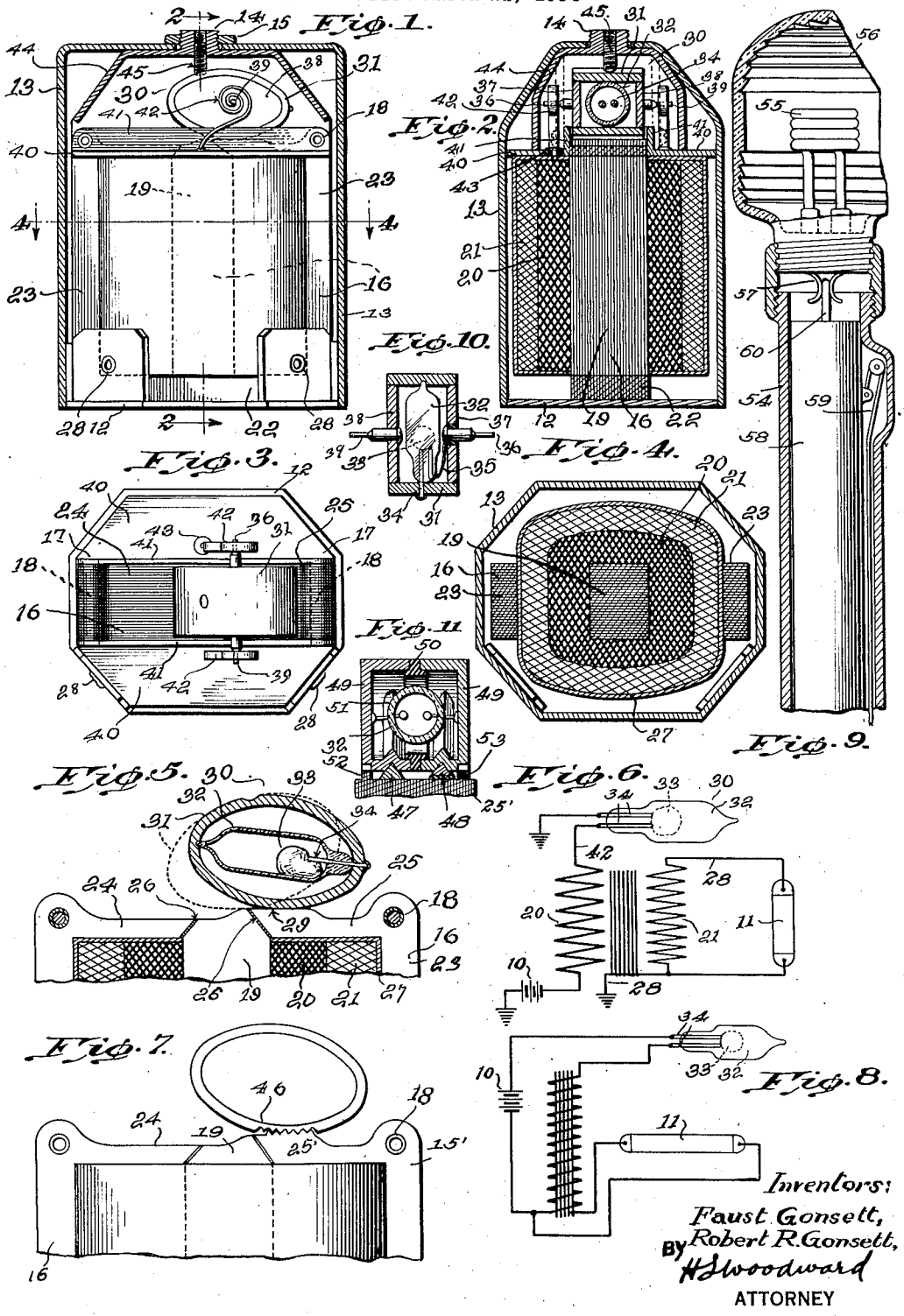
June 1, 1937. F. GONSETT ET AL 2,082,572

DISCHARGE TUBE FLASHER

Filed March 21, 1934



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Patented June 1, 1937 2,082,572

UNITED STATES PATENT OFFICE

2,082,572

DISCHARGE TUBE FLASHER

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Application March 21, 1934, Serial No. 716,718

17 Claims. (Cl. 177—329)

The invention relates to means for producing light by electrical discharge through a gaseous medium utilizing low potential direct current as the source of power, and has for an object to effect improvement enabling the use of exceedingly low voltages in the energizing current required as compared to prior practices.

