P. LA COUR.

Isochronous and Synchronous Movements for Telegraphic and other Lines.

No. 203,423. Patented May 7, 1878.

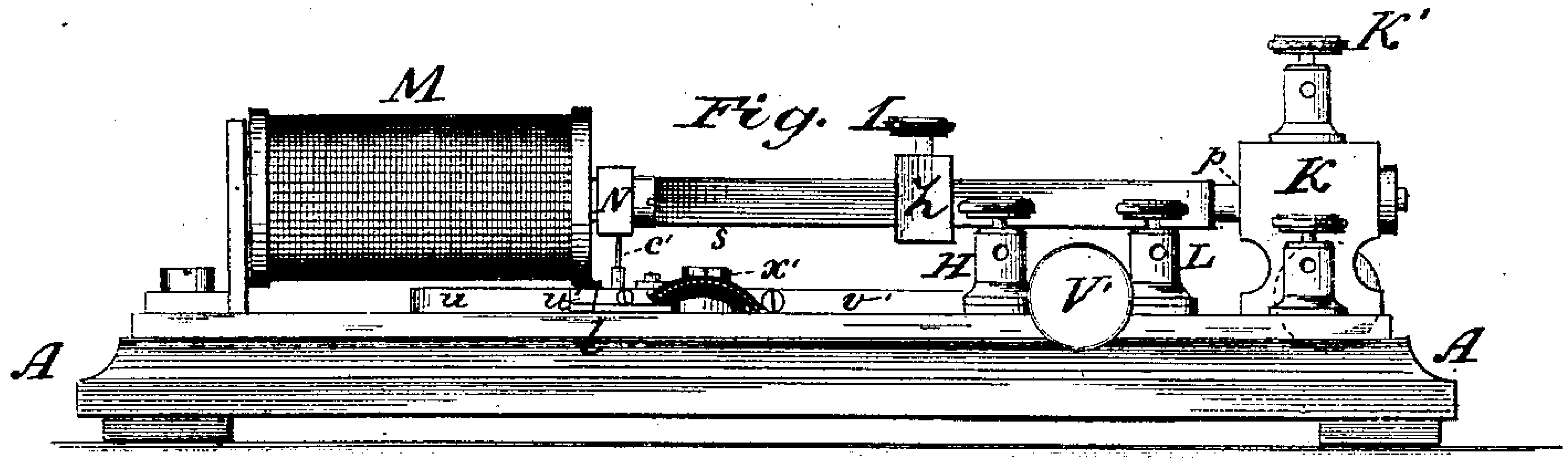


Fig. 2.

