Sept. 26, 1967 R. T. CUSICK 3,344,248

SWITCH FOR HIGH ENERGY CIRCUITS

Filed June 28, 1965 2 Sheets-Sheet 1

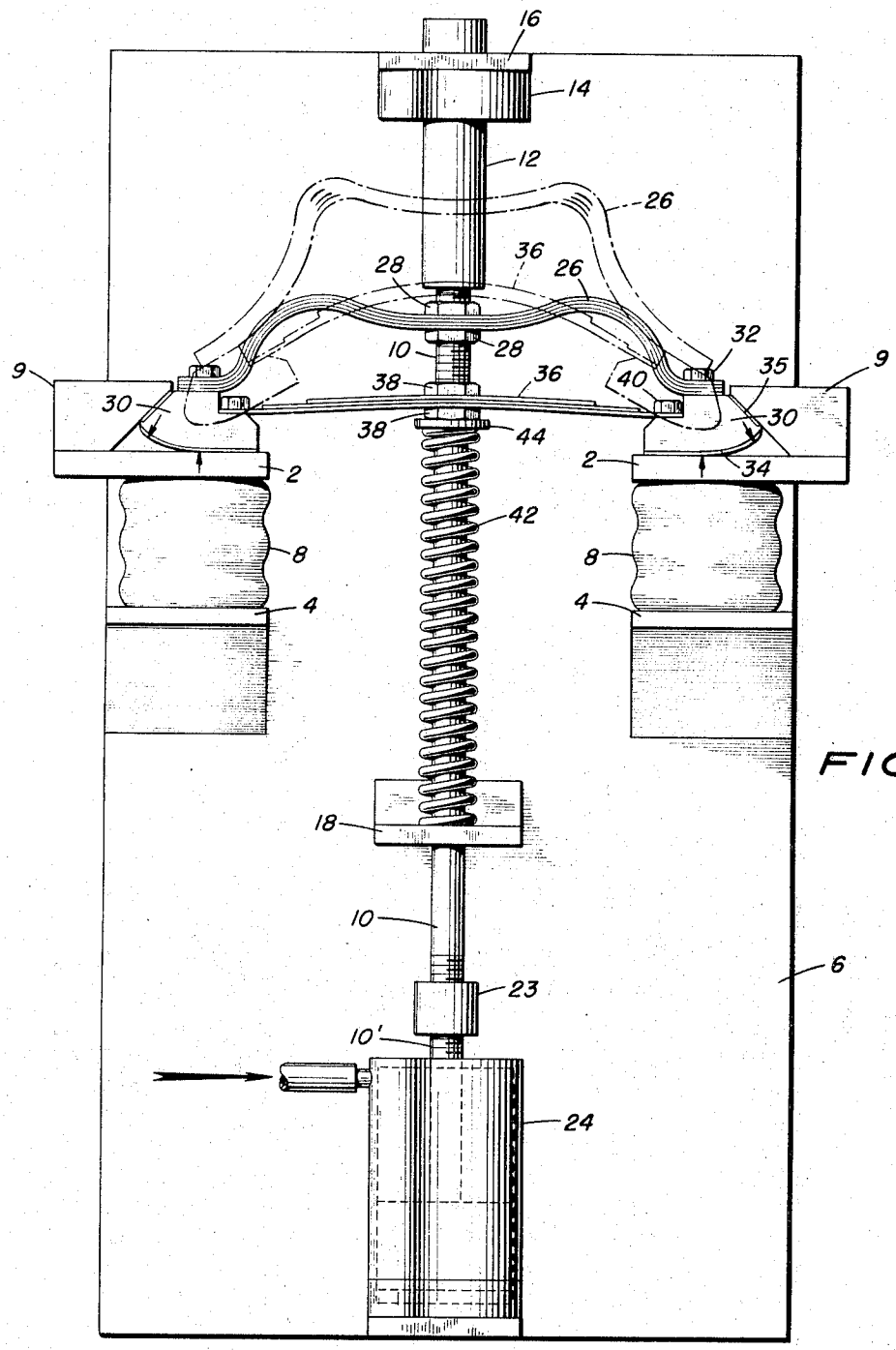



FIG. 1.

