2 Sheets--Sheet 1.

S. CHESTER.

Fire-Alarm Telegraph.

No. 169,087. Patented Oct. 26, 1875.

Fig. 6.

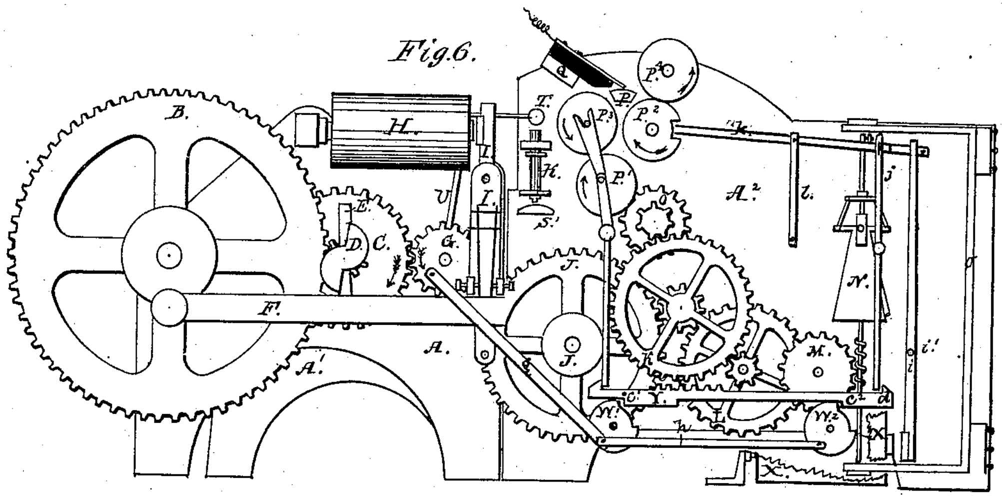


Fig. 7.

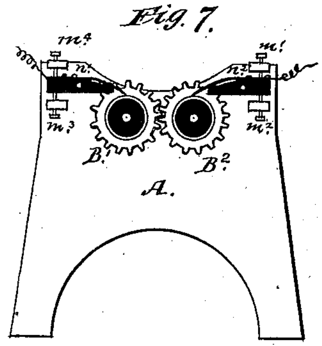


Fig. 8.

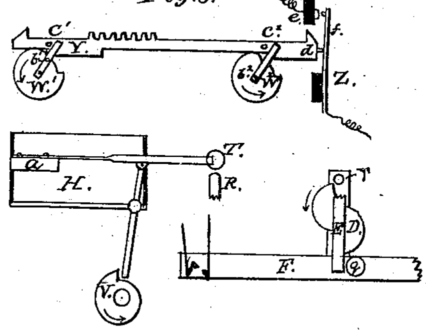


Fig. 9.

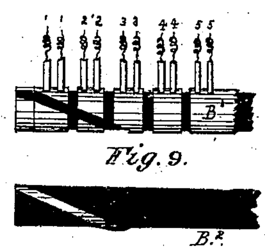


Fig. 10.

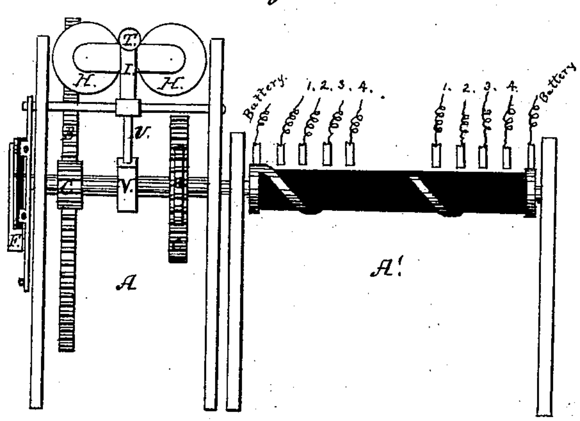
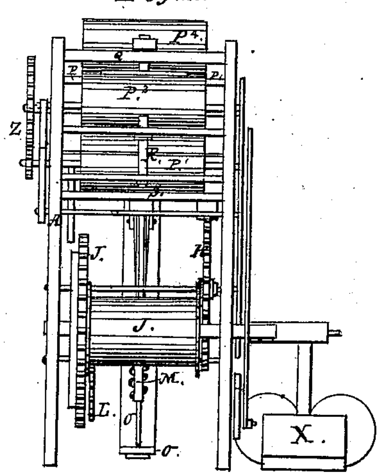


Fig. 11.



