Office de la Propriété Intellectuelle du Canada
Un organisme d'Industrie Canada

Canadian Intellectual Property Office
An agency of Industry Canada

CA 2114490 C 2004/06/29

(11)(21) 2 114 490

(12) BREVET CANADIEN
CANADIAN PATENT

(13) C

(22) Date de dépôt/Filing Date: 1994/01/28

(41) Mise à la disp. pub./Open to Public Insp.: 1994/07/30

(45) Date de délivrance/Issue Date: 2004/06/29

(30) Priorité/Priority: 1993/01/29 (A 152/93) AT

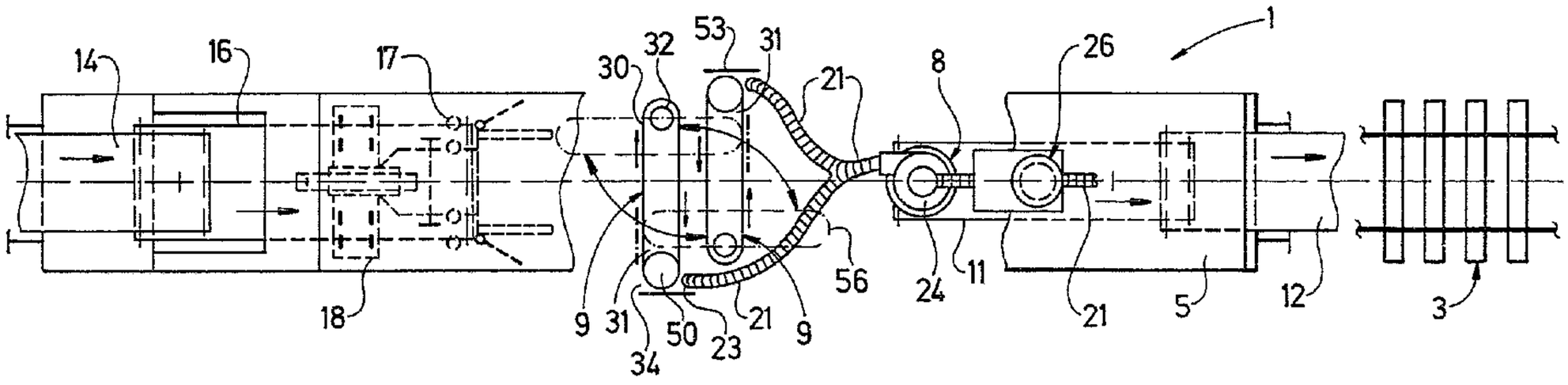
(51) Cl.Int.^{5}/Int.Cl.^{5} E01B 27/06, E01B 27/04

(72) Inventeurs/Inventors:
THEURER, JOSEF, AT;
WORGOTTER, HERBERT, AT;
OELLERER, FRIEDRICH, AT

(73) Propriétaire/Owner:
FRANZ PLASSER BAHNBAUMASCHINEN-INDUSTRIEGESELLSCHAFT M.B.H., AT

(74) Agent: RICHES, MCKENZIE & HERBERT LLP

(54) Titre : MACHINE POUR ENLEVER PAR SUCCION LE BALLAST D'UN LIT DE BALLAST
(54) Title: MACHINE FOR REMOVING BALLAST OF A TRACK BALLAST BED BY SUCTION



(57) Abrégé/Abstract:
A machine (1) for removing ballast of a track ballast bed (2) by suction has a machine frame (5) designed for travelling on the track (3) by means of on-track undercarriages (4), on which machine frame there are provided a suction arrangement (8) having a suction pipe stub (22) with a suction opening (23) and an excavating member (9) which cooperates with the said suction arrangement and by means of drives (44,38) is both vertically displaceable and rotatable about a vertical pivot axis (37) for transporting the ballast to the suction opening (23). The excavating member (9) associated with the suction arrangement (8) is designed as an endless excavating chain (3Q) guided around an excavating beam (31) extending horizontally with guide rollers (32) provided on each end. The pivot axis (37) is provided at one end (34) of the excavating beam (31) and in the operating position is provided in the sleeper end region, and in addition the suction opening (23) of the suction pipe stub (22) is arranged for vertical displacement in the sleeper end region.

ABSTRACT

A machine (1) for removing ballast of a track ballast bed (2) by suction has a machine frame (5) designed for travelling on the track (3) by means of on-track undercarriages (4), on which machine frame there are provided a suction arrangement (8) having a suction pipe stub (22) with a suction opening (23) and an excavating member (9) which cooperates with the said suction arrangement and by means of drives (44,38) is both vertically displaceable and rotatable about a vertical pivot axis (37) for transporting the ballast to the suction opening (23). The excavating member (9) associated with the suction arrangement (8) is designed as an endless excavating chain (3Q) guided around an excavating beam (31) extending horizontally with guide rollers (32) provided on each end. The pivot axis (37) is provided at one end (34) of the excavating beam (31) and in the operating position is provided in the sleeper end region, and in addition the suction opening (23) of the suction pipe stub (22) is arranged for vertical displacement in the sleeper end region.

