PATENT SPECIFICATION

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421,746

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PROVISIONAL SPECIFICATION
No. 21153, A.D. 1933.

Improvements relating to Electrically Driven Clocks

We, GENT & COMPANY LIMITED, a British Company of Faraday Works, St. Saviour's Road (East), Leicester and REGINALD SWIFT, a British Subject, of 17, The Circle, Crown Hills, Leicester, do hereby declare the nature of this invention to be as follows:—

This invention relates to electric clocks and has particular reference to master clocks for use in controlling installations comprising a group of subsidiary impulse clocks which are to be controlled by the master clock. The object of the present invention is to provide a suitable control or contact mechanism which enables a synchronous motor clock to be used as a master clock and yet will be reliable and will maintain an accurate time keeping, and will ensure actuation of the subsidiary impulse dials at regular intervals.

According to the present invention, a member which, for example, may be a pivoted lever is driven from a synchronous clock movement and acts upon a cam surface, such as a wedge-block, carried by a bar carrying one of the control contacts so that the contacts are pressed together to give the time of contact but interruption of the contacts is provided for by the moving member being constructed and arranged to release the surface of the wedge-block on the contact bar so that the latter is quickly moved away from the co-operating bar by its own spring. The pivoted lever has a folding latch pivoted at its free end, the tip of which latch co-operates with the surface of the wedge-block on one of the contact bars and thereby presses the contact bars together for a selected time period during movement of the lever in one direction and immediately there is a tendency for the lever to reverse, the latch is folded down and its tip moves out of the path of the wedge-block so as not to maintain contact but to allow the contact bar bearing the wedge block to be drawn back. In order to provide for an appreciable and controllable time of contact and to allow of a quick break of contact, the pivoted lever is arranged to remain in position at the end of its movement to keep the contacts together for a selected period and then to receive a kick due to the rebound of a suspended mass and that kick produces a quick break of contact and causes folding of the latch so that it is brought out of contact with the wedge-block and does not re-establish contact on the return movement of the lever.

In order that the nature of the invention may be clearly understood, an impulse mechanism driven from a synchronous clock will now be described by way of example in greater detail.

The clock movement consists of any approved form a synchronous clock movement driven by alternating current and may, for example, be provided with mechanism in accordance with Patent No. 385,457 for enabling it to run into synchronism. A cam, which in the example considered is a two-lift snail cam, is carried by the minute arbor of the clock movement and the purpose of the cam is slowly to lift twice in each revolution, that is every half minute a horizontal lever and to let it fall suddenly. The horizontal lever is pivoted to the framework of the clock and is drawn down against a buffer or stop by a tension spring. This is arranged by means of a pin projecting from the lever held in contact with the cam by the tension spring. The upper end of the lever is forked and in the fork is pivoted a small folding latch which is normally held by a weak leaf spring in such a position that its tip projects forwardly during the downward movement of the lever but is folded back during the upward movement.

The contact carrying members are a pair of pivoted bars which are approximately vertical. One is pressed forward towards a front stop by a leaf spring, adjustable by means of a screw. The other contact bar is normally drawn against a stop bushing by a tension spring so that, in the position of rest, the two contact bars are kept apart. The second

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contact bar is provided on its rear surface with a cam in the form of a small metal wedge-block which is in a position to be engaged by the tip of the latch already referred to. When the pivoted lever is released by the cam, it moves quickly downwards under the effect of its tension spring, the tip of the latch projects and acts on the wedge-block so as to push away the contact bar carrying the wedge-block against the action of its spring so that the bars are moved away from their stops, and the contacts are brought together during the greater part of the falling stroke of the lever and for a period of dwell at the end of that falling stroke.

It should be noted that directly there is a tendency for the pivoted horizontal lever to move in the opposite direction that is upwards, the pivoted patch is folded downwards and tilted about its pivot and the tip of the latch therefore is quickly moved out of the way of the wedge-block. The latter with its contact bar is drawn rapidly backwards by the tension spring of the bar so that contact with the co-operating contact bar is broken for the remainder of the half minute.

Provision is made for a controllable period of dwell of the contacts together at the end of the stroke and then for the contacts to separate quickly. This may be arranged by arranging an arm pivoted to the main lever near its pivot to be ballasted by attaching a considerable mass at its free end. The arm is, however, normally held in line with the pivoted lever against the stop pin on the latter by a leaf spring. Owing to the inertia of this mass, however, when the lever moves rapidly downwards as allowed by the two-lift cam, the arm is suddenly brought to rest by a stop pin, but the mass, due to its inertia causes the subsidiary arm to overshoot bending its leaf spring, but the mass immediately rebounds under the action of the spring striking the stop pin on the moving arm and slightly kicking the latter upwards. This results in the catch being quickly folded away so that its tip moves from the wedge-block and sudden interruption of contact is effected due to the flying back of the contact of the contact arm bearing the wedge-block. The moving arm then continues to rise under the action of the cam and the cycle is repeated. By suitable choice of the weight of the mass attached to the arm and of the strength of the leaf spring a period of contact of any duration desired may be obtained. In practice, a period of contact of about one tenth of a second is useful for clock purposes. It is necessary to be able to maintain contact for an appreciable time as otherwise, the magnetism may not have time to build up in the fields of the subsidiary clocks and they may fail to be driven.

Dated this 27th day of July, 1933.

For the Applicants:—
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Chartered Patent Agents,
51/52, Chancery Lane, London, W.C. 2.

PROVISIONAL SPECIFICATION

No. 16813, A.D. 1934.

Improvements relating to Electrically Driven Clocks

We, GENT & COMPANY LIMITED, a British Company of Faraday Works, St. Saviour's Road (East), Leicester, and REGINALD SWIFT, a British Subject, of 17, The Circle, Crown Hills, Leicester, do hereby declare the nature of this invention to be as follows:—

This invention relates to electric clocks and has particular reference to master synchronous clocks for use in controlling installations comprising a group of subsidiary impulse clocks which are to be controlled by the master clock. The invention is cognate with or a modification of the master clock mechanism described in patent application No. 21153/33, (Serial No. 421,746) and the object of the present invention is to provide improvements in the mechanism described in the specification of that application and also to provide means for ensuring that on interruption of the alternating current supply to the synchronous motor, the driving of the clock mechanism will be continued.

