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(54) STRING TRANSPORT SYSTEM

(57) The invention relates to the area of transport, particularly, the above-ground transport systems of string type with rail track structure related to overpass-type tracks, and can be used in development of both inner-city transport highways and in construction of intercity and international transport systems.

The proposed string transport system by Yunitski comprises two rail cords of the lower (3) level of the track structure and above them two rail cords of the upper (4) level of the track structure mounted on the foundation (1) between anchor (2a) supports resting on the intermediate (2b) supports; made in the form of prestressed load-bearing members (5) enclosed in the corresponding bodies (6) with mating therewith rolling surfaces (7) for wheeled vehicles (8) and forming two tracks, interconnected in spans *G* between adjacent supports (2) by means of two-level trussed track structure in the form of zigzag-oriented rod elements (9), forming triangles with the rail cords of the lower (3) and upper (4) levels and positioned on the outer sides of those rail cords. At each level of the track structure, left and right rail cords are connected to each other by cross bulkheads (11) installed in junction units thereof with rod elements (9). Rail cords of lower (3) level are fastened on transverse beams (13), which are pivot-lever connected to supports (2) by means of assembly units (14), located in two vertical longitudinal planes *N* and *M* with the possibility of displacement along the axis of the track structure, whereas the transverse beams (13) are arranged at conjunction points of corresponding latitudinal planes *W* passing through junction units (12) and centers of supports, while vertical longitudinal planes *A* and *B*, containing junction units (12), are displaced relative to vertical longitudinal planes *N* and *M*, containing assembly units (14), by the defined distance *L*, m.

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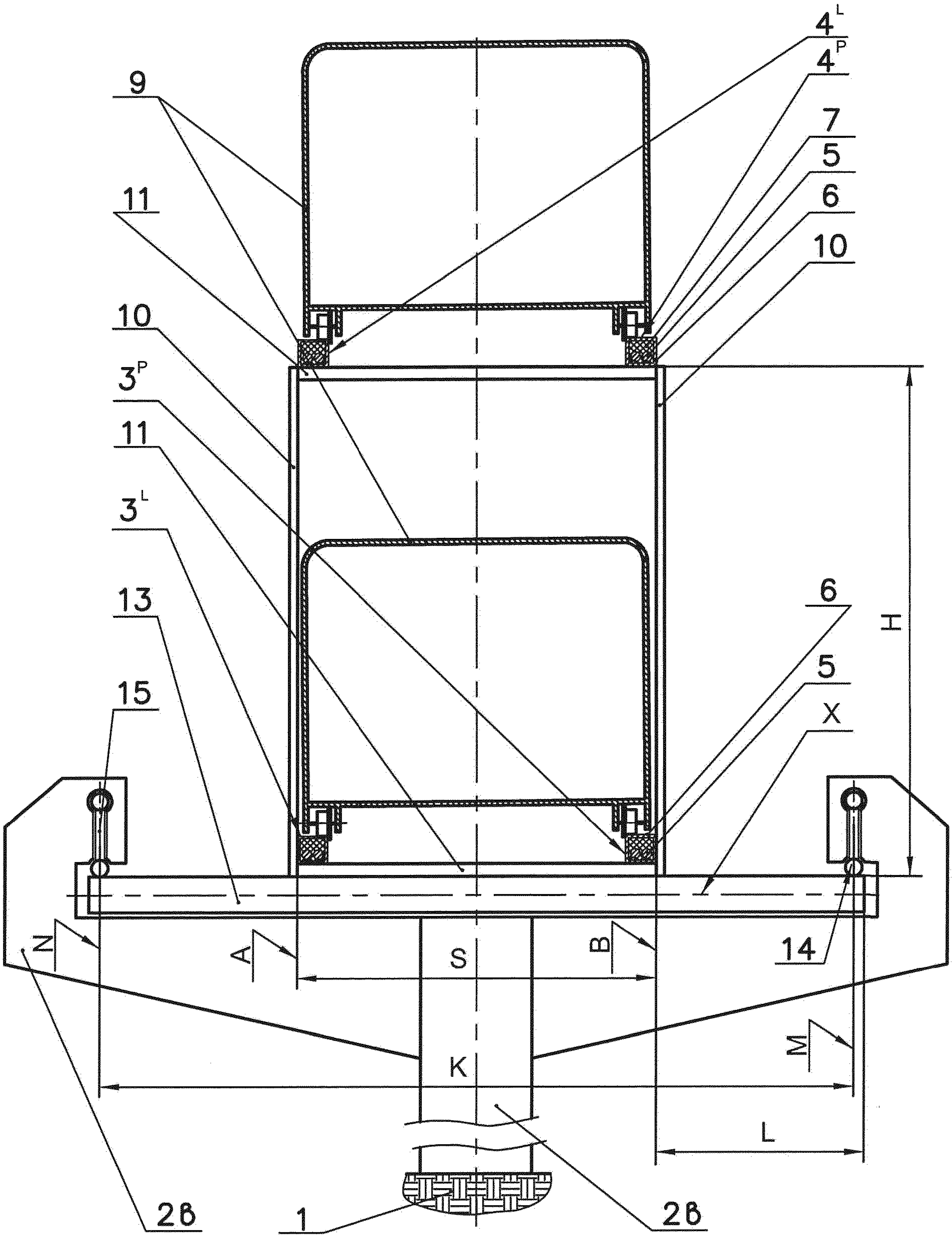

Fig. 3

Description

Technical field

[0001] The present invention relates to the above-ground transport systems of string type with rail track structure related to overpass-type tracks. It can be used in development of both inner-city highways and in construction of intercity and international transport systems.

Background Art

[0002] The logical solution to improve the existing track structures are the string transport systems by Yunitski.

