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G. S. BLACK

2,821,580

SWITCH

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Fig. 1.

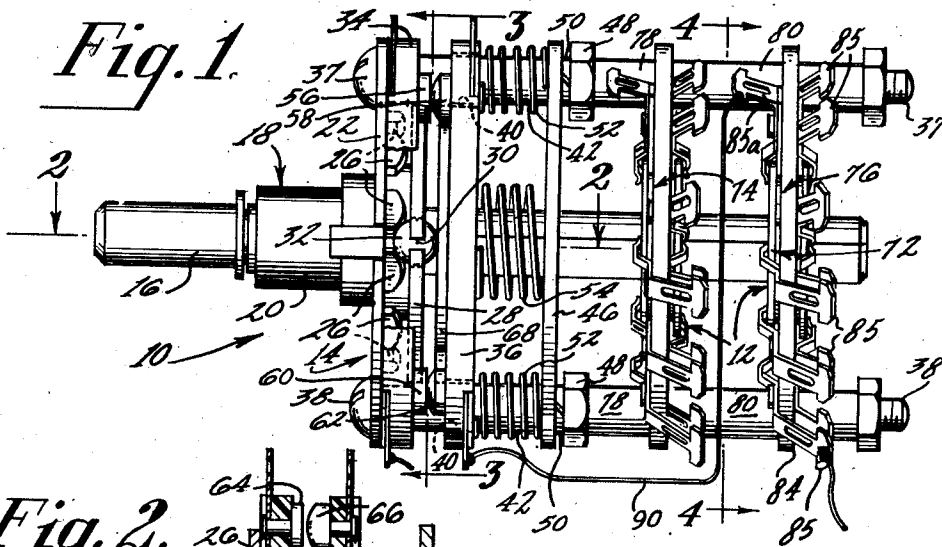


Fig. 2.

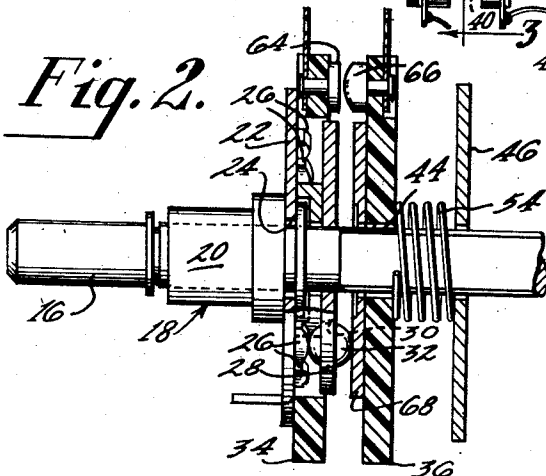


Fig. 3.

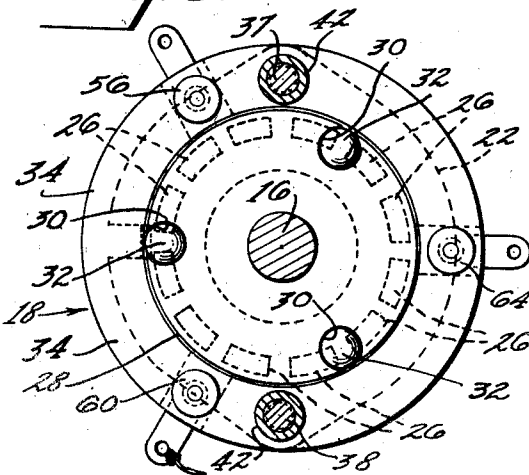
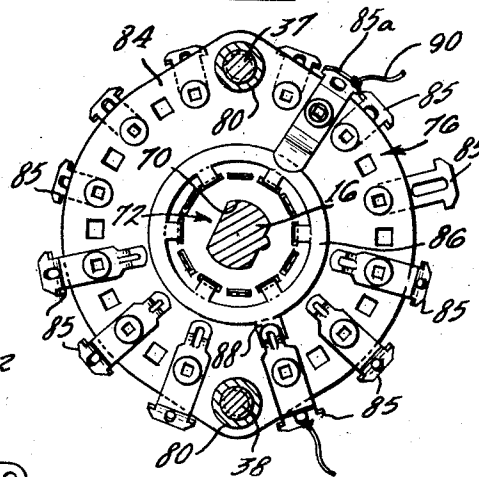


Fig. 4.



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2,821,580

SWITCH

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8 Claims. (Cl. 200-17)

This invention relates to switches, and more particularly to rotary switches of the wafer type adapted to withstand relatively high transient electrical currents. The switch of the present invention is particularly adapted for making and breaking electrical circuits having inductive components therein.

