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(54) **INSTRUMENT AND METHOD FOR MEASURING COATING THICKNESS**

INSTRUMENT UND VERFAHREN ZUR MESSUNG EINER BESCHICHTUNGSDICKE

INSTRUMENT ET MÉTHODE DE MESURE D'ÉPAISSEUR DE REVÊTEMENT

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Description

Technical Field of the Invention

[0001] The present invention relates to a coating thickness measuring instrument, to a method of providing a coating thickness measurement instrument, and to a method of measuring the thickness of a coating on a substrate, the substrate having a known surface profile.

Background to the Invention

[0002] Conventional coating thickness measuring instruments comprise an electromagnetic probe. A tip of the probe is placed in contact with the surface of a coating on a substrate. The instrument determines the distance between the probe tip and the substrate, and thereby measures the thickness of the coating.

[0003] To enable accurate measurements to be made it is necessary for an instrument to be calibrated prior to use. This is achieved by placing calibration foils of various known thicknesses onto an uncoated region of a substrate on which coating thickness is to be measured, or a sample of an equivalent substrate, and placing the probe onto the foils and taking readings. Alternatively measurements oftest coatings of known thickness may be made. The resulting information is used to generate an appropriate calibration curve to calibrate subsequent measurements of coating thickness taken on the substrate or an equivalent substrate. The calibration curve is stored by the instrument as calibration data.

[0004] To ensure accuracy it is necessary to recalibrate the instrument for each substrate or type of substrate on which measurements are to be made. Changes in characteristics of a substrate can have a significant effect on measurements taken by an instrument. The need to calibrate and recalibrate can be inconvenient and time consuming. In some circumstances an appropriate sample of an uncoated substrate is not available to enable the instrument to be calibrated. The present invention addresses these problems.

[0005] It has been found that readings taken by a coating thickness measuring instrument over a substrate are significantly affected by the profile (surface roughness) of the substrate.

[0006] GB2306651 discloses a gauge for determining a thickness of a coating on a substrate. A transducer emits ultrasonic signals and a sampler samples the signals generated by the transducer/coating interface and the coating/substrate interface. This sampled data is processed with stored acoustic data to determine the thickness of the coating. The gauge operator may select the appropriate acoustic data by selecting the coating/substrate material under investigation by means of scrolling through a menu of materials stored in the memory. The system may be calibrated by taking a reading of a material with a known thickness and manually correcting the measured thickness displayed.

[0007] US5418823 discloses a combined ultrasonic and eddy-current method and apparatus for non-destructively determining the liner thickness of a zirconium liner on the inner surface of a zirconium alloy nuclear fuel rod. The apparatus uses a computer with associated memory and I/O devices connected to electromagnetic and ultrasonic measurement subsystems. Calibrated reference impedance values for various liner thicknesses with the same inside and outside diameter dimensions are measured and retained in the memory, as are calibrated reference impedances for tubes of various inside and outside diameter dimensions with the same liner thickness.

[0008] US6529014 discloses a coating thickness gauge with at least one measuring probe having a sensor, and a means to automatically activate zero adjustment and/or calibration when contact is made between the sensor and a reference plate. A plurality of reference plates, each with a known coating thickness, may be provided. The result of measurements taken by the sensor when in contact with reference plates is stored in a memory and used to calibrate the instrument.

[0009] US2003003 8628 discloses a self-referencing eddy current probe for determining conductive coating thicknesses, which includes a housing for accommodating a reference sample. An eddy current probe further includes a reference eddy current coil situated in a housing adjacent to the reference sample and a test eddy current coil located at a testing edge. A comparison module compares a test signal from the test coil with a reference signal from the reference coil, and outputs a compared signal. The device may be calibrated by measuring an uncoated sample using the reference coil and a known coating thickness sample using the test coil. A compared signal is generated for each coating sample, which results in a plurality of calibration data. This plurality of calibration data can be stored in a signal processor.

[0010] US7352194 discloses a method for determining the thickness of a coating on a composite material by applying induced currents. A low frequency, high penetrating power probe is used to make a zero calibration of the method by measuring a coating-free area of the composite material and then a reference calibration by measuring a calibrated composite fiber.

[0011] GB2112944 discloses a coating thickness gauge comprising a probe containing a measurement coil system using induction or eddy current effects to measure the thickness of a coating over a substrate. The probe is first used to form a calibration chart in a memory system by physically raising the probe above a suitable substrate, simultaneous measurements being made of the motion of the probe and the probe output. This information is stored in a memory to form a calibration chart. The probe is subsequently positioned on a coating to be measured and the calibration chart used to recover the corresponding value of physical movement of the probe to the output of the probe, thereby to determine the thickness of the coating.

Summary of the Invention

[0012] According to an aspect of the present invention there is provided a coating thickness measuring instrument comprising:

an electromagnetic probe for measuring the thickness of a coating applied to a surface and producing an output relating to the measured thickness;

a memory for storing calibration data;

a processor arranged to process the output produced by the probe, together with calibration data stored by the memory, to produce a calibrated coating thickness measurement; wherein

at least two sets of calibration data are stored in the memory, each set appropriate to and associated with a different known surface profile value, thus enabling the instrument to produce an accurate measurement of thickness of a coating applied to a surface having the associated known surface profile value, and the instrument comprises input means arranged to enable a user to select the set of calibration data to be used by the processor according to the surface profile value of the surface on which a measurement is to be made.

