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(54) DEVICE AND METHOD FOR REMOVAL OF RUST AND PAINT
VORRICHUNG UND VERFAHREN ZUR ANSTRICH- UND ROSTENTFERNUNG
DISPOSITIF ET PROCEDE D'ELIMINATION DE LA ROUILLE ET DE LA PEINTURE

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Description

[0001] The present invention relates to a device and method for removal of rust and paint from a metal surface.

[0002] It is estimated that corrosion amounts to 3-4% of the BNP in the western world. Only in Norway millions of square meters are protected by paint each year. In order to achieve good results, the surfaces that are to be painted must be clean and pretreated. In industrial applications this is usually done by sandblasting, grinding or jet water washing. Combinations of these methods are also used.

[0003] The most frequently used method is sandblasting. Old paint and rust is removed by a blasting the surface with sand or other suitable agents. This is a costly and quite time-consuming process. The advantage of this method is that the blasting process creates a rough surface that gives a good adhesion for new paint. Furthermore, the used equipment is cheap, simple to operate and easy to maintain. The disadvantages with this method is that large quantities of sand are used, which generates a lot of dust, the equipment is heavy and awkward to handle, the method is slow and does not remove grease and other foulings such as water soluble salts, sulfates etc.

[0004] Jet water washing is a paint and rust removal method that has become more usual. The advantages of this method are that dust related problems are avoided, there is less waste, and water-soluble foulings are removed. The disadvantages of this method are that the equipment is expensive and difficult to maintain, no roughness is made on the steel surface, a lot of water is spilled, large quantities of water is required (which is a problem on e.g. a ship), and the treated surface must be dried before it can be painted.

[0005] Grinding is a method that no longer often is used. The method is mainly used for patchwise repairs.

[0006] Most often, the paint is mainly intact on the surface that is to be cleaned. Optimally, the paint only has to be removed, because the roughness on the steel surface is intact. An example is power plants, where the paint is removed. The method is widely used. The method is mainly used for patchwise repairs. However, the use of induction heat for removal of rust and paint from large surfaces is not known in the prior art.

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[0010] According to the present invention, rust and old paint is removed by means of induction heat. In addition, grease and other foulings are removed from the surface. This is a quick and reliable method that does not produce excessive waste.

[0011] Induction heat is created in magnetic metals by means of magnetic fields. This is a known principle and is used for heating steel in bending and punching processes, and in welding of steel and pipes, e.g. in connection with production of body details in the car industry.

[0012] By induction heating the steel to 250-300°C, the steel is heated without heating the rust and paint. The steel will expand and attached rust will peel of due to the much lower expansion coefficient of rust as compared to steel. The paint will peel of as a result of the heated surface.

[0013] Equipment for generating induction heat is known per se, and heating of steel by means of induction heating has been utilized for a number of years. US-A-5 938 965 and US-A-5 617 800 show the use of induction heating for removing paint from hooks for holding work pieces in a spray paint production line. However, the use of induction heat for removal of rust and paint from large surfaces is not known in the prior art.

[0014] It is of utmost importance that the steel 3 is not overheated. The provided heat has to be constant even if the speed of an induction coil 1 over the steel 3 varies. According to the present invention, the quantity of energy deposited in the steel 3 is varied according to the velocity of the induction coil 1 over the steel surface 3. This ensures a constant temperature profile in the steel 3. Furthermore, according to the present invention, this is achieved by means of arranging the induction coil 1 in a frame with a wheel 2. The wheel 2 is rolled over the steel surface, and the velocity of the wheel regulates the quantity of provided energy. The slower the wheel 2 rotates, the less energy is provided to the coil. If the rotational speed increases, the supplied energy increases. In short, the quantity of energy per unit area of steel 3 is equal for one revolution, independent of the rotational speed.

[0015] The frequency (hertz) of the AC-current supplied to the induction coil 1 determines the depth of the magnetic field in the steel 3. The frequency (and thereby the depth) can be determined from the induction device according to the present invention. By controlling the current, that is the supplied kW, and simultaneously controlling the frequency, the desired temperature is obtained in a desired layer of the steel 3.

