CLAIMS

1. A heat transfer enhancement pipe comprising:

a pipe body of a tubular shape having an inlet for entering of a fluid and an outlet for the fluid to flow out;

wherein:

an internal wall of the pipe body is welded at a welding site with a fin protruding towards interior of the pipe body,

the fin has one or more fin sections extending spirally in an axial direction of the pipe body,

each fin section has a first end surface facing the inlet and a second end surface facing the outlet, and

at least one of the first end surface and the second end surface of at least one of the fin sections is formed as a transition surface along a spirally extending direction and configured to reduce thermal stress at the welding site during operation, wherein the transition surface is a curved surface in a cross-sectional view of the fin taken parallel to the axial direction of the pipe body, and wherein the curved surface has a concave shape.

2. The heat transfer enhancement pipe according to claim 1, wherein the first end surface of a fin section closest to the inlet is formed as a first transition surface.

3. The heat transfer enhancement pipe according to claim 1, wherein the second end surface of a fin section closest to the outlet is formed as a second transition surface.

4. The heat transfer enhancement pipe according to claim 1, wherein a top surface of the fin facing a central axis of the pipe body is formed as a third transition surface of a concave shape.

5. The heat transfer enhancement pipe according to claim 1, wherein the fin sections are spaced by one or more intervals, at least one of the first end surface and the second end surface defined by two side walls of the interval is formed as a fourth transition surface.

6. The heat transfer enhancement pipe according to claim 1, further comprising a plurality of fins that, as viewed from the direction of the inlet, are clockwise or counterclockwise spirals and enclose at the center of the pipe body a hole extending in the axial direction of the pipe body.

7. The heat transfer enhancement pipe according to claim 1, wherein a heat insulator at least partially surrounds an external circumference of the pipe body.

8. The heat transfer enhancement pipe according to claim 7, wherein the heat insulator has a tubular shape and is configured to be sleeved on the outside of the pipe body, and a gap is left between the heat insulator and an external wall of the pipe body.

9. The heat transfer enhancement pipe according to claim 8, wherein a connector for connecting the heat insulator and the pipe body is arranged between the heat insulator and the pipe body.

10. The heat transfer enhancement pipe according to claim 9, wherein the connector comprises one or more of the following structures:

a first connecting piece that extends in an axial direction parallel to the pipe body;

a second connecting piece that extends spirally along the external wall of the pipe body; and

a connecting rod with its two ends respectively connected to the external wall of the pipe body and an internal wall of the heat insulator.

11. The heat transfer enhancement pipe according to claim 7, wherein the heat insulator comprises:

a straight pipe section having a first end and a second end;

a first tapered pipe section; and

a second tapered pipe section, the first tapered pipe section and the second tapered pipe section configured to be respectively connected to the first end and second end of the straight pipe section;

wherein the first tapered pipe section is tapered in a direction from close to the first end to away from the first end; and

the second tapered pipe section is tapered in a direction from close to the second end to away from the second end.

12. The heat transfer enhancement pipe according to claim 1, wherein a heat insulating layer is provided on an external surface of the pipe body.

13. The heat transfer enhancement pipe according to claim 12, wherein the heat insulating layer comprises a metal alloy layer outside of the external surface of the pipe body and a ceramic layer outside of the metal alloy layer.

14. The heat transfer enhancement pipe according to claim 13, wherein the heat insulating layer comprises an oxide layer between the metal alloy layer and the ceramic layer; and the oxide layer is prepared and formed by alumina, silica, titania, or a mixture of any two or more materials selected from alumina, silica, and titania.

15. The heat transfer enhancement pipe according to claim 13, wherein the metal alloy layer is prepared and formed by metal alloy materials including M, Cr, Al, and Y, wherein M is selected from one or more of Fe, Ni, Co, and Al.

16. The heat transfer enhancement pipe according to claim 15, wherein the metal alloy layer further comprises one or more additive materials selected from Si, Ti, Co, and Al_2O_3.

17.The heat transfer enhancement pipe according to claim 13, wherein the ceramic layer is prepared and formed by one or more materials selected from yttria-stabilized zirconia, magnesia-stabilized zirconia, calcia-stabilized zirconia, and ceria-stabilized zirconia.

18. The heat transfer enhancement pipe according to claim 12, wherein the heat insulating layer comprises:

a straight section having a first end and a second end;

a first tapered section; and

a second tapered section; the first tapered section and the second tapered section configured to be respectively connected to the first end and second end of the straight section,

wherein the first tapered section is tapered in a direction from close to the first end to away from the first end; and the second tapered section is tapered in a direction from close to the second end to away from the second end.

19. A cracking furnace or atmospheric and vacuum heating furnace, comprising:

a radiation chamber, in which at least one furnace pipe assembly is installed;

wherein the at least one furnace pipe assembly comprises a plurality of furnace pipes arranged in sequence and a heat transfer enhancement pipe communicating adjacent furnace pipes; and

the heat transfer enhancement pipe is the heat transfer enhancement pipe according to claim 1.