

Sept. 2, 1941.

E. F. BALDWIN
HIGH VOLTAGE SWITCH

2,254,560

Filed Sept. 26, 1938

5 Sheets-Sheet 1

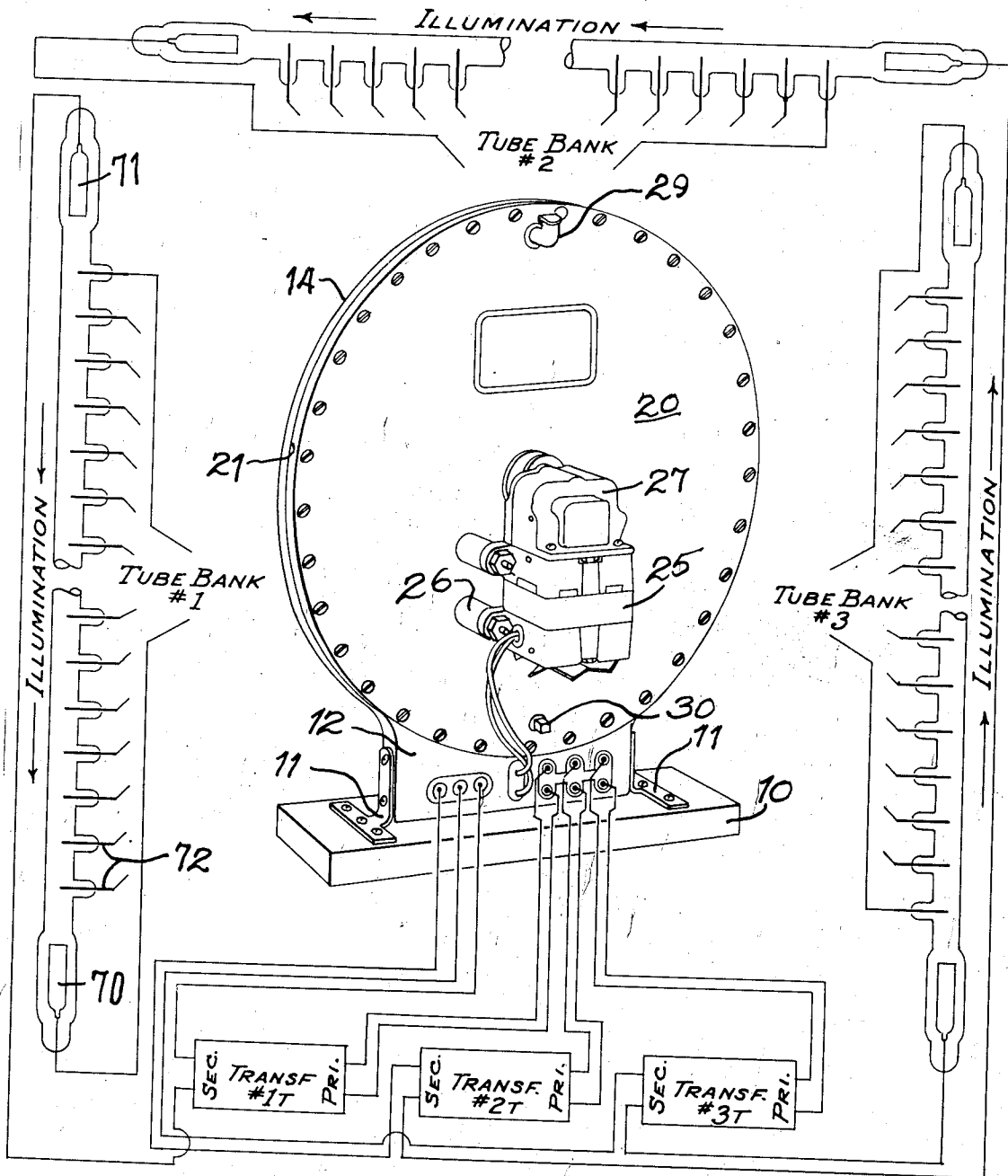


Fig. 1.

