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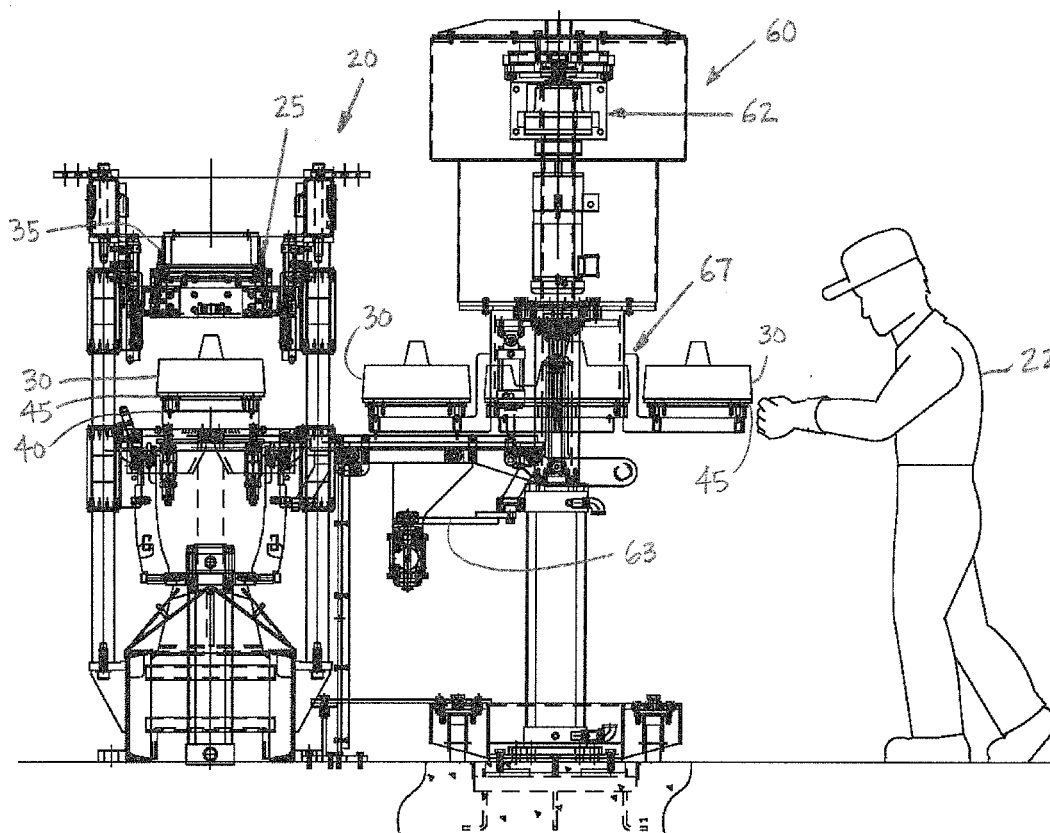
(19) **United States**(12) **Patent Application Publication**
Hunter et al.(10) **Pub. No.: US 2017/0297091 A1**(43) **Pub. Date: Oct. 19, 2017**(54) **METHOD AND APPARATUS FOR MOVING A MOLD**(52) **U.S. Cl.**CPC **B22C 21/10** (2013.01)(71) Applicants: **William Gary Hunter**, Barrington, IL (US); **Duane Krob**, Solon, IA (US)

(57)

ABSTRACT(72) Inventors: **William Gary Hunter**, Barrington, IL (US); **Duane Krob**, Solon, IA (US)(21) Appl. No.: **15/130,568**(22) Filed: **Apr. 15, 2016****Publication Classification**(51) **Int. Cl.****B22C 21/10**

(2006.01)

A method and apparatus for moving a mold in a molding machine, such as a matchplate molding machine. A lock element, preferably but not necessarily having at least 2 pieces, is movably mounted within a platen opening of a platen and within a pallet opening of a pallet. A second piece of the lock element can be fixed or secured with respect to the pallet, for example, to fix a position of a drag flask with respect to the pallet. An indexing device can be used to handle or move at least 2 molds with respect to the molding machine.



