

## MAGNETIC LEVITATION TRANSPORT SYSTEM (LIRO)

### Invention Overview:

The invention relates to a magnetic levitation transport system, specifically a system comprising a movable element in magnetic levitation. It also describes a method for moving this element using the system. This technology is applicable in various fields such as industrial transport and precision guidance systems.

### Field:

The patent pertains to the field of magnetic levitation transport systems, specifically focusing on systems comprising movable elements in magnetic levitation for use in various applications including elevators, industrial transport, and precision guidance systems.

### Problem:

The primary problem addressed by the patent is the complexity, high cost, and maintenance challenges associated with existing magnetic levitation systems and rotary-linear transmission technologies. These systems often require continuous power supply, experience mechanical wear, and need complex infrastructure for operation.

### Technical Problem Solved:

The invention addresses the need for a transport system that is simple in design, has low manufacturing and operating costs, and allows efficient and accurate movement of the movable element.

### Solution:

The patent proposes a transport system utilizing permanent magnets to achieve magnetic levitation and movement without the need for external power sources for generating magnetic fields. The system comprises:

- A rotatable shaft supported by bearings in a supporting frame.
- A series of identical permanent driving magnets fixed to the shaft, each with magnetic poles phase-shifted by 120° relative to neighboring magnets.

- At least one set of three permanent propulsion magnets configured as plates with coplanar flat surfaces facing the shaft, arranged in an N-S, N-S, N-S sequence along the shaft's longitudinal axis.
- A movable element fixed to the set of propulsion magnets and guided by two parallel guide rails with grooves. Permanent guide magnets are fixed on the extremities of the movable element and within the grooves, creating a repulsive magnetic interaction to maintain levitation.

The system enables the movement of the movable element along the shaft's longitudinal axis through the interaction of the rotating magnetic fields generated by the driving magnets and the static magnetic fields of the propulsion magnets.

#### Applications:

- Extraction of fluids (e.g., water or crude oil) from great depths and bringing them to the surface.
- Vertical movement of an elevator (residential or industrial).
- Horizontal movement of various loads (e.g., objects, goods, people, animals).

#### Key Components:

1. Shaft supported on bearings within a supporting frame, capable of rotating about a longitudinal symmetry axis.
2. Permanent driving magnets fixed to the shaft, spaced equally, with magnetic poles axis phase-shifted by  $\pm 120^\circ$  relative to neighboring magnets.
3. Set of three identical permanent propulsion magnets configured as plates, arranged coplanar and at a specific distance from the driving magnets.
4. Movable element with two profiled extremities, fixed to the propulsion magnets, arranged in alignment with the shaft.
5. Two guide rails with grooves accommodating the extremities of the movable element, using guide magnets for magnetic repulsion and levitation.

#### Preferred Embodiments:

- Driving magnets can have an annular or prismatic bar shape, fixed either on the exterior or inside the shaft.
- Keepers are used to guide and amplify the magnetic fields generated by the driving magnets towards the movable element.
- The system may include a second assembly of keepers and a closed loop conveyor belt with propulsion magnets.

#### Method of Operation:

1. Positioning the movable element in an initial position.
2. Rotating the shaft to cause the movement of the movable element along the longitudinal axis.
3. Halting the rotation to stop the movement at the desired position.

#### Advantages:

The key advantages of the proposed system include:

- Elimination of the need for external power sources to generate magnetic fields, relying solely on permanent magnets.
- Reduced operating and maintenance costs due to the lack of mechanical wear and the simplicity of the design.
- Efficient and accurate movement of the movable element facilitated by the phase-shifted magnetic fields and permanent guide magnets.

#### Novelty:

The patent introduces a novel configuration of magnetic levitation transport systems using phase-shifted permanent magnets and guide magnets to achieve movement and levitation without external power sources. The use of a 120° phase shift in the magnetic poles of the driving magnets and the specific arrangement of propulsion and guide magnets presents a unique solution not found in prior art. Given the detailed configuration and the absence of similar systems in publicly available knowledge, this invention is considered novel.

#### Inventive Step:

The inventive step lies in the specific arrangement and interaction of the phase-shifted driving magnets and the propulsion magnets, as well as the use of guide magnets for maintaining levitation. This configuration is not an obvious solution to someone skilled in the art, given the traditional reliance on continuous power supplies and more complex systems in existing magnetic levitation technologies. The invention's simplicity, cost-effectiveness, and reliance on permanent magnets provide a significant advancement over known solutions.

