C. KIRCHHOF.

Magnetic Telegraph.

No. 51,193. Patented Nov. 28, 1865.

Fig. 1.

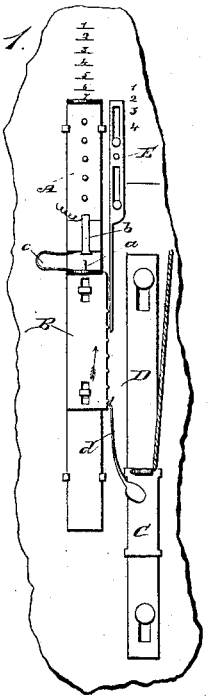


Fig. 2.

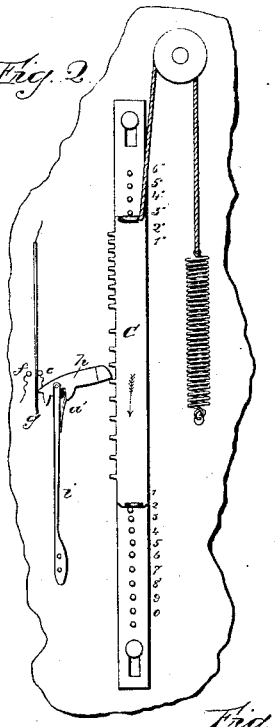


Fig. 3.

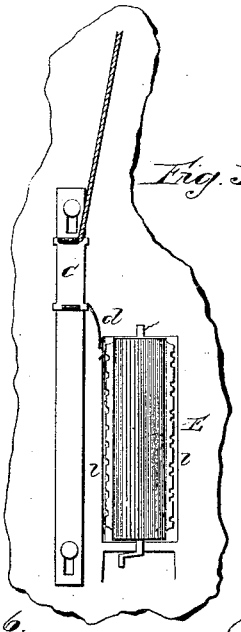


Fig. 4.

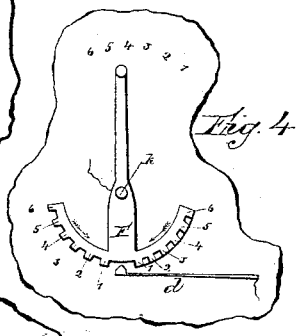


Fig. 5.

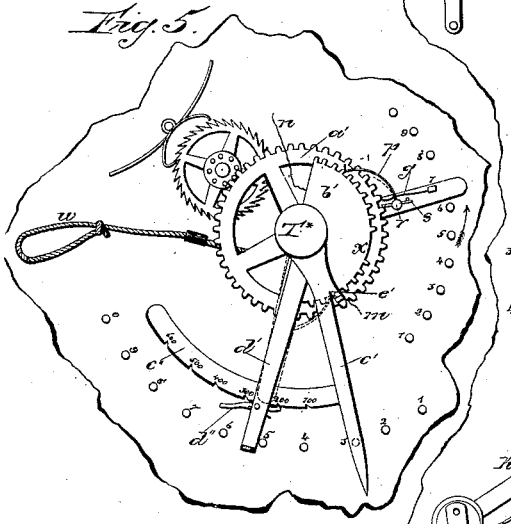
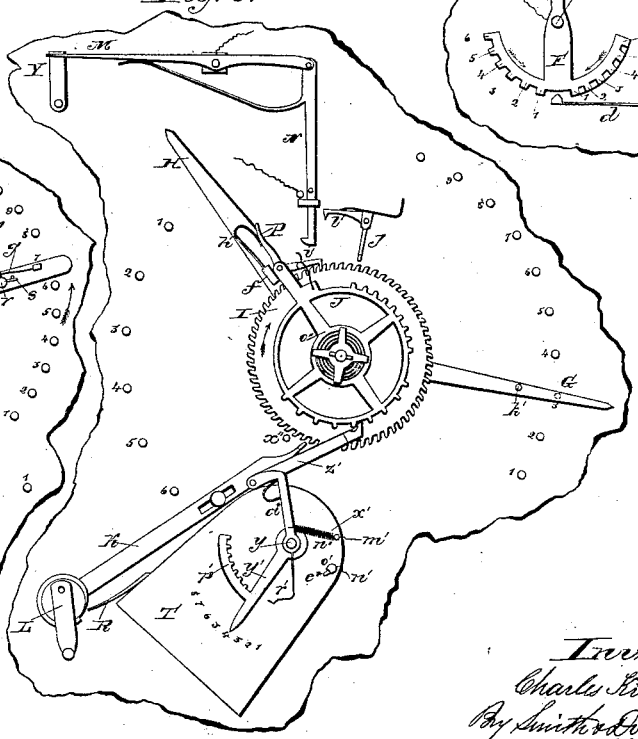


Fig. 6.