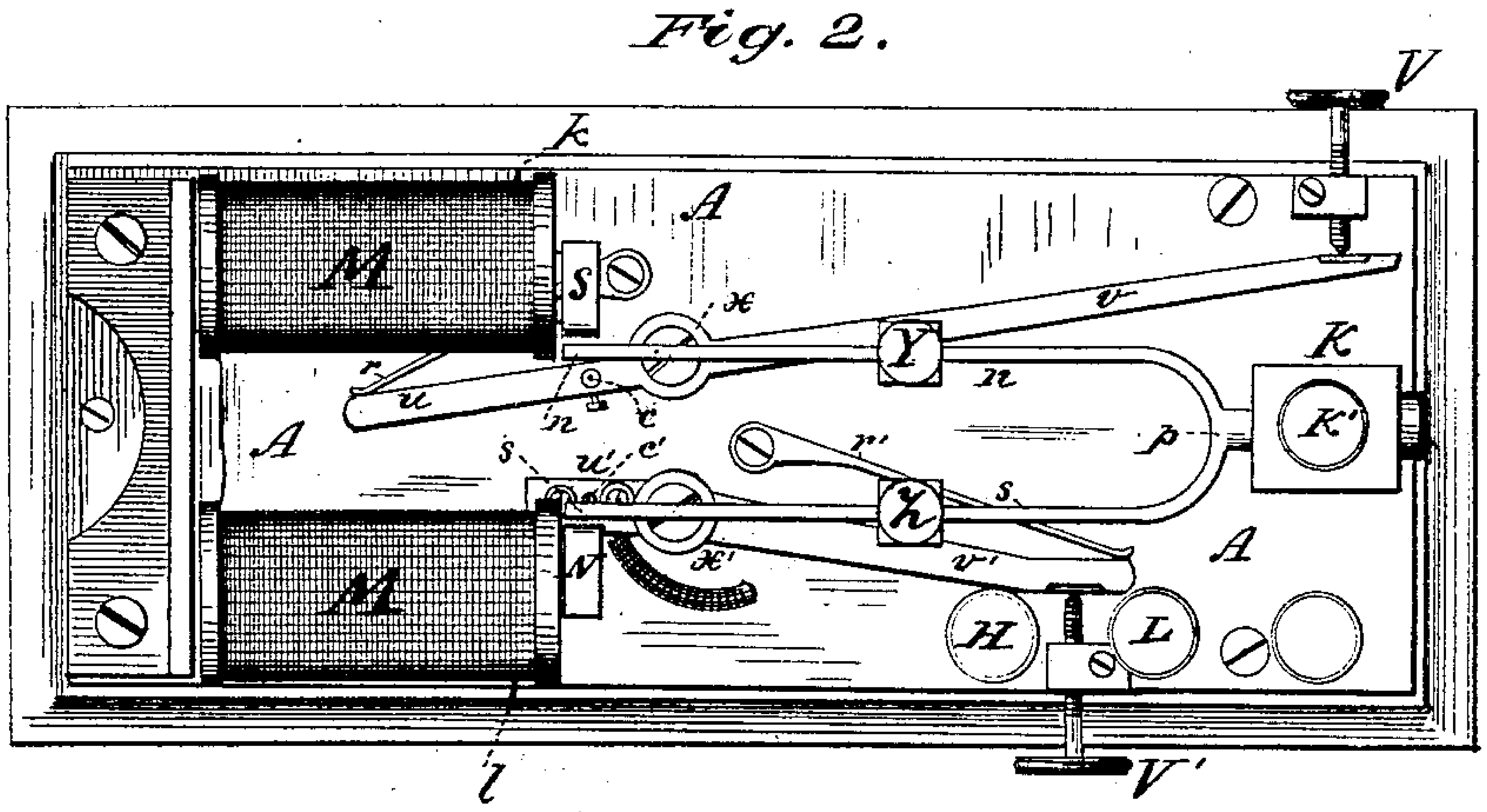
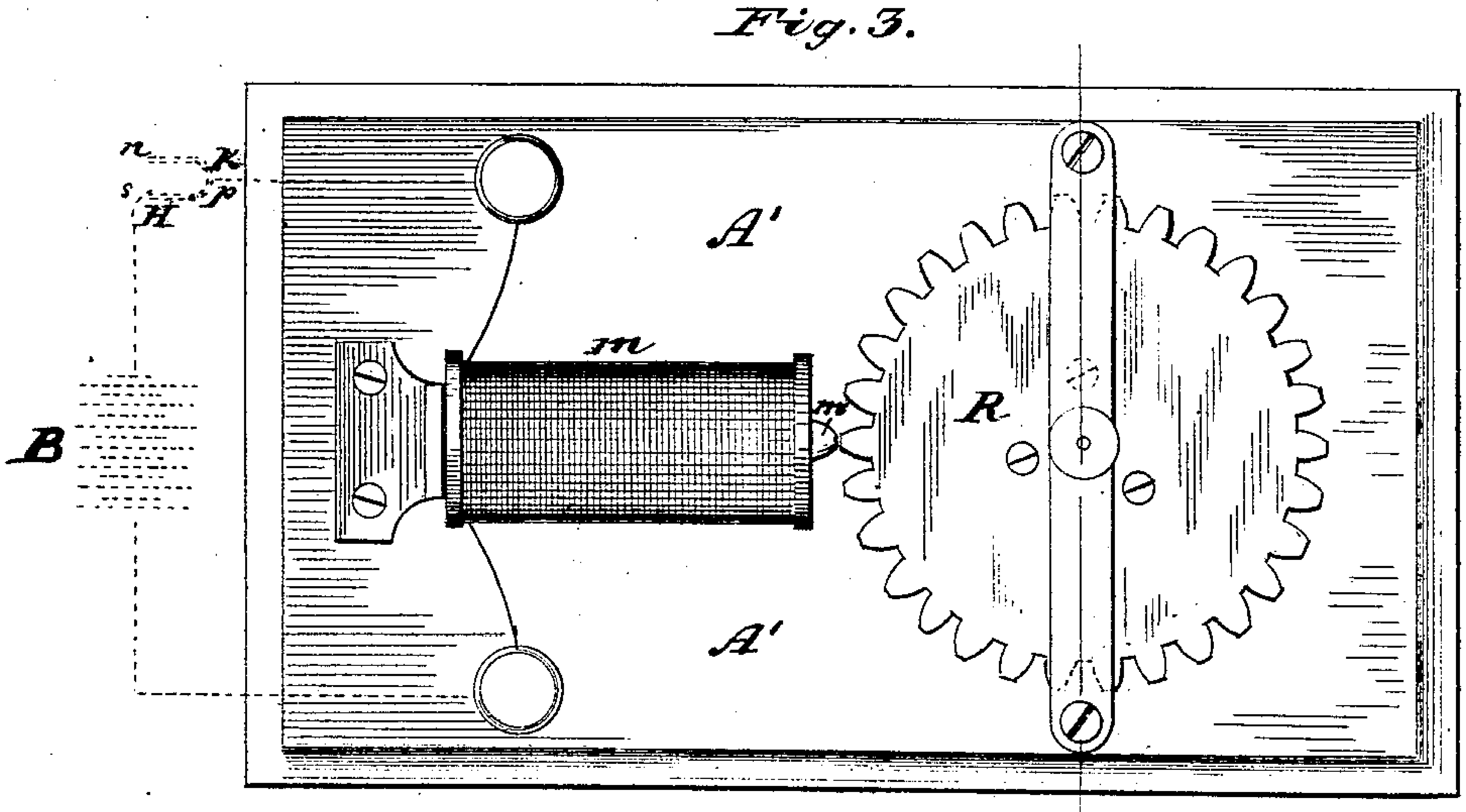


