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## ELECTRIC TIME-ELEMENT DEVICE

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This invention relates to electric time-element devices such as are used for example for closing or opening circuits when some predetermined time interval has elapsed after the action of the device has been started

Various types of such devices are known, driven in various ways for instance by spring or weight driven clockwork trains or by electric motors

In certain situations, as for example in a central station or substation it is often necessary to employ two or more of such time-element devices and according to this invention, instead of using a number of separate elements each with its own driving member, what may be termed a multiple time-element device is employed having one driving member with which, when required, any or all of the separate devices can be brought into or out of operative engagement

This common driving member may be of any suitable form but it is preferred to make it as a shaft rotated at a slow and uniform speed by a small electric motor driving the shaft through a worm reduction gear

Upon this shaft are mounted a number of toothed pinions or other driving members which rotate with the shaft, each one of these pinions being in proximity to a gear wheel on the spindle of one of the separate time-element devices

Thus for example the driving shaft may have mounted upon it four pinions and there may be two time-element devices mounted on the same base or bed-plate on each side of the shaft, each time-element device having a spindle parallel to the driving shaft and bearing a gear wheel which can be brought into engagement with the proper pinion on the driving shaft.

The operative engagement between each driving pinion and its time-element device may be brought about in any convenient way but preferably the driving pinion is fixed on the common driving shaft and the spindle and gear wheel of the time-element device are moved the requisite short distance to bring the teeth of the gear wheel into and out of mesh with those of the driving pinion. Conveniently each time-element comprises a solenoid or electromagnet which when energized moves its spindle against

the action of a spring so as to make the necessary operative engagement between the gears. This engagement will continue so long as the solenoid or electromagnet is energized and disengagement will then be effected by means of the spring

Each time-element is provided with a contact-making device or devices operated by the rotation of its spindle. For instance the spindle may carry a disc having a peripheral cam surface or two or more independent cam surfaces each such surface cooperating with one end of a pivoted lever or levers and the other end of such levers may control the position of spring contacts so that at any desired point in the cam periphery such contacts may be either closed or opened as desired. This enables any desired sequence of operations which is dependent on the circuits controlled by the spring contacts, to be either started or stopped in the right order, and with any desired time interval between the respective operations. Or again the cam or contact-making disc may be driven from the spindle of the time-element device through a worm and worm wheel. This latter construction is preferably used when a long time interval is required between the moment when the electromagnet or solenoid is energized and that at which the contact is required to be made.

Or again, the cam or cams may be made to operate mechanically locking or tripping devices, either independently or in conjunction with electrical circuits, so that when operated such trips or circuits cannot be re-operated until reset by independent device, or by hand after inspection. By such means, should any sequence of operations persist beyond a desired point, these operations can be stopped, and any risk of failure or accident prevented.

Each time-element device is so constructed that it is automatically returned to its zero position when it is brought out of operative engagement with the common driving member. This resetting operation may be either instantaneous, approximate average or average resetting. Such resetting may be conveniently brought about by a spring which is wound up by the rotation of the spindle due to the engagement of the time-element device with the common driv-

ing member, such spring starting to rotate the spindle in the opposite direction and reset the time-element as soon as disengagement is effected

5 For instance when quick or practically instantaneous resetting is required the spring may act directly on the spindle of the time-element device. On the other hand should average time resetting be desired and the time-element spindle drive the contact-making cam through gear, then the spring may be arranged in or on the drum or disc which carries the cam so that the spring in resetting has to drive the spindle back through the gear. In either case any convenient form of fly governor dash-pot or other device acting as a speed regulator or brake may be used. Or again, where average resetting is desired the relative positions of the driving and driven members, in the engaged and disengaged positions, taken in conjunction with the displacement of the cam or cams from the zero position, can be taken advantage of to introduce a reverse drive, operated by the driving motor until the zero position is reached, and in this manner any desired ratio between backward and forward drive can be obtained.

It will be appreciated that in a multiple time-element device according to this invention a number of devices having very different time intervals may all be driven from the common driving member and that such time intervals as are decided on for each time element, may be made adjustable between zero and the limit decided on, and that quite apart from differences of construction in the time-element devices themselves, different time intervals may be obtained by suitably arranging the gear ratios between the pinions on the common driving member and the cooperating gear wheels on the time-element devices.

