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(72) Inventeur/Inventor:
THEURER, JOSEF, AT

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

(74) Agent: RICHES, MCKENZIE & HERBERT LLP

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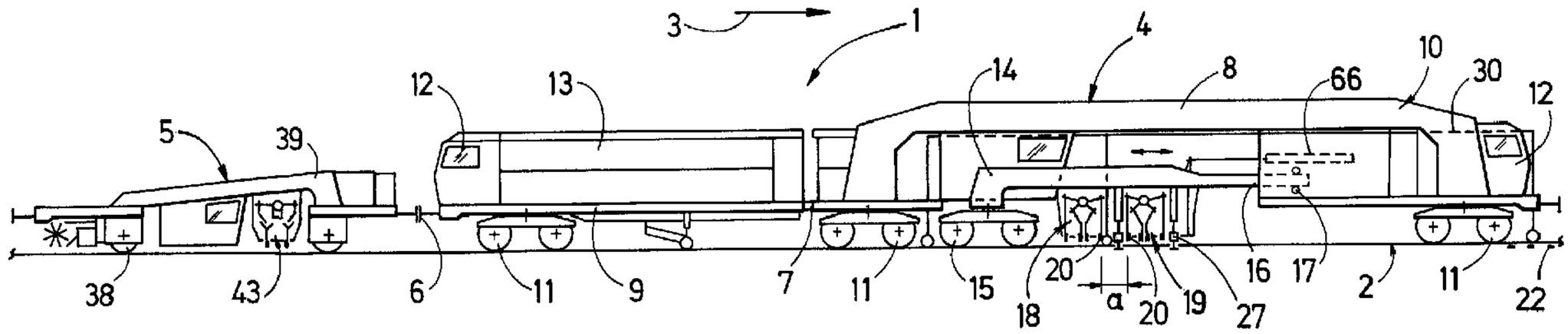
(54) Title: A TAMPING MACHINE, A MACHINE ARRANGEMENT AND A METHOD FOR TAMPING A TRACK



(57) Abrégé/Abstract:
A tamping machine (4) for simultaneously tamping a plurality of sleepers (22) of a track (2) comprises a machine frame (10) supported on on-track undercarriages (11), two multiple tamping units (18,19) designed for simultaneously tamping at least two sleepers (22) respectively and arranged one following another in the longitudinal direction of the machine, a track lifting and lining unit (27), and also a reference system (30) for performing track geometry corrections. A sleeper spacing (a) is defined by the spacing apart of two tamping tines (20) of each multiple tamping unit (18,19), the said tamping tines being adjacent in the longitudinal direction of the machine - located in their starting position for tamping - and squeezable together by means of a squeeze drive (24). The two tamping tines (20) of the two multiple tamping units (18,19), which are adjacent to one another in the longitudinal direction of the machine, are spaced apart from one another by a distance equivalent to a sleeper spacing (a).

ABSTRACT

A tamping machine (4) for simultaneously tamping a plurality of sleepers (22) of a track (2) comprises a machine frame (10) supported on on-track undercarriages (11), two multiple tamping units (18,19) designed for simultaneously tamping at least two sleepers (22) respectively and arranged one following another in the longitudinal direction of the machine, a track lifting and lining unit (27), and also a reference system (30) for performing track geometry corrections. A sleeper spacing (a) is defined by the spacing apart of two tamping tines (20) of each multiple tamping unit (18,19), the said tamping tines being adjacent in the longitudinal direction of the machine - located in their starting position for tamping - and squeezable together by means of a squeeze drive (24). The two tamping tines (20) of the two multiple tamping units (18,19), which are adjacent to one another in the longitudinal direction of the machine, are spaced apart from one another by a distance equivalent to a sleeper spacing (a).

A TAMPING MACHINE, A MACHINE ARRANGEMENT AND A METHOD FOR TAMPING A TRACK

The invention relates to a tamping machine for simultaneously tamping a plurality of sleepers of a track, comprising a machine frame supported on on-track undercarriages, two multiple tamping units designed for simultaneously tamping at least two sleepers respectively and arranged one following the other in the longitudinal direction of the machine, a track lifting and lining unit, and also a reference system for implementing track geometry corrections, wherein a sleeper spacing a is defined by the spacing apart of two tamping tines of each multiple tamping unit, the said tamping tines being adjacent in the longitudinal direction of the machine - located in their starting position for tamping - and squeezable together by means of a squeeze drive, and also a machine arrangement and a method.

A tamping machine or machine arrangement of this kind is already known through US 5 379 700. This machine arrangement, designed specifically for treating switch sections, is composed of a tamping machine with a multiple tamping unit and also an auxiliary tamping machine which can be coupled thereto and comprises a single sleeper tamping unit. Immediately prior to operational use, the auxiliary tamping machine is uncoupled from the tamping machine and is propelled independently by means of its own motive drive. The sleeper bases both in the main and in the branch track where the tamping tines are able to penetrate quickly and without difficulty into the ballast are consolidated with the tamping machine. The sleeper bases which have not been tamped by the multiple tamping unit of the tamping machine are then tamped by the independently mobile auxiliary tamping machine without the track being lifted. This combination enables even switch

sections to be tamped with an efficient multiple tamping unit.

