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(54) **THERMAL SPRAY COIL FOR WIRE ARC THERMAL SPRAY MACHINE**

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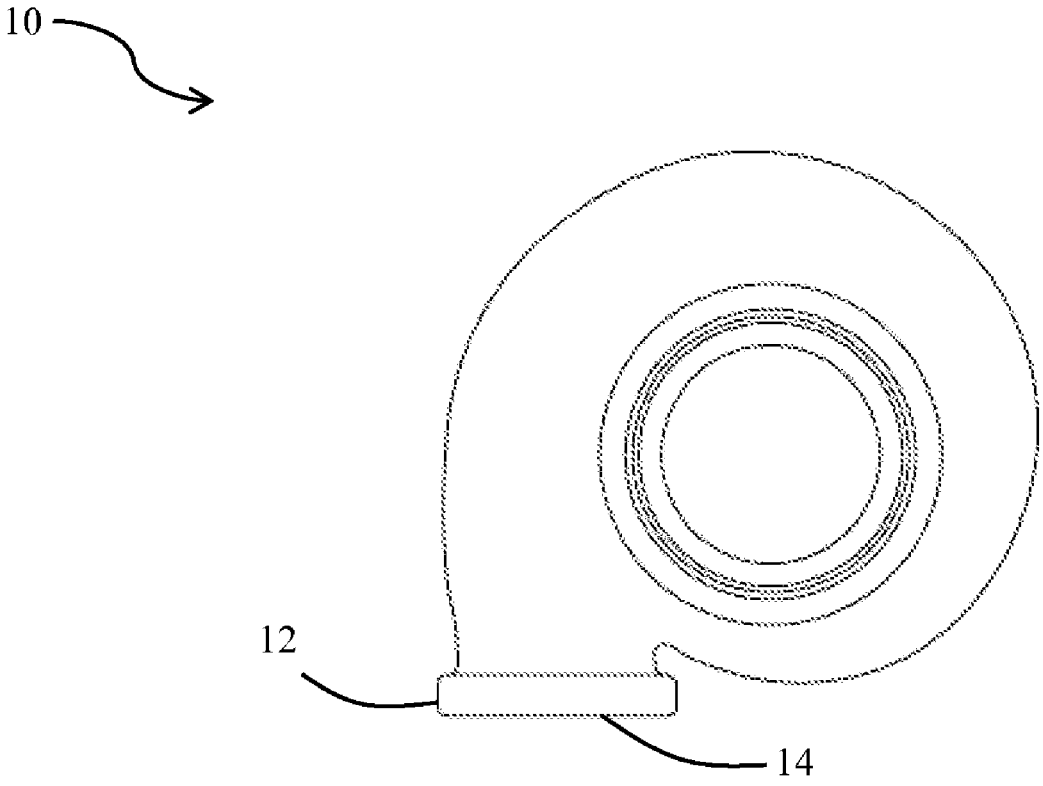
(57) **ABSTRACT**

A thermal spray coil, shaped and sized to be compatible with a wire arc thermal spray machine, is disclosed. The thermal spray coil includes a wire of FeAlSi material. The wire includes 0.5 to 6 percent aluminum, 4 to 7 percent silicon, and a remaining balance of iron.



