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(54) **BAG FILLING APPARATUS AND METHOD**

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(57) **ABSTRACT**

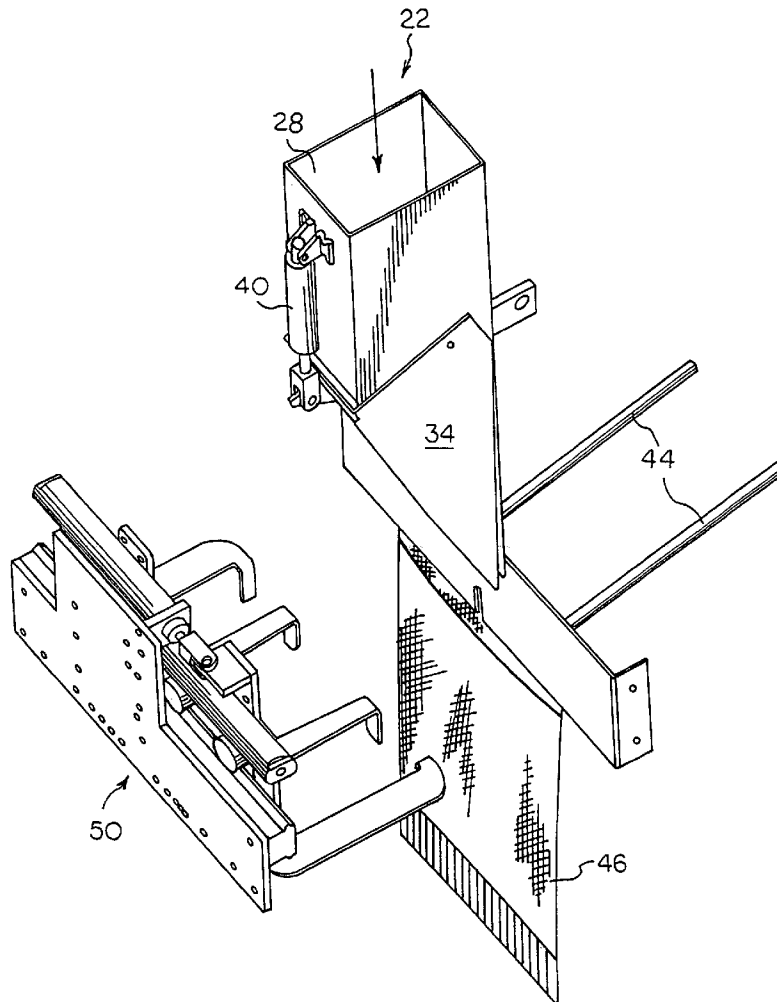
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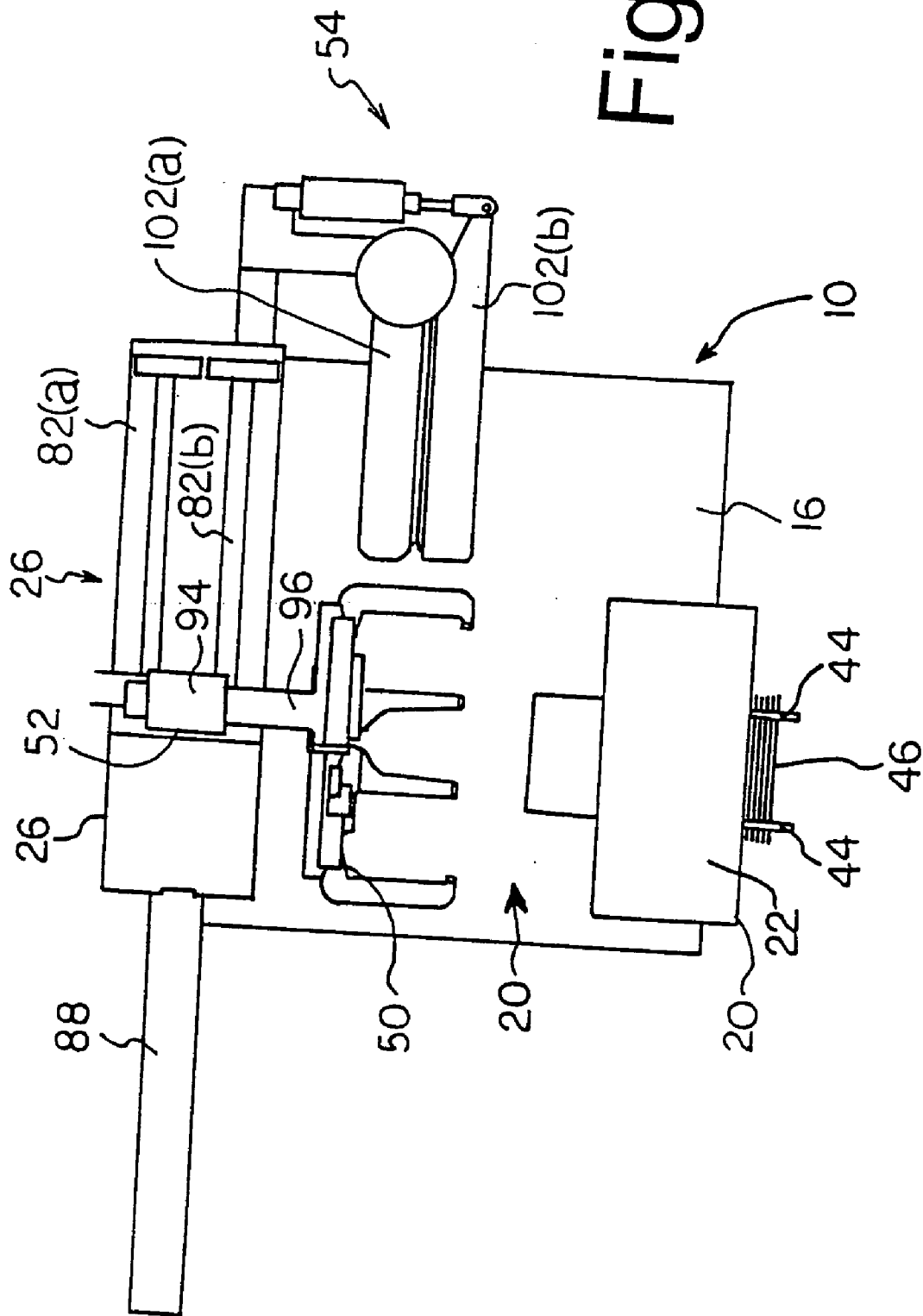
