

DIRECTIONS FOR THE PRACTICAL WORKING

OF

BEARDSLEE'S

Magneto-Electric Signal Telegraph

MANUFACTURED BY THE

BEARDSLEE MAGNETO-ELECTRIC CO.,

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OF

GEO. W. BEARDSLEE'S

MAGNETO-ELECTRIC SIGNAL TELEGRAPH

IN each of the two carts or wagons, and about the center of each, there is a multiplying gear mounted on a stand with a swivel, so that it can be swiveled to reel out or in, from either side, the front or the back of the cart. And this stand is adapted to receive any of the series of reels, so that the reel when so placed can be turned by the multiplying gears for reeling up, or left free to turn without it, for reeling out. And in each cart there are four other stands to receive four reels; each cart is also adapted to receive one of the Signal Telegraph machines, set in a box when not in use, and to be lifted out and set on the lid when it is to be used. The five reels in one cart have the insulated conducting wires reeled on them, each reel with one mile of wire, and the five reels in the other cart are empty.

Each reel is provided with a piece of copper wire, one end of which is secured to the outside of one of the iron heads of the reel by being wound around a set-bolt, and between two washers, so that by screwing up the set-bolt the wire will be firmly held between the two washers. This copper wire passes through a hole in the head to the inside of the reel and near the barrel, and is there provided with an insulated binding screw.

Each reel carries one mile of insulated wire, the inner end, of which is connected with the copper wire before described, by the binding screw. As the head of the reel is of metal and secured to the metal shaft, and the piece of copper wire is

attached to the metal head, when the inner metallic end of the covered wire is connected with the piece of copper wire by the binding screw before described, a metallic connection is thus formed between the mile of wire covered with India-rubber and the center shaft of the reel.

The first thing to be done is to place the cart or wagon containing the empty reels, and one of the Signal Telegraph machines, at the first station selected, taking care to place it is nearly level as practicable. Then take the machine out of its box, place it on the lid, the operator using the tool-box as a seat. When the cover of the machine is opened, the telegraphing handle of the machine will be found at the letter T of the dial, where it was held by a loop in the cover. The operator then turns the telegraphing handle from the letter T to the adjusting stop at the left of the dial, taking care to turn to the right, as the handle can not be turned to the left, and any attempt to turn it to the left could only strain the machine.

The operator will then turn the indicating needle to the same position as the handle, by turning it in the opposite direction—that is, from the right to the left—by taking hold of the knob on the axis of the needle with his thumb and finger. Care should be taken not to turn the needle by hand from left to right, as that would strain the machine. The next thing is to make what is termed the ground connection, which is to be done by the iron crow-bars, of which there are two for each cart or wagon. For this purpose, select a place, if practicable, where the ground is damp, and if a damp place can not be found near the station, it may be found at some distance from it. When a suitable place is found, one or both crow-bars are either driven into the ground, or a trench dug out and the bars laid in it and covered over with dirt. If the ground is very moist, one bar driven into the ground will be sufficient, but if it be quite dry at the surface, then both crow-bars should be used and driven down deep. If there be a creek or march near by, the crow-bars may be simply laid down in the water. The crow-bars are each provided at the upper end with a set-bolt and washer. If two crow-bars are used, they are both connected by a copper wire, the ends of which are wound around the set-bolts, and then griped between the washers by simply turning the set-bolts. The metallic end of an insulated wire is then secured to the copper wire connecting the two crow-bars, and the other end secured to the hitcher marked G, of the telegraph-machine. If only one crow-bar be used,

the metallic end of the insulated wire is directly attached to the set-bolt on the end of the crow-bar. When the ground about the station is very dry, the ground connection will be improved by pouring water around the crow-bars. The ground connection may be obtained without the crow-bars, by driving spikes into trees, and attaching the conducting wire to the spikes; or, instead of driving spikes into a tree, the bark may be cut off all around the tree and a copper wire wound around it. Either of these modes may be resorted to in rocky land where it is difficult to insert the crow-bars, or in case the crow-bars should be lost.

