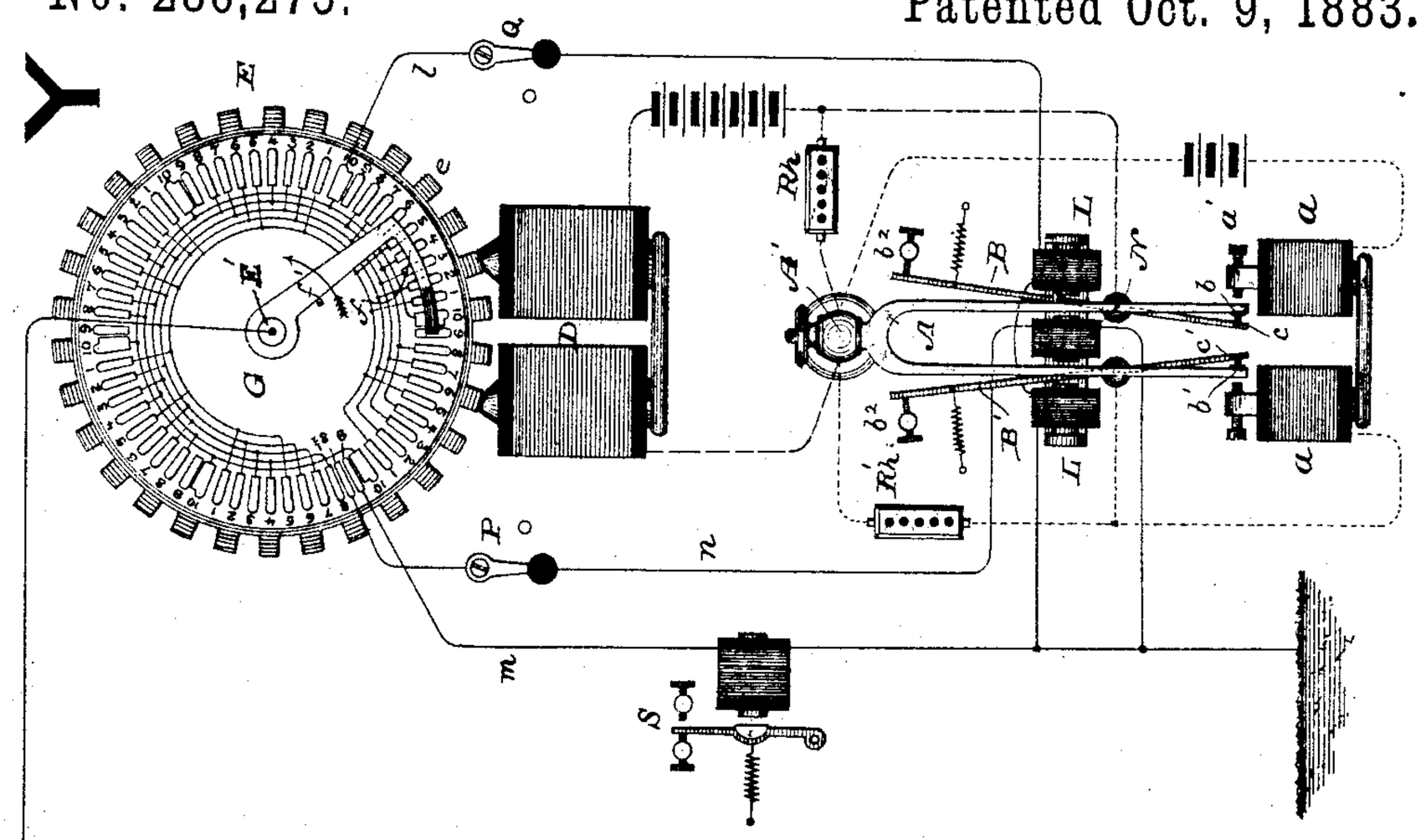
(No Model.)

P. B. DELANY

ELECTRICAL SYNCHRONOUS MOVEMENT.

No. 286,275. Patented Oct. 9, 1883.



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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. 286,275, 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, 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 is applicable to the various purposes for which said movements may be made.

It 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 either of retardation or acceleration, according as the apparatus at one station tends to move faster or slower than the apparatus at the other station.

