

Description**Title: Welding wheel**

The field of the present invention is that of welding wheels, and more particularly the welding wheels for seam welding metal plates forming tank walls, to be used for the storage and
5 transportation of liquefied natural gas.

The tanks for storing and/or transporting liquefied natural gas (LNG) are composed of a tank wall which comprises, among other things, thermally insulating portions and metal plates, ensuring the sealing of said tank wall. In order to secure and render the metal plates tight to one another, it is known practice to weld them to one another. Indeed, the welding of the metal
10 plates ensures an optimal sealing of the tank and an effective securing of the metal plates to one another. To that end, it is known practice to use a welding machine comprising at least one welding wheel capable of welding the metal plates, under the effect of an electrical current flowing through the wheel. Such a welding wheel is then composed of an alloy of different metals, exhibiting electrical conductivity properties that are compatible with the voltage and the
15 current involved. Some metals forming the alloy do however have a high cost, as in the case of beryllium for example.

In order to reduce the time to manufacture tanks described above while maintaining the level of reliability of the weld, it is desirable to increase the rate of advance of the welding machine, which means increasing the frequency of the electrical current flowing in the wheel, and the
20 intensity of the electrical current which passes through it. These increases do however present the drawback of significantly increasing the phenomena of the heating of the wheel. Indeed, it has been found by the applicant that the current structure of the wheels was not optimal for withstanding this increase in frequency and the intensity of the electrical current and that the consequence of that was to reduce their life, notably through wear of the wheel.

25 The aim of the present invention is therefore to remedy the drawbacks described above, by designing a welding wheel that is capable of withstanding the increase in the frequency of the electrical current and its intensity, while retaining a minimum size in order to not increase its production cost due to the alloys necessary to its production. Another aim of the invention is also to limit the bulk of the welding machine equipped with these wheels.

30 The invention then relates to a welding wheel for welding metal plates, the wheel comprising a contact surface which is inscribed within a disc with a diameter less than 100 mm and a cooling system for cooling the contact surface, the wheel being characterized in that the cooling system

for cooling the contact surface comprises at least two distinct cooling circuits, configured to be passed through by at least one coolant.

The welding wheel is used for example for welding metal plates forming walls of tanks for storing and/or transporting liquefied natural gas (LNG). Such tank walls are composed, among
 5 other things, of a thermally insulating portion, necessary to the low-temperature transportation of the LNG and also comprising a plurality of metal plates composed, for example, of Invar® or even of an alloy with high manganese content or of a stainless steel. The function of the metal plates is then to ensure the sealing of the tank. According to an exemplary embodiment of the tank wall, the metal plates can have raised edges at the periphery. The welding wheel is then used
 10 to weld the raised edges of the adjacent metal plates, such a weld ensuring an optimal sealing of the tank for storing and/or transporting LNG.

The welding wheel is an electrode operated by electrical current and it is understood that the contact surface constitutes the part of the wheel that is intended to be in contact with the metal plate to be welded. In other words, the contact surface of the wheel forms a welding extent.

15 The coolant is advantageously a liquid, for example water mixed with glycol. The two cooling circuits are more particularly configured to be passed through by this liquid and to contain this liquid within the welding wheel.

It is understood that the cooling system is housed within a volume defined by the wheel. In other words, the two cooling circuits of the cooling system of the wheel extend in the volume of
 20 the wheel and in such a way that they ensure cooling of the contact surface and, more generally, of the wheel as a whole. However, since the contact surface forms the part of the wheel where the temperature rise is the greatest, the cooling system is formed within the wheel to particularly cool the contact surface.

In addition, the separated circulation of the coolant in each of the two cooling circuits allows to
 25 limit the heating of each coolant, after the capture of the calories produced by the heating of the contact surface under the effect of the electric power passing through it during a welding action. Indeed, each of the coolant which circulating in separate portion of the welding wheel, the heating of each of the coolant is reduced. Furthermore, such a structure of the cooling system in two separate cooling circuits allows coolant to circulate in each of the cooling circuits in either
 30 identical or opposite direction of flow. This allow a homogeneous cooling of the contact surface of the wheel, thus providing a thermal balance of the wheel achieved faster and more stable.

