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PROVISIONAL SPECIFICATION.

Improvements in Electrical Clocks.

We, FRANK HOPE-JONES and GEORGE BENNETT BOWELL, of 53, Victoria Street, London, S.W., Electricians, do hereby declare the nature of this invention to be as follows:—

This invention has for its object improvements in electric controlling clocks and electrical indicating dials worked therefrom. These improvements include novel arrangements of the electrical circuits.

It consists in part of improvements and developments of the system described in our Patent Number 1587, 1895.

When it is desired that the self-wound controlling clock should send out impulses every second, the pendulum is usually operated by one or more gravity arms which are lifted by electro-magnets at each vibration, such as for instance that described in Figure 1 of the Patent above referred to. But for this purpose it has always been necessary to employ some form of closed circuit battery owing to the excessive duration of the contact. Now in this invention quick contacts may be obtained by the use of contact pieces between the gravity arms and the armature of the electro-magnets, the said contact pieces resting in slides with freedom to move lengthways and so arranged that when one gravity arm touches its contact piece the circuit of its electro-magnet will be closed and the armature will impart a percussive blow to the said sliding contact piece which will cause the gravity arm to engage in a catch and will instantly break the circuit, or the armature itself may be used to make contact with the gravity arm without the intervention of a sliding contact piece, in which case a fixed stop is provided to limit the armature stroke and as no such stop is provided for the gravity arm, the momentum of the latter will carry it on, causing a quick break.

When a contact at longer intervals is required, such as say at every 15 or 30 seconds, the pendulum is operated by an ordinary escapement, as for instance in the manner described in Figures 2 and 3 of our Patent referred to, where the clock is driven by a weight which meets the armature of an electro magnet, makes contact therewith and is reset, thus sending out a make and break signal every 15 or 30 seconds to operate any number of dials in electrical circuit therewith.

In this patent in order that the action of the controlling pendulum and one of the dials may be electrically interlocked we omit the fixed stop in the path of the armature of the pendulum movement and provide a contact on some moving part of a dial and arrange the wiring so that the circuit is broken there (instead of at the pendulum) immediately the operation of driving the dial one step forward has been performed. If it is desired that more than one dial be electrically locked with the controlling apparatus for closing the circuit in this manner, the breaking contacts on the dials as described above may be arranged in parallel.

[*Price* 8*d.*]

For the purpose of operating the hands of any number of indicators or dials in circuit with controlling blocks we employ a new method of step by step movement which is more simple than those commonly used and calculated to secure greater economy and reliability. This form of dial movement consists of an electro-magnet operating a vibrating armature lever. Pivoted at one end of the said lever is a pawl which engages in a toothed wheel attached or geared to the hands of the dial. Each tooth of this wheel forms a right angled isosceles triangle hypotenuse of which forms a tangent to the wheel. The free end of the pawl is also rectangular and normally rests upon a tooth in line with its face *i.e.* at an angle of 45° with the radius at this point, and when driven forward either by an electro-magnet or by a spring acting in opposition thereto, it drives the wheel and rises with it until it meets with a fixed stop which effectually prevents it or the wheel from proceeding further, while a back stop click prevents the wheel from returning. By arranging the parts in this manner it will be seen that the forward motion of the driving click in the direction of its length is equal to the rise of its free end and that while the said click normally locks the wheel it is nevertheless free to slide straight off the dead surface of the tooth without being lifted when the next impulse is sent out from the controlling clock. The angle at which the click engages the wheel is important. If the click enters the wheel at a tangent, the slightest eccentricity in the wheel will cause the click to bind between the circumference and the fixed stop at some points or will allow excessive free play between the backward and forward locking as above described.

It is also important that the direction of the outward movement of the driving click should be parallel with the face of the tooth upon which it rests.

It is sometimes desirable to attach to the backstop click the armature of a smaller magnet placed in series with the magnet for operating the dial movement in order that the driving wheel may be locked while the current is drawing out the click.

Dated this 25th day of March 1897.

WM. P. THOMPSON & Co.,
Of 6, Lord Street, Liverpool, Patent Agents for the Applicants.

FINAL SPECIFICATION.

Improvements in Electrical Clocks.

