July 11, 1967 J. E. HILL ETAL 3,330,930

SHORTING AND NON-SHORTING SWITCH CONTACT CONSTRUCTIONS

Filed Dec. 27, 1965

FIG. 1

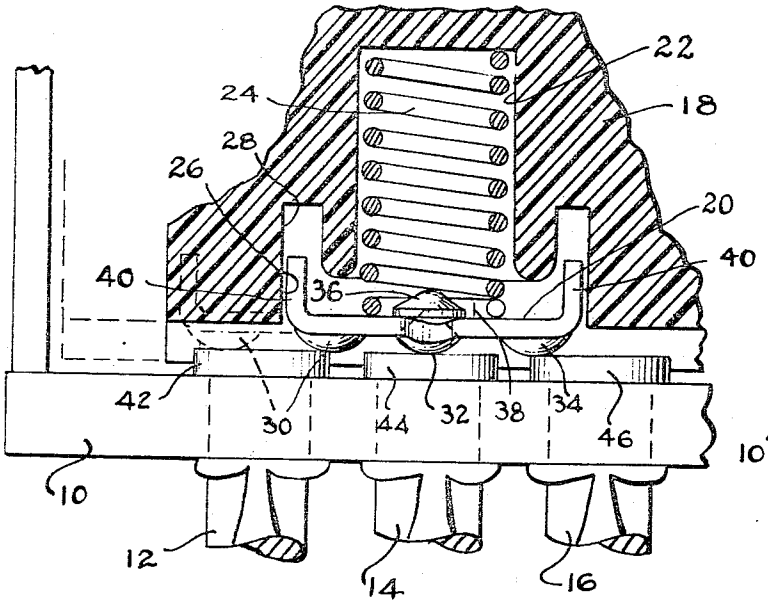


FIG. 2

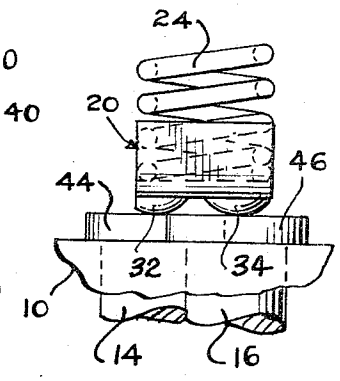


FIG. 3

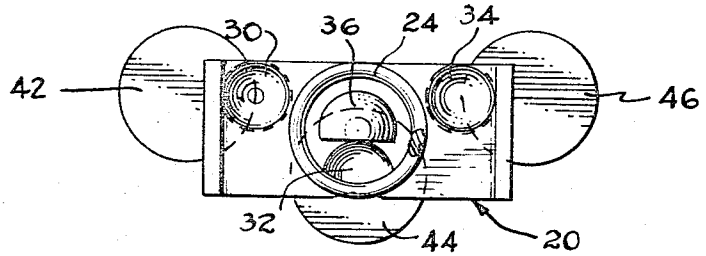


FIG. 4

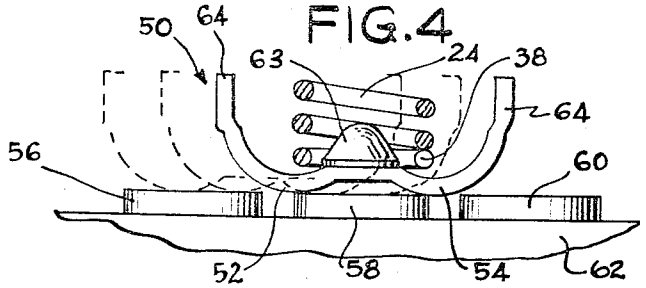


FIG. 5

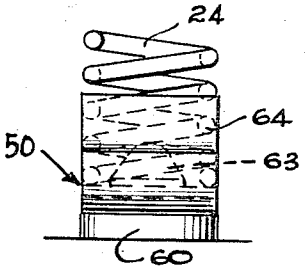
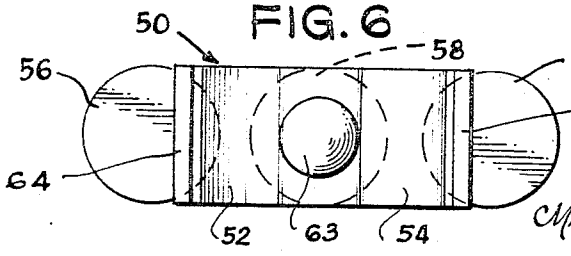


FIG. 6



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SHORTING AND NON-SHORTING SWITCH CONTACT CONSTRUCTIONS

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12 Claims. (Cl. 200—166)

This invention relates to an improved contact element for use in switch constructions. In particular, the invention is concerned with "shorting" and "non-shorting" contact elements which are particularly reliable during operation.

