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(71) Applicant: **FATA AUTOMATION S.p.A.**
Corso Novara, 112
I-10152 Torino(IT)

(72) Inventor: **Deandrea, Giorgio**
Vicolo San Pietro, 16/3
I-10098 Rivoli (Torino)(IT)

(74) Representative: **Faraggiana, Vittorio, Dr. Ing.**
Ingg. Guzzi e Ravizza S.r.l.
Via Boccaccio, 24
I-20123 Milano (IT)

(54) Suspended rail conveyance system.

(57) A conveyance system has a suspended supporting rail (15) on which run a plurality of idling trucks (12) for load conveyance. Each idling truck (12) is hooked to a powered tractive truck (11) running on said supporting rail (15).

The supporting rail (15) has a generally I-shaped cross section, the idling trucks (12) have running wheels (13,14) arranged in contact with the upper surface of the I, and the tractive trucks (11) have a drive wheel (21) each arranged in contact with the upper surface of the supporting rail (15) and pressing rollers (24,25) arranged in contact with the lower surface of the supporting rail (15). At least one (25) of the pressing rails is thrust elastically against the supporting rail (15) with thrust means (30) operated by the hooking of an idling truck (12) to the tractor (11).

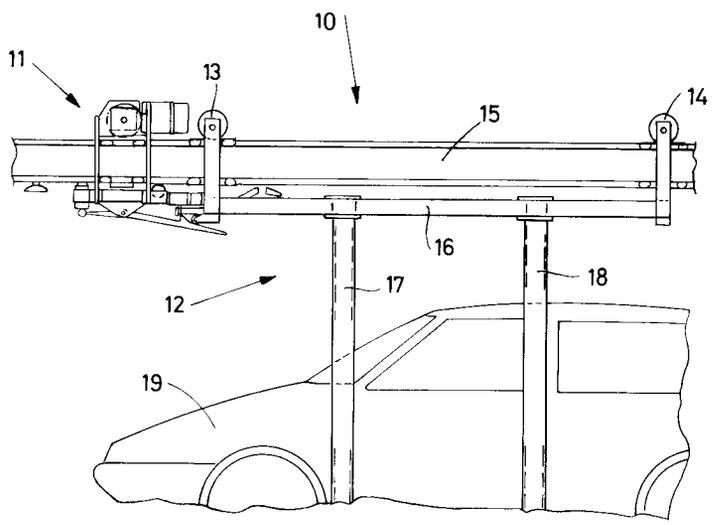

Fig.1

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In the art of material handling systems along suspended rail lines, e.g. for the automobile industry, there are known problems caused by the variability of the conveyance characteristics along the entire path.

For example, a widely used handling system for its good stepped slope travel characteristics is the one in which the idling trucks, or hangers, are made to run while suspended from a rail by means of a powered tow chain.

Said systems are relatively easy to provide, low in cost, and allow the use of the conveyance line even in environments containing potentially corrosive or explosive mixtures such as for example in paint lines or environments with relatively high temperatures as with foundry conveyance. Unfortunately, chain systems have problems of high noise and low conveyance speed, generally less than 5m per minute.

There are also known conveyance systems consisting of trucks individually powered by an electric motor mounted directly thereon. In this manner the trucks can achieve with great silence even speeds higher than 20-25m per minute.

This system cannot be used generally. Indeed, the presence of electric components on the trucks prevents their use in the hazardous or high temperature environments mentioned above.

In addition, while the chain system permits travelling over sloping sections even with heavy loads, the powered truck system, called also self-powered trucks, has large limitations in climbing rises because of the limited adherence of the drive wheels.

Additional shortcomings of the self-powered system are the difficulty of maintaining predetermined spacing between the trucks with stepped movement and the high cost of construction due also to the necessity of equipping each powered truck with the indispensable speed and position control devices.

To attempt to obviate the problems of the two different solutions while keeping in some manner their advantages, it has also been proposed to insert on the chain systems powered tow trucks. In the sections where slopes, speed and environmental conditions permit or require it, removable engagement means connect to the chain the idling trucks which are thus towed thereby. In the sections where individual powered towing is possible or necessary (e.g. to reach high translation speed) powered trucks replace the chain in the duty of towing the idling trucks.

This embodiment suffers from problems generated by the use of a chain system as the conveyance line on which the powered trucks are run. Indeed, in the chain conveyance line, the rail of the load is provided with two facing C section bars between which run both the idling truck wheels and the powered tractive truck wheels. The section bars are supported at the ends by horse-shoe arms arranged surrounding a passage for the chain-sliding rail.

This arrangement keeps the height occupied relatively low but is severely penalised for entry and exit of the tractive trucks at the beginning and end of the section bars where they are used. In addition, it is difficult to disassemble a tractor from the line in case of failure.

