea letter (air mail)
RP	Reply prepaid
TC	Collated
PR	To be forwarded by registered letter
XP	To be delivered by express (sender pays)
EXPRESS	To be delivered by express (addressee pays)
XMAS	Christmas prepaid

Sometimes parts of a message are not received correctly, perhaps due to static or momentary interference by another station. In that event the interrogation (dididahdahdidit) is used between the last word received correctly and the first word received after the interruption; there is no excuse for repeating the entire message to obtain a few lost words. Appropriate international abbreviations for getting message "fills" have been previously shown. For example, if the receiving oper-

ator for the ship message quoted above had missed the number of the pier of arrival, he might send:

PIER ?? TONIGHT, or RQ PIER TONIGHT,

whereupon the transmitting operator would say,

PIER 18 TONIGHT

and stand by for acknowledgment of receipt (R).

Use R (received) only when an entire transmission has been correctly received. K (invitation to transmit) should be used at the end of each transmission while in communication with another station, and after CQ calls. $\overline{\text{AR}}$ (end of transmission) should be used at the end of messages during communication, and at the end of a call to indicate when so used that communication is not yet established. $\overline{\text{SK}}$ (end of work) should be used by an operator when signing off with another station.

● **LAND-LINE CHECK**

The land-line or "text" count, consisting of the count of only the words in the body or text of the message, is now probably most widely used. (The "cable" count covers all words in the address and signature as well, probably accounting for its unpopularity.) When in the case of a few exceptions to the basic rule in land-line checking, certain words in address, signature or preamble are counted, they are known as extra words and all such are so designated in the check right after the total number of words.

The check includes:
1) All words, figures and letters in the body, and
2) The following extra words:

(a) Signature except the first, when there are more than one (a title with signature does not count extra, but an address following a signature does).

(b) Words "report delivery," or "rush" in the check.

(c) Alternate names and/or street addresses, and such extras as "personal" or "attention." Examples: "Mother, Father, James and Henry is a family signature, no names counted extra. "John Brown, Second Lieutenant" or "Richard Johnson, Secretary Albany Auto Club" are each one signature with no words counted as extra. An official title or connection is part of one signature, not extra. "Research Department, Smith, *Jones and Brown*" as a signature would count three extra words, those italicized after the first name counting as extras. The check of a message with ten word text and three such extras in the signature would be "CK 13 3 extra."

Dictionary words in most languages count as one word irrespective of length of the word. In counting figures, a group of five digits or less will count as one word. Bars of division and decimal points may constitute one or more of the digits in such a group. It is recommended

that, where feasible, words be substituted for figures to reduce the possibility of error in transmission. Detailed examples of word counting are about as difficult in one system of count as another.

Count as words dictionary words taken from English, German, French, Spanish, Latin, Italian, Dutch and Portuguese languages; initial letters, surnames of persons, names of countries, cities and territorial subdivisions. Abbreviations as a rule should be used only in service messages. Complete spelling of words is one way to avoid error. Contractions such as "don't" should be changed to "do not." Examples:

Emergency (English dictionary)	1 word
Nous arriverrons dimanche (French dictionary)	3 words
DeWitt (surname)	1 word
E.L.B.D. (initials)	4 words
United States (country)	1 word
President Hoover (steamship)	1 word
Prince William Sound	3 words
M.S. City of Belgrade (motor ship)	2 words

EXCEPTIONS

A.M., P.M.	1 word
F.O.B. (or fob)	1 word
OK	1 word
Per cent (or percent)	1 word

The best practice is to spell out all such when it is desired to send them in messages. In groups consisting of letters and figures each letter and figure will count as one word. The one exception to this is that amateur call signals sent as a group count as one word. In ordinal numbers, affixes d, nd, rd, st, and th count as one word. Abbreviations of weights and measures in common use count as one word each. Examples:

10 000 000 (figures)	2 words
Ten millions (dictionary words)	2 words
5348 (figures)	1 word
67.08 (figures)	1 word
45¼ (figures and bar of division)	1 word
3rd (ordinal number and affix)	2 words
W1BDI	1 word

Groups of letters which are not dictionary words of one of the languages enumerated, or combinations of such words, will count at the rate of five letters or fraction thereof to a word. In the case of combinations each dictionary word so combined will count as a word. In addition USS, USCG, etc., written and sent as compact letter-groups, count as one word. Examples:

Tyffa (artificial 5 letter group)	1 word
Adecol (artificial 6 letter group)	2 words
allright, alright (improperly combined)	2 words
Dothe (improperly combined)	2 words
ARRL	1 word

At the request of sender the words "report back delivery", asking for a service showing success or failure in delivering at the terminal station, may be inserted after the check; or "rush" or "get answer" similarly, such words counting as extras in the group or check designation as just covered by example. "Phone" or "Don't Phone" or other sender's instructions in the address are not counted as extra words. In transmitting street addresses where the words east, west, north or south are part of the address, spell out the words in full. Suffixes "th," "nd," "st," etc., should not be transmitted. Example: Transmit "19 W 9th St" as "19 West 9 St." "F St NE" should be sent, "F St Northeast." When figures including a decimal point are to be transmitted, add the words "cnt dot" in the check.

Isolated characters each count as one word. Words joined by a hyphen or apostrophe count as separate words. Such words are sent as two words, without the hyphen. A hyphen or apostrophe each count as one word. However, they are seldom transmitted. Two quotation marks or parenthesis signs count as one word. Punctuation is never sent in radio messages except at the express command of the sender. Even then it is spelled out.

● NET OPERATION

In field work, many military communications units operate in "net" fashion, wherein one station (at the headquarters of the unit) is designated as net-control station (NCS) to direct the business of the net. The operation of all stations in the same net is on one single frequency, so that any one operator may hear any other station(s) without retuning his receiver. "Break-in" is advantageously employed here — the receiver is kept running during transmissions so that nearly simultaneous two-way communication is possible.

Briefly, the procedure in net operation is as follows: The NCS calls the net together at a preannounced time and using a predetermined call. Immediately, station members of the net reply in alphabetical (or some other predetermined) order, reporting on the NCS' signal strength and stating what traffic is on hand and for whom. The NCS acknowledges, meanwhile keeping an account of all traffic on hand, by stations. He then directs the transfer of messages from one station to another, giving preference to any urgent traffic so indicated at roll-call. When all traffic has been distributed and it is apparent there is no further business, the NCS will close the net, in most cases maintaining watch on the net frequency for any special traffic which might appear.

● LOG-KEEPING

FCC requires nearly every radiocommunication station to keep a complete operating record, or log, including such data as times and dates of transmissions, stations contacted, message traffic handled, input power to the transmitter, frequency used, and signature or "sine" of the operator in charge.

Log-keeping procedure differs with each class of communications service. A typical page from an amateur radio station log, prepared on the standard ARRL form, is shown above. Being that of the amateur service, the example here shown is quite free in style, yet it is illustrative of the form and data generally required.

● RADIO OPERATOR LICENSES

Except in the military services, no one may operate a radio transmitter without possessing the necessary government operator license. The penalties for unlicensed operation are severe. Licenses are issued in this country by the Federal Communications Commission, in two broad classes: amateur and commercial. As implied in the names, a commercial license permits its holder to operate a radio station for hire, while an amateur license is usable only for experimental communication "with a personal aim and without pecuniary interest." Under the Communications Act of 1934, FCC may issue licenses only to U. S. citizens. For every license an examination is required, varying in scope according to the privileges conferred by the license. Licenses are normally issued for a term of five years, and may be renewed upon application if the applicant can show recent use of the license privileges.

An applicant for an amateur operator license must appear at one of the examining points of the FCC and pass a code test of sending and receiving at the rate of thirteen words per minute, and a written examination on radio rules and regulations as well as basic theory and practice. If he lives more than 125 miles airline from an FCC examining point, however, he may arrange to take the examination by mail. For more complete information on amateur licenses, you may write to the American Radio Relay League, West Hartford 7, Conn. Among other aids, the League publishes a companion booklet, *The Radio Amateur's License Manual,* which treats this subject in detail, including paraphrased questions and answers for the examination and the complete text of the FCC amateur regulations.

Commercial radio operator licenses are issued in three classes each, under "radiotelephone" and "radiotelegraph" divisions. In each case, the first-class license carries the greatest privileges and naturally has the most inclusive requirements. FCC commercial written examinations are divided into elements, thus:

Element 1 — Rules and regulations
Element 2 — Fundamentals of radio
Element 3 — Radiotelephone
Element 4 — Advanced radiotelephone
Element 5 — Radiotelegraph
Element 6 — Advanced radiotelegraph

Each license requires the passing of certain combinations of these elements, as follows:

Radiotelephone:
  Third Class — Element 1
  Second Class — Elements 1, 2, 3
  First Class — Elements 1, 2, 3, 4
Radiotelegraph:
  Third Class — Elements 1, 2, 5; 16 w.p.m. code test, usually coded groups
  Second Class — Elements 1, 2, 5, 6; 16 w.p.m. code test
  First Class — Elements 1, 2, 5, 6; 25 w.p.m. code test; service endorsement on second-class license

Speaking broadly, in the radiotelephone division a third-class license (actually a "permit") is useful principally for police radio dispatchers and operators, and for owners of private radio-equipped aircraft and boats; a second-class license is usable for nearly all stations employing A-3 emission except broadcast and television transmitters, which normally must be operated by first-class licensees. In the radiotelegraph division, a third-class license is useful for airline and police point-to-point operating; a second-class license is good for any kind of telegraph operation except the position of chief operator aboard certain ships which must be manned by first-class licensees.

By writing to the Federal Communications Commission in Washington, D. C., you may learn which is the local office nearest you. Write the latter for data on exact time and day of commercial examinations, and to make an appointment. Simultaneously request the necessary application blanks so you can arrange for notarization in advance; if you already hold an amateur license, duplicate proof of citizenship is not necessary. Each examination element requires between 1 and 1½ hours for completion, so allow yourself time accordingly. If you fail certain elements but pass others, you will automatically be issued a license of proper grade if the passed elements entitled you to it. For example, if in trying for a second-class telegraph license you fail Element 6 but pass in all other respects, you will receive a license carrying third-class telegraph and telephone privileges.

The holding of either an amateur or commercial license is a mark of distinction in the radio-communications field and anyone wishing to enter the field of radio operating should obtain the highest grade of license for which he can qualify.