Station No. 1 being thus established, and the direction of the place for station No. 2 determined, the wagon or cart containing the full reels is placed in position for starting, and the reel on the swivel-stand so swiveled as to pay out the wire in the most convenient direction; but before starting, the outer end of the insulated wire of this reel is secured to the hitcher marked L on the machine of station No. 1. The reel is to be disconnected from the multiplying gearing, so that it will be free to turn and pay out the wire being used, when required, to prevent the wire from being delivered too slack.

Before starting the cart, it is well to ascertain whether the wire on the reel is sound, which can be readily done by connecting the shaft of the reel with the crow-bar or other ground connection, by a piece of conducting wire, and turning the handle of the telegraph-machine of station No. 1. If the needle follows the handle, the circuit is complete, and the conducting wire sound. As the cart proceeds, the wire can be dropped on the ground or in the water, as it is perfectly insulated. It is best to select places over which troops will not be likely to pass, but when such localities can not be found conveniently, the wire can be hung on the branches of trees, and where there are no trees, and it be safely laid on the ground, it must be sustained on lances. For this purpose there are one hundred and fifty lances, fifteen feet in length, and fifty which are eighteen feet in length. The wire is put into the notch at the upper end of a lance, a hole made in the ground with the pointed end of a crow-bar, and the pointed end of the lance inserted, and the lance then turned, which winds the wire around the upper end of the lance to secure it. When greater elevation is required, the long lances should be substituted.

After reeling out one mile of wire, the end is to be disconnected from the reel which is removed from the center-stand and another reel substituted. But before proceeding with the second reel, it is best to test the first mile, which is readily done by attaching the end of the wire to hitcher L, of machine No. 2 in the cart, forming a temporary ground connection by means of a conducting wire with hitcher G, of machine No. 2, and the operators at both ends will make the calls as will be hereinafter described, when station No. 2 is completed, to determine whether the circuit is complete, and if found so, the machine is unhitched, the temporary ground connection removed, and the end of the first mile of wire spliced to the outer end of the wire on the second reel, which is done by means of the insulated binding screw. The ends of each of the two wires which project beyond the India-rubber covering, are inserted from opposite sides into the socket of the splicing piece, or binding screw, and there fastened by the thumb-screws. In doing this, care should be taken in inserting each wire, to do so until the India-rubber covering of the wires are brought in close contact with the ends of the India-rubber socket of the splicing piece. This insures the insulation of the splicing piece of the wires. This done, the second mile is to be reeled out in like manner as the first, making the same tests, and so on, mile after mile, until the second station is reached, where the like connections are to be made as at the first station. But if the second station is made before the wire on the reel is all payed out, then the shaft of the reel is to be connected by a conducting wire with the hitcher L, of machine No. 2, and the hitcher G, in turn, connected with the crow-bar or other ground connection.

Machine No. 2 is then to be adjusted as machine No. 1 was, by turning the handle and the indicating needle to the adjusting stop on the left side of the dial. Operator No. 2 shifts the switch of machine No. 2 to the letter T, (to transmit,) the switch of machine No. 1 having been placed at R, (to receive.)

Operator No. 2 makes one turn of the handle, which will cause the indicating needle of both machines to make a like revolution, and then moves his switch to R, and at the same time operator No. 1, having thus been called, moves his switch to T, makes one turn of the handle, to make the return call, and then moves back his switch to R.

Operator No. 2 then moves his switch to T, turns the handle to the letter O on the dial, making a pause, then to the stop on the right-hand side, then to the letter K, and then to the stop on the left-hand side, making a stop at each place. This indicates that all is right, and if he has no message to send, he moves the handle twice around the dial, stopping at the stop on the left side, indicating that he is ready to receive a message, and for that purpose shifts the switch to R.

During all these operations the operator should observe whether his indicating needle follows the handle, because if it does, all is right, and if it does not, there is some defect in the conducting wires, or in the ground-connections, which must be searched for and corrected.

If in either machine the line conducting and the ground-wires are inserted in the wrong hitchers—that is, the ground-wire in hitcher L, and the line-wire in hitcher G,—the circuit will be complete, but the impulses will be reversed, and the indicating needle will be one division before or behind the handle. In such cases the hitching must be corrected.

The above mode of calling must be used at either end of the line before sending a message.