Shorting contact elements are employed in switch constructions in order to avoid damage to contacts which can result from arcing. In a conventional switch construction, there may be provided three terminal contacts which are held stationary, and a movable contact associated with the terminal contacts. The movable contact may comprise two contacting portions, and in one position, these portions engage a common terminal and one of the other terminal contacts. When switching circuits, the movable contact is shifted for engagement with the common terminal and the other terminal.

During shifting, there is a period during which only the common terminal is engaged by the movable contact. At this time, there is an open circuit which is only completed when shifting has commenced to the point that the movable contact engages an opposite contact terminal. Arcing occurs when the movable contact closely approaches this opposite terminal. The arcing occurs across the air gap existing upon this close approach, and in high current operations, the intensity and duration of arcing can be considerable. Damage to contacts results to the point that contact elements and often entire switch constructions must be replaced at frequent intervals.

Problems of the type described have become more critical as switch constructions become smaller and smaller. The miniaturization of switches makes it extremely difficult to replace contact elements and, therefore, when damage occurs, an entire switch construction must usually be replaced. In addition, switch constructions are often difficult to replace in complex equipment and, therefore, the need for frequent replacement increases labor costs and down time for the equipment.

As indicated above, it is desirable to provide shorting contacts which are particularly suitable for production in extremely small sizes whereby they can be employed in miniature switches. Non-shorting contact elements, particularly adapted to be employed in switches included in relatively low current circuits are also desirably produced in extremely small sizes for miniature switches. Reliability of operation has been a major problem when both shorting and non-shorting contact elements are produced in such small sizes.

It is one object of this invention to provide a design for switch contact elements which enables the use of such elements in extremely small switches and which provides for highly reliable operation in such switches.

It is a further object of this invention to provide a shorting contact element which can be employed in switch constructions for thereby eliminating various problems which occur as a result of arcing in the switch constructions.

It is an additional object of this invention to provide a shorting contact element which is simple in design and which can be readily produced in extremely small sizes whereby miniature switches can be provided with shorting contact elements without undue expense.

It is a still further object of this invention to provide a

shorting contact element which is capable of achieving the foregoing objects and which is at the same time, extremely reliable during switch operation.

These and other objects of this invention will appear hereinafter and for purposes of illustration, but not of limitation, specific embodiments of this invention are shown in the accompanying drawings in which:

FIGURE 1 is a fragmentary elevational view in section of a switch construction incorporating the contact elements of this invention;

FIGURE 2 is a detail end view of a contact element of the invention in association with contact terminals;

FIGURE 3 is a plan view of the element shown in FIGURE 2;

FIGURE 4 is an elevational view of a non-shorting contact element in association with contact terminals;

FIGURE 5 is an end view of the contact element shown in FIGURE 4; and,

FIGURE 6 is a plan view of the contact element of FIGURE 4.

The instant invention is generally directed to contact means adapted to be utilized in conjunction with a variety of switch constructions. The contact means are adapted to be associated with a holder which is movable with respect to contact members such as stationary terminal contacts.

The design of the contact means of this invention is such that the contact means can be formed from a single stamping with the contact element portions thereof being automatically formed in the stamping operation. Furthermore, the design is such that the contact can be readily associated with a suitable holder and means are provided for locating a spring element in the holder for engagement with the contact so that desired bearing pressure can be achieved with respect to the contact terminals.