● CALL SIGNALS

Obviously every radio station needs a call signal to identify itself. In the case of military stations, these are generally arbitrarily-devised "tactical" calls which give no inkling of the location. The civil stations of the world, however, are assigned calls in accordance with an alphabetical table set up by the international telecommunications conferences, and thus it is possible to identify the nationality of a station by its call signal. "Blocks" of calls are made available to the various nations in accordance with the table hereunder. Thus, for example, any call beginning with W, K or N is seen to be a call of the United States. In many cases an initial letter is divided between two or more nations and it is therefore necessary to observe the first two letters before determining the nationality. For example, if the first two letters are XE, the station is Mexican, while if the first two letters are XU, the station is Chinese.

Whenever a three-letter call is heard (sometimes followed by a single figure) it belongs to a land station. Ship stations have four-letter calls, although such calls are also frequently used for broadcasting stations. Aircraft stations have five-letter calls. The calls of amateur and experimental stations are made up of one or two letters, a single figure, and a group of not more than three letters.

The table of international "prefixes" is as follows:

Chile	CAA-CEZ
Canada	CFA-CKZ
Cuba	CLA-CMZ
Morocco	CNA-CNZ
Cuba	COA-COZ
Bolivia	CPA-CPZ
Portuguese Colonies	CQA-CRZ
Portugal	CSA-CUZ
Uruguay	CVA-CXZ
Canada	CYA-CZZ
Germany	D
Spain	EAA-EHZ
Ireland	EIA-EJZ
Japan	EKA-EKZ
Republic of Liberia	ELA-ELZ
Japan	EMA-EOZ
Iran	EPA-EQZ
Japan	ERA-ERZ
Estonia	ESA-ESZ
Ethiopia	ETA-ETZ
Japan	EUA-EYZ
Germany	EZA-EZZ
France and Colonies and Protectorates	F
Great Britain	G
Hungary	HAA-HAZ
Switzerland	HBA-HBZ
Ecuador	HCA-HDZ
Switzerland	HEA-HEZ
Poland	HFA-HFZ
Japan	HGA-HGZ
Republic of Haiti	HHA-HHZ
Dominican Republic	HIA-HIZ
Republic of Colombia	HJA-HKZ
Japan	HLA-HMZ
Iraq	HNA-HNZ
Republic of Panama	HOA-BPZ
Republic of Honduras	HQA-HRZ
Siam	HSA-HSZ
Nicaragua	HTA-HTZ
Republic of El Salvador	HUA-HUZ
Vatican City State	HVA-HVZ
France and Colonies and Protectorates	HWA-HYZ
Kingdom of Saudi Arabia	HZA-HZZ
Italy and Colonies	I
Japan	J
United States of America	K
Norway	LAA-LNZ
Republic of Argentina	LOA-LWZ
Luxemburg	LXA-LXZ
Lithuania	LYA-LYZ
Bulgaria	LZA-LZZ
Great Britain	M
United States of America	N
Peru	OAA-OCZ
Syria and Lebanon	ODA-ODZ
Austria	OEA-OEZ
Finland	OFA-OJZ
Czechoslovakia	OKA-OMZ
Belgium and Colonies	ONA-OTZ
Denmark	OUA-OZZ
Netherlands	PAA-PIZ
Curaçao	PJA-PJZ
Netherlands Indies	PKA-POZ
Brazil	PPA-PYZ
Surinam	PZA-PZZ
Union of Soviet Socialist Republics	R
Sweden	SAA-SMZ
Poland	SNA-SRZ
Egypt	SSA-SUZ
Greece	SVA-SZZ
Turkey	TAA-TCZ
Guatemala	TDA-TDZ
Costa Rica	TEA-TEZ
Iceland	TFA-TFZ
Guatemala	TGA-TGZ
France and Colonies and Protectorates	THA-THZ
Costa Rica	TIA-TIZ
France and Colonies and Protectorates	TJA-TZZ
Union of Soviet Socialist Republics	U
Canada	VAA-VGZ
Commonwealth of Australia	VHA-VNZ
Newfoundland	VOA-VOZ
British Colonies and Protectorates	VPA-VSZ
British India	VTA-VWZ
Canada	VXA-VYZ
Commonwealth of Australia	VZA-VZZ
United States of America	W
Mexico	XAA-XFZ
China	XGA-XUZ
France and Colonies and Protectorates	XVA-XWZ
Portuguese Colonies	XXA-XXZ
Burma	XYA-XZZ
Afghanistan	YAA-YAZ
Netherlands Indies	YBA-YHZ
Iraq	YIA-YIZ
New Hebrides	YJA-YJZ
Union of Soviet Socialist Republics	YKA-YKZ
Latvia	YLA-YLZ
Free City of Danzig	YMA-YMZ
Nicaragua	YNA-YNZ
Rumania	YOA-YRZ
Republic of El Salvador	YSA-YSZ
Yugoslavia	YTA-YUZ
Venezuela	YVA-YWZ
Union of Soviet Socialist Republics	YXA-YYZ
Albania	ZAA-ZAZ
British Colonies and Protectorates	ZBA-ZJZ
New Zealand	ZKA-ZMZ
British Colonies and Protectorates	ZNA-ZOZ
Paraguay	ZPA-ZPZ
British Colonies and Protectorates	ZQA-ZQZ
Union of South Africa	ZRA-ZUZ
Brazil	ZVA-ZZZ

• "Q" CODE

In the regulations accompanying the existing International Telecommunications Convention there is a very useful internationally-agreed code designed to meet major needs in international radio communication. This code follows. The abbreviations themselves have the meanings shown in the "answer" column. When an abbreviation is followed by an interrogation mark (?) it assumes the meaning shown in the "question" column.

Abbreviation	Question	Answer
QRA	What is the name of your station?	The name of my station is ....
QRB	How far approximately are you from my station?	The approximate distance between our stations is .... nautical miles (or .... kilometers).
QRC	What company (or Government Administration) settles the accounts for your station?	The accounts for my station are settled by the .... company (or by the Government Administration of ....).
QRD	Where are you bound and where are you from?	I am bound for .... from ....
QRG	Will you tell me my exact frequency (wave-length) in kc/s (or m)?	Your exact frequency (wave-length) is .... kc/s (or .... m).
QRH	Does my frequency (wave-length) vary?	Your frequency (wave-length) varies.
QRI	Is my note good?	Your note varies.
QRJ	Do you receive me badly? Are my signals weak?	I cannot receive you. Your signals are too weak.
QRK	What is the legibility of my signals (1 to 5)?	The legibility of your signals is .... (1 to 5).
QRL	Are you busy?	I am busy (or I am busy with ....). Please do not interfere.
QRM	Are you being interfered with?	I am being interfered with.
QRN	Are you troubled by atmospherics?	I am troubled by atmospherics.
QRO	Shall I increase power?	Increase power.
QRP	Shall I decrease power?	Decrease power.
QRQ	Shall I send faster?	Send faster (........ words per minute).
QRS	Shall I send more slowly?	Send more slowly (........ words per minute).
QRT	Shall I stop sending?	Stop sending.
QRU	Have you anything for me?	I have nothing for you.
QRV	Are you ready?	I am ready.
QRW	Shall I tell .... that you are calling him on .... kc/s (or .... m)?	Please tell .... that I am calling him on .... kc/s (or .... m).
QRX	Shall I wait? When will you call me again?	Wait (or wait until I have finished communicating with ....) I will call you at .... o'clock (or immediately).
QRY	What is my turn?	Your turn is No. .... (or according to any other method of arranging it).
QRZ	Who is calling me?	You are being called by ....
QSA	What is the strength of my signals (1 to 5)?	The strength of your signals is .... (1 to 5).
QSB	Does the strength of my signals vary?	The strength of your signals varies.
QSD	Is my keying correct; are my signals distinct?	Your keying is incorrect; your signals are bad.
QSG	Shall I send .... telegrams (or one telegram) at a time?	Send .... telegrams (or one telegram) at a time.
QSJ	What is the charge per word for .... including your internal telegraph charge?	The charge per word for .... is .... francs, including my internal telegraph charge.
QSK	Shall I continue with the transmission of all my traffic, I can hear you through my signals?	Continue with the transmission of all your traffic, I will interrupt you if necessary.
QSL	Can you give me acknowledgment of receipt?	I give you acknowledgment of receipt.
QSM	Shall I repeat the last telegram I sent you?	Repeat the last telegram you have sent me.
QSO	Can you communicate with .... direct (or through the medium of ....)?	I can communicate with .... direct (or through the medium of ....).
QSP	Will you retransmit to .... free of charge?	I will retransmit to .... free of charge.
QSR	Has the distress call received from .... been cleared?	The distress call received from .... has been cleared by ....
QSU	Shall I send (or reply) on .... kc/s (or m) and/or on waves of Type A1, A2, A3, or B?	Send (or reply) on .... kc/s (or .... m) and/or on waves of Type A1, A2, A3, or B.
QSV	Shall I send a series of VVV ....?	Send a series of VVV ....
QSW	Will you send on .... kc/s (or .... m) and/or on waves of Type A1, A2, A3, or B?	I am going to send (or I will send) on .... kc/s (or .... m) and/or on waves of Type A1, A2, A3, or B.
QSX	Will you listen for .... (call sign) or .... kc/s (or .... m)?	I am listening for .... (call sign) on .... kc/s (or .... m).
QSY	Shall I change to transmission on .... kc/s (or ...... m) without changing the type of wave?	Change to transmission on .... kc/s (or .... m) without changing the type of wave or
QSZ	Shall I change to transmission on another wave?	Change to transmission on another wave.
QTA	Shall I send each word or group twice?	Send each word or group twice.
QTB	Shall I cancel telegram No. .... as if it had not been sent?	Cancel telegram No. .... as if it had not been sent.
	Do you agree with my number of words?	I do not agree with your number of words; I will repeat the first letter of each word and the first figure of each number.
QTC	How many telegrams have you to send?	I have .... telegrams for you (or for ....).

