Dec. 24, 1935. R. R. GONSETT 2,025,235

CIRCUIT INTERRUPTER

Filed June 26, 1931 3 Sheets-Sheet 1

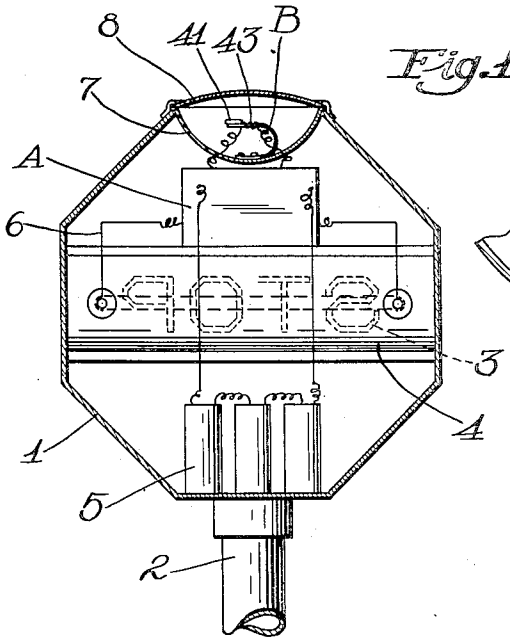


Fig.1.

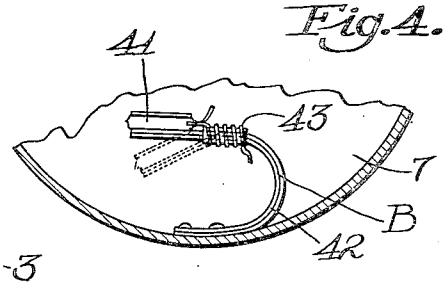


Fig.4.

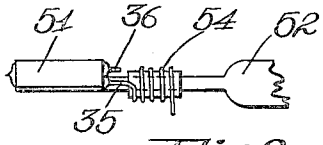


Fig.6.

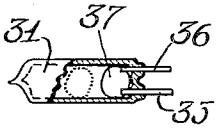


Fig.3.

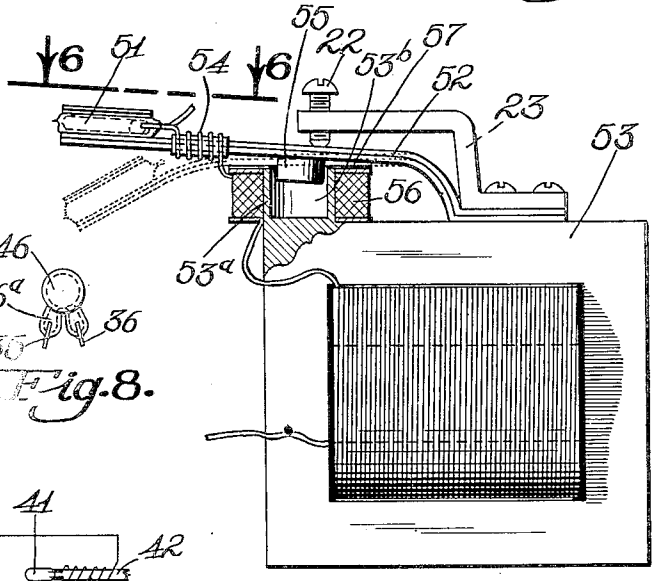


Fig.5.

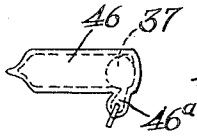


Fig.7.

Fig.8.

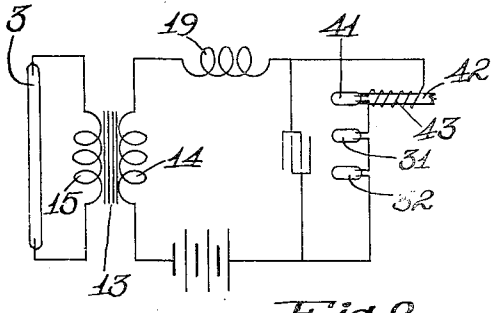


Fig.2.

INVENTOR
ROBERT R. GONSETT
BY A. B. Bowman
ATTORNEY

Dec. 24, 1935. R. R. GONSETT 2,025,235

CIRCUIT INTERRUPTER

Filed June 26, 1931 3 Sheets-Sheet 2

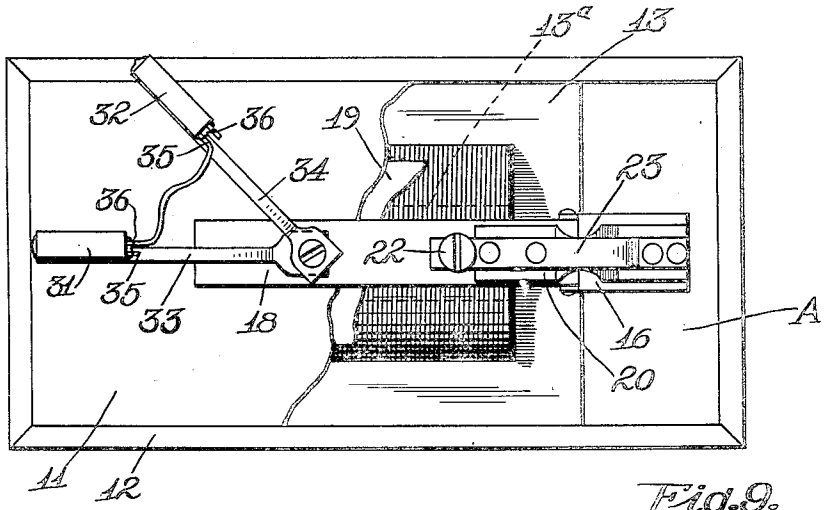


Fig. 9.