A MACHINE FOR REMOVING BALLAST OF A TRACK BALLAST BED BY SUCTION

The invention relates to a machine for removing ballast of a track ballast bed by suction, comprising a machine frame designed for travelling on the track by means of on-track undercarriages, a suction arrangement haVing a suction pipe stub with a suction opening, and an excavating member which cooperates with the said suction arrangement and by means of drives is both vertically displaceable and rotatable about a vertical pivot axis for transporting the ballast to the suction opening.

A machine of this kind is already known from Austrian Patent 384 446-B, this being designed for travelling on a track by means of on-track undercarriages provided at each end of a machine frame and having a suction arrangement for removing ballast by suction from the track bed and a screening unit for cleaning the ballast. The suction arrangement consists of three suction pipe stubs arranged on a tool frame and connected by means of suction pipes to a compressor attached to the machine frame. The trailer-like tool frame is designed for riding on the track on its own undercarriage and is displaceable in the longitudinal direction of the machine relative to the continuously travelling machine frame, while the suction pipe stubs are arranged side by side in the transverse direction of the machine for penetration into the same sleeper crib on either side of each rail and are designed for vertical and transverse displacement relative to the tool frame by means of drives.

At the lower end, provided with a suction opening, of each suction pipe stub is arranged an excavating member which serves to loosen the ballast and to convey it towards the suction opening, and which is provided for this purpose with rotatable scraper wheels having raking tines. These scraper wheels are attached to the ends of an elongated, horizontally-arranged housing which is rotatable by means of a drive about a vertical pivot axis. In operation, the excavating member is aligned parallel to the sleepers, lowered into a sleeper crib until it lies beneath the bottom edges of the sleepers, and then pivoted horizontally through 90° so as thereby also to reach the ballast lying beneath the sleepers, while the excavating member is simultaneously moved through the sleeper crib in the longitudinal direction of the sleeper. The ballast removed by suction is either cleaned in the

screening unit and reintroduced into the track-or - in order to lower the track, for example - is carried away entirely by a conveyor. Despite the ability of this machine to travel continuously, its performance or operating speed is relatively limited as a result of the complicated and elaborate guiding of the excavating members requiring a number of drives.

Another machine, known from German Patent 22 26 612-A, for removing a ballast bed has two excavating members, each attached to one longitudinal side of a machine frame and designed as excavating beams with a circulating endless excavating chain. The excavating beams are rotatable about a pivot axis provided at one of their ends and are vertically displaceable and when inoperative are folded upwards about a horizontal axis extending in the transverse direction of the machine. For ballast excavation, the excavating members are lowered into the track bed shoulder and are then pivoted inwards from either side under the track panel, the ballast conveyed to the track shoulders being delivered to a screening unit for cleaning by a conveyor arrangement running obliquely upwards.

The object of the present invention is now to provide a machine of the type described in the introduction, which, with a constructionally simple design, enables the operating performance to be substantially enhanced.

This object is achieved with a machine of the specified kind in that the excavating member associated with the suction arrangement is designed as an endless excavating chain guided around an excavating beam extending approximately horizontally with guide rollers provided on each end, the pivot axis being provided at one end of the excavating beam and in the operating position being provided in the sleeper end region, and in that in addition the suction opening of the suction pipe stub is arranged for vertical displacement in the sleeper end region.

Accordingly, in one aspect, the present invention resides in a machine (1) for removing ballast of a track ballast bed (2) by suction, comprising a machine frame (5) designed for travelling on the track (3) by means of on-track undercarriages (4), a suction arrangement (8) having a suction pipe stub (22) with a suction opening (23), and an

excavating member (9) which cooperates with the said suction arrangement and by means of drives (44,38) is both vertically displaceable and pivotable about a vertical pivot axis (37) for transporting the ballast to the suction opening (23), characterized in that the excavating member (9) associated with the suction arrangement (8) is designed as an endless excavating chain (30) guided around an excavating beam (31) extending essentially horizontally with guide rollers (32) provided on each end, the pivot axis (37) being provided at one end (34) of the excavating beam (31) and in the operating position being provided in the sleeper end region, and in that in addition the suction opening (23) of the suction pipe stub (22) is arranged for vertical displacement in the sleeper end region.

This combination of an excavating beam with a suction arrangement has the particular advantage that rapid starting up, combined with the carrying away of the ballast achievable by means which are constructionally very simple, is possible. The use of another endless excavating chain to pick up the ballast temporarily deposited by the excavating beam in the sleeper end region a second time by means of another excavating chain is thereby rendered unnecessary. Since only the suction pipe stub need be arranged in the sleeper end region, the machine according to the invention can be used without difficulty particularly advantageously even in the regions of the track in which there is only a small amount of space available between the sleeper end and a structure, e.g. a platform edge. Also, arranging the suction pipe stub in the sleeper end region advantageously enables the machine to be operated continuously and thus more efficiently.

In a more preferred aspect, the machine is characterized in that the suction opening (23) is arranged directly above a deflection region (33) of the excavating chain (30) or of the excavating member (9).

This represents the optimum arrangement of the suction opening relative to the excavating chain, with which the ballast conveyed to the track shoulder can be removed by suction more quickly, utilizing the conveying movement produced by the excavating chain. The suction opening can in this case be located either at the end of the excavating beam which has the pivot axis or at the opposite end thereof.

