ARCHIE · E. KIMBALL

STUDENTS' MANUAL

FOR THE

PRACTICAL INSTRUCTION

OF

Learners of Telegraphy

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MANUAL

OF

TELEGRAPHY

AND

Description of Instruments

ADAPTED FOR USE

ON

PRIVATE TELEGRAPH LINES.

NEW YORK:

J. H. BUNNELL & CO., 106 & 108 LIBERTY STREET.

1887.

LEARNING TELEGRAPHY.

ANY person, young or old, can learn Telegraphy, and become a good operator, but as a rule, the best time is between the ages of fifteen and twenty-five years.

The operation of a telegraph is not, as many people suppose, a complicated or difficult matter to understand. The apparatus employed is quite simple, and easily understood.

The great extension of telegraphic systems throughout the United States is creating employment for thousands of telegraph operators each year, in addition to those already in the service.

The salary paid to an operator in the United States ranges from about thirty to one hundred dollars per month, according to his or her skill, and the size of the office where engaged.

The usual course of an operator's progress is about as follows:—First, after learning to "send" fairly and to "read by sound," he or she may obtain a situation in charge of some small office, which may be either a "branch" office in a city or a small railway station.

The next step in advance is to a larger office or more important station, where there is a greater amount of telegraphing to be done, and more skillful operators required. From here, and further on, the operator who acquires skill by close attention and continual effort to improve, wherever he or she may be in these more important situations, is soon known as a "first-class operator," and can, in the present state of the business, always find employment in any large city or important telegraph centre.

The one rule which will never fail to enable a person to become a successful first-class operator, is—"*Practice constantly, and inform yourself on every practical point connected with the apparatus and operation of the telegraph.*"

Four or five months' steady practice is usually sufficient to enable a person to become fitted to take charge of a small telegraph office.

From one to two years' experience in actual telegraphing will enable almost any one to become a first-rate operator, if proper diligence is exercised.

It is always much easier for a good operator to procure a situation at the regular rate of pay for first-class skill than it is for a third or fourth-rate operator to obtain employment, even at the lowest rates.

In many cases telegraph operators are enabled to combine other occupations in railway, express and mercantile business with that of telegraphy in such a way as to make their positions handsomely remunerative, and thus lead their own way into more important and profitable business.

The fact that at this time (1887) the subject of electricity, in its many new and wonderful applications, is the foremost study of intelligent mankind throughout the world, will add interest to the efforts of the student who seeks to become familiar with electricity as applied to the telegraph.

Explanation of the Telegraph.

The telegraph consists in a combination of four things, namely:

A battery, which produces a current of electricity.

A line wire, which conducts that current from one point to another.

A transmitting key.

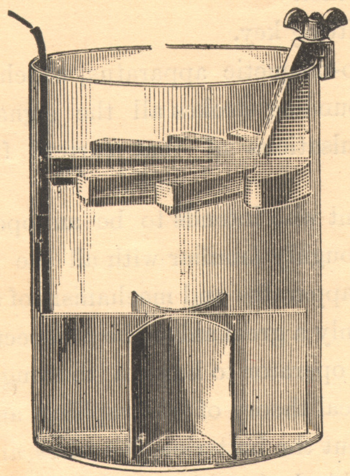
An electro-magnetic apparatus, which gives out in sounds or sounding strokes all the signals which are made by pulsations of that current from a distant point.

The student who intends to be an operator should become thoroughly familiar with all the practical features of the apparatus and mechanism of the telegraph.

It is not only a great aid to the prospects of advancement for the operator to have a thorough knowledge of the electrical theory of telegraphing and to understand all about the batteries, the wires, and the instruments, but this is for him an opening page to that great book of wonders, Electrical Science, which is now attracting the attention and the enterprise of the civilized world.

THE BATTERY.—As the Battery is the first essential part of a Telegraphic apparatus, the study will properly begin here.

It is by the chemical action in the battery that the electric current is first generated, and in practical Telegraphy this current is made to traverse long or short distances through the conducting medium of metallic wires, and by means of the proper instruments, which are herein described, made to give out tangible signals which, being arranged in the form of an alphabet, enables us to read or to speak instantaneously through great distances, for the electric current requires but a small fraction of a second's time to travel many hundreds of miles through the wires.



Gravity Battery, Size 5x6, Price, 65c. per cell.

The above cut represents a single cell of Battery of the kind now most generally used for telegraphic purposes throughout the United States. It consists of three parts, namely: The Jar, the Zinc, and the Copper.

The jar is of glass, and is about five inches diameter and seven inches deep.

The "Zinc" is shaped as shown in the cut and is provided with a brass connecting screw at the top of the arm—the arm serves as a means of supporting the Zinc in proper position.

The connecting screw is used to bind or "connect" a copper wire to the Zinc—which is called the "*Negative*" or "Zinc pole" of the battery.

In the bottom of the jar two leaves or strips of sheet copper are joined together, as shown in the cut, and having fastened to them an insulated conducting wire, which, passing out at the upper part of the jar, constitutes what is called the copper or positive pole of the battery.

When the battery is charged for operation if the wire projecting upward from the copper be connected with the zinc by binding the bared end of the wire under the screw in the arm of the zinc, a current of electricity will constantly flow through the wire from copper to zinc, and will cease to flow the moment the wire be disconnected. If the wire from the copper be extended to a mile in length, and its end connected in the same manner with the zinc, the current will flow through its entire length and come back to the zinc, just as surely as though the distance were but a few inches, and will instantaneously cease to flow the moment the wire is disconnected or broken at any point in its entire length.

Where powerful currents are required, additional cells are added by connecting either the copper or zinc pole of the first cell to the opposite pole of the next, and so on; so that in a series of fifteen or twenty cells, if the unconnected pole of the cell at one end was copper that pole would constitute the copper pole of the entire battery, and the unconnected zinc at the other end would be the zinc pole of the entire battery. By connecting the end of a wire of any length to the zinc or copper pole of such a battery, and its opposite end to the remaining pole, a much more powerful current would pass through the wire than if the Battery consisted of but one cell.

Telegraph companies on their long lines use Batteries of from twenty to a hundred cells each.

Conductors and Insulation.

Mention is made of the use of wire as the medium of conducting currents of electricity from one pole of a battery to any given point, and thence back to the opposite pole, making the "circuit," as it is called, complete. Certain substances are found to conduct electricity with more or less facility, and these substances are called conductors, while through other matter no currents whatever will pass. The latter class of substances are called non-conductors or insulating bodies.

In Telegraphy the principal materials used as conductors are copper, iron, brass and platina. For insulation, gutta-percha, hard and soft rubber, glass, silk and cotton fibre, dry wood, bone and ivory.

Iron in the shape of wire is usually employed as an outside conductor on account of its durability, cheapness and strength, although it is not as perfect a conductor as copper, which latter is generally used for all wires inside of buildings and offices.

In conducting currents of electricity from one point to another, as in Telegraphy, it is found necessary to use non-conductors wherever the wire is fastened for support, in order to prevent escape of the current at these numerous points. For this purpose, glass is principally used for outside wires. The glass "insulator" is placed on a wooden pin or "bracket" which is fastened to the pole or building on which the wire is to be supported, after which the wire is strung, and tied to the glass with a short piece of iron "tie wire." Inside of offices, hard and soft rubber tubes are used where the wires pass through the windows, and the copper conducting wires are usually covered with a coating of gutta-percha, or wrapped with a continuous covering of cotton or silk. The latter is principally used as a covering for the wires inside the finer instruments. For the handles or knobs to the various instruments which require manipulation, hard rubber is generally used.

The Earth as a Conductor.