Since the chain runs above the rail, the supporting wheels of the tractor must necessarily he received inside the C of the rails and thus must be small. To be able to have a drive wheel of greater diameter it cannot be in contact with the lower surface of the rail. Thus its adherence decreases as the weight of the powered truck increases. It is attempted to obviate this by providing preloaded wheels which thrust the drive wheel forcibly against the rail.

Obviously this translates into excessive friction and wear when the tractive trucks circulate without idling trucks in tow.

The adherence remains limited and the slopes to be travelled by the tractive truck are hence minimal.

Additional problems lie in the fact that the tractive mechanism is sacrificed by the reduced dimensions of the passage available.

Since the main load supporting structure is similar to that of a normal chain conveyor, movement speed remains limited to relatively low levels even in the case of towing by the powered truck.

The general purpose of the present invention is to obviate the above mentioned shortcomings by supplying an suspended conveyance system which would provide, with limited cost and encumbrance, optimal conveyance flexibility characteristics together with high speed and low noise.

In view of said object it has been sought to provide in accordance with the present invention a conveyance system with suspended supporting rail on which run a plurality of idling trucks for load conveyance, each idling truck being attachable to a powered tractive truck running on said supporting rail and characterised in that the supporting rail has a cross section generally in the shape of the letter I, the idling trucks have running wheels arranged in contact with the upper surface of the I, and each of the tractive trucks has a drive wheel arranged in contact with the upper surface of the supporting rail and thrust rollers in contact with the lower surface of the supporting rail, at least one of the thrust rollers being thrust elastically against the supporting rail with thrust means operated by the hooking of the idling truck to the tractor.

To further clarify the explanation of the innovative principles of the present invention and its advantages as compared with the known art there are described below with the aid of the annexed drawings possible embodiments as nonlimiting examples applying said principles. In the drawings:

- fig. 1 shows a schematic side view of a powered conveyance truck provided in accordance with the present invention;
- fig. 2 shows an enlarged view of a detail of the truck of fig. 1 in separated condition;
- fig. 3 shows a view similar to that of fig. 2 but in hooked condition; fig. 4 shows a view along plane of cut IV-IV of fig. 2;
- fig. 5 shows a view along plane of cut V-V of FIG. 2;
- fig. 6 shows a schematic view of an example of a path provided with a conveyance system in accordance with the present invention;
- figs. 7 and 8 show a schematic plan view of a switch station in two different operating positions.

With reference to the figures, fig. 1 shows a powered truck provided in accordance with the present invention and indicated generally by reference number 10.

Said truck comprises a powered or tractive part 11 and a load supporting bar or hanger 12, both running on an I-shaped supporting rail 15.

In particular, the load supporting part comprises an idling truck with rollers or wheels 13, 14 running on top of the rail and supporting a platform 16 to which is hung the load 19, e.g. an automobile body, by means of supports 17, 18. As may be seen better in fig. 2, the load truck comprises also side rollers 28 for guidance along the side ribs of the rail.

As may be seen again in fig. 2, the tractor 11 comprises a frame 20 which rests above on the rail by means of a wheel 21 powered by a motor 22. Side guide rollers 23 ensure guidance of the tractor along the rail for support on its side edges.

The frame 20 supports also thrust rollers 24, 25 arranged against the lower surface of the rail.

The front roller 25 has its own pin 27 sliding vertically in a support 29 containing a thrust spring 26 for the roller against the rail.

The load support truck 12 and the tractor 11 are connected together by removable connecting means. Connecting means comprise a rocker arm 30 pivoted at 31 to the tractor frame and bearing at the rear a hooking tooth 32 for a pawl 33 pivoted at 34 to the front part of the hanger.

The front part of the hanger 12 supports also an idling caster 34 for running on a handling arm 36 of the hanger, projecting beyond the tooth 32.

The pawl 33 has a free end folded downward and is freely moving between the horizontal position shown in solid lines and the inclined position shown in broken lines.

The tooth 32 has a flat inclined surface 37 so that, as the hanger draws near the tractor, the free end of the pawl runs on the inclined plane 37 and engages with the tooth 32 as shown in fig. 3. Simultaneously the caster 35 runs along the arm 36, pushing it downward. The rocker arm 30 rotates thus around the pivot 31 and with its opposite end 38, supporting a running roller 39, further loads the thrust spring 26 of the roller 25 against the rail.

In this manner, when the tractor is not pulling a hanger, it is essentially without preloading for the drive wheel and moves with minimal friction, the drive wheel adhering substantially only by the tractor's dead weight. When the tractor has a load in tow, the rocker arm 30 loads the preloading spring 26, supplying the drive wheel the necessary adherence to travel even over slopes not relatively high.

Fig. 4 shows a rear view of the tractor along plane of cut IV-IV of fig. 2. In this figure there is clearly seen the I shape of the rail and a C-shaped arm 40 connected laterally to the web of the rail and supporting said rail from the ceiling.

As may be seen also in fig. 5, the pawl 33 has a release rod 41 operated for example through cams 42 arranged along the path. When the free end of the rod is raised by a cam 42, the pawl rises beyond the tooth 32 and the truck is separated from the tractor.