In a further preferred aspect, the excavating beam (31) is constructed with a length of 2.60 m to about 3.25 m.

This construction is particularly suitable for track sections in which there is very little space available on one side between the sleeper end and an adjoining structure. In this case too, the entire ballast bed can be removed by providing the suction pipe stub in the opposite sleeper end region.

In another preferred aspect, the excavating beam (31) is attached at its end (34) having the pivot axis (37) by means of a vertical support (35) to a support frame (36) extending in the transverse direction of the machine and distanced in the vertical direction away from the excavating beam (31).

More preferably, the beam-shaped support frame (36) is mounted for displacement with respect to its longitudinal direction in a transverse guide (39) supported on the machine frame (5) and is connected to a transverse displacement drive (40).

In a further preferred construction, the machine is characterized in that the transverse guide (39) on which the support frame (36) and the excavating beam (31) are mounted is connected to a guide column (42) arranged in a vertical guide (43) on the machine frame (5) and is vertically displaceable relative to the machine frame (5) by means of a vertical displacement drive (44).

The aforementioned constructions enable the excavating beam to be oriented without difficulty with respect to its working position underneath the track panel, but it also enables the excavating member to be taken out of operation and stored in an equally simple manner during the transfer journey in an inoperative position lying within the clearance gauge or the machine profile.

In another preferred aspect, the invention resides in a machine characterized in that the transverse guide (39) is mounted on the guide column (42) by means of a shaft (47) extending in the longitudinal direction of the machine and is pivotable relative to the said guide column by means of a tilting drive (48) in a plane perpendicular to the longitudinal direction of the machine. With a machine so equipped, the excavating beam can be particularly easily positioned obliquely relative to the track plane or horizontal plane so that after excavating the ballast it leaves behind a formation surface with a transverse inclination which is necessary for optimum drainage.

In another preferred aspect, the invention resides in a machine characterized in that associated with the excavating beam (31) in the region adjoining the suction opening (23)on the exterior side of the machine is a baffle plate (53) which extends approximately vertically and perpendicularly to the longitudinal direction of the excavating beam (31). This construction ensures frictionless and complete extraction by suction and removal of all the excavated ballast under the most varied operational conditions.

A particularly preferred form of construction resides wherein the machine (1) is provided with two excavating beams (31) situated opposite one another with respect to a vertical plane of symmetry running in the longitudinal direction of the machine and arranged at a distance from one another in the longitudinal direction of the machine. The performance can be additionally enhanced with a machine equipped in this way by the two excavating beams being adjusted, for example, to different excavating depths and thus being able to remove the track bedding in two layers. On the other hand, because of this form of construction the machine can also be used when one of the excavating beams cannot be lowered on one side of the track because of a track obstruction.

In another aspect, the machine is characterized in that the suction arrangement (8) has a cyclone separator (24) arranged between the suction pipe stub (22) and a compressor (20), a conveyor (11) for transporting away the separated ballast (7) being associated with the said cyclone separator, with an air lock (25) connected therebetween. More preferably still, the machine is characterized in that a transfer conveyor belt (12) projecting over one end of the

machine frame (5) is associated with the conveyor (11). The arrangement represents an effective method of separating the ballast, removed by suction, in a simple manner from the suction air and of transporting it away and preferably additionally providing the facility for the dust, unavoidably sucked up at the same time, to be efficiently disposed off together with the ballast and for dust pollution in the air in the working area, constituting an annoyance to the crew operating the machine, to be eliminated.

Accordingly, in a more preferred aspect, the invention resides in a machine further characterized in that the suction arrangement (8) is provided with a dust filter (27) for the suction air, arranged between the cyclone separator (24) and the compressor (20). In a further preferred construction, a discharge device (29), designed as a screw conveyor (28), is associated with the dust filter (27) for discharging the filtered-out dust onto the conveyor (11).

In a further aspect, the machine (1) is provided with an operator's cab (10) arranged on the machine frame (5) in the region of the excavating members (9), a track lifting device (17), a ballast discharge arrangement (16) - arranged following the excavating members (9) with respect to the operating direction of the machine - for introducing new ballast (15) into the track (3), and with a track tamping unit (18). A machine equipped as described can advantageously be used in the course of complete track bed rehabilitation.

The invention is described in more detail below by means of an embodiment represented in the drawing, in which

Fig. 1 shows a side view of a machine constructed according to the invention for the removal of ballast by suction with a suction arrangement having excavating members,

Fig. 2 shows a schematized, greatly simplified plan view of the machine shown in Fig. 1,

Fig. 3 shows an enlarged detailed side view of the excavating members of the machine shown in Fig. 1, and

Fig. 4 shows a view in the longitudinal direction of the machine in the direction of arrow IV in Fig. 3.