[0016] About 90% of the supplied energy is used in the heating process. This means that the energy conversion loss is small compared to conventional methods for heating of steel. In the past, gas torches have been used for removing rust and oxide scale from steel surfaces. This process was effective, but because only 5-10% of the supplied energy was converted to heat and because the heat from the gas torch had to penetrate rust and other covering layers, this process became expensive compared to other methods such as sandblasting etc.

[0017] When using induction heating according to the
achieved in the following manner:

The present invention, only a layer of the steel, for example 0.5 mm, is heated for a limited time period, and the steel will rapidly cool down by heat propagation, thereby avoiding that loosened paint "burns" to the surface. This also entails that heat does not propagate through the other side of steel with a thickness above about 3 mm, thereby avoiding damage to possible paint on said other side.

By removal of paint by means of induction heating it is important that the temperature in the steel is controlled. If use is made of "handheld" equipment without its own drive mechanism, a power supply varying the supplied current according to the surface velocity of the induction coil 1 is needed.

According to the present invention this is achieved in the following manner:

The induction coil 1 indirectly supplying heat to the steel 3 is supported on a freely running wheel 2 that ensures a specific distance from the coil 1 to the steel 3. The wheel 2 is connected to a tachometer 4, which feeds signals to a voltage regulator 5 in a transformer unit (not shown). This insures that the supplied voltage is increased if the velocity increases and that more energy is supplied per unit time, at the same time as the deposited energy per unit area is the same, independent of the velocity.

The control unit 5 may comprise a standard PLC such as an impedance regulator, thyristor or triac. The preferred kind of PLC depends on the application and preferred function. Alternatively, a combination of the aforementioned PLSs may be used, opening up the possibility for different functional modes.

The tachometer 4 may be of the stroboscope kind or any other revolution counter that can feed signals to a PLC control unit 5.

The distance between the induction coil 1 and the surface 3 may be adjusted in addition to frequency, current strength etc. The induction coil is arranged in relation to the wheel 2 such that a certain distance, that well may be adjustable, is kept.

The frequency and current strength of the induction coil 1 may be adjusted manually or automatically by means of the control unit 5, in order to obtain the desired temperature and temperature profile (e.g. the depth of a layer with a specific temperature) in the metal surface.

An essential feature of this process is the supplied energy to the steel 3. This energy has to be constant; otherwise it will effect the quality of the work. If the supplied energy is too small, the steel 3 will not achieve a high enough temperature for paint and rust to loosen. If the supplied energy is too great, the paint on the other side of the steel may be damaged, and the loosened paint may "burn" to the surface.

In automatic embodiments this process may be developed to achieve optimal rates for removal of rust and old paint. Theoretic rates may be converged and the conversion efficiency for the supplied energy may reach 90%.

The present invention, in combination with sandblasting only when there is a need for a rough surface and jet water washing for removal of water soluble foulings, is a very attractive alternative to prior art solutions. In addition, this method also kills bacteria and other organisms that have proven to promote corrosion.

It is understood that a person skilled in the art, when reading this specification under reference to the attached drawings, may conceive of modifications or alternatives that fall within the scope of the present invention as defined in the following claims.

Claims

1. A method for removal of rust and paint from a metal surface (3) by means of induction heat, comprising the step of providing heat by means of an induction coil (1), characterized in that the method further comprises the steps of controlling the energy supplied to the metal surface (3), and that the step of controlling the energy supplied to the metal surface (3) via the induction coil (3) such that the supplied amount of energy per surface area is constant independent of the induction coil (1) velocity along the metal surface (3).

2. A method according to claim 1, characterized in that the induction coil (1) is moved along the surface by a wheel (2) comprising a tachometer (4), and that the step of controlling the energy supplied to the metal surface (3) further comprises the steps of supplying signals from the tachometer (4) to a control unit (5) to control the supply of energy to the induction coil (1).

3. A method according to claim 2, characterized in that the amount of energy supplied by the control unit (5) to the induction coil (1) is proportional to the velocity of the induction coil (1) along the metal surface (3), the velocity being registered by means of the tachometer (4).