Witnesses:

John Guion

D. Ormont Frye

Inventor:

Stephen Chester

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

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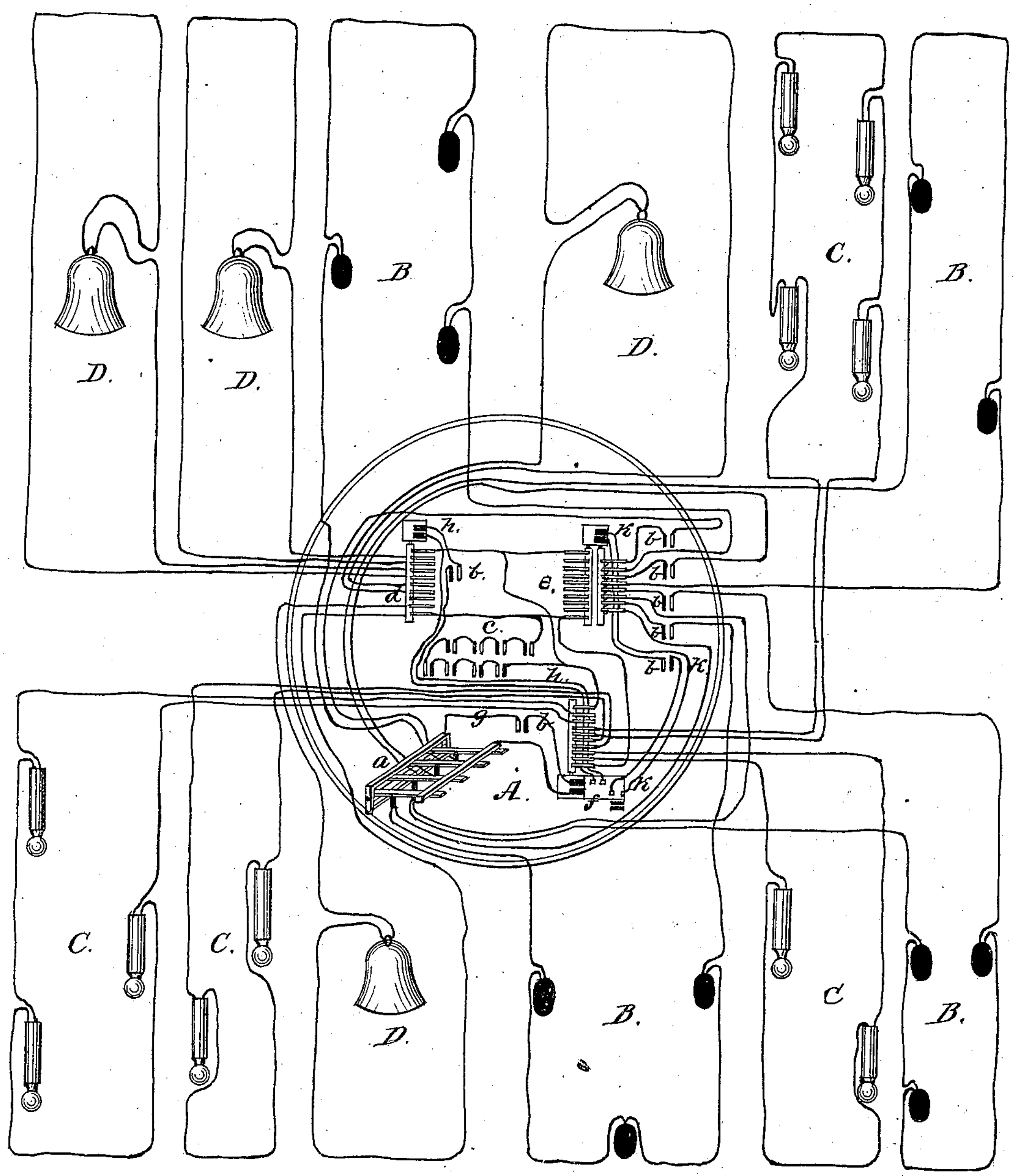

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Stephen Chester

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

UNITED STATES PATENT OFFICE

STEPHEN CHESTER, OF ELIZABETH, NEW JERSEY.

IMPROVEMENT IN FIRE-ALARM TELEGRAPHS.

Specification forming part of Letters Patent No. **169,087**, dated October 26, 1875; application filed May 5, 1875.

To all whom it may concern:

Be it known that I, STEPHEN CHESTER, of Elizabeth, New Jersey, have invented an Improvement in Fire-Alarm Telegraph, of which the following is a specification:

My invention consists of certain improved forms of apparatus for the transmission and reception of electro-telegraph signals and their combination with each other to produce specific results.

