

TUBE

This invention relates to a corrugated conduit tube for electrical installations to accommodate wiring, with projections in the interior of the corrugated conduit, which reduce the contact surface with wiring to be pulled into the corrugated conduit.

Corrugated conduit tubes for electrical installations to accommodate wiring, with longitudinal recesses in the interior of the corrugated conduit, which reduce the contact surface with wiring to be pulled into the corrugated conduit.

As used herein, conduits for electrical installations include various forms of corrugated tubes for installation purposes, especially corrugated conduits for electrical installations that are installed in walls and ceilings and protective conduits for underground installation.

Corrugated conduits for electrical installations made of plastic have been used for decades to route electrical cables and protect these. When cables are laid in a straight line, usually rigid conduits are used, while a curved course is usually accomplished with flexible corrugated conduits. The latter offer the possibility of making sharp bends without the aid of any tools. On the other hand, the high flexibility of corrugated conduits also results in a more or less meandering course, which leads to numerous friction points when wiring is pulled in, and it allows sharp bends where high frictional forces may occur. Rigid conduits, however, are also prone to such friction problems.

As a result, sometimes either the intended number of wires cannot be pulled in when installing conduits or the wires get stuck during the pulling process at a point within the conduit and cannot be moved forward or backward anymore. For the person installing the conduits, however, even the requirement of great efforts when inserting wiring or cables constitutes an inconvenience.

So far, a reduction of surface friction by means of chemical additives to the material, by providing sliding linings, e.g. via co-extrusion, or by subsequent application of

sliding coatings has been attempted. But the results of these efforts are not satisfactory.

The DE 1 849 738 U describes a plastic tube provided with transverse undulations on circumferential subregions, which undulations are provided with longitudinal recesses, in order to facilitate the pulling in of electrical wiring.

The US 4 892 442 A discloses a largely rigid tube consisting of two parts, the interior part of which, in addition to a friction-reducing coating, has longitudinal ribs projecting on the inside and outside of the wall to reduce frictional resistance. The alternative embodiment shown in FIG. 5 of the document has transverse undulations instead of these longitudinal ribs, which transverse undulations only serve to facilitate the pulling procedure, but not to increase flexibility of the installation tube.

The object of the present invention is to provide a corrugated conduit for electrical installations that facilitates the insertion of wires and reduces surface friction of interior surfaces.

According to the invention, this object is achieved by providing projections by means of support ridges extending longitudinally, which are moulded on the tube interior surface.

The inventive interior surface patterning may actually be used for any kind of electrical conduit, a particularly strong effect, however, may be achieved when it is implemented with bent tubes or flexible tubes.

This special design of the tube interior surface allows an insertion of wiring considerably faster and with less effort over longer tube stretches. In contrast to known lubricant chemical additives, the interior surface of the inventive electrical installation conduit is provided with a special patterning. The force required for pulling in or inserting wiring may be significantly reduced, which effect can also be measured. At the same time, the maximum permissible tube length for inserting

wiring is increased. Furthermore, the inventive corrugated conduit for electrical installations may be installed, without causing any sliding problems, with a significantly sharper bend than conventional tubes, and a meandering course causes only insignificant difficulties when pulling in wiring.

The projections provided by means of support ridges extending longitudinally are easily extrudable. Preferably, the longitudinal support ridges are arranged so that the friction between wires to be inserted and the tube interior surface is reduced.

In further advancement of the invention, the support ridges may be formed in the longitudinal direction following the succession of peaks and grooves on the tube interior surface, wherein the support ridges may be effective in the respective groove areas.

In order to achieve the same reduction of sliding resistance in all directions, the support ridges may - as seen in cross-section - be distributed uniformly across the tube inside circumference.

The design of the support ridges may vary considerably. The circumferential pitch of the support ridges may for example range from 3° to 30° , preferably 10° to 15° .

Another embodiment of the invention may comprise support ridges with wedge-shaped, preferably isosceles, cross-sections. These provide, in the longitudinal direction, almost linear contact surfaces for the wiring to be pulled in.

