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(54) **Winding/unwinding assembly for metal strips in coils**

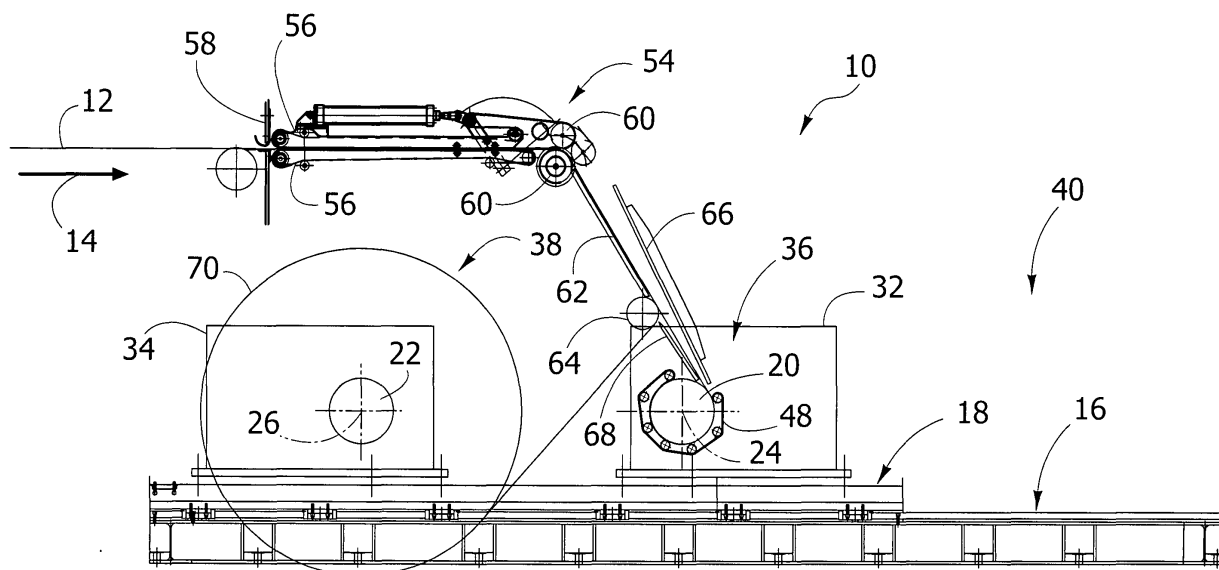
(57) Winding/unwinding assembly for metal strips in coils, comprising:

- a first and a second driven shaft (20, 22; 120, 122), rotatably mounted around respective axes (24, 26; 124, 126) parallel to each other,
- a mobile table (18, 118) carrying said shafts (20, 22; 120, 122) and movable between a first and a second working position along a direction orthogonal with respect to the axes of rotation (24, 26; 124, 126) of said shafts (20, 22; 120, 122),
- a wind/unwind starting station (36; 136), and

- a first and a second working station (38, 40; 138, 140), located on opposite sides with respect to said winding/unwinding start station (36; 136),

wherein in the first working position of said mobile table (18; 118) the first driven shaft (20, 120) is located in the wind/unwind starting station (36; 136) and the second driven shaft is located in the first working station (38; 138) and wherein in the second working position of the mobile table (18; 118) the first shaft (20; 120) is located in the second working station and the second shaft (22; 122) is located in the wind/unwind starting station (36; 136).

FIG. 1



Description

Background of the invention

[0001] The present invention concerns a winding/unwinding assembly for metal strips in coils.

[0002] The invention has been developed particularly in view of the application to continuous process lines such as for example coating lines, galvanizing lines, pickling lines, etc. envisaging the unwinding of the strips from a coil at the beginning of the process line and the rewinding of the strip in coil at the end of the process line. The invention is also applicable to "stand-alone" rolling mills and, in general, to any machine or plant in which the unwinding of a metal strip from a first coil and the rewinding of a strip on a second coil after the execution of the treatment is envisaged.

[0003] In continuous process lines for the manufacture of metal strips it is necessary to execute the coil load and unload operations without interrupting the continuous treatment process of the strip. In the prior art there are traditionally used accumulators which are designed and built in such a way to accumulate or release a certain amount of strip assuring a movement at a constant velocity of the strip upstream or downstream of the accumulator. Normally, a first accumulator located between the unwinding assembly and the beginning of the treatment line and a second accumulator located between the end of the treatment line and winding assembly are provided. When it is necessary to introduce a new coil on the unwinding shaft or to unload a complete coil from the winding shaft, the accumulators release or accumulate the strip contained therein until reaching their nearly complete emptying or filling. The time needed for the filling or the emptying of the accumulator is used for the coil load and unload operations without stopping or varying the velocity of the process part of the line comprised between the two accumulators.

[0004] In order to ensure a constant velocity operation of the treatment line, the accumulators have to be dimensioned so as to accumulate or release the amount of strip which is processed during the time needed for coil load and unload operations.

[0005] Just to fix the ideas, let's consider a coating line for metal strips working at a constant velocity of 140 m/min. Normally, the coil load and unload operations on the unwinding and winding shafts, including the accessory operations, require about two minutes. In order to ensure an operation at constant velocity of the treatment line during the coils load and unload operations, the accumulators serving the unwinding and winding shafts have to be dimensioned to contain therein at least $140 \text{ m/min} \times 2 \text{ min} = 280 \text{ meters}$ of strip.

[0006] In order to give an order of magnitude of the dimensions here involved, an accumulator containing a strip with a length of at least 280 meters (with a width of 1,5 meters) has a structure of metal carpentry which has more or less the following dimensions: height 18 meters,

width 10 meters, depth 3,5 meters. The weight of this structure, without considering the motors, may be estimated in 110 tons.

[0007] Very often, when new process lines are designed or works of modernization and enhancement of the existing lines are executed, the dimensions and the space required by the accumulators become a constraint in the design of the line layout, of the building containing the line and of the technological foundations of the line.

[0008] The time needed for the coils load and unload operations is a problem also in rolling mill trains which are not served by input and output accumulators. In these cases, the coils load and unload operations necessarily require the stop of the rolling process, with a considerable loss of productivity.

Summary of the invention

[0009] The object of the present invention is to provide a winding/unwinding assembly for metal strips allowing to overcome the problems of the prior art.

[0010] According to the present invention, this object is achieved by a winding/unwinding assembly having the features forming the subject of claim 1.