In transmitting a message, which is done by moving the handle in succession to, and making a short pause at, the letters required to spell successively the words of a message, the operator, at the end of each word, must move the handle to, and make a short pause at, one of the stops, either to the right or left of the dial, as may be most convenient. For indicating the end of a sentence, he must turn the handle once around and stop at the adjustment-stop on the left of the dial. To transmit a message, the switch must be at T, and as soon as transmitted, the switch must be shifted to R, to be ready to receive a message, if one should be sent from the other station.

If an operator wishes to transmit figures, he must first move the handle to the stop marked, "Stop for figures," at the top of the dial, and then proceed in the same manner, following the figures on the dial instead of the letters.

If the operator receiving a message does not understand it, he moves his switch to O, which breaks the circuit, and stops the needle of the operator by whom a message was being transmitted. He shifts his switch to R, and the handle and the needle to the stop on the left side, and the operator who was receiving, in like manner adjusts his handle and needle, moves his switch to T, and makes the call before described, sends a

message, stating what part of the message he did not understand, and then shifts his switch to R, to receive the corrected message.

If the line-wire is cut or broken, persons should be immediately started from each station to find the break. When found, if provided with plyers, sand-paper, and insulated hitcher, it can be connected by removing the India-rubber covering, cleaning the ends of the wire with sand-paper to make it bright, and connecting it firmly in the binding-screw, and then testing the strength of the joint by pulling each way.

If the break can not be easily found by reason of the wire being parted without the rubber separating, it must be tried at all points by pulling, as the covering will stretch where the wire is broken, and when the break is found it must be spliced; but if the break can not be found by such an examination, reel up the wire by sections until it is found, or go back with the instrument, and test it mile by mile, until the break is found.

The break may happen either on the line or the ground-connections, all of which must be examined and tested.

When both instruments and all parts of the train are at one station, the wire should be thoroughly examined and tested, reel by reel, with the current, to see that all is right, and all repairs made, ready for making any other station.

Whenever the wire has been broken, it can be repaired in the following manner: First, clean a sufficient portion of both wires to make a telegraph-splice, which is done by twisting the end of each around the other end in the same manner, first having slipped on a piece of the small rubber-tubing provided for that purpose. This rubber-tubing must be pushed away from the splice. After the wire has been twisted and the tubing slipped on and back, solder the joint firmly by melting the solder in the cup on the spirit-lamp, or by the soldering-iron heated in a fire, having first dipped the joint in the soldering-acid. When the joint is thus soldered, cover it with gutta-percha slightly softened by the spirit-lamp, and make this part slightly thicker than the India-rubber covering of the wire, then smear it over with the rubber-cement, and then slip over the sleeve of rubber-tubing, and tie it fast at each end, either with wire or twine.

When the line is to be removed, it may be taken up from either end, by removing the line-wire from the hitcher L, of the machine, and attaching it to the hitcher on the reel (placed for the time being on the central stand), and then connecting

the shaft of the reel with the gear, so that the reel may be turned by the crank as the wagon or cart progresses. Care should be taken to reel up the wire tight, and in regular coils from one end to the other and back, and at the end of each mile to take the ends of the line-wires out of the insulated splicing piece or hitcher, removing the full reel from the center-stand, and substituting an empty one.

If more than two instruments are placed in the same circuit, they must be put in the following order: If you commence with an instrument of an odd number (say 7), the next must be even (say 8), and so on with all the instruments, in the same order, alternating the odd and even numbers. In the above supposed case the third instrument would have to be of an odd number (say 9), the fourth even (say 10), and so on until all the instruments desired to be connected are brought into the circuit.

In hitching up a number of instruments, you first place the ground-wire in hitcher marked G of the first instrument, and the line-wire in hitcher marked L. The other end of the line-wire reaching to the second instrument you put into the hitcher marked L of that instrument. Then again the line-wire which is to extend to the next (third) instrument, into the hitcher marked G of the second instruments; carry your wire to the third station and instrument, and repeat the operation as above, with every succeeding instrument, until all are brought into the circuit.

If the above order is observed, more than two instruments may be put into the same circuit, and messages may be received and transmitted from, and to any of them.