The specification of patent application No. 21153/33 (Serial No. 421,746) describes a master clock mechanism driven by a synchronous electric motor and provided with a horizontal lever arranged to be lifted by a snail cam carried on the minute arbor of the clock movement. The cam surface is designed to permit the horizontal lever to fall suddenly after being lifted, and in the particular example set forth, the rate of movement is such that the horizontal lever is raised at half minute intervals. The horizontal lever is pivoted to the framework of the clock and is drawn down against a buffer or stop by a tension spring. This is arranged by means of a pin projecting from the

lever held in contact with the cam by the tension spring. One end of the lever is forked and in the fork is pivoted a small folding latch which is held by a weak leaf spring in such a position that its tip projects forwardly during the downward movement of the lever but is folded back during the upward movement.

The contact carrying members are a pair of pivoted bars which are approximately vertical. One is pressed forward towards a front stop by a leaf spring, adjustable by means of a screw. The other contact bar is normally drawn against a stop bushing by a tension spring so that, in the position of rest, the two contact bars are kept apart. The second contact bar is provided on its rear surface with a cam in the form of a small metal wedge-block which is in a position to be engaged by the tip of the latch already referred to. When the pivoted lever is released by the cam, it moves quickly downwards under the effect of its tension spring, the tip of the latch projects and acts on the wedge-block so as to push away the contact bar carrying the wedge-block against the action of its spring so that the bars are moved away from their stops, and the contacts are brought together during the greater part of the falling stroke of the lever and for a period of dwell at the end of that falling stroke.

Directly there is a tendency for the pivoted horizontal lever to move in the opposite direction that is upwards, the pivoted latch is folded downwards and tilted about its pivot and the tip of the latch therefore is quickly moved out of the way of the wedge-block. The latter with its contact bar is drawn rapidly backwards by the tension spring of the bar so that contact with the co-operating contact bar is broken for the remainder of the half minute.

In order to provide for a controllable period of dwell of the contacts together, and for subsequent rapid separation of the contacts, an arm, weighted at its free end, is pivoted to the horizontal lever and is normally held in line with the latter by a leaf spring bearing against a stop pin. When the horizontal lever falls downwardly, the weighted arm is brought suddenly to rest by the stop pin, and the weight due to its inertia causes the arm to overshoot, bending its leaf spring, but the weight immediately rebounds under the action of the spring, striking the stop pin and slightly kicking the arm upwards. This results in the latch being quickly folded away so that its tip moves from the wedge-block and sudden interruption of the contact is effected due to the flying back of the contact on the contact arm bearing the wedge-block. The horizontal lever then continues to rise under the action of the cam, and the cycle is repeated.

According to one feature of the present invention, a master clock mechanism driven normally by an alternating current synchronous motor is provided with a direct current motor which takes over the drive of the master clock mechanism if the alternating current supply to the synchronous motor fails, as set forth in patent application No. 19996/33 (Serial No. 421,744). It is important in a master clock system that the direct current motor shall effect the drive at the same speed as the alternating current motor, and in accordance with a further feature of the present invention the average speed of the direct current is maintained equal to the synchronous speed of the alternating current motor. To facilitate this, the speed of the direct current motor is varied by adjustment of the vibration period of the leaf spring bearing upon the toothed wheel and a further adjustment may be effected by inserting a variable resistance in series with the direct current field winding. It is also necessary to ensure that on resumption of the alternating current supply the drive shall be taken over by the synchronous motor with certainty. Accordingly, on resumption of the alternating current supply the mechanism is temporarily driven simultaneously by the alternating and the direct current motors and the change-over from the direct current drive to the alternating current drive is effected at an instant when there is least load on the driving motor. The speed of the alternating current motor will then not tend to fall below the synchronous speed before it has fallen into step with the supply current. Thus, according to a further feature of the invention, on resumption of the alternating current supply the armature controlling the circuit of the direct current field magnet is only attracted to the alternating current field system when it has been brought within effective range of influence of that system by a movement imparted to it by the horizontal lever during the downward movement of the latter.

It is desirable that the meeting and separation of the contacts should be rapid, and in order to assist this according to a further feature of the invention there is a certain degree of lost motion in the driving connection between the arbor and the lift cam which raises the horizontal lever. According to yet a further feature of the invention, the period of control of the contacts in engagement with each

other is controlled by a pivoted member, the inertia or period of swing of which is adjustable.

In order that the nature of the present invention may be more clearly understood, one example of a driving mechanism for a master clock constructed in accordance therewith will now be described in greater detail.

The principal features of the mechanisms described in the specifications of patent applications No. 21153/33 (Serial No. 421,746) and 19996/33 (Serial No. 421,744) are retained, but, if in consequence of failure of the alternating current supply, the direct current motor has taken over the operation of the mechanism, as mentioned previously, it is important in a master clock mechanism that the direct current motor shall effect the drive at the same speed as the alternating current motor, and certain modifications are introduced in carrying the present invention into effect. It will be readily understood that if, in order to ensure that the alternating current motor will fall into step on resumption of the supply, the direct current motor is caused to run slightly above the synchronous speed as described in the specification of patent application No. 19996/33 (Serial No. 421,744), the whole system of clocks will be fast when the alternating current motor again takes over the drive. Accordingly, the speed of the direct current motor may conveniently be controlled by a variable resistance placed in series with the battery supplying the direct current field magnet and in addition the vibration period of the leaf spring bearing upon the toothed wheel may be adjusted by altering the tension of a helical spring interposed between an adjustable screw and a clamping block for the leaf spring.