As may be seen again in fig. 5, the supports 40 of the rail 15 can also support an auxiliary rail 43 on which run trucks 44 supporting below a powered chain 45. The chain 45 has below at appropriately spaced intervals fingers 46 for engagement in striker means or elements 47. As may be seen in fig. 3, the engagement means comprise two arms 48, 49 inclined toward each other and pivoted to arrange themselves due to their dead weight in the position shown in the figures also being capable of lowering for rotation around their own pivot. In this manner, the arms can be lowered upon running on their upper surface of a finger 46 to insert itself between their facing ends. Once between the arms, the front arm 48 constitutes a striker for the finger of the chain, which then tows the truck. The rear arm 49 simultaneously prevents the truck from moving forward due to inertia and withdrawing from the finger.

In use, where desired or possible the hangers 12 with the load are hooked to the tractors 11 and are towed thereby along the rail 15. This permits transfers at high speed with minimal noise.

In sections where it is desired or necessary to use a chain movement, the hangers unhook from the tractors and are engaged by the chain. As clarified below, the sections with chain movement and those with tractive movement can be freely

arranged without any limitation and, on the contrary, with great system flexibility.

Fig. 6 shows a possible embodiment by way of example of a mixed system part in accordance with the present invention.

As may be seen schematically, along the track 15 are provided switch stations 50, 51 from which additional rails, the same as the rails 15, enter and exit and are only used for running of the tractors, as is clarified below. Between the switching stations runs a chain 45 parallel to the rail 15.

Figs. 7 and 8 show the possible embodiment of a switching station 50 or 51.

The switching station comprises a fixed frame 53 in which runs a moving frame 54, translatable between the two end positions shown in Figs. 7 and 8 by a motor 55 and a crank mechanism 56.

The moving frame 54 supports a straight rail section 57 and a curved rail section 58. In the position of fig. 7 the straight rail section 57 constitutes a connecting section between the rail 15 upstream and downstream from the switching station. In the position of fig. 8 the curved rail section 58 constitutes a connecting section between the rail 15 and the rail 52 upstream and downstream from the switching station. In this manner, by operating the motor 55 there is obtained the desired function of switching between the rails 15 and 57.

Returning to fig. 6, it is seen how the various movements of the system can be managed.

When a hanger towed by a tractor reaches the proximity of the switching station 50, constituting the beginning of the chain conveyance section, a cam 42 executes release of the tractor from¤¤ hanger. The switch is in the meantime placed in the position of fig. 8 so that the tractor can continue its travel along the rail 52. Immediately afterward, the switch returns to the position of fig. 7 so that the hanger, hooked by the chain 45, can continue along the rail 15. In the section immediately before the station 50, the chain conveyance zone and the tractor conveyance zone are slightly superimposed so that the hanger abandoned by the tractor can be recovered by the chain.

The hangers can thus complete their travel by chain while the free trucks without preloading can travel over a completely different path along the tracks 52 and be sent to a switching station 51 constituting the end of a chain movement section.

In this switching station 51, upon arrival of a tractor 11, the switch is moved into the position of fig. 8 so that it permits passage and stopping of the tractor on the rail 15 immediately downstream from the station 51.

The switch then moves into the position of fig. 7 so that upon arrival of a hanger from the chain section it hooks to the tractor as explained above and it can tow it along the section 15 downstream from the station while the chain moves away from the track so that the hooking finger slides laterally out of the coupling 47.

At this point it is clear that the purposes of supplying a flexible suspended rail conveyance system have been met.

In any section of the path where it is necessary chain or tractor conveyance can be used, the space occupied by the structure remaining limited. The empty tractors are not affected by excessive preloading forces necessary for towing fully loaded hangers in rising sections. Failed tractors or trucks can be readily removed from the rail with no need for complicated disassembly.

Naturally the above description of an embodiment applying the innovative principles of the present invention is given merely by way of example and therefore is not to be taken as a limitation of the patent right claimed here.

For example, the path of chain sections and tractor sections can be complicated. The track sections for running only tractors can naturally also be arranged to pick up the trucks at the beginning of a chain section and send them to the end of a different chain section, depending on necessity and optimization of the lengths of the various tracks. If there is need for greater motive force on the tractor path (e.g. to climb a rising slope of a certain significance) it is also possible to think of supplying the idling trucks with a rear hook to which can be hooked a second powered truck "for thrust", e.g. similar to the tractor trucks described above but rotated 180° on the rail. In this manner, where required, each idling truck could he moved by a pair of powered trucks, one ahead of and one behind it.

