WHAT IS CLAIMED IS:

1. A high-aluminum austenitic alloy or a high-aluminum austenitic centrifugal casting pipe, wherein in weight percentage, the high-aluminum austenitic alloy or the high-aluminum austenitic centrifugal casting pipe is composed of the elements of: C, 0.3-0.7%; Mn, 0-0.5%; Si, 0-0.5%; Cr, 20-26%; Ni, 40-50%; Al, 3.5-5%; Ti, 0.04-0.3%; Zr, 0.01-0.3%; Nb, 0.1-1%; Ta, 0.4-2%; Mo, 0.01-1%; W, 0.4-1.9%; N, 0.001-0.04%; rare earth elements, 0.03-0.3%; and a balance of Fe and unavoidable impurities.

2. The high-aluminum austenitic alloy or the high-aluminum austenitic centrifugal casting pipe of claim 1, wherein the elemental composition of the high-aluminum austenitic alloy or the high-aluminum austenitic centrifugal casting pipe has one or more of the following characteristics:

the content of C is 0.4-0.65%;

the content of Mn is 0-0.4%;

the content of Si is 0-0.4%;

the content of Mo is 0.2-1%;

the content of N is 0.006-0.035%;

the content of the rare earth elements are 0.08-0.3%; and

the rare earth elements are Y, Hf, and Ce, and the content of each of Y, Hf and Ce is 0.01-0.1%.

3. The high-aluminum austenitic alloy or the high-aluminum austenitic centrifugal casting pipe of claim 1, wherein the high-aluminum austenitic alloy or the high-aluminum austenitic centrifugal casting pipe further comprises one or more of Cu, V, Co and B.

4. The high-aluminum austenitic alloy or the high-aluminum austenitic centrifugal casting pipe of claim 3, wherein the elemental composition of the high-aluminum austenitic alloy or the high-aluminum austenitic centrifugal casting pipe has one or more of the following characteristics:

the content of Cu is ≤0.1%;

the content of V is ≤0.01%;

the content of Co is ≤0.03%; and

the content of B is ≤0.1%.

5. The high-aluminum austenitic alloy or the high-aluminum austenitic centrifugal casting pipe of claim 1, wherein the unavoidable impurities comprise one or more of S, P and O.

6. The high-aluminum austenitic alloy or the high-aluminum austenitic centrifugal casting pipe of claim 1, wherein in the high-aluminum austenitic alloy or the high-aluminum austenitic centrifugal casting pipe, the content of S is ≤0.005%, the content of P is ≤0.005%, and the content of O is ≤0.005%.

7. The high-aluminum austenitic alloy or the high-aluminum austenitic centrifugal casting pipe of claim 1, wherein the high-aluminum austenitic alloy or the high-aluminum austenitic centrifugal casting pipe has one or more of the following properties:

the high-aluminum austenitic alloy or the high-aluminum austenitic centrifugal casting pipe has a creep rupture life of ≥100 hours, measured under testing conditions of 1100℃ and 17MPa;

the high-aluminum austenitic alloy or the high-aluminum austenitic centrifugal casting pipe has an average creep rate of the second stage of creep of ≤0.0005%/h, measured under testing conditions of 1050℃ and 15MPa;

the high-aluminum austenitic alloy or the high-aluminum austenitic centrifugal casting pipe has an average creep rate of the second stage of creep of ≤0.002%/h, measured under testing conditions of 1050℃ and 20MPa;

the high-aluminum austenitic alloy or the high-aluminum austenitic centrifugal casting pipe has an average creep rate of the second stage of creep of ≤0.01%/h, measured under testing conditions of 1050℃ and 25MPa;

the high-aluminum austenitic alloy or the high-aluminum austenitic centrifugal

casting pipe has an average creep rate of the second stage of creep of ≤0.05%/h, measured under testing conditions of 1050℃ and 30MPa;

the high-aluminum austenitic alloy or the high-aluminum austenitic centrifugal casting pipe has a yield strength of ≥120MPa, a tensile strength of ≥185MPa, and a enlongation of ≥49%, measured at 850℃;

the high-aluminum austenitic alloy or the high-aluminum austenitic centrifugal casting pipe has a yield strength of ≥53MPa, a tensile strength of ≥65MPa, and a enlongation of ≥59%, measured at 1050℃; and

the high-aluminum austenitic alloy or the high-aluminum austenitic centrifugal casting pipe has a carbon increment of 0.5% or less at a depth of 1mm and a carbon increment of 0.05% or less at a depth of 2mm under the testing conditions of 1150℃/7 days.