We, FRANK HOPE-JONES and GEORGE BENNETT BOWELL, of 53, Victoria Street, London, S.W., Electricians, do hereby declare the nature of this invention and in what manner the same is to be performed to be particularly described and ascertained in and by the following statement:—

Our invention relates to electrical clocks and similar instruments.

One object of our invention is to construct an improved electrically wound regulator or controlling clock in which the continuity of the electric circuit is maintained for a short period of time only; by this means we are enabled to use an open circuit battery such as a Leclanche battery in place of a closed circuit battery. Another object of our invention is to so arrange the electric circuit in a system of electrically controlled clocks that the same shall be first interrupted in the movement of one of the controlled clocks, and not be made again until said clock has been operated. Consequently the next time that the regulator requires rewinding if said clock has not been operated a circuit

can no longer be established, and the whole system is stopped until the clock movement is put right.

In order that our invention may be clearly understood we will now proceed to describe the same with reference to the accompanying drawings how we may carry out the same in practice.

Figure 1 is an elevation illustrating our improved regulator.

Figure 2 illustrates diagrammatically a system wherein a regulator is controlling a single electrical clock, the circuit being arranged in accordance with our present invention.

Referring now to Figure 1 the regulator therein shewn is of the type illustrated in Figure 1 of the drawings accompanying the Specification of Letters Patent No. 1587 of 1895 granted to us. H is the pendulum supported by a suspension spring H^1 in the usual manner. C^1 C^2 are impulse arms or gravity pieces centred at C^3 C^4 and provided with contact arms C^5 C^6. A^1 A^2 are detents pivoted at A^3 A^4 and adapted to engage with pallets C^7 C^8 provided on the impulse arms C^1 C^2. The pendulum H is furnished with a roller H^2 centred at H^3 and so arranged that as the pendulum vibrates said roller alternately depresses the detents A^1 A^2, thereby releasing the pallets C^7 C^8. The electrical portion of the regulator comprises two electro-magnets D D^1 having armatures D^2 D^3 pivoted at D^4 D^5 respectively. The pivots are arranged to insulate the armatures from the base. Said armatures are provided with contact points adapted to make contact with the contact pieces C^5 C^6 of the impulse arms. The movement of the armatures D^2 D^3 is limited by insulating stops D^6 as shewn. X is an electrically operated dial movement of any suitable description and C is the battery. The electrical connections are as follows. From the battery C through wire 1 to the dial movement. From the dial movement through wire 2, electromagnet D, armature D^2, contact piece C^5, pivot C^3, to the base; and from the base by wire 3 to the battery C again. The electromagnet D^1 is connected by the wire 4 to the dial movement and through armature D^3, and contact piece C^6 to the base. It will be readily understood from the foregoing description that when armature D^2 is in contact with contact piece C^5, current will flow through electromagnet D and through the dial movement, the electromagnet D^1 being in circuit when its armature D^3 is in contact with the contact piece C^6.

The operation of the regulator is as follows:—

In the drawing the pendulum is shewn at rest the circuit being open. On starting the pendulum by swinging it say to the left, the roller H^2 presses down the detent H^1, thereby releasing the pallet C^7, the impulse arm C^1 then drops and the pin C^9 on the end thereof and comes in contact with the pendulum. As the pendulum continues to swing to the left the impulse arm C^1 is lifted rotating on its pivot C^3 and the detent A^1 is depressed still further owing to the roller H^2 travelling up the incline A^5. When the pendulum has reached the limit of its movement and begins swinging to the right the impulse arm C^1 follows it and since the detent A^1 is held down by the roller H^2 the pallet C^7 will be enabled to pass the detent. The movement of the impulse arm C^1 and pendulum H continues until contact piece C^5 makes connection with armature D^2 upon which the circuit is made through electromagnet D. The armature D^2 is thereby attracted and pulled upwards raising the impulse arm C^1. The upward movement of the armature D^2 is limited by the upper stop D^6, while the movement of the impulse arm C^1 upon its pivot C^3 is not limited; consequently the circuit will be broken between the contact piece C^5 and the pin at the end of the armature D^2. When this occurs the magnet D being no longer energized permits the armature D^2 to fall to its lower stop and the impulse arm C^1 will also drop. Meanwhile, however, as the pendulum H continues to swing to the right the roller H^2 will have left the incline A^5 and the detent A^1 will have moved up, and consequently is in position to engage the pallet C^7 when the arm C^1 drops. As soon the pendulum H has passed its middle position when swinging to the right the cycle of operations above described with reference to the left hand impulse arm

and detent A^1 and will be repeated with the right hand impulse arm C^2 and detent A^2, consequently the electromagnets D and D^1 will be put in circuit with the battery C and dial movement, alternately during each single vibration of the pendulum H.

