

CLAIMS

1. A logistics service system (10) comprising:
- at least one tube (14, 16, 43) connecting at least one terminal (11, 12, 70),
- 5 at least one carrier (17) configured to hold goods (48) to be handled in the logistics service system (10),
- at least one switching device (51) arranged to connect at least two of said tubes (14, 16, 43), and configured to redirect said carrier (17) from one of said tubes into another of said tubes,
- 10 at least one means for propulsion (15) of the at least one carrier (17) in said tube (14, 16, 43),
- at least one control unit (29, 50), and
- wherein all above being configured to produce logistics services that includes both storing and transport functions.
- 15 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 tube (14, 16, 43) and at least one permanent magnet (72) provided on the carrier (17), the electromagnets (73) and the permanent magnets (72) being configured to interact in response to the control system in order to accelerate, and/or decelerate, and/or rotate, and/or hold the carrier (17).
- 20 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),
- 25 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).
- 30 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 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
10 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:

15 - 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

 * logistics service provider

 * transport and/or storage systems

20 * e-commerce company

 * user or consumer

wherein the control system further is configured to support management of, e.g.:

25 * operation, maintenance, and replacement of components of the logistics

 * service system

 -* routing and speed of carrier movements

 -* access of persons and goods

 -* order placement and fulfillment.

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 ,
5 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
10 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
15 (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
20 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
25 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
30 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
5 a fluid, i.e., a gas or a liquid.

13. The logistics service system (10) according to claim 11, 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 11, where fluids
10 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 11-14, 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.
15

16. The logistics service system (10) according to claim 12 and 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.
20 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
25 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);
- 30 - 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);

- operating (36) the logistics service system (10) according to the assigned (34) service order information.

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).
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 (11), 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) 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) provided with at least two through

openings (31) configured to house the carrier (17) to be stored or switched, the barrel (32) being configured to be rotatable around a center axis (C) and the at least one through opening (31) being configured to be possible to align with at least one tube (14, 16, 43) of the logistics service system (10) for a storing functionality and with at least two tubes for a switching functionality.

27. The device (30) according to claim 26, wherein the through openings (31) extends in the same direction as the center axis (C) of the barrel (32).
28. The device (30) according to any one of claims 26-27, further comprising a driving means configured to rotate the barrel (32), and preferably wherein the driving means is configured to be in operable connection with a control system (29) of the logistics service system (10).
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 one of the at least two through openings (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 of the at least two through openings (31) is aligned with the first tube (14, 16) 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).
30. A device (52) for preventing and detecting leakage and opening of a carrier (17) of a logistics service system (10) comprising at least one gas proof barrier enclosing a second environment being different regarding at least one characteristics feature from the first environment surrounding said gas proof barrier, at least one detector provided within said gas proof barrier registering at least one characteristics feature of the environment, the detector is provided with means to signal its measured data to an external communication unit, and said communication unit is arranged to analyze the data and take action.

31. The device according to claim 30 where one gas proof barrier is the outer housing (22) of the carrier (17), the first environment is contained in the cavity (61) inside the tube (12), the second environment is contained in the cavity (56) inside the carrier (17), and the one detector is the sensing and communication unit (28) of the carrier (17).
5
32. The device according to any of the claim 30 or 31, also including a second additional gas proof barrier within the first gas proof barrier where the second barrier is the outer housing of the goods item (48), the third environment is contained in the cavity (60) inside the goods item (48) and the second detector is the sensing and communication unit (62) of the goods item (48).
10
33. The device according to any of the claims 30-32, where one or several environment(s) consists of gas(es), the gas(es) is (are) air, the characteristic is absolute air pressure and the sensors in the sensing and communication units (28) and (62) are air pressure sensors.
- 15 34. The device according to any of the claims 30-33, where the air pressure in cavity (56) and (60) is provided with a vacuum pump (52).
35. A method for preventing and detecting leakage and opening of a carrier (17) or goods (48) of a logistics service system (10) according to any of the claims 28-32, the method comprising the steps of:
- 20
- providing (63) at least one gas proof barrier in association with the enclosure;
 - producing (64) a second environment within said gas proof barrier;
 - said second environment is different regarding at least one characteristic feature from the first environment surrounding said gas proof barrier;
- 25
- arranging (65) at least one detector within said gas proof barrier for registering data regarding at least one characteristic feature of said second environment;
 - supplying (66) the said data from the detector to an external communication unit;
- 30
- analyzing (67) said data;
 - taking action (67) based on said analyzes.

36. The method according to claim 35, where one gas proof barrier is the outer housing (22) of the carrier (17), the first environment is contained in the cavity (61) inside the tube (12), the second environment is contained in the cavity (56) inside the carrier (17) and the one detector is the sensing and communication unit (28) of the carrier (17).

37. The method according to claim 35 or 36, where one gas proof barrier is the outer housing (22) of the carrier (17), the first environment is contained in the cavity (61) inside the tube (12), the second environment is contained in the cavity (56) inside the carrier (17), the first detector is the sensing and communication unit (28) of the carrier (17), the third environment is contained in the cavity (60) inside the goods item (48) and the second detector is the sensing and communication unit (62) of the goods item (48).

38. A logistics service system (10) comprising:

at least one main tube (14) and at least one branch tube (16) connecting at least two terminals (11, 12),

at least one carrier (17) configured to hold goods (48) to be handled in the logistics service system (10),

at least one switching device (51) arranged to connect at least two of said tubes (14, 16), and configured to redirect said carrier (17) from one of said tubes into another of said tubes,

at least one means for propulsion (15) of the at least one carrier (17) in said tube (14, 16), and

a control system comprising at least one control unit (29, 50) being arranged with at least one of the following sensor, actuator, and means for communication in at least one of the following: said goods item (48), said carrier (17), said terminals (11, 12), said tubes (14, 16), said switching device (51), said means for propulsion (15), and means for storing of carriers (17), and 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 such as an access device (21), an external transport and storage system (8), a utility and its infrastructure (2, 7), an external information system (9) of, e.g. logistics service provider, trading company, a circular economy provider, or a waste handling company,

wherein the control system furthermore is configured to handle, process, and store information related to a user of the logistics service system (10).