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(54) **YUNITSKY TRANSPORT SYSTEM AND METHOD OF CONSTRUCTION THEREOF**

(57) The invention relates to the area of transport communications, particularly, to the aboveground (elevated) complex transport systems of string type, which provide high-speed cargo and passenger traffic. Transport system by Yunitski includes track structure (4) tensioned above foundation (1) in spans (2) between supports (3), which comprises aggregated extended body (5), consisting of bearing part (6), containing prestressed load-bearing member (7), and of rail cord (8) connected with it, having rolling surface (A) for motion of vehicle (9) mounted thereon. In bearing part (6) of extended body at height *H*, m, having variable value in span (2) between supports (3), load-bearing member (7) is fastened, with use of means of reciprocal movement and fixation of arrangement, whereas rail cord (8) is equipped with, at least, two extended longitudinal guide plates (11) of height *h,* m, positioned axisymmetrically to its longitudinal axis *X* at distance *L* from each other, equal to the width of bearing part of extended body. Bearing part and rail cord are configured to be reciprocally moving along the vertical *Z* and afterfixing to each other at design height *P*, m, defined by the respective dependence.

As a result, high precision of positioning of rolling surfaces (*A*) of rail cord (8) relative to load-bearing member (7), is achieved.

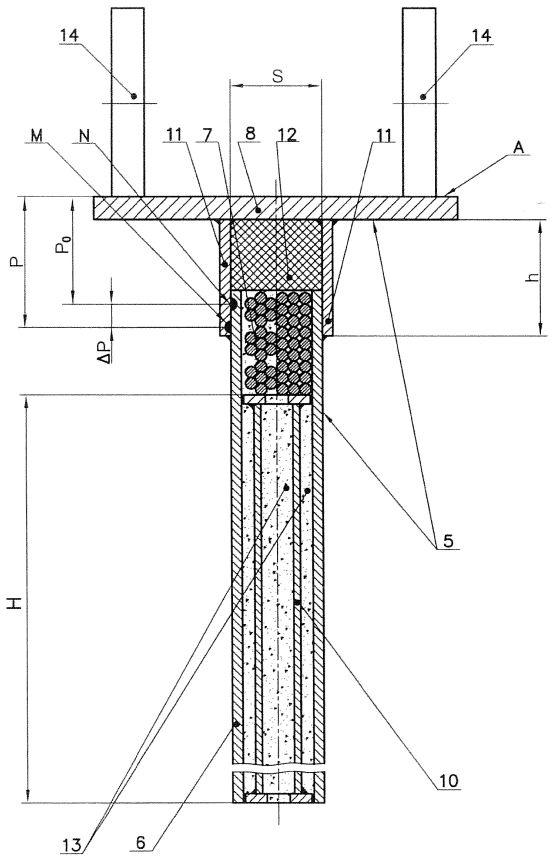

Fig. 5

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Description

Technical field

[0001] The invention relates to the area of transport communications, particularly, to the aboveground (elevated) complex transport systems of string type with transport structure, which provide high-speed cargo and passenger traffic.

Background Art

[0002] String transport system [1] by Yunitski is known, comprising at least one fastened on supports rail cord in the form of prestressed load-bearing member (string), encased in body with conjugated working surface for moving of vehicles. In such transport system, string rail cord, in span between adjacent supports, forms span sections of single-rail or multi-rail track structure. In order to equalize the natural sagging of load-bearing member of rail cord in span between adjacent supports, the track structure of this type uses inserts (gaskets) of variable height increasing towards the middle of span, which, however, complicates the technology of manufacturing and installation of rail cord in field conditions and does not achieve the effect of the "velvet-smooth track".

[0003] Transport system by Yunitski [2] also known, comprising fastened on foundation on different levels in spans between adjacent supports and interconnected at least one main cord in the form of prestressed load-bearing member, encased in body with rolling surface for vehicles conjugated therewith, and at least one auxiliary cord with prestressed load-bearing member. Main cord is connected with auxiliary cord by the system of supporting elements of various height, embodied in the form of suspensions and/or pillars, spaced along the span between adjacent supports at certain intervals therebetween. In the interval between two adjacent supports, the rolling surface conjugated with body of main cord is located with excess, increasing towards the middle of the span, over straight line passing through the points of this surface in the points of connecting main cord with adjacent supports.

[0004] Additionally, rolling surface conjugated with body of main cord may be disposed on liners of variable thickness installed inside or outside body of the cord, between the rolling surface and load-bearing member, at intervals between adjacent supporting elements or/and in span between adjacent supports, wherein body of main cord may be integrally formed with variable thickness liners.

[0005] By such embodiment of transport system, it becomes feasible to increase spans between adjacent supports up to 50 - 100 meters and more.

[0006] Selection of ratio of interval between supporting elements and reference length of vehicle provides for such interaction with track structure, during which in each specified interval, during motion of vehicle, strain-stress state of main cord will remain optimum.

[0007] The known transport system provides sufficient bearing capacity and rigidity of string track structure, however, is not high-tech and complicates the process of manufacturing rail cords in field conditions and at height of up to tens and hundreds of meters, and in addition, similar to the previous analogue, does not achieve "velvet-smooth track" effect.

[0008] Accepted as prototype, transport system by Yunitski [3] is known, which includes, at least, one tensioned above foundation, in spans between supports, track structure in the form of extended body, forming rail track with rolling surface and vehicle mounted thereupon. The body of such track structure is made hollow and equipped with positioned therein prestressed extended load-bearing elements, concreted with hardening material distributed in volume of cavity beside load-bearing elements. Those prestressed extended load-bearing elements are positioned in body in such way that the height of their position level can vary within limits of height of internal volume of body along the span between supports, increasing towards the middle of span and decreasing in directions towards supports forming it. The hardening material used represents materials based on polymer binders, composites and/or cement mixtures, whereas extended load-bearing elements of the structure are made of wire, and/or rods, and/or twisted or non-twisted ropes, and/or cords, strips, strands, tapes, pipes, and/or from different combinations of the above-mentioned variants of high-strength materials.

[0009] The transport system in the above track structure is formed by string-type rails tensioned between anchor supports, the common feature of which is the presence of extended body with rolling surface conjugated therewith, and with prestressed longitudinal load-bearing member enclosed therein. The rolling surface can be formed by the surface of the body itself, for example, in the form of its upper portion - head, or by head of overlap type, conjugated to the body. In either embodiment, the body-conjugated rolling surface forms track for supporting wheels of the vehicle.

[0010] Along with that, in structures of rail cord, and track structure as a whole, of known transport systems, the required straightness of track is not guaranteed, which does not allow, during its operation in high-speed traffic, to achieve smoothness and softness of vehicle travel throughout the transport system, and in field conditions of track structure installation - the processes of its manufacturing and achievement of "velvet-smooth track" effect become significantly complicated.

[0011] Method is known, of manufacturing rail track from concrete slabs with rails for guiding rail rolling stock, wherein the rails are lowered into slots and laid in elastic shell, respectively, whereby the said slab is made with slot to be mounted

in rail track and, finally, the rails are continuously welded together and pressed into the elastic shell of several successive slabs, the latter being rigidly jointed together while joints between adjacent slabs compacted [4].

[0012] The disadvantages of said method of construction of rail track are the difficulty of ensuring its flatness, as well as achieving smoothness and softness of movement of vehicles, which, in turn, does not allow to guarantee reliability of rolling stock at high speed of motion on this transport system.

