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Automatic Rolling System of Medium Diameter Seamless Tube by Process Computer Control

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Synopsis :
New automatic billet heating and rolling systems by the use of process computer have been developed in a new seamless tube mill at Chiba Works. Rolling control models consist of the presetting of rolling condition, its adaptive functions and a partial dynamic AGC. Several other new systems, such as for material tracking, operator guidance, data analysis and tool life control, have also been developed for this automatic rolling system. These systems are applied to the whole rolling line throughout from the billet charging to the finishing of the sizer rolling. The accuracy of the dimensions of the tube, tube-to-billet yield and production efficiency are remarkably improved over the conventional manual rolling by applying the automatic rolling system. An outline of the rolling system for each mill and an evaluation of the system are discussed.

The body can be viewed from the next page.

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Tatsuro MAGUCHI*** Yoshio TAGUCHI ***

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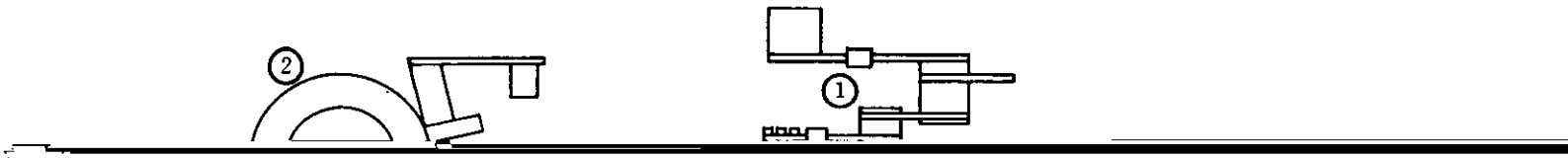
1 Introduction

A new 16$\frac{3}{4}$" plug mill was put into operation at

stable run, and has a great effect on an improvement in dimensional accuracy of the products, yield rate and productivity as well as saving energy.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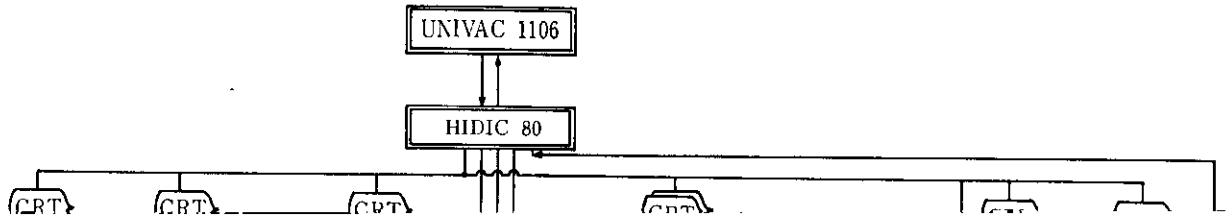
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(1) Tracking from billet charging table to straightener outlet side.
(2) Preset calculation of each mill and output of its results.
(3) Adaptive control calculation of each mill and out-

length of material just after rolling, and the proper correction value of the presetting is obtained by comparing the mean wall thickness with the target dimension, and it is output for the rolling of the next material. In this case, tool expansion caused by tool

