F. SCHNEIDER

APPARATUS FOR THE OPERATION OF ELECTRICAL CLOCKS BY ELECTRIC WAVES.

APPLICATION FILED APR. 3, 1912.

1,054,622.

Patented Feb. 25, 1913.

2 SHEETS—SHEET 1.

Fig. 1

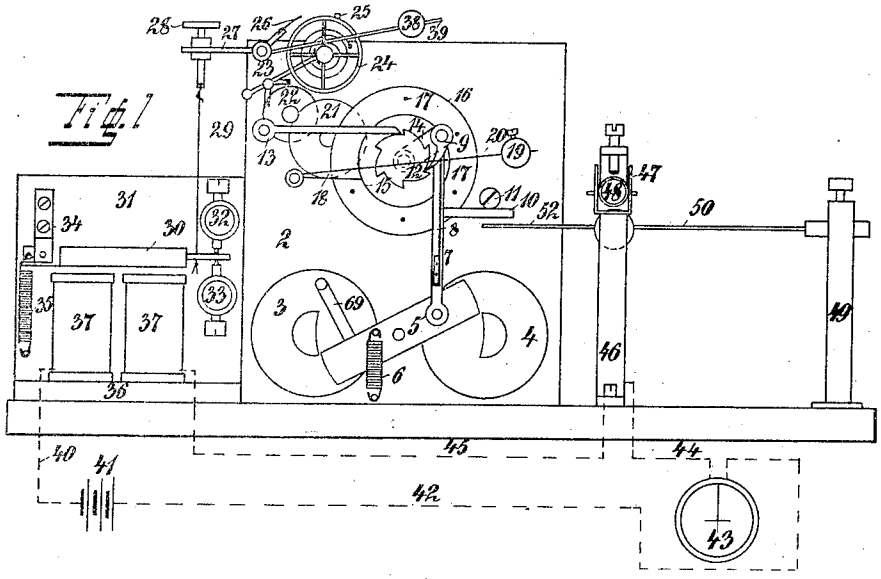
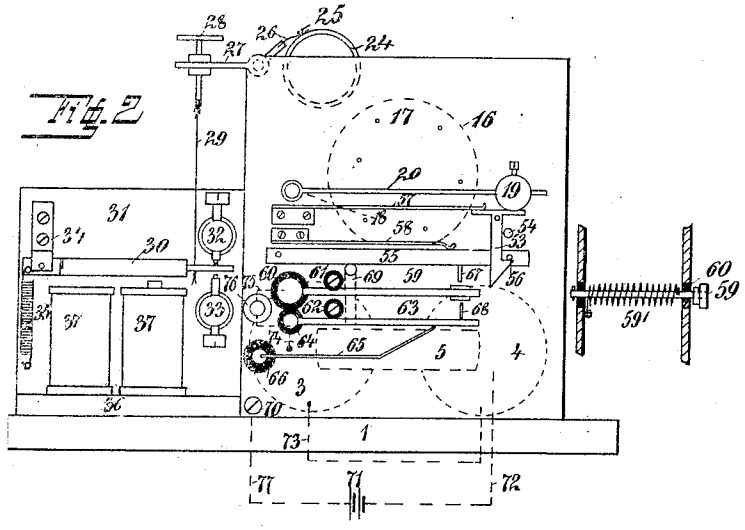


Fig. 2



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2 SHEETS—SHEET 2.

Fig. 3

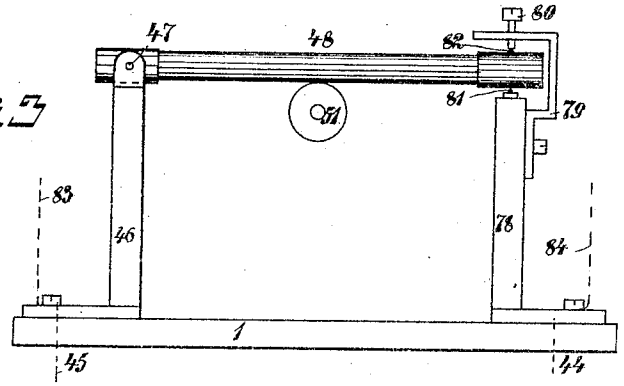


Fig. 4.