I will first describe these instruments separately and their manner of operating in combination, first, however, indicating the results the combined machinery is intended to produce.

In all systems of electro-signaling, especially for the purpose of fire-alarm, the machinery of the receiving and transmitting office, among other functions, should be required to perform the following:

First, to sound all signals emanating from distant stations intelligibly, so that the attendant (if any) shall hear and recognize them.

Second, to record on paper or an equivalent the same signals in such manner that, if desired, the hour and minute may, if required, by additional machinery, be recorded on the same paper at the same time.

Third, that all signals emanating from distant stations received at the distributing-office shall instantly be transmitted to other distant receiving-stations at the greatest rate of speed that the light and rapid moving receiving apparatus of certain stations is able to respond to, at a less rate of speed to stations where the receiving apparatus is less light and rapid in its action, and at other still slower speed to other stations where the receiving apparatus may of necessity be of a ponderous and slow-moving character, the several transmissions occurring simultaneously, and not in rotation. For instance, the receiving apparatus of one station may be a Morse sounder; of another, a gong; of a third, a huge tower-bell.

Fourth, when the machinery of distant transmitting-stations requires such action to insure perfect operation, the machinery of distributing or receiving office should automatically send a momentary flash of augmented battery force over all the circuits on which are stations directly or indirectly communicating with each other, but in such manner that while the attractive force of each magnet at such sending-stations is momentarily increased the continuity of current shall not be thereby broken.

On the drawing, Sheet 1, Figure 1 represents a combined repeater or transmitting-machine and register, of which Figs. 10 and 11 present sectional elevations of the parts A and A^2, those ends, respectively, being shown which meet in Fig. 6.

A is a frame supporting the gear-wheels B C G, of which the wheel B, actuated by spring or weight, is the driving-wheel. The wheel G has a diameter half as great as that of C, and the wheel C, in consequence, makes but half a revolution while the wheel G makes a whole revolution. Upon the shaft or axis of the wheel C are fixed the straight bar E and the double cam-wheel D. (See Figs. 1 and 3.) When the swinging bar F is horizontal one or the other end of the bar D will strike upon the roller *g*, Fig. 8, and arrest the motion of the machine; but if the movable end of F be allowed to drop sufficiently E will escape, and the machinery will revolve until the bar F be again restored to its horizontal position.

I is a swinging bar, upon one end of which is fixed the armature of magnet H. Upon or near the lower end are two adjustable hooks, one being adjusted in a plane somewhat lower than the other. These are most distinctly shown in Fig. 3, though the manner of their adjustment appears only in Fig. 1. These hooks are so placed upon the bar I in reference to the bar F that a triangular pin projecting perpendicularly from near the end of the latter, will, when the said bar is raised to a nearly horizontal position, be ready to rest upon either the upper or lower hook as the armature-bar I is moved to the one side or the other, and when thus resting the bar F will be supported in a nearly horizontal position, so that the roller *q* will be in position to arrest the motion of the machine, as described. Now, if the projecting pin be resting upon the higher hook, and the magnet cause the bar I to move, the pin will slip off from the upper and drop onto the lower hook. A reverse motion of the bar I will cause the pin to drop off from lower hook, and the bar F to fall to such distance as may be convenient to permit it, thus permitting the wheels to revolve; but in Fig. 3 it will be observed that the bar F has a perpendicular arm, from the end of which a pin or roller projects in such manner that it rests upon the two-part cam-wheel D. Therefore, if the bar F be released and allowed to fall by the double action of magnet, as above described, and the wheels begin to revolve, in little less than half a revolution of the wheel C the triangular pin will, by the raising of the bar F, be replaced upon the higher hook, and when the half revolution of the wheel C′ (whole revolution of G) is complete, one or the other end of E striking the roller arrests the machine, which is now prepared to repeat the same operation. Hence, if the circuit embracing the magnet H be opened and closed, or reversely closed and opened, this evolution will be performed, and for each entire and complete electric impulse communicated the wheel G will make one complete revolution and be arrested. The breaking of a line or abnormal opening of a circuit will not suffice to release the machinery.

