3 Sheets--Sheet 1.

J. N. GAMEWELL, M. G. CRANE & E. ROGERS.

Telegraphic Fire-Alarm Repeater.

No. 165,923. Patented July 27, 1875.

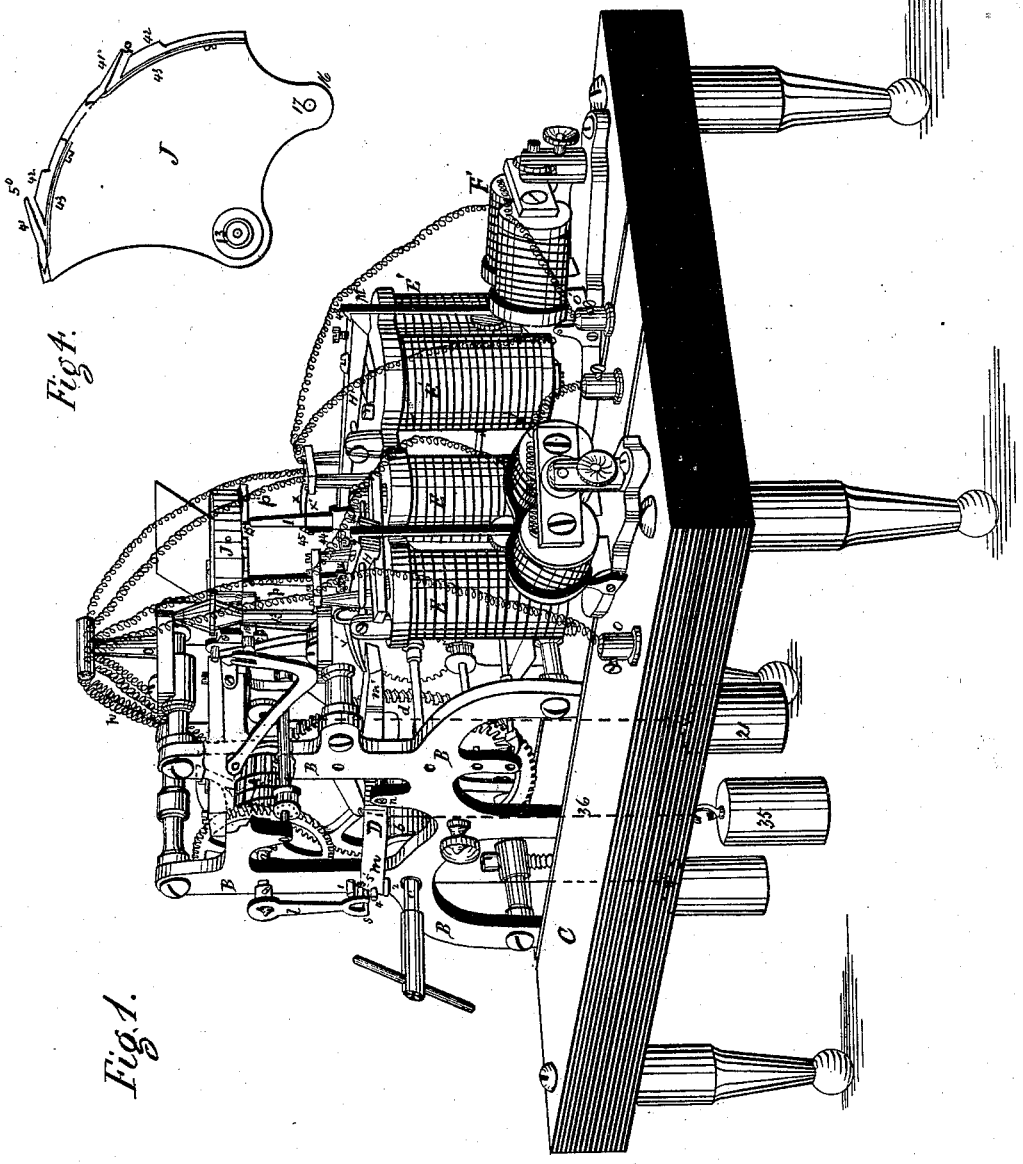

Fig. 4.

Fig. 1.

Witnesses.

