N° 24,620 A.D. 1904

Date of Application, 14th Nov., 1904

Complete Specification Left, 14th Aug., 1905—Accepted, 19th Oct., 1905

PROVISIONAL SPECIFICATION.

Electric Clocks and the like.

We, ISAAC HARDY PARSONS of St. Elmo, Woodland Avenue, Stoneygate, Leicester, Electrical Engineer, and ALFRED ERNEST JOSEPH BALL of 40 St. Saviours Road East, Leicester aforesaid, Electrician, do hereby declare the nature of this invention to be as follows:

The object of this our invention is to construct an electric master clock in which an electric contact is periodically made and broken by a method that permits of a substantial construction of the parts forming the contact, and by which ample pressure and a quick separation of the contact surfaces at the break is obtained, thus making the clock highly suitable for sending periodical impulses to a large number of step-by-step secondary dials, as well as winding or resetting its own driving weight or spring. A further object also, of this our said invention is to effect certain other improvements in master clocks and like apparatus, which we will hereinafter describe.

In carrying this our invention into effect, we construct our electric make and break device in the following manner:—

To the free end of the armature of the electro-magnet (provided for winding the said clock) we connect pivotally a short rigid link which normally stands at right angles to the armature. This link imparts the motion of the armature to a preferably short lever (disposed parallel to the armature) and is slid or pushed out of engagement with it, either by means of an inclined plane or a right-angled member bearing against a fixed stop, or other suitable means. The lever which the link engages, we will, for the purposes of this specification designate the intermediate lever. Parallel to and on the side of the intermediate lever, opposite to that of the link, we dispose a weighted lever (or a member thereof rigidly connected thereto) having a contact screw facing but normally out of contact with a contact piece on the intermediate lever. The weighted lever is provided for the purpose of driving the said clock.

The contact device and its auxiliary parts according to this our invention, operate as follows:—

At each half minute, or other prearranged interval, the weighted lever descends (as will be hereinafter described) and its contact point or screw is brought into firm contact with the contact on the intermediate lever which it normally faces. The circuit being now closed, the electro-magnet becomes energised and attracts its armature, which, through the medium of the link, the intermediate lever and the surfaces of the contact, lifts the weighted lever, replacing it to its potential position. The link is adjusted by means of its fixed stop, so that it slides out of engagement with the intermediate lever, just before the armature reaches the magnet. On being thus released, the intermediate lever returns quickly to its normal position, being impelled by a returning spring provided for that purpose, thus smartly breaking the circuit. The

[*Price 8d.*]

armature and its link also return to their normal positions either by a returning spring or springs, or by gravity. The several parts are now all in position to again operate as before.

A novel form of master clock, in which we prefer to incorporate this our improved contact, chiefly on account of its effecting a better "make" than usually obtained, is a form in which a pendulum is driven direct from the weighted lever, instead of through a train of wheels and escapement; the weighted lever imparting to the pendulum an impulse every half minute, or other prearranged interval, in order to maintain its oscillations. We construct this form of clock as follows:—

Within a suitable framework, in a position approximating the usual pallet arbor, we pivot a crutch, the shank of which we make comparatively long, and of rigid construction, and which we hang preferably between the plates. At a suitable distance from its arbor we form in one piece with, or attach thereto, an impulse pallet which may be conveniently described as an enlargement of the second pallet of the well-known Graham dead-beat escapement. Crossing the crutch shank at the position occupied by the impulse pallet we dispose our hereinbefore mentioned weighted lever. Into its side nearest the crutch shank, we fit a stud carrying a small roller. While this lever is held in its potential position by reason of a hook pivotted to it engaging a stud on the frame work, this roller just clears the simulating dead face of the impulse pallet. At each half minute, or other prearranged frequency, the weighted lever is released, by a method that we will hereinafter describe, and the roller dropping first on the safe or dead face of the pallet allows the pendulum to complete the vibration then in progress, without receiving opposing pressure from the weighted lever, but on the return swing, the weighted lever imparts an impulse to the pendulum engaged by the crutch fork by exerting a pressure (its weight) on the inclined impulse face of the pallet, until its contact point meets and is arrested by the opposing contact on the intermediate lever from where it is lifted again on to its potential position. In order to obtain the release of the weighted lever at half minute or other regular prearranged intervals, we mount within the frame work a 'scape wheel, having 30 teeth—when using a seconds pendulum—and into its rim we fix two equidistant pins. Into the shank of the crutch we screw a stud carrying two small levers, one approximately horizontal, and the other approximately vertical. This vertical lever is weighted, and rests on a tail of the horizontal lever tilting it slightly above the horizontal position. In vibrating with the pendulum, the lower end of the vertical lever passes to and fro before the scape wheel, and being provided with a lug which is turned towards the scape wheel, it is arrested in its swing by one of the pins each half minute, allowing the horizontal lever to fall slightly, and its end to engage the hook which is pivotted to the weighted lever, and to push it off from its supporting stud, and allowing it to fall just on to the safe face of the impulse pallet, from the impulse angle of which it afterwards imparts an impulse to the pendulum, and is again replaced to its potential position as hereinbefore described.

In order that the 'scape wheel may be revolved by, and at the same time with, the minimum absorption of the energy stored in the pendulum (by the periodic impulses imparted to it) we pivot between the frame work, two arbors, one on each side of the crutch arbor. Depending from these arbors, and on either side of the 'scape wheel, we provide two levers each terminating a little below the level of the scape arbor. We provide these levers with arms to enable them to be alternately lifted by the crutch shank at each swing of the pendulum. To the inner side of each lever, we fix an approximately "V" shaped pallet, which we either make of steel or agate, preferably the latter. We arrange the angles of these pallets so that whilst one is entering the teeth of the 'scape wheel (in order to revolve it) and the other is leaving, the entering pallet assists the pendulum to lift the leaving pallet, by means of the

surplus energy which it imparts to the scape wheel when entering, being transmitted by the 'scape wheel teeth to the angle at the back of the leaving pallet, thus assisting to lift it.