[0013] Thus, the instrument is pre-calibrated to at least two differently profiled surfaces and a user can select the appropriate calibration according to the surface profile on which measurements are to be made. This avoids the need for specific calibration or recalibration, and provides for more accurate measurements to be made than might otherwise be the case where an uncoated region of the surface is not available to enable a surface specific calibration to be made.

[0014] The instrument may store three or more sets of calibration data, each associated with a different known surface profile. The sets of calibration data may be stored in a non-volatile memory. This way the data can be derived and stored by an instrument manufacturer or supplier and supplied to an end user without risk of the data being lost, for example due to lack of a power supply.

[0015] A user may select a set of calibration data to be used by selecting a surface profile value from a range of values, each value associated with a different set of calibration data.

[0016] The probe may be removably mounted to the remainder of the instrument enabling different probes to be used with the instrument. In this case different sets of calibration data need to be stored for each probe which may be used with the instrument. In one embodiment memory comprised in the instrument, other than the probe, stores at least two sets of calibration data, each set associated with a different surface profile, for use in calibration of measurements made by one probe and at least two different sets of calibration data, each set associated with a different surface profile, for use in calibration of measurements made by another probe. Additional data sets may be stored for use with additional probes. In another embodiment the memory storing sets of calibration data is mounted to the probe for removal from the remainder of the instrument with the probe. Thus, each probe is provided with a memory storing probe specific calibration data sets.

[0017] A coating thickness measuring instrument according to the above aspect of the invention may be provided wherein the at least two sets of calibration data stored in the memory have been obtained by using the instrument to make a series of calibration measurements on a first surface with a known first surface profile to derive a first set of calibration data and storing the first set of calibration data in the memory; and
using the instrument to make a series of calibration measurements on a second surface with a known second surface profile, different to the first surface profile, to derive a second set of calibration data and storing the second set of calibration data in the memory.

[0018] The first and second sets of calibration data may be stored in the memory in association with values corresponding to the average surface profile of the first and second surfaces respectively. Each of the first and second surfaces may be measured using a surface profile meter, of conventional type (for example a profilometer or roughness meter) to determine their average surface profile. The first and second surfaces may be prepared by profiling the surface of a sample of material with a desired surface profile, such as by blasting with blast media, for example shot, grit or sponge.

[0019] The instrument may subsequently be delivered to a user. It is envisaged that storing the sets of calibration data would be carried out by a party other than the end user of the instrument (the instrument manufacturer, for example), so the end user is not concerned with calibrating the instrument. Typically calibration data would be stored by the instrument manufacturer in the factory where the instrument is manufactured.

[0020] According to a further aspect of the present invention there is provided a method of measuring the thickness of a coating on a surface with a known surface profile comprising the steps of:

providing a coating thickness measuring instrument according to the first aspect of the invention discussed above;
selecting from the surface profile values stored by the instrument in association with sets of calibration data the surface profile value closest to the known surface profile, thereby to select a set of calibration data to be used by the instrument; and
using the instrument to measure coating thickness on the surface using the selected set of calibration data.

Detailed Description of the Invention

[0021] In order that the invention may be more clearly understood embodiments thereof will now be described, by way of example only, with reference to the accompanying drawings, of which:

Figure 1 shows an embodiment of a measuring instrument according to the invention;
Figure 2 is a block diagram of components of the instrument of figure 1;
Figure 3 is a block diagram showing steps involved in storing sets of calibration data in the instrument;
Figure 4 shows screen views of the instrument of figure 1; and
Figure 5 shows an alternative embodiment of a measuring instrument according to the invention.

[0022] Referring to figures 1 to 3, a coating thickness measuring instrument comprises a body 1. The body houses a programmable processor 2. The processor is connected to a power supply 3, such as an electric battery, and volatile 4 and non-volatile 5 memory all disposed in the housing. The processor 2 is also connected user operable buttons 6, or some other suitable input device, and a display screen 7 mounted on the housing and visible to the exterior of the housing. The processor is also connected to an antenna 10 to enable data to be transmitted wirelessly to or received from another device such as a pc. Alternatively, or additionally, in other embodiments a suitable electrical connection is provided to enable the instrument to be directly connected to another device to enable transfer of data.

[0023] The processor is also connected to a probe 8 with an associated non-volatile memory 9. In the embodiment of figure 1 the probe is permanently mounted to the body of the instrument. In other embodiments the probe is demountable enabling different types of probe to be fitted to the instrument.

[0024] The probe is an electromagnetic probe of known type used to measure the thickness of a coating on a substrate. As with existing coating thickness measuring instruments, the probe is placed into contact with a coating on a substrate. The probe is sensitive to the distance between its tip, in contact with the coating, and the surface of the substrate and the instrument determines this distance and thereby measures the thickness of the coating.

[0025] The processor 2 operates by running software stored on the non-volatile memory 5. The volatile memory 4 is used to store information concerning measurements made by the instrument, the calibration of the instrument when the measurements were made, and information input by a user. The non-volatile memory 9 associated with the probe stores information relating to the probe and which may be read and used by the processor 2.

[0026] The general operation of instruments of this type is well known to persons of ordinary skill in the relevant field and so will not be described in further detail.

