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PROVISIONAL SPECIFICATION.

Improvements in and connected with Electric Clocks

MARTIN FISCHER of Zürich V, Switzerland, Zeltweg 40, Manufacturer do hereby declare the nature of this invention to be as follows:—

As is well-known all electric clocks have hitherto been worked by electric currents emanating from batteries or accumulators, a central or standard clock making and breaking the circuit at regular intervals,—say for instance every minute.

The two main drawbacks to which this system is liable are notorious. Nine-tenths of the stoppages are said to arise from the battery, while the liability of the contacts to oxidation is a point which I need not dwell upon, and it is only by constant careful supervision and maintenance by experienced men that good action can be assured. It is on account of these two main evils that electric clocks have not hitherto found far more extensive use.

These evils are altogether obviated by the present invention, as in it neither batteries nor contacts are required.

Electricians have long abandoned the plan of generating powerful currents by chemical means, and even for telephone alarms and railway bell-signals, *etc.* magnetic inductors set in rotation by hand, are employed for generating the current, thus also dispensing with a battery. Mechanical generation of the current affords still greater advantages when applied to electric clocks, not only on account of its reliability and uniformity but also by reason of its cheapness.

The principle of the invention is as follows:

A wheel-train driven by weights or spring-power, is coupled with a magneto-electric induction machine, at certain intervals, say for instance once in every minute, a clock releases this wheel-train and stops it again, and the armature of the magneto-electric machine is thereby made to change the poles. The various subordinate clocks connected by wires with this standard clock are likewise provided with a magneto-electric machine, which might be called, so to speak, an alternating current machine,—the armatures of which are made to move synchronously with the armature of the central clock, and in a given direction. This momentary movement is utilised for putting tension on a spring, which may be coupled in any position between the armature and hands and which converts the abrupt motion of the armature into a continuous pressure, for the purpose of moving the hands.

For working with such short currents, the subordinate clocks may also be made unpolarised, through certainly with less useful effect, in the following manner. Near the electro-magnet there is an armature, with the well-known mechanism for shifting the hand of the clock. The armature and the parts of this mechanism are of such exceedingly light weight that the short induced currents sent through the coils have no work to perform beyond putting tension on the aforesaid spring; the inertia of the parts set in motion being so slight as to constitute a negligeable quantity.

The difference between similarly constructed clocks worked by battery currents, and these novel clocks worked by short induced currents is also seen in the fact that in this new system of working all ratchet and click arrangements *etc.*, for

[*Price 8d.*]

preventing retrograde motion of the minute wheel during the period of action of the current, may be dispensed with, because, on account of the exceedingly rapid motion of the armature, as compared with the inertia of the minute wheel and hand, these latter are not likely to make any improper retrograde movements but are always controlled by the action of the mechanism.

Subjoined is a description of a few styles of execution of the generating and receiving apparatus.

Figs. 1 and 2 show an induction machine applied for this purpose, in which, firstly, all sliding contact parts for transmitting the current are avoided; secondly, the coils remain stationary; thirdly, the armature is exceedingly light and is placed near the axis, and therefore possesses little inertia.

The arrangement of this apparatus is as follows:

The cylinder 1 of soft iron is provided at its two ends with pivots 2 which revolve in bearings 3. The ends of the cylinder, as will be readily seen from Fig. 1 are moreover notched with a file so that the cylinder is made to consist partly of two semi-cylinders the curvatures of which are diametrically opposed to each other. Two iron plates 4 to which the steel magnet 5 is attached by clips or the like, have two pole-shoes 6 each screwed on to them, on the inner side, at the top and bottom, and consequently equal polarity is imparted to them on the respective side by the adjacent poles of the magnet. All the four pole-shoes are circularly hollowed out and the iron cylinder 1 can revolve between these round cavities, with a slight interstice; the cylinder will always assume such a position as to connect one magnet pole with the opposite one, that is to say, for instance the upper left-hand pole-shoe will be connected by the induction cylinder with the lower right-hand pole-shoe.

The cylinder is surrounded by a wire bobbin or coil 7, independently fixed between the iron plates and pole shoes. Now, if by some force the cylinder is caused to make half a revolution rapidly it will lose the polarity it possessed and instantly assume the opposite polarity. It is a well-known fact that by this process two current phases are produced in a surrounding coil, which phases, however, have both the same direction, and notwithstanding their shortness will completely suffice for accurately driving specially constructed subordinate clocks as described hereinafter.

In order to augment the effect of this alternating current machine the following addition is made.

