(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) **EP 1 788 331 A2**

(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
23.05.2007 Bulletin 2007/21

(51) Int Cl.:
F27B 9/24 *(2006.01)*

(21) Application number: **06123936.4**

(22) Date of filing: **13.11.2006**

(84) Designated Contracting States:
AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HU IE IS IT LI LT LU LV MC NL PL PT RO SE SI SK TR
Designated Extension States:
AL BA HR MK YU

(30) Priority: **21.11.2005 IT MI20052219**

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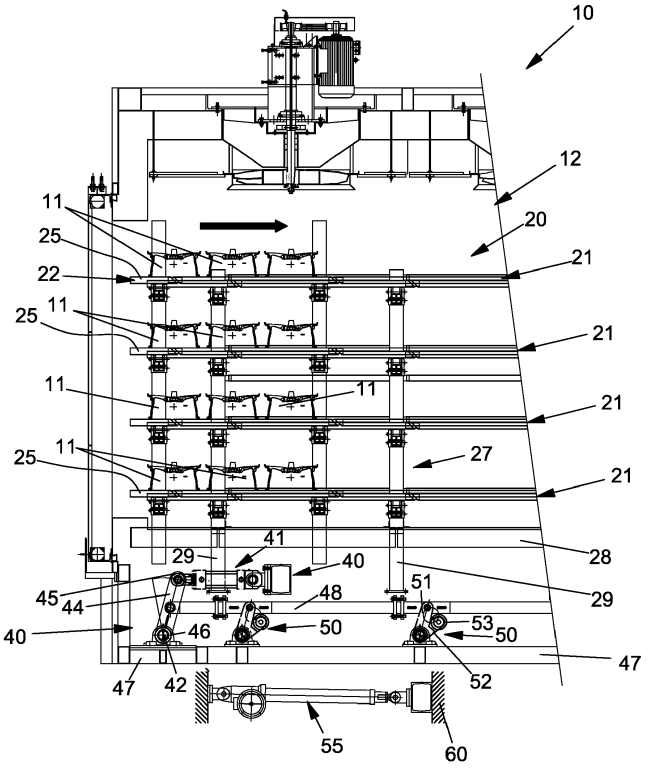
(54) **Transport system of mechanical elements to be subjected to thermal treatment**

(57) A transport system (10) of mechanical elements (11) to be subjected to thermal treatment in a furnace (12) comprises a series of supporting modules (20) arranged in series, having at least two planes (21), in which each supporting module (20) comprises a fixed supporting section (22) and a moveable supporting section (23), the moveable supporting section (23) being activated by means of a mechanism (40) suitable for lifting it and moving it by a pre-established pitch so as to intersect the fixed supporting section.

Fig. 1A



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Description

[0001] The present invention relates to a transport system of mechanical elements to be subjected to thermal treatment.

[0002] More specifically, the invention relates to a transport system of mechanical elements made of a light alloy such as wheel rims of motor vehicles to be subjected to continuous thermal treatment in a furnace.

[0003] Thermal treatment plants in the current production of series of mechanical elements substantially comprise two supporting and moving systems for the pieces to be introduced into the furnace, a batch basket system and a continuous roll system.

[0004] Both of the above systems have various drawbacks.

[0005] The basket system has high management costs of the baskets which must be continuously loaded with the pieces to be treated, in addition to labour costs necessary for the loading and unloading of the pieces, and high energy costs due to the fact that the piece-holder basket must also be treated together with the pieces.

[0006] The roll system has high management costs of the moving system, due to the frequent maintenance and substitution interventions which are particularly necessary on the gears of the rolls, the moving also implies the necessity of having processed pieces without the presence of burrs in the lower part to avoid problems relating to the jabbing and consequent advancing of the rolls.

[0007] A further disadvantage inherent to the roll transport system is due to the deformation the rolls undergo at the high thermal treatment temperature.

[0008] Under these conditions there is an heterogeneity in the advancing of the elements which requires a certain skill on the part of the operator who must take into account the different translation rates when positioning the elements at the furnace inlet.

[0009] The Applicant has therefore considered the problem of providing a transport system for a thermal treatment furnace of metallic elements in particular made of a light alloy, capable of operating without the use of baskets or other containers for the thermal treatment of the pieces.

[0010] An objective of the present invention is therefore to provide a transport system for metallic elements to be subjected to thermal treatment which allows a high productivity as pieces having different shapes and dimensions can be transported without problems relating to deformation of the baskets or to the necessity of preventive mechanical burring operations on pieces to be thermally treated.

[0011] A further objective of the present invention is to provide a transport system suitable for reducing thermal bridges and dispersions to the minimum to limit energy consumptions.

[0012] Among the objectives of the present invention is that of reducing to the minimum and simplifying the maintenance operations of the transport system.

[0013] These and other objectives according to the invention are achieved by a transport system of mechanical elements to be subjected to thermal treatment according to what is specified in claim 1.

[0014] Further characteristics of the invention form the object of the dependent claims.

[0015] The transport system of mechanical elements to be subjected to thermal treatment in a furnace according to the invention comprises a series of supporting modules arranged in series, having at least two planes, in which each supporting module comprises a fixed supporting section and a moveable supporting section, the moveable supporting section being activated by means of a mechanism suitable for lifting it and moving it by a pre-established pitch so as to intersect the fixed supporting section.

[0016] The characteristics and advantages of the transport system according to the present invention will appear more evident from the following illustrative and non-limiting description referring to the enclosed schematic drawings, in which:

figures 1a - 1e are partial schematic raised side views of the transport system according to the invention during corresponding operative moments;
figure 2 is a raised front view of the fixed structure of the transport system according to the invention;
figure 3 is a raised front view of the moveable structure and relative moving mechanism of the transport system according to the invention;
figure 4 is a schematic raised front view of the transport system according to the invention;
figures 5a and 5b respectively illustrate a raised and plan view of the lifting mechanism of the transport system according to the invention;
figures 6a and 6b respectively illustrate a raised and plan view of a pushing element of the lifting mechanism of figures 5a and 5b;
figure 7 is a raised side view of the structure of the furnace without the internal supports;
figures 8-10 illustrate details of the lifting mechanism;
figure 11 is a perspective view of the insertion device of the metallic elements inside the furnace.

[0017] With reference to the figures, a transport system 10 of mechanical elements 11 to be subjected to thermal treatment in a furnace 12, comprises a series of supporting modules 20 arranged in series having different planes 21, in particular at least two levels 21, arranged inside the furnace 12.

[0018] In the embodiment illustrated there are four planes 21 but the number of planes is pre-established in relation to the dimensions of the elements to be treated and the productivity to be obtained.

[0019] Each supporting module 20 of the mechanical elements 11 comprises a fixed supporting section 22 and a moveable supporting section 23, the moveable supporting section 23 being activated by means of a mech-

anism 40 suitable for lifting it and moving it by a pre-established pitch so as to intersect the fixed supporting section.

[0020] In each level 21 of the module 20, the fixed supporting section 22 and the moveable supporting section 23 comprise respective bar structures 25 and offset bar structures 26 with respect to each other so as to penetrate each other supporting the metallic elements.

[0021] In particular, in the application illustrated, these metallic elements 11 consist of wheel rims for motor vehicles made of a light alloy to be thermally treated before being sent for further finishing operations.

[0022] It is evident that the choice is purely illustrative and that the present invention can be used for any other metallic element to be subjected to movement inside a treatment furnace.

[0023] With particular reference to figures 1a-1e, each supporting module 20 of the rims 11 inside the furnace 12 is positioned so that the rims 11 arranged methodically on the planes 21 (figure la) are lifted by the bars 25 of the moveable supporting sections 23 and removed from the rest position on the bars 26 of the fixed supporting sections 22 (figure 1b), they are then advanced by a pre-established pitch (figure 1c), lowered and carefully positioned again on the bars 26 of the fixed supporting sections 22 (figure 1d), each moveable supporting section is subsequently moved back and brought to its initial position to effect the subsequent cycle (figure 1e).

