THE FUNDAMENTALS OF TELEGRAPHY FOR BEGINNERS

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MENOMINEE, MICHIGAN

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INTRODUCTION

TELEGRAPHY is a system of communication unexcelled and unrivaled by any other method of transmitting intelligence. It employs a code of signals composed of dashes, dots and spaces transmitted over a wire through the use of a telegraph key and received by a telegraph sounder.

So marvelous has been the growth of Telegraphy that at present there are more than three hundred and fifty thousand telegraphers engaged in the various fields.

The purpose of this book is to give you the fundamentals of Telegraphy. It is not a finished course but after the code is mastered in both sending and receiving it will be an easy matter for the student to adapt himself quickly to the methods used by railroads or commercial telegraph companies.

The rules embodied herein, are standard as near as it is possible to make them and the student should remember that the rules of the various railroads differ and we suggest that the student secure a book of rules of the railroad or commercial telegraph company to acquaint himself with their particular requirements before accepting a position.

CHAPTER ONE

THE TELEGRAPH KEY

The Telegraph key is the first instrument that the student should acquaint himself with. It is a mechanical device for opening and closing the electric telegraph circuit and is used for the purpose of forming the characters composing the telegraph code.

The key consists of a lever mounted on trunnions and equipped with a composition knob. There are four adjustment screws and the various adjustments are shown in figure No. 1.

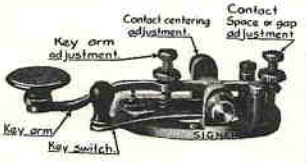


Fig. 1

The student should acquaint himself with the various adjustments and various parts of the key first, making sure that the contact points on the lever and base are in line; and before making any adjustments, see that the lock nuts are loosened, otherwise it is possible to strip the threads on the adjustment screws. The key switch (see Figure No. 1) is fastened to the frame and is equipped with a hard rubber knob. This switch should be closed when receiving a message and opened when sending, and when dry cells are used on a circuit the instrument should never be left with this switch closed as it will soon wear out the batteries. In actual operation with proper hook-up or circuit this switch is always closed when through sending as you will find explained later. The key as shown in Figure No. 1, has two binding posts on the top but there are some who prefer the leg key (see Figure No. 2) in which the leg screws are the terminals and are used in place of the binding posts.

All keys are adjusted and set properly before leaving the factory, however, it is possible that in shipment, a key will lose its adjustment; therefore, study your key closely and you will understand the reason for each adjustment and when sending try adjusting adjustment screws and set to the best adjustment for your hand. You should be able to make contact with a very light touch because a good operator sends with ease.

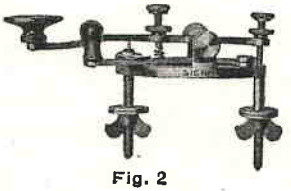


Fig. 2

THE SOUNDER

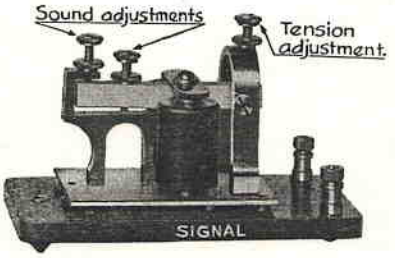


Fig. 3

The telegraph sounder is the receiving instrument from which the receiving operator reads the Morse characters made with the key, (see Figure No. 3). It consists of a bar and electro-magnets, movable lever with iron armature and a small coil spring, (see Figure No. 3). The sounding bar is pivoted in the bar frame and securely fastened to the armature of the electro-magnet. When current passes through the magnet core, the armature is attracted to the cores and the bar is pulled downward

against the bridge of the sounder frame. When the flow of current ceases, the cores no longer attract the armature and the bar is pushed upward to the upper stop on the sounder frame by the action of the spiral spring near the pivoted end of the bar. The movement of the bar should be about one-sixteenth of an inch and the distance can be regulated by means of adjusting adjustment screw (see Figure No. 3). After the proper adjustments are made it should never be tampered with.