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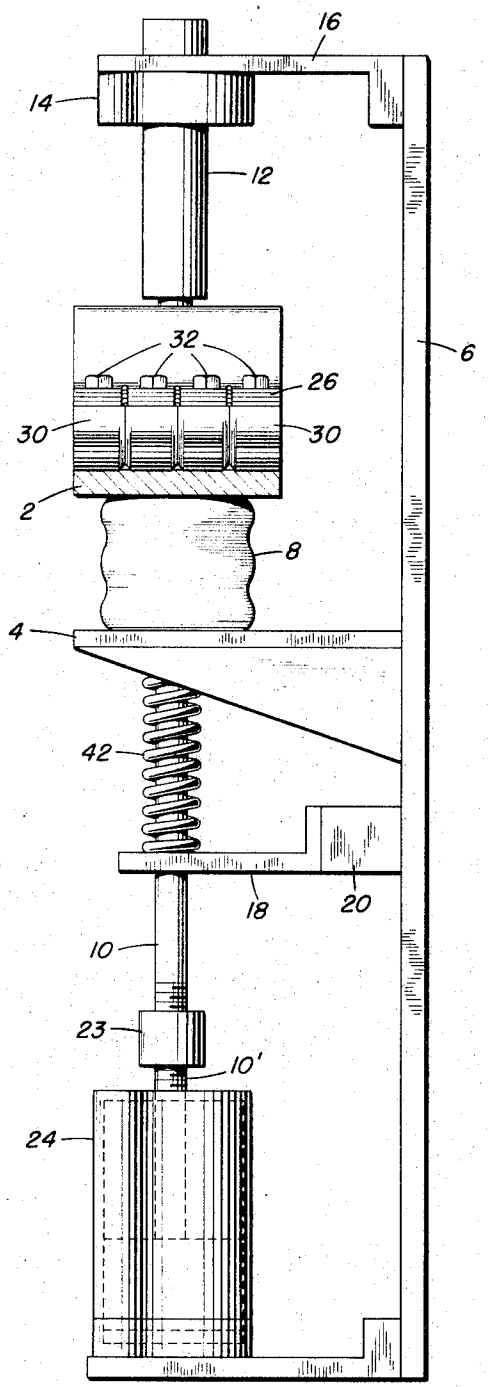



FIG. 2.

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3,344,248

# SWITCH FOR HIGH ENERGY CIRCUITS

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18 Claims. (Cl. 200—82)

## ABSTRACT OF THE DISCLOSURE

A switch for high energy circuits designed so as to avoid contact burning. The switch comprises a series of movable contact shoes mounted on a shaft which is caused to move by the action of hydraulic drive means. The contact shoes are attached to the shaft by a resilient spring-like member which continually forces the contact shoes toward a bus bar after initial contact therebetween is made, thereby reducing contact bounce. To further reduce contact bounce, auxiliary contacts are fixedly mounted on the bus bar and serve to wedge the contact shoes toward the bus bar.

This invention relates generally to a switch and more particularly to a pneumatically operated switch for closing high energy circuits.

Switches of the type used in high energy circuits have a characteristically short life due to arcing. Complete destruction or fusion welding of the contacts is common where the making of the circuit has not been effectively performed. The most common deficiencies of existing switches reside in their slow initial reaction time and poor surface contact. Hitherto, an increase in the speed of circuit closing has produced an undesirable contact bounce, with resulting arcing.

It is therefore an object of this invention to provide a switch so constructed as to provide a suitable circuit closing device for high energy circuits.

Another object of this invention is to provide a switch having a short reaction time.

A still further object of this invention is to provide an efficient yet safe switch wherein contact is made in such a manner that contact life is substantially increased.

A further object of this invention is to provide an economical switch for high energy circuits.

An additional object of this invention is to provide a pneumatically operated switch.

An important object of this invention is to provide a switch in which contact bounce upon closing is eliminated.

Further objects and many of the attendant advantages of this invention will be readily apreciated as the same becomes better understood by reference to the following detailed description when considered in connection with the accompanying drawings, wherein:

FIG. 1 is a front elevation of the switch; and

FIG. 2 is a side view of the device with the auxiliary contacts removed.

The circuit closing switch of the instant invention is adapted to be used in high energy circuits of the type utilized in supplying D.C. power to plasma arc generators. It is contemplated that the instant switch will be used in circuits where 22,000 amperes is not uncommon and the voltage ranges up to 2200 volts.

The switch of the present invention includes first and second bus bar contacts having a lateral gap therebetween and each having swage block auxiliary contacts mounted thereon, a mounting shaft disposed between said first and second bus bar contacts for vertical movement into neutral and activated positions, a spring means encompassing said shaft and adapted to urge said shaft into said neutral



position, drive means for urging said shaft in a vertical plane into said activated position, a laterally extending resilient conducting member attached to said mounting shaft, contact means connected to said conducting means and adapted to initially engage said bus bar contacts and subsequently move into engagement with said auxiliary contacts, and laterally extending resilient members attached to said mounting shaft and adapted to insure continuous contact between said contact means and said bus bar contacts.