It is found that when one pole of a battery is connected with the earth, and the wire from the opposite pole carried to a point at any distance away, and also connected with the earth, the current will flow as readily as though the "circuit" had been made complete by the use of a return wire. It is therefore shown that the earth is practically one vast conductor. This is principally due to the fact that moisture is everywhere present beneath the surface of the earth, and water itself is known to be a very fair conductor.

Telegraph companies make great practical use of earth conduction by using it in all cases for their numerous lines, both long and short, thus saving the construction of a separate or return wire on every circuit.

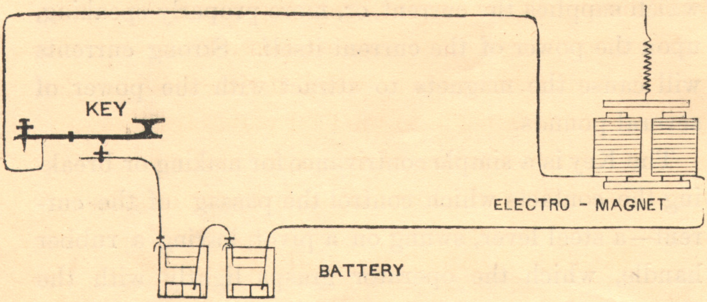
Magnets and Keys.

A careful reading of the foregoing will have enabled the student to understand how currents of electricity are generated and made to travel through space. The next feature of the study will be the mechanism employed to make these currents transmit signals.

The basis of the entire telegraphic mechanism is the Electro-magnet and the transmitting "Key." The Electro-magnet is constructed as follows: Two bars of soft iron, having round heads of hard rubber, thus making spools of each, are joined together by means of a short flat bar of iron similarly soft. The round bars in the spool of the magnet are called cores, the flat connecting bar at the back is called the "back bar" or "heel piece." The movable flat piece of iron in front which is to be attracted by magnetism to the cores, or withdrawn by the spring when no magnetism excites the cores, is called the Armature.

A silk or cotton-covered wire is wound in continuous turns about the cores, until the diameter of about an inch and a half is attained, and each core or spool of the magnet contains a great number of turns of the wire around it. Now, if a current of electricity be sent through this wire, it will, by its passing through the numerous turns, cause the iron cores within to become magnetic and to possess the power of attracting with considerable force any piece of iron brought near to their ends. The cores being made of soft iron, will lose their magnetism and cease to exert any attractive power the moment the current ceases to flow. The actual power of the attractive force thus exerted is directly dependent upon the power of the battery which supplies the current, or, more properly speaking, upon the power of the current itself. Strong currents will cause the magnets to attract with the power of several pounds.

The Key is a simple contrivance for making or breaking the contacts which control the passag of the current—a steel lever, swung on a pivot, having a rubber handle, which the operator grasps lightly with the thumb and forefingers. On pressing the lever downward, a platina point projecting under the lever is brought into contact with another platina point set into an insulation of rubber in the base of the key, so that there can be no electrical connection between them unless the key is pressed down, or "closed," as it is termed. A conducting wire being separated at any point, and one of its ends connected with the lever or base of the key, and the other end with the metal set into the rubber insulation, would convey the current while the key was closed, and cease to do so the moment it was opened. Platina is used at the points where the electrical contacts are made and broken, because it does not readily fuse or tarnish. An extra lever at the side of the key is called the "circuit-closer," and is used as a means of keeping the circuit closed when the hand of the operator is not on the key. When the circuit-closer is pushed into its closed position, it makes contact with a brass lip, which latter is fastened to the rubber along with the lower platina point. This, then, has the same effect as though the key was pressed downward and contact made at the points.



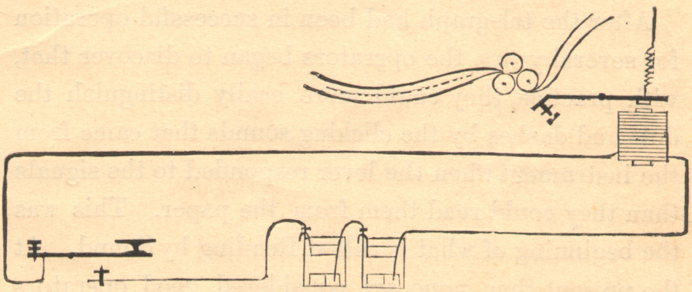
The above cut represents a magnet with its armature suspended from a spring, and connected with it by a wire, a battery, and a key. From what has now been explained, it may be seen that when the key is closed a current from the battery will pass through the wire and magnet, and cause the latter to attract the armature, overcoming the resistance of the spring, and that the instant the key is opened the current will cease to flow, the magnet cease to attract, and the spring will instantly draw the armature back to its original position. In this way the armature is made to follow exactly the movements of the key, no matter at what distance they may be placed from each other, although in practice it is found that as the circuits are lengthened, more battery power and more delicate instruments are required than on short lines.

The whole basis of the telegraph system is this duplication at one point, by the magnet and its armature, of the *motions made on the key by the hand of the operator, at another separate and distant point.*

During the first years of telegraphy, the Morse Register was the only means employed to put into tangible form the signals transmitted over the wires.

In order to give the clearest possible idea of the operation of a Register, by which it records these signals, reference is made to the next paragraph, containing an outline diagram of the main working parts of the instrument, and an accompanying explanation.

Morse Alphabet and Register.



The armature of the magnet is attached to a lever, and this lever, which swings on a pivot in the middle, is provided at the end with a pointed pin or screw, which is caused to press upwards against a strip of paper whenever the magnet attracts, and to return to its former position when the attraction ceases. Meanwhile the paper is kept moving steadily forward, so that if the lever-pin is pressed against the paper, for only an instant of time, a short mark or *dot* appears pressed or embossed into the paper. If for a longer time, the mark would be proportionately longer, or a *dash*. If alternately, the marks would come consecutively, and have *spaces* between them. As the Morse Alphabet consists entirely of dots, dashes, spaces, and extra long dashes, the letters and numerals are easily made with these marks and their combinations. So that as the hand of the operator, on the key at a distant point, makes short or long strokes, dots or dashes, or spaces, these same marks appear on the paper as it comes from the Register, and being based on the formation given by the Morse Alphabet, are as easily understood by the receiving operator as though they appeared in the well-known Roman characters.

After the telegraph had been in successful operation for several years, the operators began to discover that, with practice, they could more easily distinguish the dots and dashes by the clicking sounds that came from the instrument when the lever responded to the signals than they could read them from the paper. This was the beginning of what is called Reading by Sound. At the present time none are considered good operators who cannot read by sound, and there are comparatively few Registers in use in the United States.

To Set Up the Instrument and Battery for Practice.

First—Put the battery in operation according to the following directions :

Fill the jar about two-thirds full of water, place the copper in the bottom of the jar in such a way that the leaves of the copper are spread out like an **X** with the copper wire extending upwards and out of the jar.

Next drop carefully into the bottom of the jar about ½ lb. of blue vitriol and 2 oz. sulphate of zinc.

Then hang the zinc in the jar as shown in the cut, and the battery is ready for operation, although it will not work at its best power until it has been in use for about three days.

To hasten its full action, connect the copper with the zinc by fastening the wire into the clamp screw of the zinc, and leave it so for about twelve or fifteen hours. This is called putting the battery on a "short circuit."