I do not confine myself to this particular mode of releasing a detent by electricity, as any other method of controlling mechanical motors by magnets, so as to produce single or combined revolutions of shafts corresponding with electric signals given from a distance, would apply in this case. For the purpose of illustration only, I have herein described a method of controlling machinery heretofore invented by me, and more particularly described in patent 88,010. Figs. 2 and 5 represent a method of utilizing the motions given to the wheel G by distant stations for the purpose of causing like impulses to be communicated to other and distinct circuits. This instrument is supplemental to, and independent of, the instrument just described, except in so far as that its primary shaft B^1 is intended to connect with the shaft of the wheel G and to partake of its motion. When from any cause two or more cylinders may be required, as illustrated in Fig. 2, (where two shafts, B^1 and B^2, are shown,) motion is communicated from one to the other by similar cog-wheels, giving absolute similarity of revolution; and, thus arranged in reference to the machine previously described, it is obvious that each cylinder will revolve in exact correspondence with the electric signals affecting the "starting-magnet" H.

Upon these cylinders, which are of insulating material, may be placed conducting material in such position and such form that, when these cylinders revolve, various conducting materials may be brought in contact with terminal springs attached to the wires leading to batteries, telegraph-lines, and other instruments, so as to produce various desired changes in connections, as hereinafter more particularly described.

In the machine A^2, (Figs. 1 and 6,) J K L M represent a train of wheels terminating in any balance fly-wheel or governor, N, motion being communicated through the driving-wheel J by weight or by spring. A secondary train, driven by the same driving-wheel J, communicates motion to the roller P^1 through wheels K and O. The roller P^3 is unconnected with gear-work, its office being simply that of presser to cause the primary roller P^1 to draw forward a ribbon of paper, or its equivalent, with uniform speed when the machine is in motion. P^2 and P^4 represent a second paper roller and presser. Roller P^2 receives its motion directly from P^1 by means of gear-wheels, which, for convenience, may be slipped upon the square ends of the shafts of P^1 and P^2 outside of the frame. Thus, by having prepared sets of gear-wheels, of varying diameters, but whose added diameter shall be the same for each set, the relation of speed between the two sets of rollers can be varied at pleasure by slipping different sets of gear-wheels upon the prepared ends of the two mentioned shafts. Let us suppose that the gear-wheels Z, Fig. 6, have been thus placed, and their relation is such that the rollers P^1 and P^3 make three revolutions while the rollers P^2 and P^4 make one. The entire machine being wound up, and in readiness for action, as shown in Fig. 1, all motion is arrested by the engagement of pin or projection on one end of the fly-wheel shaft N with a pin or projection on the end of sliding rod or bar K. When the machine A, already described, is placed in connection with the machine A^2 a shaft, g, connected with a crank-motion attached to shaft of wheel G in machine A, communicates a reciprocating motion to wheel W^1 in machine A^2. Resting upon the peripheries of wheels or cams W^1 and W^2, (which are connected by shaft and partake of same motion) is a sliding bar, Y, Figs. 1 and 3, from which project the pins c^1 c^2. To the wheels W^1 and W^2, or either of them, are fixed bars b^1 b^2 (not represented in Fig. 1, but shown in Fig. 3) in such fashion that, when the wheels W^1 and W^3 are caused to move in the direction indicated by the arrows, the bars b^1 and b^2 come in contact with pins c^1 c^2, and will force the bar Y from right to left for a distance limited by the amount of reciprocating motion given to the bars b^1 b^2, as before described. The sliding bar Y has upon its upper surface teeth corresponding to the teeth of a wheel, K, fixed on the outer end of shaft of train-wheel K. It also has on its under surface projections, which, for convenience, I will call blocks, on Y. The wheels W^1 and W^2 have a portion of their circumference cut away to a depth corresponding to the thickness of blocks on Y.

It will be observed that, when the bar Y is in its extreme position toward right, and the primary machinery A is at rest, the blocks on Y rest upon the smaller diameter of the wheels W^1 W^2, and the teeth on Y are in a plane too low to engage with those of wheel K. Now, if the wheels W^1 W^2 be caused to move in the direction indicated by arrows, the bars o^1 and o^2 will carry the bar Y to its extreme left position, the blocks on Y meanwhile resting upon the small diameter of wheels W^1 W^2, the bar Y being carried in a plane where its teeth will escape those of wheel K; but when, by the completion of the revolution of wheel G, the bars o^1 o^2 and wheels W^1 W^2 are returned into their original position, the bar Y meanwhile being temporarily retained in its extreme left position, the larger diameter of wheels W^1 W^2 are forced under the blocks of Y, thus raising the bar Y into a higher plane when its teeth engage in the teeth of wheel K. The wheel K meanwhile, being in motion, will slowly carry the bar Y toward the right so long as the renewed impulse of the machine A causes the said bar to be carried to its extreme left position; but this lateral movement of Y toward the left causes its right-hand terminal hook to pull the lever *j*, and thus cause the sliding bar K to move to the right, withdrawing its left hand from the notch in wheel P^2, and releasing the fly-wheel. Of course the sliding bar K cannot return to such position as to arrest the fly-wheel until the wheel P^2 having made a complete revolution the notch again returns to where the bar K can slide into it. Shortly after the last impulse received from the machine A, the bar Y, slowly moving toward the right, drops out of gear, and rests until a new impulse again throws the machine into operation.

