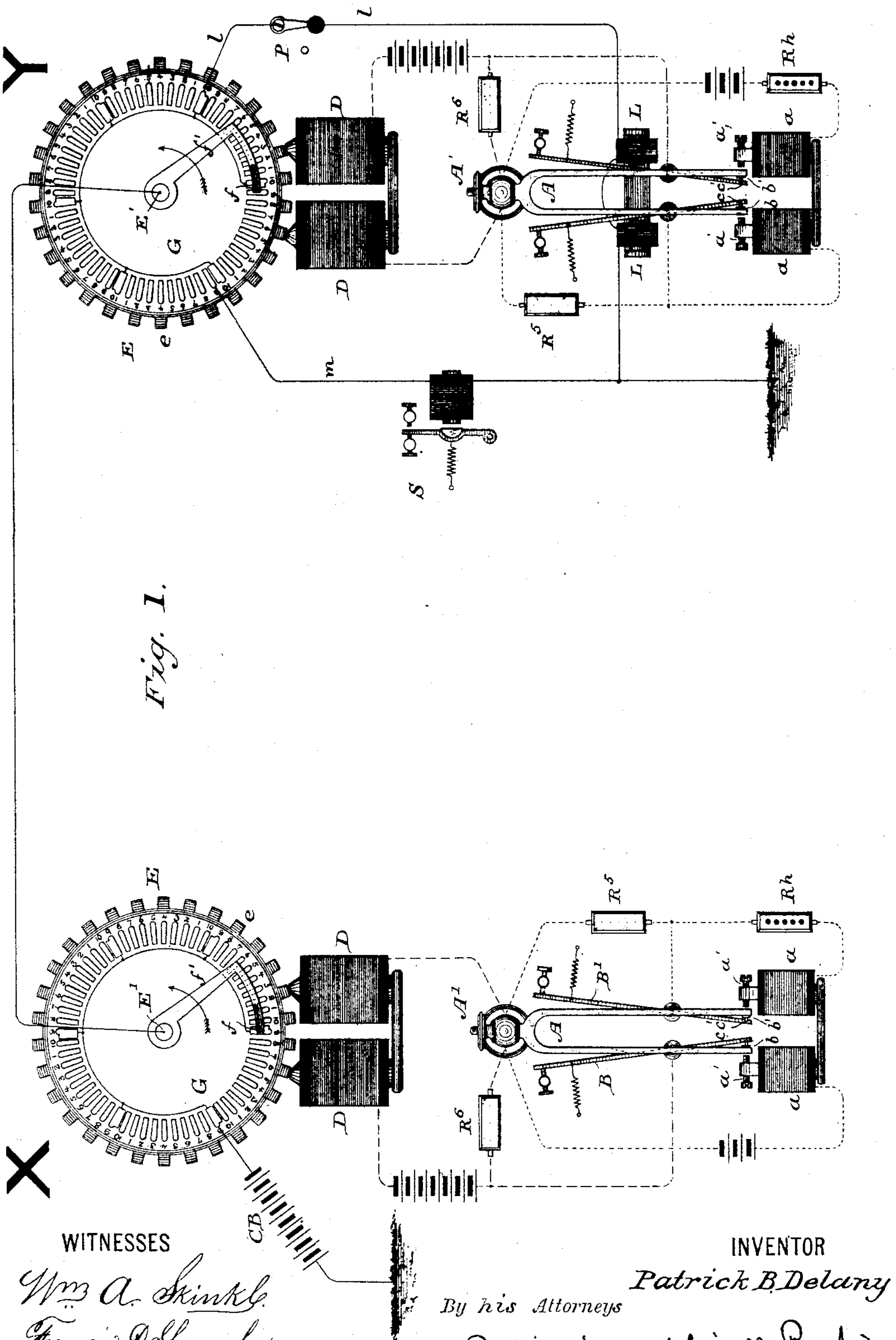
(No Model.) 2 Sheets—Sheet 1.

P. B. DELANY.

ELECTRICAL SYNCHRONOUS MOVEMENT.