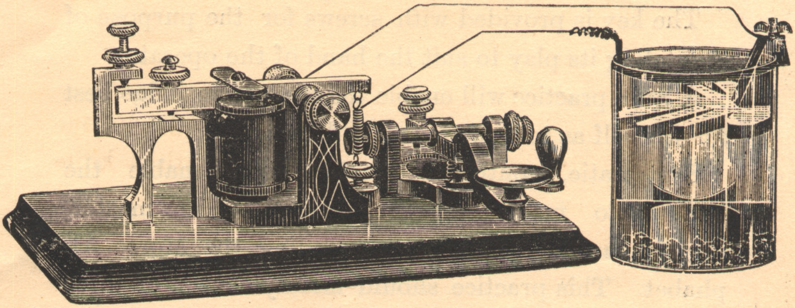
The battery should be kept supplied with enough sulphate of copper so that a blue color can always be seen in the liquid at the bottom of the jar, rising to within an inch of the lower surface of the suspended zinc. If it is found that the blue color rises higher than this, it is thereby indicated that too much sulphate of copper is being used, and no more should be put in until the blue has receded almost to the very bottom of the jar. The latter state of the battery indicates that more sulphate of copper is required. Water should be from time to time added to that in the jar, to replace the loss by evaporation.

As long as the battery continues in action there is an increase of the quantity of sulphate of zinc in solution in the upper part of the jar. A hydrometer is convenient for the purpose of testing the strength of this solution. When the specific gravity is less than fifteen degrees, the sulphate of zinc solution should be strengthened; when it is thirty degrees, or more, a portion of the top of the liquid should be drawn off with a syringe or cup, and replaced with fresh water.

Once in eight weeks or three months it will be necessary to thoroughly clean the battery. Take out the zinc carefully, and clean it by scraping with a knife and washing; pour the liquid into a separate jar, leaving behind the oxide and dirt which may have gathered on the bottom of the jar. Now take out the copper and clean it, throw the sediment away, and clean the jar. Pour the clean liquid back into the jar again, replace the copper and zinc, add water enough to cover the zinc, and put in a few crystals of sulphate of copper. The battery will again be ready for use.

In joining together any number of cells, whether of the same or of different kinds of battery, the positive pole of the first cell must be connected with the negative pole of the second cell; the positive of the second with the negative of the third, and so on throughout the whole series. It matters not which pole you commence with, if you are only careful never to connect like poles. This law must be as strictly observed in joining batteries hundreds of miles apart as if they stood side by side.

No battery should be permitted to freeze, for while frozen the current is very much impaired or altogether suspended. A battery while warm works more vigorously, as heat is a promoter of chemical action. The connections must be kept free from rust or dirt, in order to allow the current to pass through them freely.



Having set up the battery according to the preceding directions, connect one wire from the copper pole of the battery to one of the brass binding-posts at the back of the instrument, as shown above, and one wire from the zinc pole to the remaining binding-post; screw down the instrument firmly to the table with the screw in the base, as its best sound is thereby produced. See that none of the screws are loose in their places, and that the armature lever, which is the speaking tongue of the Telegraph, plays freely, with a movement of about one-sixteenth of an inch. The spring, which draws the armature lever upwards, and is called the *adjustment*, should only be set at sufficient tension to raise the lever when no current is passing through the magnets. If drawn too tightly, the spring w ll not allow the armature to respond to the attractions of the magnets. When the instrument is not in use, leave the circuit-closer of the key open about half the time. This will keep the battery well at work. See that the platina points of the key are kept clean from dirt or dust, thus preventing imperfect contacts from being made.

The key is provided with screws for the purpose of regulating its play to suit the hand of the operator.

A little practice will enable the student to judge best for himself as to how this should be set.

Systematic, continual practice will enable the student to make surprising progress in mastering the art of sending and reading the Morse Alphabet. This practice should mainly consist of three kinds.

I. Morse writing with the Key and without a companion.

II. Combined Morse writing and reading with a companion student.

III. Practice in both Morse writing and reading of messages, social conversation, printed matter, and the Exercises, where the two or more persons practicing are in separate rooms, or at a distance from each other in separate houses, and entirely dependent upon the wire and instruments for their communication with each other.

Regarding the first named, a great amount of single practice should at all times be kept up, as it brings that thorough and unhesitating familiarity with the Morse signals which is necessary before any one can become a telegraph operator. This familiarity with the Morse signals becomes, when fully acquired, as easy as the exercise of speech. An operator does not have to *think* before making a Morse letter on the key any more than he or she does before speaking a word in the English language.

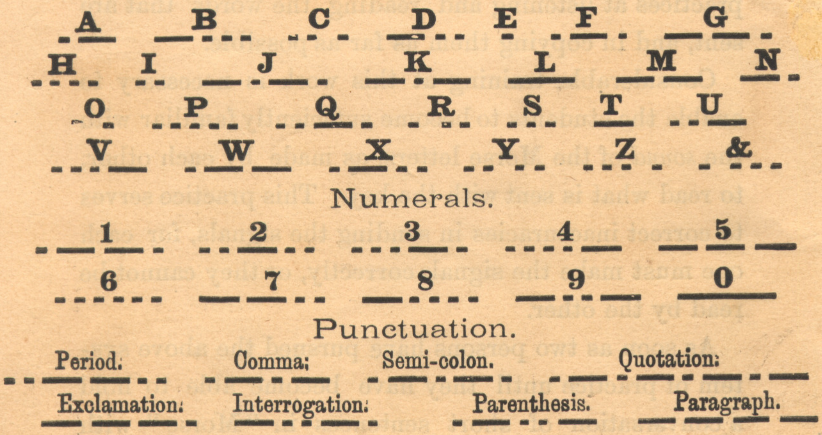
The second step of practice consists in alternate key writing or "sending" by one student while the other practices at listening and reading the words that are sent, and in copying them as far as possible.

Considerable training at this work is necessary to enable the students to become sufficiently familiar with the *sound* of the Morse letters, as made by each other, to read what is sent with the key. This practice serves to correct inaccuracies in sending the signals, for each one must make the signals correctly, or they cannot be read by the other.

As soon as two persons have pursued the above system of practice until they have become able to hold a conversation of short sentences in "Morse" with each other, they should begin the separated practice, which is the last and most interesting step in learning telegraphy, and in preparation for the duties of an operator. Set up the instruments in separate rooms, connect them with each other by wire, as explained elsewhere in this book, and practice at sending and receiving messages, printed matter, and conversation, copying everything as it is received.

Wherever it is possible, the student should secure an opportunity to finish his or her practice in a telegraph office. A few weeks of such practice will familiarize the student with the everyday work of a telegraph line, give excellent opportunity to practice at reading by sound in copying the constantly passing messages, and will thoroughly prepare the applicant for a situation as an operator.

THE MORSE TELEGRAPH ALPHABET.



The Morse alphabet consists of what are called dots, dashes and spaces. Combinations of these make intelligible signals. Many of the characters will be found to be the reverse of others: such as A is the reverse of N; B of V; D of U; C of R; Q of X; Z of &; so if the formation of one of each of these letters be obtained, its reverse is easily mastered. C, E, H, I, O, P, R, S, Z, Y, are merely represented by dots and spaces, and, if due regard be given to time, they will be found very easy to commit to memory.

The first step is to memorize the alphabet, so that each character can be called to mind at will; thus, A, dot and dash; B, dash and three dots; C, two dots, space, dot, etc. The period is the only punctuation mark in frequent use, and the student need not learn the others at first.

A dot (E) is made by a single instantaneous, downward stroke of the key. A short dash (T) is made by holding the key down as long as it takes to make three dots. A long dash (L or cipher) is made by holding down as long as required to make five dots. A cipher is prolonged so as to occupy about the time required for seven dots.

The intervals between dots or dashes in the same letter are called breaks. A space in letters should occupy the time required for a dot and break. The space between letters should occupy the time required for two dots and breaks.

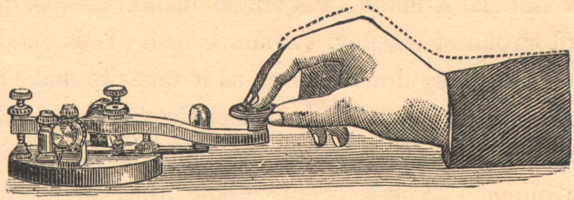
The space between words should occupy the time required for three dots and breaks.