QTE	What is my true bearing in relation to you? or What is my true bearing in relation .... (call sign)? What is the true bearing of .... (call sign) in relation to .... (call sign)?	Your true bearing in relation to me is .... degrees or Your true bearing in relation to .... (call sign) is .... degrees at .... (time) or The true bearing of .... (call sign) in relation to .... (call sign) is .... degrees at .... (time).
QTF	Will you give me the position of my station according to the bearings taken by the direction-finding stations which you control?	The position of your station according to the bearings taken by the direction-finding stations which I control is .... latitude .... longitude.
QTG	Will you send your call sign for fifty seconds followed by a dash of ten seconds on .... kc/s (or .... m) in order that I may take your bearing?	I will send my call sign for fifty seconds followed by a dash of ten seconds on .... kc/s (or .... m) in order that you may take my bearing.
QTH	What is your position in latitude and longitude (or by any other way of showing it)?	My position is .... latitude .... longitude (or by any other way of showing it).
QTI	What is your true course?	My true course is .... degrees.
QTJ	What is your speed?	My speed is .... knots (or .... kilometers) per hour.
QTM	Send radioelectric signals and submarine sound signals to enable me to fix my bearing and my distance.	I will send radioelectric signals and submarine sound signals to enable you to fix your bearing and your distance.
QTO	Have you left dock (or port)?	I have just left dock (or port).
QTP	Are you going to enter dock (or port)?	I am going to enter dock (or port).
QTQ	Can you communicate with my station by means of the International Code of Signals?	I am going to communicate with your station by means of the International Code of Signals.
QTR	What is the exact time?	The exact time is ....
QTU	What are the hours during which your station is open?	My station is open from .... to ....
QUA	Have you news of .... (call sign of the mobile station)?	Here is news of .... (call sign of the mobile station).
QUB	Can you give me in this order, information concerning: visibility, height of clouds, ground wind for .... (place of observation)?	Here is the information requested ....
QUC	What is the last message received by you from .... (call sign of the mobile station)?	The last message received by me from .... (call sign of the mobile station) is ....
QUD	Have you received the urgency signal sent by .... (call sign of the mobile station)?	I have received the urgency signal sent by .... (call sign of the mobile station) at ...... (time).
QUF	Have you received the distress signal sent by .... (call sign of the mobile station)?	I have received the distress signal sent by .... (call sign of the mobile station) at .... (time).
QUG	Are you being forced to alight in the sea (or to land)?	I am forced to alight (or land) at .... (place).
QUH	Will you indicate the present barometric pressure at sea level?	The present barometric pressure at sea level is .... (units).
QUJ	Will you indicate the true course for me to follow, with no wind, to make for you?	The true course for you to follow, with no wind, to make for me is .... degrees at .... (time).
QUK	Can you tell me the condition of the sea observed at .... (place or coördinates)?	The sea at .... (place or coördinates) is ....
QUL	Can you tell me the swell observed at .... (place or coördinates)?	The swell at .... (place or coördinates) is ......
QUM	Is the distress traffic ended?	The distress traffic is ended.

Special abbreviations adopted by the American Radio Relay League.

QST General call preceding a message addressed to all amateurs and ARRL Members. This is in effect "CQ ARRL."

QRR Official ARRL "land SOS." A distress call for use by stations in emergency zones only.

Code Practice

TONE SOURCES FOR PRACTICE — A CODE INSTRUCTION TABLE — COMMERCIAL PRESS SCHEDULES FOR PRACTICE

WHISTLING or "ditdahing" is only a substitute for the high-pitched sound of radio-telegraph code. Since a person beginning his code study without constant supervision is not capable of properly manipulating a telegraph key—should not touch it, in fact, until he thoroughly knows the code-sounds — he can best learn by the spoken ditdah method. Once he progresses to the point where he is ready to learn how to send, he needs a tone source which can be keyed for sending practice. Perhaps the best way is to have two people learn the code together and send to each other by means of a buzzer-and-key outfit. An advantage of this system is that it also develops sending ability, for the person doing the receiving will be quick to criticize uneven or indistinct sending. If possible it is a good idea to obtain the assistance of an experienced operator, so that you will learn how well-sent characters should sound.

Components of simple oscillators may be obtained from local radio stores, or perhaps from the "junk box" of a radio experimenter friend.

● TONE SOURCES FOR PRACTICE

A buzzer set, connected as shown in the diagram, will serve the purpose of a signal source to be keyed for code practice. A much better tone, however, since it is identical to the audio beat note a radio operator reads, is that produced by a vacuum-tube audio oscillator. The oscillator more closely simulates actual radio signals. The battery-operated audio oscillator shown at the bottom of this page is easy to construct. However, it employs batteries, which are difficult to acquire in wartime. Besides a pair of headphones
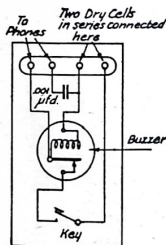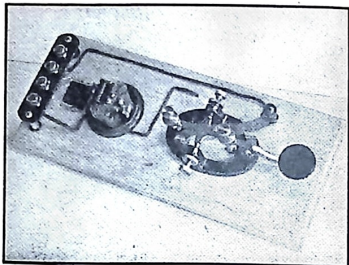

Photograph (above) and circuit arrangement (left) of a buzzer code-practice set. The headphones are connected across the coils of the buzzer with a fixed condenser in series. The value of this condenser determines the strength of the signal in the head-phones. If the value shown gives an excessively loud signal, it may be reduced to 500 $\mu\mu$fd. or 250 $\mu\mu$fd.

◆

and key, the parts required are an old audio transformer, grid resistor and condenser, tube and socket. For battery operation, the tube may be any 1½- or 2-volt filament type, such as a 1G4G,

Wiring diagram (above) and layout drawing (right) of a simple audio oscillator for use as a code-practice set. All parts are mounted directly on a wooden baseboard measuring 5 × 7 inches.

The a.c. code-practice oscillator may be built on a homemade chassis, as shown in the bottom-view photograph at the right, with 1 × 2-inch white pine supporting strips and a baseboard of ¼-inch plywood. The 6F8G is the only component mounted on top the chassis.
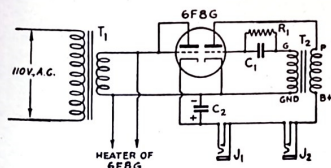
Wiring diagram of the a.c. code-practice oscillator.

C_1 — 250-$\mu\mu$fd. fixed mica condenser.
C_2 — 25-μfd. electrolytic condenser, 25-volt.
J_1, J_2 — Small closed-circuit jacks.
R_1 — 0.15 megohms, ½-watt.
T_1 — 6.3-volt 1-ampere filament transformer (Thordarson T-19F80).
T_2 — Small interstage audio transformer (Thordarson T-13A34).

1LE3, 30, etc., power being supplied by a No. 6 dry cell and a 22½-volt "B" battery. The parts may be mounted on a baseboard, as shown in the layout drawing; or they may be enclosed in a portable carrying case, in which event flashlight cells and ten or more volts of "B" battery will suffice for power. If nothing is heard in the 'phones when the key is depressed, reverse the leads going to either transformer winding; reversing both sets of leads will have no effect.

If desired, an oscillator powered from the 115-volt line may be used; the hookup of a simple one is shown above. Because of its independence of batteries, which are now sometimes a little difficult to acquire, the a.c. oscillator may be preferred.

● A CODE-INSTRUCTION TABLE

The preceding material has been written primarily for the individual who must learn his code with little or no outside help. If a number of persons wish to learn the code as a group or develop speed after learning, and if a *competent* instructor can be located, the best method of instruction is by means of a code table.

Any such table should be so wired as to permit the instructor to send to the whole class, but by a little special wiring many other things are possible. In the one shown here, for instance, each student can practice sending, independently and to himself; yet the instructor, by means of the selector switch, can listen in on each student in turn, can break in on him and correct his errors. Moreover, simply by throwing a few switches, facing pairs of students may join in independent two-way conversations, and each such pair may be monitored in turn by the instructor — all on the one table and from the common oscillator. Bigger "nets" can be switched at will, while other students at the same table
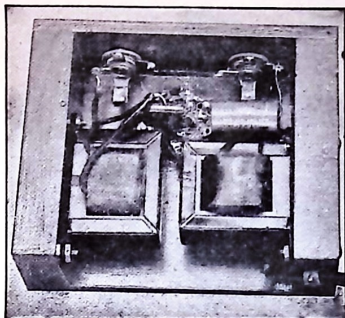
continue practice either singly or in pairs, all under control and supervision.

The instructor should sit at one end of the table, facing down its length, the students arranged along each side. A center partition and cross-partitions make a sort of "private office" of each operating position, each with its 'phones, key and switch. The oscillator is at, or handy to, the instructor's end of the table, his controls on a low panel in front of him, running across the table.

At each student's position, a key and headset in series are bridged across the line carrying the continuously-running audio tone. The headsets (and keys) may be paralleled by closing the inter-connecting switches, each switch being associated with the position of the same number. A tap from each position is taken off to the multipoint switch (S) at the instructor's position so that the latter can also place his headset and key in parallel with those at any of the ten positions.

When the instructor sends to the entire class all the small switches are closed, connecting all positions in parallel. With all switches open each student can practice sending by himself, and the instructor can listen to any student by setting the selector switch, S, to the appropriate position. This also puts the instructor in parallel with the student at that position so that the instructor can "work" the student.

Suppose now that students are to practice together in groups of two. Closing Sw_2 connects Positions 1 and 2; closing Sw_4 connects 3 and 4; Sw_6 connects 5 and 6, and so on. The odd-numbered switches would be open in this case. The instructor can listen in on any group by setting the selector switch to either position in the group, and again can break in on the work. Larger groups can easily be formed; for instance, closing switches Nos. 2, 3 and 4 will connect positions 1, 2, 3 and 4 together; closing Sw_6 and Sw_7 will connect positions 5, 6 and 7 together, and so on.
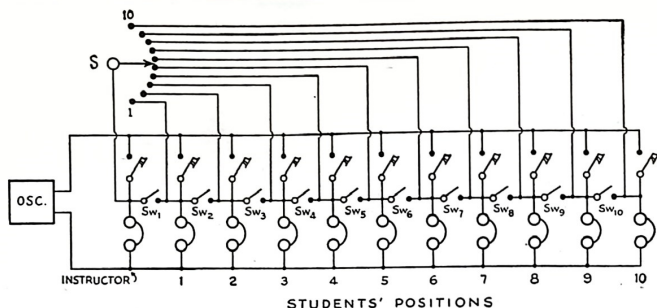
Wiring diagram of flexible multi-position code-instruction table.

The number of positions can be extended indefinitely by following the same wiring system. Separate tables, grouping perhaps ten men to a table, can be used if the room is too small to accommodate a single table for a large class. In such a case the instructor could have a central position with a separate selector switch for each table.

