# United States Patent [19]

**Furuse et al.**

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[45] **Nov. 25, 1975**


[54] **AUTOMATED DEVICE FOR TAKING OUT SLABS FROM A CONTINUOUS CASTING APPARATUS, BRINGING THEM INTO ALIGNMENT AND STACKING THEM TOGETHER**


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[73] Assignee: **The Dowa Mining Co., Ltd.,** Tokyo, Japan



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[21] Appl. No.: **437,943**

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| Feb. 8, 1973 | Japan | 48-15172 |
| Feb. 9, 1973 | Japan | 48-15699 |
| Feb. 12, 1973 | Japan | 48-16503 |

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[51] **Int. Cl.²** ..... **B22D 5/04**

[58] **Field of Search** ..... 164/329, 331, 282, 269, 164/129, 130



[56] **References Cited**

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*Assistant Examiner*—John E. Roethel
*Attorney, Agent, or Firm*—Toren, McGeady and Stanger



[57] **ABSTRACT**

An automated device for use with a continuous casting apparatus for molten metal, especially zinc metal, in which a sequence of operations starting with taking out the slabs from the mold of the casting apparatus and terminating with the stacking of the slabs for packaging is fully automated.


**7 Claims, 10 Drawing Figures**

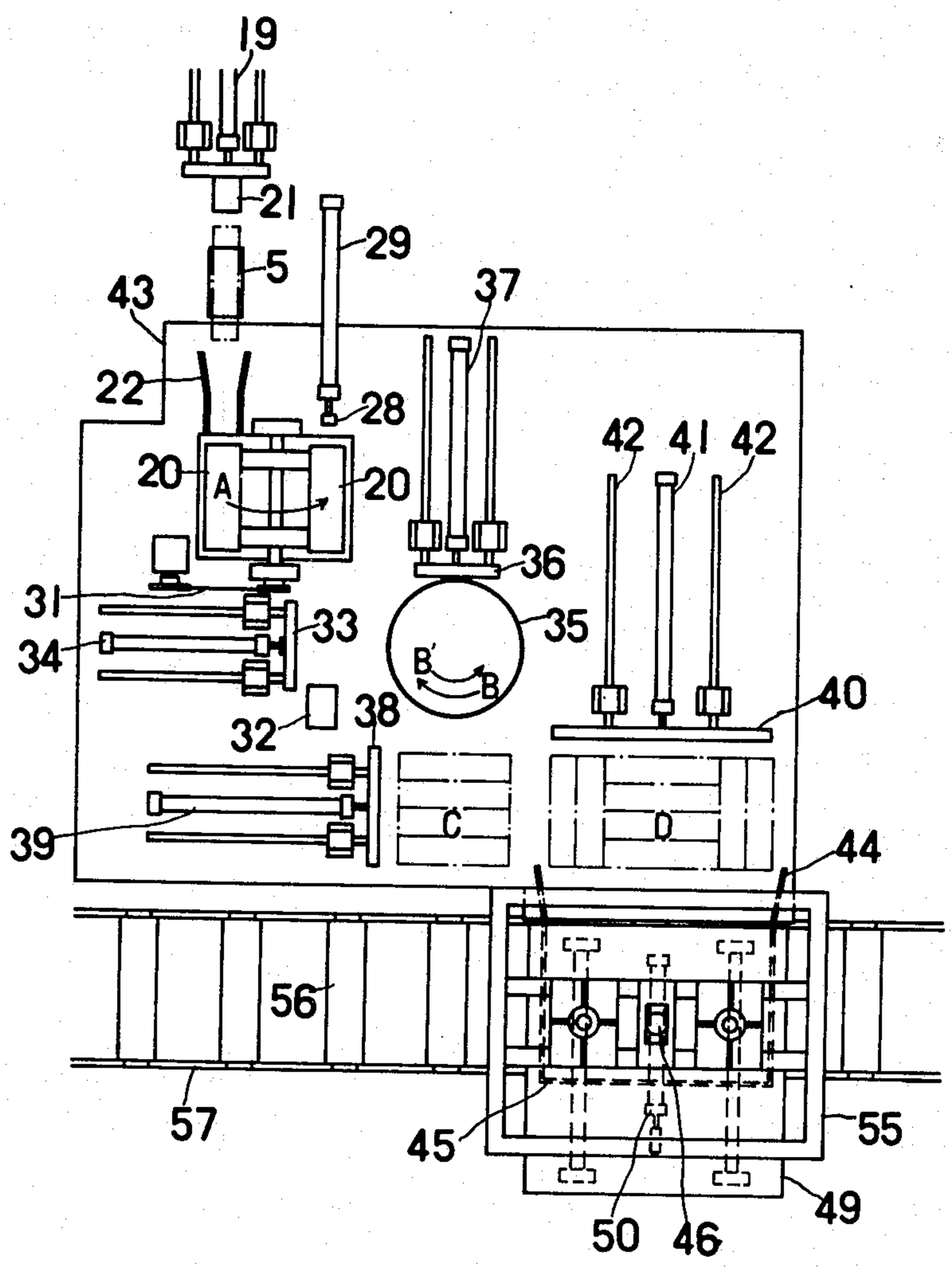
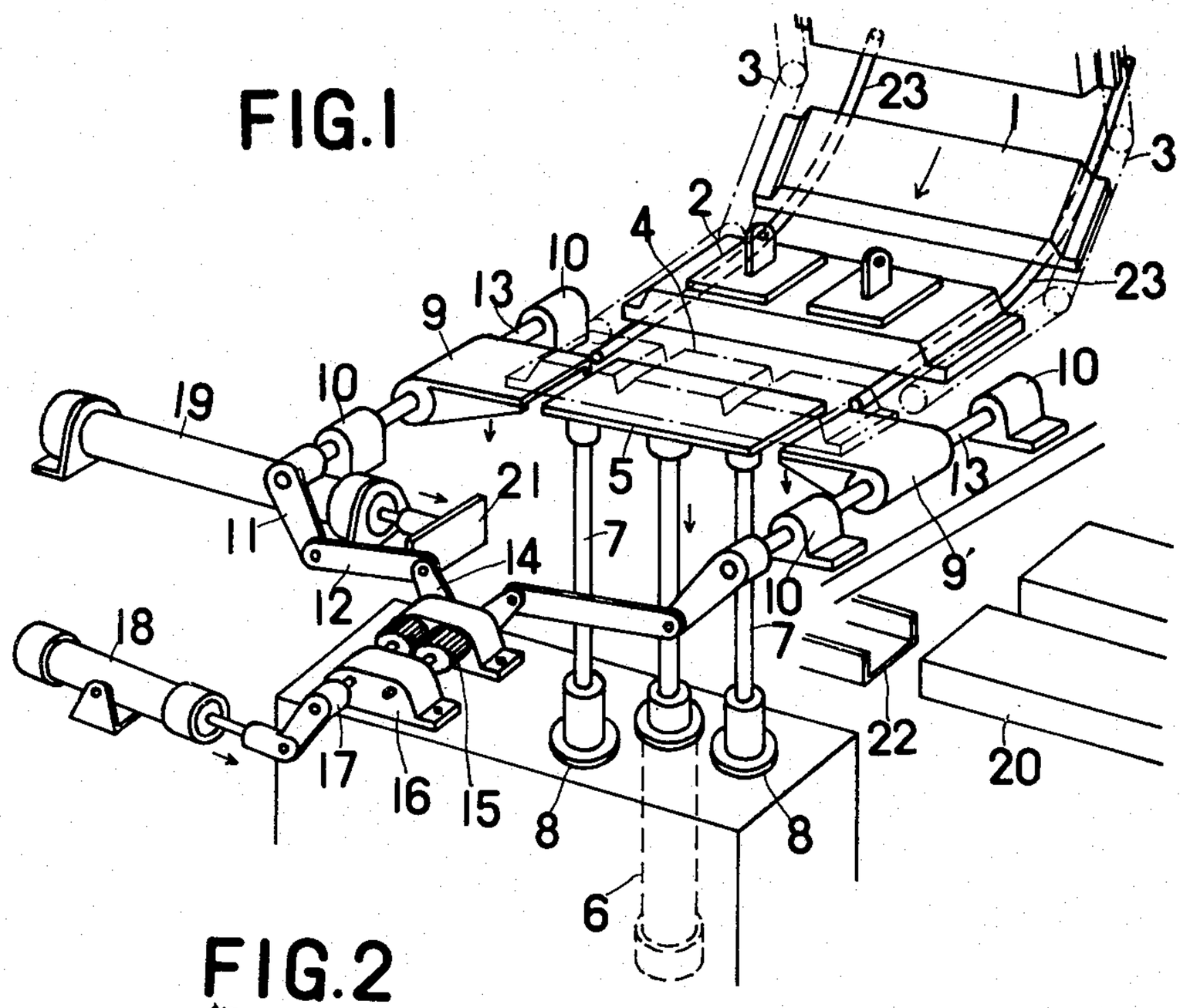