Fig. 5. Fig. 6. Fig. 7.

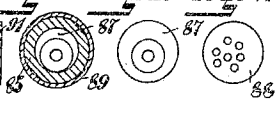
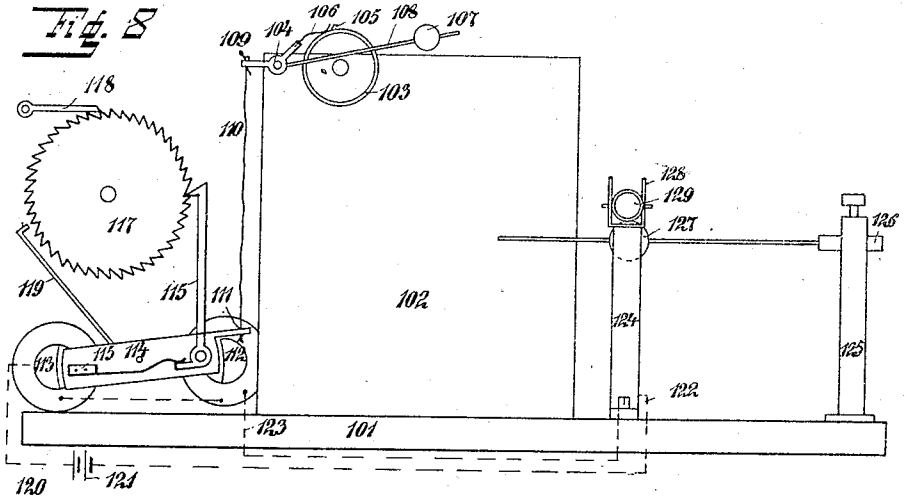


Fig. 8



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APPARATUS FOR THE OPERATION OF ELECTRICAL CLOCKS BY ELECTRIC WAVES.

1,054,622. Specification of Letters Patent. Patented Feb. 25, 1913.

Application filed April 3, 1912. Serial No. 688,334.

To all whom it may concern:

Be it known that I, FERDINAND SCHNEIDER, engineer, a subject of the German Emperor, residing at 12 Brauhausstrasse, Fulda, Germany, have invented a new and useful Apparatus for the Operation of Electrical Clocks by Electric Waves; and I do hereby declare the following to be a full, clear, and exact description of the same.

This invention relates to apparatuses for the operation of electrical clocks by means of electric waves, which are transmitted at given intervals of time from a central station.

The invention is particularly intended to provide an improved receiving apparatus which has a high sensitiveness and responds readily and does not lose this sensitiveness in permanent service. For this purpose the coherer-circuit serving for the regulation or the advance of the receiving clock remains closed until shortly before the receipt of the electric wave, and the clockwork is stopped for regulation in the time from the decoherence up to the receipt of the wave. By this construction of the receiving apparatus the advantage is obtained that it, owing to the shortness of the interruption responds extremely readily and does not require a special excitation of the coherer. But if an ordinary coherer is employed it is difficult to maintain a permanent satisfactory action of the receiving apparatus; as the coherer substance depreciates in consequence of the continued passage of current and soon loses its sensitiveness. It is therefore necessary to use a coherer which can endure a long passage of current, for instance, a coherer with tubular electrodes which are separated from one another by a mica-washer of small thickness, *e. g.* one-tenth of a millimeter.

If the minute-hand on the secondary is advanced directly by means of the electric waves, it is generally necessary to insert a relay in the same circuit, to stop and then release the balance wheel or pendulum. In accordance with the present invention the need for this relay is obviated so as to simplify the apparatus, by transferring the work of the relay to the armature of the receiving-clock.

The annexed drawing illustrates by way of example an apparatus constructed in accordance with the present invention.

Figure 1 is a view of the receiving apparatus, in which the front plate of the going-mechanism is removed. Fig. 2 is a view with the plate affixed and shows the parts situated in front of the front plate. Fig. 3 shows the arrangement of the coherer. Fig. 4 is a section showing the construction of the coherer, and Figs. 5, 6 and 7 are details of the same. Fig. 8 illustrates the simplified construction of the receiving apparatus.

