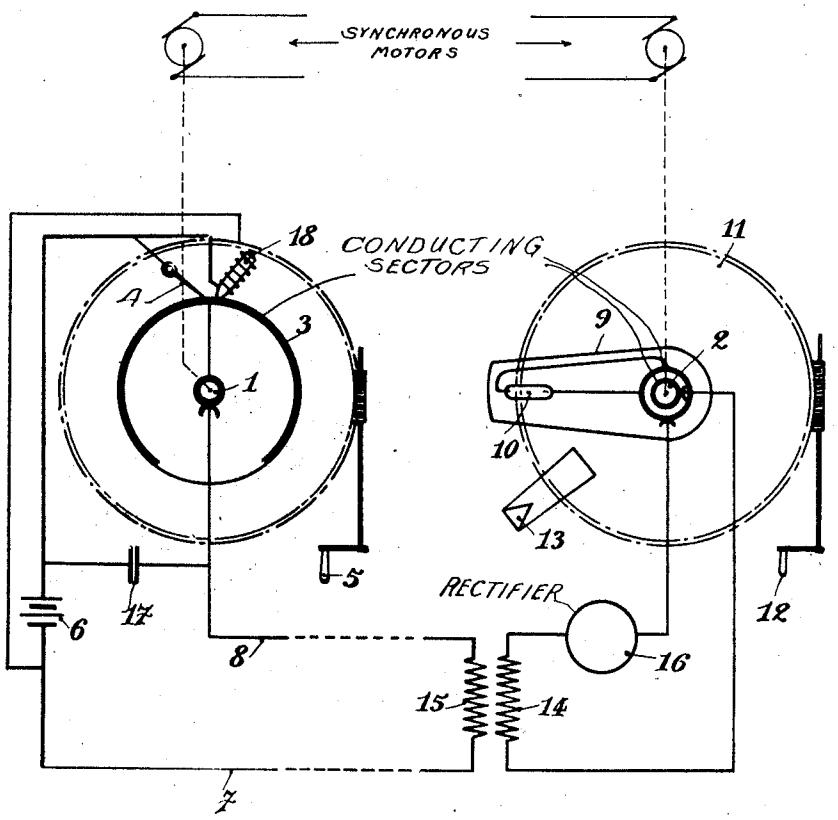
Sept. 9, 1930. N. E. METHLIN 1,775,368

APPARATUS FOR DISTANT INDICATION

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Fig. 1.