In Fig. 1, R is a punching-machine, of which S is the anvil or matrix. T is a hammer, which is raised and allowed to fall upon the punch at each revolution of the wheel G, through means of a cam-wheel or equivalent device, upon the shaft of wheel G. Thus every impulse communicated to machine A through the starting-magnet H causes the strip of paper to commence moving and holes to be punched in the paper at intervals of space corresponding to the intervals of time between the impulses communicated to the magnet H; but the paper thus punched at intervals corresponding to the velocity given by rollers P^1 P^3 passes thence over the block P and under the platina brush, or equivalent, Q, and through the rollers P^2 P^4, which we have assumed make but one revolution while the rollers P^1 P^3 make three revolutions. Hence the paper passes under the punch three times more rapidly than under the spring Q, or the interval of time required for the paper to pass under the spring Q from hole to hole in the paper is exactly three times as long as those which occurred between blow and blow punching the holes. Hence, if the spring Q and block P are connected with an electric circuit embracing electric bells or any electro-mechanical apparatus, the electric impulses communicated to all such apparatus will be in exact proportion to, but at intervals three times longer than, those which caused the starting-magnet H to act. Hence, any number of paper-rollers may be caused to revolve at different rates of speed by the same initial machinery, and electric signals may be communicated to one or several circuits or lines in such manner that the intervals separating the several impulses forming the signal shall in each case be mathematically proportionate; but the duration of such intervals shall in each case differ in exact proportion with the relative speed of the respective paper-rollers; but, as it is evident that the slower-moving set of paper-rollers must make the same number of revolutions as do the first set, then P^1 and P^3 must make three times as many revolutions (as they initially carry the others) as P^2 P^4, and, therefore, unless provision be made therefor, will continue to "pay out" an unnecessary and accumulating length of paper after the punching apparatus had finished its office, which paper would become an incumbrance to the machine and render it ineffective.

It has already been explained that, shortly after the last impulse of a signal has caused the starting magnet H to operate, the bar Y will return to its normal position, leaving the bar K free to return to the position when it arrests the fly-wheel—so soon as the slot in roller P^2 (or, in the case of several sets of rollers, a slot in the last of the series) comes opposite the end of bar K, so that it may slip in. To prevent this occurring before the last punch-hole shall have passed under spring Q, a supplemental magnet, X, is placed in the same circuit as is P and Q, in such manner that each impulse caused by a punch-hole passing between Q and P, permitting metallic connection, causes a movement of the armature-lever *i*, pivoted at *i'*. This lever engages with a pin upon the extension of sliding bar K, and draws it back in the same manner as does the bar Y when it operates. As so far explained, it is evident that this device would only be occasionally effective unless provision be made that, after the wheel P^2 shall reach that position, permitting bar K to arrest the machine, it shall not do so until the paper continues to pass for a distance equal to the greatest distance between any two punches forming part of the same signal.

I do not confine myself to the use of any one of the numerous devices that are in common use for producing similar results, and it is not, therefore, necessary to encumber these specifications with descriptions of devices which form no part of the present claims, and which are generally known.

The bar Y^2, Fig. 1, is to prevent the unnecessary accumulation of paper between the rollers P^1 P^3 and P^2 P^4. It will be observed that the ends of shaft of roller P^3 rest in a fork of Y^2, which is jointed at a point between the axis of P^3 and its own axis of motion, Y^2. This axis is a shaft running through the machine, and that portion of the device shown above the axis Y^2 exists on both sides of the machine, but the lower prolongation exists only on that side of the machine where is the sliding bar Y. Now, if this lower portion of Y^2 be carried a little to the right it will cause the portion above its axis to assume a straight line, and its consequent elongation will raise the roller P^3 slightly. If the lower end be released the weight of P^3 will cause a deflection of the upper jointed portion of Y^2, and the roller P^3 will rest upon roller P^1, so that they will perform their intended office of drawing paper. Now, a hook termination of Y, engages with the lower end of Y^2 in such manner that when Y has reached its extreme position to right, but not until then, the necessary motion will be communicated to Y^2 to cause roller P^3 to be raised. In all other positions of Y the rollers P^1 P^3 will impinge and draw the paper. Hence, at the first impulse given to magnet H a hole will be punched, and the paper will be drawn forward by rollers P^1 P^3. But when a time equal to the greatest interval that may separate parts of any signal has passed, then, though the rollers continue to revolve, the roller P^3 will be raised and the paper cease to be drawn by the first set of rollers. At this moment an amount of slack will have accumulated between the first and second sets of rollers, greater or less, as the signal punched may have been longer or shorter. But, as heretofore described, provision has been made that the succeeding set of rollers shall continue to revolve until they shall have made at least as many entire revolutions as had the preceding ones up to the time when they ceased to affect the paper. Hence, when the machine stops all the punches will have passed through the last set of rollers, and there will be no slack or accumulated paper between the successive sets of rollers.