It is obvious that this our improved electric contact device, herein described, is equally applicable to other and ordinary types of clocks such as that consisting of a train of wheels terminating in an ordinary escapement driving a pendulum, and also to a portable type of clock, consisting of a spring driven train, terminating in an escapement, driving a balance, controlled by a hairspring. This latter type is suitable for purposes and places where a pendulum could not be employed.

In constructing a master clock of the former type, we make its contact portion after the manner of the device hereinbefore described, also the weighted lever which is connected pivotally to it. Instead however, of the weighted lever when replaced to its potential position being held there by its (pivotted) catch engaging a fixed stud, its catch is held up on to a tooth of a ratchet wheel, which is in rigid connection with a train of wheels. The weighted lever in exerting a pressure on the ratchet wheel, causes the latter to drive the train of wheels and the escapement, which maintains the vibrations of the pendulum. We arrange the gearing of the train so that at each half minute or other prearranged interval, the weighted lever descends sufficiently for its contact point to come into contact with the contact face of the intermediate lever. The circuit being now completed, the weighted lever is lifted as hereinbefore described, and its catch engages the next tooth of the ratchet wheel, from which it drives the train as before.

In constructing a master clock of the latter (portable) type, we make its contact portion, and its co-operative parts as hereinbefore described. In place of the weighted lever, however, we provide a lever operated by a spring, and balanced by a counter-weight. We arranged its (pivotted) catch to exert a pressure on to a ratchet wheel as in the type hereinbefore described, the ratchet wheel driving a train of wheels terminating in a lever or other (suitable) escapement not affected by a change of position. On the (pivotted) catch causing the ratchet wheel to rotate to the extent of one tooth (each tooth representing a half minute or other prearranged interval) the spring impelled lever to which the catch is pivotted moves sufficiently for its contact point to come into contact with the contact face of the intermediate lever. The circuit being now completed, the spring impelled lever is reset, and its catch engages the next tooth of the ratchet wheel from where it drives the train as before.

It is sometimes desirable to dispose the secondary dials in groups (particularly when a large number are required to be operated by one master clock) each group being arranged in a circuit having its own battery. We provide the necessary reliable contact for each group by including in each circuit our hereinbefore described contact making device, with its co-operating parts. We start each device into action at half minute intervals (or at other prearranged frequency) by a current from the master clock flowing through a small electro magnet attached to our improved contact making device, the armature of which liberates the pivotted catch of the weighted lever (which is for this purpose preferably partly counterpoised) thereby allowing it to make contact for its own replacement, and the operation of the secondary dials in its circuit.

Dated Twelfth day of November 1904.

ISAAC HARDY PARSONS.
ALFRED ERNEST JOSEPH BALL.

COMPLETE SPECIFICATION.

Electric Clocks and the like.

We, ISAAC HARDY PARSONS of St. Elmo, Woodland Avenue, Stoneygate, Leicester, Electrical Engineer, and ALFRED ERNEST JOSEPH BALL, of 40 St. Saviours' Road East, Leicester aforesaid, Electrician, 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:—

The object of this our invention is to construct an electric master clock in which an electric contact is periodically made and broken by a method that permits of a substantial construction of the parts forming the contact, and by which ample pressure and a quick separation of the contact surfaces at the break is obtained, thus making the clock highly suitable for sending periodical impulses to a large number of step-by-step secondary dials, as well as winding or re-setting its own driving weight or spring. A further object also, of this our said invention, is to effect certain other improvements in master clocks and like apparatus, which we will hereinafter describe.

In carrying this our invention into effect, we construct our electric make and break device in the following manner:—

To the free end of the armature of the electro-magnet (provided for winding the said clock), we connect pivotally a short rigid link, which normally stands at right angles to the armature. This link imparts the motion of the armature to a preferably short lever (disposed parallel to the armature), and is slid or pushed out of engagement with it, either by means of an inclined plane or a right angled member bearing against a fixed stop or other suitable means. The lever which the link engages, we will, for the purposes of this specification, designate the intermediate lever. Parallel to, and on the side of the intermediate lever, and opposite to that of the link, we dispose a weighted lever (or a member thereof rigidly connected therewith) having a contact screw facing, but normally out of contact with, a contact piece on the intermediate lever. The weighted lever is provided for the purpose of driving the said clock.

The contact device and its auxiliary parts according to this our invention, operate as follows:—

At each half minute, or other prearranged interval, the weighted lever descends (as will be hereinafter described) and its contact point or screw is brought into firm contact with the contact on the intermediate lever which it normally faces. The circuit being now closed, the electro-magnet becomes energised and attracts its armature, which, through the medium of the link, the intermediate lever and the surfaces of the contact, lifts the weighted lever, replacing it to its potential position. The link is adjusted by means of its fixed stop, so that it slides out of engagement with the intermediate lever just before the armature reaches the magnet. On being thus released, the intermediate lever returns quickly to its normal position, being impelled by a returning spring provided for that purpose, thus smartly breaking the circuit. The armature and its link also return to their normal positions either by a returning spring or springs, or by gravity. The several parts are now all in position to again operate as before.

A novel form of master clock, in which we prefer to incorporate this our improved contact, chiefly on account of its effecting a better "make" than usually obtained, is a form in which a pendulum is driven direct from the

weighted lever instead of through a train of wheels and escapement; the weighted lever imparting to the pendulum an impulse every half minute, or other prearranged interval, in order to maintain its oscillations. We construct this form of clock as follows:—

