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K. F. BRADFORD

3,316,513

SEALED CONTACT REED SWITCH HAVING CONTOURED REEDS

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FIG. 1

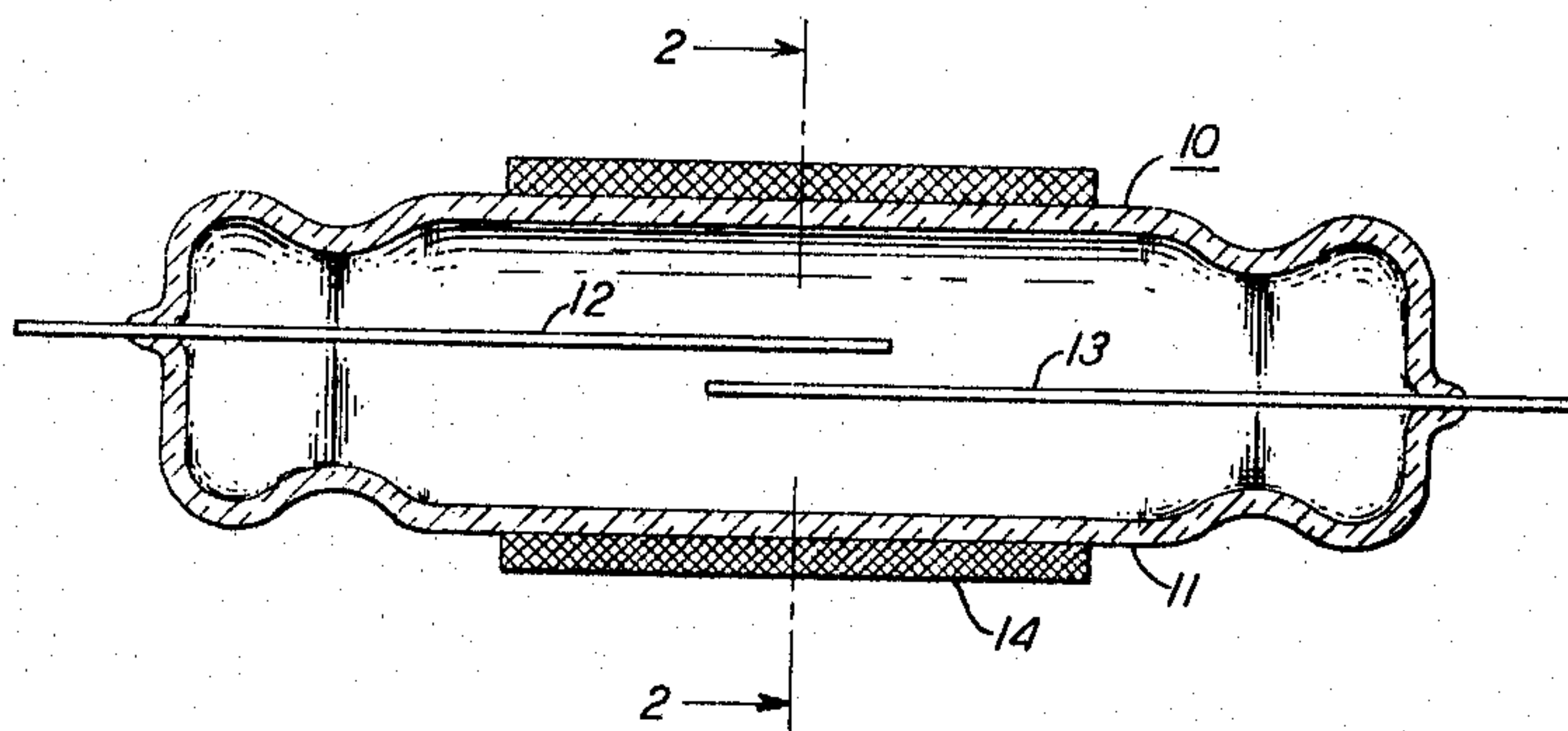


FIG. 2