[0011] The present invention provides a first and a second driven shaft, rotating around respective axes parallel to each other and a mobile table carrying said shafts and movable between a first and a second operative position along a direction orthogonal with respect to the axes of rotation of said shafts. In the first operative position of the mobile table, the first shaft is located in a wind/unwind starting station and the second shaft is located in a first working station. In the second operative position of the mobile table, the first shaft is located in a second working station and the second shaft is located in the wind/unwind starting station.

[0012] As it will be evident in the course of the detailed description which follows, this solution allows performing the coil load and unload operations without stops or interruptions of the treatment lines.

[0013] If the solution according to the present invention is applied to the winding assembly of a continuous treatment line, the installation of an accumulator at the end of the continuous process line is avoided.

[0014] If, instead, the invention is applied to unwinding and winding shafts of "stand-alone" rolling mills the machine stop times for the coil load and unload operations are considerably reduced, with a corresponding increment of productivity. In this case an improvement of the quality is also obtained because by limiting the machine stop time the lack of thermal profile (thermal crown) required by the working rollers during the rolling mill process is also limited.

Description of the drawings

[0015] The present invention will now be described in detail with reference to the attached drawings, given by

way of non limiting example, in which:

- figures 1 and 2 are schematic lateral views illustrating a winding assembly according to the present invention in two working positions,
- figures 3 and 4 are plan views corresponding to figures 1 and 2,
- figures 5 and 6 are schematic lateral views of an unwinding assembly according to the present invention in two working positions, and
- figures 7 and 8 are plan views corresponding to figures 5 and 6.

[0016] With reference to figures 1 to 4, the numeral reference 10 indicates a winding assembly adapted to form coils of a metal strip 12 advancing in the direction indicated by the arrow 14.

[0017] The winding assembly 10 comprises a stationary base 16 on which a mobile table 18 is mounted. The mobile table 18 carries a first driven shaft 20 and a second driven shaft 22. The two shafts 20, 22 are rotatably mounted around respective axes 24, 26 parallel to each other. The mobile table 18 is movable along a direction orthogonal with respect to the axes 24, 26.

[0018] In the illustrated example, the axes 24, 26 are horizontal and the table 18 is movable along a rectilinear horizontal direction.

[0019] Each of the shafts 20, 22 is actuated by a respective electric motor 28, 30. Preferably, the electric motors 28, 30 are coupled to the respective shafts 20, 22 by respective reducers 32, 34. The motor-reducer assemblies 28, 32 are fixed to the mobile table 18.

[0020] The winding assembly 10 comprises a wind starting station 36, a first working station 38 and a second working station 40. The stations 36, 38, 40 are in positions fixed with respect to the stationary base 16. The first and the second working stations 38, 40 are located on opposite sides with respect to the wind starting station 36. The mobile table 18 is movable with respect to the stationary base 16 between a first working position shown in figures 1 and 3 and a second working position shown in figures 2 and 4. In the first working position, the first shaft 20 is located in the wind starting station 36 and the second shaft 22 is located in the first working station 38. In the second working position, the first shaft 20 is located in the second working station 40 and the second shaft 22 is positioned in the wind starting station 36.

[0021] The movement of the mobile table 18 is controlled by actuator means of a conventional type (not shown), for example by an hydraulic cylinder. The position of the translating table 18 can be controlled by a position transducer, for example installed on the stem of the control cylinder. The supply of the control oil to the cylinder can be controlled by a proportional valve connected in closed-loop to the position transducer, by which it is possible to control the law of movement of the table.

[0022] Each of the stations 36, 38, 40 comprises a respective tramway 42, 44, 46 (figures 3 and 4). The tram-

ways 42, 44, 46 are parallel to each other and they extend orthogonally with respect to the direction of movement of the mobile table 18. Each of the tramways 42, 44, 46 is preferably made up of two rails fixed to the ground. On the first tramway 42 there is mounted a bogie carrying a belt wrapper 48, movable along the tramway 42 between an operative position and an inoperative position. In the operative position, the belt wrapper 48 partially surrounds the shaft 20, 22 which in each turn is positioned in the wind starting station 36. In the inoperative position, the belt wrapper 48 is in a position remote from the winding station 36 and it does not interfere with the shaft 20, 22 positioned in the wind starting station 36.

[0023] On the second and on the third tramway 44, 46 there are mounted respective coil cars 50, 52 for the removal of the complete coils from the working stations 38, 40.

[0024] With reference to figures 1 and 2, the winding assembly 10 comprises a coil guiding device 54. Such a device comprises two belt conveyors 56 holding the strip therebetween and moving at the same velocity as the strip in the direction 14. Upstream of the belt conveyors 56 there is located a flying shear 58 adapted to perform a transversal cut of the strip 12 without stopping or slowing the movement of the strip 12 in the direction of movement 14. Downstream of the belt conveyors 56, there is provided a group of deflector rolls 60 which modify the direction of movement the strip 12. Downstream of the deflector rolls 60 there is located a guiding table 62 at the end of which there is located a pass-line roll 64. The guiding device 54 is in a fixed position and the pass-line roll 64 is located in correspondence with the wind starting station 36. Preferably, the bogie carrying the belt wrapper 48 also carries a retaining wall 66 facing the guide wall 62 when the belt wrapper 48 is located in the wind starting station 36. The retaining wall 66 extends between the pass-line roll 64 and the external surface of the shaft 20, 22 which in each turn is located in the wind starting station 36.

[0025] The operation of the winding assembly 10 previously described is the following.

[0026] In the configuration shown in figures 1 and 2 the strip 12 proceeds at constant velocity in the direction indicated by the arrow 14, goes through the guiding device 54 and is wound in a coil 70 which is currently formed on the shaft 22 located in the first working station 38. While the coil 70 is formed on the second shaft 22, the first shaft 20 is located in the wind starting station 36. When the coil 70 is completed, the shear 58 cuts the strip 12 in transversal direction. While the tail of the strip is wound on the coil 70, the head of the strip 12 is guided between the walls 62, 66 and is directed to the first shaft 20. The leading end of the strip is inserted between the belt wrapper 48 and the external surface of the shaft 20. After the winding of some turns on the shaft 20, the belt wrapper 48 is moved to an inoperative position. While the winding of a new coil on the first shaft 20 begins in the wind starting station 36, the complete coil 70 in the

first working station 38 is removed by the coil car 50. After the removal of the complete coil 70, the mobile table 18 moves to its second operative position shown in figures 2 and 4. In this position, the formation of a new coil 72 on the first driven shaft 20 is completed, while the second driven shaft 22 is located in the wind starting station 36. While the second coil 72 is formed on the shaft 20 in the second working station 40, the belt wrapper 48 is positioned on the second shaft 22 in the wind starting station 36. When the second coil 72 has been completed, the strip 12 is cut and the formation of a further coil on the shaft 22 begins. The coil car 52 removes the complete coil 72 from the second working station 40. After the removal of the second coil 72 from the second working station 40, the mobile table 18 moves back to the first operative position shown in figures 1 and 2 and the cycle restarts as previously described.