In letters that do not contain spaces, the dots and dashes should follow each other as closely as possible.

The beginner should be careful to form and space his letters correctly, as this will lead to a perfect style in sending.

Position and Movement.

It should be remembered that there is no change in the tone of a sounder, the letter being determined solely by the "time or times" the lever is up or down. The back stroke, so called, is as necessary to reading by sound as the down stroke, and these must be distinguished each from the other; for, without it, the duration of the downward movement could not be determined.



Place the first finger on the top of key button, with the thumb under the edge; and the second finger on the opposite side. Curve the first and second fingers so as to form the quarter section of a circle. Partially close the third and fourth fingers. Allow the wrist to be perfectly limber. Rest the arm on the table at or near the elbow.

Let the grasp upon the key be firm, but not rigid. Never allow the fingers or thumb to leave the key, nor the elbow to leave the table. Avoid too much force, or too light touch, and strive for a medium firm closing of the key.

The motion to be imparted is directly up and down, avoiding all side pressure.

The movement is made principally at the wrist, although the finger and hand must be perfectly elastic.

The fingers, wrist and arm, should move uniformly in the same direction.

The downward movement produces the dots and dashes, and the upward, the breaks and spaces.

Commence the use of the key by making dots in succession at the rate of two every second, and increase the speed five-fold as skill is acquired. Continue to practice dots until 360 per minute can be made with perfect clearness and regularity.

When dots can be readily made as directed, begin with dashes at the rate of two in every three seconds, and gradually increase until 120 per minute can be made with perfect regularity.

Next attempt the long dash at the rate of one every second, and increase to ninety per minute.

When perfection is attained, take up the following exercises in order.

Repeat each exercise until every letter can be made at will correctly.

DOT LETTERS.

E	I	S	H	P	6
-	- -	- - -	- - - -	- - - - -	- - - - - -

DOT AND SPACE LETTERS.

Take pains to make spaces uniform, and in the proper place.

O	C	R	Y	Z	&
- -	- - -	- - -	- - - -	- - - -	- - - -

DASH LETTERS.

Be careful to proportion short and long dashes accurately.

T	L	M	5	0
—	——	— —	— — —	———

DOTS, WITH DASH, IN SUCCESSION.

Avoid leaving any space between them.

A	U	V	4
- —	- - —	- - - —	- - - - —

DASH, WITH DOTS, IN SUCCESSION.

N	D	B	8
— -	— - -	— - - -	— - - - -

DASHES OR DOTS IN MIXED COMBINATION.

F	G	J	K	Q	W
- — -	— — -	— - — -	— - —	- - — -	- — —

X	1	2	3	7
- — - -	- — — -	- - — - -	- - - — -	— — - -

9	Period.
— - - —	- - — — - -

There are almost as many styles of sending among operators as of penmanship. It is quite possible on a line where forty operators work to tell each one by his manner of manipulating the key. Cultivate a firm, even, smooth style of sending. The fast writers do not dispatch the most business. Graduate your writing to the capacity of the receiver, and never crowd him.

FRACTIONS.

Fractions are made by substituting a dot for a hyphen between the figures.

1–2	1–4
- — — - - - - — - -	- — — - - - - - - —

2–3	3–5
- - — - - - - - - — -	- - - — - - — — —

7–8	9–10
— — - - - — - - - -	— - - — - - — - — —

11–12

- — — - - — — - - - — - - — — - - —

NUMBERS.

In large numbers, a short space is usually made between every three figures.

1,000. - — — - —— —— ——

1,500. - — — - — — — —— ——

18,907. - — — - — - - - - —— - - — —— — — - -

21,369.- - — - - - - — — - - - - - — - - - - - - — - - —

UNUSUAL SPACES.

In words largely composed of dots and spaced letters, the spaces should be larger than usual between the letters.

Seen. Erie.

... . . —.   . . ..

Receive.

. .. .— .

Cicero.

.. . .

WORDS.

After the student can write the words in this Exercise satisfactorily, he may arrange several series himself for practice.

And.	Barn.	Chair.
Desire.	Exchange.	Family.
German.	Humane.	Inmate.
Judgment.	Knowledge.	Limited.
Maintain, etc.		

SENTENCES.

The student may take such sentences as he chooses for practice, always being careful to write one correctly before commencing with another.

OFFICE CALLS.

Every telegraph office has a name or call, which usually consists of one or two letters; thus the call for New York is N. Y.; Baltimore, B.; Philadelphia, P. If New York desires to communicate with Philadelphia, he repeats the latter call on the line till answered. It is proper to sign one's own office every three or five calls, so that others may know who is using the wire. Thus:

- - - - -   - - - - -   - - - - -   — - - - - -

If Philadelphia hears the call, he opens his key and answers by repeating "I" several times, and signing his own call thus:

- -   - -   - -   - -   - - - - -

When so answered, New York proceeds with his busincss.—The process is exactly the same between any other two offices.

Abbreviations.

THE SIGNALS MOSTLY USED ARE AS FOLLOWS:

1.—Wait a minute.

4.—Where shall I go ahead?

5.—Have you anything for me?

13.—Do you understand?

134.—Who are you at the key?

G. M.—Good morning.

G. N.—Good night.

Immy.—Immediately.

Impt.—Important.

Min.—Minute.

18.—What is the matter?

77.—I have a message for you.

44.—Answer quick by telegraph.

73.—Accept my compliments.

Ahr.—Another.

Ans.—Answer.

Bk.—Back.

Bf.—Before.

Bn.—Been.

Bat.—Battery.

Msgr.—Messenger.
Msk.—Mistake.
No.—Number.
Ntg.—Nothing.
N M.—No. More.
O. K.—All right.
Ofs.—Office.
Opr.—Operator.
Sig.—Signature.
P. D.—Paid.
Q. K.—Quick.
G. B. A.—Give better address.

Bbl.—Barrel.
Col.—Collect.
Ck.—Check.
Co.—Company.
D. H.—Free.
Ex.—Express.
Frt.—Freight.
Fr.—From.
G. A.—Go ahead.
P. O.—Post Office.
R. R.—Repeat.

Many other abbreviations will be acquired in actual business.

MESSAGES.

Commercial messages may be divided into five parts, viz.: date, address, body, signature and check. The date is composed of the name of the place where the message originates, the month, day of month, and year. An operator accepting a commercial message for transmission, should be careful that this is written out in full, as follows:

New York, Dec. 10, 1882.

In actual transmission, the month and year are always omitted. Between offices on the same circuit, the office call is frequently used, and the date omitted. It can do no harm to write the name in full, and the date should always be given in commercial business. This is always done when the message goes beyond the line where it originates. In sending a message, the date is always prefixed by "from" abbreviated to Fm. or Fr.

FORM OF MESSAGE.

From New York, Dec. 10th, 1882.

Or sometimes on same line.

The address should comprise the full name and place of the person to whom the message is addressed. When not known, the number and street should be given, as well as the place of destination and State. The word "to" always precedes the address, and a period divides it from the body of the message. When the office to which a message goes is on the same line, only the office call is written. When the message goes through, the destination is spelled out in full.

FORM OF MESSAGE.

From New York, Dec. 10, 1882.

To John Wilson,

22 State St., Chicago, Ill.

(Through Message.)

Local Message.

The body of the message is embraced between the period and signature. No abbreviations are permitted, or if inserted, each letter is charged for; compound words are usually considered one word. Numbers are written out in full, and if the figures also are inserted, are paid extra for. The body of some messages are written in cypher, being composed of disjointed words, having no sense unless interpreted by means of the key in possession of the sender and receiver.