In the accompanying drawings, which illustrate by way of example a multiple time-element device more especially intended for use in an automatic or semi-automatic electric power substation,

Figure 1 is a diagrammatic view showing one construction of multiple time-element device according to this invention.

Figure 2 is a plan of another construction showing the essential parts with more mechanical detail.

Figure 3 is a transverse section on the line 3-3 of Figure 2, and

Figures 4 and 5 are longitudinal sections on the lines 4-4 and 5-5 respectively of Figure 2.

With reference first to Figure 1, A indicates a motor driving through some known form of reduction gear not shown, a shaft B on which are mounted pinions B', B<sup>2</sup>, B<sup>3</sup> and B<sup>4</sup>.

On one side of the main shaft B are two

time-element contact making devices C and C' and two other similar devices C<sup>2</sup> and C<sup>3</sup> are disposed on the other side of the shaft. These time-element devices each comprise a spindle carrying a gear wheel and some means, not shown, of causing the spindle to move so as to bring its gear wheel into engagement with the cooperating pinion on the shaft B. This movement of the spindle may be caused for instance by an electromagnet inside the casing shown as part of each time-element device. Each time-element device is provided with a spring D acting to return the spindle to its normal position when the electromagnet is deenergized and thus withdraw the gear wheel from engagement with the cooperating driving pinion.

As shown in Figure 1 the time-element C is provided with a gear wheel E adapted to engage with the pinion B' and the time-elements C', C<sup>2</sup>, C<sup>3</sup> have gear wheels E', E<sup>2</sup> and E<sup>3</sup> which cooperate with the driving pinions B<sup>2</sup>, B<sup>3</sup> and B<sup>4</sup> respectively.

The time-element C has upon its spindle a cam disc F which as it rotates moves a pivoted lever G controlling contacts H. Similarly the time-element C<sup>2</sup> has a cam disc F' acting through a pivoted lever G' on contacts H'. These two time-elements C and C<sup>2</sup> are intended to reset themselves as soon as their gear wheels are disengaged from the driving pinions and therefore they are shown as provided with springs J and J' respectively which are wound up by the rotation of the spindles and cause those spindles to rotate rapidly in the opposite direction as soon as the gears are disengaged.

The time-element devices C' and C<sup>3</sup> have not cams or like contact-operating devices directly mounted on their spindles but drive contact-operating cams F<sup>2</sup> and F<sup>3</sup> through worm gears K' and K<sup>2</sup>. These cams F<sup>2</sup> and F<sup>3</sup> operate pivoted levers G<sup>2</sup> and G<sup>3</sup> which act to close the contacts H<sup>2</sup> and H<sup>3</sup>.

The return or resetting movement of the time-element devices C' and C<sup>3</sup> may be brought about by springs acting either directly on the spindles as in the case of the time-elements C and C<sup>2</sup> or, if the worm gear is reversible, acting on the spindles carrying the cams F<sup>2</sup> and F<sup>3</sup>.

Further details are not given in connection with Figure 1 as that is intended to be a diagram showing merely the general arrangement of the improved multiple time-element device. Further details of some of the essential parts are shown in Figures 2, 3, 4 and 5.

In the arrangement illustrated in Figures 2, 3, 4 and 5 the driving motor is indicated at A' and the main driving shaft at A<sup>2</sup>. On this driving shaft are three pinions B<sup>2</sup>, B<sup>3</sup> and B<sup>4</sup>, the pinion B<sup>2</sup> being shown on Figure 5. With the pinion B<sup>2</sup> can be

brought into engagement either the gear wheel E<sup>4</sup> or the gear wheel E<sup>5</sup>, the necessary motion of the particular gear wheel being imparted to its spindle by an arm L or L' which forms part of the armature of an electromagnet L<sup>2</sup> or L<sup>3</sup>. The spindle carrying the gear wheel E<sup>4</sup> forms part of one time-element device which may be employed in connection with the synchronizing of the substation generator, and carries a contact-operating cam F<sup>4</sup>. This cam has an operating surface acting on levers G<sup>4</sup> and G<sup>5</sup> which act on two pairs of contacts H<sup>4</sup> and H<sup>5</sup>.