[0027] Where this instrument differs over existing instruments is through the provision of pre-stored sets of calibration data associated with substrates with differing surface profiles (roughness) and the way in which these calibration settings are determined, recorded and used. This enables the instrument to be used by a user to take reasonably accurate measurements of coating thickness on profiled substrates, of a known type with a known average surface profile, without the user having to specifically calibrate the instrument to that substrate. This saves time and effort, and increases accuracy where there is no uncoated sample of the substrate on which the user could calibrate the instrument.

[0028] Calibration data is generated and stored following the method illustrated in figure 3. First, a sample or samples of a material on which it is ultimately intended to make coating thickness measurement is selected. This could, for example, be a particular grade of steel.

[0029] Then, two or more surfaces of that material are provided. These could be provided on separate samples of the same material, or on separate areas of the same sample of material. They should be substantially flat.

[0030] The surfaces are then separately profiled, for example by blasting with appropriate media, such a shot, grit or sponge to produce substantially evenly profiled surfaces having different average surface profiles, corresponding to the profile of surfaces on which it is ultimately desired to make coating thickness measurements. The average surface profile of each substrate is then measured using a conventional technique, for example by use of a surface profile meter. If the measured average profile does not correspond to a desired profile it may be necessary to prepare a further sample using a modified technique, and to measure the average surface profile of the further sample. The process can be repeated until a set of two or more profiled surfaces has been generated with desired surface profiles.

[0031] When a set of desired profiled surfaces has been prepared, the instrument is calibrated for each surface. This may be achieved using a two point calibration technique. First a foil (typically a plastics material film) of known thickness is placed over the sample surface. The probe 8 of the instrument is placed into contact with the foil, sandwiching the foil between the probe tip and the profiled surface, a thickness measurement is made using the instrument, and the known thickness of the foil is provided to the instrument. The process is then repeated using a foil, or combination of foils, with a different total thickness to the original foil. This enables calibration data to be generated by the instrument appropriate to the surface profile, enabling the instrument to make accurate measurements of coating thickness on the surface. This data, is then stored in non-volatile memory and associated with the measured average surface profile of the sample surface on which the instrument has been calibrated. The data could be stored either in the non-volatile

memory 5 of the instrument and/or that 9 associated with the probe 8.

[0032] The foil thicknesses should be selected according to end user requirements, so that the instrument is calibrated over a coating thickness range for which it is intended to be used to make measurements. Sets of calibration data could be stored relating to calibration of the instrument at different coating thickness values or ranges over the same surface profile.

[0033] Techniques other than the two point calibration technique may be used as appropriate. The two point and other calibration techniques for coating thickness measuring instruments are well known and understood by those skilled in the art.

[0034] The instrument is then calibrated on another surface from the prepared set, and calibration data for that surface saved in non-volatile memory and associated with the measured profile of the other surface. The process is then repeated for any other surfaces in the set.

[0035] As an alternative, sample profiled surfaces could be prepared and coated with a coating of known thickness to provide a coated reference surface for use in calibrating the instrument, and thus dispense with the need to use foils. Such sample surfaces could have different regions to which different thicknesses of coating have been applied. Appropriate samples could be provided to end users to enable the calibration of a given instrument to be checked.

[0036] Whilst not essential, it is envisaged that the process ofpreparing sample surfaces and calibrating the instrument to these surfaces be carried out by a manufacturer or supplier of the instrument rather than an end user. The sample surfaces on which the instrument is calibrated may be prepared and/or selected at the request of a particular end user of the instrument. The instrument is then shipped to a user with the calibration data sets stored in non-volatile memory.

[0037] The instrument is controlled by a user using the various control buttons 6 and via command menus displayed on the screen 7. Again, the general operation of coating thickness instruments of this type is known and understood by those of ordinary skill in the art, who will understand that an instrument must be calibrated appropriately before using it to make measurements, and that this normally requires calibrating the instrument on an uncoated sample of substrate of a type on which measurements are to be made.

[0038] With the current instrument though, when the calibration function is selected the user is presented with the screen shown to the left hand side of figure 4. This screen is entitled "Enter Average Profile" and prompts the user to select from four choices:

2 mils
3 mils
4 mils
Advanced Calibration

[0039] Each of the first three choices causes the instrument to employ pre-stored calibration data relating to measurement over surfaces with average surface profiles of 2, 3, and 4 mils respectively. Thus for measurement of coating thickness over a surface with these profiles, or near to these profiles, a user may select the appropriate one of these modes. The instrument will then use the appropriate pre-stored calibration data to modify thicknesses detected by the probe 8 to produce accurate calibrated measurements.

[0040] Clearly the display will list options appropriate to the calibration data stored in the instrument and these could be other than those shown in figure 4.

[0041] An instrument could be supplied with standard sample coated surfaces with surface profiles corresponding to some or all of the profiles for which the instrument has been calibrated, thus enabling an end user to check the instrument's calibration if required.

[0042] By using one of these pre-stored modes it is not necessary for a user to go through a calibration process before taking readings. This saves time and reduces the risk of incorrect calibration through user error. Clearly the accuracy of any measurements taken using a pre-stored calibration setting will depend on how similar the surface over which measurements are taken is to the sample surface on which the instrument was calibrated.