In many electrical circuits employing inductive components, such as solenoids, coils, transformers, and the like, the steady state current flowing therein may be relatively small. Upon breaking these circuits, however, the momentary transient current will be relatively high because of the sudden collapse of the magnetic fields about the inductive components. The use of switches adapted to carry only the steady state current in these circuits would soon show burning at the contacts due to the relatively high transient current on breaking the circuit. While switches having contacts heavy enough to withstand these transient currents may be used, the cost of these switches is relatively high. The additional weight and bulk of the usual switch adapted to withstand heavy currents may be objectionable also, especially where a number of switches are needed.

Accordingly, it is an object of the present invention to provide an improved wafer switch adapted to carry high transient currents during the breaking of a circuit having inductive loads without substantially increasing the size and weight of the switch.

Another object of the present invention is to provide an improved switch having novel heavy contact means for making and breaking a circuit, and relatively light current-carrying capacity contact means for carrying the steady state current.

A further object of the present invention is to provide, in a wafer switch, sets of relatively heavy current capacity contacts adapted to open an electric circuit before the wafer contacts open the circuit, and also adapted to complete the circuit after the wafer contacts have closed.

Still another object of the present invention is to provide, in a wafer switch having relatively light current-carrying capacity contacts, heavy current-carrying auxiliary contacts operable from a common shaft.

A still further object of the present invention is to provide an improved switch of the type described that is simple in construction and operation, economical of space and material, and highly efficient in use.

In accordance with the present invention, the foregoing objects and related advantages are attained in a modified rotary wafer switch. The rotary wafer switch is provided with a base plate having a plurality of angularly spaced, rearwardly extending cams fixed thereto. A rotatable shaft is disposed within an opening in the base plate. A ball retainer plate is fixed to the shaft, parallel to the base plate, and is adapted to guide a plurality of balls over the cams when the shaft is rotated. An auxiliary contact assembly comprises a front insulating ring, adjacent to the base plate, and a rear insulating ring disposed parallel to the front ring. The rear ring is adapted to move axially

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of the switch shaft. One heavy current-carrying auxiliary contact, of a plurality of pairs of auxiliary contacts, is mounted in the rear ring, and its mating contact is fixed in the front ring. Spring means urge the rear ring toward the front ring so that the mating contacts touch each other, when each of the balls are between adjacent cams on the base plate. The rear ring is so disposed with relation to the balls that the balls urge the rear ring away from the front ring when the shaft is rotated and the balls ride over the cams. Under the latter conditions, the heavy auxiliary mating contacts are separated from each other. With this arrangement, the auxiliary contacts may be connected in series with the contacts of the rotary wafer switch. Since both the rotary switch and the auxiliary contact assembly are operated simultaneously from the same shaft, the auxiliary contacts may be made to open first, thereby bearing the brunt of transient currents in a circuit including inductive components.

The novel features of the present invention, as well as the invention itself, both as to its organization and method of operation, will be understood in detail from the following description when considered in connection with the accompanying drawing, in which similar reference characters represent similar parts, and in which:

Fig. 1 is a side elevational view of an improved switch, in accordance with the invention;

Fig. 2 is a cross-sectional view of a portion of the switch shown in Fig. 1, taken along the lines 2-2 as viewed in the direction of the arrows;

Fig. 3 is a cross-sectional view of the switch shown in Fig. 1, taken along the line 3-3 as viewed in the direction of the arrows; and

Fig. 4 is a cross sectional view of the switch shown in Fig. 1, taken along the line 4-4 as viewed in the direction of the arrows.

Referring now particularly to Fig. 1, there is shown a switch 10, in accordance with the present invention, comprising a wafer switch assembly 12 and an auxiliary contact switch assembly 14. The switch 10 comprises a shaft 16 extending through the auxiliary contact switch assembly 14 and through the wafer switch assembly 12, adapted to actuate both of these assemblies simultaneously. The shaft 16 is journaled in a base plate assembly 18 comprising a bushing 20 fixed in any suitable manner to the base plate 22. The base plate 22 is formed with a hole 24 through which the shaft 16 extends. The base plate 22 has a plurality of rearwardly extending cams 26 fixed thereto. The cams 26 are angularly and symmetrically disposed about the base plate 22 with respect to its center. Fixed to the shaft 16 and rotatable therewith is a ball retainer plate 28. The ball retainer plate 28 is disposed parallel to the base plate 22 and is formed with a plurality of symmetrically disposed cut-out portions 30 adjacent its periphery for the purpose of retaining steel balls 32 therein. The cut-out portions 30 are so disposed that each of the balls 32 positioned therein will be midway between adjacent cams 26 in one position of the shaft 16. It will now be understood that as the shaft 16 is rotated the balls 32 will ride over the cams 26, whereby each of the balls 32 will be urged rearwardly with respect to the shaft 16.