No. 286,276. Patented Oct. 9, 1883.



WITNESSES

Wm A. Skinkle

Francis D. Shoemaker

INVENTOR

Patrick B. Delany

By his Attorneys

Baldwin Hopkins & Peyton

N. PETERS, Photo-Lithographer, Washington, D. C.

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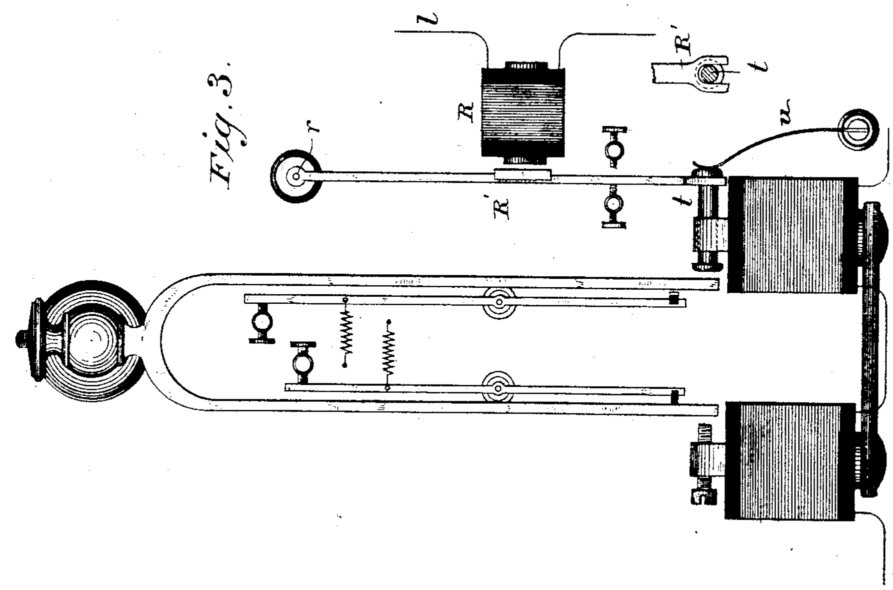
Fig. 3.



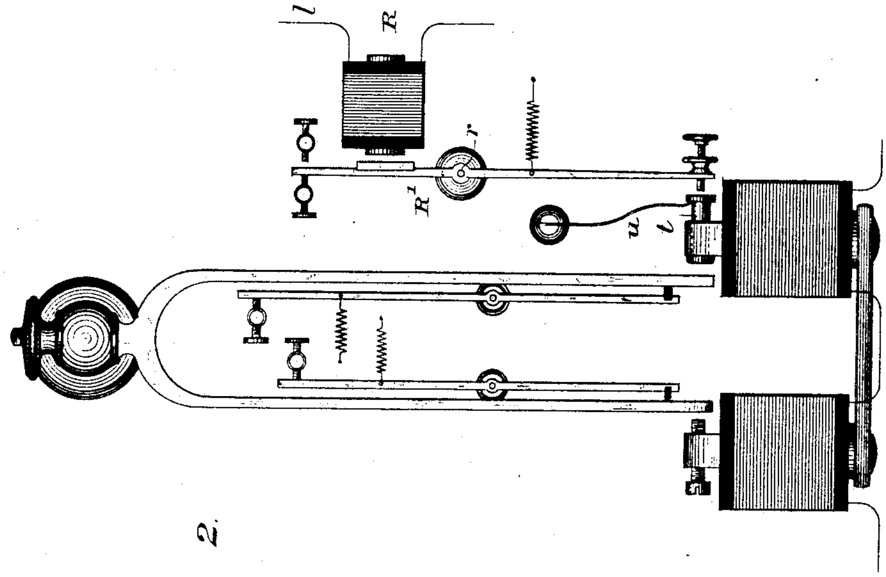


Fig. 2.

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UNITED STATES PATENT OFFICE.

PATRICK B. DELANY, OF NEW YORK, N. Y., ASSIGNOR TO THE STANDARD ELECTRIC MANUFACTURING COMPANY, OF SAME PLACE.

