N° 24,723 A.D. 1911

Date of Application, 7th Nov., 1911

Complete Specification Left, 7th May, 1912—Accepted, 7th Nov., 1912

PROVISIONAL SPECIFICATION.

Improvements in and relating to the Synchronisation of Clocks.

We, ISAAC HARDY PARSONS, of The Croft, Kibworth Harcourt, near Leicester, Electrical Engineer, and ALFRED ERNEST JOSEPH BALL, of Kingston House, Evington Road, Leicester, Clockmaker, do hereby declare the nature of this invention to be as follows:—

This invention relates to the synchronisation of clocks, and is applicable chiefly to master clocks or transmitters such as are used for driving a number of secondary clocks, synchronisation being effected by an electric current such as is sent out from Greenwich Observatory over the post office wires for the daily 10 a.m. mean time signal, or a synchronising time current of a similar nature sent at a pre-determined time by a prime or grand master clock or by any other suitable instrument of standard mean time.

In accordance with this invention, we employ in a novel manner the well-known principle of giving to the master or other clock to be controlled, a slight gaining rate and of effecting the control by stopping the wheel train or equivalent and restarting it by means of a pre-determined synchronising time signal.

This present invention however is characterised by the inter-working of two contacts in a synchronising circuit, one contact being closed when a clock to be controlled arrives (early) at the time selected for synchronisation while the other contact is opened at the precise moment of synchronisation.

When employing a grand master clock to send out the synchronising current to one or more subsidiary master clocks, we provide and arrange the following apparatus:—

Firstly, a grand master clock which we term the prime transmitter, and we provide such prime transmitter (or a secondary clock operated by it) with contacts which we term "prime contacts" and which are closed a short time before, and are separated at, the precise instant at which it is desired to send a synchronising time signal, by the cessation of a current due to the separation of the prime contacts.

Secondly, we provide each of the subsidiary master clocks to be controlled—which clocks we term sub-transmitters—with a controlling electro-magnet disposed so that when energised it either moves the driving pawl out of engagement with the 'scape or count wheel, or withholds such wheel from rotating.

Thirdly, we provide each of the sub-transmitters with a secondary clock operated by it and fitted with contacts which we term "secondary contacts." These we arrange to close at the instant the hands of the sub-transmitter or the secondary clock (which hands are fast due to the gaining rate of the former) show against the dial the pre-arranged instant of the cessation of the synchronising time signal, and we arrange that these contacts be separated at any convenient time after the cessation of such signal. It will be understood that each sub-transmitter and consequently its secondary clock has a gaining rate, and the time of the cessation of the synchronising time signal will therefore be indicated on the dial before the arrival of the actual signal as given by the cessation of current.

Fourthly, we connect each of the controlling electro-magnets of the sub-transmitters in parallel with the prime contacts by means of suitable circuits

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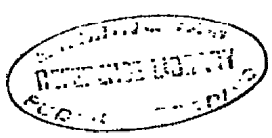


(frequently consisting of aerial wires) and provide a source of electrical energy either common to all or otherwise. We include in each circuit the source of electrical energy, the prime contacts, the controlling electro-magnet of one of the sub-transmitters and the contact of the sub-transmitter or its secondary clock.

The synchronisation is effected and the apparatus operates in the following manner:—

Shortly before the arrival of the synchronising time signal current, the prime contacts are closed as hereinbefore described. No current however flows at this moment because the various circuits are open at the secondary contacts. As each of the secondary contact clocks of the respective sub-transmitters arrive at, and indicate on their dials the time of the cessation of the pre-arranged synchronising time signal, due to the gaining rate hereinbefore described, the secondary contacts are closed and the controlling electro-magnet of each sub-transmitter (in circuit with both primary and secondary contacts) is energised with the result that its 'scape wheel or equivalent is prevented from rotating. The pendulum of each sub-transmitter so effected, then vibrates idly until the cessation of the current of the synchronising time signal which is indicated by the breaking of the circuit by the separation of the prime contacts at the pre-arranged moment of the hour or day. The instant that the circuit or circuits are broken, the controlling electro-magnet of each sub-transmitter releases its pawl or 'scape wheel, and the sub-transmitters and their respective circuits of secondary clocks again operate as before with the difference that they now show correct time instead of being a few seconds fast as they were prior to the cessation of the current of the synchronising time signal.

When employing the current of the Greenwich mean time signal for the purpose of sending a synchronising current to one or more subsidiary master or other clocks, the synchronising time current is required to be imposed on the line approximately one minute prior to the moment of synchronisation and either broken or reversed at the instant of the time signal.

In positions where the synchronising time current is reversed (as is the usual practice when the current is sent out prior to the signal) we employ a polarised relay to receive the signal, the polarity being arranged to receive the current prior to and up to the reversal but not after. The contacts of the relay are then employed as the prime contacts and are used in the manner hereinbefore referred to.