Inventor—
Nicolas Emilien Methlin
By Mann, Cameron, Lewis & Kerkam,
attorneys

Sept. 9, 1930. N. E. METHLIN 1,775,368

APPARATUS FOR DISTANT INDICATION

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Fig. 2a

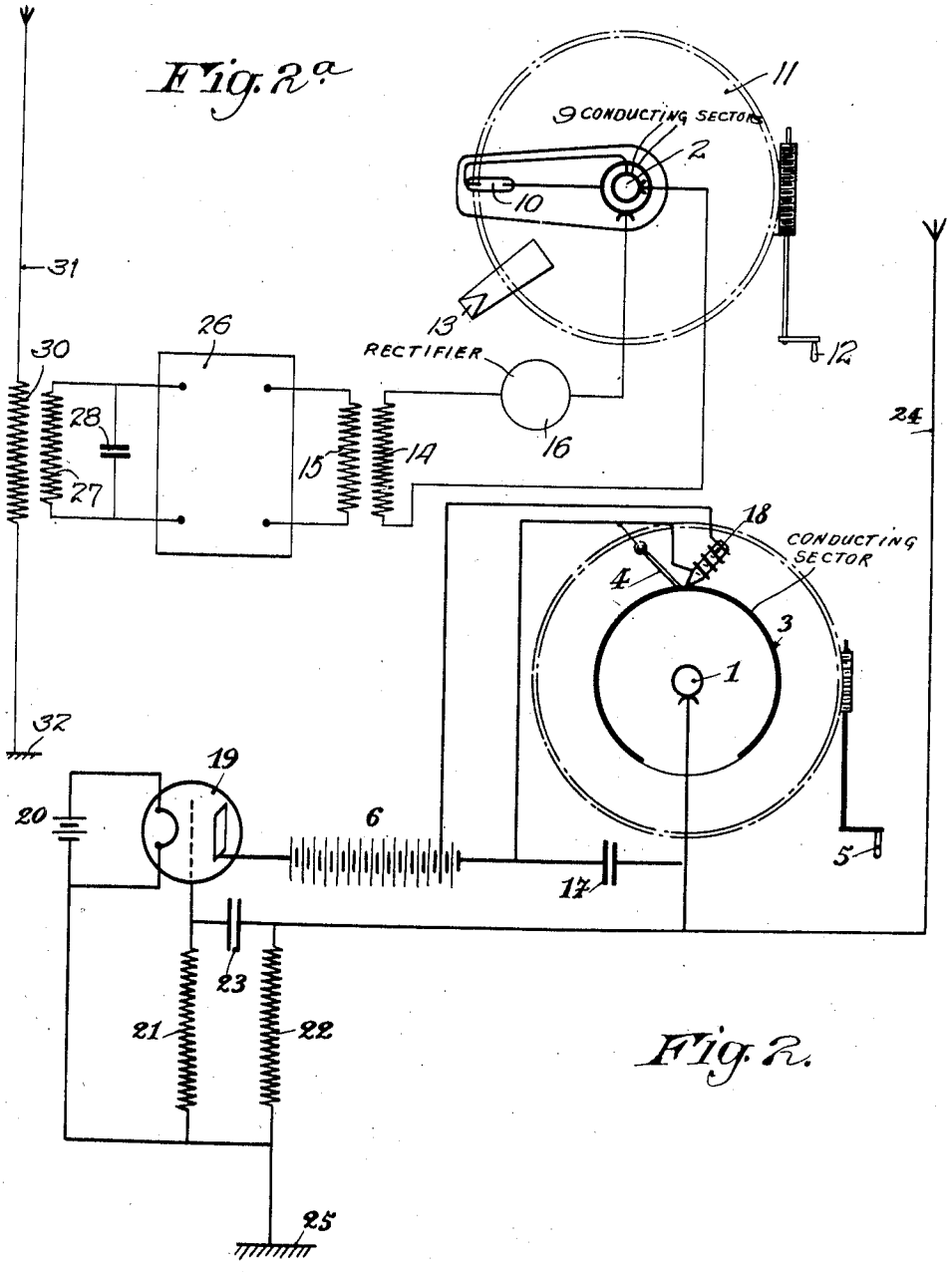


Fig. 2.

Inventor.
Nicolas Emilien Methlin
By Mauro, Cameron, Lewis & Parker
Attorneys

Sept. 9, 1930. N. E. METHLIN 1,775,368

APPARATUS FOR DISTANT INDICATION

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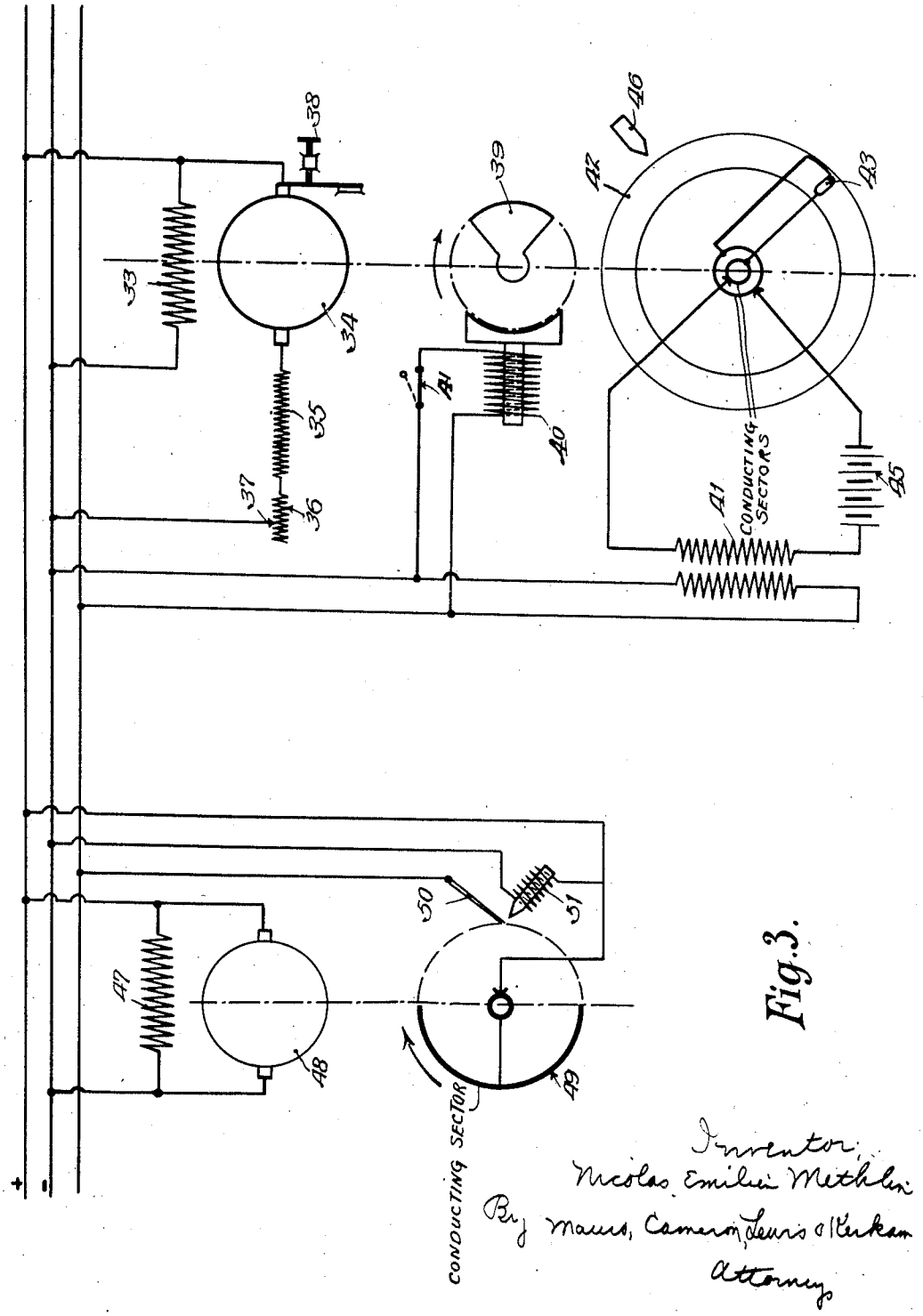


Fig. 3.