Within a suitable framework, in a position approximating the usual pallet arbor, we pivot a crutch, the shank of which we make comparatively long, of rigid construction, and which we hang preferably between the plates. At a suitable distance from its arbor, we form in one piece with, or attach thereto, an impulse pallet, which may be conveniently described as an enlargement of the second pallet of the well-known Graham dead-beat escapement. Crossing the crutch shank at the position occupied by the impulse pallet, we dispose our hereinbefore mentioned weighted lever. Into its side nearest the crutch shank, we fix a stud carrying a small roller. While this lever is held in its potential position by reason of a hook pivotted to it engaging a stud on the framework, this roller just clears the simulating dead face of the impulse pallet. At each half minute, or other prearranged frequency, the weighted lever is released by a method that we will hereinafter describe, and the roller dropping first on the safe or dead face of the pallet, allows the pendulum to complete the vibration then in progress, without receiving opposing pressure from the weighted lever, but on the return swing, the weighted lever imparts an impulse to the pendulum engaged by the crutch fork, by exerting a pressure (its weight) on the inclined impulse face of the pallet, until its contact point meets and is arrested by the opposing contact on the intermediate lever, from where it is lifted again on to its potential position. In order to obtain the release of the weighted lever at half minute or other regular prearranged intervals, we mount within the framework a 'scape wheel—having 30 teeth when using a seconds pendulum—and into its rim we fix two equidistant pins. Into the shank of the crutch we screw a stud carrying two small levers, one approximately horizontal, and the other approximately vertical. This vertical lever is weighted and rests on a tail of the horizontal lever, tilting it slightly above the horizontal position. In vibrating with the pendulum, the lower end of the vertical lever passes to and fro before the 'scape wheel, and being provided with a lug, which is turned towards the 'scape wheel, it is arrested in its swing by one of the pins each half minute, allowing the horizontal lever to fall slightly, and its end to engage the hook which is pivotted to the weighted lever and to push it off from its supporting stud, and allowing it to fall just on to the safe face of the impulse pallet, from the impulse angle of which it afterwards imparts an impulse to the pendulum, and is again replaced to its potential position, as hereinbefore described.

In order that the 'scape wheel may be revolved by, and at the same time with the minimum absorption of, the energy stored in the pendulum (by the periodic impulses imparted to it), we pivot between the framework two arbors, one on each side of the crutch arbor. Depending from these arbors, and on either side of the 'scape wheel, we provide two levers each terminating a little below the level of the 'scape arbor, so that approximately a line passing through the centre of the 'scape arbor and through the apex of the pallet, (which will be hereinafter described) forms a right angle to a line drawn from the pivot of the pallet lever to the apex of the pallet. We provide these levers with arms to enable them to be alternately lifted by the crutch at each swing of the pendulum. To the inner side of each lever we fix an approximately "V" shaped pallet, which we either make of steel or agate, preferably the latter. We arrange the angles of these pallets so that whilst one is entering the teeth of the 'scape wheel (in order to revolve it) and the other is leaving, the entering pallet assists the pendulum to lift the leaving pallet, by means of the surplus energy which it imparts to the 'scape wheel when entering, being transmitted by the 'scape wheel teeth to the angle at the back of the leaving pallet; thus assisting to lift it.

It is obvious that this our improved electric contact device hereinbefore described, is equally applicable to other and ordinary types of clocks, such as that consisting of a train of wheels terminating in an ordinary escapement driving a pendulum, and also to a portable type of clock consisting of a spring driven train, terminating in an escapement, driving a balance, controlled by a hairspring. This latter type is suitable for purposes and places where a pendulum could not be employed.

In constructing a master clock of the former type, we make its contact portion after the manner of the device hereinbefore described, also the weighted lever which is connected pivotally to it. Instead, however, of the weighted lever, when replaced to its potential position, being held there by its (pivotted) catch, engaging a fixed stud, its catch is held up on a tooth of a ratchet wheel, which is in rigid connection with a train of wheels. The weighted lever in exerting a pressure on the ratchet wheel, causes the latter to drive the train of wheel and the escapement which maintains the vibrations of the pendulum. We arrange the gearing of the train so that at each half minute, or other prearranged interval, the weighted lever descends sufficiently for its contact point to come into contact with the contact face of the intermediate lever. The circuit being now completed, the weighted lever is lifted as hereinbefore described, and its catch engages the next tooth of the ratchet wheel from which it drives the train as before.

In constructing a master clock of the latter (portable) type, we make its contact portion, and its co-operating parts as hereinbefore described. In place of the weighted lever, however, we provide a lever operated by a spring, and balanced by a counter-weight. We arrange its (pivotted) catch to exert a pressure on to a ratchet wheel as in the type hereinbefore described, the ratchet wheel driving a train of wheels terminating in a lever or other suitable escapement not effected by a change of position. On the (pivotted) catch causing the ratchet wheel to rotate to the extent of one tooth (each tooth representing a half minute or other prearranged interval), the spring impelled lever to which the catch is pivotted moves sufficiently for its contact point to come into contact with the contact face of the intermediate lever. The circuit being now completed the spring impelled lever is re-set, and its catch engages the next tooth of the ratchet wheel, from where it drives the train as before.

When a large number of secondary dials are required to be operated by one master clock, it is sometimes desirable to dispose them in groups, each group being arranged in a circuit having its own battery. We provide the necessary reliable contact for each group by including in each circuit our hereinbefore described contact device, with its own co-operating parts; we start each device into action at half minute intervals (or at other prearranged frequency) by a current from the master clock flowing through a small electro magnet attached to our improved contact making device; the armature of which liberates the pivotted catch of the weighted lever (which is for this purpose preferably partly counterpoised), thereby allowing it to make contact for its own replacement, and the operation of the secondary dials in its circuit.

In the annexed drawings illustrative of our said invention, and in which like letters indicate like or equivalent parts:—

Figure 1 illustrates a complete master clock movement with the front plate removed, the mechanism being shown in the position occupied while the hook of the weighted lever is being released.

Figure 2 illustrates part of a master clock movement in which the contact device is shown in the position occupied when contact is made.

Figure 3 illustrates part of a master clock movement in which the contact device is shown in the position occupied when contact is broken, the armature and link being shown as yet having to return to their normal positions.

Figure 4 illustrates a master clock movement complete, excepting the front plate, containing our improved contact device, but in which the pendulum is impelled by a train of wheels and an escapement.

