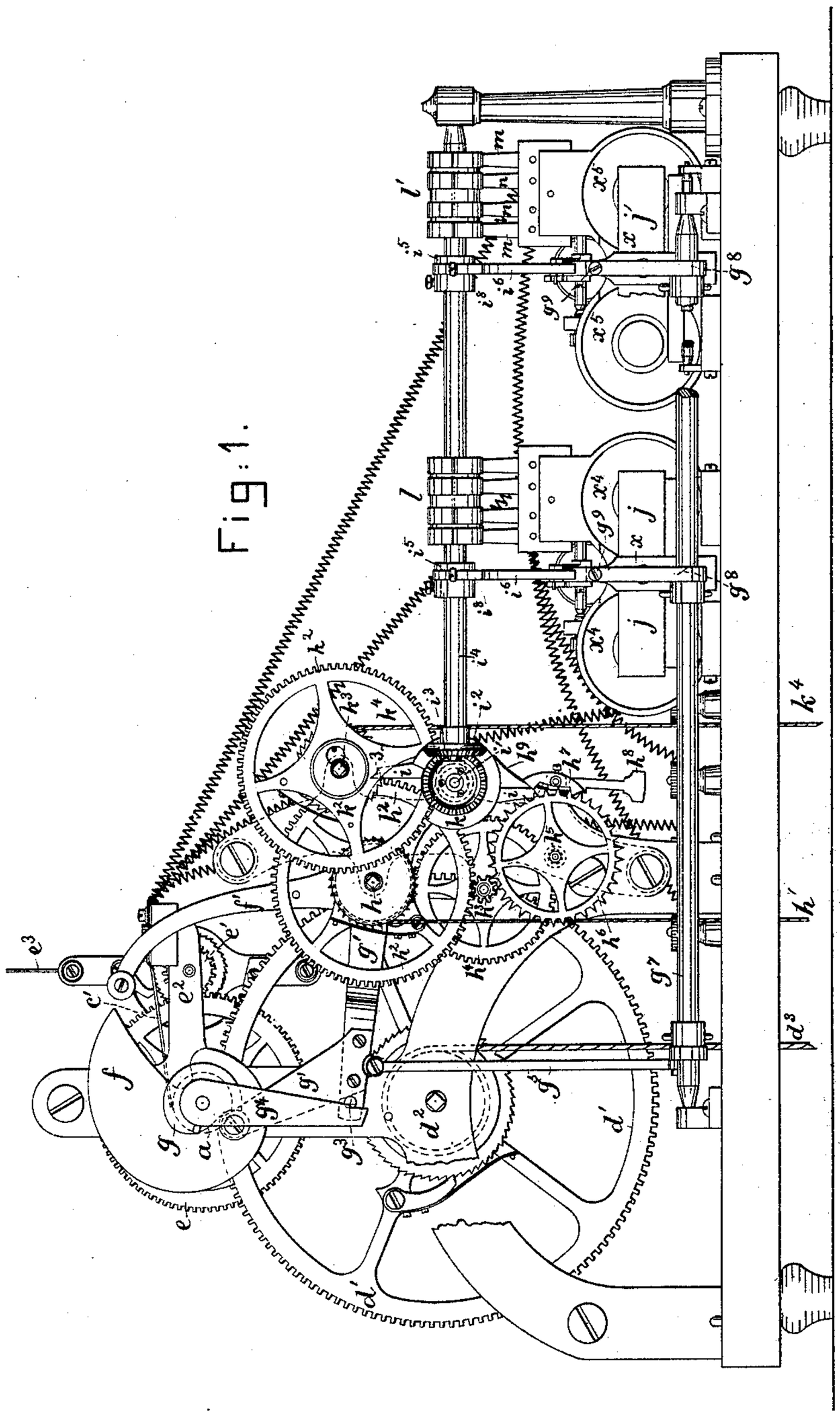
3 Sheets—Sheet 1.

E. ROGERS & M. G. CRANE.

Fire-Alarm Telegraph Repeaters.

No. 223,248. **Patented Jan. 6, 1880.**

Fig. 1.



Witnesses.

Jos. P. Livermore

N. E. Whitney.

Inventors.

Edwin Rogers & Moses G. Crane

by Crosby & Gregory Attys

N. PETERS, PHOTO-LITHOGRAPHER, WASHINGTON, D. C.

3 Sheets—Sheet 2.

E. ROGERS & M. G. CRANE.

Fire-Alarm Telegraph Repeaters.

