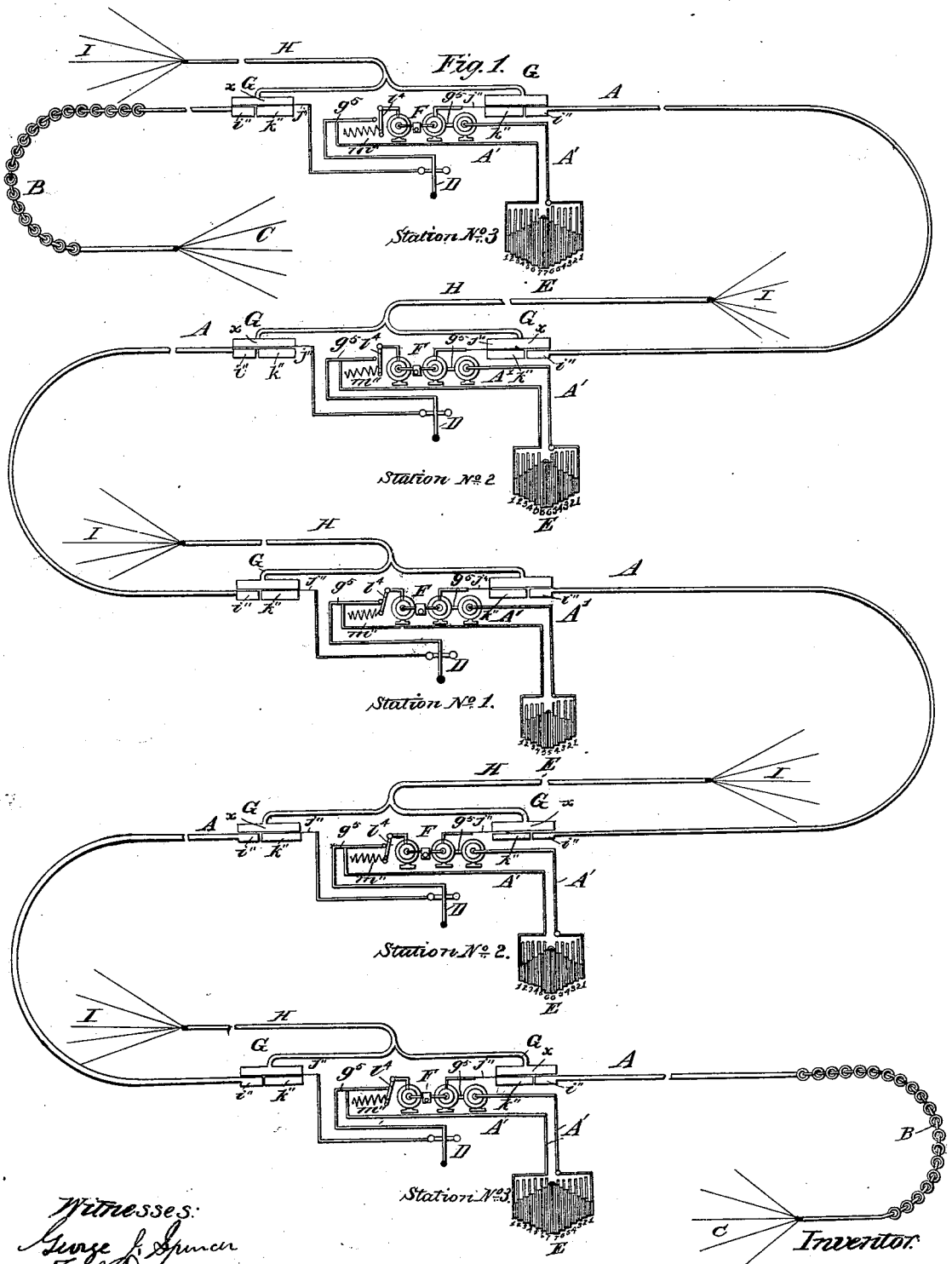
4 Sheets—Sheet 1.

R. E. HOUSE.

ELECTRO PHONETIC TELEGRAPH.

No. 48,408 Patented June 27, 1865.



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ELECTRO PHONETIC TELEGRAPH.

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Fig. 2.