Fig. 3.



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2 Sheets—Sheet 2.

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Fig. 4.

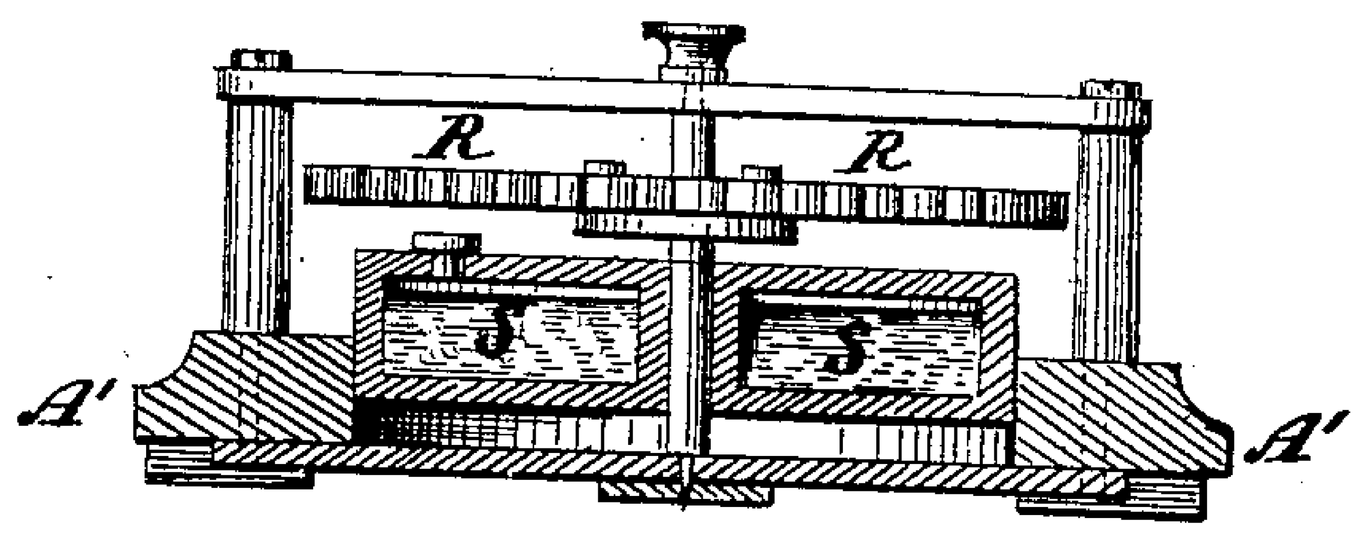


Fig. 6.