Claims:

1. Transport system comprising:

- A shaft supported on bearings provided in a supporting frame fixed to the ground, the shaft being capable of rotating when driven by a driving means about its longitudinal symmetry axis.
- A plurality of identical permanent driving magnets fixed to the shaft equally spaced in a row along the shaft.
- Each driving magnet has a magnetic poles axis perpendicular to the longitudinal axis of the shaft.
- Each driving magnet, which is not at the end of the row, has its magnetic poles axis phase-shifted by  $+120^\circ$  in respect to the magnetic poles axis of the preceding neighboring driving magnet and phase-shifted by  $-120^\circ$  in respect to the magnetic poles axis of the subsequent neighboring driving magnet.
- At least one set consisting of three identical permanent propulsion magnets, where:
  - The propulsion magnets are each configured as a plate having a flat surface facing the shaft, with all propulsion magnets' flat surfaces being coplanar.
  - The common plane of all the flat surfaces of the propulsion magnets is at a distance ranging from 1 mm to 10 mm in respect to the driving magnets.
  - The poles of the propulsion magnets are all arranged in the direction of the longitudinal axis of the shaft in the order N-S, N-S, N-S.
- A movable element provided with two profiled extremities and fixed to the at least one set of propulsion magnets, arranged between the driving magnets and the movable element.
- Two guide rails fixed to the supporting frame, symmetrically arranged on either side of the shaft, each rail being provided with a groove accommodating the extremities of the movable element, using guide magnets for magnetic repulsion.

2. Transport system according to claim 1, where the driving magnets have an annular shape, are diametrically polarized, arranged on the outside of the shaft and coaxially with it, and the distance between two consecutive driving magnets is at most 3 mm.

3. Transport system according to claim 1, where:

- The driving magnets have a substantially cylindrical or prismatic bar shape and are fixed inside diametrical through holes provided in the shaft, perpendicular to its longitudinal axis.

- The base surfaces of the driving magnets are configured to be flush with the lateral surface of the shaft, with a minimum distance between the contours of two adjacent base surfaces of at most 3 mm.

4. Transport system according to any of claims 1-3, further comprising:

- A first assembly of identical keepers fixed to the supporting frame, with the number of keepers identical to the number of driving magnets, equally spaced in a row, each facing one respective driving magnet.

- Each keeper includes:

- A first keeper surface oriented towards the shaft, matching the surface shape of the driving magnet and arranged at a distance between 1 mm to 2 mm from it.

- A second flat keeper surface opposite the first keeper surface, with all second flat surfaces being coplanar.

- The common plane of all the second flat surfaces of the keepers is parallel to and at a distance of 1 mm to 3 mm from the common plane of the flat surfaces of the propulsion magnets.

5. Transport system according to any of claims 1-4, where the movable element is configured as a plate with a length along the longitudinal axis of the shaft smaller than the length of the shaft.

6. Transport system according to claim 4, further comprising a second assembly of keepers fixed to the supporting frame, identical to the first assembly of keepers, arranged diametrically opposite in respect to the shaft, where:

- The guide rails have each the shape of a closed loop, consisting of two straight sections and two curved sections.

- The movable element consists of a closed loop conveyor belt comprising a plurality of substantially rectangular individual plates hinged to each other, with a respective propulsion magnet fixed to each individual plate.

7. Transport system according to any of claims 1-6, further comprising a plurality of containers fixed to the movable element, with the movable element arranged between these containers and the propulsion magnets.

8. Method of moving a movable element, characterized by the following steps:

- Positioning the movable element of a transport system according to any of the preceding claims 1-7 in an initial position.

- Driving the shaft by a driving means in a rotational movement about its longitudinal symmetry axis, causing the movement of the movable element along the longitudinal axis.

- Halting the rotation of the shaft and thus halting the movement of the movable element when it reaches the desired intermediate or final position.

9. Method according to claim 8, where the steps b) and c) are repeated as needed, and in step b) the rotational movement of the shaft may be clockwise and/or anti-clockwise.

This system is designed to be versatile, efficient, and cost-effective, suitable for a wide range of applications in transportation and industrial operations.

Summary:

The patent describes a magnetic levitation transport system that utilizes permanent magnets with phase-shifted poles to achieve efficient and accurate movement of a movable element. The system includes a rotatable shaft, driving magnets arranged in a phase-shifted configuration, propulsion magnets, and guide rails with repulsive guide magnets to maintain levitation and movement without the need for external power sources. This innovation presents a cost-effective and low-maintenance alternative to traditional magnetic levitation systems.

Keywords:

- Magnetic levitation transport system
- Permanent driving magnets
- Phase-shifted magnetic poles
- Propulsion magnets
- Guide rails
- Magnetic repulsion
- Movable element
- Low maintenance
- Cost-effective transportation
- Rotatable shaft
- Precision guidance systems
- Industrial transport
- Vertical movement
- Magnetic fields
- Non-electric magnetic levitation