Similarly the spindle carrying the gear wheel E<sup>5</sup> drives a contact-operating cam F<sup>5</sup> whose surfaces cooperate with pivoted levers G<sup>4</sup> and G<sup>5</sup> acting on contacts H<sup>4</sup> and H<sup>5</sup>.

The gear wheel E<sup>5</sup>, the cam F<sup>5</sup> and one set of levers and the contacts are shown more clearly in sectional elevation in Figure 4 and it will be understood that the construction of the cam F<sup>4</sup> with its levers and contacts may be of a similar character.

As will be seen by reference to Figure 4 the spindle E<sup>5</sup> upon which the gear wheel E<sup>4</sup> which forms part of a second time-element device associated for example with an overload relay, is mounted can slide in the cam F<sup>4</sup> against the action of an adjustable spring D'. The lever G<sup>4</sup> does not act directly upon the contacts H<sup>4</sup> but on another pivoted lever G<sup>4a</sup> provided with a spring G<sup>4a</sup>. The resetting spring J<sup>2</sup> is housed within the cam F<sup>4</sup>.

The two other time-element devices, i e those shown on the right-hand side of Figure 2 are each driven through worm reduction gear. The cam drum F<sup>6</sup> of one of these time-elements intended more especially for controlling the starting-up circuits for the substation generator, is driven by the worm M with which the spindle E<sup>7</sup> is in sliding engagement. Upon this spindle is mounted the gear wheel E<sup>6</sup> which can be brought into and out of operative engagement with the driving pinion B<sup>6</sup> by means of the electromagnet L<sup>4</sup> and its armature arm L<sup>5</sup>. A resetting spring J<sup>3</sup> causes the return movement of the cam drum. This cam drum F<sup>6</sup> has three operating surfaces F<sup>7</sup>, F<sup>8</sup> and F<sup>9</sup> (Figure 3). Each of these surfaces works in conjunction with a pivoted contact-operating lever. One of these levers, that cooperating with the surface F<sup>7</sup>, is shown at G<sup>7</sup> in Figure 3 with its contacts H<sup>7</sup>. The levers are held against the cam surfaces by springs of which one is shown at G<sup>10</sup> (Figure 3).

The cam ring or surface F<sup>9</sup> is adjustable relatively to the drum F<sup>6</sup> to alter the position of its throw. This adjustment may be effected by means of the nuts F<sup>10</sup> shown in Figure 2.

The cam drum F<sup>11</sup> of the remaining time-element device which may be employed in

conjunction with an underload relay to control the shutting-down circuits for the substation generator, is likewise driven through a worm M', spindle E<sup>9</sup> and gear wheel E<sup>10</sup> the spindle being moved by the armature arm L' of an electromagnet L<sup>4</sup>, the driving member being the pinion B<sup>7</sup> (Figure 5) on the main shaft A<sup>2</sup>. In this time-element device however mechanism is provided for reversing the direction of rotation of the cam drum F<sup>11</sup>. This mechanism is shown in Figure 5 and comprises two pinions B<sup>8</sup> and B<sup>9</sup> mounted on a pivoted lever B<sup>10</sup>, and driven from the pinion B<sup>7</sup>. The spindle E<sup>9</sup> can be moved so that the gear wheel E<sup>10</sup> either engages with the pinion B<sup>8</sup> as shown or engages directly with the pinion B<sup>7</sup>. The backward drive through the pinions B<sup>8</sup> and B<sup>9</sup> is stopped as soon as the cam drum returns to its zero position for in that position a pin B<sup>11</sup> at the free end of the spring-controlled lever B<sup>10</sup> (Figure 5) drops into a recess F<sup>12</sup> in the upper edge of the cam ring F<sup>12</sup>. Thus the lever will rock slightly and take the pinion B<sup>8</sup> out of engagement with the pinion B<sup>7</sup>.

The cam drum F<sup>11</sup> has three operating rings or surfaces F<sup>12</sup>, previously mentioned, and F<sup>13</sup> and F<sup>14</sup>. The ring F<sup>12</sup> is shown in Figure 3 in conjunction with a pivoted lever G<sup>11</sup> and contacts H<sup>9</sup> operated thereby. A spring G<sup>12</sup> keeps the lever G<sup>11</sup> against its cam surface F<sup>12</sup>. Other levers and contacts of similar construction are provided working in conjunction with the cam surfaces or rings F<sup>13</sup> and F<sup>14</sup> but they are omitted for the sake of clearness.