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3 Sheets--Sheet 2

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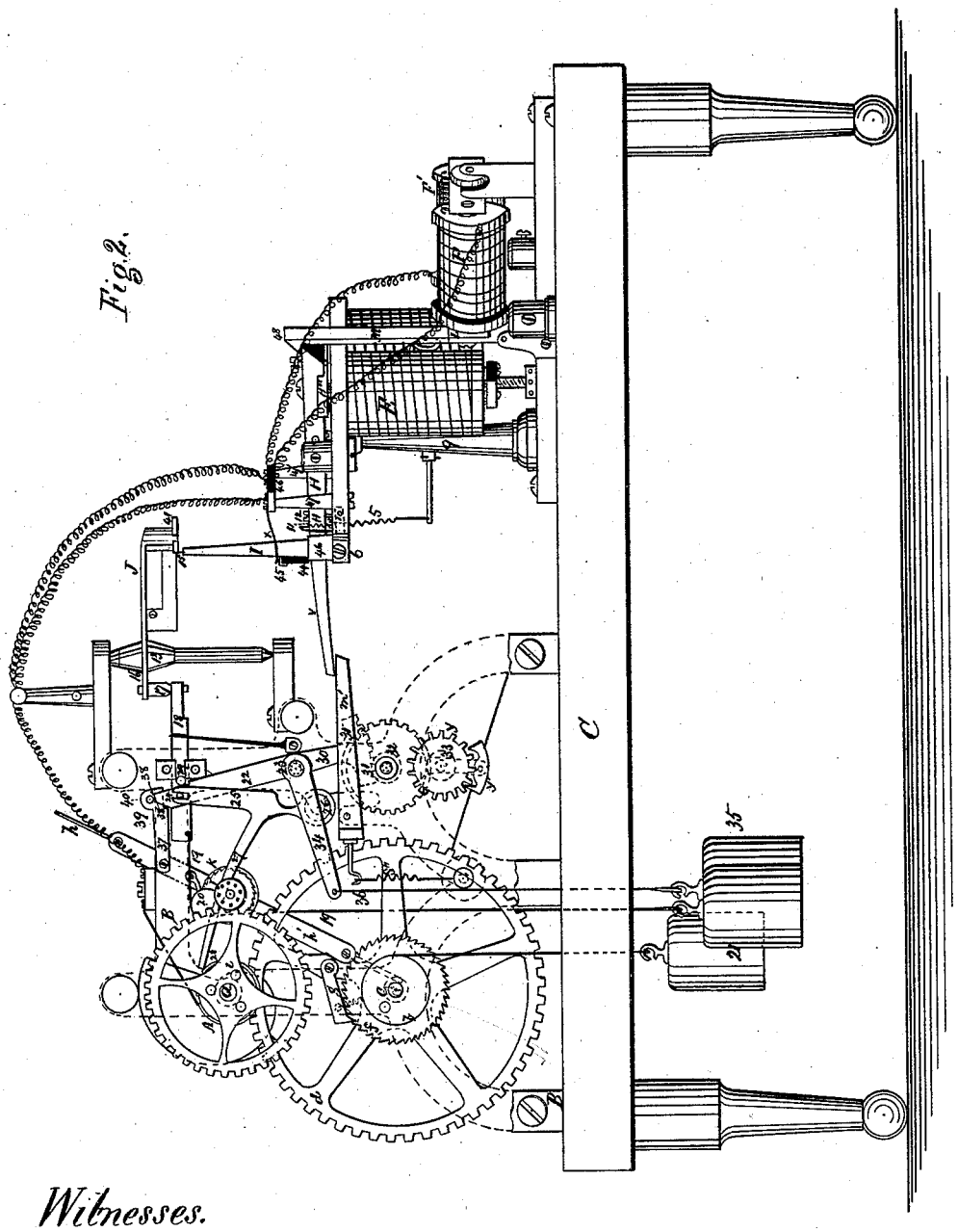
Fig. 2.



Witnesses.

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Telegraphic Fire-Alarm Repeater.