It is also a purpose to evolve a novel construction in the means for utilizing and converting the low voltage direct current into a high potential one and producing the necessary light. A particular object is to present a novel form of converter of a peculiarly sensitive nature adapted to operate with an exceedingly small expenditure of power and with a minimum liability of wear in the moving elements, as well as with a minimum liability of pitting or deterioration of the contacts.

A particular object of the invention is to minimize the number of members required to produce an apparatus for converting low voltage direct current into a high potential intermittent one. It is especially an aim to enable the use of a mercury tube switch with the peculiar effect necessary in order to utilize the low voltage current in producing high potential discharge through a gaseous medium such as neon, argon, and other gases.

It is a particular aim to produce a device as last named which will be especially fitted for producing impulses at a sufficiently rapid frequency, yet distinct from the period involved in interrupters and also adapted to be more rapid than in mercury switches as heretofore developed.

A further object is to embody such a device in an extremely compact and effective form adapted for use in isolated situations to actuate neon, argon, and other gaseous discharge light devices.

Additional objects, advantages and features of invention reside in the construction, arrangement and combination of parts, as well as the ideas of coordination of the elements to novel ends, as will be understood from the following description and accompanying drawing, wherein

Figure 1 is an elevation of a converter unit constructed in accordance with my invention, the case parts in section.

Figure 2 is a vertical cross section thereof on the line 2—2 of Figure 1.

Figure 3 is a top view of the unit with the case parts removed.

Figure 4 is a horizontal cross section on the line 4—4 of Figure 1.

Figure 5 is an enlarged vertical sectional view of the upper part only of the transformer and operative element in the major plane of the unit.

Figure 6 is a diagram of the circuits of the unit in one form and the manner of its utilization, in the system.

Figure 7 is a diagram of a modified form of the unit and system.

Figure 8 is a sectional view of a market or signal unit adapted for erection in various situations and utilizing my system in a specific novel way.

Fig. 9 shows a practical structure utilizing my invention.

Fig. 10 is a horizontal section of the armature showing the mercury switch.

Fig. 11 is a vertical section through the armature and its support at right angles to the direction of movement of the armature.

There is illustrated a light producing system in which a direct current source 10 is utilized, the current from which is converted into a high potential one capable of the use in energizing the lamp or light element 11, which may be a gaseous discharge device such as a neon tube or a container of other suitable gas, or may be an incandescent filament lamp of a suitable kind.

The specific apparatus of the system may be embodied in various forms within the scope of the invention, but the preferred embodiment is shown in the present instance. The source of power for the system may be a direct current of a three-quarter of a volt potential, or a single dry cell of the standard No. 6 size, or a small pocket size cell, commonly known as a "peanut" cell having more than the required energy. A single cell battery of ¾ volt has been found adequate to operate my device and energize a ten-foot neon tube of the ordinary manufacture commonly known in the trade, and a No. 6 cell will operate such a tube continuously for a period of twenty-five to thirty days or more in the manner hereinafter set forth, using the equipment herein described.

The equipment as herein shown is an embodiment suitable for commercial production which has been actually constructed and operated over long periods, and is shown full size in Figures 1 to 4.

A base plate 12 is shown, around which there is snugly fitted the lower open end of a bell-like case 13, both being octagonal in plan. The top of the case 10 includes a limited horizontal part having a central aperture therethrough receiving an exteriorly threaded stud 14 upon which a nut

15 is screwed by which the case is clamped in position on the base, as will be explained.