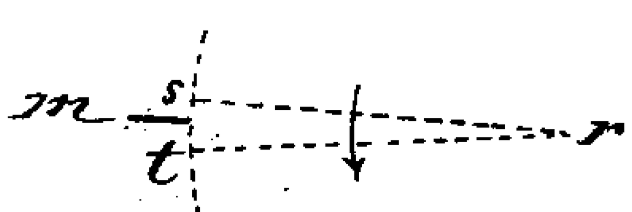


Fig. 7.

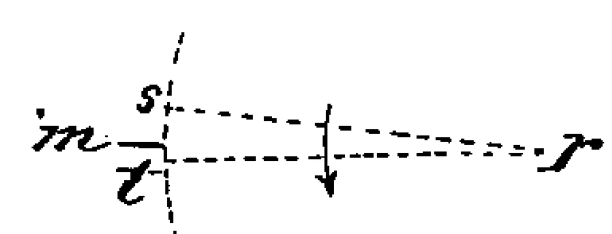


Fig. 8

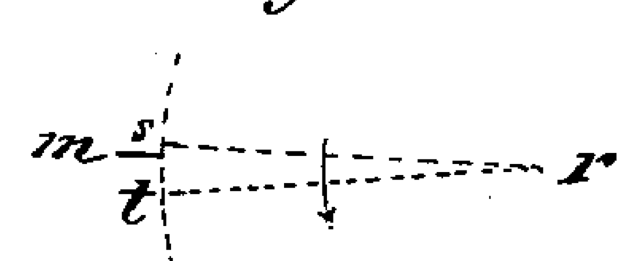
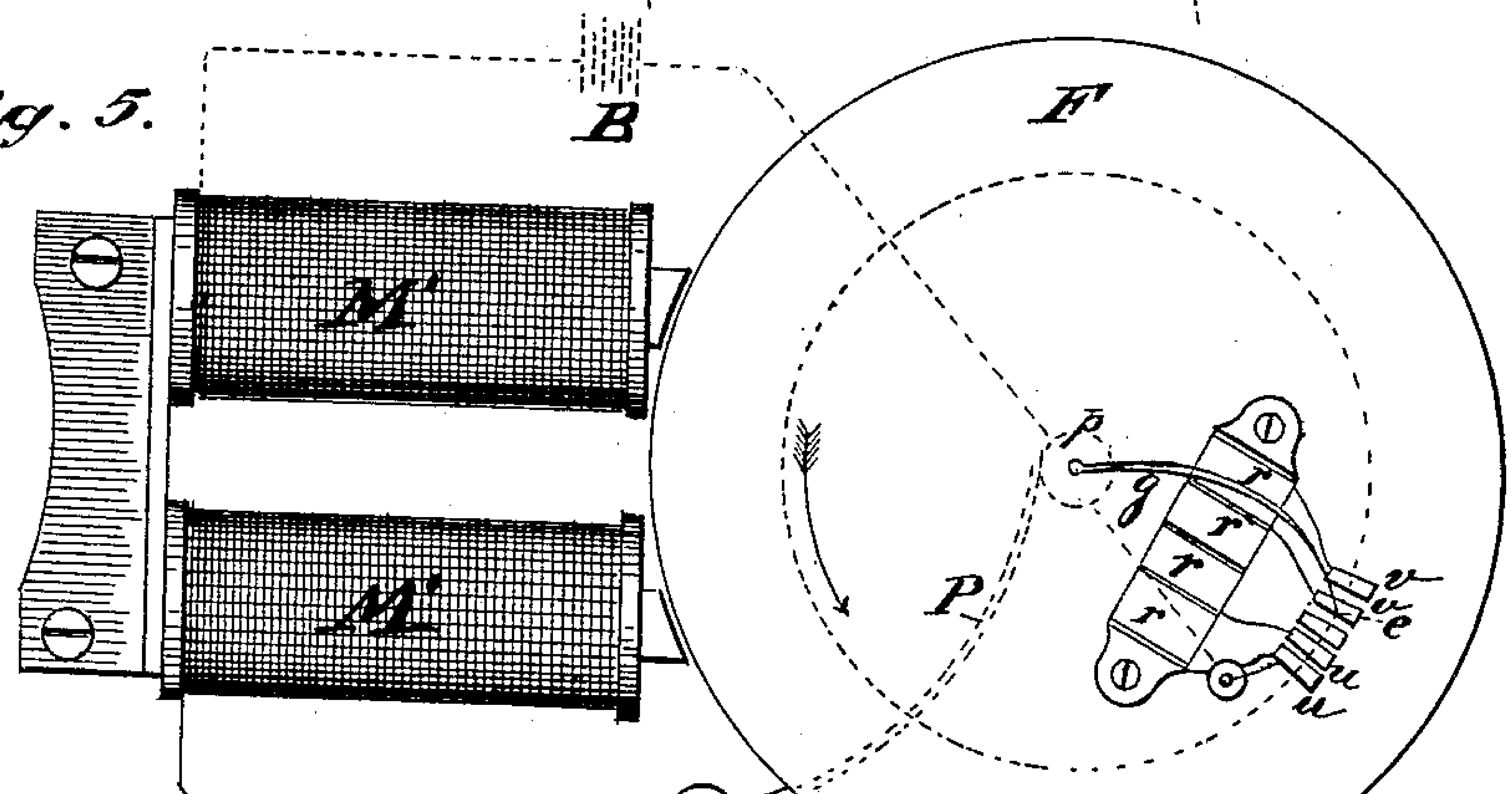