It is desirable then to have the direct current motor running at the same average speed as the alternating current motor, and provision must be made to ensure that the alternating current motor will take over the drive effectively on resumption of the supply. Thus, as indicated previously the direct current motor is not switched out of circuit immediately on resumption of the alternating current supply but the mechanism is designed as described later, to permit the mechanism temporarily to be driven simultaneously by the alternating and direct current motors, and the changeover from the direct current to the alternating current drive is only effected at the instant when the horizontal lever falls to cause engagement of the contacts, because at that instant there is least load on the driving motor and its speed will tend to be above the synchronous speed, enabling the alternating current motor effectively to take over the sole drive of the mechanism. The alternating current motor is thus assisted in falling readily into step with the frequency of the supply current. It will be understood that during operation of the mechanism there will be regularly recurring periods of variable load on the motor. Thus, as the horizontal lever is raised, the load gradually increases and the motor tends to slow down. After the horizontal lever has reached the top of its stroke, however, and falls suddenly, the load on the motor is temporarily lightened and its speed will tend to rise. This will be appreciated also because the direct current motor has the characteristic of a series motor and there will be a change in speed with a change in the load, thus rendering control necessary. However, by an initial careful adjustment of the tension on the leaf spring contact and adjustment of the variable resistance, the average speed of the direct current motor may be made equal to the synchronous speed of the alternating current motor.

The pivoted lever which carries the armature and controls the spring contact finger bearing on the toothed wheel between the alternating current and direct current rotors as described in the specification of patent application No. 19996/33 (Serial No. 421,744), is provided with a pin which rests against another pin projecting rearwardly from a downwardly extending arm of the horizontal lever. When the horizontal lever falls to effect engagement of the contacts, the pin projecting from the forwardly extending arm of the horizontal lever gives a kick to the pin projecting from the pivoted lever carrying the armature, causing the latter to approach the alternating current field magnet system. When the alternating current supply fails, the pivoted lever carrying the armature falls away from the alternating current field magnet to a distance such that, should the alternating current supply be resumed, the armature will not be attracted to the alternating current field magnet but when the armature is brought closer to the alternating current field magnet, due to the kick imparted to the pivoted lever as previously described, it is brought sufficiently near to be attracted to, and held in contact with, the alternating current magnet. From the preceding description it will be understood that when the armature has been so attracted, the circuit of the direct current motor is automatically broken, owing to the spring contact being pressed away from the

toothed wheel by the piece of ebonite on the pivoted lever.

As previously mentioned, it is desirable that the meeting and the separation of the contacts should be rapid, and in order to assist this, the driving connection between the arbor and the two-snail lift cam which raises the horizontal lever, is in the form of a pin and slot connection which provides a certain degree of lost motion between the arbor and the cam. Thus, when the pin projecting from the horizontal lever into engagement with the cam surface reaches the tip of the cam, the spring tending to draw the horizontal lever down has no positive resistance to overcome due to a rigid driving connection between the arbor and the cam, but because of the loose driving connection is enabled to draw the horizontal lever down instantaneously. The contact bar carrying the wedge-block is thus forced rapidly over towards its co-operating contact bar and the contacts meet smartly. Again, when the pivoted composite rod gives its kick to the horizontal lever to separate the contacts, the lost motion between the arbor and the cam again ensures that there will temporarily be no resistance to the necessary slight movement of the horizontal lever.

The contacting surfaces of the wedge-block and the folding latch are each provided with inserts of material known under the registered trade mark "Oilite". This is a porous bronze metal containing oil and forms a self-lubricating surface which facilitates the action of the engaging surfaces.

The device for controlling the period of dwell of the contacts which, in the form described in patent application No. 21153/33 (Serial No. 421,746) consists of a weighted arm pivoted to the horizontal lever and normally held in line with the latter by a leaf spring, is modified in the construction according to the present invention and takes the form of a composite rod which is weighted at both ends and is pivoted about the same axis as the horizontal lever. The composite rod comprises two separate rods screwed at diametrically opposite points into a hub which fits freely on to a pivot pin projecting from a point in the horizontal lever at its own pivot. The horizontal lever is provided with an arm extending downwardly and forming with the horizontal lever an angle of about 110°. The lower end of this arm is provided with a pin extending at right angles to form a stop for the lower end of the weighted rod which, in the normal position, rests against this pin.

During movement of the horizontal lever and its downwardly extending arm, the weighted rod remains in contact with the pin but on the sudden fall of the horizontal lever after it has reached the top of its stroke, the pin gives a kick to the lower end of the weighted rod, causing it to swing sharply about its pivot away from the pin. On the return stroke of the weighted rod it gives a sharp blow to the pin, causing the horizontal lever to move about its pivot to an extent sufficient to allow the folding latch pivoted at the opposite end of the horizontal lever to be tilted by the wedge-block on the contact arm, so that the cam surface of the folding latch is again brought into engagement with the wedge-block. At the same instant, the contact bar carrying the wedge-block is free to be retracted by its spring from its co-operating contact bar, and the contacts are thus sharply separated. It will be understood that the period of dwell of the contacts may be determined by the mass of the weights at the ends of the composite rod, or by the length of the separate rods screwed into the hub, and it is convenient to adjust either of these in order to vary the period of dwell of the contacts.

In order to nullify the effect of sparking at the contact points between the spring contact and the toothed wheel, a fixed condenser has one plate system connected to the toothed wheel and its other plate system connected to the spring contact.

Dated this 6th day of June, 1934.

For the Applicants:—
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51/52, Chancery Lane, London, W.C. 2.

COMPLETE SPECIFICATION

Improvements relating to Electrically Driven Clocks

We, GENT & COMPANY LIMITED, a British Company of Faraday Works, St. Saviour's Road (East), Leicester, and REGINALD SWIFT, a British Subject, of 17, The Circle, Crown Hills, Leicester, 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:—

This invention relates to electric clocks and has particular reference to master

clocks for use in controlling installations comprising a group of subsidiary impulse clocks which are to be controlled by the master clock. The object of the present invention is to provide a suitable control or contact mechanism which enables a synchronous motor clock to be used as a master clock and yet will be reliable and will maintain an accurate time keeping, and will ensure actuation of the subsidiary impulse dials at regular intervals. A further object of the invention is to enable a master clock to continue operating in the event of failure of the alternating current supply to the synchronous motor element.