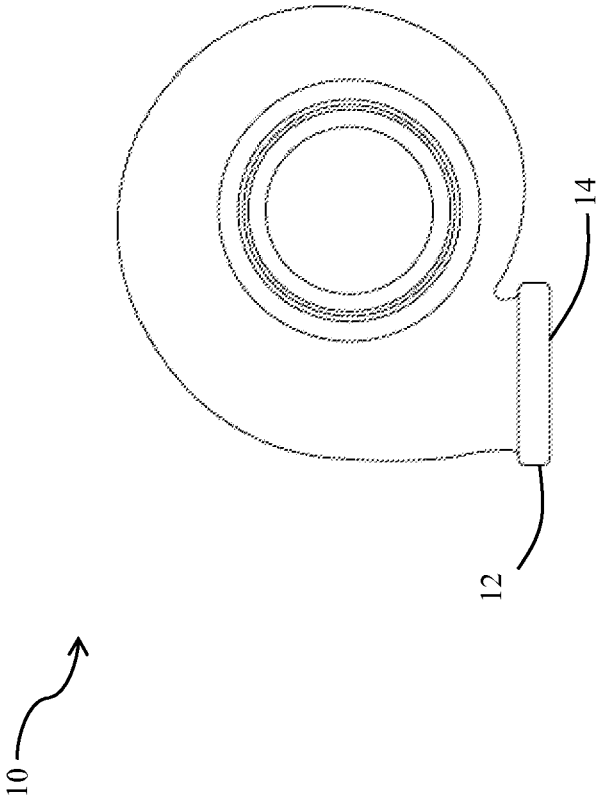


FIG. 1

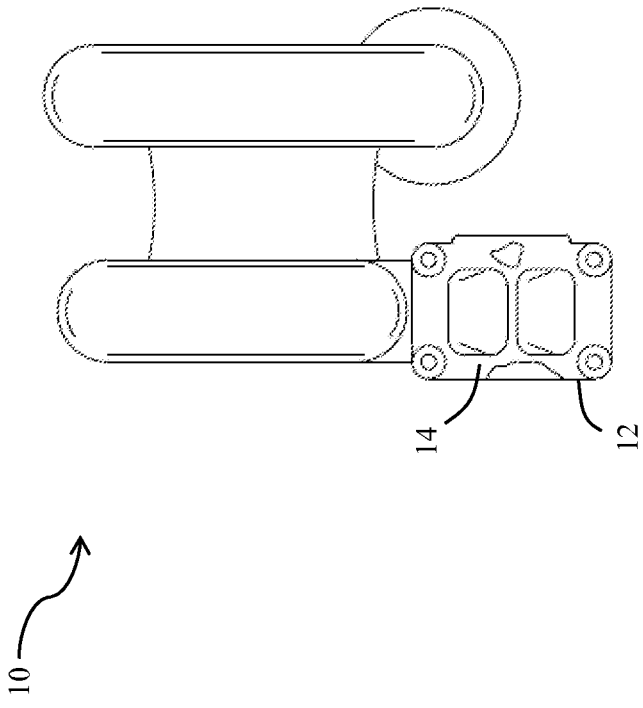


FIG. 2

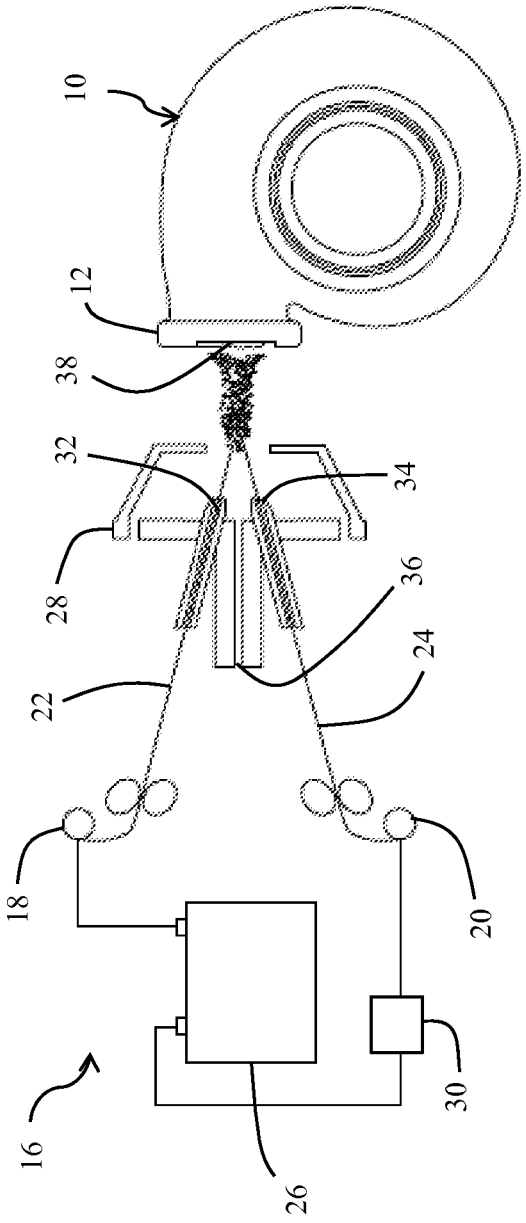


FIG. 3

THERMAL SPRAY COIL FOR WIRE ARC THERMAL SPRAY MACHINE

TECHNICAL FIELD

[0001] The present disclosure relates generally to a thermal spray coil employed in a wire arc thermal spray machine. More specifically, the present disclosure relates to a specific composition of a wire of the thermal spray coil employed in the wire arc thermal spray machine.