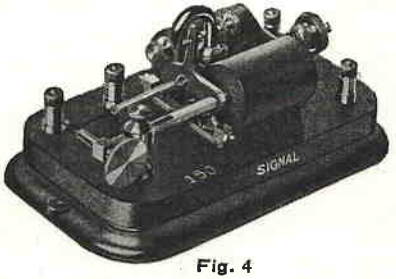


Fig. 4

THE RELAY

The relay is similar somewhat to the sounder although it is different in appearance and is not intended to produce a sound like the sounder. It is very sensitive to weak currents and weak signals and should always be used on circuits one mile or more in length. We recommend that the student use a relay in all circuits so that he can acquaint himself with the characteristics of this instrument. The relay being a very sensitive instrument and working in parallel with your sounder, the circuit current can be very low but your sounder will still produce the proper sound with a relay in the circuit; where no relay is used your voltage must always be kept at its highest peak.

The armature is mounted vertically and the coils horizontally.

The fine coil spring holds the armature away from the coils. The only practical work the electro-magnets have to perform is to overcome the tension of the spring because the armature is balanced. The relays cannot be used for receiving messages and great care should be taken in adjusting the relay. Remember that it is a very sensitive instrument and should be adjusted accurately. The armature when drawn towards the poles of the magnet should be parallel to the face of the poles and if not properly adjusted, loosen contact screws in the relay head and the base screws that hold the armature base, then place the armature firmly against the pole base and tighten the base screws and take care to maintain the wire connections which will be found in the base. The contact points must also be centered. The holes in the base are large enough to permit this adjustment.

Now, loosen the lock nuts and adjust contact screws in the relay head so that the armature will not touch the pole base and will give a movement of about 1/32". The clearance between the armature and the poles of the magnet should be about the thickness of an ordinary piece of writing paper when the armature is drawn towards the poles.

The tension of the armature spring should then be adjusted by turning the posts which wind up or let out the threads to which the spring is attached. The armature trunnion screws need not be reset until after long service and the armature should have plenty of play for free operation.

VARIOUS TYPES OF BATTERIES

There are three types of batteries that can be used in connection with Telegraphy; namely, dry cells, the sal-ammoniac cell and the gravity cell.

Fig. 5

The dry cell is the most used of the three types. It is intended for open circuit or intermittent duty only, and is the most practical type of battery for use with a learner set. There is no danger of spilling any solution; it is portable and very clean, but it should be remembered that when using a dry cell, it should always be disconnected when not actually in use. These dry cells are not re-chargeable.

The gravity cell, or wet battery, is considered best for service on lines in constant use. One unit is known as a cell and a number of cells comprise a set of batteries. It consists of a glass or glazed earthen jar, a piece each of copper and zinc (known as positive and negative poles, respectively), and a blue vitriol (copper sulphate), or bluestone solution.

After the materials have been procured, the jar should be thoroughly washed and the battery assembled in the following order: Spread out the leaves of the copper electrode and place in the bottom of the jar. A battery jar 5x7" requires 1¾ to 2 lbs., of copper sulphate and a jar 6x8" requires about 3 lbs., of copper sulphate. Place about one-third of the charge of copper sulphate between the leaves of the copper electrode. Dissolve the remainder in enough lukewarm water to fill the jar to within one inch of the zinc (crowfoot) when the latter is hung on the edge as shown in figure No. 6. Now connect the terminals of the cell together by means of a piece of wire and when the solution has cooled off to the room temperature, add water to it very carefully and slowly bringing the level of the water to about one-half or three-quarters of an inch above the zinc. Be very careful not to stir the solution and in pouring the water, it should never be poured directly into the jar; make a little trough of cardboard and pour the water on the cardboard allowing it to flow easily into the jar.

Fig. 6

The chemical action between the blue vitriol and the electrode produces the electric current as furnished by the battery. It requires approximately three days for this action to become effective although the time can be reduced if a little zinc sulphate (about three ounces) is dissolved in the water. It will be seen that the battery is short-circuited by the wires mentioned above and it should be left this way for six to twenty-four hours, depending upon whether or not zinc sulphate has been used. The action of the gravity cell depends upon the formation of a solution of zinc sulphate in the top of the jar. This solution is clear. The blue vitriol solution slowly diffuses through the white solution causing a chemical action to take place between the sulphate of copper and the zinc. When no zinc sulphate is used, there will be an almost black deposit formed on the zinc. This should be removed care being taken so as not to disturb the solution while removing the zinc for cleaning and replacing it.

As the battery is used, the line of demarcation between the two solutions will gradually recede towards the bottom of the jar and clear water should be added whenever necessary to bring the liquid in the jar to the proper level and a few crystals of copper sulphate should be gently dropped into the jar to keep the blue vitriol solution at the proper height and be sure to keep the same amount of crystals in the bottom of the jar at all times.

It will be necessary to clean the battery every eight weeks or three months.

