Aug. 21, 1951 W. D. BUCKINGHAM ET AL 2,564,877

ELECTRIC SWITCH

Filed June 29, 1948

FIG. 1

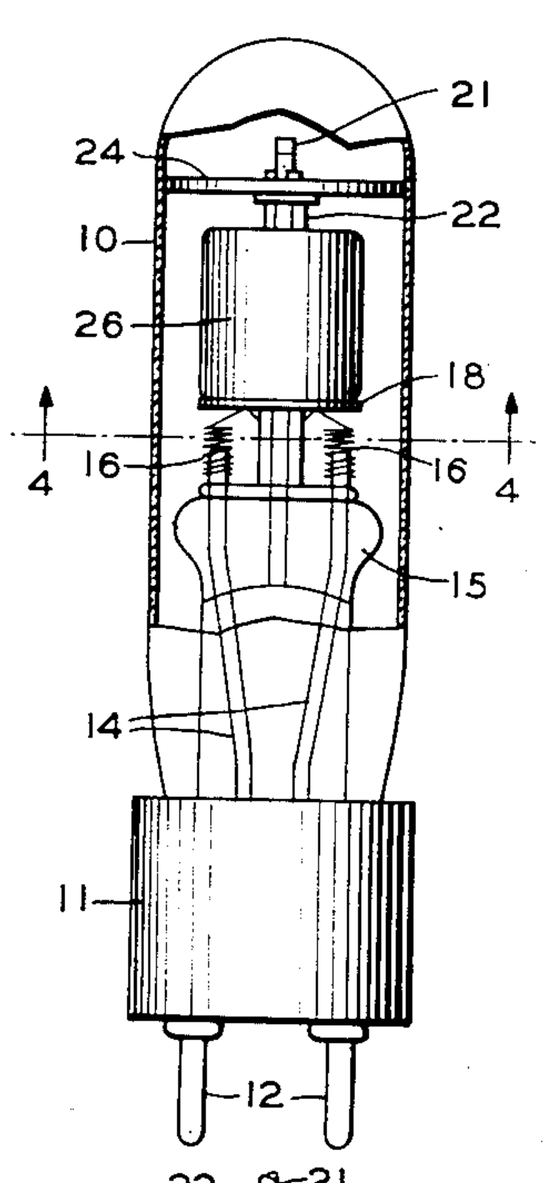


FIG. 3

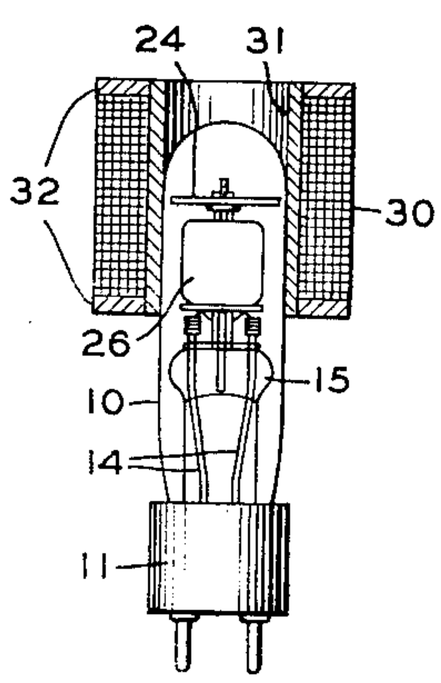


FIG. 2

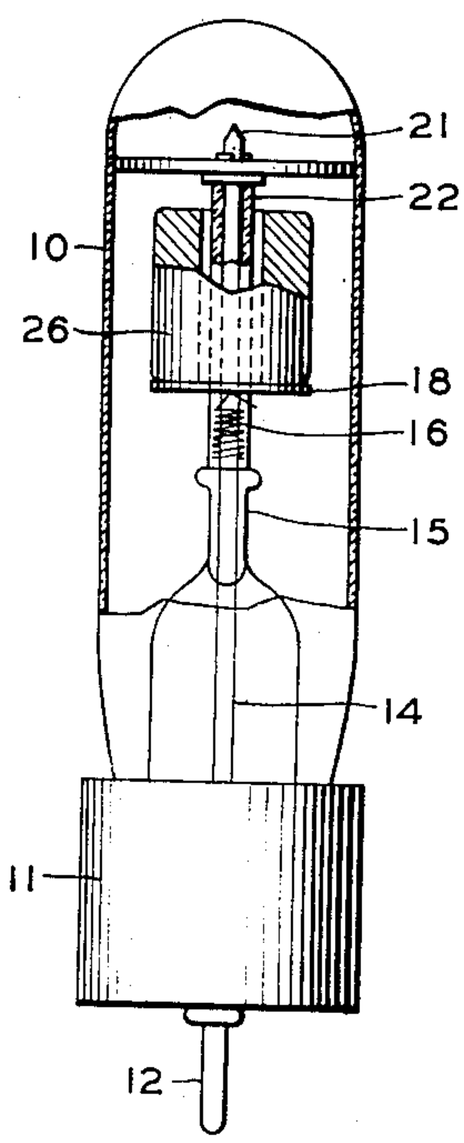


FIG. 4

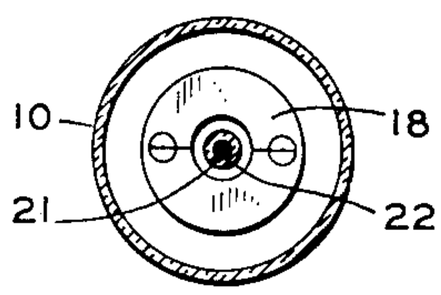


FIG. 5

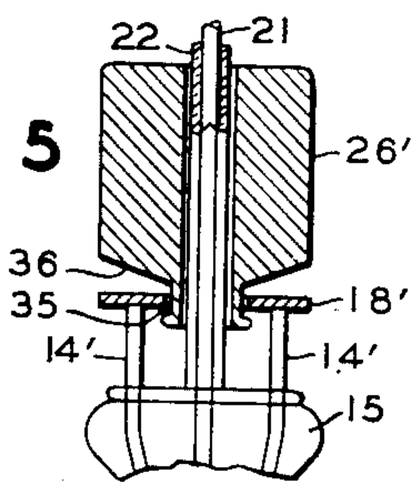
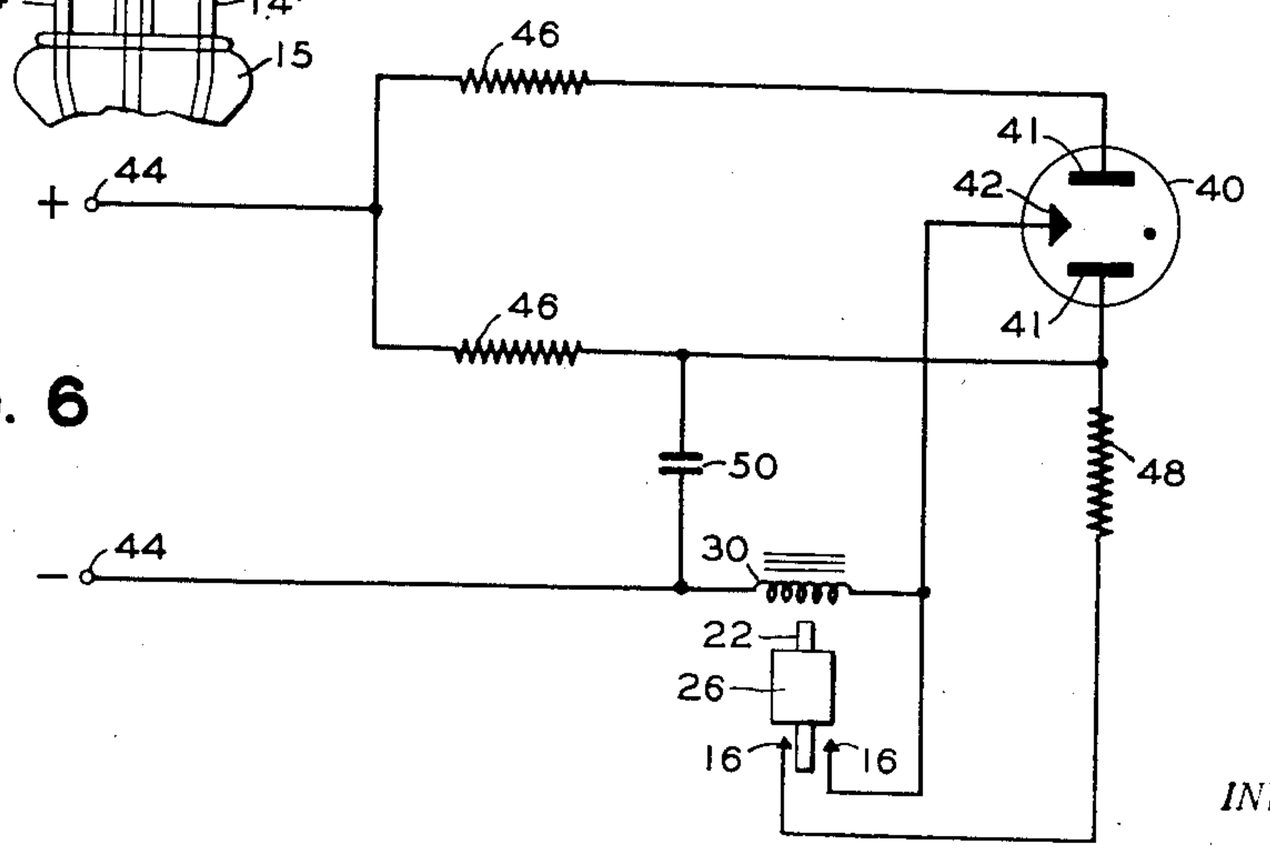


FIG. 6



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ELECTRIC SWITCH

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3 Claims. (Cl. 200—87)

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This invention relates to improvements in magnetically operated switches, and more particularly to such a switch which operates in a vacuum or rarefied atmosphere.

