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(54) **Method for producing coated grain oriented silicon steel.**

(57) A method for coating grain oriented silicon steel to improve its magnetic properties; the method including the steps of preparing a melt of said silicon steel, casting said steel, hot rolling said steel, cold rolling said steel and decarburizing said steel, and being characterised by applying to the surface of said steel a coating of $Mg(OH)_2$ and SiO_2 and thereafter final texture annealing said steel in the conventional manner with said coating thereon.

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METHOD FOR PRODUCING COATED GRAIN ORIENTED SILICON STEEL

The present invention relates to a method for producing coated grain oriented silicon steel.

It is known to produce for electrical applications grain oriented silicon steel. More specifically, for this purpose the steel is melted, cast, hot rolled, subjected to one or more cold rollings, and intermediate normalizing treatment when two or more cold rollings are employed, decarburizing, application of a refractory oxide coating and final texture annealing to provide the desired grain orientation essential for achieving the required magnetic properties.

It is a primary object of the present invention to provide an improved electrolytic coating practice for use with grain oriented silicon steels which results in improved magnetic properties.

This and other objects of the invention as well as a more complete understanding thereof may be obtained from the

following description and specific examples.

The method of the invention provides an improvement in the conventional practice of producing grain oriented silicon steel wherein a melt of the steel is produced containing from .02 to .06% carbon, up to .008% boron, up to .01% nitrogen, up to .05% aluminium and from 2.5 to 4% silicon, with the balance iron. In the conventional manner the melt is cast, hot rolled, cold rolled and decarburized. In accordance with the invention a coating is applied to the surface of the steel comprising $Mg(OH)_2$ and SiO_2 and thereafter the steel is final texture annealed with the coating thereon. It has been found that with this coating a significant improvement is achieved with respect to the magnetic properties of the steel after texture annealing. With respect to the coating it may comprise in percent by weight, 87.5 to 97 $Mg(OH)_2$ and 3 to 12.5 SiO_2, preferably 88 to 96 $Mg(OH)_2$ and 4 to 12 SiO_2. It is preferred practice that the coating be electrolytically applied by the use of a magnesium acetate electrolyte. The coating may also be applied by mixing the coating constituents with water and applying as a slurry, but this practice is not preferred. Also the constituents could be applied as individual layers, but this is likewise not preferred.

As a specific example of the practice of the invention a silicon steel of the following composition was used;

In Percent by Weight

C	B	N	Al	Si	Fe
.033	.0003	.0040	.003	3.17	Balance

This steel was in the conventional manner hot rolled, and

cold rolled to a thickness of 0.264mm (.0104 in.) prior to conventional decarburization. The surfaces of various samples of the steel were coated both in the conventional practice and in accordance with the practice of the invention and the magnetic properties e.g. core loss and magnetic permeability at 10 oersteds, were determined as reported in Table I.

TABLE I

% by Weight $Mg(OH)_2$	% by Weight SiO_2	WPP 17KB	μ @ 10H
100	0	.733	1826
96.5	3.5	.723	1834
95.2	4.8	.714	1841
92.5	7.5	.693	1847
88.1	11.9	.660	1846

In this specific example all of the coatings were electrolytically deposited using a magnesium acetate electrolyte. As may be seen from the magnetic properties reported in Table I when comparing the conventional coatings with the coatings in accordance with the invention, the SiO_2 addition generally improves core loss, particularly as the SiO_2 content is increased above about 4%.

Table II indicates the improvement achieved in accordance with the practice of the invention over conventional practice from the standpoint of the relatively shorter time required to deposit on the steel surface a coating of similar weight.

TABLE II

	Amps	Volts	Sec.	Temp.	gms/m^2 (oz/ft^2
Standard (7 Litres Mag.Acetate)	8.0	6.5	33	63°C (146°F)	.0000963 (.0294)
Std. + 300 ml Ludox *	8.0	6.5	34	63°C (146°F)	.0000911 (.0278)
Std. + 600 ml Ludox	8.0	6.5	30	63°C (146°C)	.0000983 (.030)
Std. + 900 ml Ludox	8.0	6.5	25	63°C (146°C)	.0000891 (.0272)

* Registered Trade Mark for a 30% by weight colloidal suspension of SiO_2 in water produced by duPont Chemical Co.

CLAIMS

1. A method for producing grain oriented silicon steel including the steps of preparing a melt of said silicon steel, casting said steel, hot rolling said steel, cold rolling said steel and decarburizing said steel characterised in that the method comprises applying a coating to the surface of said steel of $Mg(OH)_2$ and SiO_2 and final texture annealing said steel with said coating thereon.

2. The method of claim 1, characterised in that said coating comprises in percent by weight, 87.5 to 97 $Mg(OH)_2$ and 3 to 12.5 SiO_2.

3. The method of claim 1, characterised in that said coating comprises in percent by weight, 88 to 96 $Mg(OH)_2$ and 4 to 12 SiO_2.

4. The method of claim 1, 2 or 3, characterised in that said coating is electrolytically deposited.

5. The method of claim 4, characterised in that said coating is electrolytically deposited using a magnesium acetate electrolyte.