The flank angle and flank depth of these wedge-shaped projections may be chosen in accordance with the tube diameter, the tube material and the wiring to be pulled in.

Consequently, the flank angle α between the wedge surfaces of the support ridges may range from 15° to 90° and the flank depth t may range from 0.1 mm to 2 mm.

Another possible measure for improving the sliding properties of the inventive tube is to provide the tips of the wedge-shaped support ridges - as seen in cross-section - with an edge rounding r_2 in the range of 0.1 mm to 2 mm.

Predetermined breaking points are prevented during manufacturing when the flank base between two wedge surfaces of neighbouring support ridges is provided with a rounding, preferably with a radius r_1 of at least 0.1 mm.

The shape of the support ridges may be chosen in accordance with the respective requirements. They may, for example, have a rectangular or semicircular cross-section if this is advantageous for the type of wiring to be pulled in.

When providing the projections or support ridges by means of an extrusion procedure, the wall thickness of the tube may decrease in between, so that a further advancement of the invention may consist in the formation of areas between the projections or support ridges where the tube wall has thickenings.

The invention will now be described in detail with reference to exemplary embodiments shown in the attached drawings. Herein

FIG. 1 is an oblique view of a section of an embodiment of the inventive conduit for electrical installations cut open lengthwise;

FIG. 2 is a further oblique view of the conduit for electrical installations according to FIG 1;

FIG. 3 is a schematic cross-sectional view of the interior surface of another embodiment of the inventive conduit for electrical installations;

FIG. 4 is a schematic cross-sectional view of the interior surface of another embodiment of the inventive conduit for electrical installations;

FIG. 5 is a schematic cross-sectional view of the interior surface of another embodiment of the inventive conduit for electrical installations;

FIG. 6 is a partially enlarged sectional view of the conduit for electrical installations according to FIG 1;

FIG. 7 is an enlarged oblique view of a tube part according to FIG. 1;

FIG. 8 is a partial longitudinal sectional view of another embodiment of the inventive conduit for electrical installations;

FIG. 9 is a partial cross-sectional view of the conduit for electrical installations according to FIG 8; and

FIGS. 10, 11 and 12 are isometric views of the conduit for electrical installations according to FIG 8.

For a better understanding, FIGS. 1, 2, 6 and 7 show a conduit for electrical installations 1 cut open lengthwise that serves to accommodate electrical wiring, not shown, which is pulled in after installation. Alternatively, the conduit for electrical installations may be installed with the electrical wiring already in place.

Herein, wiring include electrical wires, e.g. YE 1.5, and cables or optical lines, such as optical fibres, which are for example used in electrical installations in e.g. walls, ceilings or underground.

In the exemplary embodiment shown in FIGS. 1, 2, 6 and 7, the conduit for electrical installations is formed by a corrugated conduit 1 made of plastic, the surface of which is provided with grooves 3 and peaks 2 in its longitudinal direction for increasing flexibility.

According to the invention, projections 4 are moulded on the tube interior surface to reduce the contact surface for the wiring to be introduced into the conduit for electrical installations 1. These projections may have various shapes since their purpose is to provide a rugged tube interior surface and to thus reduce frictional resistance regarding the wiring to be introduced.

In the embodiment according to FIGS. 1, 2, 6 and 7, these projections 4 are provided by means of support ridges 5 extending longitudinally. In a variation of this linear course, the projections 4 may also be arranged helically along the longitudinal axis or be provided in a completely irregular way across the tube interior surface and, instead of lines, may have the shape of points or islands.

In the embodiment according to FIGS. 1 and 2, the support ridges 5 are - as seen in cross-section - distributed evenly across the tube interior circumference and along the longitudinal succession of grooves 3 and peaks 2 at the tube interior surface, wherein the support ridges 5 are effective in the respective groove areas.

At the same time, the circumferential pitch of the support ridges 5 is preferably in the range of 3° to 30°, even more preferably 10° to 15°.

In the exemplary embodiment according to FIG. 3, a circumferential pitch of 10° is shown. The dashed line indicates the cross-section of a wire 6 of a wiring to be installed. The reduction of contact surface and thus the decrease of frictional resistance are visible.