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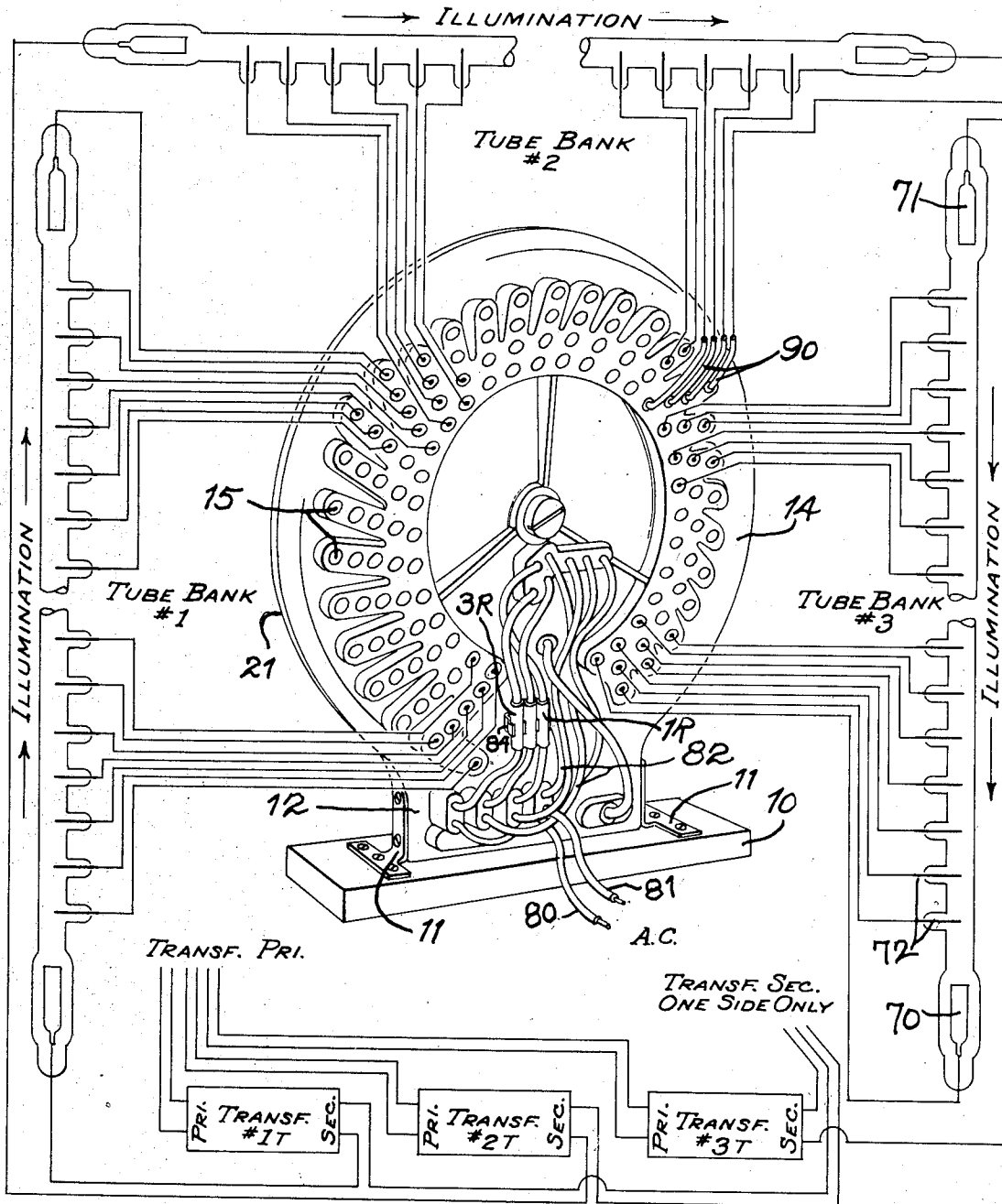


Fig. 2.