Among the advantages of this improved method of synchronisation are:—

A breakdown of overhead controlling lines through snow or storm would not stop the sub-transmitter so connected and its group of clocks, and such group would only be out of control for a time, the clocks continuing in operation with a slight gaining rate until the line or lines were re-instated, when the accumulated error would be automatically corrected.

The failure of the source of electrical energy employed to operate the control, would not result in the stoppage of any sub-transmitter as the control does not come into operation unless a current is flowing.

The controlling apparatus is simple in character and inexpensive to apply.

Such a system of controlling distant groups of clocks is particularly applicable for distributing uniform time throughout towns, or throughout works or institutions composed of a number of detached blocks of buildings. For such purposes a prime transmitter would be installed in one of the blocks and could with advantage be connected to Greenwich and be automatically controlled either by the method set forth in this specification or by other suitable means. Each block would be provided with a sub-transmitter and a group of clocks and the sub-transmitter connected to the prime transmitter in the manner herein set forth.

As hereinbefore stated, the energisation of the controlling electro-magnet of a sub-transmitter is utilised to either stop the wheel-train or to move the driving

pawl out of engagement. The former method may be employed with transmitters or master clocks constructed as shown in Fig. 1 of our prior Patent No. 24,620/1904 and the latter method may be employed with transmitters constructed as shown in Figs. 9 and 10 of our prior Patent No. 919/1907.

The method of synchronisation herein described, is, with slight modifications, applicable to mechanical clocks.

Dated this 6th day of November, 1911.

ISAAC HARDY PARSONS.
ALFRED E. J. BALL.

COMPLETE SPECIFICATION.

Improvements in and relating to the Synchronisation of Clocks.

We, ISAAC HARDY PARSONS, of The Croft, Kibworth Harcourt, near Leicester, Electrical Engineer, and ALFRED ERNEST JOSEPH BALL, of Kingston House, Evington Road, Leicester, Clockmaker, 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 the synchronisation of clocks, and is applicable to master clocks or transmitters such as are used for driving a number of secondary clocks, synchronisation being effected by an electric current such as is sent out from Greenwich Observatory over the post office wires for the daily 10 a.m. mean time signal, or a synchronising time current of a similar nature sent at a pre-determined time by a prime or grand master clock or by any other suitable instrument of standard mean time.

In accordance with this invention, we employ the well-known principle of giving to the master clock to be controlled, a slight gaining rate and of effecting the control by stopping the wheel-train or equivalent and restarting it by means of a pre-determined synchronising time signal. The synchronising current is controlled by two inter working contacts in a synchronising circuit, one contact being closed when a master clock to be controlled arrives (early) at the time selected for synchronisation while the other contact is opened at the precise moment of synchronisation.

According to our invention, when employing a grand master clock to send out the synchronising current to one or more subsidiary master clocks, we provide and arrange the following apparatus:—

Firstly, a grand master clock which we term the prime transmitter, and we provide such prime transmitter (or a secondary clock operated by it) with contacts which we term prime contacts and which are closed a short time before and are separated at the precise instant at which it is desired to send a synchronising time signal by the cessation of a current due to the separation of the prime contacts.

Secondly, we provide each of the subsidiary master clocks to be controlled—which clocks we term sub-transmitters—with a controlling electro-magnet disposed so that when energised it either moves the driving pawl out of engagement with the 'scape or count wheel, or withholds such wheel from rotating.

Thirdly, we provide each of the sub-transmitters with a secondary clock operated by it and fitted with contacts which we term secondary contacts. These contacts we arrange to close at the instant the hands of the sub-transmitter or the secondary clock (which hands are fast due to the gaining rate of the former) show against the dial the pre-arranged instant of the cessation of the synchronising time signal, and we arrange that these contacts be separated at

any convenient time after the cessation of such signal. It will be understood that each sub-transmitter and consequently its secondary clock has a gaining rate, and the time of the cessation of the synchronising time signal will therefore be indicated on the dial before the arrival of the actual signal as given by the cessation of current.

Fourthly, we connect each of the controlling electro-magnets of the sub-transmitters in parallel with the prime contacts by means of suitable circuits (frequently consisting of aerial wires) and provide a source of electrical energy either common to all or otherwise. We include in each circuit the source of electrical energy, the prime contacts, the controlling electro-magnet of one of the sub-transmitters and the contact of the sub-transmitter or its secondary clock.