[0027] The removal of the complete coils and the preparation of the shaft for the wind starting are performed while a coil is being wound on the other shaft. As a consequence, it is not necessary either to stop or to slow the movement of the strip 12 during the operations of coil change. When the cut of the strip 12 is performed, there is a shaft already set to start the winding on the wind starting station 36.

[0028] In figures 5 to 8 there is indicated by 110 an unwinding assembly for unwinding metal strips 112 from coils. The unwinding assembly 110 comprises a stationary base 116 and a mobile table 118. The mobile table carries a first driven shaft 120 and a second driven shaft 122 in a way similar to what previously described with reference to the winding assembly 10. In a way similar to what previously described, the driven shafts 120, 122 are rotatably mounted around respective axes 124, 126 parallel to each other and are actuated by respective motors 128, 130 via respective reducers 132, 134. As in the case of the winding device, the mobile table 118 is movable along a direction orthogonal with respect to the axes 124, 126 between a first operative position shown in figures 5 and 7 and a second operative position shown in figures 6 and 8.

[0029] The unwinding assembly 110 comprises an unwind starting station 136, a first working station 138 and a second working station 140. The working stations 138 and 140 are located on opposite sides with respect to the unwind starting station 136. Each station 136, 138, 140 comprises a respective tramway 142, 144, 146 preferably made up of a pair of rails. The tramways 142, 144, 146 are orthogonal with respect to the direction of movement of the mobile table 118.

[0030] As in the case of the winding assembly previously described, in the first operative position, the first shaft 120 is located in the unwind starting station 136 and the second shaft 122 is located in the first working station 138 (figures 5 and 7). In the second operative position, the first shaft 120 is located in the second working station 140 and the second shaft 122 is located in the unwind starting station 136 (figures 6 and 8).

[0031] On the tramway 142 associated to the unwind starting station 136 there is mounted a coil car 148 adapted to perform the loading of a new coil on the shaft 120, 122 which in each turn is in the unwind starting station 136. On the tramway 144 associated to the first working station 148 there is mounted a coil car 150 adapted to perform the unloading of the spool of a finished coil from the shaft 122 which is in the first working station 148. On the tramway 146 associated to the second working station 140 there is mounted a coil car 152 having a device 154 adapted to perform the detachment of the leading edge of the strip from the external surface of the coil which in each turn is located in the unwind starting station 136. The coil car 152 is also provided with a support 156 adapted to perform the removal of the empty spool on the shaft 120 located in the second working station 140.

[0032] With reference to figures 7 and 8, the first and the second working station 138, 140 can be provided with auxiliary supports 158, 160 adapted to bear the free ends of the shafts 120, 122. The supports 158, 160 are fixed to the ground and each of them is movable between an inoperative position allowing the passage of the coil cars 150, 152 on the tramways 144, 146 and an operative position in which each support 158, 160 is connected to the free end of the respective shaft 120, 122. Such auxiliary supports 158, 160 might also be provided in the winding assembly previously described.

[0033] The operation of the unwinding assembly 110 is the following.

[0034] Figures 6 and 8 show an operative condition in which the strip 112 is unwinding from a nearly finished coil carried by the first shaft 120 located in the second working station 140. The second shaft 122 is in the unwind starting station 136 and a new coil 170 is located on the shaft 122. The device 154 is in the operative position and performs the detachment of the leading edge of the strip from the coil 170. The strip being unwound 112 is deflected by a pass-line roll 160. The device 154 guides the leading stretch of the strip coming from the coil 170 towards the pass-line roll 160. When the coil carried by the shaft 120 is finished, the unwinding of the strip from the coil 170 in the unwind starting station 136 begins. When the unwinding of the strip from the coil 170 has begun, the spool of the finished coil located in the second working station 140 is removed by the coil car 152.

[0035] Subsequently, the table 116 moves to the first operative position (figures 5 and 7) in which the first shaft 120 is located in the unwind starting station 136 and the second shaft 122 is located in the first working station 138. While the coil 170 located in the first working station 138 unwinds, a new coil 172 is loaded by the coil car 148 on the shaft 120 which is in the unwind starting station 136. The device 154 performs the detachment of the leading stretch of the strip and prepares the coil 172 for the unwinding. When the coil 170 finishes, the unwinding of the new coil 172 in the unwind starting station 136 begins. The spool of the finished coil 170 is removed by

the coil car 150. Subsequently, the mobile table 116 moves back to the second working position shown in figures 6 and 7 and the cycle restarts as previously described.

[0036] The solution according to the present invention allows arranging a new coil for the unwinding of the strip while a previous coil is being unwound. Thus, the time necessary to prepare a new coil does not entail an interruption of the strip supply.

Claims

1. Winding/unwinding assembly for metal strips in coils, **characterised in that** it comprises:

- a first and a second driven shaft (20, 22; 120, 122), rotatably mounted around respective axes (24, 26; 124, 126) parallel to each other,
- a mobile table (18, 118) carrying said shafts (20, 22; 120, 122) and movable between a first and a second working position along a direction orthogonal with respect to the axes of rotation (24, 26; 124, 126) of said shafts (20, 22; 120, 122),
- a wind/unwind starting station (36; 136), and
- a first and a second working station (38, 40; 138, 140), located on opposite sides with respect to said wind/unwind starting station (36; 136),

wherein in the first working position of said mobile table (18; 118) the first driven shaft (20 ; 120) is located in the wind/unwind starting station (36; 136) and the second driven shaft (22; 122) is located in the first working station (38; 138) and in which in the second working position of the mobile table (18; 118) the first shaft (20; 120) is located in the second working station and the second shaft (22; 122) is located in the wind/unwind starting station (36; 136).

2. Winding/unwinding assembly according to claim 1, **characterised in that** each of said stations (36, 38, 40; 136, 138, 140) is associated to a respective tramway (42, 44, 46; 142, 144, 146), said tramways being orthogonal with respect to the direction of movement of said mobile table (18; 118).

3. Winding assembly according to claim 2, **characterised in that** on the tramway (42) associated to the wind starting station (36) there is mounted a bogie carrying a belt wrapper (48) cooperating with a shaft (20, 22) which in each turn is located in the wind starting station (36).