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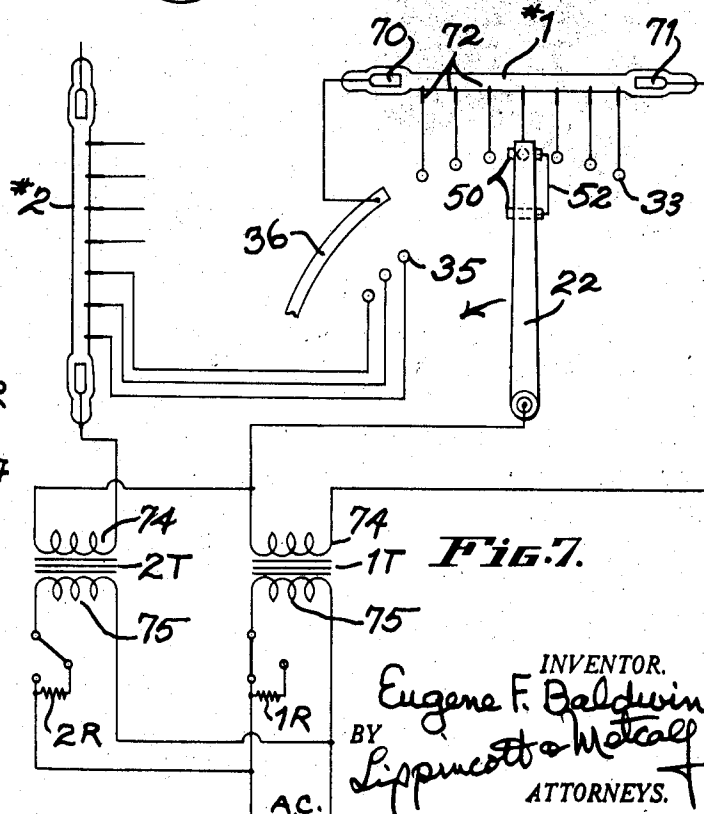
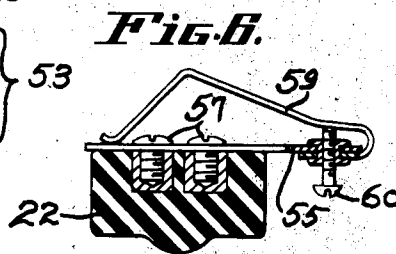
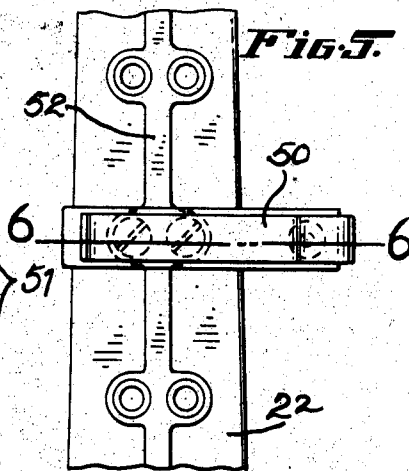
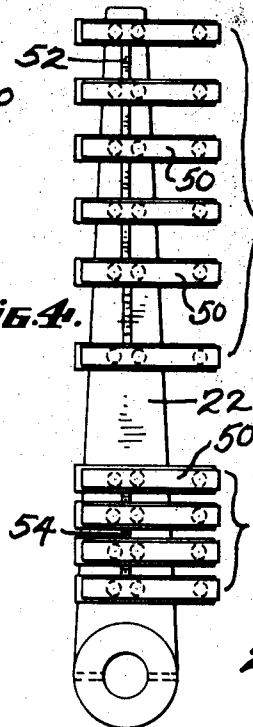
