

CABLE MECHANISMS USED FOR ACTUATING CAR ELEVATORS WITH 2 AND 4 POLES

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Abstract: *This paper presents the kinematic scheme and the operating mode of the cable mechanism used for car elevators with 2 and 4 poles. In order to increase the efficiency of the 4-pole elevator, we suggest using a new hoists type cable mechanism, which can multiply the piston travel inside the actuating cylinder twice at the platform level, when lifting and lowering.*

Keywords: cable mechanism, car elevator, actuating cylinder, platform

1. GENERAL CONSIDERATIONS

A 2-pole elevator (fig. 1) has on each pole two safety bracing plates [1-5], oscillating in a horizontal plane (fig. 2a). For the upper position (fig. 1a) a safety level to the ceiling is provided [6-9]. In the lower position the minimum necessary distances are pointed out, both to the right and to the left of the elevator (fig. 1b).

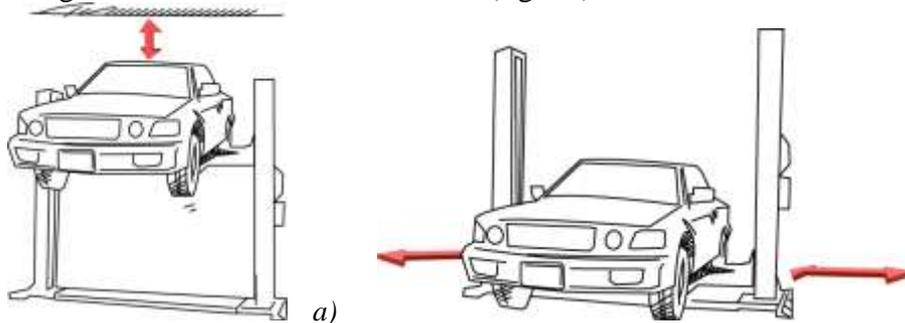


Fig. 1. Building scheme of the elevator with two cable-actuated poles [8]

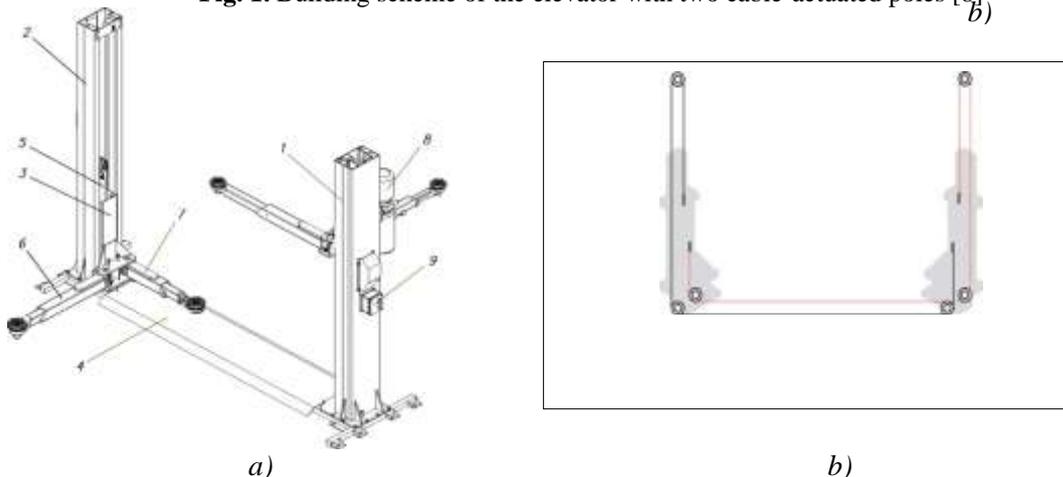


Fig. 2. Building scheme of the elevator (a) and kinematic scheme (b) of the cable mechanism

The building scheme of the car elevator with 4 poles is presented, as a photo image, perspective view (fig. 3, 4) and then the kinematic scheme is presented in a horizontal plane view (fig. 5a) as well as in side plane view (fig. 5b).



Fig. 3. Photo image of a car elevator with 4 poles – upper position [10]



Fig. 4. Photo image of a car elevator with 4 poles (simultaneously actuated by means of a cable), in the lower position (on the ground)

The 4-pole elevator uses a cable mechanism for rising / lowering and it is only suitable for indoor operation (fig. 3). Such an elevator shall not be mounted on asphalt or on other such unstable surfaces. Each elevator pole is supported only by means of anchorage / fixed installation on the floor.