4. Winding assembly according to claim 2, **characterised in that** it comprises coil cars (50, 52) mounted on tramways (44, 46) associated to the first and the

second working station (38, 40).

5. Winding assembly according to any of the preceding claims, **characterised in that** it comprises a strip guiding device (54) comprising two belt conveyors (56) mutually facing each other, a strip guiding table (62) located downstream of said belt conveyors (56), a flying shear (58) located upstream of said belt conveyors (56), and a pass-line roll (64) located in correspondence with said wind starting station (36).

6. Unwinding assembly according to claim 2, **characterised in that** it comprises a coil car (148) mounted on the tramway (142) associated to the unwind starting station (136), said coil car (148) being adapted to perform the loading of coils (170, 172) on the shaft (120, 122) which in each turn is located in the unwind starting station (136).

7. Unwinding assembly according to claim 2, **characterised in that** it comprises a coil car (150) for the unloading of spools mounted on the tramway (144) associated to one of said working stations (138, 140).

8. Unwinding assembly according to claim 2, **characterised in that** it comprises a coil car (152) including a device (154) for the detachment of the leading edge of a coil mounted on the tramway (146) associated to one of said working stations (138, 140).

9. Unwinding assembly according to claim 8, **characterised in that** said coil car (152) further includes a support (156) for the removal of spools.

10. Winding/unwinding assembly according to any of the preceding claims, **characterised in that** it comprises auxiliary supports (158, 160) adapted to support the free ends of said shafts (120, 122) and located in correspondence with said first and second working stations (138, 140).