A tamping machine composed of two machine frames arranged one following the other in the longitudinal direction of the machine is also known through US 3 744 428, a multiple tamping unit being associated with each machine frame. The following tamping unit, in the working direction, is mounted so as to be displaceable in the longitudinal direction of the machine. The tamping is performed in such a way that after two adjacent sleepers have been tamped by the front multiple tamping unit, the whole machine is advanced by a total of four sleepers, leaving out two sleepers. The sleepers which have thus not been tamped by the front multiple tamping unit are finally each tamped by the following multiple tamping unit. Assigning two single sleeper tamping units to each of the two machine frames instead of a multiple tamping unit is also known, according to a design variant shown in Fig. 7 of U.S. Patent 3 744 428. These single sleeper tamping units are spaced apart from one another by a distance which is equivalent to a sleeper spacing. In order to compensate for varying sleeper spacings, each tamping unit is mounted on the machine frame for displacement in the longitudinal direction of the machine. Other tamping machines with two multiple tamping units are known through US Patents 4 224 874, 3 595 170 and 3 494 297.

The object of the present invention is now to provide a tamping machine of the type described in the introduction with which an accurate and durable track geometry can be combined with a particularly high tamping output.

This object is achieved according to the invention with a tamping machine of the type previously defined in that the two tamping tines of the two multiple tamping units, which are adjacent to one another in the longitudinal direction of the machine, are spaced apart from one another by a distance equivalent to a sleeper spacing a.

The solution according to the invention enables a quite substantial increase in output to be achieved, advantageously incorporating tamping units which have already proved most successful in use over many years, without the structural modification thereof, in conjunction with achieving an accurate and durable track geometry. Spacing the two multiple tamping units a specific distance apart is the ideal solution, inasmuch as, on the one hand, no constructional problems or mutual interference as a result of an excessively close arrangement arise, and, on the other hand, problematic fixing of the track geometry - as a result of locating them a greater distance apart - is not to be anticipated either. Since the track which has been lifted by the track lifting and lining unit into the target position is now simultaneously tamped in the vicinity of at least four sleepers and is thus durably fixed, despite the omitted tamping of the middle sleeper in the space between the two multiple tamping units, maintaining the accuracy of the track geometry is still ensured even after the residual single sleeper tamping has been performed. The auxiliary tamping machine may be constructionally particularly simple in design, as it is only necessary to arrange thereon a single sleeper tamping unit without any auxiliary equipment of any kind.

The invention also relates to a machine arrangement for tamping a track with a tamping machine and is characterized by a further, auxiliary tamping machine designed for mobility independently with its own motive drive and comprising a single sleeper tamping unit, vertically adjustable by means of a drive, for tamping a single sleeper, wherein the two machines can be joined together by means of a coupling device for combined transfer travel.

This machine arrangement has the advantage that small tamping machines which are already in use can also be used as auxiliary tamping machines for performing the residual tamping. In addition, because of the mutually independent

mobility, optimum use can be made of the higher output of the preceding tamping machine without regard to the residual tamping.

The invention also relates to a method for tamping a track in which a group of sleepers is tamped in a first working procedure, with respect to the working direction, and the remaining sleepers which were left out in the first working procedure are tamped in a further, following working procedure. The method according to the invention consists in the fact that the first working procedure - called group tamping - covers a sleeper section involving a total of at least five consecutive sleepers, during which, with correction of the vertical and lateral geometry of the track, only a group of sleepers immediately preceding a single middle sleeper and a group of sleepers immediately following this middle sleeper are tamped simultaneously, and that in the following working procedure - called residual tamping - the middle sleeper of each sleeper section which was left out or not tamped during the group tamping is tamped.

The two-stage tamping method according to the invention results in a particularly high tamping output, the residual tamping being confined to a minimum to avoid possible interference with the corrected track geometry. It is of particular advantage that, as a result of the central positioning of the sleeper which was not tamped during the group tamping between at least two tamped sleepers on each side, the best possible safeguarding of the track geometry correction, already carried out in the first tamping stage, is ensured.

The invention is described in more detail in the following with the aid of exemplary embodiments shown in the

drawing, in which:

Fig. 1 shows a side view of a machine arrangement which is composed of a preceding tamping machine, in the working direction, comprising two multiple tamping units, and a following auxiliary tamping machine,

Fig. 2 and 3 show, in enlarged form, a front and a rear portion respectively of the machine arrangement according to Fig. 1,

Fig. 4 shows a variant of a working frame carrying tamping units,

Fig. 5 shows another exemplary embodiment of a tamping machine in side view, the auxiliary tamping machine being designed as a coupled vehicle in the form of a trailer,

Fig. 6 shows another exemplary embodiment in a partial side view, the two tamping machines being joined together by means of a longitudinal displacement drive, and

Fig. 7 shows a partial side view of a tamping machine in another embodiment.

The machine arrangement 1 shown in Fig. 1 for tamping sleepers 22 of a track 2 is composed of a preceding tamping machine 4, with respect to the working direction (arrow 3), and a following auxiliary tamping machine 5. Both tamping machines 4,5 are detachably joined together by means of a coupling device 6.