Fig. 5.



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UNITED STATES PATENT OFFICE.

POUL LA COUR, OF COPENHAGEN, DENMARK.

IMPROVEMENT IN ISOCHRONOUS AND SYNCHRONOUS MOVEMENTS FOR TELEGRAPHIC AND OTHER LINES.

Specification forming part of Letters Patent No. **203,423**, dated May 7, 1878; application filed April 9, 1878.

To all whom it may concern:

Be it known that I, POUL LA COUR, of the city of Copenhagen, in the Kingdom of Denmark, have invented certain new and useful Improvements in Isochronous and Synchronous Movements Operated by Electricity; and I do hereby declare that the following is a full, clear, and exact description thereof, which will enable others skilled in the art to which it appertains to make and use the same, reference being had to the accompanying drawings, and to the letters of reference marked thereon, which form a part of this specification.

This invention relates to isochronous and synchronous movements operated by electricity, by the aid of which mechanical movements, such as common clocks, chronographs, printing or recording telegraphs, phonographs, &c., may be regulated and controlled so as to have an absolutely isochronous or synchronous motion, which motion may be regulated so as to affect simultaneously all the movements or machines within the electrical circuit by a simple adjustment of the regulator or regulating movement; and it consists, first, in the construction, combination of parts, and arrangement of a magnetized reed or tuning-fork, which is kept in vibration by the action of two electro-magnets, one on each side of its magnetic poles; and, second, in the construction, combination of parts, and arrangement of a toothed wheel and an electro-magnet, the intermittent current or pulsations of which are regulated by the device which forms the first part of my invention, and any given number of which (each forming a part of the movement to be brought into synchronous action with the initial or principal isochronograph) may be operated synchronously, or in perfect unison, by a single regulator constructed in accordance with what forms the first part of my invention, and which I shall now proceed to describe more fully.

On the two sheets of drawings hereto annexed, Figure 1 is a side elevation of my improved isochronous and synchronous electrical movement. Fig. 2 is a top plan of the same. Fig. 3 is a top plan of the regulator which forms the second part of my invention, and is used in combination with the first part thereof, or that part illustrated in the preceding two figures. Fig. 4 is a vertical section on the line *x′ x′*, Fig. 3. Fig. 5 is a top plan, representing a modified construction of the regulator; and Figs. 6, 7, and 8 are diagrams, illustrating the operation of the regulator shown in Figs. 3 and 4.

Similar letters of reference indicate corresponding parts in all the figures.

Reference being had to Figs. 1 and 2, A denotes the base-plate, upon one end of which is secured an isolated metal block, K, provided with the binding-screw K′, and perforated longitudinally, so as to form a socket for the insertion of the reed or tuning-fork *n p s*, which is made of steel, and magnetized in like manner as an ordinary horseshoe-magnet, its magnetic poles *n* and *s* projecting horizontally between the poles S and N of the electro-magnets M M. One end of the wire coil of these electro-magnets (denoted by *k*) is connected to the base-plate A, while the other end, *l*, is connected with the isolated binding-screw L. Upon the base-plate A is pivoted, upon a projecting stud or pin, *x*, a lever-arm, *u v*, which may be adjusted by means of a set-screw, V, the end or point of which works against the long arm *v*, while the short arm *u* impinges upon a spring, *r*, secured upon the base-plate. This short arm *u* is provided with a vertical or nearly vertical platina contact-spring, *c*, which, by manipulating the set-screw V, can be brought into direct contact with the pole *n* of the tuning-fork, which has, on the side which comes in contact, a thin plate of platina attached, through which the contact is established.