The cam ring or surface F<sup>14</sup> is driven frictionally from the drum F<sup>11</sup> through a spring indicated at F<sup>15</sup> (Figure 3) and has a projection F<sup>16</sup> working between two fixed stops F<sup>17</sup> and F<sup>18</sup> (Figure 2). By this arrangement it is possible to ensure that the contacts H<sup>10</sup> (Figure 2) controlled by this cam surface shall be operated directly at the first part of either the forward or backward movement of the cam drum F<sup>11</sup>.

It will be appreciated that a multiple time-element device of the kind described can be used in many circumstances where it is necessary to have a number of electrically-controlled operations performed in a proper sequence. Operations of this nature are required for instance in the automatic or semiautomatic control of electric power substations and the multiple time-element device particularly described is primarily intended for this purpose.

What I claim as my invention and desire to secure by Letters Patent is.—

1 In a multiple electric time-element device, the combination of a single driving member, means for rotating this member at a slow and uniform speed, a plurality of separate and dissimilar time-element con-

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tact-operating devices, an operative driving connection for each device suited to the particular time characteristics of the device, and a plurality of separate and independently actuated mechanisms respectively adapted to bring the driving connections into or out of operative engagement, with the single driving member

2 In a multiple electric time-element device, the combination of a single driving shaft, means for rotating the shaft at a slow and uniform speed, a plurality of pinions mounted on the shaft, and a plurality of separate and dissimilar time-element contact-operating devices each comprising a plurality of contacts, a rotatable contact-maker for actuating such contacts, a gear wheel, an operative connection between the gear wheel and the contact maker suited to the particular time characteristics of the device, and an electromagnetic mechanism for bringing the gear wheel into operative engagement with the appropriate pinion on the driving shaft

3 In a multiple electric time-element device, the combination of a single driving shaft, an electric motor for rotating the shaft at a slow and uniform speed, a plurality of pinions mounted on the shaft, and a plurality of separate time-element contact-operating devices each comprising a rotatable contact-maker, an axially movable spindle, a gear wheel mounted on the spindle, an operative connection between the spindle and the contact-maker suited to the particular time characteristics of the device, an electromagnetic mechanism for moving the spindle axially so as to bring the gear wheel into operative engagement with the appropriate pinion on the driving shaft, and means for returning the spindle and the contact-maker to their initial positions when the device is disengaged from the driving shaft the said means in at least one of the devices including a spring whereby the contact-maker is instantaneously reset.

4. In a multiple electric time-element device, the combination of a single driving shaft, means for rotating the shaft at a slow and uniform speed, a plurality of pinions mounted on the shaft, and a plurality of separate and dissimilar time-element contact-operating devices each comprising a plurality of contacts, a rotatable disc, a plurality of cam rings so disposed on the disc that they will operate the contacts when the disc is rotated, a gear wheel, an operative connection between the gear wheel and the disc suited to the particular time characteristics of the device, and an electromagnetic mechanism for bringing the gear wheel into operative engagement with the appropriate pinion on the driving shaft.

5. In a multiple electric time-element device, the combination of a single driving shaft, means for rotating the shaft at a slow

and uniform speed, a plurality of pinions mounted on the shaft, and a plurality of separate and dissimilar time-element contact-operating devices each comprising a rotatable contact-maker, a spindle, a gear wheel mounted on the spindle, an operative driving connection between the spindle and the contact-maker, and means for moving the spindle so as to bring the gear wheel into or out of operative engagement with the appropriate pinion on the driving shaft, the operative driving connection in at least one of the devices being such that the spindle drives the contact-maker directly but can slide axially relative thereto

6 In a multiple electric time-element device, the combination of a single driving shaft, means for rotating the shaft at a slow and uniform speed, a plurality of pinions mounted on the shaft, and a plurality of separate and dissimilar time-element contact-operating devices each comprising a rotatable contact-maker, an axially movable spindle, a gear wheel mounted on the spindle, an operative driving connection between the spindle and the contact-maker suited to the particular time characteristics of the device, and means for moving the spindle axially so as to bring the gear wheel into or out of operative engagement with the appropriate pinion on the driving shaft, the operative driving connection in at least one of the devices comprising a sleeve so mounted on the spindle as to rotate therewith but to remain unaffected by the axial movement thereof, a worm on the sleeve, and a worm wheel engaging with the worm and connected directly to the contact-maker