In order to ensure the detents A^1 A^2 engaging with their respective pallets they are lightly weighted as shewn at A^6, stops A^7 being provided to prevent the detents rising too high.

It will be observed that at the time when the contact piece C^5 makes connection with the armature. D^2 the pallet C^7 is in contact with the incline A^5, so that a small amount of friction at this surface will require to be overcome when the impulse arm is raised by the electromagnet. In order to obviate this we sometimes provide additional electromagnets E E^1, shewn in dotted lines in the figure, connected in series with the magnets D D^1 respectively, and adapted when energized to pull down the respective detents A^1 A^2. By these means as soon as the magnet D for example is energized and begins to raise its armature D^2 the magnet E will also be energized and depress the detent A^1 which will therefore offer no impediment to the rise of the impulse arm C^1. A further advantage which arises from this arrangement is that the incline A^5 needs not to be extended as far as the notch of the detent, consequently during the time when the impulse arm is giving energy to the pendulum, namely, when it is falling from the position shewn in the drawing to the position where its contact piece makes connection with the armature of the electromagnet the pallet C^7 will not be in contact with the detent. The mechanism shewn in the drawings is of course bilaterally symmetrical, and the description of the parts and operation of the detent A^1 and impulse arms C^1 is applicable to that of the detent A^2 and impulse arm C^2.

It will be observed that the current from the battery C is flowing only during the movement of the armature D^2 from its lower stop to its upper stop, consequently it follows that the battery C is nearly always on open circuit.

Referring now to Figure 2 A is the regulator controlling a clock movement B, the battery or other source of electricity being indicated at C as before.

a is a ratchet wheel, the rotation of which is governed by any suitable escapement, such as an ordinary pendulum escapement for example. *b* is a lever pivoted at b^1 and provided with a click b^2 which engages with the teeth of the wheel *a*. Said lever is operated by a spring b^3, and through the click b^2 tends to rotate the wheel *a* in the direction of the arrow. Instead of the spring b^3 a weight may obviously be used to act upon the lever *b*. *c* is a lever pivoted at c^1 carrying the armature c^2 of an electromagnet *e*. Said lever also carries a contact c^3 adapted to connect with the lever *b*. The downward movement of lever *c* is limited by the stop c^4 and a stop *d* is provided for limiting the movement of the lever *b* in an upward direction.

Referring now to the movement shewn at B which is controlled by the regulator A, *f* is a wheel which may be in connection with the minute hand of a clock or which is otherwise adapted to drive the remaining wheels of a clock dial. Said wheel is provided with rectangular teeth the faces of each teeth making angles of 45° with the radius of the wheel. f^1 is a lever pivoted at f^2 carrying the armature f^3 of an electromagnet e^1. Said lever is also provided with a click f^4 which engages with the teeth of the wheel *f*. f^5 is a spring which operates to move the lever f^1 forward and so rotate the wheel *f* in the direction of the arrow. The movement of the said lever is limited on one direction by the stop f^7, in the other direction by the stop f^6 against which the click f^4 is pressed if the wheel *f* is rotated a certain distance. f^8 is a spring mounted on the click f^4 which in the normal position of the lever f^1 and click makes contact with an insulated stud f^9. To prevent the wheel *f* running back we provide a retaining click f^{10} pivoted at f^{11} and adapted to engage with the teeth of the wheel as shown. The electric circuit is as follows—From the battery C through the wire *g* to insulated terminal *t* on the base of the controller B. From terminal *t* through the electromagnet e^1 spring f^5 click f^4 and spring f^8 to stud f^9 and thence to terminal t^2 through

wire g^1 to insulated terminal t^3 on the base of the regulator A. From terminal t^3 through electromagnet e lever b and when lever b and contact c^3 are in connection, through lever c, insulated terminal t^4 and from said terminal through wire g^2 to the battery C. It must be observed that the stud c^4 and the pivot c^1 are insulated from the base of the regulator in order that the circuit may be broken when the lever b is raised out of contact with the point c^3.

