CLAIMS

1. A logistics service system (10) comprising:
at least three tubes (14, 14a, 14b, 16, 43),
at least one of which is connected to at least one terminal (11, 12, 70),
at least one carrier (17) configured to hold goods (48) to be handled in the logistics service system (10), the carrier (17) being provided with at least one permanent magnet (72) and a sensing and communication unit (28) comprising at least one sensor selected from air pressure, position, and acceleration sensors,
at least one means for propulsion (15) of the at least one carrier (17) in said tubes, the means for propulsion being a pneumatic propulsion means,
at least one control unit (29, 50),
at least one switching device (51) arranged to connect at least a first of said at least three tubes with a second and a third tube at a junction, and configured to redirect said carrier (17) from the first tube into the second or the third tube, the switching device (51) comprising electromagnets (73) provided on at least one place along the second and third tubes, wherein the control unit (29, 50) is configured to communicate with the sensing and communication unit (28) of the carrier (17) and to activate the electromagnets (73) of one of the second tube or third tube, into which the carrier (17) is destined, while the carrier (17) is pneumatically driven past the junction, such that the electromagnets (73) of that tube interact with the permanent magnet (72) on the carrier (17) in order to guide the carrier (17) into the intended tube.

2. The logistics service system according to claim 1, further comprising an acceleration arrangement (74) comprising electromagnets (73) provided on at least one place along the first tube and/or along at least one further tube (14, 16, 43), the electromagnets (73) being configured to interact in response to the control system with the at least one permanent magnet (72) on the carrier (17) in order to accelerate, and/or decelerate, and/or rotate, and/or hold the carrier (17), and to affect the speed of the pneumatically driven carrier (17).

3. The logistics service system according to claim 2, further comprising at least one turning device (71), said turning device (71) comprising at least one plate (76) provided with electromagnets (73), the at least one plate (76) being arranged in connection with an inlet tube (14) and none, one or several outlet tubes (14a, 14b), wherein, when a carrier (17) is located on the plate (76), the control unit being configured to actuate the electromagnets (73) of the plate (76) to interact with the permanent magnets (72) of the

carrier (17) such that the carrier (17) is turned to be aligned with the inlet tube (14) in order to turn the carrier 180 degrees or one of the outlet tubes (14a, 14b).

4. The logistics service system according to claim 2 comprising a turning sphere (88) as turning device, said turning device (88) comprising an outer (89), middle (90), and an inner (91) sphere controlled by internal magnetic control devices (92, 93), the sphere being arranged in connection with tubes (14, 14a-14e), wherein, when a carrier (17) is located in the sphere, the control unit is configured to actuate the magnetic devices (92, 93) to interact with the permanent magnets (72) of the carrier (17) such that the carrier (17) is turned to be aligned with any of the tubes (14, 14a-14e) based on information from the control system.

5. The logistics service system (10) according to any one of the preceding claims, where the tubes (14, 16, 43) are configured to be installable with other utility pipes and cables (2), e.g. water, sewage, district heating, electricity, phone and fiber optic cable, in a common outer enclosure (3) and/or a vertical shaft (6) in a building (5), and wherein the switching device (51) is configured to be installable with other utility devices (7), e.g., valves, joints, pumps, heat exchangers, switches, and distribution boards, in a common outer enclosure (4).

6. The logistics service system (10) according to any one of the preceding claims wherein the control system also comprises means for communication with all components, subsystems, carriers, and goods items; interface to external entities such as utilities for e.g. waste, climate, energy, water, sewage, telecom, a logistics service provider, transport and/or storage systems, an e-commerce company, and a user or consumer; and wherein the control system further is configured to support management of operation, maintenance, and replacement of components of the logistics service system, routing and speed of carrier movements, access of persons and goods, and order placement and fulfillment, using data from the sensing and communication unit (28) of the carrier (17) and from sensors elsewhere in the system.

7. The logistics service system (10) according to any one of the preceding claims, also comprising means for identifying and communicating with users of the system, users of the services of the system, and the goods item.

8. The logistics service system (10) according to any one of the preceding claims, also comprising a packaging designed to fit into an inner cavity of the carrier (17) for specific types of goods (48), e.g. liquid, gas, wet, hot, cold, or hazardous, or goods with specific requirements, e.g. temperature, atmosphere, or shock sensitive goods.