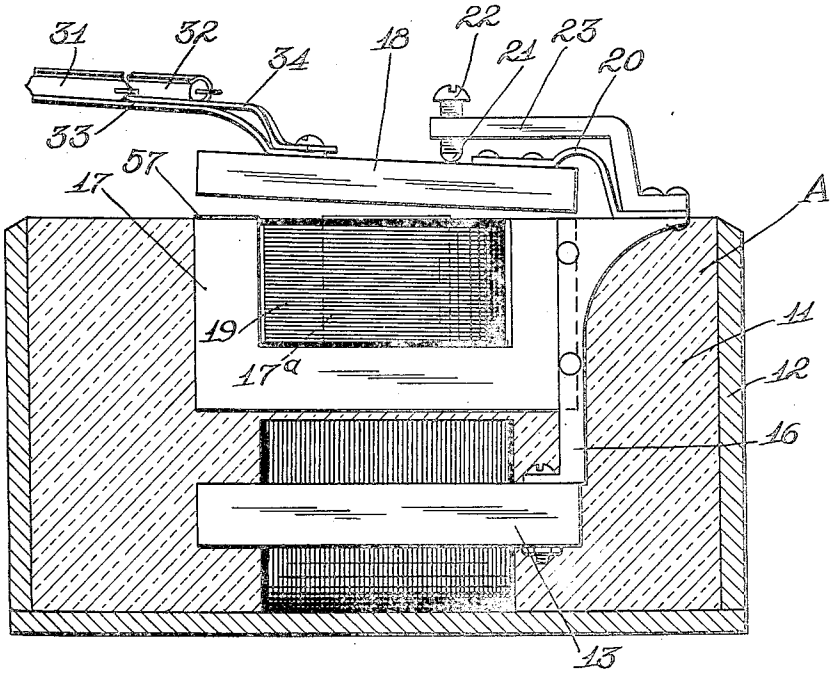


Fig. 10.

INVENTOR
ROBERT R. GONSETT
BY A. B. Bowman
ATTORNEY

Dec. 24, 1935. R. R. GONSETT 2,025,235

CIRCUIT INTERRUPTER

Filed June 26, 1931 3 Sheets-Sheet 3

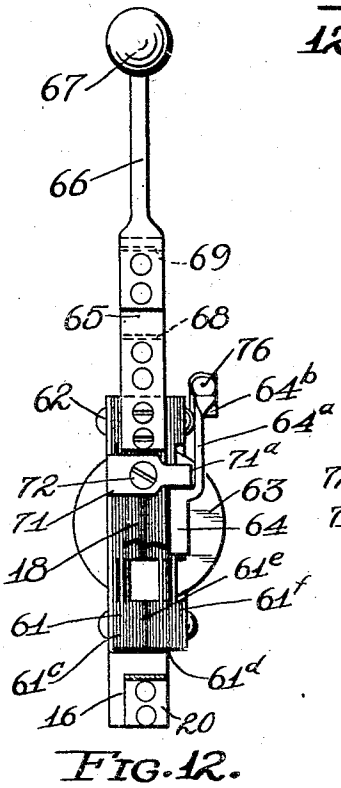


FIG. 12.

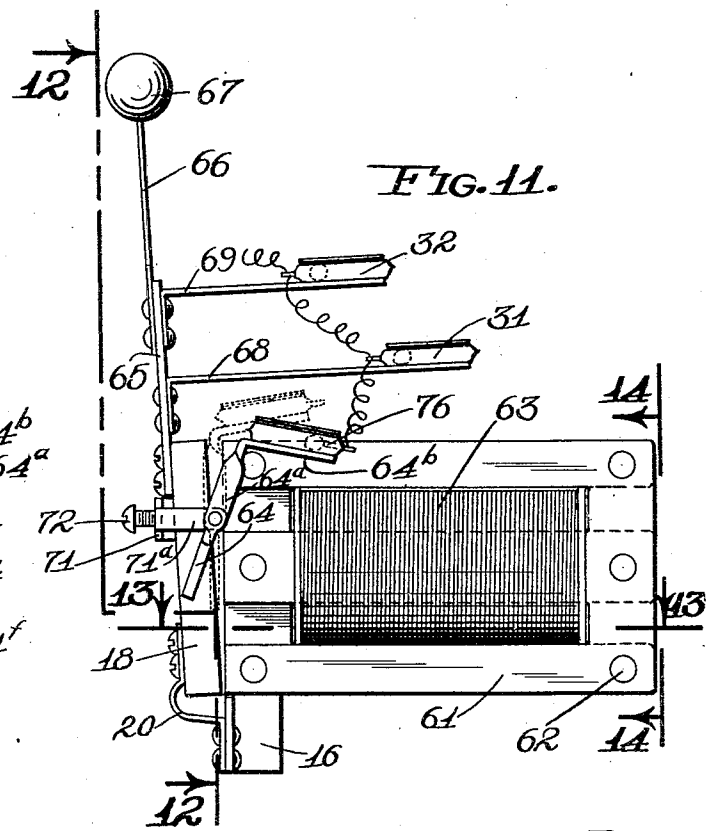


FIG. 11.

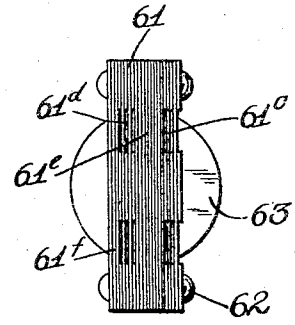


FIG. 14.