The action of the hereinbefore described mechanism with reference to the lettered drawings is as follows:—

Referring to Fig. 1, the crutch shank A, in vibrating with the pendulum B, alternately lifts the pallet levers C and C.[1] by means of the roller A.[1], and the pallet arms D and D.[1]; the pallet levers in alternately falling impell the 'scape wheel E one tooth at each double vibration of the pendulum B, by means of the "V" shaped pallets C.[2] and C.[3], in the manner hereinbefore described.

At each half minute or other prearranged frequency, the lug F.[1] of the weighted vertical lever F. & F.[2], (which together with the horizontal lever G is pivotted to the stud H) in swinging to the right (or to the left if so arranged) with the crutch shank A, is arrested in its swing by either of the pins J and J.[1], which are fixed in the rim of the 'scape wheel E.

The weighted vertical lever F and F.[2] now no longer supports by means of its pin K the horizontal lever G (by pressing on its tail G.[1]); it therefore falls sufficiently for its free end G.[2] to engage the hook M (which supports the weighted lever N), and in continuing its swing with the pendulum, pushes it off the supporting stud O, allowing the roller P to drop first on to the dead face of the pallet R attached to the crutch shank A, in which position the pendulum completes its vibration without receiving opposing pressure from the weighted lever N; but on its return swing, the roller P rolls down the impulse face R.[1] of the pallet R, imparting to the pendulum an impulse to maintain its vibration. The weighted lever N is limited it its fall, by its insulated contact screw S being arrested by the contact S.[1] of the intermediate lever T, as shown in Fig. 2. The circuit being completed at these contacts, the electro magnet U and U[1] becomes energised, and attracting the armature V, causes it to turn on to its pivot V[1], and by means of the link W it lifts the weighted lever N through the medium of the intermediate lever T until the right angled member of the link W.[1], bearing against the fixed stop L, draws the end, W.[2], of the link out of engagement with the intermediate lever T, as shown in Fig. 3. Before, however, the link disengages with the intermediate lever T, the weighted lever N is lifted sufficiently high for its hook, M, to again engage, and be held by, the supporting stud O, where it remains until released at the next half minute. Instantly that the link, W, disengages with the intermediate lever T, the intermediate lever is caused by the spring T.[1] to fly back to its normal position against its stop T.[2], as shown in Fig. 3; the armature afterwards regaining its normal position against its fixed stop V.[3], by means of its returning spring V.[4].

Referring to Fig. 4, instead of the weighted lever N being held by means of its hook, M, on to a fixed stud, its hook or catch M is held up on to a tooth of the ratchet wheel O.[2], which is either in rigid or spring connection with a train of wheels and escapement, consisting of the wheel O.[3], the pinion, O.[4], the 'scape wheel E.[2], and pallets C.[4]. The weighted lever N, in exerting a pressure on the ratchet wheel O.2, causes the latter to drive the train of wheels and escapement which maintains the vibrations of the pendulum in a well-known manner. The weighted lever N, during the half minute, or other prearranged interval, slowly descends until its contact screw S comes into contact with the contact S.[1] on the intermediate lever T, when the circuit being completed, the lever N becomes lifted as before described, until the hook M engages the next tooth of the ratchet wheel O.[2], which it again drives as before.

In constructing a master clock of the hereindescribed portable type, we replace the weight N[1], shown in Fig. 4, with a spring, and replace the pendulum

and its escapement with a lever or other escapement, controlled by a balance and a hairspring, retaining the ratchet wheel O.[2] and the train of wheels.

It will be seen by reference to Figs. 2 and 3 that ample pressure at the contact points is obtained with this our improved device, as well as a quick separation of the contacts at the break; therefore, this our contact device is highly suitable for periodically closing the circuit of a large number of secondary dials or similar clockwork mechanisms.

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 an electric clock, in which the driving weight or its equivalent is replaced electromagnetically through the contact surfaces, the employment of a link, so constructed that it is caused to slide out of engagement with one member of the contact when the driving weight has been lifted, a spring or its equivalent then returning the said member of the contact to its normal position, and so breaking the contact quickly, substantially as described.

2. In an electric clock the obtainment of an impulse to maintain the vibrations of the pendulum by a weight or equivalent, which first drops on to the dead face of a pallet fixed to or in connection with the said pendulum, and from which dead face it rolls or slides on to an impulse face of a pallet, and so imparts to the pendulum an impulse without giving opposing pressure or shock, substantially as described.

3. In an escapement of the type in which an escape wheel is propelled by two independently pivotted pallet levers, which are alternately lifted and permitted to fall against the escape teeth by the pendulum, the employment of the pallet levers of such a length that approximately a line passing through the centre of the escape arbor, and through the apex of the pallet, forms a right angle to a line drawn from the pivot of the pallet lever to the apex of the pallet, and the construction of the back face of the pallets of such angle or curve that the pallets alternately drive and are driven, as, and for the purpose herein described.

4. In an electric clock in which a driving weight or equivalent is to be released for the purpose of driving the said clock, the employment of two levers such as F. & G. or their equivalents, for the mechanical release of the said weight, as herein described and illustrated, in Figure 1 of the drawings.

5. In an electric clock, the combination of the contact device consisting of an armature V, a link W, an intermediate lever T, a weighted lever N, or their equivalents, with an escapement device such as that shown in Fig. 1 by the 'scape wheel E and the pallet levers C and C[1], having fixed thereto the pallets C.[2] and C.[3] and an impulse device consisting of a weighted lever N, a roller P, a pallet R and R[1], or their equivalents, substantially as described with references to Figs. 1, 2 & 3 of the drawings.

6. In an electric clock, the combination of the contact device consisting of an armature V, a link W, an intermediate lever T, and a weighted lever N, or their equivalents, with a train of wheels and a form of escapement, substantially as described with reference to Fig. 4 of the drawings.

7. In a clockwork or other like mechanism having an electrical contact making device, the breaking of the said contact by means of a link so constructed that it is caused to slide out of engagement with one member of the contact by means of an electro magnet in circuit with the contact device, a spring or its equivalent then returning the said member of the contact to its normal position, so that contact is broken quickly, substantially as described.