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UNITED STATES PATENT OFFICE.

CHARLES KIRCHHOF, OF NEWARK, NEW JERSEY.

IMPROVEMENT IN MAGNETIC TELEGRAPHS.

Specification forming part of Letters Patent No. **51,193**, dated November 28, 1865.

To all whom it may concern:

Be it known that I, CHARLES KIRCHHOF, of the city of Newark, in the county of Essex and State of New Jersey, have invented certain new and useful Improvements in the Art of Telegraphing or Conveying Signals by means of Electricity or Magnetism; and I do hereby declare that the following is a full, clear, and exact description thereof, reference being had to the accompanying drawings, making part of this specification, and to the letters of reference marked thereon.

My invention consists in making the signals entirely by mechanism instead of by the hand of a human operator, as is usually the case.

It also consists in arranging the mechanical operator in such a manner that it shall have imparted to it a to-and-fro motion, in contradistinction to a continuous or forward motion; and, finally, it consists in a variety of devices by which the mechanical operator may be made to transmit a combination of different signals, which combination can be varied at pleasure, whereby the mechanical operator may be made to transmit a great variety of signals and of combinations of signals.

In Figures 1, 2, 3, and 4 are represented what I term the "elements" of my invention, or the "independent operator."

In Fig. 1, A is a plate, to which is permanently secured on an insulated block an anvil, *b*, to which is connected one of the wires. A sliding plate, B, is secured upon plate A in such a manner that the point *a* will come in contact with *b*, and thus complete the circuit whenever the force of spring *c* is overcome by any force applied to B in the direction of the arrow. Another sliding plate, C, is attached to plate D in such a manner as to move to and fro thereon, and has attached to it a spring, *d*, so arranged that as C is moved forward said spring *d* will come in contact with the projecting teeth on the edge of plate B. The end of spring *d* is bent or beveled, as shown, whereby, as it comes in contact with the teeth on plate B, the latter is pushed forward until the point *a* strikes against *b*, whereby the circuit is completed and a signal transmitted. As this occurs the spring *d* slides past the tooth, the spring *c* forcing the plate B back and breaking the contact between *a* and *b*, when the operation is repeated so long as spring *d* continues to come in contact with the teeth on plate B. The number of signals can be regulated either by adjusting plate A or guard E, as shown in the drawings. In this, as in each of the following cases, a reciprocating motion may be imparted to the plate C by any suitable mechanism, whereby it shall be kept moving to and fro along the face of B until stopped by the attendant, it of course continuing to repeat the same signals, unless changed by the adjustment of A or E.

In Fig. 2 the principle is applied by reversing the order of the parts. In this case the movable plate C has the teeth on its edge, and as the plate moves the teeth come in contact with the insulated key *h*. The latter is pressed back, being mounted in a spring-support, *i*, for that purpose, whereby its rear end comes in contact with spring *g* and forces it over against pin *f*, by which the connection or circuit is completed; and as this occurs every time that one of the teeth on C strikes the key *h*, it follows that as many signals will be transmitted as there are teeth coming in contact with said key *h*. The key *h* is pivoted in the end of *i*, and is held against the teeth by the spring *a'*, as shown, so that when C is moved in the direction of the arrow it is caused to operate the spring *g*, and thus communicate signals; but when the motion of C is reversed the key *h* simply oscillates on its pivot, and does not operate *g*. Consequently in this, as in the former case, signals are sent only during the movement of the operator C in one direction.

It will be observed that C, Fig. 2, is provided with two series of teeth, the lower series being located farther apart than are those of the upper series, and also that the two series are separated by a still larger space. By this means two kinds of signals may be sent, the first or lower series representing tens, and the upper, which operate more rapidly in proportion as the teeth are nearer together, representing units, the space between them serving to indicate clearly when one series or kind ends and the other begins; or these may be used in the case of fire-alarm telegraphs, thus one series to represent the number of the district and the other to indicate the number of the station within the district. A series of holes are shown in the plate along which C moves, both at the upper and lower portions

thereof. By placing a pin in these holes the movement of C may be limited as desired, and thus the number of signals sent of either or both series can be regulated at will. In this way signals representing any desired number, from one to ninety-nine, may be transmitted.