The synchronisation is effected and the apparatus operated in the following manner:—

Shortly before the arrival of the synchronising time signal current, the prime contacts are closed as hereinbefore described. No current however flows at this moment because the various circuits are open at the secondary contacts. As each of the secondary contact clocks of the respective sub-transmitters arrive at, and indicate on their dials the time of the cessation of the pre-arranged synchronising time signal, due to the gaining rate hereinbefore described, the secondary contacts are closed and the controlling electro-magnet of each sub-transmitter (in circuit with both primary and secondary contacts) is energised with the result that its 'scape wheel or equivalent is prevented from rotating. The pendulum of each sub-transmitter so effected, then vibrates idly until the cessation of the current of the synchronising time signal which is indicated by the breaking of the circuit by the separation of the prime contacts at the pre-arranged moment of the hour or day. The instant that the circuit or circuits are broken, the controlling electro-magnet of each sub-transmitter releases its pawl or 'scape wheel, and the sub-transmitters and their respective circuits of secondary clocks again operate as before with the difference that they now show correct time instead of being a few seconds fast as they were prior to the cessation of the current of the synchronising time signal.

When employing the current of the Greenwich mean time signal for the purpose of sending a synchronising current to one or more subsidiary master clocks, the synchronising time current is required to be imposed on the line approximately one minute prior to the moment of synchronisation and either broken or reversed at the instant of the time signal.

In positions where the synchronising time current is reversed (as is the usual practice when the current is sent out prior to the signal) we employ in one arrangement a polarised relay to receive the signal, the winding of the magnet being arranged to attract the armature & make a contact prior to and up to the reversal but not after. The contacts of the relay are then employed as the prime contacts and are used in the manner hereinbefore referred to.

Among the advantages of this improved method of synchronisation are:—

A breakdown of overhead controlling lines through snow or storm would not stop the sub-transmitter so connected and its group of clocks, and such group would only be out of control for a time, the clocks continuing in operation with a slight gaining rate until the line or lines were re-instated, when the accumulated error would be automatically corrected.

The failure of the source of electrical energy employed to operate the control, would not result in the stoppage of any sub-transmitter as the control does not come into operation unless a current is flowing.

The controlling apparatus is simple in character and inexpensive to apply.

Such a system of controlling distant groups of clocks is particularly applicable for distributing uniform time throughout towns, or throughout works or institutions composed of a number of detached blocks of buildings. For such purposes a prime transmitter would be installed in one of the blocks and could

with advantage be connected to Greenwich and be automatically controlled either by the method set forth in this specification or by other suitable means. Each block would be provided with a sub-transmitter and a group of clocks and the sub-transmitter would be connected to the prime transmitter in the manner herein set forth.

As hereinbefore stated, the energisation of the controlling electro-magnet of a sub-transmitter is utilised to either stop the wheel-train or to move the driving pawl out of engagement. The former method may be employed with transmitters or master clocks constructed as shown in Fig. 1 of our prior Patent No. 24,620/1904 and the latter method may be employed with transmitters constructed as shown in Figs. 9 and 10 of our prior Patent No. 919/1907.

Referring to the annexed drawings in which like letters indicate like or equivalent parts:—

Fig. 1 shows a controlling electro-magnet and armature which operates on the driving pawl of a master clock and puts it out of action.

Fig. 2 shows a controlling electro-magnet and armature which operates on the back stop pawl of a master clock, and causes the 'scape or count wheel to oscillate backward and forward instead of advancing as normally.

Fig. 3, shows a controlling electro magnet and armature which operates on the 'scape wheel of a master clock, and holds it from progressing (when the design permits of this being done).

Fig. 4, shows diagramatically a complete system of control.

Fig. 5, shows diagramatically a system of control applicable to a prime transmitter, the control in this instance being from Greenwich or equivalent source of time.

Referring to Fig. 1, A shows the controlling electro magnet B its armature, (pivotted at B^1) and C an extension which in this instance operates on the driving pawl D which is pivotted to the pendulum at D^1. E shows the pendulum which in vibrating causes the driving pawl D to propel the 'scape wheel F tooth by tooth. The 'scape wheel, driving pawl, and pendulum, are shown in the usual positions of such parts in a design of master clock or transmitter now largely employed and well-known.

Referring to Fig. 2, the extension C of the armature B operates by depressing the tail piece G^2 of the back stop click G, pivotted at G^1. When so depressed the 'scape wheel is not stopped on the back stroke of the pawl D, and therefore returns with the pawl, the friction or pressure of the pawl pin D^2 being sufficient to move the 'scape wheel F backwards as well as forwards, and therefore the 'scape wheel oscillates until the controlling current ceases to flow through the magnet A.

Referring to Fig. 3 which shows a type of escapement which permits the 'scape wheel to be held from rotating and which allows the pallets D to oscillate idly, F shows the 'scape wheel held by the catch C of the armature B which latter is shown held by the energised magnet A. On the circuit being broken at the arrival of the instant of standard time as hereinbefore described, the magnet A releases the armature, the catch C is returned to its normal position by the spring C^2, and the 'scape wheel F rotates as before.

