

Fork Parking

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1. Introduction

Ishikawajima Transport Machinery Co., Ltd. (hereinafter called IUK) developed a new elevator parking system “IHI Fork Parking.”

This parking system consists of an elevator (cage) to transport a car and tray on a rack to store car. As a feature, the elevator and each tray have the “form” of a fork, and a car can be transferred between them by crossing vertically.

Compared to the pallet type elevator parking system, IHI Fork Parking has no need for handling an empty pallet, so the entering and exit times are reduced about 30%, that is to say, the waiting time during busy hours is shortened. And the IHI Fork Parking adopts a wire rope to reduce noise and vibrations, as well as to make adaptation to such a high-rise construction and long lifting heights. IUK installed a test tower in the Numazu Works and has conducted various demonstration tests to verify various performances. This article presents an outline of this IHI Fork Parking and the test tower.

2. Features

2.1 Short entering and exit times

Conventional elevator parking systems transport a car on a pallet. In the case of successive entering of cars, the first car on the pallet is stored in a rack and the elevator (cage) moves up and down to another rack to take in an empty pallet for the second car. After taking in the empty pallet, the cage moves down to the entrance berth. Also in the case of exits, the empty pallet is handled in the same way.

On the other hand, the IHI Fork Parking has the elevator (cage) to transport a car, the trays on the rack to store cars and the turntable to turn a car around, whose forms are

a “fork,” and entering cars can be transferred between them by crossing vertically. In case of successive entering of cars, the first car is stored in a rack, and then the cage can move down at once to the entrance berth and receive the second entering car. Therefore, there is no handling of an empty pallet, different from the pallet type elevator parking system. **Figure. 1** shows the appearance of the tray and **Fig. 2** shows the movement procedure.

At the exit time, the IHI Fork Parking succeeded in shortening the waiting time about 30% in comparison with the time of the pallet type elevator parking system from the user operation to the arrival of the car. Using the feature of shortening the waiting time during busy hours, the sales target is directed to department stores, hotels,



Fig. 1 Appearance of tray



- ① The elevator with a first car moves up above the top surface of a rack.
- ② After the tray of the rack traverses to the elevator shaft, the elevator moves down and transfers the car to the tray.
- ③ The elevator moves down to the entrance berth without stopping, and the tray with the car traverses to the rack.
- ④ After the elevator comes to rest completely at the entrance berth, it receives the second entering car.

Fig. 2 Movement procedure

and other industrial sectors that attach importance to smoothness.

2.2 Low noise and low vibration

A parking system might have to be constructed in a residential area, and quietness is required in many cases. In order to reduce the noise and vibrations of this parking system, the elevator adopts a traction drive system using wire rope, which ensures superior quietness to roller chain drive systems. And the cage has urethane guide rollers to reduce the vibrations during moving up and down.

2.3 Adaptability to high-rise construction and long lifting heights

The driving methods of wire rope elevators are divided into two types: ① Drum type driving by a wire rope wound around the drum, and ② Traction type driving by the traction between the wire rope and a sheave.

The number of the wire rope turns around the drum is influenced by the lifting height; therefore the drum diameter also must be changed. In case of a long lifting height, in particular, the drum diameter is as large as 2.3 meters, making it a cost-raising factor. The number of high-rise parking systems is increasing in recent years. This parking system adopts the traction drive method, which doesn't change the drum size greatly according to lifting height, to be adaptable to high-rise construction and long lifting heights.

2.4 Easy entering and exit

This parking system has a built-in turntable that turns a car 180 degrees at the entrance berth, so the car can exit in the forward direction.

3. Specifications

The two types of NA and GA are available, according to the car size and weight that can be stored. In terms of height, three kinds of cars can be stored, for standard, middle and high-roof cars. The major specifications are shown in **Table 1**.

4. Test tower

IUK installed a test tower in the Numazu Works to conduct various demonstration tests. The appearance of the test tower is shown in **Fig. 3**.

The test tower consists of two units installed side by side, and its height is 31 meters. The company name and the symbol mark of the IHI Parking System are painted on the wall and are illuminated at night to serve as an advertising tower.

Unit 1 is a standard IHI elevator parking system of the pallet type (see **Fig. 3**). Although drum driving was formerly adopted for the elevator, a traction drive mechanism for an adaptation to high-rise construction is installed. The reason is that the same mechanism can be used even if the hoisting height has to be longer. Also a wire rope life test and other various tests for commercial implementation were carried out with the test tower. And more, a demonstration test of a flat pallet which has no step was performed for a barrier-free measure.

Table 1 Major specifications

Item	Type	NA	GA	
Cars that can be stored	Overall length (mm)	5 000	5 300	
	Overall width (mm)	1 850	2 050	
	Overall height	Standard-sized (mm)	1 550	
		Middle high-roof (mm)	1 800	
		High-roof (mm)	2 050	
	Weight	Standard-sized (kg)	1 900	2 300
		Middle high-roof (kg)		
		High-roof (kg)	2 300	
	Lifting and lowering speed (m/min)	60 - 120 (Variable speed)		
	Transverse speed (m/min)	26 (Maximum)		
Turning speed (m/min)	5 (Maximum)			



Fig. 3 Test Tower in IUK Numazu Works

Unit 2 is the IHI Fork Parking presented in this article (see **Fig. 3**). It underwent on-the-spot examination in the test tower by the Japan Parking System Manufacturers Association Incorporated and was authorized in September 2006. The Minister of Land, Infrastructure and Transport authorization of the Parking Lot Law, Article 15, is now being applied for.

5. Further development

This parking system will be added to our parking product line, and as the elevator type, both pallet type and fork type will be sold. Thus customers can select according to their usage.

In the parking market, the elevator type is the major system and also expected to be so for a while. Recently,

adaptation to high-rise construction is required, so shortening the waiting time with faster speed of hoisting is an urgent task. The test tower will be used for various research tasks for cost reduction and performance amelioration and improvement and also used as a facility to verify the product reliability. IUK is engaged in the parking facility maintenance business, and the tower is

also used as a training facility for servicemen.

IUK Numazu Works is a manufacturing site, also assumed the role of a system development and training center, and will continue to contribute to the development and progress of parking systems.