No. 223,248. **Patented Jan. 6, 1880.**

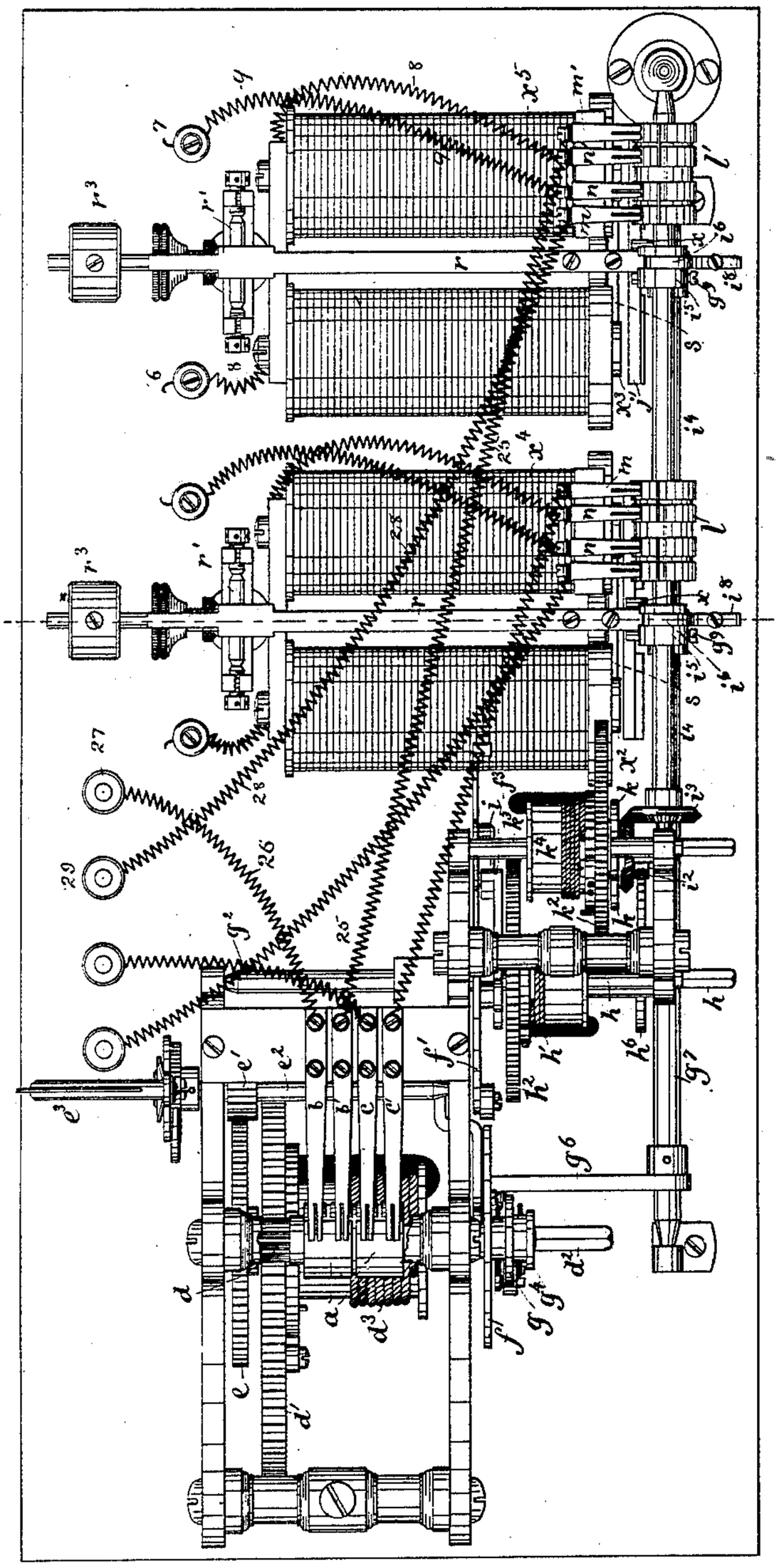


Fig. 2.

Witnesses.

Jos. P. Livermore

N. E. Whitney.

Inventors

Edwin Rogers and Moses G. Crane,

by Crosby & Gregory Attys

N. PETERS, PHOTO-LITHOGRAPHER, WASHINGTON, D. C.

3 Sheets—Sheet 3.

E. ROGERS & M. G. CRANE.

Fire-Alarm Telegraph Repeaters.

No. 223,248. Patented Jan. 6, 1880.

Fig: 9.

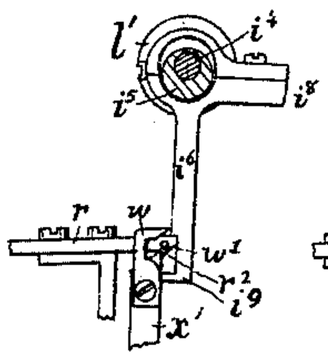


Fig: 10.

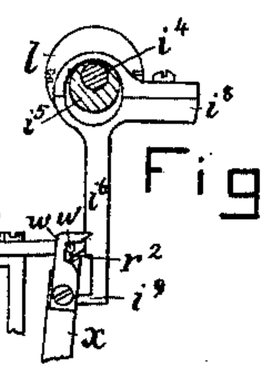


Fig: 3.