Referring to Fig. 4 which is mainly diagrammatic, H shows the prime transmitter, I the rear view of part of the mechanism of a secondary clock operated in connection therewith, and J and J^1 the contacts, while L shows a cam or equivalent which brings the prime contacts into operation. M shows that portion of a sub-transmitter to which this invention refers, and which contains the form of controlling electro magnet which is shown in Fig. 2. N shows the rear view of part of the mechanism of a secondary clock which is operated by the sub-transmitter, N^1 and N^2 being the secondary contacts which are shown as just having being brought into contact by the cam N^3, on the sub-transmitter and its system arriving to the time of control,—but a few seconds fast of true time as hereinbefore described.

The control circuit is therefore shown completed and consequently the armature B of the controlling magnet is shown in its attracted position. The controlling circuit is energised by the battery P.

Consequent on the attraction of the armature B the back stop click G is withdrawn, and the pendulum E and the 'scape wheel F therefore oscillate idly awaiting the arrival of the time signal.

At the instant of the arrival of the standard time signal, the cam L of the secondary clock I moves clear of the bearing block J^3 of the prime contact spring J^1 which then parts company with its fellow contact J, and breaks the control circuit. The control magnet A being no longer energised, the armature B and consequently the back stop click G take up their normal positions, and the pendulum of the sub-transmitter again propels the 'scape wheel as before. The control may take place every hour, every day, or at any other pre-arranged interval.

When it is desired that the intervals of control be greater than an hour we introduce into the control circuit, contacts in series which are operated by 12-hour or 24-hour wheels and such wheels may be rotated by or in connection with one or both of the cams L and N^3.

With the control hereinbefore described it is obvious that when the cam N^3 is operated by a secondary clock as shown in Fig. 4, the 'scape wheel of the sub-transmitter is put out of action by the control, immediately after an impulse has been sent through its circuit of secondary clocks, and that the sub-transmitter will take up its work from an even minute or half minute. It is sometimes an advantage for the sub-transmitter to take up its work between the half minutes a few seconds late for instance. An example of such an application is for a sub-transmitter which is to be used as a stand-by or second transmitter for controlling a turret clock fitted with a movement such as that described in our prior Patent No. 20,878 of 1907. For such a purpose it is desirable that the stand-by transmitter should send its half minute impulse through the half minute controlling magnet such as for instance that shown in Fig. 3 of the above mentioned prior patent, some few seconds after the impulse sent by the first or main transmitter, so that the stand-by transmitter may take up the work in the event of the main transmitter stopping.

We fit a stand-by transmitter to fill this condition with contacts on the 'scape wheel similar in construction to the contacts N^1 and N^2, and so arranged that contact is made in series with the contacts N^1, N^2. Assuming the control to be arranged to take place at the even hour, we set the contacts N^1 and N^2 to "make" at half a minute to the hour, and set the contacts operated by the 'scape wheel to "make" say 6 seconds to the hour, thus assuring that the stand-by transmitter is approximately 6 seconds slow, the precise error of course depending on the actual position of the pendulum in relation to its arc, on the arrival of the instant of synchronisation.

Referring to Fig. 5, which is mainly diagrammatic, F shows the 'scape wheel of the prime transmitter, A the controlling magnet, B the armature, and G the back stop click. I shows the rear view of part of the mechanism of a secondary clock operated in connection therewith, and which combines the functions of the mechanisms I and N in Fig. 4.

The contacts R and R^1 perform the functions of the contacts J and J^1, and the cam S performs the functions of the cam L but these parts are in mechanical connection through the bell crank lever S^1, the operation of which is delayed by the catch S^2 of the armature S^4. The contacts T and T^1 perform the functions of the contacts N^1 and N^2. The spring T^2 is faced with ebonite at T^5 so that the pin T, which is mounted on the wheel S^3 presses against a non-conductor before touching the exposed tip T^1. The spring T^3 conveys current to the wheel S^3 by pressing on the ring T^4.

The prime transmitter which has a slight gaining rate, advances the secondary

clock mechanism I, together with its cam S, and the contact T to the position shown and leaves the lever S^1 in its potential position, a few seconds before the instant of the time signal, with the result that the magnet A is energised by the battery P, and the pendulum oscillates idly as hereinbefore described.

On the relay S^5 being energised by a current from a source of standard time such as the Greenwich wires, the armature S^4 is attracted, the pin S^6 of the lever S^1 is freed from the catch S^2, the tail piece S^7 of the lever S^1 under the influence of the spring S^8, separates the contacts R and R^1, the magnet A releases the armature B, and the 'scape wheel F rotates as before. If by any chance the current from the standard time source fails to flow through the magnet S^5, the magnet U in consequence of its prolonged attraction of the armature V, through its rack V^1 slowly moves the time-lag train W and the escapement X until the catch V^2 allows the catch V^3 to move out of engagement, and the contact Y to part company with its fellow contact Y^1 and break the circuit, thus preventing a total stoppage of the prime transmitter.

The relay magnet S^5 is sometimes of the polarised form so as to receive a signal which is imposed on the line a few minutes before the instant of the standard time signal and reversed at the instant of the signal, the current at the reversal then effecting the release of the lever S^1.