Claims

1. Conveyance system with a suspended supporting rail (15) on which run a plurality of idling trucks (12) for load conveyance, each idling truck (12) being hooked to a powered tractive truck (11) running on said supporting rail (15) and characterized in that the supporting rail (15) has a generally I-shaped cross section, the idling trucks (12) have running wheels (13,14) arranged in contact with the upper surface of the I, and the tractive trucks (11) have each a drive wheel (21) arranged in contact with the upper surface of the supporting rail (15) and pressing rollers (24,25) arranged in contact with the lower surface of the supporting rail (15), at least one (25) of the pressing rails being thrust elastically against the supporting rail (15) with thrust means (30) operated by the hooking of an idling truck (12) to the tractor (11).

2. System in accordance with claim 1 characterized in that along the supporting rail (15) there are present first switches (50) for switching of the powered trucks (11) onto an added I rail (5) and second switches (51) for switching of the powered trucks (11) from the added I rail (52) to the supporting rail (15), in a section of supporting rail (15) between first and second switches there being arranged chain means (45) with elements (46) for hooking and towing of idling trucks (12) in said section.

3. System in accordance with claim 1 characterized in that the thrust means comprise a rocker arm (30) pivoted to the tractive truck (11) in a position (31) intermediate between its ends, one end (38) of the rocker arm acting on a spring (26) for thrust of the pressing roller (25) against the supporting rail (15), the other end (36) projecting rearward to the tractive truck (11) to be thrust downward by a caster (35) placed on an idling truck (12) upon hooking of the idling truck (12) to the tractive truck (11), in the sense of further compressing the spring (26) and increasing the thrust of the pressing roller (25) against the supporting rail (15).

4. System in accordance with claim 3 characterized in that the rocker arm (30) has on its rear end (36) a tooth (32) for connection with a pawl (33) projecting from the front of the idling truck (12).

5. System in accordance with claim 4 characterized in that the pawl (33) moves vertically to slide along a flat inclined surface (37) of said hooking tooth (32) upon drawing near of the tractive truck (11) and idling truck (12) for engagement of the pawl (33) with said tooth (32) beyond the inclined flat surface (37).

6. System in accordance with claim 4 characterized in that the pawl (33) has an operating projection (41) for its movement upward in the sense of disengaging it from the tooth (32), along the path of the supporting rail (15) being placed cams (42) for operation of said projection (41) for automatic disengagement of the idling truck (12) from the tractor (11) upon their transiting opposite the cams.

7. System in accordance with claim 2 characterized in that the hook and tow elements comprise a finger (46) projecting from the chain means (45) for engagement in corresponding striker elements (47) on the idling trucks (12).

8. System in accordance with claim 7 characterized in that the striker elements (47) comprise a front arm (48) and a rear arm (49) with free ends facing in the direction of travel of the idling truck (12) along the supporting rail (15) and inclined upward, the arms (48,49) being pivoted to he hinged down upon running of the finger (46) on their upper surfaces until it is positioned between the facing ends thereof, the facing ends constituting thus the striker upon emergence of the finger (46) from the position there between.

9. System in accordance with claims 2 and 8 characterized in that substantially opposite the second switch (51) the chain means (45) draw away from the supporting rail (15) to laterally withdraw the finger (46) from the striker arms (48,49).

10. System in accordance with claim 2 characterized in that the first (50) and second (51) switches comprise a fixed supporting frame (53) in which slides between first and second end positions a moving frame (54) in a direction substantially transverse to the supporting rail (15), interrupted opposite the moving frame (54), the moving frame (54) bearing thereon a length of straight rail (57) and a length of curved rail (58), in the first end position the straight rail length (57) aligning itself and constituting an extension for the supporting rail (15) upstream and downstream from the switch to constitute a passage for the idling truck, in the second position the curved section (58) connecting the supporting rail (15) to said added rail (52) to allow passage of the tractive truck (11).

11. System in accordance with claim 2 characterized in that the chain elements comprise a chain (45) hung to trucks (44) running along an auxiliary rail (43) placed parallel to the supporting rail (15) in said section between first and second switches (50,51).

12. System in accordance with claim 1 characterized in that the supporting rail (15) is supported by supporting arms (40) hanging from above and shaped like the letter C with lower end connected to the web of the supporting rail (15).

13. System in accordance with claim 1 characterized in that idling trucks (12) and tractive trucks (11) have guide rollers (23,28) on the side edges of the supporting rail (15).