According to the present invention, the movement of a master clock for controlling a group of subsidiary clocks is operated by a synchronous electric motor and includes a pivoted lever which acts upon a cam surface operatively associated with a member carrying a contact to cause engagement of that contact with another contact in a circuit controlling the subsidiary clocks directly or indirectly. In a particular form of clock constructed in accordance with the invention, a direct current motor is provided in addition to the alternating current motor, and the direct current motor can take over the drive of the movement on cessation of the alternating current supply. In this form of construction, the pivoted lever is raised by a cam and, on its downward movement, acts on a cam surface carried by a contact-carrying member to cause engagement of that contact with another contact in the circuit of the subsidiary clocks, the contacts being separated after a predetermined interval by release of the pivoted lever from the cam surface. The pivoted lever is provided with a folding latch pivoted at its free end and designed to act as a rigid extension of the pivoted lever when engaging the cam surface to effect engagement of the contacts, but on upward movement of the pivoted lever, the folding latch is ineffective as a rigid extension of the pivoted lever, being caused to move out of the path of movement of the cam surface. The period of dwell of the contacts in engagement with each other is controlled by a pivoted member, the time period of swing of which is adjustable.

It is important, in a master clock system, that the mechanism should be driven at a constant speed at all times, and in the particular construction in accordance with the invention in which an auxiliary direct current motor is employed, provision must be made to ensure that the direct current motor, the speed of which varies with variation of load during each cycle, shall effect the drive of the mechanism at the same speed as the alternating current motor. In accordance with a further feature of the invention, therefore, the average speed of the direct current motor is maintained equal to the synchronous speed of the alternating current motor, and the speed of the direct current motor is varied by adjustment of the vibration period of a leaf spring bearing upon a toothed contact wheel. Further control of speed is effected by adjustment of a variable resistance placed in series with the direct current field winding. It is also necessary to ensure that, on resumption of the alternating current supply, the drive shall be taken over by the synchronous motor with certainty. Accordingly, on resumption of the alternating current supply, the mechanism is temporarily driven simultaneously by the alternating and the direct current motors and the change-over from the direct current drive to the alternating current drive is effected at an instant in the cycle of operations when there is least load on the driving motors. The speed of the alternating current motor will then not tend to fall below the synchronous speed before it has fallen into step with the supply current. Thus, according to yet a further feature of the invention, on resumption of the alternating current supply, an armature controlling the circuit of the direct current field magnet is only attracted to the alternating current field system when it has been brought within effective range of influence of that system by a movement imparted to it by the pivoted lever during the downward movement of the latter.

It is desirable that the meeting and separation of the contacts should be rapid, and in order to assist this, according to still a further feature of the invention, there is a certain degree of lost motion in the driving connection between the spindle and the lift cam which raises the pivoted lever. Furthermore, the period of dwell of the contacts in engagement with each other may be controlled by a pivoted member, the time period of swing of which is adjustable.

In order that the invention may be more clearly understood and readily carried into effect, a complete master clock mechanism constructed in accordance therewith will now be described, by way of example, in connection with the accompanying drawings, in which,

Figure 1 shows the master clock mechanism mounted within a casing together with one impulse clock of the kind controlled by the master clock;

Figures 2 and 3 are detailed views

showing two positions of the pivoted lever and corresponding positions of the other parts of the mechanism; and

Figure 4 shows diagrammatically the circuit connections of the alternating current and direct current motors.

The alternating and direct current motors which drive the contact closing mechanism are similar to those described in the specification of co-pending patent application No. 19996/33 (Serial No. 421,744), and it will therefore be unnecessary to describe the construction of the motor elements in greater detail than is essential to an understanding of the present invention.

Referring to Figure 1 of the drawings, a master clock mechanism 1 is mounted within a casing 2 of wood, having a hinged cover 3 provided with a glass panel behind which is mounted an impulse dial mechanism 4. A coil 5 which energises the field system 6 of the alternating current motor, is supplied with alternating current by a twin flexible lead 7, provided with a connecting plug not shown. The coil 8 which energises the field system 9 of the direct current motor on failure of the alternating current supply is supplied with direct current from a battery, not shown in the drawings, by a twin flexible lead 10. The coil 11 which energises the impulse mechanism, is supplied with current from a battery, not shown, by a twin flexible lead 12.

The central spindle 13 is driven from the spindle 14 of the rotor 15 through ordinary gearing which, for the sake of clearness has not been shown in detail, and a two lift snail cam 16 shown clearly in Figures 2 and 3, is mounted loosely on the spindle 13. A lost motion driving connection which may be of the pin-and-slot type, is provided between the cam 16 and spindle 13. Only a small degree of lost motion is required as will appear from the subsequent description.

A composite lever 17 is mounted to pivot about a pin 18 projecting from the field system 6, and has secured to it by screws 19, a downwardly extending arm 20. A pin 21 projecting rearwardly from the lever 17, engages the surface of the cam 16 and as the cam is driven, the lever 17 is caused to rise until the pin 21 reaches the tip of the cam, when the lever then falls suddenly. The lost motion driving connection between the cam 16 and spindle 13 facilitates the rapid fall of the lever 17, because there is no restraint of movement of the pin 21 against the straight edge of the cam 16. The downward movement of the lever 17 is limited by an adjustable stop 22. A coiled spring 23, anchored at 24 to the framework of the mechanism, is attached at 25 to the underside of the lever 17 and exerts a strong downward pull on the lever at all times. Thus, during operation, when the pin 21 reaches the tip of the cam 16, the spring 23 causes the lever 17 to be drawn rapidly downwards in a positive manner.

A folding latch 26 is pivoted at 27 in a fork 28 at the free end of the lever 17. The tail 29 of the latch 26 rests against a stop 30 which bridges the limbs of the fork 28 and a light leaf spring 31 held by a screw 32 of the lever 17 presses on the latch sufficiently heavily to ensure that in the position shown in Figure 2 the tip of the latch forms a rigid extension of the lever 17.

