PATENT SPECIFICATION

Application Date: June 29, 1921. No. 17,748/21. **186,681**

Complete Accepted: Sept. 29, 1922.

COMPLETE SPECIFICATION.

Electric Apparatus for Sending Out the Time.

I, MAURICE PHILIPPE FAVRE-BULLE, of 17, rue de Gambetta, Boulogne, France, a citizen of the French Republic, do hereby declare the nature of this invention and in what manner the same is to be performed, to be particularly described and ascertained in and by the following statement:—

This invention relates to an electric apparatus for sending out the time. In particular it relates to improved apparatus for sending out the time by means of receiving clocks that receive from a standard or master clock current impulses that cause the hands of the clocks to advance a small distance at each passage of the current.

In time indicating systems electrically controlled, it has been proposed to employ a four armed armature rotating in a field of three electro-magnets, placed 120° apart, which receive current in succession with an overlap; and in connection therewith a transmitter consisting of a short cylinder and three cylindrical segments turning under four contact springs, and these operate in a single circuit or according to a modification in a relay circuit in which the relays are controlled by the contact springs which in turn control the circuits of the time receiving units; the rotary armature is carried by a sleeve and is geared down to a core bearing the minute hand which is provided with the usual motion.

In electric signalling apparatus in which the transmitter and receiver are connected by three line-wires and the indicator of the receiver is caused to rotate by electro-magnetic action, the magnetic field of which turns in accordance with the movement of the transmitter; apparatus has been proposed in which the transmitter is normally disconnected from the receiver at the automatic switch, but it is connected by the switch to the receiver when the handle of the transmitter is operated to transmit a signal. The switch armature contacts co-act with the pole-pieces of three upper and three lower horizontal magnets and when raised connect leads from the transmitter, through certain of the contacts, with the line-wire at each side, the intermediate line-wire being normally connected with the intermediate lead. On turning the transmitter handle to send a signal, the circuit is made and the indicator is electromagnetically moved into its indicating position. The line-wires are in circuit with the receiver and coils and with the coils of a relay which closes a local bell circuit. On the reception of a signal the attendant at the receiving end closes a short-circuiting switch, the bell circuit is cut out, the line-wires are disconnected, the switch returns to its normal position and the receiver indicator remains stationary until another signal is sent.

This invention has for its object to provide an electrical apparatus for sending out the time, comprising a controlled electric transmitting device consisting of a distributor serving one or more receivers having rotating fields, where the rotor follows the discontinuous rotation of the field generated by the distributor; a central clock controlling the distributor, a current interrupter which, for each position of the distributor, allows the current to flow only during the time that is necessary for moving the movable member of the receiver.

The receiver controls the hands of the receiving clock. The improved apparatus is capable of being constructed in various ways. The current interrupter may be controlled either by the central clock or by the rotor of the receiver. This distributing apparatus may be supplied with current according to the present invention normally from an electric supply circuit, and in the case of a break-

an, it may be supplied from an emergency battery that is brought into circuit by an automatic switch.

This invention comprises further various constructional forms of the receiver and of the distributor which are hereinafter described by way of examples.

In the accompanying drawings:—

Figure 1 is a diagram illustrating the general principle upon which are based the electric devices forming the subject matter of this invention. It illustrates a first constructional form.

Figures 2 and 3 are diagrams illustrating a modification of the arrangements shown in Figure 1.

Figures 4 and 5 are respectively sections on the line 4—4 of Figure 5 and the line 5—5 of Figure 4, of a constructional form of the time receiver with movable permanent magnet.

Figure 6 is a perspective view of a movable magnet of this receiver.

Figures 7, 8 and 9 are sections respectively on the lines 7—7 of Figure 8, 8—8 of Figure 7 and 9—9 of Figure 7, of a constructional form of receiving apparatus having an exciting movable armature.

Figure 10 is a perspective view of the movable armature of the receiver shown in Figures 7 and 8.

Figure 11 is an elevation illustrating a constructional form of the current distributor controlled by the central clock.

Figure 12 is a section of this distributor on the line 12—12 of Figure 11.

Figure 13 is a diagram of the electric installation for supplying current to the hour distributing circuit from a main transmitting power or light.