8. An improvement in electric clocks comprising the combination of a weighted driving device held in its potential position by a catch, the mechanical release of the same by the pendulum for imparting a gravity

impulse to the said pendulum at intervals greater than a vibration of the said pendulum, a 'scape wheel rotated by the pendulum for effecting the said mechanical release at given intervals, the electro-magnetic replacement of the weighted driving device through the surfaces of the contact and the use of the said contacts for operating secondary dial mechanisms, substantially as described.

Dated this Twelfth day of September 1905.

ISAAC HARDY PARSONS.
ALFRED E. J. BALL.

Redhill: Printed for His Majesty's Stationery Office, by Love & Malcomson, Ltd.—1905.

A.D. 1904. Nov. 14. N° 24,620.

PARSONS & *another's* COMPLETE SPECIFICATION.

4 SHEETS.

SHEET 1

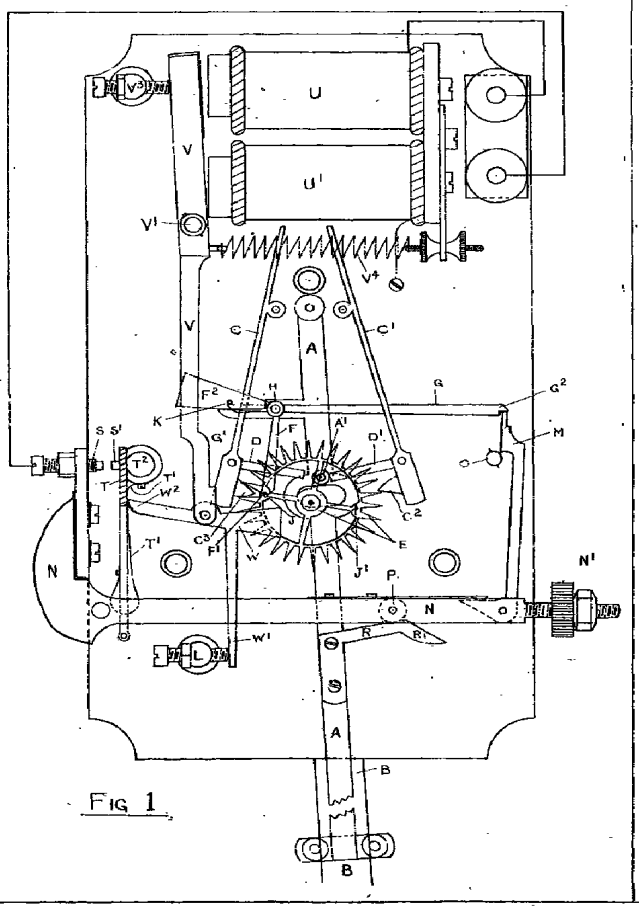

FIG 1.

SHEET 2

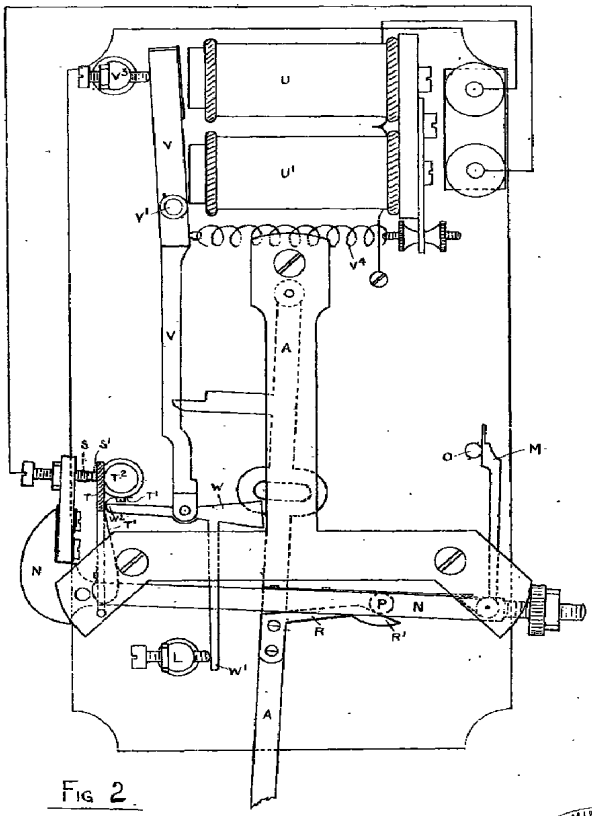

FIG 2.