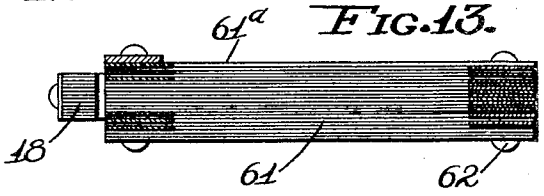


FIG. 13.

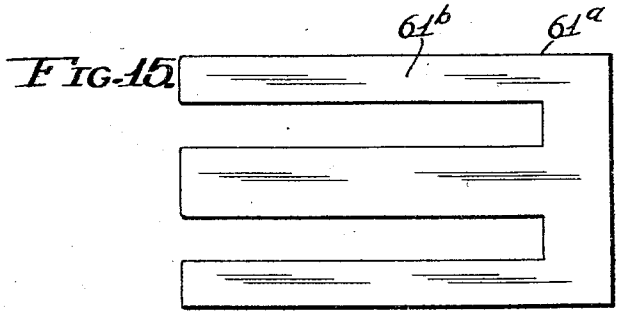


FIG. 15.

INVENTOR
ROBERT R. GONSETT
BY A. B. Bowman
ATTORNEY

Patented Dec. 24, 1935 2,025,235

UNITED STATES PATENT OFFICE

2,025,235

CIRCUIT INTERRUPTER

Robert R. Gonsett, Los Angeles, Calif., assignor to Irene Gonsett, Los Angeles, Calif.

Application June 26, 1931, Serial No. 546,950

19 Claims. (Cl. 177—329)

My invention relates to flashing discharge tube means operated by direct current, and to the circuit interrupter effecting the flashing of discharge tubes.

In the flashing of high tension discharge tubes by utilization of direct current as in my invention, it is necessary that the circuit break before the tube will flash; when the contact is not broken the tube will not be illuminated. It is therefore essential, in order to provide flashing, that the circuit be broken periodically.

The objects of my present invention are: to provide a novel, simple and economical flashing discharge tube means for operation by direct current; to provide a circuit interrupter in which the circuit controlled thereby is closed for a very short period of time compared to its open period, thus providing great efficiency in current consumption which is particularly important when batteries are used; to provide a switch in which the contacts are opened or separated, and held in such position by a throwing or centrifugal force; to provide novel means whereby the contacts are held in their open or separated positions; to provide novel means for throwing the mercury contact making and breaking means for breaking the circuit; to provide a novel transformer and electromagnet for operating said switch means; to provide novel safety means for breaking the circuit in the event that the throwing force is insufficient, or in the event of other failure of part of the apparatus in breaking the circuit; to provide a novelly constructed sign or signal whereby the same is automatically turned off by the sun; to provide a novel thermostatic switch adapted to be operated by either electrical or solar heat; to provide a novel mounting for such thermostatic switch means within a sign or signal; to provide a novelly constructed mercury contact switch; to provide as a whole a novelly constructed and operated circuit interrupter; and, to provide a flashing discharge tube means and circuit interrupter which is efficient, reliable and economical to operate and which will not readily deteriorate or get out of order. A further object is to present an interrupter which will operate without drawing energy from the lighting circuit. It is also an object to eliminate frictional wearing parts in the apparatus.

With these and other objects in view as will appear hereinafter, my invention consists of certain novel features of construction, combination and arrangement of parts and portions, as will be hereinafter described in detail and particularly set forth in the appended claims, reference being had to the accompanying drawings and to the characters of reference thereon which form a part of this application in which:

Figure 1 is a sectional elevational view of a traffic signal taken from the rear, and showing the location of the various portions of the circuit interrupter mounted therein and with respect to the other parts and portions of the signal; Fig. 2 is a wiring diagram of the apparatus; Fig. 3 is an enlarged top view of one of the switches; Fig. 4 is an enlarged sectional view of the solar thermostatically controlled switch means and its mounting; Fig. 5 is a modified form of the transformer and circuit interrupter; Fig. 6 is a partial top view of the modified structure taken at 6—6 of Fig. 5; Figs. 7 and 8 are, respectively, side and end views of a modified form of switch; Fig. 9 is an enlarged top view of one form of circuit interrupter which may be used with the thermostatically controlled switch means shown in Fig. 4, in accordance with Figs. 1 and 2; Fig. 10 is an elevation of the last mentioned interrupter with enclosing parts broken away; Fig. 11 is a side elevational view of another preferred form of interrupter; Fig. 12 is a fragmentary and elevational view of the interrupter shown in Fig. 11; Figure 13 is a section on the line 13—13 of Figure 11; Figure 14 is a rear end view of the core of the interrupter shown in Fig. 11; and, Fig. 15 is a side view of one of the laminations of the core.

Like characters of reference refer to similar parts and portions throughout the views of the drawings.

In the drawings I have shown my invention incorporated in a traffic "stop" signal adapted for periodically flashing a "stop" signal to pedestrians and vehicular traffic.

The disclosure shows my invention applied to conventional discharge tubes in contra distinction to other illuminating means, and as operated by direct and particularly electric battery current.

The whole flashing signal apparatus, including the flashing mechanism, is enclosed in a casing 1 supported on a suitable pedestal or column 2. The casing for signals of this type are usually flat and provided at one side with visible signal means. Such signal means consists, in this instance, of discharge or neon tubes 3 of the desired configuration to designate the desired signal. The tube, or tubes, 3 is mounted in a long reflector 4 extending transversely with respect to the casing and open at its front side so that the tube, or

tubes, 3 may be seen through the front open side of the reflector. The reflector 4 is, in this instance, shown from the back side so as to facilitate the illustration.