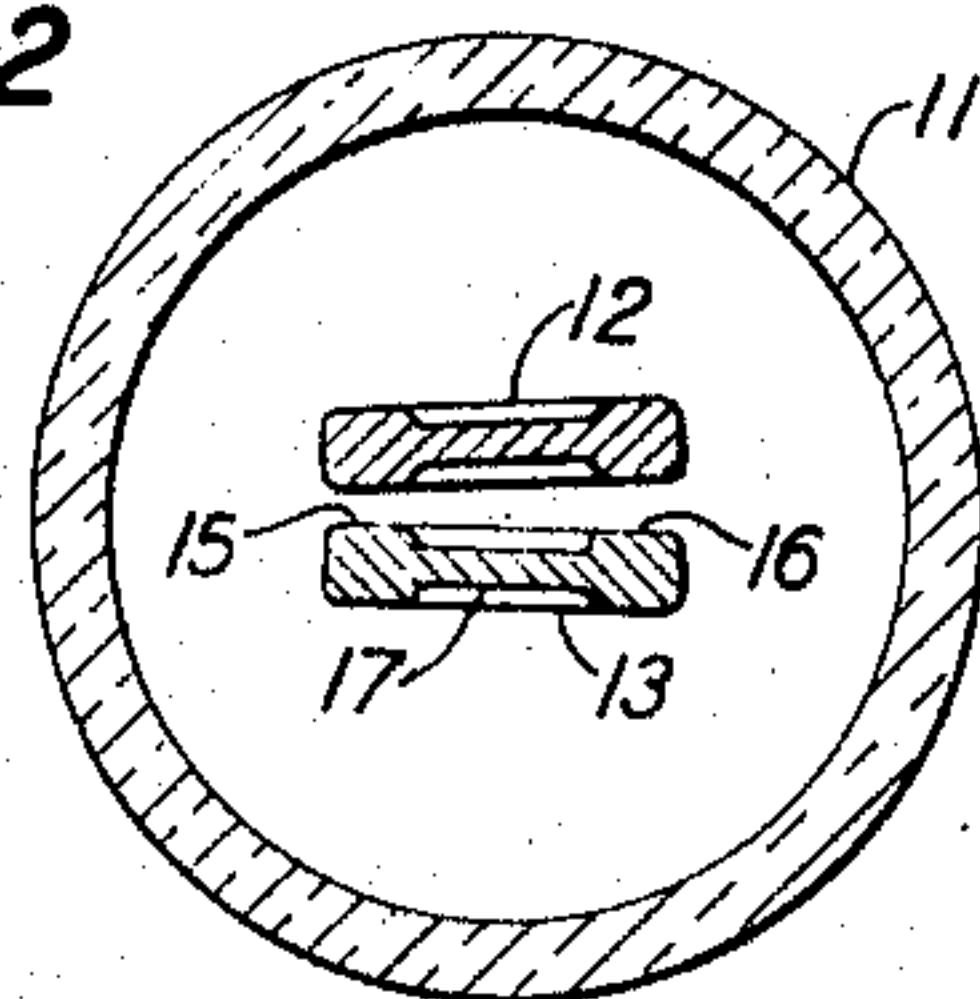
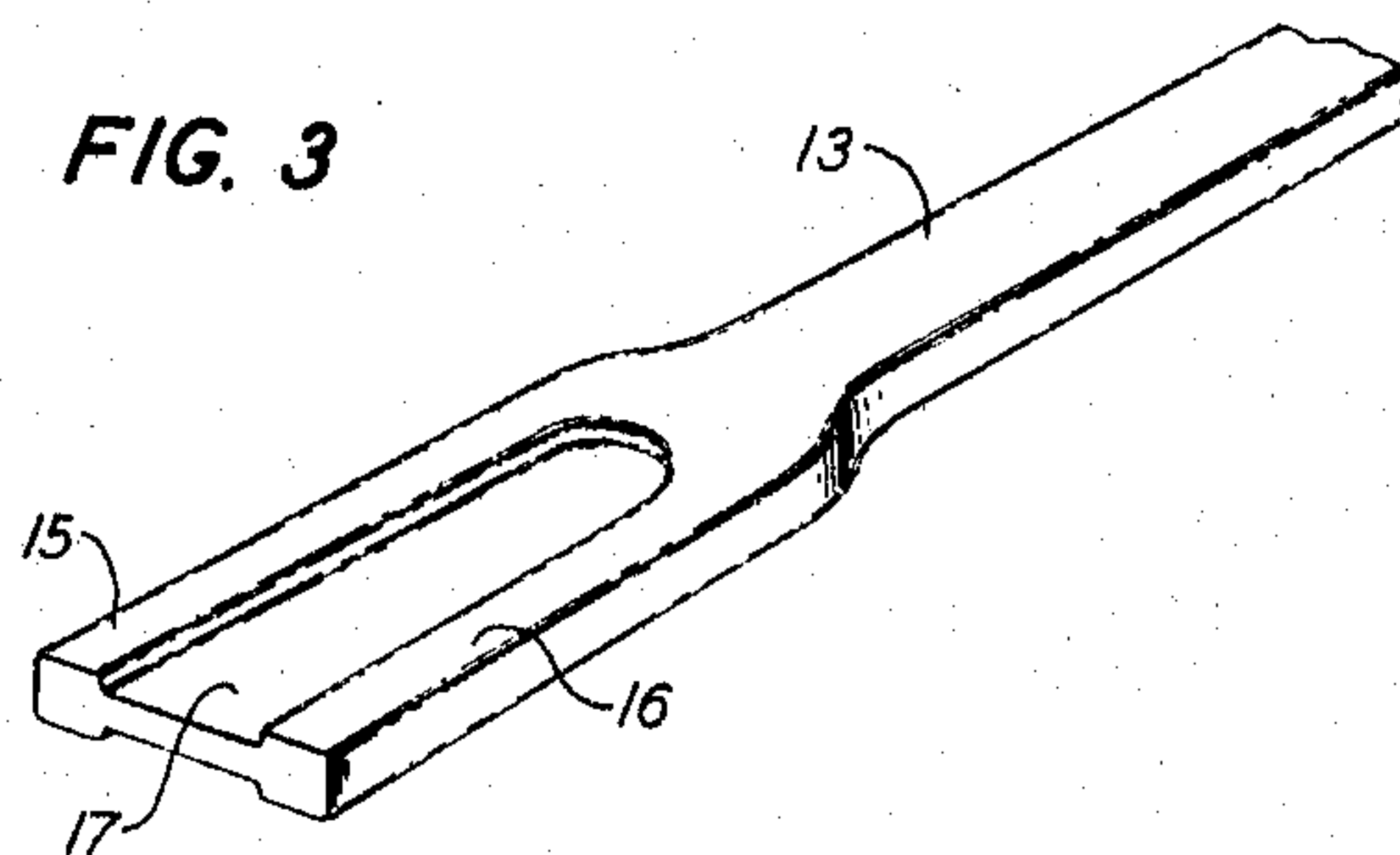
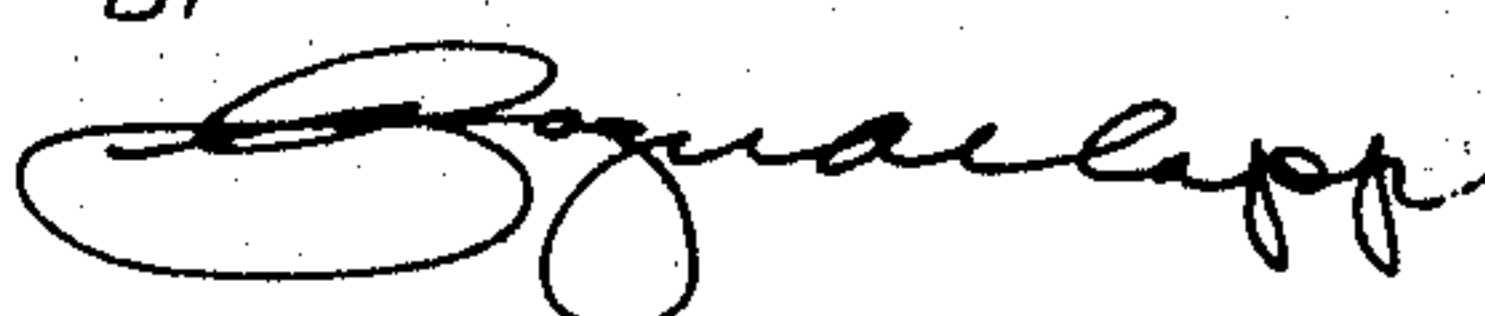