The contacts 34, 35 controlling the circuit of the impulse clocks 36, shown diagrammatically in Figure 2, are carried by levers 37 and 38, pivoted at 39 and 40 respectively, so as to rest approximately vertically. When the contacts are open, the lever 37 is held against an adjustable stop 41 by a coiled tension spring 42 anchored to a pin 43 projecting from the bearing plate 44 and attached to an eyelet 45 on the lever 37. A wedge-shaped block 46 is fixed on the lever 37 by screws, and the front surface of the block 46 provides a bearing surface for the edge of the latch 26. The bearing surface of the block 46 has a metal insert of the material known under the Registered Trade Mark "Oilite." This is a porous bronze metal containing oil and forms a self-lubricating surface which facilitates the action of the engaging surfaces.

When the contacts 34, 35 are open, as shown in Figure 2, the lever 38 is pressed against a pin stop 47 by a leaf spring 48 secured by screws 49 to the lever 38. An adjustable screw 50 serves to control the pressure exerted by the spring 48. It is convenient to point out here that on the sudden downward fall of the lever 17, the tip of the latch 26 forces the wedge block 46, and with it the lever 37, to the left, causing the contacts 34, 35 to meet suddenly and close the circuit of the impulse clocks 36. The contacts 34, 35 remain closed until the latch 26 is tilted about its pivot 27, allowing the spring 42 to retract the lever 37 and separate the contacts. It is clear that at the instant of breaking contact, there is no inertia in the lever 37 to be first overcome, as, at that moment, it is already in motion. The result is that what is known as a "flying" break is obtained. The instant at which the latch 26 is tilted depends upon the period it is desired that the contacts 34 and 35 should remain together and the following description will make clear the method of

controlling that period.

When a large number of impulse clocks are included in the controlled circuit, it is necessary that the current impulse transmitted on closure of the contacts 34 and 35 should persist for a sufficient period to ensure that all the clocks are actuated, and a device is employed to provide for a controllable period of dwell of the contacts together. The device takes the form of a composite rod 51 provided at its ends with weights 52 and 53 and pivoted freely on the pin 18. The rod 51 comprises two separate rods screwed at diametrically opposite points into a hub 54, which fits freely on the pin 18. The lower end of the rod 51 normally rests against a pin stop 55 projecting from the lower extremity of the downwardly extending arm 20. During the upward movement of the lever 17, the rod 51 remains in contact with the pin 55, as shown in Figure 2, but on the sudden fall of the lever 17, after it has reached the top of its stroke, the pin 55 gives a kick to the lower end of the rod 51, causing it to swing sharply about its pivot 18, away from the pin 55, as shown clearly in Figure 3. On the return stroke of the weighted rod 51 it gives a sharp blow to the pin 55, causing the lever 17 to be moved slightly about its pivot to an extent sufficient to allow the folding latch 26 to be tilted by the wedge block 46 against the restraining leaf spring 31, and thus permitting the spring 42 to retract the lever 37, causing the contacts 34 and 35 to be separated sharply. It will be understood that the period of dwell of the contacts together may be determined by the mass of the weights 52 and 53 or by the length of the separate rods screwed into the hub 54, and it is convenient to adjust either of these in order to vary the period of dwell of the contacts.

As indicated previously, it is a feature of the present invention that in the event of failure of the alternating current supply to the field coil 5, the drive of the mechanism is taken over by the direct current motor, and the direct current field coil 8 is automatically energised. It is important, as previously mentioned, that the direct current motor shall effect the drive at the same speed as the alternating current motor, and in order to control the speed of the direct current motor, therefore, a variable resistance 56, shown diagrammatically in Figure 4, is provided, and in addition the vibration period of the leaf spring contact 57 bearing on the toothed wheel 64, is adjusted by altering the tension of a helical spring 58 shown in Figure 1 interposed between an adjustable screw 59 and a strip of brass 60 which serves to clamp the leaf spring contact 57 to a block 61. This adjusting device is described in detail in the specification of co-pending patent application No. 19996/33 (Serial No. 421,744).

It is desirable then to have the direct current motor running at the same average speed as the alternating current motor, and provision must therefore be made to ensure that the alternating current motor will take over the drive effectively on resumption of the supply. Thus, as indicated previously, the direct current motor is not switched out of circuit immediately on resumption of the alternating current supply, but the mechanism is designed to permit the alternating and direct current motors temporarily to operate simultaneously, and the change over from the direct current to the alternating current drive is only effected at the instant when the lever 17 falls to cause engagement of the contacts 34 and 35, because at that instant there is least load on the driving element and its speed will tend to be above the synchronous speed, enabling the alternating current motor effectively to take over the sole drive of the mechanism. The alternating current motor is thus assisted in falling readily into step with the frequency of the supply current. It will be understood that during operation of the mechanism there will be regularly recurring periods of variable load on the motor. Thus, as the lever 17 is raised, the load gradually increases and the motor tends to slow down. After the lever 17 has reached the top of its stroke, however, and falls suddenly, the load on the motor is temporarily lightened and its speed will tend to rise. This will be appreciated also because the direct current motor has the characteristic of a series motor and there will be a change in speed with a change in the load, thus rendering control necessary. However, by an initial careful adjustment of the tension on the leaf spring contact 57 and adjustment of the variable resistance 56, the average speed of the direct current motor may be made equal to the synchronous speed of the alternating current motor.

A pivoted lever 62 which carries an armature 63 and controls the spring contact finger 57 bearing on the toothed wheel 64 mounted between the alternating current and direct current rotors, as in the construction described in the specification of patent application No. 19,996/33 (Serial No. 421,744), is provided with a pin 65 which rests against another pin 66 projecting rearwardly from the downwardly extending arm 20 of the lever 17. When the lever 17 falls to effect engage-

ment of the contacts 34 and 35, the pin 66 projecting from the downwardly extending arm 20 of the lever 17 gives a kick to the pin 65 projecting from the pivoted lever 62 carrying the armature 63, causing the latter to approach the alternating current field magnet system 6. When the alternating current supply fails, the pivoted lever 62 falls away from the alternating current field magnet to a distance such that, should the alternating current supply be resumed the armature 63 will not be attracted to the field system 6, but when the armature 63 is brought closer to the field system 6, due to the kick imparted to the pivoted lever as just described, it is brought sufficiently near to be attracted to and held in contact with the field system 6. From the preceding description it will be understood that when the armature 63 has been so attracted the circuit of the direct current motor is automatically broken, owing to the spring contact 57 being pressed away from the toothed wheel 64 by the piece of ebonite 67 at the lower end of the pivoted lever 62.