The tamping machine 4 - also to be called the main tamping machine - which is designed for mobility on on-track undercarriages 11 has a machine frame 10 composed of two parts 8,9 which are joined together by means of an articulation 7, driver's cabins 12 being associated with each end of the said

machine frame. A drive unit 13 for providing the various drives with energy is located on the rear part 9 of the machine frame 10 which is designed in the form of a trailer. A working frame 14, extending in the longitudinal direction of the machine, is provided between the two on-track undercarriages 11 which support the bridge-shaped part 8 of the machine frame 10. The rear end of the said working frame is supported directly on the track 2 by means of an on-track undercarriage 15, while a front end 16 is mounted for longitudinal displacement in a bearing 17 of the machine frame 10. Relative displacement in the longitudinal direction of the machine between the working frame 14 and the machine frame 10 may be effected by means of a displacement drive 66. Secured to the working frame 14 are two multiple tamping units 18,19, arranged one following the other in the longitudinal direction of the machine, each of which is designed as a two-sleeper tamping unit for simultaneously tamping two immediately adjacent sleepers 22.

As is particularly evident in the enlarged representation shown in Fig. 2, each multiple tamping unit 18,19 has four tamping tools 21 on each longitudinal rail side, arranged one following another in the longitudinal direction of the machine and provided with tamping tines 20, for simultaneously tamping two immediately adjacent sleepers 22. The tamping tools 21 which may be set vibrating by means of a vibration drive 23 may be squeezed together by means of respective separate squeeze drives 24 to perform the tamping. Two tamping tines 20 of the tamping tools 21 each forming a pair, located in their starting position for performing tamping and squeezable together, are spaced apart from one another by a sleeper spacing a. The two tamping tines 20 of the two adjacent multiple tamping units 18,19, the said tamping tines being adjacent to one another in the longitudinal direction of the machine, are similarly spaced apart from one another - with respect to their position immediately prior to tamping - by a distance equivalent to a sleeper spacing a. Vertical

adjustment of the two multiple tamping units 18,19 may be effected by means of drives 25.

A track lifting and lining unit 27 which may be vertically and transversely adjusted by means of drives 26 is arranged between the two multiple tamping units 18,19 and is connected to the working frame 14. Also located in this region is a tracing element 29 of a reference system 30 which is designed to roll along the track 2 by means of tracing rollers 28 and is mounted for vertical adjustment. This tracing element 29 is connected by way of a measuring feeler 31 to a reference line 32 of the reference system 30 which is designed as a tensioned chord. Immediately preceding the front multiple tamping unit 19 in the working direction is a second track lifting and lining unit 27.

Housed in an operator's cabin 33 connected to the machine frame 10 and projecting over the on-track undercarriage 15 of the working frame 14 is a central control unit 34 for controlling the two multiple tamping units 18,19 and the two track lifting and lining units 27. Motive drives 35 are provided for the continuous operational advance of the machine frame 10. To mark the sleeper 22 which was not tamped by the two multiple tamping units 18,19 during the first tamping procedure, also to be called group tamping because four sleepers 22 are tamped simultaneously, a marking device 36, for spraying paint for example, is provided in conjunction with a sleeper sensor 37.

As is particularly evident in Fig. 3, the auxiliary tamping machine 5 has a machine frame 39 which is supported on on-track undercarriages 38. This machine frame is designed so as to be upwardly recessed between the two on-track undercarriages 38 and is bounded by an upper contour plane 40 arranged so as to be inclined at an angle to the track plane. The inclination of this contour plane 40 is such that its distance from the top 41 of a rail at one end 42 of the

machine frame 39 - provided for the connection to the tamping machine 4 - is a maximum of 3.5 metres and at the opposite end a maximum of 2 metres.

Provided between the two on-track undercarriages 38 of the auxiliary tamping machine 5 are merely a single sleeper tamping unit 43 and an operator's cabin 44 with a control unit 45. The operator's cabin 44 is arranged, as is the single sleeper tamping unit 43, beneath a portion 46 of the machine frame 39 which is designed so as to be upwardly recessed and is inclined relative to the track plane. The single sleeper tamping unit 43 which is vertically adjustable by means of a drive 47 is provided with tamping tines 48 which can be squeezed together to tamp a single sleeper 22. Associated with the auxiliary tamping machine 5 is a detector 49 for automatically detecting a sleeper marking, denoted 50. Arranged at the rear end of the auxiliary tamping machine 5, in the working direction, is a vertically adjustable sweeping broom 52 which is rotatable by means of a drive 51 and comprises a transverse conveyor belt 53. An engine 55 serves to provide the various drives and also a motive drive 54 with energy.