ELECTRICAL SYNCHRONOUS MOVEMENT.

SPECIFICATION forming part of Letters Patent No. 286,276, dated October 9, 1883.

Application filed April 12, 1883. (No model.)

To all whom it may concern:

Be it known that I, PATRICK B. DELANY, a citizen of the United States, and a resident of the city, county, and State of New York, have invented certain new and useful Improvements in Electrical Synchronous Movements, of which the following is a specification.

The object of my invention is to insure the exact, equal, and like movements of apparatus widely removed and connected by an electric circuit. Such apparatus is capable of various applications in the field of telegraphy and elsewhere where the successful operation of a system, whatever it be, is dependent upon the synchronous movement of apparatus at different stations.

My invention consists in an improved organization by which the parts are brought into synchronous movement, and are maintained so by electrical impulses transmitted over the line from one station to correct the movement of the apparatus at the other station when it moves out of time with that at the first station.

In another application for Letters Patent filed of even date herewith, and numbered 91,490, I have shown an organization for controlling the movement of the apparatus from one station operating somewhat like that herein described, except in the present case I employ a different arrangement of contacts and use but one controlling or regulating magnet, as will hereinafter be described.

My present invention also includes improved means for controlling the apparatus.

In the accompanying drawings, Figure 1 is a diagrammatic plan view illustrating the organization at two stations, X and Y; Fig. 2 is a detail view, showing a different construction; and Fig. 3 is a similar view of a modified construction.

In an application filed of even date herewith for improvements in telegraphy, serially numbered 91,493, I have shown and described an organization of apparatus in which vibrating forks actuated by local vibrator-circuits, motor-circuits and motor-magnets, and toothed armature-disks, substantially like those herein shown, are employed. In the present case, as in the case referred to, the rotary armature-disk E, actuated by the motor-magnets, is fast on and imparts motion to the vertical shaft E′, which is connected with the main line, and carries the trailing finger or circuit-completer, which travels over the series of contacts arranged on a stationary circular table, G, of insulated contacts, placed concentrically around said shaft.

I have shown and prefer to employ vibrating forks tuned as nearly as possible to the same pitch, so as to possess the same normal rates of vibration. It is not necessary, however, that tuned forks should be used, or that forks at all should be used, as a vibrator of any description, actuated either by the action of electro-magnets or by electrically-controlled apparatus, may be employed, as fully set forth in the application for improvements in telegraphy above mentioned.

In the accompanying drawings I have shown at each station a vibrating fork, A, mounted at its base in a suitably-insulated support, A′. The tines of the forks are automatically kept in vibration, when once started, by a local circuit, (indicated by small dotted lines,) in which the vibrator-magnets *a a* are placed. The poles of these magnets are arranged upon the outsides of the tines of the forks, and may be provided with suitable screw pole extension-pieces, *a*′, which may be approached to or withdrawn from the tines of the fork, in order to regulate the influence of the magnets thereon and the consequent rate of vibration of the fork. I prefer to regulate the rate of vibration of the forks, however, by means of an adjustable rheostat, Rh, placed in the direct fork-circuit. By varying the resistance of the circuits the power of the vibrator-magnets will be increased or decreased, and there will be a consequent increment and decrement of the vibration of the forks. I prefer this means of regulating the forks, for the reason that the resistance may be placed at a distance from the fork and on a different base board or stand. When the hand is placed upon the screw pole pieces to adjust them, the apparatus is so sensitive that the mere taking hold of the screw makes more or less of a disturbance in the vibrations. Where an adjustable resistance is used, however, this difficulty is obviated.