It is of no importance in thus accomplishing these results whether this mechanical arrangement substantially described be used to make holes in paper or other materials, which subsequently are utilized to close circuit by suffering metallic contacts to be made; or whether the action be reversed, and the same mechanical force be applied to raising projections on materials, and in causing these records subsequently to break circuit instead of closing it.

Sheet No. 2 illustrates the connection to be made between these several described instruments, telegraph-lines, batteries, and signal and alarm stations. On this sheet are represented twelve separate loops or circuits, converging in one battery-station or central depot, designated by the ring A.

I do not confine myself to an arrangement wherein sending and receiving stations must of necessity be placed upon different circuits. It is only necessary that separate apparatus, either for transmission or reception, intended to act simultaneously at different rates of speed, should be placed on separate circuits. For illustration in this case I have represented each class of instrument as being confined to its own circuit, and B B B B represent circuits containing automatic signal-stations only; C C C C, containing quick-action electro-mechanical gong-strikers. On D D D D are placed great tower-bells only. The instrument *f* within the ring A represents the instrument heretofore described, and shown on Sheet No. 2, Figs. 6, 7, 8, &c., including the parts A A^1 A^2. *h* and *k* are similar instruments, including, however, the parts A and A^1 only, or the starting-machine and circuit-changing cylinders.

In the machines *h* and *f* the arrangement of the insulated and conducting surfaces brought in contact with the terminal springs resting thereon, when the cylinders rotate, in manner such that when the machine is at rest all the springs represented, except the two outside springs, rest on insulated surface. The outside springs, however, rest on metallic rings, so that the revolution of the shaft has no effect upon their condition of metallic contact; but when this cylinder revolves each pair of interior springs is in rotation brought in contact with separate metallic surfaces, which are, respectively, permanently connected with the two terminal rings.

Instrument K possesses a cylinder similarly arranged, and in addition a supplemental cylinder partaking of the same motion (as heretofore described, and shown in Fig. 2, Sheet 1.) The springs resting upon the supplemental cylinder are connected with those resting upon the primary, and may be regarded as the same: this is with the exception of the exterior springs, which rest upon the primary only. The metallic surfaces upon the supplemental cylinder are separate rings, of width to embrace the terminals of each pair of springs. These rings are not entire, but are broken at one point. The width of this break, and its position on the shaft relative to the breaks of the other wheels, are such that—both cylinders revolving—when any pair of springs has reached the metallic surfaces connecting them, respectively, with the two exterior springs, then the two corresponding or connected springs shall reach the break, and thus become disconnected with each other; but they will again come in contact with the ring before their other ends or connected parts shall have broken connection with the exterior springs resting on terminal rings of primary cylinder.

Instrument *a* consists of a series of relay-magnets, corresponding in number to the number of transmitting-circuits. These are so arranged that the axes of their several armature-levers have a common metallic connection, and their moving ends retract to a common metallic connection. Hence if these two metallic connections be placed in an electric circuit it will follow that if all the magnet-circuits be closed then this local circuit will be open. But if any one of the magnet-circuits opens, its armature-lever will fall back and close the local circuit. The battery *c*, which, for convenience, may be called the alarm-battery, has its respective poles connected with exterior springs of each of the three instruments *h k f*. As the connection of these exterior or battery springs with their respective instruments has already been described, it will be observed that the normal condition of this battery is an open circuit, and is closed for an instant only, as one or another of the several cylinders may for that instant direct its entire force to the desired circuit. The process of directing the force of single-battery series, or parts of series, through different circuits by means of revolving circuit-breakers or pole-changers, has long been in use. The novelty in this case consists in the combination of several independent mechanical devices, each actuated by separate and independent electro or mechanical starting and controlling devices, yet each in such relation with the other that their several operations must be in harmony. The several batteries *b b b b*, arranged in one row near instrument K, may be called the several "main" batteries, and they are connected in the several signal-circuits B B B B. The normal condition of these circuits is closed. There are also represented three more separate batteries, marked *b b b*, and these are, respectively, the batteries of local circuits *h*, *k*, and *g*, which embrace the several starting-magnets of the instruments *d e f*.