By comparison, the embodiment of the inventive conduit for electrical installations according to FIG. 4 has a circumferential pitch of 7.5°.

In all exemplary embodiments shown, the support ridges 5 have wedge-shaped, preferably isosceles, cross-sections. The flank angle α between the wedge surfaces of the support ridges 5 is preferable in the range of 15° to 90°. In the embodiment according to FIG. 3 the flank angle $\alpha = 68^\circ$ and the flank depth $t = 0.3$ mm, whereas in the embodiment according to FIG. 4, $\alpha = 43^\circ$ and $t = 0.18$ mm. Preferably, the flank depth t is in the range of 0.1 mm to 2 mm.

The flank base between two wedge surfaces of neighbouring support ridges 5 is provided with a radius $r_1 = 0.1$ mm, and the tips of the support ridges 5 are provided with a radius $r_2 = 0.1$ mm, preferably up to 2 mm (FIG. 3, FIG. 4). However, these roundings may also be omitted.

Furthermore, the cross-section of support ridges may have other cross-sectional shapes, e.g. a rectangular or semicircular shape.

In a further exemplary embodiment of the invention shown in FIG. 5, areas are formed between the wedge-shaped support ridges 5 where the tube wall has thickenings 8 running lengthwise. These are provided e.g. with a rounding $r_3 = 0.25$. This reduces thinnings between support ridges developing during extrusion. In this exemplary embodiment, a flank angle α of 60° and a pitch β of 15° are selected.

In the exemplary embodiment according to FIGS. 8 to 12, the wedge-shaped support ridges 5 are moulded on the grooves 3 of the corrugated conduit 1. The circumferential pitch is 60° . The areas between the support ridges 5 are not thickened. In FIGS. 8 to 12 the linear course of the support ridges in the longitudinal direction of the conduit for electrical installations 1 can be seen.

CLAIMS

1. A corrugated conduit tube for electrical installations to accommodate wiring, with projections (4) in the interior of the corrugated conduit (1) to reduce the contact surface with the wiring to be pulled into the corrugated conduit (1), **characterized in that** the projections (4) are provided by means of support ridges (5) extending longitudinally that are moulded on the tube interior surface.
2. A corrugated conduit tube for electrical installations according to claim 1, **characterized in that** the support ridges (5) are formed in the longitudinal direction following the succession of grooves (3) and peaks (2) on the tube interior surface, wherein the support ridges (5) are effective in the respective groove areas.
3. A corrugated conduit tube for electrical installations according to claim 1 or 2, **characterized in that** the support ridges (5) are - as seen in cross-section - distributed uniformly across the tube inside circumference.
4. A corrugated conduit tube for electrical installations according to claim 3, **characterized in that** the circumferential pitch of the support ridges (5) is in the range of 3° to 30°, preferably 10° to 15°.
5. A corrugated conduit tube for electrical installations according to one of the claims 1 to 4, **characterized in that** the support ridges (5) have wedge-shaped, preferably isosceles, cross-sections.

6. A corrugated conduit tube for electrical installations according to claim 5, **characterized in that** the flank angle α between the wedge surfaces of the support ridges is in the range of 15° to 90° .
7. A corrugated conduit tube for electrical installations according to claim 5 or 6, **characterized in that** the flank depth t is in the range of 0.1 mm to 2 mm.
8. A corrugated conduit tube for electrical installations according to claim 5, 6 or 7, **characterized in that** the flank base between two wedge surfaces of neighbouring support ridges is provided with a rounding, preferably with a radius r_1 of at least 0.1 mm.
9. A corrugated conduit tube for electrical installations according to one of the claims 5 to 8, **characterized in that** the tips of the wedge-shaped support ridges - as seen in cross-section - have an edge rounding r_2 in the range of 0.1 mm to 2 mm.
10. A corrugated conduit tube for electrical installations according to one of the claims 1 to 4, **characterized in that** the support ridges have a rectangular or semicircular cross-section.
11. A corrugated conduit tube for electrical installations according to one of the preceding claims, **characterized in that** areas are formed between the support ridges (5) where the tube wall has thickenings (8).