Upon the base 1 (Fig. 1) there is mounted a suitable clockwork going-mechanism; to the rear plate 2 is firmly connected the electromagnet 3, 4 between the legs of which the oscillatory armature 5 is mounted in the known manner, being in the normal position of rest drawn out of the magnetic field by means of the spring 6. Upon the oscillatory armature 5 there is pivoted the connecting rod 7 which carries both a spring 8 and a movable pawl 9, while it is movably connected to the shaft of the wheel 16 by means of the link 14. The rod 7 is also rigidly secured to the side arm 10, the upward movement of which is limited by the stop-screw 11.

In the periphery of the spring wheel 16 there are fixed tappet-pins 17 which serve to lift the hammer 18, 19, 20. Upon the shaft of the wheel 16 there is also revolubly mounted the ratchet wheel 12 which is connected with the spring barrel 15, its backward motion being limited by the pawl 13. The spring wheel 16 is connected to the going wheels 21, 22 and the balance 24 and its lever 23. Upon the rim of the balance-wheel there is a stop-pin 25. A leaf spring 26, connected to the lever 27, engages the stop-pin 25 and serves as a stop for the balance-wheel. The lever arm 39 carrying the weight 38 is also connected to the lever 27. The arm 27 is provided with an adjusting screw 28, the hollow extremity of which carries a cord 29, attached to an electromagnet armature 30 pivoted between the plate 31 and the bracket 34. The movements of the armature 30 are limited by two insulated screws 32, 33, but normally the armature yields to the tension of the spring 35. The electromagnet 36, 37, 37 is firmly secured to the plate 31. Upon the base-plate 1 (Figs. 1 and 3) there are also arranged two pillars 46, 78 of which one 46 carries at its upper end the fork 47 in which one end of the coherer 48 is pivotally mounted, while the other pillar 78 serves for the support of the end of the coherer which is provided with the contact-pin 81. The upward movements

of the coherer 48 are limited by the adjusting screw 80 in the angle-piece 79 attached to the pillar 78. The pillar 49 which is also secured upon the base 1 serves to receive the spring 50 carrying the hammer 51, the extension 52 of this spring being located normally beneath the arm 10.

A connection 45 extends from the pillar 46 to the windings of the magnet coils 37, 37 and from the latter through the connection 40 to the battery 41, the other pole of which by means of the lead 42 is connected to the continuous current secondary clock 43. The other terminal of the clock 43 is connected to the pillar 78 by means of the lead 44. The pillars 46, 78 are connected to the aerials or antennæ 83, 84.

A pawl 53 pivoted upon the front plate is in the normal position pressed by the spring 57 into contact with the stop-pin 54, and by means of its nose or projection serves as a stop to support a pin 56 secured upon the pivoted contact lever 55; the latter is provided with a contact pin 67 and is under the pressure of a spring 58. A second contact lever 59 is pivotally mounted in the front plate by means of an insulating bush 60; a spring, 59′, presses the lever 59 against the insulated screw 61. A third contact lever 63 having a contact pin 68 is pivoted in the insulating bush 64 and bears upon the screw 62 under the pressure of the insulated spring 65 insulated by the bushing 66. In order to raise the lever 55, the electromagnet armature 5 has secured to it a tappet-arm 69. Fig. 2 shows clearly the connections for the electromagnetic winding. The electrical connections are as follows:— From the battery 71 the lead 72 extends to the electromagnet winding 4; thence the connection 73 leads to the winding 3 and the connection 74 to the contact lever 63. The second pole of the battery 71 is connected by the lead 77 and the screw 70 to the plate of the going-mechanism. To prevent sparking of the extra-current, the resistance 76 is connected by the lead 75 to the levers 59 and 63.