The code-practice oscillator described earlier in this chapter is suitable only for two or three sets of 'phones; it is, therefore, necessary to build a special type of oscillator for use with the code table. A circuit diagram suitable for handling

up to thirty or forty headsets is shown in the diagram herewith. Operating directly from the 115-volt line, it consists of a 12SJ7 oscillator followed by a 70L7GT power amplifier and rectifier. The pitch of the tone is determined by the constants of the tuned circuit, L_1C_1. The inductance should be of the order of 1 or 2 henrys for use with readily-available paper condensers. In the unit shown in the photographs this inductance is an ordinary small filter choke (Thordarson T-14C61) with the straight section of the core removed and a piece of wood of the same size and shape substituted so that the mounting clamp can be replaced.
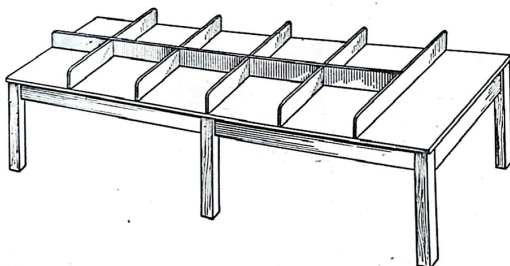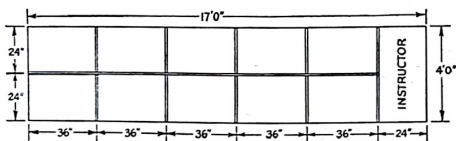
A suggested form of construction for the code-instruction table. Dimensions may be varied to suit individual needs. Legs may be made of 4 × 4-inch stock; top and side rails of 1-inch boards. Appropriate bracing should be provided underneath. A coat or two of shellac after the table is finished will prevent shrinkage.

This gives a choke of approximately 1 henry inductance.

A choice of tones should be available to avoid monotony. Variable tone is secured by means of the switching arrangement shown below the main wiring diagram. With three condensers of the values indicated, an assortment of six tones ranging from about 600 to 1600 cycles can be obtained. If only one tone is needed, however, simply use the constants shown in the main diagram.

The output switch, S_2, enables the instructor to cut off the tone from the entire class, and thus serves as a simple means of attracting attention when group work or individual sending practice is being carried on.

No specific construction is indicated for the table, since bracing and other details will depend upon the size and the builder's preferences. The important thing is to be sure each position provides enough room for the student to work comfortably. In particular there should be sufficient depth so that the key can be placed the proper distance — about 18 inches — from the edge of the table.

The interconnecting switches, Sw_1, Sw_2, etc., may be ten-cent-store s.p.s.t. knife switches and the instructor's selector switch a wafer-type unit. The latter can be obtained in the single-pole type with as many as 23 contacts.
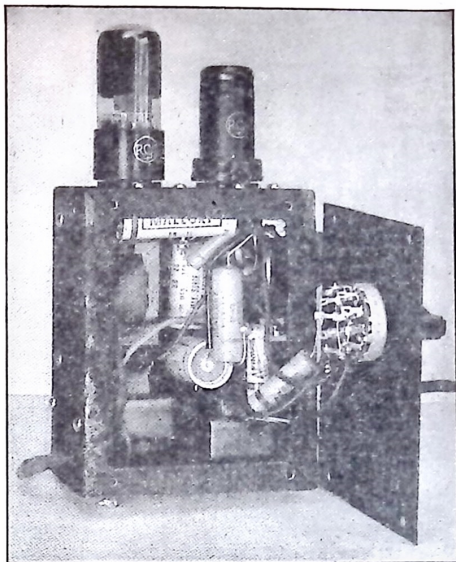
The code-practice oscillator shown in the circuit diagram below, built in a 3 × 4 × 5-inch metal box. All wiring is insulated from the case.

Since no special precautions need be taken with respect to insulation or voltage drop, probably the most economical wiring job can be done by using ordinary bell wire. In cases where the stu-
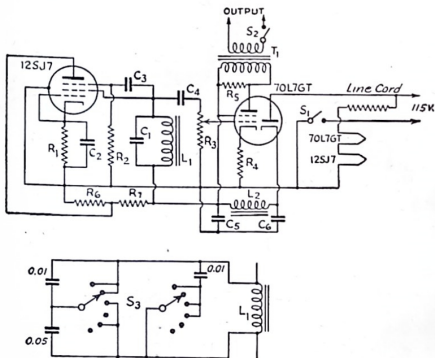
Circuit diagram of a code-practice oscillator suitable for instructing large groups.

C_1 — 0.05-μfd. paper (for tone of approximately 650 cycles where $L_1 =$ 1 henry); substitute shown at bottom circuit for variable tone.
C_2 — 25-μfd. electrolytic, 25-volt.
C_3, C_4 — 0.01-μfd. paper.
C_5, C_6 — 30-μfd. electrolytic, 150-volt.
R_1 — 2000 ohms, 1-watt.
R_2 — 0.25 megohm, $\frac{1}{2}$-watt.
R_3 — 0.25-megohm volume control.
R_4 — 150 ohms, 1-watt.
R_5 — 3000 ohms, 1-watt.
R_6, R_7 — 10,000 ohms, 1-watt.
L_1 — 1 henry, approximately (see text).
L_2 — 8-henry 55-ma. filter choke.
T_1 — Universal output transformer, tube to voice coil (connected for matching 8-ohm v.c. to 2000-ohm plate load).
S_1, S_2 — S.p.s.t. toggle.
S_3 — 2-pole 6-position wafer switch.
Line Cord — 220-ohm built-in heater-voltage dropping resistor.

dents bring their own headsets it would be advisable to mount a tip-jack assembly at each position to facilitate connection.

● COMMERCIAL PRESS SCHEDULES FOR PRACTICE

Students of code wishing to increase their copying abilities can make valuable use of transmissions by commercial stations at various speeds. A list of some good sources of practice is here given. Students making use of these transmissions are reminded that *addressed information may not be divulged except to the addressee*, and the Communications Act provides severe penalties for violators. Do not use such transmissions for anything but code practice.

Time (GCT)¹ Call	Freq (kc.)	Place	Speed
0000 NAA/NSS	9250	Wash.,D.C.	30
0000 KJY	17,440	San Francisco	45
0000 XKM4		China	—
0000 KGF2	18,460	San Francisco	40
0000 WCA	15,730	New York	45
0000 KFN	18,560	San Francisco	30
*0015 WFD/WAC	4955/10,470	New Orleans	23
*0025 KOQ	15,640	San Francisco	28
*0030 WCA	15,730	New York	45
*0030 KJY	17,440	San Francisco	45
0030 WPN	11,900	New York	35
0100 KEN	18,560	San Francisco	30
*0105 WCX/WJS	7850/15,700	New York	35
*0115 WPK/2	13,185	New York	50
*0140 KKU	15,500	San Francisco	30
*0150 WCX/WJS	7850/15,700	San Francisco	35
0200 KMN	7340	New York	35
0200 WHL2	7470	New York	—
*0200 NSS	11,475	Wash., D. C.	30
0200 WJQ	10,010	New York	30
0230 WJH	7800	New York	—
0300 WBG2	7615	New York	—
*0300 KJP	7850	San Francisco	25
0315 WPN	11,295	New York	—
*0400 WCS	7850	New York	35
0400 KOP	10,750	San Francisco	40
*0400 JUP	13,065	Japan	20
*0415 WBS	7355	New York	30
0418 WSL	11,115/5555/109	New York	30
*0418 WGG/WSC	6340/8430/21.5	New York	20
*0430 KIJ/KHI	5340/11,340	San Francisco	25
0500 WJQ/WDQ	10,010/7625	New York	25
0500 WHD	13,065	Japan	20
*0510 JUP	11,980	Japan	20
*0530 JAP	12,550/6270/97.5	San Francisco	23
*0600 KFS/KNA6	8360	New York	23
*0600 WHD	7615	New York	35
0630 WBG2-77	9250	Wash., D.C.	30
*0700 NSS	13,065	Japan	—
*0700 JUP	8810/5340	New York	25
*0730 WJP/WCF	12,735/12,380		
*0800 KPH	8400/126	San Francisco	25
	8355	Manila	25
*0800 KUH	7350	Japan	20
*0830 JAU2	12,495/11,280		
*0900 KTK	8690/6400	San Francisco	25
	18,560	New York	50
1030 WRM	19,470/15,910	New York	50
1100 WDH/WRK	7625	Los Angeles, Calif.	30
*1100 KGT5	18,560	New York	50
1200 WRM			

Time (GCT) Call	Freq (kc.)	Place	Speed
*1200 WCX	7850	New York	35
*1230 WJQ	10,010	New York	30
1300 KMN	7340	San Francisco	—
1300 XKM2	7800	China	—
*1300 WJS/WCX	15,700/7850	New York	35
*1330 WJQ/WDQ/WCA	10,010/7625/25,730	New York	30
1400 WRM	18,560	New York	50
*1440 WCA	15,730	New York	30
*1500 WJS	15,700	New York	35
1515 WBE	19,850	New York	—
1600 WRM	18,560	New York	50
*1600 WJS	15,700	New York	35
*1630 JUP	13,065	Japan	20
*1635 KOQ	15,640	San Francisco	25
1635 WJS	15,700	New York	35
*1700 WJS	15,700	New York	35
1715 WBE	19,850	New York	—
1750 WRM	18,560	New York	50
*1800 WJS	15,700	New York	35
*1800 KTV	8680	Manila, P.I.	35
1800 GBR	8640	Oxford, Eng	—
1845 WBE/WPU	19,850/14,635	New York	—
1850 WRM	18,560	New York	50
*1900 WRK/WDH	15,910/19,470	New York	25
*1900 KOQ	15,640	San Francisco	25
*2015 WJS	15,700	New York	35
2030 WPU	14,635	New York	50
2030 WCA	15,730	New York	45
2115 KFN	18,560	San Francisco	35
*2130 WJS	15,700	New York	35
*2215 WJS	15,700	New York	35
2230 KTK	16,740/12,495/7830	San Francisco	25
*2300 WJS/WCX	15,700/7850	New York	35
2300 WFC	6785		—
*2315 WRK/WHL	15,910/10,750	New York	30
*2330 KJE2	10,550	Los Angeles	18
*2330 WCA	15,730	New York	45
*2330 KJY	17,440	New York	30
0000 DLE	10,130	Germany	20
0000 DON	10,128	Germany	20
0000 GIC	8640	England	20
0000 GID	13,555	England	20
0000 GIH	10,650	England	20
0030 WPN	6410	New York	—
0040 WPJ	11,640	New York	50
0100 WCB/WBG2	15,580/7615	New York	22
0200 KUP	6440	San Francisco	—
0200 XDP	4800	Mexico	—
0200 XDD	13,043	Mexico	—
0500 VAE	8330	Vancouver	—
0545 WCX/WHL	7850	New York	25
0600 KWJ	15,000	San Francisco	—
1000 WPU	14,635	New York	50
1000 WBS/KCI2	7355/10,340]	New York/Los Ang	—
1000 VIS		Australia	—
1930 IAC	12,865		40
2030 IAC	12,865		40
2100 GIC	8640	England	20
2100 GID	13,555	England	20
2100 GIH	10,650	England	20
2200 DLE	10,130	Germany	20
2230 WBE/WJP	19,850/8810	New York	22
1230 DON	10,128	Germany	20
2300 LOL	8690	Argentina	—
2300 PPR	8310	Brazil	—

* Known to send regularly at time indicated. Stations not marked thus are known to send, but time is only approximate.