Since the welding wheel has a diameter less than 100 mm, the cooling system with double cooling circuit incorporated in the wheel is exploited inasmuch as it increases the effect of

cooling of the wheel without requiring a significant increase in the diameter of the disc in which the contact surface is inscribed. A wheel is then retained with a diameter less than 100 mm whose welding speed can be greater than that of standard wheels.

Furthermore, the homogeneous cooling of the wheel allows to obtain identical electrical conductivity at all points of the welding wheel, thus provided a homogeneous distribution of an amount of electrical energy on the part to be welded, here the raised edges of adjacent metal plates. This improves the quality of the weld beads produced by the welding wheel. Finally, the more efficient cooling of the welding wheel allows to limit and to homogenize the wear of the contact surface, thus increasing the duration life of the welding wheel over time.

According to a feature of the invention, the diameter of the disc defining the contact surface is between 70 mm and 100 mm.

According to a feature of the invention, the cooling system comprises a first cooling circuit and a second cooling circuit, the first cooling circuit comprising a first main duct associated with a first inlet orifice and a first outlet orifice for the fluid, the second cooling circuit comprising a second main duct associated with a second inlet orifice and a second outlet orifice for the fluid.

It is understood from the particular structure of the cooling system according to the invention that the first cooling circuit and the second cooling circuit extend within the volume of the wheel and that they do not communicate fluidically with one another within the welding wheel.

The coolant enters into the first cooling circuit through the first inlet orifice, circulates in the first main duct and emerges through the first outlet orifice. This particular circulation of the fluid in the cooling system for the wheel applies also to the second coolant circuit. It is then possible to have different fluids circulating in the first cooling circuit and in the second cooling circuit, but also to use only one or other of the cooling circuits in order to modulate the effect of cooling of the wheel.

The separate inlet orifices for each of cooling circuits and the separate outlet orifices for each of the cooling circuits also allow them to be positioned alternately with each other along a virtual circle projected onto the wheel. An inlet orifice of the first cooling circuit is thus followed by an outlet orifice of the first cooling circuit, then followed by an inlet orifice of the second cooling circuit, finally followed by an outlet orifice of the second cooling circuit. Alternatively, an inlet orifice of the first cooling circuit may be followed by an outlet orifice of the first cooling circuit, then followed by an outlet orifice of the second cooling circuit, finally followed by an inlet orifice of the second cooling circuit. The circulation of the coolant is thus allowed in each of the first cooling circuit and of the second cooling circuit following the same direction of circulation or

following opposite direction of circulation. This make it possible to homogenize the cooling of the welding wheel by providing a better distribution of the coolant in said wheel, and thus to obtain identical electrical conductivity over the entire welding wheel.

According to a feature of the invention, the first main duct and the second main duct of the cooling circuits extend in a duct plane parallel to a main plane of the wheel in which it extends.
5 The main plane of the wheel is at right angles to an axis of rotation of the wheel.

A first face and a second face of the wheel are defined, opposite to one another in a vertical direction of the wheel, at right angles to its main plane. The first main duct and the second main duct then extend in the wheel, in the duct plane and between the first face and the second face
10 of the wheel.

According to a feature of the invention, a first axis passes through a centre of the first inlet orifice and through a centre of the first outlet orifice and a second axis passes through a centre of the second inlet orifice and a centre of the second outlet orifice, the first axis and the second axis being parallel to one another.