The position of these several parts being understood, I will proceed to explain the connection of the apparatus with the several circuits, and, for convenience, I will separately trace the connections of the signal, gong, and great-bell circuits represented in the upper right-hand corner of drawing, Sheet 2. One end of circuit B connects with one of a pair of springs of instrument *e*, which (the instrument being at rest) is itself connected with the other spring of same pair, because their two ends rest upon the metal ring described. From this latter spring connection passes to main battery *b*, thence to relay-magnet in machine *a*, thence out to other end of circuit. Hence the normal condition of this circuit and of each other similar circuit is closed, and its relay-magnet holds its armature-lever, and local circuit *g* will be open. But if a signal-box in this (or any other similar circuit) be operated for each complete electro-impulse sent, it being thus transmitted through local circuit *g*, machine *f* will cause one complete revolution of its circuit-closing cylinder. The two ends of gong-circuit C are directly connected with a pair of springs resting on cylinder of machine *f*. Hence every revolution of said cylinder sends one flash of alarm-battery *c* through the said circuit C and all similar circuits. Local circuit *h* connects starting-magnet of machine *d* with the platina brush and anvil of machine *f*. (Sheet 1, Fig. 1, P and Q.) Hence the passage of a punch-hole between P and Q causes a single complete revolution of cylinder of machine *d*. Circuit D terminates in pair of springs resting thereon, and therefore each revolution sends flash of alarm-battery *c* over all circuits D. Local circuit K is connected with a device belonging to machine *f*, not yet explained. Referring to Sheet 1, Fig. 3, it will be observed that when the sliding bar Y is at rest its insulated end rests upon a spring, Z, and breaks connection between the metallic contacts *e f*. But if bar Y be moved to left the points *e f* will close.

It has also been explained that if bar Y be carried to left by legitimate operation of machine it will not return to its normal position, so as to open contact of *e* and *f*, until an interval of time longer than the interval occurring between any two signals in the same round of repeated signals.

Also, it has been explained that a complete electric impulse is required to operate these starting-machines—that is, a circuit must be opened and again closed, or reversely closed and again opened, to cause the machine to operate. Therefore (again referring to Sheet 2) the local circuit K will cause machine *c* to operate only after a complete round of signals has been received. This will cause a single revolution of the cylinder of machine *c*. Its connection with B circuits and alarm-battery having been fully explained, it is obvious that the effect will be to augment the force of each main battery by introducing for an instant therein the whole or any desired portion of the alarm-battery without meanwhile opening the circuit or diminishing the attractive force of any magnets placed in such circuits during this operation. Hence the armature-levers of distant magnets placed in circuits connected with this machine may be permitted to fall back, upon the opening of circuit, to such distance that the magnet, influenced by its normal battery, has no effective power over it; but the operation of this machine will so far increase the magneto force as to draw the armature-bar back to the position where the normal battery is fully competent to retain it. This is applicable not only to causing devices for what is termed "non-interference" at remote stations to operate, but also to many other devices, for various purposes, to act at intervals other than those indicated by this, or any other station operating upon this, without the use of other wires, magnets, &c. For instance, in any combinations whatever of sending or receiving stations this combination might be desired, station 36 may be required to repeat the number 36, and during its operation receive a different number, 13. It is evident that these operations could be performed without in the least interfering with the results to be accomplished by the initial station. Or, an initial machine may be required to perform any work at a distant station other than in the direct transmission of a numerical signal; and it may be desired that it should record in itself step by step the work it has actually accomplished, to be telegraphed back from the other end, and not simply what it ought to have done by so many revolutions or evolutions.

When this principle is applied to non-interference devices in systems of remote signal-stations, by allowing the falling back of an armature-bar to a distance beyond the power of its magnet, influenced by its normal battery only to recover it, to render all boxes or stations thereby affected incompetent to be operated, it has been shown that this apparatus will at the desired moment restore all these stations to their normal condition, though these stations be distributed upon any number of separate and distinct circuits converging at any one point.