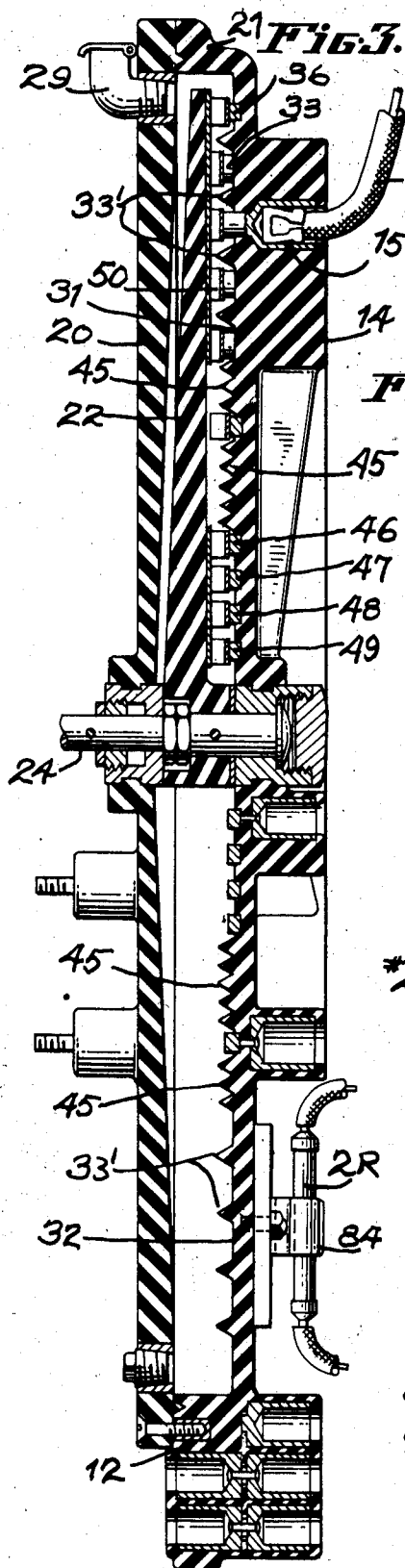
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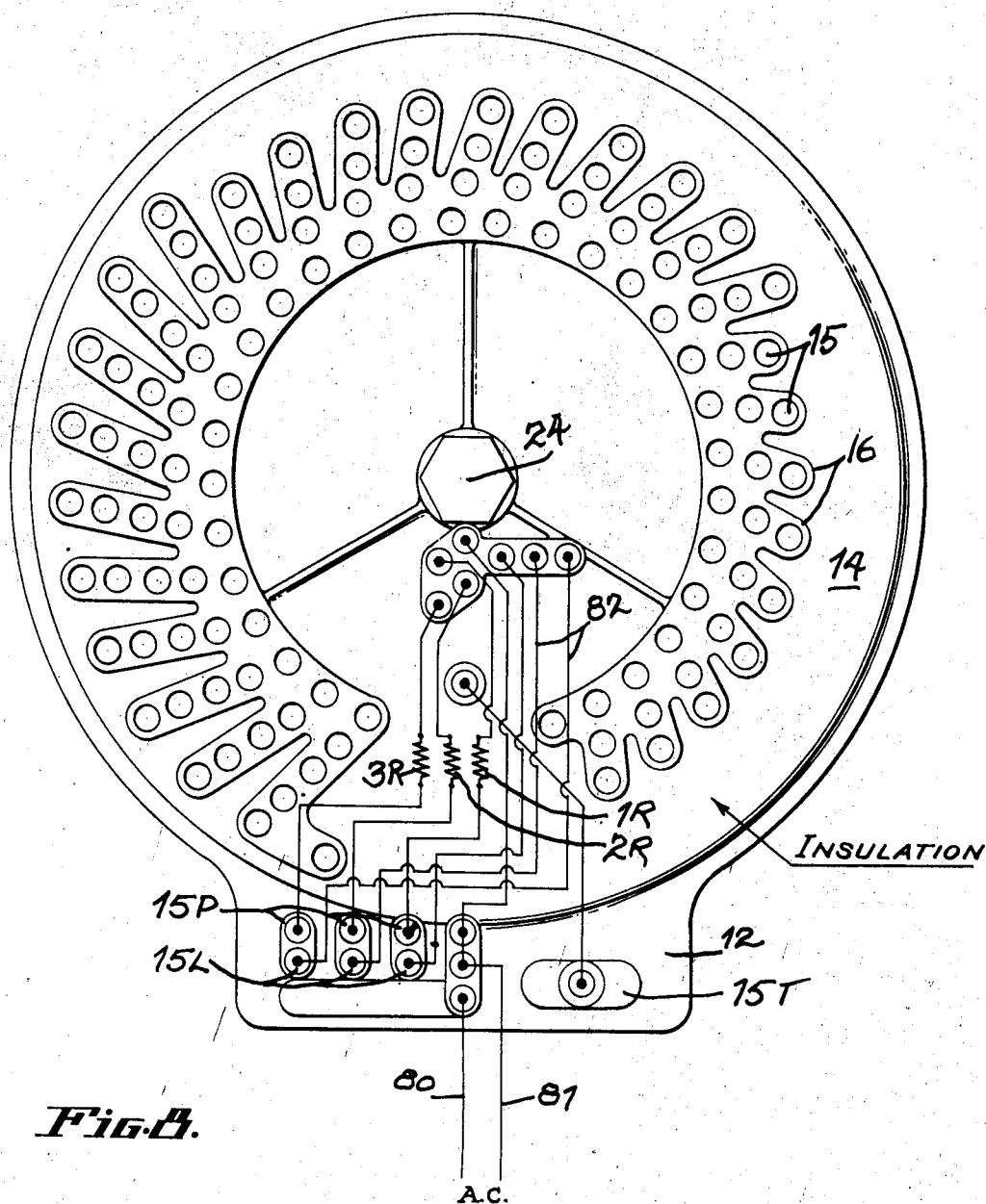
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5 Sheets-Sheet 5