The way in which the described machine arrangement 1 operates is explained in more detail in the following:

The machine arrangement 1, with the auxiliary tamping machine 5 coupled to the tamping machine 4, is expediently jointly driven to the site of use. As soon as this is reached, the auxiliary tamping machine 5 is uncoupled from the tamping machine 4. Using the front tamping machine 4 in the working direction, the machine frame 10 is now continuously advanced by operation of the motive drive 35, while the working frame 14 together with the multiple tamping units 18,19 is progressively advanced from one tamping location to the next by means of intermittent operation of the displacement drive 66. As soon as the working frame 14 is

stationary, the two multiple tamping units 18,19 are simultaneously lowered with operation of the drives 25 to tamp two sleeper pairs simultaneously, between which lies a middle sleeper 22 which is not tamped during this group tamping. Any necessary track geometry correction is performed immediately prior to the implementation of the group tamping, by using the two track lifting and lining units 27 in conjunction with the reference system 30. After the four sleepers 22 altogether have been simultaneously tamped, the two multiple tamping units 18,19 are raised again and together with the working frame 14 are advanced by operation of the displacement drive 66 by a distance equivalent to five times the sleeper spacing a (see arrows 56). There the described tamping cycle for simultaneously tamping a total of four sleepers 22 begins again with the lowering of the two multiple tamping units 18,19.

With the lowering of the two multiple tamping units 18,19, the sleeper sensor 37, preferably operating in a non-contact manner, is activated to count the sleepers. As soon as the middle sleeper 22 which was not tamped during the aforementioned tamping operation arrives in the vicinity of the marking device 36, the latter is automatically activated. The aforementioned untamped sleeper 22 is thereby sprayed with paint to mark it, producing a sleeper marking 50. In this connection, obviously any known type of sleeper marking is conceivable, for example corresponding magnetizing of the region of the rail associated with the sleeper 22, or such like. The sleeper marking 50 can of course also be effected directly in the region between the two multiple tamping units 18,19.

As soon as the operator in the operator's cabin 44 records a sleeper marking 50, the auxiliary tamping machine 5 is halted, with the single sleeper tamping unit 43 centred over the sleeper 22 provided with the sleeper marking 50. Upon operation of the drives 47 of the two single sleeper

tamping units 43 each associated with one rail 57 of the track 2, tamping, also to be referred to as residual tamping, of the sleeper 22 which was not tamped by the preceding tamping machine 4 during the group tamping is performed. The residual tamping is terminated when a tamping pressure, preselected in the control unit 45 and recorded in squeeze drives 58 of the tamping tines 48, is reached. Since the track 2 is not lifted during this residual tamping, the track geometry which was corrected during the group tamping with the simultaneous tamping of four sleepers 22 remains completely unaffected. Alternatively, the machine's advance can also be stopped automatically as soon as the detector 49 has recorded a sleeper marking 50.

In the exemplary embodiments described in the following parts with the same functions are provided, for the sake of simplicity, with the same reference numerals as in the exemplary embodiment shown in Fig. 1 to 3.

The design variant shown in Fig. 4 differs from the previously described variant in that the working frame 14 is supported on the track 2 at both longitudinal ends by means of respective separate on-track undercarriages 15. The relative displacement between the machine frame 10 and the working frame 14 is effected by operation of the displacement drive 66 in conjunction with a motive drive 59 of the on-track undercarriage 15.

As is evident in Fig. 5 in another embodiment, the tamping machine 4 is composed of two machine frames 10,39 joined together by means of an articulation 60, the trailer-like machine frame 39 which follows in the working direction and which has the single sleeper tamping unit 43 forming the auxiliary tamping machine 5. The single sleeper tamping unit 43 is displaceably mounted on guides 61 extending horizontally and in the longitudinal direction of the machine, and is connected to a longitudinal displacement drive 62. The two

multiple tamping units 18,19, designed for simultaneously tamping two sleepers 22 respectively, are arranged directly on the machine frame 10.

This tamping machine 4 or machine arrangement 1 is moved progressively from one tamping location to the next, the distance between the successive tamping locations being equivalent to five times the sleeper spacing a. While four sleepers 22 are simultaneously tamped with the two multiple tamping units 18,19 in the course of group tamping, the residual tamping of the single sleeper which was not tamped during the group tamping is performed in parallel therewith by the following single sleeper tamping unit 43. Immediately prior to the tamping, the single sleeper tamping unit 43 is automatically centred over the sleeper 22 to be tamped. This may be achieved by means of an odometer 63, connected to the control unit 34, which automatically begins the distance measurement with the lowering of the two multiple tamping units 18,19.

The tamping machine 4 or machine arrangement 1 shown in Fig. 6 has a displacement drive 64 as the coupling device between the two machine frames 10,39. With the aid of this displacement drive 64, the distance between the multiple tamping units 18,19, on the one hand, and the single sleeper tamping unit 43, on the other hand, can be changed slightly to enable the latter to be centred over the single sleeper to be tamped. Each multiple tamping unit 18,19 is provided with three pairs of tamping tines 20 for simultaneously tamping three sleepers 22 which are immediately adjacent to one another in the longitudinal direction of the machine. The whole machine arrangement 1 is moved progressively, covering a distance equivalent to seven times the sleeper spacing a. It would of course also be possible to combine a two sleeper tamping unit with a three sleeper tamping unit to form the multiple tamping unit 18,19.