[0003] Linear transport system by Yunitski is known, which includes at least one vehicle having a drive unit and guided by wheels on at least one rail containing a head and connected to a prestressed longitudinal element mounted on supports located on foundation. Prestressed longitudinal element of this transport system is made in the form of at least one string connected by gaskets of variable height with head of each rail along the whole length. Hereby, the rail head is connected to DC or AC electric power source, and the rail is connected to the support by means of electric insulator. Rails in the said transport system are connected to each other by means of transverse strips, which are equipped with electric insulators and dampers. Furthermore, in the above-mentioned transport system, the supports are rigid and movable, whereas the rail track is connected to the movable support by a mechanism of mutual relative longitudinal displacement, including, for example, with use of a rod, and/or a mechanism for adjusting its position relative to the support and foundation, and/or by means of a damper [1].

[0004] The disadvantages of such transport system are the insufficient rigidity and dynamic stability of its track structure in the spans between the supports.

[0005] Transport system by Yunitski is known, which includes at least two pretensioned rail cords in the form of load-bearing members enclosed in bodies (casings) with rolling surfaces mating therewith, for vehicles. Rail cords form two track structures. Loaded and empty vehicles [2] are installed on rail cords of track structures.

[0006] The disadvantages of this transport system are the insufficient rigidity and dynamic stability of the second level of its track structure, which especially affects the transportation of massive goods.

[0007] At the current level of transport development, the topical issue becomes the task of elaborating a transport system on the basis of the principles of mechatronics, which is characterized by high speed of movement and load capacity / traffic performance, low cost, zero environmental pollution, negligible need for useful land, while ensuring economy and maximum safety.

[0008] The closest to the proposed technical essence and the achieved positive effect is the well-known string transport system by Yunitski, which comprises a two-level string trussed track structure mounted on the foundation, resting on intermediate supports; each level whereof is equipped with two rail cords made in the form of prestressed load-bearing members, enclosed in corresponding bodies with mating therewith rolling surfaces for wheeled vehicles and forming a track. Hereby, both rail cords of each track are interconnected in spans between adjacent supports by means of two-level trussed track structure in the form of zigzag-oriented rod elements, forming triangles with lower and upper rail cords and located on the outer sides of those rail cords, wherein at each level of the track structure, left and right rail cords are connected to each other by cross bulkheads installed in junction units of rod elements and rail cords [3].

[0009] A limitation to the wide use of the said transport system is the insufficient rigidity of its track structure, caused by the significant height of the track structure (considering the height of vehicles) relative to the width of its wheel track. For the same reason, in this technical solution, the dynamic stability of the track structure in spans between the adjacent supports is also limited.

[0010] The object of the invention is to solve the following technical tasks:

- increasing the rigidity of the track structure;
- increasing the dynamic stability of the track structure in spans between the adjacent supports.

Summary of invention

[0011] Technical aims according to the objects of the present invention are achieved by means of the string transport system by Yunitski, comprising two rail cords of the lower level of the track structure and above them two rail cords of the upper level of the track structure mounted on the foundation between the anchor supports resting on the intermediate supports, made in the form of prestressed load-bearing members enclosed in the corresponding bodies with mating therewith rolling surfaces for wheeled vehicles and forming two tracks, interconnected in spans G between adjacent supports by means of two-level trussed track structure in the form of zigzag-oriented rod elements, forming triangles with rail cords of the lower and upper levels and positioned on the outer sides of those rail cords, wherein at each level of the track structure, left and right rail cords are connected to each other by cross bulkheads, installed in junction units of rod elements and rail cords, whereby the rail cords of lower level are fastened on transverse beams between vertical longitudinal planes *A* and *B*, passing through junction units of zigzag-oriented rod elements, and whereby the transverse beams are connected to supports by means of assembly units, located in two vertical longitudinal planes *N* and *M* with the possibility of displacement along the axis of the track structure, whereas the transverse beams are arranged at conjunction points of corresponding latitudinal planes *W* passing through junction units and centers of supports, while vertical longitudinal planes *A* and *B*, containing junction units, are displaced relative to vertical longitudinal planes *N* and *M*, containing assembly units, by distance *L*, m, defined by the ratio:

$$0.02 \leq L/H \leq 0.5,$$

where *H*, m, - the height of the trussed track structure, whereas the length *S*, m, of cross bulkhead and the length *K*, m, of transverse beam between its assembly units, are related by the ratio:

$$0.5 \leq S/K \leq 0.95,$$

whereas span length *G* is made multiple of the distance *R*, m, between junction units of rod elements and rail cords of lower level of trussed track structure.

[0012] The technical aims are also achieved provided that the distance R, m, between the junction units of rod elements and rail cords of the lower level of the trussed track structure in each span is made multiple of the distance between the supports.

[0013] Tackling the set tasks is also ensured by the fact that the assembly connection of the transverse beam with the support is made in the form of a pivot lever.

[0014] The abovementioned result is also achieved provided that the rail cord is current-carrying with the possibility of connection to a source of electric power of direct or alternating current.

[0015] The abovementioned features characterizing the proposed technical approach are significant, since on the whole, they are sufficient to solve the given technical task and achieve the expected technical result, while each of them separately is required to identify and distinguish the proposed string transport system by Yunitski from similar technical approaches known in the prior art.

[0016] This set of common and distinctive distinguishing features which characterize the claimed arrangement of the string transport system by Yunitski is unknown in the prior art, is new and sufficient in all cases which are covered by the scope of legal protection.

Brief description of drawings

[0017] Hereinafter, the essence of the invention will be explained by a detailed description of the arrangement and operating principle of the string transport system by Yunitski with references to the accompanying drawings (Figs. 1 - 4) showing the following:

Fig.1 - layout image of string two-level trussed track structure of transport system by Yunitski - general view (embodiment);

Fig.2 - layout image of string two-level trussed track structure of transport system by Yunitski - top view (embodiment);

Fig.3 - layout image of cross section of string two-level trussed track structure of transport system by Yunitski (embodiment);

Fig.4 - layout image of fragment of string two-level trussed track structure of transport system by Yunitski - front view (embodiment).