In order to nullify the effect of sparking at the contacts 34 and 35 a condenser 68, shown in Figure 1, is connected by means of the twin flexible lead 69, across those contacts, the connection being effected at the terminals 70 of the impulse dial coil 11. The mechanism of the impulse dial forms no part of the present invention and is a known form of electromagnetically operated step by step mechanism.

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 master clock for controlling a group of subsidiary clocks, the movement of which is operated by a synchronous electric motor and includes a pivoted lever which acts upon a cam surface operatively associated with a member carrying a contact to cause engagement of that contact with another contact controlling the circuit of the subsidiary clocks.

2. A master clock according to claim 1, provided with a direct current motor which can take over the drive of the movement on cessation of the alternating current supply to the synchronous motor.

3. A master clock according to claim 1 or claim 2, in which the pivoted lever is raised by a cam and on its downward movement, acts on a cam surface operatively associated with the member carrying the contact to cause engagement of that contact with another contact in the circuit of the subsidiary clocks, the contacts being separated after a predetermined interval by release of the pivoted lever from the cam surface.

4. A master clock according to any one of the preceding claims, in which the pivoted lever is provided with a folding latch pivoted at its free end and designed to act as a rigid extension of the pivoted lever when engaging the cam surface to effect engagement of the contacts.

5. A master clock according to claim 4, in which, on upward movement of the pivoted lever, the folding latch moves out of the path of movement of the cam surface.

6. A master clock according to any one of the preceding claims, in which a member carrying one of the contacts is provided with a spring which tends normally to hold the contacts separated.

7. A master clock according to any one of the preceding claims, in which the period of dwell of the contacts in engagement with each other is controlled by a pivoted member, the time period of swing of which is adjustable.

8. A master clock according to any one of claims 2 to 7, in which the speed of the direct current motor is made variable by adjustment of the tension and thus the period of vibration of a contact member which causes the field coil to be energised intermittently.

9. A master clock according to any one of claims 2 to 8, in which, on resumption of the alternating current supply, the change-over from the direct current drive to the alternating current drive is effected at an instant when there is least load on the driving motor.

10. A master clock according to claim 9, in which an armature controlling the circuit of the direct current field system is only attracted to the alternating current field system when it has been brought within the effective range of influence of that system by movement imparted to it by the pivoted lever during its downward movement.

11. A master clock according to any one of claims 3 to 10, in which the meeting and separation of the contacts in the circuit of the subsidiary clocks is made rapid by providing lost motion in the driving connection between the cam which raises the pivoted lever and the cam spindle.

12. A master clock, constructed and operating, substantially as described with reference to the accompanying drawings.

Dated this 11th day of July, 1934.

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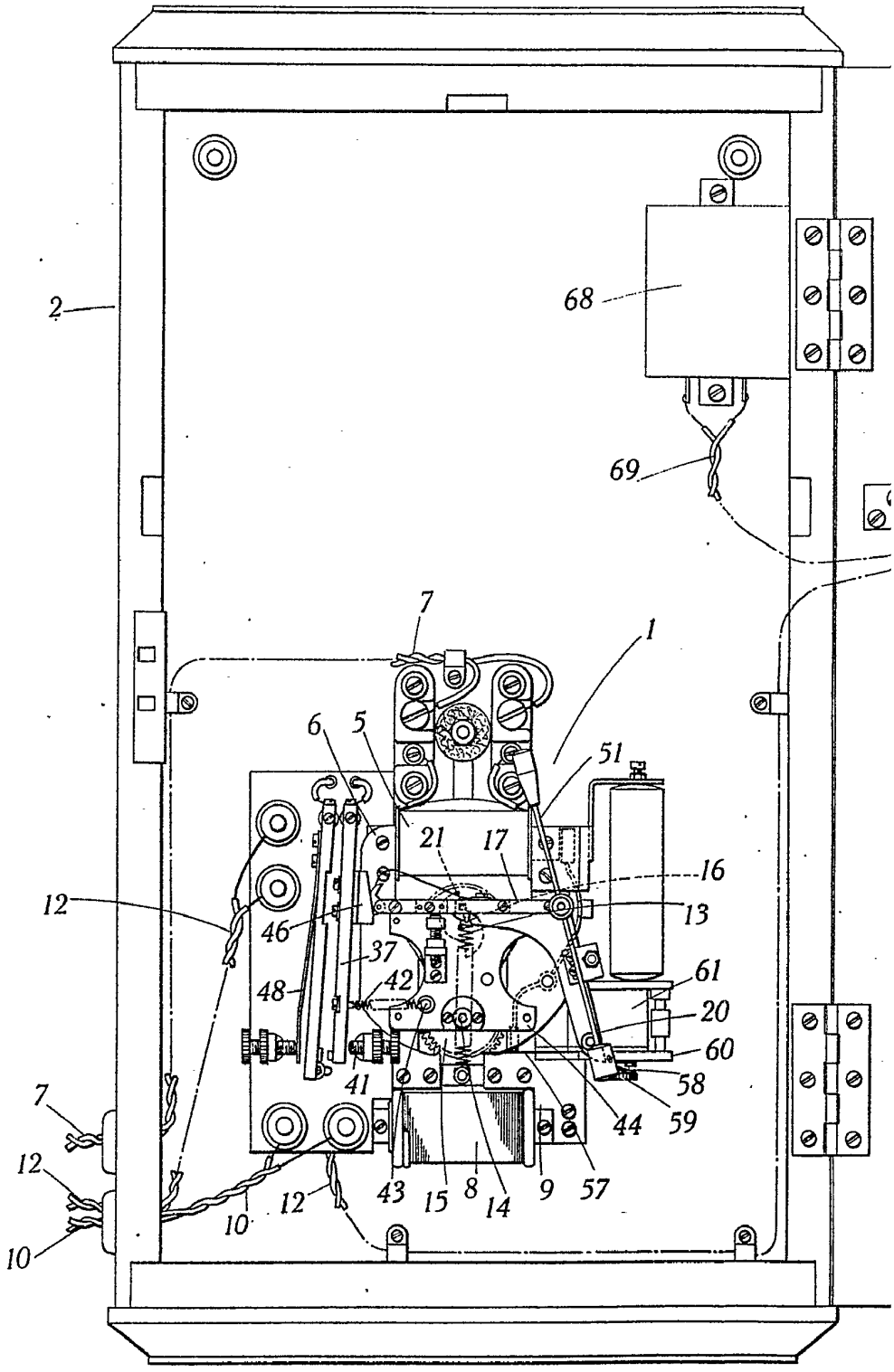
Fig. 1.