The operation of the receiving apparatus is as follows:—In the normal position (Fig. 1) the coherer-circuit 48, 47, 46, 45, 37, 40, 41, 42, 43, 44, 78, 81 is closed; consequently the current from the battery flows continuously through the magnet windings 37, 37 of the relay as well as through the magnet windings of the secondary clock 43. The armature 30 is, therefore, continuously attracted by the electromagnets 37, and the cord 29 which is tied to the armature 30 is stretched tight; the lever 27, 26, 38, 39 is thereby held in the position in which the spring 26 allows the stop pin 25 of the balance wheel 24 to pass freely. During the unwinding of the clockwork the tappet wheel 16 raises the hammer 18, 19, 20 until the arm 18 falls suddenly from one of the tappets 17, whereupon the hammer strikes the pawl 53 (Fig. 2). The pawl is thereby moved from right to left and releases the lever 55 as the pin 56 leaves its seat; the pin 67 makes contact and then presses the lever 59 downward, whereupon the latter makes contact with the pin 68 of the lever 63 and presses it down by a further amount. The circuit 55, 67, 59, 68, 63, 74, 3, 73, 4, 72, 71, 77, 70 thereby established effects the attraction of the armature 5; this causes on the one hand the winding mechanism 7, 8, 9, 14, 12, 13 to wind up in the known manner the driving spring located in the barrel or casing 15 by the amount of one tooth of the ratchet wheel 12, and on the other hand the tappet 69 to return the contact lever 55 again to its normal position, so that at the same time the above-mentioned circuit is again interrupted. During this action the arm 10 of the winding lever 7 has pressed down and tensioned the spring 52, 50 of the clapper 51; at the same time the armature 5 has tensioned the spring 6. In consequence of the sudden interruption of the circuit, the returning springs 6 and 52 produce a very powerful recoil; the clapper 51 (Fig. 3) in its stroke first raises the coherer 48, thereby breaking the contact at 78, 81 and then forcibly shaking up the coherer-powder upon the impact of the coherer 48 upon the insulated pin 82 of the screw 80, the coherer then falling back into its position of rest. The circuit 81, 78, 44, 43, 42, 41, 40, 37, 37, 45, 46, 47, 48, is thereby interrupted and the armature 30 (Fig. 2) jerked upward under the tension of the spring, so that the cord 29 allows the rotation of the lever 27 from left to right. Consequently the spring 26 engages the stop-pin 25 of the balance wheel, and the armature of the secondary clock 43 falls to its normal position. The going-mechanism is so arranged that the hammer 18, 19, 20 falls from one of the tappets 17 every $59\frac{7}{10}$ seconds; this exact division from pin to pin is substantially facilitated by the fact that the radius at which the pins are inserted is made quite large. Since the ratchet wheel 12 has the same number of teeth as the tappet wheel 16, the tension of the driving spring remains approximately constant from one tappet to the next. At the moment when at the completion of the 60 seconds the wave impulse takes place from the standard clock, the coherer located at the receiving wires 83, 84 becomes again conductive, and the electromagnets situated in the same circuit are excited, so producing on one hand the one-minute advance of the secondary clock 43 and on the other hand again the attraction downward of the armature 30 which thereupon releases the balance wheel 24 to continue its oscillation.

This action is repeated from minute to minute in the same way.

If desired other circuits for secondary clocks may be connected to the insulated screws 32, 33 (Fig. 1) and operated by the current alteration; for this purpose the clapper spring 52 is arranged to effect in its downward movement the actuation of a current-reversing device. The downward movement of the winding armature or of the coherer-clapper may also serve for the winding up a clock-work mechanism which in unwinding rotates a contact arm upon the current reversing device. The disconnection of the coherer 48 may also be effected by providing upon the pillar 46 or 78 (Fig. 3) an auxiliary contact spring to be opened by the clapper 51 before striking the coherer tube 48. Instead of the electrical winding mechanism, there may be provided a hand-winding mechanism of the usual kind; in this case the hammer 18, 19, 20 effects the decoherence.

It is of importance that the coherer 48 be not of the usual construction, but constituted in the manner to be hereafter described, in order that the action of the entire apparatus be not rendered uncertain by the decreasing sensitiveness of the coherer. By the method of construction to be explained, easier decoherence and control of the sensitiveness are obtained. The coherer comprises two tubular electrodes, between which is mounted a mica disk or washer of small thickness (*e. g.* $\frac{1}{10}$ millimeter) having one or more perforations of smaller size than the bore of the electrode tubes. In order to provide an exceedingly delicate adjustment of the sensitiveness of the coherer, the mica disk is perforated eccentrically, so that rotation of the coherer brings more or less of the filling material into contact. Fig. 4 shows both the tubular electrodes 85, 86 separated from one another by the mica washer or perforated disk 87 or 88 and supported together in the insulating tube 89. The filling material employed consists preferably of little pieces of leaf-metal, but other coherer-substances may also be employed. The openings of the tubes 85, 86 are closed by plugs or covers 90, 91.