[0024] The system uses the "pilgrim pitch" principle, with the arrangement of the elements on several planes to allow each row of elements to be moved contemporaneously.

[0025] The internal structure of the module has been produced so as to guarantee the free expansion of the planes and other components forming it.

[0026] In this respect, the linear coupling system between one module and another of the structure consists of a telescopic engagement capable of ensuring the free expansion of the supporting elements of the pieces.

[0027] Furthermore, the transport system is produced with modules to allow the possibility of varying both the height between the planes and their number to enable elements having different dimensions to be treated without the necessity of serious modifications or the substitution of the structural elements.

[0028] The planes 21 of the moveable supporting sections 23 are fixed to a framework 27 which allows the lifting and contemporaneous translation of all the planes.

[0029] The movement mechanism 40 of the moveable section is positioned in the lower part of the furnace isolated from the heating area by means of a base 28 through which vertical rods 29 pass which in turn support the framework 27.

[0030] The openings 30 produced in the base 28 and crossed by the vertical rods 29 for the moving of the planes are protected and insulated.

[0031] The vertical rods 29 slide inside a groove 31 equipped with a double labyrinth 32 capable of creating a pressure drop to avoid undesired air exchanges inside the furnace.

[0032] In this way, the dispersions and energy consumption are extremely reduced, furthermore with this arrangement the organs of the moving mechanism are easily accessible for maintenance.

[0033] The movement mechanism 40 is destined for the lifting and moving of a trolley 60 suitable for sustaining the vertical rods 29 and operates through a series of levers 50 mechanically activated by two oil-pressure cylinders 41 whose rotation fulcra 42 are rigidly connected to each other by a torque shaft 43 whose function is to synchronize both cylinders.

[0034] A further aid for the synchronization of the cylinders is provided by a twin pump flow distributor assembled on the delivery and return of the oil of the cylinders (not illustrated).

[0035] In particular, the oil-pressure cylinders 41 are hinged by means of a hinge 45 to an end of a multiplier arm 44 whose opposite end 46 is fulcrumed by means of the hinge 42 at the base 47 of the structure of the mechanism 40.

[0036] In a substantially central position to the arm, a pulling rod 48 which is divided into connected portions extends for the whole furnace and drives in synchronism the rotation of the lever 50 hinged to the pulling rod at a certain distance from each other.

[0037] The levers 50 arranged along the sides of the structure are configured with a first bracket 51 hinged to the pulling rod, and towards the centre of the furnace, a second bracket 52 equipped with coupled rolls 53 suitable for allowing the lifting of the trolley 60 in vertical translation, i.e. without horizontal translations which are annulled during the rotation of the levers thanks to the rotation of the rolls 53.

[0038] The trolley has a framework equipped with crossbars 61 transversal to the movement direction and backstays 62 and equipped below with shaped guides 63 destined for directing the sliding of the rolls without the risk of swerves.

[0039] Below the base 28 there is an interspace sealed by the use of septa 33 made of high temperature silicon rubber which adhere to the moving backstays 62 in both upward-downward and advance phases.

[0040] In this way, the trolley 60 is lifted for its whole length by means of the system of levers 50 and rolls 53 equipped with bearings and totally recordable to optimally and homogeneously level the upward movement, which takes place perfectly parallel to the ground without side movements of the elements to be treated.

[0041] The trolley 60 advances thanks to an electric servoactuator 55 acting on its framework and preferably of the ball recirculation type, managed with an inverter to have the possibility of varying the upward and downward velocity slopes thus avoiding brusque movements of the elements.

[0042] The reading of the advance pitch length of the trolley and consequently also of the metallic elements is

effected with an encoder having a millesimal precision and also with the possibility of varying the pitch length thus being able to operate with pieces having different formats and increasing the production in the case of elements having reduced dimensions.

[0043] Alternatively, the lifting can be effected with a system of servoactuators which substitute the oil-pressure cylinders, or with oil-pressure cylinders directly coupled with the structure to be lifted.

[0044] The advancing can also be effected with oil-pressure cylinders, tyres or with a self-braking motor-reducer.

[0045] With reference to figure 11, for the introduction and correct positioning of the metallic elements in the furnace and also for their removal, at each end of the furnace there is a feeder/remover 70 with layers 71 similar to the moveable supporting section 23 so as to intersect with the fixed supporting sections 22 at the end of the furnace.

[0046] Said feeder/remover 70 is activated by oil-pressure cylinders 72.

[0047] The system according to the present invention can obviously be used for other types of metallic elements without requiring substantial transformations, and consequently the example relating to the transporting of light alloy rims described, should be considered as being non-limiting.

Claims

1. A transport system (10) of mechanical elements (11) to be subjected to thermal treatment in a furnace (12), said system being **characterized in that** it comprises a series of supporting modules (20) arranged in series, having at least two planes (21), in which each supporting module (20) comprises a fixed supporting section (22) and a moveable supporting section (23), the moveable supporting section (23) being activated by means of a mechanism (40) suitable for lifting it and moving it by a pre-established pitch so as to intersect the fixed supporting section.

2. The transport system (10) according to claim 1, wherein the modules (20) comprise four planes (21) .

3. The transport system (10) according to claim 2, wherein in each plane (21) of the module (20), the fixed supporting section (22) and the moveable supporting section (23) comprise respective bar structures (25) and bars structures (26) offset with respect to each other so as to penetrate each other, supporting the metallic elements (11) in the form of light alloy rims of motor vehicles.

4. The transport system (10) according to claim 3, wherein each supporting module (20) of the rims (11) inside the furnace (12) is positioned so that the rims (11) arranged methodically on the planes (21) are lifted by the bars (25) of the moveable supporting sections (23) and removed from the rest position on the bars (26) of the fixed supporting sections (22), they are then advanced by a pre-established pitch and finally lowered and carefully positioned again on the bars (26) of the fixed supporting sections (22), each moveable supporting section is subsequently moved back and brought to its initial position to effect the subsequent cycle.

5. The transport system (10) according to claim 4, wherein the linear coupling between one module (20) and the other of the structure consists of a telescopic engagement capable of ensuring the free expansion of the supporting elements of the pieces.

6. The transport system (10) according to claim 5, wherein the planes (21) of the moveable supporting sections (23) are fixed to a framework (27) which allows the lifting and contemporaneous translation of all the planes.

7. The transport system (10) according to claim 6, wherein the moving mechanism (40) of the moveable section is positioned in the lower part of the furnace isolated from the heating zone by means of a base (28) through which vertical rods (29) pass which in turn support the framework (27).

8. The transport system (10) according to claim 7, wherein protected and insulated openings (30) are present, situated in the base (28) and crossed by the vertical rods (29) for the moving of the planes and wherein said vertical rods (29) slide inside a groove (31) equipped with a double labyrinth (32) capable of creating a pressure drop to avoid undesired air exchanges inside the furnace.

9. The transport system (10) according to claim 8, wherein said movement mechanism (40) is destined for the lifting and moving of a trolley (60) suitable for sustaining the vertical rods (29) and operates through a series of levers (50) mechanically activated by two oil-pressure cylinders (41) whose rotation fulcra (42) are rigidly connected to each other by a torque shaft (43) whose function is to synchronize both cylinders.

10. The transport system (10) according to claim 9, wherein said oil-pressure cylinders (41) are hinged by means of a hinge (45) to the end of a multiplier arm (44) whose opposite end (46) is fulcrumed by means of the hinge (42) at the base 47 of the structure of the mechanism (40) and wherein, in a substantially central position to the arm, a pulling rod (48) which is divided into connected portions extends

for the whole furnace and drives in synchronism the rotation of the lever (50) hinged to the pulling rod at a certain distance from each other.