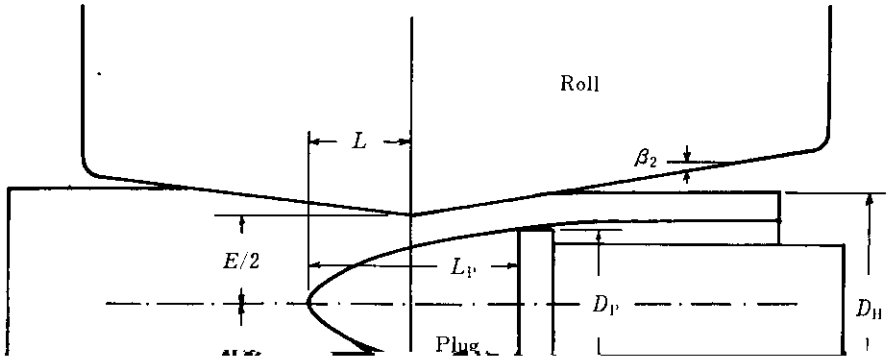
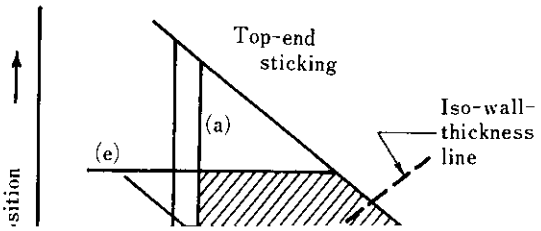
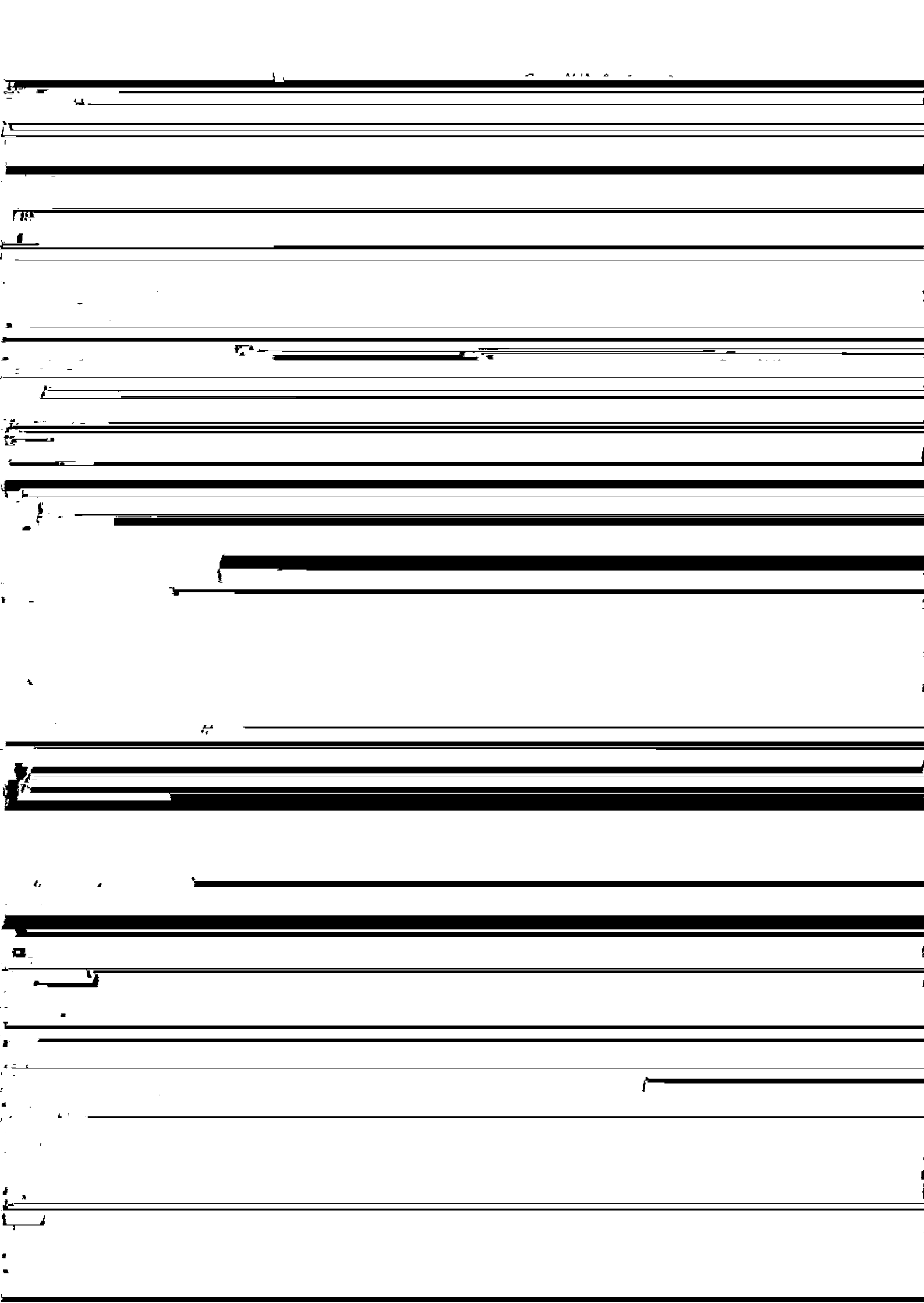


