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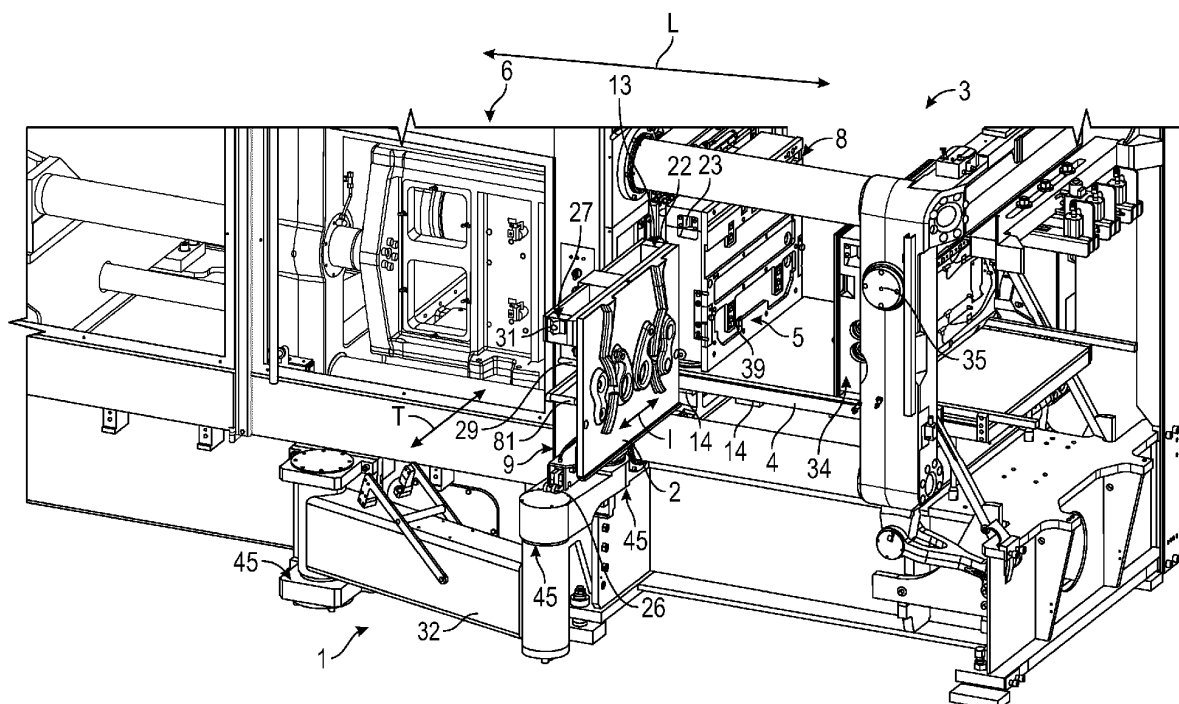
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(54) **PATTERN PLATE CHANGER FOR CHANGING PATTERN PLATES OF A SAND MOULDING MACHINE**

(57) The pattern plate changer (1) includes a movable pattern plate carrier (9). When a changer track of the movable pattern plate carrier is aligned with a pressing plate track (8) of a pressing plate (5), a pattern plate (2) may be transferred between a sand moulding machine (3) and the pattern plate changer by displacement of the pattern plate. The movable pattern plate carrier has a first pattern plate locking element adapted to lock the

pattern plate and a first carrier locking element adapted to interlock the movable pattern plate carrier and the sand moulding machine. The first carrier locking element is adapted to interact with the first pattern plate locking element in such a way that, when the first carrier locking element is in its unlocked position, the first pattern plate locking element is prevented from moving from its locked position to its unlocked position.



**FIG. 1**

## Description

**[0001]** The present invention relates to a pattern plate changer for changing pattern plates of a sand moulding machine, the sand moulding machine including a fixed frame and at least one pressing plate being adapted to carry a pattern plate and being displaceable in a longitudinal direction of a moulding chamber in order to compact sand fed into the moulding chamber, each pattern plate having an upper rail adapted to carry the pattern plate during pattern plate changing by moving in a transverse direction of the moulding chamber along a pressing plate track of the at least one pressing plate, the pattern plate changer including a movable pattern plate carrier being provided with a changer track along which the upper rail of the pattern plate may move and thereby carry the pattern plate during pattern plate changing, and wherein, when the changer track of the movable pattern plate carrier is aligned with the pressing plate track of the at least one pressing plate, the pattern plate may be transferred between the sand moulding machine and the pattern plate changer by displacement of the pattern plate in a longitudinal direction thereof.

**[0002]** Pattern plate changers of such type, however adapted for automatic operation, are well-known. Thereby, the movable pattern plate carrier is arranged automatically displaceable in different directions and all the movements of the movable pattern plate carrier are computer-controlled. However, such pattern plate changers are complex and take up relatively large space.

**[0003]** In order to provide a simpler and cost effective pattern plate changer of the above discussed type, the pattern plate changer may be adapted for manual operation. However, in this case, various safety issues must be taken into account, in order to provide a fail-safe solution.

**[0004]** The object of the present invention is to provide a pattern plate changer being suitable for manual operation in an easy and safe way.

**[0005]** In view of this object, the movable pattern plate carrier is provided with a first pattern plate locking element being movable between a locked position in which the first pattern plate locking element may engage the pattern plate and thereby prevent displacement of the pattern plate in relation to the movable pattern plate carrier in at least a first direction along the changer track and an unlocked position in which the pattern plate is freely displaceable in said at least first direction, the movable pattern plate carrier is provided with a first carrier locking element being arranged at a first end of the movable pattern plate carrier and being movable between a locked position in which the movable pattern plate carrier may be interlocked with a locking block on the fixed frame of the sand moulding machine, thereby preventing movement of the movable pattern plate carrier in relation to the fixed frame of the sand moulding machine, and an unlocked position in which the movable pattern plate carrier may be movable in relation to the fixed frame of the

sand moulding machine, and the first carrier locking element is adapted to interact with the first pattern plate locking element in such a way that, when the first carrier locking element is in its unlocked position, the first pattern plate locking element is prevented from moving from its locked position to its unlocked position.

**[0006]** In this way, by locking the movable pattern plate carrier to the sand moulding machine during pattern plate changing, and by automatically locking the pattern plate in place on the movable pattern plate carrier when the movable pattern plate carrier is not locked to the sand moulding machine, safe and easy manual handling may be ensured both when transferring the pattern plate between the sand moulding machine and the pattern plate changer as well as when moving the pattern plate, by means of the pattern plate changer, between the sand moulding machine and a jig or other storing solution.

**[0007]** In an embodiment, a front part of the first carrier locking element and a corresponding front side of the locking block have mutually interacting surfaces adapted to slide on each other, when the movable pattern plate carrier of the pattern plate changer is displaced towards the sand moulding machine horizontally in a transverse direction of the moulding chamber, in such a way that the first carrier locking element is urged away from its unlocked position. Thereby, it may be possible to automatically interlock the pattern plate carrier of the pattern plate changer and the sand moulding machine simply by moving the pattern plate carrier towards the sand moulding machine.

**[0008]** In an embodiment, the locking block forms part of the pattern plate changer and is adapted to be mounted fixedly on the fixed frame of the sand moulding machine at a pattern plate changing position of the at least one pressing plate, and the first carrier locking element is provided with a gripper adapted to grip behind the locking block in the locked position of the first carrier locking element. Thereby, it may be ensured that the pattern plate carrier of the pattern plate changer and the sand moulding machine can only be interlocked at a pattern plate changing position.

**[0009]** In an embodiment, the locking block is adapted to be arranged so that it has a limited extension in the longitudinal direction of the moulding chamber, thereby defining a limited gripping zone within which the gripper may grip behind the locking block. Thereby, it may further be ensured that the pattern plate carrier of the pattern plate changer and the sand moulding machine can only be interlocked within the limited gripping zone at a pattern plate changing position.

**[0010]** In an embodiment, in an operational position of the pattern plate changer, in the unlocked position of first the carrier locking element, the gripper is at a first vertical position, , in the locked position of the first carrier locking element, the gripper is at a second vertical position, and the first carrier locking element is biased from its locked position to its unlocked position. Thereby, when the gripper is not engaged with the locking block, the first carrier

locking element may move to its unlocked position.

**[0011]** In a structurally particularly advantageous embodiment, the first carrier locking element is adapted to perform a locking operation, when the pattern plate carrier of the pattern plate changer is displaced towards the sand moulding machine horizontally in a transverse direction of the moulding chamber, by moving the gripper from its first vertical position, past its second vertical position to a third vertical position, in which the gripper may pass under or over the locking block, and back to its second vertical position, the gripper may grip behind the locking block.

**[0012]** In an embodiment, the movable pattern plate carrier is provided with a first carrier alignment element arranged at the first end of the movable pattern plate carrier and includes a corresponding pressing plate alignment element adapted to be arranged on the at least one pressing plate, and the first carrier alignment element and the pressing plate alignment element are adapted to mutually engage each other in order to align the position of the movable pattern plate carrier in relation to the position of the pressing plate in the longitudinal direction of the moulding chamber so that the changer track of the pattern plate carrier is aligned with the pressing plate track of the pressing plate. Thereby, the changer track of the pattern plate carrier may manually be aligned with the pressing plate track of the pressing plate in an easy and accurate way.

**[0013]** In an embodiment, the first carrier alignment element and the pressing plate alignment element have mutually corresponding wedge forms fitting into each other.

**[0014]** In an embodiment, the first carrier alignment element is pivotally arranged about an axis extending at least substantially in parallel with the changer track of the movable pattern plate carrier and/or the pressing plate alignment element is adapted to be pivotally arranged on the at least one pressing plate about an axis extending at least substantially in parallel with the pressing plate track of the pressing plate. Thereby, accurate alignment of the changer track of the pattern plate carrier and the pressing plate track of the pressing plate may be possible even though the movable pattern plate carrier may be tilted slightly in relation to a vertical direction as a result of carrying a heavy pattern plate.

**[0015]** In an embodiment, the at least one pressing plate is included by the pattern plate changer, the first carrier alignment element and the pressing plate alignment element are adapted in such a way and arranged in such a way on the movable pattern plate carrier and the at least one pressing plate, respectively, that, when the gripper is positioned within the limited gripping zone and when the position of the movable pattern plate carrier in relation to the pressing plate is not aligned for mutual engagement between the first carrier alignment element and the pressing plate alignment element, the movable pattern plate carrier is maintained at such a distance in the transverse direction of the moulding chamber from

the pressing plate that the gripper of the first carrier locking element is not able to grip behind the locking block. Thereby, it may be ensured that, although the gripper is positioned within the limited gripping zone, the first carrier alignment element has to be engaged with the pressing plate alignment element in order to release the pattern plate from the pattern plate changer. This is due to the fact that the pattern plate may not be released if the gripper of the first carrier locking element is not able to grip behind the locking block and thereby move and/or hold the first carrier locking element away from its unlocked position. By this arrangement, it may be prevented that the pattern plate falls off the movable pattern plate carrier in error.

**[0016]** In an embodiment, the movable pattern plate carrier is provided with a second pattern plate locking element being movable between a locked position in which the second pattern plate locking element may engage the pattern plate and thereby prevent displacement of the pattern plate in relation to the movable pattern plate carrier in a second direction being opposite to the first direction along the changer track and an unlocked position in which the pattern plate is freely displaceable in said second direction, in that the movable pattern plate carrier is provided with a second carrier locking element being arranged at a second end of the movable pattern plate carrier and being movable between a locked position in which the movable pattern plate carrier may be interlocked with the locking block on the fixed frame of the sand moulding machine, thereby preventing movement of the movable pattern plate carrier in relation to the fixed frame of the sand moulding machine, and an unlocked position in which the movable pattern plate carrier may be movable in relation to the fixed frame of the sand moulding machine, and in that the second carrier locking element is adapted to interact with the second pattern plate locking element in such a way that, when the second carrier locking element is in its unlocked position, the second pattern plate locking element is prevented from moving from its locked position to its unlocked position. Thereby, the pattern plate changer may easily be used for changing pattern plates of for instance both a pressing plate and a swing plate of a vertical sand moulding machine. The pressing plate and the swing plate will be adapted for mounting of the respective pattern plates so that they face each other. By rotating the movable pattern plate carrier 180 degrees between pattern plate changing operations, the respective pattern plates of both the pressing plate and the swing plate may be changed from the same side of the sand moulding machine, because the movable pattern plate carrier has a carrier locking element and a corresponding pattern plate locking element at both its ends.

**[0017]** In an embodiment, the first and second pattern plate locking elements are mutually interconnected by means of a locking element connector preventing that both the first and second pattern plate locking elements take up their respective unlocked positions simultane-

ously. By this arrangement, it may be prevented that the pattern plate falls off the movable pattern plate carrier as a result of an operational error.

**[0018]** In an embodiment, the movable pattern plate carrier is provided with a first pivotal handle arranged at the second end of the movable pattern plate carrier, the first pivotal handle is coupled with the first pattern plate locking element in such a way that a pivotal movement of the first pivotal handle in a first direction moves the first pattern plate locking element from its locked position to its unlocked position, the first pivotal handle is coupled with the first carrier locking element in such a way that a pivotal movement of the first pivotal handle in a second direction moves the first carrier locking element away from its unlocked position, the movable pattern plate carrier is provided with a second pivotal handle arranged at the first end of the movable pattern plate carrier, the second pivotal handle is coupled with the second pattern plate locking element in such a way that a pivotal movement of the second pivotal handle in a first direction moves the second pattern plate locking element from its locked position to its unlocked position, the second pivotal handle is coupled with the second carrier locking element in such a way that a pivotal movement of the second pivotal handle in a second direction moves the second carrier locking element away from its unlocked position, and the movable pattern plate carrier is provided with a second carrier alignment element arranged at the second end of the movable pattern plate carrier and corresponding to the pressing plate alignment element. Thereby, by means of the pivotal handles, the respective carrier locking element may be moved away from their unlocked position, thereby facilitating the operation of interlocking the movable pattern plate carrier and the sand moulding machine or a jig on which the pattern plate may be stored. Furthermore, by means of the pivotal handles, the pattern plate may be released for performing a changing operation. However, because the respective handles can only be pivoted in one direction at a time, it may still be ensured that the pattern plate may not be released if the movable pattern plate carrier is not appropriately aligned and locked to a sand moulding machine or jig.

**[0019]** In an embodiment, the movable pattern plate carrier is arranged on a swingable arm, and the movable pattern plate carrier is arranged for rotating at least 180 degrees back and forth about a vertical axis in relation to the swingable arm.

**[0020]** The invention will now be explained in more detail below by means of examples of embodiments with reference to the very schematic drawing, in which

Fig. 1 is a perspective view of a pattern plate changer according to the present invention, carrying a pattern plate, and arranged at a sand moulding machine which is only shown in part;

Fig. 2 is a side view of a pressing plate and swing plate of the sand moulding machine of Fig. 1;

Fig. 3 illustrates the pattern plate changer of Fig. 1, carrying said pattern plate (illustrated as transparent), and being arranged next to the pressing plate of the sand moulding machine, before locking the pattern plate changer to the sand moulding machine, seen in a longitudinal direction of the sand moulding machine;

Fig. 4A is a perspective and partially sectional view illustrating a first pattern plate locking element of the pattern plate changer of Fig. 1, in a locked position of the first pattern plate locking element, and wherein the first pattern plate locking element is free to swing;

Fig. 4B is a view corresponding to that of Fig. 4A, wherein the first pattern plate locking element is in its locked position and is prevented from swinging;

Fig. 5 illustrates a detail of Fig. 3 on a larger scale;

Fig. 6 illustrates the detail of Fig. 5, wherein the pattern plate changer has been moved closer to a fixed frame of the sand moulding machine;

Fig. 7 illustrates the detail of Fig. 6, wherein the pattern plate changer has been moved even closer to the fixed frame of the sand moulding machine and has been locked to the fixed frame of the sand moulding machine;

Fig. 8 illustrates a second carrier alignment element of the pattern plate changer, seen in a transverse direction of the moulding chamber, obliquely from the left of Fig. 1, and wherein the pattern plate carried by the pattern plate changer is so heavy that the pattern plate is hanging somewhat oblique in relation to a vertical direction;

Fig. 9 illustrates a cross-sectional view through the second carrier alignment element illustrated in Fig. 8 and arranged at a second end of the movable pattern plate carrier;

Fig. 10 is a top view of a detail of the pattern plate changer and pressing plate of Fig. 1, before engagement between a first carrier alignment element of the pattern plate changer and a corresponding pressing plate alignment element of the pressing plate;

Fig. 11 is a top view corresponding to that of Fig. 10, in an engaged state of the first carrier alignment element of the pattern plate changer and the corresponding pressing plate alignment element of the pressing plate;

Fig. 12 is a view corresponding to that of Fig. 3, wherein the pattern plate changer has been locked to the fixed frame of the sand moulding machine,

and wherein a first pivotal handle of the pattern plate changer has been raised in order to release the pattern plate from the pattern plate changer;

Fig. 13 is a view corresponding to that of Fig. 12, wherein the pattern plate has been released and slightly moved to the right in the figure;

Fig. 14 is a view corresponding to that of Fig. 13, wherein the pattern plate has been moved slightly further to the right in the figure, and wherein the first pivotal handle has been lowered again;

Fig. 15 is a view corresponding to that of Fig. 14, wherein the pattern plate has been moved even further to the right in the figure, and wherein the first pattern plate locking element has been swung away from its locked position in which it was free to swing as illustrated in Fig. 4A;

Fig. 16 is a view corresponding to that of Fig. 15, wherein the pattern plate has been moved fully to the right in the figure to its mounted position on the pressing plate;

Fig. 17 is a perspective view of the pattern plate changer of Fig. 1, carrying a pattern plate, and arranged between the sand moulding machine and a jig;

Fig. 18 is a top view of the pattern plate changer and jig of Fig. 17;

Fig. 19 is a plan view of the pattern plate changer, a part of the sand moulding machine and the jig of Fig. 17, before locking the pattern plate changer to the jig, seen in the longitudinal direction of the sand moulding machine;

Fig. 20 illustrates a detail of Fig. 19 on a larger scale, and in an engaged state of the pattern plate changer and the jig;

Fig. 21 is a view corresponding to that of Fig. 19, but in the engaged state of the pattern plate changer and the jig; and

Fig. 22 is a view corresponding to that of Fig. 21, wherein the pattern plate has been partly transferred from the pattern plate changer to the jig.