11. The transport system (10) according to claim 10, wherein said levers (50) are arranged along the sides of the structure are configured with a first bracket (51) hinged to the pulling rod, and towards the centre of the furnace, a second bracket (52) equipped with coupled rolls (53) suitable for allowing the lifting of the trolley (60) in vertical translation, i.e. without horizontal translations.

12. The transport system (10) according to claim 11, wherein said trolley (60) has a framework equipped with crossbars (61)transversal to the movement direction and backstays (62) and equipped below with shaped guides (63) destined for directing the sliding of the rolls.

13. The transport system (10) according to claim 12, wherein below the base (28) there is an interspace sealed by the use of septa (33) made of high temperature silicon rubber which adhere to the backstays (62).

14. The transport system (10) according to claim 13, wherein for the advancing of the trolley (60) there is an electric servoactuator (55) acting on its framework and preferably of the ball recirculation type, managed with an inverter.

15. The transport system (10) according to claim 14, wherein for the introduction and correct positioning of the metallic elements (11) in the furnace and also for their removal, at each end of the furnace there is a feeder/remover (70) with layers (71) so as to intersect with the fixed supporting sections (22) at the end of the furnace.

Fig. 1A

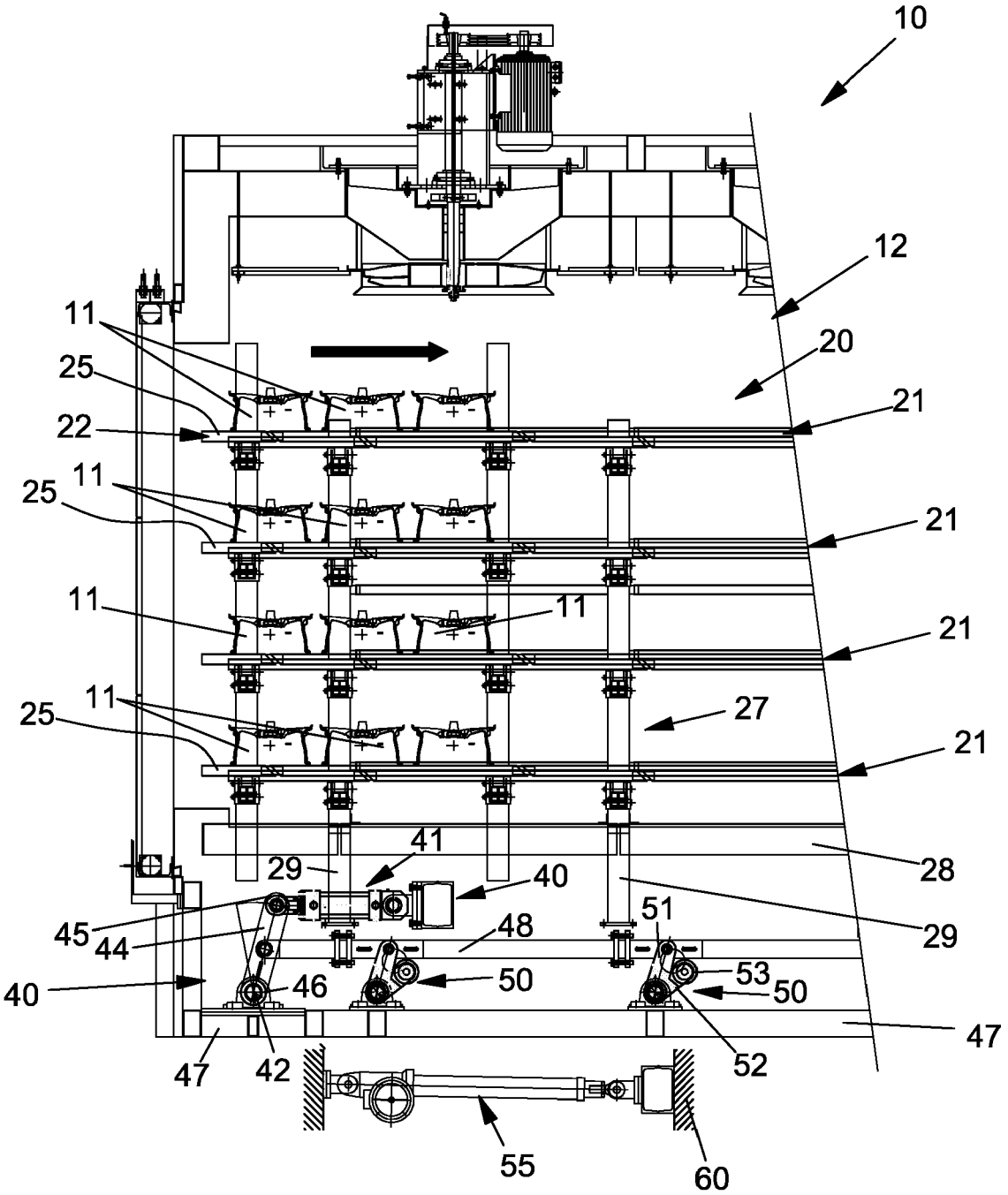

Fig. 1B

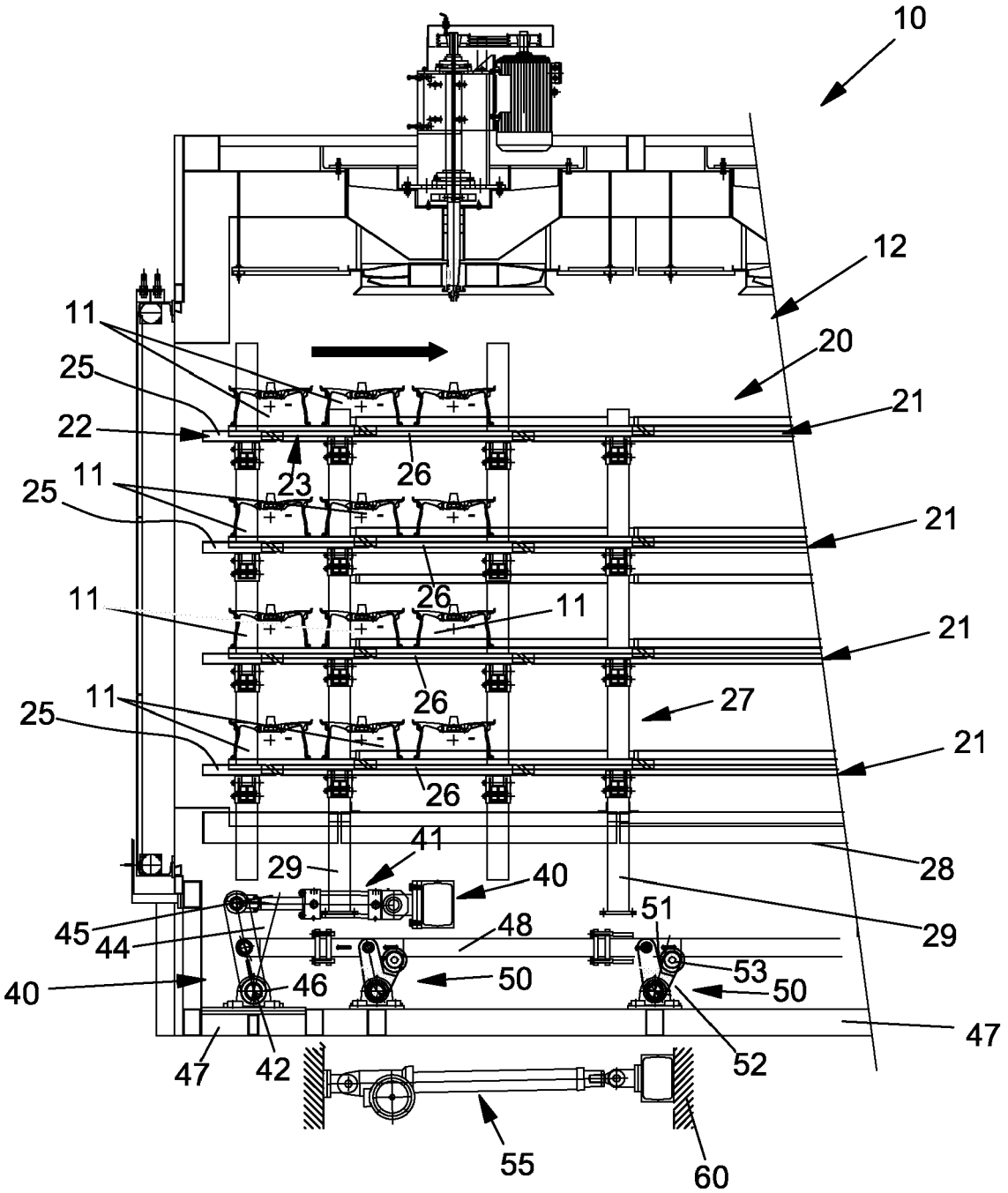
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Fig. 1C