Such a feature makes it possible for example to separate the first cooling circuit and the second cooling circuit, each within a half of the welding wheel. This allows a better distribution of the coolant inside the welding wheel and the cooling of such wheel is optimized. Thus, the homogeneity of the electrical conductivity of the welding wheel is increased, thus ensuring that the same quantity of electrical energy is delivered to the part being welded.
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According to a feature of the invention, at least one of the main ducts of one of the cooling circuits has the form of a circular arc.
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A curved portion of the first main duct is then defined, realized by its circular arc form. The curved portion is then formed at the periphery of the wheel, such that it follows the circular form of the disc defined by the contact surface. The curved portion is thus allowed to extend as close as possible to the contact surface, which has a higher heating temperature compared to a centre of the wheel.
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According to an example of the invention, the second main duct of the cooling system also has a curved portion. Such a configuration then optimizes the cooling of the contact surface of the wheel.

According to a feature of the invention, at least one of the main ducts extends in a straight line between at least one inlet orifice or one outlet orifice and an end of the circular arc.
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According to an example of the invention, the first main duct comprises a first straight portion and a second straight portion. More specifically, the first straight portion extends from a first end of the curved portion, to a first inlet orifice. Likewise, the second straight portion extends from a second end of the curved portion, to a first outlet orifice.

- 5 The first straight portion and the second straight portion of the first main duct are then aligned along the first axis, described previously.

This configuration of the first main duct applies also to the second main duct of the second cooling circuit.

- According to a feature of the invention, at least one of the inlet orifices or one of the outlet
10 orifices is closer to a centre of the wheel and its contact surface.

According to an example of the invention, the inlet orifices and the outlet orifices of the cooling system are formed as close as possible to the centre of the wheel.

According to a feature of the invention, the wheel comprises a central cavity surrounded by a shoulder, configured to centre the wheel on a hub of a welding machine.

- 15 It is understood that the central cavity forms a polarizing means coupled with a means for centring the wheel for its positioning on the hub of the welding machine. Welding defects or early wear of the wheel provoked by an imprecise mounting thereof on the welding machine are thus avoided.

- According to a feature of the invention, the wheel is composed of copper and at least one other
20 metal.

- According to an example of the invention, the wheel can be composed of an alloy of copper and beryllium offering a high electrical and thermal conductivity. Since the latter is a costly metal, the advantage of retaining a diameter of the disc defined by the contact surface of between 70 mm and 100 mm in order to not increase the needs for noble metals in the production of the wheel is
25 understood. Such an advantage is possible through the cooling system with double cooling circuit that does not require a strong increase in the size of the wheel for the latter to withstand a higher temperature.

- The invention relates also to a welding machine for linking a first plate and a second plate of a tank for storing and/or transporting a liquefied natural gas, comprising at least one wheel
30 according to any one of the preceding features.

According to an example of the invention, the welding machine comprises a first welding wheel and a second welding wheel each comprising the features described previously. Ducts housed in rotation shafts are then used to link each of the inlet orifices and of the outlet orifices of the first wheel and of the second wheel to the welding machine, in order to irrigate the cooling systems
 5 with coolant. The first wheel and the second wheel are then disposed on either side of the raised edges of the metal plates of the tank that is the subject of the welding. The first welding wheel is then brought to a first electrical potential, while the second welding wheel is brought to a second electrical potential opposite the first electrical potential. The welding wheels are then electrodes brought to the electrical potentials mentioned above discontinuously, at a given frequency and
 10 intensity which are greater than the frequency and the intensity usually used.

According to a feature of the invention, the welding machine is configured to apply a weld with continuous movement at a rate greater than or equal to two metres and a half/min. The continuous welding is advantageously performed at a rate of four m/min.

According to a feature of the invention, a first inlet orifice of a first cooling circuit is
 15 diametrically opposite a second inlet orifice of a second cooling circuit, and a first outlet orifice of the first cooling circuit is diametrically opposite a second outlet orifice of the second cooling circuit.

In other words, when the wheel is fixed to the welding machine, the fluid intakes into the first cooling circuit and into the second cooling circuit are diametrically opposite on the wheel.
 20 Likewise, the fluid outlets in the first cooling circuit and in the second cooling circuit are diametrically opposite on the wheel.

