

Automatic Marking Device for UOE Pipe End*

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1 Background of Development

Specification requires the description of marking items as shown in **Table 1** at an UOE pipe end. This marking method, performed by means of spraying over a stencil plate, has the problems of high manhour costs in preparing the stencil plate, with the paint also dispersing during the marking operation, deteriorating working environment.

In recent years, various techniques have been improved for electronic control, multi-axe type robots, and the manufacture of micro-fine-diameter nozzles, and so on, thereby paving the way for the technical environment of automatic marking. Against such backdrops, Kawasaki Steel, in cooperation with Marktec, Co., Ltd., has successfully developed the technique of indicating characters by combining micro-dots, through causing the marking head having micro-fine-diameter nozzles to follow the profile of the pipe. By applying this technique, an automatic marking device, which uses a 6-axe robot and is applicable for all sizes, has been installed on the marking line after the final inspection at the UOE plant.

2 Procedures and Contents of Marking

Marking is performed after the final inspection process, namely, on the products which have passed all inspections such as various non-destructive inspections, visual inspections for surface defects, and dimensional and weight tolerances. The flow chart of the marking

Table 1 Marking item

Shipping mark	Customer's name
	Destination
	Contract No.
	Inspection company's mark
	Logo mark
Basic mark	Manufacturer's name
	Monogram of code
	Size (OD × WT × Length)
	Grade and class
	Alloying element symbol
	Process of manufacture
	Heat treatment
	Test pressure
	Pipe No.
	Weight
	Weight per foot
	Heat No.
	Date of manufacture
	Supplementary requirement (Charpy)
	Supplementary requirement (DWTT)
	Carbon equivalent

control system is shown in **Fig. 1**, and contents to be marked are registered beforehand for each lot. In the plant, tracking for each pipe is carried out by the process control computer, and for each pipe transported into the marking device, the pattern of the display contents are designated to the marking device by host computer. At each time, when the pipe successfully passes the final inspection, the host computer forms the marking pattern, using pipe number as a key, and transmits the marking pattern in synchronization with tracking.

The marking head is equipped with 48 nozzles each with an inside diameter of $\phi 200 \mu\text{m}$. Each nozzle forms a single dot measuring $\phi 2.8 \text{ mm}$, thereby indicating 48 dots at one time, which corresponds to four lines of small letters. While the marking head moves following the profile of the pipe, the nozzles are automatically opened and closed, thereby performing the indication. The sizes of characters come in three types to suit the demands of customers.

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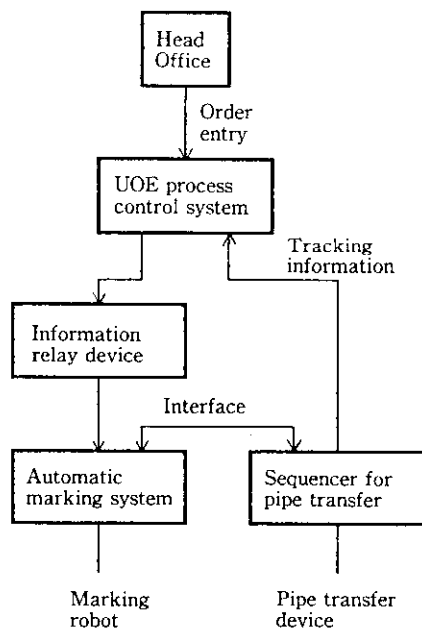


Fig. 1 Marking control system

Generally, the contents of marking are divided into the shipping mark and basic mark as shown in Table 1. For the shipping mark, the marking items are mainly determined by the special specifications of the customer, and for the basic mark, marking items are determined by the pipe code. The shipping mark is constant for each lot, but the basic mark has items which differ according to each pipe such as pipe number, length, weight, and heat number. Further, among shipping marks, there are logo marks (customer's and/or inspection company's) which have complicated shapes. In such a case, after registering various marks and figures beforehand together with the conversion code in the marking system using the graphic inputting device, register the conversion mark corresponding to the

marking specification, and the necessary items will be displayed.