7. In a multiple electric time-element device, the combination of a single driving member, means for rotating this member at a slow and uniform speed, a plurality of separate and dissimilar time-element contact-operating devices, an operative driving connection for each device suited to the particular characteristics of the device, and a plurality of separate and independently actuated mechanisms respectively adapted to bring the driving connections into or out of operative engagement with the single driving member, the operative driving connection for at least one of the devices including worm gearing and reversing gearing.

8. In a multiple electric time-element device, the combination of a single driving member, means for rotating this member at a slow and uniform speed, a plurality of separate and dissimilar time-element contact-operating devices, an operative driving connection for each device suited to the particular characteristics of the device, and a plurality of separate and independently actuated mechanisms respectively adapted to bring the driving connections into or out of

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operative engagement with the single driving member, at least one of the contact-operating devices comprising a rotatable contact-maker, a spindle, a gear wheel mounted on the spindle, worm gearing between the spindle and the contact-maker, two pinions driven in opposite directions by the driving member, and electromagnetic mechanism for bringing the gear wheel into operative engagement with one or other of the two pinions whereby the contact-maker can be driven either in the forward or the reverse direction

9 In a multiple electric time-element device, the combination of a single driving member, means for rotating this member at a slow and uniform speed, a plurality of separate and dissimilar time-element contact-operating devices, an operative driving connection for each device suited to the particular time characteristics of the device, and a plurality of separate and independently actuated mechanisms respectively adapted to bring the driving connections into or out of operative engagement with the single driving member, at least one of the contact-operating devices including a plurality of contacts, a rotatable disc, a plurality of cam rings so disposed on the disc that they will operate the contacts when the disc is rotated whereby the device can be employed to cause a series of operations to be performed in a predetermined sequence, and means for adjusting at least one of the cam rings relatively to the disc whereby the time interval between successive stages in the sequence of operations may be varied

10 In a multiple electric time-element device, the combination of a single driving member, means for rotating this member at a slow and uniform speed, a plurality of separate and dissimilar time-element contact-operating devices, an operative driving connection for each device suited to the particular characteristics of the device, and a plurality of separate and independently actuated mechanisms respectively adapted to bring the driving connections into or out of operative engagement with the single driving member, at least one of the contact-operating devices including a rotatable disc, a plurality of cam rings on the disc one of these rings being driven frictionally from the disc, a finger or projection on the frictionally driven cam ring, two fixed stops to limit the movement of the finger or projection and a plurality of contacts operated by the cam rings.

11 In a multiple electric time-element device, the combination of a single driving shaft, means for rotating this shaft at a slow and uniform speed, a plurality of pinions mounted on the shaft, and a plurality of separate and dissimilar time-element contact-operating devices each comprising a ro-

tatable contact-maker, a gear wheel, an operative driving connection between the gear wheel and the contact-maker suited to the particular time characteristics of the device, and means for moving the gear wheel into or out of engagement with the appropriate pinion on the driving shaft, at least one of the devices including a spring whereby the contact-maker is instantaneously reset when the gear wheel is disengaged from the pinion, and worm gearing which forms part of the operative driving connection and is so arranged as to allow the contact-maker to be reset by the spring

12 In a multiple electric time-element device, the combination of a single driving shaft, means for rotating this shaft at a slow and uniform speed, a plurality of pinions mounted on the shaft, and a plurality of separate and dissimilar time-element contact-operating devices each comprising a rotatable contact-maker, a gear wheel, an operative driving connection between the gear wheel and the contact-maker suited to the particular time characteristics of the device, and means for moving the gear wheel into or out of engagement with the appropriate pinion on the driving shaft, at least one of the devices having means for instantaneously resetting the contact-maker when the gear wheel is disengaged from the pinion, while another of the devices has means whereby the driving shaft drives the contact-maker in the reverse direction for resetting purposes.