The zinc electrode should be taken out, scraped and then washed thoroughly. The electrolyte may be saved for further use; therefore, it should be poured into a jar while the battery jar is being cleaned of all dirt and sediment. The copper electrode should also be washed. The materials may then be re-assembled and the battery placed in operation again in the same manner as previously directed. The battery works best when it is warm and all parts including connections should be kept free from dirt and rust and should be protected against freezing. In cleaning, any crystals remaining at the bottom can be used over. They should be rinsed and drained and are ready to use again. Set up the battery as explained above using clean crystals of blue vitriol in the solution which was saved. Great care should be taken in pouring the clear solution into the blue vitriol to mix them as little as possible.

The gravity battery should be connected to a high resistance when not in use so as to keep a small current flowing through it. A stick thoroughly coated with graphite makes a good shunt. The graphite from the lead pencil is satisfactory.

CONNECTING DRY CELL BATTERIES

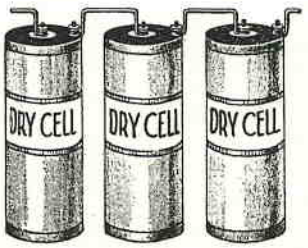


Fig. 7

For telegraph work, except in installations which are unusual, the cells are always connected in series. (See Figure No. 7). Series connections means that the positive terminal of one cell is connected to the negative of the next cell (zinc or outside post, is positive; the center or carbon post, is negative). When the cells are all connected the remaining two connections are then connected with the telegraph circuit. In a connection of this method, the voltage of the various cells is added together and the combining voltage used is the circuit voltage. For instance, four dry cells will give a voltage of six volts (one and one-half volts per cell). This voltage is open circuit voltage.

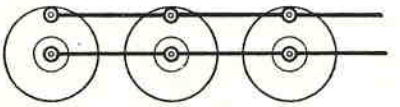


Fig. 8

Parallel connections (see Figure No. 8), are very little used and therefore, very little will be said regarding same. Under this method, the positive terminals of the cells are all connected together and a wire run through the external circuit. Then the negative terminals are all connected together and to the other lead from the external circuit. All cells must be alike. The voltage is that of a single cell, but this method gives a current output capacity which makes it possible to draw as many times as the current capacity of one cell, as there are cells.

Multiple connections or cells multiple, is a combination of the connections just explained above.

TO SET UP THE BEGINNER'S SET

The beginner's set (Figure 9) consists of a key and sounder mounted on a wooden base with three connection posts.

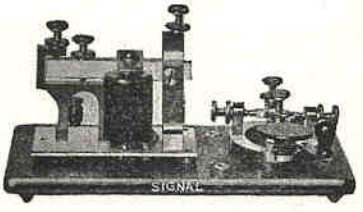


Fig. 9

Screw the instrument firmly to table wherever it is intended for a permanent location. When securely fastened down, the sound is greatly increased. Carefully inspect the instrument to see that no parts were loosened while it was in transit but do not make any adjustments until after a thorough trial has been given it and a battery connected to it, otherwise you may disturb its adjustments as they are all properly adjusted before leaving the factory.

One wire should be run from the binding post nearest to the key to the center or negative connection of a dry cell; then a wire connected from the post nearest the end to the outer or positive connection of the dry cell. Then close the key switch and the instrument should click. Do not leave switch closed.

There are several diagrams on the next pages of various connections and stations which can be used with the learner set, and be careful when you make connections of the batteries, be sure they are connected so that the batteries are not opposed because an electric circuit is always a complete loop and if the loop is traced in one direction, it will be found when properly connected, that upon leaving the positive pole of one set of cells the circuit arrives first at the negative pole of the other set, and if they are not connected in this manner, the batteries are opposed, will quickly run down and the instruments will not work properly. It is best to make a test set up. For instance, if you are going to have two or more stations, hook them up all together on the top of a table and then test them out to see that they work properly and if they do, your circuit is correct and you may then proceed to wire up the various stations at their permanent locations.