The operation of the system is as follows—The lever b moves on its pivot under the influence of the spring b^3 and through the click b^2 rotates the wheel a in the direction of the arrow, the speed of rotation of said wheel being regulated by the escapement. As soon as the lever b reaches the contact c^3 the circuit is made and a current from the battery C passing round the electromagnet e energises the same and armature c^2 is attracted, thereby raising lever b to its topmost position, so that when the armature c^2 is released the lever b will be again in a position to operate the wheel a. It will be observed that during the rise of these two levers the contact point c^3 rubs on the lever b and by this means is maintained clean and in condition to afford a good electrical contact. The making of the electric circuit also energises the magnet e^1 in the clock movement B whereupon the armature f^3 is attracted and lever f^1 moves in the direction of the arrow against the force of the spring f^5 withdrawing the click f^4 from the teeth of the wheel f. As soon as this withdrawal is accomplished the click f^4 drops so as to engage with the next tooth of the wheel f and in so dropping breaks the connection between spring f^8 and contact stud f^9. The armature c^2 in the regulator A and also the armature f^3 in the movement B are thereby released, and the levers c and f^1 return to their normal position. In doing so the lever c makes an additional break in the circuit, namely, between the lever b and contact c^3. The lever f^1 which moves forward under the influence of the spring f^5 as soon as its armature is released rotates the wheel f in the direction of the arrow through the click f^4 until said click is brought into contact with the stop f^6 at which time the spring f^8 again makes contact with the stud f^9. No current will, however, flow round the circuit until the lever b is dropped sufficiently to again make contact with the point c^3. During the rotation of the wheel f the retaining click f^{10} is raised, and falls into the next tooth of the wheel.

It will be observed from the foregoing that the wheel f is rotated through the space of one tooth every time the lever b makes contact with the point c^3. The establishment of the circuit and consequent re-setting of the lever b is, however, dependent upon the operation of the wheel f since the spring f^8 will not connect with the stud f^9 unless the click f^4 has moved forward.

One or more clock movements similar to that illustrated at B may be employed with the same regulator, the current passing through them on the same circuit and in such a case it is generally only necessary to provide for breaking the circuit in one of said movements.

An important advantage which we obtain with our improved system is that the circuit is maintained while the work is being performed but is cut off the moment the work is done, hence the duration of contact is always sufficient to ensure the proper operation of the clock movement, and at the same time is not unnecessarily prolonged.

The form of the teeth of the wheel f, namely, with straight faces making an angle of 45° with the radius taken into conjunction with the position of the click f^4 which is also normally at 45° to the radius, is important inasmuch as the click moves straight out of engagement with the wheel teeth, and consequently will be operated very readily, so that a very short duration of contact between the lever b and point c^3 will cause the operation of the clock movement B. In a movement of this description as ordinarily constructed the click f^4 is approximately tangential to the wheel f and the stop f^6 being located immediately above the said click the smallest eccentricity in the wheel f would cause the click to bind between the wheel and the stop, and thereby interfere with the operation, this does not occur with our improved device.

It is sometimes desirable to attach to the retaining click f^{10} the armature of a small magnet connected in series with the magnet e^1, by this means we ensure that the driving wheel f shall be locked while the driving click f^4 is being withdrawn.

Having now particularly described and ascertained the nature of our said invention and in what manner the same is to be performed, we declare that what we claim is:—

1. A gravity escapement provided with means operated by the pendulum for mechanically releasing the impulse arms from their respective detents, and with electromagnetic means for raising and replacing said arms when necessary, either with or without electromagnetic means for holding the detents clear of the impulse arms at the movement of replacement.
2. A gravity escapement constructed and operating substantially as described with reference to Figure 1 of the accompanying drawings.
3. A system of one or more dial movements, electrically operated and controlled by an electrically wound regulator and so arranged that the electric circuit is interrupted at a dial movement before being disconnected at the regulator and cannot be again established until the said dial movement has been operated and the regulator requires resetting.
5. In an electrical indicator dial movement of the class described, the click f^4 and its adjacent co-operating parts constructed and operating as described.
6. A dial movement constructed and operating as described with reference to Figure 2 of the accompanying drawings.