The space left to the ceiling must be checked first in order to determine the height of the elevator that can be placed inside. Mounting such a 4-pole car elevator is relatively easy and can be done in a few hours.

2. THE CABLE MECHANISM WITH A PNEUMATIC ACTUATING CYLINDER

We shall consider the kinematic scheme of the cable mechanism in two orthogonal projections, a horizontal one (fig. 3a) and another on right side (fig. 3b).

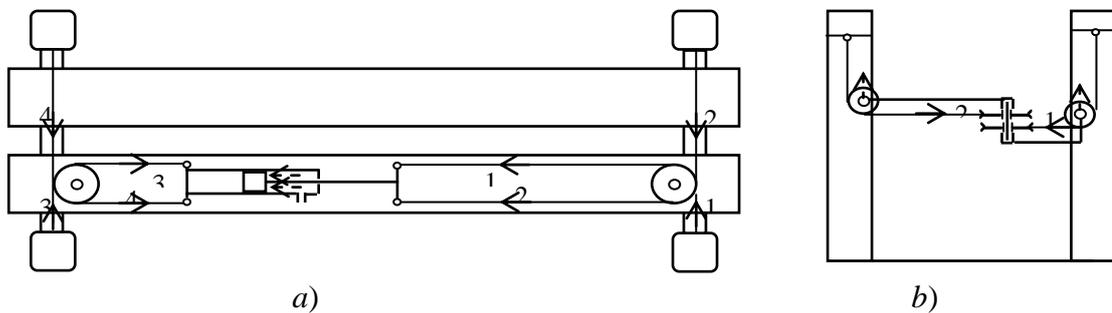


Fig. 5. Kinematic scheme of the cable mechanism (option 1)

The cross distance between two poles (left and right) is about 2,800 mm, while the longitudinal distance between two poles (front and back) is 5,000 mm.

The width of the two tracks (rolling tracks) is about 500 mm, and the distance between these tracks is 1,100 mm. The power unit is mounted on one of the front poles (electric motor + pump + compressed air tank).

Of the two tracks (rolling tracks), only one is provided with a cable spatial mechanism, actuated by a pneumatic actuator (cylinder) (fig. 5a).

The mechanism actuates four different lengths cables, one for each pole, each cable passing over a horizontal roll and over a roll situated in a vertical plane (fig. 5b).

It should be noticed that, for option 1 (fig. 5), the piston travel inside the mobile cylinder is not used efficiently, as the platform moves (rises and goes down) at half the actuator travel.

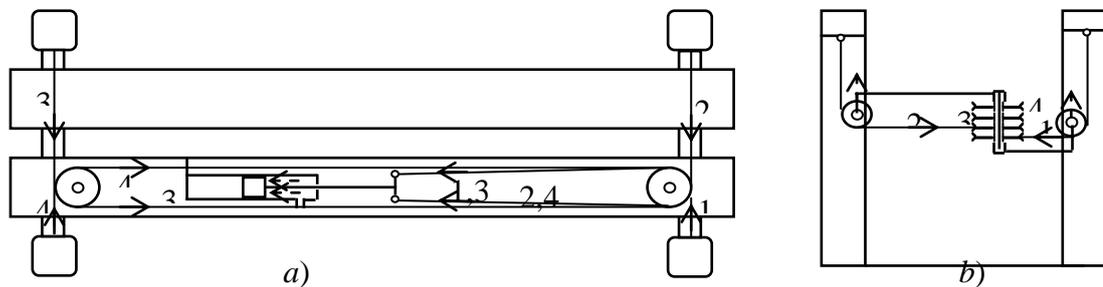


Fig. 6. Kinematic scheme of the cable mechanism (option 2)

In a different option (fig. 6a), in which the hydraulic cylinder is fixed onto the cover of the rolling track, two cables pass over only a horizontal roll each, while the other two cables pass over two horizontal rolls each (one on the right safety bar and one on the left safety bar).

3. THE CABLE MECHANISM WITH A FIXED ACTUATING CYLINDER

In this option 3 (fig. 7), four cables have been connected to the piston rod, two symmetrical cables as to the rod axis (1 with 3 and 2 with 4). Corresponding to the four cables, there are four superimposed cable wheels in a horizontal plane (fig. 7b).