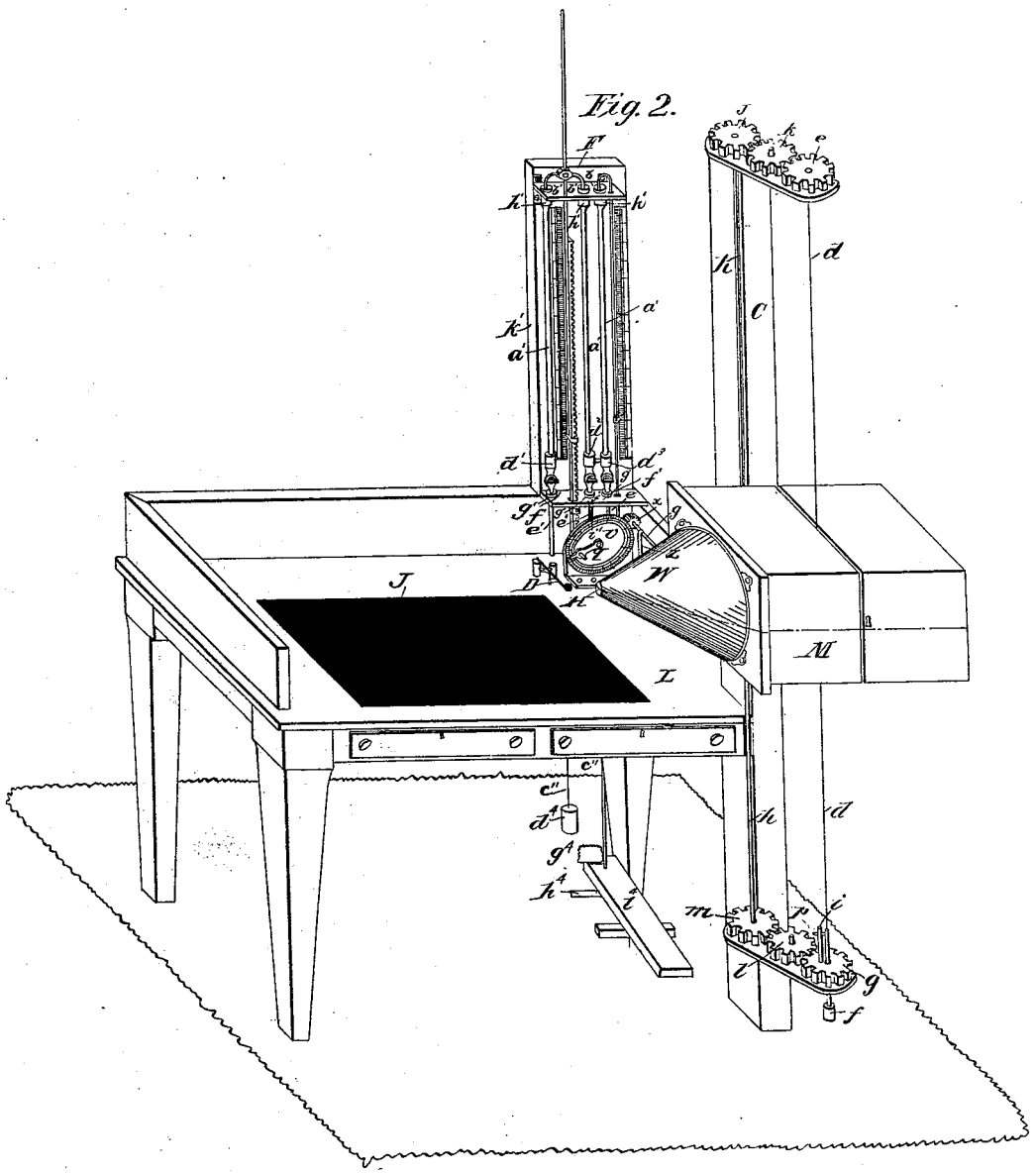

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Fig. 8.

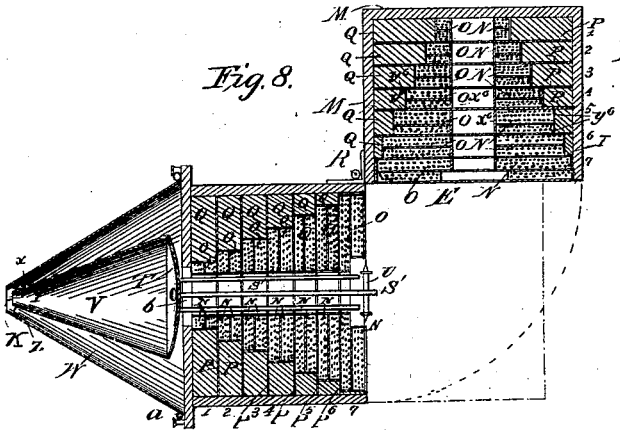


Fig. 6.

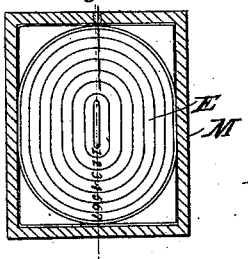


Fig. 7.

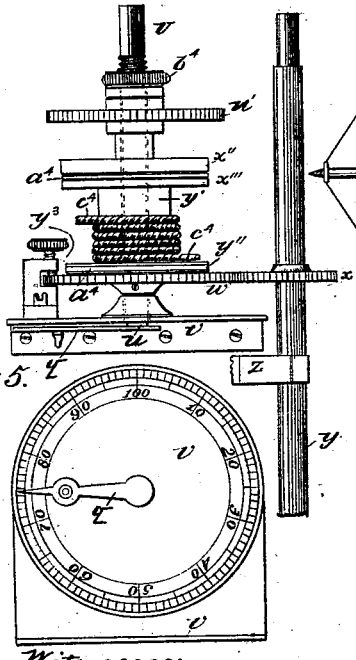


Fig. 5.

Fig. 4.

