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ELECTROMECHANICAL SWITCH

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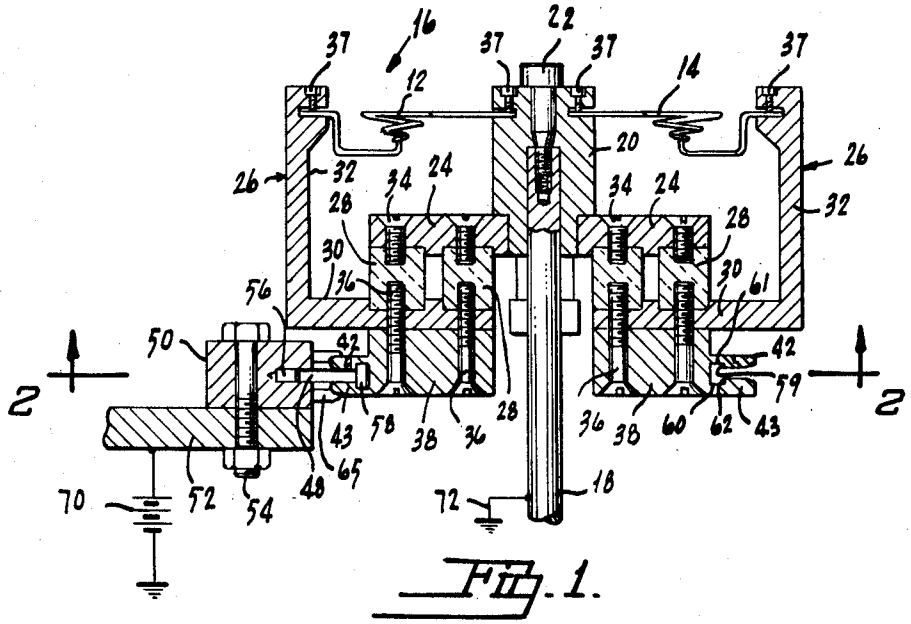



Fig. 1.

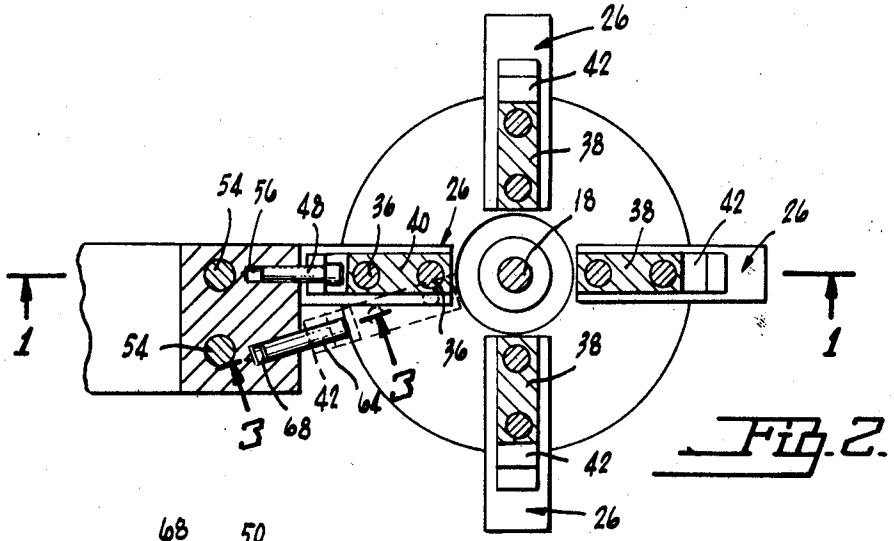



Fig. 2.

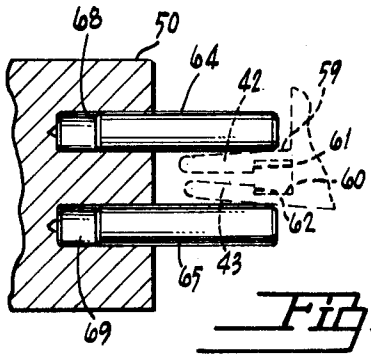



Fig. 3.

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# ELECTROMECHANICAL SWITCH

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## ABSTRACT OF THE DISCLOSURE

An electromechanical switch for use where resilient materials may not be practicable has a relatively hard contact, a malleable contact, and a device for re-shaping the malleable contact prior to each of its engagements with the hard contact.

## BACKGROUND OF THE INVENTION

This invention was made in the course of or under a contract or subcontract thereunder with the Department of the Air Force. The invention relates to the art of electromechanical switches and pertains more particularly to an electromechanical switch for use in an environment in which resilient materials cannot be effectively employed.