If we consider Fig. 1, in which the steel magnet 5 covers the lowermost part only of the iron plates 4, we find that in the position indicated the magnetic lines of force will pass from pole N. of the magnet through the lower left-hand pole-shoe, thence through the cylinder, then into the upper right-hand pole shoe, and then through the entire length of the right-hand iron plate, down to the pole S. of the steel magnet. Now, if we assume that these iron plates are wound breadth-wise, between the pole shoes, with coils running in the same direction as the windings of the central coil, currents will be generated in these new windings whenever the cylinder is turned. In the position of the cylinder shown in the figure, and while the magnetic lines of force take the course described above, no lines of force will pass along the left-hand plate, because the lines of force pass on, below, through the pole shoe and the cylinder. It is otherwise as regards the right-hand plate, in the case of which the lines of force coming from the cylinder through the upper right-hand pole-shoe have to traverse the entire length of the plate in order to reach the S. pole of the magnet. If now the cylinder is turned by half a revolution these two plates will completely reverse their condition and it is this change which will cause currents to be generated in the surrounding coils.

In the form of application of this principle, the plates are replaced by cylinders of soft iron on which wire coils are then placed, the ends of which are so connected with the ends of the central coil as to cause the currents to be superadded to each other.

Fig. 2 shows a mode of coupling this induction apparatus with a wheel-train as well as a mechanism for the releasing of this wheel-train by the action of a clock.

The last wheel 8 of the wheel-work which is set in motion, when released, by a spring or weight, gears into the pinion 9 which is fixed on the induction cylinder 1. Fixed on the same spindle or axis, above this pinion, there is a double arm 10 which carries at its ends the stop pins 11. A releasing lever 13, acted upon, every minute, *e.g.* by the escapement wheel 12 in the clock, and which is provided with 3 stop-pins 14, 15, 16, and is pivoted on the axis 17, releases the double arm 10 at each of its movements,—*viz*.: once a minute,—by disengaging it from the detaining stop-pin and permitting it to make half a revolution whereupon the pin at its other end will be caught again by the releasing lever, thus stopping its motion. This action is repeated every minute. The stop pin 16 serves for setting the hands of the subordinate clock by hand, likewise by magneto-electric means; in the absence of this third pin the induction cylinder might be set into unnecessarily rapid and injurious rotation.

Fig. 3 shows an ordinary telephone inductor which is coupled with the wheel-train by cranks. In this instance the clock releases the wheel-train 21 by means of the releasing and arresting arrangement 17, the crank 18 being permitted to make half a revolution and the connecting rod 19, acting on the arm 20 attached to the armature of the inductor so as to move the armature to and fro in alternate directions, about a quarter of a revolution at a time, whereby the necessary alternations of pole are caused and currents are consequently generated.

The field and inductor may also be applied in a quadripolar arrangement and the impulse from the driving clockwork may be given in various ways.

Fig. 4 shows another form of execution in which the armature and coils are stationary while the magnetic field, in the form of two cylindrical segments 22, executes the gyrations. These segments are mutually held together by arms 23 made of non-magnetic-material. These arms have attached to them in a centric position spindles or pivots 26 projecting outside, and as in the former arrangement, one of these pivots has an arm 24 attached to it upon which, for instance, the connecting rod 19 of the wheel-work may act. As, now, the magnetic field, in the shape of the two segments, need only make a quarter-revolution in either direction in order to cause a complete alternation of poles in the armature, the two wire ends 25 of the armature coil between the segment limbs may simply be inserted in the circuit so that, in this instance also, there is no need for any sliding contact or other arrangement for transmitting the current. If it is desired to work the subordinate clocks by a current always circulating in the same direction the induction machine indicated in Fig. 1 is modified so that for instance, the left upper and the right lower pole-shoes are absent. If by some device, the induction cylinder is now caused to be withdrawn by the driving wheel-work, from the two attracting pole-shoes and then suddenly released so that it can swing back, it will first lose its polarity on both sides, and then suddenly recover it again on being released, whereby a current will be generated in the surrounding coil.

A further combination for generating a current for the present purpose consists in causing two induction cylinders to gyrate simultaneously, one cylinder losing, on both sides, and the other gaining, on both sides, the power of a magnetic field. The wire ends of the surrounding coils are connected so that the two currents are superadded to each other.

The effect of the weight or spring may also be increased so that one weight only is required for driving both the clock and the wheel-work,—or else the wheelwork generating the current, every minute, may also produce, at certain intervals, a power of gravitation or spring tension, which will drive the clock, or *vice versa*.

If a large number of subordinate clocks are to be driven from one standard clock while at the same time it is desired that the casing of the clockwork generating the current shall remain within ordinary practicable dimensions, difficulties would arise if the means of transmitting mechanical power hitherto known and in use, such as cords, gut or wire strings or wire-cords, were employed. Of course the weight and dimensions of the clock-weight required for driving an apparatus intended to work a large number of subordinate clocks would considerably axceed the customary size of weights used to drive a striking clockwork or a contact-work only. If a gut-string of suitable thickness were used the drum arbor would have to be of abnormal length on account of the numerous turns which the chord would have to be wound on the drum, and which of course would have to be wound side by side in a single layer. Moreover, seeing that a chord would be wound or unwound from the front to the back of the arbor, considerable space would be required from the front to the back of the case. Besides, it is well known that such chords are very liable to get entangled or jammed.