FIG. 1

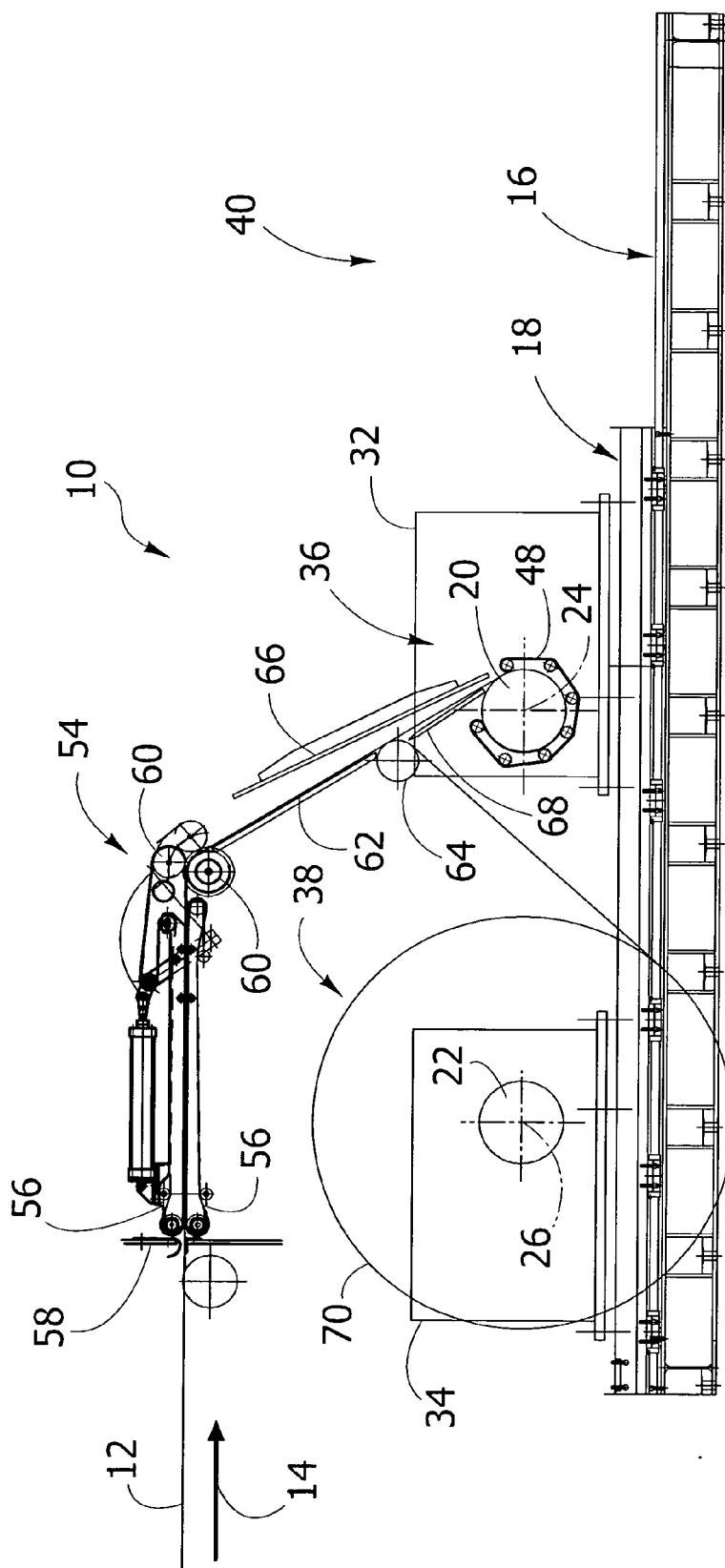


FIG. 2

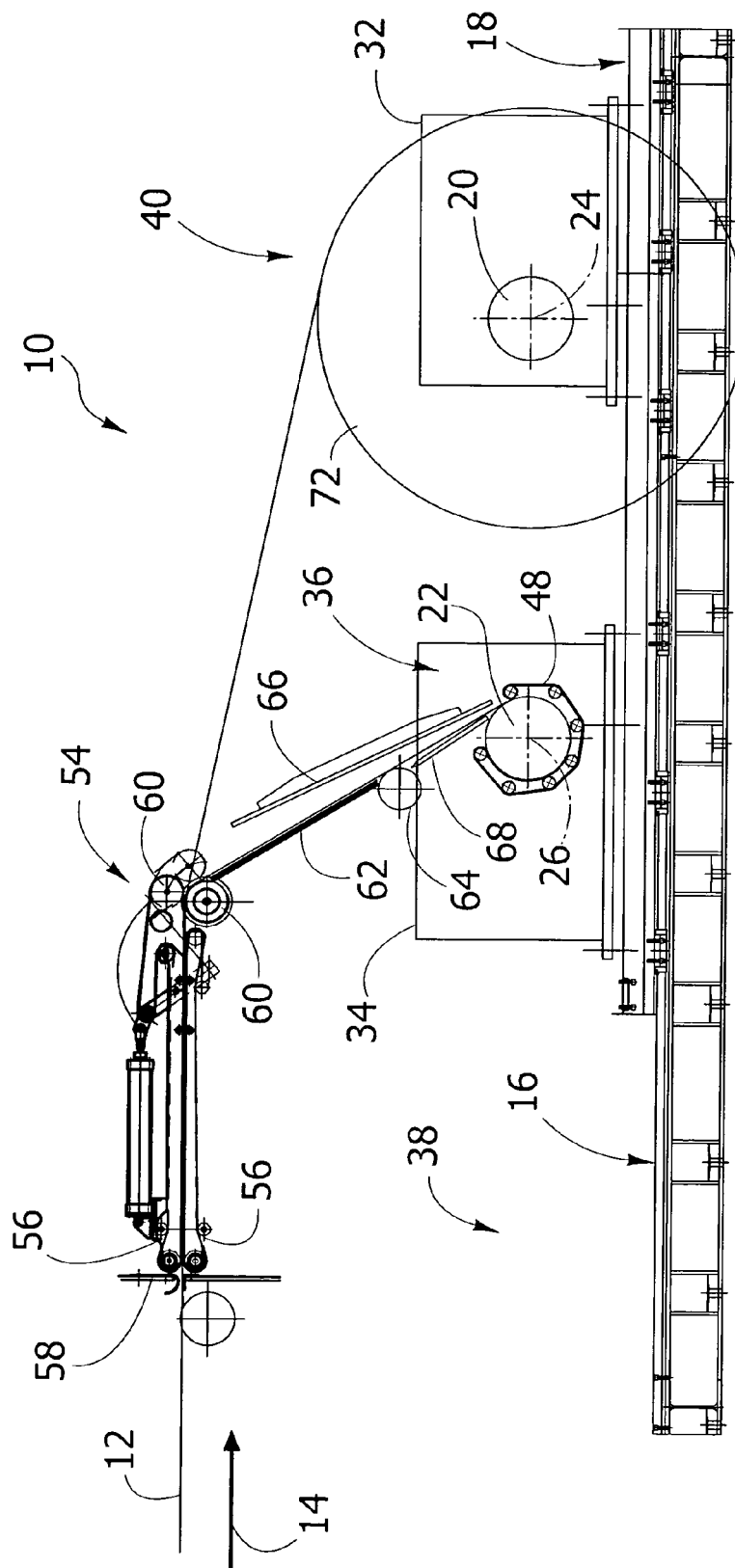


FIG. 3

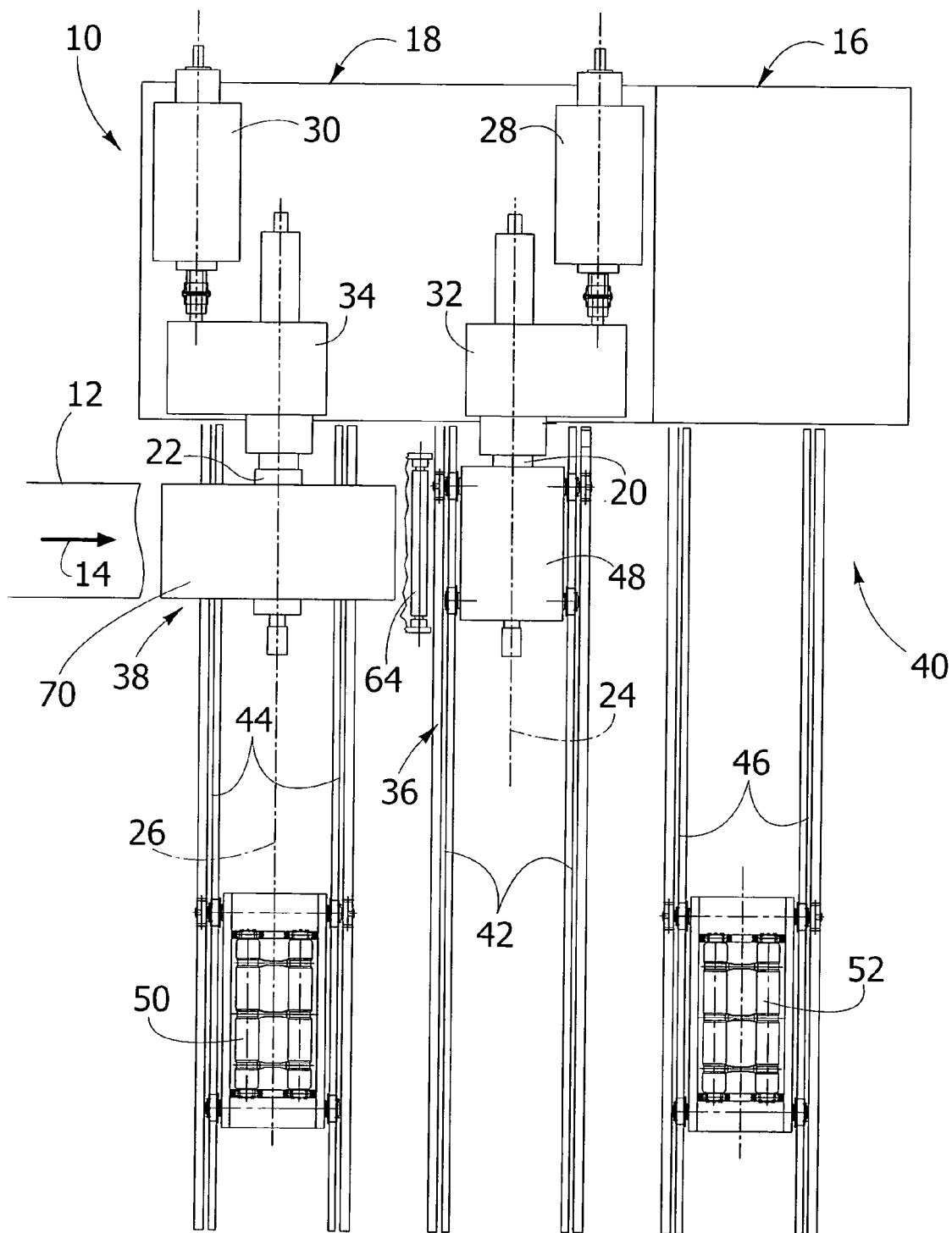


FIG. 4

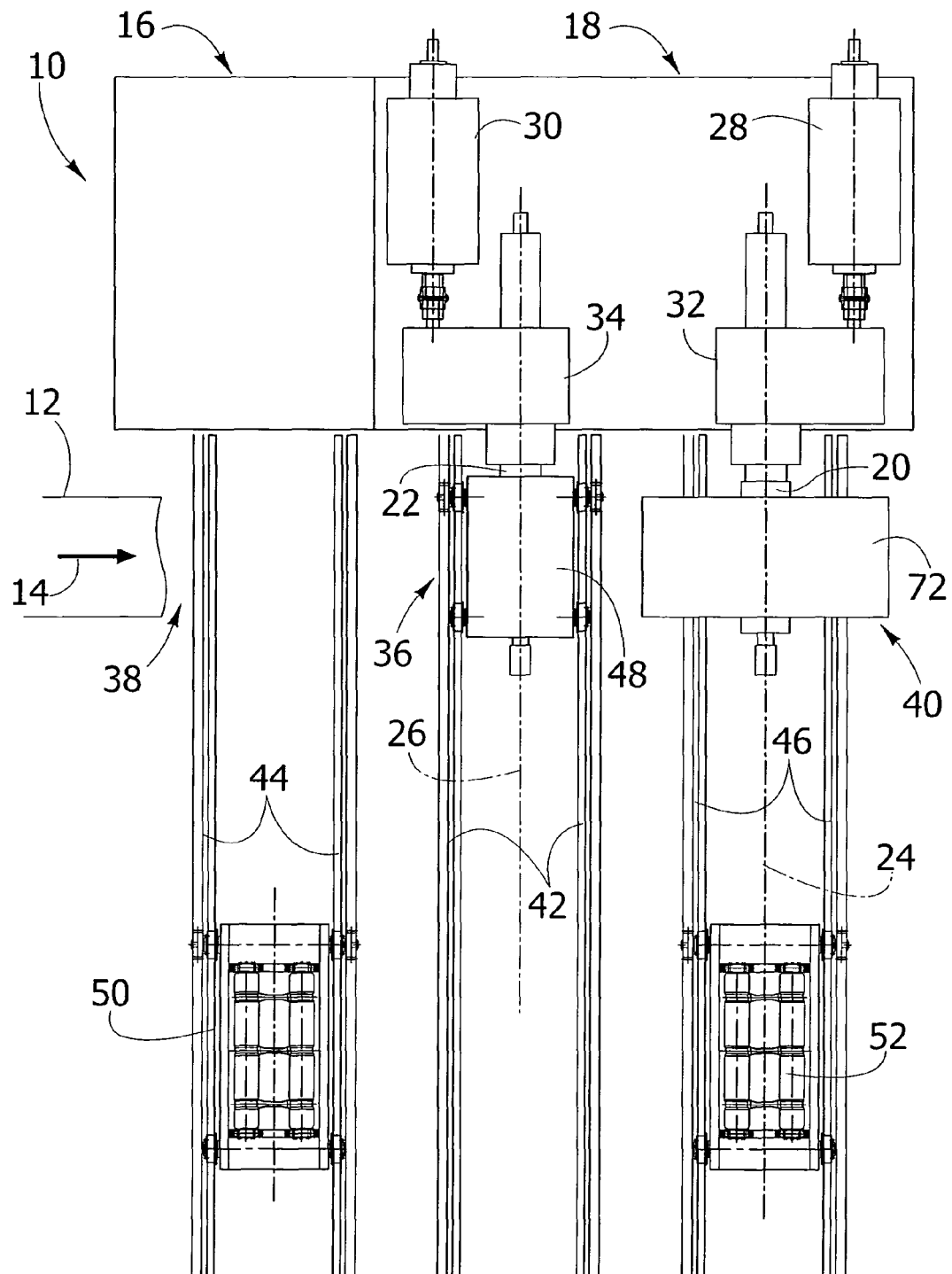


FIG. 5

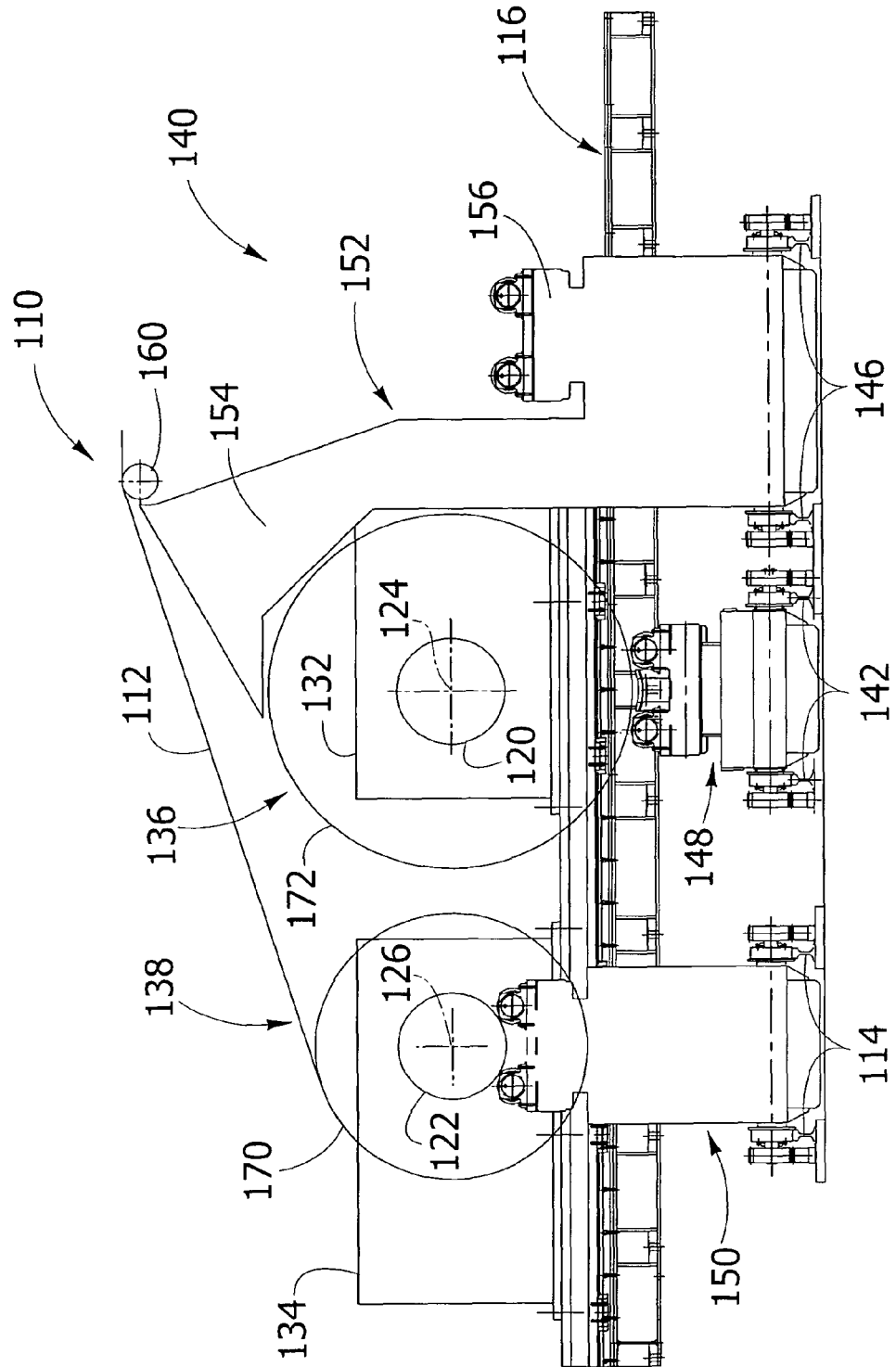


FIG. 6

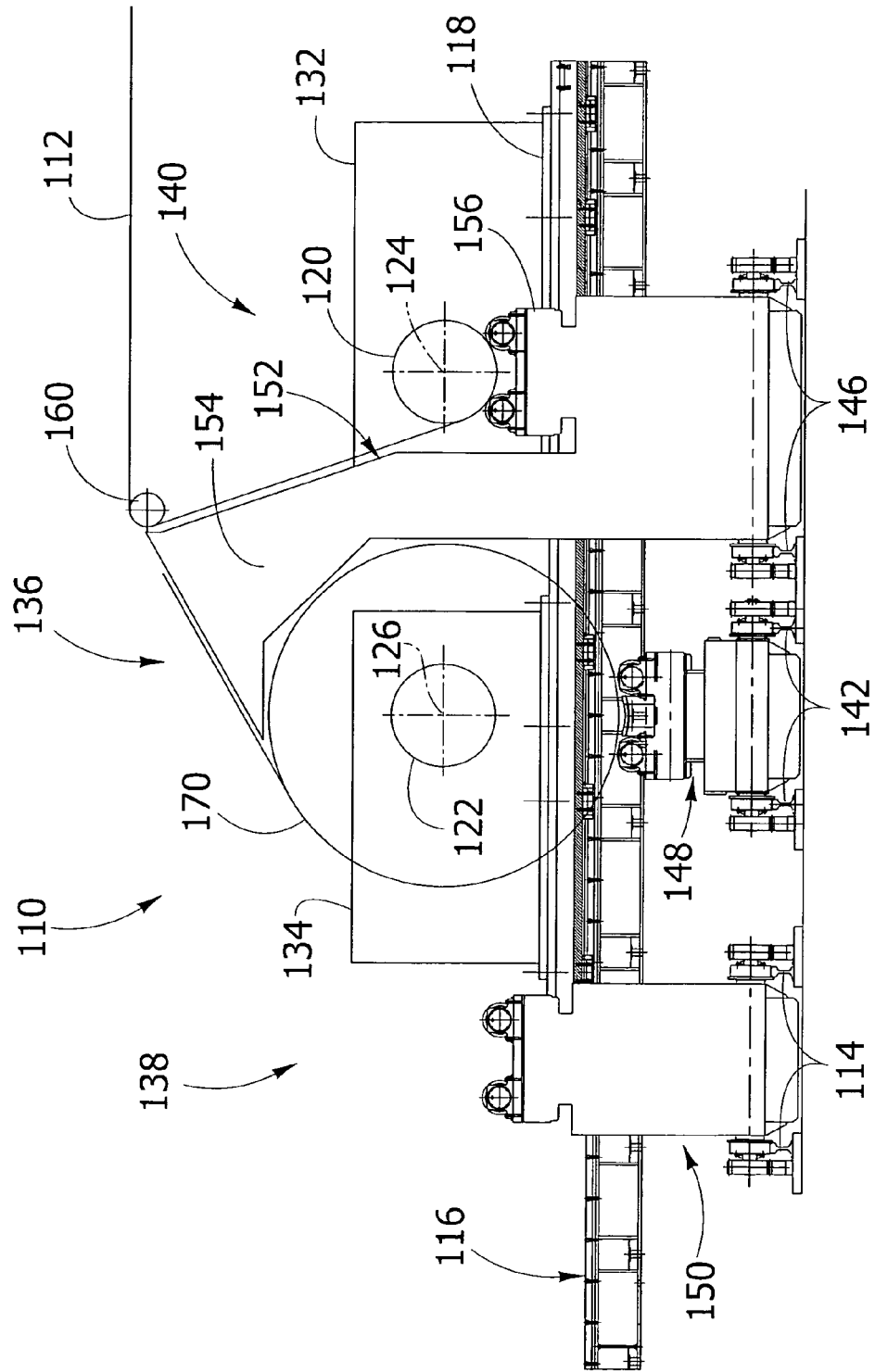


FIG. 7

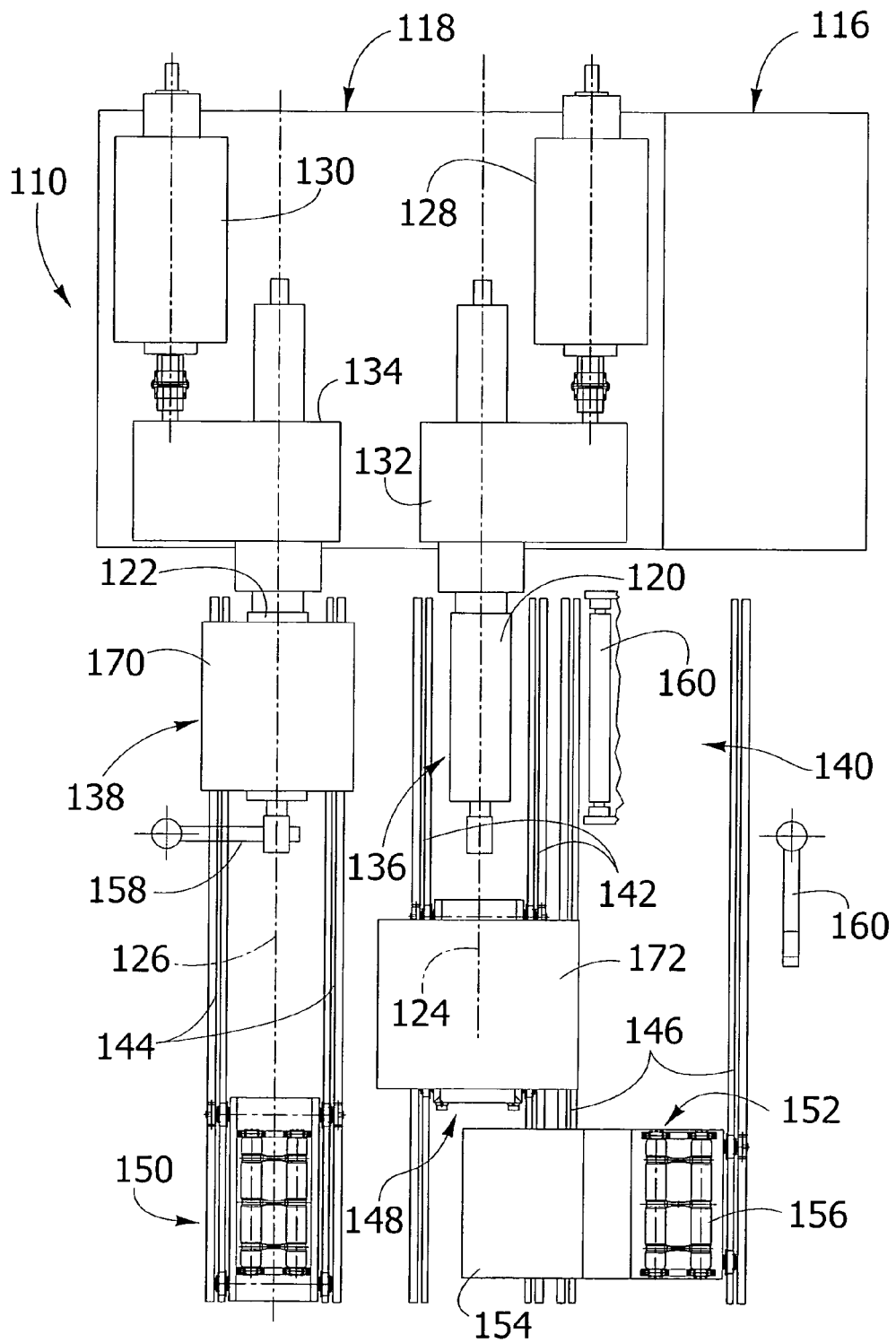