Inventor;
Nicolas Emilien Methlin
By Mauro, Cameron, Lewis & Parkam
Attorneys

Sept. 9, 1930. N. E. METHLIN 1,775,368

APPARATUS FOR DISTANT INDICATION

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Fig. 4.

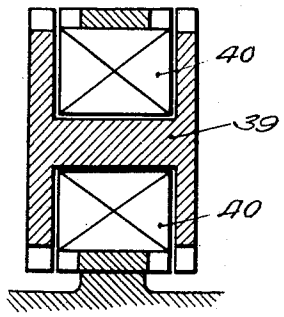


Fig. 5.

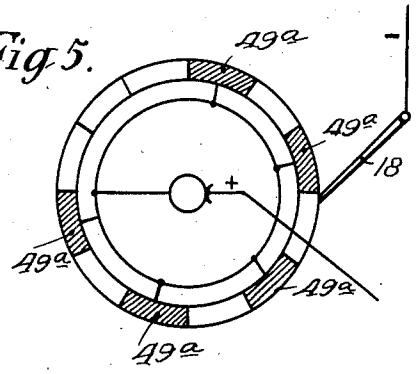
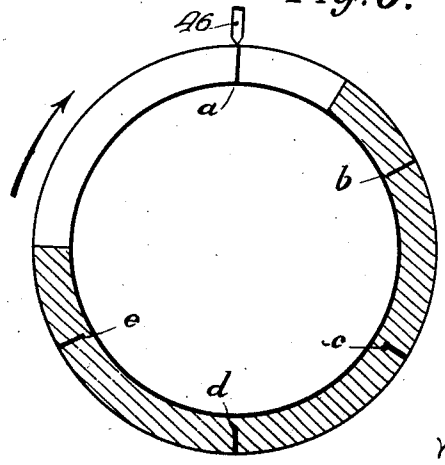


Fig. 6.



Inventor:-
Nicolas Emilien Methlin
By Mauro, Cameron, Lewis & Kerkam,
Attorneys

Sept. 9, 1930. N. E. METHLIN 1,775,368

APPARATUS FOR DISTANT INDICATION

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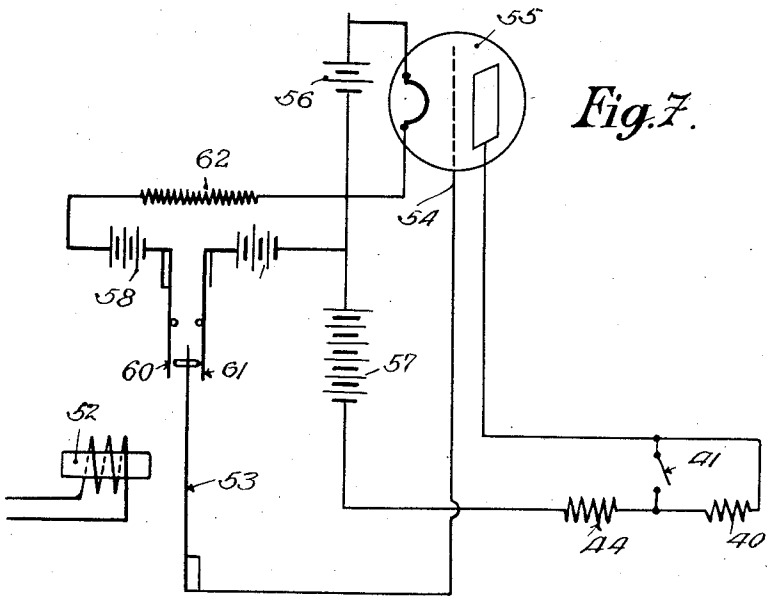
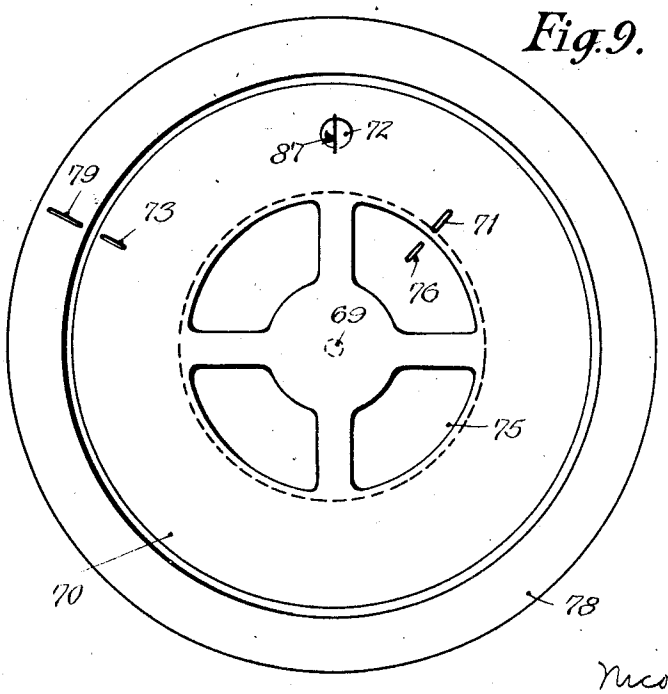


Fig. 7.

Fig. 9.



Inventor:
Nicolas Emilien Methlin
By Mauro, Cameron, Jervis & Perkins
Attorneys

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Fig. 8.