All these evils are avoided by the novel application of a metallic band, for instance, a steel band, which can be superposed as it is wound. The slight difference due to the fact that the outermost turns are further removed from the centre than the innermost, causes no perceptible disadvantage.

Of course, in very large installations the magnetic inductors might be augmented and placed separately from the clock; the release of the wheel-work would in this case be effected every minute by means of a wire or rod, or else by an electro-magnetic relay, which latter would in this case be worked by the local current of the magnete-electric apparatus.

Fig. 5 shows the subordinate clock for continuous or alternating currents, explained in principle at the commencement of this specification. With the same intensity of the current as at present employed for the electric clocks worked by batteries as now in use, the duration of the current may be made about one-tenth only of what it is in those clcoks; the clock hands will not dash violently forward because the short impetus of the current will act on parts arranged to take up the shock. 26^1 is an electro-magnet; 27 its armature pivoted on the axis 28, and which has attached to it the regulating and shifting spring 29. 30 is the stop for spring 29. 31 is the tension spring which withdraws the armature after it has been attracted and at the same time causes a minute-wheel *m* to be shifted.

At the moment when the induced current acts upon the electro-magnet (which is of ordinary construction) the exceedingly light armature causes the light flat spring 29 attached to it, to spring behind the next tooth of the minute-wheel which has 60 teeth, but meanwhile the action of the current ceases and at the same moment the flat spring comes to bear against the back of the tooth under the influence of spring 31, on which tension has been put by the movement of the armature. The minute wheel bearing the hand (and which for that matter might be entirely free) is now gently impelled forward until the flat spring strikes against the stop 30 fixed below and tangentially to the periphery of the minute wheel, thus, so to speak, jamming fast the minute wheel.

This arrangement also affords security against any false movements caused by violent shocks.

It is well known that a still better result is given by subordinate alternating current clocks, which at the same time are almost uninfluenced by atmospherical electricity. The construction of such clocks, on my system, on account of the application of short currents will involve different principles and arrangements than in the case of clocks worked by battery currents.

Figs. 6, 7 and 8 illustrate one form of application of this principle.

The electro-magnets fixed on a base plate project to a fairly considerable extent beyond their coils; in front, on the faces of the electro-magnet cores, a brass bridge 32 is screwed on in which two bearings are arranged, the iron piece connecting the two cores at the back is likewise provided with one bearing, in the centre between the two cores. A thin arbor 33, almost of the same length as the magnet cores, is carried, at one of its ends, in the bearing arranged in the iron connecting piece at the back, and at the other end, in one of the two bearings arranged in the brass bridge in front. This arbor is placed and revolves in a parallel line to and between the coils. Within the sphere of action of the electro-magnet poles, a brass ring, 34 fixed on the arbor 33, has two peculiarly bent pieces of iron plate attached to it, separately from each other. Their shape and mode of action may best be gathered from Fig. 8. Each piece of iron-plate is under the influence of one of the poles of the steel magnet N. S. These two strips of iron-plate thus constitute the polarised armature forming the escapement of the subordinate clock and as may readily be seen this armature possesses great advantages as regards a rapid and strong action, because whenever a current passes, it is simultaneously attracted in two places and simultaneously repelled in two places. Being itself rendered magnetic through the influence of the steel magnet N. S., this armature will lodge with a certain power or attraction against the cores of the electro-magnets 35 and 36. In Fig. 8, for instance, the part of the armature forming the north pole, 37 bears against core 35. The other part 38 forming the south pole, bears against core 36. If, now, a current is sent through the coils in such a direction as to make core 35 a north pole and core 36 a south pole, the whole armature will be made to turn to the left, as core 35 will simultaneously repel the armature pole 37 and attract pole 39 while core 36 will attract pole 40 and repel pole 38. A direct contact of the armature and the core may be prevented by small brass tubes or collars put over the cores.

The principal organ of this alternating current subordinate clock is however constituted by the intermediate spring 41, which is put in tension by the impetus of the polarised armature and will subsequently transmit its tension to the mechanism moving the clock hands.

