Direct conversion of energy in the electrodynamic movers (EDM)

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The simplest electrodynamic converter represents a rigid ? -shaped frame made of a piece of thin wire. Its sides 1, 2, 3 fixed with regard to each other are carrying current the circuit of which is locked by a free conductor 4. The forces of electrodynamic interaction emerge between the current-carrying conductors, and their directions correspond to the celebrated "left-hand rule". Thanks to the symmetry and rigidity of the frame forces F_{31}, F_{21}, F_{32}, F_{23}, F_{34} and F_{24} are mutually balanced. Forces F_{41} and F_{14} tend to zero with the increase of the frame length. As to forces F_{12} and F_{13}, they are not compensated and produce a resulting force of F applied to the frame. In this case equal forces of the opposite directions are applied to the locking conductor 4. If the frame and the conductor 4 may freely move with respect to each other, the electrodynamic forces will cause the frame to move upwards, while the locking conductor 4 will be moving down.

The operation principle of an electromagnetic rail accelerator and other electrodynamic devices known perfectly corresponds to the theoretical model considered.

If we use an external medium for a locking conductor the above mentioned force will cause the ?-shaped frame to move in it as a result of an electrodynamic interaction of currents inside the frame body. That makes the principal specific quality of electromechanical converters of that class which has allowed us to introduce a new term of "the electrodynamic mover" - the EDM for short.

The EDM, as well as any other electromechanical converter, consists of two main functional elements: inductor creating a magnetic field and armature, where a ponderomotive force emerges.

In the simplest EDM scheme considered vertical conductors 2 and 3 act as inductor and horizontal conductor 1 operates as an armature.

The direction of the attractive force in the EDM doesn't change with the alteration of current direction in the circuit that proves its operational capability both at direct and alternating current. There can be no doubt that energy conversion is reversible, i.e. that an electrodynamic generator can be created.

The locking of the electrodynamic mover electric circuit can be performed through the surrounding electroconductive medium (e.g., sea water) or with a high frequency bias current through a non-conductive medium (e.g., air, vacuum). We propose to name such electrodynamic devices the conductory and insulatory ones, respectively. All the electrodynamic devices known belong to the class of conductory movers with galvanic coupling. Methods of the ponderomotive force calculation have been created for such devices and the main peculiarities of their characteristics have been studied.

The insulatory EDMs had not been the subject of theoretical research and as far as the authors can judge, are not known in engineering.

In evaluating the possibilities of practical applications of the new class movers it is necessary to consider their following potential advantages.

1. Due to the absence of motion of mover elements with respect to each other or with respect to the hull of the vehicle it is most likely that the mover will have a simple, reliable construction.
2. The EDM traction control in the range required is achieved by input voltage regulation, this method being economical and simple to realize.
3. The EDM operation isn't accompanied by mass expenditure, which is of special importance for space vehicles.
4. The absence of substance outburst at operation makes the EDM ecologically clean.
5. The EDM traction doesn't depend on the velocity of motion. This permits to regard them as the only movers known at present that are capable of accelerating space vehicles to the relativistic velocities.
6. The EDMs have got a Russian Federation patent ? 2013229 (by Anatoly V. Burov and Vitaly A. Tselemetsky).