A magnetically operated switch in which the circuit controlled thereby is made and broken between solid contacts in a vacuum is particularly suitable for starting vapor and gas-filled discharge lamps or tubes, such as mercury vapor arc lamps and also concentrated arc discharge lamps of the character disclosed in Buckingham et al. application Serial No. 668,092, filed May 8, 1946, now Patent No. 2,453,118, issued November 9, 1948, and Buckingham application Serial No. 24,555, filed May 1, 1948.

Among the objects of the invention are to provide a switch of the character described which is more dependable in operation; which has a greatly increased life; and which may be made small and compact and embodies improved and simplified means for mounting the armature of the switch.

Other objects and advantages will be apparent from the following detailed description of an illustrative embodiment of the invention, taken in connection with the accompanying drawings in which:

Fig. 1 is a front view, in elevation, of a vacuum switch embodying the principles of the invention;

Fig. 2 is a side view of the switch of Fig. 1;

Fig. 3 shows the switch inserted in operating position within the coil of an electromagnet;

Fig. 4 is a cross-sectional view taken along the line 4—4 of Fig. 1, looking in the direction of the arrows;

Fig. 5 shows a modified form of the switch structure; and

Fig. 6 shows the switch employed in the starting circuit of a concentrated arc discharged lamp.

Referring to Figs. 1 and 2, the embodiment there illustrated comprises a tubular sealed glass envelope 10 having a base 11 of insulation with metal contact prongs 12 for insertion into a socket thereby to connect the switch in the circuit which it is to control. In the figures the glass envelope 10 is shown as partially broken away in order to disclose better certain of the elements within. Connected to the prongs 12 are two lead-in conductors 14 which pass through and are supported by the press 15 of the tube. Secured to the upper ends of the lead-in conductors 14, as by soldering or welding, are small tungsten coils 16, the upper ends of which coils are bent, as seen in Fig. 1, to form flexible contact members adapted to be bridged by a switch element 18.

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Extending upwardly from the press 15 is a wire 21 of molybdenum, nickel, or other suitable metal, and surrounding the wire is a glass or vitreous tube 22, the upper end of which passes through a central hole in a disk 24 of mica or other suitable material. The circular edge of the disk 24 is in contact with the inner wall of the tube 10 so that the upper rod assembly 21, 22 is firmly positioned centrally of the tube envelope.

As seen in Fig. 4, the bridging switch member 18 conveniently may comprise a round washer, preferably of molybdenum, which is spot-welded or otherwise secured to an armature in the form of a cylinder 26 of iron or other good magnetic material. The rod 21 and tube 22 provide a longitudinal supporting and guiding axis which passes through the cylinder 26 and washer 18 with a loose fit and along which the assembly 18, 26 may freely slide and about which axis the assembly may freely rotate as the switch is operated under the influence of an electromagnet shown in Fig. 3. The electromagnet comprises an inductive winding 30 containing a sufficient number of ampere turns to produce a strong magnetic field and cause quick operation of the armature 26; for use with a small vacuum switch tube, two thousand turns of No. 30 magnet wire are satisfactory. The coil is wound on a sleeve 31 of brass or other non-magnetic material within which the tube 10 is received, and the ends of the electromagnet conveniently may comprise iron washers 32 mounted on the brass sleeve 31. When current is caused to flow through the winding 30 a magnetic field is set up which attracts the cylindrical armature 26 and causes it and the bridging switch member 18 to move upwardly so that the circuit between the contact spring members 16 and the bridging member 18 is quickly broken. The circuit is maintained open so long as the electromagnet 30 is energized.

Since the armature 26 and contact member 18 are free to rotate about their common axis this causes the bridging disk 18 to present a new contact surface from time to time to the spring contact members 16 and thus minimize pitting of the contact surfaces. Also, the ends of the spring contacts 16 may wear down and still make good contact with the disk 18 and the flexibility of the springs insures that both will always make good contact with the bridging member even though the spring should wear down unevenly. The tube or envelope 10 is evacuated to as high a degree as practicable in order to insure a rapid break, without arcing, in the current flowing through the switch contacts when the electro-

magnet 30 is energized. Since the switch elements do not touch the glass envelope they can readily be degassed by heating the same while the tube is being exhausted.

