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"DEVICE FOR COVERING A CABLE TERMINATION, CABLE SPLICE
OR THE LIKE"

The invention refers to a device of plastic sheet material for a cable termination, a cable splice or any other cable portion freed from the cable sheet of electrical cables.

A multi-fingered sleeve for a cable termination made of permanently resilient sheet material has become known from the DE-OS 35 36 250 or the GB-PS 2 155 142. The termination sleeve contacts sealingly the core end portions and the cable sheath with a finger each, and-----

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encloses a cable shaping mass which fills out possibly present interstices and forms an insulation surrounding the crotch area. For the installation of the sleeve an oversized sleeve portion is shifted onto a crotch area and then partially constricted. To this purpose the sleeve portion can be mechanically pre-expanded by means of a supporting device and constricts upon removal of the supporting device. The U.S. patent specification 3 515 798 discloses mechanically pre-expanded tube-like portions having removable supporting devices.

Also, heat-shrinkable sleeves can be used if provision is made, through the selection of suitable material, that a termination sleeve made therefrom is sufficiently resilient to yield to possible movements of the core ends without transferring gap-forming forces to the crotch area.

In cable termination devices, the free core ends must be sufficiently flexible in order that the desired electrical connections can be made conveniently. However, the geometry and the sealing of the crotch area shall not be disturbingly altered by the movements of the core ends which occur during assembly and operation. Particularly, it is necessary to avoid gap-forming forces occurring in this electrical critical area. As known, gaps affect the quality of the-----

the insulation, particularly as a result of the penetration of moisture.

This problem is satisfactorily solved by a cable termination according to the already mentioned DE-OS 35 36 250 in that a rigid spreading body is inserted between the cores. The cable shaping mass of quick-curing material forms a solid body in the crotch area and its surrounding so that the core end portions are reliably held fast. In those portions where the finger-like ends of the termination sleeve surrounds the core end portions a sufficient flexibility is achieved so that the core end portions may be moved to the required extent without exerting thereby gap-forming forces on the crotch area.

After the mounting of the described termination sleeve the sheath-adjacent portion thereof is sealed against the cable sheath, e.g. by an adhesive tape. Thereafter, cable casting mass is casted through a finger portion surrounding a core end portion with oversize. Thereafter, the finger portions are constricted. As already mentioned this is caused by removal of suitable support devices effecting the pre-expansion or by heat shrinking of the respective enclosing areas. Upon the constriction of the individual sleeve portions the casting mass is forced into all inter-

stices which possibly may exist to form the cable shaping mass after the curing has taken place. The permanently resilient material of the sleeve will take a firm and intimately contiguous seat on the underlying structure.

The material used for the mentioned termination sleeve is relatively soft and flexible. Thus, it depends on the skill of the operator whether the cable shaping mass has approximately an equal thickness in radial direction about its circumference. During assembling it may occur that a sleeve portion in the crotch area will be irregularly deformed or eccentrically displaced relative to the cable axis. Above all, in case of a quick-curing cable resin mass the correct formation cannot be restored after a short time. Consequently, the crotch portion possibly does not provide the necessary insulating effect, particularly the sufficient protection against mechanical and moisture influences.

It is to be noted, that similar problems occur in those cases where tube-like sleeves of plastic materials are used for cable splices or other cable portions freed from the cable sheath.

An object of the invention is to provide a device of resilient plastic sheet material for a cable termination, a cable splice or another cable portion freed from the cable sheath of electrical cables.

According to the invention, there is provided a device for a cable termination or for a cable splice or another cable portion freed from the cable sheath of electrical cables, comprising a sleeve having an oversize portion relative to the cable prior and during its mounting and constricted finger portions and portions sealingly engaging core end portions and/or cable sheath end portions under pressure, said portions comprising plastics sheet material and said device incorporating within its interior a shaping mass which fills out possibly interstices present within the device and forms an insulation surrounding the crotch area and the splice area, respectively and further incorporating a radially effective reinforcement in the crotch area, and the splice area, respectively.