In Fig. 3 a sliding plate, C, is used similar to that shown in Fig. 1; but instead of a single plate provided with one or more series of teeth for the contact maker or spring *d* to operate upon, a series of plates of any desired number is substituted, as shown at *l l* of Fig. 3, these plates being attached radially to a cylinder, E. These plates may have their edges provided with a variety of teeth or projections and spaces, each having a uniform kind its entire length. By setting the cylinder E properly the arm *d* may be made to pass along the edge of either plate, and thus transmit either kind of signal, as the plate C, with its arm *d*, passes either up or down, care being taken to rotate the cylinder as soon as the arm *d* has reached the end of the plate *l*, so that as the arm *d* returns to its starting-point its contact end will pass along the unoccupied portion of cylinder E, whereby it is prevented from operating during its return movement. By this means the number and variety of combinations of signals transmitted may be increased to an almost indefinite extent, depending upon the number and variety of plates used upon the cylinder E.

In all the preceding instances the movements of the contact-maker have been rectilinear; but in Fig. 4 a device is shown having a curvilinear movement for accomplishing the same object. It consists of a segment, F, pivoted at *k*, and provided with two sets of contact points or projections, similar to those on plate C of Fig. 2, and answering the same purpose. In this case, however, the contacts are made during both the to and fro motions of segment F, the latter being so pivoted that it can be oscillated or vibrated on its pivot *k* far enough to bring each of the projections 1 2 3, &c., on either side of the central space in contact with the contact-maker *d*. By moving the segment in the direction indicated by the red arrow the projections on the left—and which may be supposed to represent units—will be brought in contact with *d* to any desired number, which number will of course be duplicated by the return of F to its original position. If, now, it be desired to transmit one or more units in addition to the tens already sent, the segment will be moved in the direction of the arrow in black, by which one or more of the projections on the right of the open space will be brought in contact with *d*, which, as in the former instance, will be duplicated by the return of F to its former position. If an even number of either tens or units be desired, the segment will be moved so as to cause the projections to pass entirely clear of the point of *d*, after which it will touch the same projections on its return, and thus the number will always be even. To illustrate, by passing the projection 1 (of either series) past the point of *d*, stopping it so that the point of *d* shall rest clear of both 1 and 2, and then returning it past 1 again, we have the number 2, or two signals. To give the number 4, F is so moved as to pass two of the projections over *d* and then return, and so on of any larger even number. If it be desired to transmit signals for an odd number, then the segment will be so moved as that at the instant that it ceases its forward and begins its return movement the point of *d* will remain in contact with the projection which shall have arrived opposite it. To illustrate, if we desire to send the number 1, F must be moved just far enough to bring *d* in contact with projection 1, but not to pass by it. Now, by reversing the movement of F before the contact with 1 has been broken, it follows that but a single signal can be sent which will answer to the number 1, either of units or tens, according as F is moved to one or the other side. By simply reversing the movement of F at the instant that *d* is in contact with any one of the projections 1 2 3, &c., an odd number will always be given.

It is obvious that in all the cases herein mentioned, and whichever of these modifications are used, the number and variety of combinations of signals may be indefinitely increased by simply adding to the series of projections, which I denominate the "design-line." It is only necessary that the series composing the design-line shall be so arranged as to be clearly distinguishable from each other, and this may be accomplished in a great variety of ways—as, for instance, by placing the projections composing the different series on a design-line at different distances apart, those representing units being at a certain distance, those representing tens a greater distance, and those representing hundreds a greater distance still, and so on to any desired extent, the various series being separated by a space differing from those used between the single projections of any one series, so as to mark clearly the distinction between the various series; or units may be represented by a series composed of single signals, tens by duplicate signals, hundreds by triplicate signals, &c., to any desired extent.