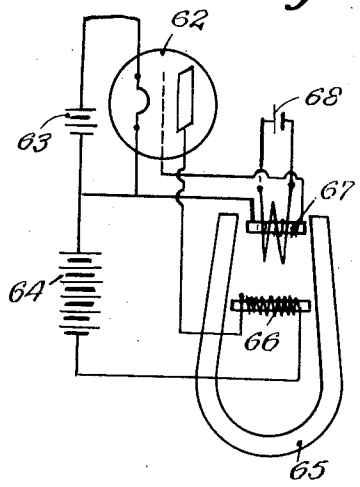
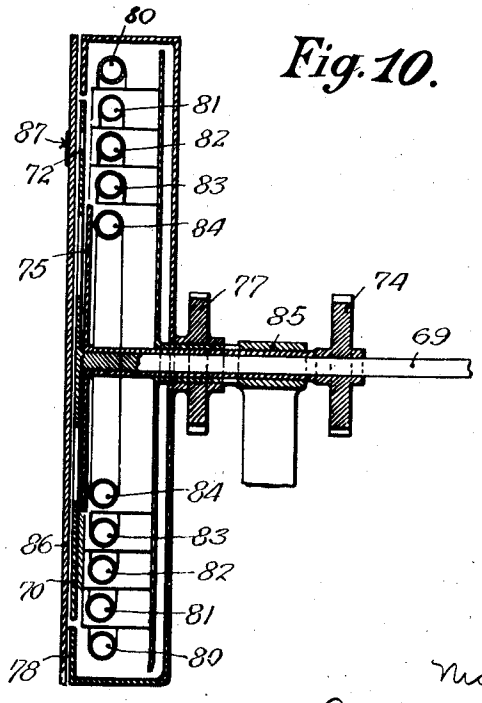


Fig. 10.



Inventor:
Nicolas Emilien Methlin
By Mann, Cameron, Lewis & Herkan
Attorneys

Patented Sept. 9, 1930 1,775,368

UNITED STATES PATENT OFFICE

NICOLAS EMILIEN METHLIN, OF PARIS, FRANCE, ASSIGNOR TO SCHNEIDER & CIE., OF PARIS, FRANCE, A LIMITED JOINT-STOCK COMPANY

APPARATUS FOR DISTANT INDICATION

Application filed January 5, 1926, Serial No. 79,466, and in France January 8, 1925.

This invention relates to means for controlling one or more members in such a manner that the same may be placed in a definite predetermined position corresponding to the position of an element located at a distance from said member or members, and it is particularly adapted for laying one or more guns located at a distance, or different distances from a control station, said guns being laid in accordance with movements of sighting means located at the control station.

The orders sent out from the control station may be transmitted either along wires or by wireless and the transmitted orders are executed at the receiving station by the gun layer, who moves the gun into a definite position corresponding to the movement of the sighting telescope at the transmitting station.

To facilitate the description and eliminate unnecessary figures in the drawings, the transmitting station has been described and illustrated in connection with only one receiving station, but it will be understod that the invention embodies any suitable number of receiving stations. Several embodiments of the present invention are illustrated in the accompanying drawings, wherein—

Fig. 1 illustrates somewhat diagrammatically one embodiment of the invention employing a wire transmission;

Figs. 2 and 2ª illustrate, respectively, a transmitting station and a receiving station constructed in accordance with the present invention and operatively connected by wireless transmission;

Fig. 3 illustrates another embodiment of the present invention;

Fig. 4 is a detailed sectional view illustrating one type of armature which may be employed in the structure diagrammatically shown in Fig. 3;

Fig. 5 is a diagrammatic view illustrating one form of rotating switch which may be employed;

Fig. 6 diagrammatically illustrates the visual signal produced by using the switch shown in Fig. 5;

Fig. 7 illustrates another form of receiving station apparatus, and Fig. 8 another embodiment of transmitting station apparatus which may be employed in accordance with the present invention; and

Figs. 9 and 10 illustrate in front elevation and in section, respectively, one form of visual indicator apparatus that may be employed at a receiving station.

In Figure 1, 1 and 2 are the shafts of two synchronous motors rotating in the same direction and placed one at the transmitting station and the other at the receiving station respectively.

The synchronous motor having a shaft 1, is adapted to actuate a suitable device which periodically makes and breaks an electric circuit at the transmitting station. In the form shown, the shaft 1 actuates a rotary switch comprising a conducting sector 3 integrally secured to 1 and a brush 4 carried by a toothed disc which may be rotated about 1 (in order to place 4 in the position corresponding to the order to be transmitted), by acting by hand upon the handle 5. The brush 4 is connected to one of the poles of a battery 6 the second pole of which is connected to the connecting wire 7. The sector 3 is also connected to the connecting wire 8.

The receiving apparatus is placed in a casing or any other cover provided with covered sighting tubes, the luminous members to be observed contained in this casing thus moving in semidarkness.

The shaft 2 drives an arm 9 at the end of which is mounted a small electric lamp 10 the action of which is instantaneous, acting as would a spark, that is to say possessing the property of becoming luminous as soon as a current of electricity passes through it and being extinguished suddenly as soon as the current is cut off.

Such a lamp may be formed for example by a glass tube containing neon or any other gas, mixture of gases, or vapour, adapted to be rendered luminous by the passage of a current of electricity, the voltage being suitably chosen according to the nature of the gas and according to the distance between the electrodes which lead in the current so that the tube may be lit with the smallest pressure possible.