FIG.1


3
23
3
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13
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23
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19
10
21
5
13
11
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14
9'
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18
7
22
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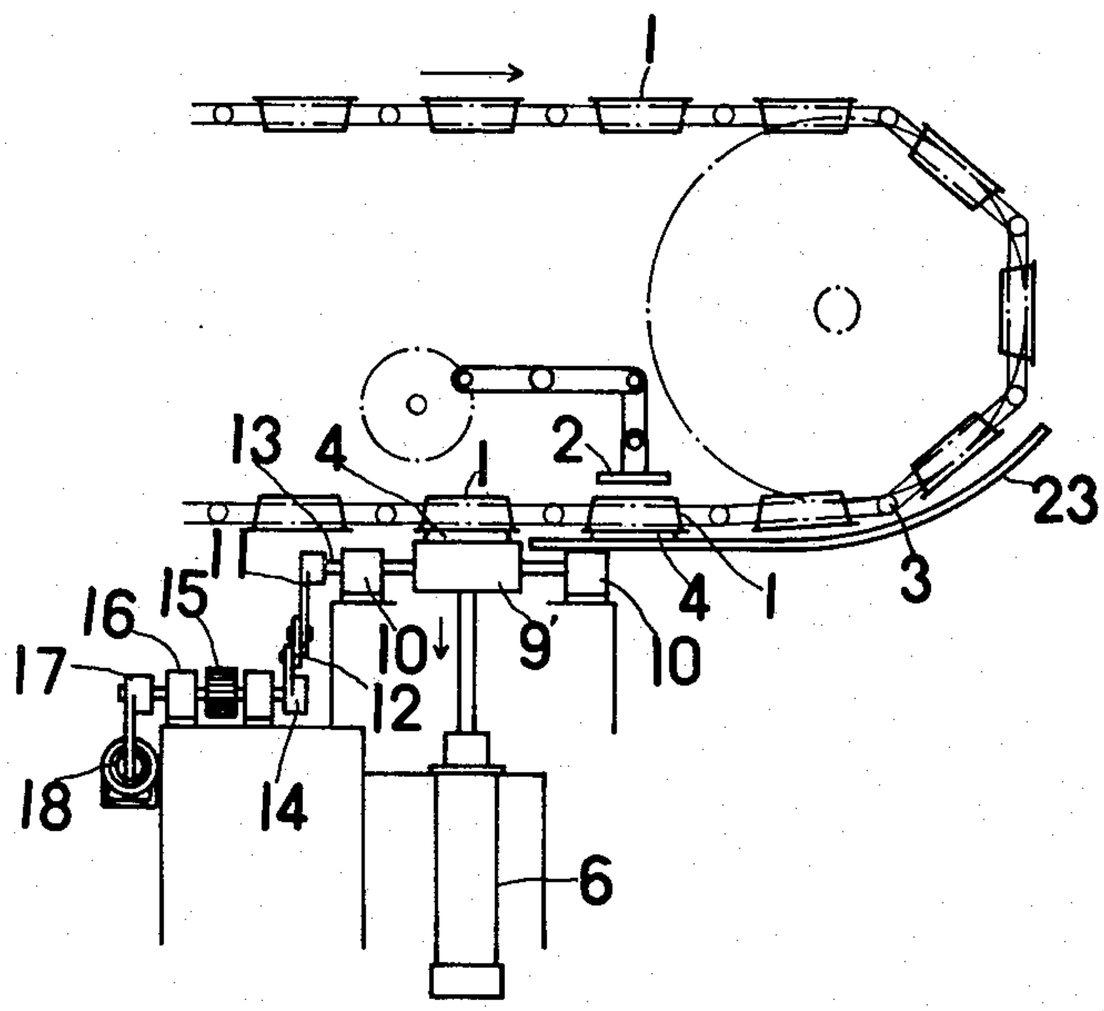
17
16
15
8
8
6

