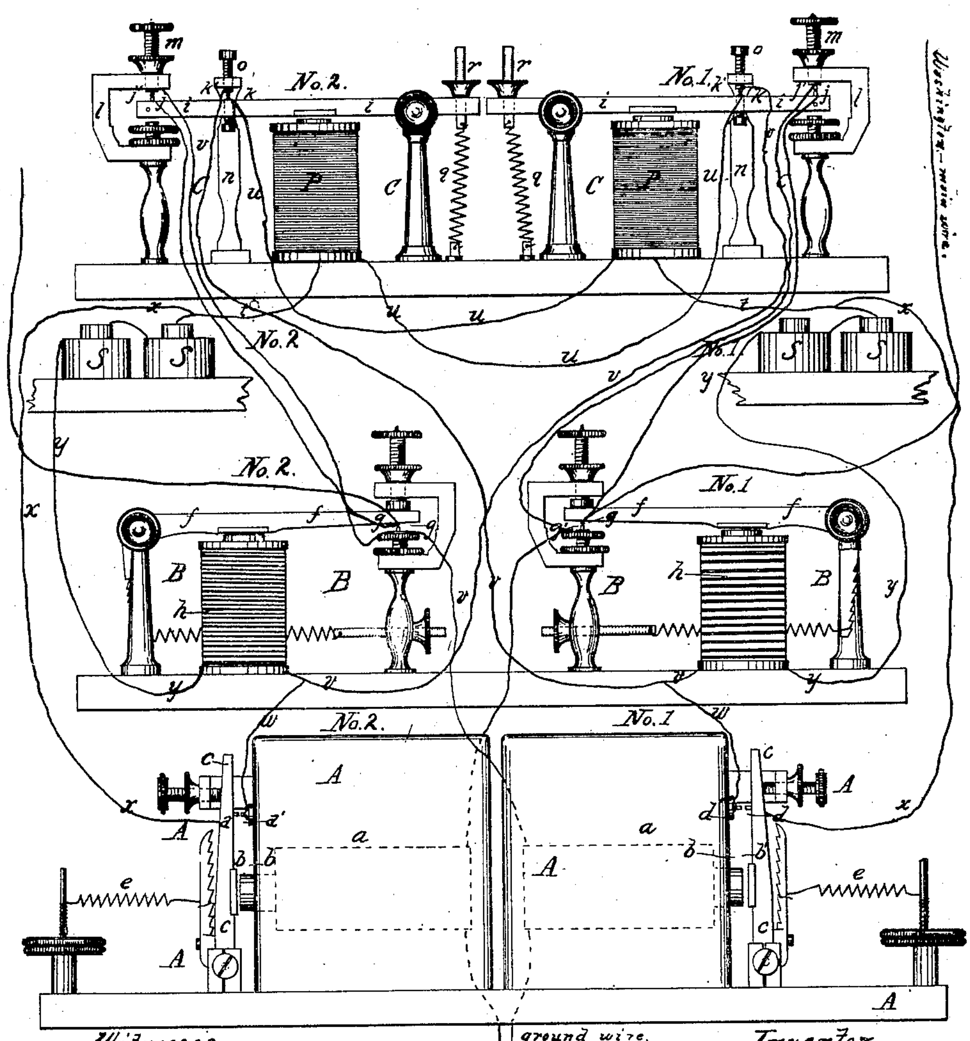
J. H. BUNNELL.
TELEGRAPH REPEATER.

No. 73,774. Patented Jan. 28, 1868.



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Letters Patent No. 73,774, *dated January* 28, 1868.

IMPROVEMENT IN TELEGRAPH-REPEATERS.

The Schedule referred to in these Letters Patent and making part of the same.

TO ALL WHOM IT MAY CONCERN:

Be it known that I, J. H. BUNNELL, of the city, county, and State of New York, have invented a new and useful Improvement in Self-Breaking Telegraph-Repeaters; and I do hereby declare that the following is a full, clear, and exact description thereof, which will enable others skilled in the art to make and use the same, reference being had to the accompanying drawing, forming part of this specification, in which the figure represents my improved apparatus in detail.