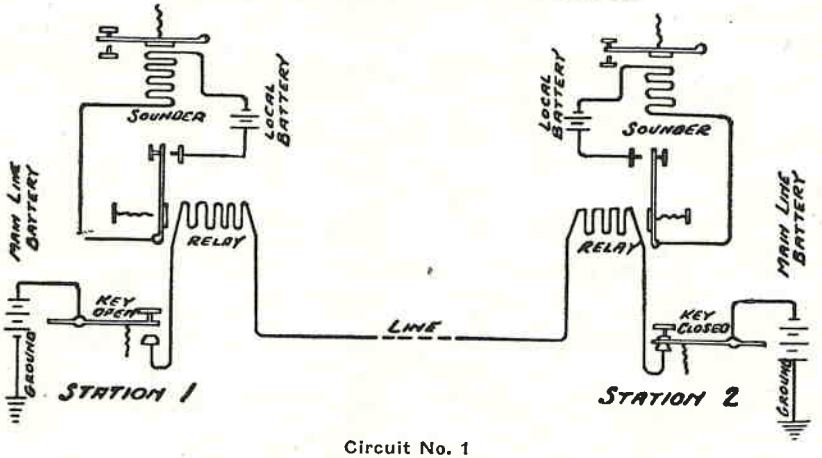
Dry cell batteries cannot be used on closed circuits. It is necessary to leave one or both keys open when you are through using your set. This makes it impossible to call from either end of the line, but you will find a circuit described where dry cells can be used with a small push button and buzzer. (See circuit No. 3). It is also possible to use dry cells as described on Circuit No. 2, but neither of these two circuits are standard. For a standard circuit see circuit No. 1.

LIGHTNING ARRESTERS

In running a line outside of the building regardless of length, it is best to always use a lightning arrester in the circuit. The same lightning arrester as used on radio sets is very satisfactory. For wiring between buildings, we recommend the use of copper wire and remember that outside wires should always run on glass insulators and in passing through a building, they should pass through porcelain tubes tilted so that they drain outside and in splicing wire, a good splice is shown above and wherever possible, they should be soldered and if it is insulated wire, it should always be wrapped with rubber and friction tape.

A Good Connection

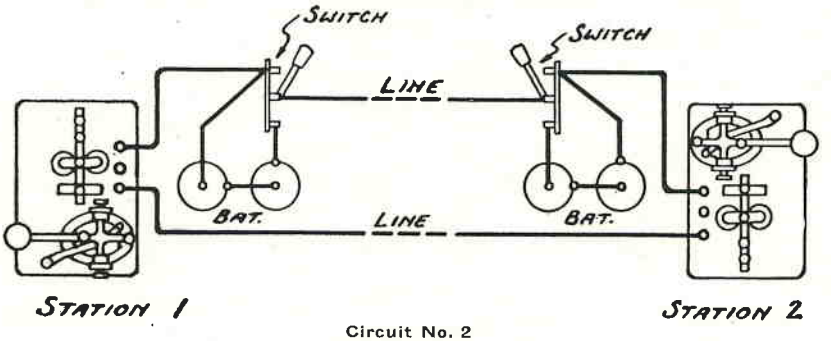
CIRCUIT NO. 1, RELAY CIRCUIT



Circuit No. 1

This would be the best circuit to use and is recommended on lines of one mile or more in length. The functions of a relay have been previously explained. Its use in telegraph circuit increases the sensitiveness of the instrument. It is far more sensitive than the sounder and those who wish to become acquainted with the operation of standard equipment and circuits, we recommend the use of relays on all circuits. It is connected on a circuit as shown in circuit No. 4 and is placed in the circuit, the same as the sounder. It is not to be used in place of the sounder, but as explained above, its function is to make your circuit more sensitive. The diagram above is very simple and very easily connected.

CIRCUIT NO. 2



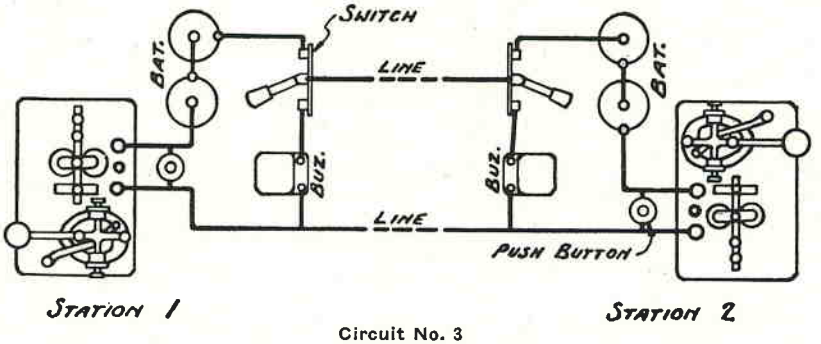
Circuit No. 2

This circuit was designed to use with dry cell batteries and with the use of a small knife switch and by proceeding as follows, one station can call the other:

When the circuit is not busy the knife switch must be closed in the upper position and the key switches closed. Now, station No. 1 is calling Station No. 2. Station No. 1 throws the knife switch to the lower side (or battery side) of the switch and opens key switch and proceeds to call Station No. 2 by sending Station No. 2's initials or pre-determined signal. No. 2 answers by throwing the knife switch to the lower side (or battery side) of the switch and opens his key switch. Then Station No. 1's sounder will not click which signifies that Station No. 2 is ready. Station No. 1 closes the key switch and station No. 2 answers and the wire conversation then proceeds.