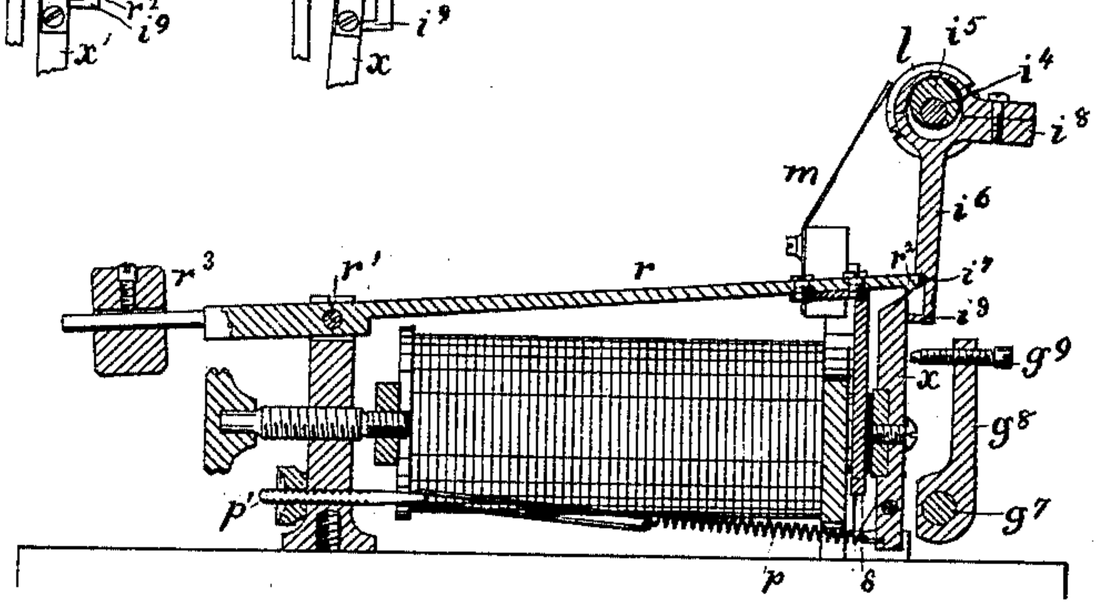


Fig: 7.

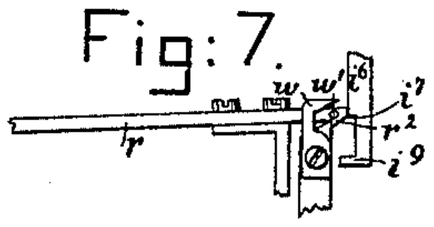
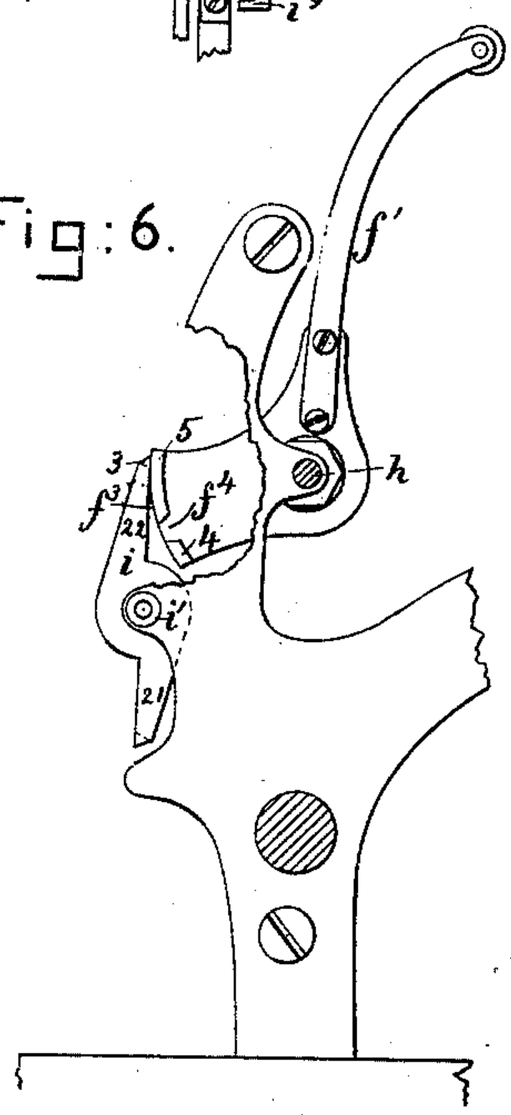


Fig: 6.