The preferred device according to the invention is provided with an enforcement effective in radial direction. The reinforcement or strengthening may also have an effect in circumferential direction, however, it is essential to the device that it has a shape strength in radial direction in its reinforced area. This shape stability results in an automatic centering within the sleeve and in a uniform distance between the oversize sleeve portion and the crotch or splice area, respectively, upon a constriction of a tubular end of the sleeve on the cable sheath and, e.g. of a cable termination. With this it is considered that the sleeve is uniformly, i.e. symmetrically pre-expanded or that the heat shrinking of the pre-expanded oversize portion symmetrically, respectively, when the sleeve is constricted onto the cable sheath. Normally, this can be achieved without more ado.

The standard of workmanship to be met by the operator is reduced with a sleeve according to the invention. He is only to observe that upon assembly of the sleeve the latter is approximately parallel to the cable axis and is maintained in this position when shifted on the crotch or splice area onto the cable sheath. The uniform distance from the critical area of the cable termination or the cable splice attained after the constriction is not affected by the consecutive work, in particular by the casting of the cast mass.

Different structural designs can be offered to realize the device according to the invention. For example, the sleeve can be provided with a reinforcement in the desired manner by a local thickening of the sleeve, an integral annular rib or the like. In an embodiment of the invention a separate annular or tube-like support element is provided. In this embodiment, the reinforcement is defined by a separate form piece. This form piece may consist of a plurality of annular support elements which are arranged one behind the other in axial direction. Alternatively, a single sleeve or tube-like support element can be applied. The sleeve or tube-like support element can be combined with the sleeve in a composite structure, such as by embedding in the material of the sleeve which appro- -----

priately has a slightly larger thickness in this respective area.

In a modification the sleeve or tube-like support element can be located at the interior or the exterior of the sleeve, the positioning at the interior being preferred. If the support element is located at the exterior a connection between the sleeve and the support element, e.g. through an adhesive, is required so that the external support element can effect the necessary stiffening.

It is known from the US patent 4 029 895 to employ a rigid tube for cable splices, the tube being provided with a plurality of slots at the ends thereof and being adapted to be slid over the splice after the cable connection has been established. An elastomeric sleeve is positioned on the rigid tube, the ends of the sleeve being rolled up in order to leave the slotted ends free for assembling purposes. After sliding the tube over the splice the ends of the sleeve are unrolled so that they extend beyond the tube ends in sealing engagement with the cable sheath. With this known embodiment the tube forms a carrier for the sleeve while in the invention the mechanical stability is substantially secured by the cable shaping mass and the

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sleeve essentially serves as container or casing for the cable shaping mass.

The support element can consist of different materials. It is particularly advantageous according to an embodiment of the invention, if the support element is a plastic sleeve which for example can be made of polypropylene. A relatively small thickness of such an enforcing sleeve is sufficient to provide the desired strength improvement. Such reinforcing sleeve as far as possible should be inserted in the sleeve without considerable manufacturing expense. To this end it is appropriate that the oversize portion of the sleeve has an inner diameter in its entrance area which is approximately equal to the outer diameter of the reinforcing sleeve. A small friction between the reinforcing sleeve and the sleeve is appropriate to position the reinforcing tube or sleeve within the outer sleeve prior to the constriction of the sleeve onto the cable sheath end.

As an alternative, the heat shrinkable oversize portion of the sleeve can be expanded such that the supporting or reinforcing tube can be easily inserted into the sleeve. Thereafter, the sleeve is slightly heat shrunk so that the tube is axially fixed within the sleeve and cannot change its position during the transport or its handling.

The reinforcing tube predetermines the inner diameter of the sleeve. Therefore, oversize sleeve portions having predetermined dimensions can be used (within limitations) for sleeves of different diameters. In case of a larger diameter reinforcement sleeve, the sleeve must be expanded more to allow a tube of greater diameter to be inserted.

It is clear from the above explanations that the reinforcement above all provides a certain pressure strength radially inwards. By forming a corrugation to the tube-like reinforcement in peripheral direction this pressure strength could be increased with a minimum of expense as to the material; preferably, a smooth cylindrical reinforcement is provided which most easily guarantees that no undesired inclusions between the reinforcement and the sleeve on the one side and the reinforcement and the casting mass on the other side affects the insulation which otherwise possibly may occur during the mounting of the sleeve according to the invention.