A laminated transformer core-frame 16 is set up on the plane 12 and secured thereto by ears 17 turned up integrally on the plate 12 and receiving screws therethrough engaged in the hollow rivets 18 by which the laminations of the frame 16 are held together at the four corners. The frame blanks constitute an adaptation of the "E" type of core, the central arm 19 comprising the core proper of the transformer having a primary winding 20 thereabout, while outwardly of and around this in turn there is a secondary winding 21. The back member 22 of the frame is set at the bottom on the plate 10 with the core arm 19 extending vertically, and the outer arms 23 lying close beside the secondary winding. All three arms of the frame extend above the windings, the core 19 having bevelled sides at its projecting part on two sides only, short inwardly extending top arms 24—25 being projected from the upper ends of the arms 23 respectively and having ends lying in close parallelism with the bevelled faces of the core 19, being separated therefrom in the blanking by shearing, so that no material is removed. They are thus in close abutment with the bevelled parts of the core 19. The extensions 24—25 are held from contact with the core 19 by an extremely thin sheet of insulating material 26, which would be much thinner than shown in Figure 5, ordinarily, and is set in place by springing apart the arms 24 and 25 sufficiently to admit the sheet.

The windings may be enclosed by a jacket 27 of sheet insulation and other insulating and enclosing practices followed as discretion dictates. The base plate has two insulated terminals 28 to which leads from the battery and to the light unit may be led in any usual manner, or other connections made. In some cases the field may be reduced by forming the gaps at 26 in only a few of the laminations, the arms 24—25 of the others being integral with the core 19 and the breaks necessary for assembly being formed elsewhere.

The top arm 24 at the left in Figures 1, 3 and 5 is of a simple rectilinear form, somewhat thinner than the side arms 23. The top arm 25 is of similar thickness near its base, or junction with the arm 23, but at its extremity next the core arm 19 is thickened vertically so that a substantially horizontal raised surface or support 29 is formed extending over the end portion of the arm a suitable distance for the purposes hereinafter described. The adjacent end portion of the core arm 19 at one side only is also raised to a level with the surface 29, from which it is curved downwardly and extended diagonally to the level of the top face of the arm 24 near the middle of the core arm 19 from which point the end face of the fore arm 19 is continued on a level with the top of the arm 24. The elevated surface of the core 19 is quite limited as shown, but the manner of forming this elevated portion and its extent on both the arm 25 and the core 19 may be varied without departing from the invention. In Figure 7 it is represented with a serrated face, the ribs and grooves extending transversely of the arm 25. The recessed parts on the arms 25—25 may be omitted if desired, leaving the entire support surface horizontal.

On this elevated support 29 there is set rollingly a switch device 30 which broadly is a curved rocker including an armature, and in the present instance consists of a strip of magnetic metal of suitable permeability bent to form an enclosing case or armature 31, ovate in longitudinal section, in which there is set and properly fixed a mercury tube 32. There is a globule 33 of mercury therein and two electrodes 34 inserted through one end and sealed therein, the sealing tit of which is set in a suitable aperture or notch 31' in one end of the case, and the other end supported by any suitable means, which may include the soldering of the outer end of one of the electrodes 34, to the case 31. The other electrode 34 of the mercury switch has a wire 35 insulated from the armature and led outwardly to an insulated trunnion 36 on the case, mounted in a hard rubber or other insulating bushing 36' in a side plate 37 fitted in the side of the armature. At the other side of the armature a plate 38 and trunnion 39 are mounted without insulation. The globule of mercury 33 is adapted to readily coengage the electrode 34.

Two frame plates 40 of non-magnetic material are mounted immediately over the coils of the transformer beside the arms 24—25 of the frame 16, these plates being trimmed to fit loosely within the bell case 13 and having inner edge portions upturned beside the arms 24—25 forming flanges 41 secured to the transformer frame by the hollow rivets 18 at the upper corners of the frame 16. These flanges 41 project slightly above the arms 24—25 and where the support 29 is planiform serve as guides to retain the case 31 in place.