The diagram of Figure 1 illustrates the general principle of the time distributing apparatus forming the subject matter of the present invention. The central clock operates an electric interrupter I and a current distributor D connected by an electric circuit, as indicated in the diagram, to a supply of direct current E and to an electro-magnetic receiving device comprising three coils B^1 B^2 B^3 arranged star-fashion around a rotary magnet N S which takes up a position in the direction of the resultant magnetic field when the coils are traversed by electric currents. The wheel work of the central clock drives the rotary interrupter I and the current distributor D at different speeds. The speed of rotation of the interrupter I is, for instance, such that the interrupter will remain closed for a short instant during each minute. The speed of rotation of the distributor is such that the latter will rotate through $^1/_6$ of a revolution during one minute, and alter the connections between the coils and the supply of electricity in such a manner that the successive current impulses will have the effect of causing the magnet N S to advance through $^1/_6$ of a revolution. The distributor consists simply of an insulating disc A comprising two conducting segments C and C^1 connected respectively by means of rings and rubbing members to the supply of electricity E. Brushes 1, 2 and 3 arranged 120° apart rub on the distributor D and are connected respectively to the coils B^1 B^2 and B^3 that are arranged in star-fashion. In the position shown in Figure 1 the current enters at the coil B^1 and passes out at the coil B^2. Since the interrupter I rotates at uniform speed, the contact endures only during a very short instant, whereupon the electric circuit is opened. The lengths of the pole piece of the cores of the coils and of the magnet are so determined that the magnet will remain in stable equilibrium in this position when the circuit is opened by reason of the smaller reluctance of the magnetic circuit. After the expiration of one minute the electric circuit is again closed by the interrupter I, but the distributor D has rotated through $^1/_6$ of a revolution, so that the brush 2 is now opposite the insulating portion of the distributor, whereas the brush 3 is opposite the negative conducting segment C^1 and the brush 1 is opposite the positive conducting sector. Under these conditions the current enters at the coil B^1 and passes out at the coil B^3 and the magnet N S rotates through $^1/_6$ of a revolution in the direction of the arrow. This working is continued identically and every minute the movable magnet will rotate through $^1/_6$ of a revolution or always in the same direction. It is merely necessary to actuate the hands through the medium of suitable gear wheels ~~receiving~~ their motion from the magnet.

The diagrams, Figures 2 and 3, illustrate a modification of the apparatus just described. The current distributor D receives uniform motion simply from the central clock. The brushes 1, 2 and 3 are likewise connected to the leading-in wires of the coils B^1 B^2 and B^3 of the receiver. But the leading-out wires of these coils are connected to three brushes 1^1, 2^1, 3^1 arranged 120° apart, rubbing on a special interrupter D^1 fixed on the shaft of the rotary magnet N S. It consists of a conducting disc carrying two insulating segments II and II^1. The fixed angular position of the interrupter D^1 relatively to the rotary magnet N S is such that the insulating segments are

arranged relatively to the brushes 1^1, 2^1 and 3^1 as indicated in Figure 2, when the magnet is in the position shown in the figure. The operation is as follows:

Starting from the position shown in Figure 2, it will be perceived that owing to the position of the distributor D no current is flowing in the coils. The distributor D in revolving in the direction of the arrow, causes the conducting segment C^1 connected to the negative pole of the battery, to come into contact with the brush 3. In these conditions an electric circuit is closed and the current enters at the coil B^1 and passes out at the coil B^3. The rotary magnet N S rotates in the direction of the arrow, and has a tendency to move towards the position shown in Figure 3, but the interrupter D^1 which is fixed to the magnet likewise rotates, and when the magnet is about to assume the position shown in Figure 3 the insulating segment H comes into contact with the brush 1^1 and the circuit is opened. The rotary magnet, nevertheless, assumes a stationary position shown in Figure 3 which, as hereinbefore stated, is a position of minimum reluctance of the magnetic circuit, and consequently a position of stable equilibrium. Moreover, it will be perceived that if by reason of the acquired velocity the magnet should pass beyond this position, the brushes 1^1 2^1 and 3^1 will be again short circuited, and the current would then pass into the coils B^1 and B^3 and bring back the magnet into the proper position.

The apparatus just described thus allows of obtaining by means of a single distributor driven by the central clock, a working in the same conditions as that which is obtained with the apparatus shown in Figure 1. The apparatus shown in Figures 2 and 3 allows further of reducing the consumption of current to a minimum because the circuit is automatically opened immediately on the termination of each rotation of the receiver through $^1/_6$ revolution. Finally, the spark produced at the instant of opening the circuit takes place at the interrupter D^1 of the receiving clock and not at the distributor of the central clock. This is a great advantage because it is necessary above all things that the central clock that feeds the whole of the time distributing installation, shall remain in a perfect state of working.