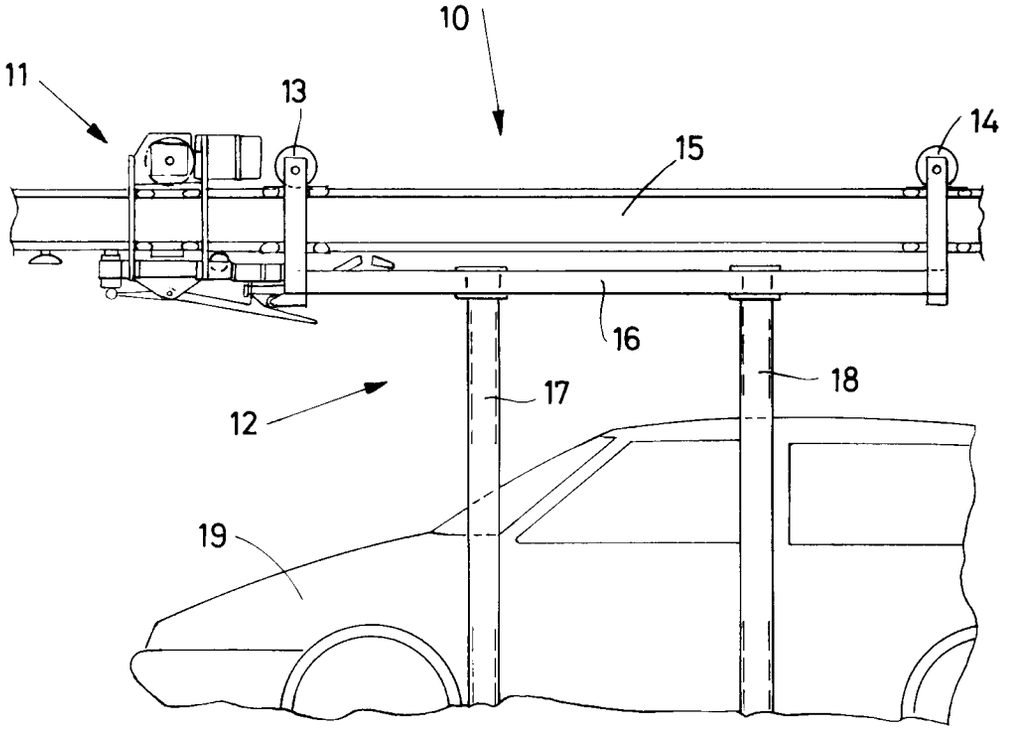
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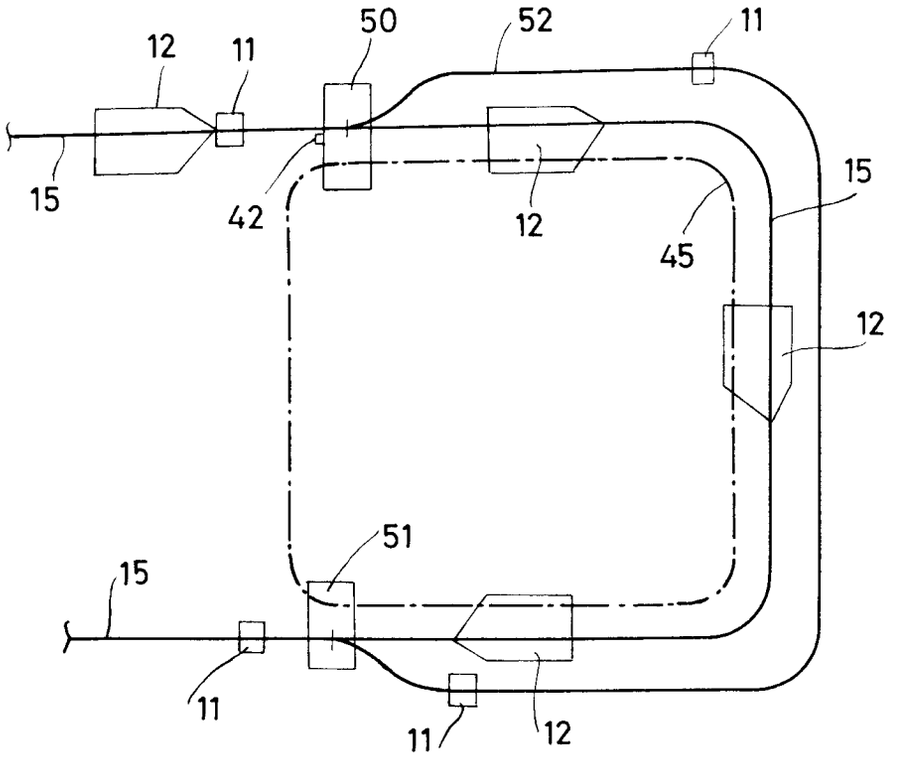
Fig.1

