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DESCRIPTION

[0001] The present invention relates to a hybrid transportation system for objects.

[0002] The patent EP0633208 describes a method for sorting objects in which a plurality of articles having different sorting addresses are sorted using a plurality of high-efficiency carriages mobile along a rail. Each high-efficiency carriage is provided with four belts that are mobile in opposite directions of feed and are designed also to operate in a synchronous way. The objects may be fed onto/picked up from the carriage by belts arranged at the opposite sides of the carriage.

[0003] The above carriage is configured to displace objects of small dimensions that may be placed on a respective belt or on a pair of adjacent belts.

[0004] The document DE 20 2014 002923U1 discloses a transportation system according to the preamble of claim 1.

[0005] The aim of the present invention is to provide a transportation system that is particularly flexible and is capable of transportation, with a high carrying capacity, a flow of objects of different dimensions.

[0006] The above aim is achieved by the present invention in so far as it relates to a transportation system for objects in which a train formed by a plurality of carriages connected in series together through articulated joints moves along a rail driven by motor means, the train comprising first carriages arranged alternating with second carriages, wherein each first carriage comprises a supporting structure that carries a pair of first motor-driven rectilinear belts arranged with their longer edges mutually parallel and perpendicular to the direction of feed of the train, each first belt defining a plane rectangular support surface facing upwards and suitable to carry at least one object, the adjacent edges of said belts being spaced apart by a first distance d ; and each second carriage comprises a supporting structure that carries just one second motor-driven rectilinear belt arranged with its own longer edges perpendicular to the direction of feed of the train, said second belt defining a plane rectangular support surface facing upwards and suitable to carry at least one object. The invention will now be described with reference to the attached drawings, which illustrate a preferred non-limiting embodiment thereof and in which:

Figure 1 is a perspective view from above of a transportation system for objects obtained according to the teachings of the present invention;

Figure 2 is a perspective view from beneath of a transportation system for objects obtained according to the teachings of the present invention;

Figure 3 is a top plan view of the system of Figures 1 and 2 in a first operating position (running along a rectilinear stretch of rail);

Figure 4 is a top plan view of the system of Figures 1 and 2 in a second operating position (running along a curved stretch of rail); and

Figure 5 illustrates a running condition during use of the transportation system of the present invention.

[0007] In the attached figures, designated as a whole by 1 is a transportation system for objects 7, in which a train 3 formed by a plurality of carriages 4 connected in series together by articulated joints 5 moves along a path defined by a rail 6 driven by a linear motor (illustrated hereinafter). Typically, but not exclusively, the path is closed and develops in a single plane.

[0008] The objects 7 transported generally comprise parcels of a parallelepipedal shape characterized by three characteristic dimensions, length L, width W, and height H. By way of non-limiting example, the characteristic parameters of the parcels 7 may be the following:

Minimum values of length, width, and height	20 x 20 x 2 (cm)
Mean values of length, width, and height	45 x 35 x 25 (cm)
Maximum values of length, width, and height	120 x 80 x 80 (cm)
Maximum value of perimeter	350 (cm)
Minimum weight of the object	0.05 kg
Mean weight of the object	6 kg
Maximum weight of the object	50 kg

[0009] Other types of typically transportable objects are trays formed by a cup-shaped body having a rectangular perimeter in plan view.

[0010] The train comprises first carriages 4-a arranged alternating with second carriages 4-b. In the example, two first carriages 4-a and two second carriages 4-b are illustrated, but the number may obviously be different.

[0011] According to the present invention, each first carriage 4-a comprises a supporting structure 8-a, which carries a pair of first motor-driven rectilinear belts 10, 11 arranged with their longer edges mutually parallel and perpendicular to the direction of feed of the train 1. Each first belt 10, 11 defines a plane rectangular support surface 10-1, 11-1 facing upwards, on which at least one object may be placed (see in this connection Figure 5). The adjacent rectilinear edges of the belts 10, 11 are spaced at a first distance d apart, which in a non-limiting example may be 100 cm.

[0012] Each second carriage 4-b comprises a supporting structure 8-b, which carries just one second motor-driven rectilinear belt 12 arranged with its own longer edges perpendicular to the direction of feed of the train 1. The second belt 12 defines a plane rectangular support surface

12-1 facing upwards, on which at least one object 7 may be placed. The second distance D between one edge of the belt 11 of the first carriage 4-a and a facing edge of the second belt 12 of the second carriage 4-b is greater than the first distance d , for example $D = 185 \text{ mm} > d = 100 \text{ mm}$.