FORM OF MESSAGE.

From New York, Dec. 10, 1879.

To John Wilson,

22 State St., Chicago, Ill.

Goods were shipped on the fifth by American Express.

Sig., Henry Harding.

— - - -   - - - -   - —   — —   -   - - -   - -   - - -

- —   — -   -   - — - -   - - - - -   - - -   -   - - -   - - -

- - -   - -   — — -   - - - -   -   — -   - - -   - - - -

- - - -   - —   -   - -   — - -   - -   — -   — — -

The check follows the signature of a message, and gives the number of words in it subject to tariff. It aids in preventing omissions and errors. The check also tells whether a message is paid, collect, or free—if free, it usually explains why.

Upon full paid business, ten words can be sent as cheaply as one, but for all over ten an additional rate (per word) is charged. The date and address of a message are not counted. The body of a message is always counted. The extra signatures, titles and directions after signatures are counted. When there are several signatures the last one goes free. Upon half-rate messages, the same rule applies, except that the tariff is computed at one-half of full rates.

The "From," "To" and "Sig." in a message are never copied by the receiver.

When an office is through receiving a message, he must always say O. K. and sign his office, thus:

- -   — - —   — -   - - - - or - -   — - —   - - -   - — -

If no O. K. is received, it will be known that the message has not been properly received, and must be repeated.

When the sender discovers that he has made a letter wrong, he stops, makes more than six dots, says "msk." (mistake), and commences again with the last word made correctly.

When the receiver finds he is not getting a message correctly, he breaks, and tells sender to "G. A." (go ahead) the last word received.

After receiving a message, the operator should be careful to see that he has the right number of words, as called for by the check of the message. If they do not agree, he should compare with sender till error is found. This is usually done by commencing at period, and writing the first letter in each word till the missing portion is discovered.

There are a few operators capable of sending and receiving forty words per minute; thirty-five words is very rapid work. The average speed does not reach thirty words. When the student finds himself capable of sending and receiving promiscuous messages at the rate of thirty words he may begin to look about for an office.

Private Lines.

In the construction of short lines, No. 12 galvanized wire is chiefly used. This wire weighs one hundred and seventy pounds, and measures thirty ohms resistance, to the mile.

Only one wire is necessary to the construction of a line, the earth being used for the return circuit.

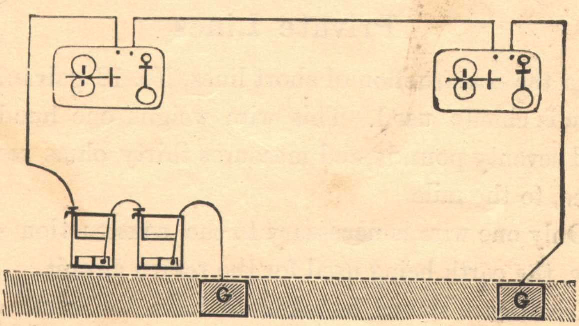
Great care should be taken to have the earth connections perfect. When possible, connect the ground wire to gas or water pipes, but when this cannot be done solder it to a sheet of copper three feet long by two feet wide, and bury the latter about four deep in damp earth.

In locations where the earth is very dry, it is sometimes impossible to make a good ground connection, and in such cases we recommend a metallic circuit, as being more economical than the large battery which would be required to overcome the excessive resistance.

The resistance in the instruments on a line should be proportioned to its length. The rule is to make the resistance in the instruments equal that of the line and battery. Instruments for use on a short circuit are made with five ohms resistance, but for long lines should be proportioned to its length.

In ordering instruments give the length of line and the number of instruments to be used on it.

To Connect Two Instruments with a Short Line.

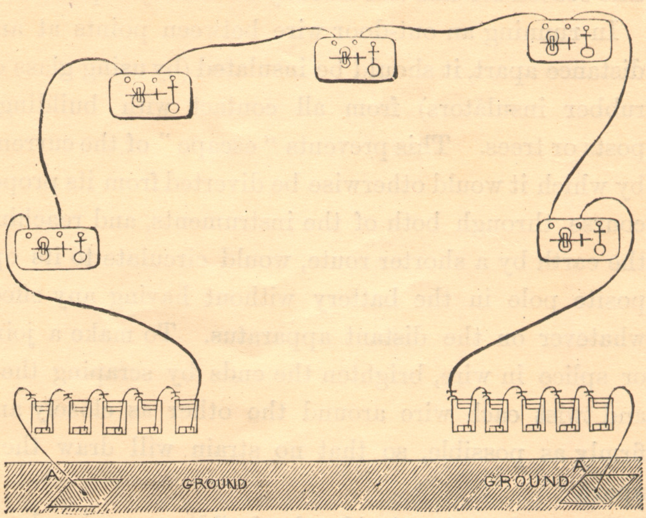


Run a wire from the zinc pole to a gas or water pipe, and carefully connect it, then run a wire from the copper pole to a binding post on the instrument; connect the line wire to the opposite binding post; at the other end of the line attach the wire to one binding post, then run a wire to the gas or water pipe from the opposite post. If part of the battery is used at each end of the line, always be careful to have the zinc and copper poles of the battery towards each other.

The return circuit may be made either by a continuous wire, as indicated, or by connection with the earth at each end, *G. G.* For wires of but a short distance in length the return wire is best.

Private Line with Several Stations or "Offices" in Connection.

Connect wires, instruments and batteries on such a line as shown in the diagram below, placing the batteries at each end of the line.



Battery at *A* has its zinc pole connected to the earth and its copper to the line; necessarily, therefore, the other battery at *B* presents its zinc pole to the line and its copper to the earth. If both batteries were connected with the same pole to the line, they would neutralize each other, and no current whatever would be produced.

The line is connected, as shown from the battery, to the first instrument and on to the next in such a way that the current is made to pass through each and every instrument on the route.

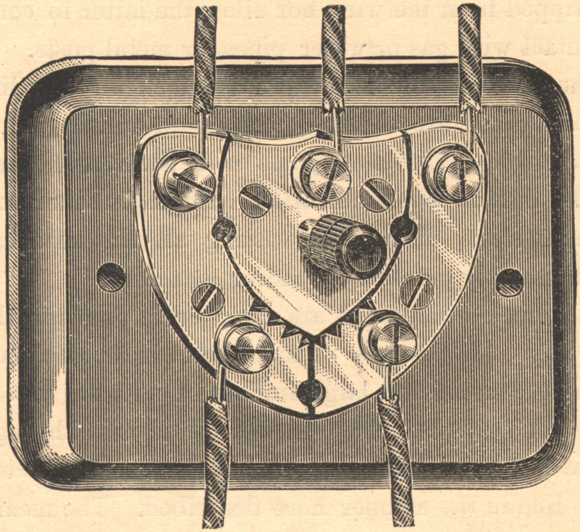
It is necessary where two or more offices are connected together on a line, that every key should be kept closed by having its circuit-closer shut, excepting only when sending communications. If any one key on the entire line is left open, all communication is stopped. The reason for this has already been fully explained.

In running an out-door wire between points at any distance apart, it should be insulated (by using glass or rubber insulators) from all contact with buildings, posts or trees. This prevents "escape" of the current, by which it would otherwise be diverted from its proper course through both of the instruments, and reaching the earth by a shorter route, would circulate to its opposite pole in the battery without having any effect whatever on the distant apparatus. To make a joint or splice in wire, brighten the ends by scraping them and twist each wire around the other as closely and firmly as possible, so that no strain will draw them apart.

In running wires inside of a building, use insulated copper wire covered either with cotton or gutta-percha; fasten it in place with small staples or tacks, but in doing so be careful not to allow the covering to be opened or stripped from the wire, nor allow the latter to come in contact with gas or water pipes, or metal posts.