¹ GCT refers to Greenwich Civil Time, a 24-hour clock system in universal use. 0000 represents midnight; 0600 is 6 A.M.; 1200 is noon; 1800 is 6 P.M.; 2400 is again midnight (same as 0000 of the following day). Persons in the Central Standard Time zone are six hours behind GCT. For example, 0630 GCT (6:30 A.M. in Greenwich, England) must be converted, by the subtraction of six hours, to 0030 or 1:30 A.M. in CST. EST is five hours behind GCT; MST seven hours; PST eight.

Class Instruction

EXERCISES IN RECEIVING AND SENDING

THE material in this book has been prepared as a text for the individual student, principally for home-study purposes. This appended section is to explain briefly the classroom technique necessary for code instruction and to present a suggested set of lessons that a class may follow.

The classroom student should be taught in terms of sound at all times. While he should understand the use of the terms dit and dah, they need not be used in learning letter-sounds; the actual code-sound of the letter in his headphones should be the student's first conception. It is obvious that only a reasonably-proficient operator should be allowed to teach; students will acquire any improper habits of a poor operator/instructor — which, once learned, will prove extremely resistant to change.

A class in code should have the equivalent of the code-training table described in the chapter on "Code Practice," with one operating position for each student up to a total of 20, the maximum which can be taught *efficiently* by one instructor. Later in the course a code tape machine, or a communications receiver to tune in slow-speed transmissions, will be found quite helpful since while one is in use the instructor may make the rounds of the class, offering individual help.

The first code-sounds should be formed at a speed of approximately 15 words per minute, with reasonably large spaces between letters to make the overall total about 5 words per minute. By forming characters at a rapid rate, they are more likely to be learned as complete sounds instead of combinations of dits and dahs. As the class progresses, spaces between words can be shortened to increase the over-all speed. The speed of transmission may be estimated by counting the total number of letters sent in one minute and dividing by 5.

No certain number of hours has been specified for the course. Instructors may take up a new lesson when approximately four-fifths of the class can copy or transmit perfectly 50 consecutive letters of the lesson under study. Some lessons may be completed in an hour's class time; others may require five or six hours.

● LESSONS IN RECEIVING

Ten lesson-groups follow, each containing adequate practice material for classroom use. It will be noted that the order of learning letter-sounds is somewhat different here than in the opening chapter. Organized class training under a competent instructor avoids certain home-study difficulties which are best met by presentation of letter-sounds beginning with 5 and 0. The classroom system presents scientifically to the new man an interesting approach to learning the code: by taking up most-used letters first, many words and even sentences can be utilized right from the first lesson, so the student can see his progress from the start. The value of code groups has not been neglected, however; the last exercise in each lesson presents adequate coded material. The student's progress can best be graded by means of these code groups.

In each lesson the procedure should be: (1) Review the work of the previous lesson; (2) send the new characters slowly in no particular order, to accustom the students to the sound of each; at first, name the English character while its code-sound is being sent; (3) send the characters of the previous lesson indiscriminately mixed with the new ones, slowly and in no particular order; (4) send the characters of both lessons in the form of words and sentences, gradually increasing their lengths.

Lesson One:

The instructor should spend a preliminary period lecturing on the introductory material in the first chapter of this book, including the timing and rhythm exercises, but using the tone source along with ditdah and whistling.

Lesson Two:

Characters used: E T O A N I S

Practice material:

AN	NO	ON	IT	TO	SO
IS	OAT	TAN	TEN	ONE	ANT
NIT	TOT	NET	TIE	ETA	TIN
TOE	SON	SIN	SIT	SET	ASS
SEA	INTO	TENT	TONE	ANON	NINE
NEAT	TOTE	TOOT	NONE	TEAT	TINT
ETON	SEAT	EASE	SENT	TAINT	STINT
EATEN	STONE	TOAST	TEASE	SNOOT	SENSE
STAIN	TASTE	TENSE	SEASON	TONITE	SONNET

a) SIN NO ONE
b) IT SENSES TASTE
c) NONE IS SENT
d) SNOOTS EAT OATS
e) NO SEASON IS SET
f) IT IS NOT TEA
g) ETA IS A NOTE
h) NO SENSE IN EASE
i) STAINS TINT A SEA
j) ASSES NET NO SENSE
k) SONNIE SAT ON A TIN SEAT
l) IT TOASTS IN TEN TASTES
m) AN OASIS IS NEAT EASE
n) TIE A NINETEEN TON STONE TO A TENT
o) TOAST IS EATEN AT ETON
p) STAINS TAINT ONES NEATNESS
q) TOTE A STONE TO TENNESSEE
r) SONNET SEASON IS AT NITE

ETO	ANI	SIN	AOT	ESI
SAOT	NITN	SOOE	IATE	ANOE
SINES	TOEIS	NAOTE	ONTIS	ESTAO
ENTOIS	TOOSEI	OENTST	ANSENO	NANOSE

Lesson Three:

New characters used: R H D U C M L
Practice material:

RAT	RUN	RUT	RICE	RUSH	RASH	RADIO
HAD	HUM	HAM	HAND	HELM	HULL	HOUSE
URN	USE	NUT	UNIT	UNDO	URAL	UNDER
DAD	DAM	DON	DUDE	DICE	DOLT	DUNCE
COT	COD	CAM	CHIT	CORD	CURT	CHORD
MAN	MAD	MET	MOSS	MICE	MODE	MODEL
LAD	LET	LID	LEAD	LORE	LUST	LURID

REDUCE	RADIUS	RANCID	RADICAL	MARCONI
HALTER	HUDDLE	HORROR	HUMIDOR	ULTIMATE
ULSTER	UNLACE	URCHIN	UNARMED	STATION
DOLLAR	DISCUS	DANCER	DUCTILE	RESISTOR
COLLAR	CRUISE	CUDDLE	COLLIER	ANTENNA
MUDDLE	MURMUR	MOTHER	MIRACLE	AERIAL
LEADER	LANCER	LUSTRE	LECTURE	COIL

TRANSMITTER	CHROMOSOME	MEDITERRANEAN
RADIATION	DASTARDLINESS	NECESSITARIANISM
OCCLUDED	CHROMIUM	OMNISCIENCE
ANTHRACITE	EDUCATIONAL	RESIDENTIAL
AMERICAN	THERMITE	SANITARIUM

a) HAMS ARE ACTORS TOO.
b) MIRACLES SELDOM OCCUR.
c) MUSIC HATH LOTS TO CHARM.
d) MAD CATS MURDER MICE.
e) SEND CODE AND SUCCEED.
f) SOME DANCERS ARE CRUDE.
g) HENS HATCH SMALL ROOSTERS.
h) MORSE CREATED THIS MIRACLE.
i) CURSES ON ALL HEARSES.
j) RURAL HOUSES ARE HUMID.
k) ANTHRACITE COAL IS HARD.
l) RESISTANCE IS MEASURED IN OHMS.
m) UNCLE SAM NEEDS US ALL.
n) THE SUN SHINES IN CONNECTICUT.
o) CODE CLASSES ARE LITTLE TOIL.
p) CHARACTERS ARE DOTS AND DASHES.
q) CODE IS HEARD NOT SEEN.
r) MARCONI LECTURED ON CURRENT RADIATION.
s) INTO DEATH MARCHED THE THREE HUNDRED.
t) AMATEUR RADIO IS AS OLD AS THE RADIO ART.

URT	HLU	ADC	CIM	SLE
LTRH	OAUD	NICM	SRHL	MAUE
HSDNM	RHUAC	ODNCL	SICDO	IUHER
TCODME	ADHRHU	CNDUTR	SLMIRU	LSEIRC

Lesson Four:

New characters used: P F W Y G B
Practice material:

POW	PEP	PIG	PAGE	PYRE	PITY	POPPY	PUFFY
FOP	FRY	FIG	FROG	FLOW	FILE	FABLE	FOGGY
WEB	WON	WHY	WHIG	WOLF	WING	WHIFF	WEIGH
YIP	YOU	YEG	YOWL	YELP	YAWN	YOUNG	YACHT
GOB	GYP	GIN	GLOW	GASP	GRUB	GABLE	GLOBE
BOY	BEG	BIT	BANG	BEEF	BLOB	BADGE	BEFOG

PACIFY	PEBBLE	PHLEGM	PEPPERY	AFFLICT
FEEBLE	FIDGET	FLINTY	FAIRWAY	BABYLON
WAFFLE	WEAPON	WINDOW	WAYWARD	CABBAGE

		FISHWIFE
DEPOSITORY	ELECTROTYPE	TAPE
PYGMY	GUYWIRE	MESSAGE
ALPHABET	PRACTICE	SIGNAL
SUPERHET	GEAR	FILTER
CAPACITY	FLYWHEEL	STABILITY
CRYSTAL	PURPOSE	AMPLIFIER
FACTOR	BEATNOTE	

a) EPIGRAMS SAY MUCH IN FEW WORDS.
b) WHAT IS WORTH DOING IS WORTH DOING WELL.

c) FORTUNE BEFRIENDS THE BOLD.
d) ILL BLOWS THE WIND WHICH PROFITS NOBODY.
e) WINGS FLY FAST.
f) WHIFFS OF FOG PACIFY FEEBLE AFFLICTIONS.
g) BOYS YELP WHEN BIT BY DOGS.
h) A PUFFY BLIMP IS A PEPPERY FISHWIFE.
i) PENTODE AMPLIFIERS RELAY POWERFUL SIGNALS.
j) RUBBER WHEELS AFFECT RIDING COMFORT.
k) PUT YOUR FLYWHEEL IN GEAR.
l) GASP AND YOWL BUT BUY DEFENSE BONDS.
m) WHOOP IT UP BEFORE DYING.
n) LIGHT GLOBES GLOW WITH POWER.
o) TIGHTEN CAP BEFORE TIPPING.
p) THE BADGE OF COURAGE IS WON BY PLUGGING.
q) ALWAYS COPY BEHIND IF POSSIBLE.
r) BICYCLE RIDING CAUSES PUFFING.
s) COPYING BY TYPEWRITER IS GOOD PRACTICE.
t) PYGMY GUYWIRES PUT STRENGTH INTO POLES.