A toothed disc 11 is mounted concentrically with 2 and may be made to rotate about 2 by actuating the handle 12. The disc 11 carries a counter index or pointer 13 upon which has been deposited by known means a coat of substance which remains constantly luminous in the dark. The electrodes which lead the current to the lamp 10, which electrodes may be within or without the tube, are supplied by the secondary 14 of a transformer the primary 15 of which is connected to the leads 7 and 8, and in the circuit is interposed a thermionic valve 16 or else an electrolytic valve, which allows only the current generated at the transmitting station when contact between 3 and 4 is broken to reach the lamp 10.

It is consequently seen that for each turn of 1 the lamp 10 will give a flash of light at the exact moment contact is broken between 3 and 4. It will therefore be possible by bringing 13 in front of the positions at which the luminous flash is produced to make handle 12 follow in all the displacements communicated to handle 5.

It will be necessary in order to assist the operation to give 1 and 2 a speed of rotation of at least ten turns per second so that the image will persist upon the retina for a sufficient length of time to enable the position of 10 for which the luminous flash is produced to appear in a continuous manner.

In order to render the action of the switch employed at the transmitting station more rapid a condenser 17 is placed between 3 and 4 and the arc may be blown out magnetically or mechanically. Use may be made for this purpose, for example, of the magnetic field produced by a small electro-magnet 18 movable with 4.

In order clearly to define the position of the axis of the tube 10 the latter will be covered with a screen pierced with a narrow slot the direction of which is perpendicular to the direction of movement of the said tube.

It will be noted that the switch employed at the transmitting station may be replaced by any device which allows a current of very short duration to intervene periodically at the exact moments when an imaginary index assumed to be fixed upon the shaft 1 occupies a definite predetermined position.

When very great precision is desired, use may be made of the transmission combinations described in French Patent No. 563,928. It will be necessary in this case to make use, for the various transmissions, of gases giving different colours (or else of special screens of different colours), and counter indexes or pointers having the corresponding colours. These transmissions may also be obtained by making use of only a single motor for each transmitting or receiving station on condition that the various lamps 10 as well as their counter indexes 13 are mounted concentrically on circles of different radii.

In Figure 2 in which the reference numerals employed in Figure 1 are used to indicate similar parts the transmitting station comprises a wireless telegraphy transmitting installation comprising for example a three-electrode valve 19, a filament battery 20, a grid inductance 21, an anode inductance 22, a condenser 23, an aerial 24, a ground 25, and an anode battery 6. This apparatus may be adapted to transmit energy periodcally to the receiving station in any suitable way, such as by controlling the grid voltage of the three electrode valve or by interrupting the plate circuit. In the form shown, the rotary switch 3, 4 actuated by motor shaft 1, is connected in the plate circuit of the valve 19. The transformer 14—15 of the receiving station is supplied by a valve amplifier 26 connected to a circuit comprising the secondary inductance 27 and the condenser 28 coupled with the inductance 30 interposed between the receiving aerial 31 and the earth connection 32. The secondary 15 of the transformer only transmits energy to the receiving station circuit when the transmitting station circuit is made and broken and the thermionic valve 16 allows current to reach the lamp 10 only when the contact between 3 and 4 at the transmitting station is broken.

In the case when the transformer 14, 15 comprises an iron core it may be of use to provide it with a third winding into which is led a continuous current.

Among the numerous possible modifications it is indicated that the switch at the transmitting station may be interposed in the grid circuit 19 and it will be noted that the instantaneous lighting of the lamp 10 may be produced no longer by a circuit breaking current produced when a circuit is broken, but by the effect of a transmission of very short duration by suitably reducing the peripheral surface of 3 and cutting out the valve 16.

The synchronous motors employed at the receiving and transmitting stations may be of any type.

Figures 3 to 10 illustrate a modification which consists chiefly in employing instead and in the place of the synchronous motors provided above, synchronous motors of a special type enabling a very high degree of accuracy to be obtained in the distant indication.

Each of these synchronous motors comprises the combination of the three following devices:

1. A device enabling a driving torque M to be developed which is equal to the value of the resisting torque R (sum of all the torques due to friction windage etc.) for the speed of n-turns per second which corresponds to synchronism.

2. An automatic synchronizing device giving $k\ n$ times per second two impulses in opposite directions the resultant of which has an accelerating effect in the case of a lag and a retarding effect in the case of an advance.

The second device is controlled by a sort of master clock which acts, after the manner of a conductor of an orchestra, upon the whole arrangement of all the motors employed in the distant indications to ensure not only their synchronous working, but also the agreement of their positions, which agreement may be defined by stating, for example, that an index fixed upon the shaft of the motor must pass periodically at exact moments, determined by the master clock, before a datum line provided upon the frame of the motor. This device is moreover arranged in such a way that a very slight phase displacement produces a very strong correcting action. In this way it is possible to maintain, within very small limits, the displacement which may be produced momentarily in the case when for any reason the value of M does not remain strictly equal to that of R.

3. A device controlled by the master clock mentioned above, enabling the lag or advance of each of the motors to be controlled continually and conformity or agreement to be re-established if desired by acting either upon M or upon R.

It is quite obvious that a synchronous motor, formed as described above, will not be able to possess an instantaneous angular velocity which is strictly constant, for, even when the adjustment is effected in a perfect manner, that is to say when M=R, the action of the synchronizing device introduces periodically, $k\ n$ times per second, two equal accelerations in opposite directions.

However, these periodical variations in the instantaneous angular velocity have no effect upon the degree of accuracy obtained in the distant indication since, as they are governed by the master clock they are synchronous with regard to each other and are produced simultaneously both at the transmitting station and at each of the receiving stations and further it is always possible to give them exactly the same amplitude.