FIG.2


1
13
4
2
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15
16
10
9'
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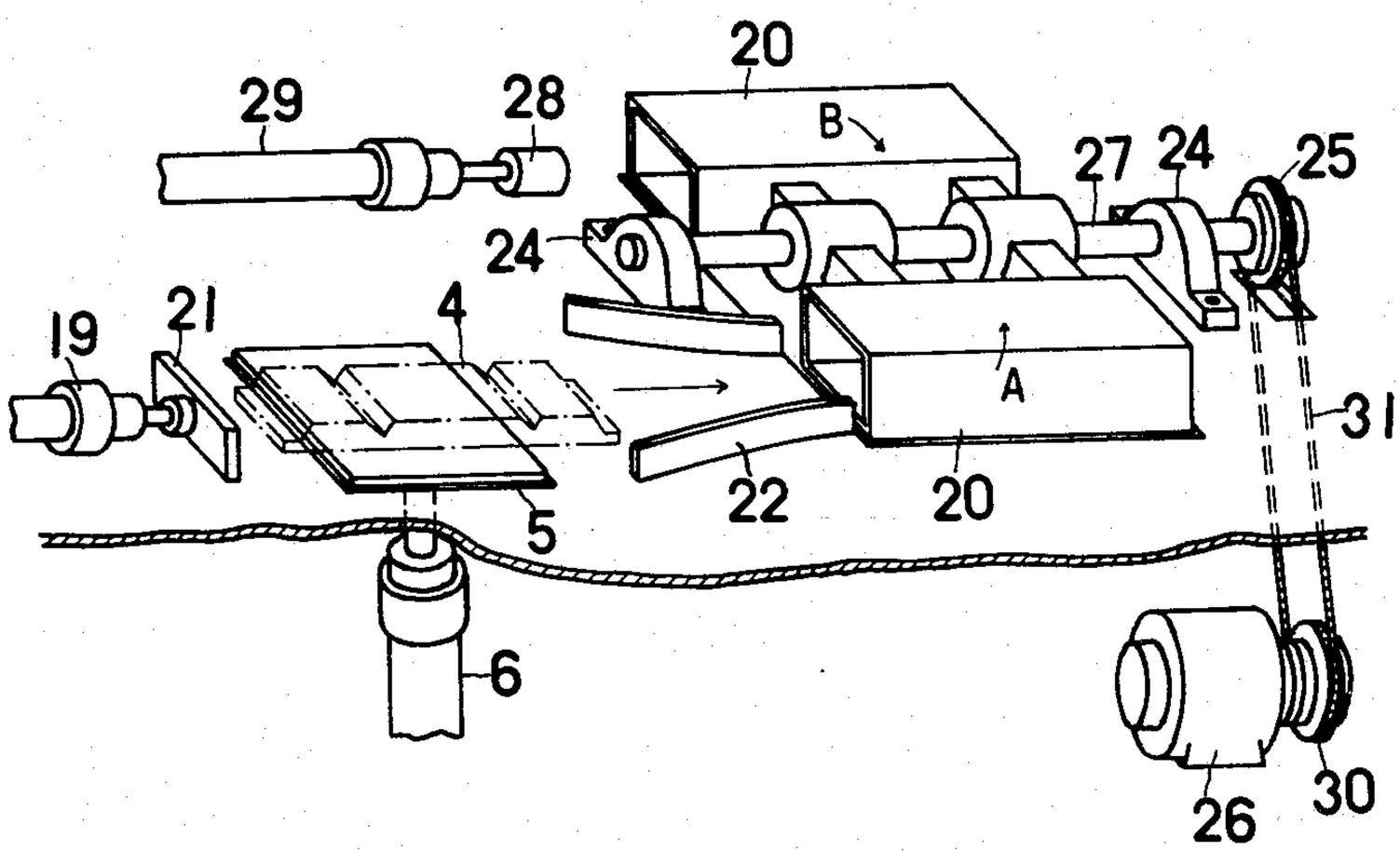
12
18
14
6

FIG.3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29
28
B
27
24
25
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19
21
4
A
31
22
20
5
6
26
30