In an electromechanical switch, there is ordinarily a fixed contact element and a movable contact element which is adapted to be brought into and out of engagement with the fixed contact element. The efficiency of the contact is dependent on, among other things, the force or pressure between the two contact elements. Customarily, resilient biasing means are used to provide the pressure necessary for good, low resistance contact. The materials of which the contact elements are made may themselves be resilient, or separate springs may be used to bias the elements together.

Under certain conditions, springs or resilient contact materials may not be practicable. For example, high temperatures may cause resilient switch materials to lose their elasticity. In very clean systems, non-resilient, inert materials such as pure gold may have to be used so as not to contaminate the system.

More particularly, in vacuum evaporation systems used in the manufacture of microelectronic devices and the like, electrical resistance heaters are used to evaporate materials which are to be deposited as films on a support or substrate. Typically, several heaters are employed within a single vacuum chamber and each is adapted to be moved selectively into a position from which evaporation is desired. Current must be supplied from outside the system to each heater individually.

Because of the high temperatures within a vacuum chamber near the resistance heaters, it has been difficult heretofore to provide switch contacts within the chamber near the heaters. Consequently, contacts have been placed within a vacuum chamber at a considerable distance from the heaters, resulting in the loss of valuable space, or separate conductors for supplying current to each heater have been led out through the wall of the chamber to switching means located outside the chamber. Such arrangements unduly complicate the structure of the chamber. It is desirable, on the contrary, that the number and complexity of openings through the wall of the chamber be kept to a minimum.

## SUMMARY OF THE INVENTION

The present novel electromechanical switch has a relatively hard contact and malleable contact. The malleable contact is adapted to be bent or otherwise deformed by engagement with the hard contact. A reshaping means



is included in the switch and is engageable by the malleable contact to force it in the direction opposite to the direction in which it is deformed by engagement with the hard contact. By this means, the malleable contact may be reshaped prior to each engagement with the hard contact, and, consequently, the switch may be used efficiently in spite of adverse conditions such as high temperature.

## THE DRAWINGS

FIG. 1 is vertical cross section through a portion of a vacuum evaporation system showing the contact elements of the present electromechanical switch in the closed condition;

FIG. 2 is a cross section on the line 2—2 of FIG. 1 showing, in phantom, another position of the movable contact elements of the present switch;

FIG. 3 is a partial cross section on the line 3—3 of FIG. 2.

## PREFERRED EMBODIMENT

The present electromechanical switch is illustrated in the drawings as applied to a resistance heating device adapted for use in a high vacuum, high temperature environment such as a thin film evaporator, for example. The resistance heating device includes a plurality of conical resistance wire coils, **12** and **14**, in which a material may be heated to evaporate it for deposition on a substrate, not shown, located elsewhere in the system.

The resistance coils **12** and **14** are supported on a turntable **16** which is mounted on a shaft **18** adapted to be rotated about its longitudinal axis to position each of the coils selectively at a location from which evaporation is desired. The turntable **16** includes a central bushing **20** which is attached to the shaft **18** by means of a fastener **22**. Attached to the bushing **20** is an annular disc **24**. L-shaped parts **26**, one for each resistance coil, are supported on the disc **24** and are separated therefrom by spacer blocks **28** made of insulating material. Each part **26** has a horizontal leg **30** and a vertical leg **32**. Fasteners **34** connect the spacer blocks **28** to the disc **24** and fasteners **36** connect each L-shaped part **26** to the spacer blocks **28**. The resistance coils **12** and **14** are each connected, as by clamping screws **37**, between the upper end of a leg **32** of an L-shaped part **26** and the bushing **20**.

The fasteners **36** also serve to attach a contact block **38** to the lower side of the horizontal leg **30** of each L-shaped part **26**. Each contact block **38** carries a fork-like contact comprising a pair of spaced contact fingers **42** and **43**. The contact fingers **42** and **43** are made of malleable material, such as vacuum grade copper.

The contact fingers **42** and **43** are adapted to engage a fixed, relatively hard contact pin **48** which is supported by a contact block **50**. The contact block **50** is mounted on a fixed plate **52** by means of a pair of fasteners **54** (FIGURE 2). Preferably, the pin **48** is inserted with a press fit into a suitable bore **56** in the block **50**. In this example, the pin **48** has an enlarged head **58** thereon, as shown.

Each of the contact fingers **42** and **43** is provided with an internal recess so that weakened areas **59** and **60** and ledges **61** and **62**, respectively, are defined. The weakened areas **59** and **60** facilitate the bending of the contact fingers **42** and **43**. The ledges **61** and **62** may engage the underside of the head **58** to limit deflection of the entire turntable assembly **16** in the axial direction of the pin **48**, which deflection may result from the axial component of the force of the engagement between the pin **48** and the contact fingers **42** and **43**.

