KAWASAKI STEEL TECHNICAL REPORT

No.22 (May 1990) Advanced Technologies of Iron and Steel, Commemorating the 20th Anniversary of the Technical Research Division

Cryogenic Non-magnetic High Mn Steel for Accelerator Superconducting Magnet

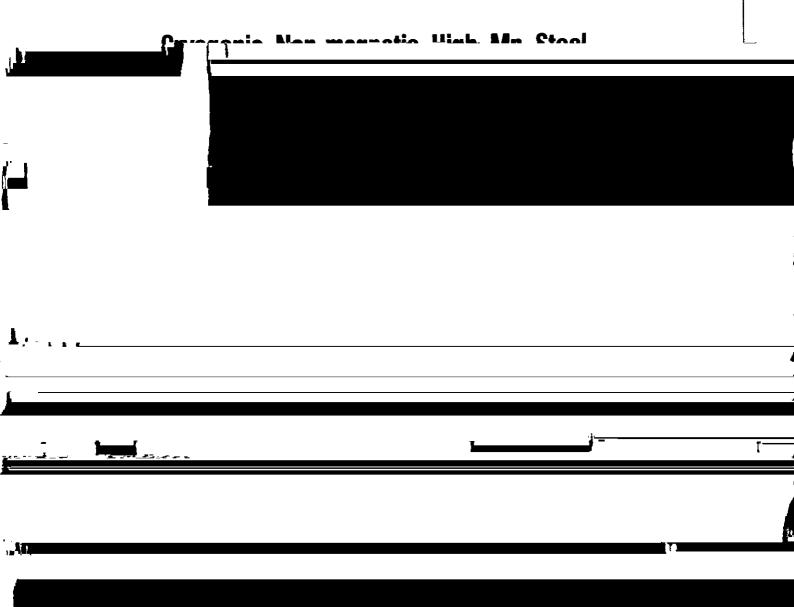
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Synopsis:

A cryogenic non-magnetic steel has been developed which is used as a supporting material for a superconducting magnet in a particle accelerator system. This steel must satisfy the following requirements: (1) Its magnetic permeability at RT and 4K shall be less than 1.002 which is far below that of conventional non-magnetic steels, and its temperature/strain dependences shall be minimized, in order to keep the deviation of magnetic field to the order of 10-4, and (2) its yield strength at RT and 4K shall be much greater than that of conventional austenitic stainless steel to withstand the local prestress and electromagnetic force, and (3) lowering of its cryogenic ductility and toughness after precipitation heat treatment of Nb3Sn superconductor shall be lessened in order to apply it to a super conducting wire. To meet the above-mentioned requirements, low C-high Mn-N-V steel has been newly developed. The steel also shows good applicability to stamping and spot-welding operations.

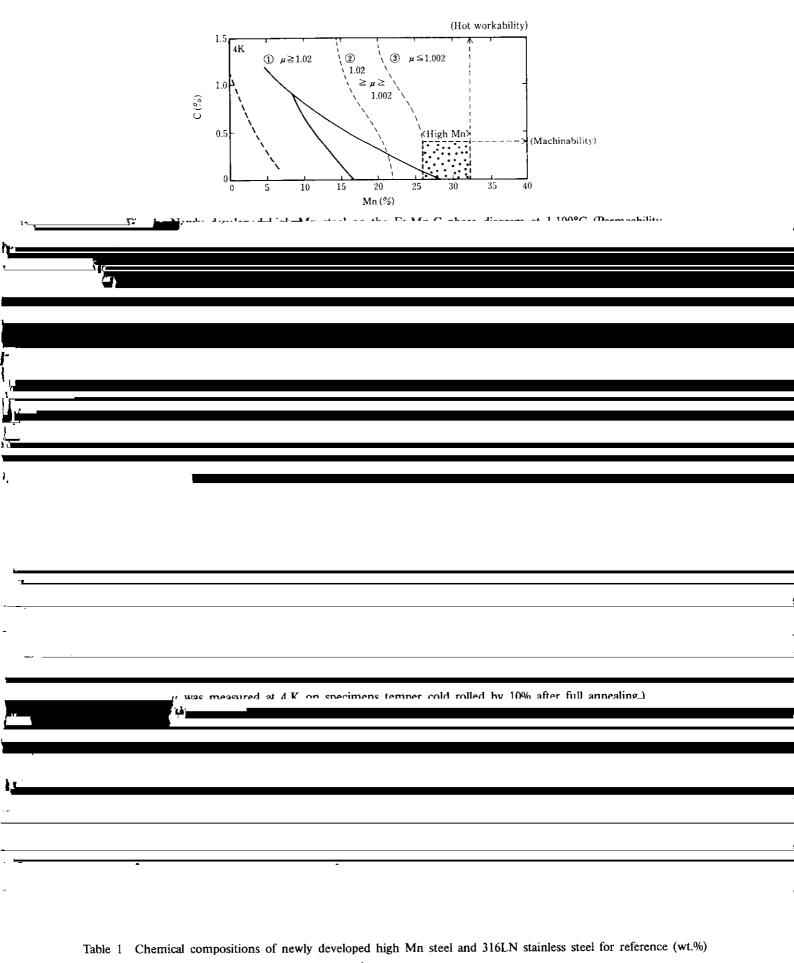
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| | cable (2) Cryogenic, high | h-strength non-magnet | tic supporting | notch portion o to 4 K was abo | out 3 min. For | from room te the stamping | mperature and spot- | |
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| | (3) High magnetic | wake material for arms | | <u> </u> | . 1 . | <u>.</u> | | |
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v Ν Steel С Si Mn Р S $\mathbf{C}\mathbf{r}$ Ni ≤0.04 <u>≤</u>0.4 $26 \sim 32$ ≤0.01 6~8 0.5~1.5 0.05~0.15 0.05~1.0 Nominal <u>≤</u>1.0 High Mn* 0 06 7 0 1 6 <u>n na</u> 0 10 or 07 0 <u>_____</u> A 007

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| | 1.500 1.400 1.300 - 4 K 1.200 - 5 KOe | رم,(MPa) | 2 000 1 500 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 | $\begin{bmatrix} 60\\ -40 & & \\ \sim \end{bmatrix}$ |
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| | Sample Sample thickness | High Mn ② 316LN 1.5 mm 1.5 LD | Voltage Current | 0.5~1.3 V 1.6~7.3 kA | |
| | Hydraulic machine To <u>ol material</u> | 10 t HP SK1 א גו רוא | Load Walting and | 600 kg | |
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there was no particular difference between the two types of steel. Namely, the high-Mn steel is not considered to be inferior in spot-weldability to the austenitic 1 200 MPa at 4 K. This is desirable against the loads of electromagnetic force and pre-stress.

(4) An addition of V into this steel has made it possible

