

**AN ELECTRICAL PLUG WITH INSPECTION WINDOW AND A METHOD OF
EXAMINING ELECTRICAL CONNECTIONS IN AN ELECTRICAL CABLE
COMPRISING WIRES**

FIELD OF THE INVENTION

The present invention relates to electrical plugs, preferably used in connection
5 with reefer containers and/or for charging ship batteries. Preferred embodiments
relates to an electrical plug with a housing and comprising a non-transparent part
being made from a non-transparent material and at least one transparent part
being made from a transparent material forming an inspection window, the
inspection window being positioned in the housing so as to provide a visual view
10 of the electrical connections of the electrical wires. In preferred embodiments
inspection window may be dimensioned and positioned to provide a visual view of
both the electrical connections of the electrical wires and the interior condition of
the plug

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BACKGROUND OF THE INVENTION

Electrical plugs such as plugs used in connection with reefer containers are
exposed to demanding environmental conditions and sometimes also exposed to
rough manhandling during loading and unloading of reefer containers. The loading
20 and unloading of the reefers containers typically involves moving the container
between a ship and a truck and/or train carrier. Due to the required speed of the
loading necessitated to avoid temperature changes in the reefer containers and an
allocated time slot a ship has been assigned to dock a harbour.

25 Although great care is taken in designing electrical plugs for reefer containers, the
handling and the environment may result in a malfunction of the plug, in the
sense that it is no longer capable of conducting a current. Further, electrical
malfunction may occurs in other elements of the electrical connection between the
plug and a source of electrical power to which the electrical connection is
30 connected.

Today, when it is observed that no, insufficient or intermittent power is supplied
to a reefer container by connecting the container with a traditional plug, an
investigation has be carried out to identify the source for the mal-function. While
35 no connection may cause issues as to the goods to be cooled, insufficient or

intermittent power may be caused by a bad connection between a wire and a pin of the plug. Such a bad connection may pose a safety risk as the bad connection may provide electrical sparks which may ignite fire on the ship or truck moving the container. Investigation of a plug must be carried out by personnel being
5 trained to carry out the investigation, as the investigation requires dismantling of the plug to identify any mal-function internally in the plug. As the personnel taking care of the loading/unloading of the containers and hooking up the electrical connection by use of the plug is not trained to carry out the investigation, there is today no way to trouble-shoot lack of electrical power other
10 than involving specially trained personnel, such as an electrician.

Today, many freight companies performs a pre-trip investigation (PTI) which is carried out by many workshops around world. Due to geographically dispersed PTI, it has been observed that the quality and procedures are not always the
15 same in each workshop. During a PTI, the personnel should open the plug and check if everything is right, but it has been found that this procedure is not always complied with – and even that some workshops do not apply such a procedure.

Further, many larger shipping line companies, (liners) have their own
20 requirements for PTI, most of them require workshops to have a full dismantle of the plug. However, other liners do not have such requirements, whereby it may result in the local workshop perform PTI according to the workshops' own procedures.

25 The inventors have realized that in many situations, the lack of electrical power from a plug is due to a lacking electrical connection internally in the plug between an electrical wire and an electrical connector. Obviously, today such a finding is today only obtainable by dismantling the plug.

30 One solution to avoid dismantling of plug could be to make the plug transparent. The inventor has also realized that there are currently existing electrical plugs with transparent bodies, but these are not suitable for the reefer container industry due to their lower physical strength compared to the plugs used on reefer containers. In essence, the today available transparent plugs are made for interior
35 decoration purposes. Plugs for reefer container should, at least for Europe, satisfy

European Standard EN 62262 with an impact protection of IK10 (20 joule). In addition, to allow for a long service life UV, oil and chemicals resistance may have to be considered. Achieving the same level of physical strength and avoiding enhanced UV degradation of a plug made fully from a transparent material would require use of very expensive materials, making the plug's price at least 2-3 times more expensive. Given that millions of reefer containers are used daily, each requiring a plug for powering, and these plugs typically have a lifespan of a few years, opting for an expensive plug would significantly increase the total cost of ownership. On the other hand, using low-quality materials would not enable the plug to withstand the demanding environment of the reefer container industry.

Turning to the disassembly of a plug option to assure correct electrical connections e.g. during a pre-trip inspection (PTI) is a possibility. However, repeatedly disassembly of the plug, wear an insert lock mechanism used for keeping the plug assembled with the risk of the mechanism fails to keep to the plug assembled whereby unplugging of the plug may result in exposure of life wire(s). In some cases, the insert lock mechanism is based on two screws locking the insert by engagement with thread provided in a plastic member. Such threads made in plastic are prone to failure (due to the relative soft material in which the threads are provided) increasing the risk that repeatedly PTI destroys the insert lock mechanism,

Hence, a plug allowing for an easier inspection, such during a PTI would be advantageous, and in particular a plug providing a more efficient and/or reliable inspection, such as during a PTI would be advantageous.

