Aug. 9, 1927. 1,638,322

C. H. CHAPMAN

ELECTROMAGNETIC TIME ELEMENT DEVICE

Filed Aug. 2, 1926

Fig. 1.

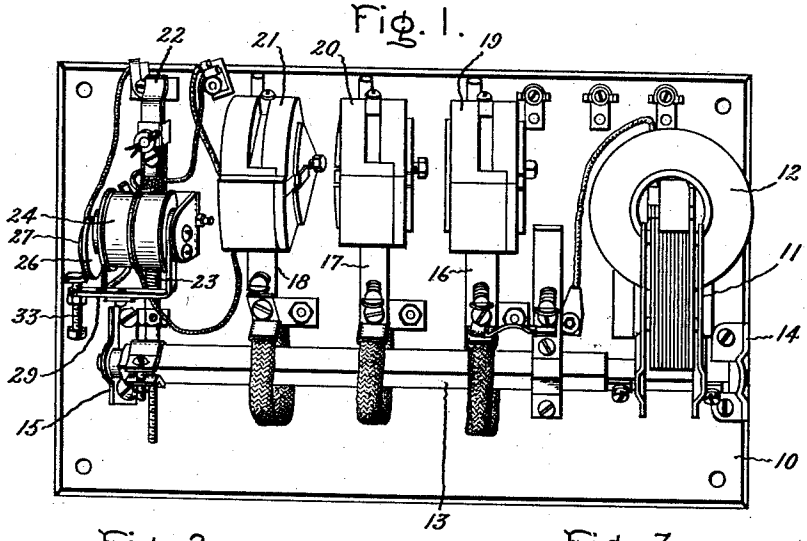


Fig. 2.

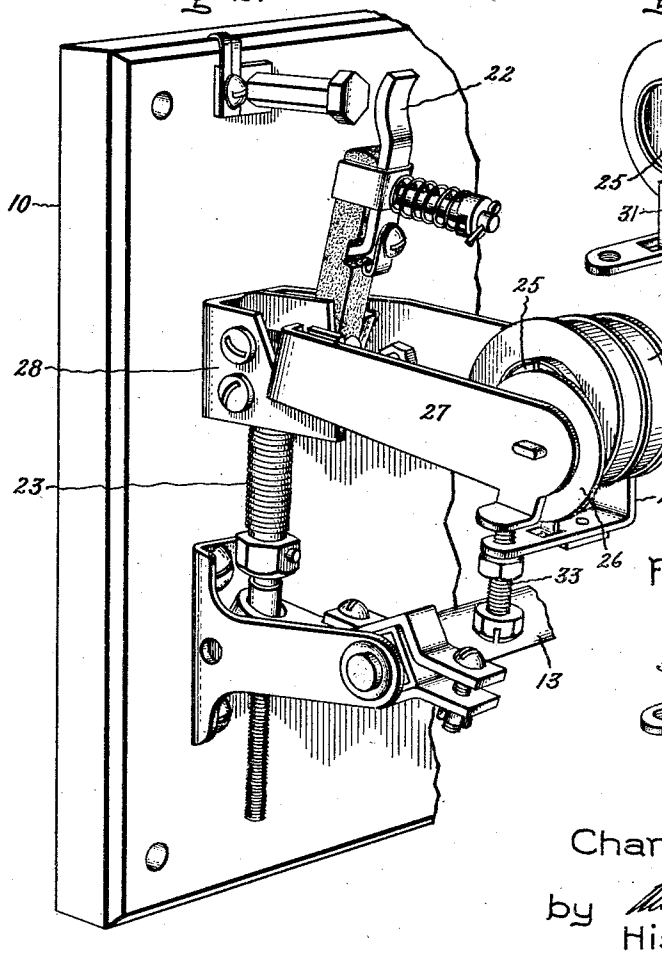


Fig. 3.

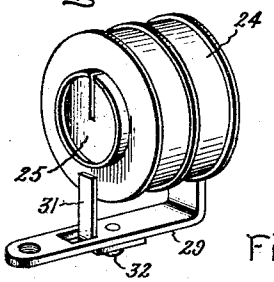


Fig. 5.

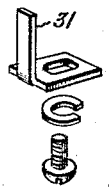
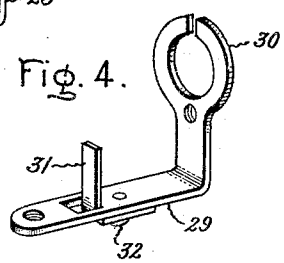


Fig. 4.



Inventor:
Charles H. Chapman,
by Alexander S. Lamb
His Attorney.

Patented Aug. 9, 1927. 1,638,322

UNITED STATES PATENT OFFICE.

CHARLES H. CHAPMAN, OF SCOTIA, NEW YORK, ASSIGNOR TO GENERAL ELECTRIC COMPANY, A CORPORATION OF NEW YORK.