In Figures 1 and 2 is shown a machine 1 for removing a ballast bed 2 of a track 3 which has a bridge-shaped machine frame 5 supported at its two longitudinal ends on on-track undercarriages 4 and which is designed for continuously travelling on the track 3 in an operating direction indicated by an arrow 6. In order to remove the ballast 7 by suction from the ballast bed 2, the machine 1 is equipped with a suction arrangement 8 which is provided in the front region of the machine frame 5 with respect to the operating direction and which will be described in more detail below. Associated with the suction arrangement 8 on the intake side are two excavating members 9 for supplying ballast, these being attached approximately in the longitudinal centre of the machine frame 5 within visual range of an operator's cab 10. A conveyor 11 situated beneath the suction arrangement 8 serves to carry away the ballast 7 removed by suction, the said conveyor having a transfer conveyor belt 12 projecting over the front end of the machine frame 5 and pivotable laterally. With this the ballast 7 can be loaded, for example, into a preceding hopper wagon 13 connected to the machine 1. By way of another hopper wagon 14 coupled to the other end of the machine 1, new ballast 15 is introduced by means of a ballast discharge arrangement 16 at a point situated following the excavating members 9 in the operating direction into the track 3 which is held in its position in this region by a track lifting device 17. The newly introduced new ballast 15 is immediately consolidated by means of a track tamping unit 18 arranged so as to be vertically adjustable immediately preceding the rear on-track undercarriage 4. Power is supplied to all the drives, units and a motive drive 55 of the machine 1 by way of a central power source 19.

The suction arrangement 8 essentially consists of a compressor 20 arranged on the machine frame 5 and a flexible suction pipe 21, connected to the said compressor, which bifurcates in the region above the excavating members 9 and ends in two suction pipe stubs 22. These are respectively associated in the sleeper end region with one of the excavating members 9 and have a suction opening 23 for removing the ballast 7 by suction from the ballast bed 2. The air stream conveying the ballast is passed through a cyclone separator 24

integrated in the suction pipe 21 between the suction pipe stubs 22 and the compressor 20, the ballast 7 being separated in the said cyclone separator from the suction air stream fed in tangentially in the known manner by the action of centrifugal force and dropping to the bottom. The lower end of the cyclone separator 24 may be covered air-tight by a sealing flap 49. A further cyclone separator arranged directly beneath and also having a sealing flap forms an air lock 25 via which the ballast 7, drawn up by suction, then passes onto the conveyor 11 for transporting away. The suction air is then passed through an air filter unit 26 in which the dust particles contained in the air are filtered out by means of a dust filter 27 and are collected in the lower area of the unit. The dust collected in a storage container is transferred cyclically onto the conveyor 11 while the machine 1 is stationary by means of a discharge device 29 designed as a screw conveyor 28 and is transported away together with the ballast 7 by way of the transfer conveyor belt 12.

As is now also shown particularly in Fig. 3 and 4, the two excavating members 9 for supplying the ballast 7 to the associated suction pipe stub 22 are respectively designed as an endless excavating chain 30 which is guided around an excavating beam 31 extending approximately horizontally with guide rollers 32 provided at its two ends. The two excavating beams 31 are disposed on the machine 1 in mirror-inverted arrangement with respect to a vertical plane of symmetry extending in the longitudinal direction of the machine, but are mutually staggered or distanced from one another in the longitudinal direction of the machine. Each excavating beam 31 is provided at one end 34 situated in the sleeper end region with a rotation drive 50 for the excavating chain 30 and is connected by means of a vertical, column-like support 35 to a support frame 36. This is distanced from the excavating beam 31 in the vertical direction and extends in the transverse direction of the machine. The support 35 is mounted for rotation on the support frame 36 and thus forms a vertical pivot axis 37 about which the excavating beam 31 is pivotable in the horizontal plane by means of rotary drives 38 linked to the support frame 36.

Each support frame 36 is designed in the form of a beam and is respectively mounted for displacement in the transverse direction of the machine in a transverse guide 39 designed as a hollow section. The support frame 36 is also connected to a transverse displacement drive

40 and rests on a bearing roller 41 for the purpose of transverse displacement. The transverse guide 39 is itself secured to the lower end of a vertically extending guide column 42 which is mounted for vertical displacement in a vertical guide 43 mounted on the machine frame 5 and is displaceable by means of a vertical displacement drive 44. For additional support relative to the machine frame 5 in the longitudinal direction of the machine, each transverse guide 39 is provided with a support roller 45 which, in the course of the vertical displacement, is designed to ride in the vertical direction on a support rail 46 connected to the machine frame 5. The transverse guide 39 is attached to the guide column 42 by a shaft 47 oriented in the longitudinal direction of the machine, with the result that the support frame 36 can be pivoted or tilted in a vertical plane extending in the transverse direction of the machine. Tilting drives 48 are arranged for this purpose between the guide column 42 and the transverse guide 39.