On the other hand this type of motor possesses the very great advantage that it enables all the free and individual pendular oscillations to be completely annulled which are produced in the operation of synchronous electric motors of the present day type, actuated directly by alternating currents and acting to a certain extent like flexible connections.

It also enables synchronization to be obtained by only making use of a very small amount of power, which is an advantage of very particular interest when the distant indication is to be effected by wireless.

It finally possesses the advantage of effecting synchronization by making use of only one alternating current and of consequently necessitating only one single special transmission to be effected for the synchronization in the case when the distant indication is to be effected by wireless.

The improvement shown in Figures 3 to 10 also comprises the replacement of the valve provided in the cases shown in Figures 1 and 2, in the circuit which supplies the neon tube, by a source of continuous current the function of which is not only to oppose the passage of the current produced when the circuit is closed, but also to reduce, to a few volts only, the pressure to be developed in order to cause the tube to be lighted. As in the previous case this last mentioned advantage is of very special interest when the distant indication is to be effected by wireless.

In the case when the distant indication is to be effected by wireless, the improvement also comprises the use of special relays formed by the combination of a three-electrode lamp and vibrating strip or blade which has the triple advantage of reducing the power required from the amplifiers, of operating without the production of any spark and of presenting an impassable barrier to disturbing transmissions. These relays are actuated by a synchronizing tuning fork the vibrations of which are maintained by induction.

The improvement finally comprises the replacement of the luminous counter indices by illuminated counter indices, the replacement of the movable gas tubes (designated by the numeral 10 in Figs. 1 and 2) by fixed tubes, as well as the combination upon a single dial of the members giving respectively the control, the precision distant indication and the rough distant indication, in the case when use is made at the same time of two transmissions in order to obtain greater accuracy as explained above with reference to Figures 1 and 2 and with reference to French Patent No. 563,928.

In the diagrammatic Figure 3 the first device comprises: a continuous current motor of the shunt type supplied under constant pressure, formed by a field magnet 33 and an armature 34, upon which is developed the driving torque M; a fixed resistance 35 connected in series with 34, the function of which resistance is to assist the action of the synchronizing device by making the driving torque M practically independent of small variations in the speed, a rheostat 36, also connected in series with 34 and enabling the value of the driving torque M to be controlled by hand, by moving the movable contact 37, an adjusting screw 38 enabling the resisting

torque R to be varied by acting for example upon the torque produced by the friction of one of the brushes upon the commutator.

The second device comprises: an iron armature 39 in the form of a sector extending over an arc a (equal to 90° in Fig. 3), mounted upon the shaft of 34, an electromagnet 40, actuated by the switch of the master clock and acting upon 39 by means of a pole piece extending over an arc b (equal to 90° in Fig. 3) and a switch 41 the function of which is indicated hereinafter.

The third device which is a particular application of the device shown in Figs. 1 and 2 comprises: a flywheel 42 mounted upon the shaft of 34, a neon lamp 43 mounted upon 42 and connected to the secondary of the transformer 44, the primary of which is supplied through the switch of the master clock, a source of continuous current 45 (which advantageously replaces the valve 16 shown in Figures 1 and 2) connected in series with the secondary of the transformer 44 the double function of which is to oppose the passage of the current produced when the circuit is closed and also to considerably reduce the voltage to be developed in order to cause 43 to be lighted at the moment the break occurs, a luminous index 46 indicating the position for which 43 is lighted, when equality exists between the two oppositely directed impulses communicated for each turn by the action of 40 upon 39.

The master clock comprises: a continuous current motor of the shunt type, supplied under constant pressure, rotating at a speed of n-turns per second and formed by a field magnet 47 and an armature 48, a rotary switch formed by a sector 49 extending over an arc $a+b$ (equal to 180° in Fig. 3) mounted upon the shaft of 48, and a fixed brush 50, and an electromagnet 51 arranged to blow out the arc which would tend to be produced between 49 and 50 at the moment the break occurs.

In operation, a synchronized motor is first started up in the following manner (see Fig. 3). After 41 has been opened 37 is acted upon and also 38, so as to render stationary the luminous flashes produced by 43. When this result is obtained the speed of 34 is equal to n-turns per second, that is, to the speed of the motor armature 48; it is then sufficient to close 41 for agreement or conformity to be automatically established and for the luminous flashes produced by 43 to come opposite 46. The electromagnet 40 is energized when the rotating switch 49, 50 of the master clock is closed, and since the arc of sector 49 is equal to $a+b$, the accelerating and retarding effect of the electromagnet on armature 39 are exactly equal and opposite when synchronism is established. However, if the armature 39 lags behind the sector 49, the accelerating effect is greater because the pull of the electromagnet on the armature as it approaches the position of agreement with the magnet pole is greater than the pull on the armature as it leaves this position. A similar but opposite effect is obtained when the armature leaves the sector 49, so that the result is that the rotation of the shafts of armatures 34 and 48 are maintained in synchronism. The motor 48 may be located at the transmitting station, and motor 34 at a receiving station, it being understood that any desired number of receiving station motors may be controlled by the master clock at the transmitting station. These receiving and transmitting station motors may be employed to operate the signalling means shown in Figs. 1, 2 and 2ª, and also the means described hereinafter and illustrated in Figs. 4 to 10 inclusive.