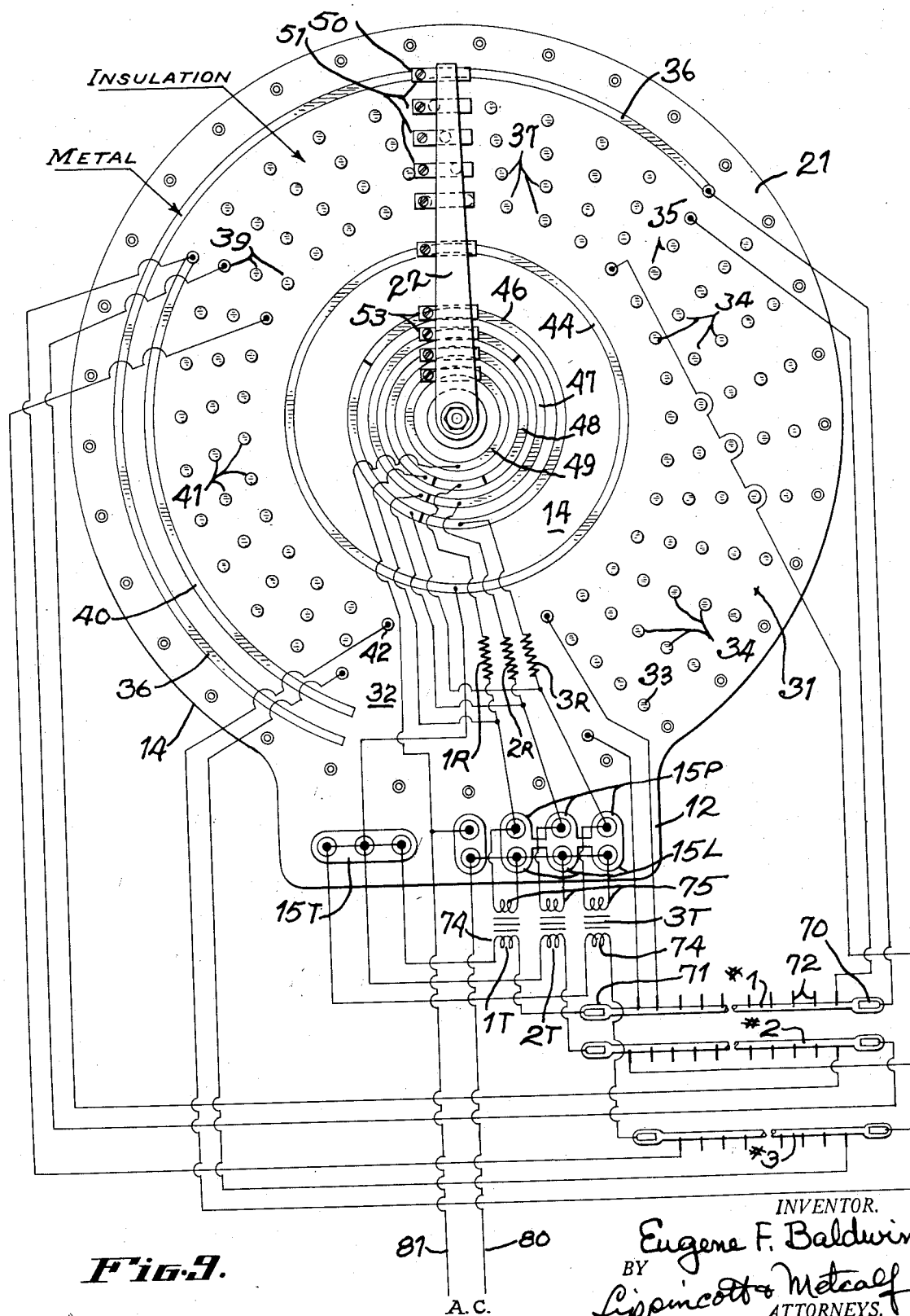


Fig. 9.

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UNITED STATES PATENT OFFICE

2,254,560

HIGH VOLTAGE SWITCH

Eugene F. Baldwin, San Francisco, Calif.

Application September 26, 1938, Serial No. 231,686

4 Claims. (Cl. 200—11)

My invention relates to high voltage switching systems, and more particularly to that type of system wherein a rotating switch commutates high voltage for the purpose of producing progressive illumination of electrical discharge tubes in signs or similar displays.

Among the objects of my invention are: To provide a high voltage switching system for the progressive illumination of electrical discharge tubes, such as used in what is known in the art as "neon" signs; to provide a high voltage switching system capable of progressively illuminating total lengths of luminous tubing beyond the maximum length capable of being energized by a single transformer; to provide a unitary enclosed high voltage switch; to provide a high voltage switching system, progressively picking up additional transformers as the length of tubing connected increases; to provide an automatic high voltage switching system which is positively stabilized and which gives substantially equal intensity of illumination at all steps along luminous tubing as the illumination advances; to provide a high voltage switching system for luminous tubes following standard underwriters code practice; and to provide a simple and safe high voltage switching system for luminous tubes.

Other objects of my invention will be apparent or will be specifically pointed out in the description forming a part of this specification, but I do not limit myself to the embodiment of the invention herein described, as various forms may be adopted within the scope of the claims.

This application is a continuation-in-part of my prior co-pending application entitled "High tension switch," Serial No. 132,287, filed March 22, 1937.

Broadly, my invention comprises a rotating switch progressively illuminating, step by step in predetermined units of length, multiple banks of luminous tubes, such as the tubes employing an electrical discharge in the monatomic gases, neon, argon, krypton, helium, mercury vapor, etc., in such a manner that progressive illumination of a sign formed from such tubing exists from the inception of the illumination or the beginning point of the sign, thence forward in an orderly sequence to a complete focal point of conclusion in a predetermined time. A dark period then is provided, following which the recreation of the sign copy is luminously enacted at a predetermined number of cycles per minute.