On the inside of the forks, preferably near their ends, are placed platinum contact-pieces b b', which make and break contact at each vibration with very delicate platinum contact springs or fingers c c', which project from pivoted insulated arms or levers B B', the positions of which levers are regulated by thumb-screws b^2, against which they are normally drawn by coil-springs. The local circuit which vibrates the tines of the fork is made and broken between the platinum contacts b' c', as is well understood, and the circuit, as above mentioned, may be traced by the small dotted line. In order to prevent sparks between the platinum contacts b' c', I throw a shunt, in which a resistance, R^5, is placed around these points. The opposite tine of the fork, at each vibration, makes and breaks contact between the platinum contacts b c, and thereby makes and breaks the motor-circuit indicated by the broken lines. These contacts are also shunted by a resistance, R^6, to prevent sparks. The makes and breaks in the motor-circuit magnetize and demagnetize the coils of the magnets D D, and the alternate attractions and cessations of attraction upon the armature-teeth e of the rotating armature-disk E cause that disk to rotate continuously and evenly and carry round the trailing finger or circuit-completer, which moves over the insulated contact on the table of contacts G.

The forks at the two stations are, as above remarked, as nearly as possible of the same pitch, so that the normal rate of vibration will be about the same; but by adjusting the rheostat Rh the speed of vibration may be so accurately adjusted that the two forks may be brought to vibrate at approximately the same speed, and each fork is vibrated by its own independent local circuit. It is practically impossible, however, to so accurately adjust the rheostat as to insure absolute synchronous vibration. The slightest variation, however small, if continuous, will, as is obvious, ultimately carry one of the rotating apparatus so far ahead of the other as to destroy their proper relative movement.

The above description of the transmission apparatus E E' f G will be sufficient to enable any one skilled in such matters to construct an instrument fulfilling the necessary conditions. The apparatus is, however, fully illustrated and described in detail in the application for improvements in telegraphy above referred to.

On the stationary tables of contacts I have shown sixty insulated contact-stops; but of course the operation is not dependent upon any exact number. These contacts are numbered in six separate series, from 1 to 10. The 9's and 10's on each of the tables are devoted to maintaining the synchronous movement of the apparatus, as is hereinafter described. The other eight contacts in each series may be devoted to the transmission of impulses of electricity for any purpose for which they may be desired, as will now be described. The 1's and 5's of each series may be electrically connected together, the 2's and the 6's similarly connected, the 3's and the 7's, and the 4's and the 8's, and these independently-connected series may be connected with independent apparatus for any suitable purpose at each station.

It will be obvious that, if the trailing fingers f at each station move together so accurately that they will be on correspondingly-numbered contacts at the same time, an electric circuit will be completed through the contact at one station, the trailing finger f, radial arm f', vertical rotating shaft E', main line to the opposite station, and correspondingly-numbered contact through the trailing finger f. If these contacts are therefore connected up with telegraphic or other apparatus in circuit with a battery, of course an electrical impulse will pass over the line through these two contacts once in each revolution of the trailing finger—that is, at that point in the revolution when the two trailing fingers f at both stations are on the contact. The spaces covered by the contacts 1, 2, 3, 4, 5, 6, 7, and 8 may of course be differently divided and connected.

As above mentioned, the contacts on the stationary table, with the exception of the 9's and 10's, are connected in four independent series, two contacts in each of the six sets of contacts being given to each of the four independent series. The instruments or apparatus, therefore, which may be connected with the independent series of connected contacts, will each receive twelve impulses of electricity for each revolution of the trailing finger. If, therefore, the forks vibrate at the rate of eighty-five per second, and make and break the motor-circuit that number of times per second, and there are thirty teeth in the rotating armature-disk, that disk will be rotated nearly three times per second, and the line will therefore be given to each of the four independent series of connected contacts thirty-four times per second. The circuit and current will be, therefore, for practical purposes, constant and entirely independent for each pair of corresponding instruments. At station X the 10 contacts are thrown out and not connected with any circuit or contacts. The 9's are, however, all electrically connected to each other, as will be plain upon an inspection of the drawings, and to the correcting-battery C B. The 9's at station Y are thrown out or unconnected, with the exception of one of them, which is made use of for a particular purpose presently described, while the 10's are electrically connected to each other and to a wire, l, which passes through the coils or the poles of the deterring-magnet L L, the poles of which are placed outside the tines of the forks, and from thence to ground.