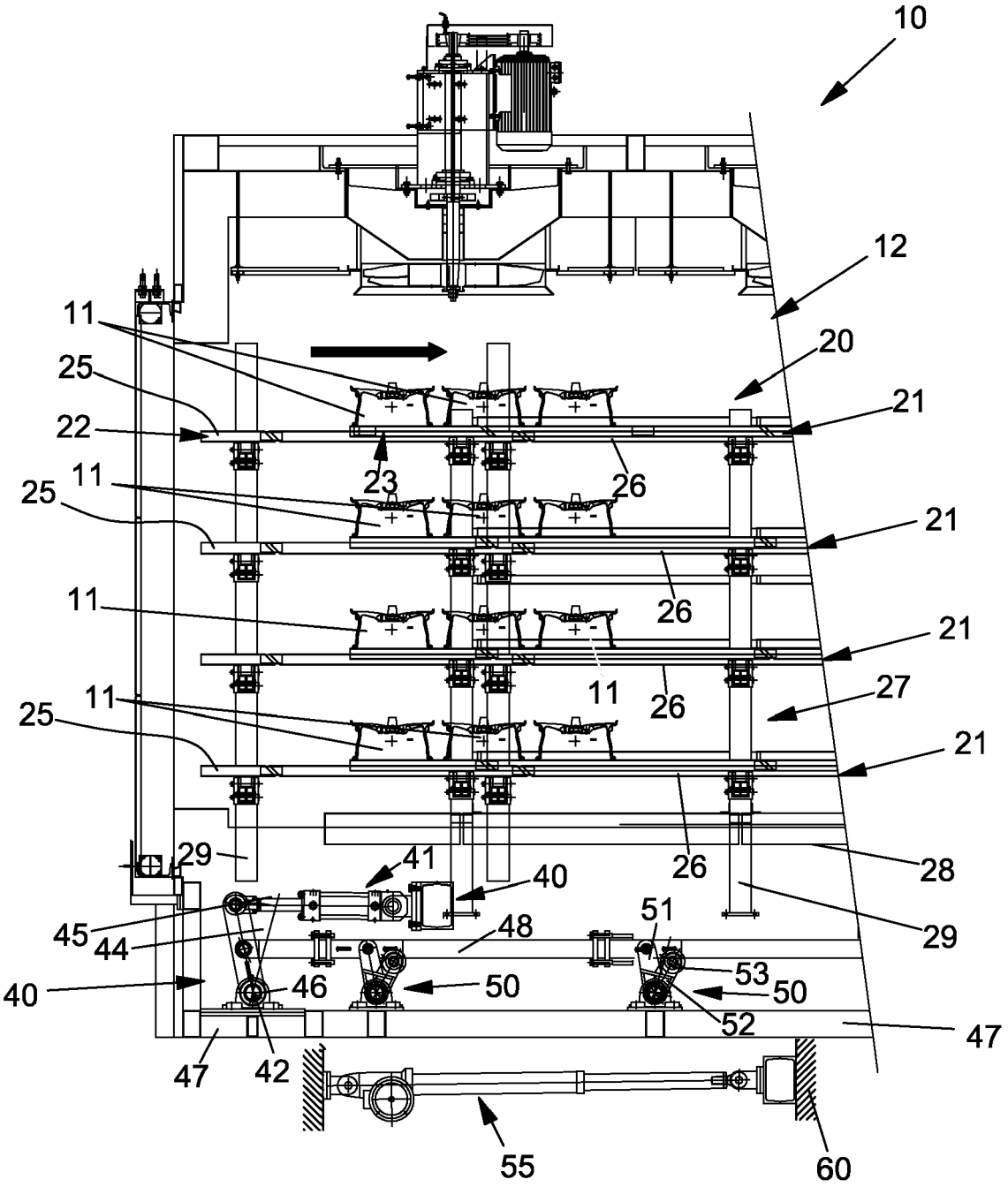
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Fig. 1D

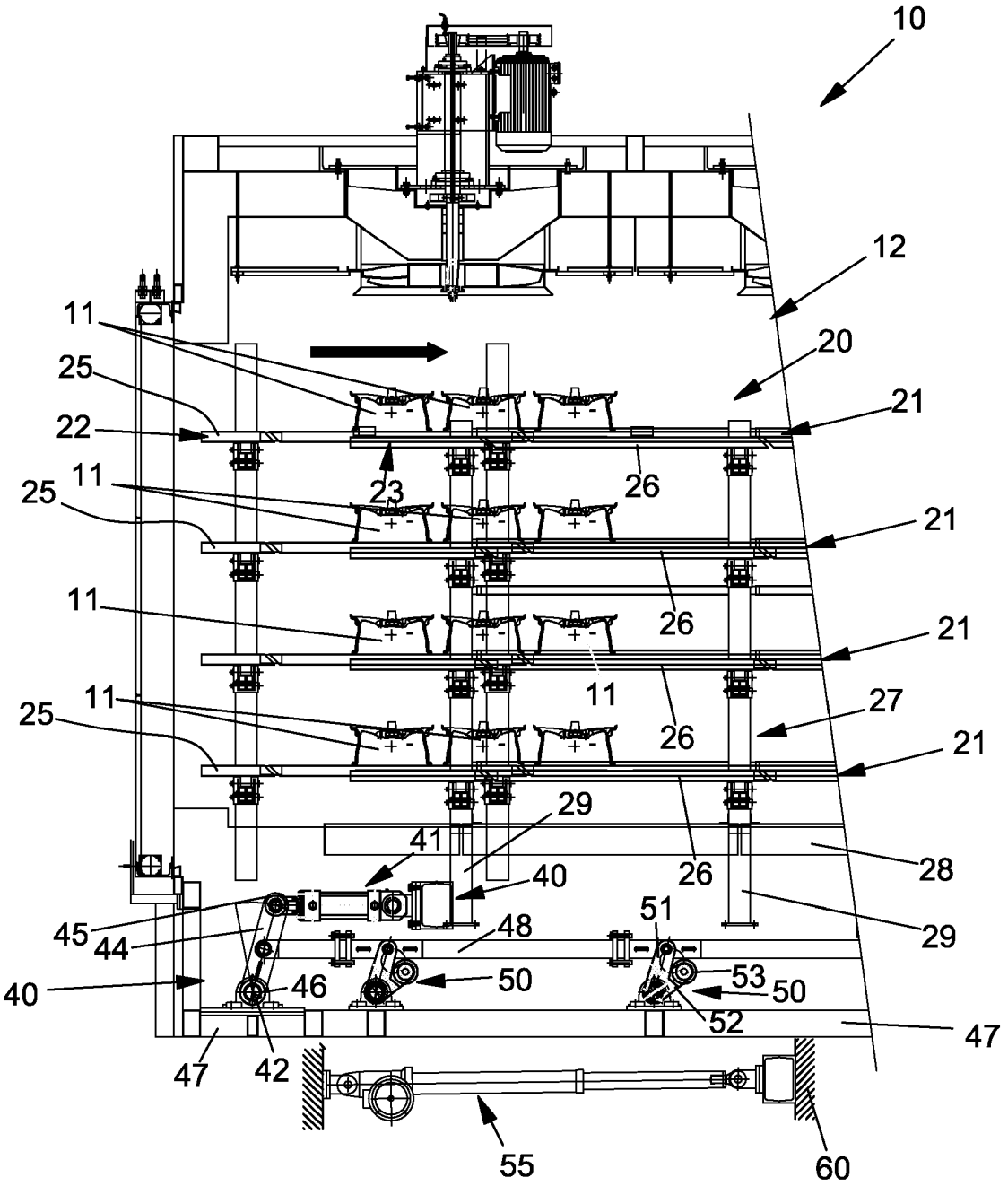
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Fig. 1E