When the conversation is completed, each operator must throw the knife switch in the upper position and close the key switch. Failure to keep the switches in these positions when not in use will cause the batteries to run down very quickly.

CIRCUIT NO. 3



Circuit No. 3

In addition to the two learner sets and the batteries, a small push button, buzzer and knife switch are required. The connections are made as the circuit shows above and when Station No. 1 wants to call Station No. 2, Station No. 1 proceeds as follows:

The knife switch must always be in the down position (on the buzzer side of the switch) and the key switches closed. Station No. 1 throws the knife switch in the upper side (or battery side) of the switch and presses the push button which will cause the buzzer of Station No. 2 to buzz. Station No. 2 hears the buzz, throws his knife switch in the upper position (on battery side) of switch, opens his key switch and answers. The wire conversation then proceeds.

When the conversation is completed, both knife switches must be in the lower position (or to the buzzer side) of the switch and the key switches must be closed.

LETTERS

A	B	C	D	E	F	G	H	I
•–	–•••	–•–•	–••	•	••–•	––•	••••	••

J	K	L	M	N	O	P	Q	R
•–––	–•–	•–••	––	–•	–––	•––••	––•–	•–•

S	T	U	V	W	X	Y	Z	&
•••	–	••–	•••–	•––	–••–	–•––	––••	•–•••