Harrison & Sons Photo-Litho

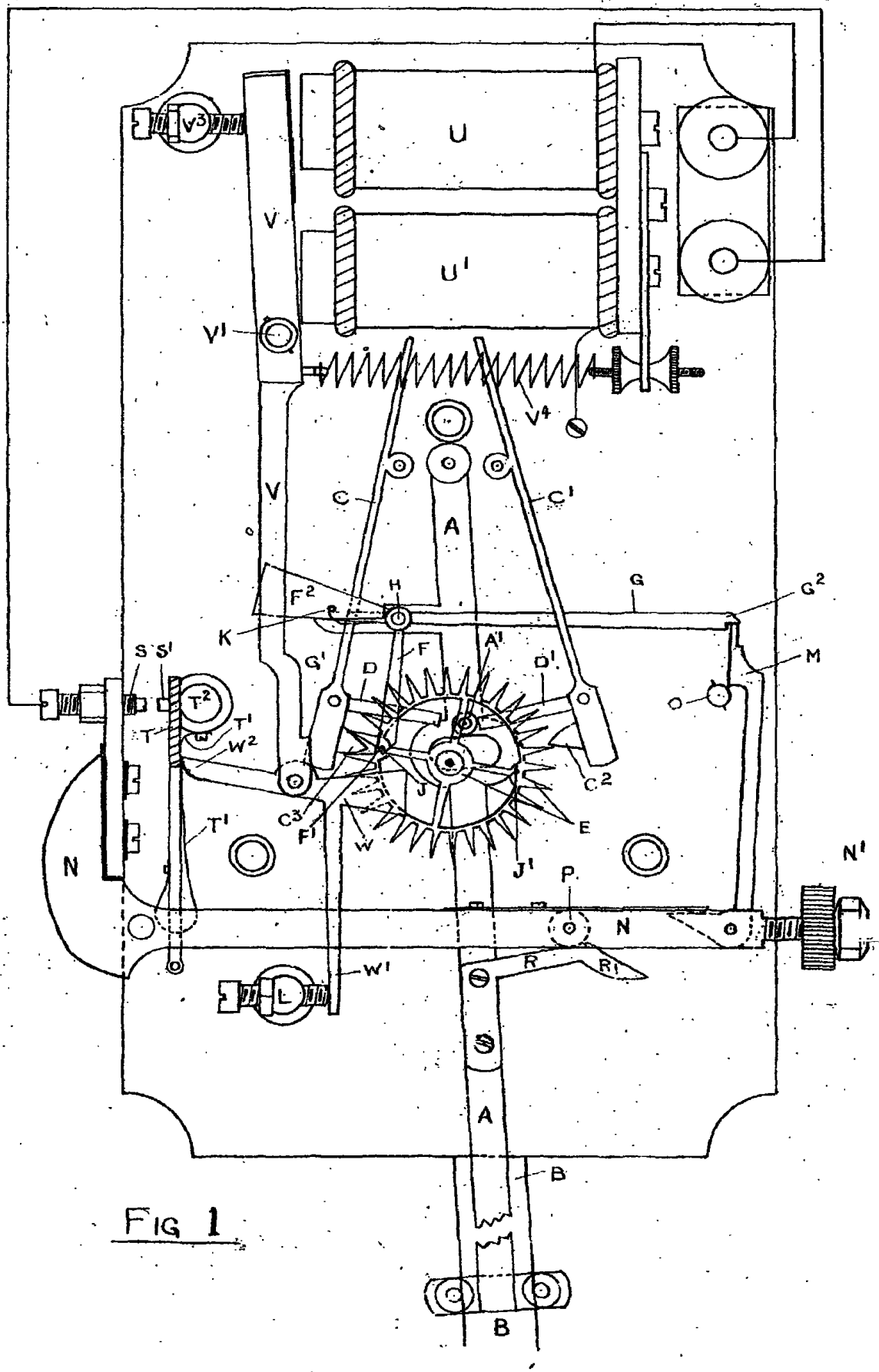

FIG 1

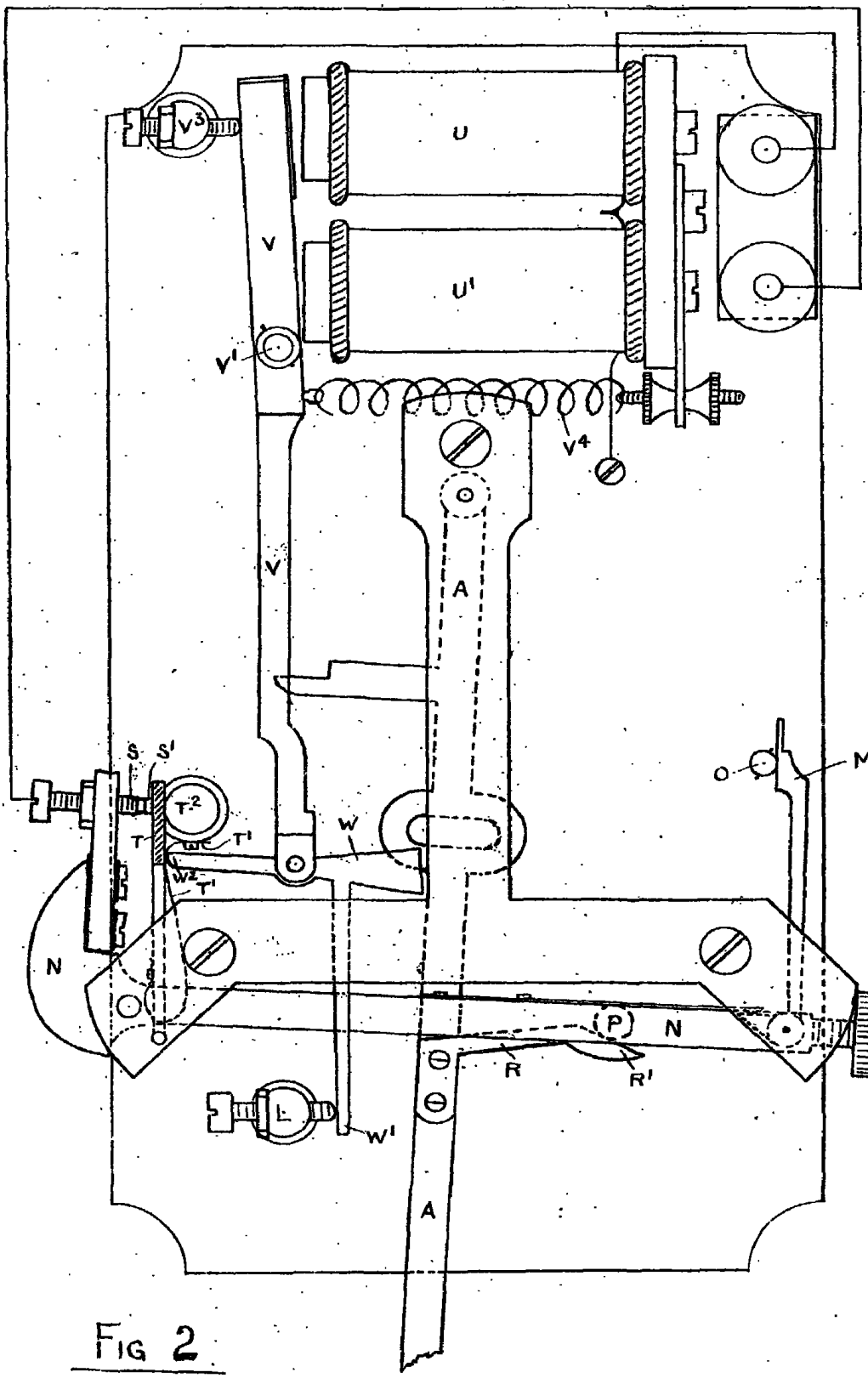

FIG 2

Malby & Sons, Photo-Litho.