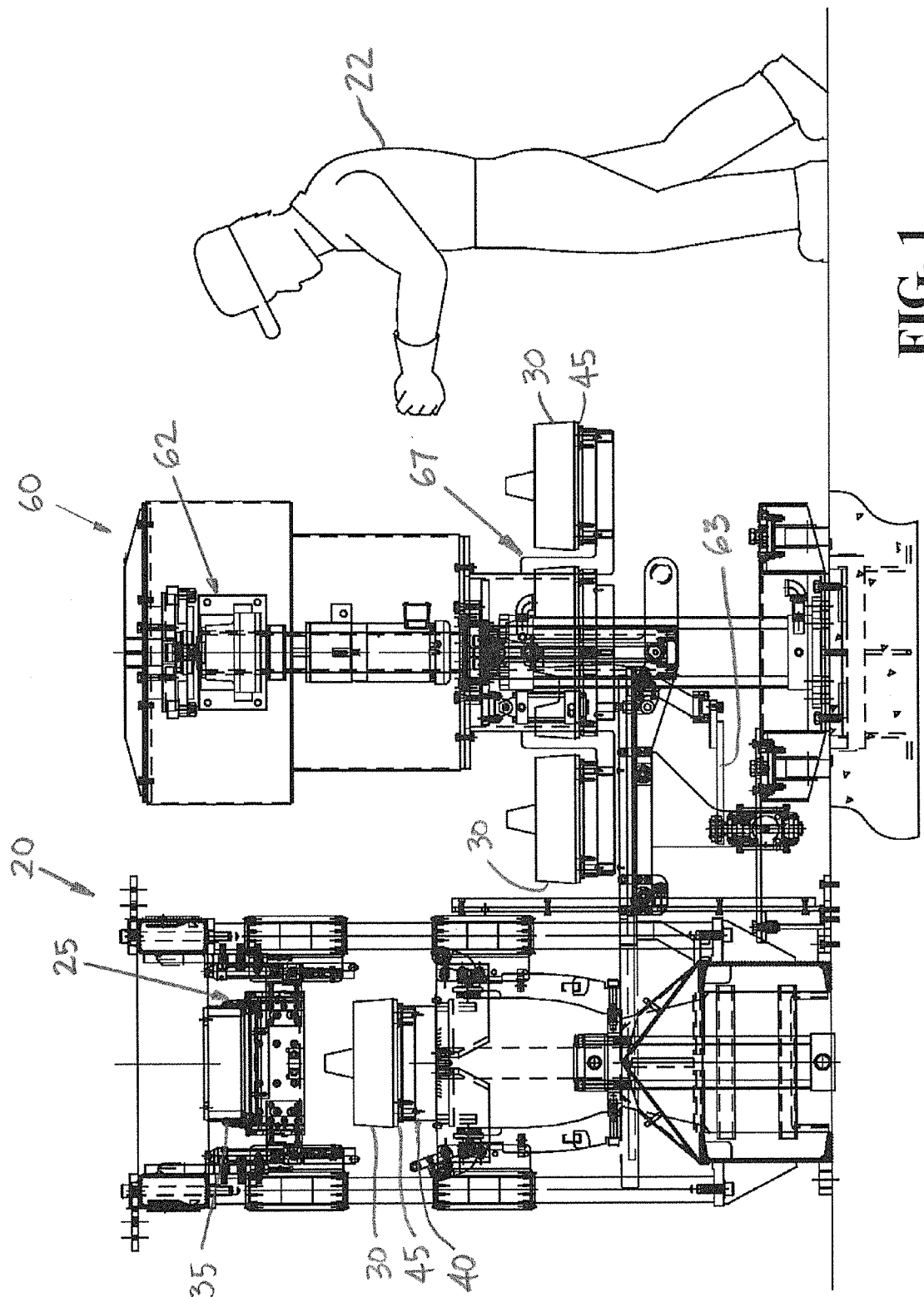


FIG. 1

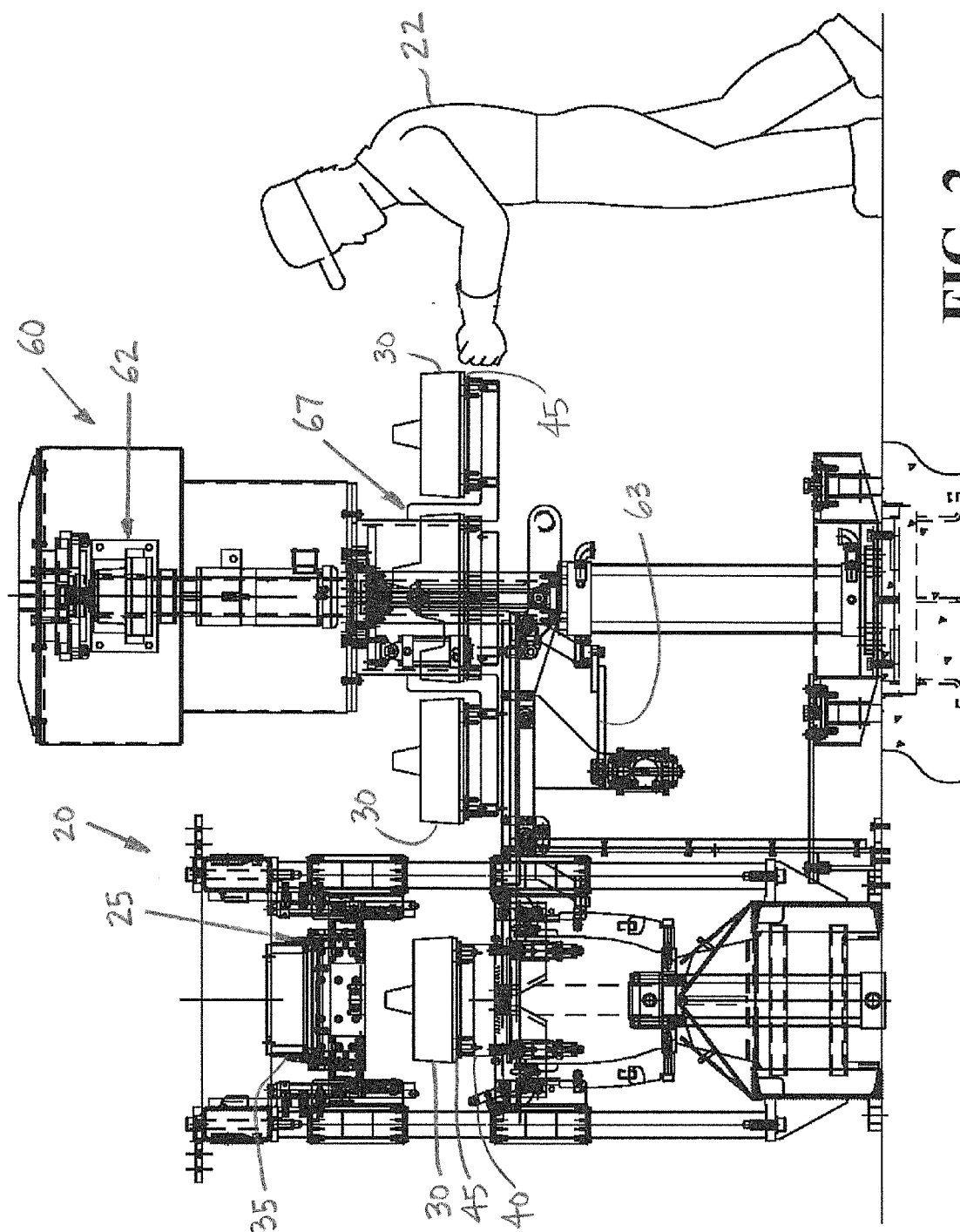


FIG. 2

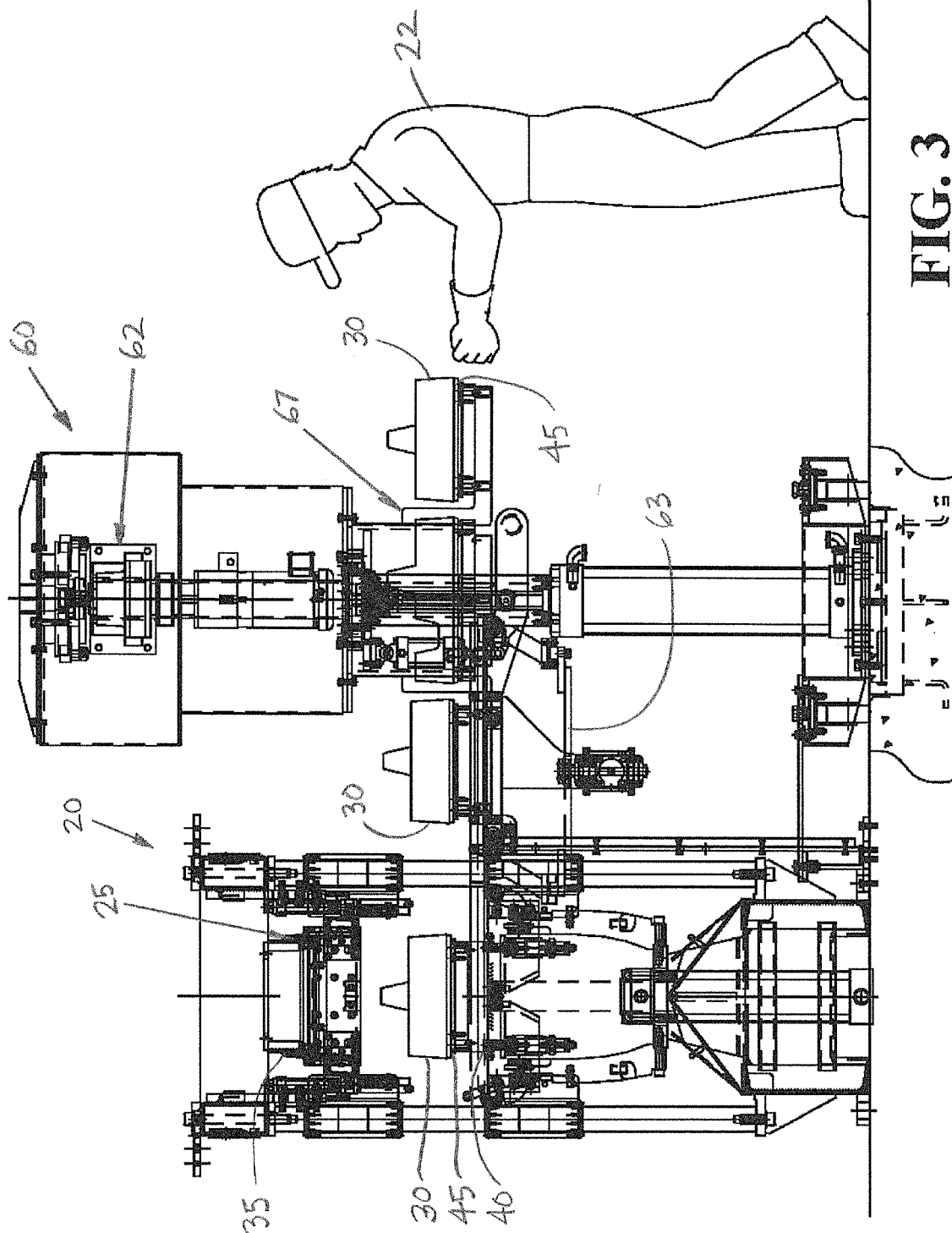


