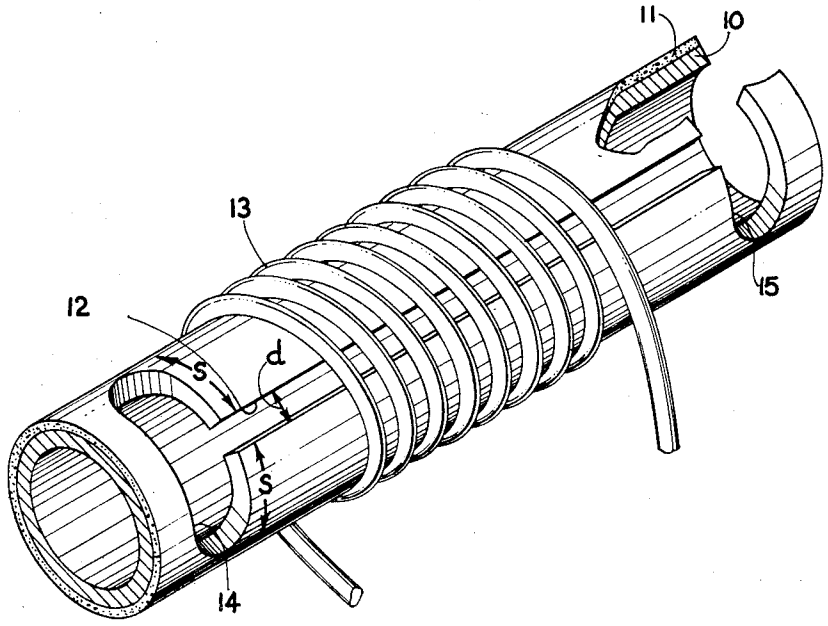
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POTENTIOMETER MANDREL

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POTENTIOMETER MANDREL

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This invention relates generally to electrical resistance potentiometers and more particularly to an improved potentiometer coil mandrel support for high precision, miniature type potentiometer coils used in systems subject to wide temperature variations.

Potentiometer coils are conventionally wound on a tubular mandrel constructed of insulating material or of metal tubing provided with an insulative coating. For potentiometers used in high precision control circuits such as are employed in guided missiles, for example, a high degree of reliability is a fundamental requirement. Not only is it extremely important that the coil itself remain intact, but the various turns must remain in their original spacing with respect to each other in order that the output of the potentiometer vary in a consistent manner with tap position. In the field of guided missile controls, the potentiometers must necessarily be miniature in size and operate satisfactorily over a wide temperature range. Temperature changes not only result from initial current passing through the potentiometer coils, but also result from extreme ambient temperature changes, particularly in the case of high altitude missiles.

Usually the co-efficients of thermal expansion of the conductor wire used for the potentiometer coils is different from the co-efficient of thermal expansion of the supporting core or mandrel. These different co-efficients result in different thermal expansion rates. If the thermal co-efficient for the coils is higher than that for the mandrel, the potentiometer coils may become loose on the supporting core. On the other hand, if the thermal co-efficient for the mandrel is greater than for the coils, tension on the coils may increase to the point where they will break. Even in the case where the thermal co-efficients of both the mandrel and the coils are almost the same value, however, there are still difficulties involved. For example, the initial heating of the coil itself due to current will cause it to expand before a corresponding expansion of the mandrel, which is initially at environmental temperature, takes place.

The primary object of the present invention is to provide an improved potentiometer mandrel in which the above noted difficulties of loose coils or possible breakage of the coils due to thermal variations is avoided.

Another object is to provide a potentiometer mandrel of the above type which is of extremely simple construction and may be readily manufactured with no appreciable increase in cost over present day mandrels.

These and other objects and advantages of this invention are attained by providing a potentiometer mandrel in the form of a thin tubular member having an elongated slot along one side. The ends of the slot terminate beyond the end points of one or more potentiometer coils wound about the mandrel. The potentiometer coils are wound under tension so that the mandrel is circumferentially contracted, the slot width accommodating this contraction. As a result, the mandrel is spring biased towards a radially expanded position so that it is urged

outwardly against the insides of the coils, thereby always maintaining them in tight engagement with the mandrel. This resilient spring type force is extremely small compared to thermal expansion forces and will not strain the coils. By this arrangement, any expansion or contraction of the mandrel as a result of thermal variations will be accommodated by a narrowing or widening of the slot width, and there is substantially no possibility of the coils breaking under tension or becoming loose on the mandrel.

A better understanding of the invention will be had by referring to a preferred embodiment thereof as shown in the accompanying drawing.

In the drawing there is shown a tubular mandrel member **10** preferably of thin stainless steel, covered, for example, by an insulative coating **11** of porcelain or anodized aluminum. This coating **11** comprises a dielectric skin capable of withstanding relatively high temperatures. The tubular mandrel member **10** includes an elongated longitudinal slot **12** in one wall of a given width "*d*." Potentiometer coils **13** are wrapped about the insulative layer **11** and slot **12** of the mandrel, the ends of the coils terminating short of the ends of the slot **12**.

Preferably the end portions of the slot **12** widen into enlarged openings. In the embodiment chosen for illustrative purposes these widened openings may take the form of elongated circular portions of circumferential extent greater than the width "*d*" of the slot.

The potentiometer coils **13** are wound about the mandrel **10** under tension resulting in a slight contraction of the mandrel. This contraction results in a narrowing of the width "*d*" of the slot. The widened end portions **14** and **15** render more resilient the longitudinal opposing edges of the slot portion. This increased resiliency is a result of the increased circumferential distance S between each longitudinal edge of the slot and the point of connection of the edge to the mandrel. In other words, the cantilevering circumferential arm length of each of the opposing edges defining the slot is defined by the distance S.

As a result of winding the coils under tension as described above, the slot portion of the mandrel is contracted radially inwardly thereby exerting a radially outwardly directed force against the inside portions of the coils **13** to place them under tension. Therefore, regardless of the respective co-efficients of thermal expansion of the coils **13** and mandrel **10**, the resilient nature of the mandrel due to the slot structure enabling the mandrel to change its diameter will accommodate any uneven thermal contractions or expansions. Therefore, the coils are maintained in uniformly spaced relationship with respect to each other and in tight engagement with the mandrel. Furthermore, by making the slot width "*d*" sufficiently large, the mandrel will have the necessary space to "give" to forestall the possibility of snapping the coils **13**, in the event of an extraordinarily large thermal expansion of the mandrel.

It will thus be seen that the present invention provides an extremely simple solution to the problem of uneven thermal expansions or uneven heating of coils and coil supports.

While a preferred form of the apparatus has been illustrated and described, certain modifications and changes as fall within the scope and spirit of the invention will occur to those skilled in the art. The potentiometer mandrel is, therefore, not to be thought of as limited to the construction shown in the drawings.

What is claimed is:

1. In combination: a mandrel comprising a tubular member having an elongated slot of given width along one side; each end of said slot terminating short of the

corresponding end of said tubular member in an enlarged opening extending circumferentially in opposite directions a given distance such that the edge portions of said mandrel defining said elongated slot are resiliently cantilevered; wire coils wrapped around said tubular member, the ends of said coils terminating short of the ends of said slot, said coils being wound under tension to circumferentially contract said portions of said mandrel between the ends of said slot whereby said member is resiliently biased radially outwardly against the insides of said coils, subsequent circumferential thermal expansion and contraction of said member and coils being accommodated by said given width.

2. The subject matter of claim 1, in which said tubular member includes an insulative layer of material between the outer surface of said mandrel and the underside of said coils.

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