Also carried by the contact block **50** is a reshaping means comprising a pair of spaced pins **64** and **65**. The pins **64** and **65** are preferably held by means of a press fit in spaced bores **68** and **69** in the block **50**. As suggested

in FIG. 2, the pins **64** and **65** are directed radially with respect to the shaft **18**. The spacing between the pins **64** and **65** is such that the contact fingers **42** and **43** will be pressed toward each other as rotation of the shaft **18** forces them past the pins **64** and **65**. After passing between the pins **64** and **65**, the contact fingers **42** and **43** will retain the bent condition imparted to them by the pins **64** and **65**.

The electrical components of the present system include a battery **70** which preferably is located outside the vacuum chamber. One side of the battery **70** is connected to the plate **52** and the other side of the battery is connected to ground. The shaft **18** is also connected to ground through a connection symbolically shown at **72**.

In operation, the turntable **16** of the device is rotated intermittently to bring each of the heater coils, such as the heater coil **12** in FIG. 1, for example, into position from which the evaporation of the material therefrom is intended to take place. This position may be determined by indexing means (not shown) operably connected to the shaft **18** outside the vacuum system. When the turntable **16** is brought into position, the contacts **42** and **43** of the movable contact **38** associated with the heater coil **12** engage the fixed contact pin **48**. This completes the circuit from the battery **60**, through the plate **52**, the contact block **50**, the fixed contact pin **48**, the movable contact fingers **42** and **43**, the contact block **38**, and the L-shaped part **26** to the heater coil **12**. From the heater coil **12**, the circuit is completed back to ground through the bushing **20**, the shaft **18**, and the ground connection **72**. Since each L-shaped part **26** is isolated by the insulating spacer blocks **28**, only one heater coil at a time receives current from the battery **70**.

After a desired amount of material has been evaporated, the shaft **18** is rotated to disconnect the movable contact fingers **42** and **43** from the contact pin **48**. Because they are malleable, the pins **42** and **43** will remain in the bent condition imparted to them by the engagement with the pin **48**. Upon rotation of the turntable **16** to again bring these contact fingers into engagement with the pin **48**, they will first encounter the spaced reshaping pins **64** and **65**. The pins **64** and **65** will force the contact fingers **42** and **43** toward each other, as the shaft is rotated. Thus, the contact fingers will be bent back in the direction opposite to the direction in which they were bent during contact with the pin **48**, to a separation distance less than the diameter of the pin **48**. Accordingly, when they again contact the pin **48**, they are in a condition such that contact pressure is restored. The contact fingers **42** and **43** associated with each of the other heater coils in the device will be acted upon similarly and will operate in the same manner.



What is claimed is:

**1.** Electromechanical switch means comprising

a relatively hard contact element,

a malleable contact element,

means mounting said hard and said malleable contact elements for relative motion therebetween into and out of engagement with each other, said malleable contact element being adapted to be deformed in one direction upon engagement with said hard contact element, and

means engageable by said malleable contact element prior to engagement with said hard contact element for causing said malleable contact element to be deformed in a direction opposite to said one direction.

**2.** Electromechanical switch means as recited in claim **1**, wherein said hard contact element is fixed in position and said malleable contact element is movable with respect thereto.

**3.** Electromechanical switch means as recited in claim **1** wherein said hard contact element comprises a cylindrical pin,

said malleable contact element comprises a pair of spaced fingers adapted to engage said pin at diametrically opposite locations thereon, and

said engageable means comprises means for bending said fingers toward each other to a spacing less than the diameter of said pin.

**4.** Electromechanical switch means as recited in claim **3** wherein said cylindrical pin has an enlarged cylindrical head and said spaced fingers each have a recess defining a ledge engageable by said head to limit motion of said malleable contact element in the direction of the axis of said cylindrical pin.

**5.** Electromechanical switch means as recited in claim **3** wherein said malleable contact element is mounted for translational movement in an arcuate path about a fixed axis, and

said hard contact element and said engageable means are located in said path.

**6.** Electromechanical switch means as recited in claim **5** wherein said engageable means comprises two spaced pins separated by a distance such that engagement of said fingers therewith forces said fingers toward each other.

**References Cited**

UNITED STATES PATENTS

| | | |
|---|---|---|
| 2,918,541 | 12/1959 | Waite. |
| 3,045,090 | 7/1962 | Wilson et al. |
| 3,301,971 | 1/1967 | Johnson. |
| 3,382,340 | 5/1968 | Moodie et al. |

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