The single 9 above referred to is connected to a wire, *m*, which passes to ground through the helix of a sounder, S. As there are six 10's in the circle of contacts, it is possible for six retarding impulses to be received over the line, as will be described, for each revolution of the trailing finger *f*.

It will be observed that the connected 9's which are in communication with the correcting-battery C B are built out or extended toward the adjoining unconnected 10's, and that at station Y the 10's which are connected to each other and with the deterring-magnet L L are built out or extended toward the adjoining unconnected 9's. Assuming that both of the trailing fingers are moving synchronously, it will be obvious that when the fingers at stations X Y rest upon the 9 contacts no current of electricity can be on the line, except when the finger at Y is on the 9 which is connected with the sounder S. Then the sounder, which is preferably muffled to reduce the sound, will tick once in each revolution of the finger *f*, and the operator will know that the apparatus is running properly, and the retarding-magnets will not be affected. If, however, while the finger at station X is on an extended 9, which is connected with the battery C B, the finger at station Y should move a trifle faster, so as to strike the side of the extended 10 at that station before the tongue at station X had left the 9. An impulse of electricity would be received from the battery C B through the 9, trailing finger, line, trailing finger at station Y, contact 10, and line *l*, to the deterring magnet L, and the effect would be to retard the vibration of the fork at the station Y.

In practice the apparatus is so adjusted that the rotating armature-disk at station Y moves slightly faster than that at station X; but any excess of movement or acceleration is constantly and at once retarded by the six retarding-contacts. As the connected 9's at station X are built out or extended toward the 10's, the contact of the trailing finger *f* at this station will be prolonged, so as to give a greater period of time within which the correcting-battery will be in circuit on each of the 9 contacts. On the other hand, at station Y the unconnected 9's are of the regular size, while the connected 10's are built out toward the 9's, so that contact of the trailing finger *f*, after leaving a 9, is made much quicker with the extended 10's, which are connected with the deterring-magnet, than when the circuit is completed with any of the other contacts after it has been broken. The result of this prolongation of contact at X and the quickening of the contact with the 10's at Y is that if there is the slightest variation of speed, however small, a retarding impulse will be sent through the magnet L. As the fork at Y is made to vibrate synchronously with the fork at X by deterring impulses only, the vibrator at Y is, as above mentioned, adjusted to vibrate more rapidly than the vibrator at X, and this acceleration is constantly overcome by the constantly-recurring automatic retardations, which, as the fingers rotate two and five-sixths times per second, may be sent into the line at the rate of seventeen impulses per second. The poles of the vibrator-magnet being placed on the outside of the tines of the vibrating fork, the tines necessarily vibrate in a magnetic field, which necessarily modifies or imposes a retarding influence on their vibration. Any increase in the intensity, therefore, in this magnetic field has a tendency to retard the vibration of the fork; hence the impulses sent through the magnets L L, which are also placed on the outside of the tines, retard the vibration and the consequent speed of rotation of the armature-disk and trailing finger.

Thus far I have limited the description of the manner of obtaining this retarding action to the use of the auxiliary retarding-magnet L L. The claims, or such of them as relate to this particular feature of the invention, are, however, based upon the improved organization illustrated on a somewhat enlarged scale in Fig. 2, which I will now describe.