FIG. 3



INVENTOR
K. F. BRADFORD
BY

ATTORNEY

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SEALED CONTACT REED SWITCH HAVING CONTOURED REEDS

Kenneth F. Bradford, Murray Hill, N.J., assignor to Bell Telephone Laboratories, Incorporated, New York, N.Y., a corporation of New York

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6 Claims. (Cl. 335-154)

This invention relates to switching devices which are sensitive to variations in contact resistance and pertains especially to switches of the sealed contact reed type.

It is a general object of this invention to increase the stability of contact resistance in such devices.

A sealed contact reed switch typically comprises a source of magnetic flux, a vessel, and a pair of contacts or reeds. The reeds are magnetically responsive, and they are sealed in the walls of the vessel as cantilevers with their free ends overlapping and spaced from one another by an air gap. When magnetic flux from the source is applied, the reeds come together to establish a continuous electrical path and when the magnetic flux is removed, they spring apart to interrupt the electrical path. While these switches are highly reliable in a mechanical sense, they are susceptible to variations in contact resistance.

Contact resistance is the electrical resistance appearing between the opposing faces of the reeds after they have come together, and it is directly related to the microscopic mechanical connections joining the two reeds. In most switching applications high contact resistance is undesirable.

Reed switches having an initially low contact resistance are readily made by plating the contact ends of the reeds with various well-known materials. In most applications, however, the contacts are subject to arcing and pitting occurs. As a result, the plating material breaks down and the mechanical connection between the reeds is changed, thereby changing the contact resistance. Although most changes result in increased contact resistance, it is possible that reduced contact resistance could also occur. In either event, however, the contact resistance becomes unstable.

Accordingly, it is a specific object of this invention to minimize changes in contact resistance during operation.

It is another specific object of this invention to concentrate pitting of the contacting surfaces in a particular area.

According to one feature of this invention, the contacting ends of the reeds are contoured to have two ribs separated by a web.

In accordance with another feature of this invention, the contacting surfaces of the two reeds are out of parallel with each other.

In one embodiment of this invention, two spaced-apart and overlapping magnetic reeds are sealed in opposite ends of a glass tube with both overlapping ends slightly out of parallel with each other. The overlapping end of one reed is contoured to have two ribs separated by a web. With this arrangement, the rib closest to the other reed makes contact first and thus sustains all arcing damage, while the rib furthest from the other reed makes contact in a circuit already closed and consequently suffers no arcing damage. As a result, the contact resistance between the latter rib and the other reed remains substantially unchanged from operation to operation.

Other objects and features of this invention will be readily apparent from the following detailed description when taken in conjunction with the drawing in which:

FIG. 1 is an elevation view of a reed switch having portions broken away to show the overlapping reeds sealed therein;

FIG. 2 is a section view taken along line 2-2 of the

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reed switch shown in FIG. 1 and shows the configuration of two overlapping reeds made in accordance with this invention; and

FIG. 3 is an enlarged view of the contoured end portion of a reed illustrated in FIGS. 1 and 2 and shows in detail the two ribs and the connecting web.

A sealed contact reed switch 10 is shown in FIG. 1. The switch 10 comprises a vessel 11, two flat overlapping and spaced-apart reeds 12 and 13, and a coil 14. The vessel 11 is conveniently made of glass, while the reeds 12 and 13 are made of a ferromagnetic material such as 52-Alloy. In addition, the reeds have cross-sections thin enough and wide enough to allow relatively easy torsional movement.

As shown in FIG. 2, the overlapping ends of the reeds 12 and 13 are contoured. Moreover, the two reeds are sealed in the vessel 11 so as to be slightly out of parallel with each other.

One or both of the reeds of the overlapping ends of the reeds can be contoured. Because it is easier to contour all of the reeds when they are made, however, in the embodiment illustrated both reeds are contoured. Because both reeds are contoured in the same manner, a description of one suffices to describe the other.

The contour of the reed 13 is shown in detail in FIG. 3. Specifically, the end portion thereof includes two ridges or ribs 15 and 16 and a web 17. The ribs 15 and 16 are raised from and separated by the web 17. In the embodiment shown, the end portion of the reed 13 has been formed so that the two ribs 15 and 16 are substantially parallel. While this arrangement is preferred, others are equally good; the important thing being that the end of the reed 13 include two raised edges.

In operation the out of parallel end portions of the reeds 12 and 13 are attracted when the coil 14 is energized. Because the rib 15 is closest to the reed 12, it makes contact first. Thereafter, the reed 13 twists and the rib 16 engages the reed 12. Consequently, both the rib 15 and the rib 16 engage the reed 12.