[0043] In view of differences in these surfaces, the instrument may be configured to limit the resolution to which it calculates coating thickness when a pre-stored set of calibration data is used, for example to a number of decimal places. Such a limit may be configurable by a user, or it may only be configurable by the manufacturer. A different resolution limit could apply to each set of calibration data, so that a resolution limit appropriate to a calibration data set is employed.

[0044] The Advanced Calibration option enables a user to opt to calibrate the instrument in a conventional way using one of three appropriate calibration techniques: zero; smooth and rough/2 point. These are well understood.

[0045] Alternatively the user may select a factory calibration setting. In this case a further set of pre-stored calibration data is employed. This is also stored following manufacture of the instrument using measurements taken over a known, typically smooth, test surface.

[0046] The instrument enables a user conveniently to take measurements over a predetermined range of differently profiled surfaces without having to calibrate, or recalibrate, the instrument for each surface.

[0047] An alternative embodiment is illustrated in figure 5. In this embodiment the probe 8 is attached to the instrument by a cable 11 via an electrical fitting 12. Different probes may be used, as appropriate, with the instrument. The illustrated probe 8 is shown in contact with a substrate 13.

[0048] When different probes may be used with a single instrument calibration data sets, may be stored on the memory 9 associated with the probe rather than with the instrument and that data read by the instrument to

enable coating thickness measurements to be calculated. In particular, calibration data relating to measurement over two or more surfaces with a different surface profile may be stored on the memory associated with the probe.

[0049] In an alternative arrangement, sets of calibration data for a number of different probes may be stored on an instrument in association with an identifier for each probe. The individual identifier for each probe is stored on memory associated with the probe. When a particular probe is used with the instrument the instrument is able to read the identifier on the probe, and thus identify sets of calibration data relevant to that probe. A user may then select which set of calibration data to use according to the surface profile on which it is desired to make measurements.

[0050] The above embodiments are described by way of example only. Many variations are possible without departing from the scope of the invention as defined in the appended claims.

Claims

1. A coating thickness measuring instrument comprising:

a. an electromagnetic probe (8) for measuring the thickness of a coating applied to a surface and producing an output relating to the measured thickness;
b. a memory (4,5) for storing calibration data;
c. a processor (2) arranged to process the output produced by the probe, together with calibration data stored by the memory, to produce a calibrated coating thickness measurement; and **characterised in that**
d. at least two sets of calibration data are stored in the memory, each set appropriate to and associated with a different known surface profile value thus enabling the instrument to produce an accurate measurement of the thickness of a coating applied to a surface having the associated known surface profile value; and **in that**
e. the instrument comprises input means arranged so to enable a user to select the set of calibration data to be used by the processor according to the surface profile value of the surface on which a measurement is to be made.

2. A coating thickness measuring instrument as claimed in claim 1 wherein three or more sets of calibration data, each appropriate to and associated with a known different surface profile value, are stored by the memory.

3. A coating thickness measuring instrument as claimed in either claim 1 or 2 wherein the sets of calibration data are stored in a non-volatile memory (5).

4. A coating thickness measuring instrument as claimed in any preceding claim wherein the input means comprises an input device (6) and a display screen (7).

5. A coating thickness measuring instrument as claimed in any preceding claim arranged so that a user may select a set of calibration data to be used by selecting a surface profile value from a range of values, each value associated with a different set of calibration data.

6. A coating thickness measuring instrument as claimed in any preceding claim wherein the probe (8) is removably mounted to the remainder of the instrument enabling different probes to be used with the instrument, and the memory (4,5) stores at least two sets of calibration data, each set associated with a different known surface profile value, for use in calibration of measurements made by one probe and at least two different sets of calibration data, each set associated with a different known surface profile value, for use in calibration of measurements made by another probe.

7. A coating thickness measuring instrument as claimed in any preceding claim wherein the probe (8) is removably mounted to the remainder of the instrument and the memory (9) storing sets of calibration data is mounted to the probe for removal from the remainder of the instrument with the probe.

8. A coating thickness measuring instrument as claimed in any preceding claim wherein the at least two sets of calibration data stored in the memory have been obtained by using the instrument to make a series of calibration measurements on a first surface with a known first surface profile value to derive a first set of calibration data and storing the first set of calibration data in the memory (4,5); and using the instrument to make a series of calibration measurements on a second surface with a known second surface profile value, different to the first surface profile value, to derive a second set of calibration data and storing the second set of calibration data in the memory.

9. A coating thickness measuring instrument as claimed in claim 8 wherein the first and second sets of calibration data are stored in the memory in association with values corresponding to the surface profile value of the first and second surfaces respectively.

10. A coating thickness measuring instrument as claimed in claim 9 wherein each of the first and sec-

ond surfaces are measured using a surface profile meter to determine their surface profile value.

11. A coating thickness measuring instrument as claimed in claim 10 wherein each of the first and second surfaces are prepared by profiling the surface of a sample of material with a desired surface profile.

12. A coating thickness measuring instrument as claimed in claim 11 wherein the surfaces are profiled by blasting with blast media.

13. A method of measuring the thickness of a coating on a surface with a known surface profile value comprising the steps of:

a. providing a coating thickness measuring instrument as claimed in any of claims 1 to 12;
b. selecting from the surface profile values stored by the instrument in association with sets of calibration data the surface profile value closest to the known surface profile, thereby to select a set of calibration data to be used by the instrument; and
c. using the instrument to measure coating thickness on the surface using the selected set of calibrated data.