[0013] A prior art, accepted as prototype, method is known, of constructing a transport system comprising tensioning to nominal design force and fastening, in spans between supports, mounted on foundation, of load-bearing member during its installation into the track structure, which is embodied as at least two interconnected portions of extended body, wherein one portion is provided with rolling surface for vehicle, and other portion includes a prestressed load-member fixed therein, height of which in this portion of body, by means of their reciprocal movement and fixation of arrangement, is changed along sinusoidal line in span between supports [3].

[0014] The disadvantage of the above method of construction of transport system is the difficulty of ensuring high flatness of rolling surface of rail cord, which is necessary during the organization of high-speed movement of vehicles.

Summary of invention

[0015] The task of achieving the following engineering purposes lies at the heart of the invention:

- ensuring presence of vertical operating flatness of rolling surfaces of rail cord required for high-speed movement of wheeled vehicles;
- stabilization of longitudinal flatness of track structure throughout transport system taking into account the actual influence of external factors thereon;

ensuring presence of "velvet-smooth track" effect.

[0016] The required technical tasks and desired aims of the present invention are achieved by using transport system by Yunitski, which constitutes, at least, one track structure, tensioned above foundation, in spans between supports, comprising aggregated extended body, consisting of bearing part, including prestressed load-bearing member, and rail cord, connected with the said bearing part, equipped with rolling surface with a mounted or suspended vehicle positioned thereon, whereby the load-bearing member in spans between supports is fixed relative to the rolling surface in the bearing part of the body at height H, m, whereas the rail cord is equipped with, at least, two extended longitudinal plates of height h, m, positioned axisymmetrically to the longitudinal axis of the rail cord at distance from each other, equal to the width of the bearing part of the body, whereby the bearing part and the rail cord are configured to be reciprocally moving along vertical direction and afterfixing to each other at design height P, m, of positioning of the rolling surface, defined by the dependence:

$$0{,}05 \le P/h \le 2,$$

where $P = P_0 + \Delta P$, and P_0, m, - actual height of arrangement of datum line of bearing part relative to design level of rolling surface of rail cord;

ΔP, m, - error of actual height of arrangement of datum line of bearing part relative to its design level.

[0017] The technical aim is also achieved on the condition that in bearing part of body, manufactured in the form of string truss, the height H, m, is embodied invariable and has constant value in spans between supports.

[0018] Said result is also attained provided that in bearing part of body, manufactured as flexible string structure, the height H, m, is set as variable.

[0019] The solution of the given problem is also ensured provided that in void volume between two extended longitudinal plates of rail cord, damping and noise absorbing filler material is placed.

[0020] Said problem is also solved provided that two extended longitudinal plates of rail cord are formed by flanges of channel or two angles, fixed on rail cord.

[0021] Said result is also achieved under condition that method of manufacturing and assembling of transport system by Yunitski, realized according to the structure as claimed in claim 1, includes tensioning to nominal rated force and fastening in spans between supports, mounted on foundation, of load-bearing member during installation thereof into track structure, embodied as interconnected, along the datum line of conjugation, constituent parts of extended body: rail cord, equipped with rolling surface for vehicle and bearing part, comprising prestressed load-bearing member fastened therein, whereas the assembling of transport system is performed in the following sequence:

- installing in spans between supports is performed of bearing part of body, while longitudinally positioning load-

bearing member in the body in accordance with design values at heights *H*, m;

- error ΔP, m, is defined, of actual height of arrangement of datum line of bearing part relative to its design level;

- alignment of rolling surface of rail cord along its longitudinal axis by moving rail cord within the value of defined error ΔP, m;
- installing of rail cord with its fastening on bearing part of body via longitudinal guide plates.

Brief description of drawings

[0022] The essence of this invention is clarified through the drawings in Fig.1-Fig.12, which illustrate the following:

Fig.1 - schematic view of transport system by Yunitski - general view (embodiment);
Fig.2 - schematic view of transport system by Yunitski - general view (embodiment);
Fig.3 - schematic view of cross section of body of rail of track structure, shown on Fig.1 (embodiment);
Fig.4 - schematic view of cross section of body of rail of track structure with span arrangement in the form of string truss, shown on Fig.2 (embodiment);
Fig.5 - schematic view of cross section of body of rail of track structure of mounted type (embodiment);
Fig.6 - schematic view of cross section of body of rail of track structure of suspended type (embodiment);
Fig.7 - schematic view of rail cord and its fastening on bearing part of body of track structure - cross section (embodiment);
Fig.8 - schematic view of rail cord and its fastening on bearing part of body of track structure - cross section (embodiment);
Fig.9 - schematic view of change in height of positioning of load-bearing member in bearing part of body of track structure, shown on Fig.1 - cross section (embodiment);
Fig.10 - schematic view of arrangement of datum line on lateral side of bearing part of body of rail of track structure;
Fig.11 - schematic view of cross section of body of rail of track structure with span arrangement in the form of string truss, shown on Fig.2 (embodiment);
Fig.12 - schematic view of cross section of rail cord in assembly with datum lines layout marked thereon (embodiment).

Embodiments of invention

[0023] The essence of the claimed invention is further presented in a closer detail.

[0024] The claimed transport system by Yunitski (see Figs.1 and 2) represents, at least, one track structure 4 tensioned above foundation 1 in spans 2 between supports 3, which comprises aggregated extended body 5. The said aggregated extended body 5 consists (see Figs.4 - 9, 11) of bearing part 6, containing prestressed load-bearing member 7, and rail cord 8 connected with the said bearing part 6 and having rail head in the form of plate 8.1 of thickness δ, m, equipped with rolling surface A for motion of vehicle 9 mounted thereon.

[0025] On rolling surface A of aggregated extended body 5, vehicle 9 - suspended 9.1 or mounted 9.2 - is installed.

[0026] In bearing part 6 of aggregated extended body 5 at height $\underline{H}$, m, which may have variable value (see Fig.3) in span 2 between supports 3, load-bearing member 7 is fastened. In design solutions providing for fastening of load-bearing member 7 at height $\underline{H}$, m, having variable value in span 2 between supports 3, such fastening of load-bearing member 7 is performed with use of means 10 of movement and fixation of position of the said load-bearing member 7, which on supports is embodied in the form of saddles 10.1 (see Figs.3, 5, 6 and 9). Additionally, rail cord 8 is equipped with, at least, two extended longitudinal plates 11 of height *h*, m, positioned axisymmetrically to its longitudinal axis *X* at distance *S* from each other, equal to the width of the bearing part 6 of aggregated extended body 5 (see Figs.1, 5 - 9). Bearing part 6 and rail cord 8 are configured to reciprocally move along vertical axis *Z* (see Figs.4 - 6, 11) and further fasten with each other at design height *P*, m, defined by the dependence:

$$0{,}05 \le P/h \le 2,$$

where $P = P_0 + \Delta P$, a P_0, m, - actual height of arrangement of datum line *N* (see Figs.5, 6, 9 and 10) of bearing part 6 relative to design level of rolling surface *A* of rail cord 8 (see Figs.5, 6 and 9);
ΔP, m, - error of actual height of arrangement of datum line *N* of bearing part 6 relative to its design level.

[0027] Error ΔP, m, of actual height of arrangement of datum line *N* of bearing part 6 of extended body 5 is defined as difference between levels (heights) of arrangement of its actual height and design level of arrangement of that datum line *N*.

[0028] Hereby, error ΔP, m, of actual height of arrangement of datum line *N* of bearing part 6 of extended body 5 may have sign (-), or sign (+).

[0029] If actual height of arrangement of datum line *N*, as result of installation of bearing part 6 of extended body 5, will appear closer to design level of arrangement of level of rolling surface *A*, than design level of arrangement of that datum line *N*, then value ΔP, m, is used with sign (+).