To the outer end of the trunnion 36 there is fixed the inner end of a scroll spring 42 the outer end of which is mounted in an insulating bushing 43 in the top frame plate 40 (at the right in Figure 2; at the top in Figure 3), and from this spring a suitable connection is made with a battery lead in accordance with the wiring diagram in Figure 6. A similar spring is connected similiarly to the trunnion 39 and fixed on the respective plate 40.

The inner cover 44 is mounted over the switch device 30, and it consists of a cap stamped from sheet metal open at its bottom and set flush on the plates 40 so as to enclose the springs 42 and case 31 with adequate clearance. The top of the cover has the threaded stud 14 mounted thereon, by which the case 13 is secured. The stud is axially bored and is interiorly threaded to receive a set screw 45, which may be screwed inwardly so as to project into engagement with the top of the switch case 31, the top of which is notched at 31' to receive the screw. By this the switch case is held against loose movement or displacement and injury by shocks in shipment and otherwise.

The case 31 may be made thick or thin as requirements dictate, the lighter weight being found to respond more quickly and produce shorter intervals in the interruption of the primary circuit, while heavier weight results in a longer interval. Parts of the material of the case 31 may be omitted to lighten it, especially the tip top part, as it does not require to be enclosed there. If desired, the top portion of the case may be omitted and only the lower curved part 46 retained as in Figure 7, wherein the lower face of the switch mount is also serrated to mesh with the serrations of the support 29'. This obviates liability of the switch device slipping out of proper relation to the transformer

core 19, longitudinally of the path of rocking movement of the armature. If desired, two rails 47—48 spaced a suitable distance apart may be utilized as the support for the rolling armature, and in such case the two sides of the armature may be identical stampings 49 of cup-like form held mouth to mouth by an interposed annulus of hard rubber or other insulating member 50 on which they may be frictionally or otherwise secured. They may each have trunnions coengaged by springs such as before mentioned, the latter being mounted as described. In this form of the armature, however, the two electrodes could be soldered to respective side elements or arranged to be pressed upon the respective pieces 48, and no insulated extension from either electrode would be required. The rails may engage in grooves on the lower part of the armature and racks may be provided as at 52 and 53, the armature being suitably toothed to mesh therewith, as may be understood. The tube 32 would be mounted on the central annulus 50 and the side pieces 49 could be readily removed manually.

One electrode of the mercury switch is grounded on the armature 31 as explained, and the other to the insulated spring 42 which is connected to one end of the primary coil 20. The other end of this coil is connected directly to one terminal of the battery, (the positive one, as shown). The opposite terminal of the battery is grounded. The neon or other gas tube 11 is suitably connected to the ends of the secondary of the transformer, and one end of this secondary may also be connected to the core 19 and grounded.

The springs 42 and center of gravity of the assembly in the armature are so arranged, constructed and adjusted that with the parts connected as described, the tube 32 will initially lie with its electrodes at the outer end of the armature,—that is, distant from the core 19, and the tube slightly inclined longitudinally of the armature and longitudinally of the path of movement of the armature with the end furthest from the electrodes slightly elevated. This will cause the mercury globule to gravitate to the electrodes gently and close the primary circuit to the source 10. The armature axis may be similarly inclined or not as operation requires. This will energize the primary coil, producing a magnetic field which will attract the armature end and draw it downward, rolling the armature and the tube 32 toward the arm 24 at the left in Figures 1, 3 and 5, until checked by the springs 42. This first movement of the armature produces a movement of translation of the tube 32 longitudinally in a direction from the electrodes toward the opposite end of the tube, and also a tilting of the tube to an inclination the reverse of that which it had initially—that is, it is inclined downwardly away from the electrodes. As a result, the mercury is caused first to bank or press against the electrodes and adjacent end of the tube, improving the contact, and then the mercury is precipitated or thrown ballistically toward the distant end of the tube breaking the primary circuit and permitting the springs 42 to begin return movement of the armature to initial position. This return movement is slightly retarded at first by reason of the mass of the mercury being at the extremity of the tube 32, and by the momentum of the mercury, and so the return of the armature is slower than its movement on response to the magnetic field.