In other applications for Letters Patent filed of even date herewith, and serially numbered 91,489, 91,491, I have shown other ways of controlling the movement of substantially similar apparatus from one station, as well as reciprocally from two stations. Such applications, however, cover organizations different from that herein set forth, and the claims in this are confined to the peculiarity of structure and operation herein described.

The accompanying drawing is a diagrammatic plan view, illustrating the organization at two stations, X and Y, connected by a main line.

In an application for patent 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 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 *f*, which travels over the series of contacts arranged on a stationary circular table, G, of insulated contacts, placed concentrically around said shaft.

The present invention involves certain differences in the arrangement and connection of the contacts devoted to the correction of the movements and the maintenance of their synchronous action, and also in a different arrangement of correcting-magnets for that purpose.

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 No. 91,489, above referred to.

In the accompanying drawing I have shown at each station a vibrating fork, A, mounted at its base in a suitably-insulated support. 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-magnet *a a* is placed. The poles of this magnet are arranged upon the outsides of the tines of the forks, and are 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 their influence thereon and the consequent rate of vibration of the fork. 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 lines. In order to prevent sparks between the platinum contacts *b' c'*, I throw a shunt, in which a rheostat, Rh', 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 rheostat, Rh, to prevent sparks. The makes and breaks in the motor-circuit magnetize and demagnetize the coils of the magnet 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 *f*, which is carried by the vertical shaft E, and moves over the insulated contacts 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 screw pole-pieces *a'* to or from the tines of the fork, the speed of vibration may be so accurately adjusted that the two forks may be brought to vibrate at approximately the same speed. Each fork is vibrated by its own independent local circuit. It is impossible, however, to so accurately adjust the pole-pieces relatively to the tines of the forks as to insure their 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 No. 91,493, for improvements in telegraphy, above referred to.

On the stationary tables of contacts I have shown sixty insulated contact-pieces; 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 thrown out or unconnected, and 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. In the drawing I have shown the 1's and 5's of each series 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'*, vertically-rotating shaft E', main line to the opposite station, and through the trailing finger *f* to the correspondingly-numbered contact. 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 contacts.

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 fingers. 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 drawing, 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 on the poles of deterring-magnet L L, which are placed outside the tines of the fork, and from thence to ground. The single 9 above referred to is connected to a wire, *m*, which passes to ground through the coil of a sounder, S. At this point in the table an extra contact, $8\frac{1}{2}$, is introduced, and the adjoining 9—that one connected to the sounder—is reduced in width. The reduced 9 and the small extra contact together only occupy the space that would be occupied by a full-width 9, so that the relative arrangement of contacts and separating-spaces is maintained. This extra contact $8\frac{1}{2}$ is connected by a line, *n*, through the coil of a magnet, N, interposed between the tines of the fork, and thence to ground. It will be further noticed that the 10's, which are all con-

nected together and to the line *l*, are built out or extended toward the adjoining 9's. The outer magnet, L, which is connected to the 10's, is the deterring or retarding magnet, and 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*. The magnet N, interposed between the tines of the fork, is connected with the single extra contact 8½, interposed between the 8 and the reduced 9. This magnet is the accelerating-magnet, and it will be possible for one impulse of electricity to pass through its coil for each revolution of the trailing finger *f*. Assuming that both of the trailing fingers are moving synchronously, it will be obvious that when the fingers at stations X and Y rest upon the 9 contacts no current of electricity can be on the line, except when the finger at Y is on the reduced 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. If, however, while the finger at station X is on a 9, which is connected with the correcting-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. If the finger at station Y should tend to run a trifle slower than that at station X, it would touch the small extra contact 8½ while the finger at station X is still on a 9. An impulse of electricity would therefore pass through the coil of the accelerating-magnet N and accelerate the vibration of the fork and the consequent rotation of the trailing finger at station Y. When the trailing fingers are therefore once brought into synchronous movement, the finger at station Y will be locked, as it were, between the extra contact 8½ and the 10's, so that any acceleration in speed will be promptly met by a corresponding automatic retardation, and any retardation by a corresponding automatic acceleration.

In practice the apparatus is so adjusted that the rotating armature-disk at station Y tends to move slightly faster than that at station X. This tendency is overcome by the six retarding-contacts. As the tendency at station Y is toward acceleration, but one accelerating-contact is deemed sufficient. This contact may be brought into service where too great an impulse of retardation has been imparted to the apparatus, or where from any cause the normal accelerating tendency of the armature-disk is momentarily disturbed.