FIG.4

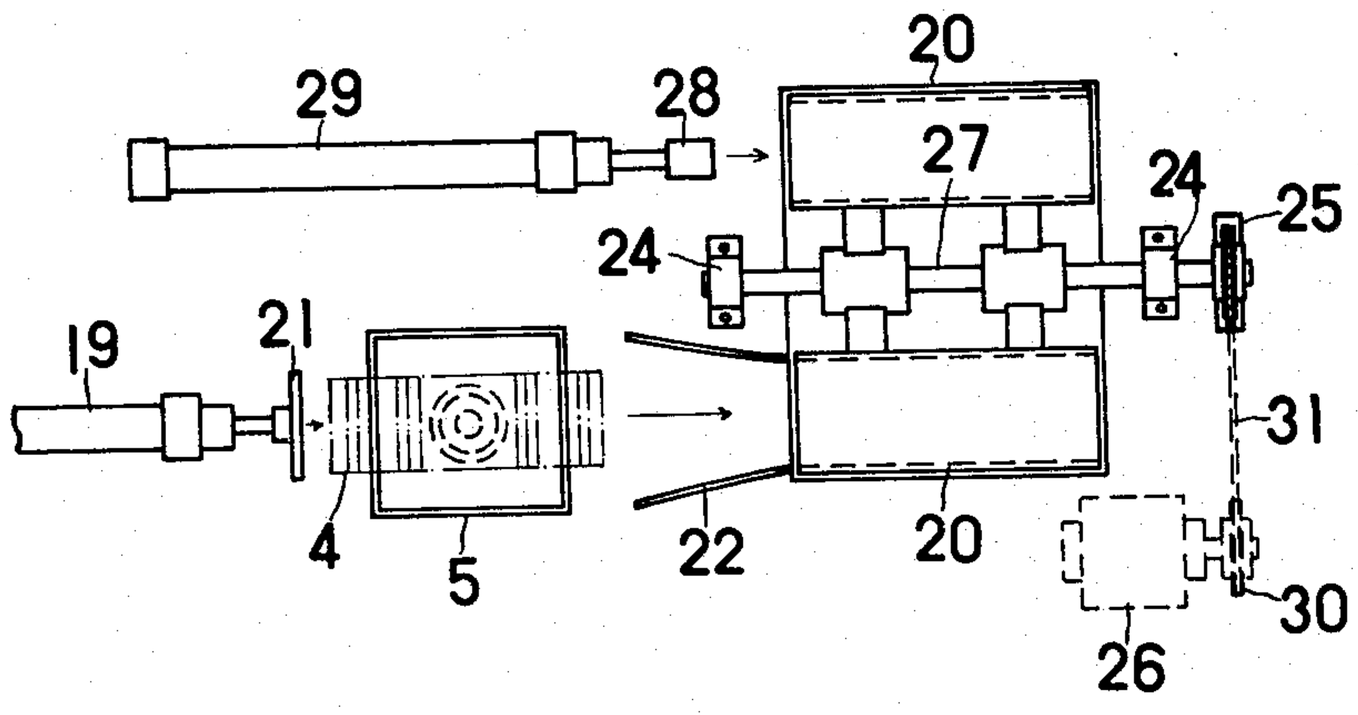
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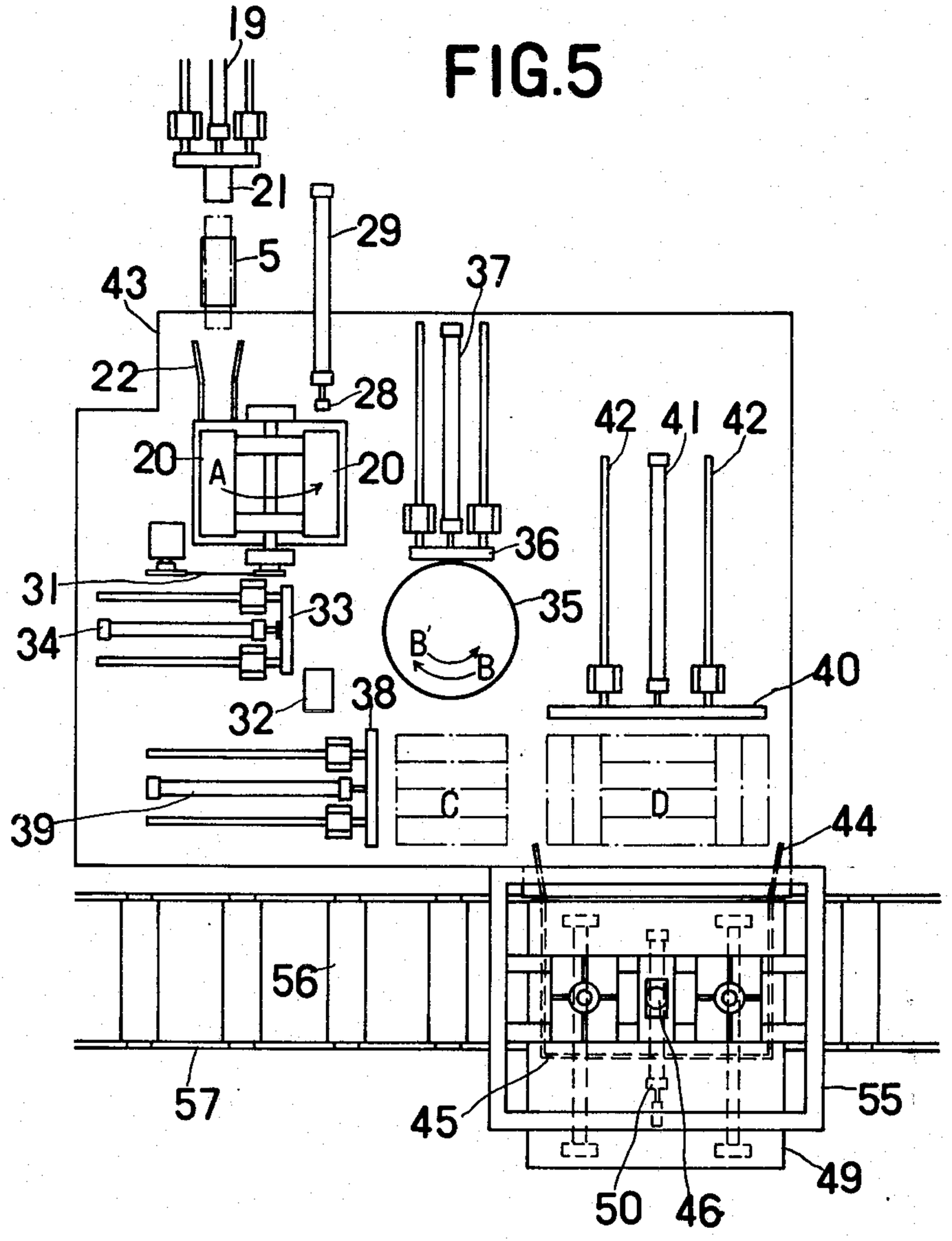
FIG.5


19
21
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43
37
22
28
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A
20
42
41
42
36
31
33
35
34
B'
B
40
38
32
C
D
39
44
56
57
45
55
50
46
49