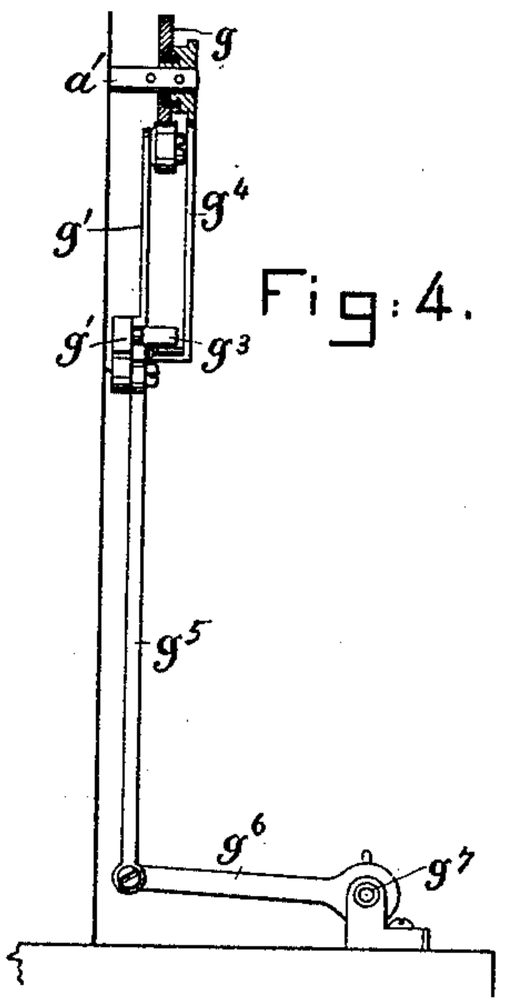
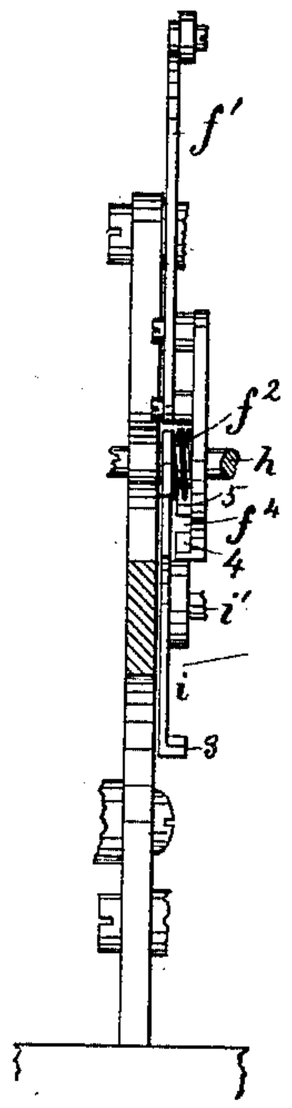
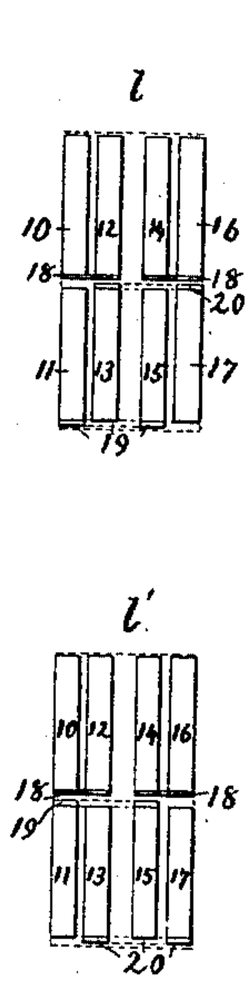


Fig: 4.

Fig: 8.

Fig: 5.





Witnesses.

Jos. P. Livermore

N. E. Whitney.

Inventors

Edwin Rogers and Moses G. Crane

by Crosby & Gregory Attys

N. PETERS, PHOTO-LITHOGRAPHER, WASHINGTON, D. C.

UNITED STATES PATENT OFFICE.

EDWIN ROGERS, OF BROOKLINE, AND MOSES G. CRANE, OF NEWTON, MASSACHUSETTS.

FIRE-ALARM-TELEGRAPH REPEATER.

SPECIFICATION forming part of Letters Patent No. 223,248, dated January 6, 1880.

Application filed May 26, 1879.

To all whom it may concern:

Be it known that we, EDWIN ROGERS, of Brookline, county of Norfolk, and MOSES G. CRANE, of Newton, county of Middlesex, State of Massachusetts, have invented an Improvement in Fire-Alarm Telegraphs, of which the following description, in connection with the accompanying drawings, is a specification.

This invention relates to fire-alarm telegraphs, and is herein illustrated as applied to that class of apparatus designated as an "automatic repeater," whereby a signal being transmitted over one circuit is automatically repeated over all the other independent circuits connected with the repeater, the object of the invention being to so place the repeater under the control of the circuit which starts it that it cannot be interfered with by any other circuit until the work required of the repeater by the first circuit is accomplished.