The closing of the primary circuit begins a building up of the flux or magnetic field of the transformer by beginning the loading of the coil 20. This loading is not instantaneous, due to counterelectromotive forces, magnetic reluctance, hysteresis, and other causes, as will be understood in the art, and especially is it not immediately effective for the purposes of effective work as contemplated in my invention. However, by reason of the inertia of the mercury, and its banking action due to the peculiar movement of the tube, the continuation of the closing of the circuit is prolonged in proportion to the period required for such loading, so that when the ballistic movement of the mercury finally occurs, the coil will have become loaded to a maximum proportionate to the capacity of the electrical source. It should be noted that in the operation of this device when the armature is retracted by the springs 42, the momentum of the mercury globule moving to the circuit closing position, will momentarily retard response of the armature to the magnetic field, and contribute to the banking effect and loading action with respect to the primary coil. The resulting interruption of the circuit therefore occurs after a maximum field has been erected, so that adequate flux is produced to energize the secondary coil as the field returns to its zero condition. The resulting high potential current induced in the secondary coil is sufficient to produce an efficient generation of light by the discharge occurring across the tube 11.

Normally, the armature case 31 will not project materially below the top of the support 29 as the break of the primary circuit will occur early enough and the springs 42 will function to check the retraction of the armature before the end of the armature projects downward over the arm 24. Should the mercury stick at the electrodes, however, the attraction of the armature will continue until it is drawn beyond the elevated part of the support 29, and the extremity of the armature will extend downwardly, causing such an extreme inclination of the tube 32 that the mercury is certain to clear the electrodes. The striking of the end of the armature against the top of the arm 24 will also jar the mercury, and further insure its clearance from the electrodes.

In utilizing this invention it may be applied in many ways, but particularly in enabling the actuation of gaseous discharge lighting devices from small dry cells, for advertising, signalling, illumination, and otherwise. The particular design of armature may also be utilized in various situations apart from light producing systems.

As one illustration, an upstanding tubular support 54 may be utilized to carry a lamp 55 mounted in an enclosing globe 56 of familiar kind. One terminal of the lamp may be grounded on the support 54, while the other terminal of the lamp consists of a central socket 57 exposed within the support 54. A cell and transformer carrier 58 may be mounted slidably in the support 50 and arranged to be raised and lowered by a cable 58 operating within the support. The carrier may have a series of dry cells arranged therein end to end and connected in multiple with one of our transformer and converter units at the top of the carrier. One lead from the secondary would be grounded on the carrier, and the other would be extended

to a suitably insulated plug conductor 59 fixed on top of the carrier 54 and alined with the socket 57, so that by merely hoisting the carrier by cable, it would be moved into place and connected with the lamp, and removal for renewal of the battery could be effected by drawing the carrier downward.

We claim:—

1. In a device of the character described, an electromagnetic field device, a support in the field, said field having a dense area manifest over said support, an armature having a curved face rollingly set upon the support having an initial position in the outer part of the field and positioned to roll toward and from the dense area, a tube fixed thereon having its major axis coincident with the plane of rolling movement of the armature, spaced contacts in one end of the tube, and a globule of mercury in the tube.

2. In a light system of the character described, a source of direct current of low voltage, a transformer, a gaseous discharge device in series with the secondary winding of the transformer, said transformer having a dense magnetic field at one part, a support in said dense field, an armature device having a rounded lower face longitudinally rollingly set upon said support, eccentrically of the dense field, and having a magnetically responsive portion projected over the dense field while in initial retracted position, means to yieldingly hold the armature device in initial position retracted from said dense field, a switch comprising an elongated receptacle carried by the armature device alined with the path of rolling movement with the end of the armature over said field normally inclined outwardly and upwardly, two spaced contacts in the lower end, and a globule of mercury in the receptacle.

3. The structure of claim 2 in which the extent of the said support is sufficient to accommodate rocking movement of the armature device by reaction from maximum limits, and said contacts are located to be engaged by the mercury short of the said limit in one direction, whereby magnetic attraction will stop the retraction of the armature and produce a banking of the mercury against said contacts, for the purposes described.

