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Development of Grooved Flat- Bar Steels for the Reaction Plates of Linear Motor Cars

(Hiroyuki Hayashi)

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Synopsis :

A method that permits jointing of aluminum plates and steel plates as key material for the manufacture of reacti on plates for linear motor cars has been developed by Kawasaki Steel jointly with Kawasaki Heavy Industries, Ltd. Hot forming of overhang grooves, with their opening narrower than their beds, on the steel plate surface was virtually impossible. But a study   using Plasticine models and hot -rolled steel models paved the way for this new method called the anchor -bonding. By applying it to commercial -scale mills, flat bars having an overhang beyond 2.0 mm have been successfully obtained. With a technology also e stablished to control cross- sectional areas of both overhang groove and aluminum projection within proper range, the resultant uniform filling of aluminum within the overhang grooves assures the manufacture of reaction plates of yet higher bonding.

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要旨

リニアモータカー用リアクションプレートを製造するために，ア
ルミ板を鋼板に接合するためのマンガン……

Soft material　　　　Hard material

突条部を充填し，機械的に結合させるもので，この結合力がリアク

さらにリアクションプレートには気体ガス温度ボルト　誘導

突条部を充填し，機械的に結合させるもので，この結合力がリアク

3.1 最適突起形状

溝両側の突起は次工程のロールによる圧下で溝の内面側に変形す

幅も大きくすると，溝底の部分でオーバーラップを生じている（No. 4 および No. 5）。これらの結果から，圧下前の突起の幅寸法を必要以上に大きくすると，溝形状の不良を招くことが明らかである。

る。このときの圧下は突起部のみであることから，断面全体の長手方向の変形はほとんどなく，突起状部の幅方向へ変形が主として

また突起部分は平ロールで圧下されるときに溝の内外面に変形が生じ，このときの抵抗，変形は下記で，平面ひずみに近くなる。

生じる。このことから，圧延ではなく平面歪み鍛造条件下でも近似

なる。このことから，突起形状の最適化とともに，突起部を平ロー

1 pass

Thick.(mm)	
○	27
△	28
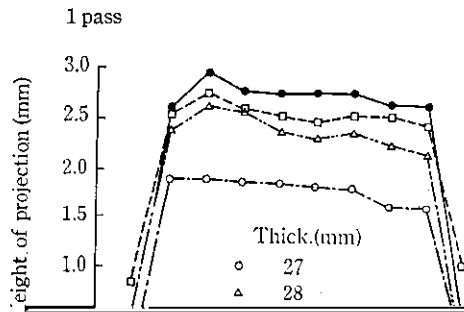
Table 2　Experimental conditions of hot rolling

Rolling mill	2 Hi rolling mill
Roll dimensions	290 ϕmm dia., 300 mm length
Material*1	
Standard	SS 41
Dimension　(mm)	34 $t \times$ 100 $W \times$ 250 $L \times$ 10 H of projection
	38 $t \times$ 100 $W \times$ 250 $L \times$ 6 H of projection
Method of forming	①　One pass of flat roll
	②　Two pass of flat roll

α＝56.3°

∞

No.1 caliber
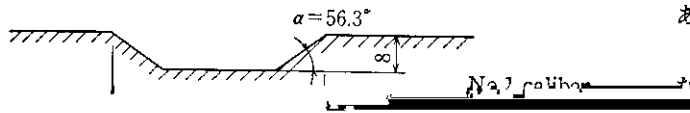
ある。
　そのため実機での生産に際しては下記の点を考慮する必要があっ

α＝35.8°

9

No.2 caliber
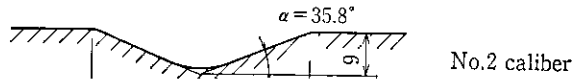
（2）　幅方向端部の突起は幅方向のメタルフローを考慮し，幅方向
　　中央部の突起以上の高さが得られること。
（3）　カリバーへの誘導がよいこと。

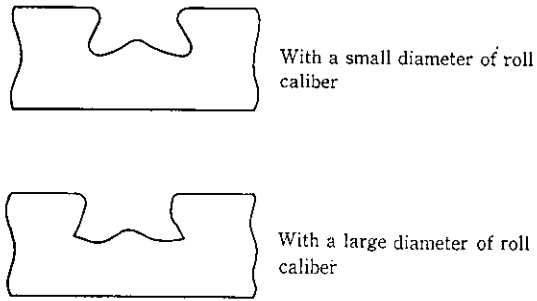With a small diameter of roll caliber

With a large diameter of roll caliber

Fig. 15 The cross-section of grooved flat-bar steel formed

Overhang on the edge in the lateral direction

$n=55$
$\bar{x}=2.4$
$\sigma=0.15$

b_1

Device for bending projection

U 5 mill

Roller for bending projection

Rolling direction

Overhang on the center in the lateral direction

$n=55$
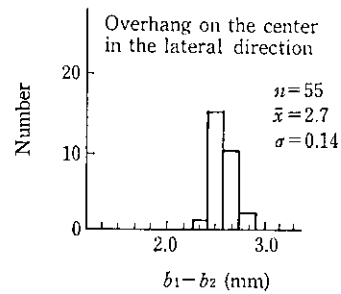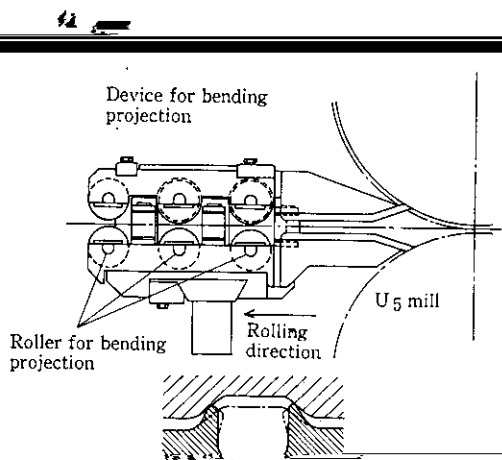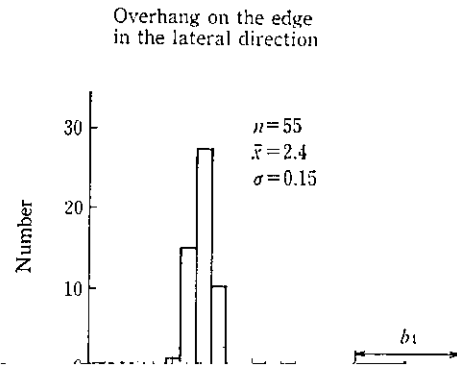$\bar{x}=2.7$
$\sigma=0.14$

b_1-b_2 (mm)

Fig. 17 Example of the quantity of overhang $(b_1\text{-}b_2)$ of commercially produced steel flat-bars

Table 4　Rolling reduction mill load and plate thickness during the rolling for bonding extruded aluminum shape to grooved flat-bar steel

Pass	Total	Rolling	Draft		An	Aluminium	