Fig.6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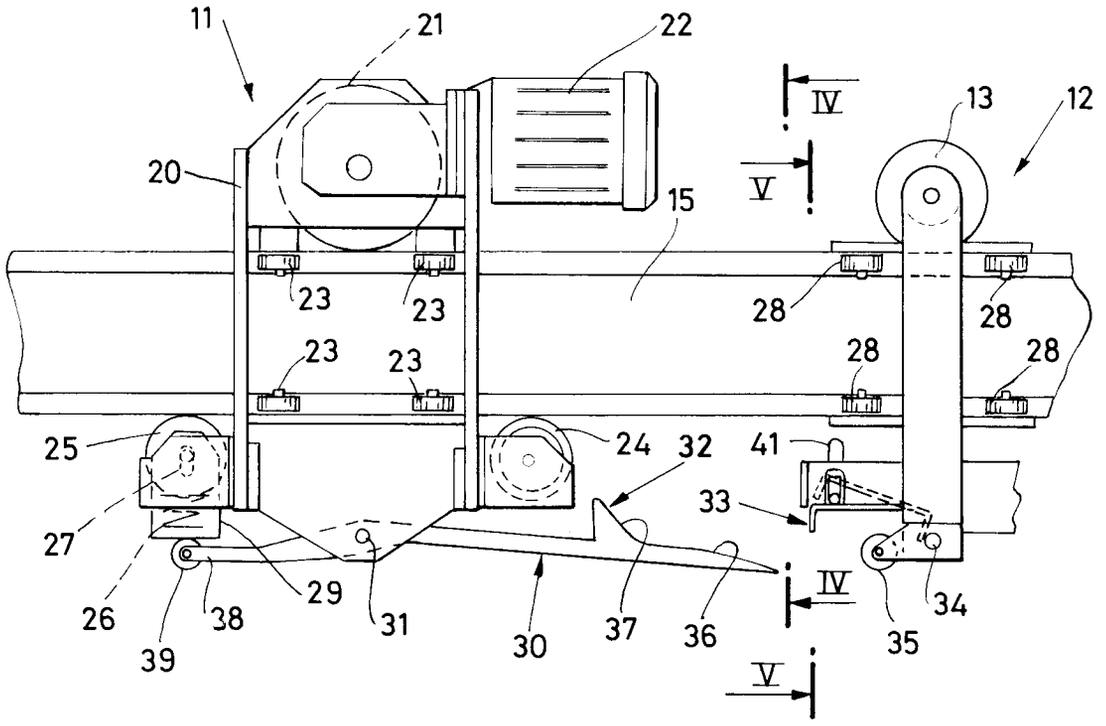
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Fig.2

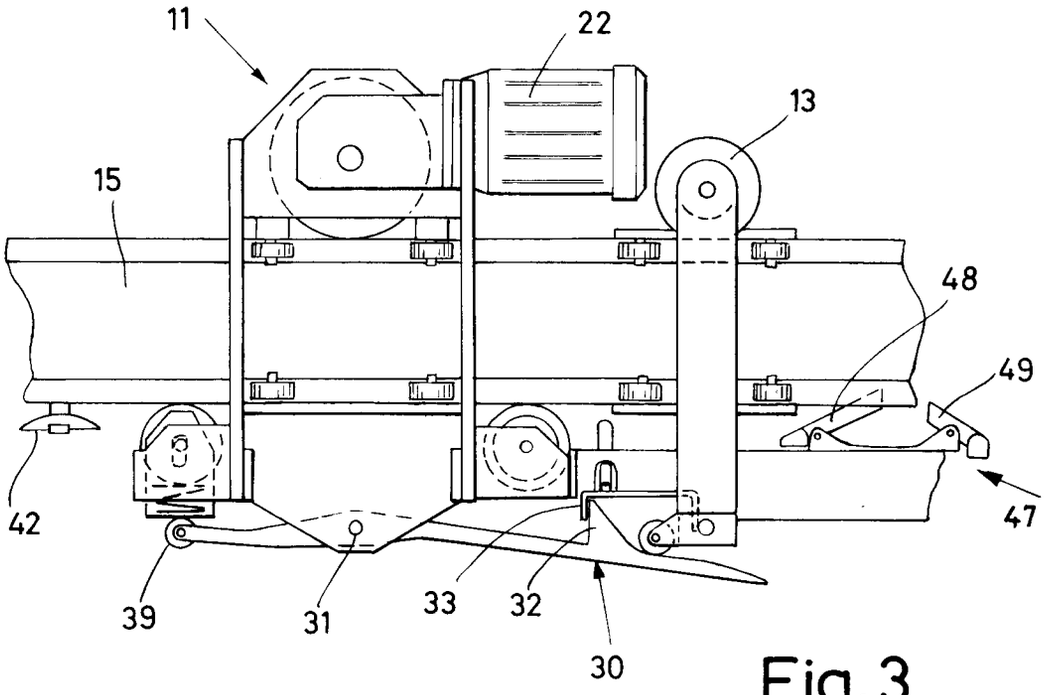
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Fig.3

