

Description

BACKGROUND OF THE INVENTION

[0001] The invention relates to a passenger train set comprising a first wagon, a second wagon and a third wagon, the third wagon being arranged adjacent to and in between the first wagon and the second wagon. In a longitudinal direction of the train set, the first wagon has a first length, the second wagon has a second length and the third wagon has a third length, at least one of the first, second and third wagon being a transport module including passenger transport seating.

[0002] In public transportation, in particular in commuter traffic, it is typically necessary to provide a maximum transport capacity in combination with an optimized use of the available traction power in order to achieve a desired maximum passenger throughput in the respective railway network. Especially for commuter traffic, typically, train sets comprising double deck units or modules are used in order to increase the transport capacity of the train set. Typically, there is a tendency in the prior art to use relatively long double deck modules in order to maximize the transport capacity of the respective train set.

[0003] Mainly depending on the support concept used for the respective wagon body (i.e. individual support of each wagon body on its own running gears or shared support of adjacent wagon bodies on a shared running gear), several different train set concepts are known in the art. For example, EP 1 024 070 A1 and EP 0 616 935 A1, among others, show a first basic train concept with individually supported, comparatively long wagons of substantially identical length.

[0004] Contrary to that, EP 0 616 936 A1, EP 0 631 917 A1 and EP 0 616 935 A1, among others, show a second basic trains concept with relatively long double deck modules without wheels suspended at each of their ends on a short intermediate support module itself being supported on a running gear and having a length of about 50% of the length of the long double deck modules.

[0005] This second basic train concept has the disadvantage that the intermediate support modules are comparatively short such that they show a rather limited range in terms of the functionality of their internal layout. More precisely, once a decision is made, for example, that this module is an entry module equipped with passenger doors, the functionality of the entire module is more or less frozen. This is due to the fact that, apart from the passenger doors with the associated passenger entry area, virtually no further space is available in these short modules which could provide flexibility in terms of the arrangement of any further functional equipment (e.g. passenger seating, service modules such as toilets etc, compartments for vehicle equipment such as energy supply equipment, traction equipment, auxiliary equipment etc) to be implemented in a train.

[0006] Both of the above basic concepts have the further disadvantage that, on the one hand, they provide

relatively poor flexibility of the train sets to be formed as far as the total length of the train set is concerned. This is disadvantageous with respect to an optimized adaptation of the total length of the respective train set to the length of passenger platforms available at stations to be serviced by the train set. Furthermore, in both of these known concepts, due to the rather rigid scaling of the total train set length, there is comparatively little room for an optimization of the axle load of the respective running gear to provide optimum traction at the motorized running gears.

SUMMARY OF THE INVENTION

[0007] It is thus an object of the invention to, at least to some extent, overcome the above disadvantages and to provide a train set that is more flexible with respect to the location of the functional equipment of the train set, to the scaling of the total length of the train set as well as to the optimization of the axle loads while at the same time providing a high transport capacity of the train set.

[0008] This and other objects are achieved according to the present invention which is based on the technical teaching that an improved flexibility with respect to the location of the functional equipment of the train set, to the scaling of the total length of the train set as well as to the optimization of the axle loads is possible if the first length of the first module and/or of the second length of the second module lies within the range from 105% to 165% of the third length of the third module (preferably 120% to 165%, more preferably 130% to 160%).

[0009] Compared to the second train concept with its shorter intermediate modules, this design allows a higher flexibility with respect to the location of the functional equipment of the train set since the longer intermediate third wagon (or module) provides more space to locate and arrange functional equipment. Furthermore, also compared to the second train concept, the longer intermediate modules allow better length scaling of the train set while still providing first and second wagons (or modules) with high transport capacity and easier optimization of axle loads.

[0010] Compared to the first train concept with its identical module lengths, this design clearly allows better length scaling of the train set while still providing first and second wagons (or modules) with high transport capacity and easier optimization of axle loads.

[0011] Thus, according to one aspect, the invention relates to a passenger train set comprising a first wagon, a second wagon and a third wagon, the third wagon being arranged adjacent to and in between the first wagon and the second wagon, at least one of the first, second and third wagon being a transport module including passenger transport seating. In a longitudinal direction of the train set, the first wagon has a first length, the second wagon has a second length and the third wagon has a third length, wherein the first length and/or the second length is 105% to 165% of said third length, in particular

120% to 165% of said third length, preferably 130% to 160% of said third length.

[0012] Thanks to its high flexibility with respect to the location of the functional equipment of the train set, the third wagon may receive arbitrary combinations of different types of functional equipment. For example, access sections (with passenger doors and associated access areas) may be combined with service modules (e.g. toilets, storage compartments etc) as well as compartments for vehicle equipment (e.g. energy supply equipment, traction equipment, auxiliary equipment etc). With preferred variants of the invention, the third wagon is a transport module including passenger transport seating since this configuration provides a very high transport capacity of the train set. In addition as an alternative, each one of the first and second wagon is a transport module including passenger transport seating in order to further enhance the transport capacity of the train set.

[0013] The present invention may be implemented for any type of wagon. For example, any one of the first, second and third wagon may be a single deck module. However, in order to achieve an optimization of the transport capacity, with preferred embodiments of the present invention, at least one of the first wagon and the second wagon is a double deck module. Transport capacity may even be pushed further if at least one of the first wagon and the second wagon is a double deck module without passenger platform access doors.

[0014] In addition or as an alternative, at least one of the first wagon and the second wagon is a module substantially free from heavy main components of an electrical energy supply equipment of the train set, in particular free from a current collector device, a main transformer, a main battery device, a main line converter and a traction converter. Such a configuration of these long modules is particularly beneficial in terms of optimization of, both, the axle loads and the transport capacity.

[0015] It will be appreciated that, the third wagon as well may be a double deck module. However, with preferred embodiments of the present invention, the third wagon is a single deck module, since such a single deck module provides enhanced flexibility with respect to the arrangement of the functional equipment mentioned above. Particularly advantageous configurations are achieved if the third wagon is a module with at least one passenger platform access door, since, in this case, the adjacent first and second wagon may be designed without such passenger platform access doors leading to an enhanced transport capacity of these modules. Furthermore, for similar reasons, the third wagon may carry at least one service compartment, in particular a toilet compartment, to keep the first and second wagon free of such service compartments.

[0016] In addition or as an alternative, the third wagon, in particular in at least one roof compartment, may carry at least a part of an electrical energy supply equipment of the train set, in particular a current collector device and/or a current converter device. Such a configuration

provides not only optimized use of the space available within the wagon. It is also beneficial with respect to an optimized axle load distribution.

[0017] The first, second and third wagon may be supported in any suitable manner, either directly or indirectly, on one or more running gears. For example, each wagon may be supported directly on at least one associated running gear. However, preferably, adjacent wagons share a common running gear in order to save space and achieve optimized axle loads. Thus, with advantageous embodiments of the present invention, the first wagon and the third wagon are supported on a common first running gear and/or the second wagon and the third wagon are supported on a common second running gear. The respective running gear may be of any suitable type. Preferably, the respective running gear is a two-axle bogie to achieve good load-bearing capacity.

[0018] Furthermore, preferably in the respective running gear is a bogie of the Jacobs type, since this type is particularly beneficial in terms of achieving optimized axle load in combination with the wagons of different length and internal equipment. This is due to the fact that the central introduction of the load resulting from both wagons into such a Jacobs bogie provides a beneficial equalization of the axle loads irrespective of the individual load introduced by the respective wagon.

[0019] It will be appreciated that the first and second wagon may have the same length, resulting in a particularly simple wagon set (comprising a plurality of wagon types of different wagon body length) with a low number of different wagon body types. However, preferably, the first and second wagons have a different length, since this is beneficial in terms of the flexibility of the scaling of the length of the train set to be formed. Hence, with preferred embodiments of the invention, the second length is 75% to 100% of the first length, in particular 80% to 95% of the first length, preferably 85% to 90% of the first length.