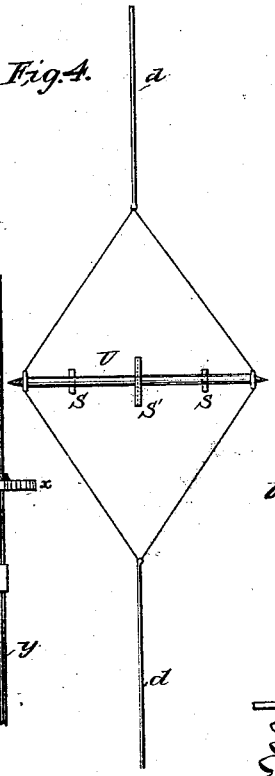
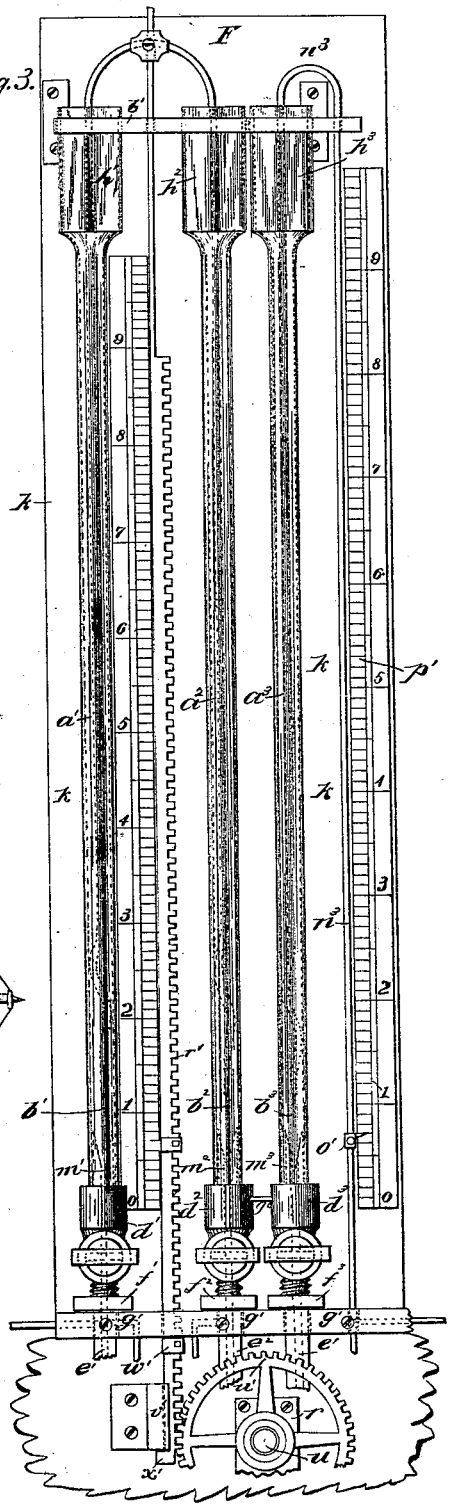


Fig. 3.



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ELECTRO PHONETIC TELEGRAPH.

No. 48,408 Patented June 27, 1865.

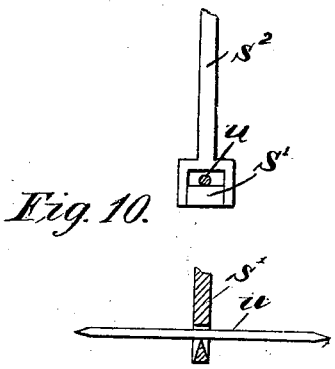
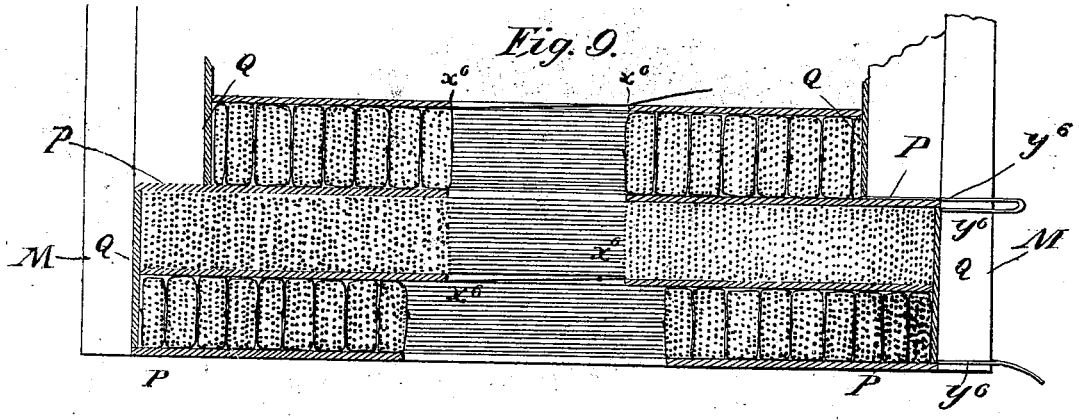


Fig. 10.

Fig. 9.



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UNITED STATES PATENT OFFICE.

ROYAL E. HOUSE, OF BINGHAMTON, NEW YORK.

IMPROVEMENT IN ELECTRO-PHONETIC TELEGRAPHS.

Specification forming part of Letters Patent No. **48,408**, dated June 27, 1865.

To all whom it may concern:

Be it known that I, ROYAL E. HOUSE, of Binghamton, New York, have invented certain new and useful Improvements in Electro-Telegraphic Apparatus; and I do hereby declare that the following, taken in connection with the drawings, is a full, clear, and exact description thereof.

In the drawings, which are on three sheets, Figure 1 represents a line of insulated electric conductors connected with apparatus for making signals according to the principles of my invention, and exhibiting one method of using my invention practically. Fig. 2 represents a telegraphic desk and its appendages constructed according to the principles of my invention. Fig. 3 is an elevation on a scale of one-half of the electrical adjuster and helix-tester and their accessories. Fig. 4 is an elevation of a needle and adjacent parts, full size. Figs. 5 and 7 are an elevation and plan of the index and dial of the torsion apparatus, and of the contrivances for moving it and the electrical adjuster. Fig. 6 is an end view of a helix and case, with the end of the case and insulating-glass removed. Fig. 8 is a section through a helix and case and through a sounding apparatus on the red line of Fig. 2. Fig. 9 is a section of part of a helix, taken on the line of its axis; and Fig. 10 exhibits two views of a needle and knife-edge.