Fig.5

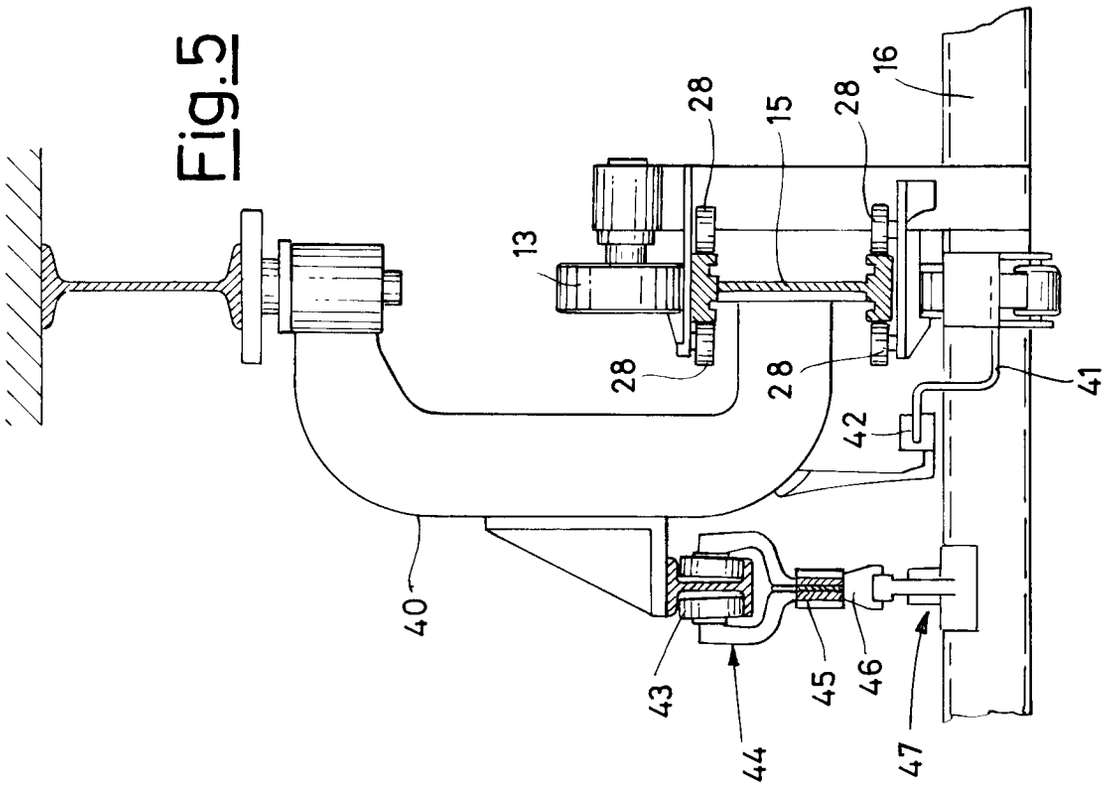
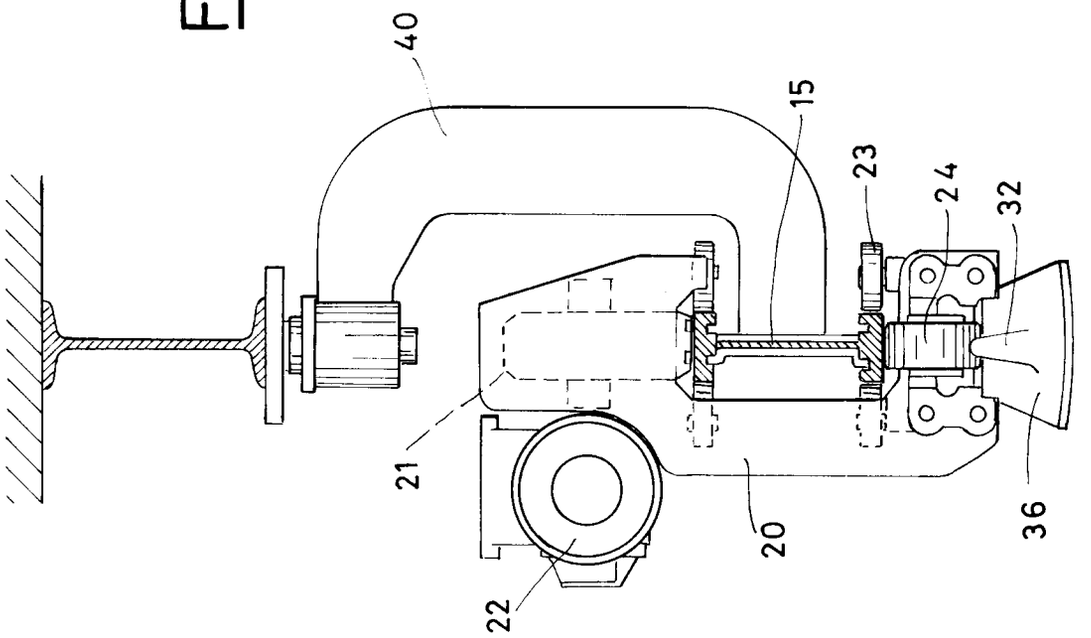


