# United States Patent

**Falke**

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[54] **SUPPORT ARRANGEMENT FOR THE CONDUCTORS OF LOW TEMPERATURE CABLES**


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[51] **Int. Cl.**.....**H01b 7/02**
[58] **Field of Search**....174/15 R, 15 C, DIG. 6, 16 B, 174/99 B, 28, 29, 131 A, 99 R



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[57] **ABSTRACT**

A low temperature cable including support means for carrying electrical conductors on a cylindrical surface disposed concentrically of the axis of the cable and which is designed to reduce tensile stress and relative movement in the cable as it is cooled. A plurality of aligned supporting rings are initially held in spaced relationship by means of a number of rod members that extend between adjacent rings with the ends of the rods loosely held in recesses near the outer peripheral surfaces of the rings. This structure is completed to a tube-like configuration by a wrapping of foil or tape. The rods and rings on the one hand and the foil or the tape on the other hand are usually, of different materials having different coefficients of contraction so that as the completed structure is cooled, the rods contract to an extent that they are disengaged from the rings and the movement of the rings, caused by the contraction of the foil or tape, relative to each other is not hampered.


**8 Claims, 3 Drawing Figures**

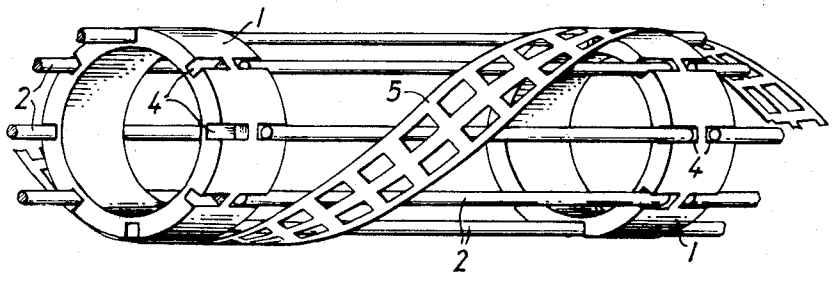


Fig. 1

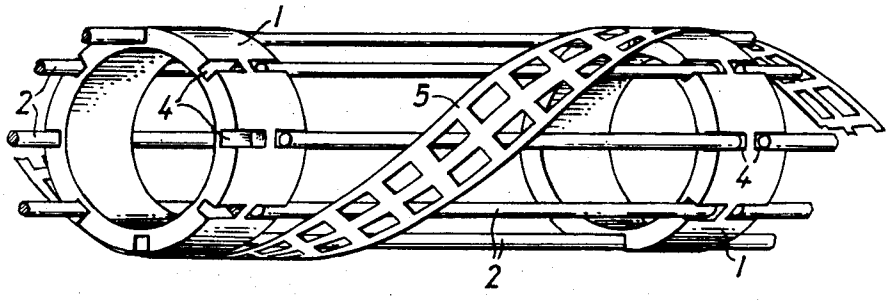



Fig. 2

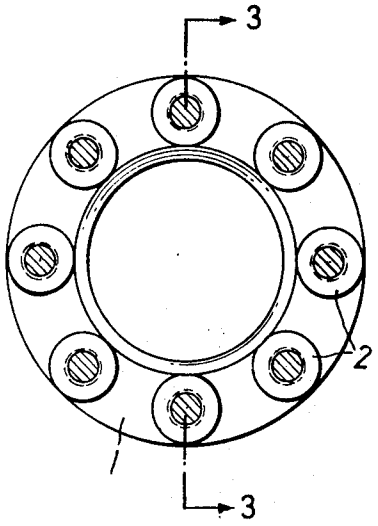
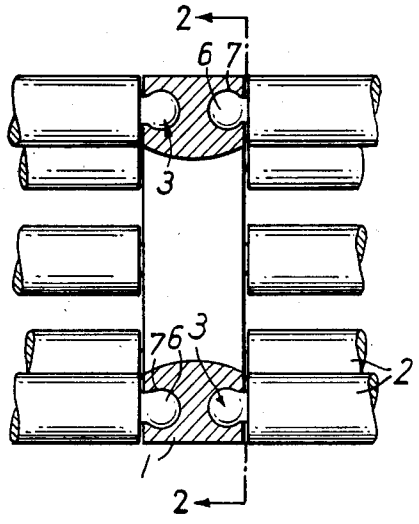



Fig. 3




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# SUPPORT ARRANGEMENT FOR THE CONDUCTORS OF LOW TEMPERATURE CABLES

## BACKGROUND OF THE INVENTION

The present invention relates to a support arrangement for the conductors of low temperature cables through which a cooling liquid flows.

The conductors in a low temperature cable, particularly band-type superconductors, or those applied to band-type carriers, surround the cable axis on a cylindrical surface which is concentric with the cable axis. The inner space of the elongate cylinder thus formed is occupied by a coolant, particularly liquefied helium. When a cable is cooled to low temperatures, unpermissible tensile stresses and relative movements occur due to the different contraction properties of the different materials generally employed to fabricate the various components of the cable.

In order to at least reduce such tensile stresses and relative movements during the cooling of cables, it is known to mount the conductors of low temperature cables on supports or supporting arrangements which consist of perforated corrugated synthetic tubes. Such a supporting arrangement permits a certain movement within the cable in a longitudinal direction. However, it still is too rigid to sufficiently suppress the undue tensile stresses and relative movements occurring between the conductors, the supporting arrangement and the cable sheath due to the different degrees of contraction of the different materials employed. Consequently, damage to the cable is not definitely eliminated.