FIG. 3

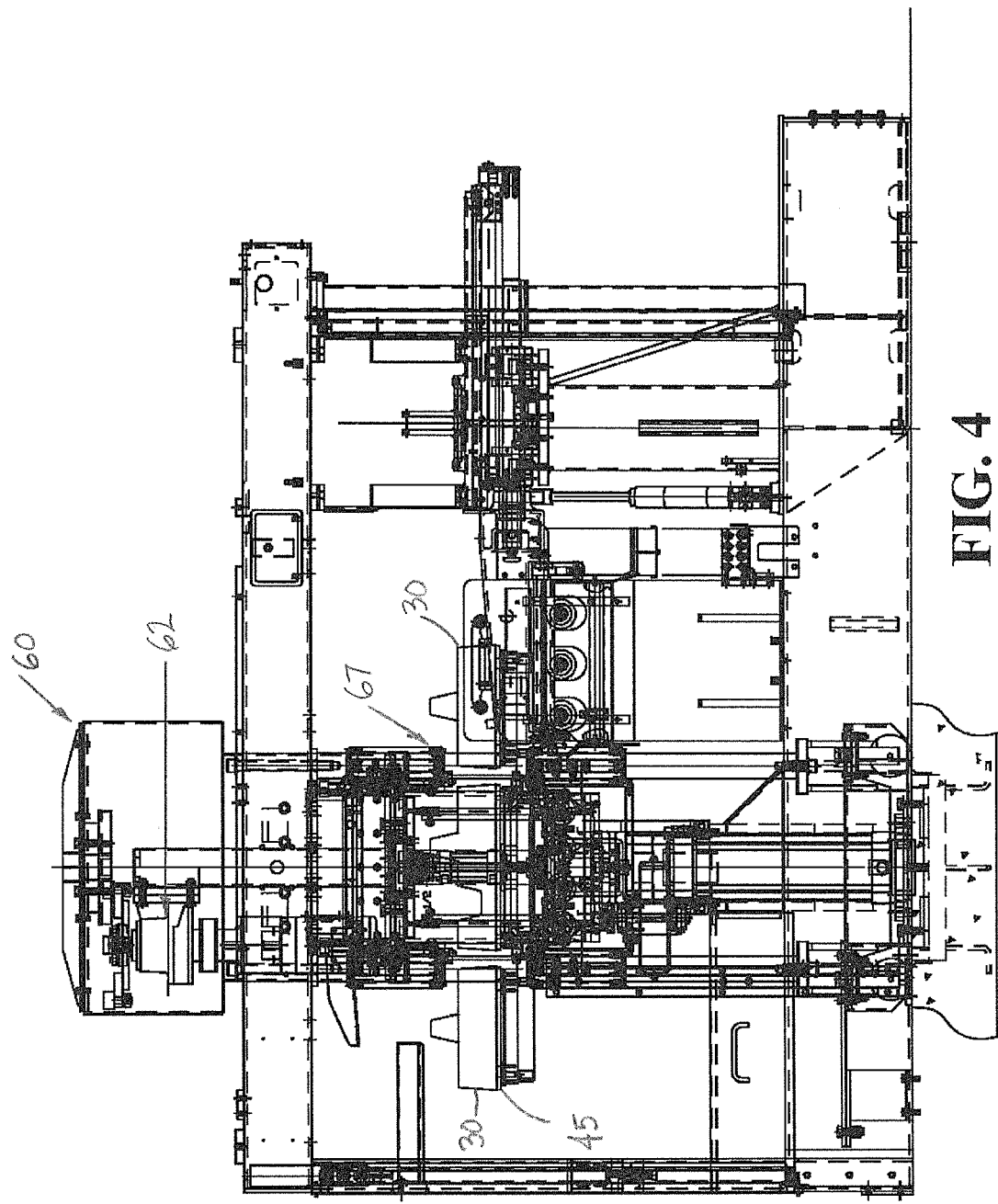


FIG. 4

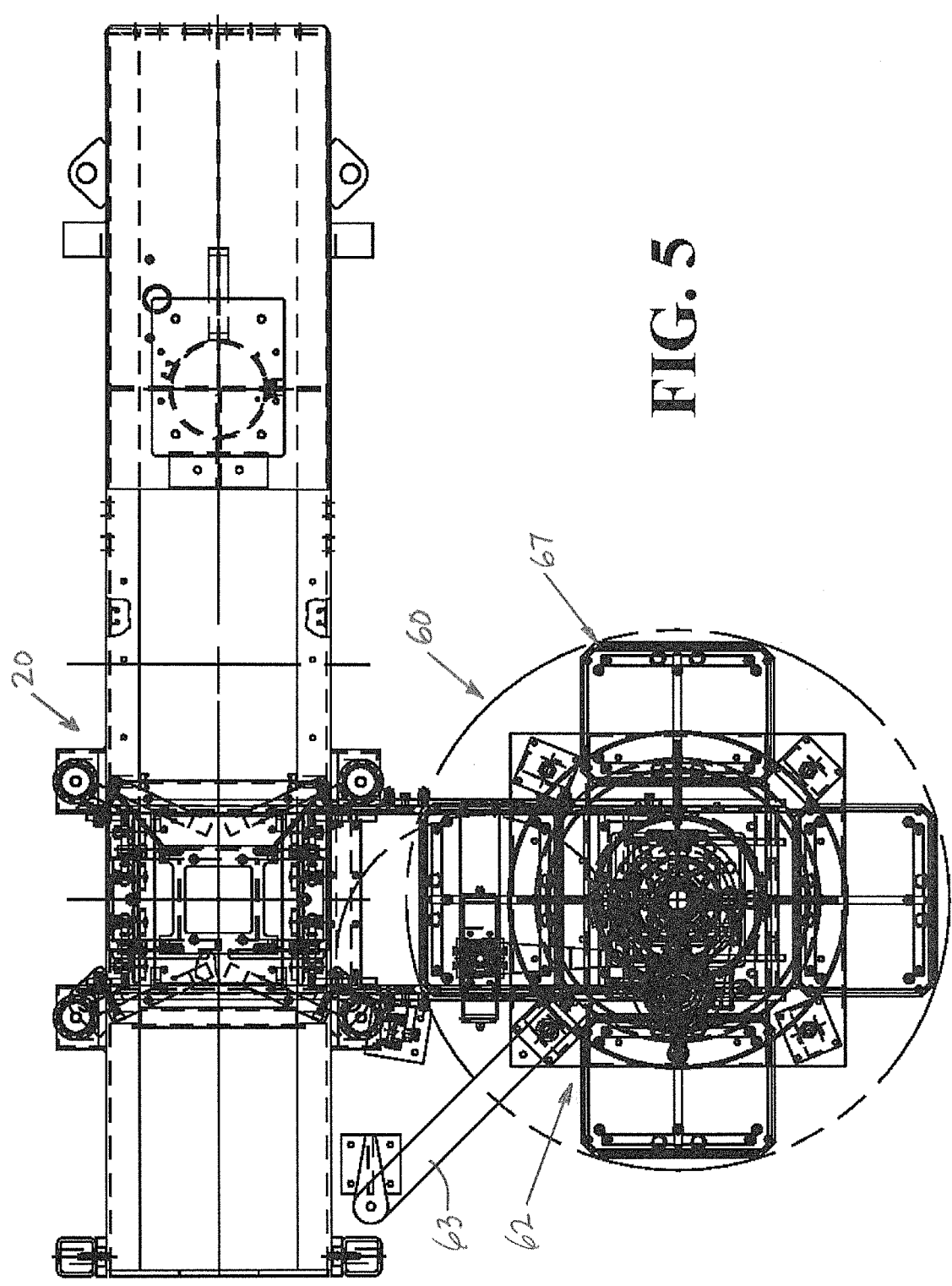


FIG. 5