In the upper portion of the casing and preferably above the reflector 4, is mounted the transformer and interrupter, designated generally by A. This transformer and interrupter is connected to an electric battery which may consist of a plurality of dry cells 5 positioned at and within the lower portion of the casing 1. The secondary coil of the transformer, as will be more fully disclosed hereafter, is connected by wires 6 to the tube, or tubes, 3 from the back side of the reflector 4. At the upper side of the casing 1 is mounted a concave and preferably wide parabolic reflector 7 which is directed upwardly and secured at its upper edge to the upper portion of the casing. This reflector is enclosed at its upper side by a lens 8. Within the reflector is positioned a thermostatically controlled switch means B which will be described hereafter.

The transformer is imbedded in a body of insulating material 11 which is enclosed in a box 12. The transformer consists of the usual core 13, primary winding 14 and secondary winding 15, as shown in Fig. 2. The core 13 is, in this instance, a closed core and arranged horizontally in the box 12. The primary winding and the secondary winding may be wound in accordance with approved practices.

To one end of the core is secured a bracket 16 which extends upwardly through the upper open side of the box 12. To the bracket 16 is secured the core 17 of an electromagnet which extends over and above the transformer. The core 17 is an open E-shaped core with its legs directed upwardly, and providing a closed magnetic field by means of an armature 18 movably mounted above the core 17 and extending from one end leg of the core to the other end leg. Around the central portion or leg 17a of the electromagnet is positioned the coil 19 of the electromaget. One end of the armature 18 is mounted, by means of a plate spring 20 on the upper end of the bracket 16. This plate spring permits the armature to be drawn downwardly by the electromagnet but normally holds the armature away from the core of the electromagnet and against a yieldable stop 21. This yieldable stop is carried at the inner end of an adjusting screw 22 which is mounted on the end of a bracket or arm 23, which arm or bracket 23 is mounted at the opposite end on the bracket 16. At the free end of the armature there is mounted the circuit interrupter switch means.

The aforementioned switch means consists of a pair of elongated hermetically sealed receptacles or tubes 31 and 32 secured respectively to the free ends of resilient arms or springs 33 and 34. The other ends of these resilient arms are secured to the free end of the armature 18. Each of the switches 31 and 32 consists of a short vacuum tube. Through the inner end of each tube extend pairs of electrodes 35 and 36 which are adapted to be electrically connected by a globule of mercury 37 contained in the tube when the tube is inclined with the electrodes 35 and 36 at the lower end. These switches 31 and 32 are connected in series with the battery, the primary winding 14 of the transformer, and the coil 19 of the electromagnet, as shown in Fig. 2. It will be noted that the switches 31 and 32 are positioned at different distances from the resilient mounting of the armature 18, and are also mounted on resilient arms 33 and 34 of different lengths. The purpose of the two switches in series is to provide a factor of safety and insure more certainly an interruption in the circuit in case one of the switches fails temporarily to function as desired.

It will be here noted that when the electromagnetic coil 19 is energized, the armature 18 is drawn downwardly forcing the switches downwardly with considerable force, and forcing the globules of mercury toward the outer ends of the tubes, causing an electrical break between the electrodes 35 and 36 in each of the switches. The mounting of the switches 31 and 32 on the resilient spring arms 33 and 34 causes the switches to oscillate for a slight period, causing, during such oscillation, the globules of mercury to be retained at the outer ends of the tubes. It will be understood that in order for this function of the arms 33 and 34 to occur, the arms must be of extreme flexibility and resilience. As soon as the oscillation has ceased sufficiently, the globules of mercury return to their initial low positions in contact with the electrodes 35 and 36 causing a completion or closing of the circuit thereby again energizing the coil 19.

By adjusting the screw 22 downwardly, the upward movement of the armature is limited, correspondingly decreasing the amplitude and period of oscillation of the switches 31 and 32.

In order further to insure a break in the cir- cuit, if at any time the globules of mercury 37 should adhere to the electrodes 35 and 36, I have provided the thermostatic switch means B (Fig. 4) which is also connected in series with the other switches. This thermostatically controlled switch 41 is a tube similar to the tubes 31 and 32. But the switch 41 is mounted at the end of a bimetallic thermostatic bar or plate 42 around which is wound a coil of heating or resistance wire 43 also connected in series with the other switches described in such a manner that if the circuit is not broken by the switches 31 and 32 instantly, the wire 43 becomes heated. The thermostatic plate 42 consists of a pair of plates of metal of different coefficients of expansion so secured together that when the plate becomes heated, the same is bent or distorted. In this instance, the thermostatic plate is made in U-shape secured with one end to the lower portion of the parabolic reflector 7 and extended with its other end or leg in close proximity to the focus of the reflector 7. The switch 41 is secured to the latter leg of the thermostatic element in such a position that normally the globule of mercury therein closes the circuit between the two electrodes therein, but when the thermostatic element is heated, the switch 41 will be inclined in the opposite direction causing the globule of mercury therein to be separated from the electrodes thereof.

The parabolic reflector 7 is so arranged at the upper portion of the casing 1 that the sun's rays are directed thereinto and are reflected in directions passing in sufficiently close proximity to the focus of the reflector that the thermostatic element is heated, causing the circuit to be broken by the downward inclination of the switch 41. Thus the circuit will remain broken as long as the sun's rays enter the reflector with sufficient intensity to distort the thermostatic element and cause the switch 41 in connection therewith to be inclined downwardly.

Thus it will be seen that the thermostatic switch performs a double function, namely, that of automatically shutting off the signal when

there is sufficient daylight by the shining of the sun and of serving as a safety means in temporarily interrupting the circuit if the regular interrupter switches fail.