The auxiliary contact switch assembly 14 comprises a front ring 34 and a rear ring 36, both of insulating material such as plastic, disposed parallel to each other. The front ring 34 rests on the base plate 22 and is fixed thereto by diametrically opposed rearwardly extending screws 37 and 38 passing through holes in both the base plate 22 and the front ring 34. The rear ring 36 is formed with diametrically opposed enlarged holes 40 through which spacer tubes 42 pass. The rear ring 36 is also formed with a central opening 44 through which the shaft 16 passes. A spring retainer plate 46 is positioned rearwardly and

parallel to the rear ring 36. The spring retainer plate 46 is fixed relative to the base plate 22 by means of nuts 48 and lock washers 50 on the screws 36 and 38. Springs 52, loosely wound around the spacer tubes 42 and extending between the spring retainer plate 46 and the rear ring 36, serve to urge the rear ring 36 toward the front ring 34. A spring 54, loosely wound around the shaft 16 and extending between the spring retainer 46 and the rear ring 36, also serves to urge the rear ring 36 forwardly.

The auxiliary contact assembly 14 comprises a plurality of heavy mating or opposing contacts. While three pairs or sets of contacts are illustrated in the embodiment shown and described, it will be understood that the number of sets of opposing contacts is limited only by the size of the switch, and that any number of sets of heavy contacts may be used.

Referring to Fig. 1, two sets of heavy mating contacts are shown. A metallic contact 56 is fixed within the front ring 34. When the balls 32 are midway between adjacent cams 26 the springs 52 and 54 urge the rear ring 36 forwardly so that a mating contact 58 in the rear ring 36 touches the contact 56. In a similar manner, the contacts 60 and 62, fixed in the front and rear insulating rings 34 and 36, respectively, contact each other.

Referring to Fig. 2, there is shown a third pair of heavy contacts 64 and 66 fixed in the front and rear insulating rings 34 and 36, respectively. Referring to Fig. 3, the lower contacts 56, 60, and 64 are shown angularly and symmetrically disposed about the shaft 16.

When each of the balls 32 is in its most forward position, that is when each is midway between adjacent cams 26, the most rearward point on each of the balls 32 just touches a spacer plate 68. The spacer plate 68 may comprise a washer of hard material, either plastic or metal, integral with or adjacent to the rear ring 36. The purpose of the spacer ring 68 is to prevent wear on the rear ring 36, caused by the friction of the balls 32 when the shaft 16 is rotated. If the ring 36 is made from relatively hard plastic materials the spacer ring 68 may be integral with the rear ring 36, whereby the ring and the spacer will be made from the same material.

When properly adjusted, the mating contacts 56 and 58, 60 and 62, and 64 and 66, of the auxiliary contact assembly 14 will be in electrical contact when the balls 32 are midway between adjacent cams 26. Such a position is illustrated in Fig. 1. With the slightest rotation of the shaft 16 the balls 32 begin to ride on the cams 26 and force the rear ring 36 rearwardly. This causes the contacts 56 and 58, 60 and 62, and 64 and 66 to separate. These heavy contacts will separate with the slightest rotation of the shaft 16. It will be noted that, as shown in Fig. 2, when a ball 32 is on the highest point of a cam 26 the contacts of the auxiliary contact assembly 14 are separated at their maximum distance of separation.

The shaft 16 extends through holes 70 in the rotary part 72 of wafer switches 74 and 76 of the wafer switch assembly 12. The wafer switches 74 and 76 each have diametrically opposed holes through which the screws 37 and 38 pass. The wafer switch 74 is spaced from the spring retainer plate 46 by means of spacer tubes 78 on the screws 37 and 38. The wafer switch 76 is spaced from the wafer switch 74 by spacer rings 80. Opposite lateral portions of the shaft 16, which pass through the holes 70, are flattened to fit the flattened sides of the holes 70 so as to cause the rotary part 72 of the wafer switches to rotate with the shaft 16. The stationary parts 84 of the wafer switches 74 and 76 have a plurality of contact lugs 85 angularly disposed thereabout with respect to the shaft 16.