9. The logistics service system (10) according to any one of the preceding claims, wherein the carrier (17) comprises a hatch (26) provided with a lock (27) which is releasable by means of an access device (21), preferably being one of a key, a mobile communication device, a fingerprint sensor, an eye sensor, or any other suitable biometric sensor, the lock (27) being configured to be maneuverable when the carrier (17) is located in the user terminal (12) or in the transfer terminal (11).

10. The logistics service system (10) according to any one of the preceding claims, wherein the carrier (17) comprises at least one sealing ring (23) arranged around its circumference, perpendicular to a direction of travel of the carrier (17), wherein the user terminal (12) is provided with at least a first and a second holding device (46), the holding devices (46) being movable between an extended position and a retracted position, wherein, when the carrier (17) is located in the user terminal (12), the sealing ring (23) is configured to rest against the first holding device (46), being in its extended position, preventing the sealing ring (23) and thus the carrier (17) from moving in a direction past the first holding device (46), and the second holding device (46), being in its extended position, is configured to prevent the sealing ring (23) and thus the carrier (17), from moving in an opposite direction past the second holding device (46).

11. The logistics service system (10) according to any one of the preceding claims, wherein the carrier (17) comprises at least one sealing ring (23) arranged around its circumference, perpendicular to a direction of travel of the carrier (17), wherein the transfer terminal (11) is provided with at least a first holding device (46), the holding device (46) being movable between an extended position and a retracted position, wherein, when the carrier (17) is located in the transfer terminal (11), the sealing ring (23) is configured to rest against the holding device (46), being in its extended position, preventing the sealing ring (23) and thus the carrier (17) from moving in a direction past the first holding device (46).

12. The logistics service system (10) according to any one of the preceding claims, where the tubes (14, 16) are arranged to transport both carriers (17) and a fluid, i.e., a gas or a liquid.

13. The logistics service system (10) according to claim 12, wherein the carrier (17) and the fluids are transported simultaneously in the tube, and wherein the fluid is used as the means for propulsion of the carrier (17).

14. The logistics service system (10) according to claim 12, where fluids are transported through said tubes (14, 16, 43), and at specific time slots, also carriers (17) are transported through said tubes (14, 16, 43), separated in time and space.

15. The logistics service system (10) according to any one of the claims 12-14, where the fluid is one of: air configured to be used for heating or cooling the interior of a building, gas for fire extinction or gas for energy production.

16. The logistics service system (10) according to claim 15, where the air for heating or cooling the interior of a building is transported in a first direction in the tube (14, 16) and in an opposite direction in the cavity of the enclosure (3) in which the tube (14, 16, 43) is arranged, and preferably where heat exchangers, e.g. between air in and out or between water from district heating to air, are co-located with storage device (30), switching device (51) and devices of other utilities (7) in the common outer enclosure (4).

17. The logistics service system (10) according to claims 12-15, where the liquid is water, e.g. fresh water, sewage water, irrigation water, storm water, district heating water.

18. A method for providing logistics services with the tube-carrier based logistics service system (10) according to any one of the previous claims 1-17, the method comprising the steps of: providing (33) a goods item (48) to the logistics service system (10); assigning (34) service order information obtained from the central control unit (29) to a carrier (17); inserting (35) the goods item (48) into the assigned carrier (17); and operating (36) the logistics service system (10) according to the assigned (34) service order information by pneumatically propelling the carrier (17) and, at a switching device (51), activating electromagnets (73) in dependence on data from the sensing and communication unit (28) of the carrier (17) to guide the carrier (17) into a selected tube.

19. The method according to claim 18, wherein the service order information is provided to the central control system (29) by a user of the system, or a user of the service.

20. The method according to any of claims 18-19, wherein the step of assigning (34) service order information to a carrier (17) is performed by identifying the ID of the carrier (17) by means of one of a barcode or QR-code scanner, a RFID chip reader or other suitable data reading means, and associating said ID with the service order information of the goods item (48).

21. The method according to any of claims 18-20, wherein the step of providing (33) a goods item (48) to the logistics service system (10) comprises providing the goods item (48) to a user terminal (12) or to a transfer terminal (11).