Finally, another variant of a tamping machine 4 or a machine arrangement 1 is illustrated by Fig. 7, in which the auxiliary tamping machine 5 has a machine frame 39 designed in the form of a trailer. This machine frame is mounted for longitudinal displacement at the rear end of the machine frame 10 of the tamping machine 4 and is displaceable longitudinally with the aid of a displacement drive 65.

Claims

1. A tamping machine (4) for simultaneously tamping a plurality of sleepers (22) of a track (2), comprising a machine frame (10) supported on on-track undercarriages (11), two multiple tamping units (18,19) designed for simultaneously tamping at least two sleepers (22) respectively and arranged one following the other in the longitudinal direction of the machine, a track lifting and lining unit (27), and also a reference system (30) for implementing track geometry corrections, wherein a sleeper spacing (a) is defined by the spacing apart of two tamping tines (20) of each multiple tamping unit (18,19), the said tamping tines being adjacent in the longitudinal direction of the machine - located in their starting position for tamping - and squeezable together by means of a squeeze drive (24), wherein the two tamping tines (20) of the two multiple tamping units (18,19), which are adjacent to one another in the longitudinal direction of the machine, are spaced apart from one another by a distance equivalent to the sleeper spacing (a).

2. A tamping machine according to claim 1, characterized in that the track lifting and lining unit (27) is arranged between the two multiple tamping units (18,19).

3. A tamping machine according to claim 1 or 2, characterized by a second track lifting and lining unit (27) which immediately precedes the front multiple tamping unit (19) of the tamping machine (4) in the working direction.

4. A tamping machine according to any one of claims 1, 2 or 3, characterized in that arranged between the two multiple tamping units (18,19) is a tracing element (29) which is designed to roll along the track (2) by means of tracing rollers (28) and is mounted for vertical adjustment, and which is connected by way of measuring feelers (31) to a reference line (32) of the reference system (30).

5. A tamping machine according to any one of claims 1 to 4, characterized in that both multiple tamping units (18,19) are

secured to a working frame (14) extending in the longitudinal direction of the machine, the rear end of the said working frame in the working direction being supported directly on the track (2) by means of an on-track undercarriage (15) and its front end (16) being supported for longitudinal displacement by means of a displacement drive (66) on the machine frame (10) of the tamping machine (4).

6. A tamping machine according to claim 5, characterized in that the working frame (14) is supported at both ends on the track (2) by means of the on-track undercarriages (15).

7. A tamping machine according to any one of claims 1 to 6, characterized by an auxiliary tamping machine (5) which is connected in an articulated manner to the machine frame (10) of the tamping machine (4) and has a machine frame (39) which is supported on on-track undercarriages (38) and which comprises a vertically adjustable single sleeper tamping unit (43) for tamping a single sleeper (22).

8. A tamping machine according to claim 7, characterized in that respective separate motive drives (35,54) are associated with the tamping- and the auxiliary tamping machine (4,5) for mutually independent mobility, and in that both tamping machines (4,5) are joined together for joint transfer travel by means of a coupling device (6).

9. A tamping machine according to claim 7, characterized in that the machine frame (39) forming the auxiliary tamping machine (5) is pivotally connected to the preceding machine frame (10) of the tamping machine (4) by means of an articulation (60).

10. A tamping machine according to claim 9, characterized in that the articulation (60) is designed so as to be displaceable in the longitudinal direction of the machine by means of a displacement drive (65).

11. A tamping machine according to any one of claims 7 to 10, characterized in that the single sleeper tamping unit (43) of

the auxiliary tamping machine (5) is displaceably mounted on a guide (61) extending horizontally and in the longitudinal direction of the machine and connected to the machine frame (39), and is connected to a longitudinal displacement drive (62).

12. A tamping machine according to claim 11, characterized in that a drive (47) is designed for vertically adjusting the single sleeper tamping unit (43), and the longitudinal displacement drive (62) is designed for automatic operation by means of a control unit (34) with which an odometer (63) is associated to determine the distance covered by the tamping machine (4).

13. A tamping machine according to any one of claims 1 to 12, characterized by a marking device (36) to mark a sleeper (22).

14. A tamping machine according to claim 13, characterized in that a sleeper sensor (37) is associated with the marking device (36) for automatically effecting a sleeper marking (50).

15. A tamping machine according to any one of claims 7 to 13, characterized in that a detector (49) is associated with the auxiliary tamping machine (5) for automatically detecting a sleeper marking (50) and initiating a tamping operation.

16. A tamping machine according to any one of claims 7 to 15, characterized in that the machine frame (39) of the auxiliary tamping machine (5) is bounded by an upper contour plane (40) whose distance from the top (41) of the rail at one end (42) of the machine frame (39) - provided for the connection to the tamping machine (4) - is a maximum of 3.5 metres and at the opposite end a maximum of 2 metres.

17. A tamping machine according to any one of claims 7 to 16, characterized in that a sweeping broom (52) which is rotatable by means of a drive (51) is associated with the rear end of the auxiliary tamping machine (5), in the working direction.