OBJECT OF THE INVENTION

It is a further object of the present invention to provide an alternative to the prior art.

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In particular, it may be seen as an object of the present invention to provide a plug that solves the above mentioned problems of the prior art with difficult and/or time consuming inspection, such as a PTI.

35 SUMMARY OF THE INVENTION

The invention relates in a first aspect to an electrical plug comprising

- a housing,
 - a number of electrical connectors each being configured to conduct electrical current and comprising
- 5 ○ an inner connection part positioned inside the housing configured for electrical connection of an electrical wire to said electrical connector, and
- a mating connection part for electrically connecting said connector with an electrical connector of a mating electrical plug, said mating
- 10 connecting part being accessible from an exterior of the housing (1); said housing being tubular and comprising
- a non-transparent part being made from a non-transparent material and at least one transparent part being made from a transparent material forming an inspection window, said inspection window being positioned in said housing so
- 15 as to provide a visual view of said electrical connections of said electrical wires.

Said in another manner, said inspection window being positioned in said housing so as to allow for an visual inspection of said electrical connections of said

20 electrical wires from an position being exterior to said plug.

A plug according to the preferred embodiments of the invention is provided with at least one transparent inspection window. In preferred embodiments, the inspection window(s) allows for a internal, such as a full visual inspection of the

25 plug and electrical connections to take place without the need for complete dismantling and reassembly of the plug.

A problem related to an electrical connection in the plug is easy to identify. Accordingly, in preferred embodiments, potential circuit connection problems can

30 easily be identified e.g. beforehand during a typically mandatory inspection process, and thereby enhance the efficiency of inspection.

The invention relates in a second aspect to a method of examining electrical connections in an electrical cable comprising wires where at least one end of the

cable is provided with a plug according first aspect of the invention. Such a method typically comprises

- arranging said plug in a position relative to an inspector, being a human, allowing said inspector
- 5 ○ to visually inspect said electrical connections of said plug for determining whether said wires are correctly connected to said electrical connectors.

Actions taken by the inspector may be

- 10 • approve said cable for use, in case the wires are correctly connected, or
- disapprove said cable for use, in case the wires are non-correctly connected.

Typically, due to the presence of the inspection window(s) the inspection of the electrical connection may be provided without dismantling the plug. This is found

15 to increase the likelihood that the wires are correctly connected to the electrical connectors, which in turn may result in a more smooth refer container operation. In addition, the effectiveness of an PTI may be increased.

Compared with a plug made entirely from a transparent material, a plug according

20 to preferred embodiments of the invention is considered to have better mechanical properties due to the transparent part(s) only forms a part of the housing made from a non-transparent material. In addition, the percentage of the outer surface constituted by the transparent section can in preferred embodiment be low as the field of view provided by an inspect window, in such embodiment,

25 may be limited to an interior region covering the positions at which the wires are connected to the electrical connectors.

The inspection window(s) reduces premature wear on an insert lock mechanism (used to dismantle the plug) during Pre-trip inspections (PTI). Not only does the

30 window(s) reduce wear, but it also speeds up the PTI visual inspection process, ensuring ongoing safety and quality of the reefer equipment.

The inspection window(s) may also help users identify the presence of water in the plug before connecting it to the power source, enhancing user safety and

35 further protecting the equipment.

Terms used herein are used in a manner being ordinary to a skilled person. Some of the terms are elucidated herebelow:

- 5 A circumferential length, S , for a circular cross section is typically determined by:

$$S = 2\pi R$$

- or for a non-cylindrical cross section, S , is the circumferential length of the cross
10 section.

A full circumferential length is preferably evaluated at the cross section in question.

- 15 *Field of view* is typically evaluated at an outer surface of the inspection window.

Planar representation typically refers to a projection of a shape onto a non-curved plane.

- 20 *Rated voltage* and *rated current* typically refers to the voltage and current at which the plug can be operated without the risk of short-circuiting or other electrical malfunctions.

- Electrical connection* as used herein is typically considered to be a region or area
25 at which an electrical wire is connected to an electrical connectors. In preferred embodiments, the region or area may include a region or area immediately above an inner connection part, and even include at least a part of the inner connection part.

- 30 In preferred embodiments, the shape and number of inspection windows are provided so as to allow for light to come through one side of the plug to another. Preferred embodiments of the plug comprising one, two, three inspection windows and/or a ring shaped inspection window.

- In a second aspect the invention relates to a system for providing electrical power
35 to a reefer container or a ship battery, said system comprising

- an electrical cable comprising wires where at least one end of the cable is provided with a plug according to any one of the preceding claims,

- a reefer container or a ship battery having a plug or a socket being configured to mate with said plug provided to said cable for providing electrical power to the reefer container or said ship battery through said cable.

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A *ship battery* is typically considered to be one or more batteries positioned onboard a vessel.