**[0021]** In the following, generally, similar elements have been designated by the same reference numerals.

**[0022]** Fig. 1 shows a pattern plate changer 1 according to the present invention, arranged at a sand moulding machine 3 for changing pattern plates 2 of the sand moulding machine. The sand moulding machine includes a fixed frame 4 and a pressing plate 5 being adapted to

carry a pattern plate 2 and being displaceable in a longitudinal direction L of a moulding chamber 6 in order to compact sand fed into the moulding chamber. Furthermore, the sand moulding machine includes a swing plate 34 also being adapted to carry a pattern plate and being swingable about a horizontal swing axis 35 and displaceable in the longitudinal direction L of the moulding chamber 6 for compaction of sand in the moulding chamber in a manner known *per se*. The illustrated sand moulding machine is adapted to operate according to the vertical flaskless sand moulding technique such as the DISAMATIC (Registered Trademark) technique. However, the pattern plate changer 1 according to the present invention is equally applicable to sand moulding machines operating according to other sand moulding techniques.

**[0023]** The moulding chamber 6 of the illustrated sand moulding machine 3 is formed by a chamber top wall 36 as seen in Fig. 2, a chamber bottom wall 37, two opposed chamber side walls 38 of which only one is visible, as well as the pressing plate 5 and the swing plate 34 forming respective chamber end walls. The chamber top wall 36 is provided with a not shown sand filling opening, typically in the form of an elongated opening or a slot extending in the direction between the two opposed chamber side walls 38. The pattern plates 2 carried by the chamber end walls formed by the pressing plate 5 and the swing plate 34, respectively, are adapted to form patterns in sand mould parts formed by compaction of sand in the moulding chamber 6. The pressing plate 5 and the swing plate 34 typically also comprise respective heating plates arranged to heat the corresponding pattern plates 2. As illustrated in Fig. 3, locking of the pattern plates 2 on the pressing plate 5 and the swing plate 34 as seen in Fig. 2, respectively, is ensured by four pattern plate locks 39 arranged on the pressing plate 5 as well as four pattern plate locks (not shown) arranged on the swing plate 34. The pattern plate locks 39 are adapted to, in a manner well-known to the person skilled in the art, engage and clamp corresponding pattern plate screws 40 arranged on each pattern plate 2, whereby the pattern plates 2 are tightened to the pressing plate 5 and the swing plate 34, respectively. Accurate positioning of the pattern plates 2 on the respective pressing plate 5 and swing plate 34 may be ensured by means of guide pins 41 arranged on the pressing plate 5 and swing plate 34 and fitting in corresponding not shown guide bushings in the pattern plates 2. The use of guide pins for accurate positioning of pattern plates is well-known.

**[0024]** As seen for instance in Fig. 3, each pattern plate 2 has an upper rail 7 adapted to carry the pattern plate during pattern plate changing by moving in a transverse direction T (as indicated in Fig. 1) of the moulding chamber 6 along a pressing plate track 8 of the pressing plate 5. It is noted that, apart from in Fig. 1, the pattern plate 2 has, when visible, been illustrated as being transparent in order to show elements behind the pattern plate 2. In the illustrated embodiment, the pressing plate track 8 of the pressing plate 5 is formed by a row of rollers 42 adapt-

ed to roll on an underside of the upper rail 7 of the pattern plate 2. The underside of the upper rail 7 is provided with a number of rounded recesses 43 corresponding to the rollers 42 forming the pressing plate track 8 so that each roller 42 sits in a corresponding recess 43 when the pattern plate 2 is correctly positioned on the pressing plate 5 or the swing plate 34. Thereby, the pattern plate 2 may easily find its correct position on the pressing plate or swing plate when being displaced along the pressing plate track 8 or a corresponding not shown swing plate track. In the illustrated embodiment, the pressing plate track 8 is formed by four rollers 42 and corresponding recesses are formed in the underside of the upper rail 7 of the pattern plate 2. However, any suitable number of rollers 42 is possible. Furthermore, the pressing plate track 8 or a corresponding swing plate track does not need to be formed by rollers 42, it may just be formed by a rail or the like adapted to slide on the underside of the upper rail 7 of the pattern plate 2. Alternatively, the upper rail 7 of the pattern plate 2 could be formed by a row of rollers, and the pressing plate track 8 or a corresponding swing plate track could be formed by a corresponding rail or the like on which the rollers of the upper rail 7 could roll.

**[0025]** As seen for instance in Figs. 1 and 3, the pattern plate changer 1 includes a movable pattern plate carrier 9 being generally plate-formed and being provided with an upper changer track 10 along which the upper rail 7 of the pattern plate 2 may move and thereby carry the pattern plate during pattern plate changing. In the illustrated embodiment, the upper changer track 10 of the movable pattern plate carrier 9 is formed by a row of rollers 44 adapted to roll on an underside of the upper rail 7 of the pattern plate 2. The rounded recesses 43 in the underside of the upper rail 7 of the pattern plate 2 also correspond to the rollers 44 forming the upper changer track 10 of the movable pattern plate carrier 9 so that each roller 44 sits in a corresponding recess 43 when the pattern plate 2 is correctly positioned on the movable pattern plate carrier 9. Thereby, the pattern plate 2 may easily find its correct position on the movable pattern plate carrier 9 when being displaced along the upper changer track 10. In the illustrated embodiment, the upper changer track 10 is formed by four rollers 44 corresponding to the recesses in the underside of the upper rail 7 of the pattern plate 2, however, any suitable number of rollers 44 is possible. Furthermore, the upper changer track 10 does not need to be formed by rollers 44, it may just be formed by a rail or the like adapted to slide on the underside of the upper rail 7 of the pattern plate 2. Alternatively, the upper rail 7 of the pattern plate 2 could, as mentioned above, be formed by a row of rollers, and the upper changer track 10 could be formed by a corresponding rail or the like on which the rollers of the upper rail 7 could roll.

**[0026]** When the changer track 10 of the movable pattern plate carrier 9 is aligned with the pressing plate track 8 of the at least one pressing plate 5, the pattern plate 2

may be transferred between the sand moulding machine 3 and the pattern plate changer 1 by displacement of the pattern plate 2 in a longitudinal direction I thereof. The pattern plate 2 may typically be displaced manually, preferably by means of a simple hand held tool for gripping a screw or the like of the pattern plate. It is noted that in the illustrated embodiment, the alignment of the movable pattern plate carrier 9 with the pressing plate track 8 may be performed manually by moving the movable pattern plate carrier 9 by hand, by gripping a fixed handle 81, whereby joints 45 of a swingable arm 32 of the movable pattern plate changer 9 are rotated. However, of course, this procedure could also be automated in the form of a robotic arm. The movable pattern plate carrier 9 is arranged for rotating at least 180 degrees back and forth about a vertical axis 33 in relation to the swingable arm 32. In the illustrated embodiment, the swingable arm 32 is mounted on the fixed frame 4 of the sand moulding machine 3.

**[0027]** The movable pattern plate carrier 9 is provided with a first pattern plate locking element 11 being movable between a locked position seen for instance in Figs. 3 to 7 in which the first pattern plate locking element 11 engages the pattern plate 2 via a lower pattern plate screw 40 of the pattern plate 2 and thereby prevents displacement of the pattern plate in relation to the movable pattern plate carrier 9 in a first direction, i.e. a direction from the left to the right in Figs. 3 and 5 to 7, along the changer track 10, and an unlocked position seen for instance in Figs. 12, 13 and 15 in which the pattern plate 2 is freely displaceable in said first direction.

**[0028]** Furthermore, the movable pattern plate carrier 9 is provided with a first carrier locking element 12 being arranged at a first end 13 of the movable pattern plate carrier 9 and being movable between a locked position as best seen in Fig. 7 in which the movable pattern plate carrier 9 is interlocked with a locking block 14 on the fixed frame 4 of the sand moulding machine 3, thereby preventing movement of the movable pattern plate carrier 9 in relation to the fixed frame 4 of the sand moulding machine 3, and an unlocked position as best seen in Fig. 5 in which the movable pattern plate carrier 9 is movable in relation to the fixed frame 4 of the sand moulding machine 3.

**[0029]** The first carrier locking element 12 is adapted to interact with the first pattern plate locking element 11 in such a way that, when the first carrier locking element 12 is in its unlocked position, the first pattern plate locking element 11 is prevented from moving from its locked position to its unlocked position. In the illustrated embodiment, this is achieved in the following way.

**[0030]** Fig. 4A is a perspective view illustrating the first pattern plate locking element 11 in a sectional view. As seen for instance in Fig. 5, the first pattern plate locking element 11 is hook-formed and is arranged on a pivot pin 47 so that it is pivotal in the direction 48 from its locked position illustrated in Fig. 4A and 5, in which a hook part 53 of the first pattern plate locking element 11 grips about

the pattern plate screw 40 of the pattern plate 2, to its unlocked position illustrated in Figs. 12 and 13 in which the hook part does not grip about the pattern plate screw 40. As illustrated in Fig. 4B, the first pattern plate locking element 11 is fixed on the pivot pin 47, and the pivot pin 47 is pivotally journaled in the movable pattern plate carrier 9. Furthermore, a locking pin 46 arranged displaceable in a locking pin bore 52 of the movable pattern plate carrier 9 is by means of a compression spring 49 biased in a longitudinal direction thereof to engage a locking bore 50 extending transversely through the locking pin 46 to thereby prevent pivoting of the locking pin 46 in the locked position of first pattern plate locking element 11 as illustrated in Fig. 4B. In Fig. 4A, the locking pin 46 has been drawn against the bias of the compression spring 49 and out of the locking bore 50 by means of a shielded wire cable 51 of the type used as gear shift cables.

**[0031]** As seen in Figs. 4A and 4B, the first carrier locking element 12 of the movable pattern plate carrier 9 has in the illustrated embodiment the form of a lever being pivotal about a pivot pin 54 and having a hook end 55 and a back end 56. A first end 57 of the shielded wire cable 51 is connected to the locking pin 46 and a second end 58 of the shielded wire cable 51 is connected to the hook end of the lever forming the first carrier locking element 12. Thereby, when the first carrier locking element 12 is in its unlocked position illustrated in Fig. 5, the first pattern plate locking element 11 is prevented from moving from its locked position to its unlocked position by means of the locking pin 46 as shown in Fig. 4B, and when the first carrier locking element 12 is in its locked position illustrated in Fig. 7, the first pattern plate locking element 11 is, as shown in Fig. 4A, free to move from its locked position to its unlocked position.

**[0032]** As illustrated in Figs. 5 to 7, in an embodiment, a front part 15 of the first carrier locking element 12 and a corresponding front side 16 of the locking block 14 have mutually interacting surfaces 17, 18 adapted to slide on each other, when the movable pattern plate carrier 9 of the pattern plate changer 1 is displaced towards the sand moulding machine 3 horizontally in a transverse direction of the moulding chamber 6, in such a way that the first carrier locking element 12 is urged away from its unlocked position. As seen, in the illustrated embodiment, the mutually interacting surfaces 17, 18 are both oblique in the same direction from top left to lower right of the figure. The surface 17 of the front part 15 of the first carrier locking element 12 is also somewhat rounded at its top side. Thereby, it may be possible to automatically interlock the movable pattern plate carrier 9 of the pattern plate changer 1 and the sand moulding machine 3 simply by moving the pattern plate carrier towards the sand moulding machine.

**[0033]** In an embodiment, the locking block 14 forms part of the pattern plate changer 1 and is adapted to be mounted fixedly on the fixed frame 4 of the sand moulding machine 3 at a pattern plate changing position 19 of the at least one pressing plate 5, as illustrated in Fig. 2, and

the first carrier locking element 12 is provided with a gripper 20 adapted to grip behind the locking block 14 in the locked position of the first carrier locking element 12. Thereby, it may be ensured that the pattern plate carrier 9 of the pattern plate changer 1 and the sand moulding machine 3 can only be interlocked at the pattern plate changing position 19.

**[0034]** As illustrated in Fig. 2, in an embodiment, the locking block 14 is adapted to be arranged so that it has a limited extension in the longitudinal direction L of the moulding chamber 6, thereby defining a limited gripping zone 21 within which the gripper 20 may grip behind the locking block 14. Thereby, it may further be ensured that the pattern plate carrier 9 of the pattern plate changer and the sand moulding machine can only be interlocked within the limited gripping zone 21 at the pattern plate changing position 19. It is noted that only the pattern plate changing position 19 at the pressing plate 5 has been indicated in Fig. 2, however, it is understood that preferably a separate pattern plate changing position is likewise defined for the swing plate 34 and, as seen, a corresponding further locking block 14 is also mounted at this position.

**[0035]** In the illustrated embodiment, in the operational position of the pattern plate changer 1, in the unlocked position of first the carrier locking element 12 illustrated in Fig. 5, the gripper 20 is at a first vertical position, in the locked position of the first carrier locking element 12, the gripper 20 is at a second vertical position illustrated in Fig. 7, and the first carrier locking element 12 is biased from its locked position to its unlocked position. This is achieved by means of the spring-biased locking pin 46 pulling the shielded wire cable 51 as explained above and illustrated in Figs. 4A and 4B. Thereby, when the gripper 20 is not engaged with the locking block 14, the first carrier locking element 12 may move to its unlocked position.

**[0036]** From Figs. 5 to 7, it is understood that according to the illustrated embodiment, the first carrier locking element 12 is adapted to perform a locking operation, when the movable pattern plate carrier 9 of the pattern plate changer 1 is displaced towards the sand moulding machine 3 horizontally in a transverse direction T of the moulding chamber 6, by moving the gripper 20 from its first vertical position illustrated in Fig. 5, past its second vertical position illustrated in Fig. 7 to a third vertical position in which the gripper 20 is a little lower than illustrated in Fig. 6, in which the gripper 20 may pass under the locking block 14, and back to its second vertical position, wherein the gripper 20 may grip behind the locking block 14 as illustrated in Fig. 7.

**[0037]** As seen in Figs. 1 and 9 to 10, in the illustrated embodiment, the movable pattern plate carrier 9 is provided with a first carrier alignment element 22 arranged at the first end 13 of the movable pattern plate carrier 9 and includes a corresponding pressing plate alignment element 23 arranged on the pressing plate 5, and the first carrier alignment element 22 and the pressing plate

alignment element 23 are adapted to mutually engage each other as seen in Fig. 11 in order to accurately align the position of the movable pattern plate carrier 9 in relation to the position of the pressing plate 5 in the longitudinal direction L of the moulding chamber 6 so that the changer track 10 of the movable pattern plate carrier 9 is aligned with the pressing plate track 8 of the pressing plate 5. Thereby, the changer track of the pattern plate carrier may manually be aligned with the pressing plate track of the pressing plate in an easy and accurate way.

**[0038]** As seen in Figs. 10 and 11, in the illustrated embodiment, the first carrier alignment element 22 and the pressing plate alignment element 23 have mutually corresponding wedge forms fitting into each other. Thereby, even better alignment may be assured. The pressing plate alignment element 23 has a V-form and the first carrier alignment element 22 has a corresponding V-form, wherein, however, the top of the "V" has been rounded so that possible sand or dust does not hinder proper engagement between the two elements. In order to align the position of the movable pattern plate carrier 9 in relation to the position of the pressing plate 5, the movable pattern plate carrier 9 has to be brought to a position in which the top of the "V" of the first carrier alignment element 22 is within an alignment zone 84 indicated in Fig. 2. When this is achieved, the accurate alignment may be performed by pressing the movable pattern plate carrier 9 further towards the sand moulding machine 3 in the transverse direction T of the moulding chamber, whereby the first carrier alignment element 22 and the pressing plate alignment element 23 engage completely.

**[0039]** As seen in Fig. 9, in the illustrated embodiment, the first carrier alignment element 22 is by means of a screw connection pivotally arranged about an axis 24 extending at least substantially in parallel with the changer track 10 of the movable pattern plate carrier 9. Thereby, accurate alignment of the changer track 10 of the pattern plate carrier and the pressing plate track 8 of the pressing plate may be possible even though the movable pattern plate carrier 9 may be tilted slightly in relation to a vertical direction as a result of carrying a heavy pattern plate, as indicated in Fig. 8. Additionally or alternatively, the pressing plate alignment element 23 could be adapted to be pivotally arranged on the pressing plate 5 about an axis extending at least substantially in parallel with the pressing plate track 8 of the pressing plate 5.

**[0040]** As understood from the above, in the illustrated embodiment, the first carrier alignment element 22 and the pressing plate alignment element 23 are adapted in such a way and arranged in such a way on the movable pattern plate carrier 9 and the at least one pressing plate 5, respectively, that, when the gripper 20 is positioned within the limited gripping zone 21 and when the position of the movable pattern plate carrier 9 in relation to the pressing plate 5 is not aligned for mutual engagement between the first carrier alignment element 22 and the pressing plate alignment element 23, the movable pattern plate carrier 9 is maintained at such a distance in

the transverse direction T of the moulding chamber 6 from the pressing plate 5 that the gripper 20 of the first carrier locking element 12 is not able to grip behind the locking block 14. As seen in particular in Figs. 10 and 11, if the position of the movable pattern plate carrier 9 in relation to the pressing plate 5 is not accurately aligned for mutual engagement between the first carrier alignment element 22 and the pressing plate alignment element 23, the first carrier alignment element 22 will keep a certain distance between the pressing plate 5 and the movable pattern plate carrier 9 when the gripper 20 is positioned within the limited gripping zone 21 illustrated in Fig. 2. This is due to the fact that the pressing plate alignment element 23 is arranged in a cavity of the pressing plate 5. If the top of the "V" of the first carrier alignment element 22 is not within the alignment zone 84 indicated in Fig. 2, accurate alignment will not be performed, and the top of the "V" of the first carrier alignment element 22 will rather abut the surface of the side of the pressing plate 5 surrounding the pressing plate alignment element 23. Therefore, although the gripper 20 is positioned within the limited gripping zone 21, the first carrier alignment element 22 has to be engaged with the pressing plate alignment element 23 in order to release the pattern plate from the pattern plate changer. This is due to the fact that the pattern plate may not be released if the gripper of the first carrier locking element is not able to grip behind the locking block and thereby hold the first carrier locking element away from its unlocked position. By this arrangement, it may be prevented that the pattern plate falls off the movable pattern plate carrier in error.