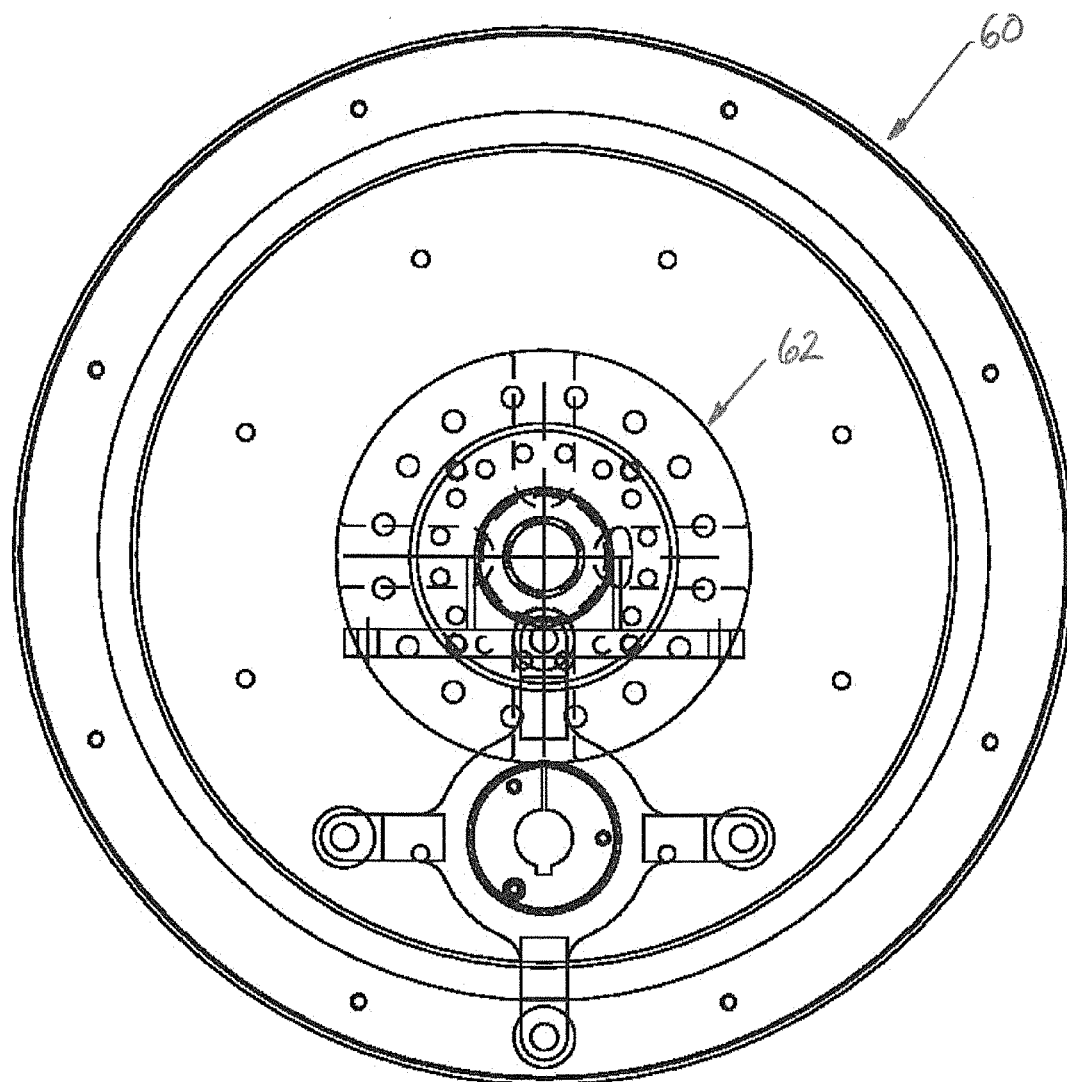


FIG. 6

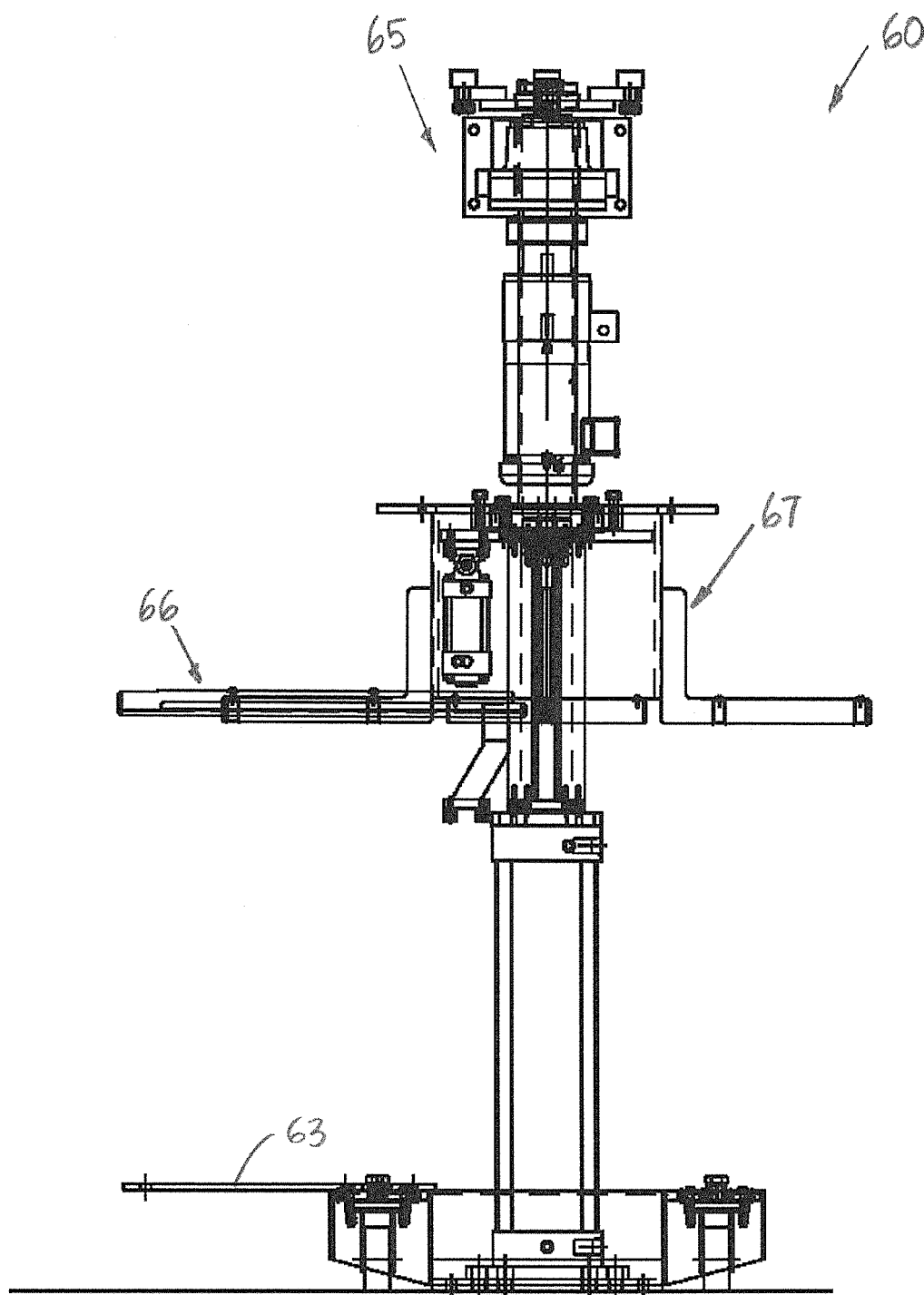


FIG. 7

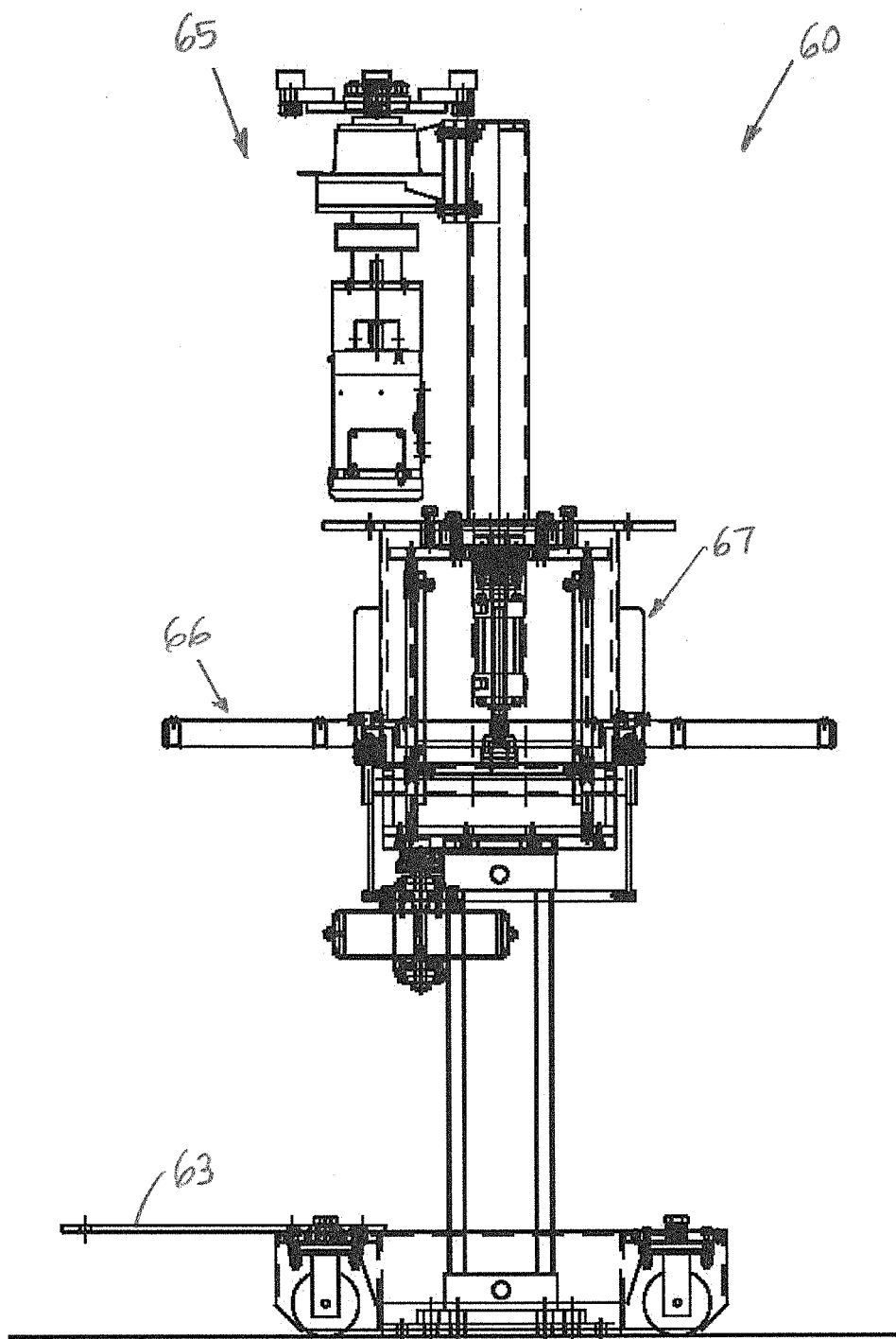


FIG. 8