[0013] Typically, but not exclusively, the first belts 10, 11 and the second belts 12 have the same width (for example, 460 mm), and the rectangular support surfaces 10-1, 11-1 and 12-1 defined by the first belts 10, 11 and by the second belts 12 have the same length (in the example, 700 mm). The support surfaces 10-1, 11-1 and 12-1 defined by the first belts (10, 11) and by the second belts 12 are coplanar with each other in planar portions of the path of the carriages.

[0014] The first belts 10, 11 are motor-driven independently by respective motors (not illustrated for simplicity). In greater detail, each belt 10, 11 extends between a first idle roller carried by a first end portion of the supporting structure 8-a and a second motor-driven roller carried by a second end portion of the supporting structure 8-a. Likewise, the belt 12 extends between a first idle roller carried by a first end portion of the supporting structure 8-b and a second motor-driven roller carried by a second end portion of the supporting structure 8-b.

[0015] With reference to what is illustrated in Figure 2, each supporting structure 8-a, 8-b is T-shaped and comprises a rectilinear cross-member 20 and a rectilinear upright 21, which extends from a central portion 20-c of the cross-member 20. The uprights 21 of the first carriages 4-a have a length that is substantially twice the length of the uprights 21 of the carriages 4-b, whereas the length of the cross-members 20 is the same in the carriages 4-a and 4-b.

[0016] Typically, the uprights 21 and the cross-members 20 are of light metal material such as aluminium or aluminium alloys.

[0017] Each carriage 4-a, 4-b comprises a pair of idle wheels 23 carried by respective C-shaped supports 24, which are in turn carried by opposite end portions of the rectilinear cross-member 20. The idle wheels 23 are designed to be placed on plane top portions of respective rails 6-a, 6-b. Between the end portion of the cross-member 20 and the support are arranged bearings (not illustrated for simplicity) so that each support 24 is mobile about a respective vertical axis 25 perpendicular to the cross-member 20. In this way, the idle wheels 23 may be oriented with respect to the supporting structure for following the profile of the rail.

[0018] Each carriage 4-a, 4-b comprises a pair of idle contrast wheels 25 carried by the cross-member 20, arranged on opposite sides of the central area 20c, which are mobile about respective axes 28 perpendicular to the cross-member 20 and are configured to come into contact with internal portions of the rails 6-a, 6-b for centring the carriage 4-a, 4-b with respect to the rails 6-a, 6-b themselves. The contrast wheels 27 are covered with rubber designed to produce a marked friction on the internal portions of the rails 6-a, 6-b.

[0019] At the end portion, the aforesaid upright 21 is provided with a first connection device (not illustrated) designed to couple with a second connection device (not illustrated) arranged in the central area of the cross-member 20 of an adjacent carriage to form an articulated joint 5. In this way, a first carriage 4-a and a second carriage 4-b coupled together constitute a set of carriages that is placed with four wheels 23 on the rails 6-a, 6-b.

[0020] A plane rectangular rectilinear magnet 30 is carried by the upright 21 and faces the rails 6. Obviously, the magnet 30 carried by the carriages 4-a has a length greater than (in particular, twice) the length of the magnet carried by the carriages 4-b.

[0021] The rectilinear magnet 30 forms the moving element of a linear motor provided with a stator 32, comprising an electromagnet arranged between the rails 6-a, 6-b. In any case, the technology of linear driving motors is known, and this detail will not be described any further.

[0022] Further provided are a power transfer system 34 of an electromagnetic transformer type between an insulated power line 36, which extends along the rail 6 and constitutes the primary winding of a transformer, and a C-shaped receiver 38, which extends from the supporting structure 8-a, 8-b towards the power line 36 constituting a secondary winding of the transformer.

[0023] Each carriage 4-a, 4-b is provided with a flexible flat wall 40, which extends horizontally, i.e., which extends from a front portion of the carriage 4-a, 4-b engaging a groove 41 of a rear portion of an adjacent carriage 4-b, 4-a, thus arranging itself so that it covers the gap existing between two adjacent carriages 4-a, 4-b.

[0024] The flexible flat wall 40 is configured to prevent a small object 7 from possibly getting trapped in the gap between two adjacent carriages 4-a, 4-b.

[0025] The flexible flat wall 40 is of a plastic material, lies in a plane parallel to the plane of the support surfaces 10-1, 11-l, and 12-l and is delimited laterally by two curved lateral edges 42 and by a U-shaped front edge 43.

[0026] During movement of the carriages 4-a and 4-b along a rectilinear stretch, the distance between each carriage and the adjacent one remains constant (Figure 3). When the train takes a bend (Figure 4b), the carriages turn with respect to one another about the articulated joints 5 to follow the curvature of the rails 6. The adjacent edges of the carriages 4-a, 4-b facing the inside of the curve approach one another without touching, whereas the adjacent edges of the carriages 4-a, 4-b facing the outside of the curve move away from one another. The second distance D is in fact such as to prevent contact between the adjacent edges of the carriages facing the inside of the curve.