It follows that, when one of the poles of an electrical battery is connected with K′ K and the other with L, a vibrating motion will be imparted to the tuning-fork *n p s*, because the current will pass from K through the branch *n* of the tuning-fork to the contact *c*, and, consequently, through the base-plate A to the electro-magnets M M, and through them to the binding-screw L, which closes the circuit and magnetizes the poles of the electro-magnets. These will attract the poles *n s* of the tuning-fork, which become expanded, thereby breaking the contact between *n* and *c*, and consequently breaking the circuit. This stops the current through the coils wound around the electro-magnets, which now lose their attraction, and the branches *n s* of the tuning-fork will return to their normal position, touching the contact *c*, which re-establishes the circuit, and so on. In this manner an intermittent current is produced by the vibration of the branches of the tuning-fork, the intervals or pulsations of which are regulated by the tune or key of the fork *n p s*. This tune or key may be regulated and changed at will by sliding adjustable weights Y Z, one upon each of the branches *n s*, which may be secured in any given position by set-screws.

The mechanism and combination of parts hereinbefore described would be sufficient to produce an intermittent current, which might be utilized for the purpose of imparting motion to a ratchet or escapement wheel; but still better results are produced by establishing an intermittent contact between the other pole, *s*, of the reed or tuning-fork and a contact-spring, *c′*, secured upon one end of a horizontal lever-arm, *u′ v′*, which is pivoted upon an isolated stud or pin, *x′*, projecting from the base-plate, and may be manipulated, in like manner as lever-arm *u v*, by a set-screw, V′, and tension-spring *r′*. An isolated wire connects the isolated contact *c′* with an isolated binding-screw, H; and it follows that when the tuning-fork is caused to vibrate in the manner described, so as to establish intermittent connections between the contacts *n c* and *s c′*, respectively, an intermittent circuit is established between H and K when connected by wire, which is made use of in the second part of my invention, which I shall now proceed to describe, reference being had to Figs. 3, 4, 5, 6, 7, and 8 of the drawings.

This apparatus consists, essentially, of a base-plate, A′, an electro-magnet, *m*, and a horizontally-pivoted toothed wheel R, made of iron, the teeth of which, as it rotates, will pass in close proximity to the pole *m′* of the electro-magnet *m*, yet without touching this. From a battery indicated by B the circuit passes through the intermittent bridge formed between H K and the electro-magnet *m*, as represented in Fig. 3, thus producing an intermitting current through the latter, which will be in exact unison with the vibrations of the tuning-fork *n p s*. When the wheel R is at rest, then that one of its teeth which happens to be nearest to the pole *m′* of the electro-magnet will be retained or caused to remain fixed in that position, on account of the magnetic attraction of the pole; but if the wheel is set in motion with such a velocity that a tooth shall pass pole *m′* for each impulse of the intermittent electrical current, then this velocity will be regulated and controlled by the action of the electro-magnet *m*, which receives its impulses from the tuning-fork in the manner already described.

This action of the electro-magnet in reference to the rotating wheel R will be more cleary understood by reference to the diagrams epresented in Figs. 6, 7, and 8 of the drawings. Suppose that the dash and letter *m* indicates the central or axial line of the pole *m* of the electro-magnet, and the letter *r* indicates the center of wheel R, which is supposed to rotate in the direction indicated by the arrow. Now, if the central line of one of the teeth is moved during one impulse from the point *s* to *t*, it (the tooth) will be accelerated on its way from *s* to *m*, but retarded on its way from *m* to *t*. If, as in Fig. 6, this acceleration and retardation are equal, the velocity of the wheel will not be affected by the electro-magnet; but if the wheel should commence to lose or go slow, Fig. 7, the acceleration *s m* will increase and the retardation *m t* decrease. Consequently the pole of the electro-magnet will increase the velocity of the wheel, and the attraction by which this is accomplished will increase in the same ratio as the wheel slows or loses time. On the other hand, if the wheel gains or increases in speed, Fig. 8, the acceleration *s m* will be decreased, while the retardation *m t* will increase, so that in this case the electro-magnet will have exactly the opposite effect and retard the velocity of the wheel, which retardation will increase in the same proportion as the velocity of the wheel would otherwise increase.