## SUMMARY OF THE INVENTION

It is the object of the present invention to provide a supporting arrangement for the conductors of a low temperature cable in which the different contractions of the various structural materials during cooling do not produce such tensile stresses and relative movements that could lead to damage of the cable.

This is accomplished according to the present invention by the provision of a supporting arrangement which includes spaced supporting rings arranged one behind the other to surround the cable axis, which rings, together with a wrapping of foils or tapes, are combined into a tube-type configuration. In order to permit better fabrication of the cable with the supporting arrangement, the present invention further proposes to have the supporting rings loosely connected together by rods at least at normal temperature, the rods being distributed around the cable axis and parallel thereto. The ends of the rods may be connected with the supporting rings in the manner of snaps or they may be disposed in recesses in the outer periphery of the supporting rings.

Due to the fact that the supporting arrangement, consisting of the supporting rings or of rods connected to supporting rings, is wrapped with tapes, a stable supporting arrangement is produced. It is particularly advisable to wrap the supporting arrangement with perforated synthetic tapes or with a shrinkable foil. When the conductors themselves are provided in the form of tapes, however, or are disposed on supporting bands, it is also possible to wind these conductors themselves directly onto the supporting arrangement instead of using the supporting tapes.



The particular advantage of the supporting arrangement according to the present invention is that during cooling the individual elements of the supporting arrangement, i.e. the supporting rings, are freely movable with respect to one another. The rods which connect the supporting rings at normal temperature contract so much during cooling that they do not hamper the movement of the supporting rings with respect to one another. Thus, the occurrence of tensile stresses and dangerous relative movements is avoided.

## BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a perspective view of a preferred embodiment of the supporting arrangement according to the present invention.

FIG. 2 is an axial view of a supporting ring according to a further embodiment of the present invention, taken along the line 2—2 of FIG. 3.

FIG. 3 is a cross-sectional view of such a supporting ring seen along the line 3—3 of FIG. 2.

## DESCRIPTION OF THE PREFERRED EMBODIMENTS

FIG. 1 illustrates one embodiment of the supporting arrangement according to the present invention composed of supporting rings 1 having recesses 4 disposed around their outer periphery along each edge in which the ends of rods 2 can be disposed. This supporting arrangement is wrapped with supporting tapes 5, e.g. of a synthetic material, to provide better stability. For reasons of simplicity only one such tape is shown in FIG. 1.

The rings 1 and rods 2 are of materials with sufficient mechanical strength at low temperature conditions, PTFE (Polytetrafluorethylene) or FEP for instance. In one embodiment of the supporting arrangement the diameter of the rings may be 60 mm and their length ca 40 mm. The length of the rods may be about 10 to 100 mm. Independent from this specific example the proportions of the rings and the rods will depend on the conditions given by the objects of the construction of the projected low temperature cable.

After the supporting tapes are applied, the conductors, or tapes bearing the conductors, are applied to this wrapped supporting arrangement. When the conductors themselves are present in the form of tapes or are disposed on supporting bands, it is also possible to wind these bands directly onto the supporting arrangement instead of first applying the supporting tapes. When such a supporting arrangement is cooled, rods 2 can contract to such an extent that they are no longer held by the recesses in the supporting rings. Therefore, the rods fall inwardly so that free movement of the supporting rings 1 with respect to one another is assured for the actual supporting elements.

In another embodiment of the invention, the rods, as shown in FIGS. 2 and 3, may also be connected with the supporting rings 1 in the manner of snaps as generally indicated at 3. For this purpose, the ends of the rods 2 are provided with spherical protrusions 6 that are received in recesses 7 in supporting rings 1. This provides better stability of the connection at normal temperature but this connection also comes apart when the arrangement is cooled and contracts due partly to the contraction of protrusions 6.

It will be understood that the above description of the present invention is susceptible to various modifications, changes and adaptations and the same are intended to be comprehended within the meaning and range of equivalents of the appended claims.

I claim:

1. In an arrangement for supporting the superconductors of a low temperature cable concentrically with the axis of the cable and enclosing the region through which a coolant flows, the improvement comprising, in combination:

a. a plurality of supporting rings disposed one behind the other in aligned and spaced relationship;

b. means securing said supporting rings to each other and allowing movement of said supporting rings relative to each other; and

c. tape means wrapped around said supporting rings and said securing means to provide a tube-type structure.

2. An arrangement as defined in claim 1 wherein said supporting rings are provided, along each axial edge, with circumferentially spaced openings, and wherein said securing means comprise a plurality of rods which extend in parallel relationship between adjacent supporting rings, said rods at least before the first time said arrangement is cooled to a low temperature, being loosely supported at the ends thereof within said openings in adjacent supporting rings.

3. An arrangement as defined in claim 2 wherein said ends of said rods have spherical protrusions, and said spaced openings are recesses having a female mating configuration for said spherical protrusions to provide a snap connection.

4. An arrangement as defined in claim 2 wherein the circumferentially spaced openings are constituted by recesses open along the outer peripheral walls of said supporting rings.

5. An arrangement as defined in claim 1 wherein said tape means are composed of perforated synthetic material.

6. An arrangement as defined in claim 1 wherein said tape means are composed of shrinkable foil material.

7. An arrangement as defined in claim 1 wherein said tape means are composed of tape-type superconductors.

8. An arrangement as defined in claim 1 wherein said tape means are composed of band-type carriers with a superconductor thereon.

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