HFM	ODW	AUY	NCG	IMB
FHEP	PRTF	YUOW	WDAY	BMNG
BCADF	GUOHP	YDTRB	WHEMG	FRSCY
PSDGCB	FUIYMW	AWPFLY	GHORBG	WRNFEY

Lesson Five:

New characters used: J K Q X Z V
Practice material:

JET	JUNK	JAVA	JERK	JACOB	JAPAN	JELLY
ASK	KINK	KEEP	KALE	KHAKI	KNACK	KNAVE
QUO	QUIT	AQUA	QUIZ	QUICK	QUAIL	QUEEN
JIM	OXEN	AXLE	XRAY	EXACT	AXIOM	OXIDE
ZOO	ZERO	JAZZ	ZING	AZURE	CRAZY	ZEBRA
IVY	VINE	HAVE	VOID	VIVID	AVAIL	EVERY

JACKAL	JERKIN	JOVIAL	JONQUIL	ZENITH
KIBITZ	KINGLY	KAISER	KICKOFF	EMBEZZLE
QUARTZ	QUAVER	QUORUM	ACQUIRE	PULVERIZE
PICKAX	EXCUSE	XERXES	EXPLAIN	GRAZE
ZEPHYR	ZIGZAG	ZOUNDS	BUZZARD	OXYGEN
VIXENS	VELVET	VIKING	VICTORY	QUADRUPLE

a) JACOB ASKED THE KING FOR QUARTZ OXIDE.
b) QUICK AXIOMS AVOID UNJUST TAXES.
c) QUIZZES QUICKEN THE REFLEXES.
d) JOVIAL KIBITZERS ARE VERY OBNOXIOUS.
e) JAPANS JUNK QUITS QUICKLY.
f) EVERY QUEEN KEEPS JONQUILS.
g) HEXAGONAL KNUCKLES HAVE CRAZY KINKS.
h) XERXES EXPLAINED THE QUICK VICTORY.
i) VELVET QUAIL GRAZE IN ZOOS.
j) KINGLY BUZZARDS QUAVER IN AZURE SKIES

JPR	SNQV	QYLGV	ZKJFBG
FKH	JAHK	XWOFZ	RHKPVO
DQW	ZGVM	KPCAJ	QLFPDQ
XYU	YXUT	BZLNX	XMZNJU
ZGM	ZWDO	IVKQW	YKWZBG
BVC	KBLI	YJCTV	HSIXJA
QPX	JFRE	EQSXR	MCVXZQ

Beginning with the next lesson, instructors may make good use of newspaper and other text for practice material.

Lesson Six:

New characters used: 1 2 3 4 5
Practice material:

215	3242	34125	244521
431	2151	42153	352142
234	4531	33214	332312
551	5324	24115	545134
422	1543	53425	152342
342	3154	14523	453152
351	2231	21435	514324

AE1	CP2X	3Z4BJ	123VJQ
3T5	14B3	XYZ51	W3X5AM
420	F3G4	3KP14	435PT1
N43	EAR5	RY311	AW1JOZ
2MC	424V	14V4U	2UV4JB
HT5	D1J3	L3VJ4	XU4PY1
425	412V	21JJ2	5SH32W

Lesson Seven:

New characters used: 6 7 8 9 Ø

Practice material:

867	9768	77689	967760
906	0060	90870	806070
760	7987	68096	688979
896	0869	86970	087068
707	8776	09006	786096
908	8609	87780	779680
807	7068	87669	696087

196	3874	62840	647359
245	1928	17395	821073
837	5603	61723	489625
604	7495	89450	107446
932	1620	42417	829310
758	4835	39850	59375S
103	2071	59636	621054

C3B7	Q78G	F3MØJ	Y9UBC	A1B3C2	9105P4
JW19	H5SH	132R5	WJV41	4D6F5E	Q6U3V4
47BE	4CY3	9LAPV	9OX23	9HG7JI	SM3801
X6Z2	ZK67	K176B	PQ954	8LØKM3	6Q7GT

Lesson Eight:

At the conclusion of the seventh lesson, most students should be able to recognize letters and numerals immediately when heard. If not, more practice is indicated, especially on the characters causing trouble. It will be helpful to send some words containing letters frequently confusing to the beginner such as G-W, F-L, O-S, P-X, Y-Q:

GOWN FILM ARK JAW OASIS APEX QUERY WAGER LEAFLET WORKER BLOSSOM EXPERT

The following sentences employ every letter of the alphabet:

a) THE EXPLORER WAS FROZEN IN HIS BIG KAYAK JUST AFTER MAKING QUEER DISCOVERIES.
b) WHENEVER THE BIG BLACK FOX JUMPED THE SQUIRREL GAZED VERY SUSPICIOUSLY.
c) MY HELP SQUEEZED IN AND JOINED THE WEAVERS AGAIN BEFORE SIX O'CLOCK.
d) WE DISLIKE TO EXCHANGE JOB LOTS OF SIZES VARYING FROM A QUARTER UP.
e) A QUART JAR OF OIL MIXED WITH GOOD ZINC OXIDE MAKES A VERY BRIGHT PAINT.
f) WHILE MAKING DEEP EXCAVATIONS WE FOUND SOME QUAINT BRONZE JEWELRY.
g) SIX JAVELINS THROWN BY THE SAVAGES WHIZZED FORTY PACES BEYOND THE MARK.
h) THE PUBLIC WAS AMAZED TO VIEW THE QUICKNESS AND DEXTERITY OF THE JUGGLER.
i) WE QUICKLY SEIZED THE BLACK AXLE AND JUST SAVED IT FROM GOING PAST HIM.
j) THE JOB REQUIRES PLUCK AND ZEAL FROM EVERY YOUNG WAGE EARNER.

Lesson Nine:

New characters used: Comma, period, interrogation, double dash (BT), end of message (AR), end of communication (VA), wait (AS), fraction bar (DN).

Practice material:

Continue practice of plain text, now including punctuation. It is not necessary to conduct instruction in more rare punctuation until the student progresses somewhat further.

Also, send the students some messages in standard form, using all procedure signals necessary in the process (see chapter on procedure operating). Send some with texts in the form of cipher groups, as well.

Lesson Ten:

To acquaint the student with receiving conditions as he will find them in actual radio communication: Play a couple of broadcast receivers while giving the students practice; or have some of the class engage in audible conversation.

If communications receivers are available, tune in code signals that can be heard while practice is going on. Decrease volume of the practice tone source. Vary tone and stability of the source. Use commercial press schedule transmissions for code practice.

● LESSONS IN SENDING

The chapter on "Learning to Send" should be thoroughly re-read at this point. It will serve as an outline of lesson material, additional practice exercises being given herewith. When taking up new material, the instructor should first send the characters he wishes his students to learn, and then have them repeat individually after him. Characters can then be combined to form words, sentences and code groups for additional practice. Here again, the instructor should thoroughly review a preceding lesson before attempting new material. While learning to send, the student's speed of transmission should be kept low until he demonstrates ability to send all the characters correctly.

Lesson One:

This period should be devoted to learning proper posture, grip of key, hand and wrist movements, and exercises in sending multiple dits and dahs, as outlined in the sending chapter.

Lesson Two:

Characters used: E I S H 5 T M O Ø

Exercises:

SEE	MOST	SHEET	MISSES	HEMOTH
HOT	HISS	THEME	THESIS	HOSTESS
SIT	EMIT	MOIST	ESTEEM	SOMETIMES
HOE	TOSS	HOSTE	SMOOTH	MOTTOES
OHM	THEM	SHOOT	SETTEE	SIMMER
595	Ø559	59595	559Ø59	595Ø59

a) SEE ME HOME SOME TIME.
b) HIS TEETH SEEM A MESS.
c) MISS THIS SHOT.
d) THIS IS HIS HOME TOO.
e) I SEEM TO OMIT IT SOMETIMES.
f) OTTO MEET HIM THIS TIME.
g) HE OMITS THE ITEMS HE MISSES.
h) THE HOE HIT ME THIS TIME.
i) THIS IS OTIS SHOE.
j) HE HIT HIS HOSTESS 5Ø TIMES

Lesson Three:

New characters used: A R L W J 1 P

Exercises:

LIL	WILL	LAIR	PLATE	HAWSER	PALATE
OWL	PASS	LAME	SPELL	ATTIRE	RAPIER
LAW	MAIL	PAIL	ALERT	HAWAII	WALLOP
APT	REEL	PEAR	JEWEL	ASHORE	RESISTOR
PAR	TRIP	RAIL	REPEL	ARTIST	LASSOES
JAP	LAST	WASH	RALPH	JESTER	JEEPERS
RIP	JAIL	POLAR	WHILE	AERIAL	REMORSE
5Ø1	JOWL	TRIAL	RATHER	JEWISH	JARMINE
JIM	51Ø5	5Ø191	515Ø1Ø	PALLOR	Ø51ØØ

a) RALPH PASS THE PLATE.
b) ALERT HAWAII RESISTS JAPS.
c) THE LAW REPELS LAME JESTERS.
d) HE WILL LET LIL SPELL RESISTOR.
e) REAL AERIALS ARE JEWELS.
f) JEWISH HATS ARE APT ATTIRE.
g) RATHER PALE PALLOR APPEARS AT HIS JOWL.
h) HAWSER REELS WASH ASHORE.
i) PHILIP WALLOPS THE ARTISTS JAW.
j) POLAR MAIL IS SLOW.

Lesson Four:

New characters used: U F 2 V 3 4
Exercises:

AVE	FIVE	HUMUS	MUSEUM	SITUATE
EVE	FUSE	STOVE	FERVOR	ISTHMUS
SUE	FIFE	SHAFT	RAFFLE	FAVOR
IOU	VILLE	UNFIT	FAMOUS	FEVER
OFF	JAVA	SIEVE	VELLUM	SHOUT
FLU	SURE	RUFUS	VERSUS	FRUIT
VIA	OVUM	PUFFS	FURROW	VOLUME
234	4132	59312	154392	123459

a) FAMOUS FRUITS PUT FLAVOR INTO LIFE.
b) SUE SURE HAS FLU.
c) EVE MUST VOTE VIA RUFUS.
d) ASSUME THE STATUS OF SOVIET RUSSIA.
e) AUTOISTS MOUNT VAST SUMMITS.
f) LET US VETO THE ISSUE OF UTAH.
g) FROM HUMUS ISSUES SCUM AND MUSS.
h) MUFFLE THE SHOUTS FROM JAVA.
i) PURSUE THAT AUTO SOUTH.
j) OUR SUITS ARE SURE FAMOUS.