Although the fluid intakes of the first circuit and of the second circuit are diametrically opposite on the wheel, the direction of circulation of the fluid in each of the circuits is identical to the direction of rotation of the wheel. Such a configuration is exploited inasmuch as it allows the
 25 cooling of the wheel to be made uniform.

Other features, details and advantages of the invention will emerge more clearly on reading the following description on the one hand, and several exemplary embodiments given by way of indication and in a nonlimiting manner with reference to the attached schematic drawings on the other hand, in which:

30 [Fig.1] is a perspective general view of a welding wheel according to the invention showing a first face;

[Fig.2] is a perspective general view of a second face of the welding wheel of Figure 1;

[Fig.3] is a side view of the welding wheel of Figure 1, showing a contact surface;

[Fig.4] is a cross-sectional view of the welding wheel of Figure 3, along a radial cross-sectional plane, showing a cooling system according to the invention comprising a first cooling circuit and a second cooling circuit;

5 [Fig.5] is a cross-sectional view of the welding wheel of Figure 1 along an axial plane, showing a first main duct and a second main duct of the first cooling circuit and of the second cooling circuit;

[Fig.6] is a cross-sectional view of the welding wheel of Figure 1 along an axial plane, showing the first main duct connected to a first inlet orifice and a first outlet orifice;

10 [Fig.7] is a schematic view of a welding machine according to the invention, linked to a first welding wheel and a second welding wheel according to the invention.

The features, variants and various embodiments of the invention can be associated with one another, according to various combinations, inasmuch as they are not mutually incompatible or exclusive. It will notably be possible to devise variants of the invention comprising only a

15 selection of features described hereinbelow isolated from the other features described, if this selection of features is sufficient to confer a technical advantage or to differentiate the invention from the state of the prior art.

Figure 1 shows a welding wheel 1 according to the invention. The welding wheel 1 can be used to weld metal plates together, by a continuous movement and spot weld. To this end, the

20 welding wheel 1 is fixed to a welding machine (that can be seen in Figure 7), the movement of which along the metal plates is continuous at a speed greater than or equal to two metres and a half/min. The movement of the welding machine then ensures the movement of the wheel 1 and the diffusion of an electrical current within the latter, allowing it to exercise its welding function.

25 Such a wheel 1 can for example be used in the production of tanks for transporting and storing liquefied natural gas (LNG). Such tanks are composed, for example, of at least one thermally insulating barrier, ensuring the thermal insulation of the tank and notably of its cargo, and of a plurality of metal plates, ensuring the sealing thereof and each comprising one or more raised edges. The wheel 1 is then required to secure the raised edges of adjacent metal plates. The

30 welding of the raised edges of the metal plates by the welding wheel 1 notably ensures an optimal and durable sealing of the tanks for transporting and storing LNG.

The welding wheel 1 that can be seen in Figure 1 and Figure 2 is of generally circular form and extends in a main plane M of the wheel 1. The welding wheel 1 then comprises a central axis X of rotation passing through a centre D of said wheel 1. The wheel 1 comprises a contact surface 2 which is inscribed within a disc 4 of a first diameter D1 (that can be seen in Figure 3).

5 According to a first aspect of the invention, the first diameter D1 of the disc 4 defined by the contact surface 2 is between 70 mm and 100 mm. Contact surface 2 is understood to be the part of the wheel 1 configured to be in contact with the metal plate when the welding method is implemented. In other words, the contact surface 2 forms a welding extent of the wheel 1. The contact surface 2 forms an electrode which is activated under the effect of the electrical current
10 which passes through the wheel 1 thus allowing the metal plates to be welded.

A central portion 6 and a peripheral portion 8 of the disc 4 forming the wheel 1 are distinguished. The central portion 6 corresponds notably to the portion of the disc 4 which extends between a first face 10 and a second face 12 of said disc 4, opposite one another in a vertical direction V of the wheel 1 at right angles to its main plane M. The central portion 6 of
15 the disc 4 has a second diameter D2, strictly less than the first diameter D1 of the disc 4 defined by the contact surface 2 of the wheel 1.