The feature of my present invention may be divided into five heads or grand divisions, and are, first, a new method of employing an electric current, passing along what is generally termed a "line," for the purpose of making signals, such method consisting in connecting the helices of a telegraphic signalizer or recorder with the main line by means of branch conducting-wires, in combination with electric adjusters, whereby a portion of the electric current may be passed directly along the line without entering the helix, and the remainder may be passed through the helix, the portion passing in either direction being adjustable according to the will of the operator, this part of the invention being applicable to all electric signalizers whose signals are produced by motion of the parts; second, a new telegraphic signalizer, in my opinion capable of being operated with more feeble currents than those heretofore known, parts of which may be used in connection with other descriptions of signalizers; third, a combination of an apparatus for indicating the comparative force of a spring with the reacting-spring of a telegraphic signalizer whose signals are produced by motion, whereby a comparison may be made between the amounts of leakage existing at any one station at different times, and which combination, when used at several stations, will indicate between what stations any excessive leakage is taking place; fourth, a combination of helices of different size at various stations along the same line, said helices being proportioned according to a law hereinafter set forth, whereby greater certainty in signalizing is attained, especially in bad weather, than when helices of the same size or helices varying only accidentally in size are employed at different stations on the same line; fifth, a combination of an electric adjuster and scale with the helix of a telegraphic signalizer, whereby the condition of the helix and batteries may be tested by the operator.

By "telegraphic signalizer" I mean apparatus which makes sounds or marks, or both, by a motion of some of its parts, or gives signals by the varying position of a needle when electric currents passing through the apparatus are broken and closed or changed in direction. By "line" I mean a line of conductors capable of conveying an electric current such as is usually employed for telegraphic purposes from one telegraphic station to another. By "leakage" I mean that loss of current which is owing to imperfect insulation of a line, and which is usually in greatest extent in wet weather in lines supported on poles, and constant or nearly so in submarine cables; and by "electric adjuster" I mean a contrivance by means of which the amount of current due to the action of a battery of a certain size can be controlled in its passage along a line—that is to say, that the whole amount of the current due to the action of the battery may be permitted to pass or only such portion thereof as may be expedient, such adjusters being instruments inserted in the line which will conduct greater or less amounts of electricity in consequence of a variation of the position or condition of their parts; and I wish it distinctly understood that the fact that greater force or power of reacting-springs in telegraphic signalizers is required (other things being equal) when the leakages are great is well known to me, and

also the fact that a current of electricity passing along a line and through helices will exert a less power in each and every helix when the number of helices on the same line are increased, and that this fact is specially evident when the helices are large or composed of fine wire, or have both these features.

I am also aware of the fact that the capacity of a line to pass quantities of electric current depends upon the size of the wire, (other things being equal,) and that the leakage of the line, which is constantly varying in wet windy weather, is almost entirely independent of the amount of current passing through it when the line is worked by the usual batteries. The amount of current which can be passed along a line which does not include helices in the circuit, or which has few or no helices making part of the line, is therefore greater than that which can be passed over one which has helices or many helices in the circuit. A greater proportion of the whole current may therefore be broken and closed at any one station and effectiveness in signalizing secured when the line is freed from helices or many of the helices, or when the whole current is not forced to pass through the various station-helices, but is permitted to pass almost entirely along the line.

I am also aware of the fact that calls can be made to the various stations with certainty when effective signalizing of messages is difficult or impossible.

My invention, based partly on a knowledge of these facts, has for its main objects, first, the successful working of telegraphs in bad weather, or when leakage is excessive from any cause, or when feeble currents only can be sent through a line; second, the saving of expense, as it permits the use in good or ordinary lines of comparatively feeble batteries; and, third, the facilitating the working of lines by enabling superintendents or operators to determine between what station excessive leakage is taking place or when helices are defective or batteries are in bad order. Attention to these definitions and assertions will materially aid in understanding this description, which I will commence by describing my new telegraphic signalizer, in which the signals are produced by a vibrating needle striking against a sounding apparatus, and I will describe, first, the helix and its accessories; second, the needle and the means of supporting it; and, third, the sounding apparatus.

The helix is best shown in Figs. 6 and 8, and is what I call a "compound" helix, made up of sections, each placed adjacent to the other, and each section composed of two members. The sections are wound separately. An end of insulated helix-wire is secured upon a mandrel, by preference of oval cross-section, and the mandrel is then revolved, the wire being wound layer over layer between collars, and the outer end being left protruding, the winding being commenced at x^6 x^6 x^6 and ending at y^6 y^6 y^6. When one member is wound one of the collars is slipped off and a plate of glass or other proper insulating material, with a hole in it of about the same shape and size as the periphery of the mandrel, is slipped on the mandrel over the end of wire and bearing against the completed member. Another end of wire is then attached, so as to form an electric connection to the first end spoken of, and the mandrel is revolved in the opposite direction, the wire being wound layer upon layer till this second member is completed. The protruding end of the last-formed member is then the whole length of the section, measuring along its axis distant from the protruding end of the first-formed member. Each member is secured while being formed by threads tied over the layers, as at x^8 x^8, Fig. 9, and when the section is completed it may have a hoop of leather, india-rubber, &c., Q, sewed or fastened around it.