Figures 4, 5 and 6 illustrate a first type of the time receiver whose rotor is a permanent magnet. This receiver comprises three coils of insulated wire 5, 6 and 7 surrounding the soft iron cores 8, 9 and 10 riveted to the soft iron plate 11. The cores of the coils are formed at their front ends with pole pieces likewise of soft iron 12, 13 and 14. A movable magnet 15 mounted on an axle 16 by means of a brass attachment member 17, is adapted to rock on the one hand in the plate 11 and on the other hand in a brass plate 18 which is fixed by means of screws such as 19 to the ends of the cores of the coils. A counter plate 20 fixed to the plate 18 assures a perfect centering of the axle of the magnet relatively to the pole pices; this plate 20 being fitted exactly in the bore of said pole pieces. The magnet has the shape shown in perspective in Figure 6. This shape allows of obtaining a relatively powerful magnet with a reduced bulk and weight. It is further to be noted that the maintenance of the magnetisation is assured by the exciting coils when they carry current, because the magnet always taken up a position in the direction of the resulting flux, so that its magnetisation will be reinforced by the flux generated by the said coils. The actuation of the hands is assured in a simple manner by means of a worm 21, fixed on the end of the axle 16, meshing with a toothed wheel 22 that drives the arbor 23 of the large hand of the receiving clock. The small hand is driven by an ordinary minute clock mechanism. The use of worm and worm wheel gear is very advantageous because this transmission is non-reversible, and unbalanced ends may be employed without risk of their falling back or moving forward at the wrong times.

The receiver just described is connected to the circuit for distributing the time, in the manner indicated in the diagrammatic Figure 1. There may likewise be mounted on the axle 16 an interrupter D^1 constructed as hereinbefore described, and the connections may be made as indicated in the diagrams of Figures 2 and 3. It will be perceived that these apparatus do not comprise any part whose operation may cause noise while they are very strong.

Figures 7, 8, 9 and 10 illustrate another type of time receiver, comprising a rotary armature of special shape magnetised by an exciting coil 25. This arrangement allows of utilising the hour distributing circuits of the type indicated in the diagrams of Figures 1, 2 and 3, but employing a supply E of alternating current. As a matter of fact as the direction of the current is reversed simultaneously in the coils B^1, B^2 or B^3 and in the exciting coil 25, the polarity of the stator and of the movable magnet is reversed at the same time and the electromagnetic couple

retains the same direction. The coils B^1, B^2 and B^3 which are mounted in star-fashion and connected to the distributor of the central clock as hereinbefore described, are mounted on a stator of soft iron consisting simply of two plates of sheet metal 26 and 27 cut out in the manner clearly shown in Figure 7. Three columns forming fixing studs 28, 29 and 30 arranged 120° apart serve to hold the plates 26 and 27 and the frame plates 31 and 32 in which are journalled the axles of the revolving armature. This construction allows of making the coils in advance and of slipping them on to the pole pieces of the plates 26 and 27. For this purpose the two plates 26 and 27 are brought into contact with each other, the coil is inserted and is passed diagonally on to one limb and then on to the other of the pole pieces, until it comes into position upon the reduced portion of these pole pieces. These plates are then moved apart and held in this position by means of stay tubes such as 33. These tubes are held by the fixing studs 28, 29 and 30. The shape of the plates 26 and 27 is such that the coils are held in place with a slight grip (see Figure 9).

The movable armature consists of an iron core 35 that constitutes the axle and carries two pieces of iron 36 and 37 shaped in the manner shown in perspective in Figure 10 . The exciting coil 25 is fixed concentrically to the core 35. The fixed position of this coil is assured by lugs such as 36^1 engaged between the plate 26 and the stay tubes 33. This construction allows of dispensing with the use of a movable winding which would compel the use of rings and brushes for supplying the current. The actuation of the hands is likewise effected by a simple reducing gear consisting of a worm 37^1 and worm wheel 38.

Figures 11 and 12 illustrate a practical construction of the current-distributor of the central clock. This distributor has been designed with the object of reducing the mechanical friction to a minimum; it comprises a disc of insulating material 40 on which are fixed two conducting sectors 41, 42 carrying respectively two axles 43 and 44 by which the current is supplied to them. Each of the three brushes arranged 120° apart consists of a lever 45 pivoted on a pin 46 and carrying at its end a small roller 47 that is movable on a brass axle. The rollers are composed of an alloy of bronze and graphite (this material being generally used in the manufacture of brushes for electric machines).