The cables connected to the right side poles (fig. 7a) are placed in a lower plane (fig. 5b), and they are shorter than the cables going to the left side poles.

There is also option 3 (fig. 7a) for the cable mechanism, in which we use only two superimposed cable rolls, placed in the area of the cross-bar of the right side poles (fig. 7b).

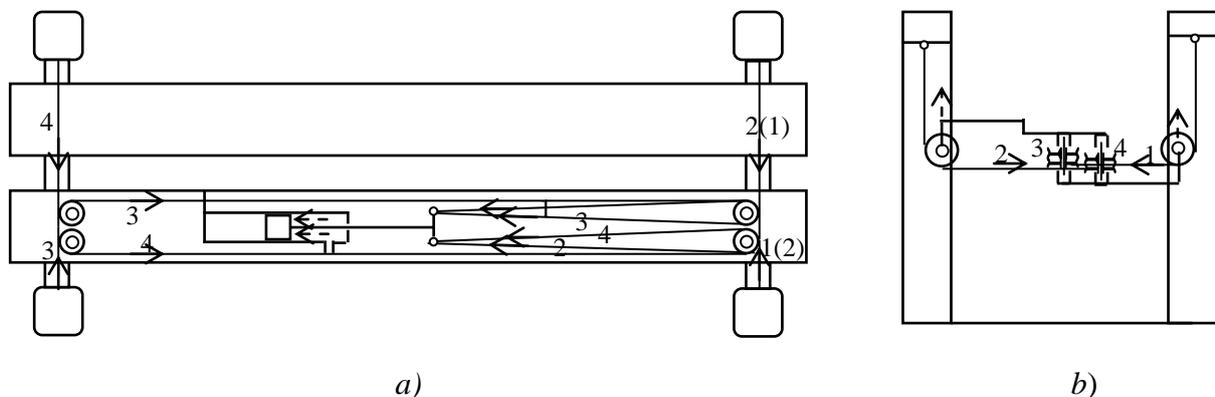


Fig. 7. Kinematic scheme of the cable mechanism (option 3)

For a better view, cables 1 and 3 respectively 2 and 4 have been represented as having different directions (fig. 7a). We should mention that the length of cable 1 is shorter than the length of cable 2.

In fact, these cables can have the same direction, which provides the rotation of rolls 1 and 3 respectively 2 and 4 in the same direction (fig. 7b).

In this case, cable 1 passes over (in a horizontal projection) cable 3, while cable 2 passes over cable 4 (fig. 7a).

Therefore, cables 1 and 2 arrive, after they pass the corresponding rolls, in the positions given by the figures between brackets (fig. 7a).

Cables 3 and 4 remain unchanged, which shows that the length of cable 3 is shorter than the length of cable 4.

The rolls of cables 3 and 4 are mounted to the left in parallel planes, just like rolls 3 and 4 are mounted to the right side (fig. 7b).

The size of the cable varies according to the maximum weight of the vehicles lifted to a certain level for inspection.

It should also be noticed that for options 2 and 3, the piston travel inside the fixed cylinder is equal to the movement of the platform when rising.

When going down, the platform is moved due to the vehicle gravity force, till the actuating piston goes back to the initial position (zero travel).

4. A NEW KINEMATIC SCHEME FOR THE CABLE MECHANISM

To increase the efficiency of the 4-pole elevator, we suggest using a new cable mechanism of the hoists type (fig. 8), which can multiply the piston travel in the fixed cylinder twice (fig. 8a) or three times (fig. 8b) at the platform level, both when lifting and when going down.

