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(54) Title: PIPELINE COATING APPLICATION METHOD

(57) Abstract: This invention relates to the corrosion protection of metallic surfaces, preferably, pipeline systems, more specifically, to the construction and repair of underground pipeline facilities, either in the field or in factory, and can be used for the isolation of metallic surfaces from the combined impact of aggressive acid and alkaline environments, moisture and oxygen, preferably, for the isolation of steel pipeline surfaces.

Pipeline Coating Application Method

This invention relates to the corrosion protection of metallic surfaces, preferably, pipeline systems, more specifically, to the construction and repair of underground pipeline facilities, either in the field or in factory, and can be used for the coating of metallic surfaces to prevent the combined impact of acid and alkaline environments, water and oxygen, preferably for the coating of steel pipeline surfaces.

Nowadays there is a large number of pipelines in the Russian Federation including main pipelines which were installed more than 20 years ago and now require the repair of outer corrosion resistant coatings.

For the replacement of pipeline coatings, special methods and devices have been developed, designed for automated application of tape coatings distinguished by the types of used basic materials and the application technologies.

Known is (RU Patent 2188980, published 10.09.2002) a method of corrosion protection of underground metallic pipelines and structures. In accordance with said known method, a primer is mixed with a corrosion inhibitor, hereafter the target metallic surface is cleaned from contamination, the prepared primer is applied onto said cleaned metallic surface, and the coating is finally applied.

A poor adhesion between the coating and the primer should be admitted as a disadvantage of the known method that leads to the accessof air and moisture to the metallic surface and the subsequent corrosion of thecoating.

Known is (Construction of Main and In-Field Pipelines, Corrosion and Heat Isolation. VSN-008-88, Moscow, Minneftegazstroi, 1990, p. 10) methodof applyingan isolating tape-on the outer surface of pipelines. In accordance with the method, the target surface is preliminarily cleaned, and a primer and an isolation polymer tape coating are applied onto the pipeline, wherein for ambient temperatures of below 10 °C the target pipeline surface is being heated up to at least 15 °C but to max. 50 °C.

A disadvantage of said known method is the insufficient adhesion of the isolation coating in the tape wound overlap zones, which leads to the ingress of air and moisture to the metallic surface and the subsequent corrosion of the coating.

A method of applying an isolation sealant on pipelines is known (RU Patent 2174642, published 10.10.2001), comprising heating of the asphalt based isolation sealant in the extrusion chamber, the feeding hoses and the pumps, and extrusion of the isolation sealant via the forming output side of said extrusion chamber, followed by wrapping the protective tape coating from the coil onto the applied sealant layer.

This method provides ~~for~~ coating application along with filling of surface roughness, but the protective properties of asphalt based sealant coatings are insufficient by reason of the known disadvantages of asphalts, such as low physical and mechanical properties, high moisture absorption, cold yield under pressure, low adhesion properties as well as multiple process disadvantages detracting from the efficiency of asphalt based coating application equipment.

Moreover, said known method is power consuming and complex in implementation.

(RU Patent 2153620, published 27.07.2000) a method of protective coating application onto pipelines i. In accordance with said known method, a multilayered protective tape is used comprising an applied sealant layer and an anti-adhesion film preventing the coiled material from sticking between the wounds. However, wrapping the strained tape from the replaceable coil onto the pipeline being repaired does not provide for adhesion in tape overlap zones and air extrusion, and furthermore the necessity of removing the anti-adhesion membrane from the tape complicates the design of the device used for said method and increases the labor consumption of the method.

In-factory coated pipe joints are isolated with the use of sleeves based on heat shrink tapes with a polymer adhesive compound applied (RU Patent 2228940, published 20.05.2004). The performance of the coatings made on their basis are tangibly superior to that of all the abovementioned coatings and have only slight differences in properties from factory-applied extrusion coatings; however, their application methods (RU Patent 2230878, published 20.06.2004) are not suitable for the in-the-field isolation of long pipeline sections.