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SHEET 3

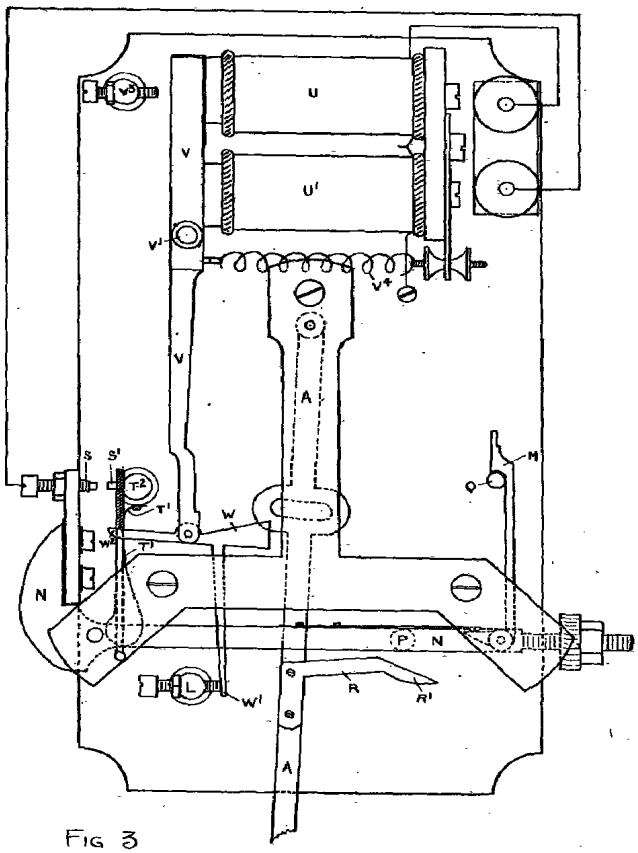

FIG 3

4 SHEETS.

SHEET 4