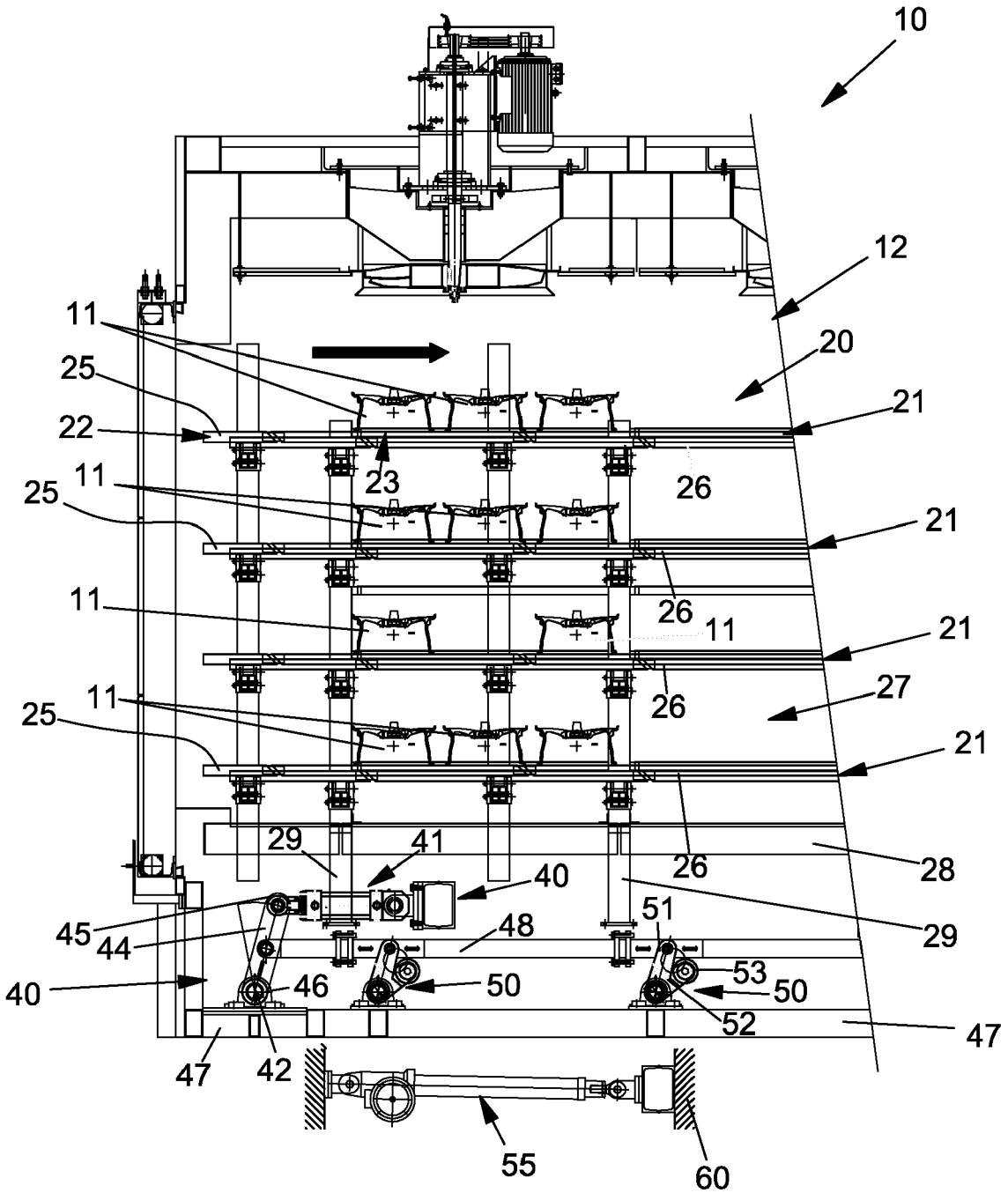
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Fig. 3

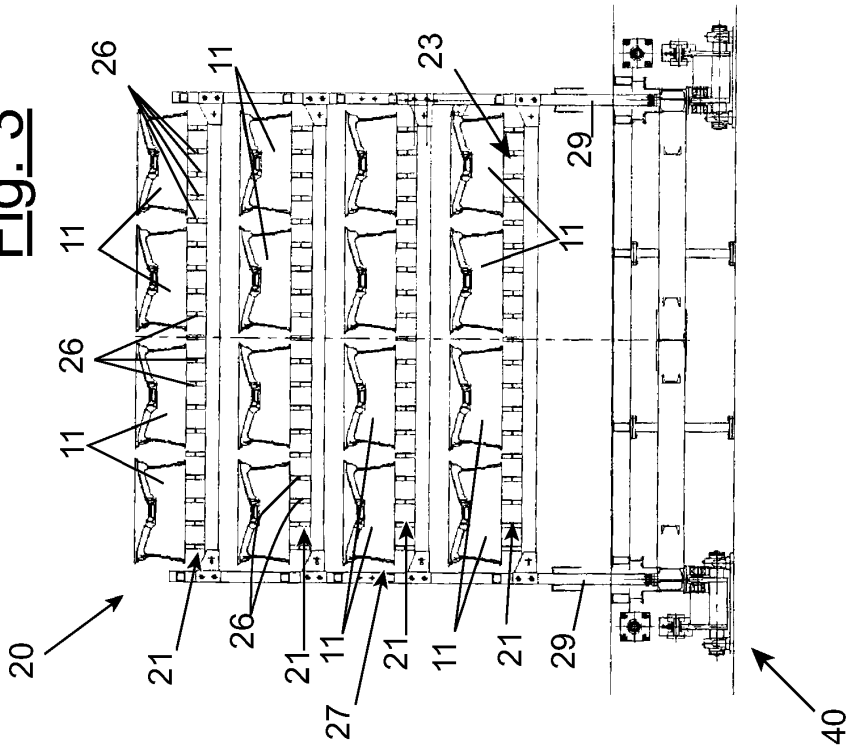
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Fig. 2