[This Drawing is a reproduction of the Original on a reduced scale.]

Fig. 1.

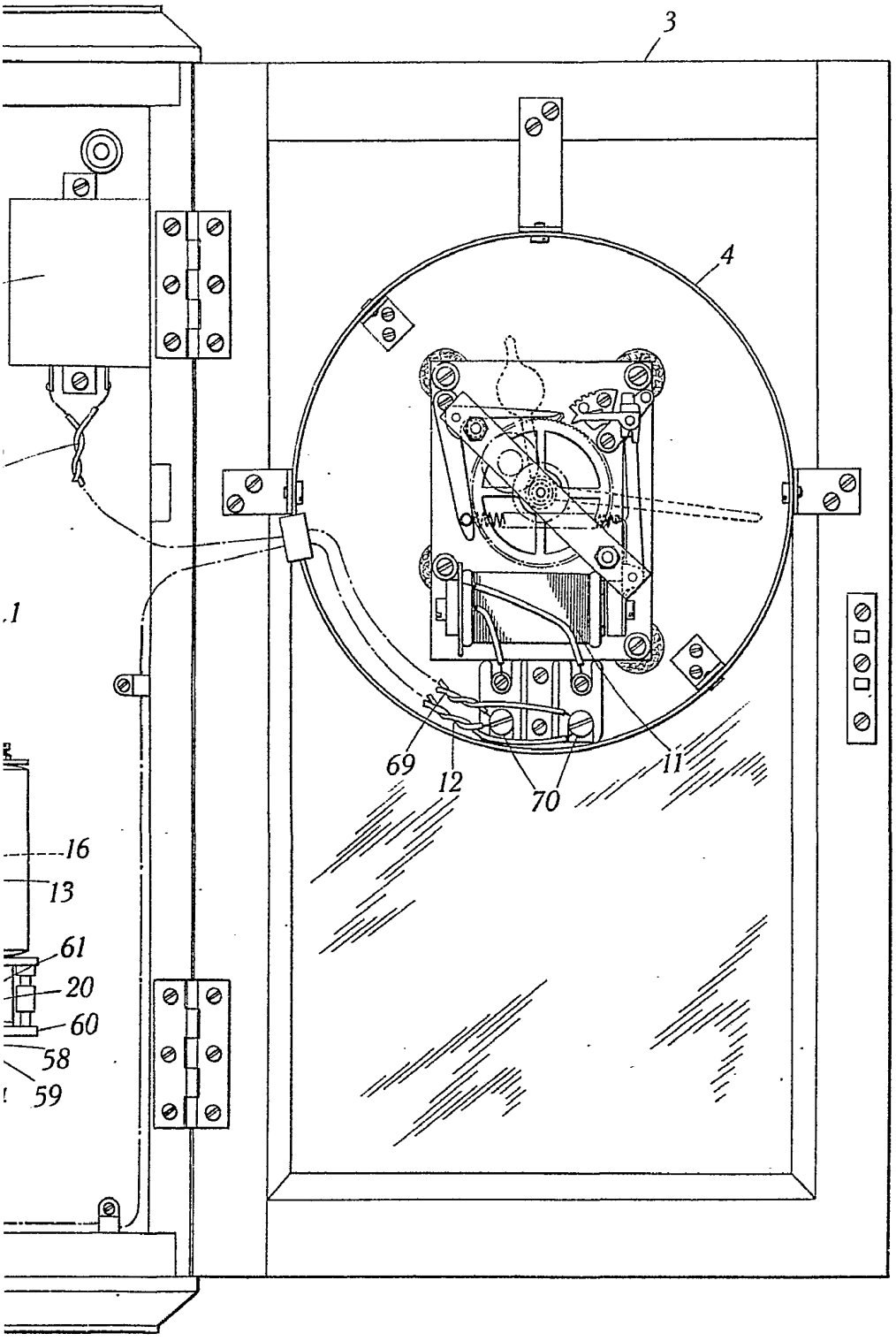


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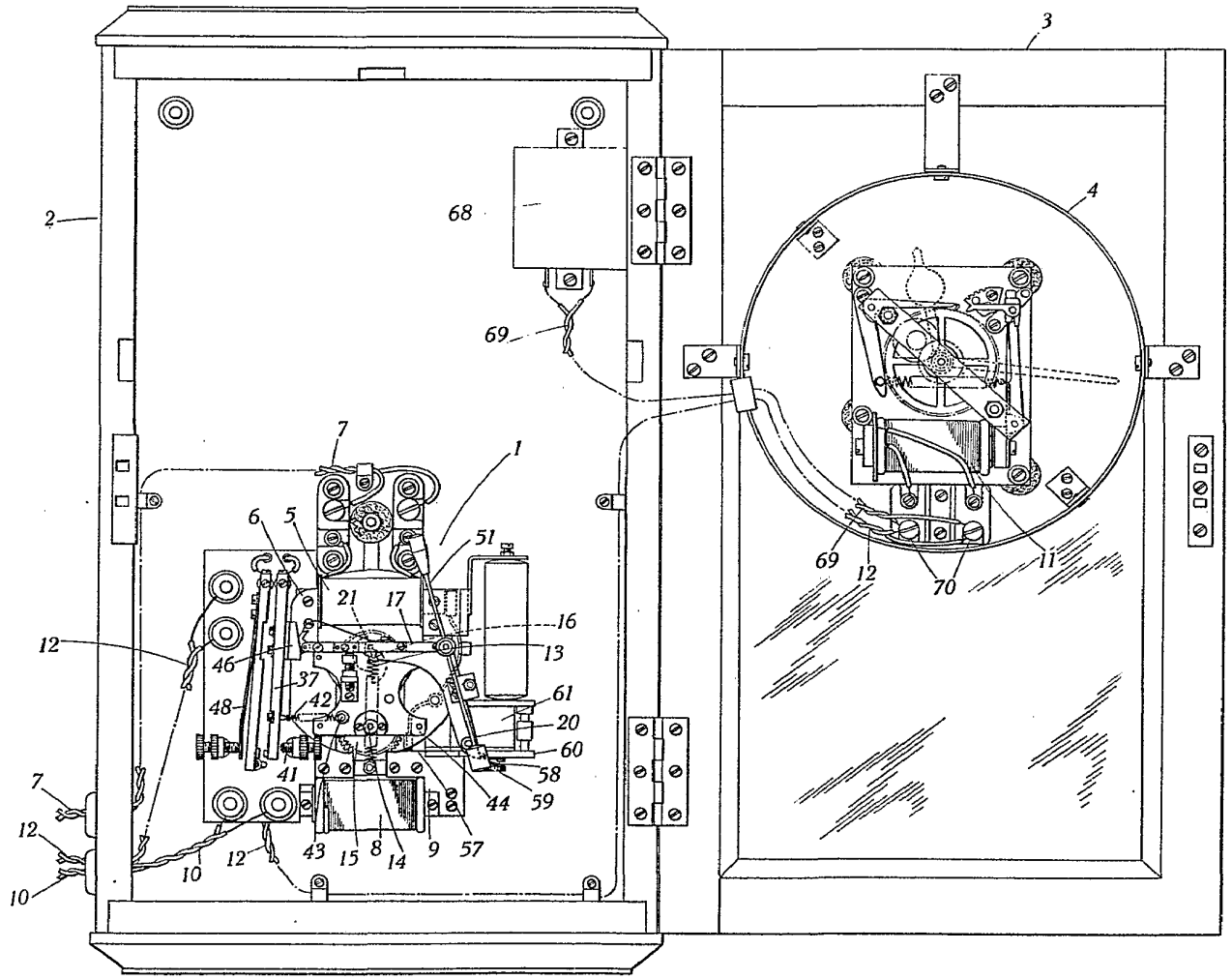
Fig. 1.