Figs. 5 and 6 show clearly the position and single perforation of the mica washer 87, while Fig. 7 shows the mica disk 88 having several perforations. The perforations are preferably formed with knife edges or countersunk, so that the sharp edges of the holes may easily divide the filling material so as to insure accurate decoherence.

The receiving apparatus illustrated in Figs. 1 and 2 may if desired be simplified by effecting the stopping and release of the balance wheel of the going-mechanism not by a special relay but by the armature of the receiving clock. For this purpose, as represented in Fig. 8, the plate 102 is secured upon the base 101; between the former and a second plate there is journaled the balance wheel 103. By means of the spindle 104 also revolubly mounted in the same plate, the weight lever 107, 108, 109 can be moved to bring the brake-spring 106 against the rim of the balance wheel 103, so that the stop pin 105 arranged in the rim of the balance wheel strikes against the spring 106. The short lever arm 109 of the weight lever acts either directly or by means of the flexible connection 110 upon the arm 111 attached to the armature 114 of the secondary clock. In this case the receiving clock comprises for example the electromagnet 112, 113, the oscillatory armature 114, the pivoted pawl 116 acted on by spring 115, the ratchet wheel 117, the retaining pawl 118 and ratchet arm 119. From one of the magnet limbs 113 the connection 120 extends to the battery 121 and coherer pillar 122, while from the other limb 112 the lead 123 extends to the coherer post 124. Upon the base 101 there is also secured the clapper carrier 125, which carries an adjustable clapper 126, 127. The coherer 129 is journaled in the known manner in the fork 128.

The action of the device is as follows:— As soon as the clapper 127 strikes the coherer 129, the magnet 112, 113 is deënergized, whereupon the armature 114 leaves the magnets 112, 113 and the attached connection 110 is slackened; the balance wheel is then held by means of the spring 106 moving with the weight lever, until a fresh wave-impulse energizes the coherer the armature is again attracted into the magnetic field and thereby releases the balance wheel to continue its rotation.

Having now described my invention what I claim as new and desire to secure by Letters Patent, is:—

1. In a receiving apparatus for the operation of electrical clocks by electric waves the combination of a coherer, a coherer-circuit, adapted to regulate and advance the receiving clock, means for maintaining said coherer-circuit in closed circuit until just before the receipt of the electric waves, means adapted to stop the clockwork of said clock for the purpose of being regulated during the time from the decoherence until the receipt of the waves, electrodes in said coherer, said electrodes consisting of conductive material and being made tubular, and a foraminous mica disk of small thickness separating said electrodes from one another.

2. In a receiving apparatus for the operation of electrical clocks by electric waves the combination of a coherer, a coherer-circuit adapted to regulate and advance the receiving clock, a hammer, a tappet pin

wheel in the going-mechanism, adapted to raise said hammer, adapted to effect the decorherence by its return just before the receipt of the electric waves, a relay in the coherer-circuit, an armature in said relay, a revoluble loaded lever, said armature being adapted to hold in raised position said revoluble loaded lever, a stop pin on the balance wheel of the clockwork engaged by said lever at the interruption of the coherer circuit, the electrodes of said coherer consisting of conductive material and being made tubular, and a foraminous mica disk of small thickness separating said electrodes from one another.

3. In a receiving apparatus for the operation of electrical clocks by electric waves the combination of a coherer, a coherer-circuit, a hammer, a tappet pin wheel in the going-mechanism adapted to raise said hammer, adapted to effect the decorherence by its return just before the receipt of the electric waves, a switch device for the electrical winding of the going-mechanism, a pawl in said switch device, released by said hammer in its return, an arm attached to the winding rod, adapted to tension and release the spring of the coherer hammer, the electrodes of said coherer consisting of conductive material and being made tubular, and a foraminous mica disk of small thickness separating said electrodes from one another.