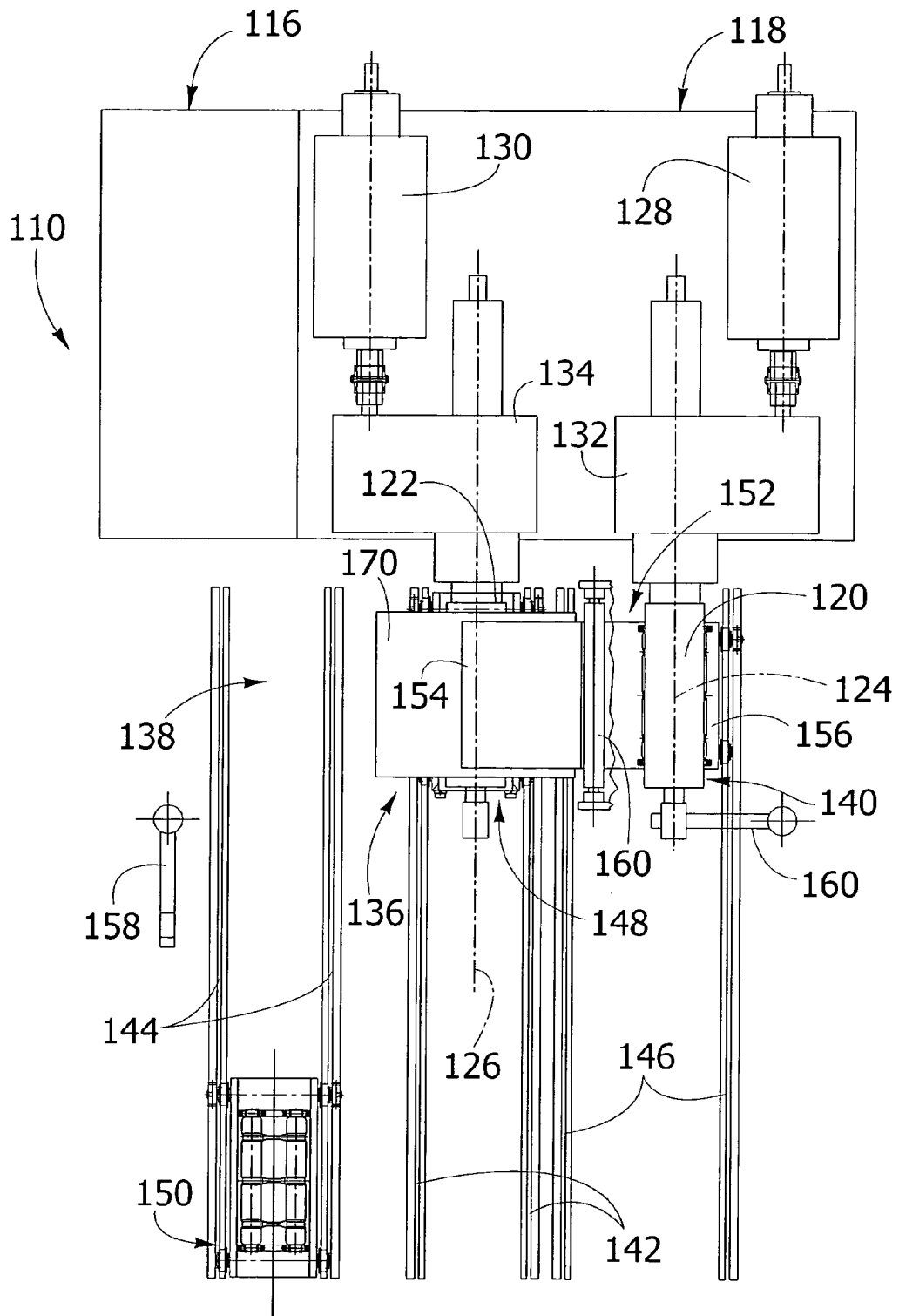


FIG. 8





EUROPEAN SEARCH REPORT

Application Number
EP 08 42 5777

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Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
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A	* column 2, line 4 - column 6, line 41; figures 1-4 *	2,3,6	B21C47/06 B21C47/24 B65H19/22
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The present search report has been drawn up for all claims			
Place of search Munich		Date of completion of the search 8 May 2009	Examiner Ritter, Florian
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document		T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document	

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EPO FORM 1503 03/02 (P04C01)

**ANNEX TO THE EUROPEAN SEARCH REPORT
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EP 08 42 5777

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
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08-05-2009

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