A coil spring suitably arranged, is attached to the lever 45 and to a part 48 that is connected to the terminal of the conductor of the time distributing circuit.

Figure 13 is a diagrammatic figure illustrating the electric arrangements for feeding the time distributing circuit. This installation allows of utilising any electric supply circuit, and of being branched automatically upon an emergency battery consisting of cells or accumulators in case the current of the district should fail. C P are the mains of the district for distributing the electricity. A shunt circuit is taken for feeding the distributor of the central clock whose leading-in terminals are shown at 50 and 51. The supply conductors 52 and 53 pass through the cut-out device C C. One of the wires, 52, is connected directly to the terminal 50. The wire 53 is connected to the terminal of a two-way automatic switch which allows of connecting the terminal 51 either to the terminal 54 or to the terminal 55. This terminal 55 is connected to one of the poles of the emergency battery 56 whose other pole is connected to the terminal 50.

A movable lever of the switch is actuated by the armature of an electromagnet 57 the winding of which is connected to the wires of the mains as shown in the figure.

It will be perceived that when current is supplied from the local district, the armature 58 is attracted and the central clock is fed from the said district. If the current should fail, the armature 58 drops and the supply is taken up automatically by the emergency battery 56. As soon as the voltage has been restored in the mains C P current is taken from the district supply. It is obvious that the voltage of the district supply may be first reduced by means of an additional resistance or preferably of a small static transformer in the case of alternating currents. It is advisable to note that this method of mounting would not be possible with certain known time receivers that comprise a ratchet wheel which is advanced one tooth by the action of an armature actuated by each current impulse. As a matter of fact, if the automatic switch just hereinbefore described should come into operation at the moment when the distributor of the central clock is working, there might be a miss and all the receiving clocks would become one minute slow. This drawback does not occur with the apparatus shown in Figure 1; as a matter of fact, if a miss should happen through the reason above referred to, the amount by which the clocks would be slow will be regained on the next following current

impulse because the armature would then advance through $^1/_3$ of a revolution in order to assume the direction of a resulting field corresponding to the position of the distributor, which latter works unceasingly.

The distributor D may be supplied directly from a source of electricity and the brushes may be connected to the coils B^1, B^2 and B^3 mounted star-fashion, of a receiver constructed as hereinbefore described with reference to Figures 4 and 10.

The armature of the receiver revolves at the same sped as that of the distributor. The distributor may be run at very high speeds. The motion is faithfully reproduced by the receiver except in the case of too sudden accelerations of the rotational motion of the distributor. This property may be utilised more particularly in circuits for sending out the time when it is desired to put forward or to put back all the receiving clocks simultaneously. In the method of mounting shown in Figure 1 it is sufficient to short circuit the interrupter I and to disengage the distributor D from the central clock. The distributor can then be caused to rotate at a relatively high speed in one direction or the other; the armatures of the time receivers rotate in the same direction and at the same speed as the distributor of the central clock.

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 installation for sending out the time comprising a controlled electric transmitting apparatus consisting of a distributor serving one or more receivers having rotating fields, the rotor of which follows the discontinuous rotation of the field generated by the distributor; a master clock actuating the distributor, and a current interrupter which, at each rotation of the distributor, allows current to pass only during the time that is required for moving the movable part of the receiver.

2. An installation as claimed in Claim 1, wherein the current interrupter is actuated by the master clock at a speed which may be different from that of the distributor.

3. An apparatus as claimed in Claim 1, wherein the current interrupter is actuated by the movable part of the receiver in such a manner as to open the circuit immediately the movement of this movable part has been completed.

4. An installation as claimed in Claim 1, characterised by the feature that it is supplied with current normally from electric mains, and in case of a breakdown, from an emergency battery which is brought into circuit by an automatic cut-out switch; the use of receivers having rotating fields allowing of regaining the delay which may be caused in these receivers if the automatic cut-out switch was operated at the time when the distributor and the interrupter are in position for allowing the passage of an electric impulse.

5. A constructional form of a receiver for an installation as claimed in Claim 1, consisting of three fixed coils arranged star-fashion, provided with pole pieces in the middle of which there moves a movable permanent magnet whose motion is transmitted to the receiving clock by means of a non-reversible mechanical transmission gear.