The arrangement of the intermediate spring 41, in this form of execution, may be as follows:

The arbor 42 is borne, on the one hand, in the second bearing arranged in the brass bridge 32 and on the other hand in the brass angle-piece 44 screwed on to the base plate 43 similarly to two "spindle" lobes of the wellknown "spindle" escapement; there are fixed on this arbor two springs 45 which gear into and shift the teeth of the minute wheel 46. Two fixed stops 47 prevent the springs 45 from catching or shifting more than one tooth of the wheel at a time. The intermediate spring 41 is attached to this same arbor 42 while its other end is bent over, and the catch-pin 48 catches into this bend; this pin 48 is fixed on the polarised armature 49 just described. The general action of the arrangement is as follows:

An electric current wave propels the polarised armature in the opposite position to that previously occupied. At the same time the intermediate spring is drawn by the catch-pin 48 towards the other side and is thus put, and remains under tension, as the armature, owing to its permanent magnetism, remains adhering to the cores. The tension of this intermediate spring 41 will now turn, with gentle pressure, the arbor 42 together with the springs attached thereto in the proper direction, causing the minute wheel and the hands to advance steadily.

A further advantage of this system is the following:

If in the case of exposed dials a strong wind presses upon the hands in either direction during the action of the electric current the hands in all electric clocks hitherto in use will be prevented from moving as the armature is unable to move or else the escapement mechanism and the wheels carrying the hands will get jammed. This does not occur in the present arrangement. Unless the counter pressure, by wind, *etc.*, should continue for more than a full minute it can in no way influence the correct action of the clock.

Of course the arrangement with an intermediate spring can be applied in manifold variations both as regards the shape of the armature and its action and as regards the mechanism for moving the hands. The main principle is always a spring connection between the armature and the hands. The armature may also be rotary or it may even itself be a straight electro-magnet which is at liberty to revolve on its axis within an ordinary coil, while flat pole extensions, projecting laterally beyond the coil, may oscillate between two permanently magnetised pole-pieces of opposite polarity.

Barmen, this 16th day of June 1900.

MARTIN FISCHER
By A. Daumas
Agent for Applicant.

COMPLETE SPECIFICATION.

Improvements in and connected with Electric Clocks.

I, Martin Fischer of 40 Zeltweg, Zürich (Switzerland) Manufacturer 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:—

As is well-known all electric clocks have hitherto been worked by electric currents emanating from batteries or accumulators, a central or standard clock making and breaking the circuit at regular intervals,—say for instance every minute.

The two main drawbacks to which this system is liable are notorious. Nine-tenths of the stoppages are said to arise from the battery, while the liability of the contacts to oxidation is a point which I need not dwell upon, and it is only by constant careful supervision and maintenance by experienced men that good action can be assured. It is on account of these two main evils that electric clocks have not hitherto found far more extensive use.

These evils are altogether obviated by the present invention, as in it neither batteries nor contacts are required.

Electricians have long abandoned the plan of generating powerful currents by chemical means, and even for telephone alarms and railway bell-signals, *etc.* magnetic inductors set in rotation by hand, are employed for generating the current, thus also dispensing with a battery. Mechanical generation of the current affords still greater advantages when applied to electric clocks, not only on account of its reliability and unifority but also by reason of its cheapness.

The principle of the invention is as follows:

A wheel-train driven by weights or spring-power, is coupled with a magneto-electric induction machine, at certain intervals, say for instance once in every minute, a clock releases this wheel-train and stops it again, and the armature of the magneto-electric machine is thereby made to change the poles. The various subordinate clocks connected by wires with this standard clock are likewise provided with a magneto-electric machine, which might be called, so to speak, an alternating current machine,—the armatures of which are made to move synchronously with the armature of the central clock, and in a given direction. This momentary movement is utilised for putting tension on a spring, which may be coupled in any position between the armature and hands and which converts the abrupt motion of the armature into a continuous pressure, for the purpose of moving the hands.

For working with such short currents, the subordinate clocks may also be made unpolarised, though certainly with less useful effect, in the following manner

Near the electro-magnet there is an armature, with the well-known mechanism for shifting the hand of the clock. The armature and the parts of this mechanism are of such exceedingly light weight that the short induced currents sent through the coil have no work to perform beyond putting tension on the aforesaid spring; the inertia of the parts set in motion being so slight as to constitute a negligeable quantity.

The difference between similarly constructed clocks worked by battery currents, and these novels clocks worked by short induced currents is also seen in the fact that in this new system of working all ratchet and click arrangements *etc.*, for preventing retrograde motion of the minute wheel during the period of action of the current, may be dispensed with, because, on account of the exceedingly rapid motion of the armature, as compared with the inertia of the minute wheel and hand, these latter are not likely to make any improper retrograde movements but are always controlled by the action of the mechanism.

Subjoined is a description of a few styles of execution of the generating and receiving apparatus illustrated on the drawings filed with the Provisional Specification

Figs. 1 and 2 show an induction machine applied for this purpose, in which, firstly, all sliding contact parts for transmitting the current are avoided; secondly, the coils remain stationary; thirdly, the armature is exceedingly light and is placed near the axis, and therefore possesses little inertia.