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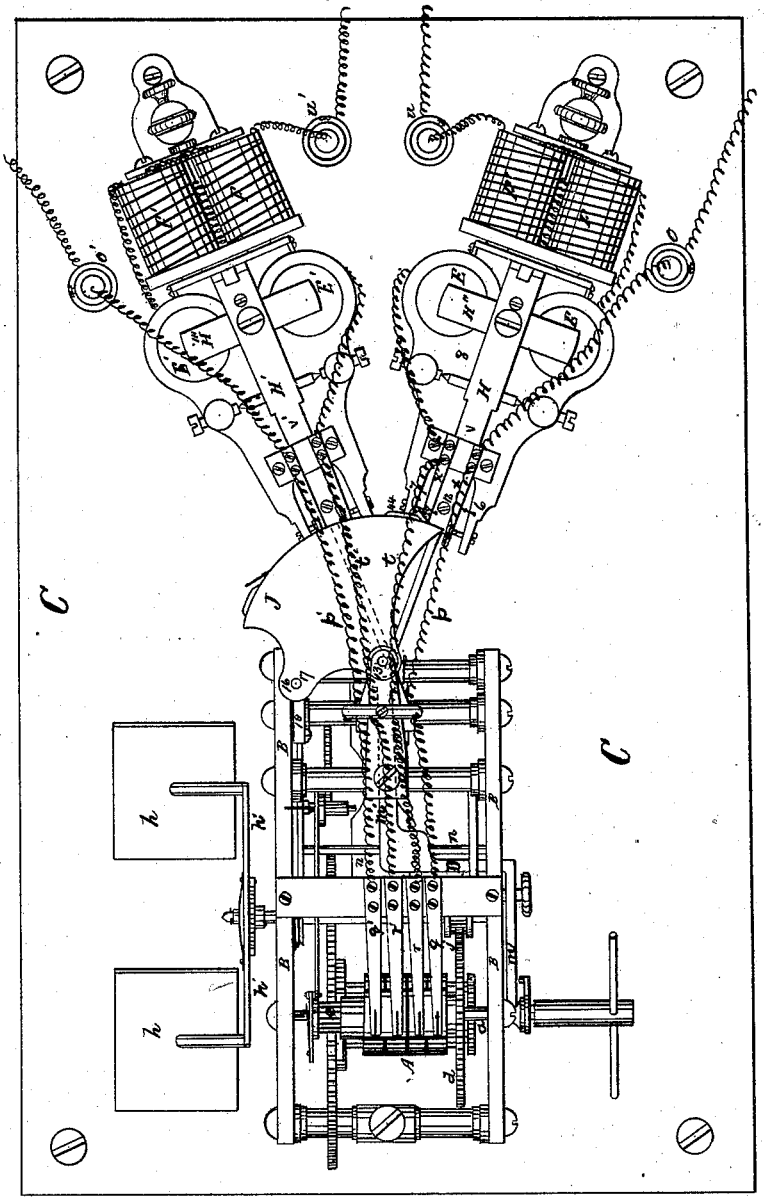
Fig. 3.



Witnesses.

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UNITED STATES PATENT OFFICE.

JOHN N. GAMEWELL, OF HACKENSACK, NEW JERSEY, MOSES G. CRANE, OF NEWTON, AND EDWIN ROGERS, OF BOSTON, MASSACHUSETTS.

IMPROVEMENT IN TELEGRAPHIC FIRE-ALARM REPEATERS.

Specification forming part of Letters Patent No. **165,923**, dated July 27, 1875; application filed July 9, 1875.

To all whom it may concern:

Be it known that we, JOHN N. GAMEWELL, of Hackensack, in the State of New Jersey, MOSES G. CRANE, of Newton, Middlesex county, in the State of Massachusetts, and EDWIN ROGERS, of the city of Boston, State of Massachusetts, have jointly invented an Improvement in Electro-Telegraphic Non-Interference Repeaters, of which the following is a specification, reference being had to the accompanying drawings, forming part thereof.

Our invention relates to that class of instruments known as electro-telegraph repeaters, whereby the telegraphic signals transmitted over one circuit are automatically repeated over one or more other independent circuits.

The object of the invention is to prevent interference between any number of telegraphic circuits connected with a repeater, so that while a signal is being transmitted over any one of said circuits all the others are for the time disabled from being called into action, thus obviating the liability of having a signal that is being transmitted over one circuit and repeated over others interfered with and thrown into confusion by an attempt to transmit a signal over one or more of the other circuits. This object we accomplish by the peculiar mechanism which we will proceed to describe.

In the drawings we have represented only two electrical circuits connected with the instrument, as we deem two sufficient to fully illustrate the principle of our invention; but it will be evident that the instrument may be constructed to operate any desired number of circuits and maintain between them as complete a non-interference as exists between the two here shown and described.

Figure 1 is a perspective view of our repeater. Fig. 2 is a side sectional elevation of the same, the front of the same being removed, so as to bring into view more plainly the interior mechanism. Fig. 3 is a plan of the same. Fig. 4 is a face view of the governor.

