Periodica Polytechnica Transportation Engineering, 50(4), pp. 357–360, 2022

Concept of a Cost-effective Underground Air-propelled Tube-capsule Transport System

István László Zádor[1*]

[1] sr. architect, individual inventor, Kassai u. 157/e, 1142 Budapest, Hungary
[*] Corresponding author, e-mail: zdr.istvan@gmail.com

Received: 12 December 2019, Accepted: 09 January 2020, Published online: 08 June 2022

Abstract

In our age, due to the rapid development of electronics, information flows at an amazing speed from the point of creation to the place of use, but in addition to electronic data traffic, we would also require physical location change at a similar rate. Due to our accelerated lifestyle, there is a growing need to implement a door-to-door fast delivery system. Current road freight transport accounts for a significant proportion of surface transport, but its efficiency is greatly impaired by congestion on the roads. The potential for road networks to be developed on the surface is limited, raising it above the surface, as is often seen in fantastic films, is impossible without antigravity knowledge, and highways are expensive to construct, the cityscape will be worse, moreover, it is not an aesthetic view from the windows of the buildings.

Keywords

door to door transport, tube tunnel track, delivery capsule, air flowing transportation, different level path circles, locked stations, airlock

1 Introduction

It can be stated that the development of surface transport cannot be continued in the present direction, it only improves the speeding up of the traffic temporarily and is accompanied by an increasing number of additional environmental damage (Szalmáné Csete, 2019). The congested roads, the level crossings of cities, the multi-lane, high-speed system of interurban traffic also lead to a significant increase in the risk of road accidents (Kocsis et al., 2019).

Nowadays, research and development directions point to the creation of ever larger and faster means of transport between two transit stations (Török, 2017).

In my opinion, this is misleading, because when I arrive, or the package arrives with a vehicle from A to B lightning fast, I still have to use one or more other tools to get to my destination, change, wait, walk (remote parking) or transship. Freight transportation is also a problem with container or combined roller conveyor systems, which have to transport smaller loads to larger vehicles at the headquarters or logistics centre near the destination, and then re-deliver them to the destination on a transport device. As a result, smaller means of transport remain popular, sometimes providing convenient door-to-door service. Therefore, it is necessary to ensure that the person or luggage is transported safely from the place of departure/origin to the destination using a single transport system, as fast as possible and with the least energy (Torok and Zoldy, 2010).

Submerging transport underground is obvious in the face of congestion on the surface, our technical development offers this opportunity, and last but not least there are many benefits. There are several international patents dealing with submerged transport (GB 1514607 (A), Georgia Tech Research Institute, 1978), but a simple and effective door-to-door solution has not yet been found. Attempts have already been made to construct submerged, low-sectional utilities with prefabricated elemental (tubing, tubular extrusion) tunnels that combine the tubular tunnel casing wall with sliding formwork and injection molded concrete (pressurized concrete technology), however, they could not widespread due to the shallow depth and lack of reinforcement in the concrete shell.

Pipelines are usually used to transport liquids and gases from one station to another through occasional pumping stations over long distances. In the past, offices

Cite this article as: Zádor, I. L. (2022) "Concept of a Cost-effective Underground Air-propelled Tube-capsule Transport System", Periodica Polytechnica Transportation Engineering, 50(4), pp. 357–360. https://doi.org/10.3311/PPtr.15423

have used a dispatch tube mail system to quickly transfer encapsulated documents from one room to another, which has become redundant due to digital development, but for example material solutions for rapid shipment of samples to the lab or for securing banknotes are currently in use.

2 Cost effective environmentally friendly underground transportation system

By creating a tunnel network of small cross-sectional existing blocks with new technology and continuously circulating air-guided capsules in this concrete cloak piping system, drastic reductions in surface traffic loads and rapid freight and passenger transport can be achieved at the same time. The proposed system combines convenient (freight) car transport with fast underground traffic with an independent series of conductive capsule transport units in an underground small tunnel system. In this case, the adverse effects of surface weather on traffic can be eliminated and the station can be compacted to provide convenient and fast transport from door to door (Fig. 1).

It consumes a lot of energy as you move continuously, accelerating and decelerating conventional transport units. In this underground system, the tunnel paths are located on several levels, one below the other. In each of the individual, one-way circuits, the speed of travel is constant, and slows down when arriving at stations or junctions, increasing the height of each capsule on a sloping orbit, such as using gravity, without changing the constant velocity of the capsules going further. Of course, to reconnect to each path circle, we also use gravity to increase the velocity by creating a sloping connection path (Fig. 2). Increasing the altitude difference will result in higher speeds, and therefore, at ever deeper levels, the constant speed of travel will increase.