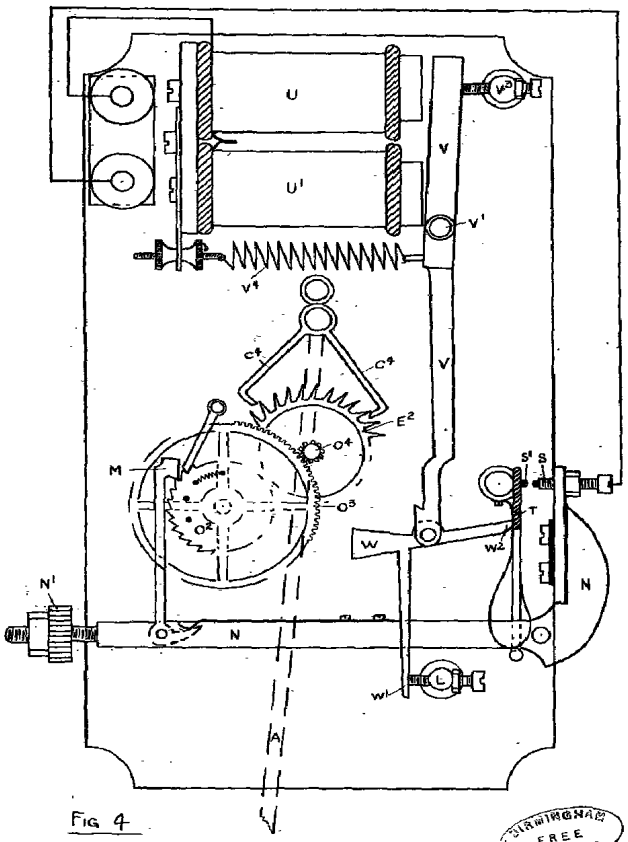

FIG 4

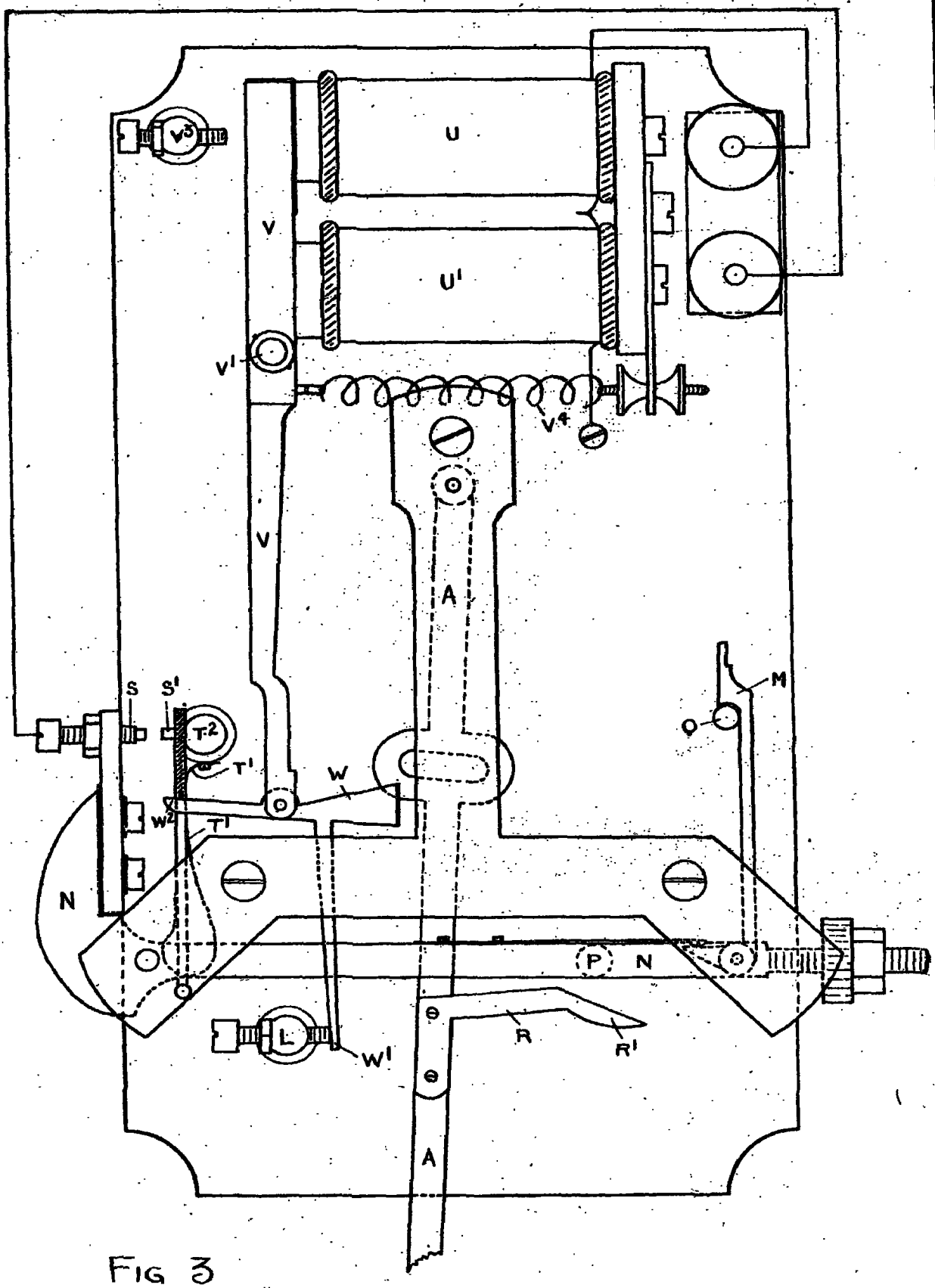

FIG 3

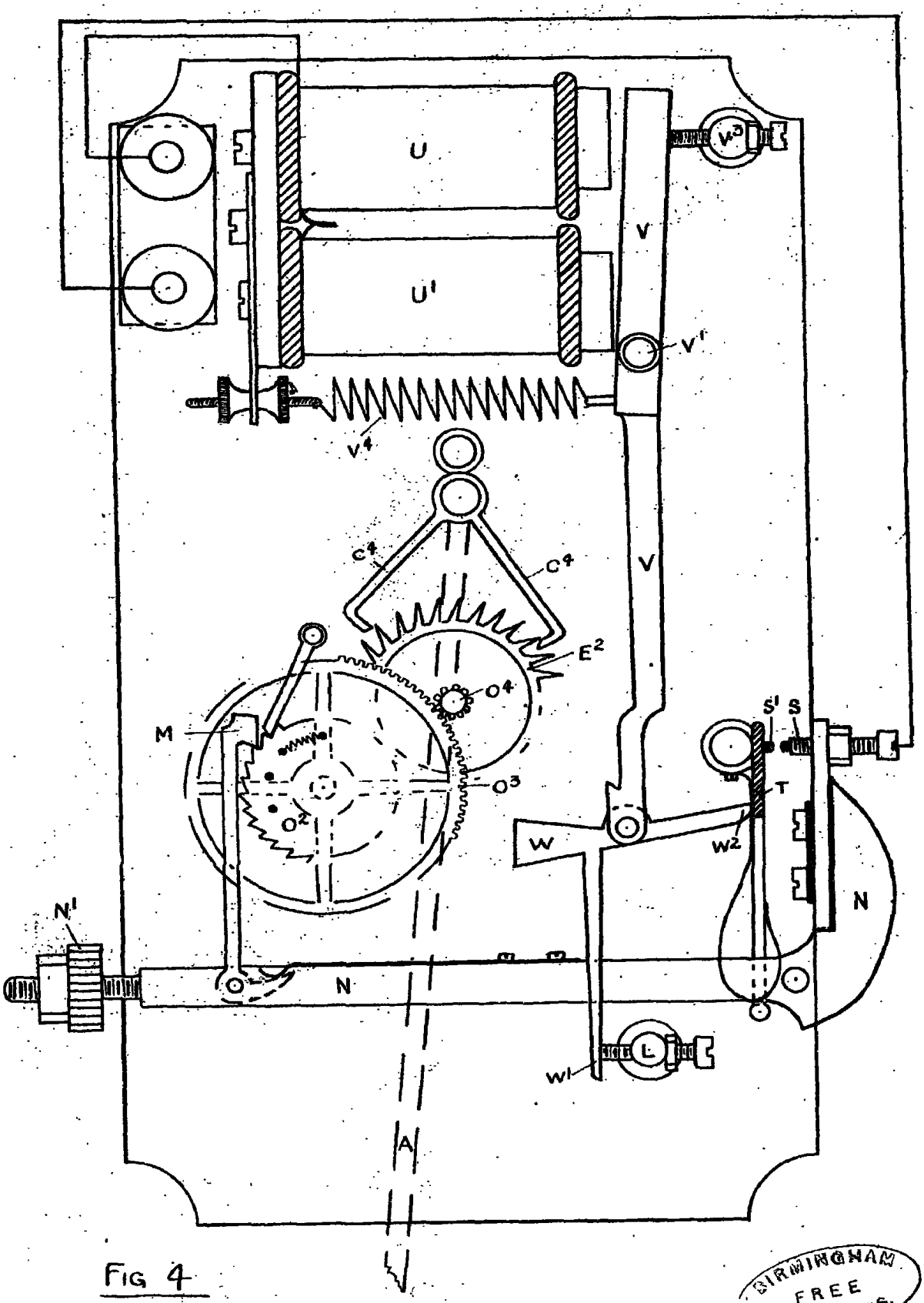

FIG 4

Malby&Sons, Photo-Litho.