SPECIAL ELEVATORS FOR THE TRANSPORTATION OF SCENARY IN THEATRES

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ABSTRACT

These elevators as a special type of large scale freight elevators for the transportation of light, voluminous goods are fitted to the technique of transportation. The design of the elevator corresponds to a large extent to the wishes of the customers.
The cars with their main parameters and special equipment, the doors of the wells, guide rails, drive and driving schemes in general are presented.
The layout drawings of the wells and the cars of different types of elevators are explained by means of outstanding theatres.

1. INTRODUCTION

The production programme of VEB Sächsischer Brücken- und Stahlhochbau Dresden, a member of VEB Schwermaschinenbaukombinat TAKRAF, includes, in addition to complete stage equipment and passenger lifts with speeds of v = 0,5 ... 6 m/s, special lifts for scenary transport.

2. TRANSPORT AND ENGINEERING CONCEPT

The scenary lifts, which are large-size goods lifts for special purposes, have been matched to the particular transport requirements in theatres and similar structures. They have been developed from lifting platforms and other vertical transport facilities.
With a few exceptions, they are operated like common goods lifts.
Transport facilities which are functional parts of the stage, of special stores etc. do not fall under this term.
The lift design is largely based on customer requirements, taking into account transport technology, storage possibilities and architecture. More aspects have to be considered when an old theatre is intended to be equipped with such a lift. Based on consultations and the necessary data given by the customer, the manufacturer will decide whether the desired version is practicable.

3. CARS

In general, the items to be lifted are voluminous and of a relatively light weight. This has been taken into consideration in the design of the cars: they have a length of up to 9 m and a rated load of 4 to 5 tons (other values are possible), shown in Figure 1.

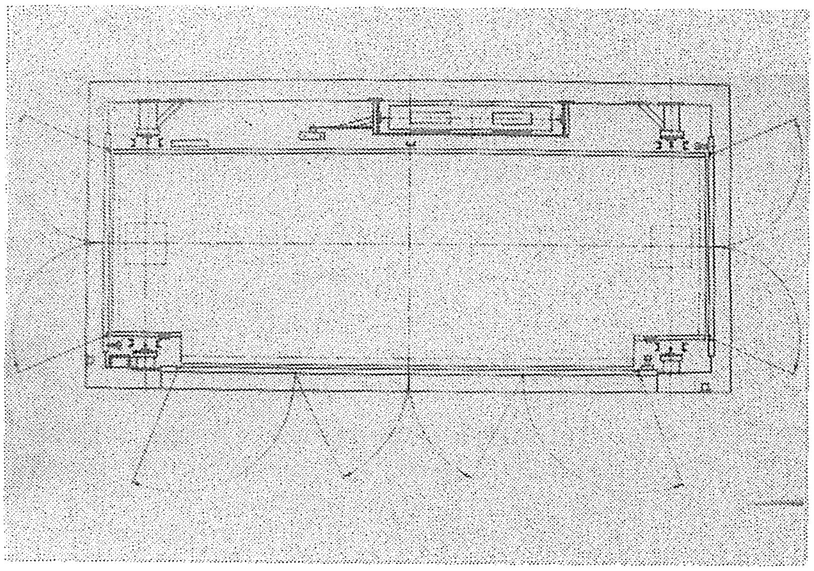

FIGURE 1: Top view of a scenary lift well
Access to the care is possible at 1, 2 or 3 point; additional balance weights can be used

The cabins, made of steel sheet, are seated in a sectional steel frame. Some parts of the car roof can be easily removed; this is of advantage, for example, when heavy parts have to be transported from the machine room to the ground floor for repair purposes. The parts can in this case be lowered in the shaft from the machine room to the floor of the lift positioned at ground floor. In general, a mechanical door of the car is not possible, it would require excessively large doors. For the new lifts, the manufacturer offers a light barrier which works on the infrared principle and cannot be influenced by sunlight or artificial lighting. There may, however, occur problems with the light barriers: if the car structure is too "soft" and the door openings are large, varying loads may cause light beam deflections leading to malfunctions. There fore, light barriers should only be used for cars with mediumsized door openings.
For safety reasons, a strip on the car floor near the door must always be kept free (non-usable car area).
The number of control panels for the operators (one or two panels) depends on the number and positions of the doors.