[0027] The system 1 envisages at least one feed branch 45 for feeding the objects onto the carriages 4-a, 4-b. For instance, the feed branch comprises a plurality of mutually parallel belts parallel to a direction of feed arranged inclined with respect to a rectilinear stretch of the rail 6.

[0028] The feed branch 45 is provided with a portal 46 equipped with optical devices of a known type for measurement of the dimensions of the objects 7 that advance along the feed branch.

[0029] Said optical devices co-operate with an electronic control unit of the feed branch, which is designed to detect:

1. a) bulky postal objects having at least one dimension L, W, or H greater than a threshold value; said postal objects may be loaded only within the perimeter formed by a pair of belts 10, 11;
2. b) medium-to-large postal objects having a width L greater than the width of the belt 10, 11; and
3. c) standard postal objects having dimensions L, W, H comprised within the threshold values;

[0030] An electronic control unit 50 is designed to select a first carriage 4-a for transfer of the bulky object from the feed branch 45 to the first belts 10, 11. In this way, a base wall of the bulky object 7 is placed on the belts 10, 11. There is thus ensured positioning of a bulky object 7 on a carriage 4-a having dimensions such as to prevent contact between walls of the bulky object and walls of postal objects carried by adjacent carriages. The electronic control unit 50 inhibits depositing of a subsequent bulky/medium-to-large object on a carriage 4-b adjacent to the one selected in order to prevent any possible collisions between the objects and optimize detection of codes, in particular bar codes, provided on the objects. This configuration enables even large parcels to be managed on pairs of belts of a same carriage, with a better control when it is taking a bend (absence of sliding of the base against the belts, which occurs when a large parcel is loaded so that it straddles two carriages).

[0031] In the case where a medium-to-large object is identified, this is preferably, but not exclusively, loaded on a carriage 4-a.

[0032] The device 1 enables different categories of objects 7 to be efficiently transported. In particular, the alternation of carriages with different numbers of belts (two - one) enables a flexibility of use that increases considerably the overall operating efficiency of the transportation system. The larger objects may in fact be loaded onto the carriages 4-a, whereas the medium-sized objects may be indifferently loaded on the carriages 4-a and 4-b.

[0033] A specific advantage of the configuration described lies in the capacity of handling a large number of medium-to-large objects as compared to the number of small objects, and at the same time enables loading of small objects in each residual position. This configuration enables the medium-sized parcels to fit on each individual available carriage and/or on each belt available of a double belt even if one of the two belts is already occupied by a small object.

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- [EP0633208A \[0002\]](#)
- [DE202014002923U1 \[0004\]](#)

Patentkrav

1. Transportsystem til genstande, i hvilket et tog (3), der er dannet af en flerhed af vogne (4), som er serieforbundet via leddelte kædeled (5), bevæger sig langs en bane (6), der drives af motormidler, idet toget omfatter første vogne (4-a), der er indrettet skiftevis med anden vogne (4-b), hvor:
- 5 - hver første vogn (4-a) omfatter en støttekonstruktion (8-a), der bærer et par af første motordrevne retlinjede bånd (10, 11), som er indrettet med deres lange kanter gensidigt parallelt og vinkelret på togets fremføringsretning, idet hvert første bånd (10, 11) definerer en plan rektangulær bæreflade (10-1, 11-1), der vender opad og er egnet til at bære mindst én genstand (7), idet de tilstødende kanter af nævnte bånd (10, 11) er adskilt fra hinanden med en første afstand d; kendetegnet ved, at:
- 10 - hver anden vogn (4-b) omfatter en støttekonstruktion (8-b), der bærer blot ét andet motordrevet retlinjet bånd (12), som er indrettet med sine egne lange kanter vinkelret på togets (3) fremføringsretning, idet nævnte andet bånd (12) definerer en plan rektangulær bæreflade (12-l), der vender opad og er egnet til at bære mindst én genstand (7).
- 20 2. Transportsystem ifølge krav 1, hvor en anden afstand D mellem en kant af ét første bånd (11) af den første vogn (4-a) og en modstående kant af den anden vogns (4-b) andet bånd (12) er større end den første afstand d.
3. Transportsystem ifølge krav 1 eller 2, hvor nævnte første bånd (10, 11) og nævnte anden bånd (12) har samme bredde, og bærefladerne (10-l, 11-l og 12-l), der er defineret af de første bånd (10, 11) og af de anden bånd (12), har samme længde.
- 25 4. Transportsystem ifølge et hvilket som helst af de foregående krav, hvor bærefladerne (10-l, 11-l og 12-l), der er defineret af de første bånd (10, 11) og af de anden bånd (12), er i samme plan som hinanden i plane dele af nævnte bane.
- 30 5. Transportsystem ifølge et hvilket som helst af de foregående krav, hvor nævnte første bånd (10, 11) er motordrevne uafhængigt af respektive motorer.
- 35

6. Transportsystem ifølge et hvilket som helst af de foregående krav, hvor hvert første/andet bånd (10, 11, 12) strækker sig mellem et par af motordrevne ruller, hvoraf den ene er en drivrulle, der bæres af modstående endedele af nævnte støttekonstruktion (8-a, 8-b).