NUMERALS

1	2	3	4	5
•––––•	••–––•	•••––•	••••–•	•••••

6	7	8	9	0
–••••••	––••••	–––••••	––––••	–––––

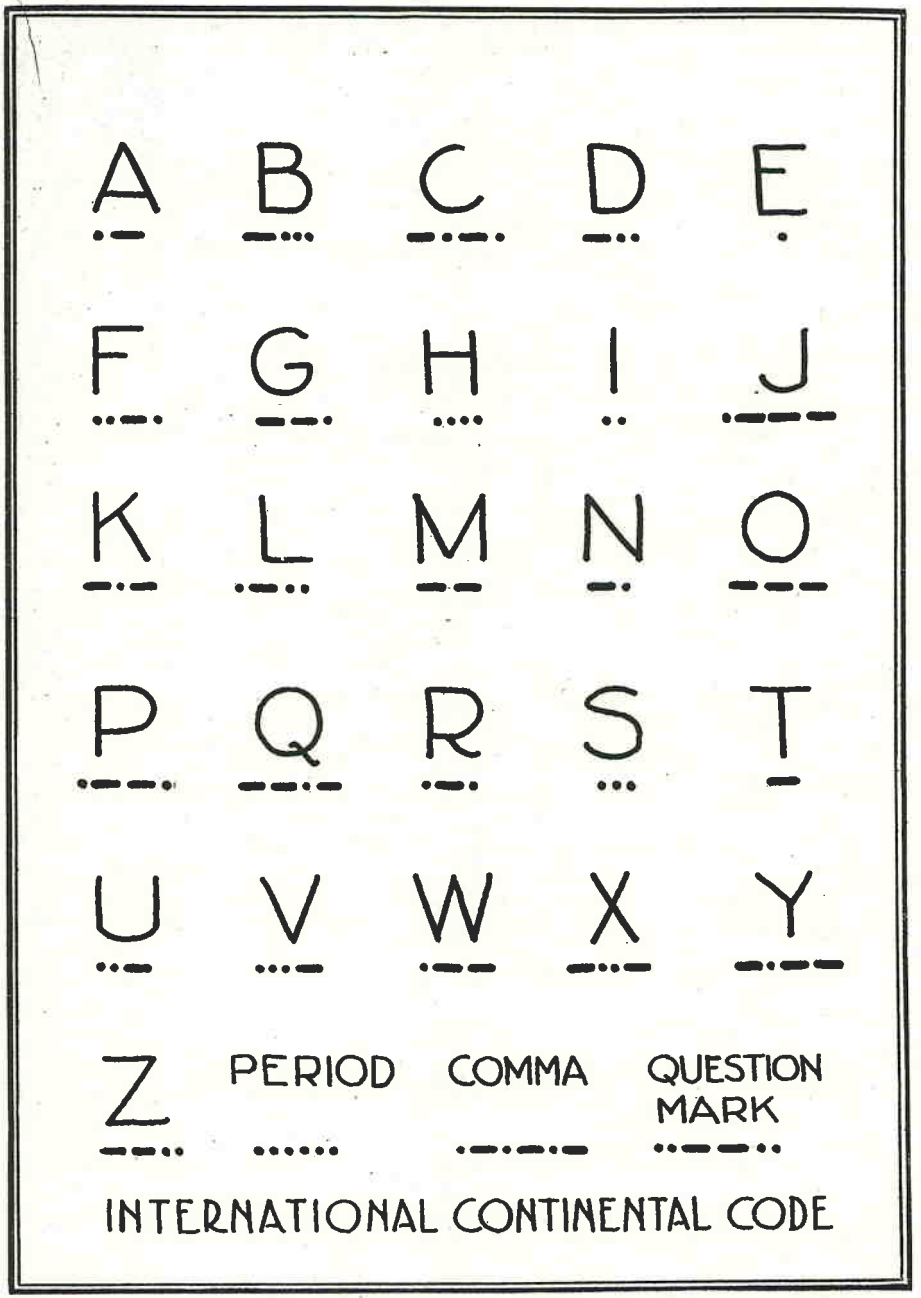
PUNCTUATION MARKS

PERIOD	COMMA	INTERROGATION
•–•–•–	––••––	••––••

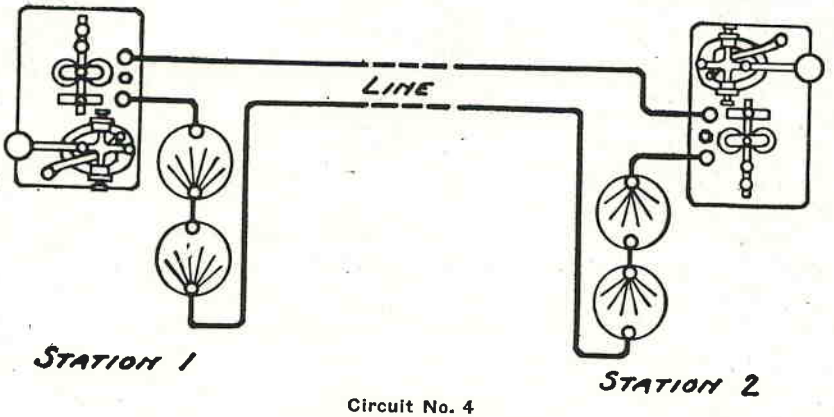
COMMERCIAL PUNTUATION MARKS

NAME OF MARK	MARK	HOW MADE
DOLLAR MARK	$	SX •••–••–
DASH	–	DX –••••–••
PARAGRAPH SIGN	¶	MM ––––
CAPITAL LETTER SIGN	(NO MARK)	CX •• •••–••
DECIMAL POINT	•	DOT –•• • • • –
CENTS MARK	¢	C •• •

MORSE CODE


A B C D E
F G H I J
K L M N O
P Q R S T
U V W X Y
Z
PERIOD
COMMA
QUESTION MARK
INTERNATIONAL CONTINENTAL CODE

CIRCUIT NO. 4



Circuit No. 4

Circuit No. 4 is a simple circuit using a crowfoot or gravity battery. If dry cells or solammaic are used the connections are similar in series with the telegraph circuit, but remember that in the event the set is to be used at each end of the line, they must be connected so that they are not opposed.

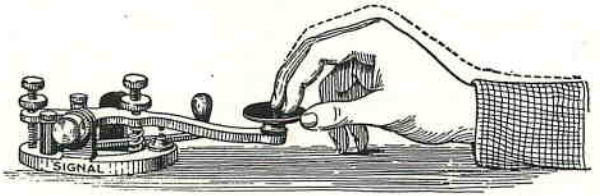
LEARNING THE CODE

In learning the code, it is first necessary to memorize the code alphabet and after the alphabet is thoroughly memorized, then it is necessary to start the key practice, and the grip most general in use is shown on page ten. The arm from the elbow down should rest on a table and all of the movement must be made with the wrist only.