When several persons are jointly practicing on a line in which there are a number of separate instruments, placed either in different rooms or in different houses, all are thus in communication with each other, and while any one of them is writing all the rest can simultaneously practice at reading by sound.

Main lines of telegraph are arranged in precisely the same way. With wires of many lines in length, main batteries, containing a large number of cells, are placed at the end stations. The return circuit is made through the earth the entire distance, and each office connected to the line in the manner here described. The means employed to "tap" a telegraph line (which is sometimes done in case of railway accidents and for other purposes) are very simple, and will serve to illustrate this. The wire is simply cut, and its two ends connect to a portable instrument in the hands of a "sound operator," who may then easily read all that passes over the wire.



The Union Lightning Arrester and Ground Switch.

PRICE, 90 CENTS.

Lightning Arresters.

As lightning is frequently attracted to out-door lines and thereby enters the offices, sometimes damaging the instruments, or even setting fire to curtains or other inflammable material about the instrument table, a simple and cheap instrument called "lightning arrester and cut-out," is used for the purpose of intercepting and carrying to the earth such discharges of lightning as would be liable to cause damage. This apparatus is entirely effective, and is a complete safeguard against lightning.

The question is often asked, "How much Battery or how many cells, and what kind of Battery, will work a certain length of line to which are connected a certain number of instruments?"

The Gravity Battery (see catalogue), described herein, is the adopted standard form in general use by most companies, and is considered to be the best for all ordinary purposes. For short lines, etc., its proper use may be practically set down according to the proportions given below; bearing in mind, however, that the greater the number of cells of Battery used, the more powerfully the instruments will work, and that if it is found when one or two instruments are properly connected in a circuit according to directions, it or they do not work with enough strength to give the amount of sound wanted, addition of more Battery will produce better results.

For one instrument use one or two cells of Gravity Battery. For two instruments in connection, not farther than 100 feet apart, two or three cells, adding one cell for each additional instrument connected to the same wire; also add further one cell for each quarter of a mile added to the length of the wire up to one mile, and then two or three cells for each additional mile.

For such lines, "No. 12 Galvanized Iron" is the least expensive wire suitable for the purpose. For lines of between one and twelve miles in length the instruments are required to have their magnets wound with finer wires than those used on circuits of less than one mile. Such instruments are designated as being of "20 ohms resistance." This fact should be remembered when ordering equipments for a line of over one and under twelve miles long.

Never use in the same line instruments of different resistance. Whatever other differences there may be in the instruments, they should be all alike in resistance.

In a manual of this kind it is not possible to go deeply into electrical science in its many bearings on Telegraphy; but to those who have advanced this far, and should now have become familiar with the main principles and apparatus on the Telegraph, and would pursue the study still further, no better source of information can be recommended than the well-known work entitled "Pope's Modern Practice of the Electric Telegraph." It is in every respect a desirable hand-book for either the young student or the experienced, first-class sound operator.

See following pages for prices of various Private Line Materials, Batteries, Instruments, Telegraphic Specialties, etc.

J. H. BUNNELL & CO.'S

Telegraph Instruments

For Learners.

The great demand, wherever they have been introduced, for our Amateur and Short Line Instruments in preference to all others, has enabled us to produce (by manufacturing them on a large scale) the

Best Learners' Apparatus in the Market.

The form, the outward appearance, the price, and even the words of description of

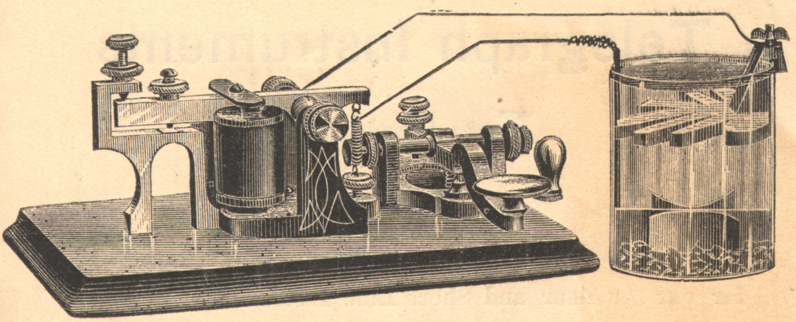
Bunnell's Learners' Instruments

are very generally imitated, but their practical excellence has not been successfully copied.

Our $3.75 outfits, shown on next page, are for in-door lines of from a few feet to 200 or 300 feet in length.

The same instruments, wound with finer wire and operated by from one to ten extra cells of battery, according to distance, are suitable for out-door lines of from a few feet to ten or fifteen miles.

THE "MORSE" LEARNERS' OUTFIT.



Price, **MORSE OUTFIT COMPLETE,** with Battery, Book of Instruction, Wire, Chemicals, and all necessary materials for operating...............	$3 75
"Morse" Instrument alone, without battery.......	3 00
Cell of battery complete........................	65
"Morse" Learners' Instrument, without battery, sent by mail, prepaid.........................	3 50
Morse Instrument, wound with fine wire, 20 ohms resistance, for use also on out-door lines of from 200 feet to 10 or 15 miles in length, price, without battery, etc...........................	3 75
Sent by mail, prepaid..........................	4 00

Battery cannot be sent by mail.

The above will be sent C. O. D. to all points if one-third of the amount of the bill is sent with the order.

Remit by Draft, Money Order, Registered Letter or Postal Note.

THE MORSE OUTFIT

shown on the opposite page is a full size, well made, complete

Morse Telegraph Apparatus

of the latest and best form for learners, including handsome Giant Sounder and Curved Key and a large Cell of the best gravity battery, latest form.

It is the best working set of Learners' Instruments for short or long lines, from a few feet up to 20 miles in length, yet produced.

See the next pages for information in regard to the cost of Instruments, Wires, Batteries and Materials needed in putting up

SHORT LINES OF TELEGRAPH.

LIST AND PRICES

OF

Private Line Materials,

And Appliances

Usually required in connection with Amateur Telegraphs.

Line Wire, No. 12, galvanized, per mile	$7 00
" " per 100 feet	20
Glass Insulators, with wooden bracket and spikes complete, each	6
Office Wire, No. 18, insulated, for all in-door use, and in connecting the out-door line with instruments, batteries, etc., per lb. (150 feet)	40
per foot	½
Round Top Steel Staples for fastening in-door wires to wood-work, etc., per gross	12
Gravity Batteries, per cell	65
Extra Zincs, each	25
Extra Coppers, each	15
Extra Jars, each	25
Blue Vitriol, per lb.	10
Sulphate of Zinc, per lb	10
Wire Connectors, each	8
Wire Cutting Pliers, Line Wire Size, each	2 25
Small Size, for office use	1 00

Equipment for ordinary Practice at Learning Telegraphy.

One regular "Morse Outfit," $3.75.

Private Line Materials and Appliances—Continued.

Equipment and Cost of a Local Practising or Communicating Line, Indoors, where two instruments are within 100 feet of each other.

2	Regular Morse outfits	$7 50
1½	lbs. Office Wire, (extra) 225 feet	60
1	Box Steel Staples	12
1	Extra Cell of Battery	65
5	lbs. Blue Vitriol	50
		$9 37

If the indoor line is less than 100 feet in length, the extra cell of battery will not be required, as the two cells which are sent with the outfits will be sufficient. The extra amount of office wire needed will also depend upon the length of the line. For each additional 150 feet of indoor line, add one more cell of battery.

Equipment and Cost of an outdoor Line of from 200 to 800 feet in length, with two instruments connected.