The arrangement of this apparatus is as follows:

The cylinder 1 of soft iron is provided at its two ends with pivots 2 which revolve in bearings 3. The ends of the cylinder, as will be readily seen from Fig. 1 are moreover notched with a file so that the cylinder is made to consist partly of two semi-cylinders, the curvatures of which are diametrically opposed to each other. Two iron plates 4 to which the steel magnet 5 is attached by clips or the like, have two pole-shoes 6 each screwed on to them, on the inner side, at the top and bottom, and consequently equal polarity is imparted to them on the respective side by the adjacent poles of the magnet. All the four pole-shoes are circularly hollowed out and the iron cylinder 1 can revolve between these round cavities, with a slight interstice; the cylinder will always assume such a position as to connect one magnet pole with the opposite one, that is to say, for instance the upper left-hand pole-shoe will be connected by the induction cylinder with the lower right-hand pole shoe.

The cylinder is surrounded by a wire bobbin or coil 7, independently fixed between the iron plates and pole shoes. Now, if by some force the cylinder is caused to make half a revolution rapidly it will lose the polarity it possessed and instantly assume the opposite polarity. It is a well-known fact that by this process two current phases are produced in a surrounding coil, which phases, however, have both the same direction, and notwithstanding their shortness will completely suffice, for accurately driving specially constructed subordinate clocks as described hereinafter.

In order to augment the effect of this alternating current machine the following addition is made.

If we consider Fig. 1, in which the steel magnet 5 covers the lowermost part only of the iron plates 4, we find that in the position indicated the magnetic lines of forces will pass from pole N. of the magnet through the lower left-hand pole-shoe, thence through the cylinder, then into the upper right-hand pole shoe, and then through the entire length of the right-hand iron plate, down to the pole S. of the steel magnet. Now, if we assume that these iron plates are wound breadth-wise, between the pole shoes, with coils running in the same direction as the windings of the central coil, currents will be generated in these new windings whenever the cylinder is turned. In the position of the cylinder shown in the figure, and while the magnetic lines of force take the course described above, no lines of force will pass along the left-hand plate, because the lines of force pass on, below, through the pole shoe and the cylinder. It is otherwise as regards the right-hand plate, in the case of which the lines of force coming from the cylinder through the upper right-hand pole-shoe have to traverse the entire length of the plate in order to reach the S. pole of the magnet. If now the cylinder is turned by half a revolution these two plates will completely reverse their condition and it is this change which will cause currents to be generated in the surrounding coils.

In the form of application of this principle, the plates are replaced by cylinders of soft iron on which wire coils are then placed, the ends of which are so connected with the ends of the central coil as to cause the currents to be superadded to each other.

Fig. 2 shows a mode of coupling this induction apparatus with a wheel-train as well as a mechanism for the releasing of this wheel-train by the action of a clock.

The last wheel 8 of the wheel-work which is set in motion, when released, by a spring or weight, gears into the pinion 9 which is fixed on the induction cylinder 1. Fixed on the same spindle or axis, above this pinion, there is a double arm 10 which carries at its ends the stop pins 11. A releasing lever 13, acted upon, every minute, *e.g.* by the escapement wheel 12 in the clock, and which is provided with 3 stop-pins 14, 15, 16, and is pivoted on the axis 17, releases the double arm 10 at each of its movements,—*viz* : once a minute,—by disengaging it from the detaining stop-pin and permitting it to make half a revolution whereupon the pin at its other end will be caught again by the releasing lever, thus stopping its motion. This action is repeated every minute. The stop pin 16 serves for setting the hands of the subordinate clock by hand; likewise by magneto-electric means; in the absence of this third pin the induction cylinder might be set into unnecessarily rapid and injurious rotation.

Fig. 3 shows an ordinary telephone inductor which is coupled with the wheel-train by cranks. In this instance the clock releases the wheel-train 21 by means of the releasing and arresting arrangement 17, the crank 18 being permitted to make half a revolution and the connecting rod 19, acting on the arm 20 attached to the armature of the inductor so as to move the armature to and fro in alternate directions, about a quarter of a revolution at a time, whereby the necessary alternations of pole are caused and currents are consequently generated.

The field and inductor may also be applied in a quadripolar arrangement and the impulse from the driving clockwork may be given in various ways.