13 In a multiple electric time-element device, the combination of a single driving shaft, means for rotating this shaft at a slow and uniform speed, a plurality of pinions mounted on the shaft, and a plurality of separate and dissimilar time-element contact-operating devices each comprising a rotatable contact-maker, a gear wheel, an operative driving connection between the gear wheel and the contact-maker suited to the particular time characteristics of the device, and means for moving the gear wheel into or out of engagement with the appropriate pinion on the driving shaft, at least one of the devices including means whereby the driving shaft drives the contact-maker at a slow speed in the forward direction and resets it by driving it at a slow but different speed in the reverse direction

14 In a multiple electric time-element device, the combination of a single driving member, means for rotating this member at a slow and uniform speed, a plurality of separate and dissimilar time-element contact-making devices, an operative driving connection for each device suited to the particular time characteristics of the device, and a plurality of separate and independently actuated controlling mechanisms respectively adapted to bring the driving con-

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nections into or out of operative engagement with the driving member, the operative driving connection for at least one of the devices including reversing gearing comprising two pinions driven in opposite directions by the driving member and a gear wheel which is

moved by the controlling mechanism into operative engagement with one or the other of the two pinions.

In testimony whereof I have signed my name to this specification

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ELECTRIC TIME ELEMENT DEVICE

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2 Sheets-Sheet 1

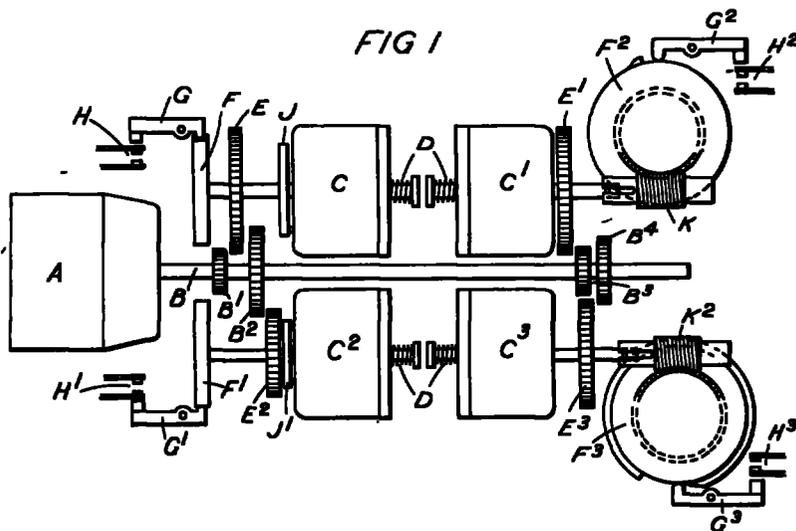
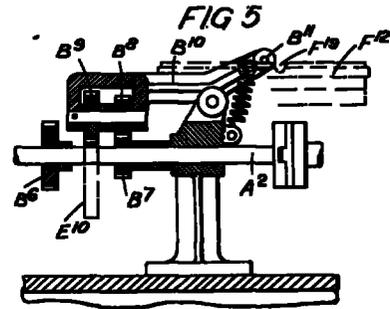
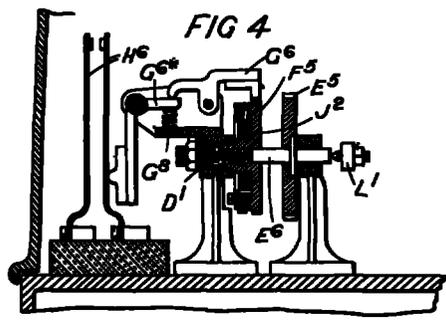
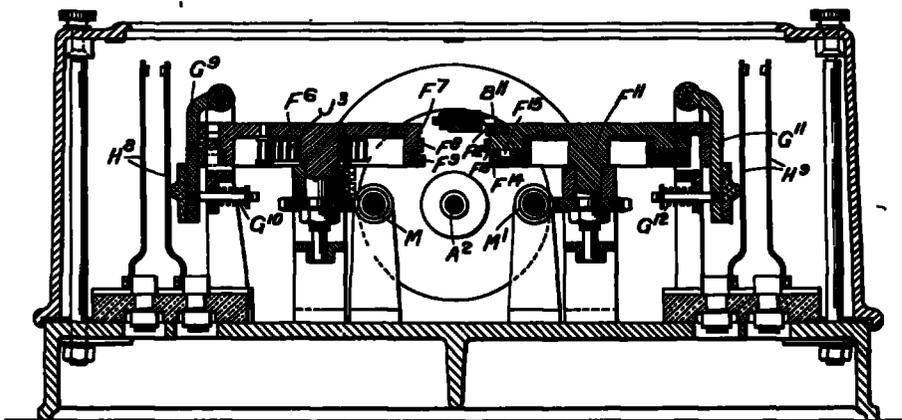