BACKGROUND

[0002] Various remanufacturing processes, such as a wire arc thermal spray process, are commonly known to refurbish and/or remanufacture used metallic components. In the wire arc thermal spray process, a wire of coating material is generally melted and applied on a metallic component to build up a surface that no longer satisfies the dimensional specifications of the metallic component. For instance, in case of a turbocharger, the thickness of a flange portion of the turbocharger may decrease with prolonged usage. Therefore, in order to remanufacture the turbocharger by the wire arc thermal spray process, the wire of coating material may be melted and applied on an external surface of the flange portion to return all dimensions to specifications. A composition and material of the wire of coating material applied to the metallic component must be selected, such that the wire of coating material exhibits characteristics that match and/or exceed the metallic material of the metallic component. For instance, in the case of the turbocharger, the wire of coating material must successfully sustain oxidation under 800 degrees Celsius, which is the operational temperature of the turbocharger.

[0003] Conventionally, the wire of Fe-22Cr-6Al material is used as the coating material in the wire arc thermal spray process to remanufacture the metallic component that has operational temperature of about 800 degree Celsius. While such materials of the wire have worked well, environmental concerns have motivated the industry to adopt a material of the coating material of the wire that avoid and/or limits the use of chromium and/or nickel.

[0004] United States Patent Application 2013/0337215 discloses a FeAlSiC material of the thermal spray wire as the coating material, to remanufacture a used component (metallic component). Such materials of the thermal spray wire may fail to oxidation when applied to the metallic component with 800 degree Celsius operational temperatures. Therefore, there exists a need for a composition and/or material of the thermal spray wire employed in the thermal spray process that may be environmentally friendly and may facilitate oxidation resistance at a temperature of about 800 degree Celsius.

SUMMARY OF THE INVENTION

[0005] Various aspects of the present disclosure are directed towards a thermal spray coil, shaped and sized to be compatible with a wire arc thermal spray machine. The thermal spray coil includes a wire of FeAlSi material. The wire includes 0.5 to 6 percent aluminum, 4 to 7 percent silicon, and a remaining balance of iron

BRIEF DESCRIPTION OF THE DRAWINGS

[0006] FIG. **1** is a side view of an exemplary turbocharger, in accordance with the concepts of the present disclosure;

[0007] FIG. **2** is a front view of the turbocharger of FIG. **1**, which illustrates a flange portion of the turbocharger to be re-manufactured, in accordance with the concepts of the present disclosure; and

[0008] FIG. **3** is a side view of a wire arc thermal spray machine to remanufacture the flange portion of the turbocharger of FIG. **1** and FIG. **2**, in accordance with the concepts of the present disclosure.

DETAILED DESCRIPTION

[0009] Referring to FIGS. **1** and **2**, there is shown an exemplary turbocharger **10** that may be required to operate at a temperature of about 800 degree Celsius. The turbocharger **10** includes a flange portion **12** that connects the turbocharger **10** to an exhaust manifold (not shown) of an engine (not shown). The flange portion **12** includes an external surface **14**, and is made up of a metallic material. The metallic material may be, but is not limited to, aluminum, steel, iron casting, and/or the like. With continuous and prolonged operation, the external surface **14** of the flange portion **12** may wear out and the thickness of the flange portion **12** may decrease. In order to correct the thickness of the flange portion **12**, and reuse the turbocharger **10**, the flange portion **12** of the turbocharger **10** may require to be remanufactured. Although reference to the turbocharger **10** are made, concepts of the present disclosure should not be limited to the turbocharger **10** and may extend to any metallic component that may require to be operated at a temperature of about 800 degree Celsius. For example, concepts of the present disclosure may also be applied to the exhaust manifold (not shown) of the engine (not shown).

[0010] Referring to FIG. **3**, there is shown a wire arc thermal spray machine **16**, which is employed to remanufacture the turbocharger **10**. For ease in reference, the wire arc thermal spray machine **16** will be referred to as the thermal spray machine **16**, interchangeably hereinafter. The thermal spray machine **16** generally employs a thermal spray coil that includes a wire of FeAlSi material. The wire may be melted and sprayed on the external surface **14** of the flange portion **12** to remanufacture the turbocharger **10**. In the current embodiment, however, a description of the thermal spray coil is supported by two thermal spray coils. Namely, a first thermal spray coil **18** and a second thermal spray coil **20** are included. Similarly, a description of the wire is supported by two wires. Namely, a first wire **22** and a second wire **24** are included. The first wire **22** is wound to form the first thermal spray coil **18**, while the second wire **24** is wound to form the second thermal spray coil **20**. Moreover, each of the first wire **22** and the second wire **24** may be melted and sprayed on the external surface **14** of the flange portion **12**, to remanufacture the turbocharger **10**.