[0020] It will be further appreciated that the length of the respective wagon may be chosen as a function of the transport capacity as well as the axle load to be achieved at the respective running gear. With preferred embodiments of the passenger train set according to the invention at least one of the first length and the second length ranges from 12500 mm to 14500 mm, preferably from 13000 mm to 14000 mm, more preferably from 13250 mm to 13750 mm. In addition or as an alternative, at least the other one of the first length and the second length ranges from 14500 mm to 16500 mm, preferably from 15000 mm to 16000 mm, more preferably from 15250 mm to 15750 mm. Furthermore, in addition or as an alternative, the third length ranges from 9000 mm to 11000 mm, preferably from 9500 mm to 10500 mm, more preferably from 9750 mm to 10250 mm. With these specific values for the respective length particularly advantageous transport capacities (of the respective train set) as well as axle loads (on the respective running gear) may be achieved.

[0021] In principle, one of the first and second wagon is may form an end wagon of the train set. However, preferably, the first, second and third wagon to form so-called middle wagons of the train set and at least one further (fourth) wagon is provided forming a so-called end wagon of the train set. The end wagon may have any suitable design.

[0022] Preferably, the fourth wagon is located adjacent to one of the first wagon and the second wagon and has a fourth length in the longitudinal direction of the train set. The fourth length may have any suitable amount. Preferably, the fourth length is 125% to 170% of the third length, in particular 125% to 155% of the third length, more preferably 135% to 145% of the third length.

[0023] The fourth wagon may be formed by any type of vehicle module. For example, it may be a double deck module. However, with preferred variants of the present invention, the fourth wagon is a single deck module. This is particularly beneficial in terms of locating the functional equipment of the train set since such a single deck module may receive a considerable amount of the vehicle's functional equipment.

[0024] It will be appreciated that any desired component of the functional equipment of the vehicle may be located in the fourth wagon. With preferred embodiments of the invention, the fourth wagon, in particular in at least one roof compartment, carries at least a part of an electrical energy supply equipment of the train set, in particular heavy components of such as a main transformer and/or a current converter device and/or a battery device of the electrical energy supply equipment. Preferably, the main transformer and/or the current converter device and/or the battery device are located in the region of an end running gear, in particular a traction running gear, of the fourth wagon. This is particularly beneficial since the arrangement of these heavy components in the region of this end running gear results in an optimized axle load on this running gear (which would otherwise be the least loaded running gear). This is not only beneficial with respect to the running stability but also with respect to the crosswind stability of the vehicle.

[0025] It will be further appreciated that the length of the fourth wagon may be chosen as a function of the transport capacity as well as the axle load to be achieved at its running gears. With preferred embodiments of the passenger train set according to the invention the fourth length ranges from 13250 mm to 15250 mm, preferably from 13750 mm to 14750 mm, more preferably from 14000 mm to 14500 mm.

[0026] With further preferred variants of the passenger train set according to the invention a fifth wagon is provided, the fifth wagon being an end wagon of the train set and having a fifth length in the longitudinal direction of the train set. Preferably, the fifth length ranges from 125% to 200% of the third length, in particular 125% to 175% of the third length, more preferably 135% to 145% of the third length.

[0027] Here as well, the length of the fifth wagon may

be chosen as a function of the transport capacity as well as the axle load to be achieved at its respective running gear. With preferred embodiments of the passenger train set according to the invention the fifth length ranges from 13250 mm to 15250 mm, preferably from 13750 mm to 14750 mm, more preferably from 14000 mm to 14500 mm. With other variants of the invention the fifth length ranges from 16500 mm to 18500 mm, preferably from 17000 mm to 18000 mm, more preferably from 17250 mm to 17750 mm. With still other variants of the invention the fifth length ranges from 18250 mm to 20000 mm, preferably from 18750 mm to 19750 mm, more preferably from 19000 mm to 19500 mm.;

[0028] The fifth wagon may as well be formed by any type of vehicle module. For example, it may be a single deck module providing the beneficial effect in terms of locating the functional equipment of the train set in such a single deck module as it has been outlined above.

[0029] However, with preferred variants of the present invention, the fifth wagon again is a double deck module. This is particularly beneficial since it allows further increasing the transport capacity of the train set. This holds, in particular, if the other end wagon of the train set is a single deck fourth wagon as it has been outlined above.

[0030] Similar to the arrangement of functional equipment components within the fourth wagon (as outlined above), also the fifth wagon, in particular in at least one roof compartment, preferably carries at least a part of an electrical energy supply equipment of the train set, in particular a current converter device of the electrical energy supply equipment. Here again, the current converter device, is preferably located in the region of an end running gear, in particular a traction running gear, of the fifth wagon.

[0031] It will be appreciated that the passenger train set according to the invention may comprise an arbitrary number of further wagons depending on the total length of the train said to be achieved. Preferably, either a further first wagon is provided, the fifth wagon being located adjacent to the further first wagon, or a further third wagon is provided, the fifth wagon being located adjacent to the further third wagon.

[0032] Furthermore, with preferred variants of the passenger train set according to the invention, two end wagons and a plurality of middle wagons are provided, the plurality of middle wagons being arranged between the two end wagons, wherein the plurality of middle wagons, in particular, consists of four to eight middle wagons. Such train sets represent a very flexible solution providing a high transport capacity particularly suitable for commuter services.

[0033] It will be appreciated that, preferably, the plurality of middle wagons, in the longitudinal direction of the train set, forms a continuously alternating sequence of longer middle wagons and shorter middle wagons, each shorter wagon being located adjacent to at least one longer wagon, the longer wagon having a length in the longitudinal direction of the train set that is greater

than the length of the adjacent shorter wagon. By means of this alternating sequence of shorter wagons (preferably representing functional modules of the train set) and longer wagons (preferably representing transport modules with passenger seating) a train configuration is achieved which is particularly well suited for high transport capacities and high passenger flow rates as they are required, for example, for commuter applications.

[0034] The present invention further relates to a set of passenger train modules comprising a plurality of different wagons, the said plurality of different wagons comprising the first wagon, the second wagon and the third wagon of the passenger train set according to the invention as it has been outlined above. Of course, this set of passenger train modules also may comprise the fourth wagon and/or the fifth wagon as it has been described above.

[0035] Further embodiments of the invention will become apparent from the dependent claims and the following description of preferred embodiments which refers to the appended figures. All combinations of the features disclosed, whether explicitly recited in the claims or not, are within the scope of the invention.

BRIEF DESCRIPTION OF THE DRAWINGS

[0036]

Figure 1A	is a schematic representation of a preferred embodiment of the train set according to the invention;
Figure 1B	is a schematic representation of a further preferred embodiment of the train set according to the invention;
Figures 2A, 2B	are schematic representations of further preferred embodiments of the train set according to the invention;
Figures 3A to 3F	are schematic representations of further preferred embodiments of the train set according to the invention;
Figures 4A to 4D	are schematic representations of further preferred embodiments of the train set according to the invention;
Figures 5A to 5C	are schematic representations of further preferred embodiments of the train set according to the invention;

DETAILED DESCRIPTION OF THE INVENTION

First embodiment

[0037] In the following, a first preferred embodiment of a passenger train set 101 according to the invention will be described with reference to Figure 1A. In order to simplify the explanations given below, an xyz-coordinate system has been introduced into the Figures, wherein (on a straight, level track) the x-axis designates the longitudinal direction of the vehicle 101, the y-axis designates the transverse direction of the vehicle 101 and the z-axis designates the height direction of the vehicle 101. Furthermore, the total length of the respective wagon (in meters) is given in the Figures as a number located centrally above the respective wagon.

