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1. Introduction

In comparison with electrogalvanized steel sheets, hot-dip galvanized steel sheets are often used in corrosion-resistant automotive panels, in which high corrosion performance and low cost are required, based on the advantages that hot-dip products with heavy coating weights are easy to produce and the cost of production is also low. Because particular importance is attached to surface quality, and particularly appearance, when these steel sheets are used in exterior body panels of automobiles, steel makers are earnestly working to improve product quality.

This report introduces a strip vibration and shape control technology using electromagnets which was developed by JFE Steel to improve the quality and productivity of hot-dip galvanized steel sheets.

2. Arrangement at Gas Wiping Section in CGL

Figure 1 shows the configuration around the molten zinc pot, which is the key section in coating layer thickness control in a continuous hot-dip galvanizing line (CGL). The steel strip advancing through the molten zinc pot changes direction at the sink roll and then rises vertically from the bath surface with a coating of zinc on the strip surface. Immediately after the strip leaves

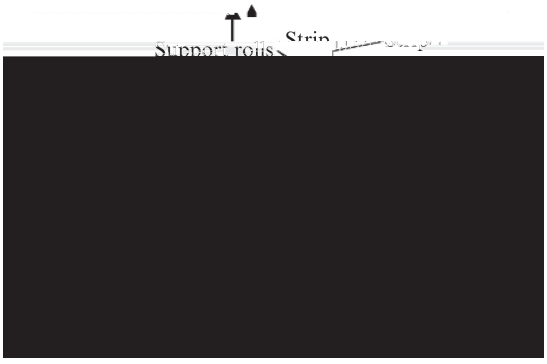

Fig. 1 Schematic of coating and gas wiping section in CGL

ness unevenness in the width direction. Accordingly, in order to achieve a uniform coating layer thickness and excellent surface appearance, vibration and cross-bow should be eliminated and the behavior of the strip should be stable at the gas wipers.

Although not shown in Fig. 1, in conventional CGLs, after the Zn coating of the steel strip is adjusted to the specified thickness by the gas wipers, the strip travels upward vertically until it reverses direction at a top roll several 10 m above the zinc pot. Although the strip passes through the galvannealing furnace, air-cooling zone, etc. in this process, it basically does not come into contact with any object while traveling over this distance of several 10 m, and vibration occurs easily under this condition. The support rolls installed above the wiping nozzles are designed to prevent this vibration. Because the wiping section is isolated from the vibration source and the span of string vibration is greatly shortened, the support rolls are effective in suppressing low frequency string vibration. However, since the zinc on the steel strip surface is still in a semi-molten state when it comes into contact with the rolls, this contact may impair the surface appearance of the strip in some cases. Moreoveh it com6e2w1enen-en-USthat suppresses strip vibration and cross-bow by a noncontact technique was developed. In this device, the strip vibration and shape are detected by a noncontact dis-

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placement meter, and the position of the strip is controlled by the attractive force generated by electromagnets. The basic configuration of the control system is shown in **Fig. 2**. This device comprises a pair of electromagnets installed on the two sides of the strip and a displacement meter. Feedback control is performed by a controller so as to reduce deviation from the target value based on information concerning the strip position from the displacement meter, and the strip is kept flat without fluctuations in its position by controlling