Patentansprüche

1. Ein Beschichtungsdickenmessinstrument, umfassend:

a. eine elektromagnetische Sonde (8) zur Messung der Dicke einer auf eine Oberfläche aufgebrachten Beschichtung und Erzeugung einer Ausgabe bezogen auf die gemessene Dicke;
b. einen Speicher (4, 5) zur Speicherung von Kalibrierungsdaten;
c. einen Prozessor (2), der angeordnet ist, um die von der Sonde erzeugte Ausgabe zusammen mit den im Speicher gespeicherten Kalibrierungsdaten zu verarbeiten, um eine kalibrierte Beschichtungsdickenmessung zu erzeugen; und **dadurch gekennzeichnet, dass**
d. mindestens zwei Sätze von Kalibrierungsdaten in dem Speicher gespeichert sind, wobei jeder Satz geeignet ist für einen und assoziiert ist mit einem verschiedenen bekannten Oberflächenprofilwert, um es dadurch dem Instrument zu ermöglichen, eine akurate Messung der Dicke der an der Oberfläche aufgebrachten Beschichtung zu erzeugen, die den assoziierten bekannten Oberflächenprofilwert hat, und dadurch, dass
e. das Instrument Eingabemittel umfasst, die derart angeordnet sind, um es einem Verwender zu ermöglichen, den Satz von Kalibrierungsdaten auszuwählen, der von dem Prozessor gemäß dem Oberflächenprofilwert der Oberfläche verwendet werden soll, auf der eine Messung durchzuführen ist.

2. Ein Beschichtungsdickenmessinstrument nach Anspruch 1, wobei drei oder mehr Sätze von Kalibrierungsdaten, die jeweils geeignet sind für einen und assoziiert sind mit einem verschiedenen bekannten Oberflächenprofilwert, mit dem Speicher gespeichert sind.

3. Ein Beschichtungsdickenmessinstrument nach einem der Ansprüche 1 oder 2, wobei die Sätze von Kalibrierungsdaten in einem nicht-flüchtigen Speicher (5) gespeichert sind.

4. Ein Beschichtungsdickenmessinstrument nach einem der vorhergehenden Ansprüche, wobei die Eingabemittel eine Eingabevorrichtung (6) und ein Anzeigedisplay (7) umfassen.

5. Ein Beschichtungsdickenmessinstrument nach einem der vorhergehenden Ansprüche, angeordnet, sodass ein Verwender einen Satz von zu verwendenden Kalibrierungsdaten auswählen kann, indem er einen Oberflächenprofilwert aus einem Wertebereich auswählt, wobei jeder Wert einem verschiedenen Satz von Kalibrierungsdaten assoziiert ist.

6. Ein Beschichtungsdickenmessinstrument nach einem der vorhergehenden Ansprüche, wobei die Sonde (8) entfernbar am Rest des Instruments befestigt ist, um zu ermöglichen, verschiedene Sonden mit dem Instrument verwenden werden können, und der Speicher (4, 5) mindestens zwei Sätze von Kalibrierungsdaten speichert, wobei jeder Satz mit einem verschiedenen bekannten Oberflächenprofilwert assoziiert ist, zur Verwendung bei der Kalibrierung von Messungen, die von einer Sonde durchgeführt wurden, und mindestens zwei verschiedene Sätze von Kalibrierungsdaten, wobei jeder Satz mit einem verschiedenen bekannten Oberflächenprofilwert assoziiert ist, zur Verwendung bei der Kalibrierung von Messungen, die von einer anderen Sonde durchgeführt wurden.

7. Ein Beschichtungsdickenmessinstrument nach einem der vorhergehenden Ansprüche, wobei die Sonde (8) entfernbar am Rest des Instruments befestigt ist und der Speicher (9), der Sätze von Kalibrierungsdaten speichert, an der Sonde befestigt ist, um sie mit der Sonde vom Rest des Instruments zu entfernen.

8. Ein Beschichtungsdickenmessinstrument nach ei-

nem der vorhergehenden Ansprüche, wobei mindestens zwei in dem Speicher gespeicherte Sätze von Kalibrierungsdaten erhalten worden sind, indem das Instrument verwendet wird, um eine Serie von Kalibrierungsmessungen auf einer ersten Oberfläche mit einem bekannten ersten Oberflächenprofilwert zu machen, um einen ersten Satz von Kalibrierungsdaten abzuleiten und den ersten Satz von Kalibrierungsdaten in dem Speicher (4, 5) zu speichern; und indem das Instrument verwendet wird, um eine Serie von Kalibrierungsmessungen auf einer zweiten Oberfläche mit einem bekannten zweiten Oberflächenprofilwert zu machen, der von dem ersten Oberflächenprofilwert verschieden ist, um einen zweiten Satz von Kalibrierungsdaten abzuleiten und den zweiten Satz von Kalibrierungsdaten in dem Speicher zu speichern.

9. Ein Beschichtungsdickenmessinstrument nach Anspruch 8, wobei die ersten und zweiten Sätze von Kalibrierungsdaten in dem Speicher gespeichert sind in Assoziation mit Werten, die mit dem durchschnittlichen Oberflächenprofilwert der ersten bzw. zweiten Oberflächen korrespondieren.