In the case when for any reason whatever the working of the motor is subsequently disturbed, the gun server will be immediately informed of this occurrence by a displacement of the luminous flashes and it will be sufficient for him to act upon 38 in order to bring them back in front of 46.

It will be further noted that it is in no way indispensable for the arc 49 to have a peripheral surface equal to $(a=b)$ and that for instance by reducing this surface $(b=2a)$ the theoretical result would be obtained of producing one single impulse per turn which would have an accelerating effect in the case of a lag and retarding effect in the case of an advance. It is however obvious that by giving 49 a peripheral surface equal to $(a+b)$ a strong correcting action is obtained for the smallest displacement.

In Figure 4, which is a section taken through the axis of rotation, the movable armature 39 is formed by a cylindrical core to which are fixed two toothed plates; the fixed magnetizing coil 40 is placed concentrically with the core of 39; it is surrounded by a toothed magnetic cylinder (which replaces the pole piece shown in Fig. 3). The number of teeth on the plates and the cylinder is 6. The peripheral development of these teeth may for example be 15°.

By way of modification it is mentioned that the device shown in Fig. 4 may be replaced by toothed wheel devices controlled by tuning forks described in French Patent No. 579,298 filed the 11 June 1923, by utilizing the electromagnet 40 in order to maintain the vibrations of the tuning forks. In order to compensate for the movements it may in this case be advantageous to adjust M to a value slighter than that of R.

In Figure 5 the rotating part of the switch is formed by a commutator with twelve bars five of which (49^a) are connected to each other and to the positive pole. These five bars are separated from each other by four insulated bars and the three other bars are also insulated.

Figure 6 shows how the flashes produced by illuminating the tube 43 of Figure 3 appear when the speed of synchronism has been reached; a series of five luminous images *a*, *b*, *c*, *d*, *e* is then obtained corresponding to the five successive cuts shown, the end images *a* and *e* being separated by a dark space of 120°, while the space between each of the other images only occupies 60°.

In order to refer the agreement to a datum line it is therefore sufficient to arrange the fixed index 46, for example, in front of the position which the first image occupies, situated to the right of the wide dark space (direction of the arrow), when equality exists between the oppositely directed impulses communicating for each turn by the action of 40 upon 39.

In order not to unnecessarily tire the eyesight of the gun server the four other images may be screened by means of a translucent screen (shown hatched in Fig. 6).

Starting up will be effected exactly as described in connection with Figure 3. However, before closing 41 it will be necessary to bring the first image situated to the right of the wide dark space in the immediate neighbourhood of the fixed index or pointer 46. This result may be obtained for example by temporarily shunting a part of the resistance 35 by means of a push contact (not shown).

By way of modification it is mentioned that 40 and 44 may be supplied through two separate rotary switches comprising respectively six sectors and one single sector. Control is then obtained in the same way as in the case shown in Figure 3, but this modification does not necessitate the provision of an additional conductor between the transmitting station and the receiving stations.

In the case when the transmission is to be effected by wireless, the continuous current motors (33, 34) shown in Fig. 3 will be supplied by local batteries and the rotary switches (49, 50) will be employed to operate an installation transmitting electromagnetic waves, which may be formed for example as shown in Figure 1. All the synchronizing devices as well as all the control devices of all the synchronized motors (comprising the one which is utilized at the transmitting station) will be actuated in the same way by this transmitting installation.

In Figure 7, 52 is an electromagnet supplied by a valve amplifier (shown by 26 in Fig. 2), 53 an oscillating valve, adjusted to produce *n*-vibrations per second and connected to the grid 54 of a three-electrode valve 55 having a high output; 56 is the filament battery and 57 the anode battery; 58 and 59 are two batteries of dry cells connected respectively on the one hand to the negative pole of 57 and on the other hand to the elastic strips or blades 60 and 61 with each of which 53 makes contact alternately *n*-times per second.

62 is a resistance adapted to prevent any accidental short circuiting between 60 and 61. The batteries 58 and 59 are arranged in such a way that the difference in potential between the grid and filament is made positive and negative alternately. It follows that the anode circuit in which are connected the synchronizing electromagnet 40 and the controlling transformer 44 (see Fig. 3) will be traversed by a pulsating current of frequency *n*, the duration of which may be adjusted as required by suitably arranging the stops provided for the blades or strips 60 and 61.

It will be noted that 40 and 44 are, by way of modification, connected in series and that with this arrangement the switch 41 must be mounted in such a way as to allow 40 to be shunted during starting up.

It will be also noted that if it is desired to employ this device in the case when *k* is greater than *l*, by making use of the type of switch shown in Fig. 5, it will be necessary to connect the transformer 44 in series with 52.

It is to be observed that by cutting out one of the batteries 58—59, the difference of potential between the grid and the filament of 55 may always be kept negative; this relay may therefore operate without any spark ever being produced between 53 and 60 or 61.

This relay is perfectly adapted to actuate the synchronizing device because the power to be supplied to 52 in order to vibrate the blade 53 will always be less than the power absorbed by 40 in order to actuate the synchronizing device. It provides in addition an efficient protection against parasitic and atmospheric interference by virtue of the controlling action of the vibrating blade 53.