4. WELL DOORS AND ACCESS TO THE WELL

The dimensions of the doors are adapted to the car dimensions and transport technology. In most cases, the shaft doors are as high as the cabin. Deviations are possible, for instance, when the lift must be lowered to the height of lorry platforms.

Mostly, two- or four-wing rotary doors are provided to reduce maintenance work and allow for tough operating conditions. Figure 2 shows a car installed at the Dresden Semper Opera House.

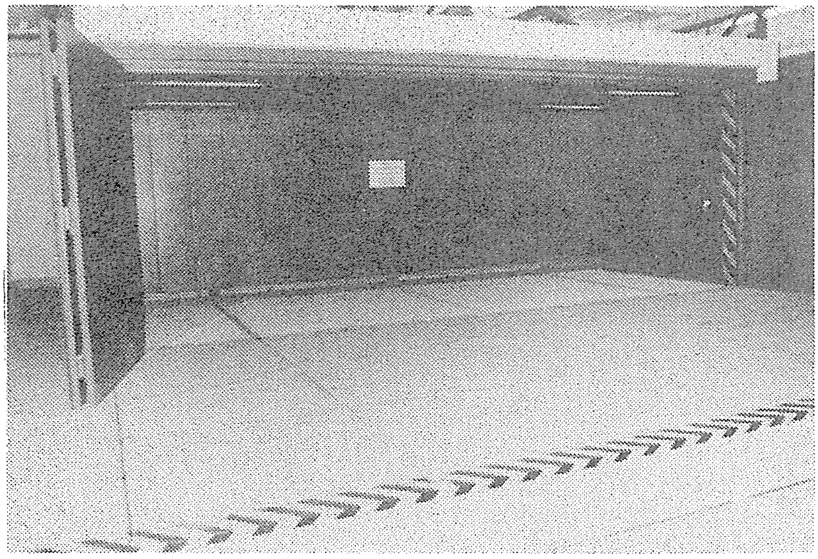

FIGURE 2: Car of the Dresden Semper Opera House lift which can be loaded on the long and narrow side

Very wide well openings can be equipped with motor-operated vertical-moving doors. The doors are of fire reaction class ofa/fw 15 (i.e. they prevent the spreading of fires and have a resistance to fires of 15 minutes). Other values are possible.

5. GUIDE RAILS

In some cases, the large sizes of the cars require an increased number of guide rails. Depending on the drive type, 2, 3 or 4 rails are used, shown in the Figure 3.

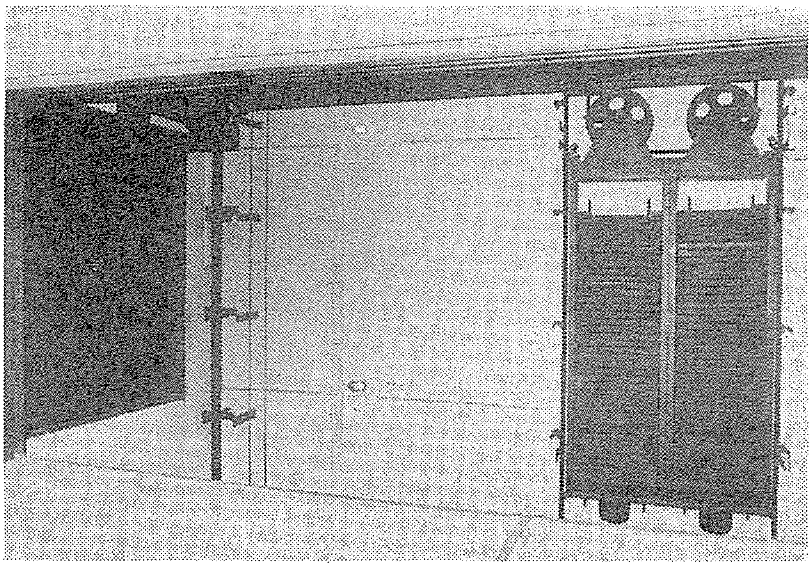

FIGURE 3: Lift shaft with installed equipment

The conventional guide rails are used for rope lifts. Spindle-driven lifts, because of their slower lifting speed, have often sectional steel guides.