In Figs. 7 and 8 I have shown a slightly modified form of construction of the switches 31, 32 and 41. In this modified form of construction the tube, designated 46, is provided at one end with a pair of spaced apart and downwardly extending pockets 46a into which the electrodes 35 and 36 extend. In these pockets are held globules of mercury in continuous contact with the inwardly projected ends of the electrodes. The upper ends of the pockets are restricted so that the mercury within said pockets is not readily ejected therefrom. In this modified form of switch, the moving globule of mercury 37 contacts with the portions of the mercury exposed at the mouths of the pockets 46a. In this mercury to mercury contact type of switch there is less likelihood of deterioration of the contacts than in the aforementioned type.

The transformer and interrupter shown in Figs. 5 and 6 is considerably simpler than the structure heretofore described although to some extent sacrificing in safety what is gained in simplicity. In this instance, there is only one switch 51, this being mounted at the free end of a resilient arm 52 which is also made of thermostatic plates as heretofore described. This thermostatic element is mounted on the core 53 of the transformer, the core, in this instance, being arranged vertically. Around the thermostatic element 52 is wound the resistance wire 54 which functions the same as the resistance wire 43 shown in Figs. 1 and 4. In this modified form of construction, however, if the globule of mercury in the tube is not forced away from the electrodes when the armature, designated 55, is forced downwardly, the current will continue to flow through the resistance wire 54, heating the same and causing the free end of the thermostatic element 52 to be bent downwardly at a considerable angle, as shown in Fig. 5. This extreme inclined position of the switch 51 will cause a break in the circuit.

In this modified form of construction, it will be noted that the core, indicated by 53a forms a part of the core 53 of the transformer at one end of the latter. The coil 56 of the electromagnet is wound around this core 53a. This core is preferably provided with a recess 53b for receiving the armature 55 secured at the lower side of the thermostatic element 52.

It will be here noted that the return of the armature 55, and also the armature 18, in the structure described above, is facilitated and operation of the device quieted by placing yieldable non-metallic pads 57 at the outer ends of the cores 53a and 17, as shown, leather having been used therefor.

In the modified structure of my circuit interrupter, shown in Figs. 11 to 15, inclusive, I have embodied certain features hereinbefore described, namely, the safety feature of a multiplicity of switches and the simplicity of a unitary core construction for the transformer and electromagnet, as well as certain additional features hereinafter described. In this construction, the core, designated 61 is positioned horizontally, while the armature 18 for the electromagnet is arranged in a vertical position at one end of the core. This armature is also yieldably and resiliently mounted on a plate spring 20, the spring being secured at its lower end to a downwardly extending bracket 16 secured to the core, the spring being secured at its upper end to the lower end of the armature.

The core is made up of a plurality of laminations 61a, which are all preferably double U shape, or which may be also referred to as E shaped laminations, as shown in Fig. 15. Some of these laminations are positioned in reverse order with respect to each other, with the legs 61b in engagement in overlapped relation, forming the portions 61c and 61d of the core, as shown best in Figs. 12 and 14. Between the portions 61c and 61d of the core, which are known as the transformer portions of the core, is positioned an electromagnetic portion 61e, and at the outer side of the portion 61d is positioned another electromagnetic portion 61f. These electromagnetic portions 61e and 61f are formed by placing all of the laminations, at these portions, with their open ends toward the armature end of the core, forming open spaces at the armature end of the core, as shown in Fig. 12. All of the laminations are secured together in any suitable manner, such as by rivets 62. Around the central legs of all of the laminations is positioned the primary and secondary winding 63 of the transformer.

With this core construction, there is provided a closed core for an efficient transformer, but one which provides or permits sufficient leakage of the magnetic flux at the armature end of the core to attract the armature 18, and a second armature 64, hereinafter described. The two portions 61c and 61d of the core provide a closed magnetic field of sufficient area that the efficiency of the transformer is not decreased to any appreciable extent. The opening at the armature end of the core, in the portions 61e and 61f of the core, however, increase the reluctance of the magnetic circuit of the transformer sufficiently to cause sufficient magnetic flux leakage to link the armatures so that they are drawn toward the core. Thus a unitary substantially continuous but partially interrupted core is provided for performing the multiple functions hereinbefore mentioned.

To the extended end of the armature 18 is secured a reduced arm 65 which forms an extension of the oscillating arm of which the armature is a part. To the extended end of the arm 65 is secured an arm 66 of greater resiliency than the arm 65 and forming a still greater extension of the oscillating arm. At the extended end of the member 66 is mounted a weight 67.

To the member 65, at the inner side thereof, that is, at the side adjacent the transformer, are secured very resilient arms 68 and 69 which extend over the transformer, the latter being positioned above and being shorter than the former so that its amplitude and period of oscillation by its reactions will be the lesser. On the extended ends of these arms 68 and 69 are mounted mercury tube switches 31 and 32, respectively, as heretofore described. These switches are also connected in series and are normally so inclined that the circuit is closed when the armature is in its receded position, as shown in Fig. 11.

With this arrangement of switches the globules of mercury will be forced against the contacts at the instant the coil is energized, but the globules of mercury will be thrown away from the contacts with greater intensity at substantially the instant the armature 18 engages the core, or when the limit of its attracted position

is reached. The switches 31 and 32 will then oscillate for a limited period by reason of the resiliency of the arms 68 and 69, causing the globules of mercury to remain at the outer ends of the tubes during such oscillation. The oscillations of the arms 68 and 69 are of course vibratory, the period of which is inherent in the arms themselves, and not affected by the movement of the armature, except that the latter initiates each series of vibratory oscillations of the arms that occur. The sudden impact upon the armature due to the attraction and release is somewhat dampened by the weight 67. This weight 67 also causes a slight oscillation of the arm 65 which in turn increases the oscillation of the arms 68 and 69 and will tend to insure clearance of the contacts by the mercury by vibration of the tubes. The arm 66 and weight 67 are not essential, however, and may be omitted if desired. At the armature end of the core there is provided a bracket 71 which extends beside the armature and in which is mounted an adjusting screw 72 for limiting the outward position of the armature 18 and for varying the extent of the oscillation.