The telegraph alphabet is composed of dots, dashes and spaces; for instance, A is a dot and a dash, B is a dash and three dots, C is two dots a space and a dot, etc. The dot is the shortest sound that can be produced on a telegraph instrument. The dash is three times as long as the dot, and the space is a brief space of time between dots. The letter T is one dash and the letter L is a long dash. The letter T or short dash is made by holding the key arm down three times as long as a dot. The letter L or long dash is made by holding the key arm down twice as long as for the letter T, or short dash. The naught or cipher, is an extra long dash. It is three times as long as the letter T or short dash.

The complete telegraph alphabet or the code is shown on the following page. As stated above, memorize the code so that with a pencil you can write down the code of each letter from memory as this will simplify your work a great deal when you begin using the key and after the code is thoroughly memorized, then take a short paragraph from a newspaper or book and transpose the words into the code, then check it up against the code as shown in this book for corrections.

KEY PRACTICE



The Proper Grip

The best operator is the one who can dispatch the greatest amount of work with the greatest amound of speed, but accuracy is more essential than speed. A graceful, easy, method will make the student more efficient and to a good operator, talking with the telegraph key becomes as easy as writing with a lead pencil.

Do not clamp the key tightly. Avoid cramping your hand or your sitting position, for sitting in a cramped position, or holding the key tightly, will make it impossible for you to ever become efficient. Always hold your key as lightly as possible. Do not try to send too fast at the beginning. Make your letters slowly and after a week's practice you can then begin to increase your speed.

LESSON 1, USING THE KEY

Practice the following dot letters. Send each one at least one hundred times before you try the next letter, and after you have completed the six letters, then send two letters; for instance, EI, then SH and then P6. Make each one at least fifty times and then make the three letter combination.

S	I	E	H	P	6
...	..	.	....	.....	.....

LESSON 2

Practice the following dash letters in the same manner as Lesson 1.

T	L	M	5	0
—	——	— —	— — —	——

LESSON 3

The following are a combination dot and dash letters and the dash and dot letter is made as follows: For instance, the letter A. Make it just as though you were making two dots except hold your key arm down on the last dot three times as long as for the first dot. Practice makes perfect. Do not go from one lesson to the other until you have mastered the previous ones. See that no spaces are left between the dots and dashes or combination dot and dash letters. You should now be able to send without the necessity of counting the dots and dashes. You should be able to begin to recognize each letter by sound.

A	U	V	4
.—	..—	...—	....—
N	D	B	8
—.	—..	—...	—....

F	J	G	K	Q	W	X
.—.	—.—.	— —.	—.—	..—.	.— —	.—..

1	2	3	7	9	Period
.— —.	..—..	...—.	— —..	—..—	.— —..

LESSON 4

Send the following words, and if you have anyone to send to you, have them go over the past three lessons with you receiving, and we repeat again, "practice makes perfect."

Two letter words—AN AS HE IT IF 68 45.

Three letter words—BAD SAM HIT FAD MIT 485 566.

After you have sent each of the above words about fifty times, if possible have someone send them to you, you receiving them.

LESSON 5

It is first necessary to make the dot and dash letters because it is a little hard for the beginner to fix in his mind the dot and dash letters combined with the space letters and the space letters are the most difficult of the alphabet. The space in the code letters is only about one-third of the time allowed between a letter in a word and we again repeat that "practice makes perfect," because your spaces must be uniform and in the proper place. First make these letters slowly by merely hesitating at the spaces. Send each letter at least one hundred times, then go back to the beginning and make the space between the dots shorter as you send each letter another hundred times.

O	C	R	Y	Z	&
. .	.. .	. ..	.. ..	... .	. ...

LESSON 6

Send the following sentences at least twenty-five times and after you have completed them if possible have some one send to you, you receive and write them down. After this is completed have someone send to you from a book or a newspaper.

Please advise when you expect to arrive.

Will arrive 6:30 A. M. Thursday morning.

Jack and I will meet you.

Glad you decided to come.

We will all go to the beach for a picnic.

The above is the fundamentals of telegraphy and there are several books on Railway and Commercial telegraphy which goes into complete detail as to the method used by railway and commercial companies. This little booklet is not intended for that purpose. It is simply to give you the fundamental teachings and you will find the book which we recommend for students listed on the next page.