References in the Figures:

[0018]

1 - foundation;
2 - support of track structure;
2a - anchor support;
2b - intermediate support;
3 - rail cord of lower level;
3^L - left rail cord of lower level;
3^P - right rail cord of lower level;
4 - rail cord of upper level;
4^L - left rail cord of upper level;
4^P - right rail cord of upper level;
5 - prestressed load-bearing member of rail cord;
6 - body of rail cord;
7 - hardening material;
8 - rolling surface of rail cord;
9 - wheeled vehicle;
9a - wheeled vehicle of rail cord of upper level;
9b - wheeled vehicle of rail cord of lower level;
10 - zigzag-oriented rod element of two-level string trussed track structure;
11 - cross bulkhead between left and right rail cords;
12 - junction unit of rod elements and rail cord;
13 - transverse beam;
14 - assembly unit of transverse beam with support;
15 - pivot lever of assembly unit of transverse beam;
G - span between adjacent supports of transport system;
A - vertical longitudinal plane (left), passing through junction unit of zigzag-oriented rod element with rail cord;
B - vertical longitudinal plane (right), passing through junction unit of zigzag-oriented rod element with rail cord;
N - vertical longitudinal plane (left) of positioning of assembly unit of transverse beam with support;
M- vertical longitudinal plane (right) of positioning of assembly unit of transverse beam with support;
W- vertical latitudinal plane passing through junction unit and center of support of transverse beam;
X- longitudinal axis of transverse beam;
R, m, - distance between junction units of rod elements and rail cords of lower level;
L, m, - distance from the plane of positioning of zigzag-oriented rod elements to the positioning of the adjacent plane of assembly units;
H, m, - height of two-level trussed track structure;
S, m, - length of cross bulkhead (the distance be-

tween the planes of positioning of junction units of zigzag-oriented rod elements with rail cords);

K, m, - length of cross bulkhead between planes of positioning of assembly units thereof.

Embodiments of invention

[0019] The essence of the invention is as follows in a more detailed description.

[0020] The inventive string transport system by Yunitski, as shown on Figure 1, comprises two rail cords of lower 3 level mounted on the foundation 1 between the supports 2 (anchored 2a, resting on intermediate *2b*), and two rail cords of upper 4 level of the track structure, arranged above them.

[0021] Additionally, depending on the design option, reinforced concrete, pipe concrete, steel columnar, frame or various other structures of known modifications of supports with their individual design can perform as supports 2 - for example, in the form of towers or columns. Anchor supports 2*a* may be buildings and structures with specially equipped boarding and loading areas in the form of loading and unloading stations: passenger for passenger routes and cargo for freight routes (not shown on the Figures).

[0022] Rail cords of the lower 3 and upper 4 levels of the track structure are made (see Figs. 1 and 4) in the form of prestressed load-bearing members 5 enclosed in the respective bodies 6 (see Fig. 3).

[0023] As prestressed load-bearing member 5 of the rail cord 3, cross-sectional view of which is shown on Fig. 3, one or more bundles made from high strength steel wire load-bearing elements may be used, either from rods assembled in a single bundle, or dispersed along the cross-section of the cavity (empty space) of the body 6, or one or more standard twisted or untwisted steel ropes, as well as cords, strips, bands or other extended elements made of any high-strength materials. The cavities in the body 6 between the elements of the load-bearing member 5 can be filled with a hardening material 7 based on polymer binders, composites, cement mixtures and/or similar hardening materials, which are rigidly connected into one piece by the load-bearing member 5 and the body 6 with its associated rolling surface 8 (see Figs. 1 and 4). concreting thereby as a whole the structure of the rail cord.

[0024] Hereby, the rolling surface 8 may be formed by the surface of the body 6 itself. In some cases, the body 6 of the rail cord 3 and/or 4 may partially serve the functions of the prestressed load-bearing member 5, if it has also been stressed by tensioning during assembling of the structure.

[0025] Thanks to the fact that the rail cords of the lower 3 and upper 4 levels with mating therewith rolling surfaces 8 for the wheeled vehicles 9 and, accordingly, the tracks formed by them, are made of an innovative modification - prestressed by tensioning in the longitudinal direction, those rail cords are load-bearing rigid beams of the lower and upper chords of the span arrangement (superstructure) of the two-level trussed track structure.

[0026] An image of cross section and fragment of frontal view of the span arrangement of the track structure of the proposed transport system (see Figs. 3 and 4) shows that the tracks of its rail cords of lower 3 and upper 4 levels are interconnected in the spans *G* between adjacent supports 2 into two-level trussed track structure by means of zigzag-oriented rod elements 10 forming triangles with the rail cords of the lower 3 and upper 4 levels.

[0027] Hereby, at each level of the track structure, the left 3^L (4^L) and, correspondingly, the right 3^P (4^P) rail cords are connected to each other by cross bulkheads 11, which are installed in junction units 12 of zigzag-oriented rod elements 10 and rail cords (see Figs. 2 - 4), whereby zigzag-oriented rod elements 10 are placed on the outer sides of those rail cords, which ensures the formation of the profile of the two-level trussed track structure with minimal aerodynamic drag and high parameters of its rigidity (including torsional) and dynamic stability in the spans between adjacent supports 2.

[0028] At the same time, the length *S*, m, of the cross bulkhead 11 is defined as the distance between the vertical planes *A* and *B* of the respective junction units 12 of the zigzag-oriented rod elements 10 with the rail cords of the lower 3 and upper 4 levels of the track structure.

[0029] The structural coupling (connection) of the cross bulkheads 11 to the bodies 6 of rail cords, depending on the design option, may be accomplished by any of the known methods: welding, riveting, threaded connection, gluing, kinematic engagement - through various guides made integral with mating elements located on the opposite ends of cross bulkheads 11, by attaching those opposite ends of cross bulkheads 11 to internal and/or external surfaces of bodies 6 of rail cords by various combinations of known joint methods (not shown on the Figures).