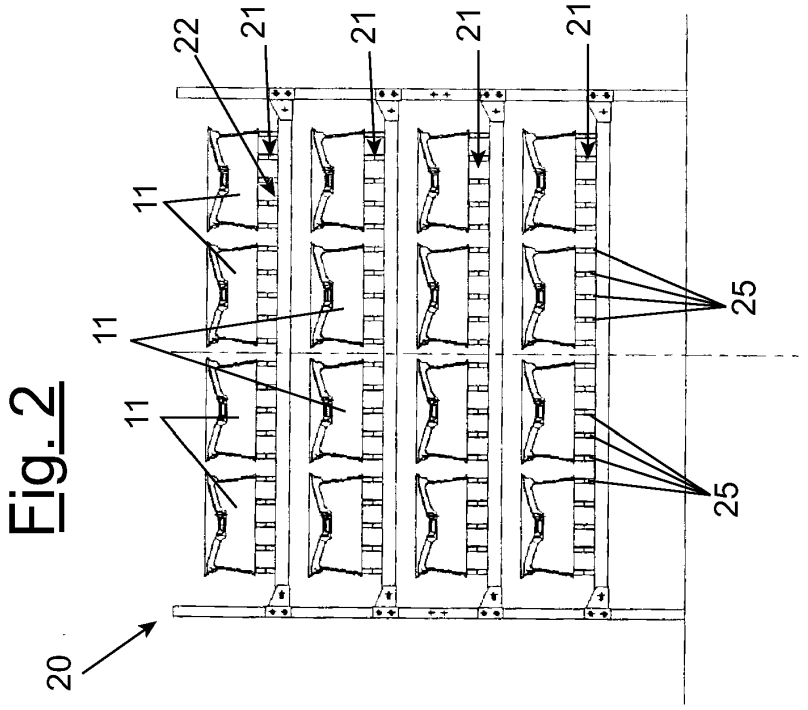
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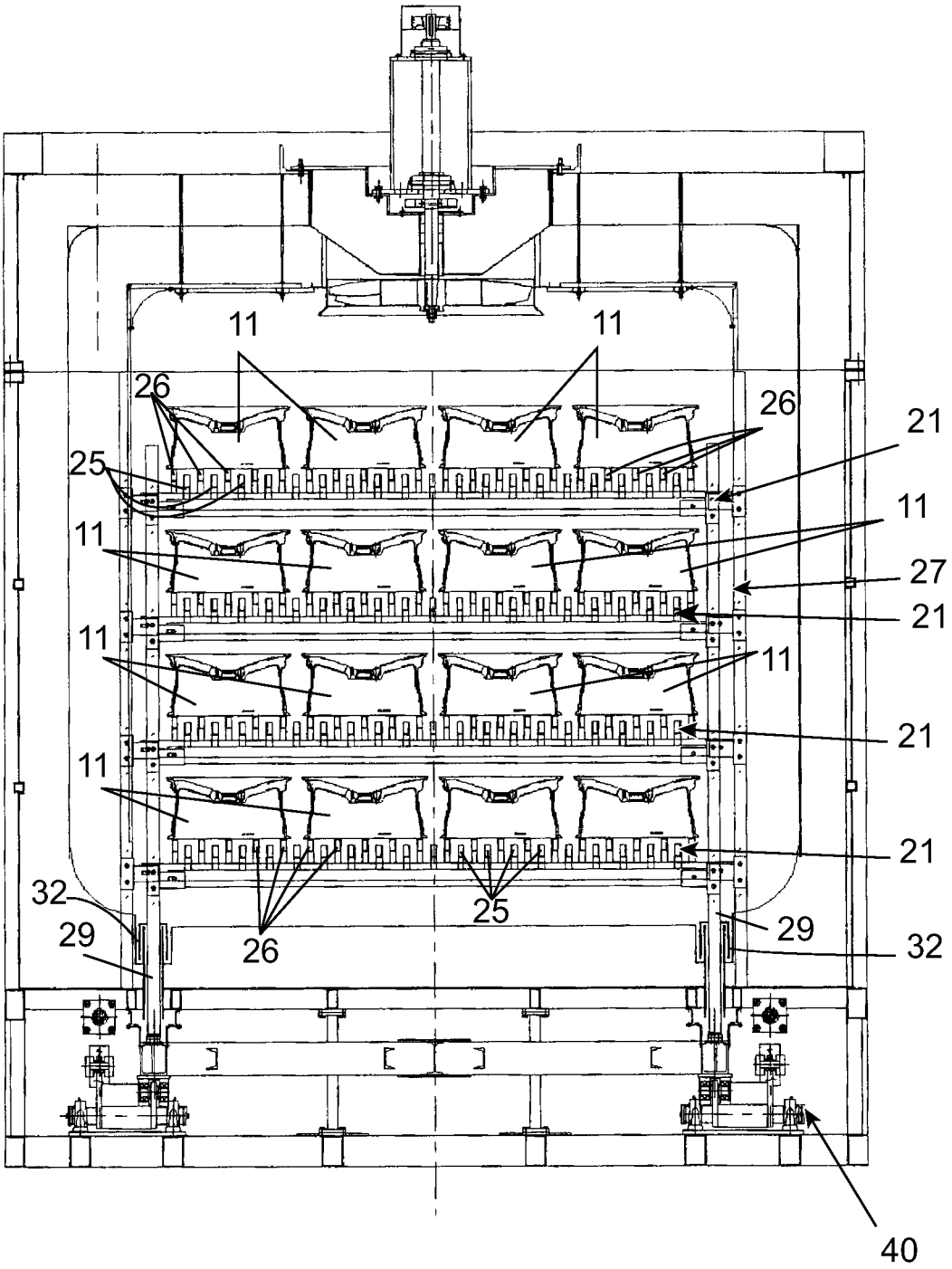
Fig. 4