FIGURES 1, 2 and 3 illustrate the application of the principles of this invention to a switch element of the shorting type. In the construction shown, there is provided an insulating base **10** having terminal contact members **12**, **14** and **16** associated therewith. A holder **18** is adapted to be movable over the base **10**, and this holder carries contact shoe **20**. It will be appreciated that the concepts of this invention will be applicable to a wide variety of switch constructions. Reference is made to copending applications Ser. No. 439,009, filed Mar. 11, 1965, and entitled "Switch Constructions," and Ser. No. 516,301, filed Dec. 27, 1965 and entitled "Spring Operated Switch," for a description of switch constructions which could be adapted for the use of the contact elements described herein.

The holder **18** defines a bore **22**, and a coil spring **24** is retained within this bore. The bore terminates in an enlarged end portion **26**, and an annular groove **28** communicates with this end portion.

The contact shoe **20** comprises a stamping which includes protuberances **30**, **32** and **34** extending outwardly from one face thereof. An additional protuberance **36** extends outwardly from the opposite side of the shoe, and this protuberance is centrally located whereby the end **38** of the spring **24** fits around the protuberance.

The end portions **40** of the shoe are bent relative to the main body thereof, and these end portions are aligned with the annular groove **28**. The enlarged end **26** defined by the holder **18** is dimensioned to substantially correspond to the length of the shoe **20**, and the end portions **40** of the shoe serve to retain the shoe in position with respect to the holder.

The solid line showings in FIGURES 1 and 3 illustrate the shoe **20** in an intermediate switching position. In this position, the contact elements **30**, **32** and **34** are in engagement with the heads **42**, **44** and **46** of the re-

spective terminal contacts 12, 14 and 16. When the holder 18 is shifted to the left, contact is broken between the element 34 and the head 46. Accordingly, the arrangement provides for the completion of a circuit which includes the terminal 12 and the terminal 14, the latter comprising a common terminal.

When the holder 18 is shifted to the right, a circuit is completed between the terminals 14 and 16. During this shifting movement, the contact between the element 30 and the head 42 is not broken until the element 34 reaches the head 46. It will, therefore, be apparent that there is always a closed circuit in the described system. In this connection, it will be understood that it is not necessary that the element 32 be included in the circuit when final shifting has been completed. It is contemplated that the circuit between the terminals 14 and 16 as well as the circuit between the terminals 12 and 14 could be maintained by contact of the elements 30 and 34, respectively, with the terminal 14. In such an instance, shifting movement would first result in the element 32 being included in the circuit with the element 30 or 34 being thereafter included.

The arrangement as described in FIGURES 1 through 3 is characterized by definite advantages when compared with prior art arrangements. The arcing problem is eliminated and, in addition, the particular design of the contact element is extremely reliable. This reliability arises due to the fact that the triangular three-point contact insures against one of the elements on the shoe moving out of contact due to tilting of the shoe or the like. Thus, the action of the spring 24 provides bearing pressure while the design of the shoe prevents one of the elements from movement away from an engaging position. Even if the manufacturing of the contact shoes resulted in some misalignment, the triangular design will still provide for the desired three-point contact. The same results are achieved even if some misalignment exists with respect to location of the terminals with respect to the insulating base.

The triangular relationship illustrated is of significance with respect to the results described above. Thus, it will be noted that the protuberance 36 is located at approximately the center point of the triangule formed by the elements 30, 32 and 34. The spring 24, when located by means of the protuberance 36, thus bears down in a fashion which insures the application of engaging pressure to each of the contact elements.

It will be appreciated that the reliability described could not be achieved if the contact elements 30, 32 and 34 were all in the same line. If one of the elements were even in a slightly different plane, the spring action could readily cause tilting of the shoe causing a break in contact. Similarly, slight deviations in the heads 42, 44 or 46 could result in a loss of engaging action with respect to one of the elements of the shoe.

A further distinct advantage of the shoe described relates to the simple design and its ready applicability with respect to a holder. In a single stamping operation, the contact elements can be provided in the form of protuberances and, in addition, the end portions can be formed for properly retaining the shoe with respect to the holder. Finally, the additional protuberance shown at 36 is readily formed for purposes of alignment with the end of the coil spring.