18. A tamping machine according to any one of claims 16 or 17, characterized in that provided between the two on-track undercarriages (38) of the auxiliary tamping machine (5) are merely the single sleeper tamping unit (43) and an operator's cabin (44), the operator's cabin (44) and the single sleeper tamping unit (43) being arranged beneath a portion (46) of the machine frame (39) which is designed so as to be upwardly recessed.

19. A machine arrangement (1) for tamping a track (2) with a tamping machine (4) according to claim 1, characterized by a further, auxiliary tamping machine (5), designed for independent mobility with its own motive drive (54) and comprising a single sleeper tamping unit (43) which is vertically adjustable by means of a drive (47) for tamping a single sleeper (22), wherein the two tamping machines (4,5) are joined together by means of a coupling device (6) for combined transfer travel.

20. A method for tamping a track, the method comprising the steps of:

a) tamping a group of sleepers in a first working procedure, with respect to a working direction; and

b) tamping remaining sleepers which were left out in the first working procedure in a further, following working procedure, with a tamping machine according to claim 1 or a machine arrangement according to claim 19;

c) wherein the first working procedure comprises group tamping a sleeper section involving a total of at least five consecutive sleepers and which includes tamping only a first sub-group of sleepers immediately preceding a single middle sleeper and a second sub-group of sleepers immediately following the middle sleeper, during which vertical and lateral geometry of the track is corrected; and

d) wherein the following working procedure comprises residual tamping by tamping the middle sleeper of the sleeper section which was not tamped during the group tamping.

21. A method according to claim 20, characterized in that correction of the track geometry is carried out only in combination with the group tamping.

22. A method according to claim 20 or 21, characterized in that the single sleeper tamping unit (43) is automatically centred over the sleeper (22) to be tamped in dependence on the distance covered by the machine's advance and is lowered to perform the tamping operation.

23. A method according to any one of claims 20, 21 or 22, characterized in that the residual tamping is automatically terminated when a preselectable tamping pressure is reached.

24. A tamping machine according to claim 14, characterized in that a detector (49) is associated with the auxiliary tamping machine (5) for automatically detecting the sleeper marking (50) and initiating a tamping operation.