Cable terminations, cable splices or the like which are provided with a device as described above if compared with the prior art are distinguished by improved insulation properties,

properties, an increased moisture protection, an increased shape stability and improved strength in the critical insulation area. These advantages are achieved without a need for a particular skill with respect to the assembling operation. The time expense for the assembly most easily is less than with conventional structures. The manufacturing of the sleeve according to the invention requires only an insignificant larger expense as conventional sleeves. In case the sleeve substantially serves as container to receive the at first liquid cable shaping mass, its wall thickness can be reduced in comparison to known sleeves in order to save material.

The invention is explained hereinafter in more detail along an embodiment illustrated in drawings. These drawings are merely diagrammatic illustrations.

Fig. 1 shows an end view of the device according to the invention in direction of arrow 1 in Fig. 2.

Fig. 2 shows a section through the device according to Fig. 1 along line 2-2.

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Fig. 3 shows a perspective view, partially in section, of the assembling of the device according to Figs. 1 and 2 in connection with a cable termination.

Fig. 4 shows a perspective view of the device after having been finally mounted.

In the Figures 1 and 2 a glove-like multi-fingered termination sleeve 10 of permanently resilient, flexible material is shown which has core fingers 11, 12, 13 at one end and a cylindrical or sleeve-like cable finger 14 at the other end. More specifically, Figures 1 and 2 show an oversize sleeve portion of a cable termination which is made by suitable expansion with oversize. The used material is heat-shrinkable.

A sleeve 15 of plastic material, e.g. polypropylene, is slid into the cylindrical finger 14 of sleeve 15. Sleeve 15 has approximately a wall thickness equal to that of the sleeve 10 and is slightly pressed therein in order to keep it under friction. As an alternative, sleeve 15 can be held in its position approximately adjacent the inner ends of-----

the core fingers 11 to 13 by gluing or welding. Finally, the sleeve 15 can also be fixed by a pre-shrinking of the termination sleeve 10. The sleeve 15, however, has a smaller length than the cable finger 14 to leave a portion 16 of the cable finger 14 not covered by the sleeve 15.

Fig. 3 shows a cable termination for a paper-insulated electrical three-core cable 10 for medium voltage, particularly about 7 to 18 kV. The cable 20 has a cable sheath 21 which terminates in a cable sheath end portion 22. The cable sheath 21 comprises an oil paper layer (not shown), a semi-conductive paper layer (not shown), a metallic spiral armor (not shown) and a plastic outer sleeve 23. In a cable end portion freed from the cable sheath 21 exposed core end portions 24, 25, 26 having paper insulations extend from a crotch area 27 in which an essentially wedge-shaped spreading body 29 is inserted between the cores and as far as into the area of the cable sheath end portion 22 whereby in the crotch area 27, the exposed core end portions are fixed in the space between the spreading body 29 and the cable sheath end portion. The core end portions 24, 25, 26 are provided with an additional core sleeve 30, 31, 32. In the embodiment illu-

strated, these consist of hoses of permanently resilient, flexible plastic material. The core sleeves form a contact under pressure and also may have stress-controlling properties, if desired. In the embodiment illustrated, the core sleeves 30, 31, 32 extend as far as to the area of the spreading body. They are sitting with their cable-adjacent ends at a projecting shoulder of the spreading body 29. With this kind of construction, the spreading body 29 preferably is introduced after the core sleeves have been applied, with the core sleeves being positioned so that the spreading body will snap with its shoulder under the cable adjacent ends of the core sleeves. Prior to mounting the core sleeves preferably are provided with oversize to allow an easy shifting (not illustrated in the Figures). The core sleeves can be pre-expanded by mechanical supporting devices enabling a radial constriction and a pressure contact against the core end portions after removal of the supporting devices. Alternatively, the core sleeves may consist of heat-shrinkable plastic material. In this case the core sleeves 30, 31, 32 are shrunk by supply of heat after having been assembled to their predetermined position.

The cable sheath 21 is pre-treated in its end portion 22 in accordance with the structure of the cable. In the area freed from the metallic reinforcement a layer 40 of high voltage insulating tape is attached over the projecting insulating paper (oil paper). In the embodiment illustrated, a further reinforcement of this end portion is provided by a wrapper 41 of none-extensible cord.