**[0041]** In the illustrated embodiment as seen in Fig. 3, the movable pattern plate carrier 9 is provided with a second pattern plate locking element 25 being movable between a locked position in which the second pattern plate locking element 25 may engage the pattern plate 2 and thereby prevent displacement of the pattern plate in relation to the movable pattern plate carrier 9 in a second direction being opposite to the first direction along the changer track 10 and an unlocked position in which the pattern plate 2 is freely displaceable in said second direction. The movable pattern plate carrier 9 is furthermore provided with a second carrier locking element 26 being arranged at a second end 27 of the movable pattern plate carrier 9 and being movable between a locked position in which the movable pattern plate carrier 9 may be interlocked with the locking block 14 on the fixed frame 4 of the sand moulding machine 3, thereby preventing movement of the movable pattern plate carrier 9 in relation to the fixed frame 4 of the sand moulding machine 3, and an unlocked position in which the movable pattern plate carrier 9 may be movable in relation to the fixed frame 4 of the sand moulding machine 3. The second carrier locking element 26 is adapted to interact with the second pattern plate locking element 25 in such a way that, when the second carrier locking element 26 is in its unlocked position, the second pattern plate locking element 25 is prevented from moving from its locked position



to its unlocked position. In the illustrated embodiment, the second carrier locking element 26 is adapted to interact with the second pattern plate locking element 25 in the same way as the first carrier locking element 12 is adapted to interact with the first pattern plate locking element 11. Thereby, the pattern plate changer 1 may easily be used for changing pattern plates 2 of both the pressing plate 5 and the swing plate 34 of the vertical sand moulding machine 3. The pressing plate and the swing plate are adapted for mounting of the respective pattern plates so that they face each other. By rotating the movable pattern plate carrier 180 degrees between pattern plate changing operations, the respective pattern plates 2 of both the pressing plate 5 and the swing plate 34 may be changed from the same side of the sand moulding machine 3, because the movable pattern plate carrier 9 has a carrier locking element and a corresponding pattern plate locking element at both its ends.

**[0042]** In the illustrated embodiment, as seen in Figs. 5 to 7, the first and second pattern plate locking elements 11, 25 are mutually interconnected by means of a locking element connector 28 preventing that both the first and second pattern plate locking elements 11, 25 take up their respective unlocked positions simultaneously. By this arrangement, it may be prevented that the pattern plate falls off the movable pattern plate carrier as a result of an operational error. The locking element connector 28 has the form of a lever being pivotal about a pivot axis 59 and having a first end 60 being engageable with an end 63 of the first pattern plate locking element 11 being opposite to the hook part 53 and a second end 61 being engageable with an end 64 of the second pattern plate locking element 25 being opposite to the hook part 53 thereof. As further seen, the end 63 of the first pattern plate locking element 11 is biased to the locked position of the first pattern plate locking element 11 by means of a spring 65 and the end 64 of the second pattern plate locking element 25 is biased to the locked position of the second pattern plate locking element 25 by means of a spring 66.

**[0043]** As seen in Figs. 12 to 15, in the illustrated embodiment, the movable pattern plate carrier 9 is provided with a first pivotal handle 29 arranged at the second end 27 of the movable pattern plate carrier 9. The first pivotal handle 29 is coupled with the first pattern plate locking element 11 in such a way that a pivotal movement of the first pivotal handle 29 in a first direction, i.e. upwards as seen in Fig. 12, moves the first pattern plate locking element 11 from its locked position to its unlocked position. In the illustrated embodiment, this is achieved in that the first pivotal handle 29 has a lever 67 with a first end 68 coupled to the end 63 (illustrated in Fig. 5) of the first pattern plate locking element 11 being opposite to the hook part 53 by means of a shielded wire cable 69.

**[0044]** Furthermore, the first pivotal handle 29 is coupled with the first carrier locking element 12 in such a way that a pivotal movement of the first pivotal handle 29 in a second direction, i.e. downwards in the figures,

moves the first carrier locking element 12 away from its unlocked position. In the illustrated embodiment, this is achieved in that the lever 67 of the first pivotal handle 29 has a second end 70 coupled by means of a shielded wire cable 71 to the back end 56 of the lever forming the first carrier locking element 12, as illustrated in Figs. 4A and 4B. As seen in Figure 12, the second end 70 of the lever 67 is adapted to pull the cable by means of an end stop element mounted on the wire and being thicker than the wire, wherein the wire runs through an opening of the second end 70 having smaller cross-section than the wire. Therefore, as seen, the second end 70 of the lever 67 may pull, but not push the wire, and thereby a certain play is provided. A similar connection between the first end 68 of the lever 67 and the corresponding shielded wire cable 69 may preferably be provided. Such a connection may also be provided for instance between the shielded wire cable 71 and the first carrier locking element 12.

**[0045]** In a similar way as explained above in relation to the first pivotal handle 29, the movable pattern plate carrier 9 is provided with a second pivotal handle 30 arranged at the first end 13 of the movable pattern plate carrier 9. The second pivotal handle 30 is coupled with the second pattern plate locking element 25 in such a way that a pivotal movement of the second pivotal handle 30 in a first direction, i.e. upwards as seen in the figures, moves the second pattern plate locking element 25 from its locked position to its unlocked position. In the illustrated embodiment, this is achieved in that the second pivotal handle 30 has a lever with a first end coupled to the end 64 (indicated in Fig. 5) of the second pattern plate locking element 25 being opposite to the hook part thereof by means of a shielded wire cable 62. It is noted that the lever of the second pivotal handle 30 is not visible in the figures, because it is arranged on the opposite side of the movable pattern plate carrier 9 in relation to the first pivotal handle 29.

**[0046]** Furthermore, the second pivotal handle 30 is coupled with the second carrier locking element 26 in such a way that a pivotal movement of the second pivotal handle 30 in a second direction, i.e. downwards as seen in the figures, moves the second carrier locking element 26 away from its unlocked position. In the illustrated embodiment, this is achieved in that the not visible lever of the second pivotal handle 30 has a second end coupled by means of a shielded wire cable 72 to a back end of a lever forming the second carrier locking element 26.

**[0047]** Furthermore, the movable pattern plate carrier 9 is provided with a second carrier alignment element 31 arranged at the second end 27 of the movable pattern plate carrier 9 and corresponding to the pressing plate alignment element 23, as seen in Fig. 2.

**[0048]** Thereby, by means of the first and second pivotal handles 29, 30, the respective carrier locking elements 12, 26 may be moved away from their unlocked position, thereby facilitating the operation of interlocking the movable pattern plate carrier 9 and the sand moulding

machine 3 or a jig 73, as illustrated in Figs. 17 to 22, on which the pattern plate 2 may be stored. Furthermore, by means of the pivotal handles, the pattern plate may be released for performing a changing operation. However, because the respective handles can only be pivoted in one direction at a time, it may still be ensured that the pattern plate 2 may not be released if the movable pattern plate carrier 9 is not appropriately aligned and locked to a sand moulding machine 3 or a jig 73.

**[0049]** Figs. 12 to 16 illustrate the steps of transferring a pattern plate 2 from the movable pattern plate carrier 9 to the pressing plate 5 after alignment of the movable pattern plate carrier 9 and the pressing plate 5. In Fig. 12, the first pivotal handle 29 has been rotated in its first direction, i.e. upwards as seen in Fig. 12, thereby moving the first pattern plate locking element 11 from its locked position to its unlocked position so that the pattern plate 2 may be displaced towards the pressing plate 5. In Fig. 13, the pattern plate 2 has been displaced a first step towards the pressing plate 5 and a pattern plate screw 40 seen to the right of the pattern plate is passing above the hook part 53 of the first pattern plate locking element 11. In Fig. 14, the pattern plate 2 has been displaced a second step towards the pressing plate 5 and the pattern plate screw 40 has passed the hook part 53 of the first pattern plate locking element 11. The first pivotal handle 29 has been rotated back to its initial rotational position, and the first pattern plate locking element 11 has rotated back to its locked position. In Fig. 15, the pattern plate 2 has been displaced a third step towards the pressing plate 5 and a pattern plate screw 40 seen to the left of the pattern plate is now passing above the hook part 53 of the first pattern plate locking element 11. This happens without operating the handle 29, because the pattern plate 2 has enough momentum to pivot the first pattern plate locking element 11 from its locked position to its unlocked position when the pattern plate screw 40 seen to the left of the pattern plate hits the hook part 53 of the first pattern plate locking element 11. In Fig. 16, the pattern plate 2 has been displaced a fourth step to its final position on the pressing plate 5, and the first pattern plate locking element 11 has rotated back to its locked position.

**[0050]** Figs 17 to 22 illustrate how the pattern plate 2 may be transferred from the sand moulding machine 3 to the jig 73 by means of the pattern plate changer 1. The jig 73 includes a rolling table 74 and a fixed pattern plate carrier 75. The fixed pattern plate carrier 75 is provided with a jig alignment element 76 corresponding to the pressing plate alignment element 23 described above. Thereby, the movable pattern plate carrier 9 may be aligned with the fixed pattern plate carrier 75 of the jig 73 in the same way as it may be aligned with the pressing plate 5 of the sand moulding machine 3. The fixed pattern plate carrier 75 is further provided with a jig track 77 is formed by a row of rollers 78 adapted to roll on the underside of the upper rail 7 of the pattern plate 2 in the same way, as the pressing plate 5 is provided with the pressing plate track 8 formed by a row of rollers 42 adapt-

ed to roll on an underside of the upper rail 7 of the pattern plate 2. Just as explained above, the jig track 77 could alternatively just have the form of a rail or the like.

**[0051]** As shown in Fig. 20, the jig 73 is provided with a locking bracket 79 which may be gripped by the first or second carrier locking element 12, 26 of the movable pattern plate carrier 9 in the same way as the locking block 14 on the fixed frame 4 of the sand moulding machine 3 may be gripped by the first or second carrier locking element 12, 26. Thereby, the movable pattern plate carrier 9 may be locked to the jig 73 in the same way as it may be locked to the sand moulding machine 3. The locking bracket 79 has a limited extension in a longitudinal direction of the jig, thereby defining a limited gripping zone of the gripper of the first or second carrier locking element 12, 26 in the same way as a limited gripping zone is defined by the locking block 14, as explained above.

**[0052]** As mentioned above, in the case of the locking block 14, a front part 15 of the first carrier locking element 12 (or the second carrier locking element 26) and a corresponding front side 16 of the locking block 14 have mutually interacting surfaces 17, 18 adapted to slide on each other, when the movable pattern plate carrier 9 of the pattern plate changer 1 is displaced towards the sand moulding machine 3 horizontally in a transverse direction of the moulding chamber 6, in such a way that the first carrier locking element 12 is urged away from its unlocked position. In the illustrated embodiment of the jig 73, as best seen in Fig. 20, however, the locking bracket 79 has a front surface 80 being oblique in an opposite direction than the surface 17 of the second carrier locking element 26, thereby preventing that the second carrier locking element 26 is urged away from its unlocked position. This embodiment of the jig 73 may be preferred, because a manual operation, i.e. tilting of a handle, is thereby necessary to couple the movable pattern plate carrier 9 to the jig and release the pattern plate 2.

#### List of reference numbers

##### [0053]

L	longitudinal direction of moulding chamber
l	longitudinal direction of pattern plate
T	transverse direction of moulding chamber
1	pattern plate changer
2	pattern plate
3	sand moulding machine
4	fixed frame of sand moulding machine
5	pressing plate of sand moulding machine
6	moulding chamber of sand moulding machine
7	upper rail of pattern plate
8	pressing plate track of pressing plate
9	movable pattern plate carrier
10	changer track of movable pattern plate carrier
11	first pattern plate locking element of movable pattern plate carrier

12	first carrier locking element of movable pattern plate carrier	60	first end of locking element connector
13	first end of movable pattern plate carrier	61	second end of locking element connector
14	locking block on fixed frame	62	shielded wire cable
15	front part of first carrier locking element	63	end of first pattern plate locking element
16	front side of locking block	64	end of second pattern plate locking element
17	surface of front part of first carrier locking element	65, 66	spring
18	surface of front side of locking block	67	lever of first pivotal handle
19	pattern plate changing position of pressing plate	68	first end of lever
20	gripper of first carrier locking element	69	shielded wire cable
21	limited gripping zone of gripper	70	second end of lever
22	first carrier alignment element of movable pattern plate carrier	71, 72	shielded wire cable
23	pressing plate alignment element to be arranged on pressing plate	73	jig
24	axis extending in parallel with changer track	74	rolling table of jig
25	second pattern plate locking element	75	fixed pattern plate carrier of jig
26	second carrier locking element	76	jig alignment element
27	second end of movable pattern plate carrier	77	jig track
28	locking element connector	78	roller of jig track
29	first pivotal handle of movable pattern plate carrier	79	locking bracket of jig
30	second pivotal handle of movable pattern plate carrier	80	front surface of locking bracket
31	second carrier alignment element of movable pattern plate carrier	81	fixed handle of movable pattern plate carrier
32	swingable arm of pattern plate changer	82	end stop element of shielded wire cable
33	vertical axis of pattern plate changer and movable pattern plate carrier	83	spring for biasing lever of first pivotal handle
34	swing plate of sand moulding machine	84	alignment zone
35	horizontal swing axis		
36	chamber top wall		
37	chamber bottom wall		
38	chamber side wall		
39	pattern plate lock		
40	pattern plate screw		
41	guide pin		
42	roller forming part of pressing plate track		
43	recess of upper rail of pattern plate		
44	roller forming part of upper changer track		
45	joint of swingable arm		
46	locking pin		
47	pivot pin of pattern plate locking element		
48	pivot direction		
49	compression spring		
50	locking bore of locking pin		
51	shielded wire cable		
52	locking pin bore of movable pattern plate carrier		
53	hook part of first pattern plate locking element		
54	pivot pin of lever		
55	hook end of lever		
56	back end of lever		
57	first end of shielded wire cable		
58	second end of shielded wire cable		
59	pivot axis of locking element connector		

## Claims

1. A pattern plate changer (1) for changing pattern plates (2) of a sand moulding machine (3), the sand moulding machine including a fixed frame (4) and at least one pressing plate (5) being adapted to carry a pattern plate (2) and being displaceable in a longitudinal direction (L) of a moulding chamber (6) in order to compact sand fed into the moulding chamber, each pattern plate (2) having an upper rail (7) adapted to carry the pattern plate during pattern plate changing by moving in a transverse direction (T) of the moulding chamber (6) along a pressing plate track (8) of the at least one pressing plate (5), the pattern plate changer (1) including a movable pattern plate carrier (9) being provided with a changer track (10) along which the upper rail (7) of the pattern plate (2) may move and thereby carry the pattern plate during pattern plate changing, and wherein, when the changer track (10) of the movable pattern plate carrier (9) is aligned with the pressing plate track (8) of the at least one pressing plate (5), the pattern plate (2) may be transferred between the sand moulding machine (3) and the pattern plate changer (1) by displacement of the pattern plate (2) in a longitudinal direction (L) thereof, **characterised in that** the movable pattern plate carrier (9) is provided with a first pattern plate locking element (11) being movable between a locked position in which the first pattern plate locking element (11) may engage the pattern plate (2) and thereby prevent displacement of the pattern plate in relation to the movable pattern plate carrier (9) in at least a first direction along the changer track

- (10) and an unlocked position in which the pattern plate (2) is freely displaceable in said at least first direction, **in that** the movable pattern plate carrier (9) is provided with a first carrier locking element (12) being arranged at a first end (13) of the movable pattern plate carrier (9) and being movable between a locked position in which the movable pattern plate carrier (9) may be interlocked with a locking block (14) on the fixed frame (4) of the sand moulding machine (3), thereby preventing movement of the movable pattern plate carrier (9) in relation to the fixed frame (4) of the sand moulding machine (3), and an unlocked position in which the movable pattern plate carrier (9) may be movable in relation to the fixed frame (4) of the sand moulding machine (3), and **in that** the first carrier locking element (12) is adapted to interact with the first pattern plate locking element (11) in such a way that, when the first carrier locking element (12) is in its unlocked position, the first pattern plate locking element (11) is prevented from moving from its locked position to its unlocked position.
2. A pattern plate changer according to claim 1, wherein a front part (15) of the first carrier locking element (12) and a corresponding front side (16) of the locking block (14) have mutually interacting surfaces (17, 18) adapted to slide on each other, when the movable pattern plate carrier (9) of the pattern plate changer (1) is displaced towards the sand moulding machine (3) horizontally in a transverse direction of the moulding chamber (6), in such a way that the first carrier locking element (12) is urged away from its unlocked position.
  3. A pattern plate changer according to claim 1 or 2, wherein the locking block (14) forms part of the pattern plate changer (1) and is adapted to be mounted fixedly on the fixed frame (4) of the sand moulding machine (3) at a pattern plate changing position (19) of the at least one pressing plate (5), and wherein the first carrier locking element (12) is provided with a gripper (20) adapted to grip behind the locking block (14) in the locked position of the first carrier locking element (12).
  4. A pattern plate changer according to claim 3, wherein the locking block (14) is adapted to be arranged so that it has a limited extension in the longitudinal direction (L) of the moulding chamber (6), thereby defining a limited gripping zone (21) within which the gripper may grip behind the locking block.
  5. A pattern plate changer according to claim 3 or 4, wherein, in an operational position of the pattern plate changer, in the unlocked position of first the carrier locking element (12), the gripper (20) is at a first vertical position, wherein, in the locked position of the first carrier locking element (12), the gripper (20) is at a second vertical position, and wherein the first carrier locking element (12) is biased from its locked position to its unlocked position.
  6. A pattern plate changer according to claim 5, wherein the first carrier locking element (12) is adapted to perform a locking operation, when the movable pattern plate carrier (9) of the pattern plate changer (1) is displaced towards the sand moulding machine (3) horizontally in a transverse direction (T) of the moulding chamber (6), by moving the gripper (20) from its first vertical position, past its second vertical position to a third vertical position, in which the gripper (20) may pass under or over the locking block (14), and back to its second vertical position, wherein the gripper (20) may grip behind the locking block (14).
  7. A pattern plate changer according to any one of the preceding claims, wherein the movable pattern plate carrier (9) is provided with a first carrier alignment element (22) arranged at the first end (13) of the movable pattern plate carrier (9) and includes a corresponding pressing plate alignment element (23) adapted to be arranged on the at least one pressing plate (5), and wherein the first carrier alignment element (22) and the pressing plate alignment element (23) are adapted to mutually engage each other in order to align the position of the movable pattern plate carrier (9) in relation to the position of the pressing plate (5) in the longitudinal direction (L) of the moulding chamber (6) so that the changer track (10) of the movable pattern plate carrier (9) is aligned with the pressing plate track (8) of the pressing plate (5).
  8. A pattern plate changer according to claim 7, wherein the first carrier alignment element (22) and the pressing plate alignment element (23) have mutually corresponding wedge forms fitting into each other.
  9. A pattern plate changer according to claim 7 or 8, wherein the first carrier alignment element (22) is pivotally arranged about an axis (24) extending at least substantially in parallel with the changer track (10) of the movable pattern plate carrier (9) and/or the pressing plate alignment element (23) is adapted to be pivotally arranged on the at least one pressing plate (5) about an axis extending at least substantially in parallel with the pressing plate track (8) of the pressing plate (5).
  10. A pattern plate changer according to claim 4 and any one of the claims 7 to 9, wherein the at least one pressing plate (5) is included by the pattern plate changer (1), wherein the first carrier alignment element (22) and the pressing plate alignment element (23) are adapted in such a way and arranged in such a way on the movable pattern plate carrier (9) and

the at least one pressing plate (5), respectively, that, when the gripper (20) is positioned within the limited gripping zone (21) and when the position of the movable pattern plate carrier (9) in relation to the pressing plate (5) is not aligned for mutual engagement between the first carrier alignment element (22) and the pressing plate alignment element (23), the movable pattern plate carrier (9) is maintained at such a distance in the transverse direction (T) of the moulding chamber (6) from the pressing plate (5) that the gripper (20) of the first carrier locking element (12) is not able to grip behind the locking block (14).