The letters corresponding to those used in Fig. 1 indicate like parts, and no repetition of the description is therefore necessary. The line *l*, instead of passing to deterring-magnet L L, as indicated in Fig. 1, passes through the coil of an electro-magnet, R, in front of which an armature, R′, having suitable adjustable front and back stops, vibrates. This armature is pivoted at *r*, and is normally drawn away from the magnet against its back stop by a coiled spring. The vibrator-magnet placed opposite the tine of the fork which makes and breaks the local vibrators, instead of having a screw-extension pole-piece, as illustrated in Fig. 1, is provided with a soft-iron pole-piece, *t*, which slides back and forth to and from the tine of the fork in an aperture or socket in the pole of the magnet, the ends of the pole-piece being enlarged to prevent its withdrawal therefrom. A spring, *u*, normally presses the pole-piece away from the tine of the fork. A thumb-screw on the lower end of the pivoted armature R can be adjusted to rest against the outer end of the loose pole-piece. When the parts are approximately properly adjusted, the further adjustment will be accomplished by a rheostat, as described. Ordinarily, when the magnet R is neutral, the coil-spring on the pivoted armature tends to draw the thumb-screw away from the end of the loose pole-piece, which is held away from the tine of the fork by the spring *u*. When a correcting impulse of electricity is, however, received through the line *l*, as above described, the armature-lever is drawn toward the magnet and the loose pole-piece is advanced toward the tine of the fork, thus increasing the strength of the magnetic field and retarding its rate of vibration. Such an apparatus has a much more vigorous effect upon the fork than where the action of a retarding-magnet is applied directly to the tines of the fork, because in the latter case the magnetic field in which the fork vibrates is only increased by the sum of the magnetism of the retarding-magnet; but under the organization shown in Fig. 2 the approach of the pole-piece to the tine of the fork materially increases the strength of the field, because, as is well understood, the attraction of the magnet is equal to the square of its distance.

In an application for patent for synchronous movements filed simultaneously herewith, serially numbered 91,490, I have shown an accelerating-magnet placed between the tines of the fork, and explained that the effect of such a magnet was to oppose and neutralize the outside magnet, thus diminishing the strength of the field and permitting the tines to vibrate more freely, and consequently more rapidly. So in the present case it has been stated that drawing the screw pole-piece away from the fork or adjusting the rheostat made it vibrate more rapidly, the effect being of course to decrease the force of the attraction. When, therefore, it is desired to work the present apparatus with accelerating instead of retarding impulses, the magnet R and armature R' may be arranged to draw the pole-piece away from the vibrator, as shown in Fig. 3.

In starting the rotating armature-disks at both stations, impulses of rotation are imparted to them by means of thumb-screws upon the ends of their vertical shafts, or otherwise, until the speed of rotation coincides with the magnetizing and demagnetizing of the motor-magnets, when the wheels will be picked up by the magnets and continuously rotated, as will be well understood. The speed of vibration of the forks can then be regulated by the rheostat Rh.

In practice the apparatus at station X is started independently of any special adjustment, the adjustment being made at station Y, so as to have the apparatus there run a trifle faster than at station X, as above mentioned.

In connecting up the apparatus the switch P is left open and the fork started into vibration at station Y, the apparatus at station X having previously been started.

If the apparatus happens to start in synchronism, the sounder S will tick, and if the ticking continues for any length of time the operator will adjust the rheostat Rh, so as to tend to increase the rate of vibration of the fork. Then, if the sound begins to die away on the sounder S, he closes the switch P, and the apparatus is in working condition.

If the apparatus does not start in synchronism, there will be no sound at first on the sounder S; but the operator at station Y, by adjusting the rheostat, will cause the fork to vibrate at a speed which, by previous understanding, he will know to be very much greater than that of the fork at the distant station. The finger at Y will therefore gain rapidly on the finger at X, and as they occasionally come into conjunction there will be a stroke on the sounder. Then, by further adjusting the rheostat, the strokes on the sounder will become less frequent, and by continuing the adjustment the fingers will travel together sufficiently long to give a series of ticks on the sounder, and when the ticking on the sounder continues for several seconds or more the switch P is closed and the apparatus is in proper condition, any subsequent variation being corrected automatically as described. If for any reason fewer retarding impulses are desired, some of the connected 9's and 10's may be thrown out or left unconnected. Other variations will doubtless be suggested to skilled persons.

In other applications for patent filed herewith, and numbered 91,489 and 91,490, I have shown similar organizations designed for the same purpose as that herein set forth, in which retarding-magnets as well as accelerating-magnets are employed to correct the speed of the vibrators. The present application is designed to cover peculiarities of organization not found in those cases.

The right to hereafter file any applications for any matter herein described or illustrated, but not fully claimed, is reserved.