[0030] Transverse beam 13 is fixed on support 2. It is essential that the transverse beam 13 is movably fastened along the longitudinal axis of the track structure by means of assembly units 14, which in turn are placed in two, respectively, left *N* and right *M*, vertical longitudinal planes. At the same time, an important feature of the proposed transport system is that the rail cords of the lower 3 level of the two-level trussed track structure are connected to each other in the junction units 12 of the zigzag-oriented rod elements 10 by cross bulkheads 11, and fixed on the transverse beams 13 at the locations of those cross bulkheads 11 and the junction units 12 (see Fig. 3) by any known method, e.g. welding, or kinematically (not shown on the Figures).

[0031] In any of the non-limiting embodiments of the inventive string transport system, various non-exclusive embodiments of the cross bulkhead 11 and its connection to the rail cords (in junction units 12) are feasible, one of which is shown on Figs. 3 and 4.

[0032] Via such embodiment of the transport system, the peculiarity of which, unlike the prototype, is that the spans *G* between the adjacent supports are made with a length multiple of the distance *R*, m, between the adjacent cross bulkheads 11 of the lower 3 level of the track structure, and between the assembly units 14 of the transverse beam 13, by means of (as an embodiment) fixing it in a certain position (in the vertical latitudinal plane *W* (see Fig. 2), passing through junction units 12 and center of support 2 of transverse beam 13) of cross bulkhead 11, the corresponding two-level trussed track structure is fastened, wherein cross bulkhead 11 is installed in junction unit 12 of zigzag-oriented rod elements 10 of track structure of lower 3 level and is located along longitudinal axis *X* of transverse beam 13, whereby vertical planes *A* and *B* of arrangement of zigzag-oriented rod elements 10 are shifted relative to assembly units 14 of transverse beam 13 to its center, and distance *L*, m, from plane *A* (*B*) the arrangement of zigzag-oriented rod elements 10 of the trussed track structure up to assembly unit 14 of the transverse beam 13 (see Figs. 3 and 4) is defined by the established dependence, - thus, increasing the base of the support surface of the track structure and, as a result, increasing its rigidity and dynamic stability in general, due to damping of longitudinal dynamic forces, the origin of which is due to temperature difference and dynamic loads arising during the movement of the wheeled vehicle 9 along the rail cords 3 and 4.

[0033] Embodiment of the two-level trussed track structure with zigzag-oriented rod elements 10 located on its outer side and the arrangement of cross bulkheads 11 in junction units 12 of zigzag-oriented rod elements 10 of the trussed track structure, when the terminal cross bulkhead 11 of the span structure is located and fixed along the longitudinal axis *X* of the transverse beam 13, for example, pivot-lever secured on the support 2, provides, if observed are the empirically obtained ratios of dimensions of the height *H*, m, of the trussed track structure, and distance *L*, m, from the plane of positioning of zigzag-oriented rod elements 10 of the trussed track structure up to corresponding assembly unit 14 of transverse beam 13, favorable redistribution of active loads and internal stresses in all structural elements of the two-level trussed track structure of the string transport system. This leads to a significant increase in the rigidity and dynamic stability of the trussed structure of the span arrangement of the track structure.

[0034] In achieving the required rigidity and ensuring the dynamic stability of the track structure, the optimization of the support surface of the track structure plays a significant role, which, in turn, depends on the length *K*, m, of transverse beam 13, and height *H*, m, of two-level trussed track structure, defined by the dependencies:

$$0.02 \le L/H \le 0.5, \qquad (1)$$

and

$$0.4 \le S/K \le 0.95, \qquad (2)$$

where *L*, m, - the distance from the plane of positioning of zigzag-oriented rod elements 10 of trussed track structure to corresponding assembly units 14 of transverse beam 13,

S, m, - the length of cross bulkhead 11,

K, m, - the length of cross bulkhead 13 between planes N and M of positioning of assembly units 14 thereof with support 2 (see Fig.3).

[0035] When resting the rail cords 3 of the lower level of the two-level trussed track structure on the intermediate support 2b through the transverse beam 13 and the cross bulkhead 11, the parameters of which are in accordance with the values defined by the ratios (1) and (2), it is possible to guarantee, without any obstacles, the required improvement in the dynamic stability of the track structure without significantly increasing its weight.

[0036] The values specified in the ratio (1) correspond to the optimal range of interdependence between the height *H*, m, of trussed track structure (and, accordingly, the height of the location of the center of mass of the span arrangement and the value of the support surface of such track structure.

[0037] If the ratio (1) is less than 0.02, then the dynamic stability of the span arrangement of the track structure is significantly reduced due to its low torsional rigidity.

[0038] If the ratio (1) is more than 0.5, then the material capacity of the entire structure, and therefore the cost of the transport system, are unjustifiably increased.

[0039] With the ratio (2) less than 0.5, the implementation of the design option becomes difficult without substantial overconsumption of the materials of the track structure.

[0040] If the ratio (2) is more than 0.95, then the dynamic stability of the span arrangement (superstructure) is reduced.

[0041] Increasing the width of the support surface of the two-level trussed track structure from the length *S*, m, of cross bulkhead 11 to the length *K*, m, of transverse beam 13, ensures the improvement in rigidity and dynamic stability of the trussed structure of the span arrangement in the track structure. Furthermore, the arrangement on the intermediate supports 2*b* of transverse beams 13 of length *K*, m, defined by the ratio (2), allows, in an alternative embodiment, to install, on those intermediate supports 2*b*, various zones of maintenance of the transport system, for example, emergency passenger evacuation zones (not shown on the Figures).

[0042] Thanks to the fact that, as noted above, the assembly units 14 of the transverse beam 13 are movable, for example, in the form of a pivot lever 15, a decrease in local overstresses in the rail cords of the track structure is attained, caused by temperature deformation and the impact of the wheeled vehicles 9, which, as a result, are redistributed along the entire length of the track of the proposed string transport system.