Referring now to Fig. 4, there is shown the front side of the wafer switch 76. A metallic wiper 86, fixed to the rotary part 72, is adapted to touch individual contact lugs 85 when the shaft 16 is rotated. In the particular rotary switch 76, illustrated in Fig. 4, one of the contact lugs 85a is always in contact with the wiper 86. Thus, it will be understood that as the rotary part 72 is rotated

by the shaft 16, electrical contact is made between the lug 85a and one of the other lugs 85, depending upon the position of the protruding portion 88 of the wiper 86.

The operation of the switch 10, in accordance with the present invention, will now be explained. Let it be assumed that the switch 10 is in an electrical circuit (not shown), a portion of which includes the auxiliary contacts 60 and 62, connected in series with the contact lug 85a through a wire 90. Let it also be assumed that there are inductive components in this circuit so that heavy sparking would ordinarily occur at the point where the circuit is broken. The circuit will be closed between the contact 85a and one of the lugs 85 through the wiper 86, for example, when the balls 32 are midway between the cams 26, as shown in Fig. 1. With the slightest rotation of the shaft 16 the balls 32 begin to ride up on the cams 26 and urge the rear ring 36 away from the front ring 34, thereby breaking the auxiliary contacts 60 and 62. The electrical circuit will now be broken. Any sparking that may occur because of inductive components in the circuit will be at the heavy contact points 60 and 62. Since the points 60 and 62 are heavy contact points they can withstand this sparking over a long period of time without any detrimental effects. It will be noted that while a slight turning of the shaft 16 will open the auxiliary contact points the electrical contact between the wiper 86 and the lugs 85 will still be closed. Thus, no sparking will take place in the wafer switch. When the shaft 16 is rotated through an angular distance equivalent to one cam it will be noted that electrical contact is made between the wiper 86 and one of the lugs 85 before the auxiliary contacts 60 and 62 touch. Thus, any transient currents that may cause burning will affect the heavy auxiliary contacts in the auxiliary contact switch section 14 rather than the contacts in the wafer switch section 12.

What is claimed is:

1. A switch comprising a front insulating ring and a rear insulating ring, said front ring having a plurality of rearwardly extending electrical contacts fixed thereon, said rear ring having a plurality of forwardly extending contacts fixed thereon oppositely disposed with respect to said plurality of rearwardly extending contacts fixed in said front ring, a rotatable shaft disposed transversely to said rings, a base plate disposed around said shaft and in front of said front ring, means including a spring urging said rear ring toward said front ring and said base plate whereby to cause opposing contacts in each of said rings to touch, means associated with said shaft and base plate to urge said rear ring away from said front ring in predetermined angular positions of said shaft, and said last-mentioned means comprising means to maintain said rear ring in parallel alignment with respect to said front ring in all positions of said rear ring.

2. A switch comprising a rotatable shaft, a base plate assembly disposed transversely to said shaft and formed with an opening through which said shaft extends, said base plate assembly comprising a base plate having a plurality of angularly spaced cams extending rearwardly therefrom, a ball retaining plate fixed transversely to said shaft and parallel to said base plate, said ball retaining plate comprising means to guide a plurality of balls over said cams when said shaft is rotated, a front insulating ring disposed about said shaft between said base plate and said ball retaining plate, a rear insulating ring disposed parallel to said front ring, a first electrical contact fixed within said front ring, a second electrical contact fixed within said rear ring and disposed opposite to said first contact, and means urging said rear ring toward said front ring whereby to cause said first and second electrical contacts to touch each other when said balls are between adjacent cams.

3. A switch comprising a rotatable shaft, a base plate assembly disposed transversely to said shaft and formed with an opening through which said shaft extends, said base plate assembly comprising a base plate having a

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plurality of angularly spaced cams extending rearwardly therefrom, a ball retaining plate fixed transversely to said shaft and parallel to said base plate, said ball retaining plate comprising means to guide a plurality of balls over said cams when said shaft is rotated, a front insulating ring disposed about said shaft between said base plate and said ball retaining plate, a rear insulating ring disposed parallel to said front ring, a first plurality of electrical contacts fixed within said front ring, a second plurality of electrical contacts fixed within said rear ring and disposed opposite to said first plurality of contacts respectively, and spring means urging said rear ring toward said front ring whereby to cause said first and said second plurality of electrical contacts to touch each other respectively when said balls are between said adjacent cams.