BRIEF DESCRIPTION OF THE FIGURES

10 The present invention and in particular preferred embodiments thereof will now be described in more detail with regard to the accompanying figures. The figures show ways of implementing the present invention and are not to be construed as being limiting to other possible embodiments falling within the scope of the attached claim set.

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Fig. 1A illustrates a first preferred embodiment of the plug in a partial exploded view;

Fig. 1B illustrates in an exploded view electrical connectors and assembly element
20 of the embodiment of Fig. 1A;

Fig. 1C illustrates a transvers cross sectional view of the plug of Fig. 1A along the line A-A shown in Fig. 1A;

25 Fig. 1D illustrated a longitudinal cross sectional view of the plug of Fig. 1A;

Fig. 1E illustrates in a 3-dimensional view an inspection window;

Fig. 1F schematically illustrates an extension of an inspection window in
30 accordance with a preferred embodiment.

Fig. 2 illustrates in a front view a female type plug according to a preferred embodiment.

Fig. 3 illustrates in a cross sectional view of a preferred embodiment having a tubular inspection window.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

5 Reference is made to Figs. 1A-1D illustrating a first embodiment of an electrical plug. The illustrated plug is of a type for powering reefer containers, however, the plug may be used for other power purposes.

The plug comprises a housing 1 for housing electrical inter alia parts of wires
10 extending into the housing and connected to electrical connectors 2. The plug comprising in the illustrated embodiments four connectors 2 each of which is configured to conduct electrical current. This typically means that the connector 2 are made from an electrical conductive material such as copper or copper alloy.

15 Each of the connectors 2 has an inner connection part 3 positioned inside the housing 1 configured for electrical connection of an electrical wire to electrical connector 2. In the illustrated embodiment, the connection part 3 comprising a cavity 15 with an opening facing towards the interior of the housing. Such cavities 15 are shown in Fig. 1D showing inter alia a cross sectional view of two of the four
20 connectors 2. As seen in Fig. 1B and 1C, an electrical wire inserted into the cavity can be fastened by tightening of the screws 16 seen in Fig. 1B and 1C. Fastening by tightening the screws 16 furthermore secure electrical connection between the wire and the connector 2.

25 While the inner connection parts 3 are non-accessible from an outside position of the housing (unless the plug is dismantled), the connectors 2 each has a mating connection part 4 for electrically connecting the connector 2 with an electrical connector of a mating electrical plug. In general, the mating connecting part 4 is accessible from an exterior of the housing 1, which in the embodiment of Fig. 1 is
30 provided by the mating connection parts form electrical pins 6 of a male type plug.

As detailed above, preferred embodiments of the invention aim at allowing a visual inspection of electrical connections interior of the plug. To accomplish this
35 aim, the housing 1, which in the preferred embodiment is tubular, comprises a

non-transparent part being made from a non-transparent material and at least one transparent part being made from a transparent material forming an inspection window 5. In the embodiment shown in Fig. 1, two inspection windows are present, although the invention is not limited to two inspection windows, as a single inspection window 5 may be present or even more than two inspection windows may be present. However, the inspection window(s) 5 is(are) positioned in the housing 1 so as to provide a visual view of the electrical connections of the electrical wires.

10 The positioning of the inspection window(s) is typically selected so as to allow visual inspection one or more of the following:

- inspect whether the wires are correctly connected to the connectors 2. As illustrated in Fig. 1C, each of the four electrical wires should be connected to a designated connector 2, that is the four wires should be connected respectively to L1, L2, L3 and earth. It is noted that a general accepted colour coding of the wires makes it possible to visually inspect for correct connectivity.
- inspect whether the electrical wires have been correctly stripped, introduced into the cavity of the inner connection parts 3 to a required extent and/or secured at the inner connection parts 3. For instance, if metal of the electrical wire is clearly visible in a region above the inner connection part 3, there is a risk that too much insulation has been stripped, the wire is not introduced into the cavity to the required extent and/or not secured at the inner connection part 3.
- inspect for sign of bad electrical connection(s) between the wires and the inner connection parts 3. Such bad connections may be identified by the wires are getting darker (compared to fabrication standard colouring) and/or appears to break.
- inspect for sign of ingress of water, such as sea water ingress. Ingress of water into the plug often results in corrosion of the wires and/or the electrical connectors 2, which corrosion may be increased due to electricity. In addition, a high ingress of water may be visible by water droplets.

In preferred embodiment, the visual field of view for inspection of the electrical connections is provided by the inspection window 5 extends in a circumferential direction of the housing 1 by an amount s being less than a fourth, such as less than fifth, of a full circumferential length S of the housing 1. The circumferential direction and the amount s are schematically illustrated in Fig. 1F. It is noted that circumferential direction preferably is evaluated in a cross section along the line A-A in Fig. 1A. When more than one inspection window 5 is provided, the inspections windows 5 typically have substantially equal circumferential extension, although the inspection windows may have different extensions. In a longitudinal direction of the plug, the inspection window(s) 5 is(are) positioned in the housing 1 to provide a transverse field of view covering the electrical connections of the electrical wires.