The general mechanism employed by us in this repeater, whereby is accomplished the repetition of signals from one circuit over another or others, does not differ essentially in principle from that now in use. It consists of a break-circuit wheel or cylinder, upon which converge all the several circuits between which it is intended there shall be effected, interchangeably, repetitions of signals, mounted in a suitable frame, and caused to rotate by the stress of a spring or weight, it being held at rest against the stress of the spring by a detent, from which it is liberated by the opening of any one of the circuits, and its rotation causing the opening and closing of all the circuits connected with it. We have combined with the mechanism certain devices, hereafter particularly described, to secure non-interference between the circuits.

A is the break-circuit wheel, fixed upon the revolving shaft *a*, which has its bearings in the frame B, upon which are mounted the other movements of the repeater, aside from the magnets and their attachments. The said frame and the magnets are all mounted upon, and secured to, a metal platform or table, C. Motion is given to the break-wheel shaft by a weight acting upon a drum, *b*, on the shaft *c* of which is a loose spur-gear, *d*, which engages with a pinion, *e*, fixed on the break-wheel shaft. Upon the shaft *c* is fixed a toothed pinion, *f*, with which engages a pawl, *g*, that is pivoted in an arm of the gear *d*, thus permitting the shaft *c* to be turned backward to wind up the weight or spring on or in the drum *b* without moving the gear *d*, while the latter is revolved, and with it the break-circuit wheel, by the forward movement of the pinions *f*. The movement is regulated, in the usual way, by a fly, *h*, driven by the gear-wheel *i*, fixed on the break-wheel shaft, and meshing into a pinion, *j*, on the fly-shaft. The fly-arms *h'* are loose on their shaft, and a positive forward motion with said shaft is secured by a ratchet, *k*, secured to said shaft, and a pawl pivoted in said arms, while the fly is permitted to move forward without the said shaft, in order to relieve the strain when the motion of the shaft is suddenly arrested.

Upon the end of the break-wheel shaft, outside of the frame, is secured an arm, *l*, on the lower end of which are two fingers, *s* and *s'*, extending inward toward the frame. One of these fingers is a little farther from the center

of the shaft *a* than the other, and the former is placed a little in advance of the other. These are designed to arrest the motion of the break-circuit wheel, and hold it at rest until, by the action of the armature of the magnet in the circuit, it is liberated for another revolution, as will be presently more particularly described. D is a bent lever, pivoted on the shaft *n*, the outer arm *m* of which is outside of the frame. A little in the rear of the shaft *n* it bends at right angles, and extends to the center of the frame, where it bends again and extends some distance parallel with the frame. The shaft *n* passes through the forward arm *m'* a little in advance of the bend, and in the rear of said shaft is attached a spiral spring, *s''*, which acts to depress the outer arm *m*, and of course to elevate the opposite arm *m'*. The vertical motion of the said lever is limited by two pins, 1 and 2, fixed in the frame. In this lever are fixed two pins, 3 and 4, and the parts are so arranged that when the outer end of the lever is at its upper limit against the pin 1, the finger *s'* is stopped against the pin 4, and when at its lower limit against the pin 2. The finger *s* is stopped against the pin 3, and yet, if the lever is raised while the parts are in the position last indicated, the finger will pass between the pins 3 and 4, permitting the break-wheel shaft to make a revolution. E and E' are two electro-magnets, each pair of spools being in a separate and independent circuit, the respective circuit-wires coming into the repeater to the binding-screws *o o'*, and thence (indicated by the letters *p p'*) to the spring-fingers *q q'*, and out from the spring-fingers *r r'*, by the wires, (indicated by the letters *t t'*,) embracing the coils of the magnets E E' and F F', to the binding-screws *u u'*, the break-circuit wheel being insulated on its shaft, and the circuit being closed by a metallic connection being established upon the face of the wheel, between the ends of the fingers *q q'* and *r r'*, respectively. H H' are pivoted levers of the armatures H'' H''' of the magnets E and E'. Their long arms *v v'* converge to and rest upon the end of the arm *m'* of the lever D, and each is forced downward by a spiral spring, 5. Now, it is evident that when the armatures H'' H''' are drawn down to their magnets E E', thus elevating the ends *v v'* of the levers H H', and thereby removing their pressure from the end *m'* of the lever D, the outer arm of the latter, in which are the stop-pins 3 and 4, will, by the action of the spring *s''*, be forced downward to its limit against the pin 2, and bring the stop-pin 3 in range of the finger *s;* and that, when the said armatures are released from their magnets, the arms *v v'* will, by the action of the spring 5, press down the arm *m'* of the lever D, and throw its opposite end to its upper limit against the pin 1, and thereby bring the stop-pin 4 in range with the fingers *s'*.