In regard to the best mode of practice for new operators, it has been found that the first and most essential thing is to become familiar with the arrangement of the alphabet as arranged on the dial, and also to become expert in the making of the movements of the handles, and stopping the same at the proper letter or stop, and making sure that the needle and handle are always stopping at the letter or stop desired. And to become familiar with the rules, the best practice is to transmit the rules from one station to another, and have them written out by the new operator. By the time a new operator shall be able to send these full instructions, and reduce them to writing without an error, he will be competent to send any message.

The machines will not be liable to get out of repair; they will require to be oiled but seldom. In oiling the bearings,

(which will be readily found by an examination of the interior,) only the best sperm oil should be used.

The top-journal of the magnet-shaft is oiled from the top of the machine, through the oil-holes under the velvet cover.

The needle-spindle will not want oil oftener than once in six months, and then but very little should be put on to the journals by means of a small wire or stick.

If the magnet that vibrates between the spools, to work the needle, should fail to vibrate fully, this will indicate that either oil or small particles of iron have got attached to the magnet, which may be cleaned off by drawing a cloth or rag between the magnet and the end of the spools.

It is important, in all cases where a splice is to be made, or a connecting wire attached, to have the wire clean where the attachment is made.

In laying down or taking up a line through the woods, or other place which will not admit of the passage of the cart or wagon, two bearers, provided for that purpose, are to be inserted in rings, which will be found at the end of the reel-stands, and then the reel can be carried by hand.

The following directions are for the working of the bell and telegraph-switches, also for the connecting of the wires of the several spools, in the event of their being in any way deranged, and the annexed drawing will illustrate the same.

A, A, A, in the drawing, represents the box or case of the instrument; B, the radiating magnet which, with its radial points, is revolved beneath the spools, c, c, c, there being six poles alternating, three north and three south poles.

d, d, d, are the terminal wires of the magneto-spools, showing the manner in which they are connected together. The outside wire m, of No. 1 spool, is connected together with the lug l, of the telegraph-switch, extending to the lug o, of the bell-switch.

The inside wire of the same spool is connected with the outside wire of the next spool, No. 2, and so on through the series of spools to No. 6, which has its inside wire h, connected with L hitcher e, above the word telegraph, and extends to the lug k, of the telegraph-switch, and then to the lug p, of the bell-switch.

W, w, w, represent the electro-magnet spools, whose terminal wires, t, t, t, are connected, throughout the series, outside with an inside wire. The terminal outside wire s, is connected

with the telegraph-switch, n, and the inside terminal g, is connected with the G hitcher e, over the word telegraph.

A² A² are the wires connecting with the hitchers e, e, and extending to the second station or other instrument.

f, is a wire connecting G hitcher e, over the word "Telegraph," with G hitcher e, over the word "Bell."

r, is a wire which connects the bell-switch with L hitcher e, over the word "Bell."

d' is the vibrating magnet between the cores of the electro-magnet spools.

The arrows indicate in what direction the wires of the several spools are wound.

B² B² are the wires connecting the bell-spool with the hitchers e, e, (L and G,) over the plate marked "Bell."

The bell and telegraph-switches have each a plate with the letters T for "transmit," O for "open circuit," and R to "receive" message.

The switches of all the instruments in a given circuit, when not in operation, have their telegraph-switches placed over O, and the bell-switch over R.

When message is to be sent from either of the stations, the operator places his bell-switch over T, makes one turn of the handle from the adjustment-point of the dial to the same place and stops, and repeats this movement till the number of the station to which a message is to be sent is reached; he then places his bell-switch over R, when the operator at the station called will place his switch over T, and repeat the call.

When this is done, the operators of all the instruments in the circuit will place their telegraph-switches over R, their bell-switches over O. The operator who made the call will then move his telegraph-switch over T, and proceed to transmit his message as before described.

The telegraph-machines are all numbered consecutively from one upward, and before leaving the factory they are all adjusted in the following manner, which must at all times be borne in mind, whenever the machines are taken apart and put together again.