[0011] In an embodiment of the present disclosure, the thermal spray machine **16** may employ the first thermal spray coil **18** with the first wire **22**, the second thermal spray coil **20** with the second wire **24**, a battery unit **26**, and a thermal spray torch **28**. The first thermal spray coil **18** and the second thermal spray coil **20**, are shaped and sized to be compatible with the wire arc thermal spray machine **16**. As is already mentioned, the first thermal spray coil **18** and the second thermal spray coil **20**, respectively include a first wire **22** and a second wire **24** of coating material. Each of the first wire **22** and the second wire **24** are in electrical connection to the battery unit **26**, via a control switch **30**, and are fed through the thermal spray torch **28**. The thermal spray torch **28** includes a first opening **32**, a second opening **34**, and a central

gas passage **36**. The central gas passage **36** is connected to a supply of pressurized air and/or pressurized gas. The first opening **32** and the second opening **34**, respectively are adapted to receive the first wire **22** and the second wire **24** and route those wires continuously in front of the central gas passage **36**, separated by a minimal gap. As the control switch **30** is actuated, a spark is produced between the first wire **22** and the second wire **24**, which causes the first wire **22** and the second wire **24** to melt. A stream of molten metallic material is then projected to the external surface **14** of the flange portion **12**. Therefore, the first wire **22** and the second wire **24** are deposited in the form of a coating layer **38** on the external surface **14** of the flange portion **12** By this process, a remanufacture of the turbocharger **10** occurs.

[0012] In the current embodiment, the first wire **22** and the second wire **24** of the first thermal spray coil **18** is made of the FeAlSi material. The first wire **22** and the second wire **24** include 0.5 to 6 percent aluminum, 4 to 7 percent silicon, and a remaining balance of iron. The specific composition of the first wire **22** and the second wire **24** is environment friendly and provides an ordered Body Centered Cubic (BCC) crystal structure that provides oxidation resistance at about 800 degree Celsius. Therefore, the coating layer **38**, when applied to the external surface **14** of the flange portion **12**, sustains relatively high operational temperatures of the turbocharger **10**.

INDUSTRIAL APPLICABILITY

[0013] As part of the thermal spray remanufacturing process, an operator may identify the external surface **14** of the flange portion **12** of the turbocharger **10** that is required to be remanufactured. Thereafter, the operator may activate the thermal spray machine **16**, via actuation of the control switch **30**. This is to supply high electric voltage between the first wire **22** and the second wire **24**. As the first wire **22** and the second wire **24** are separated by a minimal gap in the thermal spray torch **28**, a spark is produced between the first wire **22** and the second wire **24**. The spark melts both of the first wire **22** and the second wire **24**. The molten first wire **22** and the molten second wire **24** are then deposited on the external surface **14** of the flange portion **12** of the turbocharger **10**, in form of the coating layer **38**. Furthermore, as the first wire **22** and the second wire **24** are made up of FeAlSi material, the coating layer **38** is also made up of the FeAlSi material, with composition of 0.5-6 percent aluminum, 4-7 percent silicon, and a balance of iron. Notably, the specific composition of the coating layer **38** is free from chromium and any other environmentally hazardous material. Moreover, the specific composition of the coating layer **38** provides an ordered BCC crystal structure that facilitates oxidation resistance at a high operational temperature of about 800 degree Celsius. Therefore, the specific composition of the first wire **22** and the second wire **24** facilitates an environment friendly and relatively high temperature oxidation resistant material of the coating layer **38** deposited on the turbocharger **10**.

[0014] It should be understood that the above description is intended for illustrative purposes only and is not intended to limit the scope of the present disclosure in any way. Those skilled in the art will appreciate that other aspects of the disclosure may be obtained from a study of the drawings, the disclosure, and the appended claim.

What is claimed is:

1. A thermal spray coil shaped and sized to be compatible with a wire arc thermal spray machine, the thermal spray coil comprising:

a wire of FeAlSi material, wherein the wire includes 0.5 to 6% aluminum, 4 to 7% silicon, and a remaining balance of iron.

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