By this construction and arrangement of parts, it is evident that so long as the circuit is closed, the arm *l*, and, of course, the break-circuit wheel, will be held at rest, the finger *s* being stopped against the pin 3, but that the opening of the circuit will liberate the arm *l*, when it will, with the break-circuit wheel, make a single revolution and then stop, the finger *s'* stopping against the pin 4 if the circuit remains open, and the finger *s* stopping against the pin 3 if the circuit is closed, when the revolution is accomplished.

It is also evident that the opening of one of the circuits will cause the opening of all other circuits which pass over the face of the break-circuit wheel.

We will now proceed to describe particularly the devices whereby non-interference between the circuits upon the giving of signals is effected; the object being, when any one of the circuits is opened for the purpose of giving a signal in that circuit, to immediately lock the armatures of the magnets in the other circuits until the signal is completed, so that if any one of the other circuits is meantime opened, the armature of the magnet in that circuit is not thereby released and permitted to move.

I is an upright lever, forked at the lower end, and pivoted between the arm 6 and 7 of the plate 8, which is supported on the post 9. Between the forked ends of this lever lies the long arm *v* of the armature-lever H. Fixed between the forked ends of this lever, underneath the armature lever, is a short arm, 10, to which is attached a small spiral spring, 11, which acts to lift the said arm 10, and thereby swing the lever I over to the left. A set-screw, 12, in the latter lever extends to and rests upon the said arm 10. Now, it is evident that when the lever I is maintained in its upright position, and not allowed to swing over to the right, the short arm 10, pressing upward against the set-screw, will prevent the arm *v* of the armature-lever from being drawn downward by the spring 5, even though the armature should be released from the magnet by the opening of the circuit. This result is accomplished by means of the locking devices, which we will now describe.

J is the segment of a disk, which we call the governor, mounted upon the vertical shaft 13. On the outer curved edge of this segment is a thin flange projecting downward. It is so proportioned and arranged that the pin 15, fixed in the upper end of the lever I, coincides with the said flange, so that when it is on the inside of the flange the lever is prevented from swinging to the right, and when on the outside is prevented from swinging in the opposite direction, or to the left. In an ear or lug, 16, upon the outer radial edge of this segment, is fixed a short post, 17, on which is pivoted the end of a sliding bar, 18, arranged to slide in ways against the inner surface of the side of the frame B. To the opposite end of the bar 18 is attached a cord, 19 that passes over a pulley, 20, that extends down through the table C, and has a weight, 21, attached at its lower end. 22 is a swinging lever fixed on a

shaft, 23, in the frame B. To this lever is fixed a pin, 24, which passes through a slot or notch in the upper end of the pivoted lever 25, the latter being pivoted on the shaft or stud 26, and has an arm, 27, which extends to and rests upon the face of a scroll-cam, 28, that is fixed upon the break-circuit-wheel shaft *a*. A stop-pin, 29, is fixed in the sliding bar 18, just before the lever 22, with which the latter engages when swung to the right. 30 is an arm of the lever 22, extending on the opposite side of the shaft 23, and terminating in a segmental rack, 31, which meshes in a small loose pinion, connecting with gear-wheel by ratchet and pawl on the shaft 32, upon which is said gear, which meshes into a pinion on a second shaft, 33. On the latter is an escapement-wheel, *y*, which, with its pallet, *y'*, and a reciprocating fly, *z*, constitutes an auxiliary escapement for graduating the reverse movement of the lever 22 and its accessories after it has been thrown forward, as will be presently described. Upon the shaft 23 is fixed an arm, 34, to the end of which is attached a weight, 35, by a cord, 36.

37 is a latch pivoted in the frame B, having on its lower edge a notch, 38, which, when the sliding bar 18 is forced far enough to the right, falls down behind its rear end, and thus holds it at rest until the latch is raised. An inclined surface, 39, is formed on the upper end of the lever 32, which engages with a pin, 40, fixed in the said latch, and acts to raise the latch and hold it up when the lever 22 swings back to the left, as shown in Fig. 2.

Upon the outside of the flange of the segmental disk J is fixed an inclined guide, 41, and behind and under this is made an inclined abutment, 42. The two together form an inclined channel or opening from the outside to the inside of the flange, a notch being cut in the lower edge of the flange to complete such channel, 50. A slight leaf-spring, 43, is placed on the inside of the flange, spanning the said channel, which will permit an object to pass inward through the channel, but close to the channel against its movement in the reverse direction.