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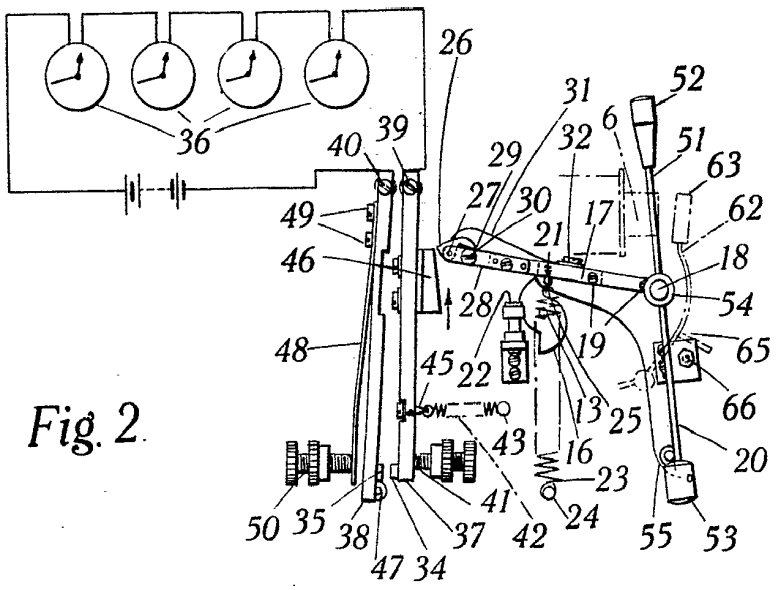

Fig. 2.

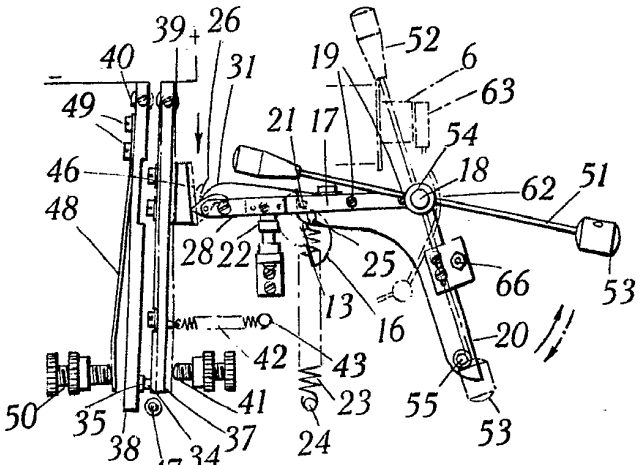

Fig. 3.

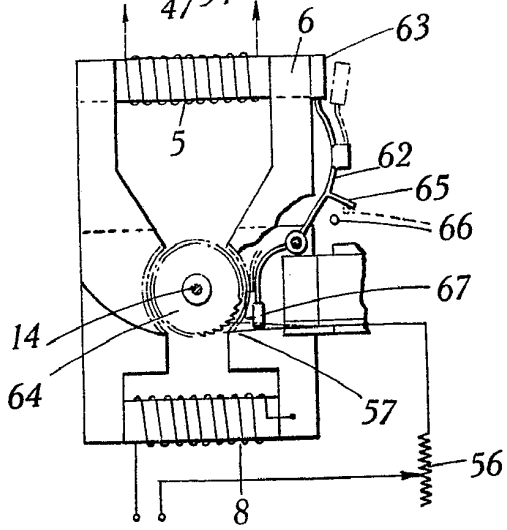

Fig. 4.

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