In the operational or working position shown in Fig. 4, the pivot axis 37 of the excavating member 9 is located in the end region of the sleepers 51 of the track 3. The length of the excavating beam 31 is designed to correspond to the particular sleeper length of the track to be treated and in the case of a standard gauge track is about 3.25 metres (where a machine is provided for use in narrow gauge tracks, the length of the excavating beam is accordingly shorter). The suction opening 23 or the suction pipe stub 22 is similarly arranged in the sleeper end region at the end 34 of the excavating beam 31 which has the pivot axis 37 and is positioned directly above the deflection region 33 of the excavating chain 30 immediately preceding the said excavating chain in the operating direction. However, arranging the suction opening following the excavating chain 30 in the operating direction would also be conceivable. The suction pipe stub 22 is connected to the support 35 for vertical displacement by means of a drive 52, by which the suction opening 23 is adjustable in the vertical direction in relation to the ballast delivered by the excavating chain 30. Provided in the area of the excavating member 9 adjoining the suction opening 23 on the exterior side of the machine is a respective vertical baffle plate 53, connected to the excavating beam 31 or the support 35, which - in the operative position of the excavating member 9 - extends parallel to the longitudinal direction of the machine and cooperates with the excavating chain 30 in order to accumulate the ballast in the deflection region 33 and concentrate it under the suction opening 23.

During the transfer journey to the worksite, the two excavating members 9 are in a raised position, pivoted parallel to the longitudinal direction of the machine, entirely within the clearance gauge 54 indicated in Fig. 4 by double dot-dash lines (see the outlines 56, indicated in dot-dash lines, of the excavating members in Fig. 1; 2 and 4). The transfer of the excavating members 9 into the operating position begins with operation of the transverse displacement drives 40 until the excavating beams 31 come to lie above the sleeper end region: The support frame 36 is then lowered by means of the vertical displacement drives 44. As soon as the excavating chains 30 touch the surface of the ballast, the rotation drives 50 are also switched on, causing the excavating beams 31 to cut into the ballast bed 2 until the upper surfaces of the excavating beams 31 are positioned beneath the lower surfaces of the sleepers 51. (If necessary, an appropriate depression to accommodate the excavating beam in the sleeper end region must be made manually beforehand). The excavating beams 31 are then pivoted horizontally through about 90° by means of the rotary drives 38 and the compressor 20 is switched on in order to commence the removal by suction of the ballast. By means of the tilt drives 48, each excavating beam 31 is pivoted, if appropriate, in a vertical plane perpendicular to the longitudinal axis of the machine, in order to impart to the formation surface exposed by the excavating chain 30 the necessary transverse inclination promoting drainage of the ballast bed. During the removal by suction of the ballast, the continuous operational advance of the machine 1 takes place with the operation of the motive drive 55. The terms "horizontal" and "vertical" used in the text relate to the situation in which the machine is positioned on a straight track running in a horizontal plane.

The combination according to the invention of a suction arrangement with an excavating beam can obviously also be employed in conjunction with the continuous cleaning of the sucked-up ballast by means of a screening unit.

Claims

1. A machine (1) for removing ballast of a track ballast bed (2) by suction, comprising a machine frame (5) designed for travelling on the track (3) by means of on-track undercarriages (4), a suction arrangement (8) having a suction pipe stub (22) with a suction opening (23), and an excavating member (9) which cooperates with the said suction arrangement and by means of drives (44,38) is both vertically displaceable and pivotable about a vertical pivot axis (37) for transporting the ballast to the suction opening (23), characterized in that the excavating member (9) associated with the suction arrangement (8) is designed as an endless excavating chain (30) guided around an excavating beam (31) extending essentially horizontally with guide rollers (32) provided on each end, the pivot axis (37) being provided at one end (34) of the excavating beam (31) and in the operating position being provided in the sleeper end region, and in that in addition the suction opening (23) of the suction pipe stub (22) is arranged for vertical displacement in the sleeper end region.

2. A machine according to claim 1, characterized in that the suction opening (23) is arranged directly above a deflection region (33) of the excavating chain (30) or of the excavating member (9).

3. A machine according to claim 1 or 2, characterized in that the excavating beam (31) is constructed with a length of 2.60 m to about 3.25 m.

4. A machine according to any one of claims 1 to 3, characterized in that the excavating beam (31) is attached at its end (34) having the pivot axis (37) by means of a vertical support (35) to a support frame (36) extending in the transverse direction of the machine and distanced in the vertical direction away from the excavating beam (31).

5. A machine according to claim 4, characterized in that the beam-shaped support frame (36) is mounted for displacement with respect to its longitudinal direction in a

transverse guide (39) supported on the machine frame (5) and is connected to a transverse displacement drive (40).

6. A machine according to claim 5, characterized in that the transverse guide (39) on which the support frame (36) and the excavating beam (31) are mounted is connected to a guide column (42) arranged in a vertical guide (43) on the machine frame (5) and is vertically displaceable relative to the machine frame (5) by means of a vertical displacement drive (44).

7. A machine according to claim 6, characterized in that the transverse guide (39) is mounted on the guide column (42) by means of a shaft (47) extending in the longitudinal direction of the machine and is pivotable relative to the said guide column by means of a tilting drive (48) in a plane perpendicular to the longitudinal direction of the machine.

8. A machine according to any one of claims 1 to 7, characterized in that associated with the excavating beam (31) in the region adjoining the suction opening (23) on the exterior side of the machine is a baffle plate (53) which extends approximately vertically and perpendicularly to the longitudinal direction of the excavating beam (31).

9. A machine according to any one of claims 1 to 8, characterized in that the machine (1) is provided with two excavating beams (31) situated opposite one another with respect to a vertical plane of symmetry running in the longitudinal direction of the machine and arranged at a distance from one another in the longitudinal direction of the machine.