While it may be sufficient to be able to provide a visual inspection of electrical connection, it may also be advantageous to inspect interior regions above the electrical connections, e.g. to identify discolouring of the wires (being a sign on bad connections) and to accomplish this, the inspection window(s) 5 may extend in a longitudinal direction of the housing 1 by an amount being larger than a longitudinal extension of said electrical connections of said electrical wires.

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Accordingly, the inspection window (s) 5 may in preferred embodiments be dimensioned and/or positioned to provide a visual view of both the electrical connections of the electrical wires and the interior condition of the plug.

25 The shape of the inspection window(s) 5 may be selected to provide a required field of view and/or have a shape that is adapted to the overall contour of the plug 1. Preferred shapes of the inspection window(s) are shapes having a planar representation of trapezoid with rounded corners, triangular with rounded corners, squared with rounded corners, circular or ellipsoid. A planar representation is preferably the projection of the shape onto a flat plane. The preferred rounded corners may be applied to avoid increase of stresses otherwise occurring in sharp corners.

Fig. 1E illustrates an example of an inspection window having a trapezoid shape with rounded corner.

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The inspection window 5 may be tubular. One such example on a tubular inspection window is illustrated in Fig. 3. Although the plug in Fig. 3 is shown in a cross section view similar to the view of Fig. 1D, thereby only showing a half of the tubular inspection window 5, the inspection window extends through-out the circumference of the plug.

Preferred materials for the transparent materials are plastic materials, such as PA 12 (Nylon 12), PA 11 (nylon 11), or polycarbonate.

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Preferred materials for the non-transparent material are plastic materials, such as PA 6 (Nylon 6), PA 66 (NYLON 66) or transparent ABS.

PA typically refers to polyamide.

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Preferred materials for the transparent part and the non-transparent part may advantageously be UV, oil and/or chemical resistant.

The preferred embodiments for the transparent and the non-transparent material has inter alia the advantage that they can be used in a moulding process such as injection moulding.

The embodiment illustrated in Fig. 1A-D is a male-type plug where the mating connection parts 4 are electrical pins 6 extending outside the housing. This is clearly seen in Fig. 1D, where a part – designated 6 - of each of the electrical connectors 2 extends outside the housing 1.

With electrical pins 6 extending outside the housing 1, it is advantageous to provide a shield which typically co-operates with a female plug to protect the coupling between a female and male plug from e.g. ingress of moisture and/or water. To this, preferred embodiments of a plug may comprise a shield 8 as seen in Fig. 1D. The shield 8 forms an extension of the housing and laterally shielding the electrical pins 6. The shield 8 is typically a tubular part having a longitudinal extension beyond the distal ends of the pins 6. Distal here refer to a position being opposite to the connection part 3.

While Figs. 1A-1D illustrate a male type plug, preferred embodiments relates to a female plug. A preferred embodiment of a female plug is illustrated in Fig. 2 showing the female view in a front view. In preferred embodiments of a female
5 plug, the mating connection parts 4 are sockets arranged retracted relatively to an external surface of the housing 1. Although the sockets are retracted, they are accessible from the outside so as to allow pins of a male type plug to be inserted into the sockets.

10 In preferred embodiments, the electrical plug has a single inspection window 5.

As illustrated in Fig. 1C and 1D, preferred embodiments of an electrical plug have two inspection windows 5. Preferably, the two inspections windows are positioned opposite to each other such as diametrically opposite to each other. For the
15 embodiment illustrated in Fig. 1C and 1D, the two inspection windows 5 are positioned diametrically opposite to each other, and being of same shape and size. In addition, the longitudinal position of the two inspection windows 5 is the same for the two.

20 As illustrated in the figures, the electrical connectors 2 may be arranged in an assembly element 7 releasable inserted in said housing 1 thereby forming part of the housing. The assembly element 7 maintains the electrical connectors in designated positions relatively to each other and relatively to the assembly element 7. The assembly element 7 is releasable inserted into the housing,
25 whereby the electrical connectors 2 can be released from the housing 1 in common. The assembly element 7 preferably further allows for tightening of the screws 16 as seen in Fig. 1C showing that the screws are accessible. In preferred embodiments the assembly element 7 and the housing 1 form a bayonet coupling, which allows easy dismantling of the plug. The bayonet coupling may comprise a
30 screw which prevents the bayonet coupling to be un-intended released. By releasing the screw, the bayonet coupling can be released.

In preferred embodiments, a part of the housing 1 have a frusto conical shape tapering inwardly in a longitudinal direction away from the inner connection parts
35 3. This is illustrated inter alia in Fig. 1D where the end distal to the shield 8 has a

smaller diameter than the diameter at the shield. By providing the housing with a frusto conical shape, a seal can effectively be provided between the wires and the housing at the distal end where the wires run into the housing since the sealing area is reduced compared to e.g. a cylindrical shaped housing. In the

5 embodiments shown in Fig. 1A-D, the sealing is provided by a nut compressing a compressible sealing element through which the wires extend into the interior of the housing.