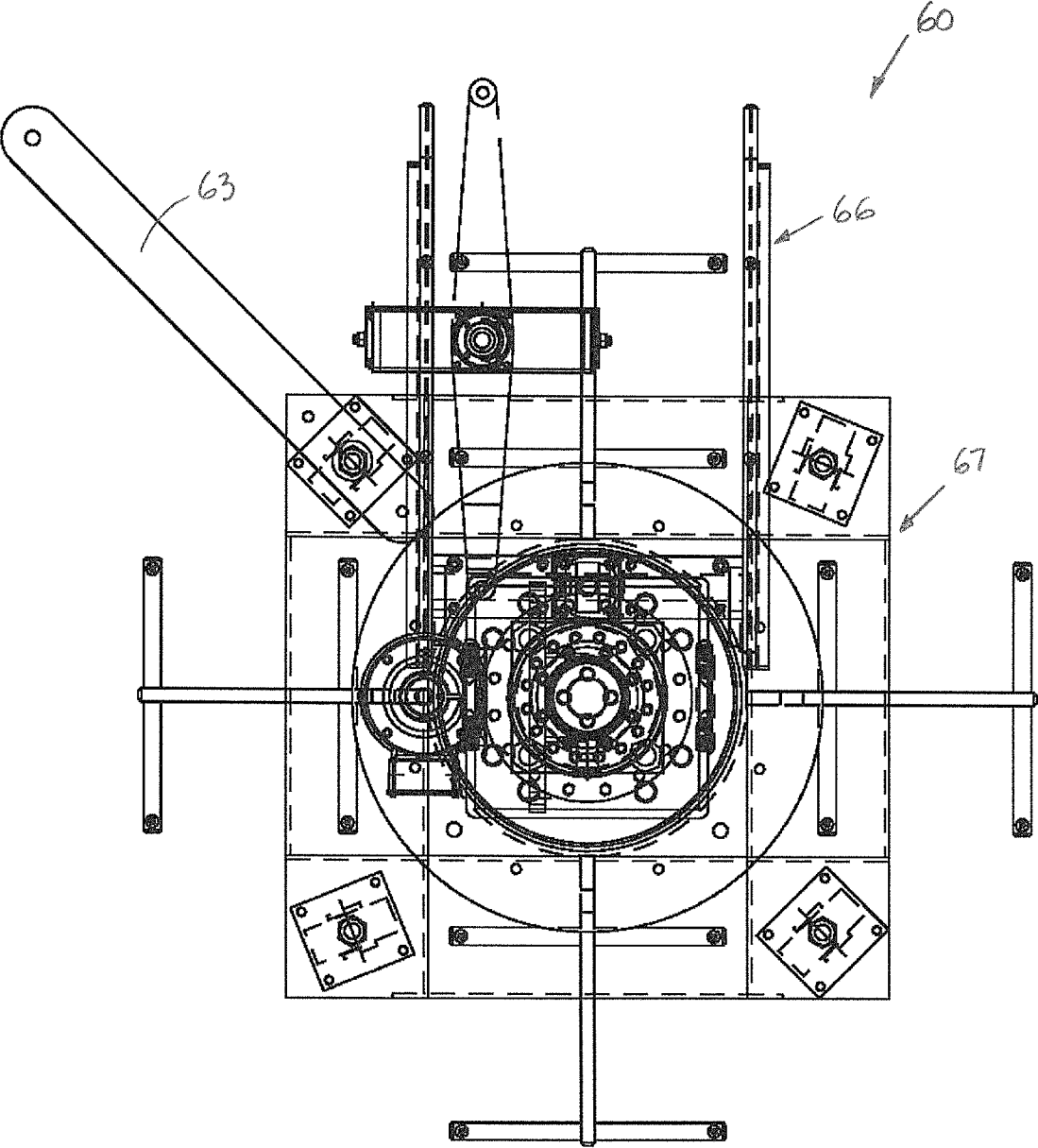


FIG. 9

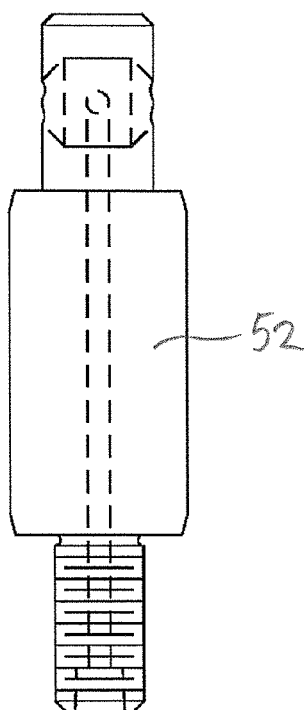
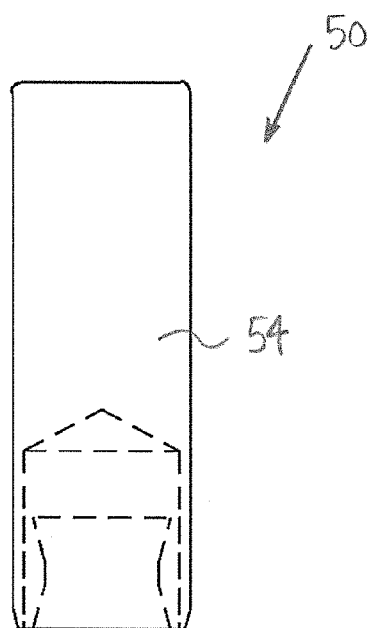