[0030] If actual height of arrangement of datum line *N*, as result of installation of bearing part 6 of extended body 5, will appear farther to design level of arrangement of level of rolling surface *A*, than design level of arrangement of that datum line N, then value ΔP, m, is used with sign (-).

[0031] To perform, during conjugating of parts of aggregated extended body 5, the alignment of rolling surface *A* of rail cord 8, on its extended longitudinal plates 11, similar to bearing part 6 of extended body 5, target *M* of datum line is marked (see Figs.10, 6, 12). Hereby, as target *M* of datum line, end edge of, at least, one of extended longitudinal plates 11 of rail cord 8 is used.

[0032] In the process of aligning rolling surface *A* of rail cord 8 along its longitudinal axis *X*, rail cord 8 is moved along the vertical *Z*, so that the distance between datum lines *M* and *N* marked, respectively, on rail cord 8 and bearing part 6 of aggregated extended body 5, corresponds to the detected error of datum line *N* of bearing part 6 of aggregated extended body 5 (see Figs.5 and 6). As target of datum line *N*, end edge of bearing part 6 of aggregated extended body 5 can be accepted. As a result, it is achieved that the rolling surface *A* of rail cord 8 is arranged strictly in accordance with design level of its positioning.

[0033] In void volume *V* between two extended longitudinal plates 11 of rail cord 8, filler material 12, produced, for instance, from damping and noise absorbing material, is placed (see Figs.4 - 8, 11).

[0034] Supports 3 may be embodied as anchor 3.1 supports, whereas intermediate 3.2 (backup) supports (see Figs.1 and 2) may be installed therebetween. On supports 3 of transport system, sections of one or more of track structures 4 may be assembled. As supports 3, guncrete (STCC) foundations may be used, trusses of various design, buildings, structures, specially equipped landing and loading platforms for both passenger and cargo routes (not shown on Figs.). Anchor 3.1 supports are intended for arrangement of nodal transition sections thereon, as well as for fastening (anchoring) of tensioned elements of load-bearing members 7 of track structure 4.

[0035] Design of anchor 3.1 and intermediate 3.2 supports may vary depending on characteristics of foundation 1, place of their installation and set of functions of supports.

[0036] Devices for fastening of aggregated extended body 5 and load-bearing member 7 (and track structure 4 as a whole) on supports 3 are any known devices similar to those used in suspended and rope bridges, cable roads and prestressed reinforced concrete structures for fastening (anchoring) of tensioned load-bearing elements (reinforcement, wire cables, high-strength wires, etc.).

[0037] On track structure 4 (see Figs.1 and 2), vehicles 9 (passenger and/or cargo, and/or cargo-passenger) are positioned, which may be suspended from below to track structure 4 - suspended 9.1 vehicles, as shown on Fig.2, or mounted from above on track structure 4 - mounted 9.2 vehicles.

[0038] According to any of the non-limiting embodiments of vehicle 9 for the proposed transport structure, the said vehicle, depending on realization variant and relevant design approach, can be made mono- and multiaxial, with and without pressure driving wheels or without thereof, with at least one support wheel on the axle or in arbitrary combination of the above and/or other possible embodiments of the vehicle wheel group 9 (not shown on Figs).

[0039] According to any of the non-limiting embodiments of the proposed engineering approach, bearing part 6 of aggregated extended body 5 of track structure 4 includes prestressed load-bearing member 7, which is made, for example, in the form of twisted and/or untwisted ropes, cables, bands / tapes, strips, cords, strands, reinforcement bars, high-strength steel wire, tubes or other extended load-bearing members and their combinations from any high-strength materials, assembled in one bunch and/or several bunches or dispersed along the section of cavity of bearing part 6 of aggregated extended body 5 (see Figs.4 - 9 and 11).

[0040] In accordance with the alternative variant of the claimed technical solution within the framework of the proposed engineering approach, whereby load-bearing member is fixed at height *H*, m, having variable value in span 2 between supports 3, it is advisable that the means 10 of reciprocal movement and fixation of location of bearing part 6 of aggregated extended body 5 and prestressed load-bearing member 7 to have any embodiment, selected from among those known, for example, in the form of rivets, pins, rods, cradles, inserts, retainers or other elements ensuring fixation of the position of load-bearing member 7 in bearing part 6 of aggregated extended body 5 at design height *H*, m (see Figs.3, 5, 6 and 9). In particular, it is advisable to use means 10 of reciprocal movement and fixation in the form of variable length retainers, which, in order to ensure accuracy and reliability of positioning and fixation of prestressed load-bearing member 7 relative to bearing part 6 of aggregated extended body 5, can be provided with a retaining stop on the side of load-bearing member 7 and a base platform on the reverse side. Such retainers may be located both above and below load-bearing member 7, for example in staggering order (see Figs.6, 9).

[0041] At such alternative embodiment of bearing part 6 of aggregated extended body 5, the length of retainers varies in span 2 between supports 3.

[0042] Hereby, the length of retainers, located above load-bearing member 7, varies in span 2 between supports 3, decreasing towards the middle of span 2, whereas the length of retainers, located below load-bearing member 7, varies in that section of track structure 4, increasing towards the middle of span 2.

[0043] Retainers may be any known technical solution, such as, for example: rods, screw-nut, elsewise, providing adjustment of their length and rigid connection of load-bearing member 7 with bearing part 6 of aggregated extended body 5 and forming the designed sinusoidal profile of the said load-bearing member 7 in span 2 between supports 3 (see Fig.2).

[0044] As a result, prestressed extended load-bearing member 7 is placed in the inner space of bearing part 6 of aggregated extended body 5 so that the height H of its position (see Figs.3, 5, 6) may vary within the inner space of bearing part 6 of aggregated extended body 5 along the sinusoidal line along each span 2 between adjacent supports 3, maximizing towards the middle of span 2 and decreasing on its supports 3, thus providing the required design geometry of track structure 4 throughout its length.

[0045] In alternative embodiments, when bearing part 6 of aggregated extended body 5 is located (see Figs.2 and 11) in the rigid section of span, which represents a beam, or a truss, or an overpass, or a cable-stayed system, or combination thereof, or is an integral element of the said span, height *H*, m, of fastening load-bearing member 7 in bearing part 6 of aggregated extended body 5, may have a constant value.

[0046] The volume of cavity of bearing part 6 of aggregated extended body 5, void of prestressed load-bearing member 7, is filled with hardening material 13 (see Figs.3-6, 9, 11). As hardening material 13, compositions based on polymer binders, composites, or cement mixtures with addition of corrosion inhibitors, plasticizers and/or other protective additives are used, which provides reliable protection of load-bearing member 7 and the inner walls of bearing part 6 of aggregated extended body 5 from corrosion with increased operation life of track structure 4. Said hardening material 13 rigidly binds together all elements of bearing part 6 of aggregated extended body 5, which ensures transmission and redistribution of high contact stresses from wheels 14 of vehicles 9 through rail head, in the form of a plate 8.1 having thickness δ, m, onto load-bearing member 7; which ultimately results in additional significant increase in flexural rigidity in the vertical-longitudinal section of aggregated extended body 5, and hence, also in straightness, evenness and stability of track structure 4 in each span 2 between adjacent supports 3 throughout its length.

[0047] Thanks to the fact that rail cord 8 and, in particular, its rail head in the form of plate 8.1, having thickness δ, m, is provided with at least two extended longitudinal plates 11 with height *h*, m, located axisymmetrically to its longitudinal axis *X* at distance *S* from each other, corresponding to the width of bearing part 6 of aggregated extended body 5, it is possible to reciprocally move along the vertical *Z* and securely fasten the said constituent parts of aggregated extended body 5.