Fig. 4 shows another form of execution in which the armature and coils are stationary while the magnetic field, in the form of two cylindrical segments 22, executes the gyrations. These segments are mutually held together by arms 23 made of non-magnetic material. These arms have attached to them in a centric position spindles or pivots 26 projecting outside, and as in the former arrangement, one of these pivots has an arm 24 attached to it upon which, for instance, the connecting rod 19 of the wheel-work may act. As, now, the magnetic field, in the shape of the two segments, need only make a quarter-revolution in either direction in order to cause a complete alternation of poles in the armature, the two wire ends 25 of the armature coil between the segment limbs may simply be inserted in the circuit so that, in this instance also, there is no need for any sliding contact or other arrangement for transmitting the current. If it is desired to work the subordinate clocks by a current always circulating in the same direction the induction machine indicated in Fig. 1 is modified so that for instance, the left upper and the right lower pole-shoes are absent. If by some device, the induction cylinder is now caused to be withdrawn by the driving wheel-work, from the two attracting pole-shoes and then suddenly released so that it can swing back, it will first lose its polarity on both sides, and then suddenly recover it again on being released, whereby a current will be generated in the surrounding coil.

A further combination for generating a current for the present purpose consists in causing two induction cylinders to gyrate simultaneously, one cylinder losing, on both sides, and the other gaining, on both sides, the power of a magnetic field. The wire ends of the surrounding coils are connected so that the two currents are superadded to each other.

The effect of the weight or spring may also be increased so that one weight only is required for driving both the clock and the wheel-work,—or else the wheelwork generating the current every minute, may also produce, at certain intervals, a power of gravitation or spring tension, which will drive the clock, or *vice versa.*

If a large number of subordinate clocks are to be driven from one standard clock while at the same time it is desired that the casing of the clockwork generating the current shall remain within ordinary practicable dimensions, difficulties would arise if the means of transmitting mechanical power hitherto known and in use, such as cords, gut or wire strings or wire-cords, were employed. Of course the weight and dimensions of the clock-weight required for driving an apparatus intended to work a large number of subordinate clocks would considerably exceed the customary size of weights used to drive a striking clockwork or a contact-work only. If a gut-string of suitable thickness were used the drum arbor would have to be of abnormal length on account of the numerous turns which the chord would have to be wound on the drum, and which of course would have to be wound side by side in a single layer. Moreover, seeing that a chord would be wound or unwound from the front to the back of the arbor, considerable space would be required from the front to the back of the case. Besides, it is well known that such chords are very liable to get entangled or jammed.

All these evils are avoided by the novel application of a metallic band, for instance, a steel band, which can be superposed as it is wound. The slight difference due to the fact that the outermost turns are further removed from the centre than the innermost, causes no perceptible disadvantage.

Of course, in very large installations the magnetic inductors might be augmented and placed separately from the clock; the release of the wheel-work would in this case be effected every minute by means of a wire or rod, or else by an electro-magnetic relay, which latter would in this case be worked by the local current of the magneto-electric apparatus.

Fig. 5 shows the subordinate clock for continuous or alternating currents, explained in principle at the commencement of this specification. With the same intensity of the current as at present employed for the electric clocks worked by batteries as now in use, the duration of the current may be made about one-tenth only of what it is in those clocks; the clock hands will not dash violently forward because the short impetus of the current will act on parts arranged to take up the shock. 26^1 is an electro-magnet; 27 its armature pivoted on the axis 28, and which has attached to it the regulating and shifting spring 29. 30 is the stop for spring 29. 31 is the tension spring which withdraws the armature after it has been attracted and at the same time causes a minute-wheel to be shifted.

At the moment when the induced current acts upon the electro-magnet (which is of ordinary construction) the exceedingly light armature causes the light flat spring 29 attached to it, to spring behind the next tooth of the minute-wheel which has 60 teeth, but meanwhile the action of the current ceases and at the same moment the flat spring comes to bear against the back of the tooth under the influence of spring 31, on which tension has been put by the movement of the armature. The minute wheel bearing the hand (and which for that matter might be entirely free) is now gently impelled forward until the flat spring strikes against the stop 30 fixed below and tangentially to the periphery of the minute wheel, thus, so to speak, jamming fast the minute wheel.

This arrangement also affords security against any false movements caused by violent shocks.

It is well known that a still better result is given by subordinate alternating current clocks, which at the same time are almost uninfluenced by atmospherical electricity. The construction of such clocks, on my system, on account of the application of short currents will involve different principles and arrangements than in the case of clocks worked by battery currents.

Figs. 6, 7 and 8 illustrate one form of application of this principle.