6. A constructional form of a receiver for an installation as claimed in Claim 1, comprising an armature that is polarised by an exciting coil whose field varies in the same manner as the field of the coils of the fixed electro-magnets, thereby allowing the installation to be fed with alternating current.

7. A constructional form of a receiver stator for an installation as claimed in Claim 1, consisting of two cut-out plates carrying pole pieces on which the coils can be slipped when the two plates are in contact with each other and on which the coils are jammed when the plates are moved to their normal distance apart.

8. A constructional form of a distributor for an installation as claimed in Claim 1, comprising an insulating rotary disc having conducting segments; pivoting contacts provided with rollers; and springs for assuring both the supply of current to said contacts and their bearing upon the rotating disc.

9. Electric apparatus for sending out the time, constructed, arranged, and operating substantially as set forth and as illustrated by the accompanying drawings.

Dated this 29th day of June, 1921.

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Fig.1.

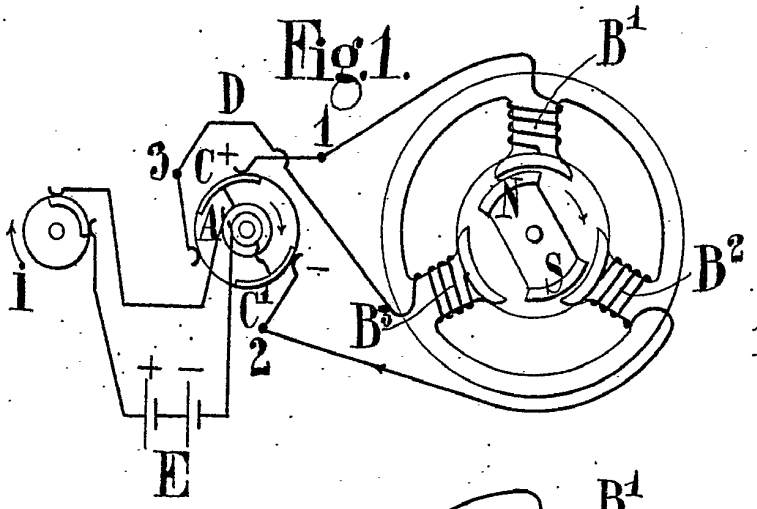
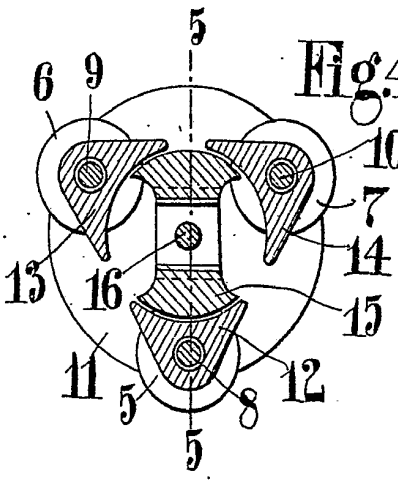


Fig.4.



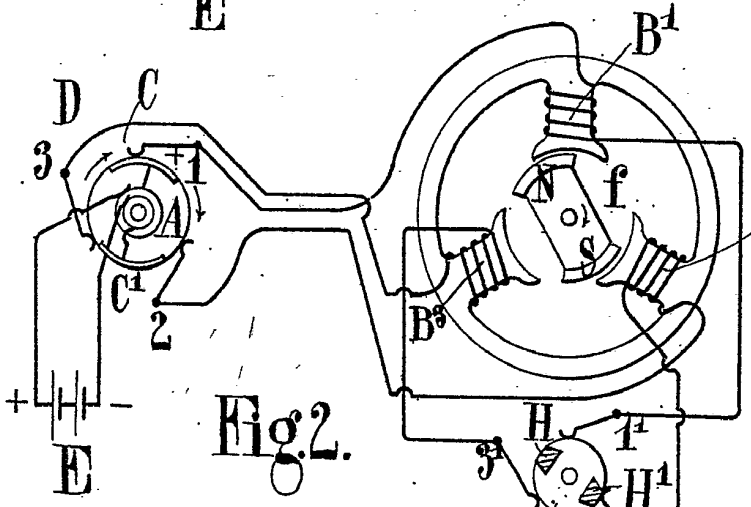
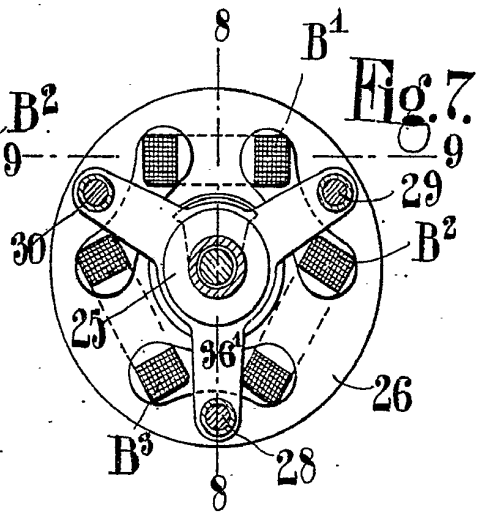