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7. Transportsystem ifølge et hvilket som helst af de foregående krav, hvor: hver støttekonstruktion (8-a, 8-b) er T-formet og omfatter et retlinjet tværelement (20) og en retlinjet opstander (21), der strækker sig fra en central del (20-c) af tværelementet (20), idet hver vogn (4-a, 4-b) omfatter et par af
10 uvirksomme hjul (23), der bæres af respektive understøtninger (24), som igen bæres af endedele af det retlinjede tværelement (20), og som er indrettet til at skulle anbringes på øverste dele af respektive skinner (6-a, 6-b), der definerer nævnte bane, og idet hver understøtning (24) er mobil omkring en respektiv akse (25), der er vinkelret på tværelementet,
15 hver vogn (4-a, 4-b) omfatter et par af uvirksomme kontakthjul (25), der bæres af tværelementet, og som er indrettet på modstående sider af den centrale del (20-c), er mobile omkring respektive akser (28), der er vinkelrette på tværelementet (20), og er konfigureret til at komme i kontakt med indvendige dele af skinnerne (6-a, 6-b) med henblik på at centrere vognen i forhold til
20 skinnerne selv, idet en endedel af nævnte opstander (21) er tilvejebragt med første forbindelsesmidler, der er beregnet til at kobles med anden forbindelsesmidler, som er indrettet i det centrale område af en tilstødende vogns tværelement (20) til dannelsen af et nævnt leddelt kædeled.

25 8. Transportsystem ifølge krav 7, hvor en langstrakt retlinjet flad magnet (30) bæres af nævnte opstander (21) og vender mod skinnerne (6-a, 6-b), idet nævnte retlinjede flade magnet (30) udgør det bevægelige element i en lineær motor, der er tilvejebragt med en stator (32), som omfatter en elektromagnet, der er indrettet mellem nævnte skinner.

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9. Transportsystem ifølge et hvilket som helst af de foregående krav, hvor der er tilvejebragt et elektromagnetisk transformatoreffektoverførselssystem mellem en isoleret effektledning (36), der strækker sig langs nævnte bane (6) og udgør den primære vikling af en transformator, og en C-formet modtager (38), der
35 strækker sig fra nævnte støttekonstruktion (8-a, 8-b) mod nævnte effektledning (36), og som udgør en sekundær vikling af nævnte transformator.

10. Transportsystem ifølge et hvilket som helst af de foregående krav, hvor nævnte første bånd (10, 11) og nævnte anden bånd (12) har en bredde på 460 mm, og de rektangulære bæreflader, der er defineret af de første bånd (10, 11) og af de anden bånd (12), har en længde på 700 mm, idet nævnte første afstand
5 d er 100 mm, og nævnte anden afstand D er 185 mm.

11. Transportsystem ifølge et hvilket som helst af de foregående krav, hvor hver vogn (4-a, 4-b) er tilvejebragt med en fleksibel flad væg (40), der strækker sig vandret fra en forreste del af vognen (4-a, 4-b), idet den går i indgreb med
10 en rille (41) af en bageste del af en tilstødende vogn (4-b, 4-a), og idet den arrangerer sig selv således, at den dækker mellemrummet mellem to tilstødende vogne (4-a, 4-b), idet nævnte fleksible flade væg (40) er konfigureret til at forhindre en genstand i eventuelt at blive fanget i mellemrummet mellem to tilstødende vogne.

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12. Transportsystem ifølge krav 11, hvor nævnte flade væg er afgrænset på modstående sider af to buede laterale kanter (42) og af en U-formet forkant (43).

20 13. Transportsystem ifølge et hvilket som helst af de foregående krav, hvor der er tilvejebragt mindst én fremføringsgren (45) til fremføring af genstande til nævnte vogne (4-a, 4-b), idet nævnte fremføringsgren (45) er tilvejebragt med en portal (46), der er forsynet med optiske indretninger til måling af de karakteristiske dimensioner (L, B, H) af genstandene (7), og som er beregnet til
25 at genkende mindst én af følgende:

- a) omfangsrige genstande, der har mindst én dimension L, B eller H, som er større end en tærskelværdi, idet nævnte omfangsrige genstande kun indføres inden for den omkreds, der dannes af et par af første bånd (10, 11),
 - b) mellemstore til store postgenstande, der har en bredde L, som er større end
30 bredden af de første bånd (10, 11), og
 - c) standardpostgenstande, der har dimensioner L, B, H, som ligger inden for grænseværdierne,
- idet der er tilvejebragt styremidler (50), som er indrettet til at: vælge en første vogn (4-a) til transport af den omfangsrige genstand (a) fra fremføringsgrenen
35 (45) til de første bånd (10, 11), på hvilken en bunddel af den omfangsrige genstand placeres, og hæmme afsætning af en efterfølgende omfangsrig genstand på en vogn tilstødende den valgte med henblik på at forebygge

eventuelle mulige kollisioner mellem genstandene og optimere detektering af koder, især stregkoder, der er tilvejebragt på genstandene.

5 14. Transportsystem ifølge krav 13, hvor nævnte styremidler (50) er indrettet til at indføre fortrinsvis, men ikke udelukkende, en mellemstor til stor genstand på en første vogn (4-a).

15. Transportsystem ifølge et hvilket som helst af de foregående krav, hvor nævnte bane er dannet af en skinne.

DRAWINGS

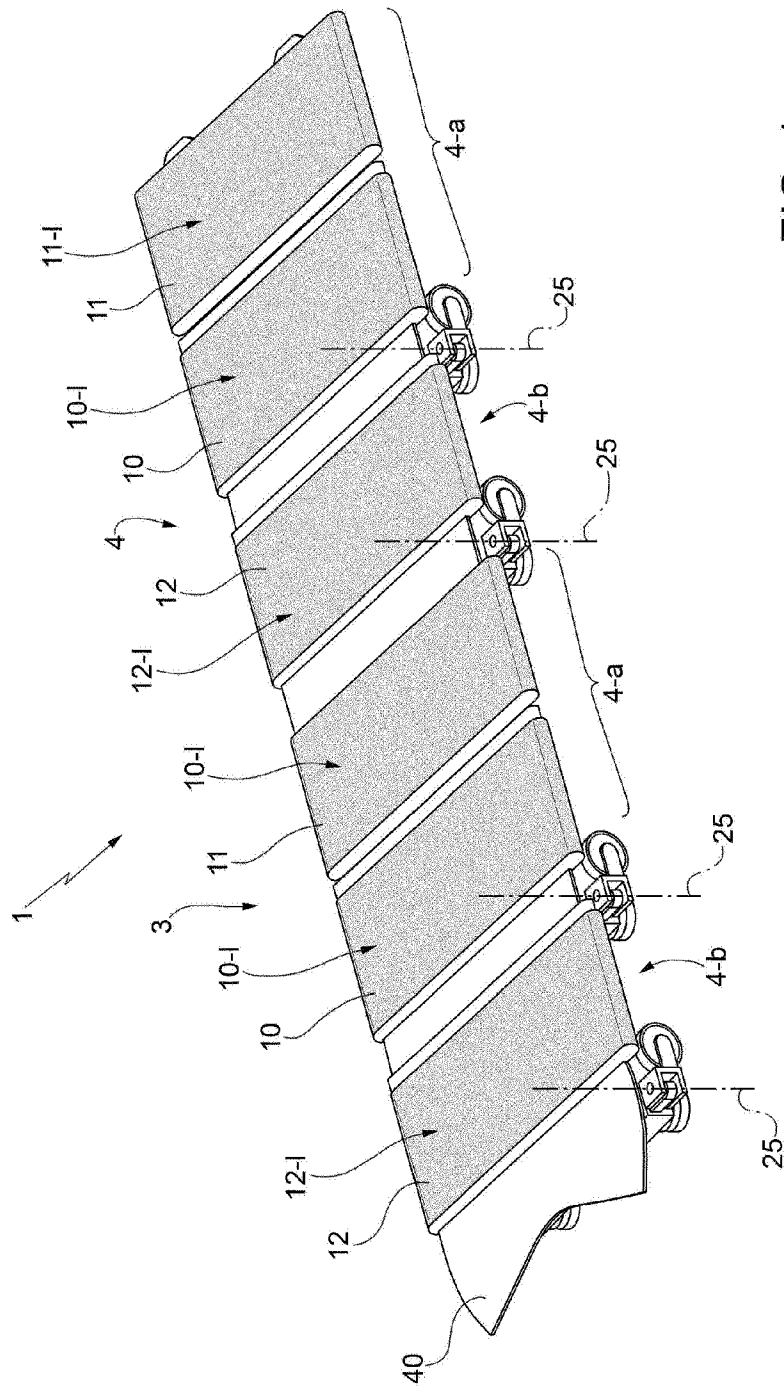


FIG. 1

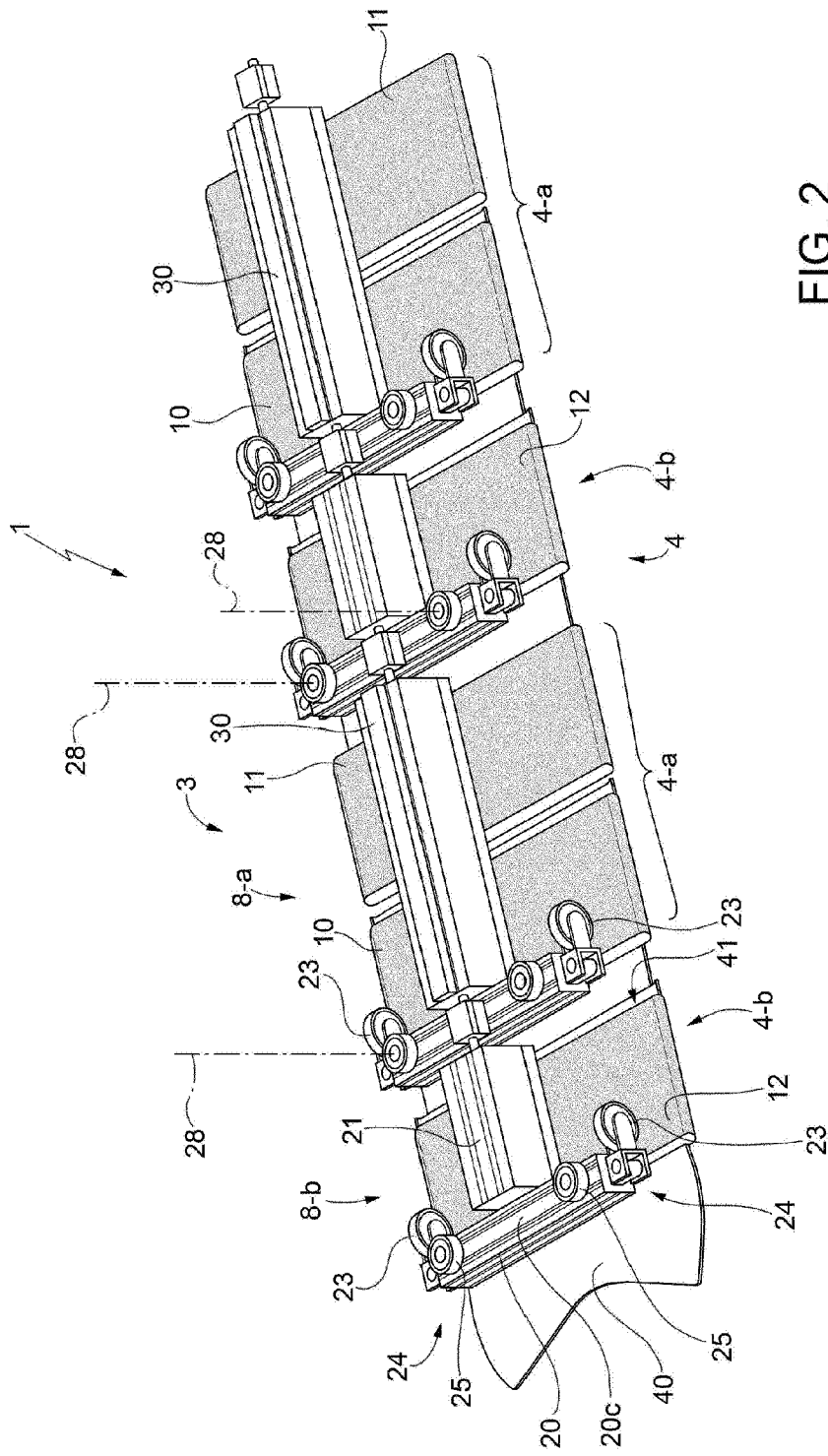


FIG. 2

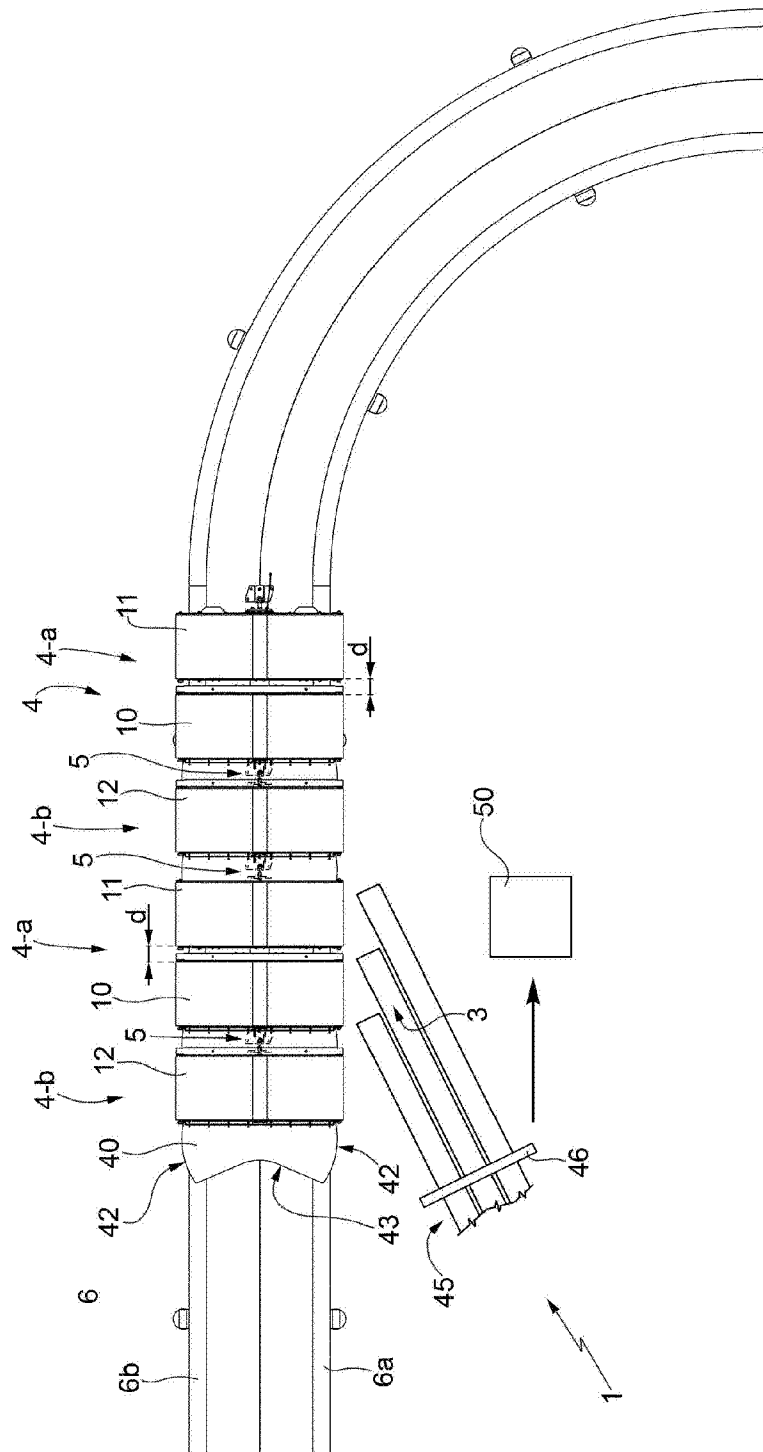


FIG. 3

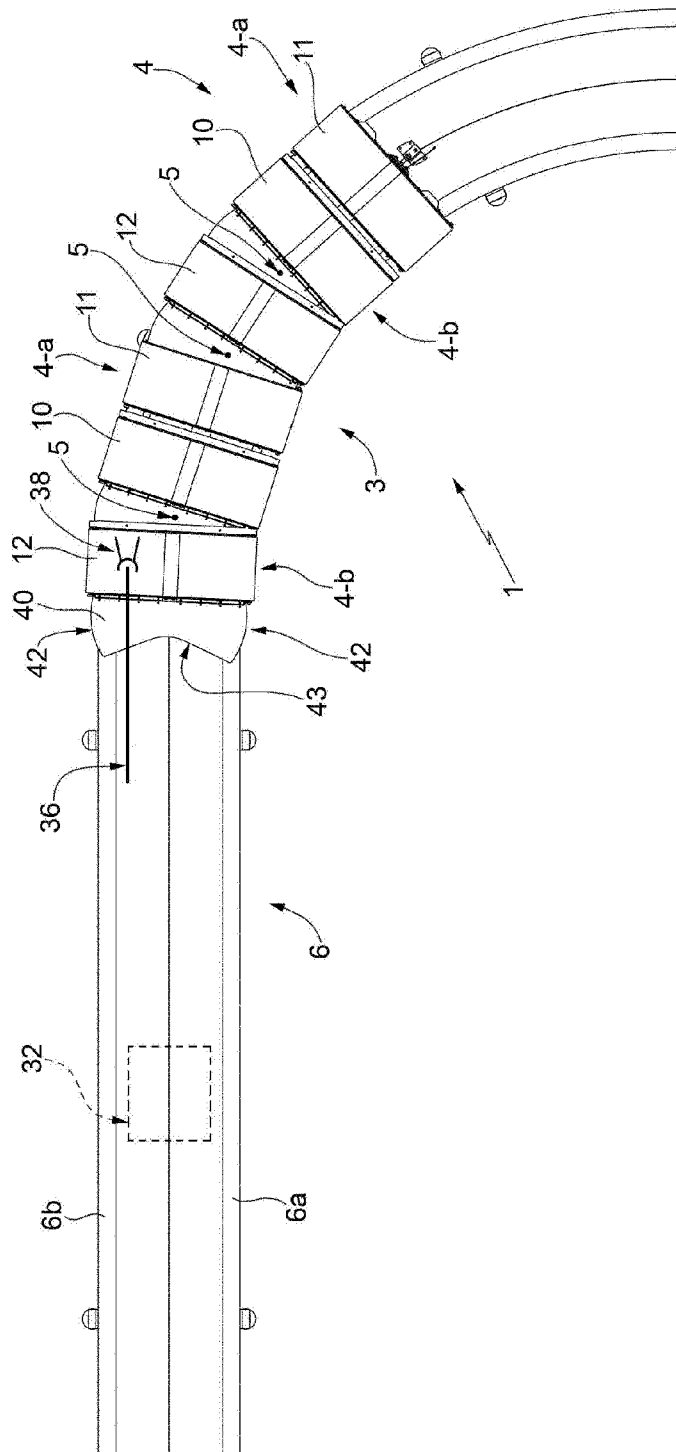


FIG. 4

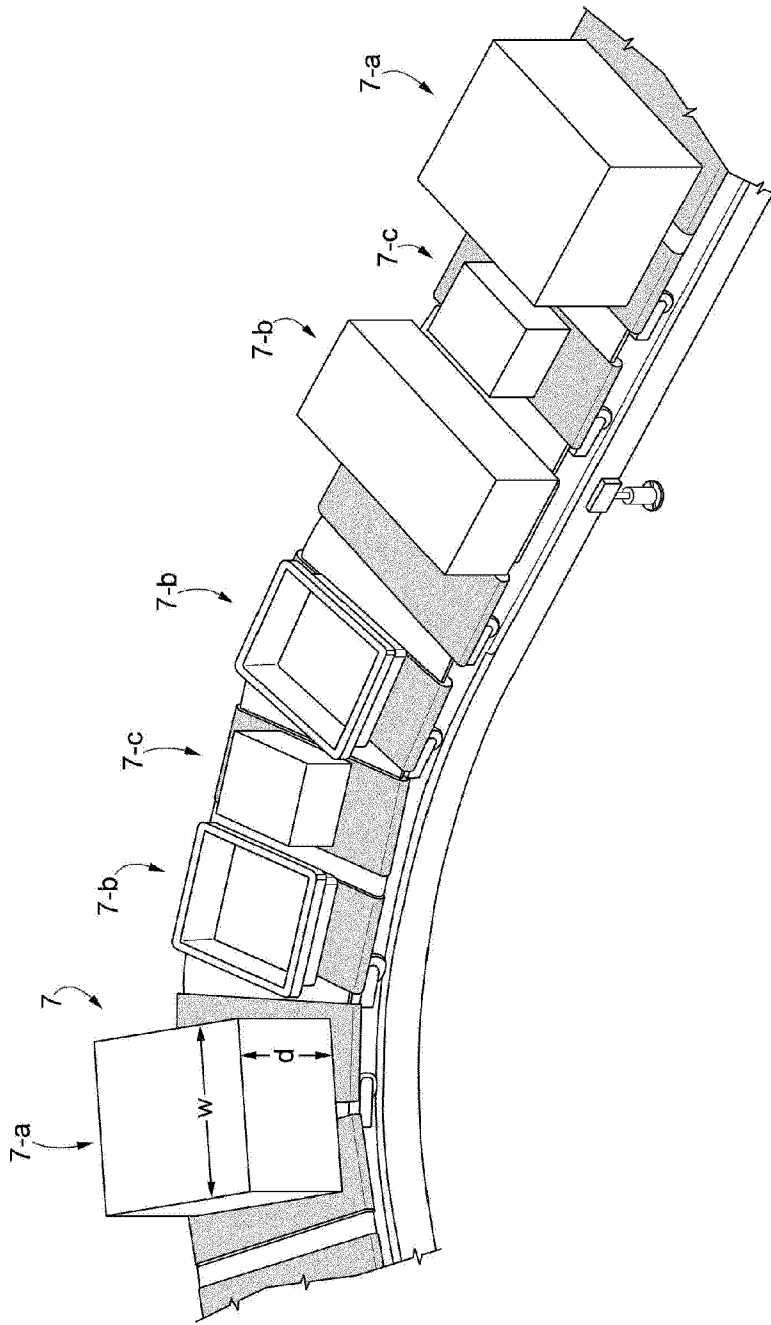


FIG. 5