FIG. 10

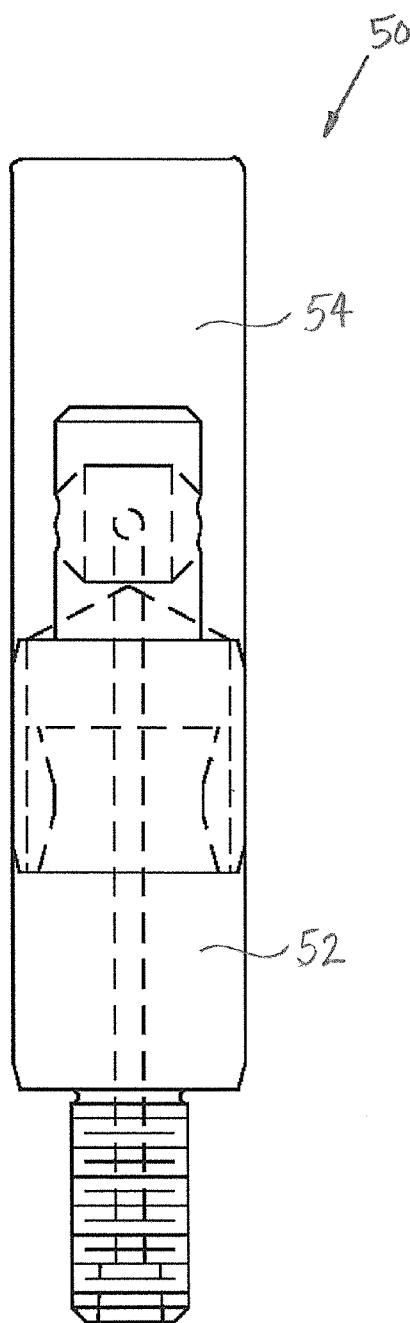


FIG. 11

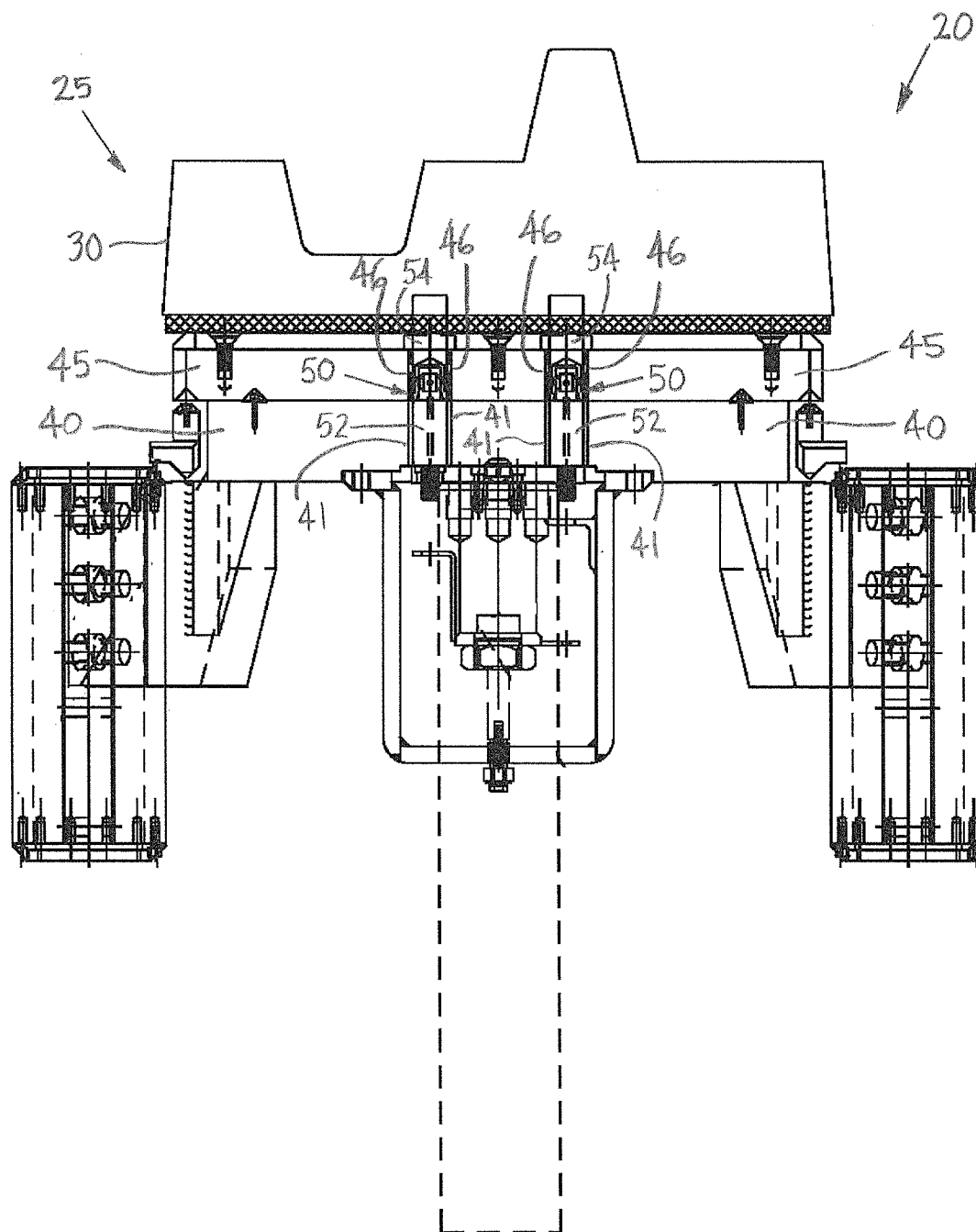


FIG. 12

METHOD AND APPARATUS FOR MOVING A MOLD

BACKGROUND OF THE INVENTION

Field of the Invention

[0001] This invention relates to a method and an apparatus for moving or transferring a drag mold out of and back into a molding machine, particularly a matchplate molding machine while maintaining proper alignment with the cope mold.

Discussion of Related Art

[0002] Conventional mold machines are often used in foundries for matchplate molding and other mold handling systems. Mold machines can be run in cycles and can be used to mold, squeeze or otherwise form a suitable molding sand about a mold pattern to form a cavity into which a molten metal or another suitable flowable material can be poured, to produce a molded part within the mold.

[0003] Sand cores are often placed within these mold cavities to produce hollow molded parts.

[0004] Many conventional machines use movable parts or other systems to help a worker operate the mold machine, for example, a compression device can be used to compress the molding sand at a squeeze station. It is often important to maintain precise alignment of a cope mold and a drag mold, particularly during the mold squeeze and draw and close. When moving the cope flask drag flask, and drag mold, it is often important to maintain precise alignment, for example, to eliminate or reduce mold shift.

SUMMARY OF THE INVENTION

[0005] Some embodiments of this invention can use an external device, such as a transfer device and/or a programmable robot, to reach within or into a mold machine and grab, attach or otherwise engage, to move or transfer the drag mold and thus move the drag mold away from or out of the mold machine and then replace the removed drag mold with a new or replaced drag mold. In some embodiments of this invention, the external device can significantly decrease the time required to operate one cycle of the mold machine, particularly when using cored molds.

[0006] Some embodiments of the external device of this invention can be used to eliminate the need to manually blow loose sand off of or away from the mold, which can save significant time and thus costs.

[0007] Some embodiments of this invention can use a removably attachable or securable part, device and/or element to move within and secure a pallet and/or a platen to or with respect to a mold machine and/or a suitable part of the mold machine. Some embodiments of this invention can use the removably attachable or securable part, device and/or element to lock and securely move and maintain alignment of a cope flask and/or a drag mold with respect to each other and/or with respect to any suitable part of the mold machine.

[0008] In some embodiments of this invention, an external device, such as a robotic arm and/or a programmable robot device, removes the drag mold from the mold machine and replaces the removed drag mold with or puts into the mold machine a cored drag flask or another mold that is already cored or that already has a core in the drag mold. The

method and the apparatus of this invention can be used to automate steps associated with manually setting cores, which is often done by hand.

[0009] The method and apparatus of this invention is particularly suitable for use in a molding machine, such as a matchplate molding machine that uses a gravity flow feed system for delivering molding sand to a mold. Many embodiments of this invention cannot be used in connection with a molding machine that uses blowing or pressurized air to deliver molding sand to a mold.

BRIEF DESCRIPTION OF THE DRAWINGS

[0010] The objects and features of this invention are better understood from the following detailed description taken in conjunction with the drawings.

[0011] FIGS. 1-4 each is a front view of a molding machine, according to one embodiment of this invention.

[0012] FIG. 5 is a top view of the molding machine of FIGS. 1-4.

[0013] FIG. 6 is a top view of a portion of an indexing device, according to one embodiment of this invention.

[0014] FIGS. 7-9 are side, front and top views, respectively, of a portion of an indexing device, according to one embodiment of this invention.

[0015] FIG. 10 is a front view of an exploded two-piece lock element, according to one embodiment of this invention.

[0016] FIG. 11 is a front view of an assembled two-piece lock element, as shown in FIG. 10.

[0017] FIG. 12 is a front view of a section of a molding machine, according to one embodiment of this invention.

DETAILED DESCRIPTION OF THE INVENTION

[0018] In some embodiments according to this invention, molding machine 20 at least partially operates by running or cycling mold 25, which comprises drag flask 30 releasably attached to cope flask 35, through cycles including but not limited to steps of aligning and/or moving drag flask 30 and cope flask 35. Reducing the cycle time necessary for molding machine 20 to run through each cycle can significantly reduce the costs associated with manufacturing parts or products using molding machine 20, particularly a matchplate molding machine.