My invention has for its object to furnish an improved form of self-breaking telegraphic repeaters, by which I am enabled to do away with extra local batteries, heretofore generally used in all practical forms of self-breaking repeaters, and by so doing away with extra local batteries, and the many necessary connections resulting from their use, to greatly simplify the general adjustment and operation of the complete instrument; and it consists in the employment of two governor-magnets placed in the same local circuit as the respective local sounders in a telegraphic repeater; in winding the iron cores of the said governor-magnets with a finer wire than is used upon the sounder-magnets worked in the same circuit; and in the combination of the fine-wire governor-magnets with the regular local batteries and sounder-magnets of a repeater; the whole being constructed and connected as hereinafter more fully described.

The repeater being of two parts or sets, each set exactly alike in construction, like letters indicate like parts in each, the first-described set being distinguished as No. 1, and the other as No. 2.

A are telegraphic "relay" instruments, of ordinary construction in every respect. *a* is a box, in which the coils of relay A are enclosed. *b* and *b'* are the poles of the coils, protruding through the box. *c* is the relay armature-lever, which vibrates in response to the attractions of poles *b* and *b'*. *d* is a platina point, near the upper end of lever *c*. *d'* is a corresponding platina point, placed on the face of box *a*, so as to receive contact of point *d* upon the forward motion of lever *c*. *e* is an "adjustment-spring," which draws lever *c* backward when said lever is released from magnet-poles *b b'*. B is an ordinary "local sounder," having simple "repeater-points," and is of the ordinary construction, commonly called "repeater-sounders." *f* is the sounder-armature lever. *g* is the platina point near the end of lever *f*. *g'* is the corresponding platina point, so placed as to receive contact of point *g* upon the downward stroke of lever *f*. *h* are coils of sounder B. C is a controlling governor-instrument, for the most part like an ordinary local sounder. *i* is the armature-lever of governor-instrument, constructed the same as an ordinary sounder-armature lever. *j* is a platina point placed in the upper side of lever *i*, near its end. *k* is a platina point placed in the upper side of lever *i*, near the middle of the same. *l* is an upright standard, with bracket or projecting top, having graduating-screws so arranged as to receive the strokes of lever *i*, and is of the same construction as the corresponding part of a sounder. *m* is the graduating-screw, passing downward through the bracket of standard *l*. *j'* is a platina point in the end of screw *m*, corresponding to and receiving contact of platina *j* on lever *i*, upon the upward stroke of the latter. *n* is an upright standard with projecting top, placed so that its top shall be directly over point *k* on lever *i*. *o* is a screw passing downward through projecting standards *n*, so as to be directly over point *k*. *k'* is a platina point in the lower end of screw *o*, and receives contact of point *k* upon the upward stroke of lever *i*. By this it will be seen that upon the upward stroke of lever *i* contact is made simultaneously of point *j* with point *j'*, and of point *k* with point *k'*. *p* are the coils of governor-instrument C, differing from the coils of sounder-magnets in that they are wound with fine wire, such as is used in relay-coils, and therefore present about ten times as much resistance to the electric current as the coils of sounders as they are usually made. *q* is the adjustment-spring of governor-instrument C, and is the same as in a sounder. *r* is the sliding screw with nut, by which spring *q* is adjusted, being the same as in a sounder. *s* represents a local battery, such as is used in working a local sounder, and which it is necessary to show here to explain clearly the operation of my instrument. *t* is a conducting-wire, passing from one pole of local battery to coils *p* of governor-instrument. *u* are conducting-wires passing from coils *p* in governor-instrument to platina points *k* in lever *i*, governor-instrument No. 2. *v* are conducting-wires passing from platina points *k'*, Nos. 1 and 2, to coils *h* of sounder Nos. 2 and 1. *y* are conducting-wires passing from the coils *h* of sounders to the remaining poles of the local battery *s s*. By this arrangement, thus far, the current from local battery *s s'* is simply carried to and through both the coils of sounder and of governor-instrument, and back to the battery, thus making the local circuit complete; this,

however, depending upon the contact of points *k* and *k'* in governor-instrument No. 2, as it is plain that when these points are not in contact, the circuit is broken at that point. *w* is a conducting-wire, one end of which is connected to wire, *v*, and the other end to platina point *d'* on the face of box *a*. *x* is a conducting-wire, one end of which is connected to conducting-wire *t*, and the other end to relay-armature lever *c*.