A central cavity 14 of circular form is formed on the first face 10 of the central portion 6 of the disc 4. The central cavity 14 is surrounded by a circular shoulder 16 and a third diameter D3 is defined corresponding to the diameter of the circumference of said central cavity 14. The third
20 diameter D3 is then strictly less than the second diameter D2 of the central portion 6 of the disc 4. The term central cavity 14 is understood to mean that the latter corresponds to a removal of material of the central portion 6 on the first face 10 of the disc 4, creating an indentation in said central portion 6. The function of the central cavity 14 is to form a polarizing means and a means for centring the welding wheel 1 for its assembly on a hub of the welding machine. The
25 central cavity 14 then allows the wheel to be centred on said hub. It is therefore understood that the first face 10 of the central portion 6 is the face facing said welding machine.

Once the welding wheel is positioned on the welding machine, at least one through-bore 18, formed in the central portion 6 of the disc 4, allows said wheel 1 to be secured to the welding machine. The through-bore 18 is understood to be a hole which passes straight through the
30 wheel 1, that is to say that the bore 18 is open on the first face 10 and the second face 12 of the central portion 6, as can be seen in Figure 1 and in Figure 2. The bore 18 can then cooperate with a fixing means, for example a screw, in order to secure the wheel 1 with the welding machine.

According to an example of the invention that can be seen in particular in Figure 5, the bore 18 has a counter bore of a greater diameter on the second face 12 with respect to the first face 10 of the central portion 6. Such a feature notably allows a head of a screw to be housed within a plane that is common with a main plane of the second face 12.

5 According to the embodiment illustrated, the wheel 1 comprises four through-bores 18 formed on the central portion 6 of the disc 4. The four bores 18 are advantageously distributed peripherally in the central cavity 14 in order to offer a better hold of the wheel 1 on the welding machine.

As can be seen in particular in Figure 3, the peripheral portion 8 corresponds to the portion of
10 the wheel 1 which extends at the periphery of the central portion 6 on which the contact surface 2 is formed. The peripheral portion 8 comprises at least one first inclined wall 30, one second inclined wall 32 and the contact surface 2.

The first inclined wall 30 and the second inclined wall 32 extend radially respectively from the periphery of the first face 10 and of the second face 12 of the central portion 6 of the disc 4. The
15 expression inclined walls is then understood to mean that the latter have an angle of inclination with respect to the main plane M of the wheel 1 of between 20° and 80°. The first inclined wall 30 and the second inclined wall 32 are notably inclined toward one another and are linked together by the contact surface 2.

According to the example of the invention illustrated, the contact surface 2 extends at right
20 angles to the main plane M of the wheel 1 and in such a way that it links the first inclined wall 30 and the second inclined wall 32 as described previously. The contact surface 2 forms a strip which delimits the weld.

According to the invention and as can be seen in particular in Figures 4 to 6, the wheel 1
25 comprises a cooling system 20 formed in the central portion 6 of the disc 4 surrounded by the contact surface 2.

The cooling system 20 according to the invention advantageously comprises a first cooling circuit 22 and a second cooling circuit 24. The cooling system 20 comprises inlet orifices 26 and outlet orifices 28 in order to have a coolant enter into the welding wheel 1, and the latter are formed in the central cavity 14 of the central portion 6 as can be seen in Figure 1.

30 The function of the cooling system 20 is to cool the wheel 1 while it is being used, that is to say while electrical current is circulating within it. The cooling system 20 notably makes it possible to limit the temperature of the wheel 1 and thus reduce the overheating phenomena that can

ultimately damage it. One advantage of the cooling system 20 comprising the double cooling circuit is that it increases the effect of cooling of the wheel 1 and makes it possible to increase the frequency and the intensity of the electrical current passing through the wheel 1 without requiring an excessive increase in the diameter of the disc 4 defined by the contact surface 2. The rate of welding of the metal plates is thus increased, without greatly increasing the cost of production of the wheel 1.