4. In a receiving apparatus for the operation of electrical clocks by electric waves the combination of a coherer, a coherer-circuit, a hammer, a tappet-pin wheel in the going-mechanism adapted to raise said hammer, an auxiliary contact operated by said hammer and adapted to disconnect the coherer before the decoherence, the electrodes of said coherer consisting of conductive material and being made tubular, and a foraminous mica disk of small thickness separating said electrodes from one another.

5. In a receiving apparatus for the operation of electrical clocks by electric waves the combination of a coherer, one end of the tube of said coherer being pivoted and the other end resting upon a contact, said contact adapted to close the coherer circuit in the normal position of the coherer tube, a hammer, a tappet pin wheel in the going-mechanism adapted to raise said hammer, the electrodes of said coherer consisting of conductive material and being made tubular and a foraminous mica disk of small thickness separating said electrodes from one another.

6. In a receiving apparatus for the operation of electrical clocks by electric waves the combination of a coherer, a coherer-circuit adapted to regulate and advance said receiving clock, a hammer, a tappet pin wheel in the going-mechanism adapted to raise said hammer adapted to effect the decoherence by its return just before the receipt of the electric waves, a revoluble loaded lever a relay in the coherer-circuit adapted to hold in raised position said loaded lever, a stop pin on the balance wheel of said receiving clocks engaged by said lever at the interruption of the coherer-circuit, the electrodes of said coherer being made tubular, and a mica disk between the electrodes, said mica disk having one or more eccentric perforations in order to permit adjustment of the sensitiveness by rotation of the coherer about its longitudinal axis.

7. In a receiving apparatus for the operation of electrical clocks by electric waves the combination of a coherer, a coherer-circuit, a hammer, a tappet pin wheel in the going-mechanism adapted to raise said hammer, adapted to effect the decoherence by its return just before the receipt of the electric waves, a switch device for the electrical winding of the going-mechanism, a pawl in said switch device, released by said hammer in its return, an arm attached to the winding rod, adapted to tension and release the spring of the coherer hammer, the electrodes of said coherer being made tubular, and a mica disk between the electrodes, said mica disk having one or more eccentric perforations in order to permit adjustment of the sensitiveness by rotation of the coherer about its longitudinal axis.

8. In a receiving apparatus for the operation of electrical clocks by electric waves the combination of a coherer, a coherer-circuit, a hammer, a tappet pin wheel in the going-mechanism, adapted to raise said hammer, an auxiliary contact operated by said hammer and adapted to disconnect the coherer before the decoherence, the electrodes of said coherer being made tubular, and a mica disk between the electrodes, said mica disk having one or more eccentric perforations in order to permit adjustment of the sensitiveness by rotation of the coherer about its longitudinal axis.

9. In a receiving apparatus for the operation of electrical clocks by electric waves the combination of a coherer, one end of the tube of said coherer being pivoted and the other end resting upon a contact, said contact adapted to close the coherer circuit in the normal position of the coherer tube, a hammer, a tappet pin wheel in the going-mechanism, adapted to raise said hammer, the electrodes of said coherer being made tubular, and a mica disk between the electrodes, said mica disk having one or more eccentric perforations in order to permit adjustment of the sensitiveness by rotation of the coherer about its longitudinal axis.

10. In a receiving apparatus for the operation of electrical clocks by electric waves the combination of a coherer, a coherer-cir-

cuit adapted to regulate and advance said receiving clock, a hammer, a tappet pin wheel in the going-mechanism, adapted to raise said hammer, adapted to effect the decoherence by its return just before the receipt of the electric waves, a revoluble loaded lever, a relay in the coherer circuit adapted to hold in raised position said loaded lever, a stop pin on the balance wheel of said receiving clocks engaged by said lever at the interruption of the coherer-circuit, the electrodes of said coherer being made tubular, and a mica disk with perforations between the electrodes, said perforations being formed with knife-edges, in order to insure correct decoherence.

11. In a receiving apparatus for the operation of electrical clocks by electric waves the combination of a coherer, a coherer-circuit, a hammer, a tappet pin wheel in the going-mechanism, adapted to raise said hammer adapted to effect the decoherence by its return just before the receipt of the electric waves, a switch device for the electrical winding of the going-mechanism, a pawl in said switch device released by said hammer in its return, an arm attached to the winding rod adapted to tension and release the spring of the coherer hammer, the electrodes of said coherer, being made tubular, and a mica disk with perforations between the electrodes, said perforations being formed with knife-edges, in order to insure correct decoherence.