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 adjustable pole-pieces on the vibrator-magnet. 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 switches P Q are opened and the fork started into vibration at station Y, the apparatus at station X having previously been started. If the trailing fingers happen to start in synchronism, the sounder S will tick, and if the ticking continues for a short time the operator will adjust the pole-pieces of the vibrator-magnet very slightly away from the tine of the fork, so as to tend to increase its rate of vibration. Then, if the sound begins to go away on the sounder S, he closes the switches P and Q, 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 screwing the pole-pieces away from the tines of the fork, will cause them 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 gradually adjusting the pole-pieces to approach them to the tines of the fork, 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 switches P and Q are closed and the apparatus is in proper condition, any subsequent variation being automatically corrected, as above described.

I have said that the magnets L (the poles of which are on the outside of the tines of the fork) at station Y are retarding-magnets, and that the interposed magnet N is an accelerating-magnet. This I have demonstrated by repeated experiments and practical use, and the operation may be thus explained: The poles of the vibrator-magnet are placed on the outside of the tines, so that the tines vibrate in magnetic fields which modify or in a measure overcome the normal speed of vibration. As this magnetic field is decreased in strength the tines vibrate more freely, and consequently more rapidly. When, however, these exterior magnetic fields are increased or supplemented by the action of the deterring-magnet L L, the resistance to the vibration of the fork

is increased, and there is a consequent diminution in the rate of vibration. On the contrary, when an impulse of electricity is passed through the interposed accelerating-coil N, the magnetic fields created thereby are opposed to and neutralize more or less the effect of the vibrator-magnet, thus reducing the opposition to the vibration of the forks and the sum of the exterior attraction on the tines of the fork, and permitting a freer, and consequently more accelerated, rate of vibration. If, for any reason, fewer retarding-impulses are desired, some of the 10's at Y or 9's at X, or some at each station, may be thrown out or left unconnected, and if more accelerating impulses are needed, obviously additional $8\frac{1}{2}$ contacts may be added. Obviously the greater number of correcting-contacts might be connected to the accelerating-magnet and the lesser number to the deterring-magnet. When thus arranged, I would prefer to connect the connected 10's to the accelerating-magnet and the $8\frac{1}{2}$ to the deterring-magnet. In this case the apparatus at Y would of course be adjusted to run slower than that at X. Other variations will doubtless be suggested to skilled persons.

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 Nos. 91,488, 91,489, 91,491, 91,492, or 91,493, filed of even date herewith, or No. 102,928, filed August 6, 1883, are disclaimed herein.

What I claim as my invention is—

1. The combination, substantially as set forth, of a vibrator, means for independently actuating it, a main electric circuit, a motor controlled by said vibrator, a circuit-completer actuated by the motor, a series of correcting-contacts through which the circuit is completed, and an accelerating-magnet for correcting the speed of the vibrator.

2. The combination of the two electrically-connected stations, the independently-actuated vibrators at each station, the motor circuits and magnets, the rotating trailing fingers or circuit-completers, the tables of contacts, the contacts at one station electrically connected to each other and to a correcting-battery, and the correcting-contact at the other station, which is connected with the ground through the coils of an accelerating-magnet.

3. The combination of independently-actuated vibrators placed at electrically-connected stations, with apparatus, substantially such as described, for automatically retarding or accelerating the vibrator at one station when it tends to move faster or slower than that at the other station.

4. The combination, substantially as set forth, of two electrically-connected stations, an independently-actuated vibrator at each station, and mechanism for actuating it, the motor circuits and magnets, the traveling circuit-completers actuated by the motors, the table of contacts, the correcting-contacts connected with a battery at one station, and the correcting-contacts connected with accelerating and deterring magnets which act on the vibrator at the other station.

5. The combination, substantially as set forth, of two electrically-connected stations, an independently-rotated circuit-completer at each station, mechanism for actuating them, tables of contacts, a correcting-battery connected to some of said contacts at one station, and accelerating and retarding magnets connected to some of the contacts at the other station.

6. The combination, substantially as set forth, of electrically-connected stations, the tables of contacts, a rotary circuit-completer at each station, the motor magnets and circuits, the independently-vibrated vibrators, which make and break the motor-circuit, a correcting-battery electrically connected with a given number of contacts on the circular table of contacts at one station only, another series of contact on the table at that station, which are thrown out or not in electrical connection in any circuit, and at the other station a series of connected contacts corresponding to those thrown out at the first station, which are electrically connected through the coils of a correcting-magnet to ground.