Any arcing during closure occurs between the rib 15 and its counterpart on the reed 12. Thus, when the rib 16 engages the reed 12, the electrical potential between the two is substantially reduced. As a consequence, the rib 16 suffers little if any arcing damage. Because the rib 15 suffers little or no arcing damage, practically no pitting occurs and the contact resistance between the rib 16 and the reed 12 remains stable, operation after operation.

The following table contains data comparing the failure rate of reed switches containing contoured reeds with reed switches containing uncontoured reeds. For the purposes of the tests, failure was deemed to have occurred when the total contact resistance in the switch being tested exceeded .150 ohm.

Number of Operations (in millions)	Percentage of Switch Failures	
	Uncontoured	Contoured
3	12.0	.6
4.6	30.0	4.0
6	50.0	12.0

In summary, there has been described herein an embodiment of this invention whereby contact resistance in a sealed contact reed switch is stabilized by contouring the ends of two overlapping reeds so that each has two raised edges separated by a web and by sealing the two overlapping reeds so that they are out of parallel with each other. The embodiment described, however, is merely illustrative of the principles of this invention and many

other embodiments within the scope of the invention will readily occur to others skilled in the art.

What is claimed is:

1. In a switching device sensitive to variations in contact resistance, the combination comprising:

- a sealed vessel;
- a first contact sealed in said vessel as a cantilever and having a flat free end;
- a second contact for engaging said first contact to open and close an electrical path, said second contact being sealed in said vessel as a cantilever and having a flat free end overlapping and spaced from the flat free end of said first contact, the flat free end of said second contact including two ribs separated by a web, said two ribs for engaging the flat free end of said first contact one after the other and being disposed along the long axis of said first contact and one of said first and second contacts being out of parallel with the other whereby the order in which said two ribs engage said first contact remains fixed and the first rib to engage said first contact electrically connects said first and second contacts and carries and extinguishes any electrical arc appearing between said first and second contacts and the last rib to engage said first contact is not subject to any electrical arc and establishes a connection having a stable contact resistance between said first and second contacts.

2. In a switching device sensitive to variations in contact resistance, the combination comprising:

- a sealed vessel;
- and first and second contacts for interacting with each other to open and close an electrical path, said first and second contacts being sealed in said vessel as cantilevers and having free ends overlapping and spaced from each other by an air gap, one of said free ends including two raised portions separated by a web and one of said first and second contacts being out of parallel with the other whereby said two raised portions engage the other free end one after the other in a fixed sequence.

3. The combination in accordance with claim 2 wherein the other of said free ends includes two raised portions separated by a web.

4. In a switching device sensitive to variations in contact resistance the combination comprising:

- a sealed vessel;
- a first contact sealed in said vessel as a cantilever and having a free end;
- a second contact for engaging said first contact, said second contact being sealed in said vessel as a cantilever and having a free end overlapping and spaced from the free end of said first contact, the free end of said second contact including two separate raised edges joined by a web for engaging the free end of said first contact one after the other in a fixed sequence.

lever and having a free end overlapping and spaced from the free end of said first contact, the free end of said second contact including two separate raised edges joined by a web for engaging the free end of said first contact one after the other in a fixed sequence.

5. In a switching device sensitive to variations in contact resistance the combination comprising:

- a sealed vessel;
- a first contact sealed in said vessel as a cantilever and having a free end;
- a second contact for engaging said first contact, said second contact being sealed in said vessel as a cantilever and having a free end overlapping and spaced from the free end of said first contact, the free end of said second contact including two separate raised edges for engaging the free end of said first contact one after the other in a fixed sequence, and the free ends of said first and second contacts being out of parallel.

6. In a switching device sensitive to variations in contact resistance the combination comprising:

- a sealed vessel;
- a first contact sealed in said vessel as a cantilever and having a free end;
- a second contact for engaging said first contact, said second contact being sealed in said vessel as a cantilever and having a free end overlapping and spaced from the free end of said first contact, the free end of said second contact including two separate raised edges joined by a web for engaging the free end of said first contact one after the other in a fixed sequence, and the free ends of said first and second contacts being out of parallel.

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BERNARD A. GILHEANY, *Primary Examiner.*

J. J. BAKER, R. N. ENVALL, JR., *Assistant Examiners.*