I prefer to make the mandrel in sections, like a hat-block, so that it may be removed in pieces when a section is completed; and I prefer to make the sections of varying diameter, as represented in the drawings, as I have discovered in the course of a multitude of experiments on helices used for the purpose of deflecting needles that the same amount of wire is more effective when wound into a helix whose diameter decreases toward the ends, and this is true as well in helices of the usual construction as in those made up of sections on my plan.

The glass plates between the members are represented at O O and the members at N N.

When a sufficient number of sections are formed they are to be placed in a wooden case fitted inside with blocks or projections so formed as to hold all the sections with their axial lines coincident. After one section is placed in position a plate of glass or other proper insulating material, P, with an aperture like that through the sections, is placed against it. The next section is then placed, then another plate P, and so on until the helix is built up. The protruding ends of each section are to be passed through the case and attached by soldering to the protruding ends of the next section on each side, and the outside protruding ends of the two end sections are those which are to be connected to the line.

In placing the sections next to each other care must be taken to locate them in such wise that a current of electricity passing along the wire from one end of the whole helix to the other end shall throughout its course revolve around the axis of the helix in the same direction.

I prefer to make the sections of varying diameter, but they may be of equal diameter; and I prefer to wind the two adjacent members of the two middle sections with a larger axial aperture than the others, so as to give room for the needle; but the apertures through the sections may be all of equal or of varying size.

A helix made up of sections is not new, and the distinguishing novel characteristics of mine are, first, that the sections are made of members, each connected to the other on the layer of wire nearest the axis; second, that such

members have insulating-plates interposed between them; third, that the sections, each composed of two members, are packed up with insulating-plates interposed; fourth, that the sections are connected to their neighbors by the outside layers of each; and, fifth, the shape of the helix diminishing in exterior diameter toward its ends.

I prefer to make the helix and helix-case in two parts, so that one may be removed from the other to get at the needle, by preference attaching the two parts of the case by a hinge. The outside connecting-wires of the middle sections are to be made long enough to admit of the removal of one part of the helix from the other, and one part of the case M is to be attached to a post, pillar, or other proper support. I intend sometimes to use a helix composed of a single section and two members only.

The needle *u* may be of any usual or proper construction. I prefer to make it about three inches long and of thirty-four grains troy in weight, of equal diameter throughout except at the ends, which are conical, of cast-steel wire, and with as a great a lifting magnetic power as possible. I prefer to suspend the needle by torsion-wires, hairs or threads, or fibers *d d*, (No. 34 wire, iron or brass, about six feet long, serves a good purpose,) forked at one end, and with the forks secured to collars of demagnetic metal, through which the needle can be slipped. The torsion-wire extends both above and below the needle through proper apertures in the box and helix. The upper end is secured to a cog-wheel (see Fig. 2) and the lower end to a weight passing through the axis of a cog-wheel and forced to revolve with it by pins attached to the weight and the wheel, the connection being such that the weight may rise and fall as it revolves, so as to compensate for the varying length of the wire when more or less twisted. By turning these wheels, which are mounted upon movable supports, so as to bring the wire, and consequently the needle, to its proper position in the helix, either or both ends of the torsion-wire may be twisted or untwisted, and I call a torsion-wire so supported that it may be twisted and untwisted an "adjustable torsion suspensory apparatus."

Any proper means for supporting and twisting the torsion-wire may be employed; but I prefer cogs, and also prefer to engage the cogs by means of intermediate gearing with other cogs mounted on a shaft, *n*, and to connect this latter shaft by means of miter-gearing with a shaft, *y*, Figs. 2 and 7, and to connect the latter shaft by gearing (cogs *x* and *w*, Fig. 7) with a shaft, *u*, Fig. 7, which has attached to its end an index and crank hand, *q*, Figs. 2, 5, and 7, working in front of a dial, *v*. The purpose of the whole arrangement is to twist both ends of the torsion-wire at once, thus adjusting the torsion, and to register the amount of torsion, and consequently of reacting force, the gearing being such that the index-hand makes one turn for each turn of the torsion-wires.

Upon the shaft *y* is secured a tape-line, *z*, which rolls up and unrolls as the shaft revolves. This line is graduated, and inspection of the amount or length unrolled will show the amount of turns given to the torsion-wire, while inspection of the index-hand will show the parts of a turn. Other arrangements of gearing, or bands and pulleys, and other registering apparatus, may be substituted for those shown and described, so long as both wires can be twisted and the amount of torsion or twist determined by inspection.

The extension of the torsion-wire both above and below the needle is important in preventing tremulous motion, and this motion may be further prevented by causing a knife-edge, S′, Fig. 10, to bear lightly against the center of the needle. This edge may be supported by a demagnetic or non-conducting support from the helix or the helix-case, or the bell or gong upon the rod S^2. I prefer to attach the rod to the gong, as I find by actual trial that the sound of the clicking of the needle is thereby intensified.

Outside of the helix is secured a gong or bell, T. To this bell are secured the limiters and sounders S S, made of demagnetic metal, which pass through the aperture of the helix without touching the helix, and serve the double purpose of limiting the motion of the needle, which strikes against their ends as it vibrates, and transferring the shock of the needle against them to the bell; and by reference to Fig. 8 it will be perceived that these limiters lie both on one side of the needle, while the knife-edge (which is supported in an eye in the support S^2, through which the needle passes) is on the other side. The needle, as it oscillates, therefore strikes with one side against a limiter, while its other side rests against the knife-edge. This arrangement prevents tremulous motion of the needle.