[0048] In alternative embodiment of track structure 4, two extended longitudinal plates 11 of rail cord 8 may be made of channel or angles (see Figs.7, 8, 11 and 12), or of extended single-layer or multi-layer strips, or other standard extended profiles and combinations thereof, the cross section of which, in all embodiments of the profile of aggregated extended body 5 of rail cord 8, is a rectangle of *U*-shaped profile.

[0049] Production of extended longitudinal plates 11 in the form of strips or above specified profiles is used in cases of need for simplification, facilitation, cost-cutting and increase in technological effectiveness of design of track structure 4 when ensuring required strength parameters thereof.

[0050] Hereby, extended longitudinal plates 11, forming in their arbitrary configuration a *U*- shaped profile, are rigidly connected with plate 8.1 of rail head of rail cord 8 of aggregated extended body 5 by any known fastening method, ensuring calculated structural reliability, for example, welding, riveting (see Figs.4 -8, 11 and 12), pinning, gluing, or placing extended longitudinal plates 11 in special mounting sockets, embodied integral with plate 8.1 of rail cord 8 (not shown on Figs), or other.

[0051] Embodiment of aggregated extended body 5 from two interconnected main parts - bearing part 6 and rail cord 8 of described structures allows to guarantee alignment and fixation of rolling surface *A* of track structure 4 along entire length thereof.

[0052] Thus, detected prior to joining and fixation of main constituent parts (bearing part 6 and rail cord 8) of aggregated extended body 5, the error ΔP, m, of actual height of arrangement of datum line *N* of bearing part 6 of aggregated extended body 5 relative to its design level, which is formed as result of manufacturing and installing of this part of aggregated extended body 5 of track structure 4, can be efficiently eliminated by alignment of rolling surface *A* of rail cord 8 along its longitudinal axis *X* as result of moving along the vertical *Z* of extended longitudinal plates 11 and fixation of position of rail cord 8 on design height *P*, m, defined by the dependence:

$$0{,}05 \le P/h \le 2, \qquad (1)$$

where $P = P_0 + \Delta P$, and P_0, m, - actual height of arrangement of datum line *N* (see Figs.5, 6 and 10) of bearing part 6 relative to design level of rolling surface *A* of rail cord 8;

ΔP, m, - error of actual height of arrangement of datum line *N* of bearing part 6 relative to its design level.

[0053] Said ratio (1) limits distinguish the optimum range of dependence of height of rail cord 8 fixation on bearing part 6 of aggregated extended body 5 with height of extended longitudinal guide plates 11 of rail cord 8, which provides operational evenness of rail cord' rolling surface, necessary for high-speed movement of vehicle 9.

[0054] If the ratio (1) is less than 0.05, then the construction of aggregated extended body 5 becomes unnecessarily bulky and less technological, which leads to overconsumption of materials and increase in the cost of the system as a whole.

[0055] If the ratio (1) is more than 2, then reliability of basing the rail cord 8 on bearing part 6 is reduced, which entails a decrease in carrying capacity of aggregated extended body 5 of track structure 4 and transport system as a whole.

[0056] Reciprocal fixation of two main parts of aggregated extended body 5 - bearing part 6 and rail cord 8 into single track structure 4, after alignment of rolling surface A of rail cord 8, is carried out by any known fastening method and/or a combination thereof, ensuring calculated structural reliability, for example, by different methods of welding, riveting, pinning, gluing, hardening filling, kinematic engagement or other methods, making it feasible to achieve technological effectiveness of installation, as well as high accuracy, strength and durability of track structure 4 all through its entire length (see Figs.4 - 8, 11).

[0057] At that mentioned, in case of use of hardening filler as fixing element, instead of filler material produced from damping and noise absorbing material, a filler similar to hardening material 13 (used for rigid binding into one whole of all elements of bearing part 6 of aggregated extended body 5) can be used for filling up of void volume *V* between two extended longitudinal plates 11 of rail cord 8 and bearing part 6 of aggregated extended body 5.

[0058] In this particular variant of practical implementation, the said hardening filler rigidly binds into a whole two main parts of aggregated extended body 5 - bearing part 6 and rail cord 8 - into one-piece track structure 4, which also ensures its efficiency due to transfer and redistribution of high contact stresses from wheels 14 of vehicle 9 through rail cord 8 onto load-bearing member 7.

[0059] In order to improve the quality, accuracy, reliability and efficiency of the process of forming one-piece track structure 4, it becomes advisable to perform alignment of rolling surface *A* of rail cord 8 and reciprocal fixation of two main parts (bearing part 6 and rail cord 8) of aggregated extended body 5, with use of special automatic installation complex, with function to simulate, during its operation, weightload of vehicle 9 (not shown).

[0060] Considering alternative embodiments of different elements of track structure 4, it is feasible to offer a wide array of variants of practical realization of the claimed transport system by Yunitski, and those, generally, include installation on foundation 1 of anchor 3.1 and intermediate 3.2 supports, in spans 2 between which, in the certain sequence, the components of extended body 5 of track structure 4 are fixed and connected, while at the same time, the accumulated error of manufacture and installation is defined and eliminated. Then the resulting assembly of track structure 4, consisting of two main parts (bearing part 6 and rail cord 8) of aggregated extended body 5, is fixed and at least one vehicle 9 is guided along thus formed track structure 4.

Industrial applicability

[0061] The method of manufacturing and mounting transport system by Yunitski of this type is implemented as follows.

[0062] After installation of anchor 3.1 supports and intermediate 3.2 supports on foundation 1, preliminary prepared bearing part 6 of aggregated extended body 5, including prestressed load-bearing member 7, arranged in certain manner in this part of aggregated extended body 5 of track structure 4, is lifted in spans 2 and tensioned (See Figs. 1 and 2) onto anchor 3.1 supports to predetermined design values (T, T1, T2). After fastening on anchor 3.1 supports of bearing part 6 of aggregated extended body 5, it is fastened on all intermediate 3.2 supports, and, in each span 2 between adjacent supports 3, the actual position and deviation from design value of arrangement of datum line N of bearing part 6 of extended body 4 is determined thereon.

[0063] By subsequent alignment of rail cord 8 being connected to installed bearing part 6 - the second of main parts of aggregated extended body 5 of track structure 4 - along its longitudinal axis X as a result of vertical displacement Z of extended longitudinal plates 11 to corresponding height *P*, m, assembling into whole of aggregated extended body 5 of track structure 4 is carried out. In process of such assembling and alignment on both main parts of aggregated extended body 5, their final reciprocal fixation into single track structure 4 is performed.

[0064] As a result, independent of embodiment of load-bearing member 7 in bearing part 6 of aggregated extended body 5, high precision of positioning of rolling surfaces *A* of rail cord 8 relative to load-bearing member 7, is achieved according to design concept of the specific track structure 4, whereby the following advantages are gained: guaranteeing of vertical operational smoothness of rolling surfaces of rail cord, required for high-speed of wheeled vehicles; stabilization of longitudinal evenness (flatness) of track structure throughout the transport system taking into account the actual influence of external factors thereupon; provision of "velvet-smooth track" effect.

[0065] By the specified distinguishing features, the claimed engineering solution differs from prototype, i.e. meets the

requirement of novelty of invention.

[0066] Upon reviewing the patent and scientific-technical literature, no subjects containing features, that distinguish the claimed approach from the prototype and allow to achieve the specified effect, have been found, therefore, in view of what follows that it meets the requirement of the invention "essential distinction".