8. The high-aluminum austenitic alloy or the high-aluminum austenitic centrifugal casting pipe of claim 1, wherein the high-aluminum austenitic alloy or the high-aluminum austenitic centrifugal casting pipe has one or more of the following properties:

the high-aluminum austenitic alloy or the high-aluminum austenitic centrifugal casting pipe has a creep rupture life of ≥110 hours, measured under testing conditions of 1100℃ and 17MPa;

the high-aluminum austenitic alloy or the high-aluminum austenitic centrifugal casting pipe has an average creep rate of the second stage of creep of ≤0.0003%/h, measured under testing conditions of 1050℃ and 15MPa;

the high-aluminum austenitic alloy or the high-aluminum austenitic centrifugal casting pipe has an average creep rate of the second stage of creep of ≤0.0015%/h, measured under testing conditions of 1050℃ and 20MPa;

the high-aluminum austenitic alloy or the high-aluminum austenitic centrifugal casting pipe has an average creep rate of the second stage of creep of ≤0.007%/h, measured under testing conditions of 1050℃ and 25MPa;

the high-aluminum austenitic alloy or the high-aluminum austenitic centrifugal casting pipe has an average creep rate of the second stage of creep of ≤0.035%/h, measured under testing conditions of 1050℃ and 30MPa.

9. The high-aluminum austenitic alloy or the high-aluminum austenitic centrifugal casting pipe of claim 1, wherein the high-aluminum austenitic alloy or the high-aluminum austenitic centrifugal casting pipe has a creep rupture life of ≥115 hours, measured under testing conditions of 1100℃ and 17MPa.

10. The high-aluminum austenitic centrifugal casting pipe of claim 1, wherein the high-aluminum austenitic alloy centrifugal casting pipe has an outer diameter of 60-250mm and a wall thickness of 6-10mm.

11. The high-aluminum austenitic centrifugal casting pipe of claim 1, wherein the microstructure of the high-aluminum austenitic alloy or the high-aluminum austenitic centrifugal casting pipe comprises columnar grains with a volume fraction of 80% or more and equiaxed grains with a volume fraction of 20% or less.

12. The high-aluminum austenitic centrifugal casting pipe of claim 11, wherein in the wall thickness direction of the high-aluminum austenite centrifugal casting pipe, columnar grains are located near the outer wall and uniform equiaxed grains are located near the inner wall.

13. A method for manufacturing the high-aluminum austenitic alloy or the high-aluminum austenitic centrifugal casting pipe of any one of claims 1-12, comprising the following steps:

1) smelting: smelting chemical components of the high-aluminum austenitic alloy or the high-aluminum austenitic centrifugal casting pipe except Al, rare earth elements, Ti and Zr in an intermediate frequency furnace according to the target chemical components to obtain a molten steel;

2) deoxidation and deslagging: subjecting the molten steel obtained in step 1) to deoxidation and deslagging;

3) adding Al: adding Al to the molten steel treated in step 2), and carrying out deslagging after Al is dissolved;

4) modification: adding rare earth elements, Ti, and Zr to the steel ladle, introducing the molten steel treated in step 3) into the steel ladle, and carrying out deslagging after rare earth elements, Ti, and Zr are dissolved;

5) pouring: carrying out deslagging before pouring, and then pouring the molten steel into a metal mold, and cooling to obtain the high-aluminum austenitic alloy or the high-aluminum austenitic centrifugal casting pipe.

14. The method of claim 13, wherein the method has one or more of the following characteristics:

in step 1), contents of Pb, Sn, Sb, Zn, As and Bi in the molten steel are controlled to be less than 50 ppm respectively;

in step 2), after the molten steel is heated to 1650 ± 50℃, deoxidation is performed with a deoxidizer and then deslagging is performed;

in step 2), deslagging comprises: covering the molten steel in the furnace with a slagging agent, beginning to blow argon at the bottom of the furnace, and carrying out deslagging after blowing argon, wherein the time of blowing argon is 3 ± 1 minutes;

in step 3), the furnace mouth is covered and protected with argon to block the reaction between air and the surface of the molten steel;

in step 3), blowing argon at the bottom of the furnace and covering and protecting the furnace mouth with argon are performed in the process of adding Al and Al dissolution;

in step 3), after the dissolution of Al, the molten steel is heated to 1680 ± 50℃, and then a slagging agent is added to form slag and deslagging is carried out.