10. Ein Beschichtungsdickenmessinstrument nach Anspruch 9, wobei jede der ersten und zweiten Oberflächen unter Verwendung eines Oberflächenprofilmeters gemessen wird, um ihren Oberflächenprofilwert zu bestimmen.

11. Ein Beschichtungsdickenmessinstrument nach Anspruch 10, wobei jede der ersten und zweiten Oberflächen durch Profilieren der Oberfläche einer Materialprobe mit einem gewünschten Oberflächenprofil hergestellt wird.

12. Ein Beschichtungsdickenmessinstrument nach Anspruch 11, wobei die Oberflächen durch Strahlen mit Strahlmedien profiliert sind.

13. Ein Verfahren zum Messen der Dicke einer Beschichtung auf einer Oberfläche mit einem bekannten Oberflächenprofilwert, umfassend die Schritte:

a. Bereitstellen eines Beschichtungsdickenmessinstruments nach einem der Ansprüche 1 bis 12;
b. Auswählen aus den Oberflächenprofilwerten, die durch das Instrument in Assoziation mit Sätzen von Kalibrierungsdaten gespeichert wurden, des Oberflächenprofilwerts, der dem bekannten Oberflächenprofil am nächsten ist, wodurch ein Satz von Kalibrierungsdaten ausgewählt wird, die von dem Instrument verwendet werden sollen; und
c. Verwenden des Instruments zum Messen der Beschichtungsdicke auf der Oberfläche unter Verwendung des ausgewählten Satzes von Kalibrierungsdaten.

Revendications

1. Instrument de mesure de l'épaisseur d'un revêtement comprenant :

a) une sonde (8) électromagnétique pour mesurer l'épaisseur d'un revêtement appliqué à une surface et pour produire un signal de sortie se rapportant à l'épaisseur mesurée;
b) une mémoire (4,5) pour mettre en mémoire des données d'étalonnage;
c) un processeur(2) agencé pour traiter le signal de sortie produit par la sonde, ensemble avec des données d'étalonnage mises en mémoire par la mémoire, afin de produire une mesure étalonnée de l'épaisseur de revêtement ; et **caractérisé en ce que**
d) au moins deux ensembles de données d'étalonnage sont mises en mémoire dans la mémoire, chaque ensemble étant propre et associé à une valeur différente connue du profil de la surface, permettant ainsi à l'instrument de produire une mesure précise de l'épaisseur d'un revêtement appliqué à une surface ayant la valeur associée connue du profil de la surface; et **en ce que**
e) l'instrument comprend des moyens d'entrée agencés de manière à permettre à un utilisateur de sélectionner l'ensemble de données d'étalonnage à utiliser par le processeur en fonction de la valeur de profil de surface de la surface sur laquelle une mesure doit être faite.

2. Instrument de mesure de l'épaisseur d'un revêtement tel que revendiqué à la revendication 1, dans lequel on met en mémoire dans la mémoire trois ensembles ou plus de données d'étalonnage, chacun propre et associé à une valeur connue différente du profil de la surface.

3. Instrument de mesure de l'épaisseur d'un revêtement tel que revendiqué à la revendication 1 ou 2, dans lequel les ensembles de données d'étalonnage sont mises en mémoire dans une mémoire (5) non volatile.

4. Instrument de mesure de l'épaisseur d'un revêtement tel que revendiqué à l'une quelconque des revendications précédentes, dans lequel les moyens d'entrée comprennent un dispositif (6) d'entrée et un écran (7) d'affichage.

5. Instrument de mesure de l'épaisseur d'un revêtement suivant l'une quelconque des revendications

précédentes agencé de manière à ce qu'un utilisateur puisse sélectionner un ensemble de données d'étalonnage à utiliser en sélectionnant une valeur de profil de surface dans une plage de valeurs, chaque valeur étant associée à un ensemble différent de données d'étalonnage.

6. Instrument de mesure de l'épaisseur d'un revêtement tel que revendiqué à l'une quelconque des revendications précédentes, dans lequel la sonde (8) est montée de manière amovible sur le reste de l'instrument en permettant d'utiliser des sondes différentes avec l'instrument, et la mémoire (4,5) met en mémoire au moins deux ensembles de données d'étalonnage, chaque ensemble étant associé à une valeur différente connue du profil de la surface, à utiliser dans un étalonnage de mesures fait par une sonde et au moins deux ensembles différents de données d'étalonnage, chaque ensemble étant associé à une valeur différente connue du profil de la surface, à utiliser dans un étalonnage de mesures faites par une autre sonde.

7. Instrument de mesure de l'épaisseur d'un revêtement suivant l'une quelconque des revendications précédentes dans lequel la sonde (8) est montée de manière amovible sur le reste de l'instrument et la mémoire (9) mettant en mémoire des ensembles de données d'étalonnage est montés sur la sonde pour être retirée du reste de l'instrument avec la sonde.

8. Instrument de mesure de l'épaisseur d'un revêtement suivant l'une quelconque des revendications précédentes dans lequel les au moins deux ensembles de données d'étalonnage mis en mémoire dans la mémoire ont été obtenus en utilisant l'instrument pour faire une série de mesures d'étalonnage sur une première surface ayant une valeur connue d'un premier profil de surface pour déduire un premier ensemble de données d'étalonnage et en mettant en mémoire le premier ensemble de données d'étalonnage dans la mémoire (4,5) et en utilisant l'instrument pour faire une série de mesures d'étalonnage sur une deuxième surface ayant une valeur connue du profil de la deuxième surface différente de la valeur du profil de la première surface pour déduire un deuxième ensemble de données d'étalonnage et en mettant en mémoire le deuxième ensemble de données d'étalonnage dans la mémoire.