FIG 3



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ELECTRIC TIME ELEMENT DEVICE

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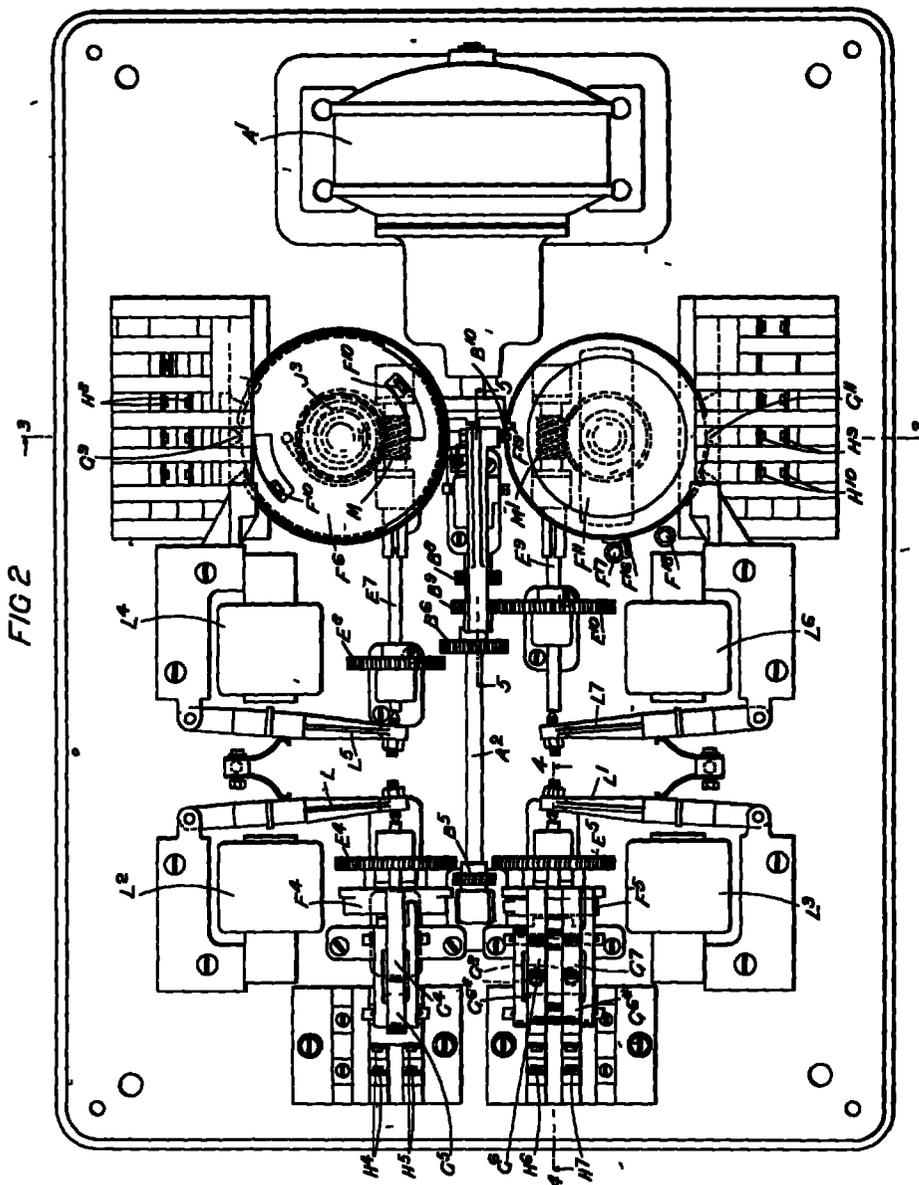


FIG 2

INVENTOR

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 Patent, Const. Mould & Foundry,  
 ATTYS.