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

1. In the electrical synchronisation of clocks, the closing of one part of a synchronising circuit before the instant of a synchronising standard time signal, the closing and completing of the circuit by a secondary clock of the system to be synchronised, the stopping of the wheel train or equivalent of the master clock by an electro magnet operated by a current flowing through the synchronising circuit, and effecting the synchronisation by the breaking of the synchronising circuit at the instant of a synchronising standard time signal, substantially as herein described.

2. In the electrical synchronisation of electric master clocks or transmitters, the holding of the driving pawl—used for driving the 'scape or count wheel—out of engagement with the teeth of such 'scape wheel, by a controlling electro magnet which is energised when a contact is closed, by one of the secondary clocks, until a contact in the circuit energising the controlling electro magnet is broken, substantially as described.

3. In the electrical synchronisation of electric master clocks, the holding of the back stop click—used in connection with the 'scape or count wheel—out of engagement with the teeth of such 'scape wheel by a controlling electro magnet which is energised when a contact is closed by one of the secondary clocks until a contact in the circuit energising the controlling electro magnet is broken, substantially as described.

4. In the electric synchronisation of electric master clocks the holding of the 'scape wheel or equivalent by means of a catch or equivalent operated by a controlling electro magnet which is energised when a contact is closed by a secondary clock until a contact in the circuit which is energising the controlling electro magnet is broken, substantially as described.

5. In the electrical synchronisation of electric master clocks, the stopping of the 'scape wheel or equivalent as in Claims 2, 3 or 4, and the re-starting of the 'scape wheel by a current sent from a source of standard time such as that of Greenwich, at the instant of the time signal, by the electrical release of a lever which has been previously moved to a potential position by a secondary clock and the breaking of the circuit energising the controlling electro magnet by such lever on its release substantially as described.

6. In the electrical synchronisation of an electric master clock as in Claim 5,

the breaking of the circuit by a time-lag switch as shown in Fig. 5 in the event of the synchronising time current failing to effect the electrical release of a lever such as S^1 substantially as herein described and illustrated.

7. The improved synchronising apparatus constructed and operating substantially as herein described with reference to the accompanying drawings.

Dated this Sixth day of May, 1912.

J. HARDY PARSONS.
ALFRED E. J. BALL.

Redhill: Printed for His Majesty's Stationery Office, by Love & Malcomson, Ltd.—1912.

A.D. 1911 Nov. 7. N° 24,723.
PARSONS & *another's* COMPLETE SPECIFICATION.

(3 SHEETS)

SHEET 1.

FIG 1

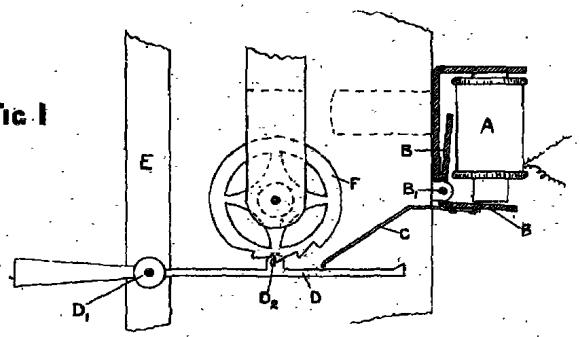
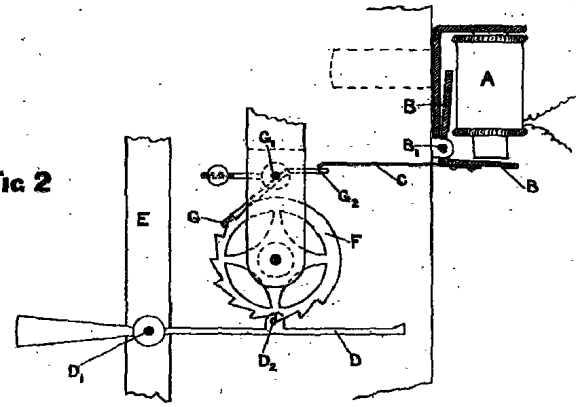


FIG 2



SHEET 2

FIG 3

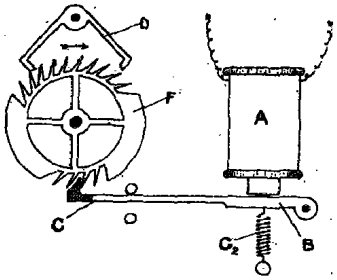
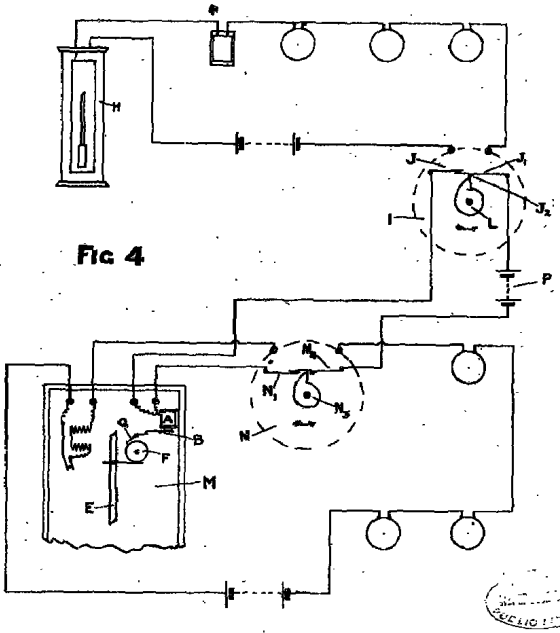


FIG 4



SHEET 1.