[0038] The train set 101 comprises a total six wagons, namely (starting from a first end of the train set 101) a first end wagon 102, four middle wagons 103 to 106 and a further, second end wagon 107 (located at the second end of the train set 101).

[0039] In the embodiment shown, each wagon is supported in the region of each of its ends on a running gear 108, 109. Only the end running gears 108 located at the free end of each end wagon 102 are exclusively associated to the respective end wagon. All other middle running gears 109 are shared running gears, each being located in the coupling area of two adjacent wagons and supporting both these adjacent wagons. However, it will be appreciated that any other type of support concept may be used with other embodiments of the invention.

[0040] It will be further appreciated that any type of suitable running gear (single or multi-axle) may be used for either one of the end running gears 108 and the middle running gears 109. In the example shown, running gears in the form of end bogies 108 and middle bogies 109 are used. The middle bogies 109 are designed as so called Jacobs bogies, wherein the support loads of both wagons are introduced centrally into the bogie frame leading to equalized axle loads irrespective of the individual support load of the respective wagon.

[0041] The middle wagons 103 to 106 are arranged in a continuously alternating sequence of longer and shorter intermediate wagons, each shorter intermediate middle wagon 104, 106 being located adjacent to at least one longer middle wagon 103, 105, the longer middle wagon 103, 105 having a length (i.e. a dimension in the longitudinal direction of the train set 101) that is greater than the length of the adjacent shorter wagon 104, 106.

[0042] More precisely, the middle wagons 103 to 106 comprise a (longer) first middle wagon 103, a (longer) second middle wagon 105, a (shorter) intermediate third middle wagon 104, and a further (shorter) intermediate middle wagon 106. The third middle wagon 104 is arranged between the first middle wagon 103 and the second middle wagon 105.

[0043] As can be seen from Figure 1A, the (longer) first middle wagon 103 has a total first length L1 of 13,695

mm (or 13.695 m as indicated in Figure 1A). In the embodiment shown, the same applies to the (longer) second middle wagon 105 having a total second length L2 of 13,695 mm (or 13.695 m as indicated in Figure 1A). The (shorter) third middle wagon 106 has a total third length L3 of 10,020 mm (or 10.020 m as indicated in Figure 1A). Consequently, here, the first length L1 and the second length L2 are 136.7% of the third length L3.

[0044] As will be explained in the following, these dimensional relations between the wagon lengths allow a very favorable train configuration which is particularly well suited for high transport capacities and high passenger flow rates as they are required, for example, for commuter applications.

[0045] First of all, the first wagon 103 and the second wagon 105 are designed as transport modules in the form of double-deck modules without any platform access doors and without any substantial components of the main energy supply and traction equipment of the train set 101. More specifically, only auxiliary equipment, such as air conditioning modules 110, is arranged within the (longer) first and second wagon 103, 105. Thus, the space within these longer wagons may almost exclusively be used for passenger transport, in particular, the arrangement of passenger seating, such that these modules 103, 105, in an advantageous manner, have a very high transport capacity.

[0046] On the other hand, the third wagon 104 as well as the further wagon 106 (both being shorter intermediate modules in the sense of the present invention) both are designed as functional intermediate modules in the form of single deck modules. Compared to the conventional designs mentioned initially (wherein the length of the longer modules is about twice the length of the shorter modules), these shorter modules 104, 106 are comparatively long which allows very favorable arrangement of functional components within these shorter modules 104, 106.

[0047] More precisely, each of the wagons 104, 106 comprises access sections with platform access doors 111, a service module in the form of a toilet module 112, as well as a few rows of passenger seating (not shown in detail in Figure 1A) located at both of its ends. Furthermore, in one or more roof compartments, each of the wagons 104, 106 receives heavy components of the main energy supply and traction equipment of the train set 101, such as a pantograph 113, current converters 114, high tension equipment 115, brake resistors 116, compressed air production equipment 117, further air conditioning equipment 118 etc.

[0048] Due the comparatively high length L3 of the shorter modules 104, 106, two access sections with up to four passenger platform access doors 111 (with comparatively large entry platform areas) may be arranged in each of the wagons 104, 106 allowing very high passenger flow rates. Furthermore, it is possible to arrange the toilet module 112 (comprising up to two toilet compartments) at a favorable central location within the re-

spective wagon such that, on the one hand, it is easily accessible from both adjacent wagons 103, 105 while not hampering flow to and from the doors 111. On the other hand, the central arrangement of the comparatively heavy toilet module is beneficial as far as the well-balanced load distribution within the respective wagon 104, 106 is concerned.

[0049] It will be appreciated that, with other embodiments of the invention, the central part of these shorter modules 104, 106, may, at least in part, also be used for other purposes or functions, respectively. For example, additional passenger seating may be located here as well as storage compartments, bicycle racks, platforms for disabled passengers (e.g. with wheelchair fixation devices etc) or the like.

[0050] Furthermore, due to the comparatively high length L3 of the shorter modules 104, 106, the roof compartment (receiving the components 113 to 118) provides sufficient space allowing an arrangement of these components 113 to 118 which is also favorable to a well-balanced load distribution within the respective wagon 104, 106. It will however be appreciated that, depending on the respective axle load to be achieved at the respective middle bogie 109, the relatively large roof compartments allow a distribution of these components 113 to 118 which is well tuned to the desired axle loads. This is particularly beneficial with respect to the axle loads at the traction middle bogies 109.1 among the middle bogies 109.

[0051] Finally, the additional rows of passenger seating within the respective shorter module 104, 106, in an advantageous manner, further raise the total transport capacity of the passenger train set 101.

[0052] The end wagon 102, in the sense of the present invention, forms a fourth wagon of the train set 101. The end wagon 102 is located adjacent to the first wagon 103 and has a fourth length L4 in the longitudinal direction of the train set 101. As can be seen from Figure 1A, the fourth length L4 is 14,300 mm (or 14.3 m as indicated in Figure 1A), hence, 142.7% of the third length L3.

[0053] The fourth wagon 102 as well is designed as a functional single deck module receiving considerable parts of the functional equipment of the train set 101. More precisely, the fourth wagon 102 comprises an access section with platform access doors 111, a service module in the form of a toilet module 112, a platform 119 for disabled passengers (e.g. with wheelchair fixation devices etc) as well as a few rows of passenger seating (not shown in detail in Figure 1A). Furthermore, among others in one or more roof compartments, the fourth wagon 102 receives heavy components of the main energy supply and traction equipment of the train set 101, such as a main transformer 120, current converters 121, a battery device 122, brake resistors 116, further air conditioning equipment 118 etc. Here again, the space available in the roof compartments of this single deck module allows proper balancing and tuning of the axle loads to desired values.

[0054] As can be seen from Figure 1A, the main transformer 120 and the battery device 122 are located in the region of the end running gear 108, which is designed as a traction running gear, of the fourth wagon 102. This is particularly beneficial since the arrangement of these heavy components in the region of this end running gear 108 results in an optimized axle load at this running gear (which would otherwise be the least loaded running gear). This is not only beneficial with respect to the running stability but also with respect to the crosswind stability of the vehicle. Furthermore, this design is of course also beneficial with respect to the traction power that may be transmitted at this running gear 108.

[0055] Finally, the end wagon 107, in the sense of the present invention, forms a fifth wagon of the train set 101. The end wagon 107 is located adjacent to the further intermediate wagon 105 and has a fifth length L5 in the longitudinal direction of the train set 101. As can be seen from Figure 1A, the fifth length L5 is 19,215 mm (or 19.215 m as indicated in Figure 1A), hence, 191.8% of the third length L3.