[0019] FIGS. 1-4 show various working positions of molding machine 20 and indexing device 60, according to different embodiments of this invention. FIGS. 1-3 show user 22 operating molding machine 20 at different operating positions throughout an operating cycle of molding machine 20. In some embodiments according to this invention, user 22 operates indexing device 60 to transfer, remove, replace and/or otherwise move drag mold 30, cope flask 35, platen 40 and/or pallet 45 with respect to each other and/or with respect to any other element of molding machine 20. In different embodiments of this invention, indexing device 60 provides automation of manual steps and thus reduces the cycle time and/or the time necessary to complete any manufacturing step throughout one or more cycles or partial cycles of molding machine 20.

[0020] As mold 25 is transferred, conveyed, removed, replaced, cycled and/or otherwise moved along a distance, such as between manufacturing steps, it is important to maintain alignment, particularly a precise alignment,

between drag mold 30 which is attached to, secured to and/or otherwise connected to cope flask 35, so molding sand forms a cavity within mold 25 that does not shift and thus distort or change the shape of the cavity. In some embodiments of this invention, an already cored mold 25 is attached to pallet 45 and/or platen 40. Maintaining a precise shape of the cavity allows molding machine 20 to produce or manufacture a molded part or a molded product that is within tolerances or as close as possible to specified dimensions and/or shapes. Producing a molded part or product close to the specified dimensions and shapes will require significantly less unnecessary additional time needed to further work a molded part or a molded product, particularly one that has unwanted materials in non-specified areas.

[0021] According to different embodiments of this invention, the cycle time of molding machine 20 can be reduced by locking or securing a position of drag mold 30, cope flask 35, platen 40 and/or pallet 45 with respect to each other, with respect to any suitable element of molding machine 20, and/or with respect to any suitable element of indexing device 60. In some embodiments of this invention, the cycle time of molding machine 20 can be reduced by using or operating indexing device 60 to assist with and/or automate one or more manual manufacturing steps within one or more cycles of operating molding machine 20.

[0022] In some embodiments of this invention, it is possible to lock and/or secure a position of drag mold 30, cope flask 35, platen 40 and/or pallet 45 with respect to each other, to any suitable element of molding machine 20 and/or any suitable element of indexing device 60, for example, by moving a mold 25 in molding machine 20. In some embodiments of this invention, lock element 50 is movably mounted within a first platen opening 41 of platen 40 and within a first pallet opening 46 of pallet 45. In some embodiments of this invention, particularly when drag mold 30 is moved with respect to molding machine 20, lock element 50 is secured with respect to platen 40 and/or pallet 45.

[0023] FIGS. 10 and 11 show one embodiment of lock element 50 according to this invention. FIG. 10 shows first portion 52 of lock element 50 secured directly to or indirectly to second portion 54 of lock element 50. FIG. 11 shows first portion 52 of lock element 50 disengaged and/or separated from second portion 54 of lock element 50. First portion 52 and/or second portion 54 can have any suitable mechanical structures, dimensions and/or shapes that allow first portion 52 to be releasably securable or releasably attachable, directly or indirectly, to second portion 54. For example, in some embodiments of this invention, first portion 52 has threads that engage with corresponding threads of second portion 54, and it is also possible for first portion 52 and second portion 54 to have any other suitable frictional fit structure, interference fit structure, mechanical structure, electromechanical structure and/or magnetic structure that allows first portion 52 to be secured or connected to second portion 54 with enough engaging or closing force to prevent first portion 52 from separating or disengaging from second portion 54, for example, when a moving force, a transfer force and/or any other force is applied directly and/or indirectly to lock element 50.

[0024] In some embodiments according to this invention, lock element 50 is lockingly engaged within platen opening 41 and within pallet opening 46, particularly when mold 25 including at least drag flask 30 and pallet 45 is transferred or

otherwise moved to different stations or sections of molding machine 20. In some embodiments of this invention, lock element 50 is a two-piece pin that can act as a mold lock pin that can be moved into and between a locked or an engaged position and an unlocked or disengaged position. In some embodiments of this invention, lock element 50 can also comprise 3 or more pieces with each piece having similar technical features as described with respect to the two-piece lock element 50.

[0025] In some embodiments according to this invention, a second lock element 50 can be moved into and between a locked or engaged position and an unlocked or disengaged position within a second platen opening 41 of platen 40 and within a second pallet opening 46 of pallet 45. In other embodiments of this invention, a third, fourth or higher number of lock elements 50 can be moved into and between a locked or engaged position and an unlocked or disengaged position within a corresponding third, fourth or higher number of platen openings 41 of platen 40 and within a corresponding third, fourth or higher number of pallet openings 46 of pallet 45. In some embodiments of this invention, a multiple piece lock element 50 is separated into at least 2 portions by a force applied to first portion 52 and/or to second portion 54.

[0026] In some embodiments of this invention, it is possible to have only one lock element 50, as described in this specification. With only one lock element 50, it is possible for lock element 50 to have a noncircular cross-section to prevent movement and thus maintain alignment, particularly a precise alignment, between drag flask 30, cope flask 35, platen 40 and/or pallet 45, so that molding sand forming a cavity within mold 25 does not shift and thus does not distort or change the shape of the cavity, as mold 25 is transferred or moved. However, some embodiments of this invention that have two or more lock elements 50 provide increased stability, particularly of mold 25 as it is moved, even with relatively smaller structural shapes and dimensions of lock elements 50. FIG. 12 shows molding machine 20 comprising four lock elements 50 positioned within four platen openings 41 and four pallet openings 46, and in different embodiments of this invention lock elements 50 can be spaced as shown in FIG. 12 or can have any other suitable spacing, layout and/or arrangement, relative to each other.

[0027] Preventing mold shifting or significantly reducing the effects of a shifted mold can save time and costs by requiring no or relatively little additional machining, working and/or other processing of a molded part or piece. In some embodiments of this invention pallet 45 each is secured and then transferred from molding machine 20 to indexing device 60. FIG. 12 shows lock element 50 lockingly movable and engageable within platen opening 41 and pallet opening 46. Each lock element 50 can be reduced in size, manually and/or automatically, to move within platen opening 41 and/or pallet opening 46, and then increased in size to lock or engage within platen opening 41 and/or pallet opening 46, for example, to secure and lock a position of platen 40 and/or pallet 45 with respect to each other and/or with respect to any suitable element of molding machine 20 and/or indexing device 60. In some embodiments of this invention, lock element 50 is separated into first portion 52 and second portion 54 and second portion 54 is maintained or secured within a second pallet opening 46. Each lock element 50 can be operated or moved between an engaged

position and a disengaged position, depending upon the particular operational requirements of molding machine 20 and/or indexing device 60.

[0028] According to some embodiments of this invention, lock element 50 comprises first portion 52 and second portion 54. In other embodiments of this invention, lock element 50 comprises 3 or more portions and still accomplishes the same function and result as lock element 50 with only 2 portions or pieces. Each portion of lock element 50 can have any suitable cross sectional shape or other suitable size and/or shape that allows lock element 50 to move into position, be locked and then unlocked. Lock element 50 can also have any other suitable mechanical, magnetic and/or electrical design and operation that accomplishes the same function and result of lock element 50 as described throughout this specification and as shown in the drawings.

[0029] In some embodiments of this invention, an upper portion of lock element 50 is invested in the molding sand. For example, lock element 50 can comprise a mold lock pin that has a top portion or an upper portion contacting the molding sand, such as the molding sand within drag flask 30. The molding sand can be compacted or otherwise tightly formed about or around the top portion or the upper portion of lock element 50.

[0030] According to some embodiments of this invention, lock element 50 engages and in a locked position or an engaged position connects, attaches or otherwise secures lock element 50, for example, to tightly hold platen 40 with respect to pallet 45. In some embodiments of this invention, in the engaged position platen 40 is integrated with or becomes one connected element with pallet 45. In some embodiments of this invention, the two-piece lock element 50 is separated into first portion 52 and second portion 54 and second portion 54 is maintained or secured within pallet opening 46 so that lock element 50 fixes a position of platen 40 with respect to pallet 45. Lock element 50 can also be moved and/or operated so that second portion 54 remains secured within pallet opening 46 and thus so that lock element 50 remains secured with respect to pallet 45. In some embodiments of this invention, during certain movements of molding machine 20, first portion 52 of lock element 50 does not remain fixed within platen opening 41 of platen 40.