The number of electrical connectors is selected according to a particular use and a
10 particular mate with a mating plug or socket in general. For reefer container use, the plug may typically comprise three, four or five of said electrical connectors 2 and one of said electrical connectors 2 is configured for providing an earth connection and the remaining of said electrical connectors 2 are configured for providing an electrical current connection. The electrical connector for providing
15 an earth connection has a mating connection part 4 typically having a larger diameter than the mating connection part 4 for providing electrical current connection. The diameter of the mating connection parts 4 for providing electrical current connection typically have an equal diameter.

20 It may be preferred that the inspection window(s) 5 are shaped in a manner not creating a distorted visual view of the interior of the housing 1. This may be provided by a uniform thickness of the inspection window(s) 5. In some preferred embodiments the inspection window(s) 5 is(are) shaped so as to have a lenticular part configured to visually enlarge said electrical connections.

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Preferred embodiments of an electrical plug are configured for a rated AC voltage of AC380 Volt and rated AC current 16 amps or configured for a rated AC voltage of AC 440 Volts and a rated AC current of 32 amps. However, other ratings are considered within the scope of the present invention.

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Reference is made to Fig. 1E illustrating a preferred embodiment of a transparent part. The illustrated transparent part has an inspection window part 10 which when provided in the plug 1 is arranged in a through-going opening provided in the non-transparent part of the plug. The through-going opening in the housing
35 preferably has a shape corresponding to a circumferential contour of the

inspection window part 10. In preferred embodiments, the through-going opening and the window part form a snug-fit when joint together.

The transparent part may have a flange part 11 circumferentially proceeding
5 along a perimeter of said inspection window part 10, where the flange part 11 and the inspection window part 10 forms a recess 12 having a surface 13 abutting an inner surface of said non-transparent part, when the non-transparent part and the transparent part are joint. The transparent part has a fixture element 17 which is used to maintain the transparent part in the mould in a required position during
10 moulding of the non-transparent part.

In preferred embodiments, the transparent part 11 is moulded as a separate piece which is introduced in a moulding machine such as a blow-moulding machine. One inserted, the non-transparent part is molded.

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To accomplish fastening – or increase fastening - of the transparent part to the non-transparent part (and vice versa), the flange part 11 preferably has a plurality of through-going openings 14 by which the transparent part 2 is attached to said non-transparent section by the non-transparent material occupies the
20 through-going openings 14. Occupation of the through-going opening by the material of the non-transparent part may be provided in the above detailed moulding process. However, the through going opening 14 may also be used to plastic spot-weld the transparent part to the non-transparent part.

25 It is generally preferred that the joining of the transparent part and the non-transparent part is made so as to provide a seal in-between the parts to avoid ingress of moisture and/or water into the housing at the interface between the transparent and non-transparent part. Such sealing may be provided by melting and/or gluing the two parts together e.g. at the flange part 11.

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A thickness of the housing 1 and the inspection window(s) 5 is typically larger than 2.0 mm and smaller than 5.0 mm.

Preferred embodiments of a plug may have a protection degree of IP67.

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Preferred embodiments comprising an electrical cable comprising wires where at least one end of the cable is provided with a plug according to a preferred embodiment. In some preferred embodiments, the cable is provided with a female type plug according to a preferred embodiment at one end and a male type plug
5 according to a preferred embodiment at the other end.

The invention also relates to a method of examining electrical connections in an electrical cable comprising wires where at least one end of the cable is provided with a plug according to the invention. The plug and cable are electrically
10 connected by the wires being connected to the electrical connector 2. The wires are stripped to expose a section of the electric conductive material of the wires which exposed sections are introduced into cavities 15 of the electrical connectors 2 and fastened by the screws 16.

15 During inspection, an inspector, being a human, and the plug is arranged so as to allow the inspector to perform a visually inspection of the electrical connections of said plug for determining whether said wires are correctly connected to said electrical connectors 2. If the plug is not connected to a socket, the inspector may arrange the plug suitable to provide the inspection, and if the plug is connected to
20 a socket, the inspect may arrange its field of view to inspect the connections.

During the inspection, the inspector typically finds that

- the wires are correctly connected, in which case the inspector approves the electrical cable for use, or
- 25 • one or more of the wires are non-correctly connected, in which case the inspector disapproves the electrical cable for use.

In case the electrical cable is disapproved, the disapproved electric cable may be discarded. Alternatively, the connections may be repaired by dismantling the plug
30 and assembling plug after repairing of the connections.

Examining the electrical connections is in preferred embodiments carried out during a pre-trip investigation. Such a pre-trip investigation is typically related to examining electrical cables for electric requiring containers, such as reefer
35 containers, to be transported by a vessel, train or truck, and pre-trip preferably

refers to that the electrical cables are examined prior to the cables are deployed and electrical connected to containers.