FIG.6

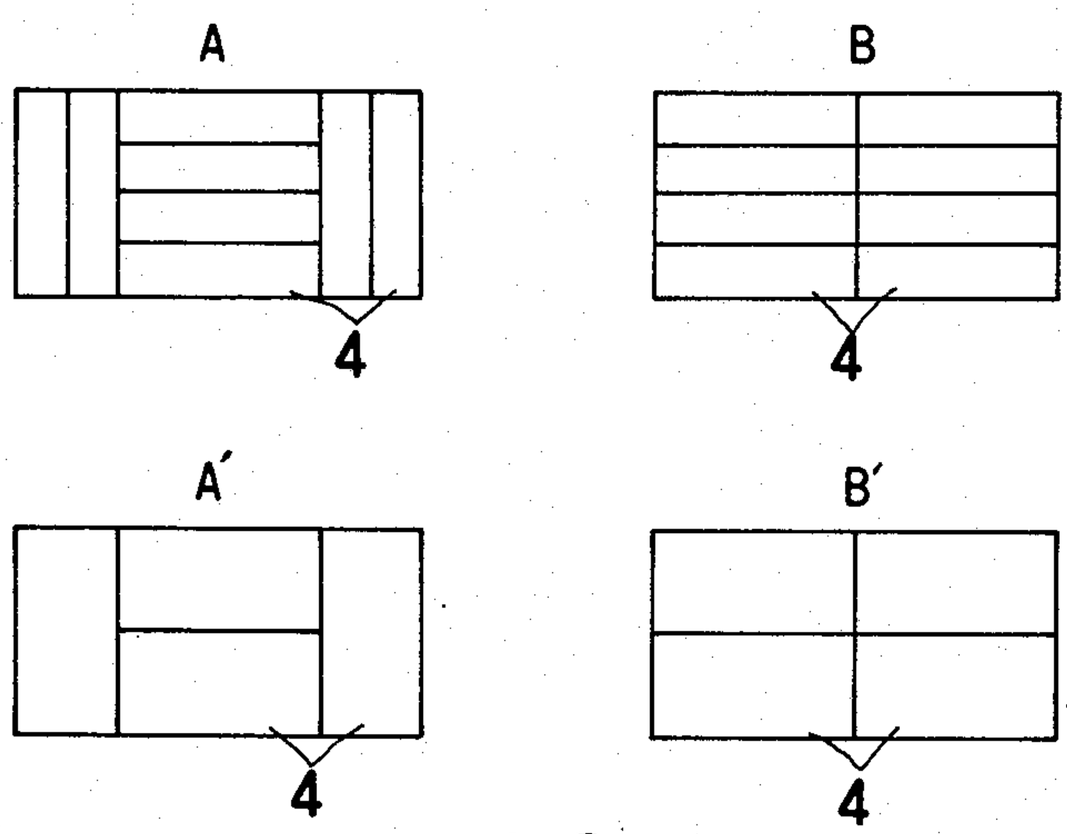



FIG.6a

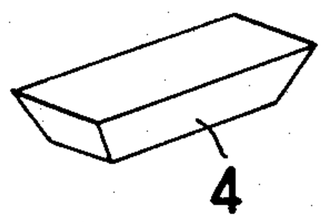


FIG.7

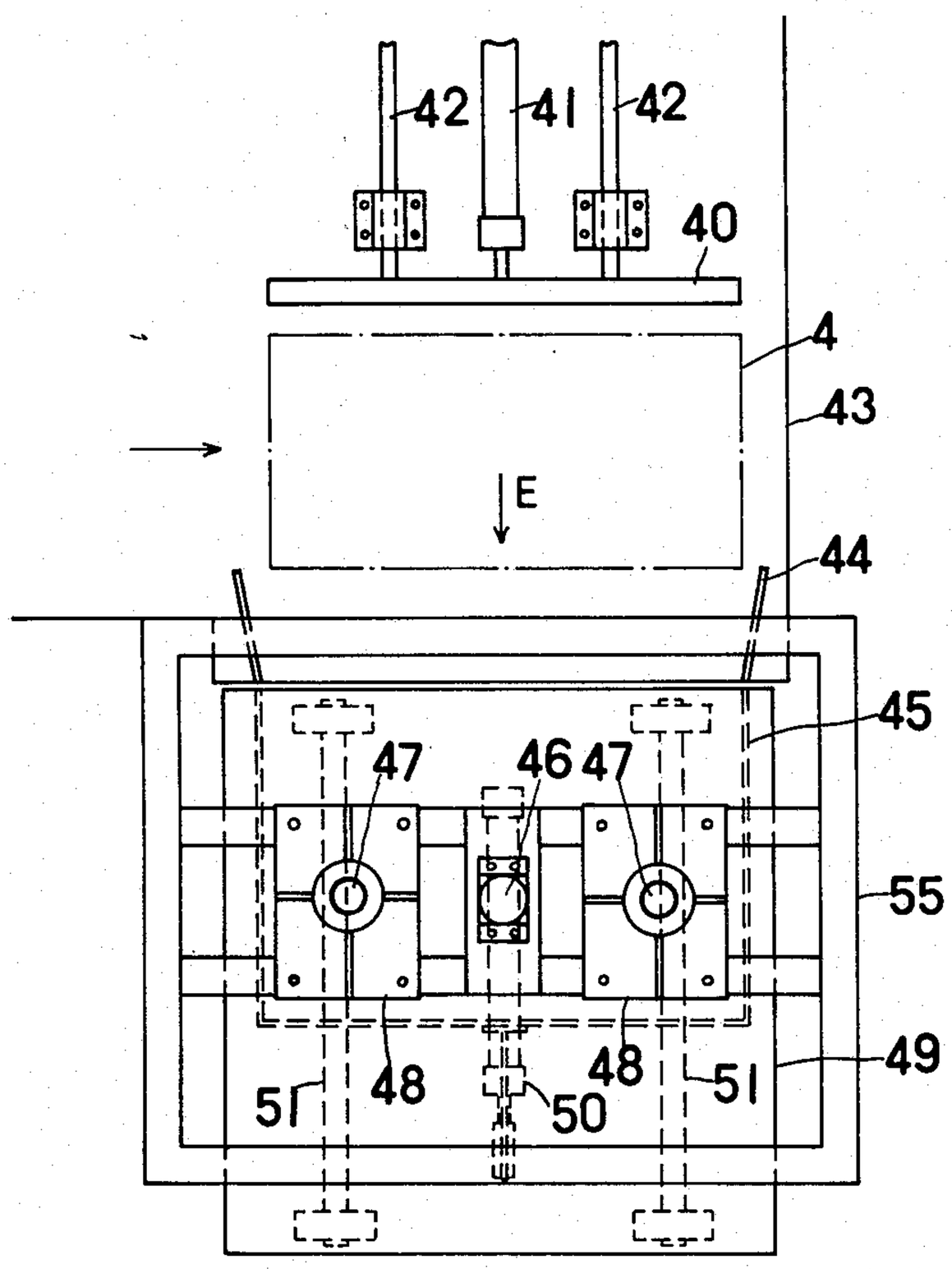


FIG.8

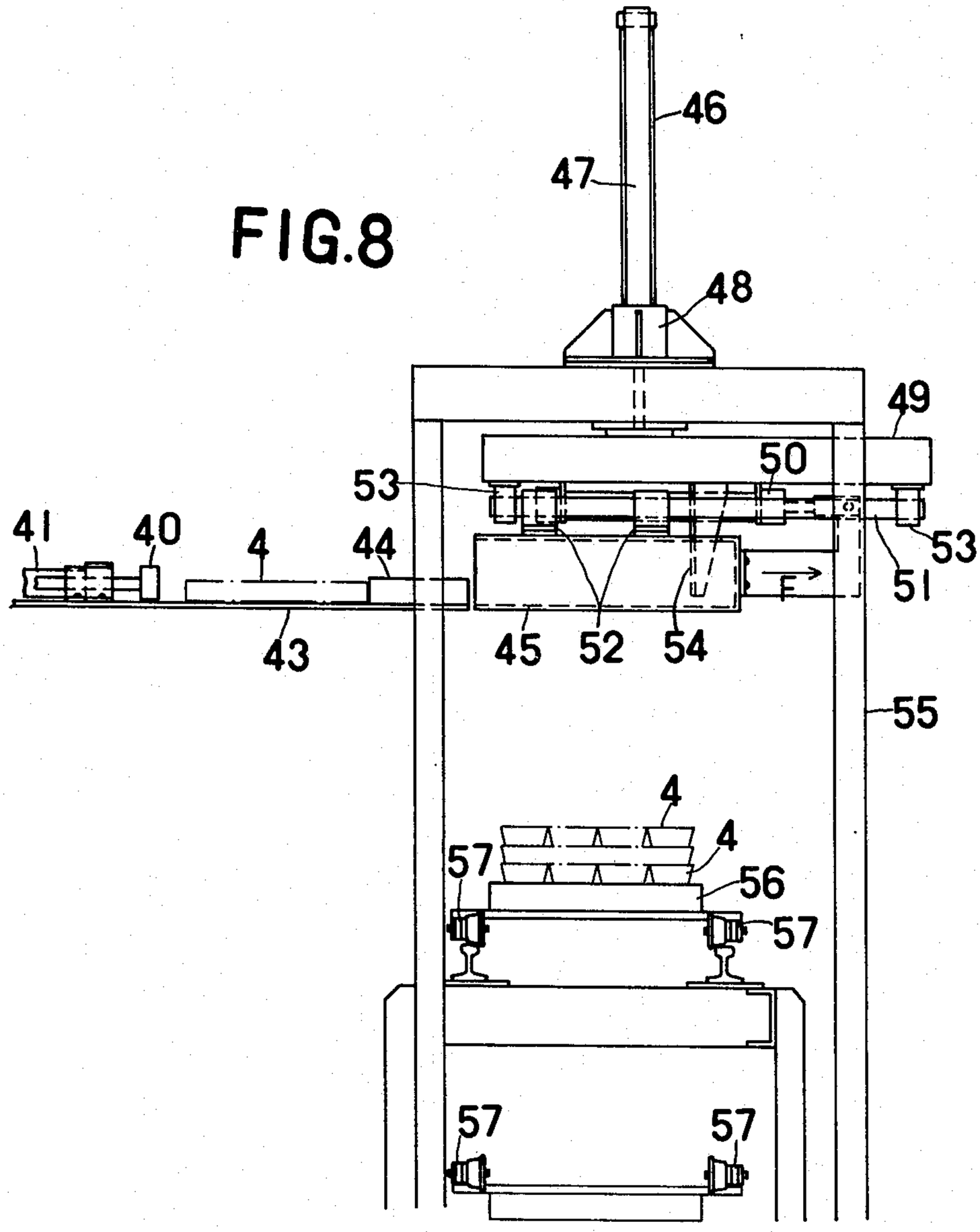
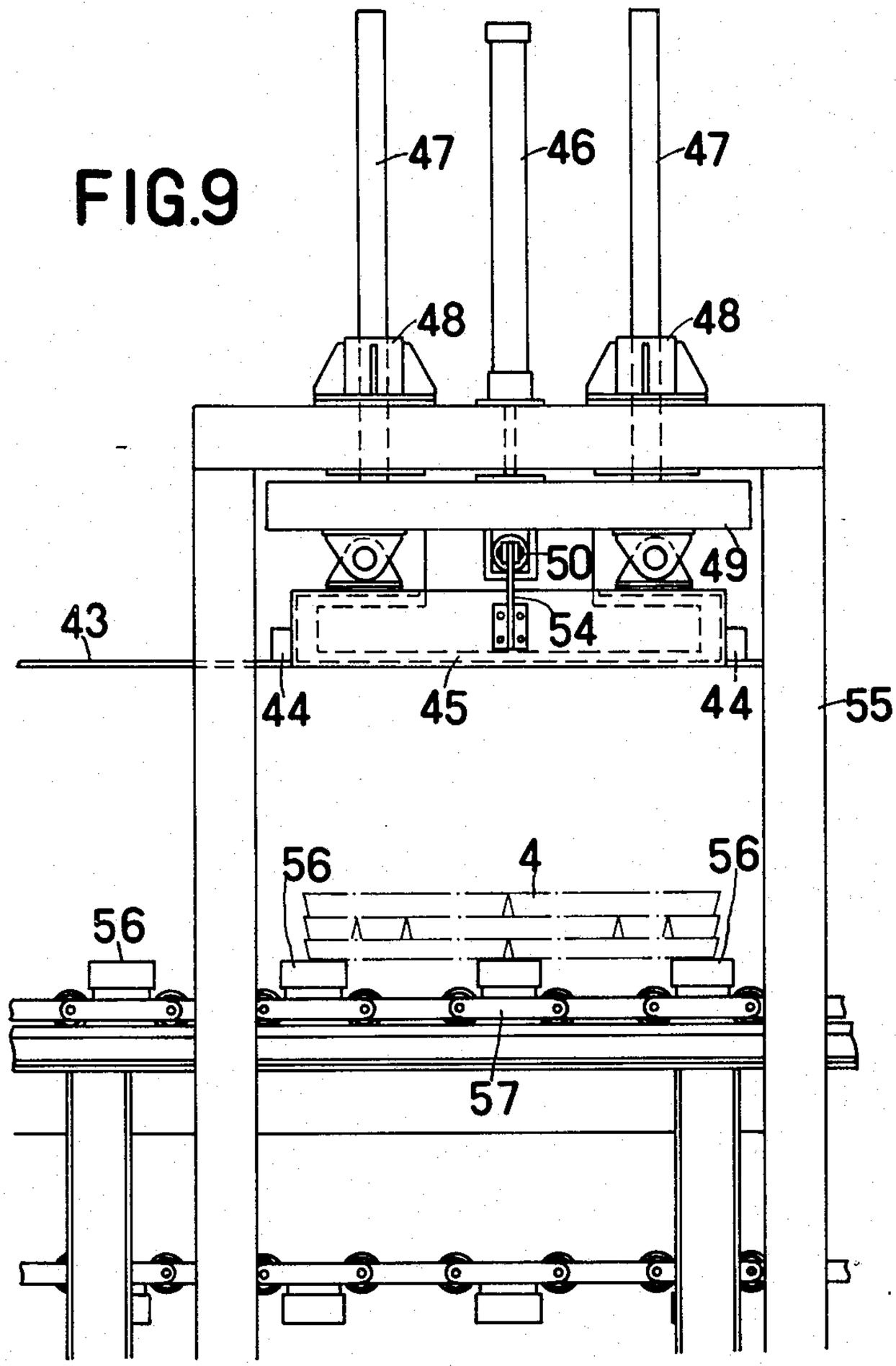


FIG.9



# AUTOMATED DEVICE FOR TAKING OUT SLABS FROM A CONTINUOUS CASTING APPARATUS, BRINGING THEM INTO ALIGNMENT AND STACKING THEM TOGETHER

This invention relates to an automated device for use with a continuous casting apparatus for molten metal, especially zinc metal, in which a sequence of operations starting with taking out the slabs from the mold of the casting apparatus and terminating with the stacking of the slabs for packaging is fully automated.

According to the present invention, the sequence of these operations may be conducted reliably and efficiently without the fear of inflicting an injury to the slabs. The device of this invention consists of a group of operating units that is controlled by one control unit interlocked with the casting apparatus and with the accessory units for pouring, skimming and cooling, and that is driven hydraulically with smooth and reliable operation.

The device of this invention consists of a take-out unit for taking out the slabs from the continuous casting apparatus, an alignment unit for bringing the slabs into alignment together, and a stacking unit. The take-out unit consists in turn of a percussion station and a receiving station, while the alignment unit consists of a reversing station and an assortment station.