The cooling system 20 will now be described in more detail with Figures 4 to 6, Figure 5 and Figure 6 showing axial cross-sectional views respectively along a second axial plane B-B and a third axial plane C-C, that can be seen in Figure 1. Hereinafter in the description, the first cooling circuit 22 of the cooling system 20 will be described in detail, but it should be considered that the characteristics of the first cooling circuit 22 apply *mutatis mutandis* to the second cooling circuit 24, unless stipulated otherwise.

The first cooling circuit 22 comprises a first main duct 36 and a first inlet orifice 26a and a first outlet orifice 28a. More specifically, the first main duct 36 is open on the central cavity 14 of the first face 10 of the disc 4 by means of the first inlet orifice 26a and of the first outlet orifice 28a, as can be seen in particular in Figure 6. It is then understood that, when the welding machine is operating, the coolant enters into the first cooling circuit 22 through the first inlet orifice 26a, then circulates in the central portion 6 of the wheel 1 through the first main duct 36 and emerges through the first outlet orifice 28a.

According to the invention and as is illustrated in Figure 1, when the welding wheel 1 is linked to the welding machine, the entry of the fluid into the first cooling circuit 22 and into the second cooling circuit 24 takes place respectively through the first inlet orifice 26a and the second inlet orifice 26b, and the latter are then diametrically opposite on the central cavity 14 of the first face 10 of the disc 4. Likewise, the fluid exits from the first cooling circuit 22 and from the second cooling circuit 24 respectively through the first outlet orifice 28a and the second outlet orifice 28b, and the latter are diametrically opposite on the central cavity 14 of the first face 10 of the disc 4.

However, the circulation of the fluid in the first cooling circuit 22 and in the second cooling circuit 24 takes place in a direction of circulation that is identical to the direction of rotation of the wheel 1.

It is understood that when the fluid enters into the first cooling circuit 22 and into the second cooling circuit 24, it has a higher temperature at its outlet than at its inlet, due to the high temperature of the wheel 1 when it is operating during the welding method. The cooling of the

wheel 1, and notably of its contact surface 2, is thus optimized, by diametrically opposing each of the inlet orifices 26 and each of the outlet orifices 28 of the cooling circuits 22, 24 on the wheel 1.

5 The first main duct 36 of the first cooling circuit 22 can be seen in particular in Figure 4, showing a cross-sectional view along a first radial plane A-A that can be seen in Figure 3, parallel to the main plane M of the wheel 1. The first main duct 36 extends in a duct plane C parallel to said main plane M of the wheel 1 and in a thickness of the wheel 1, that is to say between the first face 10 and the second face 12 of the central portion 6. More specifically, and as is illustrated in Figure 6, the duct plane C is centred in the thickness of the central portion 6 of the disc 4 of the wheel 1 in its vertical direction V.

According to a feature of the invention, the first main duct 36 has a part in the form of a circular arc and a straight part. In other words, the first main duct 36 comprises a first curved portion 38a and at least one straight portion 40.

15 The first curved portion 38a advantageously has the form of a half-circle which extends at the periphery of the central portion 6 of the disc 4 defined by the contact surface 2. Such a disposition of the first curved portion 38a advantageously allows the first main duct 36 to be as close as possible to the contact surface 2 and thus to optimize the capture of the calories generated by the welding point applied by the contact surface 2.

20 A first straight portion 40a and a second straight portion 40b each extend from an end of the first curved portion 38a of the first main duct 36. More specifically, the first straight portion 40a of the first main duct 36 extends from a first end 42 of the first curved portion 38a to the first inlet orifice 26a, while the second straight portion 40b extends from a second end 44 of the first curved portion 38a to the first outlet orifice 28a. It is then understood that the function of the straight portions 40 of the first cooling circuit 22 is to link the first curved portion 38a to the first inlet orifice 26a and first outlet orifice 28a.

According to the invention, the first inlet orifice 26a and the first outlet orifice 28a are formed in the central cavity 14 of the central portion 6 of the disc 4. In other words, the first cooling circuit 22 is open on the central cavity 14 of the central portion 6 of the disc 4.