The marking device and typical marking sample are shown in **Photos 1 and 2**.

3 Outline of Apparatus

Marking apparatus consists of the transportation device which transports and rotates the pipe, marking device and information relay device, which commands and relays the contents of marking. For the transportation device, the conventional device has been partially modified. The specifications of the marking device and information relay device are shown below.

Type: Manufactured by Marktec Co., Ltd.; dot-marking type; multiple pencil-gun type

Robot: S-Model (Fujitsu Fanuc Ltd.) 4-Y2 000 6-axe robot

Printing head: Equipped with 48 guns; nozzle inside diameter, $\phi 200 \mu\text{m}$

Marking unit: Airless pump (max. pressure, 25 kgf/cm²)

Marking area: Max. 700 mm (L) \times 1 200 mm (W); one-side; internal surface and/or external surface

Number of displayed letters:

Small letters 30 mm (H) \times 24 mm (W), 40 letters \times 20 lines

Medium Letters 39 mm (H) \times 30 mm (W), 36 letters \times 15 lines

Capital Letters 54 mm (H) \times 42 mm (W), 30 letters \times 10 lines

Independent or composite display of small, medium, and capital letters.

Contents of marking:

Numerals, 0 to 9; alphabet, A to Z; 26 kinds of mark (ex./, (), *); special marks (API monogram, inspection company's mark, customer's logo mark, etc.)

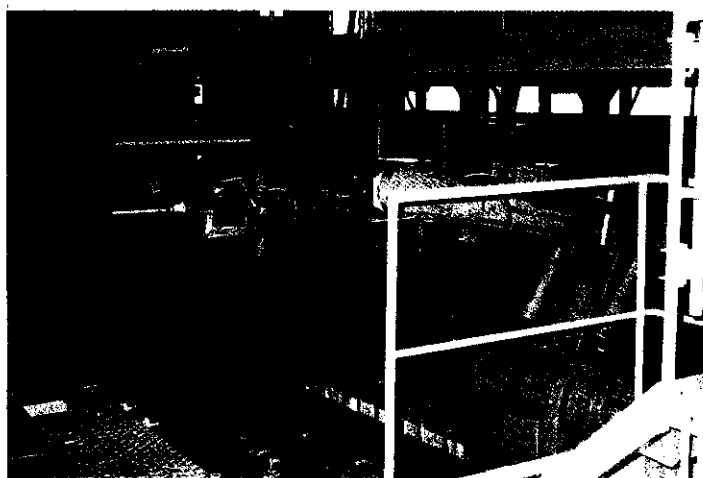


Photo 1 Automatic marking device



Photo 2 Marking on the inside surface

Pipe-end start position: 0 to 600 mm

Host CPU: Fujitsu M3805 (for specification registration and preparation of pattern making) (Fujitsu Ltd.)

Process CPU: TOSBAC 7/70E (for tracking) (Toshiba Corp.)

Information relay device: Multi way (Nippon System Development Co. Ltd.)

4 Concluding Remarks

A full-automatic marking device has been installed in which the marking head that has combined micro-nozzles and a robot which moves along the outer and inner circumferences of the pipe and spray character patterns. The features of this marking device are shown below.

- (1) Marking is possible without an error in respect of the shipping mark, length, heat number etc., of each pipe on the basis of its inspection approval information.
- (2) Marking is possible on the internal, external or both surfaces of UOE pipe of any size having an outer diameter of 20" to 64".
- (3) Easy marking is possible in respect of indication of special marks such as customer's logo mark and inspection company's mark.
- (4) Compared with the conventional operation, marking paint was minimal, and the working environment has been greatly improved.

This automatic marking apparatus has been operating satisfactorily since its commissioning, thereby contributing to upgrading quality assurance.