9. Instrument de mesure de l'épaisseur d'un revêtement tel que revendiqué à la revendication 8, dans lequel le premier et le deuxième jeux de données d'étalonnage sont mis en mémoire dans la mémoire en association avec des valeurs correspondantes à la valeur du profil de surface des première et deuxième surfaces respectivement.

10. Instrument de mesure de l'épaisseur d'un revêtement tel que revendiqué à la revendication 9, dans lequel chacune de la première et de la deuxième surface sont mesurées en utilisant un dispositif de mesure du profil d'une surface afin de déterminer leur valeur de profil de surface.

11. Instrument de mesure de l'épaisseur d'un revêtement tel que revendiqué à la revendication 10, dans lequel chacune de la première et de la deuxième surface sont préparées en profilant la surface d'un échantillon de matériau ayant un profil souhaité de la surface.

12. Instrument de mesure de l'épaisseur d'un revêtement tel que revendiqué à la revendication 11, dans lequel les surfaces sont profilées par décapage avec des agents de décapage.

13. Procédé de mesure d'un revêtement sur une surface ayant une valeur connue du profil de la surface, comprenant les stades dans lesquels :

a. on se procure un instrument de mesure de l'épaisseur d'un revêtement tel que revendiqué à l'une quelconque des revendications 1 à 12;
b. on sélectionne, dans les valeurs de profil de surface mises en mémoire par l'instrument en association avec des ensembles de données d'étalonnage, la valeur du profil de la surface la plus proche du profil connu de surface, en sélectionnant ainsi un ensemble de données d'étalonnage à utiliser par l'instrument; et
c. on utilise l'instrument pour mesurer une épaisseur de revêtement sur la surface en utilisant l'ensemble sélectionné de données d'étalonnage.