FIG. 1

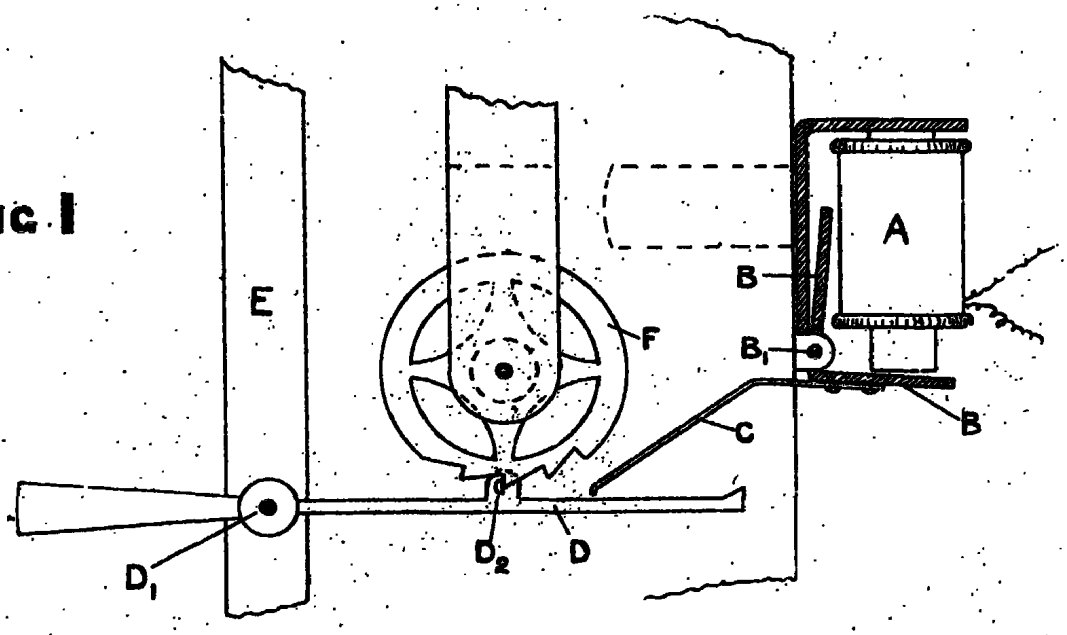
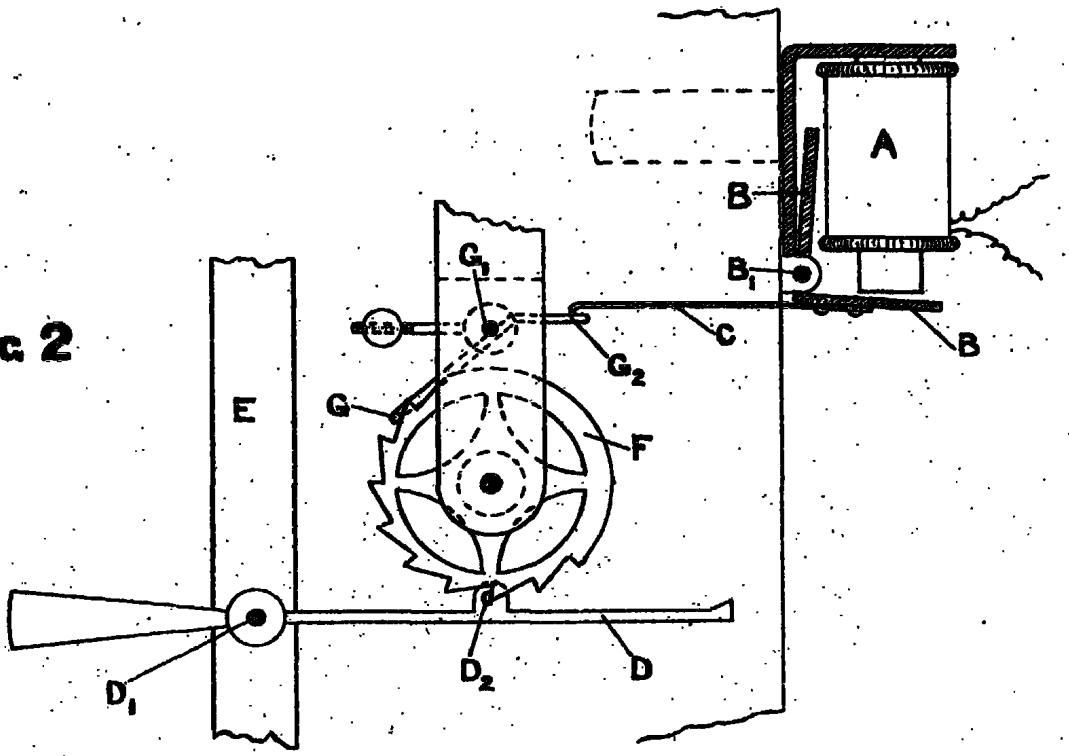