Fig. 4 Notation of piercer and elongator

D_P, L_P: Diameter and working length of plug
E : Distance between rolls
L : Plug advance
H : Distance between guide shoes
β_2 : Outlet cone angle of roll
θ : Outlet taper angle of guide shoe




324
(mm)



trol is given by the following equation:

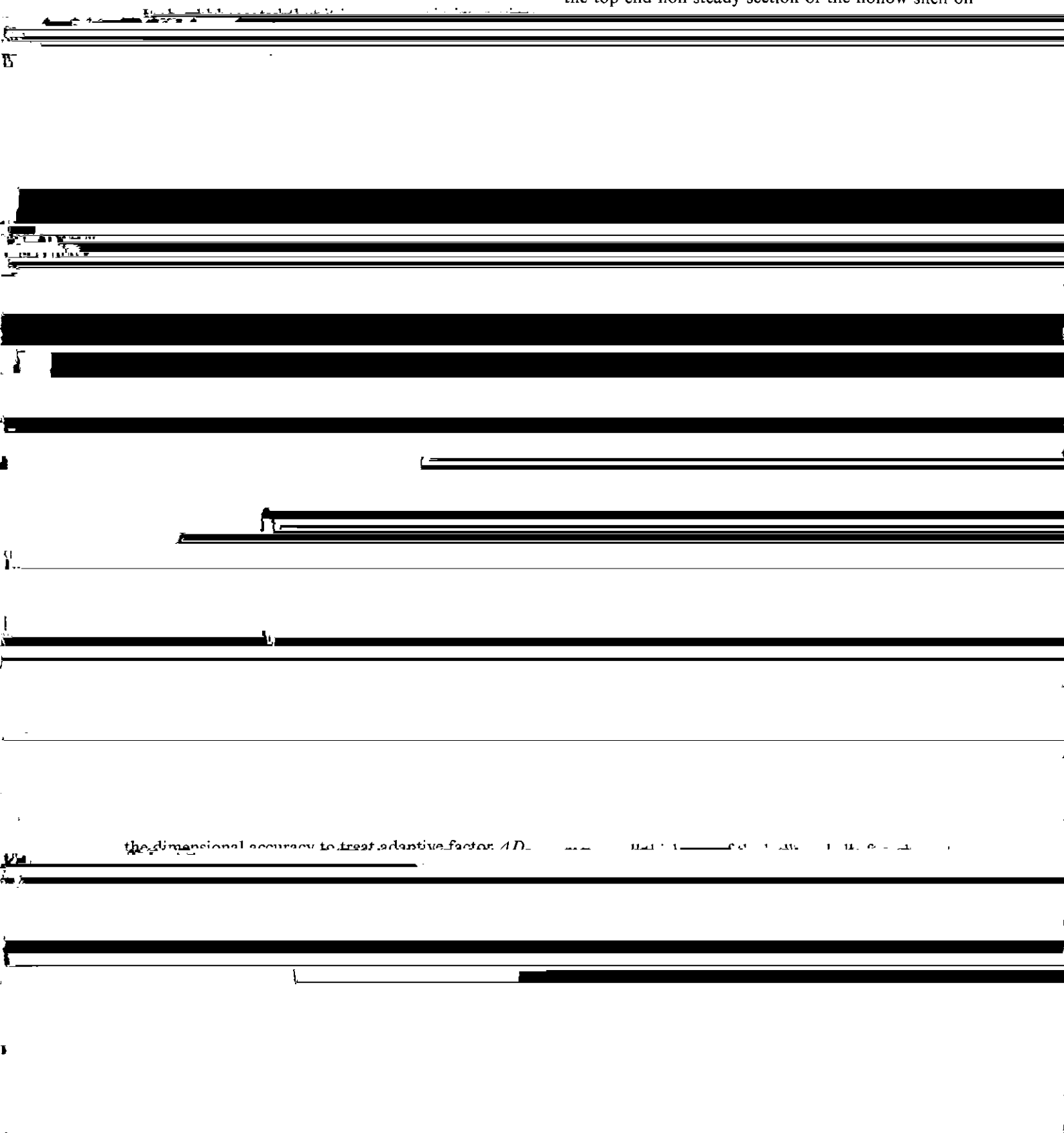
$$G = G_0 - D_K + D_P + 2t_B + \Delta D_P - P/M \quad \cdots\cdots\cdots\cdots\cdots\cdots (7)$$