Tape isolation coatings are applied on long pipeline sections using devices comprising a dismountable rotor traveling in a screw path along the pipeline and rotating in order to provide the isolation tape unwrapping from the coil located on the wrapping head of the rotor and for tape wrapping onto the pipeline surface (see e.g. RU Patent 2218515, published 10.12.2003).

Known is (RU Patent 2303743, published 27.07.2007) a method of applying isolation coatings on pipelines, said method comprising wrapping the isolation tape in a screw path from an exchangeable coil onto a preliminarily cleaned pipeline surface coated with a primer layer, wherein said isolation tape is a thermoplastic two-layered tape with a polymer adhesive compound, during wrapping the tape sections preliminarily unwrapped from the coil are shaped so as to form a coil the diameter of which is greater than the pipeline diameter, further wherein the tape being unwrapped is oriented so the adhesive compound layer faces outwards the pipeline, the unwrapped tape section is heated at the adhesive compound side to the viscous flow transition point of the adhesive compound, the tape is then oriented so the adhesive compound layer faces the pipeline, and at the time of adhesive compound layer contact with the pipeline surface the base layer of the tape is exposed to a distributed load for adhesive compound distribution over the pipeline surface, filling roughness on the pipeline surface and air extrusion with simultaneous tape edge adhesion in the overlap zone with the previous tape wound and the application of tensile stress that increases from the tape edge in the overlap zone towards the opposite tape edge.

It is suggested to implement said known method (see above) using a device for applying isolation coatings on pipelines, said device comprising a dismountable rotor capable of resting upon the pipeline surface with its rubber-coated rolls and having at least one wrapping head capable of installation of a replaceable coil of isolation tape and an electrically driven carriage comprising an electric motor, a drive and toothed wheels equipped with supporting rollers for resting upon the pipeline, wherein said carriage is linked with said rotor via tie rods. Said known device further comprises a primer container comprising a piston, a batching device and a device for primer distribution over the pipeline surface, an isolation coating heater unit capable of translation movement along the pipeline, with one side of said heater unit resting upon the pipeline with a couple of wheels and the other side resting upon the pipeline and the freshly applied isolation coating, said rotor being capable of connection to a power source via sliding contacts, said rotor having tape guiding and unwrapping rolls and a tape guiding heat insulating sheath capable of forming a coil of isolation tape with a diameter greater than the pipeline diameter and connected via an air duct to a flow air heater that provides for tape heating at the adhesive compound layer side, a agent for distributing the heated adhesive compound of the isolation tape over the pipeline surface, said agent providing for tape edge adhesion in the overlap zone with the previous tape wound and the application of tensile stress that increases from the tape edge in the overlap zone towards the opposite tape edge.

Disadvantages of said known technical solution are the necessity of bending the tape during its application and the tangible sliding friction ratio produced in the tape bending zone during tape movement (change of tape movement plane during the tape travel from the coil to the pipe).

The closest counterpart of the technical solution provided herein is (RU Patent 2360178, published 27.03.2009) a method of applying isolation coatings on pipelines, said method comprising isolation tape wrapping on the pipeline in a screw path from an exchangeable coil, wherein said isolation tape comprises an adhesive compound layer and during wrapping the tape is oriented so the adhesive compound layer faces outward the pipeline, heating the unwrapped tape section at the adhesive compound layer side, orienting the tape so the adhesive compound layer faces the pipeline, and, at the time of adhesive compound layer contact with the pipeline surface, exposing the base layer of the tape to a distributed load, wherein the tape, which is oriented so the adhesive compound layer faces outward the pipeline, is passed at the outer side of the pipeline through at least six rolls arranged on the circumference of the pipeline being isolated, and the replaceable tape coil is oriented in parallelto the pipeline axis.

It is suggested to implement said known method (see above) with an coating application unit comprising at least two coil holders each of which is capable of installing an exchangeable coil with the isolation tape, a unit for tape heating at the isolation coating adhesive compound side, a system of tape guiding and turning rolls, a sheath covering said system of rolls, and a means for distributing the heated adhesive compound of the isolation tape over the pipeline surface, wherein said system of rolls comprises at least six rolls oriented inparallel to the pipeline axis and arranged on the pipeline circumference, further wherein the coil holder containing the tape coil being currently used is oriented parallel to the pipeline axis.