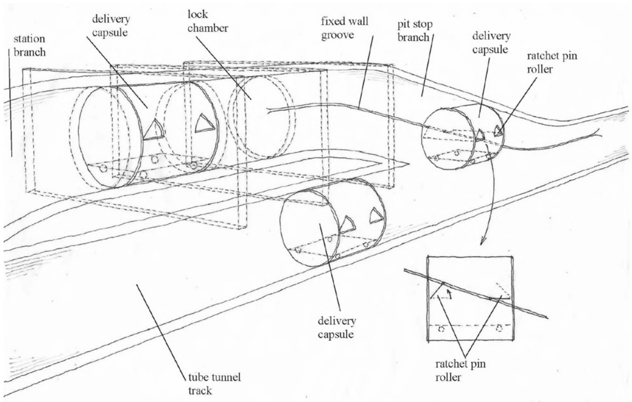

Fig. 2 Exit to the station side branch lock

The flow of paths is provided by air flowing at a constant speed through the tunnel. Continuous airflow is maintained by counter-rotating fan pairs, located in a tunnel overhang along the route circuit (Fig. 3). For the sake of simplicity, there are no rails or any mechanical or electrical equipment in the main circuits, so there is no need for servicing within the main track. The track itself is exactly of the size and smoothness of the abrasion-resistant inner tube surface of the tunnel. In bends, the light capsule tilts to the side corresponding to its own weight and the bend of the curve because of its low centre of gravity.

For ease of movement of each capsule by the air flow, the "rolling" resistance of the capsules is reduced by air cushioning by varying the pressure between the capsule and the tunnel wall, creating an overpressure on the lower gap surface and a vacuum on the upper gap surface. Due to the small slit cross-section, a compressor built into a capsule performs flotation with relatively little energy invested, reducing and compressing air between the two slit surfaces. The spaces of different pressures must be used to separate both the track tunnel airspace and each

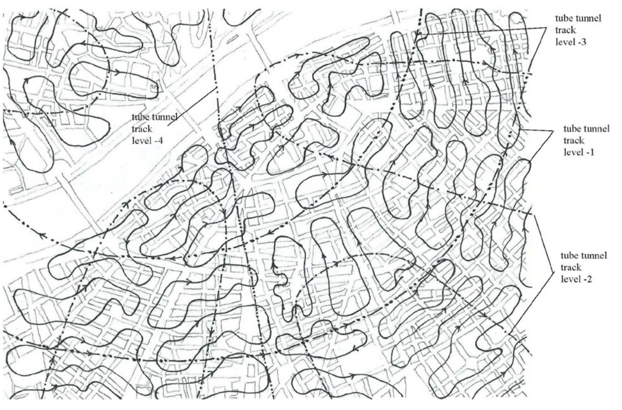

Fig. 1 Different levels of sub route circles

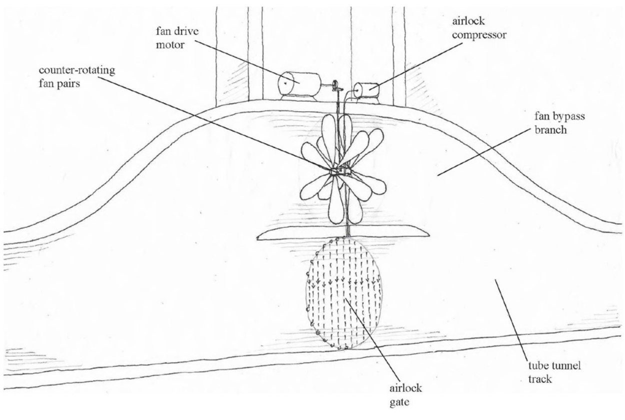

Fig. 3 Counter rotating fan pairs and the airlock gate

other using flexible seals that do not significantly impede the capsule during travel.

The capsule provides its own power for the compressor, the computer, the ratchet pin roller, and the operation of the transmitting and receiving equipment by a built-in battery (Fig. 4).

The individual path circles are connected by temporary branches, which, like the stations, are always at the top, zero level. The sluice doors ensure complete stop with forming the inflow of air in front of the capsule as an air cushion, the capture, storage and use at the start of the compressed air. After stopping, loading, or disembarking, the capsule rolls to the landing side of the sluice-gate, where it waits and charges its battery. At start, the capsule receives a free path to reconnect to the route circle, based on the detection of the availability of the previously occupied main path.