10. A machine according to any one of claims 1 to 9, characterized in that the suction arrangement (8) has a cyclone separator (24) arranged between the suction pipe stub (22) and a compressor (20), a conveyor (11) for transporting away the separated ballast (7) being associated with the said cyclone separator, with an air lock (25) connected therebetween.

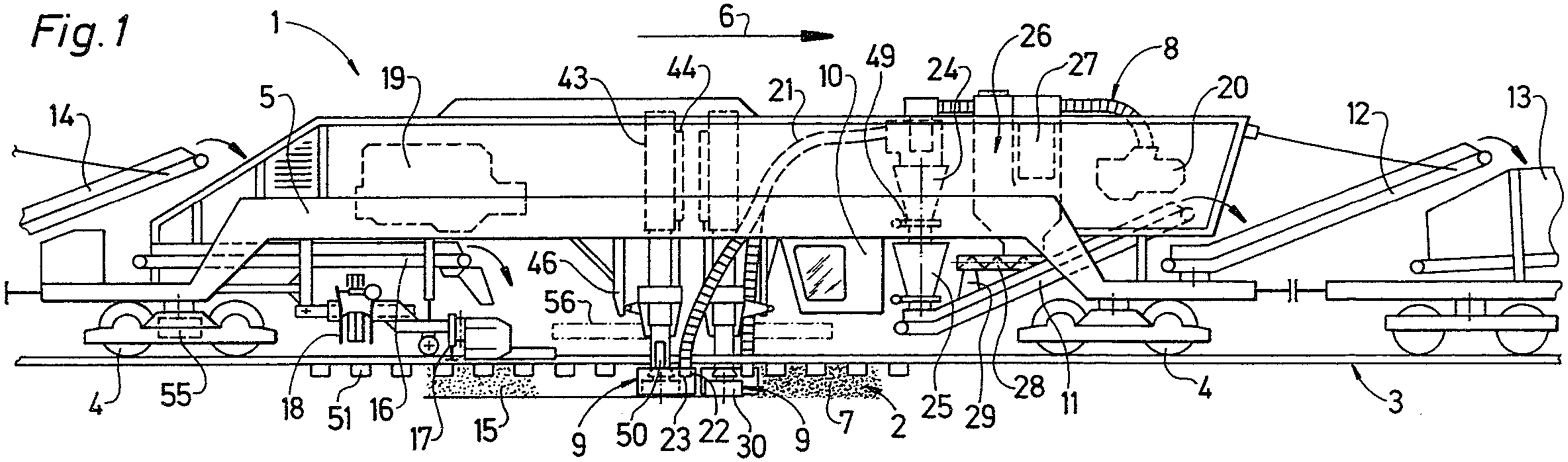
11. A machine according to claim 10, characterized in that a transfer conveyor belt (12) projecting over one end of the machine frame (5) is associated with the conveyor (11).

12. A machine according to claim 10, characterized in that the suction arrangement (8) is provided with a dust filter (27) for the suction air, arranged between the cyclone separator (24) and the compressor (20).

13. A machine according to claim 12, characterized in that a discharge device (29), designed as a screw conveyor (28), is associated with the dust filter (27) for discharging the filtered-out dust onto the conveyor (11).

14. A machine according to any one of claims 1 to 13, characterized in that the machine (1) is provided with an operator's cab (10) arranged on the machine frame (5) in the region of the excavating members (9), a track lifting device (17), a ballast discharge arrangement (16) - arranged following the excavating members (9) with respect to the operating direction of the machine - for introducing new ballast (15) into the track (3), and with a track tamping unit (18).