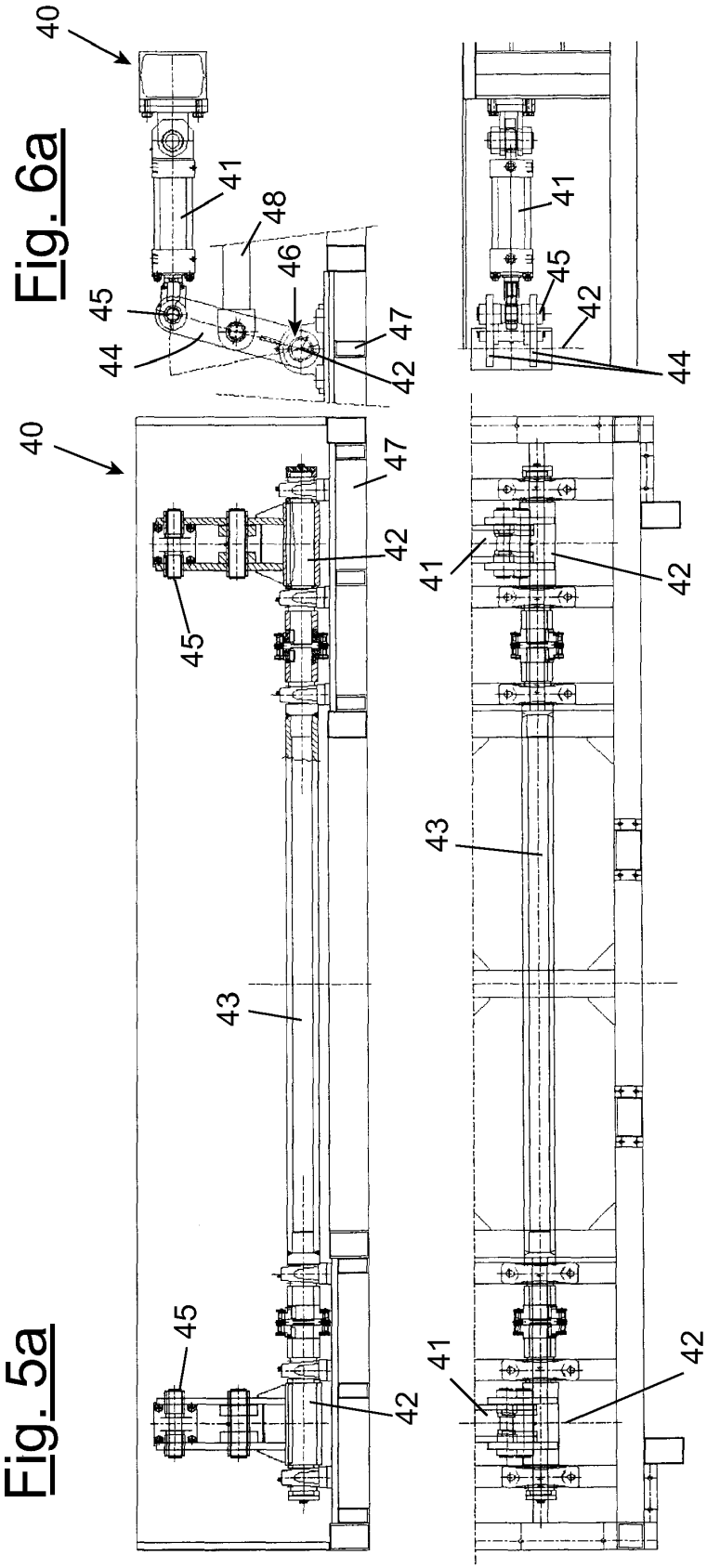


Fig. 6a

Fig. 6b

Fig. 5a

Fig. 5b

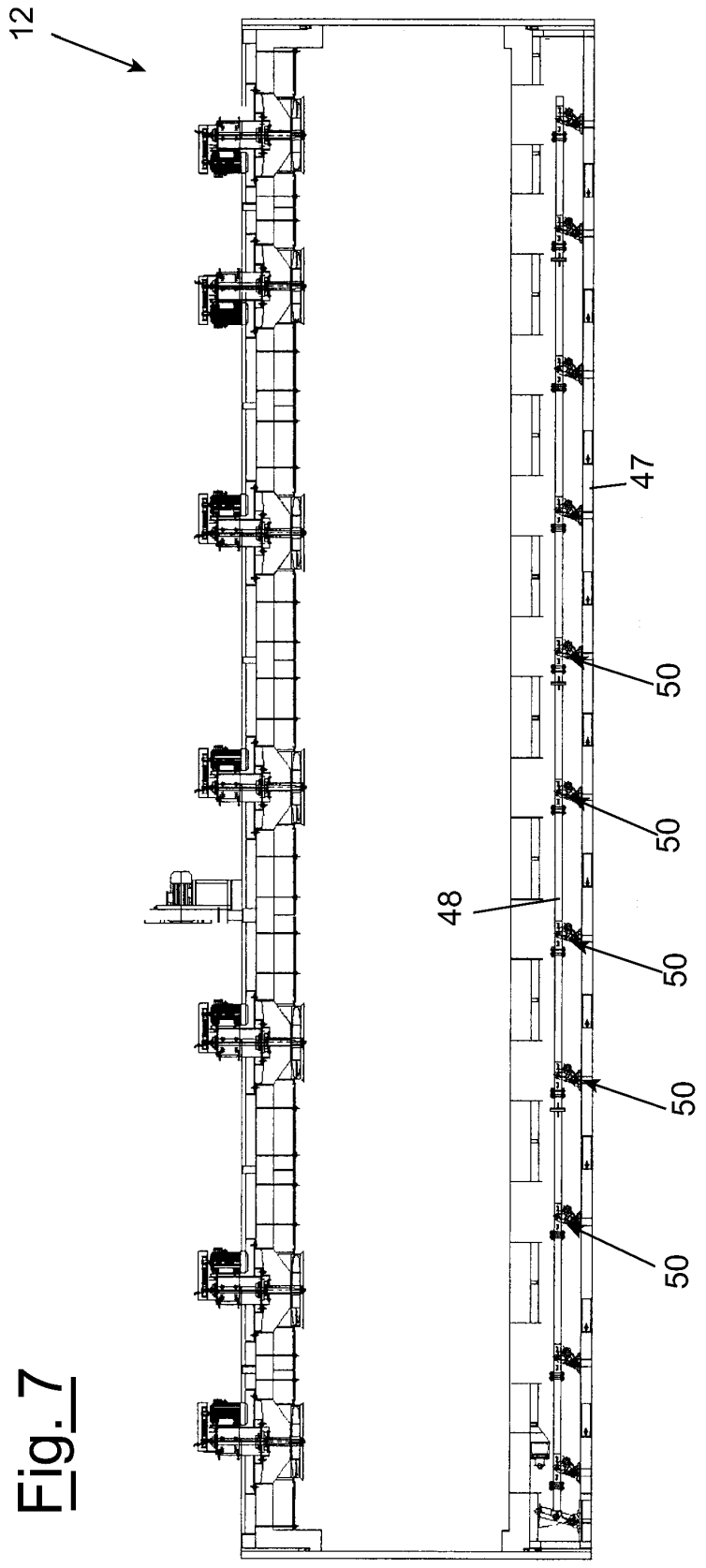


Fig. 7

Fig. 8