Referring now to the drawings, the bus bar contacts **2** are supported by plastic or Glastex insulators **8** on supports **4** which are connected to a wall protection plate **6**. Swage blocks or auxiliary contacts **9** are mounted on the bus bar contacts **2**. Disposed between the ends of the bus bars **2** is a mounting shaft **10**. Attached to the upper portion of this shaft is an insulating member **12** of high strength glass fiber such as G–**10** which slides in a bushing **14** to guide the vertical motion of the shaft **10**. The bushing **14** is attached to a bracket **16** mounted on the wall protection plate **6**. The lower portion of the shaft is guided by a plate **18** which is attached to the wall plate **6** by an insulating spacer **20**. Connected to the lower end of the shaft is a second insulating member **23** which effectively insulates the shaft **10** from a shaft extension **10'** which is connected to the lower portion of the insulating member **23**. The shaft **10'** enters a pneumatic cylinder **24** containing a piston (not shown) which is adapted to drive the shaft **10** downwardly.

Mounted on the shaft **10** near its upper end is a laterally extending resilient conducting member **26**. The mounting shaft extends through the conducting member **26** medially of its length and width and is secured thereto by locking nuts **28**. The member **26** is formed of thin plies of copper, is of generally bow-like configuration, and is connected at its extremities to contact shoes **30** by bolts **32**. As shown in FIG. 2, four of the shoes **30** are connected to each end portion of the conducting member **26**.

The contact shoes **30** are formed with curved portions **34** which serve when initially brought into engagement with the bus bars **2** to make contact at lines shown (in cross-sections as points) by the arrows on the contact shoes **30**, with lines shown (in cross-section as points) by the arrows on the bus bar **2**, as shown in broken lines in FIG. 1. The curved or bus bar engaging areas **34** of the contact shoes **30** are formed of high heat resistant 50 percent silver and 50 percent tungsten alloy, which is necessary when initial contact is made.

When the shaft **10** is moved into its lower position, as shown in full lines in FIG. 1, the curved portions **34** of the contact shoes **30** will slide on the bus bar until the portions **35** of said shoes engage the swage blocks **9**. The contact portions **35** are formed of a material containing 80 percent silver and 20 percent tungsten, and are therefore of higher electrical conductivity than are bus bar engaging areas **34**. This material is not required to be as resistant to heat as that used at the contact areas **34**, since no initial contact is made between the contact portions **35** and the swage blocks **9**, and consequently there is no excessive heat concentration or arcing in this area.

Also mounted centrally on the shaft **10** below the conducting member **26** are multiple leaf springs **36** which are held in position by lock nuts **38**. The springs **36** are connected to the contact shoes **30** by bolts **40**, and function to prevent any contact bounce. That is, when initial contact is made, the springs **36** operate to prevent the contact shoes **30** from rebouncing or breaking contact with the bus bars **2**.

Encompassing the shaft **10** and engaging the plate **18** is a spring **42**. A washer **44** is positioned on the shaft **10** below the lower lock nut **38** to provide an adequate upper spring stop. The spring **42** is adapted to urge the shaft

and contacts toward the neutral, or open, position when the shaft **10** is in its activated position. Upon failure of the pneumatic drive means the spring **42** will cause the switch to open, thereby providing inherent safety.

Obviously, many modifications and variations of the present invention are possible in the light of the above teachings. It is therefore to be understood that within the scope of the appended claims the invention may be practiced otherwise than as specifically described.

What is claimed is:

**1.** A switch for a high energy circuit, comprising

first and second bus bar contacts, the surfaces of which are mutually parallel and having a gap therebetween, and each having an auxiliary contact mounted thereon,

a mounting shaft disposed between said first and second bus bar contacts and capable of vertical movement into neutral and activated positions,

spring means encompassing said shaft and adapted to urge said shaft into said neutral position,

drive means associated with said shaft and capable of urging said shaft in a vertical plane into said activated position,

a laterally exetnding resilient conducting means attached to said mounting shaft,

contact shoes connected to said conducting means and adapted to initially engage said bus bar contacts and subsequently move into engagement with said auxiliary contacts, and

laterally extending resilient members attached to said mounting shaft and said contact shoes, said resilient members being concave to said bus bar contacts while said shaft is in its neutral position and in a plane substantially parallel to the surfaces of said bus bar contacts while said shaft is in its activated position, and thereby adapted to insure continuous contact between said contact means and said bus bar contacts.

**2.** The invention as recited in claim **1**, wherein each of said contact shoes comprises first and second contact surfaces.

**3.** The invention as described in claim **2**, wherein said first contact surfaces comprise highly heat resistive material and said second contact surfaces comprise material having a lower heat resistance and a higher electrical conductivity than said first contact surfaces.

**4.** The invention as described in claim **3**, wherein said first contact surfaces are arcuate and said second contact surfaces are planar.