The present application describes a standardized switching system adapted to control progressive illumination up to approximately 210'

of 15 millimeter blue gaseous tubing, or the proportionate footage of other colors in conventional use, calculated according to standard code practice of millimeter sizes and gas resistance.

During one cycle of operation, the unit to be described provides for 119 advance movements of progressive illumination, i. e., 119 single letters in sequence, or, where straight-away borders or script lettering are used, 119 units of length, the rapidity of the progressive illumination being such as to denote continuous forward motion.

Referring to the drawings:

Fig. 1 is a perspective view of the back of a preferred form of switch casing, together with a schematic wiring diagram and representation of three tube banks.

Fig. 2 is a perspective view of the front of the casing showing certain jumper connections, a wiring diagram of the transformers, and certain connections to the three tube banks. In this view of the front of the casing the tubes have been rotated end for end to simplify the wiring diagram, and therefore the direction of progression of illumination has been reversed.

Fig. 3 is a longitudinal sectional view taken through the axis of the high voltage switch shaft.

Fig. 4 is a view in elevation of the switch arm.

Fig. 5 is a detailed view in elevation of a switch arm contact.

Fig. 6 is a cross sectional view, taken as indicated by the line 6—6 in Fig. 5.

Fig. 7 is a simplified wiring diagram showing the action of the switch.

Fig. 8 is a plan view of the front of the switch, with a wiring diagram superimposed thereon to show primary circuit connections.

Fig. 9 is a plan view of the contact face of the switch, showing the switch arm, individual contacts, slip rings, a complete wiring diagram to the slip rings, and a partial wiring diagram of the tube banks. In this view the insulating ridges have been omitted for clarity of illustration.

The drawings are substantially to scale.

For a better understanding of my switching system, a description will first be given of the high voltage switch, as shown in Figs. 1 and 2.

A foundation 10 is provided, having brackets 11 fastened thereto and supporting an extension block 12 molded integrally with a contact plate 14, the outside of which is shown in Fig. 2. On the outside of contact plate 14 are multiple receptacles 15 imbedded in raised ribs 16. Each receptacle 15 extends through contact plate 14

to form an electrical contact on the other side thereof, certain of these contacts being circular, certain of them being arcuate, and certain of them being complete rings, as will be described later.

A cover 20 is provided engaging the periphery 21 of the contact plate 14 to make a tight seal therewith, thus leaving an interior space in which a switch arm 22 may rotate, driven by central shaft 24 which in turn is rotated by motor 25 mounted on lugs 26 attached to cover 20, through a reduction gear 27. The cover is also provided with an external oil filling pipe 29 and a drain plug 30 at upper and lower levels, respectively. The switch arm will be described in detail later.

Referring now to Fig. 9 for the interior arrangement of contacts on the interior surface 31 of contact plate 14, it will be seen that the contact plate is provided with a completely blank segment 32 of approximately 40° of arc. At one side of this blank segment aligned rows of separate contact raised studs 33 begin. Studs in adjacent rows are circularly positioned and the circles are separated by insulating ridges 33' shown only in Fig. 3. In the embodiment described each row, at the beginning, comprises five separate contacts, each connected through to the back of the plate and terminating in a receptacle 15. The rows are not parallel or radial, but are aligned tangentially to a circle drawn around the axis of shaft 24. Similar rows continue around the plate until fifty-one contacts have been laid out, five in each of nine successive rows 34, and four in the tenth row 35. From this point on, the outer circle of contacts becomes a continuous arcuate contact 36, continuing in the same radial position until the opposite edge of blank segment 32 is reached. Ten rows 37 having four each of contact studs 33 are then provided, and the next row 39 has only three studs 33, the next to the outer contact circle then being continued as an arcuate contact 40 terminating at the same radius as arcuate contact 36. Nine rows 41 of three each contacts follow, and the end row on the terminating radius is then a single contact 42.

Immediately inside the rows of studs 33 is a complete slip ring 44 separated from the studs by ridges 45 shown in section in Fig. 3, but omitted from Fig. 9. Still further toward the center of the plate are three interrupted resistor rings 46, 47 and 48, numbering from outside inwardly, and a final complete inner ring 49. Rings 46 to 49 inclusive are separated from ring 44 by another series of ridges 45, also omitted from Fig. 9.

Switch arm 22 is of insulating material and carries two groups of identical brushes 50, the outer group 51 of six brushes being all connected together by secondary jumper 52 and positioned at proper radial distances to wipe studs 33, continuous contacts 36 and 40, and the complete slip ring 44. An inner group 53 of four brushes, joined by a primary jumper 54, is positioned to wipe rings 46 to 49 inclusive during rotation of the arm. The details of each brush 50 are shown in Figs. 5 and 6.