Dated this 26th day of January 1898.

W. P. THOMPSON & Co.,
Of London, Liverpool, Manchester and Birmingham,
Patent Agents for the Applicant.

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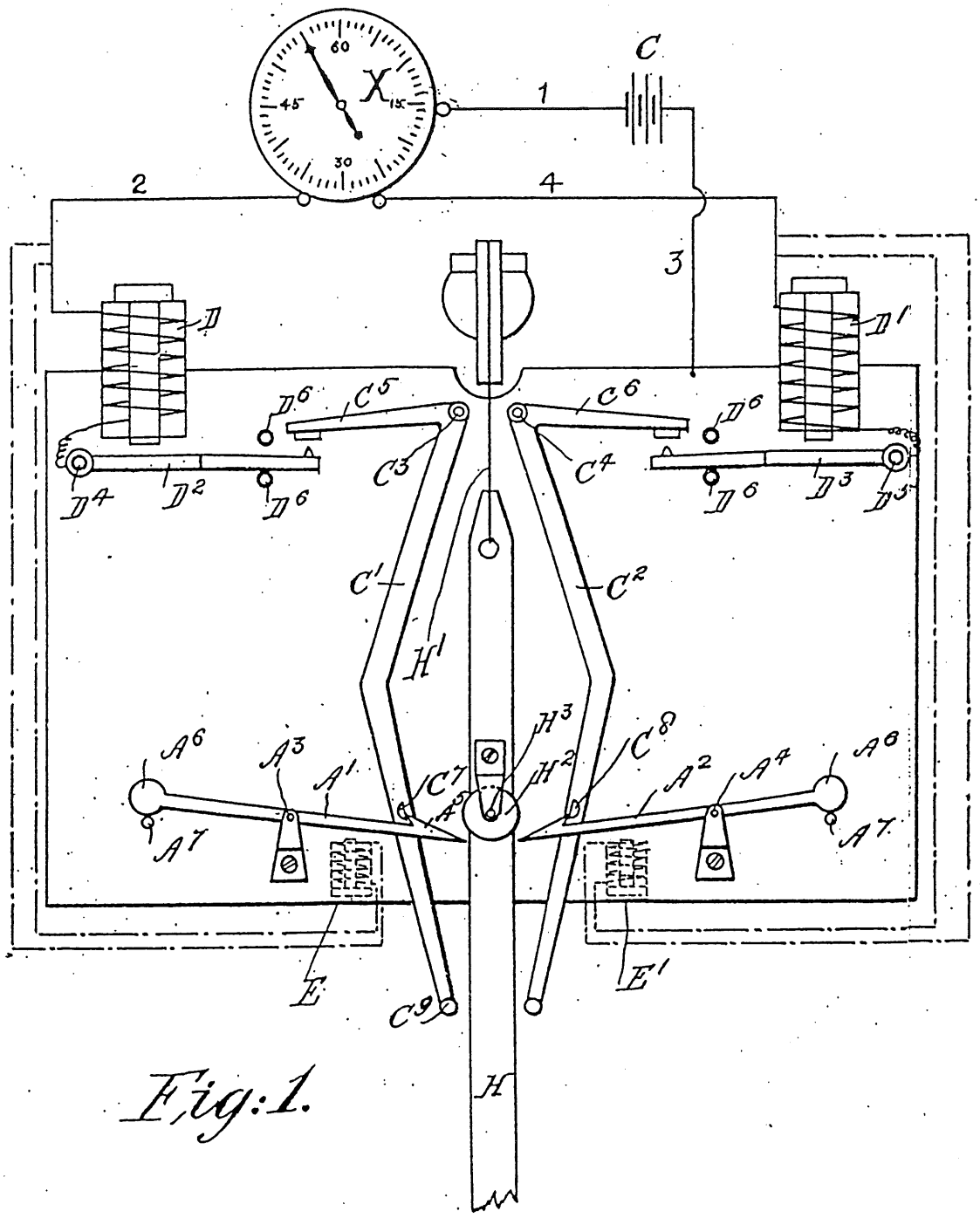
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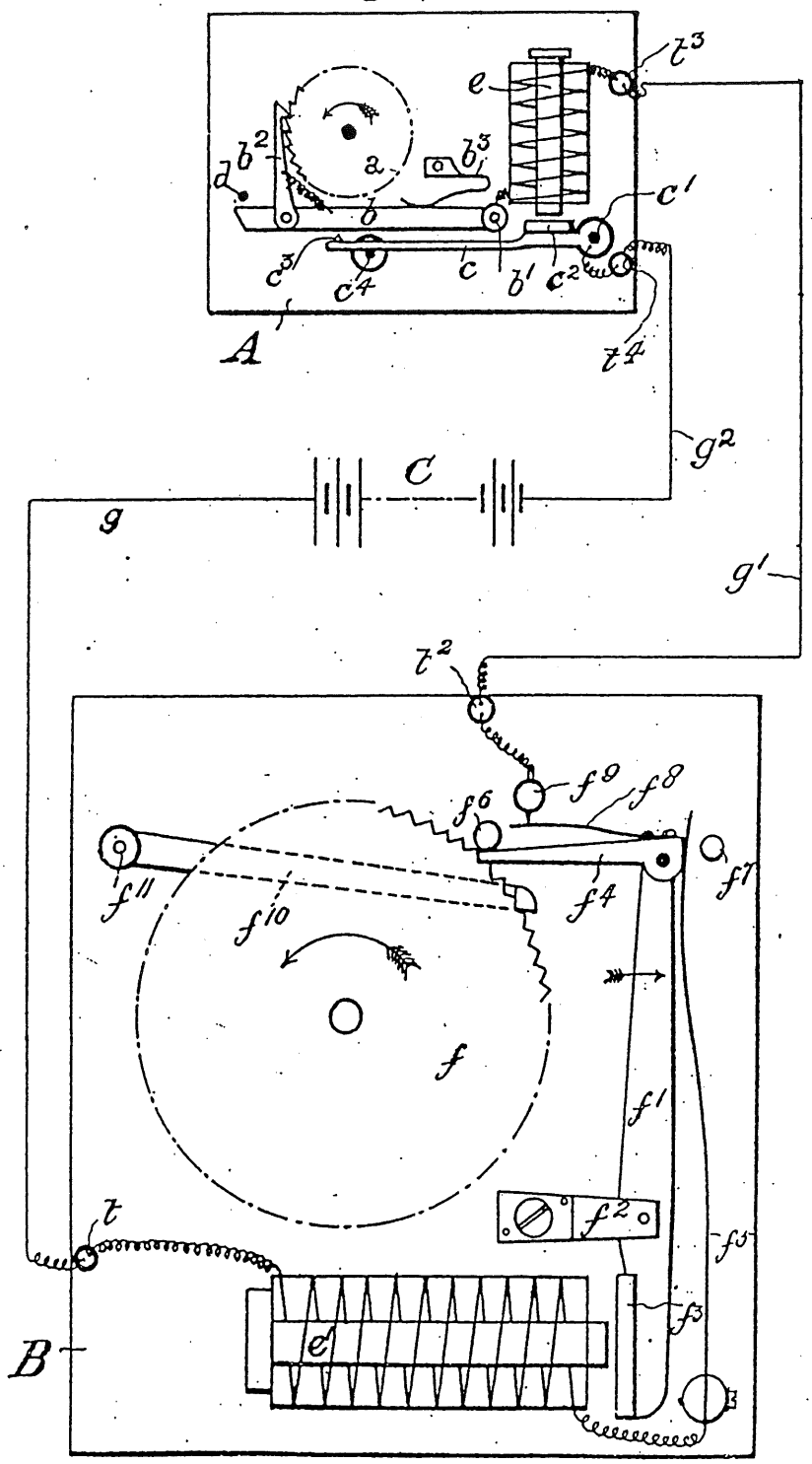
Fig. 1.

Fig: 2.



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