**5.** A switch for closing high energy circuits, including

a mounting plate,

a pair of spaced supports each secured to said mounting plate,

a pair of insulators each mounted on one of said supports,

first and second bus bar contacts each supported on one of said pair of insulators,

a pair of auxiliary contacts each secured to one of said bus bar contacts,

a mounting shaft disposed between said bus bar contacts,

a guide plate for guiding the vertical travel of said mounting shaft,

an insulating spacer for insulating and spacing said guide plate from said mounting plate,

a mounting bracket connected to the upper end portion of said mounting plate,

a cylindrical insulating member connected to the upper end of said mounting shaft coaxially therewith,

a bushing connected to said mounting bracket and capable of slidably receiving said cylindrical insulating member,



a spring disposed about said mounting shaft and abutting said guide plate so as to be able to exert an upwardly directed force on said mounting shaft,

a pneumatic cylinder,

a shaft extension connected to the lower end of said mounting shaft and insulated therefrom, said shaft extension being connected to said pneumatic cylinder and capable of being moved in a vertical direction thereby,

a laterally extending resilient conducting member connected to said mounting shaft beneath said cylindrical insulating member,

a plurality of contact shoes connected to the opposite end portions of said resilient conducting member and capable of engagement with said first and second bus bar contacts and said pair of auxiliary contacts so as to form an electrically conductive path between said first bus bar contact and its associated auxiliary contact and said second bus bar contact and its associated auxiliary contact, and

means connected to said mounting shaft and to each of said plurality of contact shoes for preventing bouncing of said contact shoes upon engagement with said first and second bus bar contacts.

**6.** The invention as set forth in claim **5**, wherein said contact bouncing preventing means comprises a plurality of leaf springs.

**7.** The invention as set forth in claim **5**, wherein each of said contact shoes comprises first and second contact surfaces.

**8.** The invention as recited in claim **7**, wherein said first contact surfaces comprise highly heat resistive material and said second contact surfaces comprise material having a lower heat resistance and a higher electrical conductivity than said first contact surfaces.

**9.** The invention as set forth in claim **8**, wherein said first contact surfaces are arcuate and said second contact surfaces are planar.

**10.** In a switch for closing high energy circuits the combination including,

first and second bus bar contacts, the surfaces of which are mutually parallel,

first and second auxiliary contacts connected to said first and second bus bar contacts, respectively,

a mounting shaft,

a laterally extending resilient conducting member connected to said mounting shaft,

a plurality of contact shoes connected to the opposite end portions of said resilient conducting member, and means including laterally extending resilient members which are concave to said bus bar contacts while said shaft is in a first position and which lie in a plane substantially parallel to the surfaces of said bus bar contacts while said shaft is in a second position, said means being capable of urging said contact shoes to initially come into line contact with one of said bus bar contacts, slide therealong to thereby generate a planar contact, and subsequently engage one of said auxiliary contacts in planar contact.

**11.** The invention as described in claim **10**, additionally including

drive means for moving said mounting shaft in a vertical direction so as to enable said contact shoes to engage said bus bar contacts and said auxiliary contacts and maintain such engagement.

**12.** The invention as set forth in claim **11**, additionally including

means for providing rapid disengagement of said contact shoes from said first and second bus bar contacts and said first and second auxiliary contacts upon failure of said drive means.

**13.** The invention as recited in claim **12**, wherein said disengaging means comprises a spring and said drive means comprises a pneumatic cylinder.

14. The invention as described in claim 10, wherein said contact shoes are each provided with first and second contact surfaces.

15. The invention as described in claim 14, wherein said first contact surfaces are arcuate and said second contact surfaces are planar.

16. The invention as set forth in claim 14, wherein said first contact surfaces comprise highly heat resistive material and said second contact surfaces comprise material having a lower heat resistance and a higher electrical conductivity than said first contact surfaces.

17. The invention as recited in claim 16, additionally including

drive means for moving said mounting shaft in a vertical direction so as to enable said contact shoes to engage said contacts and maintain such engagement.

18. A switch for closing high energy circuits, including

a plurality of bus bar contacts, the surfaces of which are mutually parallel,

a plurality of auxiliary contacts each connected to one of said plurality of bus bar contacts,

a mounting shaft,

resilient conducting means connected to said mounting shaft,

a plurality of contact shoes connected to said resilient conducting means, and means including laterally extending resilient members which are concave to said



bus bar contacts while said shaft is in a first position and which lie in a plane substantially parallel to the surfaces of said bus bar contacts while said shaft is in a second position, said means being capable of urging said contact shoes to initially come into line contact with one of said plurality of bus bar contacts, slide therealong to thereby generate a planar contact from said line contact, and subsequently engage one of said plurality of auxiliary contacts in planar contact.


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