When the tube is positioned within the sleeve 31 of the electromagnet, as shown in Fig. 3, the switch contacts 16 are closed when the electromagnet is not energized and are opened when it is energized, but by inverting the tube within the sleeve the contacts may be caused to remain open when the electromagnet is deenergized and closed when it is energized. Thus, the circuit controlled by the switch may normally be kept either open or closed, depending upon the character and purpose of the circuit.

Fig. 5 shows a modified form of the switch structure in which the bridging contact member, viz., the molybdenum washer or disk 18', is loosely mounted on a neck portion 35 of the iron armature 26', which neck portion is peened over so that the disk can not come off, although it is loose so that it is floppy. In this modification the switch contacts may simply comprise stubs 14' of wire, preferably molybdenum or nickel, without the spring tips shown in the first described form. The washer or disk 18' will align itself to take care of any difference in height of the two contacts. The bevel 36 on the bottom of the armature assures that it will always press on the member 18' at its center. The couple thus formed with the disk touching one of the contacts 14' assures that the disk will touch the other contact also. The vertical play between the armature 26' and disk 18' provides a hammer action which is useful in opening the contacts if they should tend to stick to the disk.

Fig. 6 shows a starting circuit for a concentrated arc lamp 40 controlled by a vacuum switch constructed in accordance with the instant invention. The lamp 40 is of the type in which two anodes 41 cooperate with a common cathode 42, the lamp being operated from a source of direct current supply 44. Ballast resistors 46 are inserted in the positive side of the circuit to the anodes 41. The electromagnet 30, which also comprises a choke coil, is connected to the cathode 42 for controlling the armature 26 of the vacuum switch, the circuit through the contacts 16 of the switch including a current limiting resistor 48. When starting the lamp, current through the coil 30 actuates the armature 26 and causes the switch to open its contacts, and the inductive surge produced by the coil 30 due to operation of the vacuum switch is impressed across the arc lamp, the condenser 50 readily permitting the inductive surge to be impressed upon the anode.

When the gas in the lamp becomes ionized, current flows through the ballast resistors 46 in parallel so that the arc stream is divided between the two anodes 41, the return path from the cathode 42 including the coil 30 which attracts the armature 26 and maintains the vacuum switch in open circuit position so long as the lamp is operated. Since the arc stream is divided between the anodes, only one-half of the current flowing passes through each anode and the heating effect on each anode is correspondingly decreased.

In addition to its use in the starting circuit of a vapor lamp or other arc discharge device, the switch may be employed for controlling various types of circuits in which it is desirable or necessary to open and close a circuit between solid electrodes with a minimum of arcing and without any appreciable time delay in operation.

While there are shown and described herein certain preferred embodiments of the invention, many other and varied forms and uses will present themselves to those versed in the art without departing from the invention which, therefore, is not limited either in structure or use except as indicated by the scope of the appended claims.

We claim:

1. An electric switch comprising a sealed envelope having a press portion, a pair of fixed contacts supported within said envelope by the press portion, an armature of magnetizable material within the envelope movable in one direction when subjected to an external magnetic field and movable in the opposite direction under the influence of gravity, a bridging contact member carried by said armature and adapted to extend between and engage said fixed contacts in the circuit-closing position of the switch, a fixed rod extending through said armature and bridging member with a loose sliding fit and providing a supporting and guiding axis defining the path of movement of the armature and bridging contact member, and means including said press portion of the envelope and a spacer member engaging the inner wall of the envelope for mounting said fixed rod.

2. An electric switch comprising a sealed envelope having a press portion, a pair of fixed contacts within said envelope, an armature of magnetizable material within the envelope movable in one direction when subjected to an external magnetic field and movable in the opposite direction under the influence of gravity, a bridging contact member carried by said armature and adapted to extend between and engage said fixed contacts in the circuit-closing position of the switch, said bridging member being loosely mounted on said armature so as to be floppy whereby the bridging member will align itself to take care of any difference in height of the fixed contacts relative to each other, a fixed rod extending through said armature and bridging member with a loose sliding fit and providing a supporting and guiding axis defining the path of movement of the armature and bridging contact member, and means including said press portion of the envelope and a spacer member engaging the inner wall of the envelope for mounting said fixed rod.

3. An electric switch comprising a sealed envelope having a press portion, a pair of fixed contacts within said envelope, an armature of magnetizable material within the envelope movable in one direction when subjected to an external magnetic field and movable in the opposite direction under the influence of gravity, a bridging contact member carried by said armature and adapted to extend between and engage said fixed contacts in the circuit-closing position of the switch, a fixed rod extending through said armature and bridging member with a loose sliding fit and providing a supporting and guiding axis defining the path of movement of the armature and bridging contact member, and means including said press portion of the envelope and a spacer member engaging the inner wall of the envelope for mounting said fixed rod, said spacer member being positioned along the rod at a place to provide a stop for the movement of the armature in one direction of its travel.

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