To control the flow of tubular encapsulation, fixed transceivers are installed at the stations and at the transient and fan branches as well as within the capsules. Based on the information transmitted by the devices placed in this way, the aggregated traffic data is compiled evaluated and updated by the computer, the occupancy of the network is then continuously transmitted to the network. By typing the destination in the capsule at the point of departure,

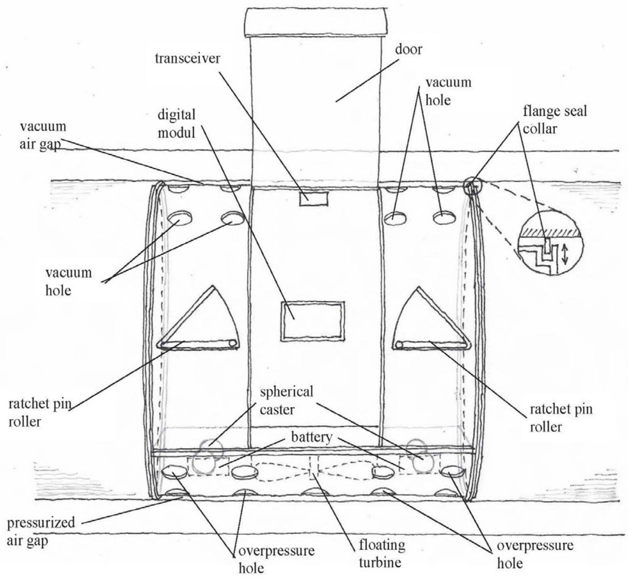

Fig. 4 Delivery capsule

the capsule's own computer calculates the route using the current path occupancy data transmitted by the system and automatically conveys the capsule to the destination. Each capsule determines its connections to and from the position and traffic data transmitted continuously by transducer receivers located at the sidings, thus providing information on the traffic in that section, thereby ensuring the smoothness of the main traffic lane.

3 Summary

The advantages of the system are the follows:

- no emissions, ambient air, noise and visual pollution, relieving the surface,
- optimized energy use because there is no air resistance and no unnecessary acceleration or deceleration due to traffic,
- the oil-based energy needs of conventional transport systems can be replaced by environmentally friendly energy sources,
- the operation is economical because there are no mechanical or electrical elements in the main traffic lane tunnels which should be maintained at all times, so that traffic flows smoothly, congestion and disruption are avoided,
- there is no need for human control, the target is given to the destination specified at departure or changed on the way by optimum route of the capsule after entering the destination,
- creates the required velocity change at each station by gravity,
- there are no weather obstacles on the traffic which could adversely affect traffic,
- direct door-to-door transportation of goods and persons, without the need for transit stations, e.g., it also improves the speed of e-commerce,
- the combination of increasingly deep circuit paths will increase the transport time as fast as possible,
- the accident-free traffic is ensured by the same speed of movement of each capsule within the route and by the air-plug formed between them,
- there is a significant benefit to be gained from underground passenger transport from speed, by redeploying existing public transport resources.

References

Georgia Tech Research Institute (1978) "Pneumatic transport system with blocking valve control", USA, GB 1514607 (A). [online] Available at: https://worldwide.espacenet.com/searchResults?submitted=true&locale=en_EP&DB=EPODOC&ST=advanced&TI=&AB=&PN=GB+1514607+&AP=&PR=&PD=&PA=&IN=&CPC=&IC=&Submit=Search [Accessed: 11 December 2019]

Kocsis, B., Vida, G., Szalay, Z., Ágoston, G. (2019) "Novel Approaches to Evaluate the Ability of Vehicles for Secured Transportation", Periodica Polytechnica Transportation Engineering. https://doi.org/10.3311/PPtr.13785

Szalmáné Csete, M. (2019) "Climate Change Impacts on Society and the Economy", In: Palocz-Andresen, M., Szalay, D., Gosztom, A., Sípos, L., Taligás, T. (eds.) International Climate Protection, Springer, pp. 277–282. ISBN: 978-3-030-03815-1 https://doi.org/10.1007/978-3-030-03816-8_35

Török, Á. (2017) "Introducing the Methodology of Transplanting a New National Speed Management Strategy", Transport and Telecommunication Journal, 18(2), pp. 118–127. https://doi.org/10.1515/ttj-2017-0011

Torok, A., Zoldy, M. (2010) "Energetic and economical investigation of greenhouse gas emission of Hungarian road transport sector", Pollack Periodica, 5(3), pp. 123–132. https://doi.org/10.1556/Pollack.5.2010.3.10