Fig.2.

Fig.7.



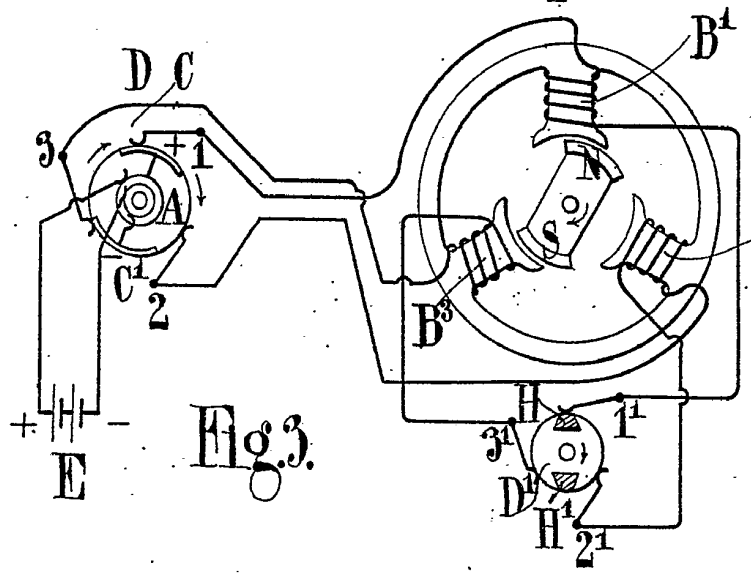


Fig.3.

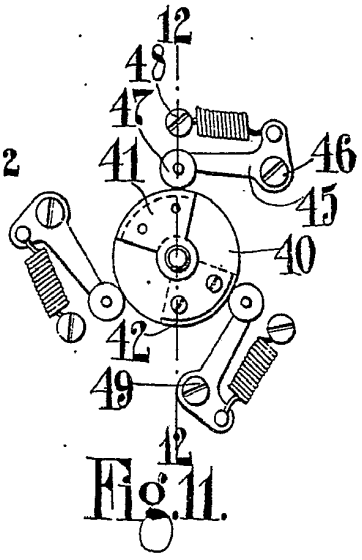
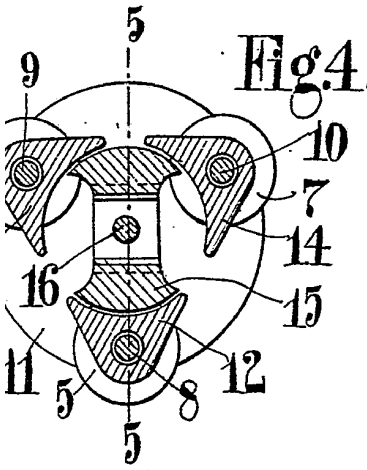


Fig.11.



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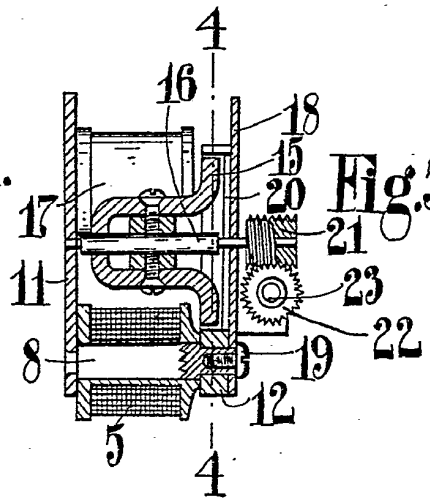