From the foregoing it will be observed that this simple apparatus may be used both as a motor and as a regulator, and in either capacity it will not be affected by outside influences, whether these operate in the same direction as or contrary to the rotation of the wheel. It must be understood, of course, that these outside causes or influences should not exceed a certain limit. If, for instance, they should cause the wheel to lose or increase during a single impulse a distance equal to about one-half the space between its teeth, it may happen that the balance of motion will be broken and the wheel will come to a standstill; but, unless exterior causes should be sufficient to produce divergence to about that extent, they will exert no influence upon the movement of the wheel, which will rotate in unison with the pulsations of or impulses in the electro-magnet.

If preferred, the wheel R may be made of wood, hard rubber, ivory, or brass, and its teeth substituted by armatures made of iron or magnetized steel placed diagonally across the disk, which, in that case, forms the body of the wheel, these armatures projecting at each end so as to form the teeth. When this construction is adopted, the single electro-magnet *m* should be replaced by a horseshoe electro-magnet. In either case—that is, regardless of the construction of the wheel as described—it would require some skill and experience to start it at the proper speed, so as to bring it under the controlling influence of the electro-magnet; but this difficulty may be overcome by attaching to the under side of the disk or wheel R a cylindrical case, S, Fig. 4, filled with mercury and carefully sealed. On account of the inertness of the mercury, this will, by its friction against the inner annular wall of the cylindrical reservoir S, gradually and very evenly reduce the starting velocity of the wheel, which will thus, by almost imperceptible degrees, attain the true grade of velocity or movement, in which it will then remain by the action of the electro-magnet in the manner described. This regularity of motion having been once attained, it is obvious that the wheel R may be employed for the purpose of moving and regulating clocks, chronographs, printing-telegraphs placed at a distance from each other, or other mechanisms where a synchronous motion is desired, one wheel, R, with its corresponding electro-magnet, being used in each apparatus, and all of these brought within the circuit of the intermittent bridge H K, as described; or, in other words, a single tone-giver reed, tuning-fork, vibrating plate, or chord, the key or number of vibrations of which may be regulated, can, with the aid of suitable relays, be used to control any number of motors or regulators, each of which moves or regulates, or moves and regulates, a certain mechanism, and all of which mechanisms will be in synchronous action with each other, and each isochronic in itself, regardless of the distance that may intervene between them.

Besides the method described, there are various other ways by which the same result may be effected. For example, the first wheel, R, through which the regulating intermittent current passes, may be used to communicate the electrical pulsations to successive wheels or regulators by constructing its vertical pivot or axle with a spring-contact, which, as the wheel revolves, will touch successive stationary contacts arranged in circular form around, but isolated from, the wheel.

The breaks in the circuits thus produced may be employed to establish or form another intermittent bridge, which will be of the same key as the first one, and so on; or the intermittent current may be sent direct from the apparatus which forms the first part of my invention to and around the electro-magnets of a similar apparatus located at a distant station, which will cause the reed or tuning-fork of the latter to vibrate in the same key, or in exact unison with the tuning-fork at the initial station. Even if the key of the two tuning-forks should, in themselves and after adjustment, differ somewhat, the impulses of the current received from the initial station will regulate the vibrations, and thereby set the key at the receiving-station; and I have found by experiment that, even if purposely or accidentally the intermittent current from the initial station is deprived of some of its impulses or pulsations, so as to leave spaces, this will not affect the key at the receiving-station, so that the synchronic movement at both stations will remain uninterrupted and intact—a circumstance which may be made available in various electrical and telegraphic mechanisms in which it is desirable to obtain synchronous movements or impulses.

In order to prevent the burning and destruction of the platina contacts described in the first part of my invention, the contacts or conductors on each side of the intermittent bridges may be connected, each by an isolated wire, with resistance-coils suitably arranged in the base-plate of the apparatus.