[0067] Transport system by Yunitski of the described structure, as well as the method of manufacturing and assembling thereof, meet the requirements of novelty and essential distinction, and allow to embody high-technology transport system of string type, having improved operational characteristics with reduction of its cost and improvement of speed characteristics of vehicles.

Information sources

[0068]

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2. Patent EA 006111, IPC B61B 3/00, 5/00; E01B 25/00, publ.25.08.2005.
3. Patent EA 005017, IPC B61B 5/00, E01B 25/24, publ.28.10.2004.
4. Patent RU 2449071, IPC E01B 2/00, publ.27.04.2012.

Claims

1. Transport system, which constitutes, at least, one track structure, tensioned above foundation, in spans between supports, comprising aggregated extended body, consisting of bearing part, including prestressed load-bearing member, and rail cord connected with it, equipped with rolling surface with a mounted or suspended vehicle positioned thereon, whereby the load-bearing member in spans between supports is fixed in relation to the rolling surface in the bearing part of the body at height *H*, m, ***characterized in that*** the rail cord is equipped with, at least, two extended longitudinal plates of height *h*, m, positioned axisymmetrically to the longitudinal axis of the rail cord at distance from each other, equal to the width of the bearing part of the body, whereby the bearing part and the rail cord are configured to be reciprocally moving along vertical direction and afterfixing to each other at design height *P*, m, of positioning of the rolling surface, defined by the dependence:

$$0{,}05 \le P/h \le 2,$$

where $P = P_0 + \Delta P$, and P_0, m, - actual height of arrangement of datum line of bearing part relative to design level of rolling surface of rail cord;
ΔP, m, - error of actual height of arrangement of datum line of bearing part relative to its design level.

2. Transport system according to claim 1, ***characterized in that*** in bearing part of body, manufactured in the form of string truss, the height H, m, is invariable and has constant value in spans between supports.

3. Transport system according to claim 1, ***characterized in that*** in bearing part of body, manufactured as flexible string structure, the height H, m, is set as variable.

4. Transport system according to claim 1, ***characterized in that*** in void volume between two extended longitudinal plates of rail cord, damping and noise absorbing filler material is placed.

5. Transport system according to any of claims 1 and/or 4, ***characterized in that*** two extended longitudinal plates of rail cord are formed by flanges of channel or two angles, fixed on rail cord.

6. Method of manufacturing and assembling of transport system, including tensioning to nominal rated force and fastening in spans between supports, mounted on foundation, of load-bearing member during installation thereof into track structure, embodied as interconnected, along the datum line of conjugation, constituent parts of extended body: rail cord, equipped with rolling surface for vehicle, and bearing part, comprising prestressed load-bearing member fastened therein, ***characterized in that*** *the* assembling of transport system is performed in the following sequence:

- installing in spans between supports is performed of bearing part of body, while longitudinally positioning load-

bearing member in the body in accordance with design values at heights *H*, m;
- error ΔP, m, is defined, of actual height of arrangement of datum line of bearing part relative to its design level;
- alignment of rolling surface of rail cord along its longitudinal axis by moving rail cord within the value of defined error ΔP, m;
- installing of rail cord with its fastening on bearing part of body via longitudinal guide plates.