The electro-magnets fixed on a base plate project to a fairly considerable extent beyond their coils; in front, on the faces of the electro-magnet cores, a brass bridge 32 is screwed in which two bearings are arranged, the iron piece connecting the two cores at the back is likewise provided with one bearing, in the centre between the two cores. A thin arbor 33, almost of the same length as the magnet-cores, is carried, at one of its ends, in the bearing arranged in the iron connecting piece at the back, and at the other end, in one of the two bearings arranged in the brass bridge in front. This arbor is placed and revolves in a parallel line to and between the coils. Within the sphere of action of the electro-magnet poles, a brass ring, fixed on the arbor 33, has two peculiarly bent pieces of iron plate 34 attached to it, separately from each other. Their shape and mode of action may best be gathered from Fig. 8. Each piece of iron-plate is under the influence of one of the poles of the steel magnet N. S. These two strips of iron-plate thus constitute the polarised armature forming the escapement of the subordinate clock and as may readily be seen this armature possesses great advantages as regards my rapid and strong action, because whenever a current passes, it is simultaneously attracted in two places and simultaneously repelled in two places. Being itself rendered magnetic through the influence of the steel magnet N. S., this armature will lodge with a certain power or attraction against the cores of the electro-magnets 35 and 36. In Fig. 8, for instance, the part of the armature forming the north pole, 37 bears against core 35. The other part 38 forming the south pole, bears against core 36. If, now, a current is sent through the coils in such a direction as to make core 35 a north pole and core 36 a south pole, the whole armature will be made to turn to the left, as core 35 will simultaneously repel the armature pole 37 and attract pole 39 while core 36 will attract pole 40 and repel pole 38. A direct contact of the armature and the core may be prevented by small brass tubes or collars put over the cores.

The principal organ of this alternating current subordinate clock is however constituted by the intermediate spring 41, which is put in tension by the impetus of the polarised armature and will subsequently transmit its tension to the mechanism moving the clock hands.

The arrangement of the intermediate spring 41, in this form of execution, may be as follows:

The arbor 42 is borne, on the one hand, in the second bearing arranged in the brass bridge 32 and on the other hand in the brass angle-piece 44 screwed on to the base plate 43 similarly to two "spindle" lobes of the wellknown "spindle" escapement; there are fixed on this arbor two springs 45 which gear into and shift the teeth of the minute wheel 46. Two fixed stops 47 prevent the springs 45 from catching or shifting more than one tooth of the wheel at a time. The intermediate spring 41 is attached to this same arbor 42 while its other end is bent over, and the catch-pin 48 catches into this bend; this pin 48 is fixed on the polarised armature 49 just described. The general action of the arrangement is as follows:

An electric current wave propels the polarised armature in the opposite position to that previously occupied. At the same time the intermediate spring is drawn by the catch-pin 48 towards the other side and is thus put, and remains under tension, as the armature, owing to its permanent magnetism, remains adhering to the cores. The tension of this intermediate spring 41 will now turn, with gentle pressure, the arbor 42 together with the springs attached thereto in the proper direction, causing the minute wheel and the hands to advance steadily.

A further advantage of this system is the following:

If in the case of exposed dials a strong wind presses upon the hands in either direction during the action of the electric current the hands in all electric clocks hitherto in use will be prevented from moving as the armature is unable to move or else the escapement mechanism and the wheels carrying the hands will get jammed. This does not occur in the present arrangement. Unless the counter pressure, by wind, *etc.*, should continue for more than a full minute it can in no way influence the correct action of the clock.

Of course the arrangement with an intermediate spring can be applied in manifold variations both as regards the shape of the armature and its action and as regards the mechanism for moving the hands. The main principle is always a spring connection between the armature and the hands. The armature may also be rotary or it may even itself be a straight electro-magnet which is at liberty to revolve on its axis within an ordinary coil, while flat pole extensions, projecting laterally beyond the coil, may oscillate between two permanently magnetised pole-pieces of opposite polarity.

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

1) In an electric clock a central regulator operating a number of secondary clocks and consisting of a spring or weight acted wheel train being released every minute or in other intervals by the clock and turning an iron core within a magnetic field in such a manner that the polarisation of said core is produced vanished or changed and in a coil surrounding said core electric currents are produced for the purpose described and set forth.

2) In an electric clock a central regulator operating a number of secondary clocks and consisting of a spring or weight acted wheel train being released every minute or in other intervals by the clock and turning a magnetic field round an in iron core in such a manner that the polarisation of said core is produced vanished or changed and in a coil surrounding said core electric currents are produced for the purpose described and set forth.

3) An electric clock characterized in Claim 1 the arrangement and use of a magnet inductor as shown and described in Figures 1 and 2.

4) An electric clock characterized in Claim 2 the arrangement and use of a magnet inductor described and shown in Figure 4.

5) In an electric clock as characterized in Claim 1 the arrangement and use of a metal band for the purpose described and set forth.

6) In an electric secondary clock worked by alternating induction currents the arrangement and use of an intermediate spring in combination with an exceedingly light armature for the purpose described and set forth.