[0056] Since the other functional modules already receive a majority of the main vehicle equipment components, the fifth wagon 107 is designed as a double deck module with passenger seating. This is particularly beneficial since, thus, the transport capacity of the train set 101 is further increased.

[0057] However, also the fifth wagon, among others in at least one roof compartment, carries a part of an electrical energy supply equipment of the train set 101, in particular a current converter device 114, as well as air-conditioning equipment 110, 118 and a battery device 122. Here again, these components 114, 110, 118, 122 are located in the region of the traction running gear 108 in order to achieve the beneficial effect on axle load outlined above in the context of the fourth wagon 102.

[0058] As had been outlined previously, beyond the advantages mentioned above, the design of the individual wagons 102 to 107 allows optimized scaling of the total length of the train set 101 to different transport capacities required as well as to different available passenger platform lengths at stations to be serviced if further wagons from a set of passenger modules according to the invention are added as will be explained in the following with reference to the further embodiments.

Second embodiment

[0059] A further preferred embodiment of a six wagon train set 201 according to the present invention will now be described with reference to Figure 1 B. The train set 201, in its basic design and functionality, largely corresponds to the train set 101 such that it will be mainly referred to the differences only. Moreover, identical components are given identical reference numerals while like components are given the same reference numerals increased by 100. Unless deviating explanations are given in the following it is here explicitly referred to the explanations

given above with respect to the features and functions of these components.

[0060] The only (major) difference with respect to the train set 101 lies within the fact that a different first wagon 203 is chosen from the set of passenger modules and replaces the first wagon 103 of Figure 1A. This first wagon 203 has a first length L1 of 15,445 mm (or 15.445 m as indicated in Figure 1 B), such that, here, the first length L1 is 154.1 % of the third length L3. By this means, a slightly longer train set 201 may be achieved with slightly higher transport capacity.

Third and fourth embodiment

[0061] Further preferred embodiments of seven wagon train sets 301 and 401 according to the present invention will now be described with reference to Figures 2A and 2B. The train sets 301 and 401, in their basic design and functionality, largely correspond to the train sets 101 and 201 such that it will be mainly referred to the differences only. Moreover, identical components are given identical reference numerals while like components are given the same reference numerals increased by a multiple of 100. Unless deviating explanations are given in the following it is here explicitly referred to the explanations given above with respect to the features and functions of these components.

[0062] A difference of the third embodiment (see Figure 2A) with respect to the train set 101 lies within the fact that the first wagon 203 mentioned above is chosen from the set of passenger modules and replaces the first wagon 103 of Figure 1A. Furthermore, a different second wagon 305 is chosen from the set of passenger modules and replaces the second wagon 103 of Figure 1A. This second wagon 305 has a second length L2 of 15,445 mm (or 15.445 m as indicated in Figure 1 B), such that, here, the second length L2 is 154.1% of the third length L3. By this means, a slightly longer train set 301 may be achieved with slightly higher transport capacity.

[0063] A further difference of the third embodiment with respect to the train set 101 lies within the fact that the intermediate wagon 306 carries less equipment in its roof compartment, while the fifth wagon 307 is designed as a single deck module receiving these components (removed from the roof compartment of the intermediate wagon 306) in its own roof compartment. The fifth wagon 307 has a fifth length L5 of 14,300 mm (or 14.3 m as indicated in Figure 2A), such that, here, the fifth length L5 is 142.7% of the third length L3. It will be appreciated that the wagon body of the fifth wagon 307 may correspond to the wagon body of the fourth wagon 102.

[0064] Finally, a further difference lies within the fact that a further first wagon 103 as mentioned above is chosen from the set of passenger modules and inserted (as a seventh wagon) between the intermediate (sixth) wagon 306 and the fifth wagon 307.

[0065] The only difference between the train set 301 (see Figure 2A) and the train set 401 (see Figure 2B) lies

within the fact that the first wagon 203 mentioned above is chosen from the set of passenger modules and replaces the wagon 103 of Figure 2A as the seventh wagon 423.

Fifth to tenth embodiment

[0066] Further preferred embodiments of eight wagon train sets 501 to 1001 according to the present invention will now be described with reference to Figures 3A to 3F. The train sets 501 to 1001, in their basic design and functionality, largely correspond to the train sets 101 to 401 such that it will be mainly referred to the differences only. Moreover, identical components are given identical reference numerals while like components are given the same reference numerals increased by a multiple of 100. Unless deviating explanations are given in the following it is here explicitly referred to the explanations given above with respect to the features and functions of these components.

[0067] A difference of the fifth embodiment (see Figure 3A) with respect to the train set 101 lies within the fact that the third wagon 504 and the sixth wagon 506 have a slightly different equipment, while an additional eighth wagon 524 is inserted between the seventh wagon 323 and the fifth wagon 507.

[0068] Furthermore, the fifth wagon 507 again is a double deck module, apart from its length L5, corresponding to the fifth wagon 107. This fifth wagon 305 has a fifth length L5 of 17,415 mm (or 17.415 m as indicated in Figure 3A), such that, here, the fifth length L5 is 173.8% of the third length L3.

[0069] The difference between the train set 501 (see Figure 3A) and the train set 601 (see Figure 3B) lies within the fact that a third wagon 104 is used (instead of wagon 504), a sixth wagon 606 with slightly different equipment is used, and intermediate wagon 106 is used as the eighth wagon 624, and again a fifth wagon 107 is used.

[0070] The difference between the train set 601 (see Figure 3B) and the train set 701 (see Figure 3C) lies within the fact that a second wagon 305 is used (instead of wagon 105).

[0071] The difference between the train set 701 (see Figure 3C) and the train set 801 (see Figure 3D) lies within the fact that a first wagon 203 is used (instead of wagon 103), a second wagon 105 is used (instead of wagon 305), a sixth wagon 806 having slightly different equipment is used (instead of wagon 706), a further wagon 203 is used as the seventh wagon 823 (instead of wagon 323), and a seventh wagon 824 with slightly different equipment is used (instead of wagon 624).

[0072] The difference between the train set 801 (see Figure 3D) and the train set 901 (see Figure 3E) lies within the fact that a first wagon 103 is used (instead of wagon 203), a second wagon 305 is used (instead of wagon 105), and a sixth wagon 906 having slightly different equipment is used (instead of wagon 806).

[0073] The difference between the train set 901 (see Figure 3E) and the train set 1001 (see Figure 3F) lies

within the fact that a first wagon 203 is used (instead of wagon 103), and a sixth wagon 306 is used (instead of wagon 9 in 06).

Eleventh to fourteenth embodiment

[0074] Further preferred embodiments of nine wagon train sets 1101 to 1401 according to the present invention will now be described with reference to Figures 4A to 4D. The train sets 1101 to 1201, in their basic design and functionality, largely correspond to the train sets 101 to 1001 such that it will be mainly referred to the differences only. Moreover, identical components are given identical reference numerals while like components are given the same reference numerals increased by a multiple of 100. Unless deviating explanations are given in the following it is here explicitly referred to the explanations given above with respect to the features and functions of these components.

[0075] The difference between the train set 1101 (see Figure 4A) and the train set 1001 (see Figure 3F) lies within the fact that a second wagon 105 is used (instead of wagon 305), a sixth wagon 606 is used (instead of wagon 306), an intermediate wagon 1124 with slightly different equipment is used (instead of wagon 824), an additional wagon 103 is used as the ninth wagon 1125, and again a wagon 307 is used as the fifth wagon.

[0076] The difference between the train set 1201 (see Figure 4B) and the train set 1101 (see Figure 4C) lies within the fact that a wagon 203 is used as the ninth wagon 1225 (instead of wagon in 1125).

[0077] The difference between the train set 1301 (see Figure 4C) and the train set 1201 (see Figure 4B) lies within the fact that a second wagon 305 is used (instead of wagon 105), and a sixth wagon 706 is used (instead of wagon 606).