G : Roll gap
G_0 : Reference roll gap
D_K : Nominal diameter of groove of roll
D_P : Diameter of plug
t_B : Wall thickness at groove bottom of material after rolling
ΔD_P: Adaptive factor
P : Separating force
M : Mill rigidity

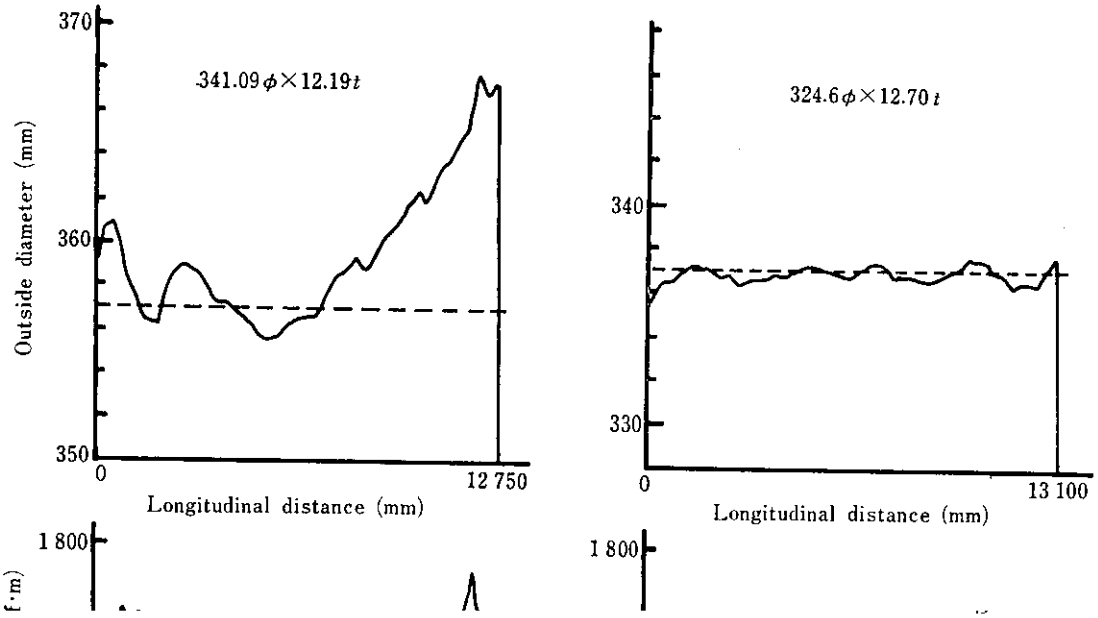
shown in **Fig. 9**[8]. This figure shows the case of random length mode control, and it is clear from this figure that the deviation of wall thickness is remarkably reduced by this gage control system.