4. A method according to claim 2 or 3, characterized in that the frequency and current strength of the induction coil (1) is adjusted manually or automatically by means of the control unit (5) in order to achieve the preferred temperature and temperature profile in the metal (3).

5. An apparatus for removal of rust and paint from a metal surface (3) by means of induction heat, comprising an induction coil (1) for supplying heat to the metal surface (3), characterized in that the apparatus comprises means (2) for moving the coil along...
the metal surface (3), a control unit (5) for controlling the supply of energy to the induction coil (1) and hence to the surface (3), such that a constant amount of energy per unit surface area is supplied independent of the velocity of the apparatus along the metal surface (3), wherein the means (2) for moving the coil along the metal surface (3) is a wheel, and that the wheel is further provided with a tachometer (4).

6. An apparatus according to claims 5, characterized in that the control unit (5) is arranged to control the supply of energy to the induction coil (1) as a function of a signal received from the tachometer (4).

7. An apparatus according to claim 5 or 6, characterized in that the supplied amount of energy from the induction coil (1) is proportional to the rotational velocity of the wheel (2).

8. An apparatus according to any of the claims 5 - 7, characterized in that the frequency and current strength of the induction coil (1) adjusted manually or automatically by means of the control unit (5) in order to achieve the preferred temperature and temperature profile in the metal (3).

Patentansprüche

1. Verfahren zur Entfernung von Rost und Anstrich von einer Metalloberfläche (3) durch Induktionswärme mit dem Schritt des Bereitstellens von Wärme durch eine Induktionsspule (1), charakterisiert, dass das Verfahren ferner die folgenden Schritte umfasst:
   Bewegen der Induktionsspule (1) entlang der Metalloberfläche (3),
   Steuern der auf die Metalloberfläche (3) von der Induktionsspule (1) übertragenen Energie, sodass die je Oberflächenbereich zugeführte Energie unabhängig von der Geschwindigkeit der Induktionsspule (1) entlang der Metalloberfläche (3) konstant ist.

2. Verfahren gemäß Anspruch 1, dadurch gekennzeichnet, dass die Induktionsspule (1) entlang der Oberfläche durch ein Rad (2) mit einem Tachometer (4) bewegt wird und dass der Schritt des Steuerns der zu der Metalloberfläche (3) geführten Energie ferner die Schritte des Liefern von Signalen von dem Tachometer (4) zu einer Steuereinheit (5) umfasst, um die Energiezufuhr zu der Induktionsspule (1) zu steuern.

3. Verfahren gemäß Anspruch 2, dadurch gekennzeichnet, dass die durch die Steuereinheit (5) zu der Induktionsspule (1) geführte Energie proportio-

4. Verfahren gemäß Anspruch 2 oder 3, dadurch gekennzeichnet, dass die Frequenz und die Stromstärke der Induktionsspule (1) manuell oder automatisch durch die Steuereinheit (5) eingestellt wird, um die bevorzugte Temperatur und das bevorzugte Temperaturprofil in dem Metall (3) einzustellen.

5. Vorrichtung zur Entfernung von Rost und Anstrich von einer Metalloberfläche (3) durch Induktionswärme mit einer Induktionsspule (1) zum Zuführen von Wärme zu der Metalloberfläche (3), dadurch gekennzeichnet, dass die Vorrichtung umfasst: ein Mittel (2) zum Bewegen der Spule entlang der Metalloberfläche (3), eine Steuereinheit (5) zum Steuern der Energiezufuhr zu der Metalloberfläche und somit zu der Oberfläche (3), sodass eine konstante Energiemenge je Oberflächenbereich unabhängig von der Geschwindigkeit der Vorrichtung entlang der Metalloberfläche (3) zugeführt wird, wobei das Mittel (2) zum Bewegen der Spule entlang der Metalloberfläche (3) ein Rad ist, und dass das Rad ferner mit einem Tachometer (4) ausgestattet ist.