A single piece of metal 55 is fastened across the extent of arm 22 by screws 57. This metal is bent back upon itself to form a broad V 59, terminating on the other side of screws 57 in contact with itself. An adjustment screw 60 is provided to regulate the distance of the point of the V from the arm. Thus, each brush 50 may separately flex to accommodate any unevenness

in contact height. In practice, however, very little unevenness of this sort is encountered, because after all contact rings, segments and studs are in place, the entire switch plate is placed in a lathe and the metal portions faced off to a substantially uniform plane.

Having thus described the complete mechanism of the switch, I will now describe the wiring set-up as used for multiple tube banks with multiple transformers.

Fig. 7 shows a simplified wiring diagram, which will be described first in order to make the wiring diagram of the actual device easier to understand. In this simplified diagram only two tube banks are shown connected. First tube bank 1 is provided with the usual end electrodes 70 and 71 and intermediate electrodes 72 equally or variably spaced along the extent of the tube. One end electrode 71 is connected directly to the secondary 74 of transformer 1T, and one end electrode of tube bank 2 is connected to secondary 74 of transformer 2T. The first contact on the switch is connected to the first intermediate electrode 72, and so on until the end of the tube is reached, where the opposite end electrode 70 is connected to the first continuous contact 36. Arm 22, in this case, being shown as electrically conductive, is connected to both of the other sides of secondaries 74 of transformers 1T and 2T. Thus, as arm 22 rotates the outer brush 50 on arm 22 progressively wipes over the contacts 33 and progressively illuminates, step by step, tube bank 1. After the outer brush 50 has passed over all the contacts 33 it will thereafter ride on continuous contact 36 and tube 1 will remain illuminated. Continued movement of arm 22 will cause the next four brushes 50 to pick up the next inner circles of studs 35, these being connected to intermediate electrodes in tube bank 2 in order, until the end of that tube bank is reached, and so on for the number of tube banks provided until all contact ceases, whereupon all energization of the tubing will cease and the transformers 1T and 2T will be open-circuited on the secondaries thereof.

In order, therefore, to prevent the voltage rising on open circuit, I prefer to provide the primaries 75 of transformers 1T and 2T with series resistors 1R and 2R, and provide separate switching means so that when the transformers are energizing tubing the primary resistors for those transformers are out of circuit, but when the rotating arm passes off all contacts the resistors will be in the primary circuits, thus reducing the secondary voltage. In the schematic drawing shown in Fig. 7 this switching is not shown as being automatic. In the actual device, however, this switching is entirely automatic, as will be described later.

Referring directly to Fig. 9 for the actual wiring diagram, tube bank 1 has one end thereof connected to the secondary 74 of transformer 1T. Tube bank 2 similarly has one end thereof connected to the secondary 74 of transformer 2T. Tube bank 3 similarly has one end thereof connected to the secondary 74 of transformer 3T. The other ends of the secondaries of these three transformers are connected together within extension 12 at receptacles 15T, and a single connection is then made between the three receptacles 15T and complete slip ring 44, which has the inner brush of the outer group 51 bearing against it, this brush being connected to the remaining five brushes of the outer group. Thus, the common side of all the transformers is con-

connected to outer brush group 51 at all times. Contact studs 33 in rows 34 are then connected serially to intermediate electrodes 72 in tube bank 1, and the opposite end electrode 70 of tube bank 1 is then connected to outer continuous contact 36. Similarly, intermediate electrodes of tube bank 2 are serially connected to studs 33 in rows 37 until the continuous contact 40 is reached, which connects to the opposite end electrode of tube bank 2. The remaining studs 33 in rows 41 are then connected serially to intermediate contacts in tube bank 3, end contact 42 being connected to the end electrode of tube bank 3, this latter electrode being the last in the entire length of tubing. This comprises the complete secondary circuit.

The primary circuit is as follows: The primaries 75 of transformers 1T, 2T and 3T are connected together at one end in primary receptacles 15L on extension 12, and these connected receptacles are connected directly to one side 80 of the A. C. supply line. The other side 81 of the A. C. line goes to innermost annular slip ring 49. The remaining open ends of the three primaries are attached to receptacles 15P on extension 12 and thence divided, one branch passing through resistors 1R, 2R and 3R to resistor rings 46, 47 and 48 respectively. These resistor rings are divided into two segments, one of which may be termed a resistor segment and the other a shorting segment. 1R connects to the shortest resistor segment, 2R connects to a longer resistor segment, and 3R connects to a still longer resistor segment. The length of the resistor segments corresponds to the length of the arcuate extent of the three groups of contact rows 34, 37 and 41, and these resistor segments are also positioned in such a manner that the resistors are in circuit only during the times when the transformers are not being used. For example, during the passage of the arm over rows 34, transformers 2T and 3T are not being used. As soon as rows 37 are reached, transformer 3T is not being used, and when the blank area is reached none of the transformers is being used. The shorting segments, therefore, are connected directly to receptacles 15P so that when the inner bank of brushes 52 rotates over the resistor segments, the resistors are cut in and out in accordance with the position of the arm on the stud rows.