The above described features are also adaptable for incorporation into a shoe 50, which is illustrated in FIGURES 4, 5 and 6. This shoe includes two contact elements 52 and 54. The contact elements are adapted to engage the heads 56, 58 and 60 of stationary contact terminals mounted in an insulating base 62. In this instance, the terminals are in a direct line, and the contact shoe is of the non-shorting variety.

It will be noted that the end 38 of a coil spring 24 is adapted to be associated with a protuberance 63 formed

centrally of the shoe 50 in the same manner as explained with reference to the shoe 20. An important feature of the design illustrated relates to its interchangeability in a holder 18 with respect to a shoe 20. End portions 64 are formed in the shoe 50 for association of the shoe with a holder 18 in the manner described above. It will be obvious that the manufacture of the shoe 50 can be readily accomplished with the same ease as the shoe 20. Furthermore, incorporation of this shoe 50 into a switch construction is extremely simple, and the design of the shoe provides for extremely reliable operation.

It will be understood that various changes and modifications may be made in the above described constructions which provide the characteristics of this invention without departing from the spirit thereof particularly as defined in the following claims.

What is claimed is:

1. In a switch construction comprising a plurality of contact members and a contact shoe movable over said members to complete circuits therebetween, the improvement wherein said contact members comprise at least three members with two of the members in a line parallel to the path of movement of said shoe and with one other member offset from said line, said shoe comprising at least three contact elements with two of said elements positioned for movement in contact with said two members and with one other element positioned for movement in contact with said other member, and means resiliently pressing said shoe against said contact members.

2. A construction in accordance with claim 1 wherein said contact members are fixed to an insulating base, and wherein said shoe is carried by a holder which is reciprocally movable with respect to said base.

3. A construction in accordance with claim 1 wherein said contact shoe comprises a stamping which includes three protuberances formed outwardly on one side thereof to form said contact elements.

4. A construction in accordance with claim 3 including a holder reciprocally movable relative to said contact members, a bore formed in said holder, and a spring located in said bore, said shoe located adjacent the end of said bore whereby said spring resiliently presses said shoe against said contact members.

5. A construction in accordance with claim 4 including an additional protuberance on the other side of said stamping, one end of said spring positioned around said additional protuberance.

6. A construction in accordance with claim 5 wherein said stamping includes out-turned end portions, and recesses formed in said holder for receiving said end portions whereby said stamping is retained in association with said holder.

7. In a switch construction comprising a plurality of contact members, an insulating base holding said contact members, and a contact shoe movable over said members to complete circuits therebetween, the improvement wherein at least three of said contact members are associated with said base, two of said members positioned in a line parallel to the path of movement of said shoe and the other of said members positioned intermediate said two members at a point offset from said line, said shoe comprising an integral member including three outwardly extending contact elements, two of said elements positioned for movement in contact with said two members, the other of said elements positioned for movement in contact with said other member, said other member comprising a common contact member for first and second circuits which include the common member and respective ones of said two members, said two contact elements completing each of said circuits with said other contact element in contact with said common contact member during switching between said circuits, and means resiliently pressing said shoe against said contact members.

8. A construction in accordance with claim 7 wherein said contact shoe comprises a stamping which includes

three protuberances formed outwardly on one side thereof to form said contact elements.

9. A construction in accordance with claim 8 including a holder reciprocally movable relative to said contact members, a bore formed in said holder, and a spring located in said bore, said shoe located adjacent the end of said bore whereby said spring resiliently presses said shoe against said contact members.

10. A construction in accordance with claim 9 including an additional protuberance on the other side of said stamping, one end of said spring positioned around said additional protuberance.

11. A construction in accordance with claim 10 wherein said stamping includes out-turned end portions, and recesses formed in said holder receiving said end portions whereby said stamping is retained in association with said holder.

12. A contact shoe for use in a switch construction comprising a conductive stamping having outwardly extending protuberances on one side for engagement with

contact members, a centrally located protuberance on the other side of said shoe, and out-turned end portions extending away from said other side, three of said protuberances formed on said one side of said shoe with two of the three protuberances aligned longitudinally of the shoe and with the third protuberance offset with respect to said two protuberances and located intermediate the two protuberances to form a triangular arrangement, and wherein the protuberance on the other side of said shoe is centrally located with respect to said triangular arrangement.

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