[0078] The difference between the train set 1401 (see Figure 4D) and the train set 1301 (see Figure 4C) lies within the fact that again a wagon 1225 is used as the ninth wagon (instead of wagon 1125).

Fifteenth to seventeenth embodiment

[0079] Further preferred embodiments of ten wagon train sets 1501 to 1701 according to the present invention will now be described with reference to Figures 5A to 5C. The train sets 1501 to 1701, in their basic design and functionality, largely correspond to the train sets 101 to 1401 such that it will be mainly referred to the differences only. Moreover, identical components are given identical reference numerals while like components are given the same reference numerals increased by a multiple of 100. Unless deviating explanations are given in the following it is here explicitly referred to the explanations given above with respect to the features and functions of these components.

[0080] The difference between the train set 1501 (see Figure 5A) and the train set 1401 (see Figure 4D) lies

within the fact that a first wagon 103 is used (instead of wagon 203), a third wagon 504 is used (instead of wagon 104), a second wagon 105 is used (instead of wagon 305), an intermediate wagon 1506 with slightly different equipment is used as the sixth wagon (instead of wagon 706), a wagon 323 is used as the seventh wagon (instead of wagon 823), a wagon 103 is used as the ninth wagon 1525 (instead of wagon 1225), and a fifth wagon 507 is used (instead of wagon 307).

[0081] The difference between the train set 1601 (see Figure 5B) and the train set 1501 (see Figure 5A) lies within the fact that a first wagon 203 is used (instead of wagon 103), a third wagon 104 is used (instead of wagon 504), a wagon 1606 with slightly different equipment is used as the sixth wagon (instead of wagon 1506), a wagon 823 is used in the seventh wagon (instead of wagon 323), a wagon 1124 is used in the eighth wagon (instead of wagon 1524), a wagon 1225 is used as the ninth wagon (instead of wagon 1125), an intermediate wagon 1626 with slightly different equipment is used as the tenth wagon (instead of wagon 1526), and a wagon 107 is used as the fifth wagon.

[0082] Finally, the difference between the train set 1701 (see Figure 5C) and the train set 1601 (see Figure 5B) lies within the fact that a second wagon 305 is used (instead of wagon 105).

[0083] It will be appreciated that the set of passenger train modules according to the invention comprises three different middle wagon types with three different wagon bodies, in particular different wagon lengths (namely the first and second wagon, and the third wagon) as well as three different end wagon types with three different wagon bodies, in particular different wagon lengths (namely the single deck fourth wagon and the two double deck fifth wagons). Thus, the above embodiments (and, of course, further embodiments beyond that) may be obtained with as little as six different wagon bodies. Hence, the set of passenger train modules according to the invention provides a very high flexibility in the length and transport capacity scaling.

[0084] It should be noted that the longitudinal distance or gap between the individual wagons has not been shown in Figures 1A to 5B in the value it has in reality (since the location of inter-wagon shock absorbing devices is also shown in the Figures). In reality, any interface between two wagons typically is equipped with a conventional passenger transit area or device, allowing passenger transit between these wagons traversing the (relatively) small gap between two wagons.

[0085] In the foregoing, the invention has been described in the context of train sets used in commuter applications. However, it will be appreciated that the invention may be used in the context of any other type of use of a train set for passenger transport.

Claims

1. A passenger train set comprising

- a first wagon (103), a second wagon (105) and a third wagon (104),
- said third wagon (104) being arranged adjacent to and in between said first wagon (103) and said second wagon (105);
- at least one of said first, second and third wagon (103, 104, 105) being a transport module including passenger transport seating;
- in a longitudinal direction of said train set, said first wagon (103) having a first length, said second wagon (105) having a second length and said third wagon (104) having a third length,

characterized in that

- said first length and/or said second length is 105% to 165% of said third length, in particular 120% to 165% of said third length, preferably 130% to 160% of said third length.

2. The passenger train set according to claim 1, wherein

- said third wagon (104) is a transport module including passenger transport seating and/or
- each one of said first and second wagon (103, 105) is a transport module including passenger transport seating.

3. The passenger train set according to claim 1 or 2, wherein

- at least one of said first wagon (103) and said second wagon (105) is a double deck module, in particular a module without passenger platform access doors;

and/or

- at least one of said first wagon (103) and said second wagon (105) is a module substantially free from main components of an electrical energy supply equipment of said train set, in particular free from a current collector device, a main transformer, a main battery device, a main line converter and a traction converter.

4. The passenger train set according to any one of the preceding claims, wherein

- said third wagon (104) is a single deck module, in particular a module with at least one passenger platform access door (111).

and/or

- said third wagon (104), in particular in at least one roof compartment, carries at least a part of an electrical energy supply equipment of said train set, in particular a current collector device (113) and/or a current converter device,

and/or

- said third wagon (104) carries at least a service compartment, in particular a toilet compartment (112).

5. The passenger train set according to any one of the preceding claims, wherein

- said first wagon (103) and said third wagon (104) are supported on a common first running gear (109), in particular a first two-axle bogie, preferably a bogie of the Jacobs type,

and/or

- said second wagon (105) and said third wagon are supported on a common second running gear (109), in particular a second two-axle bogie preferably a bogie of the Jacobs type.

6. The passenger train set according to any one of the preceding claims, wherein said second length is 75% to 100% of said first length, in particular 80% to 95% of said first length, preferably 85% to 90% of said first length.

7. The passenger train set according to any one of the preceding claims, wherein

- at least one of said first length and said second length ranges from 12500 mm to 14500 mm, preferably from 13000 mm to 14000 mm, more preferably from 13250 mm to 13750 mm;

and/or

- at least the other one of said first length and said second length ranges from 14500 mm to 16500 mm, preferably from 15000 mm to 16000 mm, more preferably from 15250 mm to 15750 mm;

and/or

- said third length ranges from 9000 mm to 11000 mm, preferably from 9500 mm to 10500 mm, more preferably from 9750 mm to 10250 mm;

8. The passenger train set according to any one of the

preceding claims, wherein

- a fourth wagon (102) is provided;
- said fourth wagon (102) being an end wagon of said train set located adjacent to one of said first wagon (103) and said second wagon (105);
- said fourth wagon (102), in said longitudinal direction of said train set, having a fourth length;
- said fourth length, in particular, being 125% to 170% of said third length, in particular 125% to 155% of said third length, preferably 135% to 145% of said third length;

and/or

- said fourth length, in particular, ranging from 13250 mm to 15250 mm, preferably from 13750 mm to 14750 mm, more preferably from 14000 mm to 14500 mm.

9. The passenger train set according to claim 8, wherein

- said fourth wagon (102) is a single deck module
- said fourth wagon (102), in particular in at least one roof compartment, carries at least a part of an electrical energy supply equipment of said train set, in particular a main transformer (120) and/or a current converter device (121) and/or a battery device (122) of said electrical energy supply equipment,
- said main transformer (120) and/or said current converter device (121) and/or said battery device (122), in particular, being located in the region of an end running gear (108), in particular a traction running gear, of said fourth wagon (102).

10. The passenger train set according to any one of the preceding claims, wherein

- a fifth wagon (107) is provided;
- said fifth wagon (107) being an end wagon of said train set;
- said fifth wagon (107), in said longitudinal direction of said train set, having a fifth length, said fifth length, in particular, being 125% to 200% of said third length, in particular 125% to 175% of said third length, preferably 135% to 145% of said third length.