By thus connecting wires *w* and *x*, it will be seen that when relay-armature lever *c* is attracted forward, making contact at points *d* and *d'*, the current is cut off from or carried past governor-coils *p*, and only passes through coils *h* of the sounder, and that when lever *c* breaks contact at points *d* and *d'*, the current passes without diversion through both coils *h* and *p*, and also, that by the attachment of wires *w* and *x*, in the manner described, the breaking of the local circuit at points *k* and *k'*, governor-instrument No. 2, by their not being in contact, will only affect governor-coils No. 1, and will have no effect upon the sounder No. 1, through the coils of which latter the current will pass each time contact is made at *d* and *d'*. Now, the resistance of coils *p* of governor-instrument being far greater than that of sounder-coils *h*, when the local current is passed through both at once, (contact being made at points *k* and *k'*, No. 2,) by the breaking of contact at points *d* and *d'*, the current will then have no effect upon coils *h* of sounder, as it is well known that two coils placed in the same local circuit, one coil being wound of finer wire than the other, the current will have no effect upon the coils having the coarsest wire, provided the difference in size be a material one, and that its effect will only be apparent upon the coils having the finer wire. Hence, by closing of lever *c*, making contact at points *d* and *d'*, I get a corresponding vibration of sounder-lever *f*, whether points *k* and *k'* are closed or not. But when the latter points are closed, I get, in addition, the necessary corresponding upward movement of lever *i*, governor-instrument No. 1, as well as that of sounder-lever No. 1, whilst if points *k* and *k'*, No. 2, are open, the sounder-lever No. 1 alone will vibrate when contacts are made at *d* and *d'*.

The arrangement of the local wires in No. 2, and their connection also with governor-instrument No. 1, are precisely the same as in No. 1, and have exactly similar operations and relations to each other.

In attaching the main wires or outside lines to the repeater, the connections are made as follows:

Supposing the instrument to be placed at New York, and a wire from Washington be attached to it on one side, and a wire from Boston to it on the other side, for the purpose of repeating to and from Washington and Boston, the wire from Washington will first be connected to point *g* on lever *f*, No. 1. A wire is then passed from point *g'*, under lever *f* of No. 1, to relay-magnet A, No. 2, which is connected with the ground or battery-terminus, thus making the Washington circuit complete when contact is made at points *g* and *g'*, lever *f* of No. 1. A wire is then connected from point *g*, lever *f*, No. 1, to point *j'* in lever *i*, governor-instrument, No. 1. Another wire is connected from point *g'* to point *j'*, so that when contact is made at either points *g* and *g'*, No. 1, or *j* and *j'*, No. 1, the Washington circuit will be complete, *i. e.*, closed, and when points *j* and *j'*, No. 1, are in contact, the vibrations of sounder-lever *f*, No. 1, causing breakings of contact of *g* and *g'*, will have no power to break the Washington circuit, unless contact of points *j* and *j'*, No. 1, is also broken at the same time. The Boston wire will then be attached to the opposite side of the instrument, in the same manner as the Washington wire, and the operation of the various parts of the instrument will take place in combination, as follows:

The first duty of each governor-instrument is to prevent its co-operating sounder from "breaking," or repeating into the opposite circuit when the repeater is ready to commence working. This it does by the arrangement of the main wires just described. The next duty of each governor-instrument is, that when, as its operation begins, it does allow its co-operating sounder to repeat into the opposite circuit, it will at the same time prevent the opposite governor-instrument from operating, thus preventing any return breaks from the opposite sounder. The last-named duty is performed by means of the arrangement of local wires, previously described.

