

360-OBSERVATION TOWER WITH A DYNAMIC MAST

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Abstract. *The article presents a circular observation tower on a rising mast, in which a rigid structure with an invariable position of the vertical axis is provided due to a new arrangement of structural elements and their mutual connections. This ensures uniform distribution of the load on the foundation, eliminates blocking and vibration during operation of the tower.*

Keywords: *tower, mast, hydraulic drive, linear bearings, hollow-rod hydraulic cylinder, tourism, UNESCO-protected sites*

There are numerous currently existing towers around the world that are designed for recreation and entertainment purposes. In such towers, an observation deck that sometime includes restaurants or shops is installed at a certain height. As a result, visitors use elevators or stairs in order to get from the ground level to the deck. Normally, the elevators and stairs are located in the inner shaft of such towers. As a result, visitors of the towers are deprived of the opportunity to observe the surroundings during their ascent to the deck and descent from the deck. On the contrary, there are designs of towers with transparent elevators outside a shaft, for instance, in the Macau Tower in China. However, external elevators frequently become unsightly over time thus spoiling the aesthetic appearance of a tower.

On the other hand, the towers described in UK Patent No. 655970 and European Patent EP 0337673 are equipped with observation decks that move up and down. In this case, the tower structure either folds using a “caterpillar” system (an articulated parallelogram bracket) or is completely lowered into the ground. Both cases require either a significant horizontal or vertical surface area. The “caterpillar” system requires an increased surface area for greater heights and in the latter example the entire height of the tower’s structure must be placed below the ground surface. Therefore, the restrictions associated with the placement of the observation tower apply to both examples of the transformable tower.

In the matter of fact, UNESCO [1-2] introduced the height restrictions of newly installed buildings and structures in the area surrounding existing historic urban landscapes in order to preserve them.

In this regard, a reliable 360-observation tower was designed that both complies with the height restrictions in the folded state as well as providing the necessary lifting height. This tower is designed for vertical lifting of the observation deck consisting of the capsule that carries visitors inside it. The base of the tower consists of the elevating mechanism of a spatial form of a scissor type. In addition, the elevating mechanism is formed by sliding structural elements that are interconnected. Each of the elements includes a series of hinged-connected levers. The lift is a drive which interacts with the sliding structural elements. Moreover, the lifting mechanism is made in the form of a mast that comprises three blocks. The longitudinal geometric axes of the blocks form an equilateral triangle in horizontal section. In turn, each block contains two sliding structural elements in which the last row of hinged-connected levers is made in the form of half of the previous row and the structural elements are rigidly fixed to each other by axles. These axles connect the centers of the levers and the connection nodes of the rows respectively. In the upper part, the blocks are rigidly connected to each other using a frame installed coaxially with the mast. In addition, the platform containing the capsule is rigidly fixed to the upper ends of the blocks.

The vertical movement of the platform with the capsule is provided by a hydraulic drive and a scissor-type lifting mechanism (patent for utility model UA No. 114755, IPC B66 F3 / 00, B66 F3 / 22, published 10.03.2017) [3].

This type of tower is complex from a technical and technological point of view as it involves increased precision during manufacturing. Subsequently, this leads to a significant increase in the cost of both manufacturing and operation of the product. Also, the operating efficiency is low and the lifting height is limited.

The basis of the invention is the task of creating the 360-observation tower, located on the dynamic mast, where due to new arrangement of the structural elements and their connections, rigid construction with fixed location of the vertical axis of the structure is provided. This ensures uniform distribution of loading on the base, secured on the rigid foundation, excludes jamming and vibration in the process of operation. Such technical solution enables to use the suggested construction for lifting/lowering the capsule with the people providing security and comfort of the operation. Besides, enables to reduce the height of the tower in non-working condition to minimum, this feature provides the possibility to use the tower in historic places of the cities and settlements, conserving the urban landscape.

The task, put forward is solved the following way. 360-observation tower contains a telescopic mast, comprising the base, fixed rigidly on foundation; lifting mechanism is installed on the base, lifting mechanism is formed by interconnected pull-out sections, platform with the capsule, installed on the platform and hydraulic drive, which interacts with the pull-out sections. According to the given invention, the lifting mechanism is executed in the form of telescopic mast, consisting of the first fixed and subsequent pull-out sections interconnected in the rigid structure with right triangle in the cross-section, each section consists of the vertical racks, located in the angles of the right-triangle and interconnected by the girders, each upper section is installed in the corresponding low section with the same step.

Between each rack of the lower section and corresponding rack of the upper section plunger single-cavity hydraulic cylinder with hollow rod is installed, it is used for the transfer of the working fluid from the hydraulic cylinder of one section into the hydraulic cylinder of the next section, besides, linear bearings, consisting of the guides with carriages are installed between the racks of each section on both sides. Hydraulic drive, containing hydraulic station, is equipped with the control system.

Capsule is mounted on the platform of the last upper section of the elevator. Capsule is intended for the location of the observation desk, bar or restaurant.

Control system of the hydraulic drive provides hydraulic synchronization of the hydraulic cylinders rods motion, braking and emergency operation modes.

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БАШТА КРУГОВОГО ОГЛЯДУ НА ЩОГЛІ, ЩО ПІДНІМАЄТЬСЯ

Анотація. Представлена Башта кругового огляду на щоглі, що піднімається, в якій за рахунок нової компоновки структурних елементів та їх взаємних зв'язків забезпечено жорстку конструкцію з незмінним положенням вертикальної осі. Це забезпечує рівномірне розподілення навантаження на фундамент, виключає блокування та вібрації під час експлуатації башти.

Ключові слова: башта, щогла, гідравлічний привід, лінійні підшипники, гідроциліндр з порожнистим штоком, туризм, об'єкти під захистом ЮНЕСКО.

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