The modification in the construction of the second part of my invention, which is represented in Fig. 5, is intended to be used for regulating the movements of more powerful motors than that class of mechanisms which are usually employed for telegraphic or chronographic purposes. In this figure, F represents an iron disk keyed upon one of the rotating axles of the machine or motor to be regulated, which is supposed to rotate in the direction of the arrow. Upon the same axle is pivoted a toothed wheel, R, which rotates loosely upon the axle, and is regulated by an electro-magnet, as described in describing the second part of my invention; but neither this wheel R nor its electro-magnet are shown in Fig. 5, as their construction and operation will be fully understood. The wheel R has secured upon that of its sides which faces wheel F a sliding spring-contact, g, the contact end e of which slides upon the face of wheel F, describing a circle, as indicated in dotted lines. At any suitable place upon the face of wheel F is placed a series of isolated contacts, u u v v, each of which is connected to its neighbor through a resistance-coil, r. The end contact u is also connected by an isolated wire with an isolated metal ring, p, concentric with wheel F, and secured upon the same axle, and from the ring-contact p another spring-contact, P, conducts the current through the coils of an electro-magnet, m' m', to a battery, B, the opposite pole of which communicates through the axle with the sliding contact g of the loosely-revolving toothed wheel. It follows that, if the wheel or disk F gains or increases its motion through an increase of motive power, decrease of resistance to be overcome, or through other causes, so as to move quicker than the toothed regulator-wheel R, its contact v will catch up with the end e of the sliding contact g, producing a current through the circuit indicated by B g e v r u p P m' m' and back to B, which magnetizes the electro-magnet m' m', which, in turn, retards the motion of the disk F and its axle. The retardation exerted by the electro-magnet will increase in proportion as the contact u approaches e, and it follows that, when one of the contacts u actually touches the contact-point e, the amount of retardation will equal or counterpoise the surplus of motive power, so that disk F cannot rotate quicker than does the end e of contact g, so that the two will move in unison with each other.

If the machine is so powerful that the retardation exerted by the electro-magnet in the manner described should not in itself, even with the aid of a powerful battery, be sufficient to regulate the movement of disk F and its axle, substantially the same combination of elements may be employed in the construction of a suitable braking device or governor operated by the electro-magnet *m*, which will regulate the motion of the machine, either by friction, as in the case of a brake appliance, or by controlling the flow of steam, vapor, air, or water, as in the case of a governor, by which the machine is operated.

Having thus described my invention, I claim and desire to secure by Letters Patent of the United States of America—

1. As an improvement in isochronous and synchronous movements operated by electricity, the reed, lamel, or tuning-fork *n p s*, having adjustable weights Y Z, whereby its tune or key may be changed, thereby changing the electrical impulses or pulsations, substantially as and for the purpose hereinbefore set forth.

2. The combination, with the tuning-fork *n p s*, of the adjustment-levers *u v u′ v′* and set-screws V V′, substantially as and for the purpose hereinbefore set forth.

3. In combination with the tuning-fork *n p s* and adjustment-levers *u v u′ v′*, operated by the set-screws V V′, respectively, the tension-springs *r r′*, substantially as and for the purpose hereinbefore set forth.

4. The combination of the reed, lamel, or tuning-fork *n p s* and socket-block K, having binding-screw K′, with the contact-springs *c c′* and adjustment-levers *u v u′ v′*, whereby, with the aid of a connecting isolated wire between the isolated contact-spring *c′* and the isolated binding-screw H, an intermittent bridge is formed between H and K when the apparatus is operated, substantially as and for the purpose hereinbefore set forth.

5. The combination of the adjustable tone-giver or tuning-fork *n p s*, having free ends or poles, with the poles S N of electro-magnets M M and adjustable contact springs or points *c c′*, substantially as and for the purpose hereinbefore set forth.

6. The toothed regulator-wheel R, in combination with the regulating electro-magnet *m* and impulse-producing reed or tuning-fork *n p s*, substantially as and for the purpose hereinbefore set forth.

7. The motor or regulator-wheel R, pivoted horizontally in a base-plate, A′, and provided with a concentric cylindrical chamber, S, containing mercury or similar inert fluid of considerable gravity, substantially as and for the purpose hereinbefore set forth.

8. The wire-connection B H K *m* B, Fig. 3, whereby the circuit passes from one of the poles of the battery B to the binding-screw H, then through an isolated wire to the isolated contact-point *c′*, then through the branch *s* of the tuning-fork to the binding-screw K′, then through the electro-magnet *m* and back to the other pole of the battery, or to earth, substantially as and for the purpose hereinbefore set forth.

In testimony whereof I have signed my name to the foregoing specification in the presence of two subscribing witnesses.

POUL LA COUR.

Witnesses:
FREDERIK WOLFF,
J. P. ERIKSEN.