30 According to a feature of the invention, a first axis A1 runs to the centre of the first inlet orifice 26a and to the centre of the first outlet orifice 28a. The first straight portion 40a and the second straight portion 40b of the first main duct 36 are then aligned along the first axis A1. Still according to the invention, the first inlet orifice 26a and the first outlet orifice 28a are positioned along the first axis A1, substantially centrally, with respect to the centre D of the wheel 1. In

other words, the first inlet orifice 26a and the first outlet orifice 28a are positioned closer to the centre D of the wheel 1 than to its contact surface 2.

In an equivalent manner, the second cooling circuit 24 comprises a second main duct 37 composed of a second curved portion 38b linked on either side to a third straight portion 40c and a fourth straight portion 40d. The third straight portion 40c and the fourth straight portion 40d are then linked respectively to the second outlet orifice 28b and to the second inlet orifice 26b. According to the invention, a second axis A2 runs through a centre of the second inlet orifice 26b and a centre of the second outlet orifice 28b, this second axis A2 being parallel to the first axis A1. In the same way as for the first inlet and outlet orifices, the second inlet orifice 26b and the second outlet orifice 28b are formed on the central cavity 14 of the central portion 6 of the disc 4 in such a way that they are substantially central, that is to say closer to the centre D of the wheel 1 than to its contact surface 2.

The welding method will now be described with Figure 7, schematically showing a first metal plate 52 and a second metal plate 54 respectively having a first raised edge 56 and a second raised edge 58. The first raised edge 56 and the second raised edge 58 are then formed in such a way that they face one another.

The welding machine 60 of Figure 7 is represented schematically and it is understood that its dimensions and its disposition with respect to the welding wheels 1 are not to scale. Likewise, the electrical connections between the welding machine 60 and the welding wheels 1 are not represented, but it is understood that the welding machine 60 allows an electrical current to be supplied to the welding wheels 1 as has already been explained previously in the detailed description.

A first welding wheel 1a and a second welding wheel 1b are disposed on either side of the raised edges 56, 58 of the metal plates 52, 54. More specifically, the first welding wheel 1a faces the first raised edge 56 and the second welding wheel 1b faces the second raised edge 58. A first contact surface 2a of the first wheel 1a is then in contact with the first raised edge 56 and a second contact surface 2b of the second wheel 1b is in contact with the second raised edge 58.

When the method for welding the metal plates 52, 54 is implemented, an external device (not represented) is used to advance the welding machine 60. During the movement of the welding machine 60, the latter sends an electrical current into the welding wheels 1a, 1b, provoking the creation of a weld bead 64. The activation of the plurality of electrodes makes it possible to weld the raised edges 56, 58 of the metal plates 52, 54 but also provokes a significant temperature rise on the contact surfaces 2a, 2b of the welding wheels 1a, 1b.

In order to avoid overheating phenomena due to the high temperatures, the first wheel 1a and the second wheel 1b respectively comprise a first cooling system and a second cooling system. Each of the first cooling system and of the second cooling system then comprises the first cooling circuit and the second cooling circuit explained previously.

- 5 A first rotation shaft 63a extends between the first welding wheel 1a and the welding machine 60, and a second rotation shaft 63b extends between the second welding wheel 1b and the welding machine 60. In order to irrigate the first cooling circuit and the second cooling circuit of each of the wheels 1a, 1b with coolant, a plurality of ducts 62 links said wheels to the welding machine 60.
- 10 The plurality of ducts 62 extends in each of the first rotation shaft 63a and the second rotation shaft 63b. Notably, a first duct 62a linked to the first inlet orifice, a second duct 62b linked to the first outlet orifice, a third duct 62c linked to the second inlet orifice and a fourth duct 62d linked to the second outlet orifice extend in the first rotation shaft 63a. An identical configuration between the ducts 62 formed in the second rotation shaft 63b and the inlet and outlet orifices is
15 applied for the second cooling system of the second welding wheel 1b.