4. A circuit maker and breaker comprising a magnetic element, a rest bearing in the field of the magnet, an armature device having a curved face rollingly set against the rest bearing, having its center of mass offset from the magnetic axis of the field, and a switch on the armature device including a relatively movable weight element operative to close the switch and open the same by reaction of its mass to rocking movements of the armature device.

5. An interrupter device comprising a magnet element, a rest bearing surface in the field of the magnet, an armature member having a curved bearing face set rollingly against the rest bearing face, and having an initial position with its center of mass eccentric to the field, a switch on the armature including a relatively movable weight operative to close and open the switch by reaction of its mass to rocking movements of the armature member, and a spring device having a fixed anchorage with respect to the rest bearing surface, and connected to the armature member to yieldingly limit movement of the same from initial position.

6. The structure of claim 5 in which the spring device consists of two volute springs located at respective sides of the armature, each having one end attached to the armature on the transverse medial axis of the armature, and the other end anchored in fixed relation to the magnet.

7. In a light producing system, a direct current source of exceedingly low voltage, a transformer including a primary and a secondary circuit, a gaseous discharge device in series with the secondary circuit, the transformer having an upstanding core and provided with a terminal rest bearing surface, an armature member having a curved face set rollingly upon the bearing surface with its center of mass initially offset from the axis of the core and a part projected thereover, a switch in the primary circuit on the armature member including a weighted element movable relatively to the armature by gravity under rolling movement of the armature constructed and operative to open the switch under response of the armature to the energy of the field, and to close the switch when the armature is in retracted position.

8. The structure of claim 7 in which a volute spring of extreme flexibility is mounted at each side of the armature having one end fixed in relation to the bearing face, and its inner end connected to the adjacent side of the armature.

9. The structure of claim 4 in which the armature member is formed with an increment of weight in addition to that of the switch and beyond the structural requirement of the armature and switch assembly, whereby under retractive movement, upon closing of the circuit, the inertia of the armature will oppose response of the armature to the field then set up proportionately to the loading period of the primary circuit.

10. The structure of claim 4 in which said rest bearing is formed with a part offset from that which initially engages the armature member whereby to clear the armature at the extremes of its movement.

11. A circuit maker and breaker comprising an electromagnet element, a rest bearing in the field thereof, an armature device having a curved face rollingly set upon the rest bearing face with its normal rest-contacting parts offset from the center of the field so as to roll in response to energization of the magnet and means responsive to the movement of the armature to open and close an electrical circuit.

12. The structure of claim 1 in which the armature device is formed with a lower face in the form of the side of an oblate ellipse.

13. The structure of claim 1 in which the support is formed with a substantially horizontal area upon which the armature rests initially, said support having downwardly recessed portions closely adjacent said horizontal area.

14. The structure of claim 1 in which the said armature is a holder including a substantial element of magnetic material and having said curved face at a lower side and transversely shaped to contact the support at more than one point transversely of the armature, and means being included to hold said tube against relative longitudinal movement thereon.

15. The structure of claim 1 in which the said armature is a holder including a substantial element of magnetic material and having said curved face at a lower side, and transversely shaped to contact said support at more than one point transversely of the armature, said tube being longitudinally arranged and secured on the holder with its axis closely adjacent a chord of the curved face that is spaced from

the central part of said curved face materially less than the length of the armature.

16. The structure of claim 1 in which the magnetic field device includes a core having outer ends and an axial inner end and a winding, said core having arms integral with the outer ends of the core extended toward and closely abutting said inner end in insulated relation, the extremity of said inner end of the core being bevelled on opposite sides whereby opposite faces are convergent toward the dense field, the said armature initially resting upon one outer end of the core with a part spaced over said inner end.

17. In a device of the character described, an electromagnet element, a rest bearing face in the field thereof, an armature device having a face superposed on said rest bearing with its normal rest-contacting part offset from the center of the field but with a part projecting over said center, at least one of said faces being convex for rocking movement of the armature device, said armature device including a receptacle, a conductive globule therein, and spaced contacts positioned to be engaged by the globule by gravity when the armature device is in normal position, and yielding means to hold the armature device in normal position.

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