In all machines marked with even numbers, the indicating handle being placed at the adjustment-stop at the left of the dial, the north poles of the radial magnet must be placed under the spools marked 1, 3, and 5, and in the machines marked with odd numbers, the indicating handle being at the same division of the dial, the north poles of the radial magnet should

be under the spools marked 2, 4, and 6. In putting the machines together, this adjustment is readily effected by simply lifting the intermediate cog-wheel (which is between the driving wheel and the one on the shaft of the radial magnets) and placing the indicating handle as stated, and turning the radial magnets until the poles are in the position stated, and then replacing the intermediate cog-wheel.

When a message is being transmitted from a station, the current is generated in the magneto-spools over the radiating magnet by the passage of the several radial poles of magnet in close proximity to the ends of the cores of the several spools.

When the poles of the magnet are approaching and leaving the cores, magnetism is temporarily induced and discharged from the soft iron cores of the spools. This peculiar action in the soft iron induces electric impulses in the surrounding insulated coils of wire, which impulses are transmitted through the wires connecting the electro-magnetic spools of the instruments, and the lines connecting the stations.

The effect of these impulses of the electric current passing around the soft iron cores of the electro-magnets, induces magnetism in them, which causes the vibrating magnet to be attracted or repelled alternately in opposite directions, as the current is alternately reversed.

When the north poles of the magnet are passing spools Nos. 1, 3, and 5, and the south poles Nos. 2, 4, and 6, the current is in one and the same direction, with the power and strength of all the impulses of the six spools united.

When the reverse is the case, that is, when the south poles are passing where the north poles have just left, and the north poles where the south poles were, the current is induced in the opposite directions.

This change of direction causes the vibrating magnet to be alternately repelled and attracted in opposite directions, giving a pendulous motion to the magnet and pallets, which causes the needle to be moved around the dial, to indicate the letter intended, each impulse moving it the distance of one division of the dial.

When the instruments are in operation, the telegraph-switch of the receiving instrument being placed over R, the currents induced in the transmitting instruments are conducted along the wire h, through the hitcher L, e, and line wire A² to the receiving instrument, through the lug k, of that instrument and the telegraph-switch n, along the wire s, through the elec-

tro-magnets w, w, w, along the wire g, g, to the hitcher G, e, over "Telegraph," along the wire or ground A², to the same hitcher in the transmitting instrument, then along the wire g, g, through the electro-magnets w, w, w, and the wire s, and the switch n, the lug l, and the wire m, through the magneto-spools back to the terminal wire h, of Spool 6.

Thus it will be observed that the electric current passes from the generating instrument only through the electro-magnetic spools of the respective instruments, and does not follow through the bell-spools as they are switched open, nor through the magneto-spools of the receiving instruments as they are switched out of the circuit.

When the bells are operated, it will be observed that when the switches are placed as before described for that purpose, all the electro-magnetic spools are switched out, as well as the magneto-spools of the receiving and transmitting instruments.

If from any cause the spools of the electro-magnet require adjusting, this can be done by the set-screws and the holding-screws, but in no case should the ends of the cores be placed so near the range of vibration of the vibrating magnet as to permit it to come into contact with them, but so as to be just clear when the pallets are seated down in the escapement ratchet-wheel of the needle-shaft. Care should be taken to give the like adjustment to all the cores of the electro-magnets.

The instruments may all be moved from their cases by removing first the holdings-hinge, then the velvet cover, the beads around the dial-top, then the six screws in the bottom of the box; care being taken, when replaced, that all is made tight and firm, and that no dirt or other matter is allowed to remain in case or instrument, and particularly no particles of iron are left in, or allowed to get in, as these will be attracted to the vibrating-magnet, and get between that and the cores of the spools, and prevent its vibrations, and thereby prevent the instrument from working.

It will be observed that the radial magnet-shaft rests in a step, which may be raised or lowered by a set screw, which is then secured in place by a jamb-nut. This magnet should always be so adjusted as to revolve as near as possible to the ends of the cores of the magneto-spools without touching; and to prevent their being lifted into contact by the magnetic attraction, a set screw is provided on top to hold it down, which will be required to be adjusted for that purpose, whenever it may be necessary to do so.

It is also important, that whenever more than two instruments are placed in the same circuit, if it be desired that the messages shall pass any given instrument or instruments, it or they can be closed out of the circuit, by uniting the two hitches e, e, over the plate marked "Telegraph," by means of a wire.

Section showing the wire Connections.