11. The passenger train set according to claim 10, wherein

- said fifth wagon (107) is a double deck module

and/or

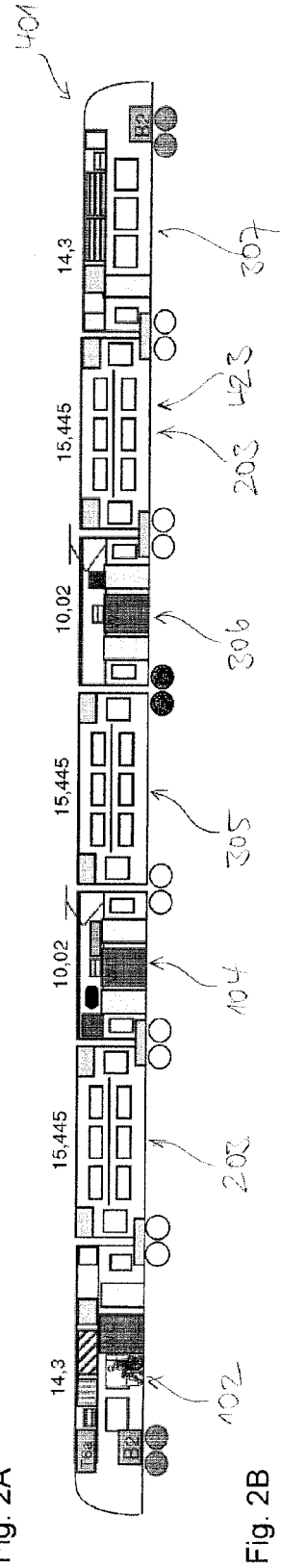
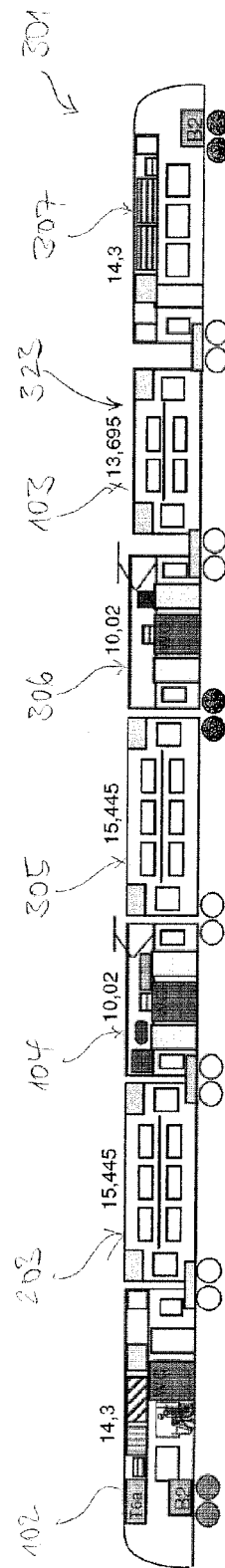
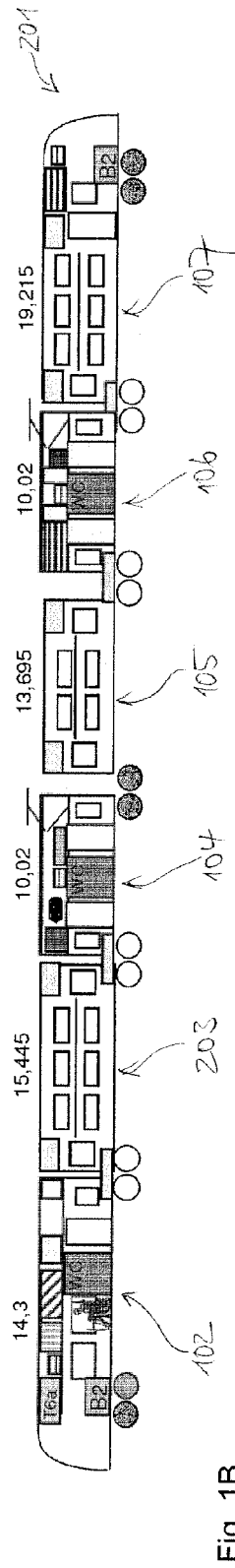
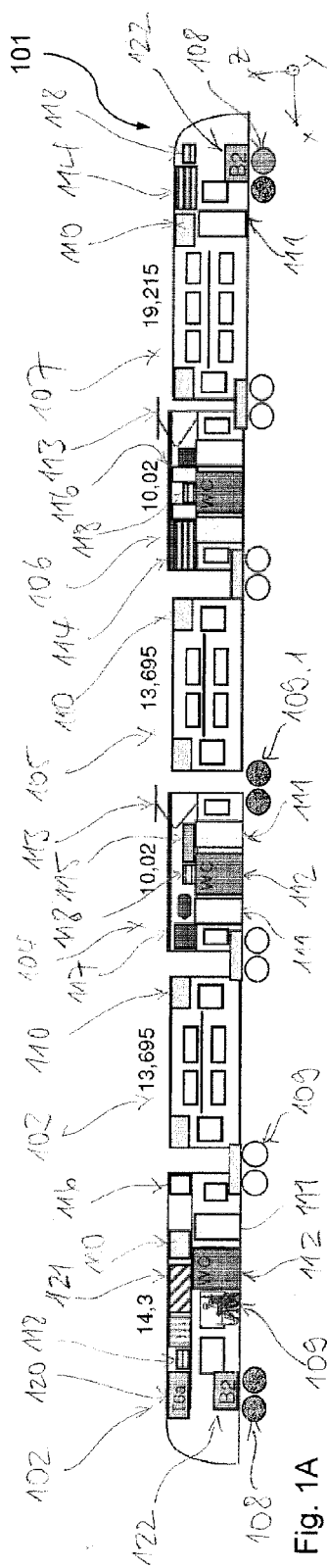
- said fifth wagon (107), in particular in at least one roof compartment, carries at least a part of an electrical energy supply equipment of said train set, in particular a current converter device (114) of said electrical energy supply equipment, 5
 - said current converter device (114), in particular, being located in the region of an end running gear (108), in particular a traction running gear, of said fifth wagon (107). 10
- 12.** The passenger train set according to claim 10 or 11, wherein
- a further first wagon (323) is provided, said fifth wagon (307) being located adjacent to said further first wagon (323); 15
- or 20
- a further third wagon (106) is provided, said fifth wagon (107) being located adjacent to said further third wagon (106).
- 13.** The passenger train set according to any one of claims 10 to 12, wherein 25
- said fifth length ranges from 13250 mm to 15250 mm, preferably from 13750 mm to 14750 mm, more preferably from 14000 mm to 14500 mm; 30
- or
- said fifth length ranges from 16500 mm to 18500 mm, preferably from 17000 mm to 18000 mm, more preferably from 17250 mm to 17750 mm; 35
- or 40
- said fifth length ranges from 18250 mm to 20000 mm, preferably from 18750 mm to 19750 mm, more preferably from 19000 mm to 19500 mm. 45
- 14.** The passenger train set according to any one of the preceding claims, wherein
- two end wagons (102, 107) and a plurality of middle wagons (103 to 106) are provided, said plurality of middle wagons (103 to 106) being arranged between said two end wagons (102, 107); 50
 - said plurality of middle wagons (103 to 106), in particular, consisting of four to eight middle wagons (103 to 106); 55