[0043] In any of the non-limiting embodiments of the proposed string transport system, various non-exclusive embodiments of the pivot levers 15 of the assembly units 14 of the transverse beam 13 are possible.

[0044] In accordance with any of the non-limiting design versions of the track structure of the proposed string transport system, depending on the design option in use, the rail cord 3 (4) may be made current-carrying with the possibility of connection to a direct or alternating current electric power source. This will allow to electricize transport services and reduce environmental pollution.

[0045] It will be apparent to a specialist skilled in the art that, in the present embodiment, the rail cords 3 and 4 can be connected to the trussed track structure by means of electrical insulators, as well as that the trussed track structure can be made of an electric insulating (dielectric) material (not shown on the Figures).

[0046] An alternative embodiment of the proposed string transport system is to provide the connection of rail cord 3 (4) with cross bulkhead 11 with electric insulators (not shown on the Figures) for isolating from each other the rail cords in each track, which increases the reliability, safety and efficiency of the entire system.

[0047] It is also advantageous that the cross bulkhead 11 is made of an electric insulating (dielectric) material.

[0048] According to any of the non-limiting embodiments of the track structure, according to the design option, it is advantageous that in connection with the rail cord 3 (and 4), the cross bulkhead 11 is provided with a damper (not shown on the Figures).

[0049] In accordance with the project specification, an electric insulator can be used as a damper.

[0050] Alternatively, the transverse beam 13 may be connected to the string trussed track structure by an electric insulator (not shown).

[0051] The transverse beam 13 may also be made of an electric insulating (dielectric) material.

[0052] A significant effect on increasing the dynamic stability and rigidity of the track structure is ensured by installing of the transverse beam 13 of the above dimensions, pivot-lever connected to the support 2, and the corresponding positioning on the said transverse beam 13 of the cross bulkhead 11 of lower chord of the trussed span structure; through which, as an embodiment, it is connected to the transverse beam 13, and which is also made and installed in the structure in accordance with the parameters indicated above.

[0053] The positioning of the cross bulkheads 11 between the rail cords 3 and 4 of the trussed structure of the span arrangement of the two-level trussed track structure is determined by the terms of request for proposal for the design thereof, according to which alternative versions of the proposed string transport system are possible, one variant of which is the implementation of spans *G* between adjacent supports 2 of length multiple of the distance *R*, m, between the junction units 12 of the zigzag-oriented rod elements 10 and the rail cords of the lower 3 level of the track structure. In another embodiment, the distance *R*, m, between the junction units 12 of the zigzag-oriented rod elements 10 and the rail cords of the lower 3 level of the trussed track structure in each span *G* may be a multiple of the distance between the adjacent supports 2.

[0054] As a result, trussed structures in various spans *G* can differ in spacing (not shown on the Figures) in positioning of their structural elements, for example, cross bulkheads 11.

[0055] The present invention is not limited to the embodiments described and shown in the drawings, which can be amended, modified and supplemented within the scope protected by the claims.

[0056] In any of the non-limiting embodiments of the proposed track structure and various non-exclusive versions of its design, an increase in the rigidity and dynamic stability of the string track structure in the spans G between adjacent supports is achieved, which is a priority goal of the proposed technical arrangement.

Industrial applicability

[0057] In the most general case, the construction of the represented string transport system by Yunitski includes installation on the foundation 1 of supports 2 and appropriately arranged and pivot-levered fixation thereon of transverse beams 13 of the specified length *K*, m, and the subsequent assembly in spans *G* between adjacent supports 2 of the span arrangements of the two-level trussed string track structure.

[0058] For this purpose, lower and upper chords of this two-level trussed string track structure are constructed, each of them formed by left and right rail cords connected to each other by cross bulkheads 11 uniformly distributed in span *G*. At the same time, the side faces of the two-level trussed string track structure are made in the form of zigzag-oriented rod elements 10 forming triangles with the rail cords of the lower 3 and upper 4 levels, and the junction units 12 of zigzag-oriented rod elements 10 with cross bulkheads 11 are arranged in respective vertical longitudinal planes *A* and *B*.

[0059] At the final stage, the cross bulkheads 11 of the rail cords of the lower level 3 are arranged in a certain way on the transverse beams 13, fixed on those transverse beams 13 by any of the known methods, after which the rail cords 3 and 4 are equipped with wheeled vehicles 9, and the rail cords, which are made current-carrying, are connected to DC or AC electric power source.

[0060] The string transport system by Yunitski of the described structure, in the most general case of a variety of alternative embodiments, operates as described below.

[0061] During operation of the transport system, during the movement of wheeled vehicles 9 along the rail cords of the two-level trussed string track structure, as well as due to temperature fluctuations, thanks to pivot lever, with the possibility of longitudinal displacement, installation on supports 2 of transverse beams 13 of the given length, with a specially made and fastened thereon, two-level trussed string track structure, during its operation there occurs redistribution and damping of active loads of two-level trussed track structure of string transport system. Hereby, transverse beams 13, made with the above dimensions and properly fixed, increase the support surface of the two-level trussed track structure and reduce the influence of the tipping moment from the side of the rail cord of the upper level 4, when the wheeled vehicle 9 moves along it at its maximum load.

[0062] As a result, during practical implementation of the invention the following benefits are achieved: increase in the rigidity of the track structure, as well as improvement in its dynamic stability in spans between adjacent supports.

[0063] Thus, the claimed arrangement of the string transport system by Yunitski proposed in the present technical approach allows to attain the intended targets and, at the same time, possesses a set of distinguishing features different from the known technical solutions, which meet the criteria of the invention "novelty" and "key distinctive features" (inventive step), which makes it possible to regard the proposed technical approach as inventive one.