Having thus described the elements or principle of my invention, I will now proceed to describe a working machine in which these principles are applied, as shown in Fig. 5. This machine consists, first, of a metallic post or stud, T*, attached rigidly to any suitable surface, and which post has leading to it the wire *m*. Upon this post is pivoted loosely the arm *o*, a coiled spring connecting the post and arm *o* in such a manner as to move the arm in the direction indicated by the arrow. Over the arm *o* is placed the wheel *a'*, working loosely on the post and gearing into the ratchet-wheel, as shown, to which is attached an escapement to regulate the motion. Above the wheel *a'* is mounted the disk or segmental plate *b'*, which is made stationary on the post and insulated therefrom by having a hub composed of some

non-conducting substance, which hub protrudes above and below the face of b', so as to prevent the current from passing to it from any of the other parts. Two arms, c' and d', are then pivoted loosely on the post above the disk b', one of them, c', being provided with a segmental arm, c'', having notches in its edge, as shown, for the purpose of securing d' thereto at any desired point, a spring-catch, d'', serving to hold it in place wherever set. From the arm c' a small arm, e, projects, which is bent down past the edge of plate b', but not in contact therewith. Upon the arm o is pivoted, at r, a contact-maker, p, which is pressed forward by a spring, q. A small bar, s, is secured to the bolt r in such a manner that when the contact-maker p is thrown forward against the projections forming the design-line on the periphery of b' the inner end of s shall rest in the space between two of the teeth on wheel a', as shown. A cord, w, is attached to arm o in such a manner that when it is pulled the arm o will be drawn back until it strikes a stop on the under side of arm d', (shown in dotted lines,) which movement winds up the spring.

The operation is as follows: The cord being pulled draws back the arm o. As the arm o begins to move the inner end of bar s hits against the tooth of wheel a', by which bolt r is partially rotated, thus throwing the contact-maker p clear from the projections on plate b'. This movement is continued until the arm o is brought against the stop attached to arm d', when the cord w is released. The instant that w is released the spring begins to move o in the direction indicated by the arrow, the spring q pressing the contact-maker against the projections on b', and of course transmitting an impulse or signal each time it hits a projection. Supposing the index-arms c' and d' to be set as shown in the drawings, then p will strike one tooth or projection before it reaches the breaker e, and as in passing e it is kept from making any connection with the projections, it follows that there will be an interval or space separating the signal already sent from those coming after. The one signals thus sent may represent hundreds. After passing the breaker e the contact-maker p will strike the next four projections, imparting as many impulses, which may represent tens. It then passes the space x, where there are no projections, which of course creates another interval, serving to separate or distinguish the signals representing tens from those yet to follow, which will of course represent units. The arm o continuing to advance until arrested by a pin, z, inserted in any one of the series of holes, (in the drawings shown to be in number seven,) the contact-maker p strikes seven of the projections, and of course transmitting seven signals representing units, thus indicating the number seven; and thus it will be seen that the instrument has automatically sent signals representing the number 147, and that as often as the cord w is pulled the same signal will be repeated. As the arms c' d' and pin z may be adjusted as desired, it follows that any number, from 1 to 999, may be thus transmitted at each movement of the arm o. It is also obvious that by adding more arms like c', with its contact-breaker e', and increasing the number of projections on plate b', the capacity of the machine may be extended indefinitely.

In Fig. 5 the design-line was stationary; but Fig. 6 illustrates another machine for the same purpose, in which the design-line is made movable. In this case one wire, n', is connected to the stationary stud o' and the other to the stationary pin x', the connection being made by the contact-maker r', attached to the movable arm a^*, which is pivoted at y, as is also the arm y', which is provided with the segmental projecting arm p', having a series of projections along its inner edge, which in this case are made to represent hundreds. A coiled spring, n'', serves to convey the current from pin x' to arms a^* and y', and also r', and at the same time to draw the insulated pawl z' to the right, as hereinafter explained.

Upon a stud or fixed journal are mounted the arms G and H, which are movable and can be adjusted as desired by means of a pin projecting from their under surfaces and fitting into any of the series of holes 1 2 3, &c. Above these arms, on the same journal, is mounted the toothed wheel I, and above that the wheel J, provided on its periphery with the two series of projections, as shown, and which are arranged in two separate series, the same as on plate C of Fig. 2, one series representing tens and the other units. Thus the design-line in this case is composed of the two series of projections on wheel J and a third series on arm p'. A coiled spring, o'', is connected at one end to wheel J and at its opposite end to the stud or journal on which said wheel is mounted. A catch or dog, P, pivoted to an arm projecting from the wheel J, is so arranged as to catch in the teeth of wheel I, by which means as the latter is moved by the pawl K, operated by the eccentric L, the wheels I and J are caused to move together in the direction indicated by the arrow. A small spring, i', pressing against a shoulder on the dog P, serves to keep the dog in position, either in or out of the teeth of wheel I, according as it may be set.