FIG. 2



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

FIG 3

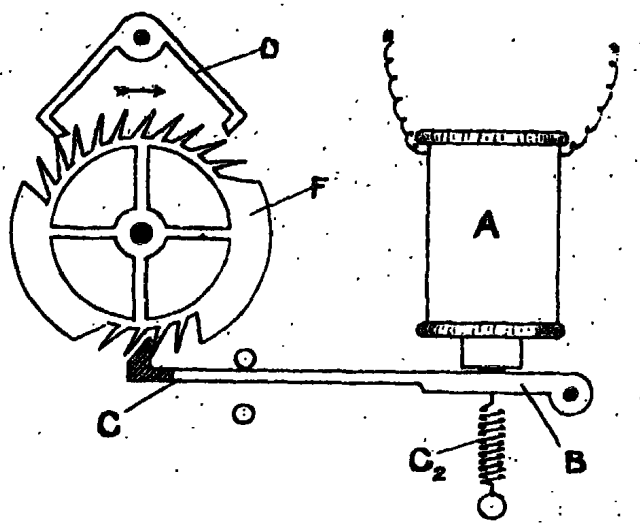
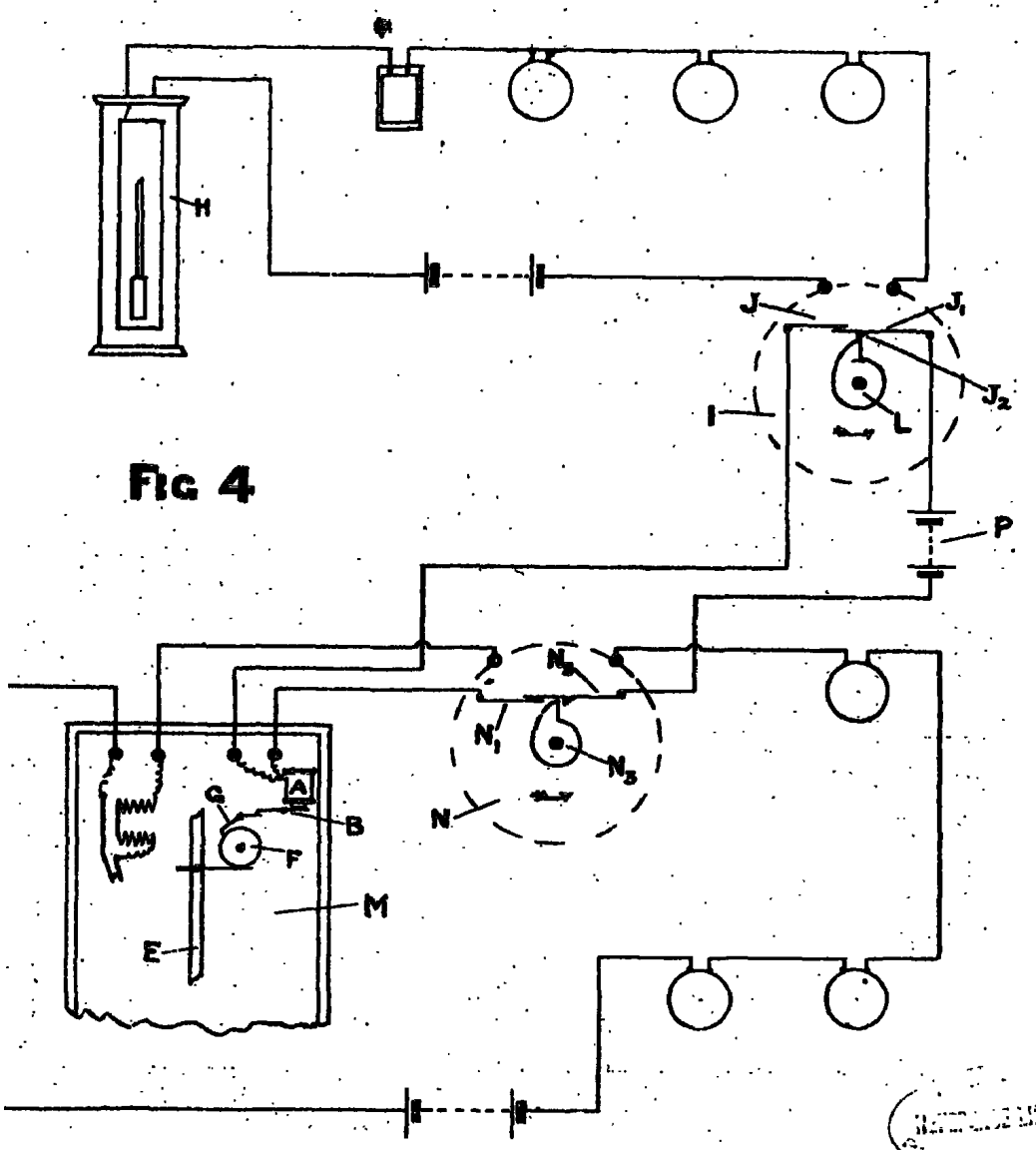