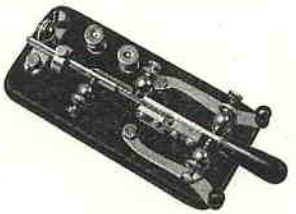
After the student has become efficient in using the telegraph key heretofore shown and used in this booklet we suggest that he then secure one of the Signal Sematic keys which is a semi-automatic key. With the use of this key, the operator can attain greater speed and send more accurately and with greater ease. This is the type of key that is used by some of the best operators of today. This is the so-called side-swiper key. The dots are made semi-automatically by pressing the key on one side and the dashes are made by pressing the key to the opposite side and we highly recommend its use after the student has become efficient on the type of key (see Fig. 1) and in receiving the code.

SIGNAL TELEGRAPH INSTRUMENTS

SEMI AUTOMATIC

A key of the very latest design for professionals. Increases speed and efficiency.

OR



DOUBLE ACTION

Has minimum adjustments, very sturdy construction, easily adjusted. Heavy cast base with heavy plated brass parts.

SEMATIC KEY
List Price $16.00

LEGLESS KEY
Type M-100

Polished and lacquered brass base, nickel plated lever, coin silver contacts.

Price $2.75

LEG KEY
Type M-101

Same as type M-100 except with legs. The legs are used as binding post on this type.

Price $2.85

JUNIOR KEY
Type 112-K

Black enamel key base. Mahogany finish wood base. Nickel plated lever. Coin silver contacts.

Price $2.00

SR. LEARNER SET

Golden finish brass bar frame, sounding plate and key base, aluminum sounding bar, nickel plated key lever, rubber covered coils and mahogany finish base.

M-108— 4 ohm, Price $6.25
M-109—20 ohm, Price $6.50
M-110— 4 ohm, Price $5.00
M-111—20 ohm, Price $5.25

M-110 and M-111 same as M-108 and M-109 except sounder plate and key base is steel in place of brass.

The prices on this page are subject to change.

SIGNAL TELEGRAPH INSTRUMENTS

JR. LEARNER SET

Black enamel key base and bar frame. Brass bridge and aluminum sounding bar. Nickel plated key base. Mahogany finish wood base.

M-112— 4 ohm, Price $4.00
M-113—20 ohm, Price $4.25

SOUNDERS

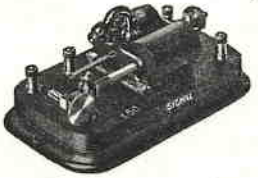
Sounding plate bar frame and bridge of lacquered brass. Aluminum sounding bar and rubber covered coils. Mounted on mahogany finish wood base.

M-102— 4 ohm, Price $3.25
M-103—20 ohm, Price $3.50

SOUNDERS

Black enamel bar frame, aluminum sounding bar and brass bridge. Mahogany finished wood base.

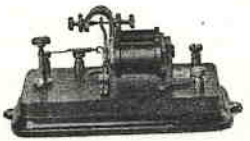
112-S— 4 ohm, Price $2.50
113-S—20 ohm, Price $2.75



COMMERCIAL RELAY

Our Commercial Standard Relay is the type used by railroad and commercial companies. It is the best for long lines. Made of the best materials and workmanship.

916—150 ohm, Price $9.50
917—250 ohm, Price $10.00



PONY RELAY

Recommended for use on all short and indoor lines. Very efficient and best grade materials and workmanship.

M-104— 4 ohm, Price $4.25
M-105—20 ohm, Price $4.50
M-106—50 ohm, Price $4.75
M-107—75 ohm, Price $5.00

RESONATOR
758

We recommend the use of the resonator at all times. The student will find it a great help in memorizing the code by sound.

Price $5.00

The prices on this page are subject to change.

SIGNAL WIRELESS INSTRUMENTS

R-60

High Frequency Buzzer

This type buzzer is the same as used on our R68 practice set. It is adjustable. Has standard resistance of 2 ohms. Can be furnished in special resistances on quantity orders. Black crystalized lacquer finish.

List $1.25

R-68

Wireless Practice Set

Just the instrument for those who want to learn the code. The code is printed on a little brass plate fastened to base.

Equipped with our Type R-60 High Frequency Buzzer.

List $3.40

R-62, 63, 64

Brass base, heavily insulated, 3 contact sizes of coin silver, sturdy construction.

R-62—$\frac{3}{16}$″ contact, list $3.50
R-63—¼″ contact, list 3.70
R-64—⅜″ contact, list 3.90

R-48

Sturdy Construction

¼ K. W. Key Platroid Contact

List price $2.80