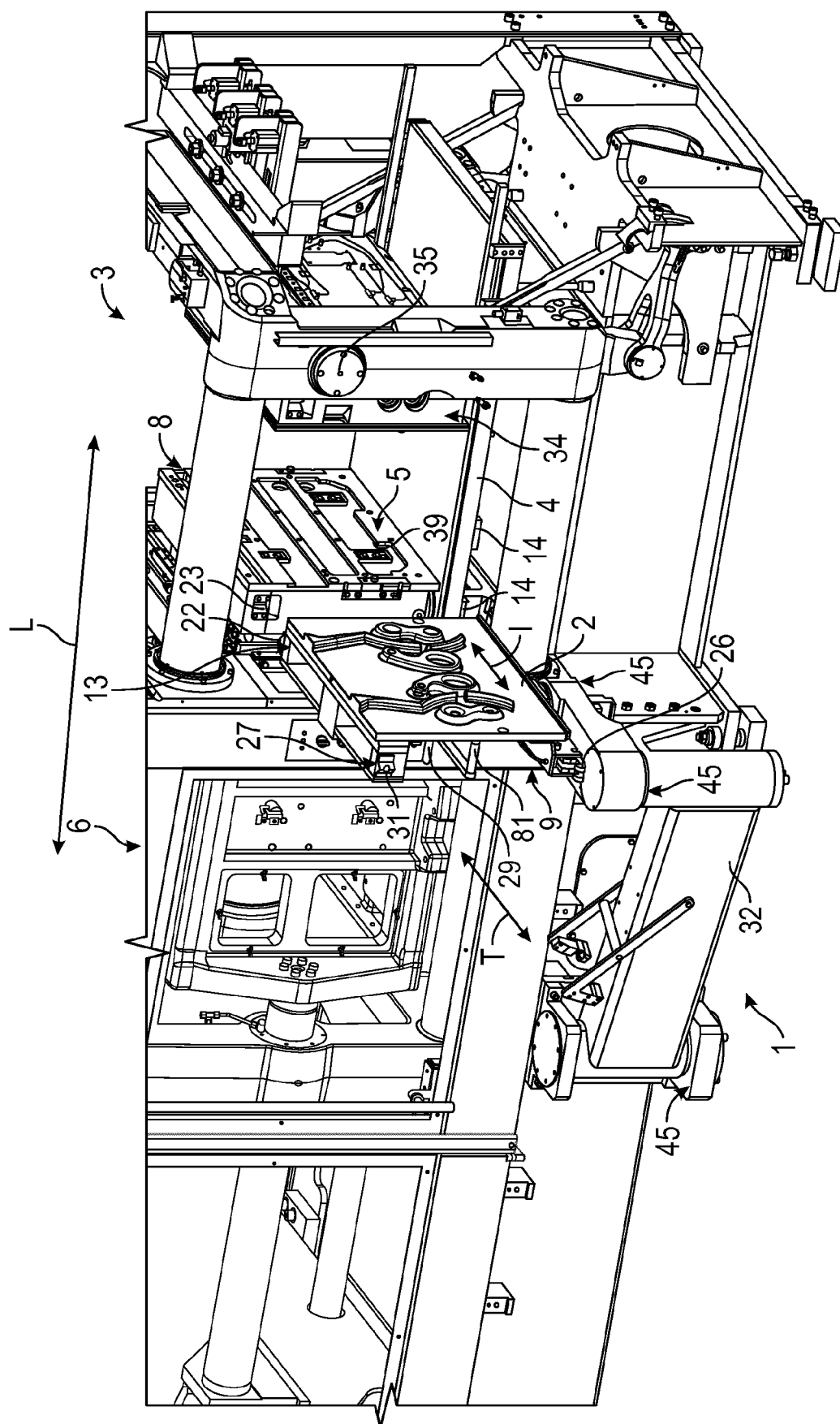
11. A pattern plate changer according to any one of the preceding claims, wherein the movable pattern plate carrier (9) is provided with a second pattern plate locking element (25) being movable between a locked position in which the second pattern plate locking element (25) may engage the pattern plate (2) and thereby prevent displacement of the pattern plate in relation to the movable pattern plate carrier (9) in a second direction being opposite to the first direction along the changer track (10) and an unlocked position in which the pattern plate (2) is freely displaceable in said second direction, in that the movable pattern plate carrier (9) is provided with a second carrier locking element (26) being arranged at a second end (27) of the movable pattern plate carrier (9) and being movable between a locked position in which the movable pattern plate carrier (9) may be interlocked with the locking block (14) on the fixed frame (4) of the sand moulding machine (3), thereby preventing movement of the movable pattern plate carrier (9) in relation to the fixed frame (4) of the sand moulding machine (3), and an unlocked position in which the movable pattern plate carrier (9) may be movable in relation to the fixed frame (4) of the sand moulding machine (3), and in that the second carrier locking element (26) is adapted to interact with the second pattern plate locking element (25) in such a way that, when the second carrier locking element (26) is in its unlocked position, the second pattern plate locking element (25) is prevented from moving from its locked position to its unlocked position.

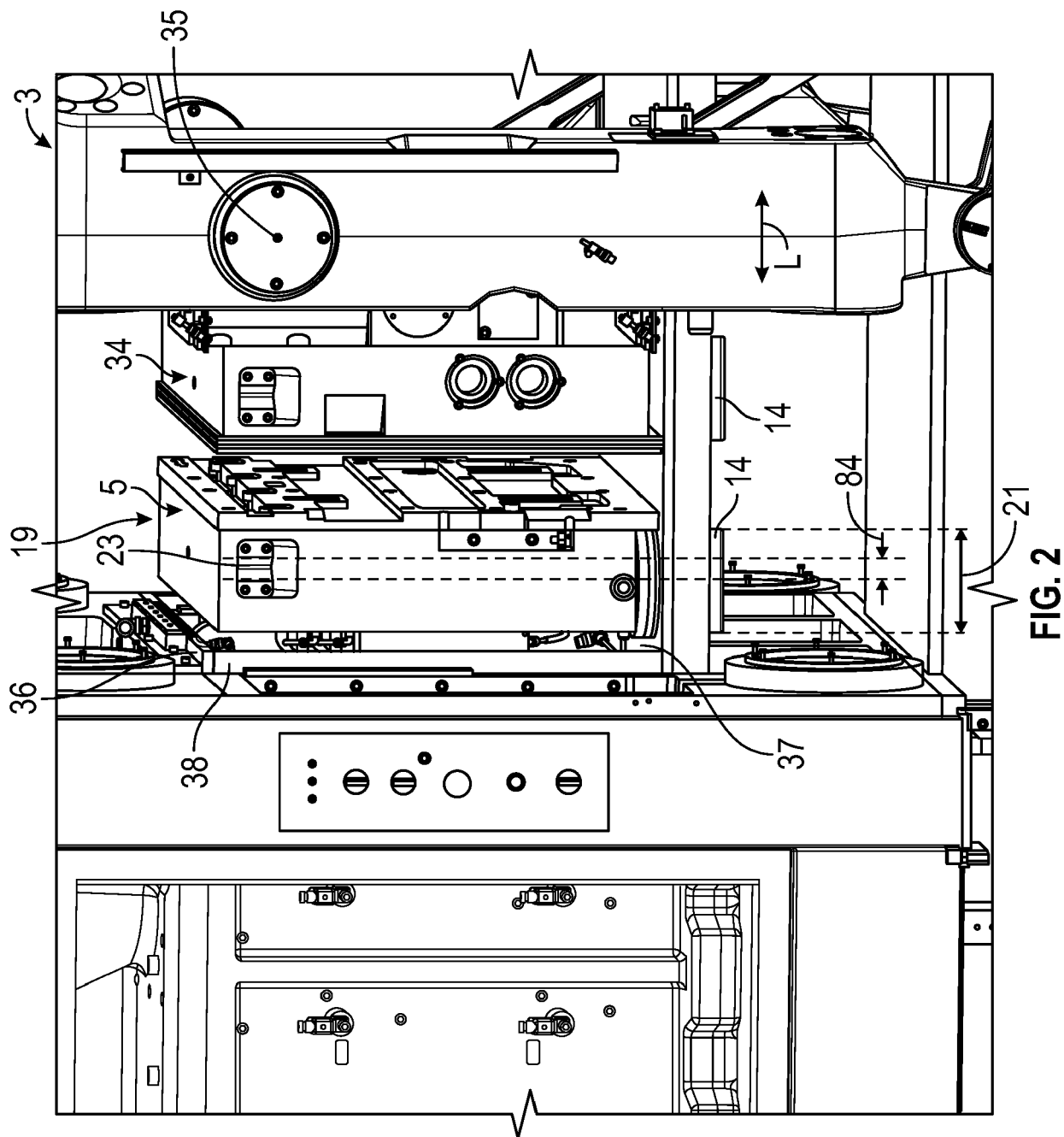
12. A pattern plate changer according to claim 11, wherein the first and second pattern plate locking elements (11, 25) are mutually interconnected by means of a locking element connector (28) preventing that both the first and second pattern plate locking elements (11, 25) take up their respective unlocked positions simultaneously.

13. A pattern plate changer according to claim 10 or 11, wherein the movable pattern plate carrier (9) is provided with a first pivotal handle (29) arranged at the second end (27) of the movable pattern plate carrier

(9), wherein the first pivotal handle (29) is coupled with the first pattern plate locking element (11) in such a way that a pivotal movement of the first pivotal handle (29) in a first direction moves the first pattern plate locking element (11) from its locked position to its unlocked position, wherein the first pivotal handle (29) is coupled with the first carrier locking element (12) in such a way that a pivotal movement of the first pivotal handle (29) in a second direction moves the first carrier locking element (12) away from its unlocked position, wherein the movable pattern plate carrier (9) is provided with a second pivotal handle (30) arranged at the first end (13) of the movable pattern plate carrier (9), wherein the second pivotal handle (30) is coupled with the second pattern plate locking element (25) in such a way that a pivotal movement of the second pivotal handle (30) in a first direction moves the second pattern plate locking element (25) from its locked position to its unlocked position, wherein the second pivotal handle (30) is coupled with the second carrier locking element (26) in such a way that a pivotal movement of the second pivotal handle (30) in a second direction moves the second carrier locking element (26) away from its unlocked position, and wherein the movable pattern plate carrier (9) is provided with a second carrier alignment element (31) arranged at the second end (27) of the movable pattern plate carrier (9) and corresponding to the pressing plate alignment element (23).

14. A pattern plate changer according to any one of the preceding claims, wherein the movable pattern plate carrier (9) is arranged on a swingable arm (32), and wherein the movable pattern plate carrier (9) is arranged for rotating at least 180 degrees back and forth about a vertical axis (33) in relation to the swingable arm (32).