The armature 64 is provided with an offset upwardly extending arm 64*a* which is pivotally mounted at the end adjacent the armature upon a bearing or bracket 71*a* which may be formed as an extension of the bracket 71. At the end of the arm 64*a*, opposite the armature 64, is an integral second arm 64*b* which is projected inward beside the upper leg of the core and is normally inclined downwardly toward its extremity when the coil 63 is deenergized. Upon the arm 64*b* is mounted a third mercury tube switch 76 connected in series with the switches 31 and 32, and in which the contacts are disposed toward the extremity of the arm 64—*b*, so as to be closed when the coil 63 is deenergized. When the coil 63 is energized, the tube switch 76 is moved oppositely to the arms 68—69, being thrown to the dotted line position shown in Figure 11, in which position it is oppositely inclined to the horizontal plane and causes the globule of mercury to be disengaged from the contacts by the action of gravity as well as by momentum of the mercury. It is obvious that the breaks of the contact in the switch 76 is considerably slower than in the switches 31 and 32 and will therefore generally attend to cause directly the initial break in the circuit only when the switches 31 and 32 fail temporarily to break the circuit. If the switches 31 and 32 should fail, the coil 63 remains energized for a sufficient time to operate the switch 76. This armature 64 and switch are returned to initial position by gravity due to the predominating weight of the arm 64—*b*, tube and mercury.

There are two peculiar functional effects involved in the use of the extremely flexible mountings 68—69 of the mercury tubes. One lies in the fact that, when the magnet is energized and the mercury is thrown to the far end of the tube from the contacts, this changes the center of gravity of the tube to such extent that, while the mercury is piled or banked in the end of the tube, and when the armature is returned to initial position, instead of the tube returning at once to initial inclined position the location of the mercury so far outward causes the inclination of the tube to be changed from normal so much that the mercury does not tend at once to return by gravity to contact position. This is possible owing to the degree of flexibility required for the oscillation first mentioned.

The other peculiar effect consists in the action whereby when the magnet is energized, the movement of the tube mounting and of its mercury content causes an oscillation of the tube by flexure of the spring 68 or 69 at a frequency shorter than the period of normal readjustment of the mercury to normal form, and sufficient to develop such centrifugal force in the mercury on each such oscillation over a short time, that the mercury is held at the end of the tube until the diminishing arc of oscillations permits its return to normal form by its surface tension. This resumption of normal form, with the diminished variation of the tube from the normal angle on the diminishing oscillations, permits the beginning of return of the mercury to contact position. Owing to the flexure of the spring arms the oscillation arc of the tubes has a center beyond the middle of the arms, or in other words, on a short radius so that the centrifugal effect is quite pronounced.

In a primary coil such as utilized here to induce a high tension current in the secondary to illuminate a neon tube with high efficiency, an appreciable period of time is involved in securing the building up of the lines of force around the primary (called here "loading") to the maximum, and a simple oscillation device such as a vibrator spring, or immediately responsive armature switch, is not adapted to form the closed primary circuit for a sufficient period to secure an effective result. My invention overcomes this deficiency by reason of the fact that closing of the primary circuit in which the tubes 31 and 32 are included as shown in Figure 11 causes projection of the tubes longitudinally in the direction opposite the electrodes or contacts. The inertia of the mercury causes it to bank and press into the impacting end of the tube so as to secure not only high efficiency in contact, but retaining the contact throughout the movement of the armature toward the magnet, delaying the opening or breaking of the circuit for a sufficient period to build up a maximum loading effect in the primary coil. It results in the highest possible potential in the induced current being attained. On the other hand, the period during which it is necessary to hold the circuit closed for full loading is still very brief, and a simple tilting mercury tube contact will close the circuit for an unnecessarily long period, while my device opens the circuit so quickly after closure that wasted energy in maintaining the primary closed circuit after the necessary loading period is minimized. The period of closure may be made proportionate to the loading period without materially varying the period of intermission by adjusting the initial position of the armature. The period of intermission may be regulated by adjusting the whole device so that the initial inclination of the tubes is varied, and by using longer or shorter tubes, or increasing the flexibility of the arms 68—69 to secure a longer period of oscillation producing centrifugal force.

While the drawings show the supports 68 and 69 of substantial thickness this is due to the drafting requirements for reproduction of the views, and in fact in practice before the filing of my application these supports were made only a small fraction of the thickness illustrated.

In regard to the operation of the armature without detracting from the discharge efficiency, it may be pointed out that operation of the arma-

ture occurs at a time when the discharge current is not being produced, that it is operated by a part of the field that would be without advantage otherwise, and that at the instant when the primary circuit is broken to produce the discharge in the secondary circuit, the armature is at its inner position where it serves as a closure of the core in effect, reducing losses.

In the action of the armature, while the initial movement may cause a momentary invert inclination of the tube from normal, such opposite inclination is not very largely effective in securing the projection of the mercury from the contacts toward the closed end of the tube, and is in fact not necessary for the movement of the mercury to open or interrupting position. It is incidental only to the particular means disclosed for producing the longitudinal movement, although quite useful in initiating the vibratory oscillation of the arms 68 and 69. Other means may, however, be used for moving the mercury and inducing oscillation of the tube. The oscillations do not require to be in a vertical plane.