In order that the switching arrangement may be made flexible, the connections just described are made on the back of the contact plate 14 by patch cords 82, as shown in Fig. 2. Likewise, the connections to the tube banks are made with removable connectors 90, as shown in Figs. 2 and 3, so that they may be readily removed, changed, or the order of progression varied as desired. The resistors 1R, 2R and 3R are preferably connected in the appropriate patch cords 82, and mounted on the outside of the contact plate 14 in clips 84.

The switching system of my invention has many advantages. For example, all switching is done on the common side of the transformers, or as may be stated, at zero potential. Thus, there is never any difference of potential between high voltage switch brushes 50. The tangential arrangement of contacts causes a make potential equal only to the voltage drop in the length of tubing between intermediate electrodes, inasmuch as a number of the studs are in contact with group 51 at the same time. At the end of the illumination cycle when all the contacts are broken, all the resistors are thrown into the cir-

cuit so that arcing is greatly reduced. A light oil is preferably used to fill the switch cavity, thus still further reducing arcing and danger caused by open sparks. High voltage contacts have between them a long surface insulation due to the use of ridges on the inside of the plate and completely enclosed receptacles on the outside of the plate.

In practice, I prefer to rotate the switch arm to give seven cycles per minute, one cycle every $8\frac{1}{2}$ seconds, including a dark period of 1 second. It should also be noted that there is only one moving part, and that all electrical contact points, terminals and connections are either enclosed or are located below the surface level of the main insulating structure. Thus, when the usual high voltage cable is utilized no live conductor is exposed on the outside of the device.

It will be noticed that in the device shown that the first tube bank will handle fifty intermediate electrodes, the second tube bank thirty-nine intermediate electrodes, and the third tube bank twenty-seven intermediate electrodes. However, it is to be understood that the same footage may be handled in all banks by varying the spacing of the intermediate electrodes, or, if desired, the continuous contacts 36 and 40 may be positioned in two additional outer rings, thus giving each bank of studs the same number. I prefer, however, and have found it more practical, to reduce the number of studs in succeeding banks, because the preferred manner of making the switch contact plate is to mold it of insulating material in one piece, with all metallic portions inserted before molding. The arrangement shown utilizes all the space available, whereas if separate peripheral space were to be used for the continuous contacts, that peripheral space between the beginning and end of these continuous contacts would be wasted. Thus, with the arrangement shown I am actually able to obtain two outer partial rows of studs within the same circular diameter. If, however, it is desired that all tube banks have the same number of intermediate electrodes with the same spacing therebetween, then it will be obvious to anyone skilled in the art, when patching in the tube connections, to leave out connections to the two outer rows up to the beginning of both continuous contacts.

It will thus be seen that by the patching arrangement shown partially in Fig. 2, that I am able to obtain connections for almost any type of sign desired, and that the switch itself as a unit is adaptable for many sign and display designs without change thereof, except in the outer circuit arrangements, as determined by patching into the receptacles.

I claim:

1. A rotary switch comprising a contact plate of insulating material provided with a blank area over a predetermined angular outer segment thereof, a plurality of radially spaced circular rows of contacts concentrically arranged in said plate around a central point on said plate and occupying the remaining angular outer segment of said plate, at least one outer row having an initial portion of serially spaced contacts beginning at one side of said blank angular segment and a remaining continuous contact portion ending at the other side of said blank angular segment and at least one inner row having serially spaced contacts throughout, the serially spaced contacts in each circular row being regularly staggered from those in an adjacent row to pro-

vide non-radial alinement thereof, a circular continuous contact extending around said center point inside of said segments, an arm pivoted to said contact plate at said central point and rotatable over said contacts and said angular blank area in succession, and connected radially positioned brushes on said arm positioned to contact said serial contacts and said continuous contacts during rotation of said arm.

2. Apparatus in accordance with claim 1, wherein at least two outer rows are provided with continuous contacts and wherein said continuous contacts are of different length in said latter rows.

3. Apparatus in accordance with claim 1, wherein a circular ridge of insulating material is raised from said plate between each circular row of contacts and wherein a plurality of similar circular ridges are provided between said circular continuous contact and the inner rows of the remaining rows of contacts.

4. Apparatus in accordance with claim 1, wherein all of said contacts are extended through said plates and terminate in a hollow socket on the back of said plate.

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