12. In a receiving apparatus for the operation of electrical clocks by electric waves the combination of a coherer, a coherer-circuit, a hammer, a tappet pin wheel in the going-mechanism, adapted to raise said hammer, an auxiliary contact operated by said hammer and adapted to disconnect the coherer before the decoherence, the electrodes of said coherer being made tubular, and a mica disk with perforations between the electrodes, said perforations being formed with knife-edges, in order to insure correct decoherence.

13. In a receiving apparatus for the operation of electrical clocks by electric waves the combination of a coherer, one end of the tube of said coherer being pivoted and the other end resting upon a contact, said contact adapted to close the coherer-circuit in the normal position of the coherer tube, a hammer, a tappet pin wheel in the going-mechanism, adapted to raise said hammer, the electrodes of said coherer being made tubular and a mica disk with perforations between the electrodes, said perforations being formed with knife-edges in order to insure correct decoherence.

14. In a receiving apparatus for the operation of electrical clocks by electric waves the combination of a coherer, a coherer-circuit adapted to regulate and advance the receiving clock, a hammer adapted to effect the decoherence just before the receipt of the electric waves, a magnet armature on the receiving clock, a revoluble loaded lever, said armature being connected with said revoluble loaded lever and adapted to hold it in raised position if the coherer-current is closed, and a stop pin on the balance wheel of said receiving clock, said pin being engaged by the revoluble lever at the interruption of the current.

15. In a receiving apparatus for the operation of electrical clocks by electric waves the combination of a coherer, a coherer-circuit adapted to regulate and advance the receiving clock, a hammer, a tappet pin wheel in the going-mechanism, adapted to raise said hammer, adapted to effect the decoherence by its return just before the receipt of the electric wave, a magnet armature on said receiving clock, a revoluble loaded lever, said armature being connected with said revoluble loaded lever and adapted to hold it in raised position if the coherer-current is closed, and a stop pin on the balance wheel of the clockwork, said pin being engaged by the revoluble lever at the interruption of the current.

16. In a receiving apparatus for the operation of electrical clocks by electric waves the combination of a coherer, the electrodes of said coherer consisting of conductive material and being made tubular, a foraminous mica disk of small thickness separating said electrodes from one another, a coherer-circuit adapted to regulate and advance the receiving clock, a hammer adapted to effect the decoherence just before the receipt of the electric waves, a magnet armature on the receiving clock, a revoluble loaded lever, said armature being connected with said revoluble loaded lever and adapted to hold it in raised position if the coherer-current is closed, and a stop pin on the balance wheel of said receiving clock, said pin being engaged by the revoluble lever at the interruption of the current.

17. In a receiving apparatus for the operation of electrical clocks by electric waves the combination of a coherer, the electrodes of said coherer being made tubular, a mica disk having one or more eccentric perforations, a coherer-circuit adapted to regulate and advance the receiving clock, a hammer, adapted to effect the decoherence just before the receipt of the electric waves a magnet armature on the receiving clock, a revoluble loaded lever, said armature being connected with said revoluble loaded lever and adapted to hold it in raised position if the coherer-current is closed, and a stop pin on the balance wheel of said receiving clock, said pin being engaged by the revoluble lever at the interruption of the current.

18. In a receiving apparatus for the operation of electrical clocks by electric waves, the combination of a coherer, the electrodes of said coherer being made tubular, a mica disk with perforations, said perforations being formed with knife-edges, a coherer-circuit adapted to regulate and advance the receiving clock, a hammer adapted to effect the decoherence just before the receipt of the electric waves, a magnet armature on the receiving clock, a revoluble loaded lever, said armature being connected with said revoluble loaded lever and adapted to hold it in raised position if the coherer-current is closed, and a stop pin on the balance wheel of said receiving clock, said pin being engaged by the revoluble lever at the interruption of the current.

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

FERDINAND SCHNEIDER.

Witnesses:
WILHELM WEHUER,
WALTER DUSE.