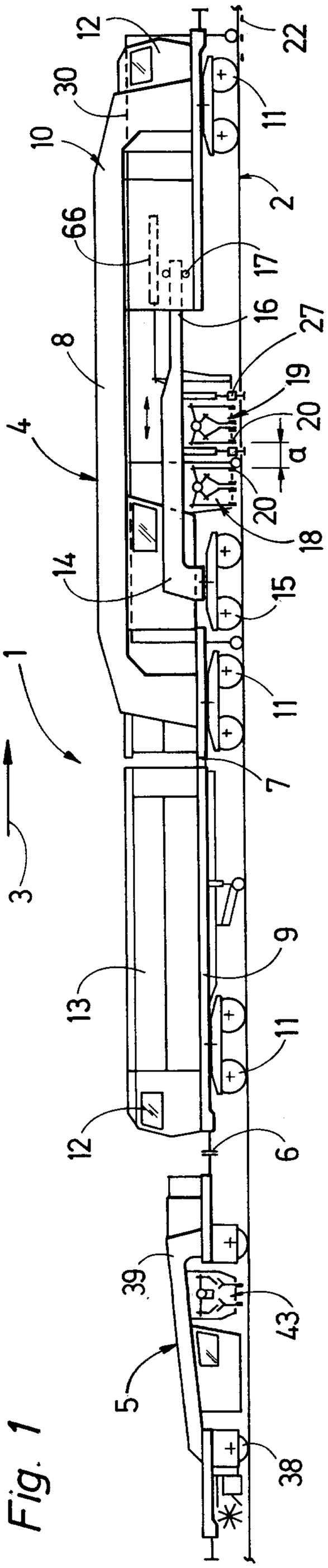


Fig. 1

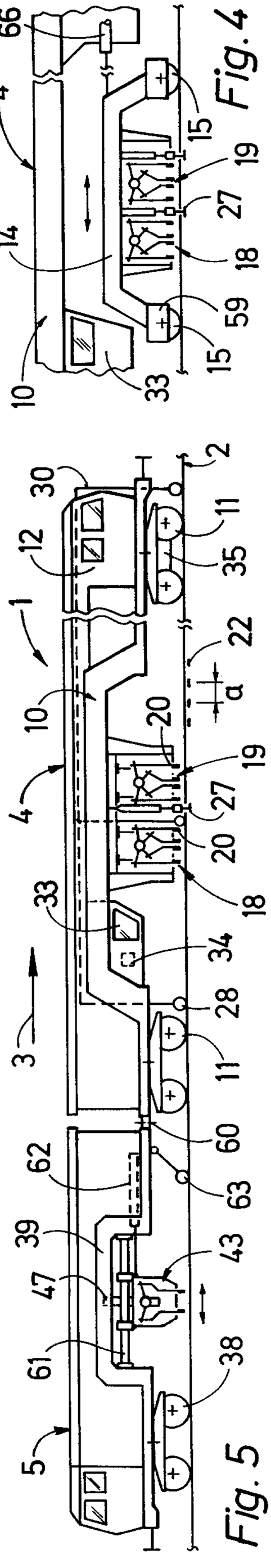


Fig. 5

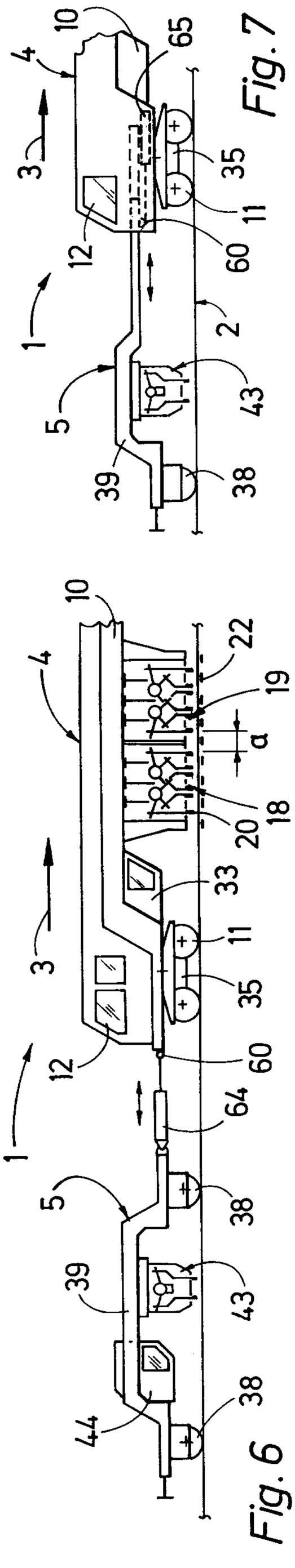


Fig. 6

Fig. 4

Fig. 7

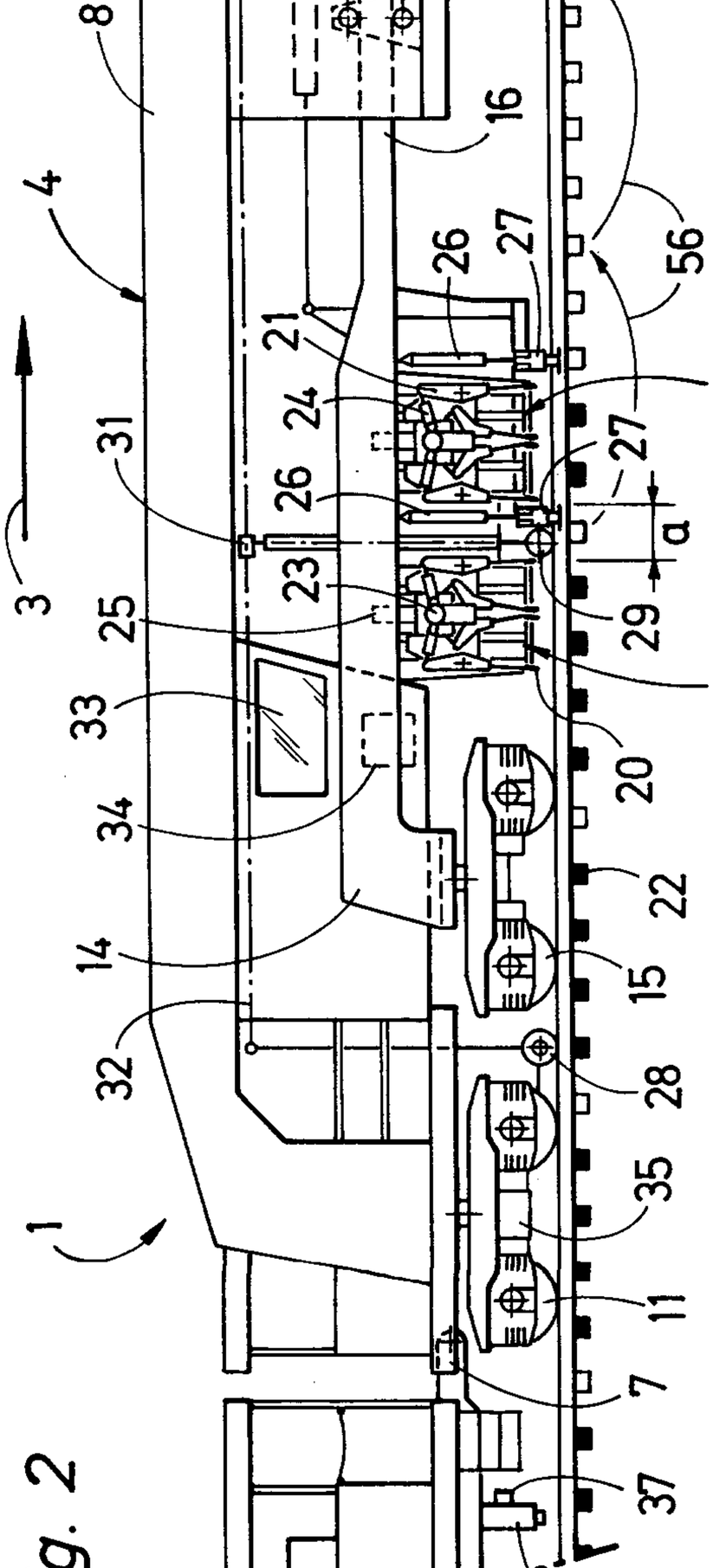