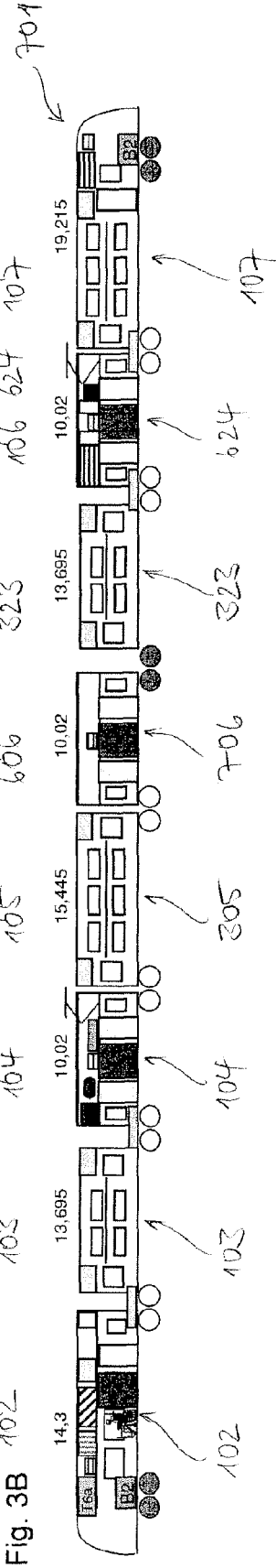
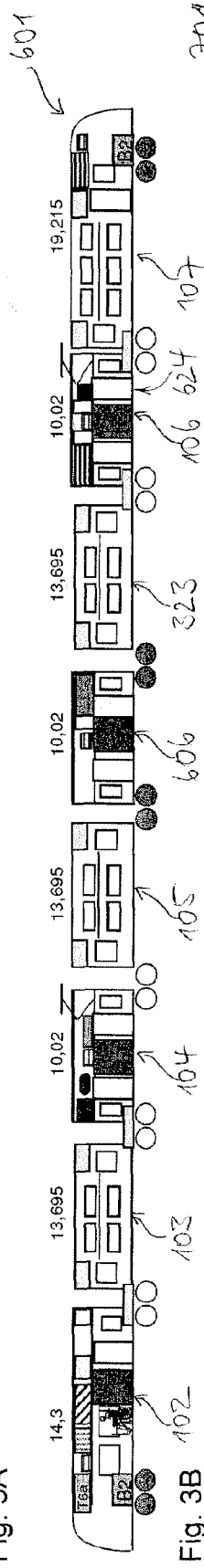
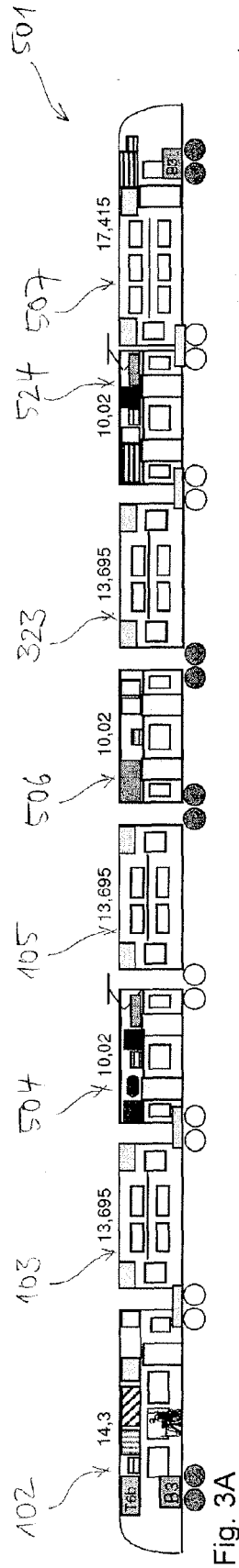
and/or

- said plurality of middle wagons (103 to 106), in said longitudinal direction of said train set, forming a continuously alternating sequence of longer middle wagons (103, 105) and shorter middle wagons (104, 106), each shorter wagon (104, 106) being located adjacent to at least one longer wagon (103, 105), said longer wagon (103, 105) having a length in said longitudinal direction of said train set that is greater than the length of said adjacent shorter wagon (104, 106).

15. A set of passenger train modules comprising

- a plurality of different wagons ;
- said plurality of different wagons (102 to 107) comprising said first wagon (103), said second wagon (105) and said third wagon (104) of said passenger train set according to any one of the preceding claims.