Examining the electrical connections may alternatively or in combination with the
5 pre-trip investigation be carried out during a trip investigation. By this, the electrical connections are examined when the cables have been deployed and electrically connected to the containers.

While examining of electrical connections in some embodiments aims at
10 preventing use of a faulty cable and/or plug, the examining may also be useful in connection with a fault finding investigation. In such fault finding investigations, an error in electrical supply to a device has shown up in the form of an error code, lack or poor operation of the device or other manifestations on lack of electrical supply.

15 Typically, the wires are considered to be non-correctly connected in case, one or more of the wires are broken, such as broken-off at the electrical connector 2, insulation of one or more of said wires is incomplete, such as having burn marks, either exposing the conductive material or increasing the risk of such exposure,
20 one or more of said wires are not connected to said electrical connectors and/or liquid such as water is present within said plug. However, the invention is not limited to finding such non-correctly connections as other non-correctly connections may be found by a plug according to preferred embodiments of the invention.

25 It is noted, that use of the cables and plug in combination with containers is a non-limiting example and that the plug, cable and examining of connections may be used for other electric requiring equipment(s) in general.

30 ITEMIZED LIST OF PREFERRED EMBODIMENTS

Item 1. An electrical plug comprising

- a housing (1),
- a number of electrical connectors (2) each being configured to conduct electrical current and comprising

- an inner connection part (3) positioned inside the housing (1) configured for electrical connection of an electrical wire to said electrical connector (2), and
- a mating connection part (4) for electrically connecting said connector (2) with an electrical connector of a mating electrical plug, said mating connecting part (4) being accessible from an exterior of the housing (1);

said housing (1) being tubular and comprising

- a non-transparent part being made from a non-transparent material and at least one transparent part being made from a transparent material forming an inspection window (5), said inspection window (5) being positioned in said housing (1) so as to provide a visual view of said electrical connections of said electrical wires.

Item 2. A plug according to item 1, wherein said inspection window (5)

- extends in a circumferential direction of the housing (1) by an amount (s) being less than a fourth, such as less than fifth, of a full circumferential length (S) of said housing (1),
- being position in the housing (1) to provide a transverse field of view covering said electrical connections of said electrical wires.

Item 3. A plug according to item 1 or 2, wherein said inspection window (5) extends in a longitudinal direction of said housing (1) by an amount being larger than a longitudinal extension of said electrical connections of said electrical wires.

Item 4. A plug according to any one of the preceding item, wherein a planar representation of said inspection window (5) is trapezoid with rounded corners, triangular with rounded corners, squared with rounded corners, circular or ellipsoid, or said inspection window (5) may be tubular.

Item 5. An electrical plug according to any one of the preceding items, wherein said transparent material is a plastic material, such as PA 12 (Nylon 12), PA 11 (nylon 11), or polycarbonate.

Item 6. An electrical plug according to any one of the preceding items, wherein said non-transparent material is a plastic material, such as PA 6 (Nylon 6), PA 66 (NYLON 66) or transparent ABS plastic.

- 5 Item 7. An electrical plug according to any one of the preceding items, wherein the plug is a male-type plug and the mating connection parts are electrical pins (6) extending outside the housing.

Item 8. An electrical plug according to item 7, wherein the plug comprising a
10 shield (8) forming an extension of said housing and laterally shielding said electrical pins (6).

Item 9. An electrical plug according to any one of the preceding items 1-6,
wherein the plug is a female-type plug and the mating connection parts (4) are
15 sockets arranged retracted relatively to an external surface of the housing (1).

Item 10. An electrical plug according to any one of items 1-8, wherein the plug is
a female-type plug and the external connection parts comprising sockets
positioned retracted from an exterior surface of the housing.
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Item 11. An electrical plug according to any one of the preceding items, wherein
said plug comprising a single inspection window (5).

Item 12. An electrical plug according to any one of the preceding items, wherein
25 said plug comprising two inspection windows (5), said two inspections windows
being positioned opposite to each other such as diametrically opposite to each
other.

Item 13. An electrical plug according to any one of the preceding items, wherein
30 the electrical connectors (2) are arranged in an assembly element (7) releasable
inserted in said housing (1).

Item 14. An electrical plug according to any one of the preceding items, wherein a
part of the housing (1) has a frusto conical shape tapering inwardly in a
35 longitudinal direction away from the inner connection parts (3).

Item 15. An electrical plug according to any one of the preceding items, wherein the plug comprising three, four or five of said electrical connectors (2), wherein one of said electrical connectors (2) is configured for providing an earth
5 connection and the remaining of said electrical connectors (2) are configured for providing an electrical current connection.

Item 16. An electrical plug according to any one of the preceding items, wherein said inspection window (5) comprising a lenticular part configured to visually
10 enlarge said electrical connections.