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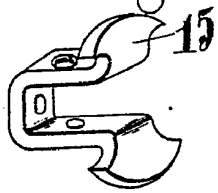

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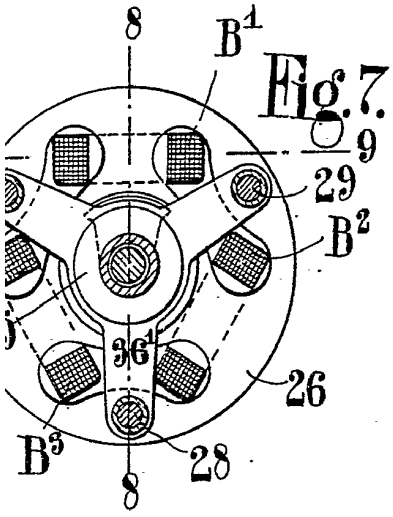

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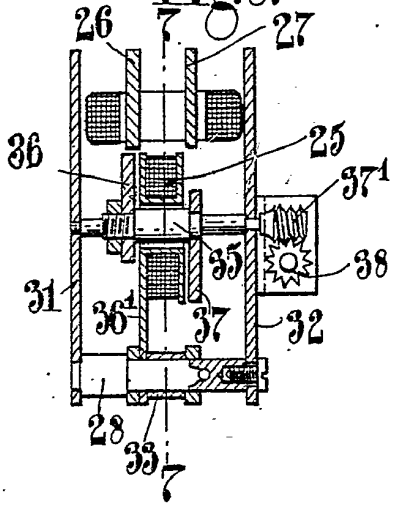

Fig.8.

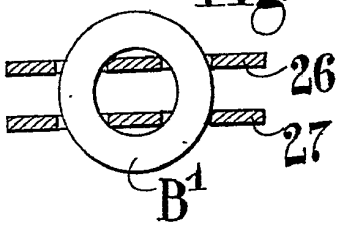

Fig.9.

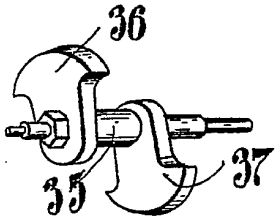

Fig.10.

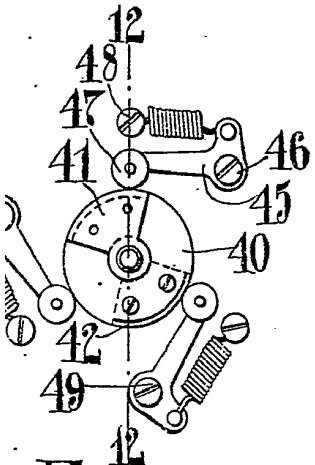

Fig.11.

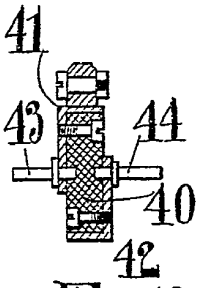

Fig.12.

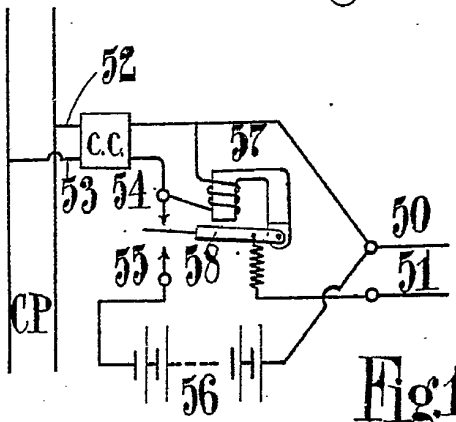

Fig.13.

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Fig.1.