Fig. 1



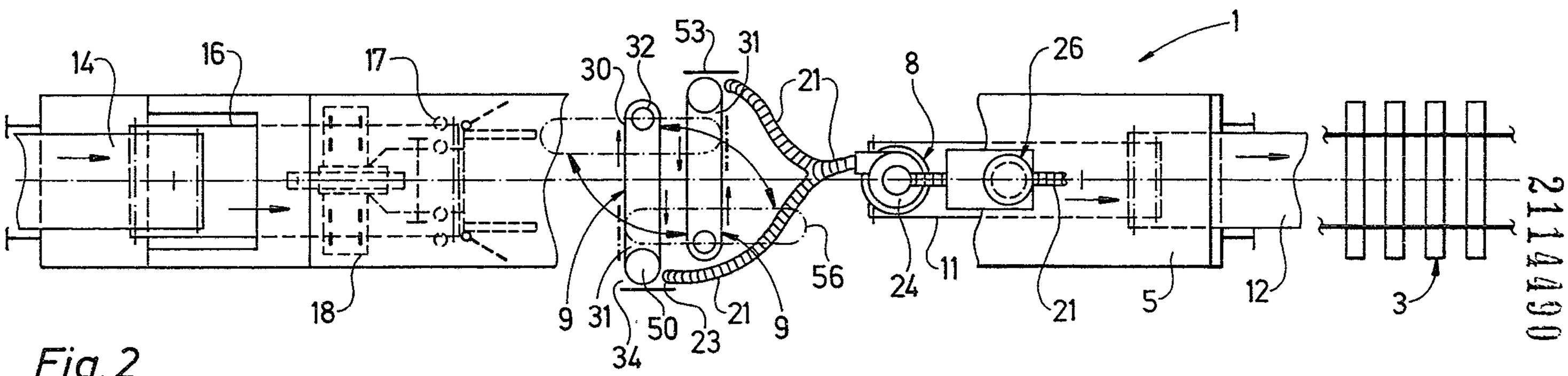


Fig. 2

2114490

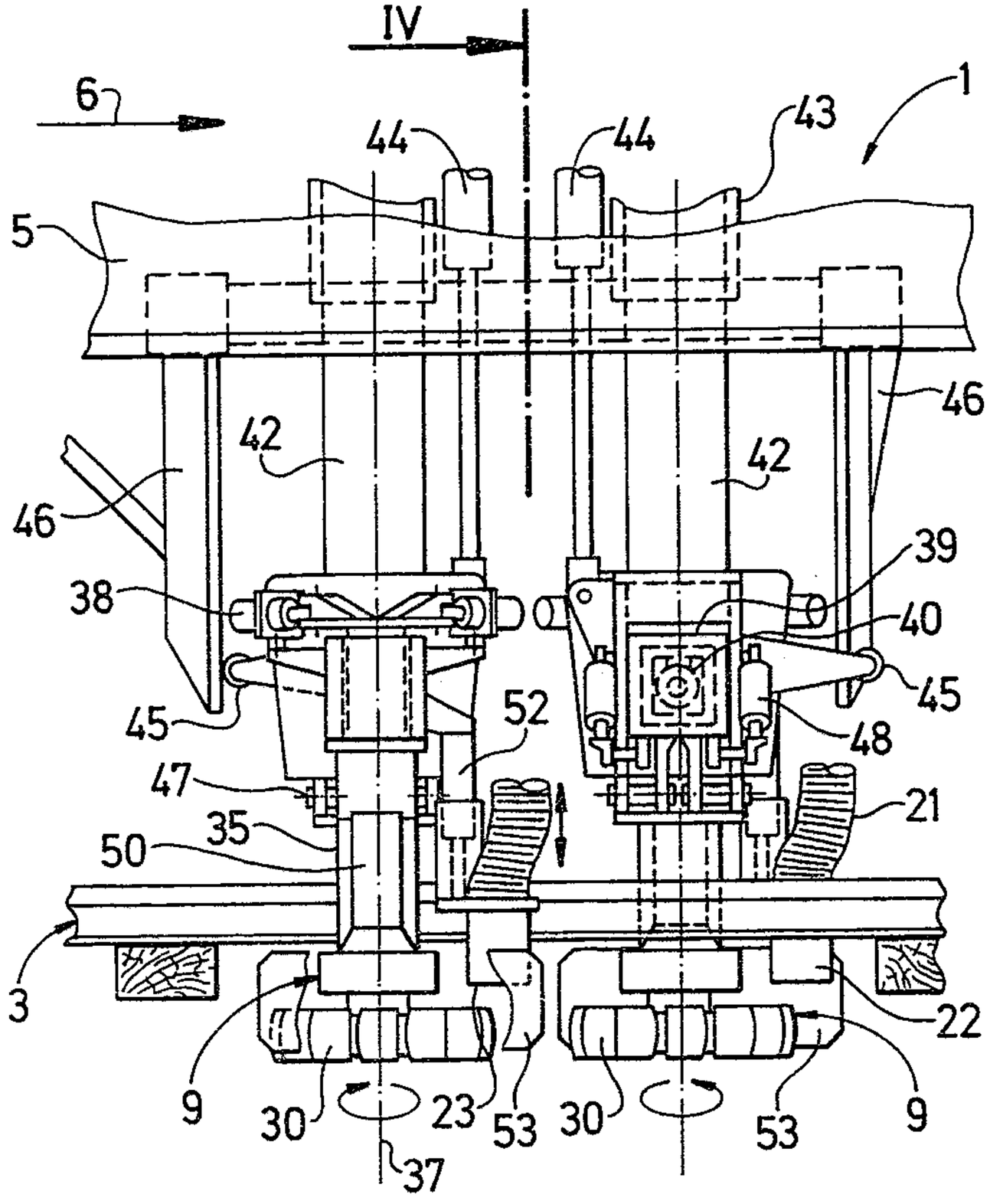


Fig. 3

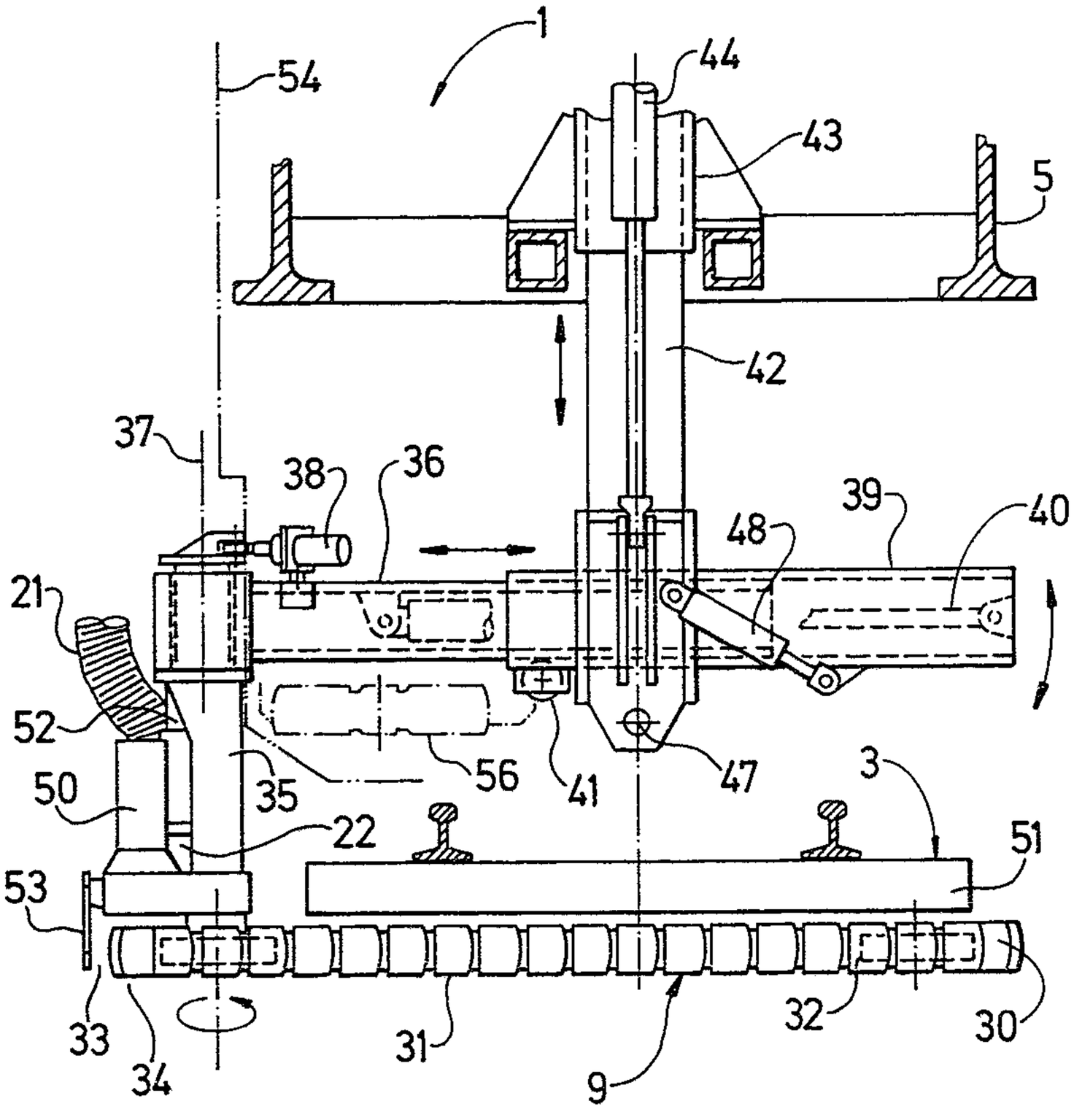