In Figure 8, 62 is a three-electrode valve, 63 its filament battery and 64 its anode battery; 65 is a tuning fork, 66 an electromagnet arranged in such a way as to be adapted to maintain the vibrations of 65 and connected in series in the anode circuit; 67 is an electromagnet comprising a field winding connected to a battery 68 and an armature winding connected between the filament and the grid. It is consequently seen that the vibrations of the tuning fork, by varying the magnetic reluctance of 67 produce periodic variations in the potential difference employed between the grid and filament. There correspond to the maximum displacement of the arms of the tuning fork maxima and minima of flux, that is to say the zeros of the grid voltage, or else the means values of the anode current. The necessary conditions for the vibrations to be maintained automatically are therefore satisfactorily obtained on condition that 68 is suitably connected to the primary winding of 67. It will be noted that it may be advantageous to connect in the secondary circuit of this transformer 67 a

battery of dry cells rendering the grid negative.

This device possesses the advantage of operating without giving rise to the production of any spark. In the case when the distant indication is effected along wires, it obviously enables the synchronous vibrations of several tuning forks to be maintained simultaneously, by connecting in series the electromagnets 66 of the supplementary tuning forks (which does not comprise an electromagnet with two windings such as 67).

It is also immediately applicable (by making use of any one of the known connections) to a transmitting installation sending out electromagnetic waves in order to obtain a tuning according to a regular sinusoidal rhythm.

In Figures 9 and 10, 69 is the shaft of the synchronized motor, 70 a metal crown fixed upon 69 by four arms between which exist large spaces; 71 is a radial slot formed near the inner edge of the crown, 72 a circular aperture formed in the central part and 73 a radial slot formed near the outer edge; 74 is a pinion driven by the reduction gear and driving a disc 75 which is seen through apertures in 70; 76 is a radial slot formed near the outer edge of 75, 77 a pinion controlled by the precision transmission and driving an outer crown 78; 79 is a radial slot near the inner edge of the crown 78; 80, 81, 82, 83 and 84 are five circular gas tubes, separated by cylindrical screens, supported by the bearing 85, and supplied with current through diametral points of supply, 80 and 84 being kept constantly luminous, 81 being employed for the rough transmission, 82 for the controlling device and 83 for the precision transmission; 86 is a protecting glass window provided with a datum or reference line 87 in the part opposite to the aperture 72.

It is consequently seen that the reference line 87 has the same function as the index 46 shown in Figure 3 and that in order to obtain synchronism it is sufficient to keep 87 upon the centre of the circular spot of light which is seen through 72. It is also seen that since 71 and 73 are indexes the illuminated slots 76 and 79 act as counter indexes.

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. An electrical transmission for controlling movements from a distance including a transmitting station having a source of electrical energy, a rotating contact, and a brush adapted to engage said contact, said source of energy, contact and brush constituting an electric circuit, a receiving station having an electric circuit including an electric discharge lamp, means for rotating said lamp in synchronism with said rotating contact, means for transmitting electrical energy from said first-named circuit to said second-named circuit, and means in said second-named circuit for energizing said lamp only when said first-named circuit is interrupted.

2. An electrical transmission for controlling movements from a distance having a transmitting station circuit including a source of power, a rotating contact, and a brush adapted to engage said contact, a receiving station circuit including an electric discharge lamp, means for rotating said lamp in synchronism with said rotating contact, means including a transformer for transmitting energy from said first-named to said second-named circuit, and means in said second-named circuit for preventing the energizing of said lamp except when said transmitting circuit is interrupted.

3. An electrical transmission for controlling movements from a distance having a transmitting station circuit adapted to be periodically made and broken and including a source of energy, a rotating contact, and a brush adapted to engage said contact, a receiving station circuit including an electric discharge lamp, means for rotating said lamp in synchronism with said contact, said lamp being adapted to flash instantaneously when energized, and means including a transformer for transmitting energy from said first-named circuit to said second-named circuit only when said first-named circuit is made and broken, whereby said lamp is flashed periodically, the position of said lamp at the instant of flashing indicating the movement which should be given to a member to be controlled.

4. In apparatus of the class described, a transmitting station having a motor, a conducting sector rotated by said motor, a brush adapted to periodically engage and disengage said sector, and a source of power in circuit with said brush and conducting sector, a receiving station having a motor rotating in synchronism with said first-named motor, an electric discharge lamp rotated by said last-named motor, means connected in circuit with said lamp and adapted to oppose the passage of current in one direction through said circuit, and means including a transformer for transmitting energy from said transmitting station to said receiving station only when said brush engages and disengages said sector.

5. Electrical apparatus for transmitting the movements of a control element to a distance including a transmitting station having in circuit a source of power, a rotating contact, and a movable brush adapted to engage and disengage said contact, said brush being operatively connected to said control element, a receiving station having a circuit including an electric lamp, means for rotating said lamp in synchronism with said contact, said lamp being adapted to flash in-

stantaneously when energized, means including a transformer for transmitting energy from said transmitting station circuit to said receiving station circuit only when said brush engages and disengages said contact, and means in said receiving station circuit for opposing the passage of current in one direction whereby said lamp flashes when said brush disengages said contact, the position of said lamp at the instant of flashing indicating the position of said movable brush.

6. Apparatus of the class described including a transmitting station having in circuit a rotating contact, a brush adapted to engage said contact, and a source of power, a receiving station having in circuit an electric discharge lamp and means for opposing the passage of current in one direction, electric motors for rotating said contact and lamp, means operated by one of said motors for periodically transmitting electric impulses to said other motors, means actuated by said impulses for maintaining said motors in synchronism, and means including a transformer energized by said impulse and connected in the receiving station circuit.

In testimony whereof I have signed this specification.

NICOLAS EMILIEN METHLIN.