The repeater, when at rest and in its normal condition, acts to hold all the circuits closed if the connections are complete. The breaking of a circuit permits the armature of the electro-magnet of that circuit to fall back and start the repeater to break all the other circuits; but just before or at the time the said circuits are broken the locking-out devices are automatically operated by a shaft and locking-out train to force down suitable hooks or catches to lock the main armatures of the electro-magnets of all the other circuits, so that they will be held against their magnets, to thereby prevent the said armatures from being moved back and affecting the repeater when the electric circuit is broken, which would interfere with the repeater that it is desired to place exclusively under the control of one circuit.

The hooks to operate and hold the main armatures, as described, are shown as weighted levers, provided at their hooked ends with armatures, these latter armatures, when the circuits are closed, acting to so move the hooks as to leave the main armatures free to move when the circuit breaks. The main armature is withdrawn from the magnet quickly, as by a spring, while the armature which moves the said lever and hook, and which we shall call the "auxiliary" armature, is made to move more slowly than the main armature, thereby permitting the main armature to be thrown back when the circuit is broken before the auxiliary armature and the hook operated by it can descend and catch it. This slower motion of the armature may be attained in various ways, as herein shown. The lever and auxiliary armature are operated by gravity, and are of great enough weight to be sufficiently retarded by inertia. These hooks also operate to hold in place the main armature of any circuit in which, for any fault, the circuit is broken or left open.

To the train of gears we have added a suitable cam and connections, whereby we are enabled to automatically move all the main armatures of the electro-magnets in all the circuits up to their respective poles, to thereby save greatly in battery-power, for a very weak current will hold an armature against the poles of an electro-magnet, while a strong current would be required to draw the said armature through any considerable space. In this our plan we are at liberty to move the main armatures any desired distance away from their poles, thereby enabling us to save fine and expensive fitting or adjustments and insure greater accuracy of working, this feature of automatically and mechanically moving the armatures up to their poles after being released by the break of a current being especially available and desirable where the armatures are to be made operative for other purposes.

Figure 1 is a side elevation of an apparatus containing our invention; Fig. 2, a top view thereof; Fig. 3, a sectional detail, showing one electro-magnet, its armatures, and their operating devices, including the locking-out device; Fig. 4, a detail of the shaft and its connections between the circuit-breaker and the main armatures; Fig. 5, a rear-end view of the lever which releases the locking-out train of gearing which operates the shaft that carries the locking-out devices; Fig. 6, a side view thereof, showing the said lever and the locking-arm of the said locking-out train; Fig. 7, a detail of the ends of the levers or arms which carry the armatures; Fig. 8, a detail, showing the rheotropes laid out or developed on a plane surface; Figs. 9 and 10, details of the locking-out devices, showing them in different positions.

The circuit-breaking cylinder *a*, provided, as usual, with metal plates and spaces between to contact with the circuit-springs *b b' c c'*, according to the number of circuits, (two springs being used for each circuit,) is provided with a pinion, *d*, engaged by a toothed wheel, *d'*, on the shaft d^2, which is driven in any usual way—as, for instance, by means of a cord, d^3, having an attached weight, or by a clock-spring. The toothed gear *e* on the shaft *a* engages the pinion *e'* on the shaft e^2 and drives the usual regulating-fan e^3.

At the end of shaft *a* are two cams, *f g*. The cam *f* is adapted to act upon the roll of a lever, *f'*, loose on the shaft *h*, but held frictionally thereon by a spring, f^2, (see Fig. 5,) to operate the said lever at the proper time, so that its face f^3, notched at f^4, will release the arm *i* on the shaft *i'* of the locking-out train, a projection, 3, on the said arm passing through the said notch. This shaft *i'* is provided with the bevel-pinion i^2, that engages the bevel-pinion i^3 on the shaft i^4, that, provided with the eccentrics i^5, at the proper time actuates the locking-out devices i^6, herein shown as weighted arms or levers, notched at their lower ends, as at i^7, (see Fig. 3,) and mounted loosely, for purposes hereinafter described, on the said eccentrics, the arms i^6 being sufficiently heavy at i^8 to keep their lower ends pressed toward the ends of the levers *r*.

The cam *g* on the shaft *a* acts upon the roll of a portion of the arm *g'* projecting from the shaft g^2, this arm *g'* being provided with the locking-pin g^3, which acts upon and holds the locking-lever g^4 in its normal position, as shown in Fig. 1, all the circuits being then closed.

The pin-carrying arm *g'* is, by a link, g^5, connected with the arm g^6 of a rock-shaft, g^7, provided with a series of arms, g^8, having adjusting-screws g^9, which act upon the outer sides of the arms of the main armatures *j j'* to place them against the poles x^2 x^3 of their respective electro-magnets x^4 x^5, of usual construction. When the arm *g'* is thrown down by the cam *g* the said armatures are mechanically moved up to their poles x^2 x^3 without the aid of battery-power.