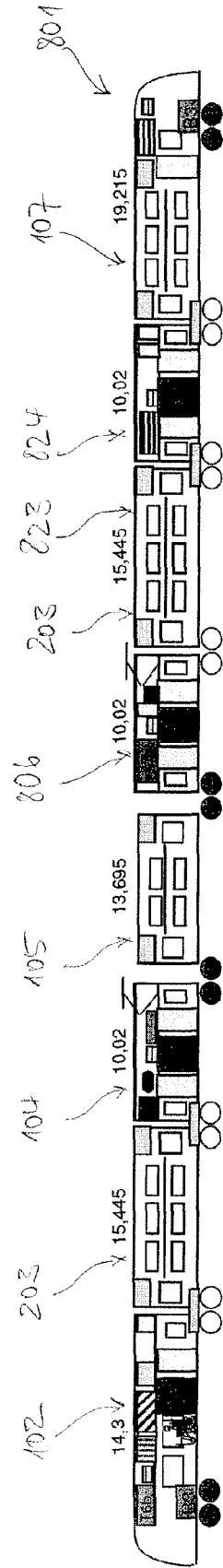


Fig. 3D

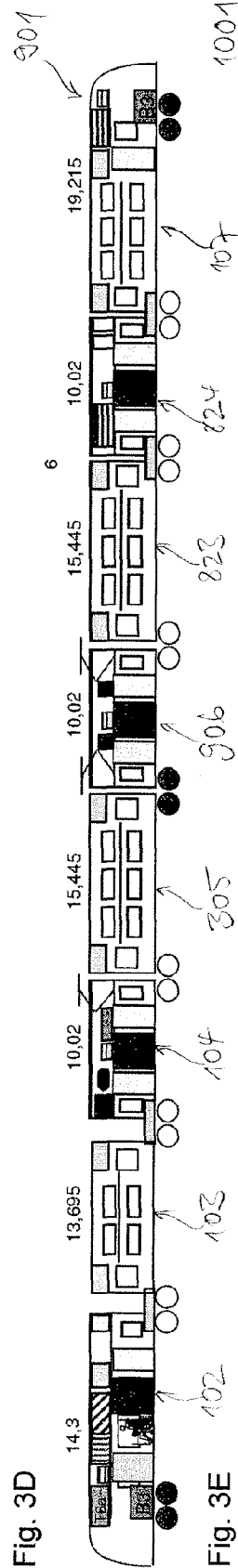


Fig. 3E

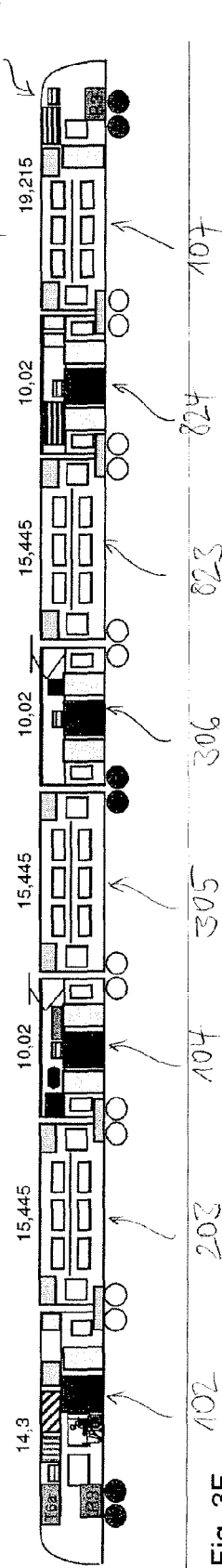


Fig. 3F

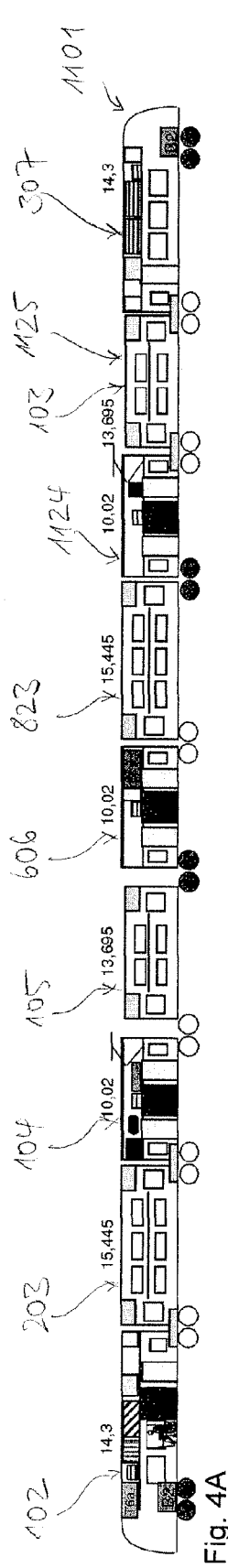


Fig. 4A

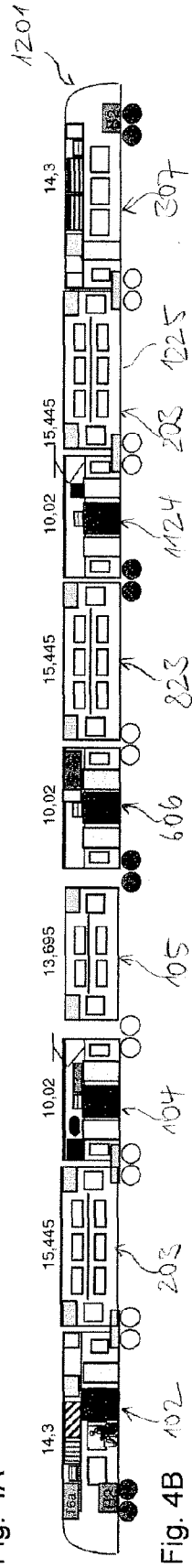


Fig. 4B

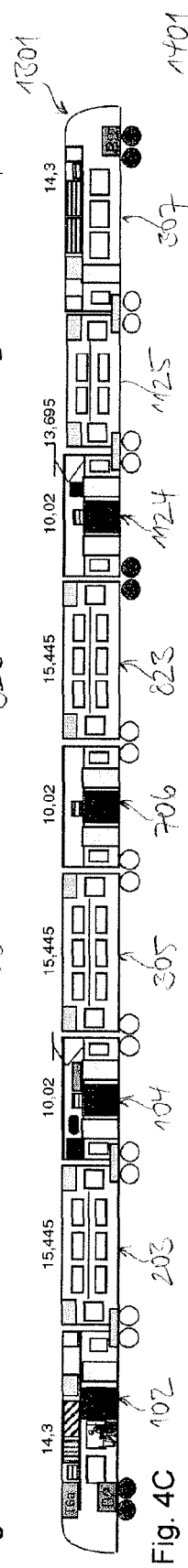


Fig. 4C

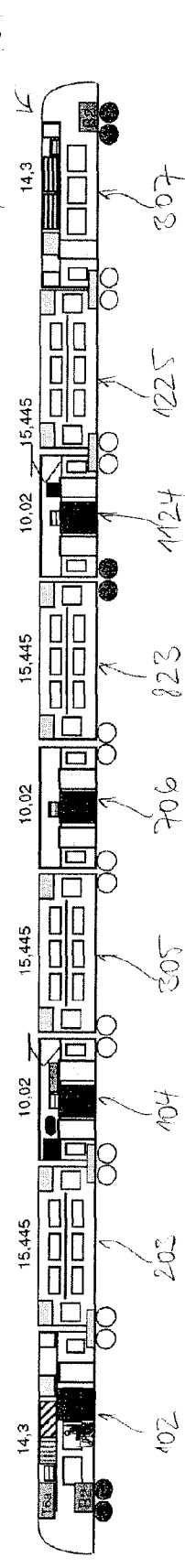


Fig. 4D

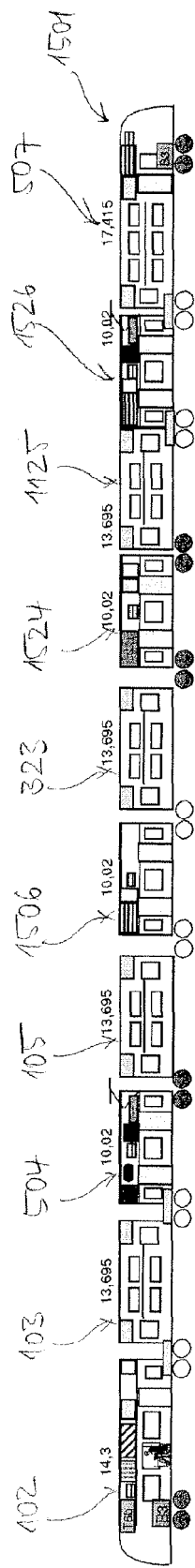


Fig. 5A

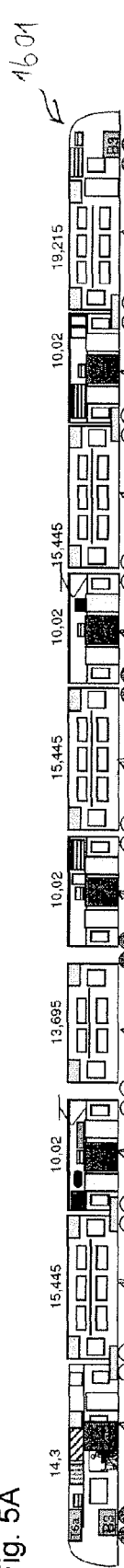


Fig. 5B

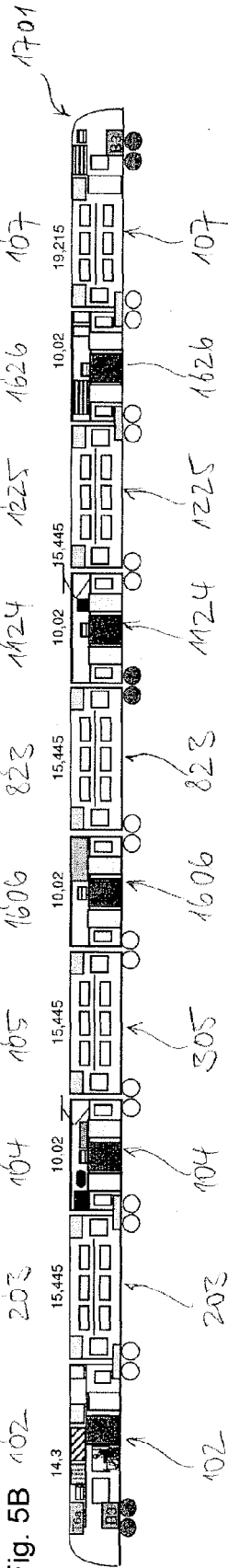


Fig. 5C



EUROPEAN SEARCH REPORT

Application Number
EP 09 17 9876

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
A	EP 1 958 844 A1 (ALSTOM TRANSPORT SA [FR]) 20 August 2008 (2008-08-20) * paragraph [0015] - paragraph [0031]; figure 1 *	1,15	INV. B61D3/10 B61D17/04 B61C3/00
A	US 1 875 214 A (CARL BUDERUS) 30 August 1932 (1932-08-30) * page 1, line 60 - page 2, line 76; figures 1-5 *	1,15	
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			TECHNICAL FIELDS SEARCHED (IPC)
			B61D B61C
The present search report has been drawn up for all claims			
Place of search The Hague		Date of completion of the search 29 April 2010	Examiner Chlosta, Peter
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			

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EP 09 17 9876

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29-04-2010

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