Information sources

[0064]

1. Patent RU № 2080268, IPC B61B5/02, 13/00, E01B25/22, publ. 27.05.1997 (аналог).
2. Patent RU № 2475386, IPC B61B 1/00, 3/02, publ. 20.02.2013 (analog).
3. Patent RU № 2520983, IPC B61B5/02,13/00, E01B25/00, publ. 27.06.2014 (prototype).

Claims

1. String transport system, comprising two rail cords of the lower level of the track structure and above them two rail cords of the upper level of the track structure, mounted on the foundation between the anchor supports resting on the intermediate supports, made in the form of prestressed load-bearing members enclosed in the corresponding bodies with mating therewith rolling surfaces for wheeled vehicles and forming two tracks, interconnected in spans *G* between adjacent supports by means of two-level trussed track structure in the form of zigzag-oriented rod elements, forming triangles with rail cords of the lower and upper levels and positioned on the outer sides of those rail cords, wherein at each level of the track structure, left and right rail cords are connected to each other by cross bulkheads installed in junction units of rod elements and rail cords, ***characterized by*** *that* the rail cords of lower level are fastened on transverse beams between vertical longitudinal planes *A* and *B*, passing through junction units of zigzag-oriented rod elements, wherein the transverse beams are connected to supports by means of assembly units, located in two vertical longitudinal planes *N* and *M* with the possibility of displacement along the axis of the track structure, whereas the transverse beams are arranged at conjunction points of corresponding latitudinal planes *W* passing through junction units and centers of supports, while vertical longitudinal planes *A* and *B*, containing junction units, are displaced relative to vertical longitudinal planes *N* and *M*, containing assembly units, by distance *L*, m, defined by the ratio:

$$0.02 \leq L/H \leq 0.5,$$

where *H*, m, - the height of the trussed track structure, whereby the length *S*, m, of cross bulkhead, and the length *K*, m, of transverse beam between assembly units thereof, are related by the ratio:

$$0.5 \leq S/K \leq 0.95,$$

whereby the length of spans *G* is made multiple of the distance *R*, m, between junction units of rod elements and rail cords of lower level of trussed track structure.

2. The system according to claim 1, **characterized by** that the distance *R*, m, between the junction units of rod elements and rail cords of the lower level of the trussed track structure in each span *G* is made multiple of the distance between the supports.

3. The system according to claim 1, **characterized by** that the assembly connection of the transverse beam with the support is made in the form of pivot lever.

4. The system according to claim 1, **characterized by** that the rail cord is current-carrying with the possibility of connection to a source of electric power of direct or alternating current.