The bell I prefer to make spherical or parabolic, and with one or more apertures in it, as experiments prove that the sound is intensified when they are used. This bell is made of metal, hard, thin, and sonorous, or of other proper material, and has soldered to it a concentrating-cone of sheet-brass or other proper material, V, open at the apex K, where the ear is to be placed; and I have found that the effect is better when this cone is surrounded by an outer cone, W, attached to the helix-case or other proper support, and that the best way of supporting the whole sounding apparatus is to attach the outer cone to the case, the inner cone to the outer one by wires or metal rods at the apex of both, and the bell and limiters to the base of the inner cone or concentrator, V, all as shown in Fig. 8.

It is in practice sometimes desirable to prevent too long a continuance of the vibrations of the bell, and I have tied thread from the ends of the limiters to the case of the helix in such wise as to prevent sidewise vibrations of the limiters, and have made small cushions of chamois-skin or cloth to bear against the bell with good effect in limiting the continuance of

vibrations. When currents of electricity passing through the helix are broken and closed or changed in direction the needle will vibrate and strike against the limiters, with a sound perfectly audible to the ear of the operator placed at the apex of the cones, and by means of such sounds messages may be communicated as in the present way of using what is commonly called the "Morse telegraphic signalizer" or "Morse instrument."

When signalizers like the one described or like those now in use are placed in a line connected thereto, either on the plan now used or on my new plan, presently to be described, the power or force of the reacting-spring or torsion-wire must be increased as the leakages increase, and in my signalizer the torsion of the wire causes the needle to react as the spring causes the armature to react in signalizers now in use. I mean, therefore, to combine a registering apparatus substantially such as is described hereinbefore, not only with my new signalizer, but with those now in use, whereby the proportionate force of the reacting-spring or torsion may be known at all times, the combination in the one case being really the same as in the other. If the indications of the registers of the reacting force on the various signalizers of a line be compared when a line is working well and the indications noted, then a comparison of the indications when there is excessive leakage will show between what stations the leakage is excessive, as the registers at each end of the section of line where leakage is excessive will indicate greater differences than they would if the leakage in such sections bore only its proper proportion to the leakage of the whole line. A superintendent can therefore, by the use of these registers, direct what part or section of a whole line needs examination and putting in order.

My new plan of connecting my new helices and signalizers or other signalizers or helices with a line is best shown in Figs. 1 and 3. By references to these it will be perceived that the main-line A A A extends to a commutator or key, D, at each station, which is the key that is operated to send messages. This key D is located in the main line at a point between the next station and the point of attachment of the branch wire to that line, so that the currents passing through both the main and the branch lines may be broken by it. The main line extends from the key D to an electrical adjuster, F, thence to the next station, and it will be perceived that the helices are connected to the main line by branch wires A′ A′, each but in electrical connection with the main line, on opposite sides of the adjuster; hence, if the adjusters were non-conductors, the whole electric current would pass through the helices, as is now the practice; but, in accordance with assertions heretofore made, I find it highly desirable that only so much of the whole current should pass through the helices as is necessary to give indications. I therefore interpose adjusters between the ends of the line at each station, and by their use permit the whole current to pass along the main line, excepting only such an amount thereof as is necessary to cause the helix either to make a magnet or deflect a needle, which amount flows along the branch lines A′ A′.

The electric adjuster which I prefer to use is best exhibited in Fig. 3. It consists of two tubes of glass, a' a^2, with their upper ends enlarged, so as to permit the free introduction of water, supported at their lower ends in faucets d' d^2, and with their upper ends extending through holes in a shelf attached to a board, k k. These faucets are to draw off water when it becomes foul, and they extend up inside of the tubes and have their upper ends formed like the counterpart of a wedge, as at m' m^2. The faucets are supported in a wooden shelf by nuts f' f^2, so that they may be adjusted in height, so that both ends l' l^2 of a staple-shaped wire may be brought to bear at the same time in the cavities m' m^2. The two ends of the line are to be connected to these two faucets, as at g' g', and as they are of metal the two ends of the main line will be at m' m^2, and the branch lines are to be attached to the main line at some point near the ends, as at g^5 g^5, Fig. 1. To a rack, r', fitted in proper guides, I attach a staple-shaped piece of wire, whose ends l' l^2 reach down into the tubes. These ends are wedge-shaped, and in order to insure their fitting into the cavities m' m^2, I bend the wires so as to touch the bore of the tubes. When in use the tubes are to be filled with water or other suitable fluid. When the ends of the staple are down in contact with the cavities, the whole, or practically the whole, current will flow along the main line, the staple being, in fact, part thereof, and the helix will exercise no influence on a needle or magnet. When the ends l' l^2 are lifted from the cavities m' m^2 to a distance which experiment in each case will determine, a sufficient amount of current will pass through the helix to cause it to perform its work, and the rest of the current will pass through the staple and water from m' to m^2 directly along the main line. The same effect would be produced if the staple were directly attached at one end to the main line and only one tube were used; but I prefer two tubes and a staple separated at each end from the line; but in either form of the apparatus the ends of a severed main line are caused to approach and recede from each other, while a water-connection is kept up between them, and the amount of current forced to pass through the helix will depend upon the distance that the ends are apart. When signals are to be received at a station the ends l' l^2 are to be brought downward till the signalizer works practically. After the message is received the ends l' l^2 are to be lifted so that only enough current passes through the helix to insure its sounding a call; or the same objects may be attained by adjusting the ends l' l^2 in the proper position for sounding a call and then securing them in that position, throwing the rack out

of gear. Then, when a call is sounded and a message is to be received, the main circuit is to be broken by the key l^4, Fig. 1, so that the whole of the current will then pass through the helix until the message is finished. This method of working is valuable when the whole current is required to sound a message properly.