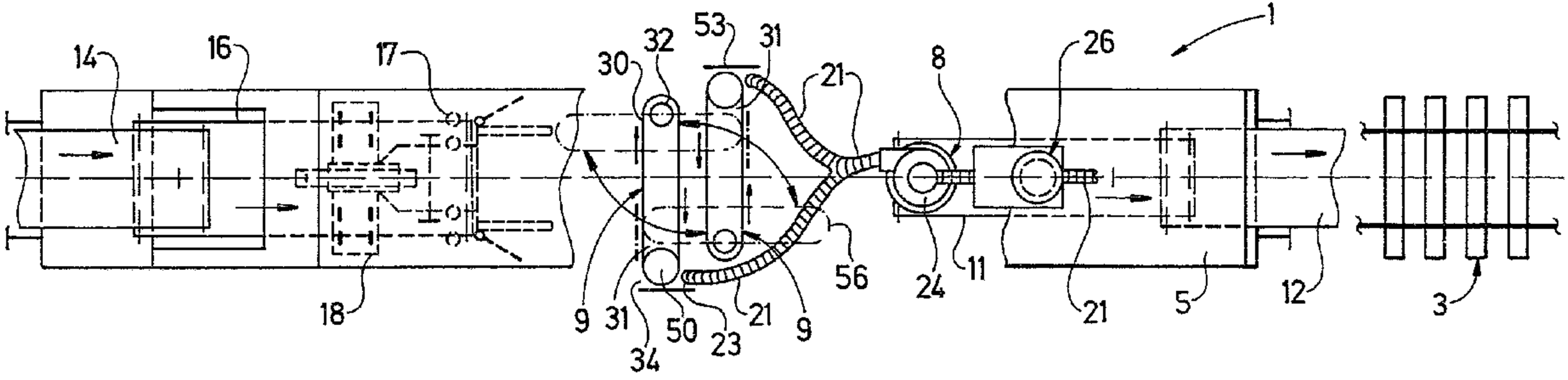


Fig. 4

2114190


14
16
17
18
30
32
53
31
21
9
31
34
50
23
21
9
56
8
24
11
26
21
5
12
1
3