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Fig. 2

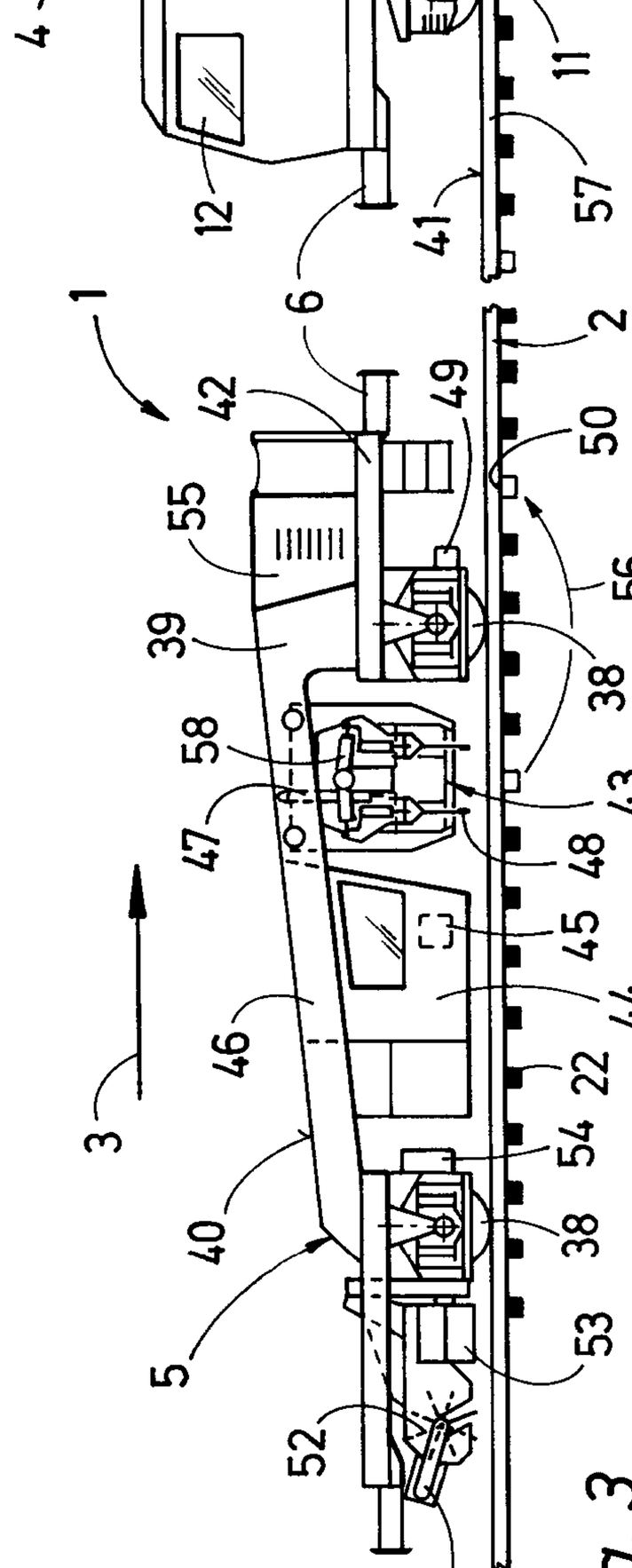
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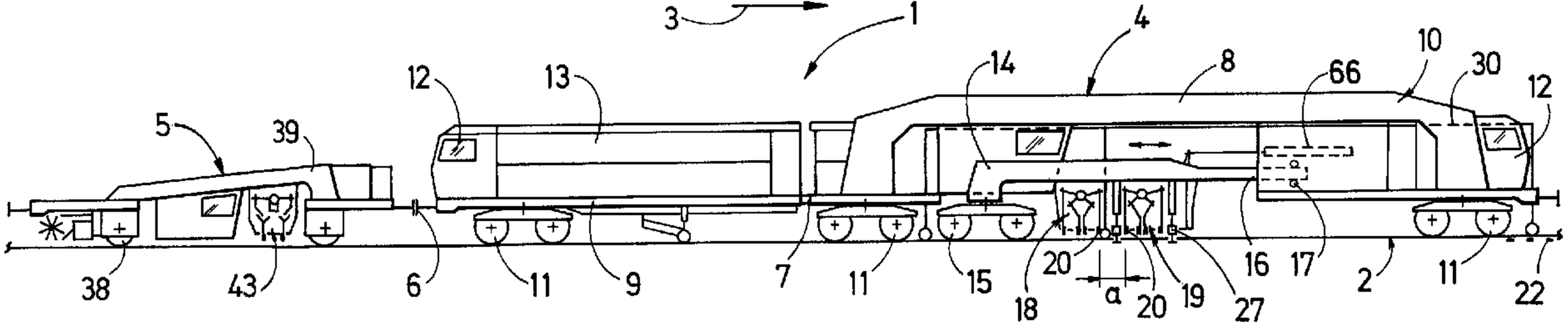
Fig. 3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