The plurality of ducts 62 therefore ensures the irrigation of the cooling systems of the wheels 1a, 1b with coolant, in order to prevent said wheels from overheating during the circulation of the electrical current at high frequency and higher intensity, in their welding extents 2.

- 20 The invention thus achieves the aim set for it by proposing a welding wheel whose structure allows the circulation of an electrical current of higher intensity without provoking overheating phenomena. A faster welding of the raised edges of the metal plates is thus allowed and the time to produce the walls of a tank for storing or transporting LNG is reduced.

- 25 The invention should not however be limited to the means and configurations exclusively described and illustrated, and applies equally to all equivalent means and configurations and to any combination of such means or configurations.

CLAIMS

1. Welding wheel (1) for welding metal plates (52, 54), the wheel (1) comprising a contact surface (2) which is inscribed within a disc (4) with a diameter (D1) less than 100 mm and a cooling system (20) for cooling the contact surface (2), the wheel (1) being characterized in that
5 the cooling system (20) for cooling the contact surface (2) comprises at least two distinct cooling circuits (22, 24), configured to be passed through by at least one coolant.
2. Welding wheel (1) according to the preceding claim, wherein the diameter (D1) of the disc defining the contact surface (2) is between 70 mm and 100 mm.
3. Welding wheel (1) according to either one of the preceding claims, wherein the cooling
10 system (20) comprises a first cooling circuit (22) and a second cooling circuit (24), the first cooling circuit (22) comprising a first main duct (22) associated with a first inlet orifice (26a) and a first outlet orifice (28a) for the fluid, the second cooling circuit (24) comprising a second main duct (37) associated with a second inlet orifice (26b) and a second outlet orifice (28b) for the fluid.
- 15 4. Welding wheel (1) according to the preceding claim, wherein the first main duct (36) and the second main duct (37) of the cooling circuits (22, 24) extend in a duct plane (C) parallel to a main plane (M) of the wheel (1) in which it extends.
5. Welding wheel (1) according to either one of Claims 3 and 4, wherein a first axis (A1) passes through a centre of the first inlet orifice (26a) and through a centre of the first outlet
20 orifice (28a) and a second axis (A2) passes through a centre of the second inlet orifice (26b) and a centre of the second outlet orifice (28b), the first axis (A1) and the second axis (A2) being parallel to one another.
6. Welding wheel (1) according to any one of Claims 3 to 5, wherein at least one of the main ducts (36, 37) of one of the cooling circuits (22, 24) takes the form of a circular arc.
- 25 7. Welding wheel (1) according to Claim 6, wherein at least one of the main ducts (36, 37) extends in a straight line between at least one inlet orifice (26) or one outlet orifice (28) and an end of the circular arc.
8. Welding wheel (1) according to any one of Claims 3 to 7, wherein at least one of the inlet orifices (26) or one of the outlet orifices (28) is closer to a centre (D) of the wheel (1) than its
30 contact surface (2).

9. Welding wheel (1) according to any one of the preceding claims, which comprises a central cavity (14) surrounded by a shoulder (16), configured to centre the wheel (1) on a hub of a welding machine (60).
10. Welding wheel (1) according to the preceding claim, wherein the wheel (1) is composed
5 of copper and at least one other metal.
11. Welding machine (60) for linking a first plate (52) and a second plate (54) of a tank for storing and/or transporting a liquefied natural gas, comprising at least one wheel (1) according to any one of the preceding claims.
12. Welding machine (60) according to the preceding claim, configured to apply a weld with
10 continuous movement at a speed greater than or equal to two metres and a half/min.
13. Welding machine (60) according to either one of Claims 11 and 12, wherein a first inlet orifice (26a) of a first cooling circuit (22) is diametrically opposite a second inlet orifice (26b) of a second cooling circuit (24), and a first outlet orifice (28a) of the first cooling circuit (22) is diametrically opposite a second outlet orifice (28b) of the second cooling circuit (24).