It is hardly necessary to say that the tubes may be vertical, inclined, or horizontal, if furnished with stuffing-boxes, and that the faucets might be moved toward the wire instead of the wire toward the faucets.

For convenience of working I engage the rack with a cog-wheel, n', upon the shaft u. This wheel is loose upon the shaft, upon which is mounted a drum, y', also loose upon the shaft, having attached to its ends (see Fig. 7) disks x^3 y^2. A disk, x^2, is attached to the wheel n', and a disk, y^3, to the wheel w, and rings of cloth, leather, &c., a^4 a^4, are interposed between the disks. A nut, b^4, upon the shaft serves to cause the disks to bear upon the interposed rings in such wise that a rotation of the drum will revolve the cogs n' and w' by friction. The drum is revolved by a weight, d^4, and a treadle, e^4, Fig. 2, attached to the ends c^4 c^4 of a cord wound round the drum.

The treadle is provided with adjustable stops g^4 h^4, and the rack r' has adjustable stops x' w' secured to it, which strike against a fixed stop, v'. By the use of these stops the treadle may be confined to increasing and diminishing the torsion within certain limits, and the range of motion of the staple may be limited, and in consequence of the friction-connections the staple may be moved without affecting the torsion, or the torsion may be adjusted without affecting the position of the staples.

In all ordinary working of the contrivance the torsion should be diminished as the ends of the line l' m' l^2 m^2 approach each other, and practice will soon enable an experienced operator to adjust the parts in such way that a depressing of the treadle will put all parts in proper position for reception of messages, and the letting it rise again will make the proper disposition necessary for calling only; but such adjustment must be changed from time to time, as the exigencies of working demand.

The rack is attached to the staple by a set-screw, so that the relative positions of the two may be varied, and also has an index upon it, which works over a scale, so that the position of the staple, and consequently the distance between the ends of the line, may be seen at any time, even when the water is discolored.

Having thus described the electric adjuster and the method of working the same which I prefer to use, I wish it distinctly understood that my invention, in so far as it relates to my new method of connecting helices with a line, does not depend upon the use of any special kind of electrical adjuster, but that I intend to insert in place of the electrical adjuster described other electrical adjusters, such as are now in use or described in publications, so long as such adjusters are inserted between branch wires leading from the line to a helix in such manner, substantially as described, that such a proportion of the whole amount of current passing over the line as may be desired may be forced to pass through the helix, while the remainder of the current passes through the adjuster along the main line.

In order to ascertain the condition of the helix or of the batteries, I intend to connect one of the wires leading from the helix to the main line by means of an adjuster with a scale thereon, instead of by a direct connection, as before described. When this plan is used one of the helix-wires is to be connected at g, Fig. 3, to a bent-wire, n^3, ending at b^3 in a tube, a^3, provided with a faucet, d^3, and this faucet is to be in electrical connection with one of the ends of the main line, as at g^5, Fig. 3. This bent wire has upon it an index, o', working over a scale, p', and may be moved up and down and secured in place by a set-screw, g. In the ordinary working of the line the wedge b^3 is to rest in the cavity m^3, and the helix-wire will be directly connected with the main line.

When it is desired to test whether a helix has been injured by atmospheric electricity or otherwise, the current through the main line is to be broken entirely, either by the use of the key l^2, Fig. 1, which may be connected with the treadle, or in some other proper way. The helix-wire n^3 is then to be lifted, carrying its end b^3 away from its end m^3, and these ends are to be separated until the helix has no effect upon the needle or magnet, whichever may be used. If the degree of separation is less at that time than when the same test was made with helix and batteries known to be in good order, then the operator may be sure that either his helix or the batteries are defective. A message sent by him to the extremities of the line, as at B C B C, Fig. 1, will cause the batteries to be examined and, if necessary, tested, and, if they are reported back as in order, the operator may be sure that his helix is defective.

The adjusters, commutator, helix-case, and cone of sounding apparatus, torsion apparatus, and register may be all arranged with reference to each other and a desk as shown in Fig. 2, under which arrangement the receiver can sit with his ear at the apex of the cone and engross the message as dictated to him by the signalizer, and at the same time see his registers and control his torsion apparatus and his adjuster.

I intend to apply protectors, as usual, at G G, Fig. 1, at each side of each station, consisting of a plate in electrical connection with the line and separated from plates having a good ground-connection, H I, by thin sheets of paper. Such protectors will conduct off heavy charges of atmospheric electricity, but may not free the lines from lighter charges which would be injurious. I therefore cut out a short piece of the ordinary line-wire and insert in its place a piece of fine or helix wire between the ordinary protector and the helix. This fine wire

is to be covered with insulating-covering, and around and outside of the covering fine wire is to be wound and connected to the ground-connection; or, in lieu of this, grooved plates connected with the ground are to be clamped upon the insulating-covering. This latter arrangement is represented on sheet first where the fine-wire part of the line extends from ∝ to ∠.