Lesson Five:

New characters used: N D B 6 8 9 X
Exercises:

BOX	698	OXEN	OXIDE	19964	DEXTER
NED	BOND	6289	BANAL	BUBBLE	EXPAND
DEN	NEXT	DUMB	DEBUT	DIDDLE	491523
BUS	DRAB	DIXIE	ANNEX	BINDER	ABANDON
AXE	EXAM	EXTRA	NINTH	DINNER	BENEATH
BID	NEED	BUXOM	NOBLE	BAXTER	DENTIST
SIX	BURN	BOUND	EDITION	DEXTRIN	AMBITION

a) ABANDON BURNED OXEN FOR DEAD.
b) ONE MAN DID NOT BET.
c) BAD ADDITION MADE NED DUMB.
d) EXTRA BOXES ARE NEEDED IN MADISON.
e) BOBS AMBITION MADE HIM BANAL.
f) DONT MENTION DRAB SUBJECTS AT DINNER.
g) SEND NO NOTES ABOUT DISUNITED NATIONS.
h) EXPANDED BASES NEED EXTRA MEN.
i) INSANE INDIANS BEHEAD BUXOM DAMES.
j) NOT DEXTRIN BUT OXIDES NEED BE USED
   IN DENTAL LABORATORIES.

Lesson Six:

New characters used: G Q Z 7 K C Y
Exercises:

GUY	QUAY	GOOFY	GALLEY	KNUCKLE
COG	QUIZ	QUICK	QUARTZ	OXYGEN
QRA	AGED	CRAZY	KIBITZ	JONQUIL
DIZ	ZERO	KNACK	KINGLY	EXCUSE
KIN	KICK	CHECK	CACKLE	13579
KEY	CODE	YACHT	PACIFY	GAZELLE
COY	COPY	QUACK	654729	73737
EKE	8714	96472	ZONITE	QUIRKS
719	1357	PYGMY	KAZOO	COCKY

a) GOOFY PYGMY COGITATES QUIZZICALLY.
b) JONQUILS GLORIFY KINGLY PACIFIC YACHTS.
c) QUACKS CANT COPY CRAZY CODE GROUPS.
d) KIBITZERS EXCUSE MY KNACK OF CACKLING.
e) INQUIRING SCIENTISTS CHECK OXYGEN
   MASKS.
f) PSYCHIC CRYSTAL GAZERS EKE CRAZY
   QUIRKS.
g) AGED CYGNET HECKLES YOUNG GAZELLE.
h) DIZZY QUIZZES QUICKLY GYRATE MINDS.
i) GALLEY COOK SCRUBS DECKS WITH ZONITE.
j) CUT ZIRCONIUM QUARTZ TO 700 KILOCYCLES.

At this point the instructor should conduct a general review of Lessons One through Six, including: additional practice in sending characters causing trouble to particular students; sending of plain text by students, instructor to comment on quality; sending of coded groups by students, instructor likewise to comment.

Lesson Seven:

New characters used: Common punctuation marks and procedure signals learned in a comparable receiving lesson.
Exercises:

In addition to sending of plain text with elementary punctuation included, students should send some messages in standard form, using all the necessary procedure signals; instructor to listen and comment, showing the correct method if any errors occur.

Lesson Eight:

Instruction from this point may take the form of lectures and exercises based on the "advanced" chapters of this booklet, covering high-speed operation, typewriter copy, bug sending, general operating data, etc.

— • • • • —

Selections from the following text will be useful as practice material in tests for accuracy of copy. Speed of transmission should be somewhat below the average of the class, since this is exceedingly difficult text:

SENTIENT ENTENTE UTTER TRANSCONDUCTANCE EVASIVE JUJUTSU KHANATE QUOIT
OINTMENT MENTION ONION ONTOGENY REENTER FAFNIR IRITIS TMESIS CENTENNIAL
SENTIMENT SEDIMENT MENDACIOUS OUSTER STERLING LINGERIE AERIAL ALUMINUM NUMB
TOMFOOLERY ERRONEOUSNESS ETESIAN JANISSARY JINRIKISHA SHAH NIFLHEIM NUMBERED
ZENANA NATANT TANTAMOUNT ANTECEDE EDELWEISS XANTHIPPE PEPWERMINT MINIMIZE
ZETHUS.NAUSICAA HEXAHEDRON

MISSTRESSSHIP TETEATETE DEBILITATE PUNXSUTAWNEY MUTAUL ZIGZAG YTTERBIUM
MAMMA ENSIFORM XYST MNEMONIC ENFEOFF BREVET XYLYLENE TSETSE BREE SHIRR
ATAXIA HESSIAN ATTESTATION OSSEOUS TATARIAN UITLANDER WHEEEZE CHLOROPHYLL
DEVISEE MISSISIPPI HOMONYM JINNEE ICHNEUMON ZOOPHYTE LYDITE NAIVETE PYJAMA
REREDOS QUEUE VIVIVOCE GEISHA SKOVVEIEN ONOMATOPOEIA ULULATE YWAINE TIRESIAS
32343B SCHEHERAZADE ISIS FORESHEET XIPHOIDIAN MNEMOSYNE ERRATIC

TANTALUM UMLAUT AUTUMN MNEMONICS ICHTHYOPHAGOUS NICTITATING NIHILISM TEUCRI
ISEULT TENNESSEE JERERD ORIENTATE JEQUIRITY SIESTA ARIES SIMOOM SIRENIAN
APPANAGE PATENTEE YTTRIA LAITY UDOMETER ERRANT VITEBSK ANTEATER AORTA
BACCARAT DEIFY COOPERAGE FANFARONADE TIENTSIN GENRE HAWAIIAN QUARTERN KANAKA
KAYAK LIGNIN NITER DROHOBYCZ VERISIMILITUDE WAPITI VALLETTA CACATECAS 7M3432
LAUTTASAARI ENZYME MELLIFLUENCE BYSSUS VALUVULAR FINDESIECLE

The HRO gives superb unfaltering service, 24 hours a day, week in and week out, year after year. It's a receiver to depend on.

NATIONAL COMPANY, INC., MALDEN, MASS.
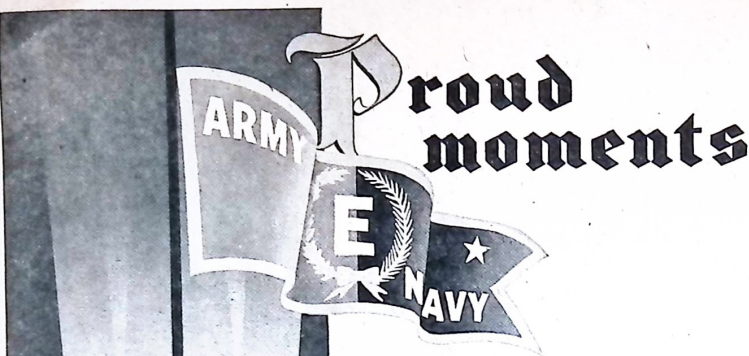
Proud moments

On November 8, 1943, the men and women of the McElroy Manufacturing Corporation were awarded the Army-Navy "E". Six months later, on June 5, 1944, our efforts were again recognized when the White "Star" was sewn on the flag which flies above our building. Proud as we are of the products we manufacture, we are even prouder of the two high compliments which have been paid to us by the military services of the United States.

Here, in Boston, we have a happy factory group. There are several hundred of us . . . fine men and women . . . putting our utmost into each job. On the basis of thirty years' experience, I have ideas as to what constitutes good telegraph apparatus. Our engineers work out the original models which are later translated into actual equipment by our skilled personnel.

As for our selling policy . . . we have no salesmen. We do have a few resident representatives at points where they may be helpful. To these men, and to the men and women of McElroy plant, I'd like to say — thanks . . . keep building for Victory.

McElroy engineers are constantly alert to the needs of our industry. The equipment we produce stands as eloquent testimony to their efforts. We never imitate. We never copy. We design. We build. We deliver. Perhaps a McElroy engineer can be of service to you.

McElroy MANUFACTURING CORP.
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WORLD'S LARGEST MANUFACTURER OF AUTOMATIC RADIO TELEGRAPH APPARATUS

IMPROVED radiotelegraph communications from

SHIP to SHIP
SHIP to SHORE
POINT to POINT

NEW McELROY
ELECTRONIC CODE TAPE PERFORATOR PFR-443-A

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Entirely mechanical, the PFR-443-A comprises two units: The Keying Unit which is made up of an assembly of two keys, the space bar and punching mechanism; plus the Electronic Unit which relieves the keying contacts of high current and voltage, and provides for utmost ease in operation.

Operation of the PFR-443-A is similar to a semi-automatic ("bug") key excepting that the transmission of dots and dashes is automatic. A light touch actuates the punching mechanism for as long as either the key or space bar is depressed. Experienced operators can maintain, with ease, an accurate speed of more than 40 words per minute . . . in all Morse combinations assigned to the Russian, Turkish, Greek, Arabic and Japanese alphabets and languages, which are not found on the keyboards of standard perforators manufactured in the United States and Great Britain. *Write for additional information.*

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Whenever you see the McElroy name on a piece of equipment... that's McElroy and nobody else. We never imitate... never copy. We create... design... build... and deliver. One of our most notable achievements is the new XTR-442 BM Automatic Transmitter— an essential where transmission must be regulated to a given number of words per minute. The new XTR-442 BM comprises two units.
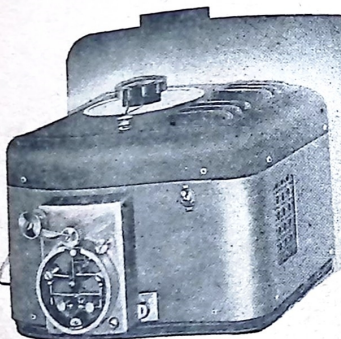
Keying Unit which consists of the McElroy keying head coupled to a newly designed drive. The speed of the keying head is instantly adjustable at any rate from 10 to 200 words per minute. At any given setting, the rate cannot vary because of the constant speed motor.
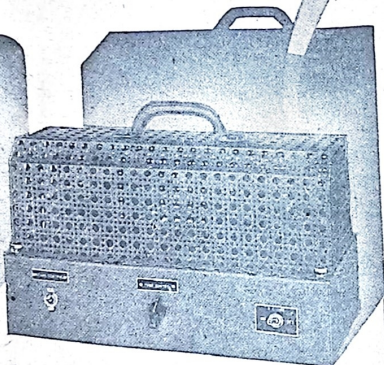
Electronic Unit which responds to the keying head to produce either tone for keying a radiotelegraph transmitter, or to key a transmitter with a heavy-duty pivotless relay. The tone can be impressed on a radiofrequency carrier current, sent to a remote transmitting station, filtered and used to operate a transmitter without requiring relay action. The heavy-duty relay in this unit may also be used to break the actuating current to a relay in a radiotelegraph transmitter.