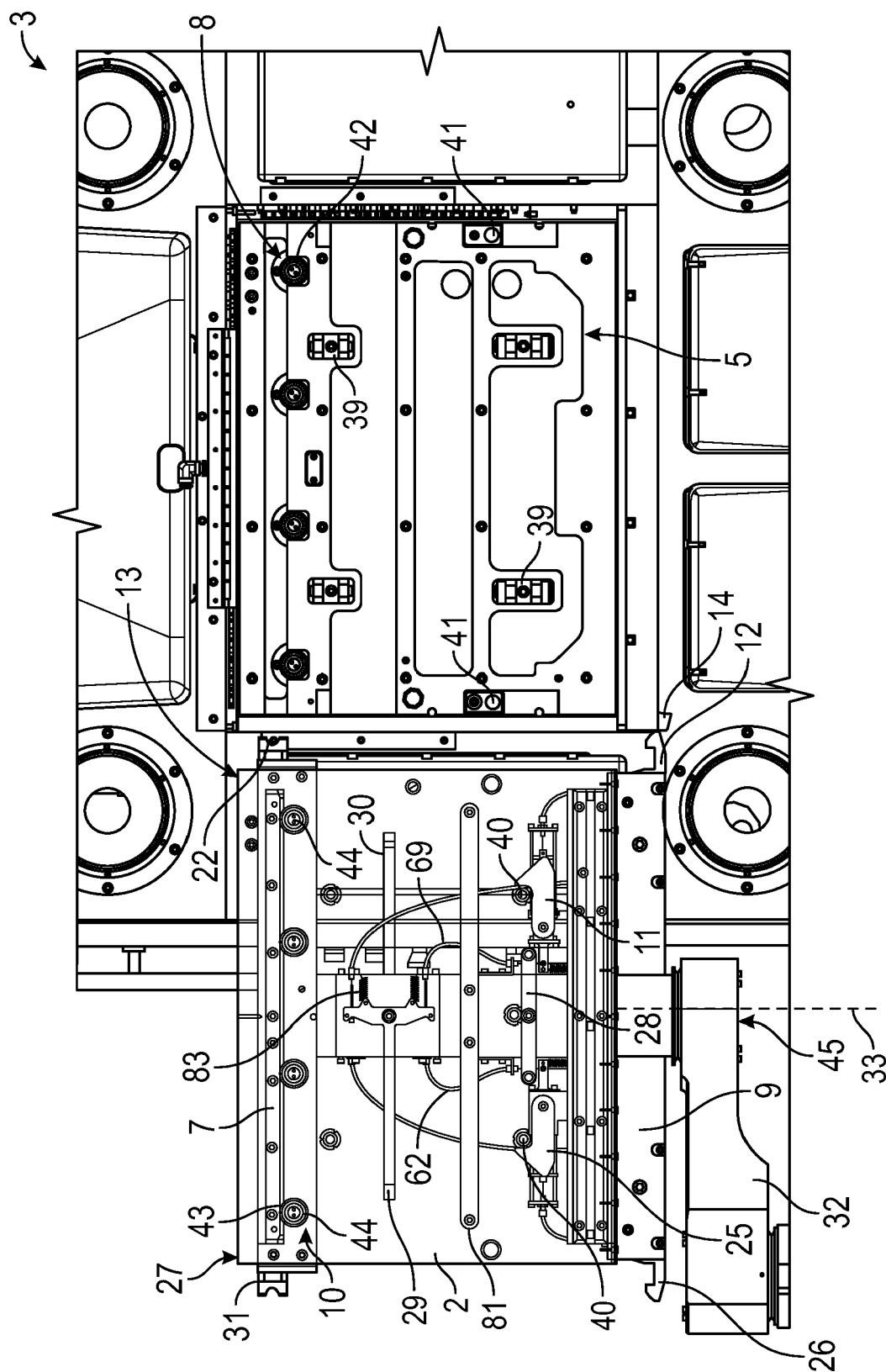


FIG. 3



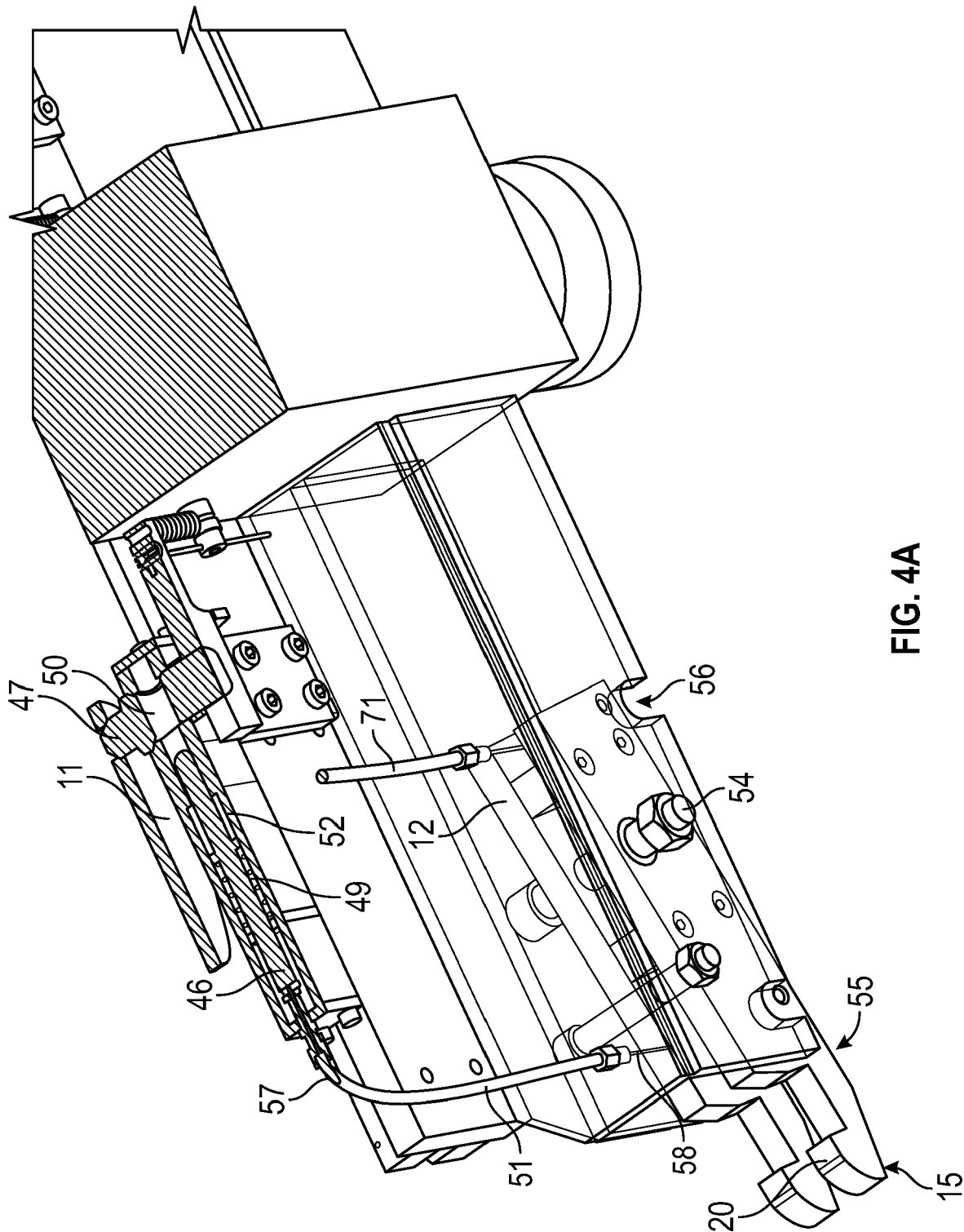


FIG. 4A

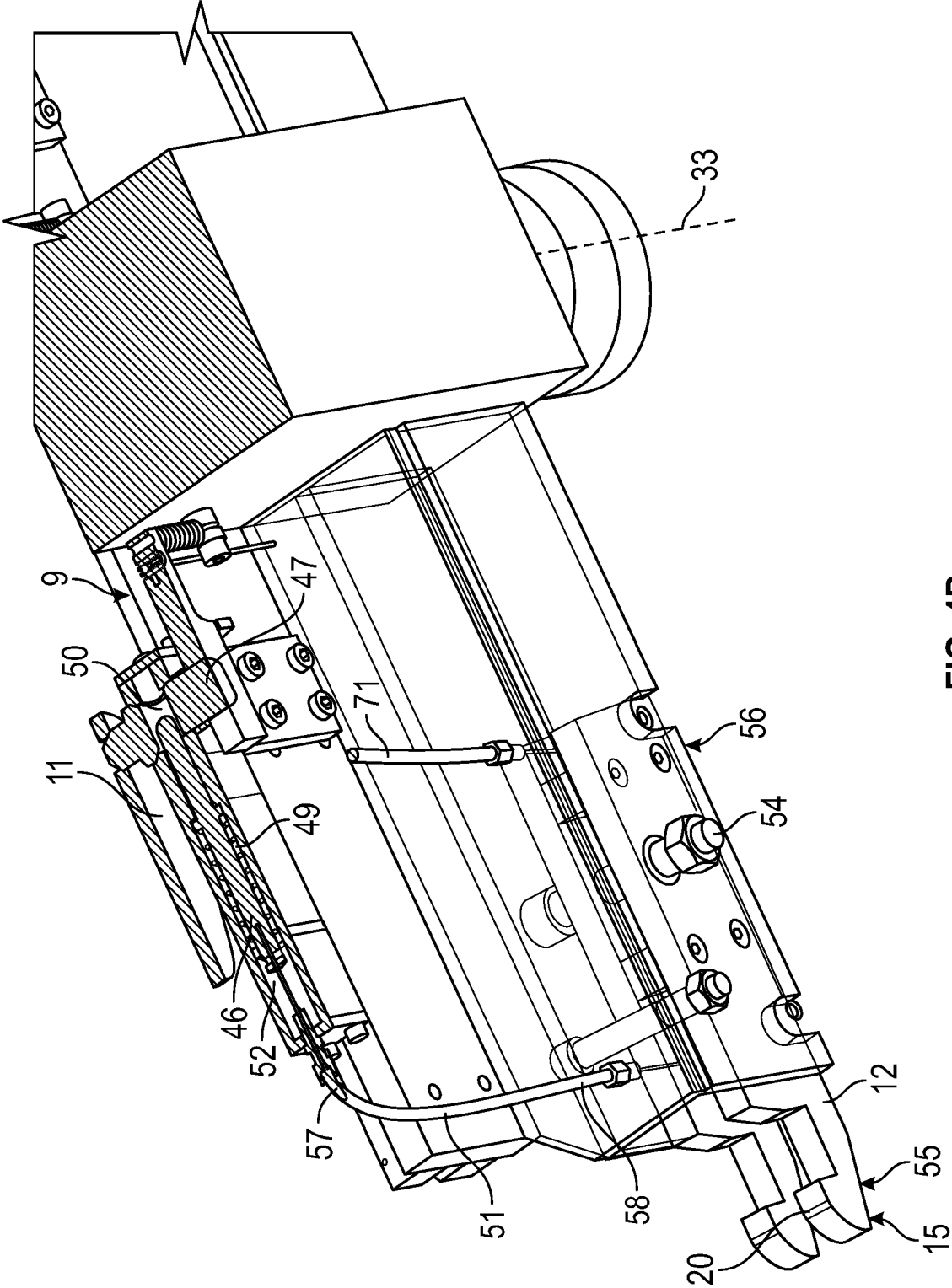
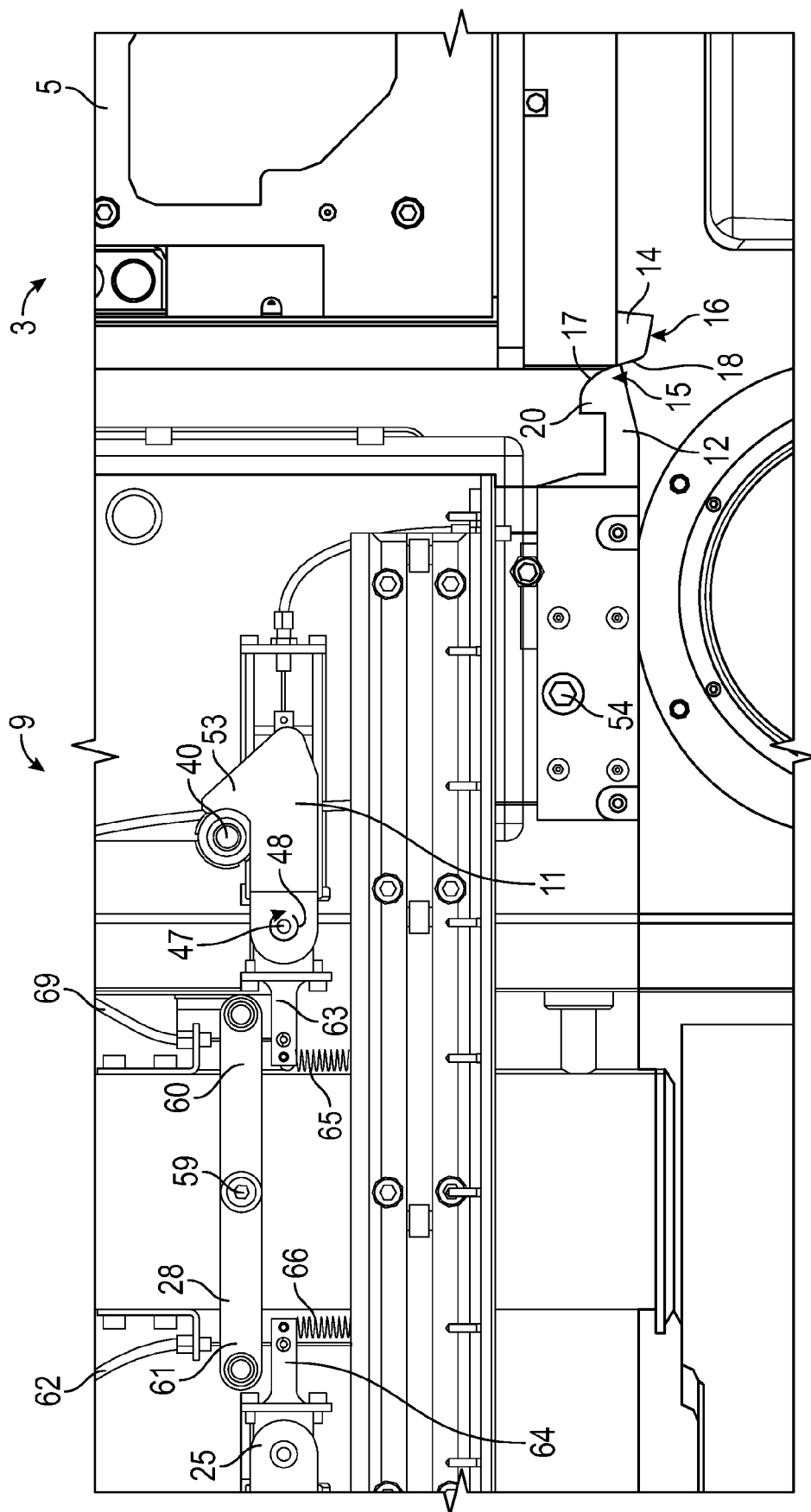
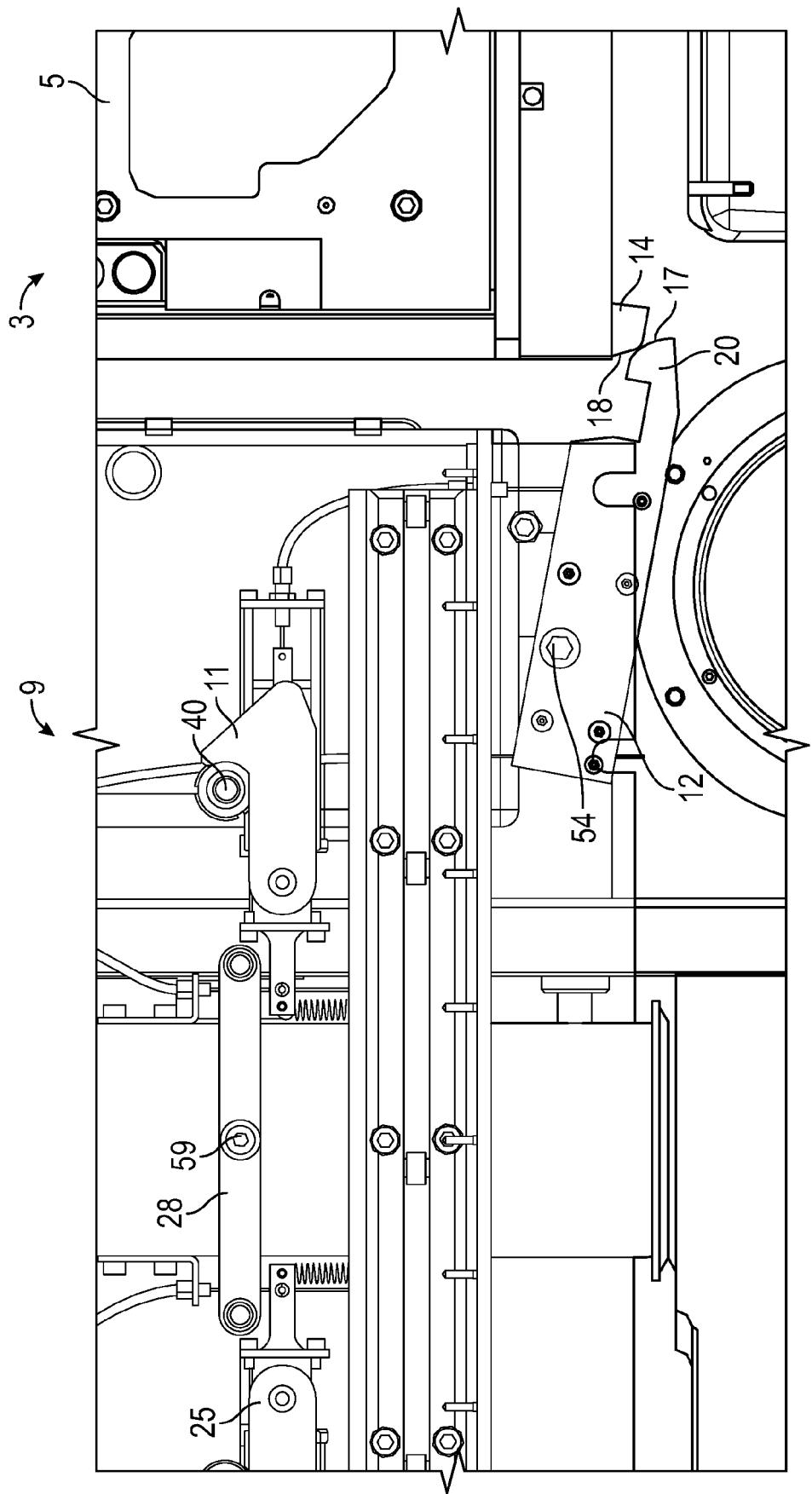