2 twenty ohm Morse Instruments	$7 50
4 to 10 cells of battery, 65c. each.	
10 lbs. Blue Vitriol	1 00
2 lbs. Sulphate Zinc	20
6 to 10 Pony Insulators and Brackets, 8c. each.	
1 lb. Office Wire	40
1 box Steel Staples	12
200 to 800 feet No. 12 Galvanized Telegraph Wire, per 100 feet, 50c.	

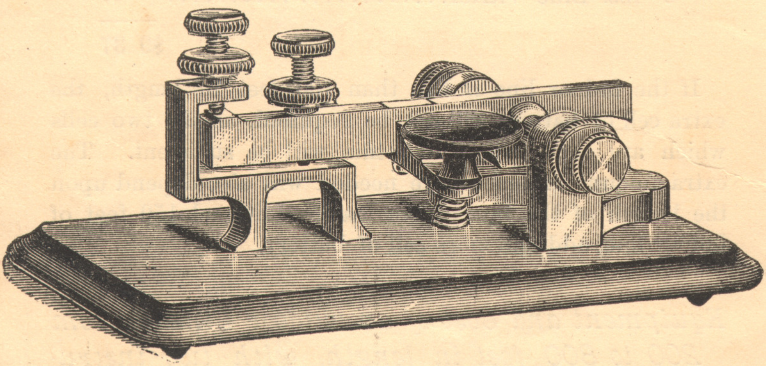
If more instruments are to be connected to the line, add one more cell of battery for each 20 ohm instrument so connected, and one cell for each additional quarter mile added to length of line.

J. H. BUNNELL & CO.'S

NEW MECHANICAL

Telegraph Instrument.

(*PATENTED APRIL 4th, 1882.*)



COMBINED KEY AND SOUNDER.

No Battery Required.

Works perfectly as a KEY, with Sound equal to the best SOUNDER.

For MORSE ALPHABET PRACTICE in sending and reading by sound, and for TEACHING THE MORSE ALPHABET. Can be carried in the pocket.

Price, with package of Morse Alphabet Cards, Telegraph Instruction Pamphlet, etc., ***$1.50.*** Sent anywhere in the United States by mail, prepaid, on receipt of price in Stamps, Money Order, Registered Letter or Postal Note.

To learn *in a short time* to read and write the Morse alphabet requires almost continual practice. For this reason it is a great advantage to students of telegraphy to possess a small portable instrument without a battery, upon which they may practice anywhere in any leisure moments which they may have.

We have therefore designed the

MECHANICAL

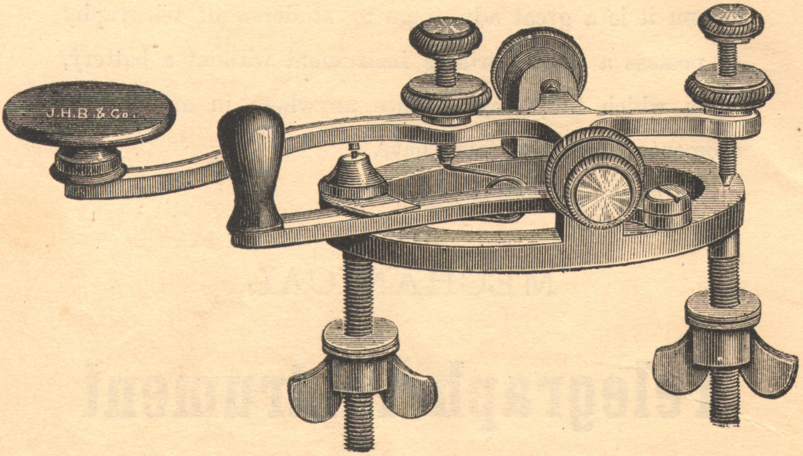
Telegraph Instrument

for this purpose. The Mechanical Instrument is not intended to take the place of the Morse Learners' Instrument and Battery outfit, because, after the student has become proficient in reading and writing the alphabet, it is still necessary to use the battery instrument for practice at sending and receiving, where the sender and receiver are in separate rooms or at a greater distance apart, with the Learners' Instruments in connection by wire.

But the Mechanical Instrument is a valuable assistance in the beginning to students who wish to learn in the shortest possible time, as it can be carried around in the pocket, and thus affords many opportunities for practice which could not otherwise be had.

STEEL LEVER SOLID TRUNNION KEY.

Pat. Feb. 15th, 1881.



We have much pleasure in being the first to make and bring to the notice of Telegraphers and Managers of Telegraphs this new and important improvement in keys.

It is *more durable* and in every respect *better* than any other for rapid and perfect Morse sending, for the following reasons :

The lever is *only one-half the weight* of the ordinary brass lever, as generally made.

The entire Lever and Trunnions together being made of *but one piece* of fine wrought steel, the common defect of loose trunnions is avoided ; the strength of a heavy brass lever is obtained with much less weight of metal, and, by the perfect bearing which the solid trunnion gives, together with the use of *hardened platina points, sticking is absolutely prevented.*

The size and proportions are such as to make it the most perfect operating key possible to obtain, either for the hand of the skilled and rapid expert or the beginner.

Price, ... $2.25

Sent by mail to any distance, carefully boxed and prepaid, on receipt of price.

The following are a few of the *hundreds* of testimonials which we are constantly receiving as to the superiority of these keys :

FROM THE GREATEST TELEGRAPH OFFICE IN THE WORLD.

Manager's Office, Western Union Telegraph Co.,
New York, January 30th, 1883.

"In reply to your inquiry of some days ago, there are in use in this office, *one hundred and ten* Bunnell's Patent Steel Lever Keys.

"As an evidence of the favor in which they are held, I enclose the names of *one hundred and ninety-eight* of our *operators* who prefer them.

"Very respectfully, WM. J. DEALY."

ST. LOUIS, MO., January 29th, 1883.

We have forty-six of the Bunnell Steel Lever Keys in use in this office, and it is the general verdict that it is the *finest key we have ever seen for fast, clear and easy work.* I personally endorse it as such.

J. H. TOPLIFF, Chief Operator, W. U. T. Co.

GALVESTON, TEXAS, February 19th, 1883.

It is the opinion of operators here generally that the Steel Lever Keys *stick less and are less fatiguing* under steady work than any other key we have in use.

T M. SKINNER, Chief Operator, W. U. T. Co.

SUPERINTENDENT'S OFFICE, WESTERN UNION TELEGRAPH CO.,
MOBILE, ALA., January 27th, 1883.

I take pleasure in saying that I think your Steel Lever Key about *as near perfection as possible.* It is certainly popular in this district, and those furnished have given perfect satisfaction.

Many of the offices, when making requisitions, ask that "Bunnell's" Key be furnished.

Yours, C. G. MERIWETHER, Superintendent.

SUPERINTENDENT'S OFFICE, WESTERN UNION TELEGRAPH CO.,
OMAHA, January 29th, 1883.

I have a large number of your Steel Lever Keys in use in my District, and they are *more satisfactory than any other key we have used.*

Very respectfully, J. J. DICKEY, Superintendent.

BALTIMORE AND OHIO RAILROAD TELEGRAPHS.

BALTIMORE, January 18th, 1883.

The Bunnell Steel Lever Solid Trunnion Key is *everywhere the favorite on our lines.* We have three or four hundred in use, and regard them as being the very best.

R. STEWART, Superintendent Telegraph.

CENTRAL PACIFIC RAILROAD.

OFFICE OF SUPERINTENDENT TELEGRAPH,
SAN FRANCISCO, CAL., February 9th, 1883.

J. H. BUNNELL & CO., 112 *Liberty Street, New York:*

GENTLEMEN: My operators prefer your *Steel Lever Keys* to any yet introduced on our lines.

Yours truly F. L VANDENBURGH, Superintendent.

B. & M. R. R. IN NEBRASKA.

OFFICE SUPERINTENDENT TELEGRAPH,
LINCOLN NEB., January 29th, 1883.