Though I have shown and described a particular construction, combination and arrangement of parts and portions of my invention, and certain modifications thereof, I do not wish to be limited to this particular construction, combination and arrangement, nor to the modifications, but desire to include in the scope of my invention the construction, combination and arrangement substantially as set forth in the appended claims.

Having thus described my invention, what I claim as new and desire to secure by Letters Patent is:

1. In a device of the class described, an electromagnet, a resilient thermostatic member, means operated by energization of said electromagnet for oscillating said member, a switch means mounted on said resilient thermostatic member and provided with contacts separable by said oscillation, and by gravity, an electrical heating unit for said thermostatic member, said heating unit being adapted when energized to heat said thermostat for tilting said switch means and causing gravitational separation of said contacts.

2. In combination, a core, primary and secondary windings therein, a movable armature mounted to respond to magnetic energy in the field adjacent said core, means to retract the armature, a gaseous discharge tube, a secondary circuit including said secondary winding and said tube, a circuit interrupter, a primary circuit including a source of electrical energy, said primary, and said interrupter, means to actuate said circuit interrupter to suddenly open said primary circuit as a result of movement of said armature including means to delay the said opening of the primary circuit proportionately to the loading period of the primary winding.

3. In combination, an electromagnetic device having a primary winding, a movable armature mounted to respond to magnetic energy in the field adjacent said device, means to retract the armature, a source of electrical energy, a switch operatively connected to said armature comprising a closed tube slightly inclined normally having spaced contacts at the low end and a mercury globule therein movable bodily longitudinally of the tube a considerable distance and tending to gravitate to and bridge the contacts, a resilient mounting for the tube consisting of a highly flexible spring fixed at one end on the armature for translation therewith and connected to the tube to support the tube for individual oscillation, the major arc of the tube movement when so oscillated being at the end of the tube opposite the contacts, a primary circuit including said source, said primary winding and said contacts and being open at said contacts for closure by the mercury, and means to positively stop the armature at respective limits of its movement.

4. The structure of claim 3 in which the high end of the tube is in the direction of initial translation of the tube, whereby the mercury is caused by its inertia during such movement to bank in the end of the tube against the contacts, and when the armature is stopped be precipitated longitudinally in the tube by momentum acquired during such initial movement, said tube being also caused thereby to oscillate for a substantial period to delay return of the mercury to the contacts.

5. In a device of the character described an electromagnetic device, a movable armature operatively mounted in responsive relation thereto, means to retract the armature, means to positively stop the armature at respective limits of its movement, a resilient arm connected to the armature and adapted to be moved thereby, said arm being mounted for individual vibratory oscillation, and a switch means comprising an elongated receptacle mounted on the arm at a slight normal initial inclination with its high end constantly in the direction of magnetic actuation, spaced contacts extending into the low end of the receptacle and insulated from each other therein, and mercury in the receptacle adapted normally to gravitate to the low end of the receptacle for electrically connecting the contacts.

6. In a device of the character described, an electromagnetic device, a movable armature operatively mounted in responsive relation thereto, means to retract the armature, a resilient arm connected to the armature and adapted to be moved thereby to initiate vibration of the arm, said arm being mounted for individual vibratory oscillation, a switch means comprising an elongated receptacle mounted on said arm at a normal substantially constant mean inclination with its high end toward the major arc included within the path of vibration of the arm by reaction to initial stress, spaced contacts located at the normal lower part of the receptacle therewithin and a globule of mercury in the receptacle of a size to be moved therein a substantial distance with slight distortion, adapted to electrically connect the contacts when at the low end of the receptacle and an electrical source in series circuit with the electromagnetic device and the contacts of the switch, whereby closure of the circuit by said globule will operate the armature once and the resulting oscillation of said arm will hold the globule separated from the contacts for a time.

7. In a device of the character described, an electromagnetic device, a movable armature operatively mounted in responsive relation thereto, yielding means to positively retract the armature, means to positively stop the armature at respective limits of its movement, a resilient arm connected to the armature and adapted to be moved thereby, a switch means comprising an elongated receptacle mounted on said arm at a slight mean inclination spaced contacts at the low end, a globule of mercury therein, adapted to bridge the contacts at times, said receptacle extending in such direction that movement of the arm by

the armature will produce motion of the receptacle having a component transverse to the receptacle, whereby when the armature is stopped after magnetic response vibratory oscillation of the switch will be initiated, said switch and arm being mounted for individual vibratory oscillation of the switch at a period inherent in the arm and switch assembly, means being included to intermittently energize said electromagnetic device.

8. A timing device comprising an elongated tube, a globular element therein movable longitudinally of the tube, a resilient movably mounted support connected with the tube to hold the tube normally with the globular element at one end of the tube, said support being exceedingly flexible whereby to permit and sustain diminishingly oscillation of the tube, means tending to hold the support at initial position, means to move the support by translation suddenly in the direction of the major axis of the tube and means to stop the movement abruptly at a predetermined limit whereby to precipitate the globule element longitudinally in the tube from initial position, means being included to initiate oscillation of the tube relatively to the mounting of said support.

9. In a device of the class described, an electromagnetic device including a movable armature to be actuated thereby movable substantially in a horizontal direction, an exceedingly resilient member, means tending to retract said armature, means connecting one end of said member to said armature for translation therewith substantially in the direction of the major axis of said member, a switch means comprising a closed elongated receptacle having contacts at one end and longitudinally movable means therein adapted to close said contacts, said receptacle being mounted on said member so that the receptacle assumes an inclined position when said armature is in retracted position with the lower end of said receptacle toward the end of the said member that is fastened to said armature, and the higher end of said receptacle away from the fastened end of said member.