Any subjects-matter herein shown or described, but claimed in cases 91,488, 91,489, 91,490, 91,492, or 91,493, filed of even date herewith, or No. 102,928, filed August 6, 1883, are disclaimed herein.

I claim as my invention—

1. The combination of two electrically-connected stations, a vibrator at each station, the motor circuits and magnets, the tables of contacts, the trailing fingers or circuit-completers, the connected correcting-contacts at one station built out or extended toward the adjoining unconnected contacts, the connected contacts at the other station which correspond to the unconnected ones at the first station and are built out or extended toward the adjoining unconnected contacts, which correspond to the connected contacts at the other station, the correcting-battery with which the extended contacts at one station are connected, and the controlling magnet or regulator connected with the extended contacts at the other station.

2. The combination, substantially as set forth, at electrically-connected stations, of tables of correcting-contacts, circuit-completers, the connected correcting-contact at one station extended toward the adjoining unconnected contact, the connected contact at the other station, which corresponds with the unconnected one at the first station, extended toward the adjoining unconnected contact which corresponds with the connected contact at the other station, a correcting-battery with which the extended contact at one station is connected, and from which correcting impulses are sent into the line through said contact, and devices connected with the extended cor-

recting-contact at the other station for correcting the speed of the apparatus.

3. The combination, substantially as set forth, at electrically-connected stations, of independently-actuated vibrators, vibrating mechanism for each vibrator, means for adjusting such mechanism so that a tendency to acceleration may be imparted to the vibrator at one station, with means for automatically retarding the rate of vibration of said vibrator to maintain its synchronous movement with the vibrator at the other station.

4. The combination, substantially as set forth, at electrically-connected stations, of apparatus for making and breaking the main-line circuit at each station, mechanism for continuously actuating or rotating such apparatus, said mechanism at one station being set to run at a slightly-different speed from that at the other, and means for automatically constantly correcting the speed of said actuating mechanism at one station by impulses of electricity received from the distant station to maintain the synchronous movement of the circuit-breaking apparatus at the stations.

5. The combination of the vibrator, the vibrator-magnet, the loose pole-piece which is normally drawn away from the vibrator, and mechanism for automatically moving the pole-piece toward the vibrator to regulate its speed of vibration whenever a correcting impulse of electricity is received over the line.

6. The combination, substantially as set forth, of the vibrator, the vibrator-magnet, its loose pole-piece, the pivoted armature-lever, and its controlling-magnet, which is energized by correcting impulses of electricity received over the line.

7. The combination, substantially as set forth, of the vibrator, the vibrator-magnet, its loose pole-piece, means for holding it in its normal position, an electric circuit, and mechanism for automatically moving the pole-piece relatively to the vibrator whenever a correcting impulse of electricity is received over the circuit.

8. The combination, substantially as set forth, at electrically-connected stations, of synchronously-moving apparatus, mechanism for transmitting correcting impulses of electricity from one station to the other, and means for correcting the movement of the apparatus at the latter station whenever a correcting impulse is received by changing the position of a controlling magnet-pole.

9. The combination, substantially as set forth, of synchronously-moving apparatus, the vibrator, its local circuit, battery, and magnet, which actuate such apparatus, and an adjustable rheostat in the local circuit for regulating the rate of vibration of the vibrator and the consequent speed of the synchronously-moving apparatus.

10. The combination, substantially as set forth, of the vibrating fork, its local circuit, battery, and vibrator-magnet, the adjustable pole-pieces on the poles of the vibrator-magnet, and an adjustable rheostat in the local circuit.

11. The combination, substantially as set forth, of an electro-magnet, its circuit, a circuit-breaker actuated by said magnet, a second circuit, which is made and broken by the circuit-breaker, apparatus actuated thereby, and an adjustable resistance in the circuit which actuates the circuit-breaker, whereby the speed of the driven apparatus may be varied.

In testimony whereof I have hereunto subscribed my name this 3d day of April, A. D. 1883.

PATRICK B. DELANY.

Witnesses:

EDWD. A. CALAHAN,

H. D. MUNSON.