FIG. 4B



**FIG. 5**



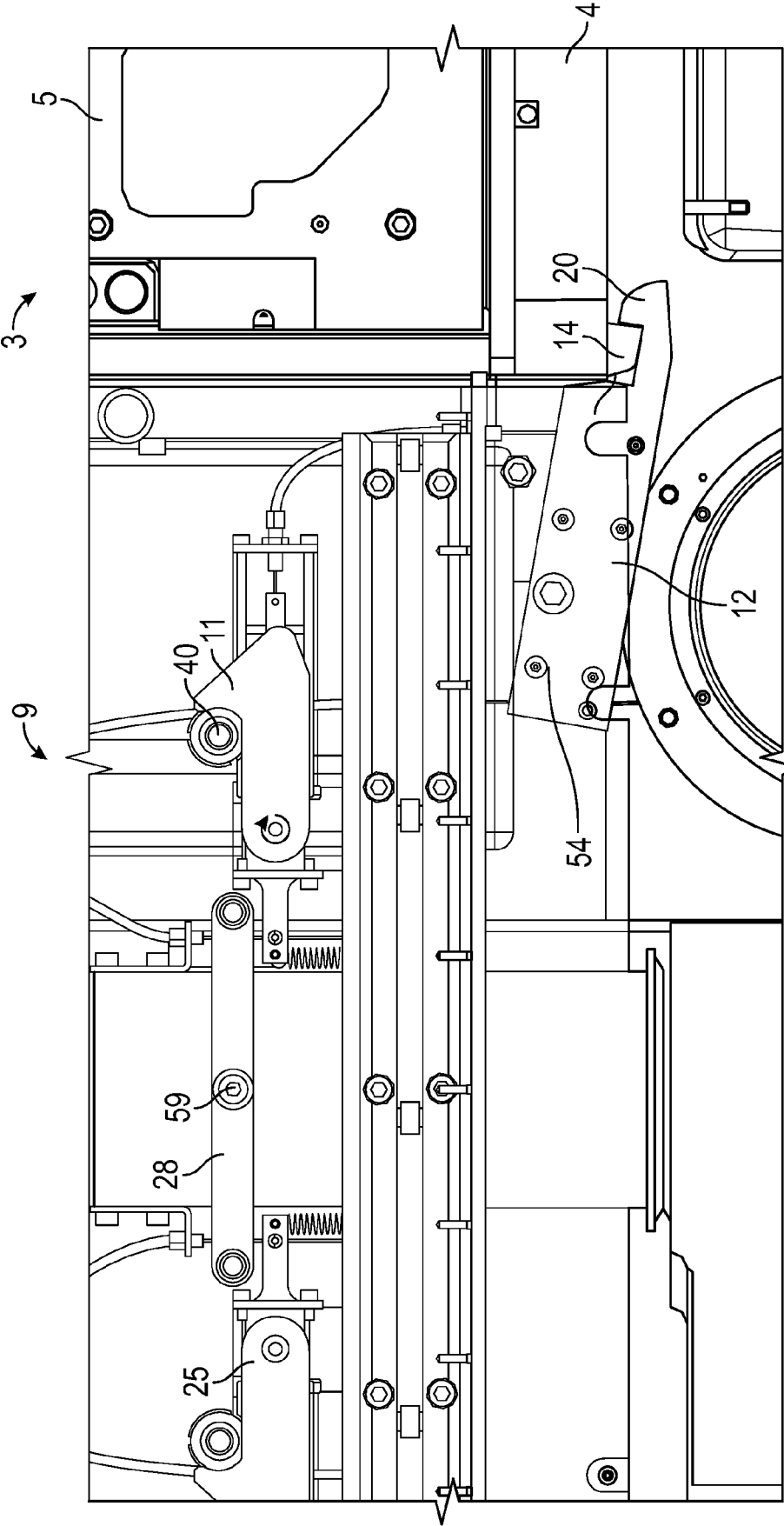


FIG. 7

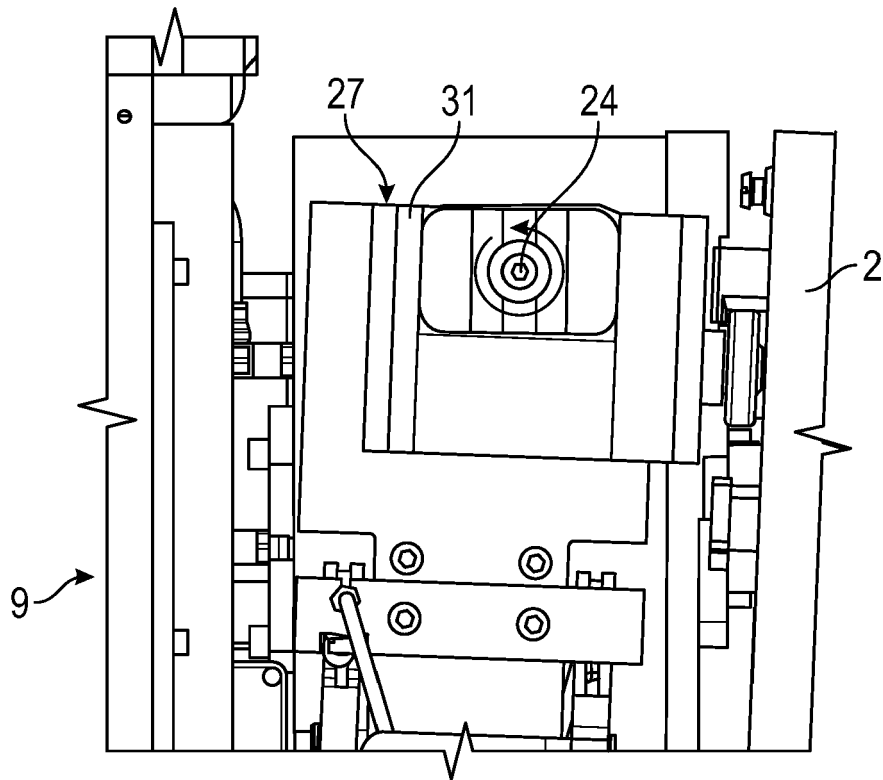


FIG. 8

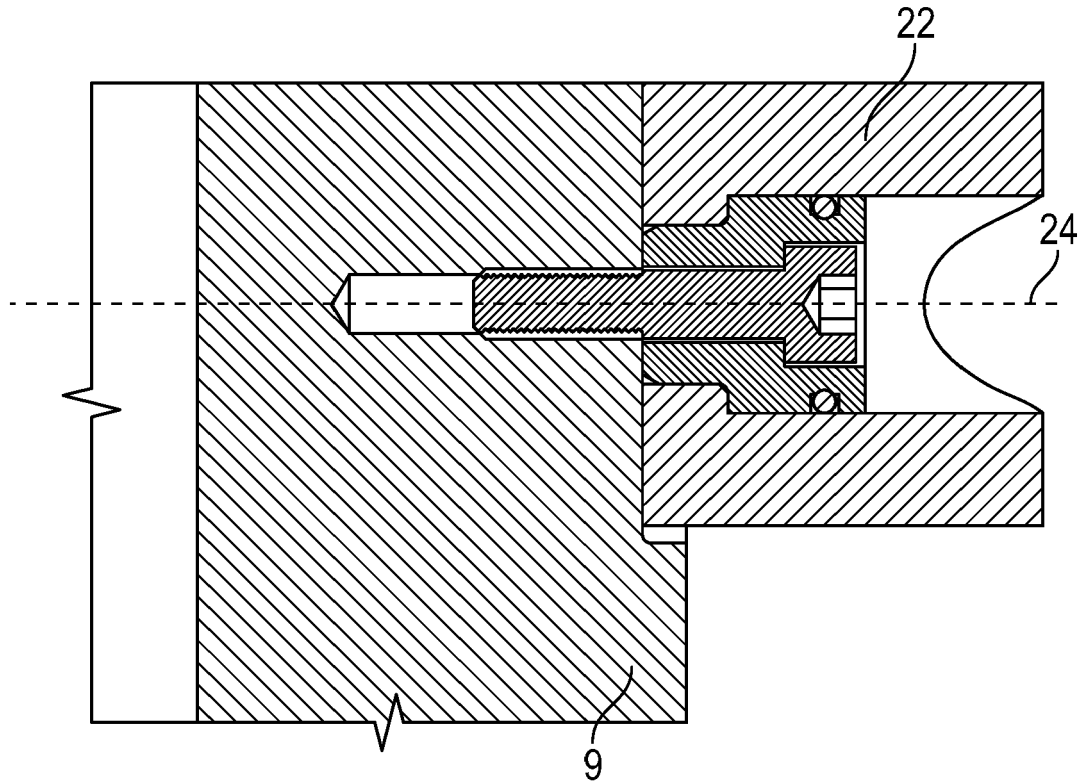


FIG. 9

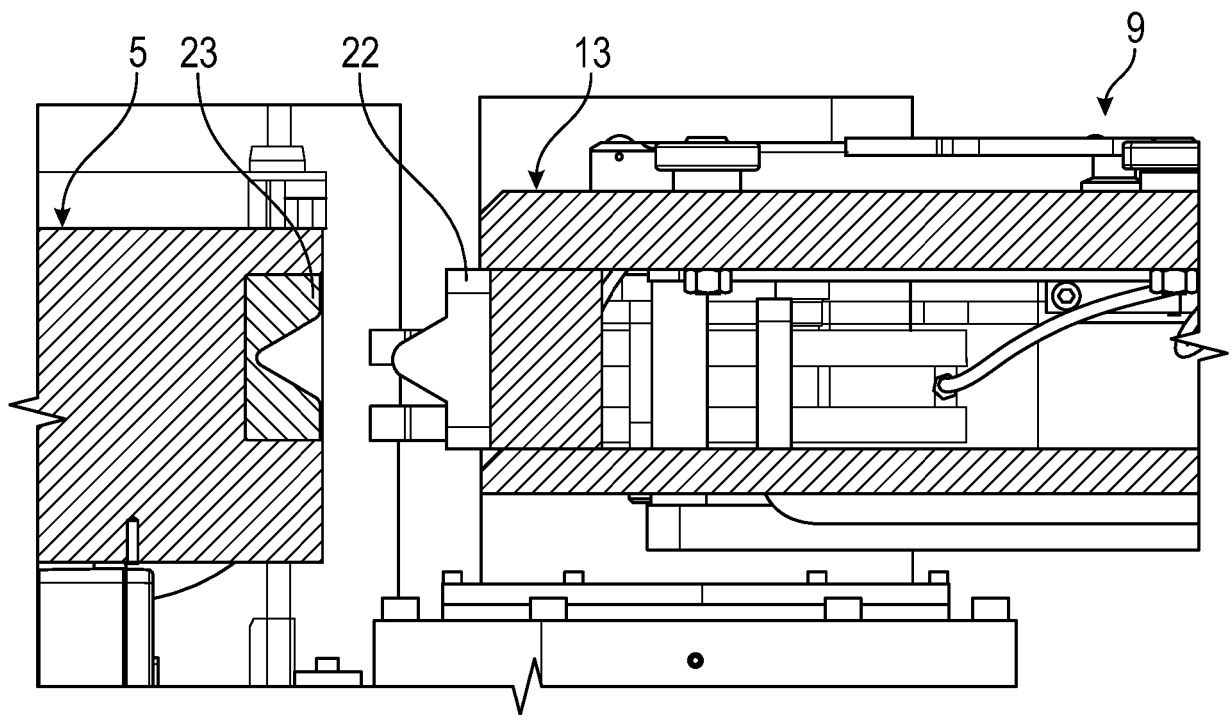


FIG. 10

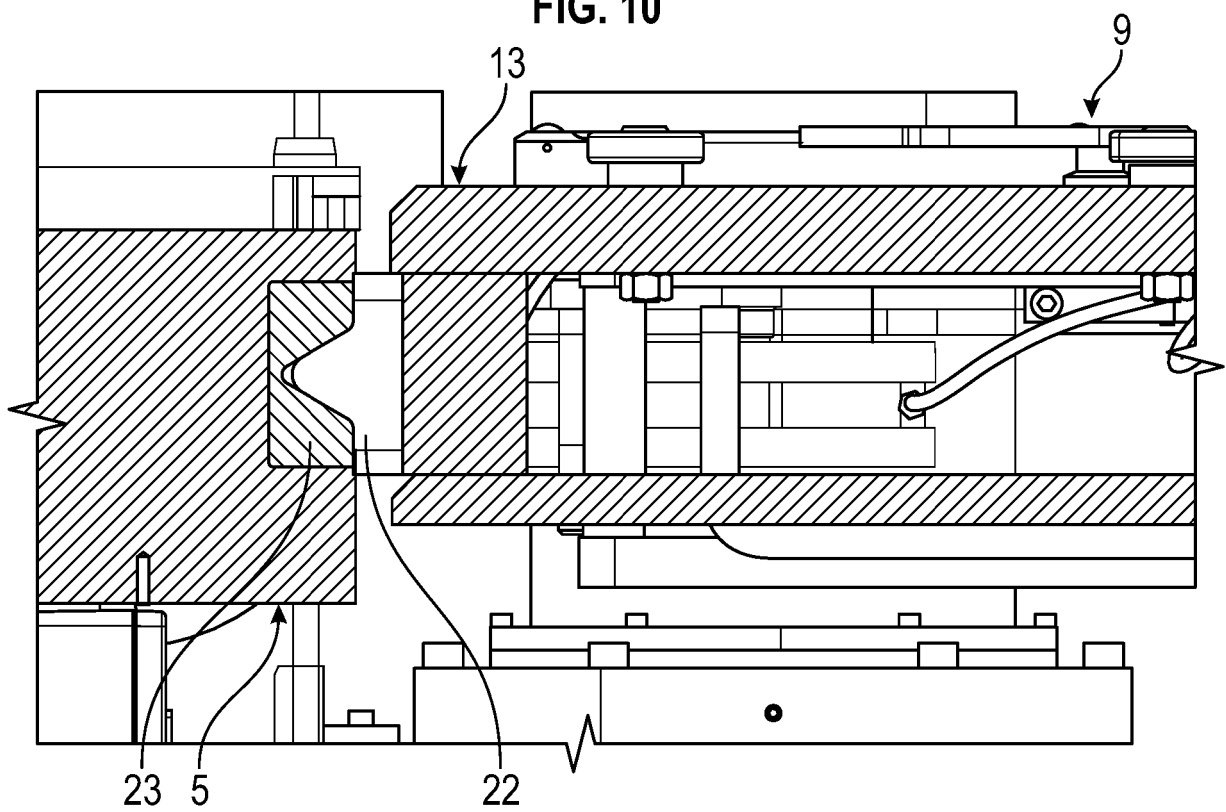


FIG. 11

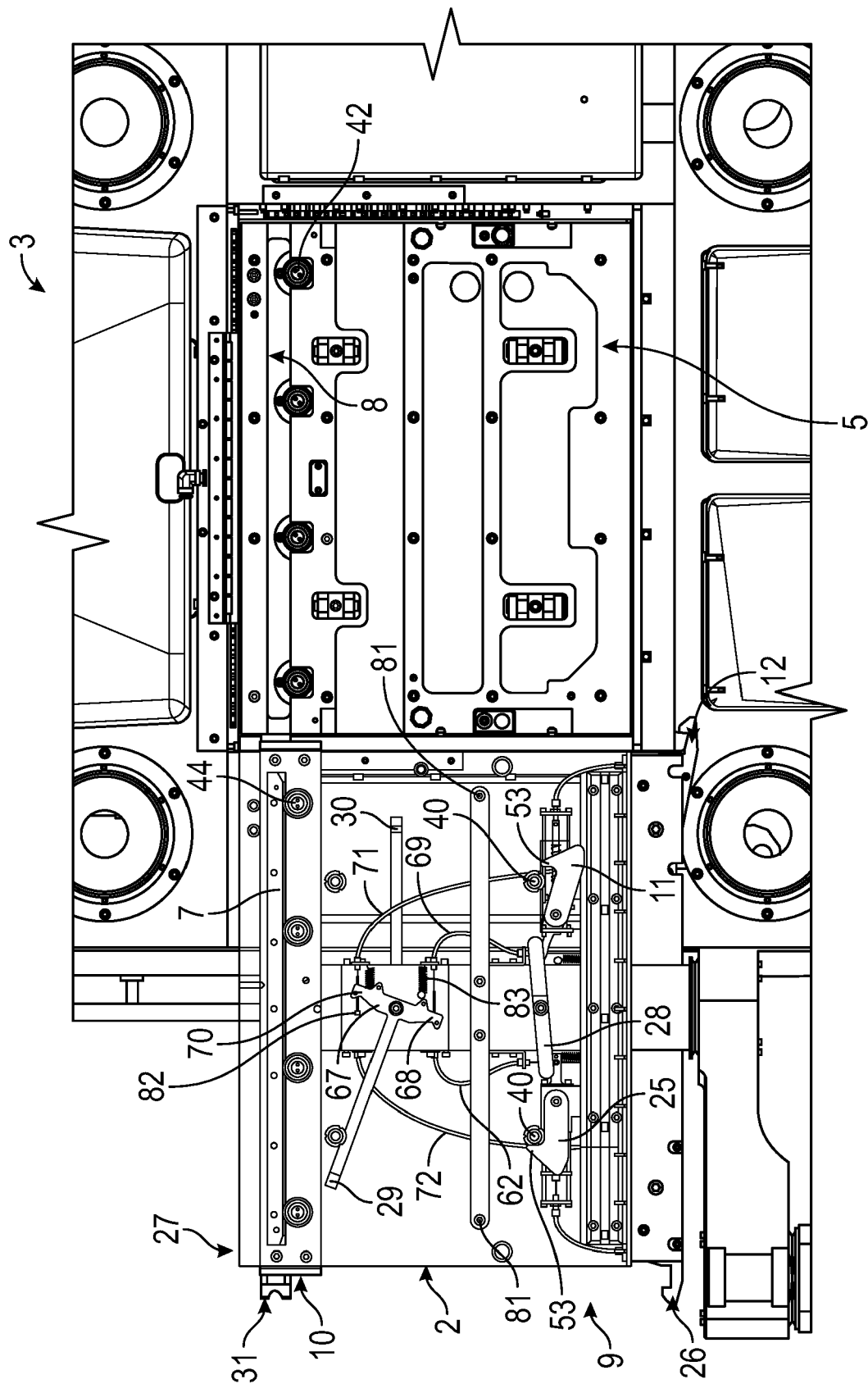


FIG. 12



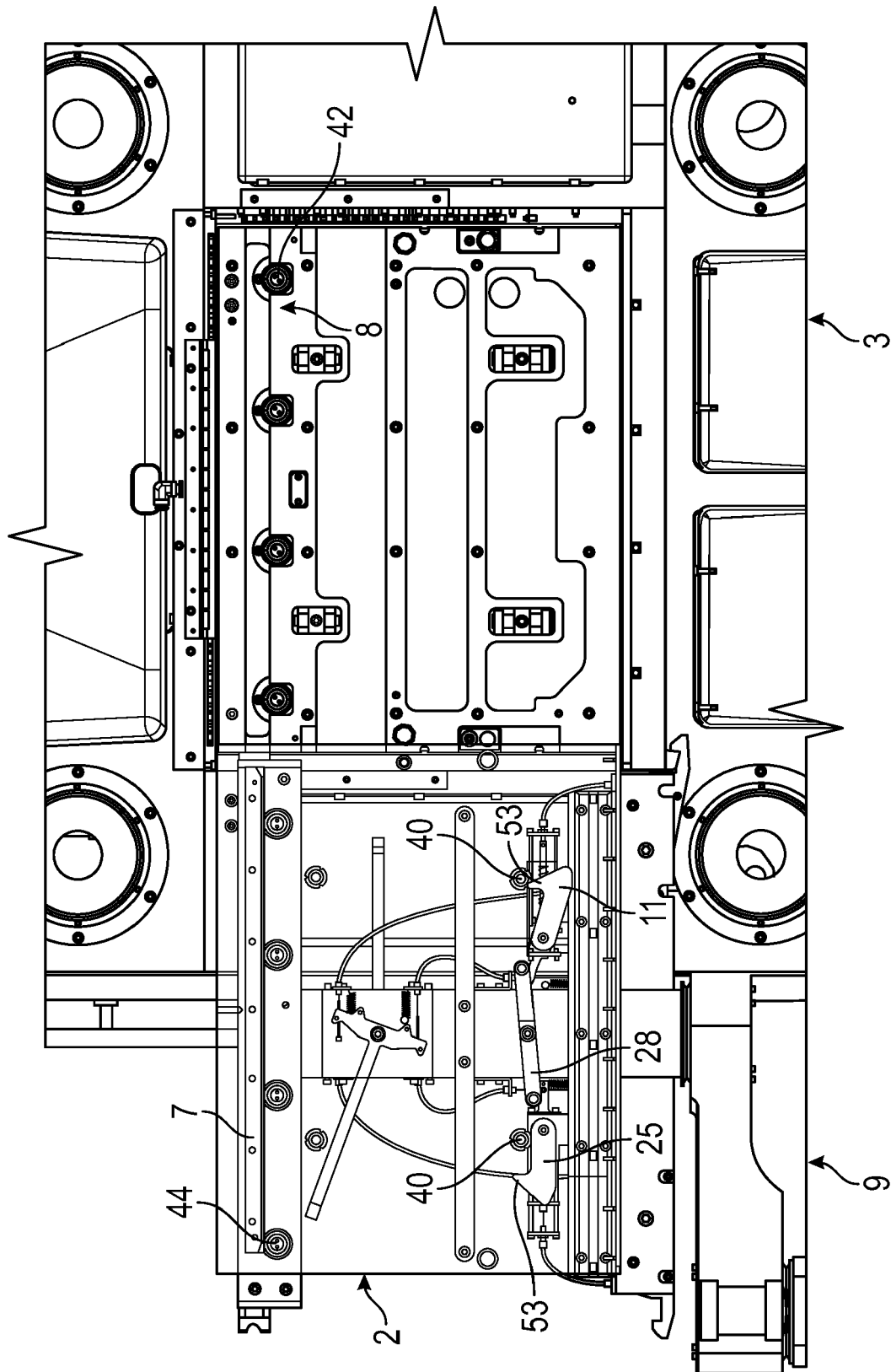


FIG. 13

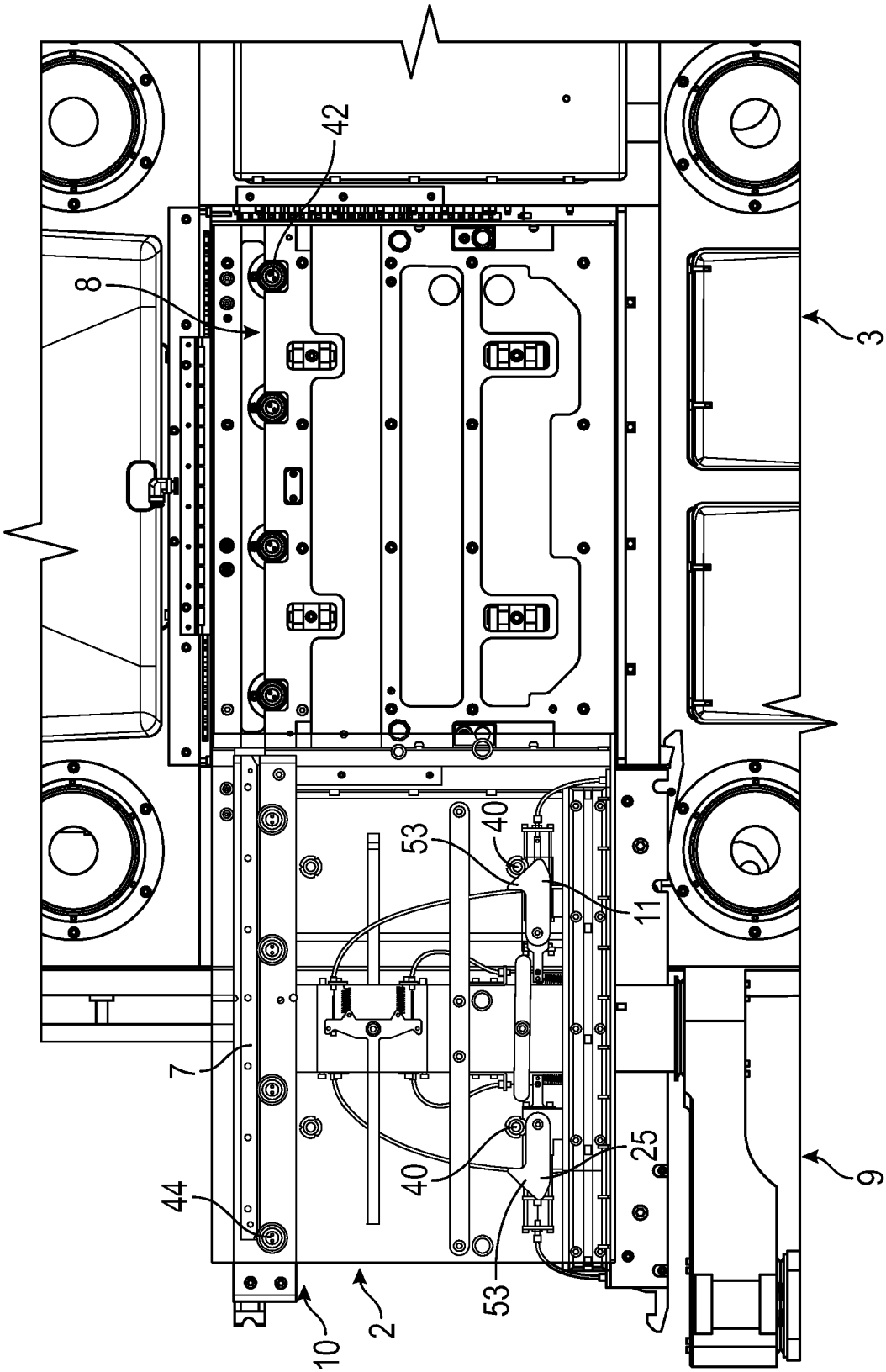


FIG. 14

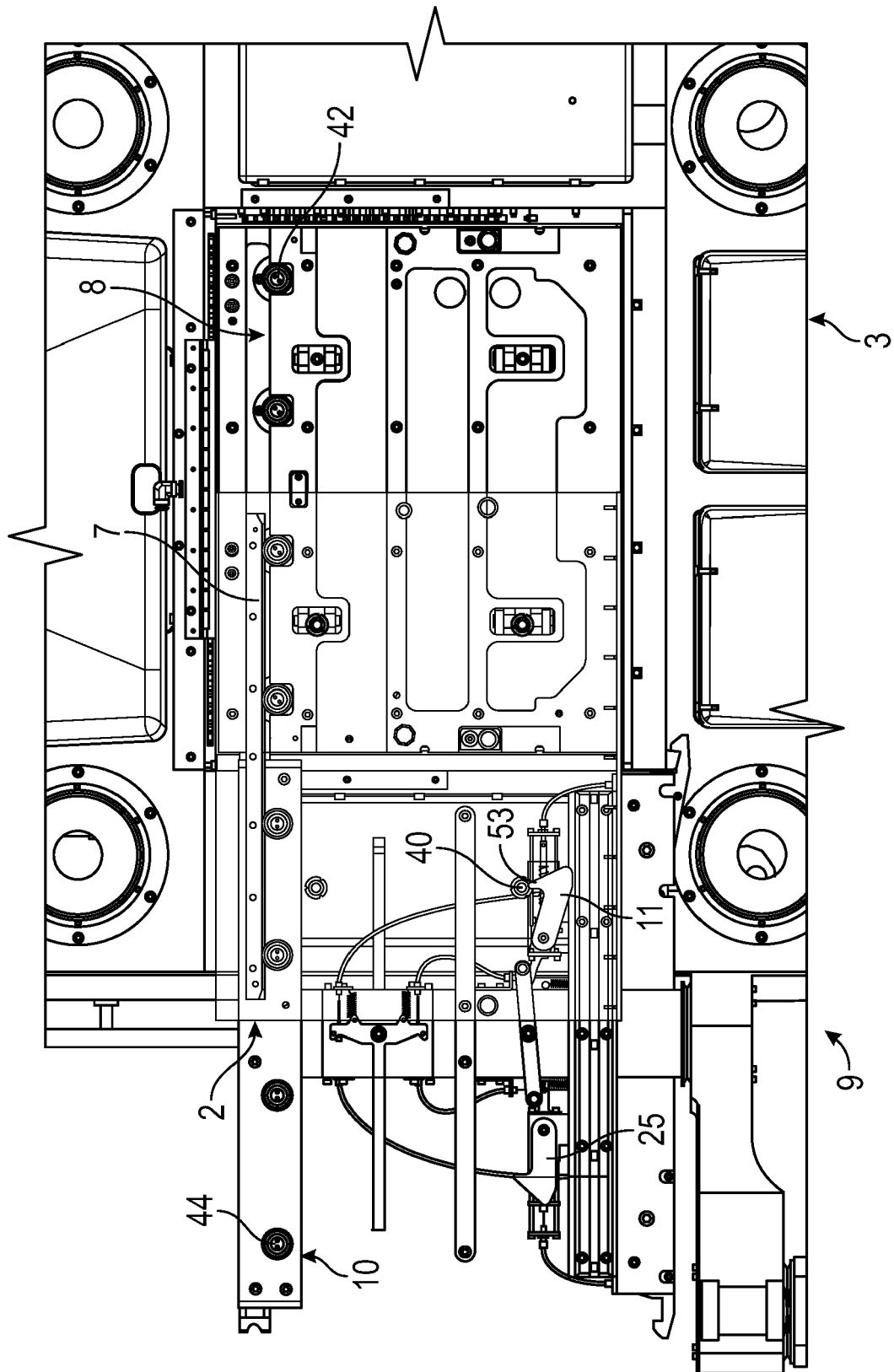


FIG. 15

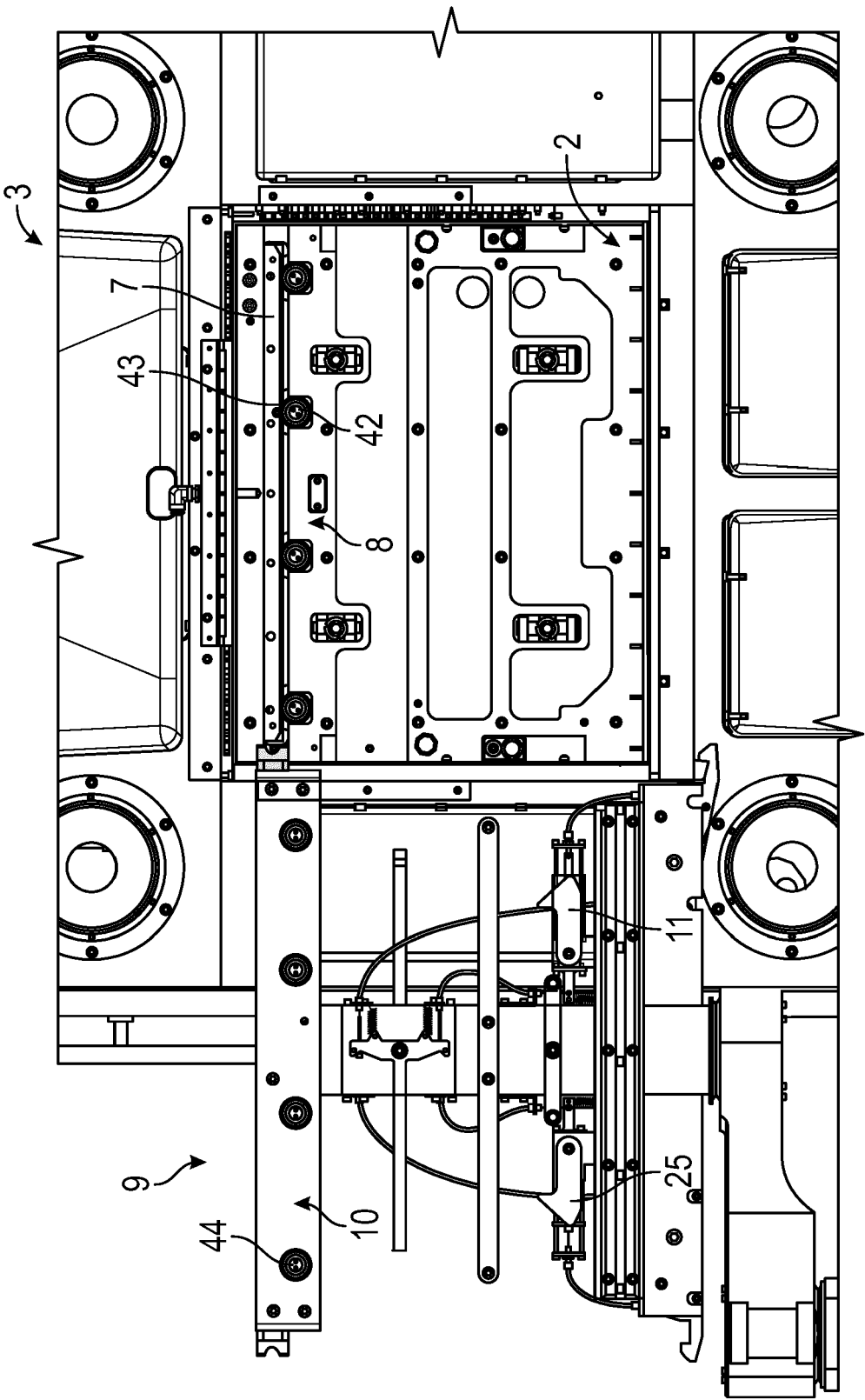


FIG. 16

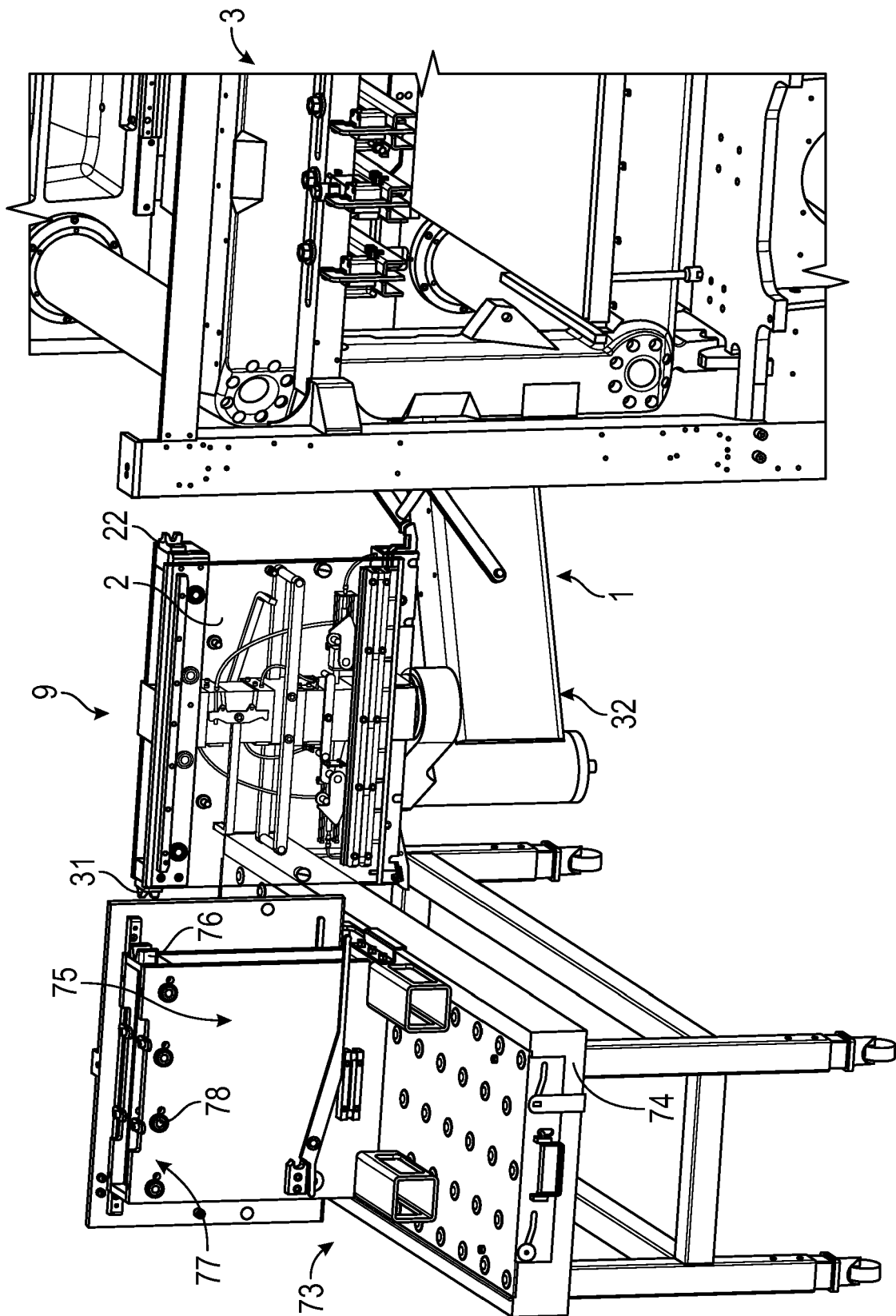


FIG. 17

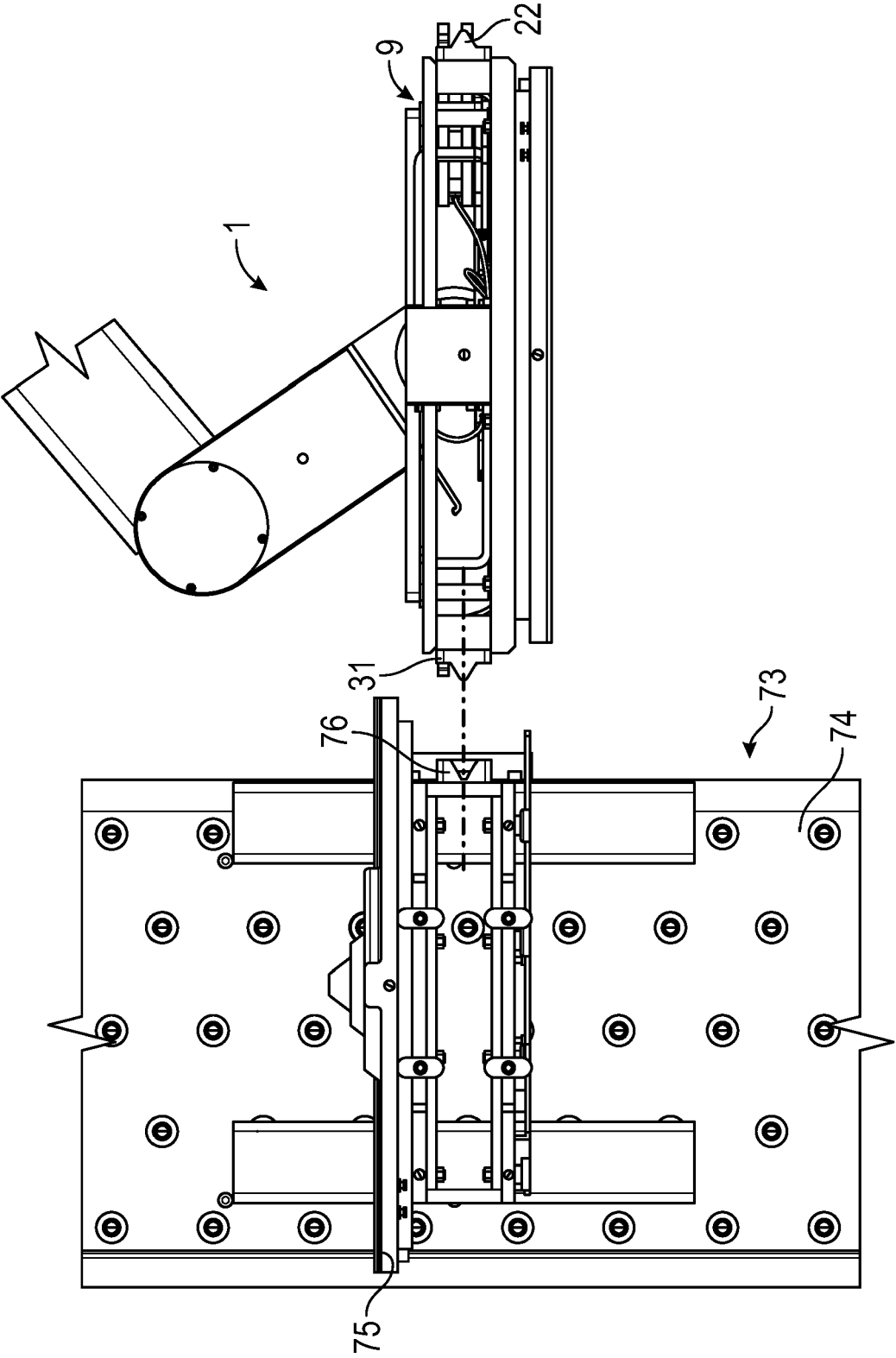


FIG. 18

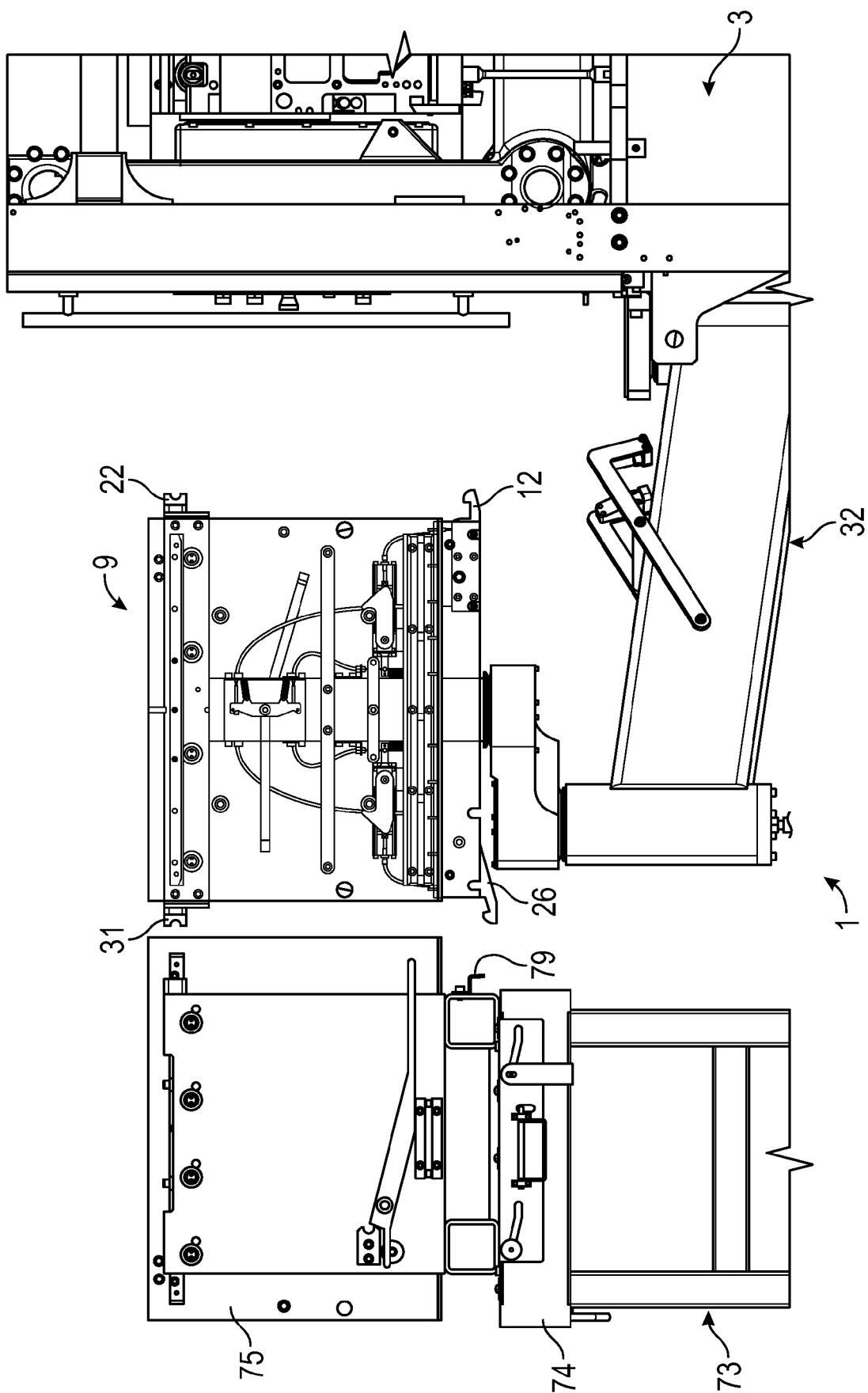


FIG. 19

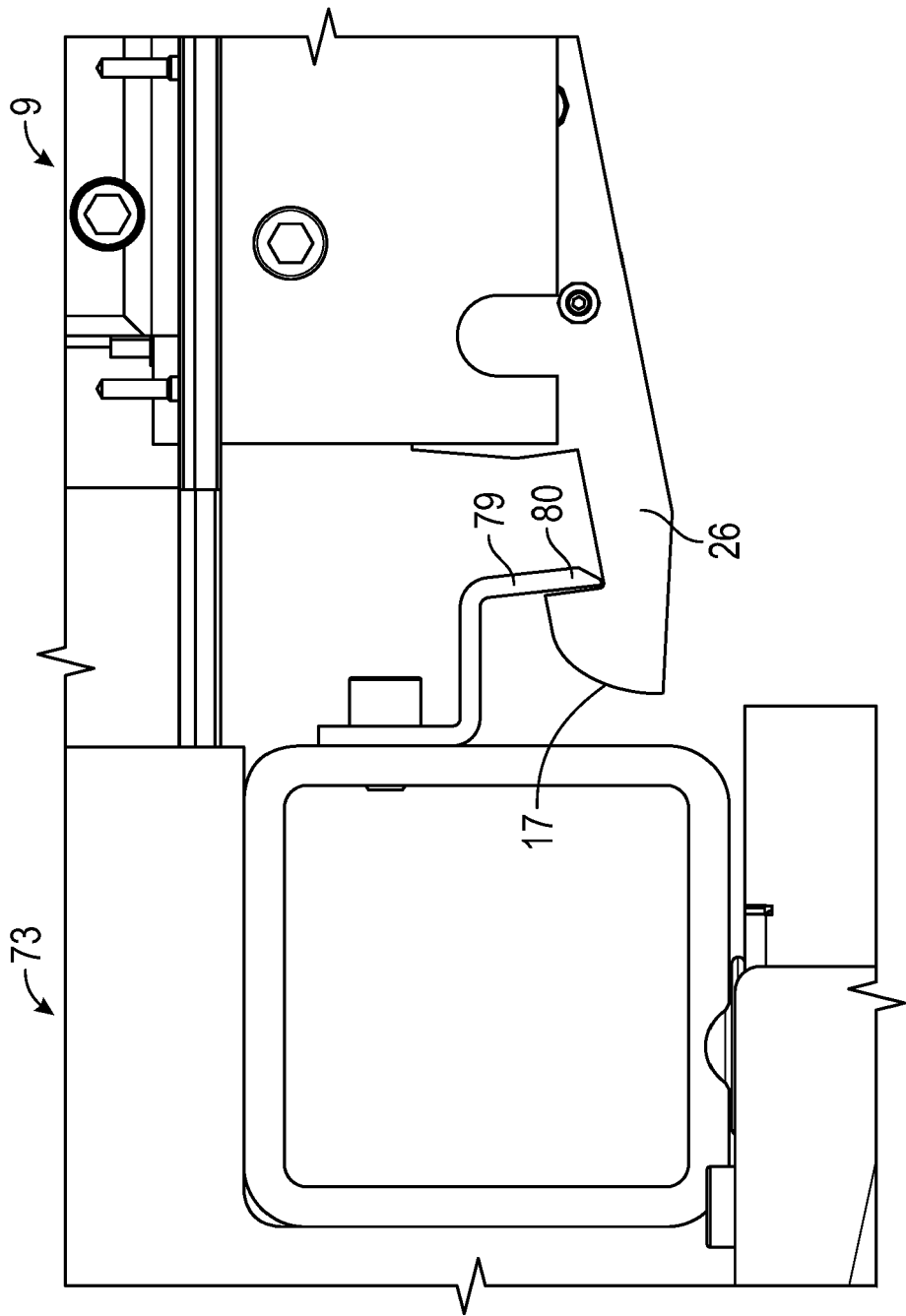


FIG. 20



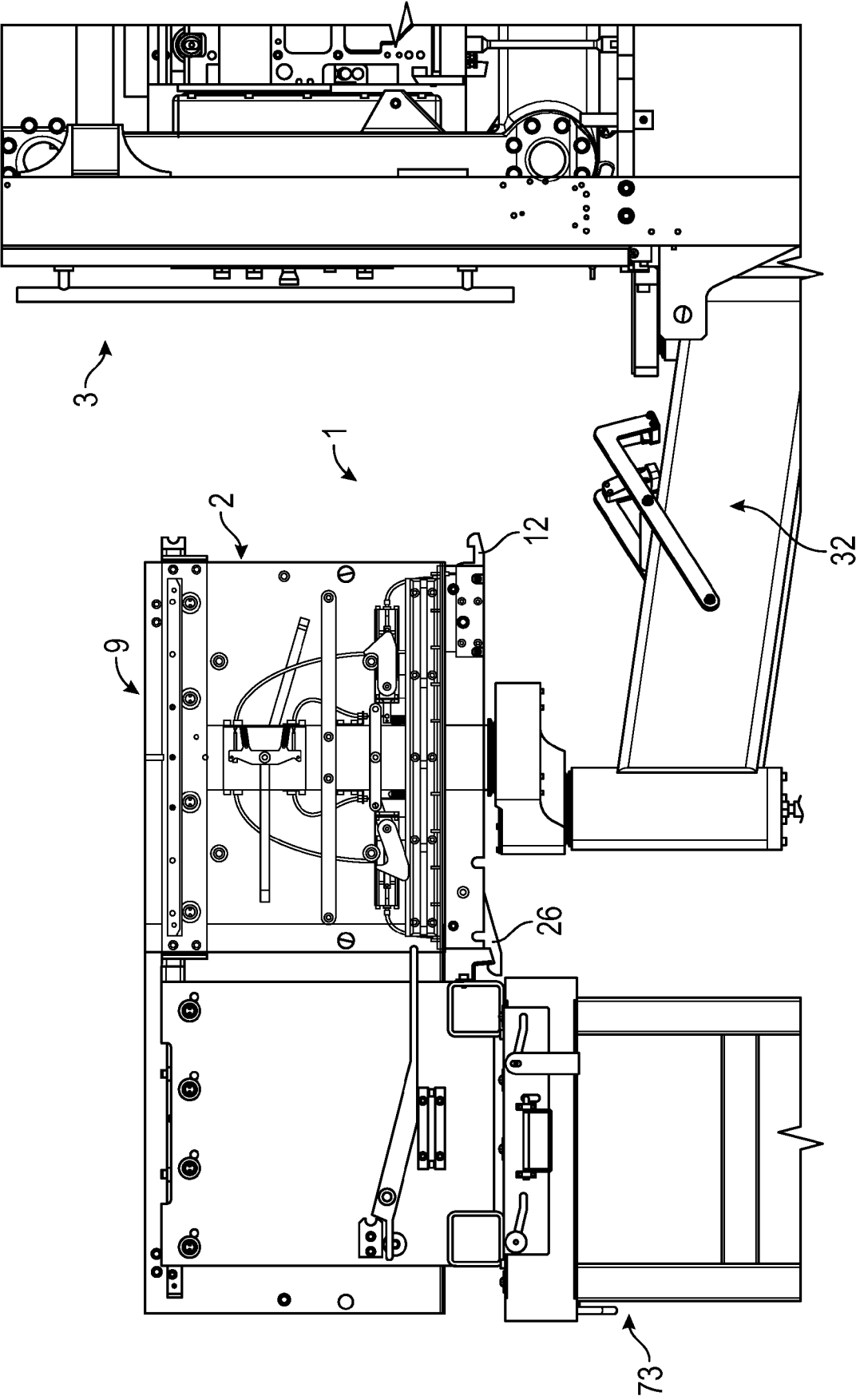


FIG. 21

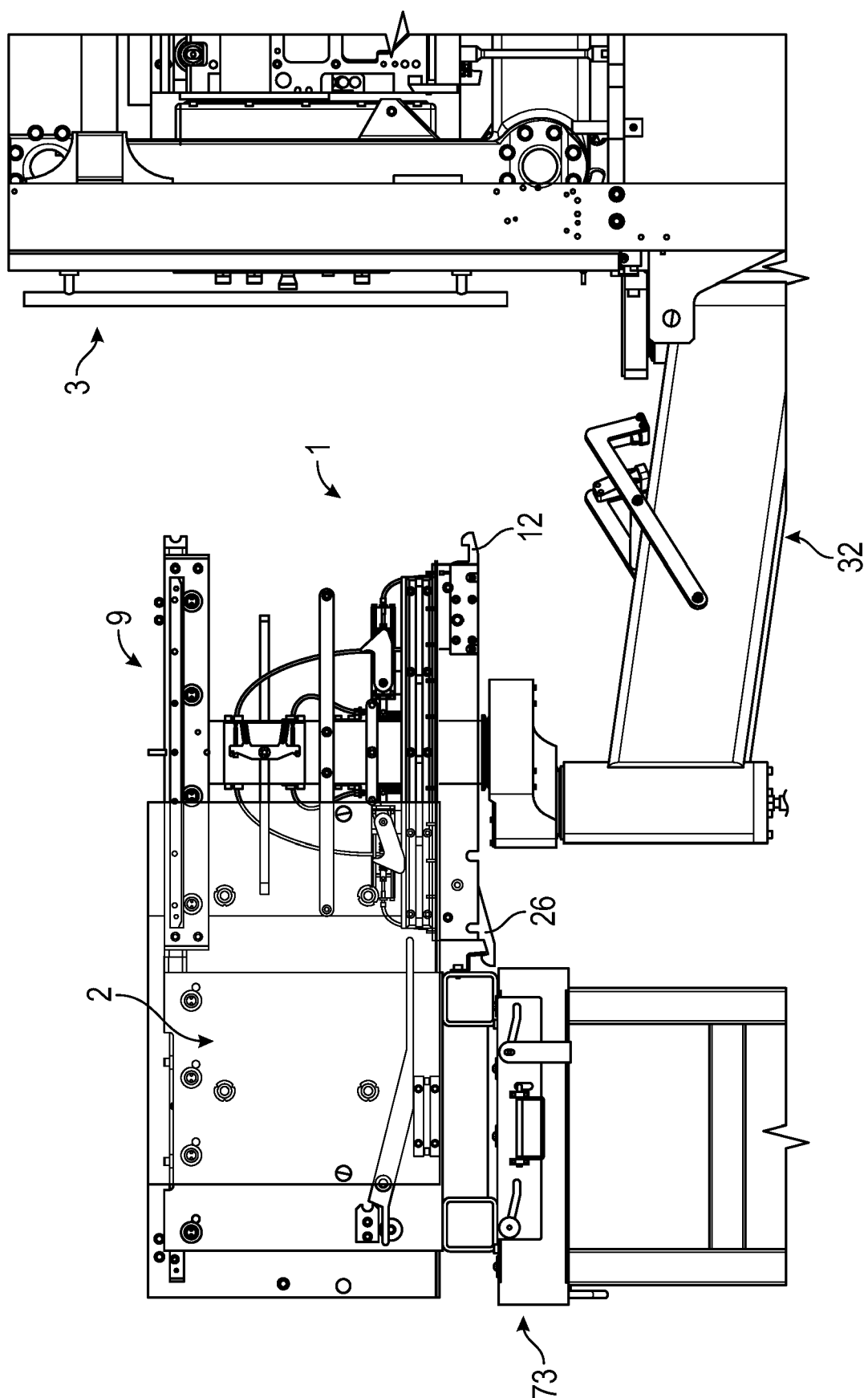


FIG. 22



## EUROPEAN SEARCH REPORT

Application Number

EP 22 16 4795