Disadvantages of said known technical solution are the complex design of the above described unit and its insufficient reliability.

The technical task solved using the method provided herein is the development of a method of applying isolation coatings on metallic pipeline surfaces and coating hardening with the use of low-temperature heating aimed at providing high adhesion combined with repairability improvement, higher environment friendliness of the works, higher speed and quality of the works, a significant improvement of the corrosion protection performance of the coatings and hence reduction of costs for scheduled overhauling of the metallic pipeline surfaces due to their increased service life.

The technical result achieved using the method provided herein comprises process temperature mode control improvement, use of the so-called “infinite coil” technology for which the tape coil is replaced without process interruption as well as an improvement in the processability of contactless pyrometrical temperature control at any point of the material, i.e., facilitation of the isolation coating application method which in turn provides for trouble-free operation and lack of process route deviation at high wrapping machine speeds.

It is suggested to achieve said technical result using the pipeline isolation coating application method provided herein. Said method comprises wrapping the isolation tape in a screw path from the replaceable tape coil, wherein said isolation tape comprises an adhesive compound layer, heating the tape at the adhesive compound layer side, orienting the tape so the adhesive compound layer faces towards the pipeline surface, and, at the time of adhesive compound layer contact with the pipeline surface exposing the base layer of the tape to a distributed load, wherein the exchangeable tape coil which can be installed on the wrapping machine control rod at the trench side or at the isolation material storage facility which is transported by the pipe laying machine and does not move relative to the wrapping machine, is oriented parallel to the pipeline axis, further wherein the tape, which is oriented so the adhesive compound layer faces outwards the pipeline, is passed at the outer side of the pipeline through at least two rolls arranged in a line relative to the tape heater on the circumference of the pipeline being isolated, wherein during wrapping the air temperature is additionally measured in the tape heating zone or directly after the heated zone at the adhesive compound layer side.

Preferably, said isolation tape comprises a heat shrink base.

Typically, tape coils wrapped in a screw path are uniformly heated.

Preferably, a primer layer is preliminarily applied on the pipeline surface.

For tape coil replacement the end of the isolation tape of the previous coil is connected with the beginning of the tape of the next coil by overlapping the adhesive layer of the previous coil tape heated to a viscous flow state and the polyethylene base of the tape of the next coil with short-time compression of the contacting surfaces using a process tool (a clamp) in the overlap point (typically approx. 100 mm). Alternatively, the tape ends can be connected using the Method of Tape End Connection (RU Patent 2368839, published 27.09.2009).

Preferably, the isolation tape is wrapped on a preliminarily cleaned pipeline surface.

Preferably, the unwrapped tape section is heated to the viscous flow transition point.

Typically, the adhesive compound is distributed for filling roughness on the pipeline surface and air extrusion with simultaneous tape edge adhesion in the overlap zone with the previous tape wound and the application of tensile stress that increases from the tape edge in the overlap zone towards the opposite tape edge.

It is suggested to implement said method using the isolation coating application device provided herein. Said device comprises at least one coil holder capable of being installed outside the wrapping machine rotor at the control rod or at the isolation material storage facility and installation of an exchangeable tape coil, a tape heater at the isolation coating adhesive layer side, a heated adhesive compound distribution means, a system of tape wrapping rolls and a means for tape pressing to the pipeline, wherein said system of rolls comprises at least two rolls arranged in a line along the tape heater and oriented parallel to the pipeline axis, further wherein at least said tape heater, said system of clamping rolls and said heated adhesive compound distribution means are mounted on the rotor of the isolation tape wrapping machine. Furthermore, said device comprises a means for measuring the temperature in the tape heating zone or directly after the heated zone at the adhesive compound layer side.