BLOOD IS AMMUNITION ... GIVE A PINT TO THE RED CROSS TODAY

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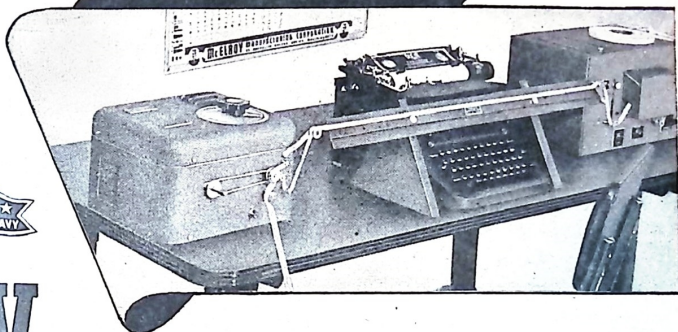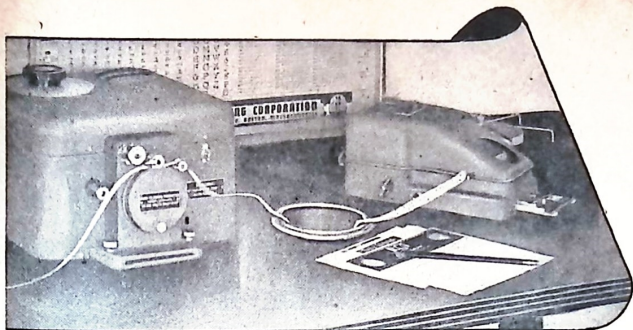
We dare to be different

We dare to explore...we dare to try the unfamiliar. In this manner, our creative engineers have built the world's largest organization devoted to the design and manufacture of automatic radiotelegraph apparatus.

Indicative of the *McElroy technique are these completely automatic transmitting and receiving assemblies. Designed in the McElroy plant, these installations are typical of the high-speed radiotelegraph equipment that we supply to such international companies as RCA Communications, Mackay Radio, Globe Wireless . . . and to the military branches of the government. Descriptive literature of all McElroy apparatus may be obtained by writing direct to us.

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FOR MORE RAPID, MORE ACCURATE, MORE EFFICIENT TRANSMISSION OF DOTS AND DASHES
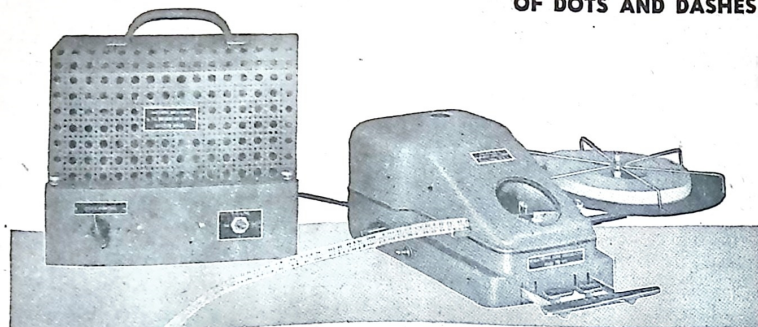
McELROY ELECTRONIC CODE TAPE PERFORATOR PFR-443-A

For **improved** radiotelegraph communications from **ship-to-ship, shore-to-shore, point-to-point.** Entirely mechanical, the PFR-443-A comprises two units. **The Keying Unit** which includes an assembly of two keys, space bar and punching mechanism . . . plus the **Electronic Unit** which relieves the keying contacts of high current voltage, and provides for ease in operation. Experienced operators can easily maintain an accurate speed of more than 40 words per minute . . . in all Morse combinations assigned to the Russian, Turkish, Greek, Arabic and Japanese languages.
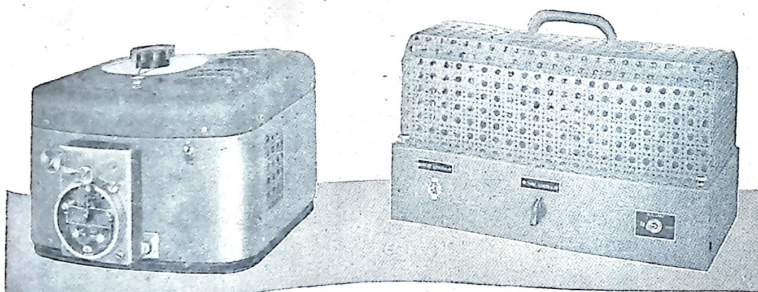
McELROY MODEL XTR-442 BM AUTOMATIC TRANSMITTER

An essential where transmission must be regulated to a given number of words per minute. **The Keying Unit** consists of the McElroy keying head coupled to a newly designed drive. The speed is adjustable at any rate from 10 to 200 words per minute, and at any given setting, the rate cannot vary. **The Electronic Unit** responds to the keying head to produce either tone for keying a radiotelegraph transmitter, or to key a transmitter through the medium of a heavy duty pivotless relay. The tone can be impressed on a radiofrequency carrier current, sent to a remote transmitting station, filtered and used to operate a transmitter without requiring relay action.

Requests for additional information will be handled promptly

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A FEW AIDS TO GOOD SENDING
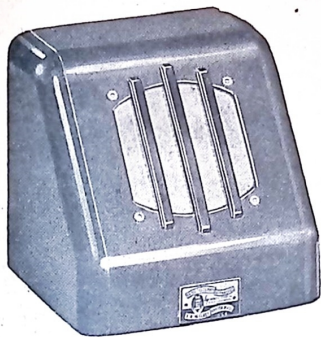
MASTER OSCILLATONE MS-700

This powerful audio oscillator may prove to be most valuable in teaching or learning code. Operates on 110 volts, either AC or DC. Uses 117N7GT or 117P7GT tube. Headphone output is "off the ground" with additional provision for keying "off the ground." Whenever desired, speaker can be cut out entirely. Encased in attractive plastic case with protective speaker grille.
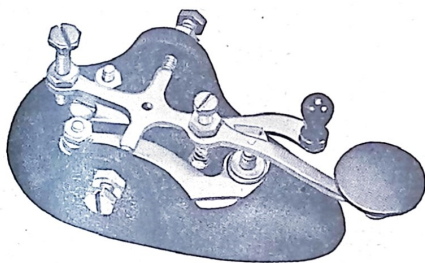
MODEL 200 STREAMKEY

McElroy, the world's champion telegrapher, continues to set the pace in the design and construction of keys that are ideal aids to sending good code. This manual streamkey is well proportioned with the heavy metal base casting finished with two coats of baked wrinkle enamel. Balanced key lever with pigtail connection to base. 3–16" platinoid contacts. A "natural" for any operator.
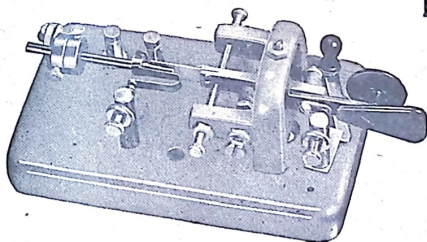
MODEL 500-742 SPEED KEY

An excellent, professional "speed key" incorporating all the design refinements developed by McElroy in his 25 years as a champion American Morse and wireless operator. Metal parts are either cadmium or chrome plated. Pigtail connections, bakelite paddle and knob, 3–16" platinoid contacts, Swedish blued steel main spring and U spring.

Schools engaged in training operators, and distributors, in the middle or far west may facilitate deliveries of these products by contacting Telegraph Apparatus Co., 325 West Huron Street, Chicago, Illinois.

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DEATH *before* DISHONOR!
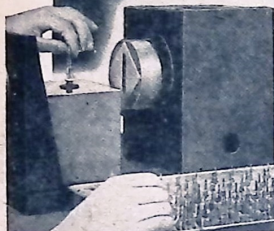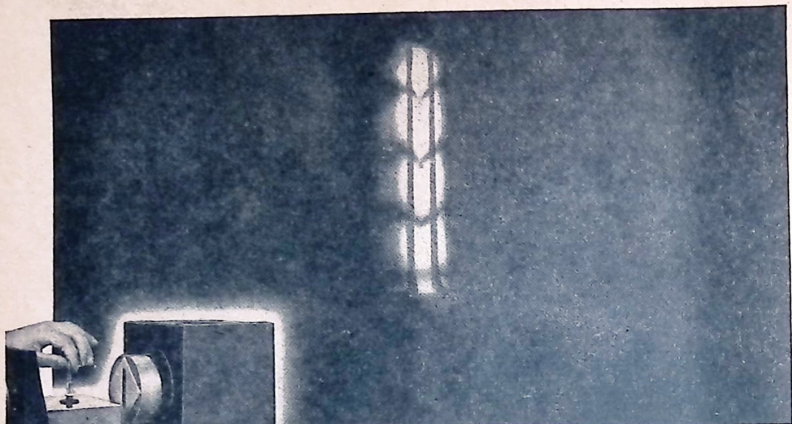
Observation of the stress points on glass bead seals around vacuum tube leads is made with this device. Close-up photo above shows the actual view of a faulty lead. Note the change in polarized light creating distorted shadows which show up stress and strain in beads. Such strain sometimes occurs where metal and glass are sealed together.

Casual observation of a vacuum tube does not reveal its flaws. That's why Eimac engineers have developed many devices for the purpose of exposing even slight weaknesses in construction. The above is not a dungeon window, but a close-up photo of a faulty bead on a filament stem as viewed through a special bead testing device. Needless to say, this stem will never reach final assembly . . . better "death before dishonor" to the Eimac tradition of dependability.

Such care in production plus constant research into the phenomenon of the electron tube assures you of the utmost in performance from every Eimac tube . . . provides the answer to why Eimac tubes are first choice by most of the leading engineers throughout the world.

Inspecting the entire glass bulb with the help of a polarized light. This device shows up stress and strain on the glass which might be created during the shaping operations.

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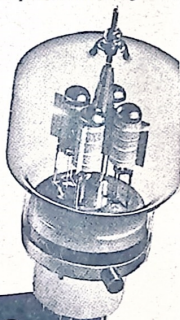
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TUBES

Mfg. by Eitel-McCullough, Inc., San Bruno, California, U. S. A.
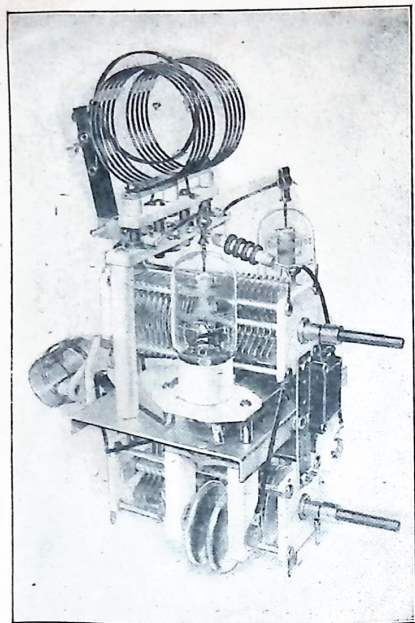
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