[0031] According to some embodiments of this invention, during a cycle of molding machine 20, lock element 50 moves between a secured or engaged position and an unsecured or disengaged position, such as within platen opening 41 and pallet opening 46. In some embodiments of this invention, lock element 50 is movable between the secured or engaged position and an adjustable position with respect to platen 40. In some embodiments according to this invention, in the secured or engaged position drag flask 30 is accurately aligned with cope flask 35 which can be attached with respect to pallet 45. In some embodiments of this invention, lock element 50 retracts or is pulled back at the end of a cycle in order to move drag mold 30, for example.

[0032] In some embodiments of this invention, lock element 50 is automatically and/or manually moved between the engaged position and the disengaged position. Any suitable control device and/or programmable controller can be used to operate and/or move lock element 50, based upon one or more input signals delivered to lock element 50.

[0033] According to some embodiments of this invention, a method for moving mold 25 in or with respect to molding machine 20, comprises or includes transferring a first mold 25 attached to a first pallet 45 from molding machine 20 to indexing device 60. A second mold 25 attached to a second pallet 45 is transferred from indexing device 60 to molding machine 20.

[0034] In some embodiments of this invention, lock element 50 is movably mounted within a first platen opening 41 of platen 40 and within a first pallet opening 46 of pallet 45, and a portion of lock element 50 is secured with respect to platen 40 and pallet 45. It is also possible to movably mount a second lock element 50 within a second platen opening 41 of platen 40 and/or within a second pallet opening 46 of pallet 45.

[0035] In some embodiments of this invention, transfer device 60 which is external to molding machine 20 moves the first mold 25 from molding machine 20 to indexing device 60 and moves the second mold 25 to molding machine 20 from indexing device 60. According to some embodiments of this invention, transfer device 60 operates a transfer fork 66 that engages and moves the first mold 25 and the second mold 25 to and from, between indexing device 60 and molding machine 20.

[0036] According to some embodiments of this invention, a method for moving a mold in a molding machine comprises or includes transferring a first mold 25 attached to a first pallet 45 from molding machine 20 to indexing device 60, transferring a second mold 25 attached to a second pallet 45 from indexing device 60 to molding machine 20, and moving lock element 50 within a first platen opening 41 of platen 40 and within a first pallet opening 46 of pallet 45. In some embodiments of this invention, a portion of lock element 50 is secured with respect to platen 40 and/or pallet 45. In some embodiments of this invention, lock element 50 has first portion 52 and second portion 54 attachable and detachable with respect to first portion 52.

[0037] According to some embodiments of this invention, indexing device 60 is an external device that operates externally with respect to molding machine 20. In some embodiments, indexing device 60 comprises a programmable robot device, a robotic arm and/or another suitable robotic device that moves with respect to molding machine 20 and that can also assist with transferring and/or moving one or more molds 25 and/or one or more elements of each mold 25. In some embodiments of this invention, indexing device 60 rotates about a longitudinal axis and/or moves in any desired direction in three dimensions with respect to molding machine 20. In some embodiments of this invention, indexing device 60 is movable with respect to a floor surface and/or a base of molding machine 20. Indexing device 60 can be used to automate one or more steps of moving and/or transferring one or more molds 25 or any element of each mold 25.

[0038] FIGS. 5 and 7-9 show different embodiments of indexing device 60 comprising transfer device 65, transfer fork 66 and turntable 67. Indexing device 60 can also comprise an indexing table and/or any other suitable device that can move and/or transfer one or more molds 25 or any element of each mold 25. As indexing device 60 moves and/or transfers mold 25, in some embodiments of this invention, mold 25 experiences no or relatively minimal mold shift, particularly if one or more lock elements 50 according to this invention are used as described in this

specification and as shown in the drawings. In some embodiments of this invention, as indexing device 60 moves and/or transfers drag mold 30, at least a portion of lock element 50 is secured or engaged within pallet opening 46 and thus locked with respect to pallet 45. According to some embodiments of this invention, a diameter or other outside dimension of lock element 50, required for clearance within platen opening 41 and/or pallet opening 46, can be changed or varied to allow lock element 50 to move between the engaged position and the disengaged position, and any suitable mechanical, electrical and/or magnetic device can be used to expand and contract the outside diameter or other outside dimension.

[0039] In some embodiments of this invention, indexing device 60 is fixed with respect to molding machine 20 and indexing device 60 operably rotates turntable 67 which preferably has at least 2 tables or trays that accepts or accommodates a corresponding drag mold 30 and/or pallet 45.

[0040] According to some embodiments of this invention, indexing device 60 transfers or removes drag mold 30 out of or away from molding machine 20 and replaces the removed drag mold 30 with a second or a new drag mold 30 that already has a core within the sand of the second or new drag mold 30, sometimes referred to as a cored mold or a cored drag mold. In some embodiments according to this invention, molding machine 20 comprises a gravity flow machine that fills or charges mold 25 with a gravity fed flow of molding sand. In some embodiments of this invention, indexing device 60 cannot be used with a blow-fill type matchplate machine.

[0041] In some embodiments of this invention, indexing device 60 comprises a carriage and Geneva drive 62 that moves and/or transfers a carriage into and out of molding machine 20. Geneva drives are commonly known and provide a relatively smooth movement, such as a smooth acceleration and/or deceleration, which is important for eliminating or minimizing mold shift. As shown in FIGS. 5 and 7-9, indexing device 60 comprises pivot lever 63 that can be used to accommodate movement of indexing device 60 with respect to molding machine 20, for example.

[0042] While in the foregoing detailed description this invention has been described in relation to certain preferred embodiments thereof, and many details have been set forth for purposes of illustration, it will be apparent to those skilled in the art that the invention is susceptible to additional embodiments and that certain of the details described herein can be varied considerably without departing from the basic principles of the invention.

What is claimed is:

1. A method for moving a mold in a molding machine, including the steps of:

movably mounting a two-piece lock element within a first platen opening of a platen and within a first pallet opening of a pallet;

securing the two-piece element with respect to the platen and the pallet;

transferring the secured platen and the pallet from the molding machine to an indexing device; and

transferring a second pallet secured to a second platen to the molding machine.

2. The method according to claim 1, further including separating the two-piece lock element into a first portion and a second portion and maintaining the second portion within the first pallet opening.

3. The method according to claim 2, wherein the two-piece lock element is separated by a force applied to the first portion and/or the second portion.

4. The method according to claim 1, wherein during a cycle of the molding machine the two-piece lock element moves between a secured position and an unsecured position within the first platen opening and the first pallet opening.

5. The method according to claim 1, further including movably mounting a second two-piece lock element within a second platen opening of the platen and within a second pallet opening of the pallet.

6. The method according to claim 5, further including separating the second two-piece lock element into a first portion and a second portion and maintaining the second portion within the second pallet opening.

7. The method according to claim 1, wherein the two-piece element is movable between a secured position and an adjustable position with respect to the platen.

8. The method according to claim 7, wherein in the secured position a drag mold is accurately aligned with a cope mold attached with respect to the pallet of the mold.

9. The method according to claim 1, wherein a cored mold is attached to the pallet.

10. A method for moving a mold in a molding machine, including the steps of:

transferring a first mold having a first drag mold attached to a first pallet from the molding machine to an indexing device; and

transferring a second mold having a second drag mold attached to a second pallet from the indexing device to the molding machine.

11. The method according to claim 10, further including movably mounting a lock element within a first platen opening of a platen and within a first pallet opening of the pallet, and securing a portion of the lock element with respect to the platen and the pallet.

12. The method according to claim 11, further including movably mounting a second lock element within a second platen opening of the platen and within a second pallet opening of the pallet.

13. The method according to claim 10, wherein a transfer device external to the molding machine moves the first drag mold from the molding machine to the indexing device and moves the second drag mold to the molding machine from the indexing device.

14. The method according to claim 13, wherein the transfer device operates a transfer fork engaging and moving the first drag mold and the second drag mold between the indexing device and the molding machine.

15. The method according to claim 10, wherein a mold core is positioned within the second drag mold.

16. The method according to claim 10, wherein in the molding machine the first mold has a first cope mold attached to the first drag mold.

17. A method for moving a mold in a molding machine, including the steps of:

transferring a first mold attached to a first pallet from the molding machine to an indexing device, transferring a second mold attached to a second pallet from the indexing device to the molding machine, and moving a

lock element within a first platen opening of a platen and within a first pallet opening of the pallet, and releasably securing a portion of the lock element with respect to the platen and the pallet.

18. The method according to claim 17, wherein the lock element has a first portion and a second portion attachable and detachable with respect to the first portion.

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