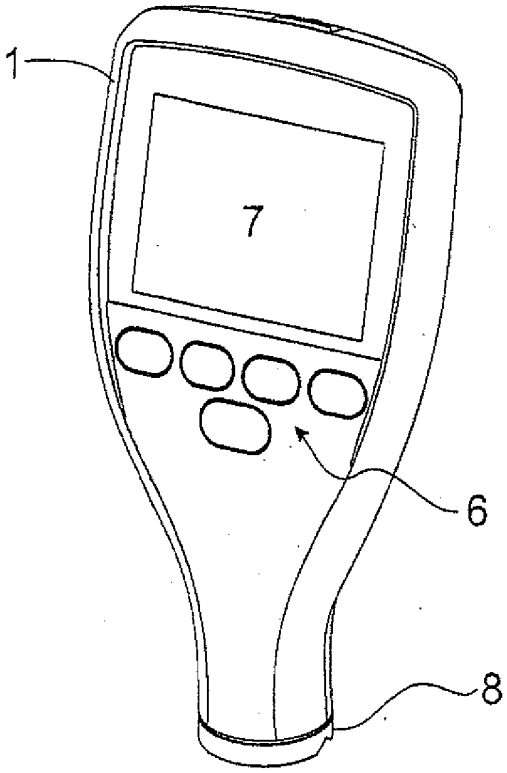

Figure 1

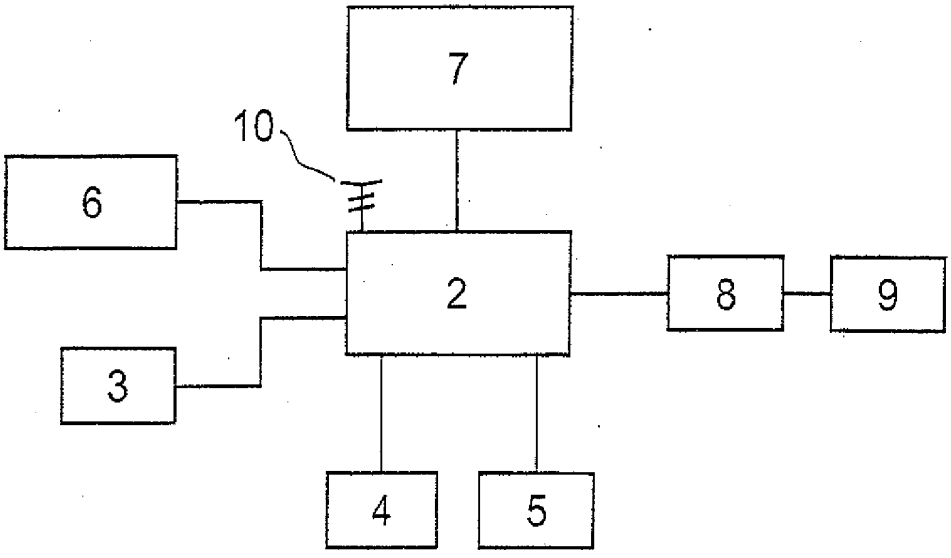

Figure 2

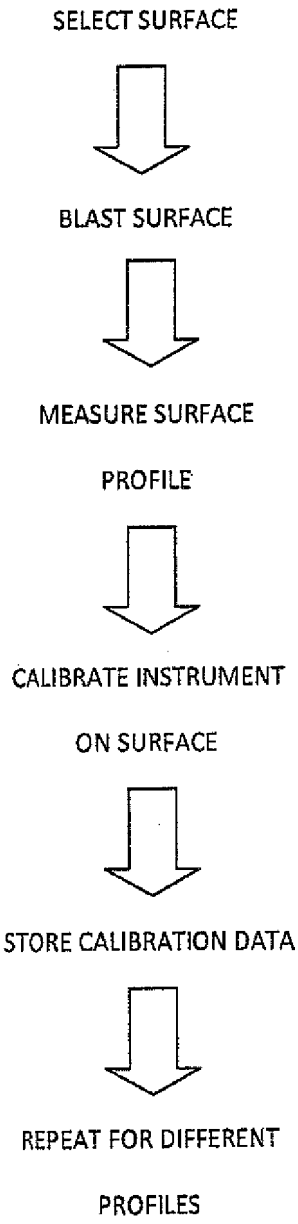
SELECT SURFACE
BLAST SURFACE
MEASURE SURFACE PROFILE
CALIBRATE INSTRUMENT ON SURFACE
STORE CALIBRATION DATA
REPEAT FOR DIFFERENT PROFILES

FIG 3

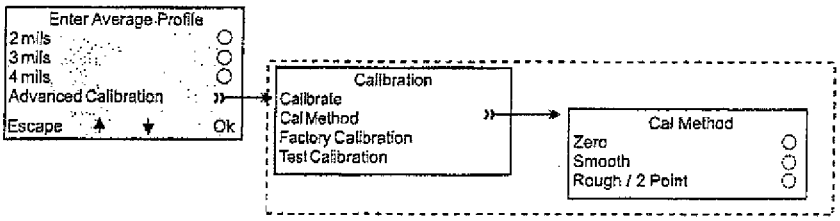

Figure 4

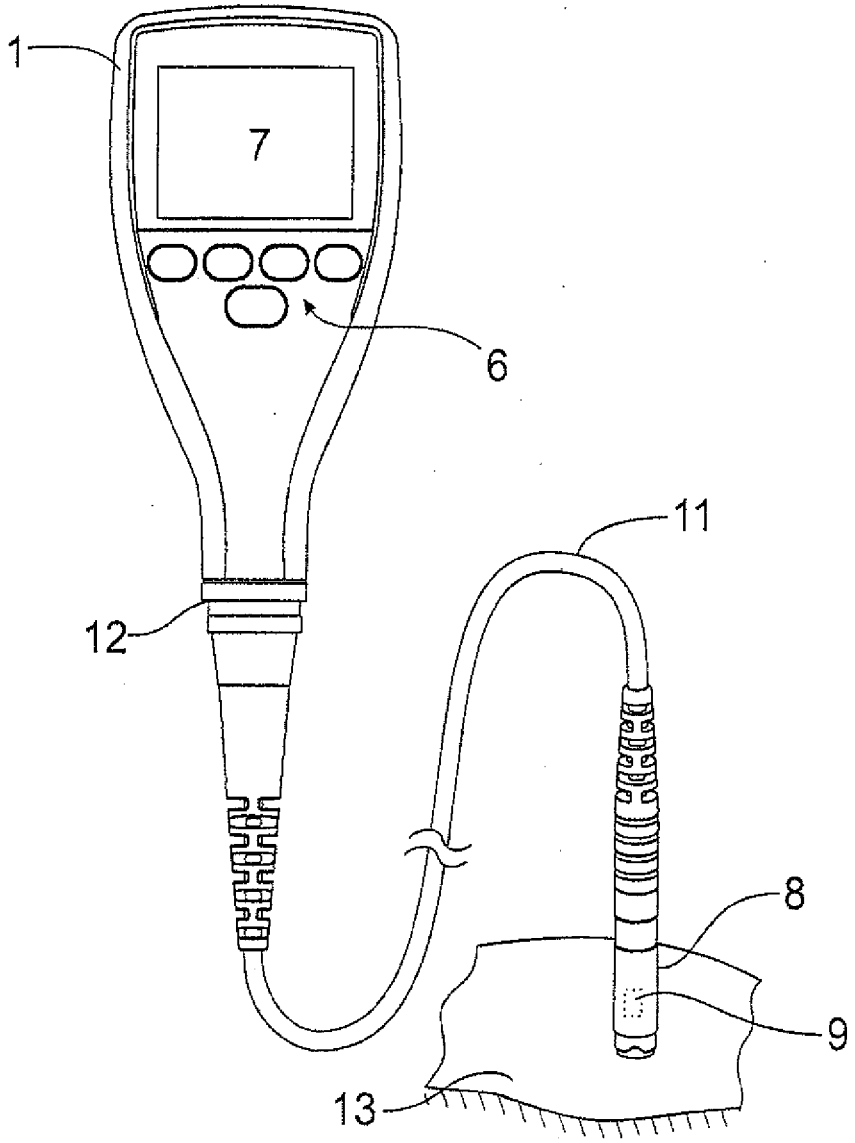

Figure 5

REFERENCES CITED IN THE DESCRIPTION

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