CLAIMS

1. A friction joining method of connecting joining surfaces of a pair of metal parts to each other with the use of frictional heat generated at the joining surfaces of the pair of metal parts, comprising:

a heating process heating at least one of the joining surfaces of the pair of metal parts;

a contact process, after the completion of the heating process with the joining surfaces of the pair of metal parts being faced to each other, relatively moving one of the metal parts toward the other to bring the joining surfaces of the pair of metal parts into contact with each other;

a first joining process, after the completion of the contact process with the joining surfaces of the pair of metal parts being faced to and in contact with each other, reciprocating one of the metal parts relative to the other in a direction orthogonal to a facing direction, pressing at the same time one of the metal parts to the other to soften with frictional heat the joining surfaces of the pair of metal parts, and stopping the relative reciprocation of the metal parts upon a movement of the pair of metal parts reaching a pre-target movement that is set to be smaller than a target movement; and

a second joining process, after the completion of the first joining process, continuously pressing one of the metal parts to the other until the movement of the pair of metal parts reaches the target movement so that the joining

surfaces of the pair of metal parts are set into each other and are joined together, wherein

the heating process makes a temperature at any one of the joining surfaces of the metal parts at the start of the joining process equal to 20% or greater of a melting point of material of the metal part.

2. The friction joining method according to claim 1, wherein the heating process makes a heating depth of any one of the metal parts at the start of the joining process equal to 1.0 mm or greater.

3. The friction joining method according to claim 1 or 2, wherein the heating process heats each of the joining surfaces of the pair of metal parts.

4. The friction joining method according to any one of claims 1 to 3, wherein the metal parts are engine parts used for a gas turbine engine.

1. A friction joining method of connecting joining surfaces of a pair of metal parts to each other with the use of frictional heat generated at the joining surfaces of the pair of metal parts, comprising:

a heating process heating at least one of the joining surfaces of the pair of metal parts;

a contact process, after the completion of the heating process with the joining surfaces of the pair of metal parts being faced to each other, relatively moving one of the metal parts toward the other to bring the joining surfaces of the pair of metal parts into contact with each other; and

a joining process, after the completion of the contact process with the joining surfaces of the pair of metal parts being faced to and in contact with each other, reciprocating one of the metal parts relative to the other in a direction parallel to the joining surfaces, and at the same time, relatively pressing one of the metal parts to the other until a movement of the pair of metal parts reaches a target movement, thereby softening with frictional heat the joining surfaces of the pair of metal parts and joining the joining surfaces together, wherein

the heating process makes a temperature at any one of the joining surfaces of the metal parts at the start of the joining process equal to 20% or greater of a melting point of material of the metal part.

2. The friction joining method according to claim 1,

~~wherein the heating process makes a heating depth of any~~ one of the metal parts at the start of the joining process equal to 1.0 mm or greater.

3. The friction joining method according to claim 1 or 2, wherein the heating process heats each of the joining surfaces of the pair of metal parts.

4. The frictional joining method according to any one of claims 1 to 3, wherein the joining process includes:

a first joining process, after the completion of the contact process with the joining surfaces of the pair of metal parts being faced to and in contact with each other, reciprocating one of the metal parts relative to the other in a direction parallel to the joining surfaces, pressing at the same time one of the metal parts to the other to soften with frictional heat the joining surfaces of the pair of metal parts, and stopping the relative reciprocation of the metal parts upon the movement of the pair of metal parts reaching a pre-target movement that is set to be smaller than the target movement; and

a second joining process, after the completion of the first joining process, continuously pressing the metal part to the other until the movement of the pair of metal parts reaches the target movement so that the joining surfaces of the pair of metal parts are set into each other and are joined together.

5. The friction joining method according to any one of claims 1 to 5, wherein the metal parts are engine parts

~~used for a gas turbine engine.~~

6. A joined structure formed according to the friction joining method according to any one of claims 1 to 5.