ELECTROMAGNETIC TIME-ELEMENT DEVICE.

Application filed August 2, 1926. Serial No. 126,468.

My invention relates to improvements in electromagnetic time element devices whereby a substantially definite time interval will always be obtained in the operation of a device and whereby the desired time interval of operation may be readily adjusted.

My invention is directed primarily to an improvement of the electromagnetic time element device for which George E. Stack filed an application on May 3, 1923, Serial No. 636,456, and assigned the same to the same assignee to whom this invention is assigned.

The particular form of electromagnetic devices selected by Stack for the purpose of illustrating the broad principle of his invention is entirely operative and practical for certain conditions, but leaves something to be desired in the adjustment of the device for obtaining various time intervals. The object of my invention is to provide a simple and effective device intended for cooperation with the Stack electromagnetic time element device whereby adjustments of the time interval of operation may be very easily effected.

In carrying the invention into effect in the form which I now regard as the preferred form, I provide a relatively low reluctance path for the flux of the electromagnet and provide means whereby an adjustment is had between the path of relatively low reluctance and the magnetic movable element of the Stack device.

In order to insure satisfactory operation of the device at low frequencies, I provide a laminated core on which the winding of the electromagnet is mounted. The effect of residual magnetism in causing the magnetic movable element to be arrested at low frequencies is thus practically obviated.

For a better understanding of the invention, reference is had to the accompanying drawing, wherein Fig. 1 shows a three-pole electromagnetic switch or contactor and an electromagnetic time element relay intended for operation in a definite interval of time after the operation of the contactor. Fig. 2 is a detail in perspective of a portion of the assembly shown in Fig. 1 for the purposes of more clearly showing the time element relay and my improvement incorporated therewith. Fig. 3 is a detail showing the winding spool of the time element relay mounted on a core of magnetic material and the adjustable part of magnetic material which forms the low reluctance path for the flux set up by the winding. Fig. 4 is a perspective view of the strap of magnetic material which forms the low reluctance magnetic return path for the flux of the electromagnet of the time element relay and the adjustable part whereby the time interval of operation of the relay may be adjusted. Fig. 5 is a detail showing the adjustable part of the low reluctance magnetic return path of the electromagnet of the time interval relay.

Referring to Fig. 1, the three-pole contactor and the time interval relay are mounted on a base 10 of suitable insulating material. The three-pole contactor comprises an operating electromagnet having an armature 11 and a winding spool 12. The armature 11 is secured to the shaft 13, which is supported on the base 10 by means of brackets 14 and 15 at each end thereof. The switch contacts 16, 17 and 18 are also suitably secured to the shaft 13 so as to be operated thereby, and the magnetic blow-out devices 19, 20 and 21 cooperate respectively with the contacts 16, 17 and 18 to interrupt the arcs formed at these contacts.

The time interval device is shown on the left end of the supporting base 10. This device is shown in more detail in Fig. 2. In general, it may be said that when the winding 12 of the operating electromagnet is energized, the switch contacts 16, 17 and 18 will be operated to their closed positions and the movable contact 22 of the time element relay will be placed under a bias to the closed position by means of the shaft 13 acting through the spring 23. The closing movement of the relay contact 22 will be delayed by means of the relay electromagnet, which comprises the winding spool 24, the core 25 of magnetic material, and the movable armature 26. When the winding of the time element relay is energized by a current such as an alternating current, and the armature 14 is in its attracted position, the armature 26 will be periodically magnetically held and released to move counter-clockwise with reference to the core 25 of the relay electromagnet. A step by step advance of the arm 27 and the armature 26 is thereby effected, the spring 23 acting to effect a continuous advance of these parts and the relay electromagnet acting to periodically retard this advance. As the armature 26 and the arm 27, which carries and supports the armature,

are permitted to periodically rotate about the pivot provided by the support 28, the contact 22 is correspondingly periodically permitted to advance toward its cooperating stationary contact. The time element device so far explained is the invention of George E. Stack, for which he filed his aforesaid patent application.

In order to provide a simple and effective means whereby the time interval of operation of the relay may be readily adjusted over a greater period of time interval of operation than is the case in the ordinary form of the Stack relay, I have provided the strap of magnetic material shown in detail in Fig. 4. This strap comprises a main body portion 29 and a split ring-shaped end portion 30 which is intended to fit over the right hand end of the core 25 of the electromagnet of the relay. This strap is of good magnetic material so as to provide a relatively low reluctance magnetic return for the flux set up by the winding 24 of the relay. The adjustable member 31 is shown more in detail in Fig. 5. This member has an upwardly projecting portion and a slotted base portion, the base portion cooperating with the main portion of the strap and arranged to be secured thereto by means of the machine screw 32. The left hand end of the strap is provided with a screw threaded opening for receiving the adjusting screw 33 for determining the initial position of the armature 26 and the supporting arm 27. The projecting portion 31 extends upwardly toward the core 25 of the relay electromagnet and is interposed between the armature 26 and the left-hand end of the winding spool 24.