The operation is as follows: Suppose we desire to transmit the number 423. The arm y' is set so that its index-point shall be opposite the number 4 on board T. Arm H is set at number 2 of its series, and arm G at number 3 of its series, all except H being shown thus set in Fig. 6. Motion being given to wheel I by the pawl K it moves forward, carrying wheel J with it, which forces the pawl z' back and causes the contact-maker r' to sweep along the face of arm p', touching four of the projections thereon, by which four signals are sent, the current passing from r' through p' y' and plate e^* to wire n'. The motion of wheels I and J being continued forces the pawl z' backward until it comes in contact with pin x'', at which time r' will have been swung round to the right, so as to come in contact with stud o' as each pro-

jection on wheel J slips past the beveled end of z', the latter being prevented from moving farther to the left by the pin x''. In this way two of the first series of projections will slip past the pawl z', making two contacts of r' with o', and of course sending two signals representing tens. The motion of the wheels being continued brings the next series of projections past the pawl z', each one making a contact as it passes between r' and o', a signal being sent at each contact. By the time three signals have been thus sent the dog P comes in contact with pin k' on arm G, by which the dog is tripped and made to release its hold on wheel I, when the sping o'' immediately returns wheel J to its original position, the wheel J being prevented from going beyond the point from which it started by the projection f on arm H, a spring, h', serving at the same time to throw the dog P forward, so as to engage in the teeth of wheel I again, ready for repeating the operation. A spring, R, is so arranged as to prevent the eccentric L from being so turned as to rotate the wheel I backward, a similar spring-pawl being applied to the wheel itself for the same purpose.

It is obvious that by adding to the number of wheels J and arranging them so as to be successively and automatically set in motion a far greater capacity may be given to the machine. Suppose another wheel J to be added, which shall be held in position by an arm projecting so as to be caught by the hook on lever l'. Lever j is connected to l' in such a manner that it will yield as hit by the pivot of dog P, which protrudes for that purpose, when the wheel moves in the direction of the arrow, and thus let the arm of J pass without unlocking the duplicate wheel J; but when the dog P returns in the backward movement of the wheels, then the projecting pivot of P strikes against the opposite side of j and raises the lever-catch l', whereby the duplicate wheel J is unlocked, and that then transmits its signals in addition to those already sent by the other parts.

If it be desired not to repeat the signals and still continue the motion of the driving mechanism, it is only necessary to relieve the lever M by removing the catch Y, which will cause the stop N to drop down far enough to arrest the return of wheel J by having the pivot of P strike against the right-hand side of N, near its lower end, the end of N being beveled, as shown, to permit the wheel J to pass by it when moving forward without obstruction, the pivot of P as it comes in contact with the beveled end of N gently pressing N back for that purpose.

Having thus described my invention and several modes of applying it, what I claim, and desire to secure by Letters Patent, is—

1. An independent mechanical operator having a to-and-fro motion, in contradistinction to a continuous motion in one direction, when said operator is so arranged as to close and break the circuit while passing in one direction only, and this I claim, whether the design-line be stationary and the contact-maker movable, or the reverse, or both are made movable, substantially as described.

2. So arranging the design-line, or a series of them, in combination with a contact-maker that by their combined action, as herein described, additions, combinations, or variations of the single signals may be produced at pleasure by the use of a mechanical operator, as set forth.

3. Limiting the to-and-fro movement of the operating parts by means of the slides, stops, and pointers, whereby I am enabled to regulate the number of signals sent, as may be desired.

4. In combination with the mechanical operator, the use of the adjustable contact-breaker e', for the purpose of creating an interval or space between the various series of signals sent, whereby one series may be distinguished from another.

5. Two or more independent mechanical operators, when arranged to operate successively, substantially as described.

6. So arranging two or more mechanical operators that as one ceases to operate it shall release or set in operation another, whereby a compound telegram may be produced, substantially as described, and as illustrated in Fig. 6.

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