10. In a device of the class described, an electromagnetic device including a movable armature to be actuated thereby movable substantially in a horizontal direction, yielding means to retract the armature, a resilient vibratory member connected to the armature for translation thereby substantially in the direction of the major axis of said member, a switch means mounted on said member comprising an elongated inclined receptacle its major axis substantially coincident with the direction of translation, its low end in the direction of retraction, contacts at the lower part of the receptacle, separable by oscillation and including a globule, means being included to individually oscillate said switch means, said resilient member being adapted to react to inertia of the switch means when oscillated whereby to sustain vibratory oscillation of the switch transverse to the major axis of the receptacle for a substantial period.

11. The structure of claim 10 in which said armature is pivotally supported at its lower part to oscillate in a vertical plane with a substantial element of horizontal movement, and said resilient element is extended therefrom at a tangent thereto in the direction of movement of the armature in magnetic actuation, the high end of the tube being also in the same direction.

12. In a device of the class described, an electromagnetic device, a movable armature operatively associated therewith, an exceedingly flexible resilient arm connected to the armature and adapted to be moved thereby, and a switch means comprising an elongated receptacle mounted on the arm at an inclination normally, its longitudinal axis in a plane coincident with the path of the armature, its high end in the direction of its movement under magnetic response, spaced contacts extending into the low end of the receptacle and a body of mercury in the tube, the normal inclination of the tube and the size of the mercury body being proportioned to the action of the armature and the position of said arm being coordinated with the tube axis whereby on magnetic response the mercury will be precipitated a substantial distance longitudinally and said arm be caused to oscillate for a substantial period.

13. A timing device comprising a closed tube, a globular element of mercury therein movable longitudinally of the tube, a resilient support capable of oscillation, means for mounting said support by fastening said support at one end of its effective length for oscillation, means for mounting said tube on said support to hold the tube normally with the globular element at one end of the tube, means to translate said support and tube in a direction other than perpendicular to the effective length of said support and then stop, said support being exceedingly flexible whereby to permit oscillation transverse to the general direction of the effective length of said support.

14. In a device of the character described, a timing device for an interrupter or the like comprising an extremely resilient vibratory support, a receptacle mounted thereon to oscillate at an inherent period of the support by vibratory reaction of the support to initial strain, means to initiate oscillation of the support, said receptacle having a normal initial position with surfaces inclined upwardly from its low part, mercury in the receptacle tending to gravitate to the low part, and means to move the support intermittently to initiate movement of the receptacle in a direction to cause the mercury to move a substantial distance along said inclined surfaces from said initial position.

15. The structure of claim 14 in which the direction of movement and action of said means to move the support is such as to cause an oscillation of the receptacle transverse of the direction of normal direct gravitation of the mercury toward said initial position.

16. In a device of the character described, an electro-magnetic device having a movable armature positioned to be actuated thereby, a resilient member secured to said armature in position to vibrate on the armature as a base at all times free and clear at its outer part to oscillate by inherent reflexive quality with a major component of movement transverse to the mean direction of movement of the armature, a switch means mounted on the extremity of the resilient member and having separable contacts one of which includes a free weight to move the contact and being movable from closed position in a direction longitudinally outward from the resilient member and transverse to the path of oscillation of the resilient member on its own base and adapted to be held in open position by centrifugal force incident to oscillation of the resilient member, means to energize the electro-magnetic device, and means to mount the armature for movement with a substantial component coinciding with the

direction of oscillation of the said resilient member.

17. In a device of the character described, a transformer having a core of continuous form but having a partially interrupted part, an armature in magnetically responsive relation to the core adjacent said partially interrupted part whereby a moderate actuation of the armature is produced, means for mounting said armature for movement with a major horizontal component of movement, a mercury tube switch having a receptacle with contacts in one end thereof and a globule of mercury to bridge the contacts by gravity, means for mounting said switch on said armature with the receptacle in an inclined position and in a relation to maintain a mean inclination in one direction with the contacts at the lower part of the tube, said receptacle being operatively connected with the armature with its high part in the direction of magnetic response of the armature for translation substantially in a direction from the low toward the high part, whereby to project the mercury along the receptacle a distance without disruption of the globule, and return of the mercury by gravity, the mounting of the receptacle including a resilient member connected with the receptacle in supporting relation to react to inertia of the receptacle and content when the armature is actuated and oscillate the receptacle in a direction transverse to the direction of the path of gravitation of the mercury.

18. In a device of the class described, a support, switch means comprising an elongated receptacle mounted on the support at a slight normal and substantially constant mean inclination spaced contacts extending into the low end of the receptacle, a globule of mercury having substantial movement as a globule longitudinally of the receptacle and adapted to normally gravitate to the low end of the receptacle to bridge said contacts, means for periodically moving the support suddenly by translation in a direction from the low end toward the high end of the receptacle whereby to impart momentum to the mercury acting in said direction, means to suddenly stop the said movement of the support, means to retract the support, after said stoppage and before dissipation of said momentum, said support comprising a resilient member of extreme flexibility adapted to yield to displacement of the mercury toward the high end of the receptacle to vary the inclination of the switch by gravity and to delay return of the mercury to its contact-bridging position.

19. The structure of claim 18, in which the strength and flexibility of said support is such that under operation, the receptacle is caused by displacement of the mercury and movement of the support and switch to oscillate for a comparatively long period through a substantial arc, so as to develop in the mercury centrifugal force acting away from the contacts.

ROBERT R. GONSETT.