It remains, then, to add that, in order that this should be fully applicable to effecting complete non-interference in the system of lines and circuits I have described and represented on Sheet 2, I must cause the break which occurs on the primary signal-circuit to be repeated on all the other signal-circuits. It is obvious that this could readily be accomplished in the arrangement of the relay-magnets, or in the primary circuit-closing machine, by adding another cylinder; but I have not deemed it expedient to add to the confusion of my drawings or to the length of these specifications of any one of the many devices that may be employed.

It would be preferable that the first break only should be repeated to other signal-circuits, and that these circuits should then remain closed circuits unaffected by the succeeding breaks occurring on the signal-sending circuit.

This may be thus accomplished: The armature-bars of the several relays may be held suspended each by its own magnet where their contacts mutually close each other's circuits. The breaking of any one of these circuits will cause all circuits to break, and all the bars will fall to another contact-bar when the contacts are arranged to close each circuit independently of the others. Hence they will not receive any impulses from the working circuit. When, after the close of a round of signals, the machine *e*, Sheet 2, operates, the lower bar may be caused to be mechanically raised, so as to restore all the armature-bars to their original positions without meanwhile unclosing circuits.

As this, however, is not to be made the subject of the present claims, but may be embodied in a future application, I have not more particularly described this, as it only seemed necessary to show that "non-interference" on many separate circuits could be attained in the system I have described.

In the above-described system I do not claim any device "to break each circuit from the one first broken, and to mechanically close each circuit, though the one first broken may remain open." (Patent 104,357, of 1870.)

I do not claim the locking in or out of circuit the break-circuit wheel by any magnetic device. (Patent 113,649, of 1871.)

It is evident that, for the purposes of this invention, instead of several series of batteries, divided or split batteries, part in operation at one time, and more in operation at another, may be used; or that the electro-motive force of any circuit may also be varied by cutting in or out, at desired times, a resistance or resistances.

I do not claim, in detail or in combination, any devices wherein a magnet-armature requires any varying adjustment of its length of play or retractile force, as different results, when or where required, are produced by varying electro-motive force applied to respective circuits; but

I do claim—

1. The combination of a prime motor and train, an electro-magnet controlling the same, a revolving cylinder or cylinders causing on rotation a change or changes in the connections of one or more electric circuits, a perforator, and a train of wheels, giving uniform motion to the strip to be perforated, substantially as and for the purposes set forth.

2. The combination of a perforator, two or more sets of devices for removing the perforated strip therefrom, and moving at different rates of speed, and two or more electric circuits controlled by the operation thereof, whereby the signals upon one circuit are repeated over other electric circuits at different rates of speed for different circuits, substantially as and for the purposes set forth.

3. The combination, with a prime motor and train, and an electro-magnet controlling the same, of electric circuits, and two or more insulators or circuit-closers rotated by a prime motor, and throwing into circuit at one period during rotation an extra amount of battery, whereby the electro-motive force in the circuits is increased, substantially as and for the purposes set forth.

4. The combination, with any instruments carrying several sets of motors designed to cause paper or other material whereon impressions have been made to repeat electric impulses over several circuits, at various rates of speed, of a device connected with any other part of a running gear of such instrument, to successively render these several motors inoperative, by removing the pressure of the frictional roller or equivalent at specific periods in such manner that the paper or equivalent will cease to be moved thereby, so soon as the impressed portion has been carried past a fixed point, but that it shall continue to be carried by the succeeding motors, substantially in the manner and for the purpose hereinbefore described.

5. The combination of a rack and pinion, with the supporting-wheels W^1 W^2, having a portion of their periphery cut down to a smaller diameter, and provided with arms for moving the rack in one direction, a connecting lever and pitman connected to one wheel and train, and imparting a rocking movement to the wheels, whereby, upon their movement in one direction, the rack is allowed to drop away from the pinion, but is held to engagement

therewith on their movement in the other direction, substantially as and for the purposes set forth.

6. The combination, with the two independent motive trains, one of which is controlled by an electro-magnet, or a rack and pinion, connected with the trains, and controlling one thereof, whereby the motion of the first causes the release of the second, substantially as and for the purposes set forth.

7. The combination, with two independent motive trains, a rack and pinion connected therewith, and acting to release the second upon the movement of the first, of an extra magnet, and devices operating to allow the continuance of motion of the second train, after the motion of the first train has ceased, substantially as set forth.

8. The combination, with two or more batteries, or divisions or series of batteries, of the automatic circuit closer or breaker, to change the connections of the batteries, and thereby vary the electro-motive force of the circuits, or any of them, substantially as and for the purposes set forth.

STEPHEN CHESTER.

Witnesses:
D. ORMOND FRYE,
A. D. HUNTING.