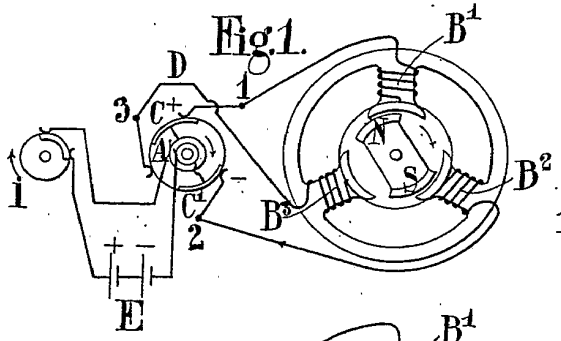
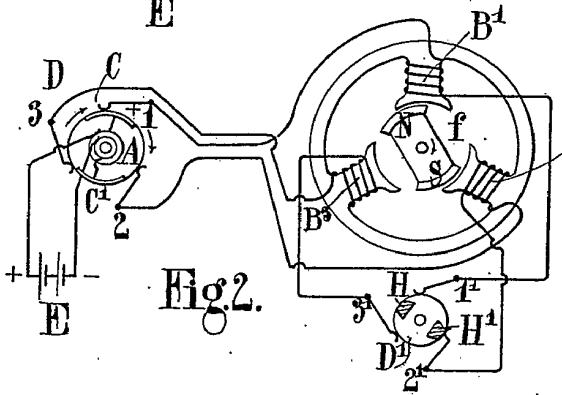


Fig.2.



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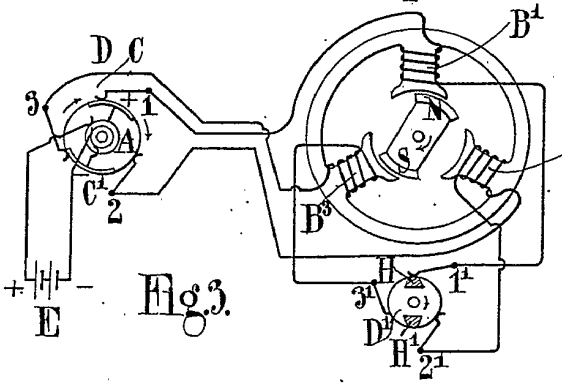


Fig.4.

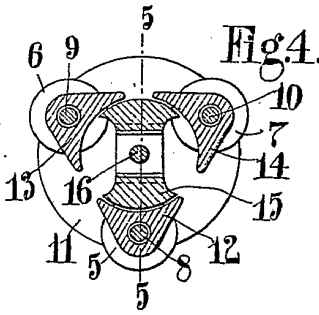


Fig.5.

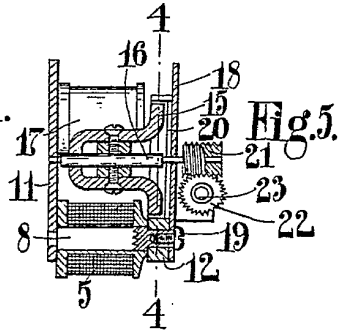


Fig.6.

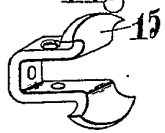


Fig.7.

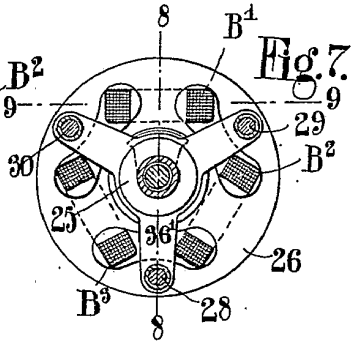


Fig.8.

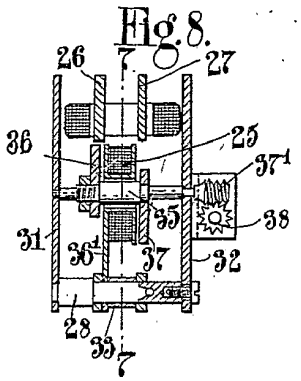
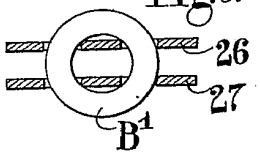


Fig.9.



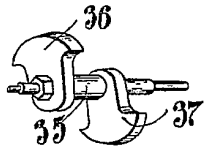


Fig.10.

Fig.11.

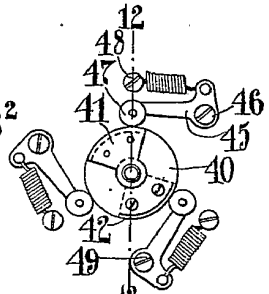


Fig.12.

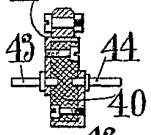
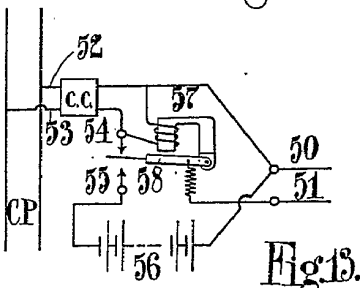


Fig.13.



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