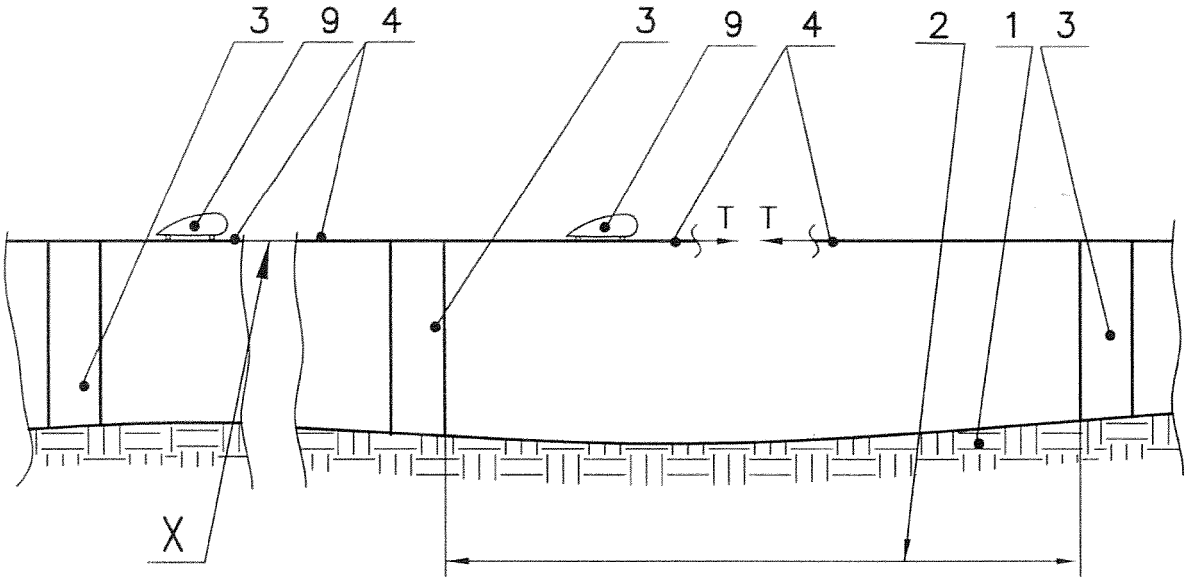

Fig. 1

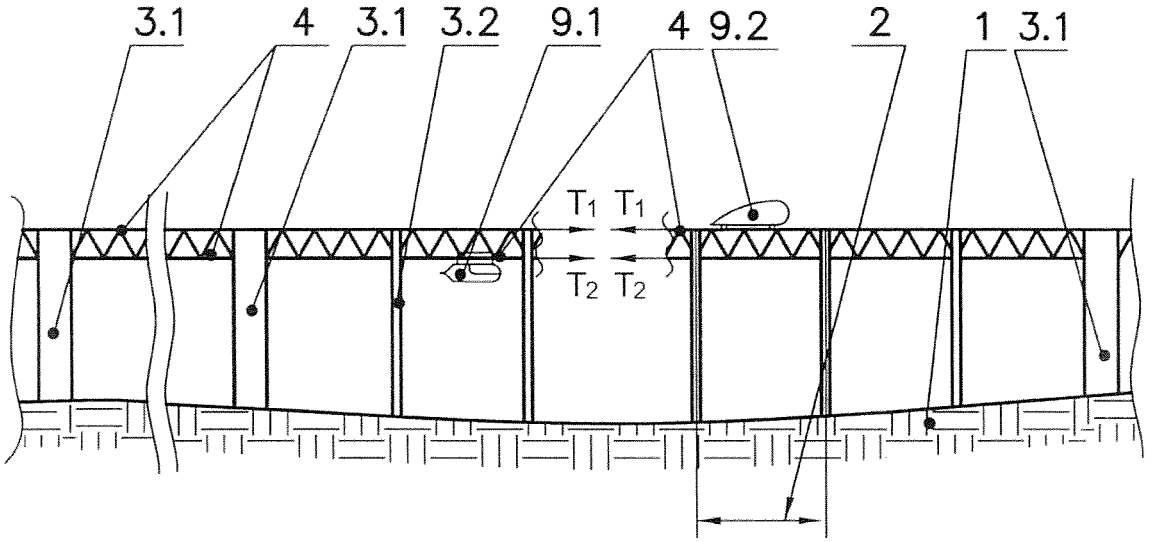

Fig. 2

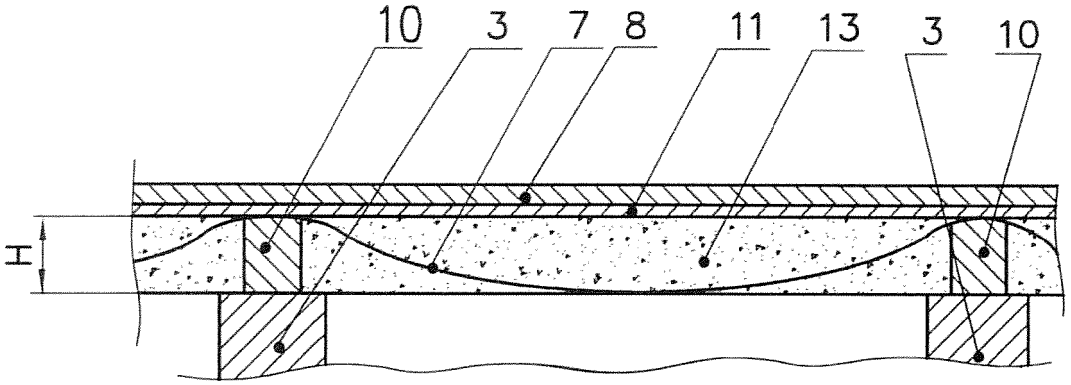

Fig. 3

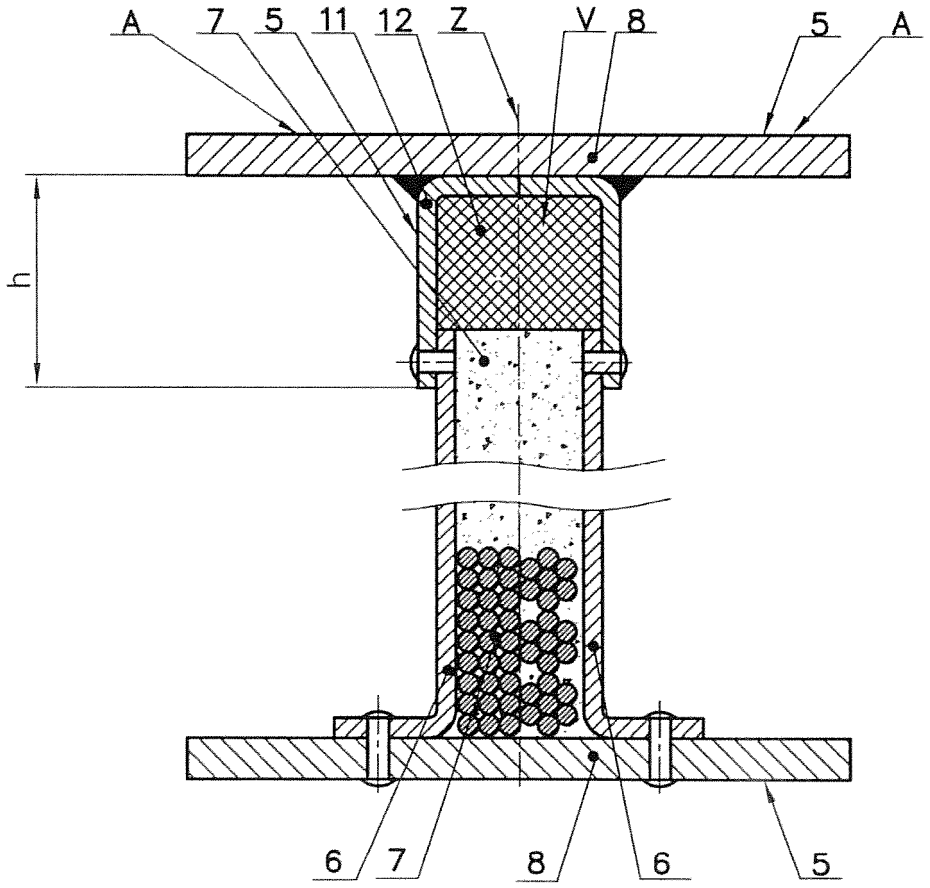

Fig. 4

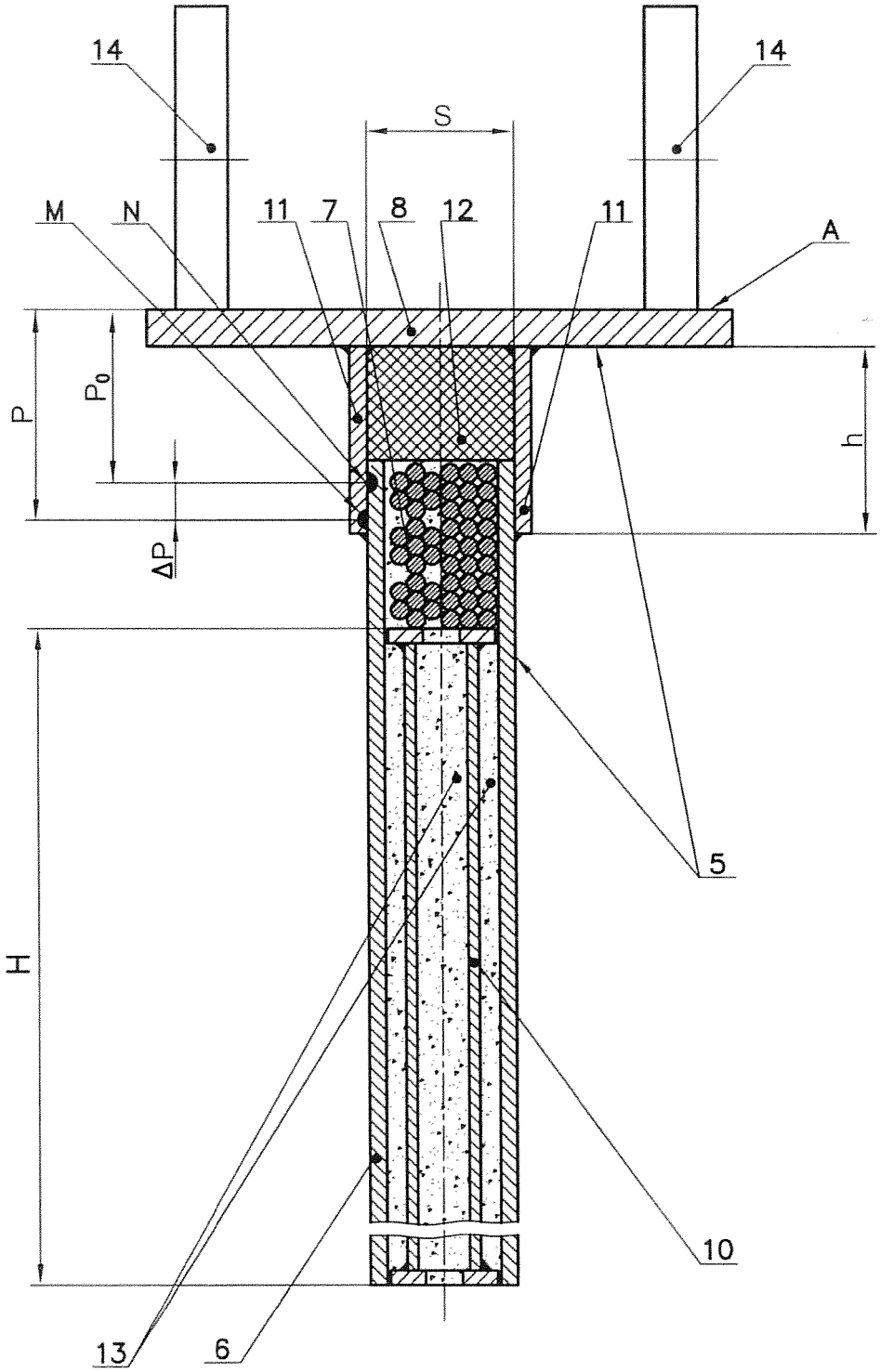

Fig. 5

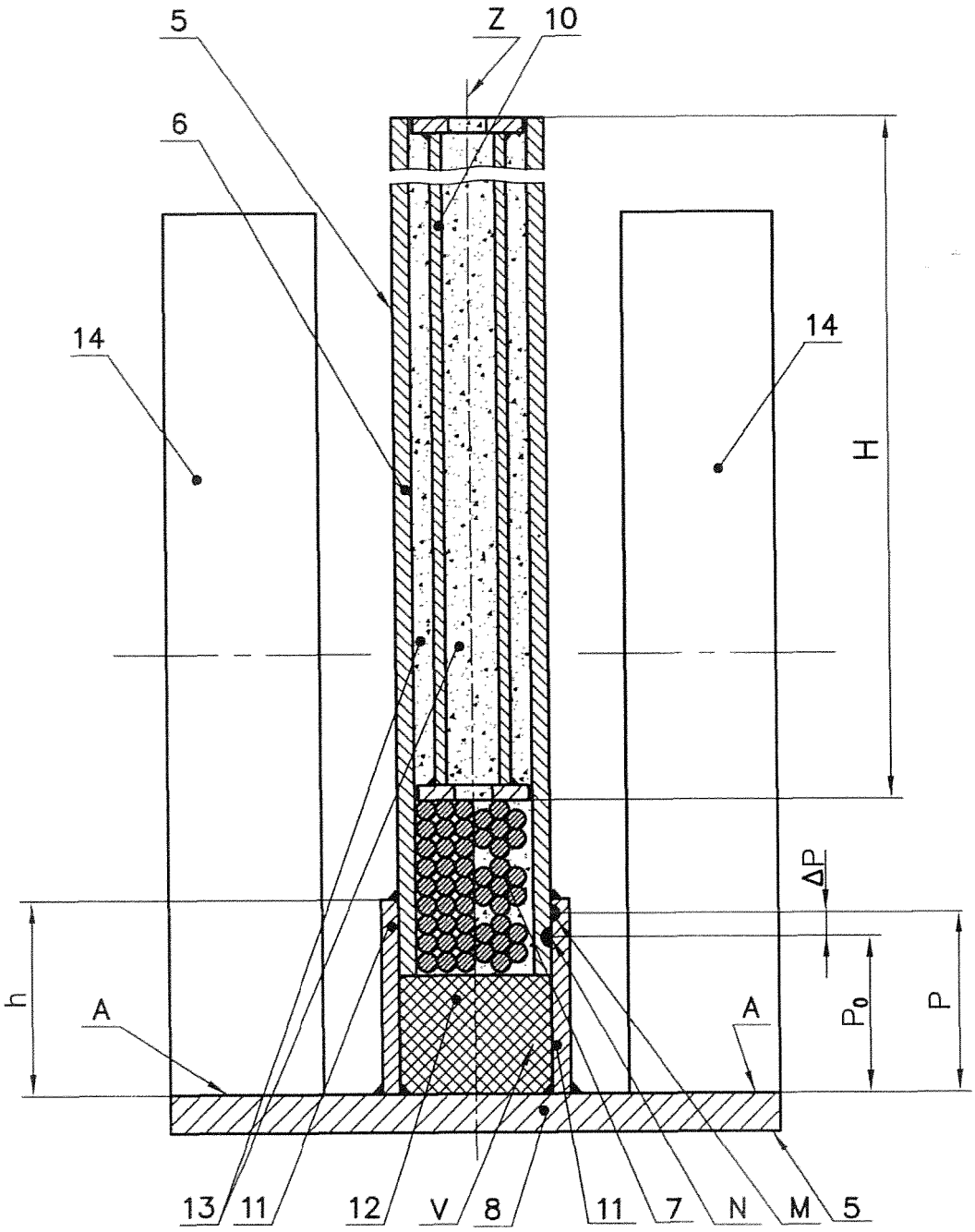

Fig. 6

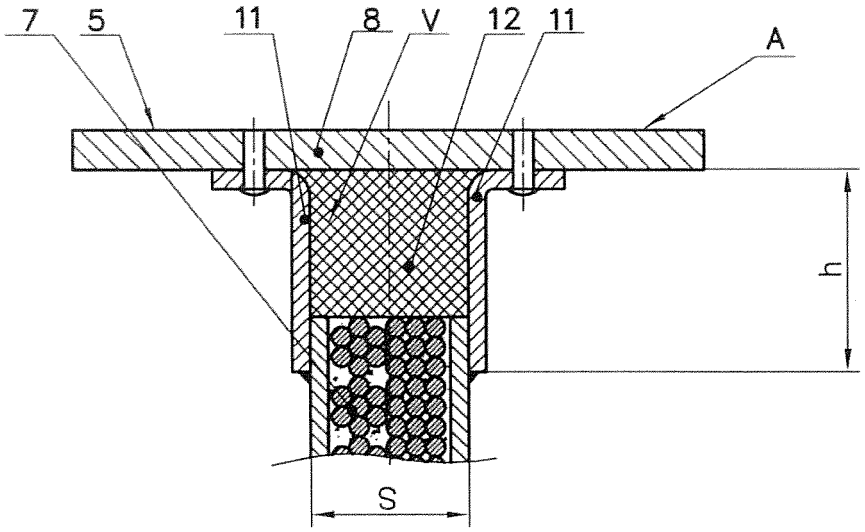

Fig. 7

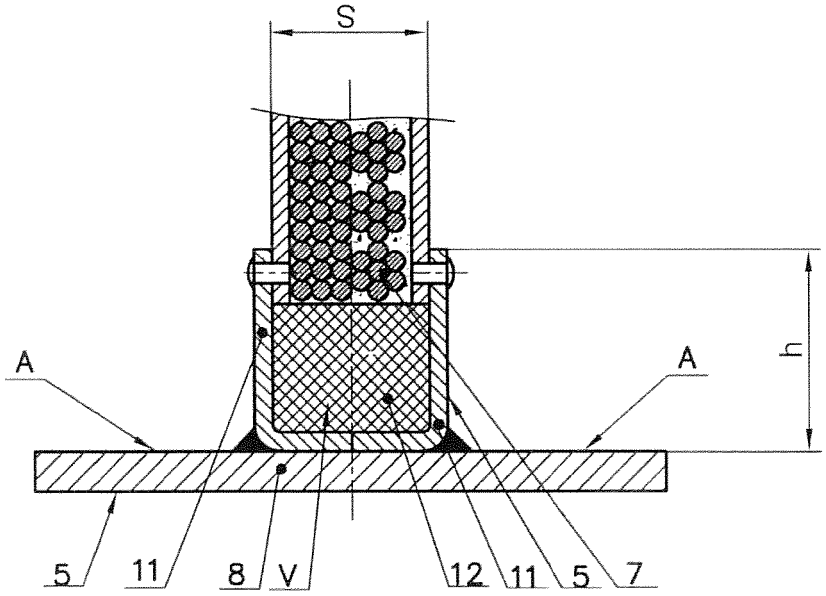

Fig. 8

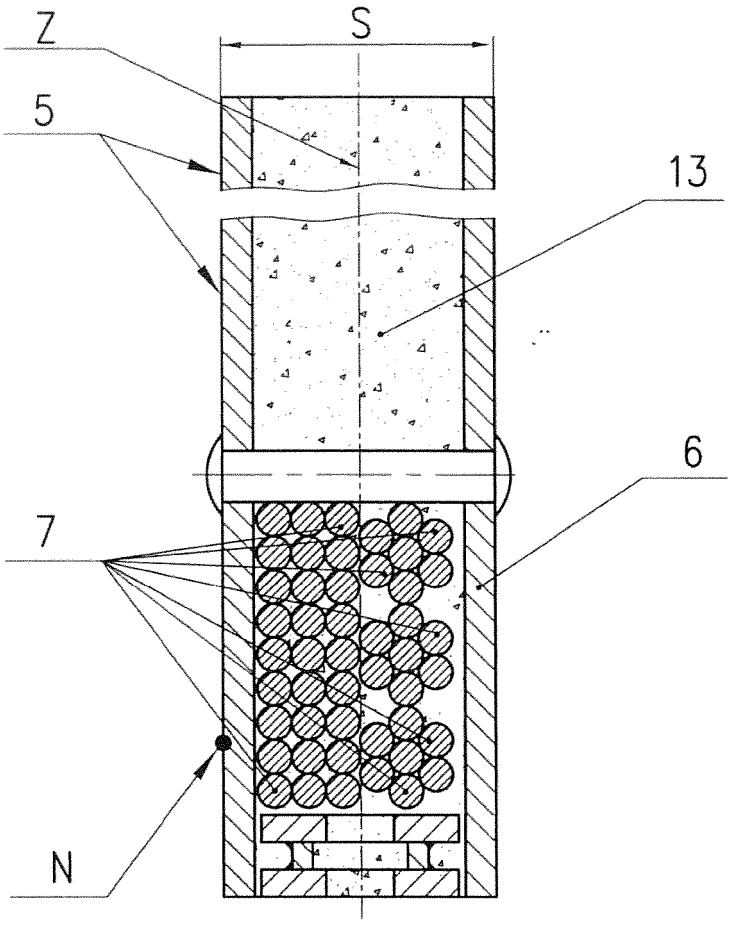

Fig. 9

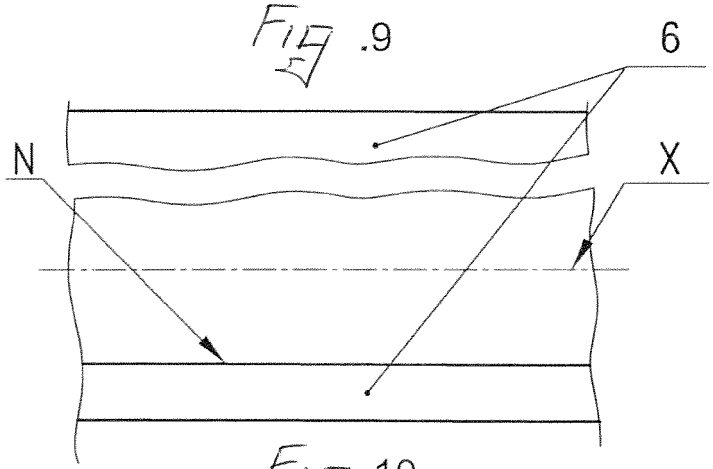

Fig. 10

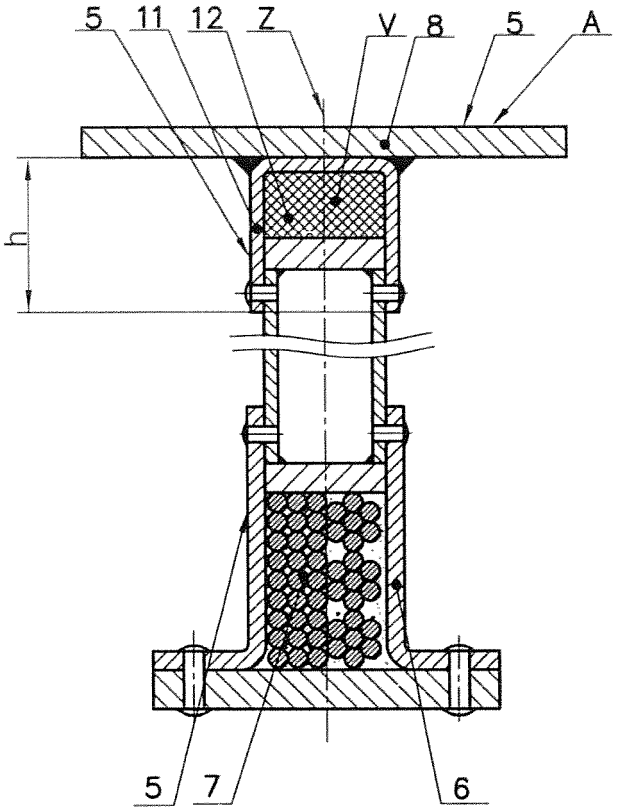

Fig. 11

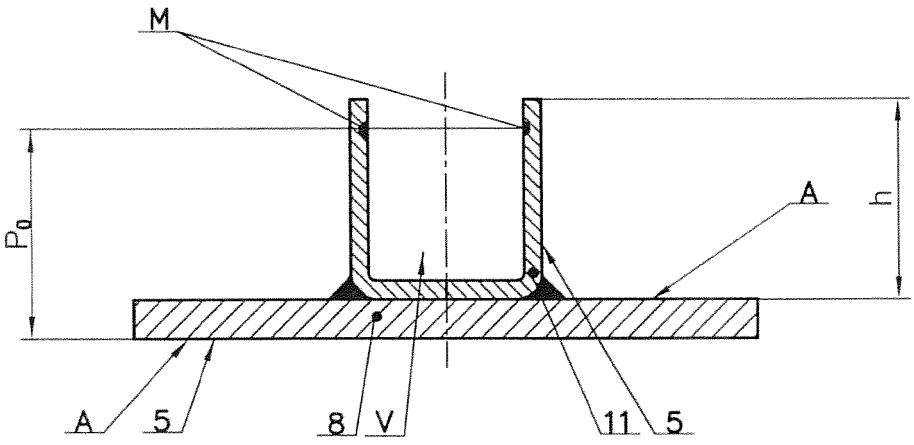

Fig. 12

INTERNATIONAL SEARCH REPORT

International application No.
PCT/BY 2019/000007

A. CLASSIFICATION OF SUBJECT MATTER
B61B 13/00 (2006.01); E01B 25/08 (2006.01); E01B 25/22 (2008.01)

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, E01B

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)
Espacenet, PatSearch, USPTO, RUPTO, PAJ, WIPO

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A, D	EA 005017 B1 (JUNITSKY A.E.) 28.11.2004	1-6
A	S 2003/0140817 A1 (MILAN NOVACEK) 31.07.2003	1-6
A	RU 2220249 C1 (JUNITSKY A.E. et al.) 27.12.2003	1-6
A	RU 2475387 C1 (JUNITSKY A.E.) 20.02.2013	1-6

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

* Special categories of cited documents:
"A" document defining the general state of the art which is not considered to be of particular relevance
"E" earlier application or patent but published on or after the international filing date
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
"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
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"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
23 September 2019 (23.09.2019)	03 October 2019 (03.10.2019)
Name and mailing address of the ISA/ RU	Authorized officer
Facsimile No.	Telephone No.

Form PCT/ISA/210 (second sheet) (April 2005)

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- RU 2080268 **[0068]**
- EA 006111 **[0068]**
- EA 005017 **[0068]**
- RU 2449071 **[0068]**