Claim No: HP 2018-000011

IN THE HIGH COURT OF JUSTICE
BUSINESS AND PROPERTY COURTS
INTELLECTUAL PROPERTY LIST (ChD)
PATENTS COURT

EMTELLE UK LIMITED

Claimant

- and -

(1) HEXATRONIC UK LIMITED
(2) HEXATRONIC CABLES & INTERCONNECT SYSTEMS AB
(3) HEXATRONIC GROUP AB

Defendants

RE-AMENDED ANNEX A2 TO STATEMENT OF GROUNDS

A CLAIMS
Claims as proposed to be amended (redline version)

[NB: red-redlining shows differences from claims as granted
Green mark up shows difference from former proposed amendment]

1. A cable assembly adapted to be installed into a duct by means of blowing using compressed fluid, the cable ~~comprising~~ assembly consisting of an inner layer, an outer layer and a plurality of flexible signal transmitting members,

~~a~~ the plurality of flexible signal transmitting members being arranged such that neighbouring signal transmitting members are in touching contact with each other,

said signal transmitting members being surrounded by ~~a first~~ said inner layer such that axial movement of at least the outermost signal transmitting members relative to said ~~first~~ inner layer is substantially prevented,

~~and~~ said outer layer being a continuous thermoplastic polymer outer~~most~~ layer arranged outwardly of said ~~first~~ inner layer and having a thickness of less than 400 microns around at least 10% of the circumference of the cable assembly.

2. An assembly according to claim 1, wherein the outer~~most~~ layer has a thickness of less than 200 microns around at least 10% of the circumference of the cable assembly.

3. An assembly according to claim 2, wherein the outer~~most~~ layer has a thickness of less than 125 microns around at least 10% of the circumference of the cable assembly.

4. An assembly according to any one of the preceding claims, wherein at least one said polymer is high-density polyethylene.

5. An assembly according to any one of the preceding claims, wherein said signal transmitting members are embedded in said ~~first~~ inner layer.

~~6. A cable assembly substantially as hereinbefore described with reference to the accompanying drawings~~

6. An assembly according to any one of the preceding claims wherein said inner layer is a UV-curing acrylate material.

7. An assembly according to claim 6 wherein said UV-curing acrylate material is DSM Cabelite 950-706.

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RE-AMENDED ANNEX A4 TO
908 RE-AMENDED STATEMENT OF GROUNDS

'A' DESCRIPTION

Description pages 7, 7a, 8, 12, 14 as proposed to be amended (redline version)

According to the present invention, there is provided a cable assembly adapted to be installed into a duct by means of blowing using compressed fluid, the cable ~~comprising~~ assembly consisting of an inner layer, an outer layer and a plurality of flexible signal transmitting members,

~~a~~ the plurality of flexible signal transmitting members being arranged such that neighbouring signal transmitting members are in touching contact with each other,

said signal transmitting members being surrounded by ~~a first~~ said inner layer such that axial movement of at least the outermost signal transmitting members relative to said ~~first~~ inner layer is substantially prevented,

~~and~~ said outer layer being a continuous thermoplastic polymer outer~~most~~ layer arranged outwardly of said ~~first~~ inner layer and having a thickness of less than 400 microns around at least 10% of the circumference of the cable assembly.

It has been found to be beneficial for the outer layer to be relatively thin and certainly thinner than the 0.5 mm of foamed low density polyethylene in the arrangement of US4952021. This has the benefit that a harder material can be used without adversely affecting the bending properties of the cable.

Harder materials provide more robust cables with better resistance to abrasion during installation and improved protection of the fragile signal transmitting members. It is also the case that harder materials such as nylon or high density polyethylene have intrinsically better friction properties than other polymers comprising the outer layer of other prior art cables such as low density polyethylene and acrylate polymer. Thus it may not be necessary to modify the polymer with antifriction agents considerably reducing the cost of the material of the outer layer and the cost of the process.

The outer~~most~~ layer preferably has a thickness of less than 200 microns around at least 10% of the circumference of the cable assembly.

The outer~~most~~ layer preferably has a thickness of less than 125 microns around at least 10% of the circumference of the cable assembly.

At least one said polymer may be high-density polyethylene.

The flexible signal transmitting members may be embedded in said ~~first~~ inner layer.