6. DRIVE SCHEMES

Figure 4a shows the driving principle of the lifts in the Semper Opera House in Dresden, where only one counterweight is used. An other possibility is shown in Figure 4b.
An additional balance weight serving the reduction of the static load on the driving machine. Such lifts are not only installed in theatres. Figure 4c is the rope schema with some technical data of a lift installed in a steel works.
Spindle fine adjustments are possible.

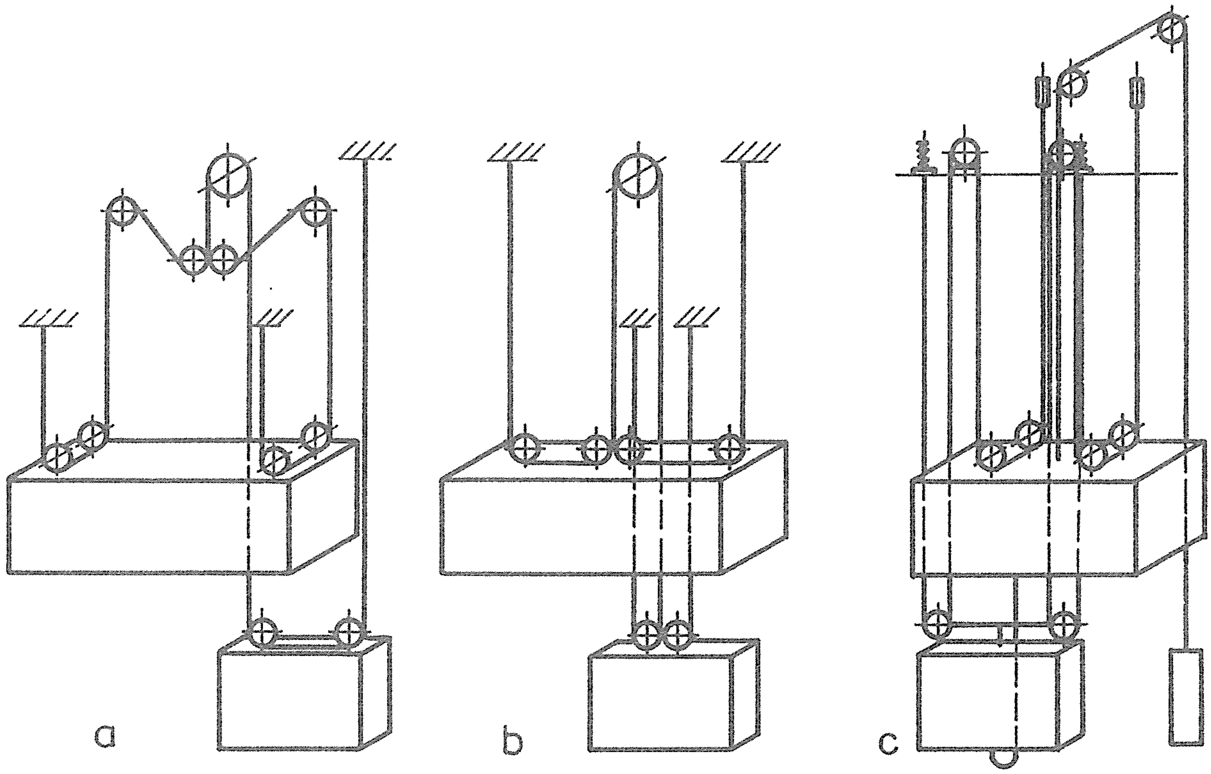

FIGURE 4: Drives schemes

7. DRIVES

Preferably are used traction-sheave drives with pole-changeable three-phase motors, shown in Figure 5.
The lifting speed is v = 0.3 ... 0.5 m/s.