The shaft *h* of the time-train, driven by a cord, *h'*, and weight, or by a spring, in any usual way, has upon it a gear, h^2, that engages the pinion h^3 on a shaft provided with a gear, h^4, that, in turn, engages a pinion, h^5, (shown in dotted lines, Fig. 1,) on a shaft provided with an escapement-wheel, h^6, engaged by an escapement-pallet, h^7, governed by pendulum h^8, and provided with a finger, preferably a spring-finger, h^9, which is acted upon by the locking-cam *k*, fixed on the shaft *i* of the locking-out train, the said locking-cam operating the said pallet h^7 to hold the time-train or release it.

The shaft *i'* (hereinbefore referred to) of the locking-out train is provided with a pinion engaged and driven by the toothed wheel k^2 on the shaft k^3, driven by a cord, k^4, and weight, or by a spring, in any usual way.

When the repeater is in its normal condition the roll of the lever *f'* rests upon the cam *f* at its point of smallest radius, the cam then being as in Fig. 1, the locking-lever g^4 resting against the pin g^3.

We have so shaped the said cam *f* that at the commencement of its motion, the locking-lever being then released from the pin g^3 by the opening of one of the circuits, which releases the main armature of its magnet, whereupon said armature, drawn back by the spring, acts, through the lever g^8, shaft g^7, arm g^6, and link g^5, to raise the lever *g'* and pin g^3, said cam *f* will positively lift the lever *f'*, bringing its notched part f^4 into position to permit the passage through it of the end 21 of the arm *i*, which releases the locking-out train and permits it to turn the shaft *i'* one-half a revolution, when the end 22, which is longer than 21, stops on the part 5 of the face f^3. As the bevel-gears i^2 i^3 have the same number of teeth, this half-revolution of shaft *i'* turns the shaft i^4 half a revolution, and throws down the locking-out devices i^6 upon the levers *r*, which act to hook over or catch upon and hold the main armatures, as before described, the shaft *i'* of the said locking-out train at the same time turning the locking-cam *k* so far as to release the pallet of the escapement-wheel of the time-train, permitting the said time-train to be operated by its weight or spring while the arm *f'* is further elevated or fully raised.

The cam having rotated once with its shaft, the locking-arm g^4 is held by the pin g^3 of the lever *g'*, and the arm *f'*, connected frictionally with the shaft *h* by the spring f^2, as described, begins to travel with the said shaft *h*, moving gradually but slowly backward under the control of the time-train toward the point of smallest radius of the cam *f;* and just before the arm *f'* reaches its lowest position the notched part f^4 again releases the arm *i*, and permits the locking-out train to again operate its main shaft i^4 half a revolution, when the end 21 of arm *i* is again locked upon the part 4 of the face f^3; whereas, when the arm *i* was locked and the lever *f'* was being raised by that part of the cam *f* having longest radius, the end 22 of the arm *i* was held by the portion 5 of the said face f^3.

The cam *f* is so shaped and the time-train is so proportioned with relation to it and the lever *f'* that the said lever, moved up quickly by the cam and back slowly by the time-train, shall occupy in its return movement a length of time, measured by seconds, which shall be in excess of the pause or number of seconds determined upon for the interval between the repetitions of the complete number to be sounded on the primary sounders or bells of the circuits then in operation; but with a compound number, as forty-two, the space between the four strokes and the two strokes being shorter than the interval between the repetitions of the complete number, (forty-two,) the lever *f'* does not have an opportunity to completely descend, and consequently the arm *i*, during

the time the signals are being sounded, is compelled to move only over the part 5 of the face f^3.

As the shaft i^4 is turned for half a revolution, and the eccentrics i^5 push the locking-out devices i^6 down, their shoulders i^7 meet the ends of all the levers r except the one belonging to the circuit which is in operation from the signal-box, thereby moving the said levers r and causing their hooks r^2 to engage and hold the main armatures, as shown in Fig. 9, co-operating with them, so that when the circuits of all the magnets are subsequently broken by the circuit-breaker of the repeater the main armatures of the electro-magnets which it is desired to lock out cannot fall back away from their respective poles.

The locking-out device i^6 for the circuit which is in operation is prevented by the projection i^9, which rests upon the arm x of the main armature, as shown at Fig. 10, from engaging, by the shoulder i^7, the end of the lever r, and, owing to the space between the eccentric i^5 and its strap, the shoulder i^7 still does not engage the end of the lever r when the arm x is brought up by the lever g^8 and caught by the hook r^2, as shown in Fig. 7.

In operation, the circuits being closed and the parts being in the position shown in Fig. 3, both armatures against the magnets and the hooks r^2 clear from the arms x, when a circuit, as that of the electro-magnet x^4, is broken the main armature j' is acted upon and thrown back quickly by the spring p, made adjustable, as herein shown, by a screw, p', and a nut; but the lever r, pivoted at r', having connected with it the auxiliary armature s, is provided with an adjustable counter-weight, r^3, which, as the armature s is released, acts to move the said lever r so slowly that the hook of the said lever is unable to catch and hold the arm x of the rapidly-moving main armature.