The present invention will now be described hereafter by referring to the accompanying drawings.

In the drawings:

FIG. **1** is a perspective view of the slab receiving station;

FIG. **2** is a front view of the same;

FIG. **3** is a perspective view of the slab reversing station;

FIG. **4** is a plan view of the same;

FIG. **5** is a plan view of the alignment unit;

FIG. **6** shows, by way of examples, the various patterns of the slabs;

FIG. **6***a* is a plan view of the slab cast in this invention;

FIG. **7** is a plan view of the stacking unit;

FIG. **8** is a left-hand side view of the same; and

FIG. **9** is a front view of the same.

The take-out unit is explained by referring to FIGS. **1** and **2.** A series of molds **1** are mounted on an endless conveyor **3** which comprises an upper run and a lower run. Molten metal is poured in a predetermined amount into the molds of the upper run while they are in an upturned position. After skimming of the slug and subsequent cooling, the molds are moved at a fixed speed continuously in a direction shown by the arrow, and the slab is allowed to coagulate during this time interval. The molds of the lower run assume a down turned position after passing through the upper run of the casting apparatus and they are then moved past a percussion station **2** which is arranged intermediate the upper and lower runs of the continuous casting apparatus and adapted to apply a percussion force to the bottom of the molds in order to release therefrom a casting or slab **4.**

The slab **4** is removed from the mold **1,** but is carried by the guide rail **23** against accidental dropping and supplied to the receiving station as it is pulled past the mold. The receiving station is mounted below the return means and provided with pivotable plates **9** adapted to receive the slab from the terminal part of



the guide rail **23** in a horizontal receiving position as shown. The slab receiving plate **5** is then raised by means of a hydraulic cylinder **6** of the receiving station to support the slab **4.** The plates **9,9'** are then caused to swing by operation of the hydraulic cylinder **18** to depend downwards and through gear **15** and link means **17, 14, 12, 11, 13** to allow for free downward movement of the slab. The slab receiving plate **5** is lowered together with the slab to its lowest limit by operation of the cylinder **6** and stopped there, and the slab is delivered to the alignment unit.

The pivotable plates **9,9'** are returned by operation of the cylinder **18** to their horizontal positions ready for receiving the next slab, while the continuous casting apparatus is in operation. The guide shafts **7** fixed to the plate **5** are adapted to prevent angular displacement or twisting movement of the plate **5** and, to this end, they are secured at one end to the receiving plate **5** and arranged to guide vertical displacement thereof.

The apparatus comprises an alignment unit which includes a slab inverter or reversing station, and the hydraulic cylinder **19** of the reversing station comes in operation when the slab receiving plate **5** of the receiving unit is stopped at its lowermost position with the slab resting thereon, so that the slab **4** is pushed by the pusher plate **21** into the reversing cage **20** of the reversing station from the receiving plate **5** by way of guide means **22.** When the slab is thus pushed into the cage **20,** the cylinder **19** and the plate **21** are returned immediately to their staring positions. Two reversing cages **20, 20** each having a channel section are provided symmetrically on both sides of a rotary shaft **27** and are rotatable with rotation of the shaft **27,** which is adapted to make a partial revolution through 180° in both directions as shown by the arrows A and B by means of a torque actuator **26** and through sprocket wheels **30, 25** and chain **31.** Each rotary cage is stopped in a horizontal position with its open end correctly aligned with cylinders **19** and **29.** When the cages are stopped in their reversed positions, the slab **4** pushed into the cages **20** by the cylinder **19** and the pusher plate **21** is delivered to the opposite extrusion side from where it is extruded onto a table **43** by means of an extruder cylinder **29** and extruder attachment **28.** The table **43** is positioned flush with the bottom of the reversing cage. The extruder cylinder **29** and the attachment **28** are returned to their starting positions on completion of the extruding operation. The charging and extruding operations are carried out at the same time at the two reversing cages as the latter are stopped in their reversed positions. The slab **4** thus reversed in its position is then delivered to the next assortment station.

The reason for reversing the position of the slab is that the latter is cast in this embodiment into a frustoconical shape as shown in FIG. **6***a* for easiness in the slab handling operation and, hence, the reversing operation may be unnecessary when the slab has been cast into the rectangular shape. While the slab is adapted to make a half revolution of 180°, it may also be rotated intermittently or continuously in one direction such as shown by the arrows A or B in the drawing.

Before proceeding to the description of the assortment station, the method of assorting the slabs will be explained.

The slabs are assorted together in a pattern in the assortment station as shown by the plan views (A, B, A' and B') of FIG. **6** and are stacked to a predetermined

tiers in the stacking unit, with each tier consisting of a pattern of the slabs above referred to. Although the slabs of the same pattern may be stacked in tiers, they are usually stacked so that, for instance, different patterns of the slabs such as shown at FIGS. 6A and B are stacked alternately into a heap as shown in FIG. 8 to prevent the heap from collapsing and for convenience in packaging operation. Therefore, the assortment station must be so designed that the slabs may be grouped into patterns and these different patterns may be stacked in tiers. This assortment procedure may be carried out accurately according to a prearranged control program. The number of the slabs that make up each pattern and the outline configuration of such pattern are not limited to those shown at FIGS. 6A, B A' or B'. As the assortment operation is the same for any possible combinations, the details of the operation will be made hereafter with reference to the combination shown at FIG. 6A.

In FIG. 5, when a slab 4 has been extruded onto table 43 by operation of the reversing station, a pneumatically or electrically actuated stamping or printing device 32 operates to print a lot number on each slab. The actuating mechanism for the printing device is not shown in the drawing for simplicity. The cylinder 34 provided in the position of alignment then operates to extrude the slab 4 onto a turntable 35 provided flush with the table 43. This procedure is repeated twice and two slabs are placed on the turntable 35. A further cylinder 37 then operates to shift the slabs to the position designated as C, from where the slabs are further fed to the position D by operation of a cylinder 39. Two further slabs are placed on the turntable 35 by the cylinder 34 and rotated through 90° in the direction of B. The slabs are fed in this attitude to the position C by operation of the cylinder 37. This operation is repeated twice and thus the four slabs are placed at the position C from where they are fed by the cylinder 39 to the position D. Two further slabs are arranged at right angles to the above four slabs in the way described in the foregoing and are fed to the position D via position C, thus completing the pattern shown at FIG. 6A. After completion of the one slab pattern, a further pattern of the slabs as shown at FIG. 6B is completed by the assortment procedure as described in the foregoing and is carried over to the next stacking unit. The individual operations are controlled in accordance with a prearranged control program to prevent the possibility of troubles.