Preferred embodiments of the present invention will now be described, by way of example only and not in any limitative sense, with reference to the accompanying drawings, in which:-

Figure 1A is a schematic cross-sectional view of a fibre optic cable of a first embodiment of the present invention;

Figure 1B is a schematic cross-sectional view of a fibre optic cable of a second embodiment of the present invention;

Figure 1C is a schematic cross-sectional view of a fibre optic cable of a third embodiment of the present invention;

Figure 1D is a schematic cross-sectional view of a fibre optic cable of a fourth embodiment of the present invention;

Figure 2 is a schematic representation of apparatus for manufacturing the cables of Figure 1A to 1D;

Figure 3 is a drawing of the test equipment used to measure the coefficient of friction between cables and a tube suitable for installation of cables by blowing.

manufactured for receiving installation of cables by blowing. The tube 104 is wrapped around a wheel 105 to provide a total of 450 degrees of wrapping. After the cable has been threaded through the tube 104 it is then inserted into a haul off 106, which pulls the cable at a constant speed of 10 metres per minute. The tube 104 is clamped at both ends by clamps 107, and as the cable is pulled through the tube 104, the friction of the cable on the tube imposes a turning moment on the wheel 105 and rotates a lever 108 which imposes a load on a mass balance 109.

The load on the mass balance 109 was measured for both the invention and the prior art and the coefficient of friction calculated using the formula :

Coefficient of friction is given by

$$\mu = \frac{1}{\theta} \ln \left[\frac{FL}{Tr} + 1 \right]$$

Where

θ	total wrap angle of tube (rads)
F	force recorded at mass balance (N)
L	Moment arm length of force F (m)
T	Weight lifted by fibre (N)
r	Bend radius of primary tube (m)

The cable of the invention had a coefficient of friction of 0.27 whilst the cable of the prior art had a coefficient of friction of 0.21. The friction characteristics of the invention are therefore inferior compared to those of the prior art.

Referring now to Figures 4a and 4b, the blowing performance of the cable, manufactured according to the above process is the invention has inferior friction properties and has a surface which had not been physically modified in any way to enhance fluid drag.

Referring now to Figure 5, the signal loss over a wide temperature range associated with cables manufactured according to the above process is shown. The different curves show signal attenuation in the individual fibres 2 of the cable of Figure 1B. It can be seen that the cable 1 can withstand exposure to a wide temperature range. This is a surprising result. Prior art cables as described in EP0157610 incorporating polyethylene outer layers display poor optical performance below approximately ~~B20 C~~ -20°C. This is usually attributed to a change of phase in polyethylene at around this temperature and for this reason polyethylene is not normally selected for the tight jacketing of fibre optic elements.

It will be appreciated by persons skilled in the art that the above embodiments have been described by way of example only, and not in any limitative sense, and that various alterations and modifications are possible with departure from the scope of the invention as defined by the appended claims. For example, as an alternative to, or in addition to, the friction reducing materials described in the above embodiments, erucamide and/or oleamide materials may be used as slip agents. ~~Furthermore, although the~~ The cable assembly of the present invention comprises ~~a first and second~~ an inner and an outer layer~~, however it will be obvious to those skilled in the art that it might be constructed from more than two layers~~.

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RE-AMENDED ANNEX B2 TO
908 RE-AMENDED STATEMENT OF GROUNDS

B CLAIMS

Claims as proposed to be amended (redline version)

[NB: red-redlining shows differences from claims as granted
Green mark up shows difference from former proposed amendment]

1. A cable assembly adapted to be installed into a duct by means of blowing using compressed fluid, the cable ~~comprising~~ assembly consisting of an inner layer, an outer layer and a plurality of flexible signal transmitting members and being manufactured without foamed thermoplastic,

~~a~~ the plurality of flexible signal transmitting members being arranged such that neighbouring signal transmitting members are in touching contact with each other,

said signal transmitting members being surrounded by ~~a first~~ said inner layer such that axial movement of at least the outermost signal transmitting members relative to said ~~first~~ inner layer is substantially prevented,

~~and~~ said outer layer being a continuous thermoplastic polymer outer~~most~~ layer arranged outwardly of said ~~first~~ inner layer and having a thickness of less than 400 microns around at least 10% of the circumference of the cable assembly.

2. An assembly according to claim 1, wherein the outer~~most~~ layer has a thickness of less than 200 microns around at least 10% of the circumference of the cable assembly.

3. An assembly according to claim 2, wherein the outer~~most~~ layer has a thickness of less than 125 microns around at least 10% of the circumference of the cable assembly.

4. An assembly according to any one of the preceding claims, wherein at least one said polymer is high-density polyethylene.

5. An assembly according to any one of the preceding claims, wherein said signal transmitting members are embedded in said ~~first~~ inner layer.