The main armature as moved by the spring strikes the screw g^9, moving the arm g^8, which, by its connections, raises the locking-pin g^3, freeing the arm g^4, to thereby permit its shaft to rotate, operating the circuit-breaker a and, by the cam f, the locking-out device, as before described. At the same time the cam g depresses the lever g', and it, through its connections with the shaft g^7 and arms g^8, mechanically moves the main armature j up to the poles of its magnet, where it is held by the hook r^2, which falls over it, as shown in Fig. 7, as long as the circuit remains open, and upon the closing of the circuit it is held by the magnet, which also attracts the auxiliary armature, thereby raising the hook r^2 and leaving the arm x free to act as before upon a new breaking of the circuit.

It will be seen that by pivoting the carrying-lever r of the auxiliary armature s, as shown, at a considerable horizontal distance from the poles of the magnet, and arranging said armature s to be attracted to the sides of the cores of the magnet in a direction substantially at right angles to the axes thereof, while the main armature moves in substantially the same direction with the axes of the cores, the hook r^2 is enabled by the action of gravity alone, the circuit being open, to readily engage the end of the arm x of the main armature when brought up and held for a moment in front of the poles by the arm g^8 and connected devices, and then to disengage when the circuit is closed, the hook being then raised through the auxiliary armature s by the attraction of the magnet, and again, when desired, to engage the arm x when the circuit is closed, the auxiliary armature being then positively broken away from the magnet by the locking devices i^6.

The above-described relative arrangement of the magnet, its armatures, and their pivots forms an exceedingly simple and effective means for effecting the desired movements and conditions of the armatures under the various circumstances described.

If the lever r were operated merely by its own weight, there would be danger that it might be held by the magnetism lingering in the electro-magnet after the circuit is broken. To obviate this difficulty we provide a cam, w, (see Fig. 7,) upon the arm x, which acts upon the pin or projection w' to positively depress the end of the lever r as the main armature moves away from the magnet, the cam w, however, not striking the pin w' until the arm x has passed beyond the hook r^2. It is obvious that this may be accomplished in other ways, as by a spring, it only being necessary for the movement of the lever r to be too slow to catch by its hook r^2 the arm x of the main armature.

When sufficient time has elapsed for the time-train to release, by movement of the lever f', the arm i of the locking-train, the final half-rotation of the shaft i^4 lifts all the locking-out devices i^6 and releases the levers r above the ends of the armature-holding arms x, the main armatures j j' and the auxiliary armatures s s' being thereafter held closed against the poles of the electro-magnets by the current passing through the circuits ready to be broken and operated, as before described.

The rheotropes l l' for reversing the currents in the usual way are placed on the shaft i^4, which operates the locking-out devices, and, as herein shown, the spring-fingers m m' and n n', the former to complete the line-circuit and the latter to complete the battery-circuit, are insulated and supported near the electro-magnets. As herein employed, these rheotropes (represented as laid out or developed in Fig. 8) are shown as composed each of eight pieces or strips of metal, 10 11 12 13 14 15 16 17. The ends of the strips 10 12 and 14 16 are connected by metal strips 18, and the ends of 11 and 15 are connected by metal strips 19 passing beneath and insulated from 13, as shown by dotted lines, and the ends of 13 and 17 with a metal strip, 20. (Shown in dotted lines.)

Following one circuit, the course of the cur-

rent is as follows: The binding-posts are connected with the poles of the battery, and the current passes by wire 8 from the binding-screw 6 through the coils of the magnet to the spring-finger n', and thence, when the rheotrope is in the normal condition, the machine not sounding but waiting an alarm, through the metal strips 14 18 16 of said rheotrope to the spring-finger m' and wire 25, from which the said current passes through the spring-fingers b' b and circuit-breaker to the wire 26, which is connected with the binding-post 27, for attaching one end of the main line. The other post, 7, is connected by wire 9 with the finger n, pieces 12 18 10 of the rheotrope, and spring-finger m, and thence by wire 28 with the binding-post 29, for attaching the other end of the main line. Thus, when the rheotrope is in its normal condition, the binding-posts 27 29 are connected with the same poles of the battery, respectively, as the ones marked 6 and 7; but when the rheotrope is reversed, as while a signal is being struck, the current passes from the spring-finger n' to the one m, and from n to m', thereby connecting binding-screws 6 and 29 and 7 and 27, thus, because of the position of the electro-magnet between the battery and rheotrope, having reversed the current through the main line to change the polarity of the magnets in the signal-boxes of the circuit, to thereby avoid interference between boxes, without, however, having reversed the current through the electro-magnet.

This plan of changing the polarity of the magnets of the signal-boxes is not new, as such provision has been made to shunt a signal-box; but in this our method we change the polarity of the magnet to actuate a block and place it in such position with relation to the operating lever or pull of the signal-box that the movement of the said lever or pull cannot lift the holding or locking arm or catch to disengage the circuit-breaking wheel of the signal-box, and consequently the boxes in which the polarity of the magnets is changed cannot be released to sound a signal.