By providing this relatively low reluctance magnetic return path for the electromagnet, I am able to secure a greater holding effect on the armature 26 for the same number of ampere turns in the winding of the relay electromagnet, and I am thus able to secure a greater time interval of operation of the device. The time interval of operation may be adjusted by sliding the projection 31 back and forth in the slot cut in the strap 29. When the projection 31 is moved nearer the armature 26 a greater percentage of the flux of the relay electromagnet will be caused to pass through the armature 26 and thus produce a greater holding effect. When the projection 31 is moved to the right, nearer the winding spool 24, a greater percentage of the flux of the relay electromagnet is shunted from the armature 26 and the time interval of operation of the device is thereby shortened.

The armature 26 is intended to move step by step with reference to the axis of the core 25 of the relay electromagnet, the armature being alternately restrained and released in a periodicity bearing a definite relation to the alternations, pulsations, or variations in the energization of the winding of the relay electromagnet.

My invention has a particular application in the control of the starting of synchronous motors responsively to the current induced in the field winding of the motor. The switch contact members 16, 17 and 18 are used to connect the armature of the motor to a three phase source of supply promptly upon the energization of the winding 12 of the operating electromagnet. The time interval device shown in Fig. 2 is used to delay the interruption of the local circuit in which the field winding of the motor is included when the motor is initially connected to its source of supply and the connection of the field winding to a direct current source of supply when the speed of the motor has approached closely to the synchronous speed. For such application, the coil 24 is included in the local circuit in which the motor field winding is connected at starting. The frequency of the current in the coil 24 is thus line frequency with the motor at stand-still, and gradually decreases relatively to a very low value as the motor speed approaches synchronism. The core 25 is made of laminated magnetic material, thus keeping down the effect residual magnetism plays in causing the armature 26 to stick to core 25 when the frequency of the current in coil 24 is nearly zero. By using a coil 24 of a definite number of turns and the device of Fig. 4 to provide a low reluctance return path for the flux which passes through the core 25, an adjustment is enabled whereby the relay switch member 22 locks open definitely when the induced voltage of the motor field is high, as at standstill, and to not reach an operating condition until the induced voltage of the field winding corresponds to a frequency of approximately that corresponding to 90% of synchronous speed. In other words, the invention provides means whereby the opening of the local circuit in which the motor field winding is included is arrested at values of induced field voltage which correspond to low motor speeds and a definite timing action when the motor speed has increased to a predetermined value.

What I claim as new and desire to secure by Letters Patent of the United States is:

1. In combination, an electromagnet having a core and a winding disposed thereon, a magnetic movable element cooperating with said core and arranged to be alternately magnetically attracted and released when the said winding is energized by a periodically varying current, the said element being arranged to move step by step with reference to a position of minimum reluctance between said core and element as the element is released, and a member of magnetic material cooperating with the core and said element to provide a low reluctance path for

the magnetic flux set up by said winding, and an adjustable air gap between said member and said element to adjust the time taken by said step by step movement of said element.

2. In combination in a time element device, an electromagnet having a core of laminated magnetic material, a magnetic movable element associated with said core and arranged to be magnetically attracted and released when the winding of the electromagnet is energized by a periodically varying current, the said element being arranged to move step by step with reference to a position of minimum reluctance between said core and element as the element is released, and a member of magnetic material cooperating with said core and element to provide a low reluctance path for the magnetic flux set up by the winding, the said member having a part arranged to be adjusted to provide an adjustable air gap between said member and element to adjust the time interval of operation of the device.

3. In combination in a time element device, an electromagnet having a core of laminated magnetic material, a winding disposed thereon, and a magnetic movable element cooperating with said core and arranged to be magnetically attracted and released when the said winding is energized by an alternating current, the said element being arranged to move step by step toward a position of minimum reluctance with reference to said core as the element is released, and a member of magnetic material cooperating with said core and said element to provide a low reluctance path for the magnetic flux set up by said winding and an adjustable air gap between said member and element, whereby the time taken by said step by step movement is adjusted and the device is adjustable to delay the timing action thereof until the frequency of the energizing current of said winding has reduced to a predetermined value.

4. As an element of an electromagnetic time element device having a core, a winding thereon, and a movable magnetic member which is alternately restrained and released by the magnetic pull of the electromagnet and which is caused to advance step by step with reference to the core of the electromagnet from one definite position to another, a magnetic member forming a return path of relatively low reluctance for the flux set up by the said electromagnet, the said magnetic return member having a split ring arranged to cooperate with one end of the core of the electromagnet and an adjustable element of magnetic material arranged to be adjusted with reference to the said magnetic movable member for the purpose of adjusting the time interval of operation of said magnetic movable member from one of its definite positions to another thereof.

In witness whereof, I have hereunto set my hand this 28th day of July, 1926.

CHARLES H. CHAPMAN.