We have about eighty of your keys on our lines, and *they are giving the best of satisfaction.* We have adopted your Steel Lever Key as our standard.

Yours truly, C. E. YATES, Superintendent Telegraph.

ATLANTA & CHARLOTTE AIR LINE AND GEORGIA PACIFIC R. R. CO.

ATLANTA, GA., January 30th, 1883.

We are using a great number of your Steel Lever Keys on our lines, giving entire satisfaction. I consider the Steel Lever Solid Trunnion Key *complete and perfect in every feature,* and see no chance for further improvement in keys.

Very respectfully, A. N. OLDFIELD, Supt. of Telegraph.

THE MISSOURI PACIFIC RAILWAY CO.

(Telegraph Department.)

MARSHAL, Texas, February 3d, 1883.

Your Solid Trunnion Steel Lever Keys are in very general use on the lines under my charge, namely: St. Louis, Iron Mountain & Southern, Texas & Pacific, and International & Great Northern Railroads, and are *giving complete satisfaction.*

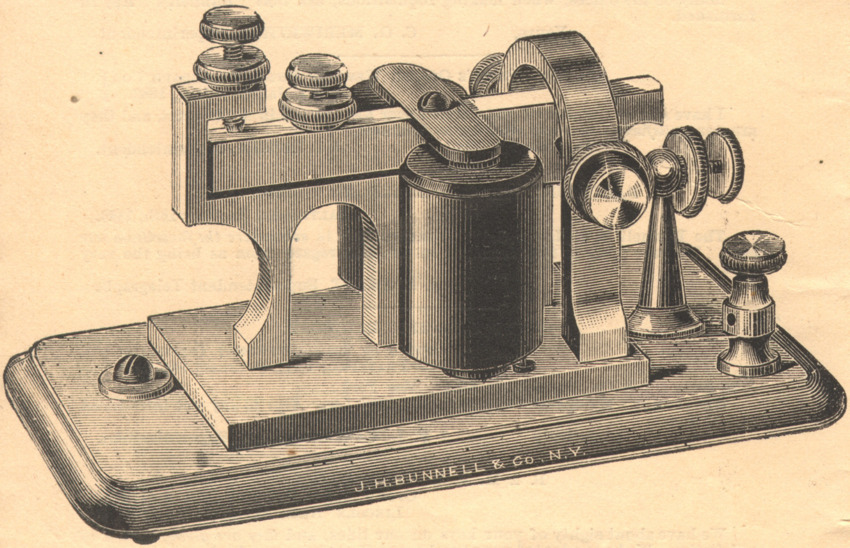
Respectfully, C. W. HAMMOND, Superintendent of Telegraph.

The Giant Sounder

J. H. BUNNELL'S

PATENT, FEBRUARY 16th, 1875,

With Improved Adjustments.



The original Giant Sounder, as shown above, is now recognized throughout America as the BEST standard of excellence in Sounders. It gives loud, clear sound with just half the amount of local battery generally required for other forms of sounders.

Price.. $3 50

Giant Sounders, wound with fine wire to 20 ohms resistance for Main Line use (without relay), on lines up to 15 miles in length........................ 4 00

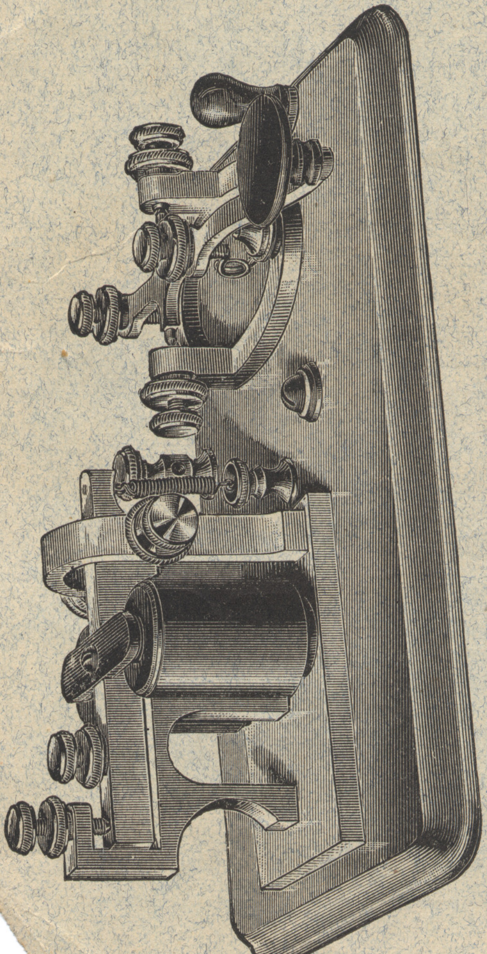
FOR

PRIVATE LINES,

CITY WIRES,

AND ALL

Short Lines up to 10 or 15 Miles in Length.



GIANT SOUNDER,

(20 Ohms Resistance) and

STEEL LEVER KEY COMBINATION SET.

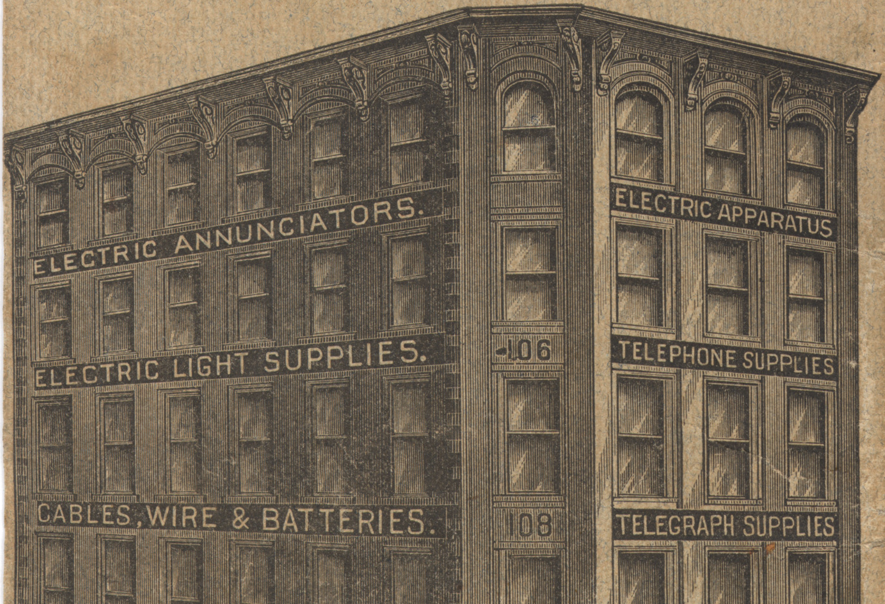
Our Standard first-class Giant Sounder, finely finished, with Rubber-Covered Coils, fine Silk Covered Wire, wound to 20 ohms resistance, mounted on Polished Mahogany Base, with a Steel Lever Key, making the prettiest and most perfect set of Short Line Instruments ever produced.

Price $6.25

Sent by mail to any distance, carefully boxed, and PREPAID, on receipt of price.

Same set, but wound to 3 ohms (local) $5.75

The latter set with large cell of battery, book of instruction, chemicals, wire, etc., making an Extra Fine Finished Learners' Set $6.75


ELECTRIC ANNUNCIATORS.
ELECTRIC LIGHT SUPPLIES.
CABLES, WIRE & BATTERIES.
ELECTRIC APPARATUS
TELEPHONE SUPPLIES
TELEGRAPH SUPPLIES
106
108
J. H. BUNNELL & CO.
TELEGRAPH INSTRUMENTS
106-108
J. H. BUNNELL & CO.
Bookhout Bros N.Y.