Preferably, said heated adhesive compound distribution means comprises a shaft with a clamping roll for holding the isolation tape edge, wherein the working surface of said shaft is coated with an elastic polymer material (e.g. silicone).

Said rolls can be either rigidly mounted or capable of rotating about their longitudinal axis as a result of tape passage, including the capability of forced rotation.

Preferably, remote contactless temperature measuring means are used, e.g. pyrometers.

Figure 1 shows schematic of the device provided herein, with the notations as follows: heater 1, tape 2 and rolls 3.

The herein provided device for isolation coating application on long pipeline sections in accordance with the method of this invention can be operated as follows.

Before the device for isolation coating application starts moving, the edge of the tape 2 (Fig. 1) preliminarily unwrapped from the replaceable tape coil is passed, with the adhesive compound layer facing outside, at the outer side of the system of rolls, reoriented at the last roll so the adhesive compound layer faces the pipeline being isolated, pulled towards the pipeline surface and applied onto the pipeline. The hot air source of the heater 1 is turned on for heating the adhesive compound layer. As the isolation tape wrapping unit moves along the pipeline, the tape is unwrapped from the coil and wrapped onto the pipeline surface. At the time of contact with said surface, the tape 2, which is oriented so the heated adhesive compound layer faces the pipeline surface, is exposed to a load provided by the adhesive compound distribution means at the outer surface side. The adhesive compound is distributed over the pipeline surface for filling surface roughness and complex surface shape zones, e.g. tape overlap zones and straight or spiral pipe weld seams, as well as for air extrusion with simultaneous adhesion of the edge of the tape 2 at its overlap with the previous tape wound, with the tensile stress increasing from the tape edge in the overlap zone towards the opposite tape edge. Preferably, the adhesion of the tape 2 at its overlap with the previous tape wound is provided by clamping with an elastic roll (which can be made e.g. from silicone) the rotation axis of which is orthogonal to the edge of the tape 2. When pressure is applied to the outer surface of the tape 2, the tape is stretched along its generatrix. Following that the tape is thermoset with hot air.

For tape coil replacement the end of the isolation tape 2 of the previous coil is mechanically connected with the beginning of the isolation tape of the next tape coil, thus providing, *inter alia*, uninterrupted tape wrapping process. This embodiment of the entire working cycle of the herein provided device for the application of isolation coatings provides for guaranteed air extrusion from roughness on the pipeline surface and their simultaneous filling with the adhesive compound and tight isolation tape contact with the pipeline surface roughness thus improving the pipeline isolation quality.

In particular, the use of the device provided herein for wrapping two-layered isolation tape NRL-ST60 225×2.0TU 2293-001-29200582-02 in a pipeline section provided a uniform and high-quality pipeline isolation coating with the cohesion strength in the polymer coating overlap zones A_{coh} = 60-65 N/cm and the cohesion strength at the primed metallic surface A_{coh} = 70-75 N/cm.

What is claimed is a:

1. Method of applying an isolation coating onto a pipeline comprising sequentially unwrapping the isolation tape in a screw path from a replaceable tape coil, said isolation tape comprising an adhesive compound layer, heating the unwrapped tape sections at the adhesive compound layer side, reorienting the tape so the adhesive compound layer faces the pipeline surface, applying a distributed load onto the tape base at the time of adhesive compound layer contact with the pipeline surface, and passing the tape, which is oriented so the adhesive compound layer faces outwards the pipeline, at the outer side of the pipeline through at least two rolls arranged in a line along the tape heater and around the pipeline being isolated, wherein the air temperature is additionally measured in the tape heating zone or directly behind the tape heating zone at the adhesive compound layer side.

2. Method of Claim 1 wherein said isolation tape comprises a heat shrink base.

3. Method of Claim 2 wherein tape wound-wrapped in a screw path are uniformly heated.

4. Method of Claim 1 wherein the pipeline surface is primed before tape wrapping.

5. Method of Claim 1 wherein the unwrapped tape sections are heated to the adhesive compound viscous flow transition point.