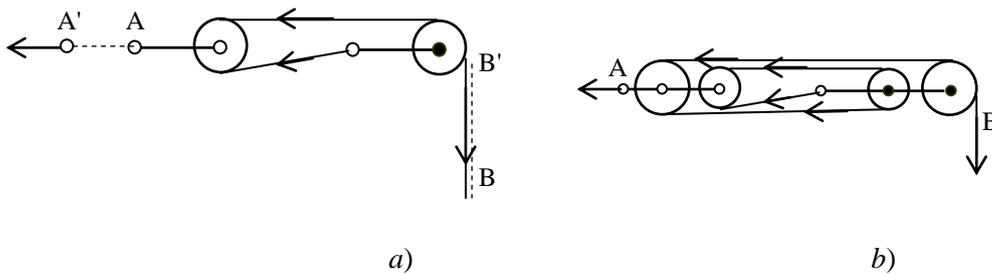


Fig. 8. Hoists type cable mechanism: simple (a) and double (b)

Thus, in the first option (fig. 8a), when point A moves (together with the mobile roll), point B (on the cable passing over the fixed axis roll) moves along a double distance:

$$\frac{BB'}{AA'} = 2$$

In the second option of the hoists (fig. 8b) the ratio between the two rectilinear motions (out / in) equals 4:

$$\frac{BB'}{AA'} = 4$$

Therefore, by means of using this hoists type cable mechanism, for the same movement of the 4-pole platform, the piston travel in the fixed cylinder is much shorter (half or a quarter), than for the current option of the installation (fig. 5).

With the new simple hoists type cable mechanism (fig. 8), for cables 1 and 3 respectively 2 and 4, two such cable systems overlap (fig. 9).

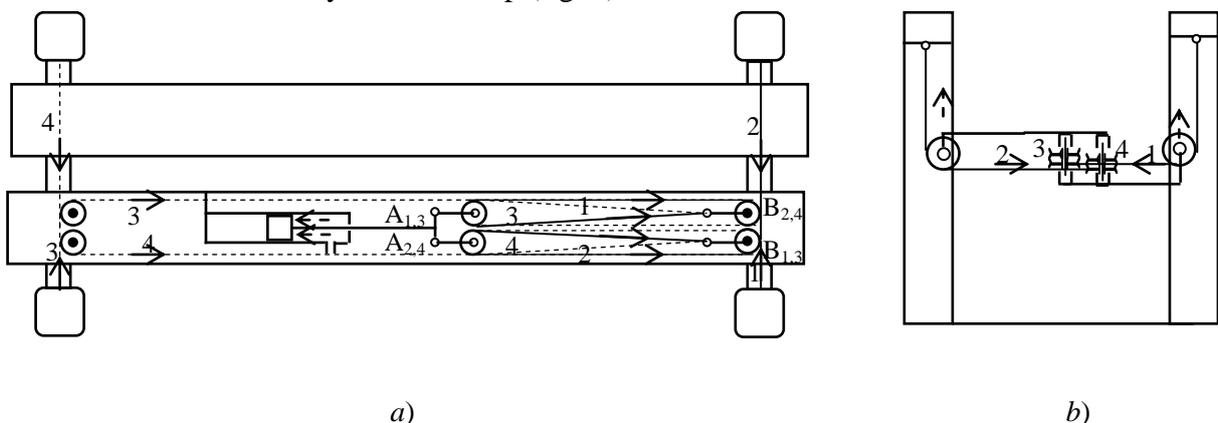


Fig. 9. Kinematic scheme of the new simple hoists type cable mechanism [1, 2]

Considering the new kinematic scheme (fig. 9a), four simple hoists type cable mechanisms are identified, one for each car elevator pole.

According to the previous notations (fig. 8a), points $A_{1,3}$ respectively $A_{2,4}$ connect the piston rod to the mobile hoist roll, where cables 1 and 2 are shown by means of a continuous line, and cables 3 and 4 by means of an interrupted line.

It should be mentioned that, in the horizontal projection of the mechanism (fig. 9a), cables 1 and 3 respectively 2 and 4 overlap for a certain sector, between the mobile axis roll and the fixed axis roll (to the right side).

5. CONCLUSIONS

The cable mechanism of the 2-pole elevator consists of two vertical actuating cylinders, which are pneumatically driven at the same time (fig. 2b).

The cable mechanism used for the 4-pole elevator consists of a single actuating cylinder mounted on one of the two horizontal platforms (fig. 5a, 6a).

With the 4-pole elevator, the actuating cylinder is mobile, and the cable rolls are mounted two on each vertical axis.

If the actuating cylinder is fixed (options 2 and 3), building solutions are different as the cable rolls are mounted four (fig. 6b) and two (fig. 7b) on the same vertical axis. The new cable mechanism presented in this paper (fig. 9a) uses a fixed actuating cylinder in a horizontal position and has the cable rolls mounted two on the same vertical axis (fig. 9b).

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