By reference to Sheet 1, where the extremities of the line are represented at C C and the batteries at B B, it will be perceived that the helices at the extremities of the line are larger than that at the center, and that the intermediate helices are of a size between the two. I have discovered as a fact that when helices of a certain size will do the work at the extremities of a line under the worst conditions, then a helix of about half the power will at the same time do the work at the center of the line, and that helices at other stations will do the work if made of a size proportionate, or nearly so, to their distance from the farthest extremity of the line. In other words, if the size of helices at each extremity of a line be represented by 10, then the helix of the middle station should be represented by 5 and the helices half-way between the middle and either extremity should be represented by 7½, and in this proportion for the helices of all stations intermediate between the extremities, providing the leakage along the line is pretty nearly equal for equal distances, as is usually the case, the law of the size of all the helices on any one line being that they should be in proportion to the leakage of the line between the helix and the most distant extremity of the line, or nearly so. If helices substantially in this proportion to each other are employed, better results can be obtained than when all the helices are large or all are small, and the fact discovered by me is entirely at variance with ordinary practice, as helices of the same, or nearly the same, size, and varying, if at all, accidentally from each other, are now employed universally on the same line.

I claim as of my own invention—

1. In combination, a magnetized needle, a helix, and an adjustable torsion suspension apparatus extending both above and below the needle, the combination being substantially such as described.

2. In combination with a magnetized needle suspended by a torsion wire or thread, limiters for limiting its motion, and which give sounds when struck by the needle, the combination being substantially such as described, and in combination with these a gong or bell, substantially such as specified.

3. In combination with a torsion, suspended magnetized needle, a knife-edge applied to the needle and acting substantially as set forth, and also, in combination with a magnetized needle, a knife-edge and limiters arranged with reference to the needle substantially as described.

4. A suspension torsion apparatus consisting of wires or threads attached to collars or rings, as described, in combination with a magnetized needle supported in the collars, substantially as described, and also a magnetized needle in combination with a torsion suspensory apparatus both ends of which can be adjusted, as set forth, and also a magnetized needle in combination with a torsion suspension apparatus both ends of which can be adjusted at once by reason of being geared together, both these combinations being substantially as set forth, and also, in combination with a magnetized needle, an adjustable torsion suspensory apparatus extending both above and below the needle and having one thread or wire attached to a weight, substantially as described, so as to compensate for the varying length of the wire.

5. A magnetized needle, in combination with limiters, and a gong or bell and concentrating-cone, and, in combination with these, an outer cone, all these parts being substantially such as set forth, and also a sounding apparatus consisting of a bell and a truncated concentrating-cone arranged with reference to each other as described, and, in combination with such an apparatus, an outer concentrating-cone arranged with reference to a bell and interior cone as described.

6. Sections of a helix composed of members connected to and insulated from each other, substantially as set forth.

7. A helix made up of sections of varying diameter insulated from each other, as described.

8. A helix made up of sections connected to and insulated from each other, as set forth.

9. A helix made up of sections composed of members, where both the members and the sections are connected to and insulated from each other, substantially as set forth.

10. A helix made of decreasing area to the ends, as described, and also a divided helix, or helix made in two parts, so that one part may readily be moved away from the other, and also a divided helix in combination with a divided case, all substantially as specified.

11. Apparatus, substantially such as is described, for registering the power or force of reaction, in combination with a telegraph-line and a signalizer, whereby the locality of excessive leakage may be determined, as described.

12. A helix making part of a signalizer, in combination with branch lines and ends of a main line capable of being advanced toward and drawn away from each other, the combination being as described.

13. A helix making part of a signalizer, in combination with branch lines and ends of a main line capable of being operated as described, and with tubes containing liquid, as described, whereby varying amounts of electricity may be caused to pass through a helix, substantially in the manner and for the purposes specified.

14. In combination, a helix making part of

a signalizer, branch lines or conducting-wire, an electric adjuster located between the points where the branch wires are connected to the main wire, and a key or circuit-breaker, also located between the points where the branch wires are connected to the main line, and operating, when open, to send the whole current through the helix.

15. A helix making part of a signalizer and united to a main line by branch lines or wires, substantially as described, in combination with an electric adjuster in connection with or making part of a main line, and located between the points where the branch lines are connected with the main line, as described, whereby the relative proportions of electricity passing through the adjuster and the helix may be governed and regulated as described.

16. A helix of a signalizer, in combination with a line by means of a tube and adjustable severed wire, as described, when the wire is provided with a register or index, as set forth, whereby the condition of a helix or of the batteries that work the line may be tested in the manner specified.

17. An apparatus, substantially such as is described, whereby the apparatus for adjusting torsion and the apparatus for adjusting the relative position of the ends of a main line may be put in operation at the same time, substantially as set forth.

18. In combination with a line, a series of helices differing in size at each station thereof, and proportion each to the other in proportion to the length of line between each helix and the most distant extremity thereof, the combination being substantially as set forth.

19. The new telegraphic signalizer herein described, composed of a helix, a torsion, suspended magnetized needle, limiters, and a bell and concentrating apparatus, all substantially such as hereinbefore specified.

20. In combination with a helix making part of a signalizer and connected to a line by branch wires, a key or commutator located in the line and capable of breaking the current through both the main line and the branch wires, the combination being substantially such as described.

21. In combination with an ordinary protector, such as is described, applied to the ordinary wire of a line, a protector such as is specified applied to a fine wire inserted in and making part of the main line, for the purposes specified.

Witnesses: ROYAL E. HOUSE.
HENRY B. RENWICK,
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