6. Vorrichtung gemäß Anspruch 5, dadurch gekennzeichnet, dass die Steuereinheit (5) angeordnet ist, um die Energiezufuhr zu der Induktionsspule (1) als eine Funktion eines von dem Tachometer (4) empfangenen Signals zu steuern.

7. Verfahren gemäß Anspruch 5 oder 6, dadurch gekennzeichnet, dass die von der Induktionsspule (1) zugeführte Energiemenge proportional zu der Drehgeschwindigkeit des Rades (2) ist.

8. Verfahren gemäß einem der Ansprüche 5 bis 7, dadurch gekennzeichnet, dass die Frequenz und die Stromstärke der Induktionsspule (1) manuell oder automatisch durch die Steuereinheit (5) eingestellt wird, um die bevorzugte Temperatur und das bevorzugte Temperaturprofil in dem Metall (3) einzustellen.

Revendications

1. Procédé pour l'élimination de la rouille et de la peinture sur une surface de métal (3) au moyen de chaleur d'induction, comportant l'étape consistant à fournir la chaleur au moyen d'une bobine d'induction (1), caractérisé en ce que le procédé comporte en outre les étapes suivantes :
   déplacer la bobine d'induction (1) le long de la
surface de métal (3), commander l’énergie fournie à la surface de métal (3) par l’intermédiaire de la bobine d’induction (3) de telle sorte que la quantité d’énergie fournie par unité de surface soit constante indépendamment de la vitesse de la bobine d’induction (1) le long de la surface de métal (3).

2. Procédé selon la revendication 1, **caractérisé en ce que** la bobine d’induction (1) est déplacée le long de la surface par une roue (2) comportant un tachymètre (4), et **en ce que** l’étape consistant à commander l’énergie fournie à la surface de métal (3) comporte en outre les étapes consistant à émettre des signaux depuis le tachymètre (4) vers une unité de commande (5) pour commander la fourniture d’énergie à la bobine d’induction (1).

3. Procédé selon la revendication 2, **caractérisé en ce que** la quantité d’énergie fournie par l’unité de commande (5) à la bobine d’induction (1) est proportionnelle à la vitesse de la bobine d’induction (1) le long de la surface de métal (3), la vitesse étant enregistrée au moyen du tachymètre (4).

4. Procédé selon la revendication 2 ou la revendication 3, **caractérisé en ce que** la fréquence et la force de courant de la bobine d’induction (1) sont réglées manuellement ou automatiquement au moyen de l’unité de commande (5) afin d’obtenir la température préférée et le profil de température préféré dans le métal (3).

5. Appareil pour l’élimination de la rouille et de la peinture sur une surface de métal (3) au moyen de chaleur d’induction, comportant une bobine d’induction (1) pour fournir de la chaleur à la surface de métal (3), **caractérisé en ce que** l’appareil comporte des moyens (2) pour déplacer la bobine le long de la surface de métal (3), une unité de commande (5) pour commander la fourniture de l’énergie à la bobine d’induction (1) et par conséquent à la surface (3), tels qu’une quantité constante d’énergie par unité de surface est fournie indépendamment de la vitesse de l’appareil le long de la surface de métal (3), les moyens (2) pour déplacer la bobine le long de la surface de métal (3) étant une roue, et la roue étant en outre équipée d’un tachymètre (4).

6. Appareil selon la revendication 5, **caractérisé en ce que** l’unité de commande (5) est agencée pour commander la fourniture de l’énergie à la bobine d’induction (1) en fonction d’un signal reçu du tachymètre (4).

7. Appareil selon la revendication 5 ou la revendication 6, **caractérisé en ce que** la quantité d’énergie fournie par la bobine d’induction (1) est proportionnelle à la vitesse de rotation de la roue (2).

8. Appareil selon l’une des revendications 5 à 7, **caractérisé en ce que** la fréquence et la force de courant de la bobine d’induction (1) sont réglées manuellement ou automatiquement au moyen de l’unité de commande (5) afin d’obtenir la température préférée et le profil de température préféré dans le métal (3).
REFERENCES CITED IN THE DESCRIPTION

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