6. Method of Claim 1 wherein said adhesive compound is distributed for filling pipeline surface roughness and air extrusion with

simultaneous tape edge adhesion in the overlap zone with the previous tape wound and the application of tensile stress that increases from the tape edge in the overlap zone towards the opposite tape edge.

7. Method of Claim 1 wherein the temperature is measured using a contactless method.

8. Method of Claim 1 wherein the temperature is measured using a remote method.

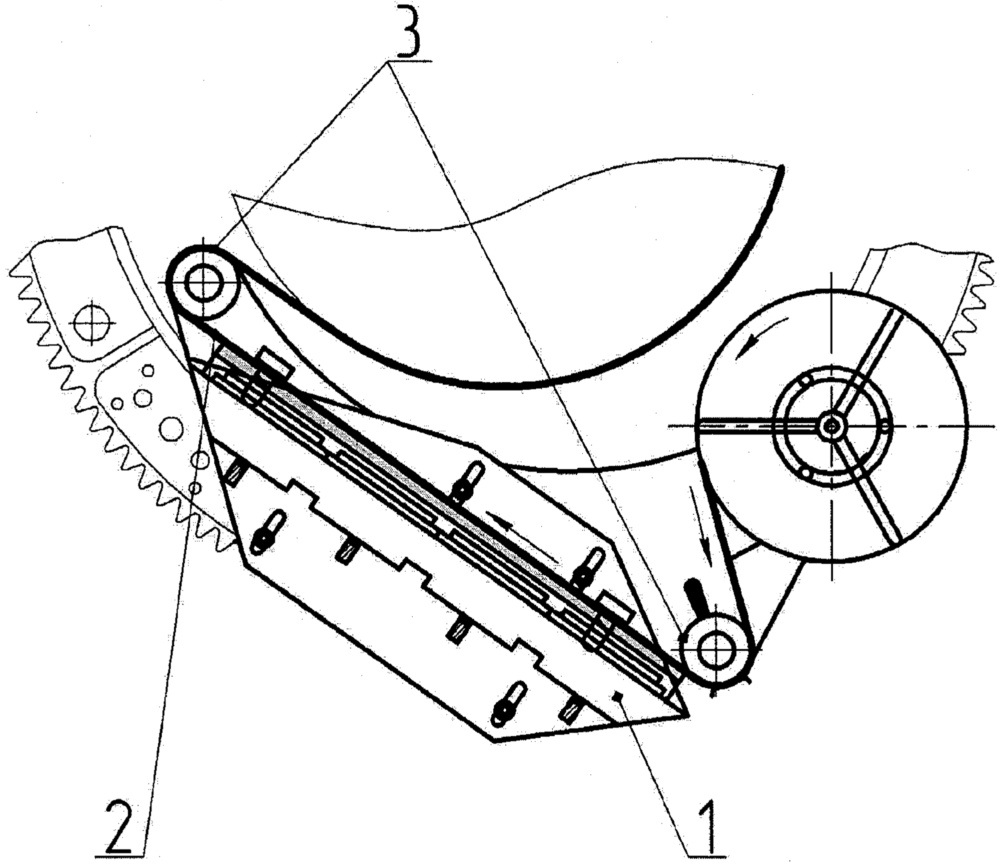

Fig. 1.

INTERNATIONAL SEARCH REPORT	International application No. PCT/RU 2018/000616

A. CLASSIFICATION OF SUBJECT MATTER

F16L 58/02 *(2006.01)*
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According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

F16L 58/00-58/16, 57/00, 59/00-59/14

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

PatSearch (RUPTO internal), USPTO, PAJ, Esp@cenet, DWPI, EAPATIS, PATENTSCOPE

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A, D	RU 2360178 C1 (RASSTRIGIN IVAN IVANOVICH) 27.06.2009	1-8
A	RU 2375633 C2 (OOO «KURGANMASHINZHINIRING») 10.12.2009	1-8
A	US 8932681 B2 (UPONOR INFRA OY) 13.01.2015	1-8

☐ Further documents are listed in the continuation of Box C.

☐ See patent family annex.

* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

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