Reference is now made to the stacking unit. When one pattern is completed at position D on the table 43 by operation of the alignment unit (FIG. 5), the extruder plate 40 is moved in the direction of E by operation of the cylinder 41 of the stacking unit, together with the support shafts 42. Thus, one pattern of the slabs are pushed from the edge of the table 43 by way of the guide plates 44 and into a slab receiving box 45 mounted flush with the table 43. When the pattern of slabs are pushed into the box 45 and the cylinder 41 has been returned to its starting position together with the extruder plate 40, a cylinder 46 provided with guide shafts 47 above the base 55 is actuated so as to lower the frame 49 together with the guide shafts 47, this frame 49 carrying a hydraulic cylinder 50, the slab receiving box 45 and stopper means 54. The frame comes to a stop directly above the pattern unloading position, that is, at a position where the underface of the box 45 is spaced about 10 to 20 mm from the upper surface of the stock conveyor attachment 56 or the preceding slab 4. The frame may be stopped in this position in a way so that the pressure oil delivery to the cylinder 46 is stopped by operation of a magnetic valve as the correct stop position is sensed by the electrical or mechanical sensor such as photoconducting switch attached to the lower end of the slab receiving box 45. When the cylinder 50 comes into operation, a slide bearing 52 is displaced along a slide bar 51 carried by fulcrum 53, and thus the slab receiving box 45 suspended from the bearing 52 is also displaced in the direction shown by the arrow F. The pattern of the slabs are prevented from moving by the stopper 54 secured to the frame 49 and are allowed to descend by gravity from the bottom plate of the box 45. Thus, all the slabs 4 of the pattern are allowed to descend by gravity on the attachment 56 or on the preceding slabs at the stroke end of the hydraulic cylinder 50. After completion of the above procedure, the frame 49 is raised in its position with the receding of the cylinder, while the slab receiving box 45 is returned to its starting position with the receding of the cylinder 50. The slab patterns may be stacked in a predetermined number of tiers by repetition of the foregoing procedure. After completion of the stacking operation, the stock conveyor 57 is moved one step and there stopped, thus readying for the next stacking operation.

In accordance with the present invention, the overall device is so constructed and arranged that the following operation of a sequence of operations may not be started unless the preceding operation comes to a close, and the individual operations are checked by the electrical or mechanical sensor means so that the overall device may be halted together with the continuous casting apparatus upon the issuance of an alarm signal indicating that any one operation has been defective. The operation units are operated hydraulically, thus assuring a quiet operation. Furthermore, the device is compact in size, and controlled from one control device in synchrony with the continuous casting apparatus, so that the operation is performed promptly and positively without the fear of trouble occurrence.

We claim:

1. A slab transposal and stacking mechanism, particularly suitable for use with continuous casting apparatus which includes a conveyer having molds thereon, said mechanism comprising means for ejecting castings from said molds, an inverting device for inverting the position of castings received therein, first transfer means for receiving said ejected castings from said molds and for transferring said castings to said inverting device, alignment means adapted to have said castings placed thereupon, said alignment means being rotatable to effect a desired orientation of castings placed thereupon, second transfer means for transferring said inverted castings from said inverting device to said alignment means, a grouping station for receiving said castings, third transfer means for transferring said castings from said alignment means to said grouping station to form said castings into a group with said castings arranged in a predetermined orientation, a stacking device for receiving formed groups of castings from said grouping station and for forming said groups into a stack, and fourth transfer means for transferring formed groups of said castings from said grouping station to said stacking device.

2. A mechanism according to claim 1 wherein said casting conveyor comprises an endless configuration including an upper run and a lower run of said molds, said molds in said lower run being in an inverted position relative to said molds of said upper run, and wherein said ejecting means comprise a hammer for applying a percussive force to said molds of said lower run to eject castings therefrom, said first transfer means including rail means located to have said ejected castings received thereupon by force of gravity and for transporting said castings by traction along said rail means.

3. A mechanism according to claim 2 wherein said first transfer means further include a pair of pivotable plates arranged at a terminal end of said rail means and located to have said castings deposited thereon, a transfer plate mounted for vertical movement between an uppermost position and a lowermost position and located to receive said castings from said pivotable plates, means for pivoting said plates to a position for disengaging said castings to deposit said castings upon said transfer plate when said transfer plate is in its uppermost position and means for pivoting said pair of plates to their original positions to engage a next deposited casting when said transfer plate is at its lowermost position.

4. A mechanism according to claim 3 wherein said inverting device comprises a rotatable shaft, a pair of cages open at two opposed ends thereof, each adapted to receive said castings, said cages being mounted on opposite sides of said shaft, and means for intermittently rotating said shaft through 180° to reverse the positions of said cages relative thereto, said first transfer means comprising a hydraulically operated pusher member for transferring said castings from said transfer plate into said cages, said second transfer means comprising a pair of hydraulically operated pusher members, with one of said pusher members of said second transfer means operating to transfer said castings out of said cages and with the other of said pair of pusher plates of said second transfer means operating to subsequently transfer said castings onto said alignment means, said pusher plate of said first transfer means and said one pusher plate of said second transfer means being located on opposite sides of said shaft and operating simultaneously to respectively transfer said castings into and out of said cages.

5. A mechanism according to claim 4 wherein said alignment means comprise a rotatable turntable, said third transfer means comprise a hydraulically operated pusher plate for transferring said castings off said turntable towards said grouping station, said other pusher plate of said second transfer means, said turntable and said pusher plate of said third transfer means operating in synchronism to deliver said castings to said grouping station in a desired orientation.

6. A mechanism according to claim 1 including a stack conveyor assembly for transporting stacks of said castings from said mechanism wherein said stacking device comprises a stacker frame, a stacker plate mounted on said frame over said conveyor assembly for vertical movement relative thereto between an uppermost an a lowermost position, a stacker box for receiving casting therein, means for moving said stacker box horizontally relative to said stacker plate, said fourth transfer means comprising means for moving said formed groups of castings into said stacker box from said grouping station when said base plate is in its uppermost position, and stopper means for presenting movement of a group of castings contained in said stacker box when said stacker box is moved horizontally relative to said stacker plate to enable said castings group to be deposited upon said conveyor assembly by movement of said stacker box relative thereto when said base plate is in said lowermost position.

7. A mechanism according to claim 5 wherein said other pusher plate of said second transfer means and said pusher plate of said third transfer means operate in directions perpendicularly to each other, and wherein said mechanism further includes a hydraulically operated grouping station pusher plate for transferring said castings from a first location on said grouping station to a second location therein, said grouping station pusher plate operating in a direction perpendicularly to said pusher plate of said third transfer means.

* * * * *