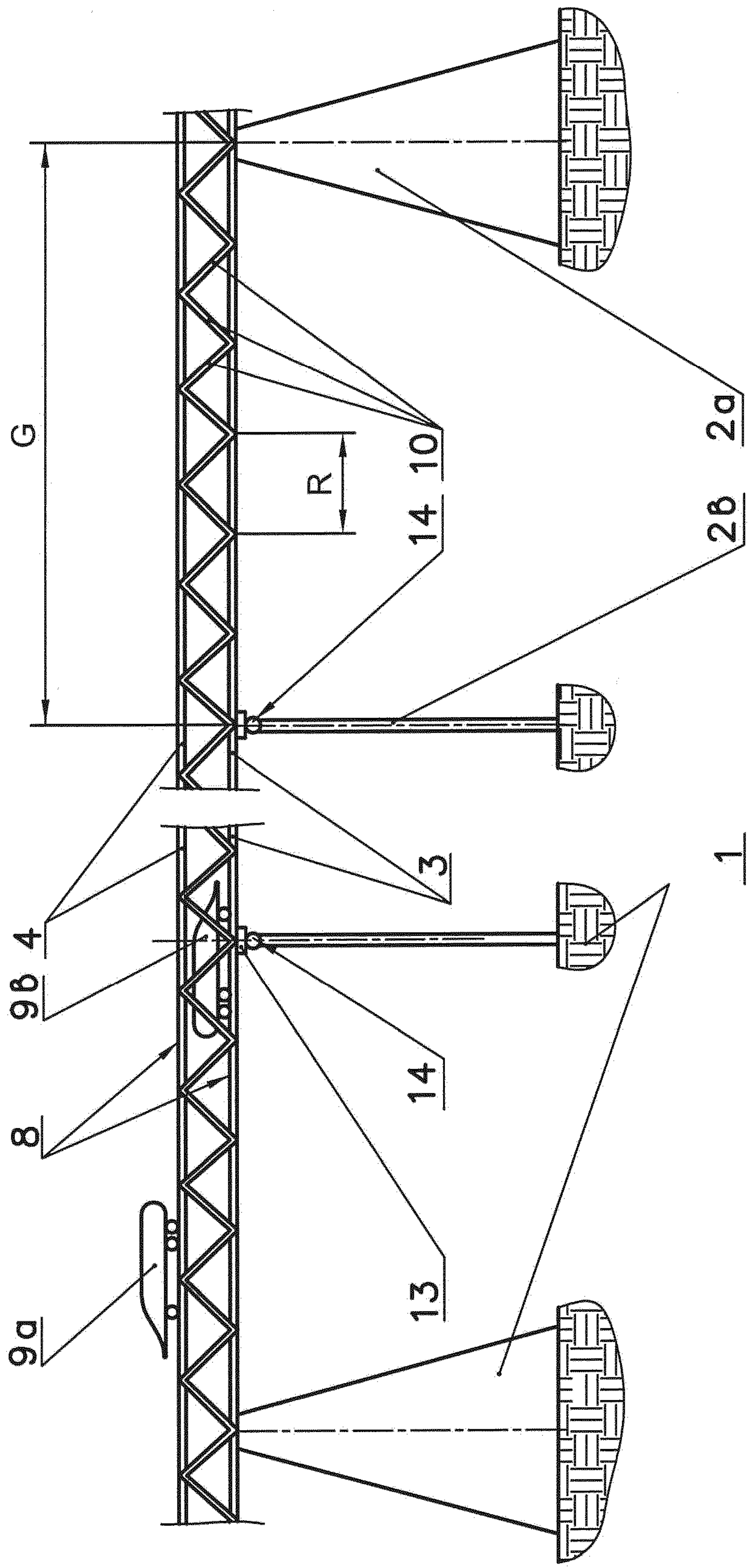

Fig.1

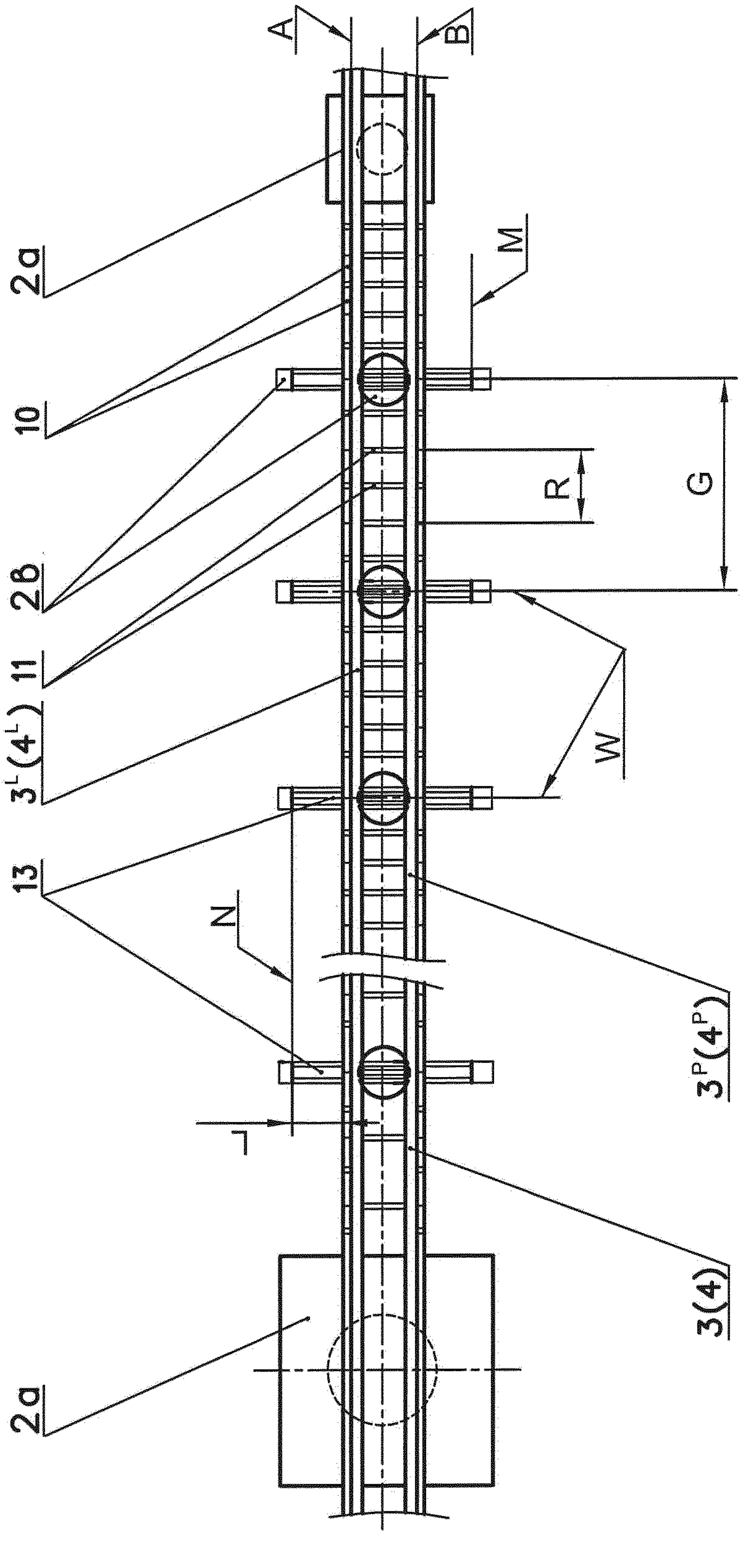

Fig.2

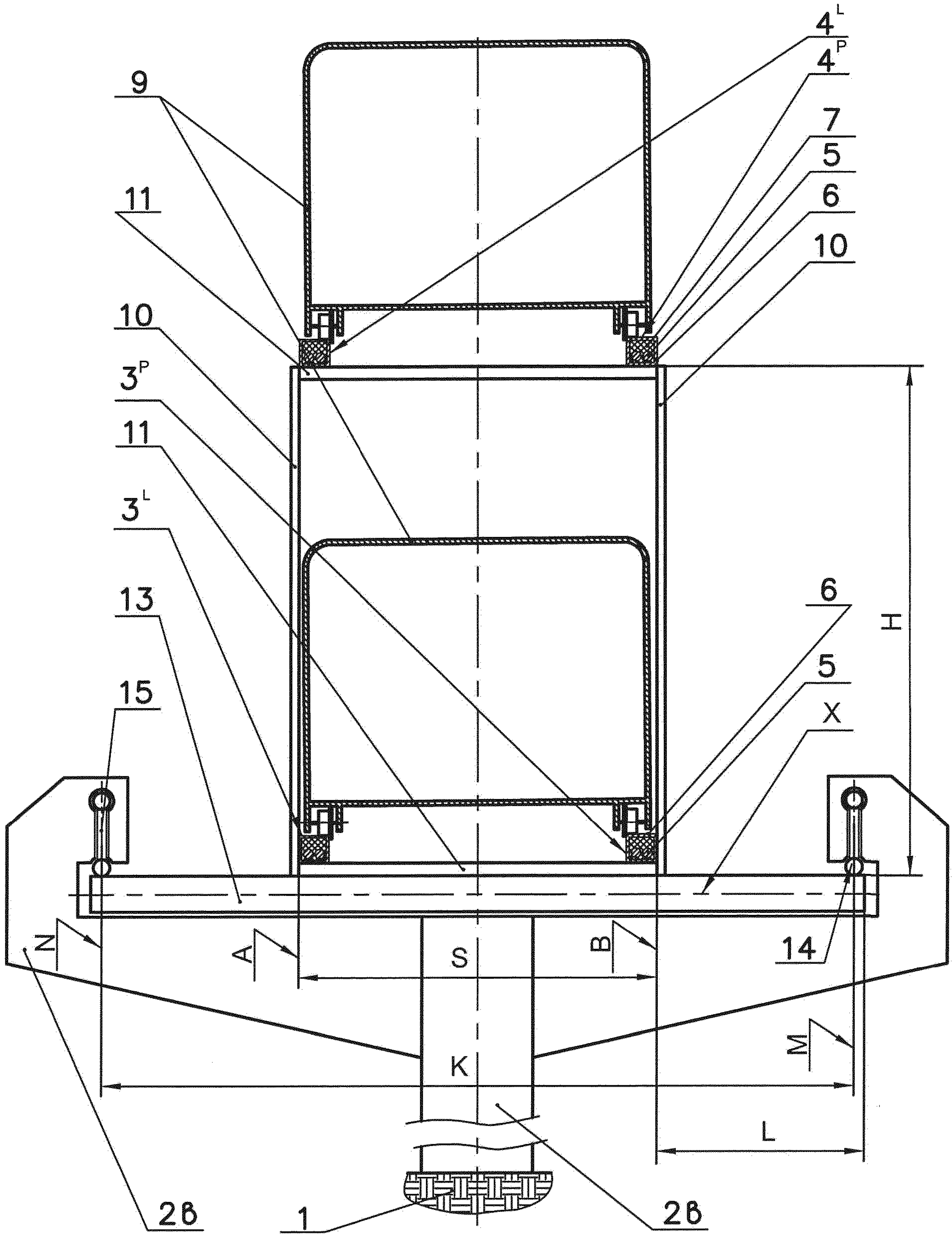

Fig. 3

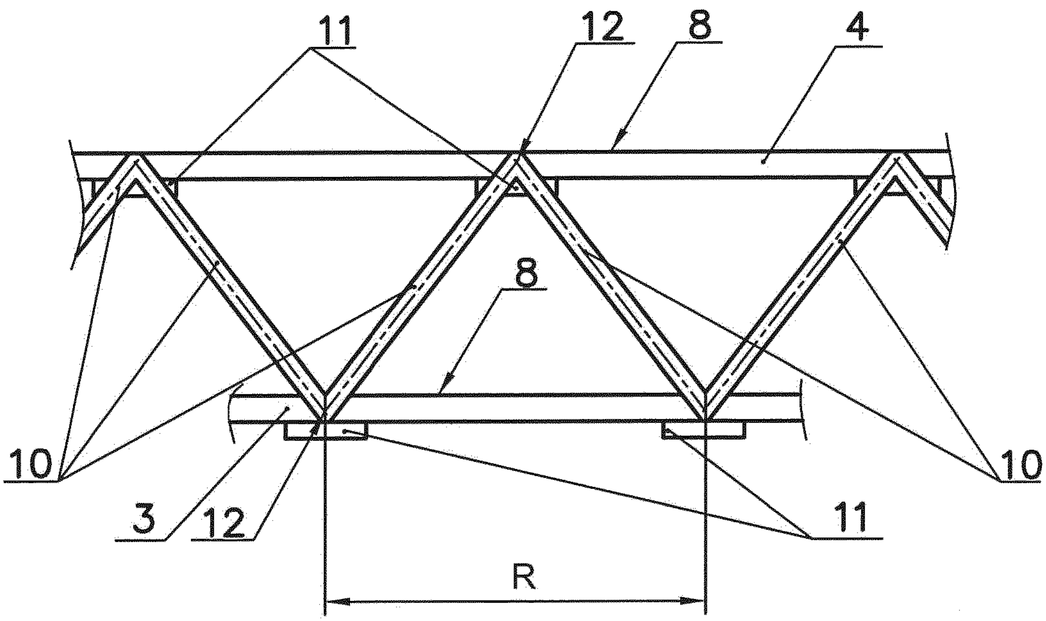

Fig.4

INTERNATIONAL SEARCH REPORT

International application No.
PCT/BY 2020/000012

A. CLASSIFICATION OF SUBJECT MATTER

B61B 5/02 *(2006.01)*
B61B 13/00 *(2006.01)*
E01B 25/00 *(2006.01)*

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

B61B 1/00, 1/02, 3/00, 3/02, 5/00, 5/02, 13/00, 13/04, 13/06, 15/00, E01B 25/00, 25/22, 26/00

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

PatSearch (RUPTO Internal), USPTO, PAJ, Espacenet, Information Retrieval System of FIPS

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A, D	RU 2520983 C2 (JUNITSKY ANATOLY EDUARDOVICH) 27.06.2014, the claims, abstract, fig. 1-4	1-4
A	RU 2224064 C1 (JUNITSKY ANATOLY EDUARDOVICH et al.) 20.02.2004, the claims, abstract, fig. 1-126	1-4
A	UA 71059 U (MESONZHNIK SEMEN MOISEEVICH et al.) 25.06.2012, the claims, abstract, fig. 1-12	1-4
A	JP 2006096057 A (HONDA MAS AO) 13.04.2006, the claims, abstract, fig. 1-4	1-4

☐ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

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"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
28 January 2021 (28.01.2021)	18 February 2021 (18.02.2021)
Name and mailing address of the ISA/ RU Facsimile No.	Authorized officer Telephone No.

Form PCT/ISA/210 (second sheet) (January 2015)

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- RU 2080268 **[0064]**
- RU 2475386 **[0064]**
- RU 2520983 **[0064]**