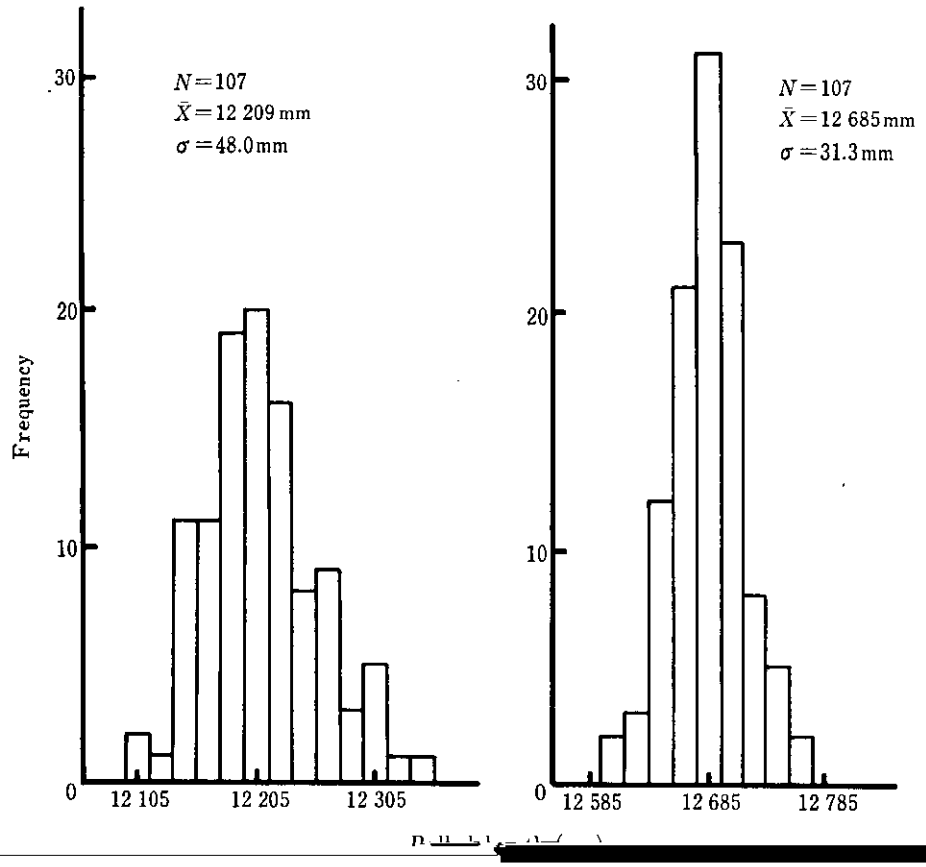
4.3 Reeler

Unlike the case of other mills, the control of the reeler is provided with the functions of presetting and AGC. The presetting model is used for the calculation of the mill presetting value at the start of rolling, and eqs. **(1)** and **(2)** are used as the basic formulas as in the cases of the piercer and the elongator. For the calculation of presetting, the wall thickness distribution in the top end non-steady section of the hollow shell on



the dimensional accuracy to treat adaptive factor ΔD_P


341.09φ×12.19t
Outside diameter (mm)
370
360
350
0
12 750
Longitudinal distance (mm)
1 800
324.6φ×12.70t
340
330
0
13 100
Longitudinal distance (mm)
1 800