Now, it is evident that if the governor J is revolved around toward the lever I while the circuit is closed, (the end *m'* of the armature-lever D being thereby elevated,) causing the said lever I to be swung to the left, the flange of the governor will pass outside of the pin 15 in the end of the lever, thus locking the armature-lever, and preventing the arm *m'* from being drawn downward, even though the armature should be liberated from the magnet by the opening of the circuit, and that the armature-lever will thus remain locked so long as the pin 15 remains on the inside of the said flange. It is also evident that at the moment the governor J is revolved the circuit is broken, permitting the lever *m'* to be carried downward, and thereby the lever I to swing to the right, and the flange of the governor will pass inside of the pin 15, leaving the lever I free to vibrate, and that, the governor being revolved as described, the pin 15 will slide over the inclined guide 41, and rest on the abutment 42; that then, when the governor is swung back in the reverse direction, the pin will pass through the inclined channel 50, between the inclined guide and the abutment, and come out on the inside of the flange of the governor back to its first position. Upon the side of the lever I is fixed a small plate, 44, of rubber, or some other non-conducting substance. Upon the upper edge of this plate is secured a piece of metal, 45. Two metal fingers, *x x'*, one connected with each of the line-wires of the circuit, are secured at one end upon an insulated plate, 46, placed on the posts 47. At the other end they rest over or upon the metal plate 45. The arrangement of these parts is such that when the lever I is swung to the right these fingers are in contact with the metal plate 45, the circuit thereby being closed over said plate, and when swung to the left such contact is broken, and the fingers *q q'* are brought into circuit. The armature L of the magnet F is attached to a swinging lever, M, which is pivoted near the lower end on a small shaft, and is retracted from the magnet by the stress of a small spiral spring attached to the lower end and below the said shaft. The upper end of this lever is furnished with a hook, 48, designed to engage with the forward end of the armature-lever H, and thereby lock that lever in position, and prevent the opposite end from being forced downward when the circuit is opened, as will be presently more fully explained when we come to describe the operation of the machine. This auxiliary magnet F is made with cores of larger diameter than the main magnets E, so that a little more time will be occupied in its being charged and discharged.

We have above described the structure and arrangement of a single circuit, with its magnets, their armatures, the armature-levers, and their connection with the non-interference mechanism. The corresponding devices in the other circuit shown in the drawings are similarly constructed and arranged, the corresponding lever I being situated about midway between the ends of the flange on the governor, and a central portion of the said flange being cut away, thus dividing the flange into two sections of similar construction and arrangement.

The operation of this machine is as follows:

It is designed to be worked with a closed circuit. Its normal condition, therefore, is that in which the armatures are all drawn to or toward their respective magnets, the arms *v v'* of the armature-lever H thrown up, and the arm *m* of the swinging lever D thrown down, so that the pin 3 in the said arm stops the finger *s*, and holds the arm *l*, and consequently the break-circuit wheel, at rest, the several circuits being closed, through their respective

spring-fingers $q\ q'\ r\ r'$, over the metal plate upon the surface of the said wheel.