Item 17. An electrical plug according to any one of the preceding items, wherein the plug is configured for a rated AC voltage of AC380 Volt and rated AC current 16 amps or configured for a rated AC voltage of AC 440 Volts and a rated AC
15 current of 32 amps.

Item 18. A plug according to any one of the preceding items, wherein each of said transparent part (s) comprising:

- an inspection window part (10) arranged in a through-going opening provided
20 in said non-transparent part having a shape corresponding to a circumferential contour of said inspection window part (10);
- a flange part (11) circumferentially proceeding along a perimeter of said inspection window part (10), said flange part (11) and said inspection window part (10) forms a recess (12) having a surface (13) abutting an inner surface
25 of said non-transparent part.

Item 19. A plug according to claim 18, wherein said flange part (11) comprising a plurality of through-going openings (14) by which the transparent part(s) is (are) attached to said non-transparent section by the non-transparent material occupies
30 said through-going openings (14).

Item 20. A system for providing electrical power to a reefer container or a ship battery, said system comprising

- 35 • an electrical cable comprising wires where at least one end of the cable is provided with a plug according to any one of the preceding items,

- a reefer container or a ship battery having a plug or a socket being configured to mate with said plug provided to said cable for providing electrical power to the reefer container or said ship battery through said cable.

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Item 21. A method of examining electrical connections in an electrical cable comprising wires where at least one end of the cable is provided with a plug according to any one of the preceding items, the method comprises

- arranging said plug in a position relative to an inspector, being a human,
10 allowing said inspector:
 - to visually inspect said electrical connections of said plug for determining whether said wires are correctly connected to said electrical connectors;
- in case said wires are correctly connected, approve said electrical cable for
15 use, or
- in case the one or more of said wires are non-correctly connected, disapprove said electrical cable for use.

Item 22. A method of examining electrical connections according to item 21,
20 wherein said disapproved electric cable is discarded.

Item 23. A method of examining electrical connections according to item 22, wherein said plug of said disapproved electrical is dismantled and said electrical connections are corrected into correct connections.

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Item 24. A method according to any one of the preceding items 21-23, wherein the method is carried out during a pre-trip investigation.

Item 25. A method according to any one of the preceding items 21-24, wherein
30 the method is carried out during a trip investigation.

Item 26. A method according to any one of the preceding items 21-25, wherein the method is carried out in a fault finding investigation.

Item 27. A method according to any one of the preceding items 21-27, wherein said wires are non-correctly connected in case, one or more of said wires are broken, insulation of one or more of said wires is incomplete, one or more of said wires are not connected to said electrical connectors and/or liquid such as water is
5 present within said plug.

Although the present invention has been described in connection with the specified embodiments, it should not be construed as being in any way limited to the presented examples. The scope of the present invention is set out by the
10 accompanying claim set. In the context of the claims, the terms "comprising" or "comprises" do not exclude other possible elements or steps. Also, the mentioning of references such as "a" or "an" etc. should not be construed as excluding a plurality. The use of reference signs in the claims with respect to elements indicated in the figures shall also not be construed as limiting the scope of the
15 invention. Furthermore, individual features mentioned in different claims, may possibly be advantageously combined, and the mentioning of these features in different claims does not exclude that a combination of features is not possible and advantageous.

LIST OF REFERENCE SYMBOLS USED:

1	Housing
2	Electrical connector
3	Inner connection part
5 4	Mating connection part
5	Inspection window
6	Electrical pin
7	Assembly element
8	Shield
10 9	Coupling nut
10	Inspection window part
11	Flange part
12	Recess
13	Surface
15 14	Through-going opening
15	Cavity
16	Screw
17	Fixture element
s	Circumferential length
20 S	Full circumferential length