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EPO FORM 1503 03.82 (P04C01)

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
A	GB 1 066 622 A (GIESSEREI UND MASCHB FERDINAND) 26 April 1967 (1967-04-26) * the whole document *	1-14	INV. B22C7/04 B22C19/06 B22C15/08
A	WO 2014/187671 A1 (LORAMENDI S COOP [ES]) 27 November 2014 (2014-11-27) * page 6, line 8 - page 9, line 20; figures 1-4 *	1-14	
A	JP H06 198391 A (SINTOKOGIO LTD) 19 July 1994 (1994-07-19) * Machine translation; paragraph [0002] - paragraph [0009]; figures 3,4 *	1-14	
			TECHNICAL FIELDS SEARCHED (IPC)
			B22C
The present search report has been drawn up for all claims			
Place of search <b>The Hague</b>		Date of completion of the search <b>29 August 2022</b>	Examiner <b>Desvignes, Rémi</b>
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	

# ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO.

EP 22 16 4795

5

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 The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

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Patent document cited in search report	Publication date	Patent family member(s)	Publication date
<b>GB 1066622 A</b>	<b>26-04-1967</b>	<b>NONE</b>	
<hr/>			
<b>WO 2014187671 A1</b>	<b>27-11-2014</b>	<b>CN 105492139 A</b>	<b>13-04-2016</b>
		<b>DK 2999560 T3</b>	<b>27-05-2019</b>
		<b>DK 3492195 T3</b>	<b>28-09-2020</b>
		<b>EP 2999560 A1</b>	<b>30-03-2016</b>
		<b>EP 3492195 A1</b>	<b>05-06-2019</b>
		<b>ES 2727254 T3</b>	<b>15-10-2019</b>
		<b>ES 2823161 T3</b>	<b>06-05-2021</b>
		<b>KR 20160033075 A</b>	<b>25-03-2016</b>
		<b>MX 367467 B</b>	<b>22-08-2019</b>
		<b>RU 2015154327 A</b>	<b>22-06-2017</b>
		<b>TR 201907576 T4</b>	<b>21-06-2019</b>
		<b>US 2016089713 A1</b>	<b>31-03-2016</b>
		<b>WO 2014187671 A1</b>	<b>27-11-2014</b>
<hr/>			
<b>JP H06198391 A</b>	<b>19-07-1994</b>	<b>JP 3058380 B2</b>	<b>04-07-2000</b>
		<b>JP H06198391 A</b>	<b>19-07-1994</b>
<hr/>			