~~6. A cable assembly substantially as hereinbefore described with reference to the accompanying drawings.~~

6. An assembly according to any one of the preceding claims, wherein the hardness of the polymer of the outer layer is greater than or equal to a Shore D hardness of 60.

7. An assembly according to any one of the preceding claims wherein the outer layer is adapted to be removed from said inner layer by sliding over said inner layer.

8. An assembly according to any one of the preceding claims wherein said inner layer is a UV-curing acrylate material.

9. An assembly according to claim 8 wherein said UV-curing acrylate material is DSM Cabelite 950-706.

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RE-AMENDED ANNEX B4 TO
908 RE-AMENDED STATEMENT OF GROUNDS

'B' DESCRIPTION

Description pages 7, 7a, 8, 12, 14 as proposed to be amended (redline version)

According to the present invention, there is provided a cable assembly adapted to be installed into a duct by means of blowing using compressed fluid, the cable ~~comprising~~ assembly consisting of an inner layer, an outer layer and a plurality of flexible signal transmitting members and being manufactured without foamed thermoplastic,

~~a~~ the plurality of flexible signal transmitting members being arranged such that neighbouring signal transmitting members are in touching contact with each other,

said signal transmitting members being surrounded by ~~a first~~ said inner layer such that axial movement of at least the outermost signal transmitting members relative to said ~~first~~ inner layer is substantially prevented,

~~and~~ said outer layer being a continuous thermoplastic polymer outer~~most~~ layer arranged outwardly of said ~~first~~ inner layer and having a thickness of less than 400 microns around at least 10% of the circumference of the cable assembly.

It has been found to be beneficial for the outer layer to be relatively thin and certainly thinner than the 0.5 mm of foamed low density polyethylene in the arrangement of US4952021. This has the benefit that a harder material can be used without adversely affecting the bending properties of the cable.

Harder materials provide more robust cables with better resistance to abrasion during installation and improved protection of the fragile signal transmitting members. It is also the case that harder materials such as nylon or high density polyethylene have intrinsically better friction properties than other polymers comprising the outer layer of other prior art cables such as low density polyethylene and acrylate polymer. Thus it may not be necessary to modify the polymer with antifriction agents considerably reducing the cost of the material of the outer layer and the cost of the process.

The outer~~most~~ layer preferably has a thickness of less than 200 microns around at least 10% of the circumference of the cable assembly.

The outer~~most~~ layer preferably has a thickness of less than 125 microns around at least 10% of the circumference of the cable assembly.

At least one said polymer may be high-density polyethylene.

The flexible signal transmitting members may be embedded in said ~~first~~ inner layer.

Preferred embodiments of the present invention will now be described, by way of example only and not in any limitative sense, with reference to the accompanying drawings, in which:-

Figure 1A is a schematic cross-sectional view of a fibre optic cable of a first embodiment of the present invention;

Figure 1B is a schematic cross-sectional view of a fibre optic cable of a second embodiment of the present invention;

Figure 1C is a schematic cross-sectional view of a fibre optic cable of a third embodiment of the present invention;

Figure 1D is a schematic cross-sectional view of a fibre optic cable of a fourth embodiment of the present invention;

Figure 2 is a schematic representation of apparatus for manufacturing the cables of Figure 1A to 1D;

Figure 3 is a drawing of the test equipment used to measure the coefficient of friction between cables and a tube suitable for installation of cables by blowing.

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Referring now to Figures 4a and 4b, the blowing performance of the cable, manufactured according to the above process is the invention has inferior friction properties and has a surface which had not been physically modified in any way to enhance fluid drag.

Referring now to Figure 5, the signal loss over a wide temperature range associated with cables manufactured according to the above process is shown. The different curves show signal attenuation in the individual fibres 2 of the cable of Figure 1B. It can be seen that the cable 1 can withstand exposure to a wide temperature range. This is a surprising result. Prior art cables as described in EP0157610 incorporating polyethylene outer layers display poor optical performance below approximately ~~B20 C~~ -20°C. This is usually attributed to a change of phase in polyethylene at around this temperature and for this reason polyethylene is not normally selected for the tight jacketing of fibre optic elements.

It will be appreciated by persons skilled in the art that the above embodiments have been described by way of example only, and not in any limitative sense, and that various alterations and modifications are possible with departure from the scope of the invention as defined by the appended claims. For example, as an alternative to, or in addition to, the friction reducing materials described in the above embodiments, erucamide and/or oleamide materials may be used as slip agents. ~~Furthermore, although the~~ The cable assembly of the present invention comprises ~~a first and second~~ an inner and an outer layer~~, however it will be obvious to those skilled in the art that it might be constructed from more than two layers~~.