CLAIMS

1. An electrical plug comprising
- a housing (1),
 - a number of electrical connectors (2) each being configured to conduct
- 5 electrical current and comprising
- an inner connection part (3) positioned inside the housing (1) configured for electrical connection of an electrical wire to said electrical connector (2), and
 - a mating connection part (4) for electrically connecting said connector
- 10 (2) with an electrical connector of a mating electrical plug, said mating connecting part (4) being accessible from an exterior of the housing (1);
- said housing (1) being tubular and comprising
- a non-transparent part being made from a non-transparent material and at
- 15 least one transparent part being made from a transparent material forming an inspection window (5), said inspection window (5) being positioned in said housing (1) so as to provide a visual view of said electrical connections of said electrical wires.
- 20 2. A plug according to claim 1, wherein said inspection window (5)
- extends in a circumferential direction of the housing (1) by an amount (s) being less than a fourth, such as less than fifth, of a full circumferential length (S) of said housing (1),
 - being position in the housing (1) to provide a transverse field of view covering
- 25 said electrical connections of said electrical wires.
3. A plug according to claim 1 or 2, wherein said inspection window (5) extends in a longitudinal direction of said housing (1) by an amount being larger than a longitudinal extension of said electrical connections of said electrical wires.
- 30 4. A plug according to any one of the preceding claims, wherein a planar representation of said inspection window (5) is trapezoid with rounded corners, triangular with rounded corners, squared with rounded corners, circular or ellipsoid, or said inspection window (5) may be tubular.
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5. An electrical plug according to any one of the preceding claims, wherein said transparent material is a plastic material, such as PA 12 (Nylon 12), PA 11 (nylon 11), or polycarbonate.
- 5 6. An electrical plug according to any one of the preceding claims, wherein said non-transparent material is a plastic material, such as PA 6 (Nylon 6), PA 66 (NYLON 66) or transparent ABS plastic.
7. An electrical plug according to any one of the preceding claims, wherein the
10 plug is a male-type plug and the mating connection parts are electrical pins (6) extending outside the housing.
8. An electrical plug according to any one of the preceding claims, wherein the plug comprising a shield (8) forming an extension of said housing and laterally
15 shielding said electrical pins (6).
9. An electrical plug according to any one of the preceding claims 1-6, wherein the plug is a female-type plug and the mating connection parts (4) are sockets arranged retracted relatively to an external surface of the housing (1).
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10. An electrical plug according to any one of the preceding claims 1-6, wherein the plug is a female-type plug and external connection parts comprising sockets positioned retracted from an exterior surface of the housing.
- 25 11. An electrical plug according to any one of the preceding claims, wherein said plug comprising a single inspection window (5).
12. An electrical plug according to any one of the preceding claims, wherein said plug comprising two inspection windows (5), said two inspections windows being
30 positioned opposite to each other such as diametrically opposite to each other.
13. An electrical plug according to any one of the preceding claims, wherein the electrical connectors (2) are arranged in an assembly element (7) releasable inserted in said housing (1).

14. An electrical plug according to any one of the preceding claims, wherein a part of the housing (1) has a frusto conical shape tapering inwardly in a longitudinal direction away from the inner connection parts (3).

5 15. An electrical plug according to any one of the preceding claims, wherein the plug comprising three, four or five of said electrical connectors (2), wherein one of said electrical connectors (2) is configured for providing an earth connection and the remaining of said electrical connectors (2) are configured for providing an electrical current connection.

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16. An electrical plug according to any one of the preceding claims, wherein said inspection window (5) comprising a lenticular part configured to visually enlarge said electrical connections.

15 17. An electrical plug according to any one of the preceding claims, wherein the plug is configured for a rated AC voltage of AC380 Volt and rated AC current 16 amps or configured for a rated AC voltage of AC 440 Volts and a rated AC current of 32 amps.

20 18. A plug according to any one of the preceding claims, wherein at least one of said least one transparent part (s) comprising:

- an inspection window part (10) arranged in a through-going opening provided in said non-transparent part having a shape corresponding to a circumferential contour of said inspection window part (10);
- 25 • a flange part (11) circumferentially proceeding along a perimeter of said inspection window part (10), said flange part (11) and said inspection window part (10) forms a recess (12) having a surface (13) abutting an inner surface of said non-transparent part.

30 19. A plug according to claim 18, wherein said flange part (11) comprising a plurality of through-going openings (14) by which the transparent part(s) is (are) attached to said non-transparent section by the non-transparent material occupies said through-going openings (14).

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20. A system for providing electrical power to a reefer container or a ship battery, said system comprising

- an electrical cable comprising wires where at least one end of the cable is provided with a plug according to any one of the preceding claims,
- 5 • a reefer container or a ship battery having a plug or a socket being configured to mate with said plug provided to said cable for providing electrical power to the reefer container or said ship battery through said cable.

10 21. A method of examining electrical connections in an electrical cable comprising wires where at least one end of the cable is provided with a plug according to any one of the preceding claims, the method comprises

- arranging said plug in a position relative to an inspector, being a human, allowing said inspector:
 - 15 ○ to visually inspect said electrical connections of said plug for determining whether said wires are correctly connected to said electrical connectors;
- in case said wires are correctly connected, approve said electrical cable for use, or
- 20 • in case the one or more of said wires are non-correctly connected, disapprove said electrical cable for use.

22. A method of examining electrical connections according to claim 21, wherein said disapproved electric cable is discarded.

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23. A method of examining electrical connections according to claim 22, wherein said plug of said disapproved electrical is dismantled and said electrical connections are corrected into correct connections.

30 24. A method according to any one of the preceding claims 21-23, wherein the method is carried out during a pre-trip investigation.

25. A method according to any one of the preceding claims 21-24, wherein the method is carried out during a trip investigation.

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26. A method according to any one of the preceding claims 21-25, wherein the method is carried out in a fault finding investigation.

27. A method according to any one of the preceding claims 21-27, wherein said
5 wires are non-correctly connected in case, one or more of said wires are broken, insulation of one or more of said wires is incomplete, one or more of said wires are not connected to said electrical connectors and/or liquid such as water is present within said plug.