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ALLOY FOR TURBINE BLADES.

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To all whom it may concern:

Be it known that ITYRO IYTAKA, a subject of the Emperor of Japan, residing at No. 26, Sanchome, Sugamomachi, Toyko Prefecture, Japan, has invented certain new and useful Improvements in Alloys for Turbine Blades, of which the following is a specification.

This invention relates to an alloy for turbine blades, containing copper, aluminium, nickel and iron in special percentages. The object of the invention is to produce an alloy which has a remarkable resistance to oxidation and also to atmospheric and sea water corrosion, together with a high tensile strength and good elongation, and particularly efficient as a material for turbine blades.

Heretofore, alloys such as manganese copper, phosphor bronze, brass and nickel steel, etc., have been used for the material of turbine blades. The former three have tensile strengths of 25 tons per square inch or less. Therefore, the strength of such alloys is not sufficient for turbine blades of recent type turbines in which the blade is subjected to the action of superheated steam of extremely high temperature and pressure. Nickel steel has a tensile strength of 35 tons per square inch. But this alloy has small resisting power to oxidation and corrosion. In the United States of America, the so called Monel metal is used to a great extent but the cost of this alloy is very high as the content of nickel is exceedingly large.

If only one piece of the great number of vanes in a turbine blade be broken, then many other vanes may become damaged and finally the turbine itself may be brought to a stop.

I will now proceed to explain how the alloy according to the invention is superior to the known alloys for use in making turbine blades.

According to the invention, the content of Al is limited to 5 to 7%, and this is one of the important features of the invention. Alloys described in Japanese Patents Nos. 28665 and 29068 somewhat resemble the present alloy, but they contain Al of 7 to 12%, which makes the metallic structure of them quite different from that of the present alloy and thus makes them unsuitable for the material of turbine blades. This difference is really due to a slight difference of percentage of Al. It is a known fact that when in an alloy, Al is contained in slight excess, it becomes a structure of aluminium bronze, its hardness increases, its elongation suddenly decreases, and the rolling or drawing of it becomes very difficult.

Also according to the invention, the percentage of Ni is limited to 3 to 8% and that of Fe to 1 to 3%. The sum of Cu and Al is 90 to 96% and accordingly the sum of Ni and Fe to 4 to 10%, and that of Ni and Al to 10 to 14%.

Of course, the method of manufacturing ingots of the new alloy, may be varied, but one example is as follows:

Any suitable type of furnace may be used which is capable of readily generating a temperature of 1400 degrees C. For instance, a graphite crucible furnace can be used. Copper is charged therein and is covered by charcoal. The charge is heated and when the copper is melted, iron and nickel in the determined proportions are added. When the mixture is sufficiently melted, aluminium is added, also in predetermined quantity. After a suitable agitation, the melted metal is cast into moulds. The melting temperature is about 1300 degrees C. and the casting temperature is 1250 to 1300 degrees C.

Even an alloy having the above percentages, can not become an excellent material for turbine blades unless it is subjected to the special heat treatment, quite different from the ordinary process. First, the block of material for the turbine blade is prepared from an ingot of alloy, the method of preparing the ingot, however, being quite ordinary and convenient. This block is tempered by heating at a temperature of about 800 degrees C. for a few hours. Then the temperature is lowered to 500 to 700 degrees C., and this state is maintained one to three hours. Then the block is somewhat rapidly cooled by means of water, air blast or any other convenient means. The article of manufacture containing the percentages mentioned and subjected to the above heating treatment, has the enormous tensile strength of 35 to 45 tons per square inch and 30 to 60% elongation. Therefore, when comparing these figures with those of the known alloys, that is, 25 tons and 3% maximum the differences must be quite surprising.

Having now particularly described and ascertained the nature of this invention and

in what manner the same is to be performed, I declare what I claim is:—

An alloy for turbine blades, including copper as the main constituent, and subordinate constituents consisting of 5 to 7% of aluminium, 3 to 8% of nickel, and 1 to 3% of iron, and further characterised by the proportions of 90 to 96% of copper plus aluminium, 4 to 10% of nickel plus iron and accordingly 10 to 14% of nickel plus aluminium, substantially as set forth.

In testimony whereof he affixes his signature.

ITYRO IYTAKA.