The repeater being ready for operation, the relay-armature levers and sounder-armature levers will be closed or attracted towards their magnets, but the levers of both governor-instruments will be "open," as it has been explained that the closing of the relay-armature levers makes contacts which cut off the local current from coils *p;* but as the contacts of platina points on the levers of governor-instruments are only made when the levers are "open," all the different pairs of points in the complete instrument are in contact at the time of commencing its operation. Suppose the operator at Boston begins writing to Washington, his writing to be passed on to the Washington wire by the operation of the repeater at New York. Upon the breaking of the Boston main circuit by the operator in Boston, the current is withdrawn from relay-magnet *a*, No. 1. Its armature-lever, *c*, is then drawn backward by its spring, and contact at its points, *d* and *d'*, is broken, and, as heretofore explained, this breaking of contact causes, simultaneously, the opening of sounder-lever *f*, No. 1, and the closing of governor-lever *i*, No. 1, thereby breaking contact of all the points in these two respective instruments in the following order: First, the points of lever *f*, No. 1; next, and simultaneously with each other, points *j* and *j'* and *k* and *k'*, in lever *i*, governor-instrument No. 1, and the effect produced is as follows: Upon the opening of points *j* and *j'*, a break is caused in the Washington circuit-lever *f*, No. 1 being open. Upon the simultaneous opening of points *k* and *k'*, the local current is prevented from being passed through coils *p*, governor-instrument No. 2, and its lever is thus retained in its first position. At this time the opening of lever *f*, No. 1, causing a break in the Washington circuit, armature-lever *c*, No. 2, opens, breaks contact at its points, and thus causes sounder-lever *f*, No. 2, to vibrate in response; but sounder-lever *f*, No. 2, will not, in vibrating at this time, break the Boston circuit, because being prevented from so doing by the points *j j'* of the governor-instrument No. 2, which, in its turn, is held in its normal position by the action described of governor-instrument No. 1. Then, upon the closing of the circuit in Boston, armature-lever *c*, No. 1, is attracted forward, making contact at its points, *d* and *d'*, thus closing sounder-lever *f*, No. 1, and opening lever *i*, No. 1: the first result of which is, lever *f*, No. 1, closes the Washington circuit; then, as the lever *i*, No. 1, returns to its normal position, the instrument is ready for the same operation to take place again when the Boston operator

open and closes the circuit in writing; and as the instrument returns to its normal position each time the circuit is closed, the same operation may take place in reverse by the operator in Washington breaking the circuit and writing, as the respective sides of the instrument have precisely the same action upon and relative to each other. But in bad or wet weather, when the lines are not working clearly, and the relays are adjusted "high," and do not, therefore, respond promptly to the closings of the circuit, it becomes necessary to adjust lever *i*, so that it will not return to its normal position until after the opposite relay-armature lever has responded to the closing of the circuit. This is done by simply easing the tension-spring of lever *i*, it being a well-known fact that when a magnet is simply "cut off" from the current, by giving the current a shorter route the magnet will retain a portion of its strength a short time; hence when the closing of points *d* and *d'* cuts off the current from coils *p*, the lever thereof will not respond quickly unless strongly pressed by its tension-spring, therefore the operator adjusting the instrument may, by simply turning the adjustment-spring of lever *i* tighter or looser, adjust the governors so that they will work exactly in accordance with the rest of the instrument. So, as the governor-instrument controls the operation of repeating, and is adjusted entirely by its adjustment-spring, the whole adjustment of the repeater is reduced to the adjustment of the two respective springs of the governor-instruments, and these being adjusted in precisely the same manner as the common relay-adjustment, but little skill is required to adjust and cause the complete instrument to operate perfectly.

Thus it may be seen that by placing these fine-wire governor-magnets in the same local circuits, and thus working them by the same local batteries as those which work the local sounders in a telegraphic repeater, I am enabled, first, to do away with extra local batteries in my form of self-breaking repeater, and also to dispense with the numerous connections and complications consequent upon the use of extra local batteries, and that by the use of a finer wire in the governor-magnets than that of which the sounder-magnets are constructed, I am enabled to get the exact movements desired of its armature, and to give such scope to the adjustment of the governor-magnets as to conform their operation to any condition of the lines upon which the repeater is to work.

Having thus described my invention, what I claim as new, and desire to secure by Letters Patent, is—

1. The employment of two governor-magnets, placed in the same local circuit as the respective local sounders in a telegraphic repeater, when the said governor-magnets are there placed for the purpose of making the repeater self-breaking, and controlling its operation, substantially as herein shown and described.

2. I claim a governor-magnet, wound with wire of such relative size and resistance to that upon the local magnet, as that when both are included in the local circuit, the governor-magnet shall be charged while the local magnet is not.

3. The combination of fine-wire governor-magnets, as herein described, with the regular local batteries and sounder-magnets of a repeater, as and for the purpose set forth.

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Witnesses:
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