4. In combination, a switch comprising a rotatable shaft, a plurality of contacts disposed around said shaft, a wiper actuated by said shaft to move over said contacts, a base plate formed with an opening therethrough, said shaft extending through said opening, a plurality of symmetrically disposed angularly spaced cams fixed to and extending rearwardly from said base plate, a ball retaining plate fixed to said shaft parallel to said base plate, a front insulating ring and a rear insulating ring disposed on each side of said ball retaining plate, a pair of contacts each fixed within said front and said rear rings and opposite to each other respectively, spring means urging said rear ring toward said front ring whereby to cause said pair of contacts to touch, a plurality of balls, said ball retaining plate comprising means to guide said balls over said cams when said shaft is rotated, and means connecting said balls with said rear ring whereby to force said rear ring rearwardly against said spring means when said balls are guided over said cams.

5. In combination, a switch comprising a rotatable shaft, a first plurality of contacts disposed around said shaft, a wiper actuated by said shaft to move over said contacts, a base plate formed with an opening therethrough, said shaft extending through said opening, a plurality of symmetrically disposed angularly spaced cams fixed to and extending rearwardly from said base plate, a ball retaining plate fixed to said shaft parallel to said base plate, a front insulating ring and a rear insulating ring disposed on each side of said ball retaining plate, a second plurality of contacts fixed in sets of two within said front and said rear rings opposite each other respectively, spring means urging said rear ring toward said front ring whereby to cause said sets of contacts to touch, a plurality of balls, said ball retaining plate comprising means to guide said balls over said cams when said shaft is rotated, and means connecting said balls with said rear ring whereby to force said rear ring rearwardly against said spring means when said balls are guided over said cams.

6. In combination, a switch comprising a rotatable shaft, a first plurality of contacts disposed around said shaft, a wiper actuated by said shaft to move over said contacts, a base plate formed with an opening therethrough, said shaft extending through said opening, a plurality of symmetrically disposed angularly spaced cams fixed to and extending rearwardly from said base plate, a ball retaining plate fixed to said shaft for rotation therewith, a front insulating ring and a rear insulating ring disposed on each side of said ball retaining plate, each of a pair of contacts each fixed within said front and said rear rings opposite each other respectively, spring means urging said rear ring toward said front ring whereby to cause said pair of contacts to touch,

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a plurality of balls, said ball retaining plate comprising means to guide said balls over said cams when said shaft is rotated, means connecting said balls with said rear ring whereby to force said rear ring rearwardly against said spring means when said balls are guided over said cams, and means whereby the contacts of each of said pair of contacts touch each other only when said balls are midway between adjacent cams.

7. A rotary tap switch comprising a rotatable shaft, a plurality of contacts disposed around said shaft, a wiper actuated by said shaft to move over said contacts, a base plate assembly disposed transversely to said shaft and formed with an opening through which said shaft extends, said base plate assembly comprising a base plate having a plurality of angularly spaced cams fixed thereon, a ball retaining plate fixed transversely to said shaft and parallel to said base plate, said ball retaining plate being formed with a plurality of angularly disposed cut-out portions, a front insulating ring transversely disposed about said shaft between said base plate and said ball retaining plate, a rear insulating ring disposed parallel to said front ring, said front and rear rings each having a contact of a set of opposing contacts fixed thereto, a ball retained within each of said cut-out portions of said ball retaining plate and disposed to ride over said cams when said shaft is rotated, means urging said rear ring toward said front ring when said balls are between adjacent cams whereby said contacts of said set of opposing contacts touch each other, and connecting means between said balls and said rear ring for moving said rear ring axially of said shaft when said balls ride over said cams whereby to separate said contacts of said set of opposing contacts.

8. A rotary tap switch comprising a rotatable shaft, a plurality of contacts disposed around said shaft, a wiper actuated by said shaft to move over said contacts, a base plate disposed transversely to said shaft and formed with an opening through which said shaft extends, said base plate having a plurality of angularly spaced rearwardly extending cams fixed thereon, a ball retaining plate fixed transversely to said shaft and parallel to said base plate, said ball retaining plate being formed with a plurality of angularly disposed cut-out portions, a front insulating ring transversely disposed about said shaft between said base plate and said ball retaining plate, a rear insulating ring disposed parallel to said front ring, said rear and front rings each having one contact of a plurality of sets of opposing contacts fixed thereto, a ball retained within each of said cut-out portions of said ball retaining plate and disposed to ride over said cams when said shaft is rotated, means urging said rear ring toward said front ring when said balls are between said cams, whereby said contacts of said plurality of sets of opposing contacts touch each other, and connecting means between said balls and said rear ring for moving said rear ring axially of said shaft when said balls ride over said cams whereby to separate said contacts of said plurality of sets opposing contacts.

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