A signal-box containing this invention referred to forms the subject-matter of another application for patent filed concurrently with this.

The apparatus has been so far described as to be locked on the closed circuit; but to adapt it to lock on the open circuit while the alarm is being given, as in United States Patent No. 165,923, we may interpose a lever with a locking-pin upon it preceding the present pin g^3, said lever being operated by the shaft i', which sets in motion the locking-out devices.

We claim—

1. In combination, a circuit-breaker, an electro-magnet and its armature, and a mechanical motor automatically set in operation upon the breaking of the circuit and consequent release of the armature from its magnet to immediately move the armature back to the poles of the magnet, as and for the purpose set forth.

2. In an electric apparatus, a circuit-breaker, an electro-magnet and its armature, and a mechanical motor automatically operated to return the armature to the poles of the magnet immediately after it has been released therefrom by the breaking of the circuit, combined with a detent adapted to catch and hold the armature up to the poles of the magnet as long as the circuit remains open, and to be disengaged as soon as the circuit is closed, thereby leaving said armature free to again fall away from the magnet by another opening of the circuit, substantially as described.

3. In an electro-magnetic apparatus, a circuit-breaking wheel or shaft, a cam and lever actuated by it to release the holding-arm of a locking-out train, combined with an independent locking-out train, substantially as described, a shaft, and locking-out devices actuated thereby to automatically lock one or more of the main armatures of a series of electro-magnets and hold them up to their respective poles when the circuit is broken by the circuit-breaking wheel, substantially as and for the purpose described.

4. In an electro-magnetic apparatus, one electro-magnet and a spring-actuated main armature, combined with an auxiliary armature and a connected hooked lever of sufficient weight as by its inertia to act so slowly as to thereby enable the main armature to be moved so quickly as not to be caught by the lever of the auxiliary armature, substantially as described.

5. The combination, with a time-train of an electro-magnetic apparatus, as described, of a locking-cam and mechanism to rotate it at certain intervals to lock and release the pallet of the escapement of the time-train, substantially as and for the purpose described.

6. The intermittingly-operated shaft i^4 and its eccentrics, combined with the locking-out devices to engage the levers which catch and hold the main armatures, substantially as and for the purpose described.

7. The mechanically-driven locking-out train and its arm i, combined with a lever having a notched face, and actuated by a cam set in motion by a mechanically-driven train, which operates the circuit-breaking wheel of the repeater, substantially as and for the purpose described.

8. The mechanically-driven locking-out train, an arm, i, thereon, a locking device for the said arm, and a locking-out cam, combined with a mechanically-driven time-train and a weighted pallet provided with a finger acted upon by the locking-out cam, substantially as and for the purpose described.

9. The combination, with the circuit-breaking shaft or wheel, its locking-arm g^4, and cam g, of the pin-carrying lever g', link g^5, rock-shaft, and armature-moving arms g^8, as and for the purpose described.

10. The combination, with the main armature, its arm, and cam w, of the lever r and its pin or projection, substantially as and for the purpose described.

11. The combination, with the shaft i^4, of the loosely-held locking-out device i^6, weighted to cause its lower end to be held pressed toward and to engage a projecting portion of the lever r, substantially as and for the purpose described.

12. The locking-out device, provided with a shoulder to act upon the levers r of the electro-magnets of the circuits upon which the signal is being repeated, and a projection and loosely-fitting eccentric-strap to prevent it from acting upon the lever of the electro-magnet of the circuit giving the signal, substantially as described.

13. In an electro-magnetic apparatus substantially such as described, an electro-magnet placed in circuit between the battery and a rheotrope to avoid the reversal of the current through the said magnet when the rheotrope reverses the currents of the main lines, combined with a rheotrope and means to connect it with the battery and main line, substantially as and for the purpose described.

14. The combination, with the same electro-magnet, of two independent armatures to be attracted by the poles of the magnet when the circuit is closed, and means connected with the arm of one of the said armatures to enable it to engage and hold the other one up to the poles of the magnet, as may be desired when the electric circuit is open, substantially as described.

15. The combination, with the shaft of the time-train, of a frictionally-held arm provided with a notched flange, the said arm being adapted to be turned about the said shaft in one direction and move with it in the opposite direction, substantially as described.

16. The lever provided with a notched face and a cam to operate the lever, combined with the arm of the locking-out train, to co-operate with the said notched face and hold or release the locking-out train at the proper periods, substantially as described.

17. The combination, with a single electro-magnet and two armatures, of a finger or projection on one to operate upon a portion of the other armature or its arm to positively disengage one armature from the said electro-magnet when the other is released by breaking the circuit, substantially as described.

In testimony whereof we have signed our names to this specification in the presence of two subscribing witnesses.

EDWIN ROGERS.
MOSES G. CRANE.

Witnesses:
JOS. P. LIVERMORE,
N. E. WHITNEY.