7. The combination, substantially as set forth, of electrically-connected stations, the tables of contacts, the rotary trailing finger or circuit-completers, the series of insulated contacts on the tables, which are divided into series or sets of equal number, the corresponding contacts in each series—say the 9's and 10's—which are devoted to maintaining the synchronous movement of the apparatus, the 9's at one station only being connected to a correcting-battery, and the 10's thrown out or unconnected with any circuit, and the 10's at the distant station connected together and through the coils of a deterring-magnet.

8. The combination, substantially as set forth, of two electrically-connected stations, an automatic independently-operated vibrator at each station, motor circuits and magnets, the rotating armature-disks and trailing fingers, the stationary tables of contacts, the contacts thereon divided into independent series or sets of equal numbers, corresponding contacts—say the 9's and 10's—in each series being devoted to maintaining the synchronous movement of the apparatus, the correcting-battery to which the 9 contacts are connected at one station, the 10 contacts at that station being thrown out or unconnected with any circuit, the deterring-magnet at the other station, which operates upon the automatic vibrator at that station and is electrically connected with the 10's in the circle of contacts, the thrown-out or unconnected 9's at said station, and a sounder of relay electrically connected with one of said 9's.

9. The combination, substantially as set forth, of two electrically-connected stations, an automatic independently-operated vibrator at each station, motor circuits and magnets, the rotating armature-disks and trailing fingers, the stationary tables of contacts, contacts thereon divided into independent series or sets of equal numbers, corresponding contacts—say the 9's and 10's—in each series being devoted to maintaining the synchronous movement of the apparatus, the correcting-battery to which the 9 contacts are connected at one station, the 10 contacts at that station being thrown out or unconnected with any circuit at the distant station, the deterring-magnet which operates upon the automatic vibrator at the other station and is electrically connected with the 10's in the circle of contacts, the thrown-out or unconnected 9's at said station, a sounder or relay electrically connected with one of said 9's, and an extra contact placed between the sounder 9 and the adjoining 8, and electrically connected to the coils of an accelerating magnet which also acts upon the automatic vibrator at that station.

10. The combination, substantially as set forth, of two tables of contacts and circuit-completers, mechanism for actuating the circuit-completers, a main line, the contacts connected with a battery at one station only, and the correcting-contacts at the other station extended toward the adjacent unconnected contacts and connected with the correcting mechanism, which regulates the speed of the mechanism that actuates the circuit-completer.

11. The combination, substantially as set forth, at electrically-connected stations, of apparatus at each station which is continuously actuated or rotated to make and break the line-circuit, electrically-controlled mechanism for actuating such apparatus, and means for automatically correcting the movement of said electrically-controlled actuating mechanism at one station by impulses of acceleration or retardation, according as said apparatus moves too fast or too slow, caused by impulses of electricity transmitted from the distant station.

12. The combination, substantially as set forth, at electrically-connected stations, of apparatus at each station which is continuously actuated or rotated to make and break the line-connection with a series of independent contacts, electrically-controlled mechanism for continuously actuating such apparatus, and means for automatically controlling the movement of said electrically-controlled actuating mechanism at one of the stations by retarding or accelerating impulses of electricity from the other to maintain the synchronous movement of the apparatus at each station.

13. The combination, substantially as set forth, of a vibratory fork, vibrator-magnets for vibrating it, the poles of which act on the outsides of the tines of the fork, an electro-magnet, the poles of which are placed on the outside of the tines of the fork, an electric circuit in which the coils of said magnet are placed and over which impulses of electricity may be received to energize the magnet and retard the vibration of the fork, an electro-magnet interposed between the tines of the fork and its circuit, over which impulses of electricity to accelerate the vibration of the fork may be received.

14. The combination, substantially as set forth, of a vibrator, an electro-magnet acting on one side of the vibrator for automatically vibrating it, a second electro-magnet placed to act on the same side of the vibrator for retarding the rate of vibration, and a third magnet placed to act on the opposite side of the vibrator to accelerate its rate of vibration.

15. The combination, substantially as set forth, of a vibrator, an electro-magnet and its circuit operating upon one side of the vibrator to vibrate it, and an electro-magnet or coil acting on the opposite side of the vibrator, the coil of said magnet being placed in a circuit over which correcting-impulses of electricity may be received to accelerate the vibration of the vibrator.

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.