It is now desired to send a signal over one of the lines which shall be repeated over the other. To that end the circuit is opened by a transmitter, or keys, or otherwise, when the arm v of the armature-lever H is drawn down, and carries with it the arm m' of the lever D, the armature of the magnet F not acting quick enough (in consequence of the greater resistance in the core of that magnet) for the hook 48 to catch over the end of the lever H before the latter is out of its reach. The opposite end of the lever D being by this movement thrown up, the arm l is thereby liberated, and the break-circuit wheel is, by the stress of its motor weight or spring, caused to revolve until the finger s' is stopped against the pin 4, if the signaling-circuit remains open, in which position the other circuit remains open at the fingers $r\ r'$, as the metal plate on the circuit-wheel does not pass under them until the revolution of the wheel is completed. If the signaling-circuit is again closed before the revolution is thus completed, the rear end m of the lever D will be depressed, and then the finger s will stop against the pin 3, entirely completing the revolution, closing the circuits at the spring-fingers. By this movement the other circuit is broken as soon as its spring-fingers $r\ r'$ pass off from the metal plate on the face of the circuit-wheel; but at the instant that the break-circuit wheel commences its revolution, the scroll-cam on its shaft, acting to raise the arm 27 of the swinging lever 25, thereby pushes that lever forward, and with it the lever 22 and the sliding bar 18, whereby the segmental governor is swung around toward the lever I. This lever, belonging to the organization of the circuit that is opened, will fall back, so that its pin 15 will range outside of the flange of the governor J, while the corresponding lever of the unbroken circuit will range inside of said flange; and the arrangement and movements of the parts are such that the said levers will have respectively taken the above-named positions with reference to said flange before the break-circuit wheel has revolved far enough for the metal plate on its surface to pass from under the fingers, and thereby break the second circuit, so that at the moment when the said second circuit is broken its armature-lever is locked in position by the lever I, and will remain thus locked until the governor returns to its first position and thereby liberates lever I. But, meantime, the armature-lever M has fallen back from its magnets, and its hook at the upper end has caught on the end of the lever H and locked it in position, so that it cannot move, even when released from the restraint of the magnet. When the circuit-wheel has completed its revolution the scroll-cam 28 will have acted to push forward the lever 25, carrying with it the sliding bar 18, and thereby rotating the governor J. As the said bar reaches its limit of motion in that direction, the upper end of the lever I will have passed over the inclined guide and rested on abutment behind it, while the latch 37 will have fallen down and locked the bar 18 in position, while the lever 25, and with it the lever 22, are left free to return to their first position under the stress of the weight 35; but the arm 30, in its reverse movement, brings into action the auxiliary escapement through the gear-segment 31, and is thus retarded. When, after an interval of time, the reverse movement is completed, the latch 37 being thereby thrown up, the liberated bar 18 is quickly drawn back by the stress of the weight 21, thereby swinging the governor back to its first position, which, in making this movement, forces the end of the lever I through the inclined channel in the flange of the governor, whereby the said lever is swung back to the left, and thus, if the circuit has remained open, raising the end v of the lever H, when the hook on the end of the lever M catches over the armature end of the said lever H and locks it in position.

The intention is that the interval of time between the successive signals of any series that may be given in giving an alarm of fire shall be less than that occupied in the reverse movement of the lever, as the same is graduated by the auxiliary escapement, and so that when the governor J is, by the revolution of the cam 28, (upon the opening of one of the circuits,) rotated into the positions where it locks the armatures belonging to the other circuits, it will continue at rest in that position until the entire series of signals is given. This, it is evident, will occur as each successive revolution of the cam 28 will arrest the lever 22 in its backward movement, and carry it forward again before it reaches the pin in the latch 37, and thereby unlocks the bar 18.

It is evident that so long as the armature-lever H in either of the circuits is locked by the action of the governor J, as described, the opening of that circuit cannot cause the rotation of the break-circuit wheel, and therefore cannot interfere with a signal which is meantime being given over the other circuit. Hence, if, while a signal is being sent over one circuit, a signal-box or the key, as the case may be, on the other, is manipulated in an attempt to give a signal on that circuit, the breaking of the latter line will not interrupt or interfere with the signal in progress. Thus non-interference between the lines is secured.

It will be observed that the revolving of the break-circuit wheel will break all the circuits in connection with it, except that in which the signal originates. The latter is not thereby broken, for the reason that as soon as the revolution of the break-wheel commences the movement of the lever I caused thereby closes the circuit over the fingers $x\ x'$ and the insulated metal plate 45, and thus cuts out the break-wheel from the circuits. The integrity of the signaling line is therefore maintained

during the giving of the signal, unaffected by the operation of repeating it over the other lines.

It will be observed, also, that the accidental breaking or otherwise disabling of any one of the lines in connection with the repeater can have no effect upon the other lines, except to occasion a single revolution of the break-wheel, causing a single blow upon the signaling-instrument, for the reason that upon the completion of such revolution the arm *v* of the lever H will be forcibly elevated by the movement of the lever I, as before described, and that the opposite end of the said lever H will be locked down by the hook 48, when no farther movement of that armature-lever can occur until the said circuit is closed and again opened.