22. The method according to any claims 18-21, wherein the step of operating (36) the carrier (17) in the logistics service system (10) comprises one or more of: operating the carrier (17) to a user terminal (12), to remain in motion or non-motion in the tube (14, 16), to a

storage device (30), to a transfer terminal (11), to a carrier service terminal (70), or operating the carrier (17) to any position along an extension of the tube (14, 16, 43), including selectively activating electromagnets (73) at a switching device (51) to guide the carrier (17) into a selected tube.

23. The method according to any of claims 18-22, wherein the step of operating (36) the carrier (17) comprises operating the carrier (17) to a user terminal (12), and the method further comprises a step of transmitting (37) a notification to the user of the service.

24. The method according to any of claims 18-23, further comprising the steps of identifying (38) the user of the service, checking that the identified user of the service has the authority to retrieve the goods (48), and subsequently unlocking (39) the door (20) of the user terminal (12) and the hatch (26) of the carrier (17).

25. The method according to any of claims 18-24, wherein the data from the sensors anywhere in the system (10), including data from the sensing and communication unit (28) of the carrier (17), are used by the control system (29) to learn where to preposition goods (48), to make inference about when to take carriers (17) out of the system (10) for cleaning and proactive maintenance, and to make inference when to provide maintenance of system components.

26. A storing and switching device (30) for carriers (17) of a logistics service system (10), the device (30) comprising: a barrel (32) rotatable around a center axis (C) and provided with a plurality of through openings (31) configured to house carriers (17); a driving means configured to rotate the barrel (32) around the center axis (C); a first tube and a second tube arranged on opposite sides of the barrel (32) such that rotation selectively aligns at least one of the through openings (31) with both the first tube and the second tube to form a continuous tube segment through the barrel (32); at least one holding device configured to support and restrain a carrier (17) within a through opening (31) when that through opening (31) is not aligned with a tube; and a control unit (29, 50) configured to control the driving means to rotate the barrel (32) to (i) align an empty through opening (31) to permit pass-through movement of carriers (17) between the first tube and the second tube, and (ii) align a selected through opening (31) containing a carrier (17) to retrieve or dispatch the carrier (17), whereby the device (30) simultaneously provides storing and switching functionality.

27. The device (30) according to claim 26, wherein the through openings (31) extend in the same direction as the center axis (C) of the barrel (32), and wherein the holding device comprises rods (46) movable between an extended position in which they extend into a

through opening (31) to support the carrier (17), and a retracted position permitting movement of the carrier (17).

28. The device (30) according to any one of claims 26-27, wherein the driving means is configured to be in operable connection with a control system (29) of the logistics service system (10), and wherein the control system (29) is configured to register which carrier (17) is stored in which through opening (31).

29. A method for storing and switching carriers (17) in a storing and switching device (30) according to any one of claims 26-28 provided in a logistics service system (10), the method comprising the steps of: rotating (40) the barrel (32) such that an empty through opening (31) is aligned with a first tube (14, 16, 43) of the logistics service system (10); operating (41) a carrier (17) to be stored or switched through the first tube (14, 16, 43) and into the through opening (31) aligned with the first tube (14, 16, 43) such that the carrier (17) is housed within the through opening (31); rotating (42) the barrel (32) such that another through opening (31) is aligned with the first tube (14, 16, 43) and, when the device (30) is being operated for switching, the through opening (31) housing the carrier (17) is aligned with a second tube (14, 16, 43); and retrieving a selected carrier (17) by rotating the barrel (32) such that the through opening (31) containing that carrier (17) is aligned with a tube.

30. The logistics service system (10) according to any one of claims 1-17, wherein the control system comprises at least one of a sensor, actuator, and means for communication in at least one of: the goods item (48), the carrier (17), the terminals (11, 12), the tubes (14, 16), the switching device (51), the means for propulsion (15), and means for storing carriers (17), the control system being configured to handle, process, and store information related thereto, wherein the control system is connected to at least one system and/or device selected from an access device (21), an external transport and storage system (8), a utility and its infrastructure (2, 7), and an external information system (9) of a logistics service provider, trading company, circular economy provider, or waste handling company, and wherein the control system is configured to handle, process, and store information related to a user of the logistics service system (10).