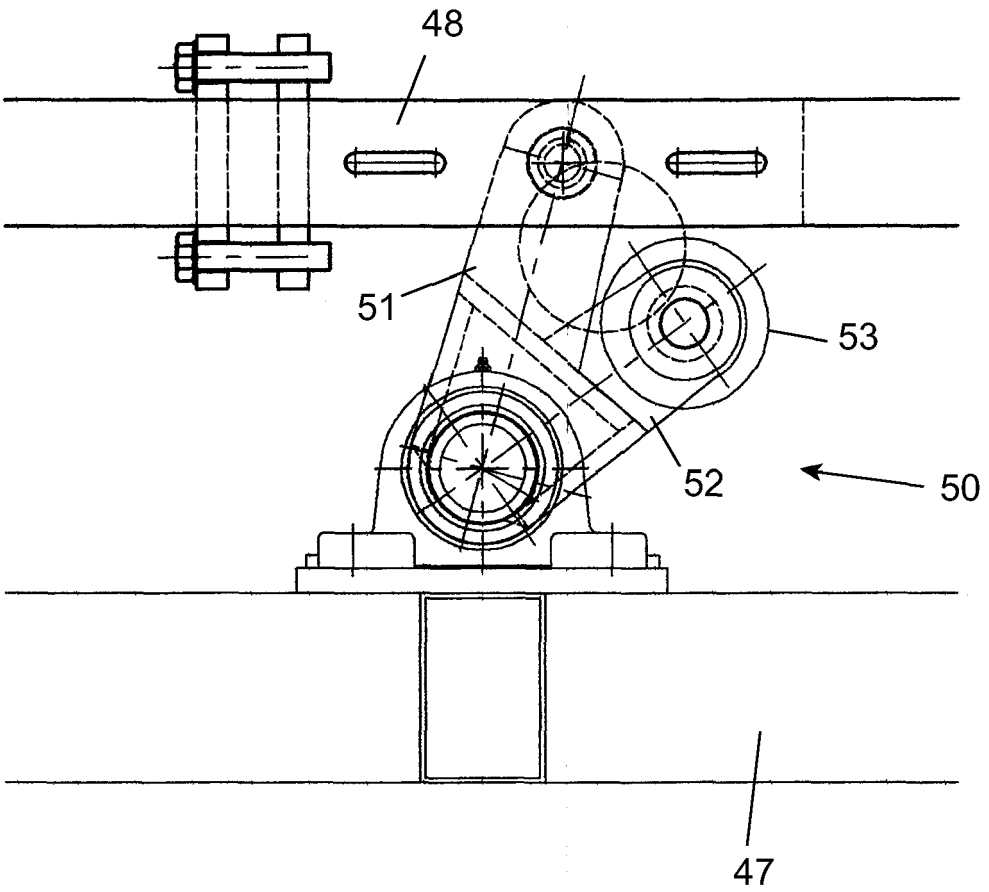


Fig. 9

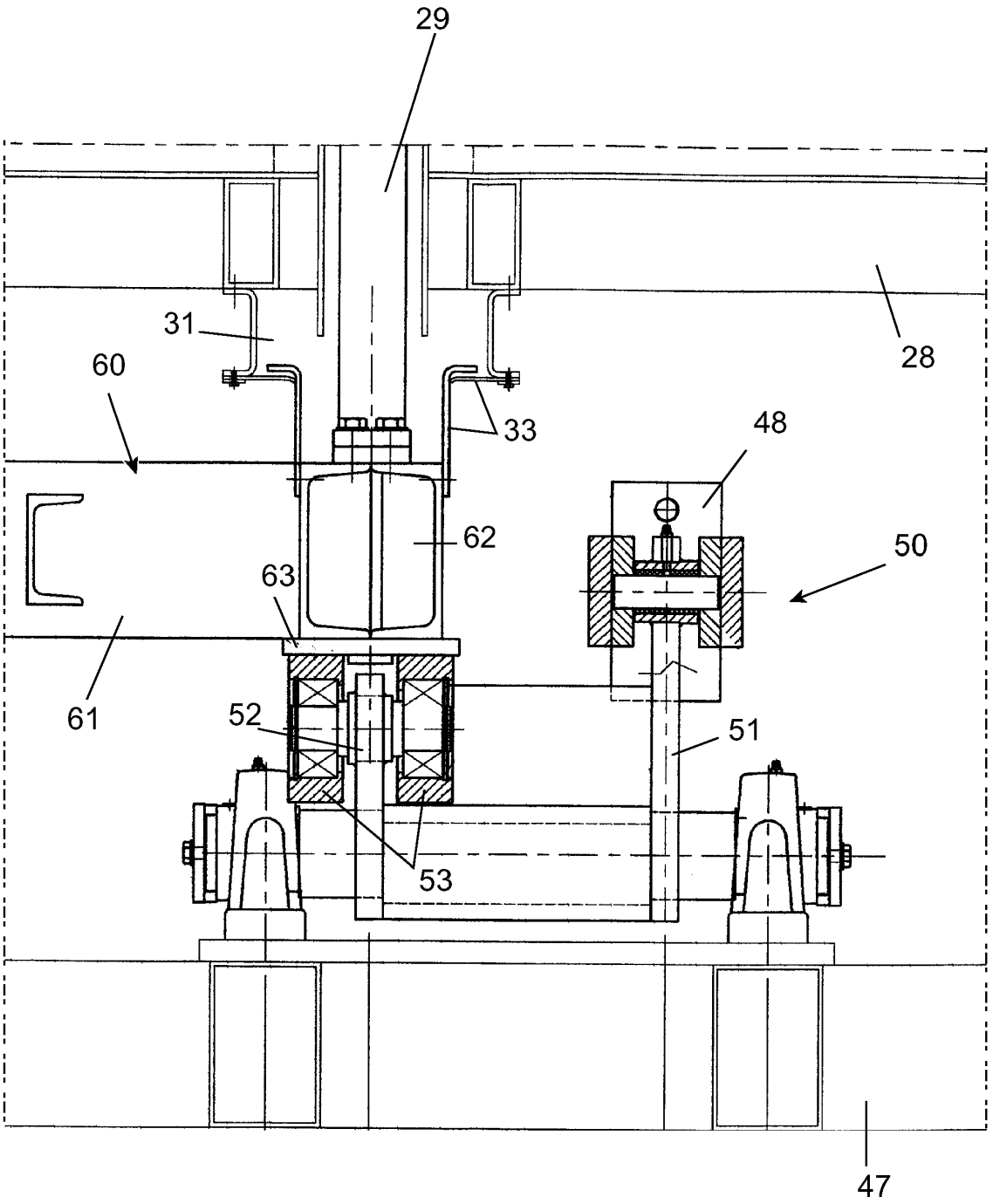


Fig. 10

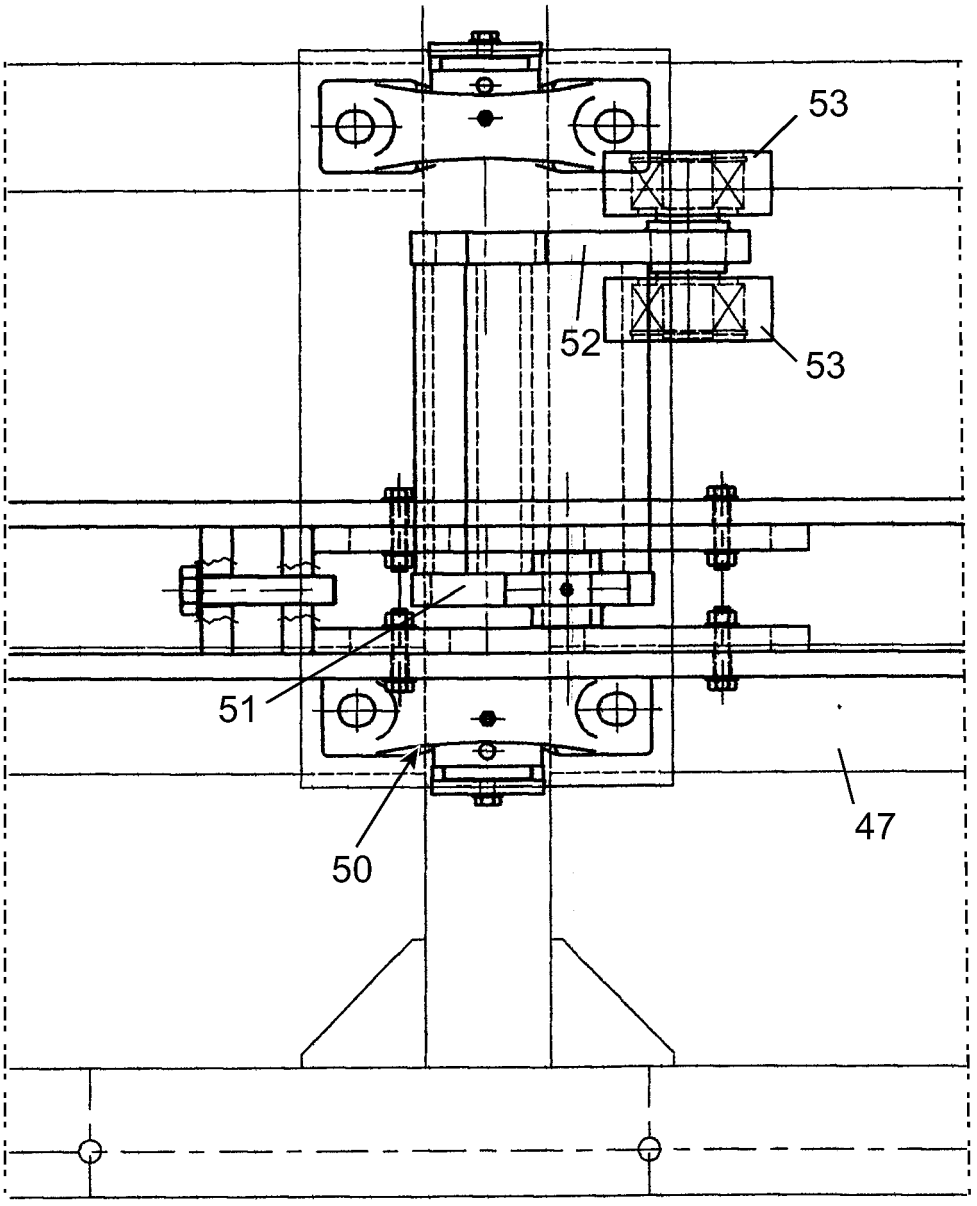


Fig. 11