To recapitulate the description of the operation of the machine—the signal-box or key, as the case may be, is manipulated to successively break and close either of the circuits a number of times in a given order, and thereby give upon the alarm-gong a series of strokes, constituting together a fire-alarm signal. Instantly upon the breaking of the circuit the movement of the lever D disengages the finger *s* from the pin 3, thus liberating the arm *l*, and permitting the break-wheel to revolve, thereby breaking the other circuit, moving the governor J into position to lock the armature-lever H, as above described, closing the signaling-circuit over the fingers *x x'*, and winding up the auxiliary escapement-train. The arm *l* will now revolve until the finger *s'* is stopped against the pin 4, in which position the other circuits are still left open, the circuit-wheel not having quite completed one revolution, and brought the connecting metal on its surface under the fingers *r r'*. This position will continue until the auxiliary train runs down, and thereby the latch 37 is raised, thus liberating the governor and allowing it to move back to its first position, thereby lifting the arm *v* of the lever H, and locking said lever by the hook 48, and permitting the end *m* of the lever D to rise, when the finger *s'* will become disengaged from the pin 4, and the arm *l* will move forward until the finger *s* is stopped against the pin 3, thus completing the revolution of the circuit-wheel and closing the other circuit.

These are the movements which take place upon a single breaking of the circuit, the circuit remaining open during the movement. If the circuit is again closed before the movement is completed, the arm *m* of the lever D will thereupon drop down to its lower limit, and the finger *s* will be stopped by the pin 3, the circuit-wheel making a complete revolution and closing the other circuit.

To give a series of signals constituting a fire-alarm, there is not a sufficient interval between the signals to permit the auxiliary train to run down, and so the governor, during the giving of the alarm, is kept in position to leave the armature-lever H in the signaling-circuit free to vibrate and keep the arm *v* of the corresponding lever in the other circuit raised, thereby preventing interference.

By a careful examination of the machine we have thus described and shown, it will be apparent, as is the fact, that if, while a signal is being given over the one circuit, an attempt should be made at the alarm-boxes or keys of the other circuits to give a signal, no effect could be produced and no interference could occur.

It is obvious that any desired number of circuits may be brought into this instrument by converging their wires all upon the break-circuit wheel, and also all the armature-levers of the principal magnets upon the lever or device by which the said wheel is stopped and liberated.

It is also obvious that it is not essential that the governor should be a segment of a disk, or be mounted on a rotating shaft. It may be a sliding bar, which any competent machinist can construct and arrange, so as to perform the function of the governor, as herein described. Indeed, when any considerable number of circuits are brought into this repeater, it will be found more convenient to use the sliding bar rather than the rotating segment or disk.

What we claim as our invention, and desire to secure by Letters Patent is—

1. The combination, with the break-circuit wheel of a telegraph-repeater, upon which the lines of two or more circuits converge, of a governor, whereby, when a signal is being given over any one of the circuits, and repeated over the other circuits, the armatures of the magnets in such other circuits are locked in position, thereby preventing interference between the several circuits, as and for the purpose specified.

2. The auxiliary escapement-movement, in combination with the governor J and the break-circuit wheel, whereby the reverse movement of the governor is not permitted to take place during several successive revolutions of the said wheel, as and for the purpose specified.

3. The auxiliary escapement-movement, the circuit-wheel and its shaft, and the lever 25, combined and operating as described, whereby, after the winding up of the escapement by the revolution of the circuit-wheel shaft, the reverse motion of the said lever is prolonged and graduated, as specified.

4. The combination, in an electro-telegraphic repeater, of two electro-magnets in the same circuit, one of which has a larger core than the other, whereby there results an appreciable difference in the periods required for them to be charged and discharged, respectively, as and for the purpose specified.

5. The device described, whereby the breaking of any one of several circuits connected with the repeater for the purpose of signaling occasions the break-circuit wheel to be cut out from that circuit by closing the same over aux-

iliary fingers *x x'*, all combined and operating as and for the purpose specified.

6. The auxiliary magnets F F', with their armatures and hooked lever M, in combination with the armature-lever H and swinging lever D, as and for the purpose specified.

7. The combination of the swinging lever D, with its two stop-pins, and the arm *l*, with its two fingers *s s'* upon the break-circuit-wheel shaft, as and for the purpose specified.

8. The combination of the cam 28, levers 22 and 25, and sliding bar 18, as and for the purpose specified.

9. The combination of the governor J, bar 18, lever 25, and latch 37, as and for the purpose specified.

10. The lever I, with its short arm 10, the armature-lever H, and lever D, and the governor J, combined and operating as and for the purpose specified.

11. The auxiliary escapement *y y'*, with its train 31 32, in an electro-telegraph repeater, employed to graduate the movement of the mechanism by which said train is actuated relatively to the movement of another telegraphic repeating mechanism.

Witness our hands this 11th day of August, 1874.

JOHN NELSON GAMEWELL.
MOSES G. CRANE.
EDWIN ROGERS.

Witnesses:
A. S. FITCH,
B. S. CLARK.