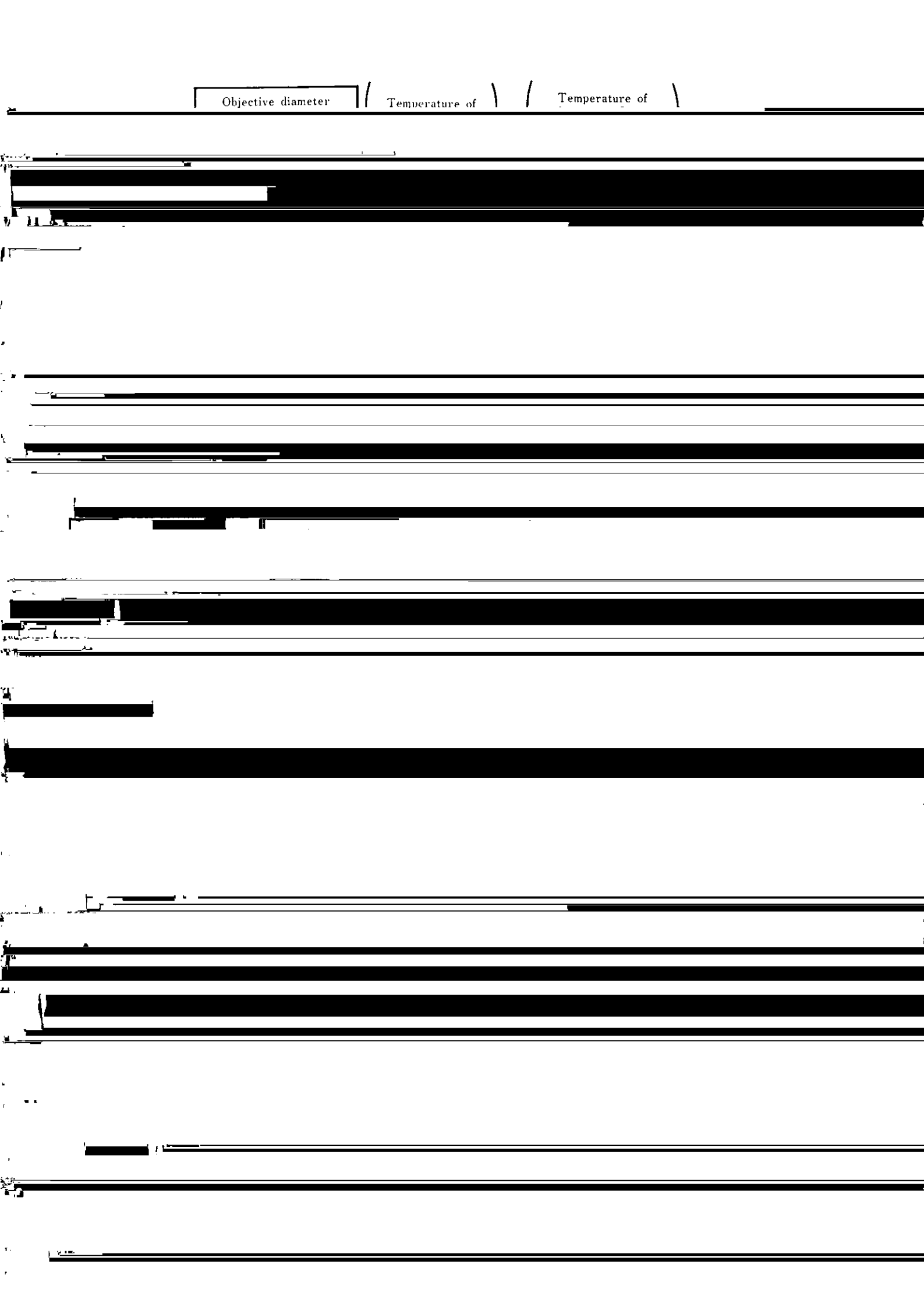
(Dimension of tube after sizer : 180.20ϕ×9.28 t)

(a) After plug mill (b) After sizer

Fig. 11 Comparison of length of rolled materials after plug mill and after sizer

tube to tube from the target dimensions of product

$$D_{\mathrm{I}} = a_{\mathrm{I}} + \sum_{l} b_{\mathrm{II}} \cdot G_{l} \quad \cdots\cdots\cdots\cdots\cdots\cdots (8)$$


Objective diameter
Temperature of
Temperature of