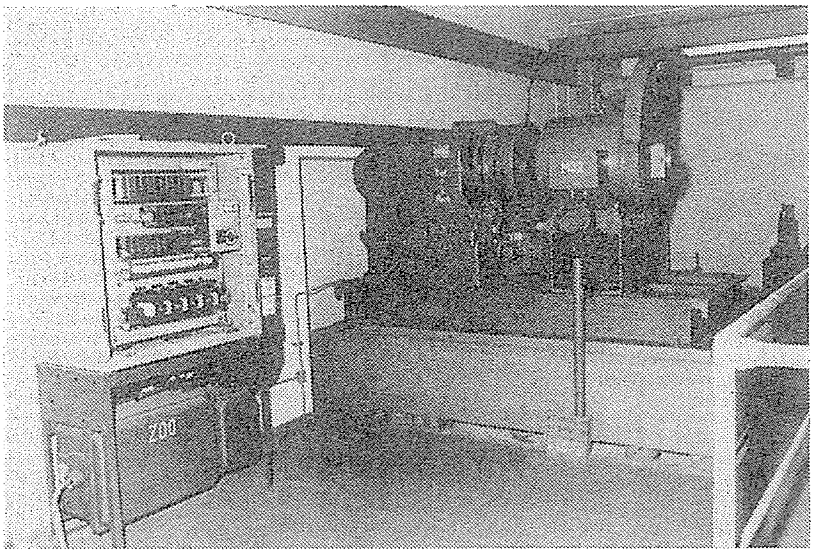

FIGURE 5: Hoisting machine with vibration insulators

The spindle drives with single-speed standard motors, shown in Figure 6, are installed at the bottom of the shaft so that a machine room above the well is not needed.

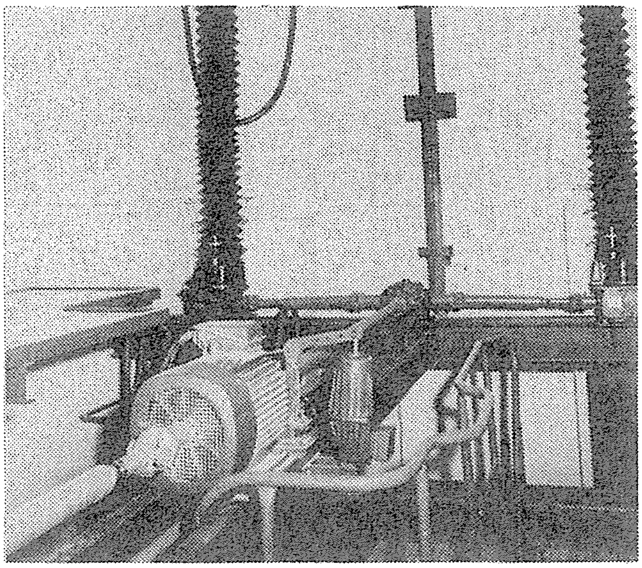

FIGURE 6: Spindle drive

Contrary to rope-type lifts, the under- and overtravels can be kept short. The lifting speed of spindle-type lifts is v = 0,04 m/s.
Because of the low number and short duration of operations, the motors are in most cases chosen on the basis of their maximum moment only, and not on the basis of their thermal behaviour.
The resultant low power reserve permits soft starting and braking.

8. SCENARY LIFTS IN THE DRESDEN SEMPER OPERA HOUSE

The scenary lifts of the Semper Opera House are described here as an example. Details could already be seen in Figures 2, 3, 4a and 5.
The items are transported by two mirror-inverted lifts installed in the rear corners of the building.
The parts to be lifted are moved to the narrow side of the lifts in special containers resting on extremely low-built carriages.
The carriage with container runs alongside into the car. On the various floors, the container can be moved out of the lift (crossways) on wheels of its own.

Technical data of the lift:

Rated load		m = 4 t
Speed		v = 0,3 m/s
Travel of lift		t = 10,05 m
Cabin dimensions		
length		l = 9,06 m
width		w = 3,0 m
height		h = 3,0 m
Access to the cabin		
narrow side,	width	b = 2,5 m
	height	h = 2,5 m ; 3,0 m
long side,	width	b = 7,8 m
	height	h = 2,5 m ; 2,8 m
Drive		traction-sheave drive, lifting machine with gear and pole-changeable motor 13/3,25 kW

9. CONCLUSION

Scenary lifts, a special kind of goods lifts, are indispensable to theatres and other cultural centres. Their dimensions are adapted to the specific transport technology.

10. BIOGRAPHICAL NOTES

Dr. Dietmar Küntscher graduated as material handling engineer at the Technical University of Dresden in 1969. For 2 years he worked in the elevator industry in the design and project department, later 9 years as department manager. In 1983 he took his doctor`s degree at the College of Transport and Communication of Dresden. Later he worked as university lecture and now as director in technology. He is a member in the special committee of elevators and the author of a number of papers on lifts and ropes.