7) In an electric secondary clock for induction currents characterized in Claim 5 the arrangement and use of a polarized light armature which being driven by short induction currents is capable to span an intermediate spring located between said armature and the pointers for the purpose described and set forth.

8) In an electric secondary clock for alternating induction currents the arrangement and use of a polarized armature as shown and described in Figure 8.

9) In an electric secondary clock for continous or alternating currents having an electromagnet excited by induction currents, said magnet attracting an exceed-

ingly light armature and repelling it immediately, said attraction serving for the tension of and releasing the driving spring and driving means in such a manner that all stopping devices for the back motion of the driving wheel during the working of the current may be dispensed with during the attraction, the light driving means combined with the short induction currents preventing the pointers to move contrary to the driving means as described and for the purpose set forth.

Dated this 2nd day of March 1901.

MARTIN FISCHER.
By A. Daumas
Agent for Applicant.

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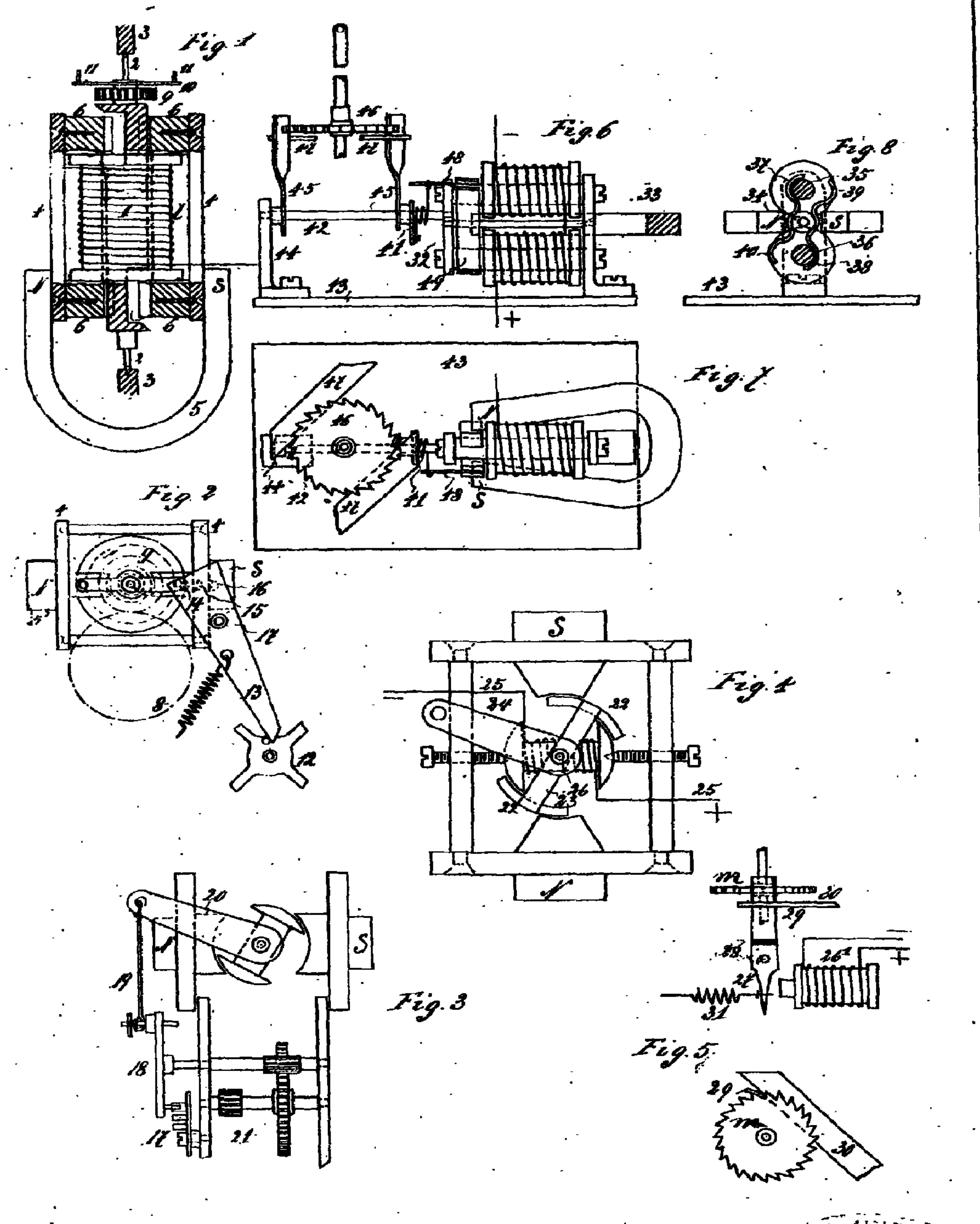

[This Drawing is a reproduction of the Original on a reduced scale.]

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