Such a design of a cable termination is prior art and disclosed in the already mentioned DE-OS 35 36 250. A sleeve 10 according to the Figures 1 and 2 is pushed onto the thus prepared arrangement. The cable-adjacent end of the sleeve 10 overlaps the outer sleeve 23 of the cable sheath 21 a certain amount as illustrated in Fig. 3. By supply of heat, the portion 16 is heat-shrunked onto the sleeve 23 and onto portion 22 freed from sleeve 23. If the sleeve 10 is coaxially placed onto the cable end portion the centered position is maintained after the heat shrinking of portion 16 caused by the centering effect of the reinforcing sleeve 15 extending as far as in the end portion 22 beyond the crotch area. Sleeve 15 thus serves that sleeve 10 has approximately the same distance from the crotch area about its circumference along the axial extent of sleeve 15.

Sleeve 15 in conjunction with sleeve 10 defines a mold for the casting mass symmetrically arranged with respect to the cable; the casting mass as shown at 42 can be casted into the sleeve 10 from a bag 23 including a spout 44 through the core fingers 45.

The constriction of portions 16 of sleeve 10 prior to the filling-in of the casting mass besides the mentioned centering effect has the further advantage that preliminary sealing measures, e.g. by means of an adhesive tape or the like can be omitted.

After the filling-in of the casting mass the core fingers 11, 12, 13 also are heat-shrunked whereby they contact the core sleeves 30, 31, 32 under pressure. By this the casting mass is pressed in all interstices. After the curing has taken place, an inclusion-free insulating body of cable shaping mass is formed, and the permanently resin material of sleeve 10 engages firmly and intimately contiguously the outer contour of the insulating body.

Since, as already mentioned, the sleeve is coaxially arranged on the cable end portion the thus formed insu-

lating structure has a uniform thickness about its circumference in the crotch area. This area, therefore, is particularly effectively insulated and secured against the penetration of moisture and against mechanical influences. In the embodiment illustrated a cylindrical sleeve is used. It is understood that also a slightly conical sleeve can be applied.

In the embodiment illustrated a sleeve of heat-shrinkable material is employed. As an alternative also a permanently resilient material can be used which is expanded to an oversize by means of a mechanical supporting device; the expanded portion can be easily mounted on the exposed core end portions and the cable sheath end portion as described above. Such supporting devices are known and disclosed in the mentioned publication DE-OS 35 36 250. Normally, such supporting devices are provided only in those portions of the sleeve 10 which extend beyond sleeve 15. Prior to the filling-in of the casting mass as described in connection with Fig. 3 first the supporting device for portion 16 of sleeve 10 is removed whereby portion 16 can sealingly engage the sheath sleeve 21 and the end portion 22, respectively, under pressure.



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CLAIMS

1. A device for a cable termination or for a cable splice or another cable portion freed from the cable sheath of electrical cables, comprising a sleeve having an oversize portion relative to the cable prior and during its mounting and constricted finger
5 portions and portions sealingly engaging core end portions and/or cable sheath end portions under pressure, said portions comprising plastics sheet material and said device incorporating within its interior a shaping mass which fills out possibly interstices present within the device and forms an insulation surrounding
10 the crotch area and the splice area, respectively and further incorporating a radially effective reinforcement in the crotch area, and the splice area, respectively.
2. A device according to Claim 1 wherein the plastics sheet material consists of heat-shrinkable material.
- 15 3. The device according to Claim 2 wherein the reinforcement comprises a further sleeve-like or tube-like supporting element.
4. The device according to Claim 3 wherein the said supporting element is located at the inner wall of the sleeve.
5. A device according to any of Claims 2 to 4 wherein the support-
20 ing element is a plastic sleeve.
6. A device according to Claim 5 wherein the plastic sleeve is of polypropylene.
7. A device according to any preceding claim wherein the reinforcement is electrically conductive or stress-controlling.



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8. A device according to Claim 3 or any claim appendant thereto wherein the outer diameter of the supporting element approximately corresponds to the inner diameter of the sleeve.

9. A device according to Claim 3 or any claim appendant thereto
5 wherein the supporting element has a smaller diameter than the internal diameter of the oversize portion and is arranged for fixing in the sleeve by heat-shrinking of the oversize portion.

10. A device for a cable termination, splice or any other cable portion substantially as described herein with reference to the
10 accompanying drawings.