FIG 4



Malby & Sons, Photo-Litho.

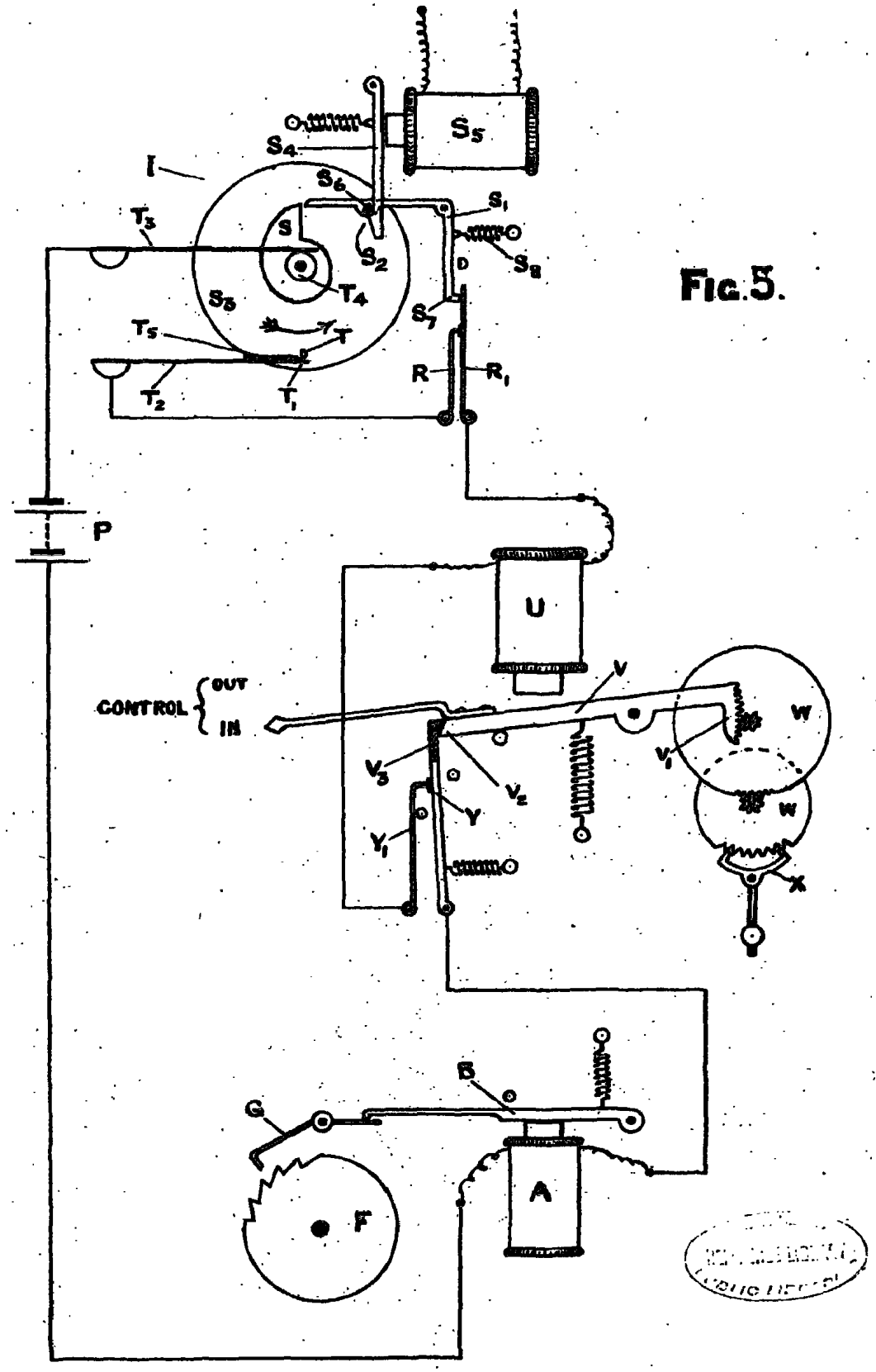


FIG. 5.