Fig.4



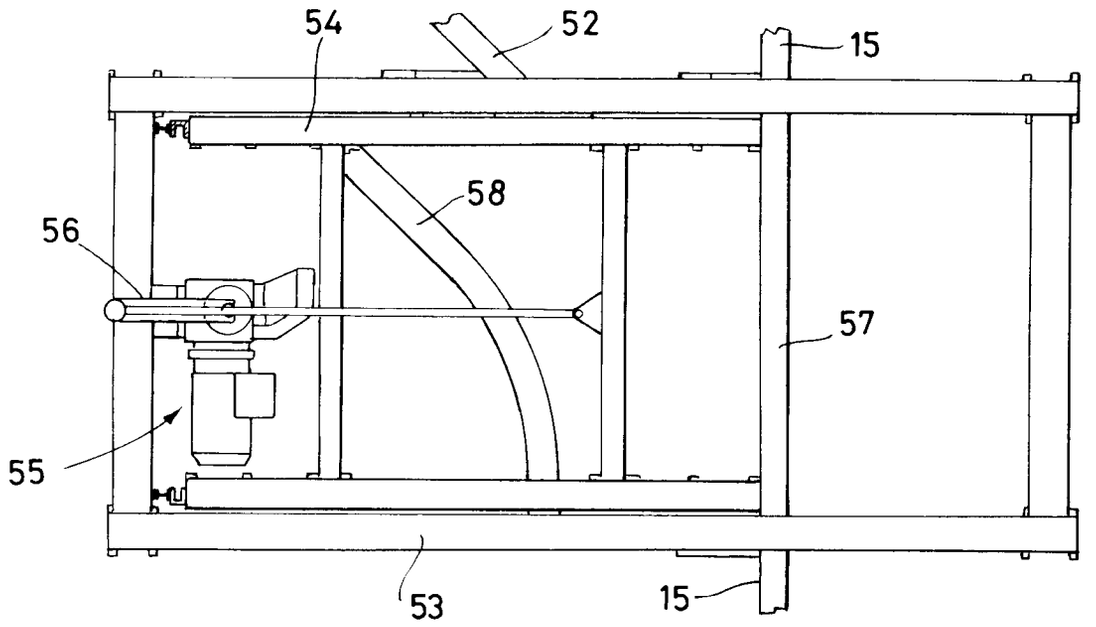


Fig.7

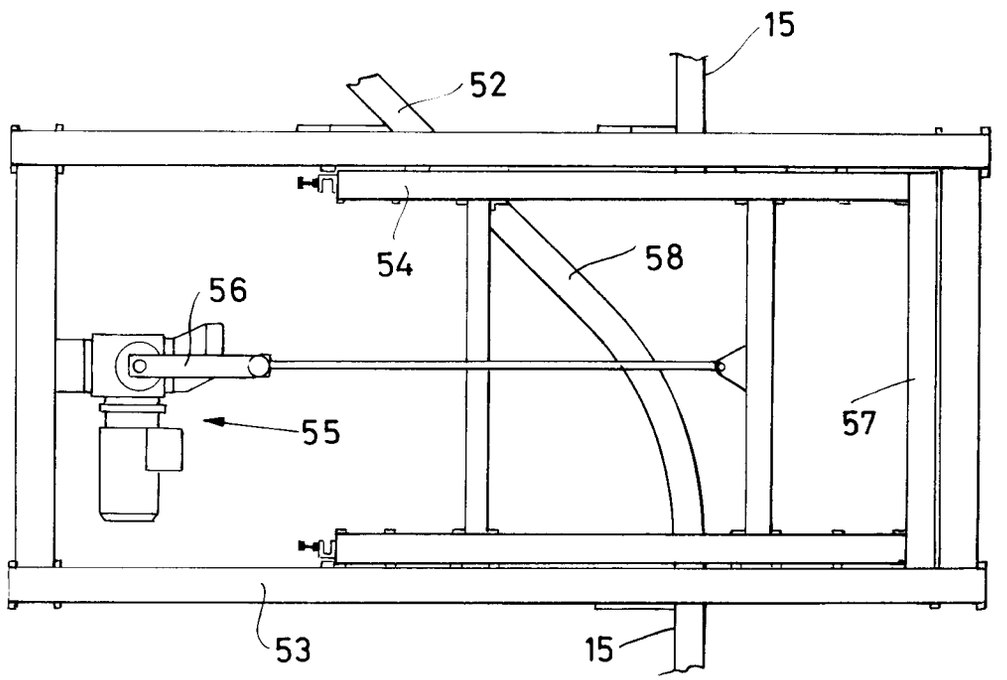


Fig.8

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EUROPEAN SEARCH REPORT

Application Number
EP 93 20 2273

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.5)
A	EP-A-0 379 206 (NAKANISHI METAL WORKS CO., LTD.) * column 3, line 52 - column 4, line 32; figures 1-3 *	1	B61C13/04
A	DE-A-38 01 057 (F. GÄRTNER) * column 1, line 34 - column 2, line 28; figures 1-3 *	1	

TECHNICAL FIELDS SEARCHED (Int.Cl.5)
B61C
B61B
B62D
B65G

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	15 November 1993	CHLOSTA, P

CATEGORY OF CITED DOCUMENTS

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