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(62) Division of application No. 09/890,083, filed on Jul. 25, 2001, now Pat. No. 6,662,532, filed as 371 of international application No. PCT/CA00/00114, filed on Feb. 7, 2000.

Automated apparatus for filling of a bag with a loose commodity comprises a bag filling station for dispensing commodity into a bag; a wicket for feeding a stacked and interconnected array of empty bags; and a conveyor for removing filled bags from the filling station. Reciprocating clamps grip the open mouths of the filled bags, and transfer the filled bags away from the filling station, with a subsequent bag being drawn into appropriate position for filling by means of the connection formed between the contacting bags.





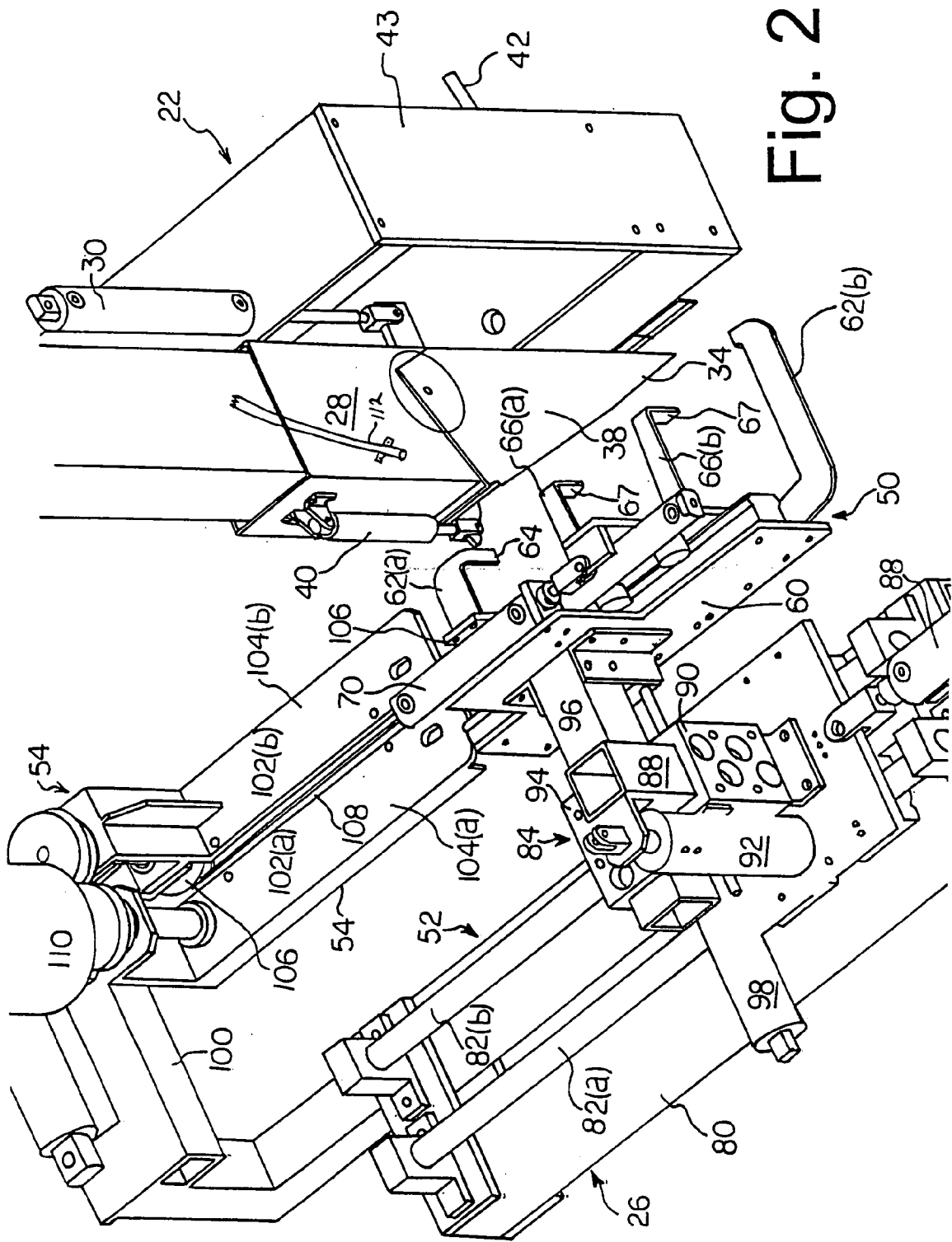
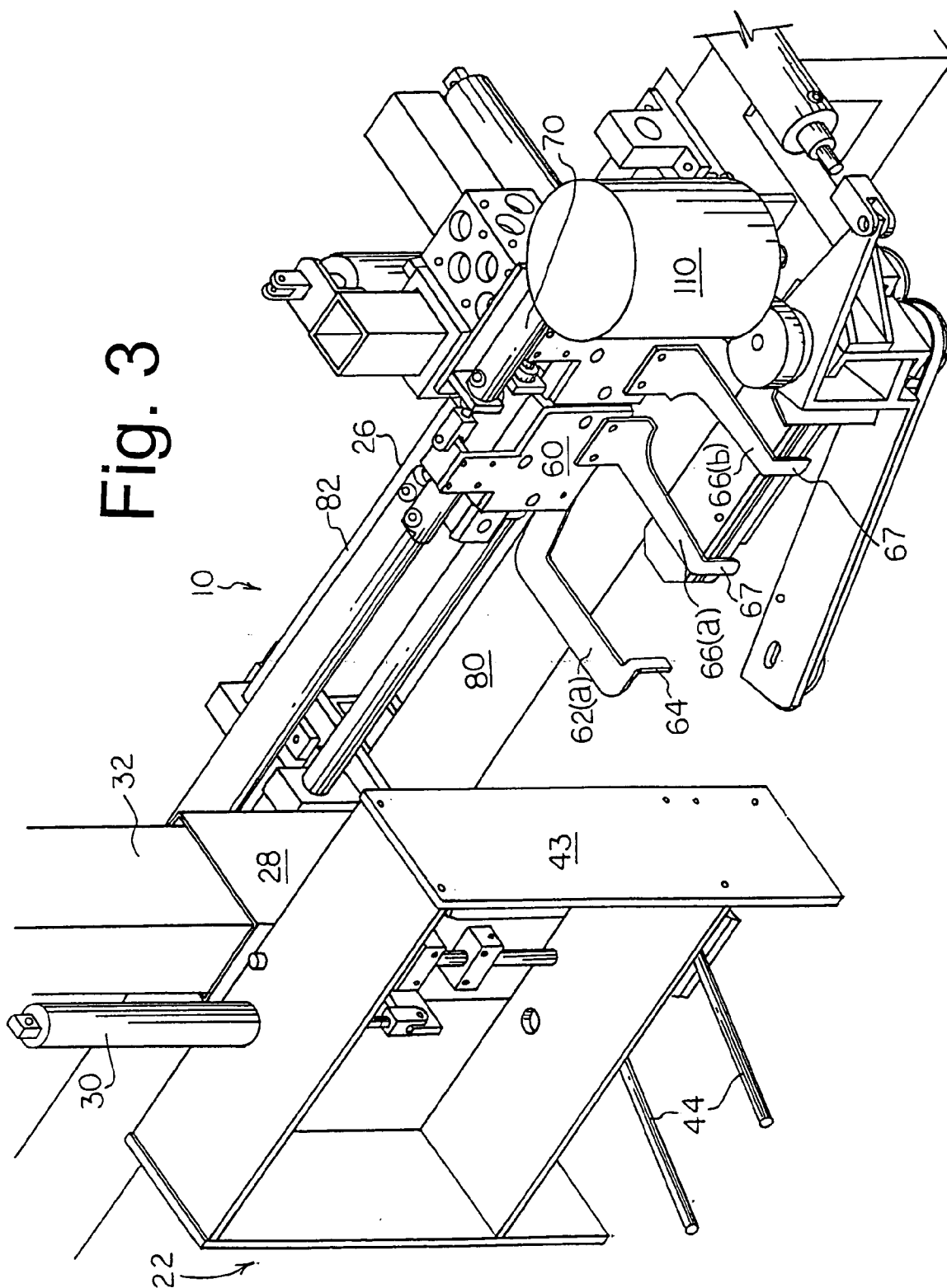
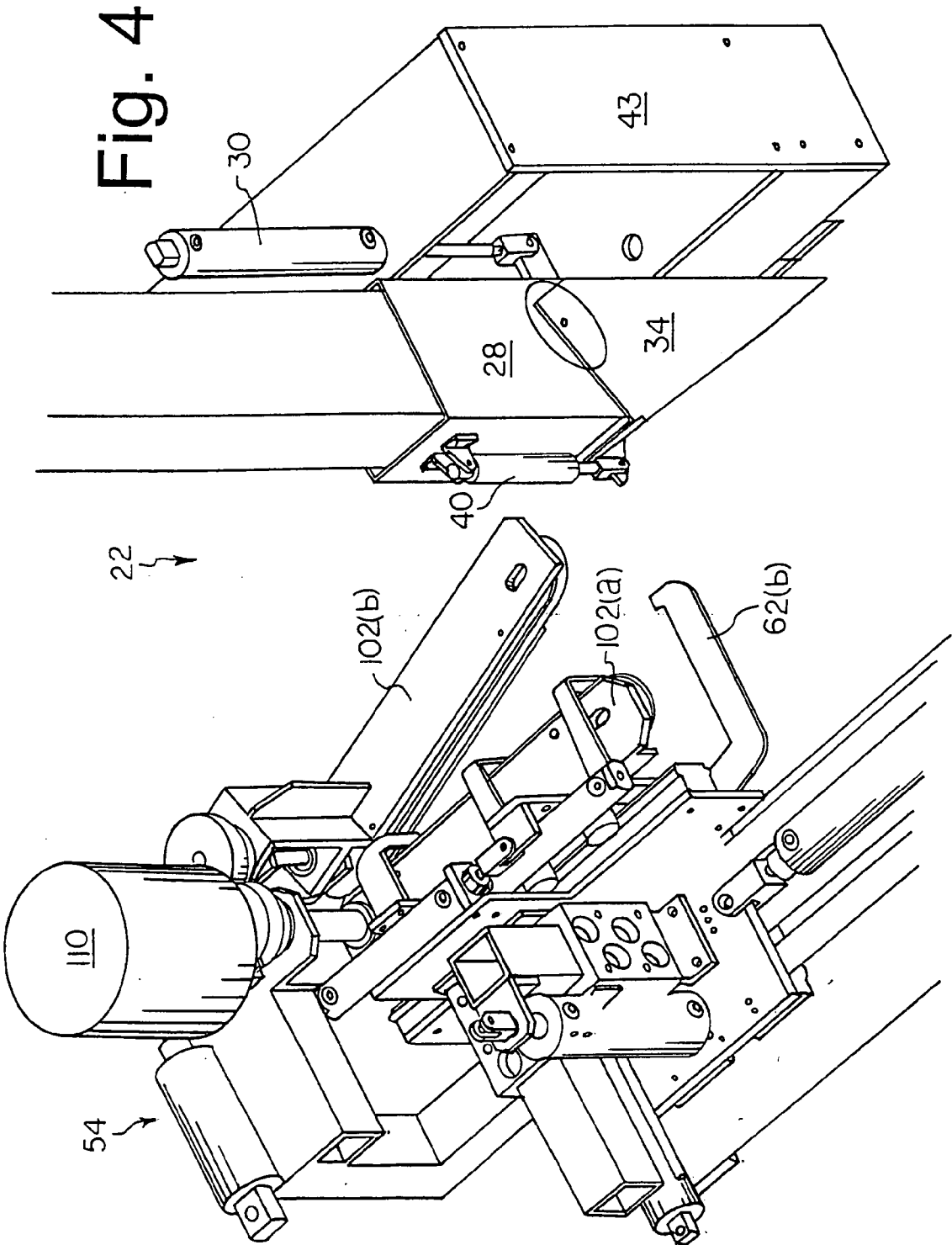


Fig. 2

Fig. 3





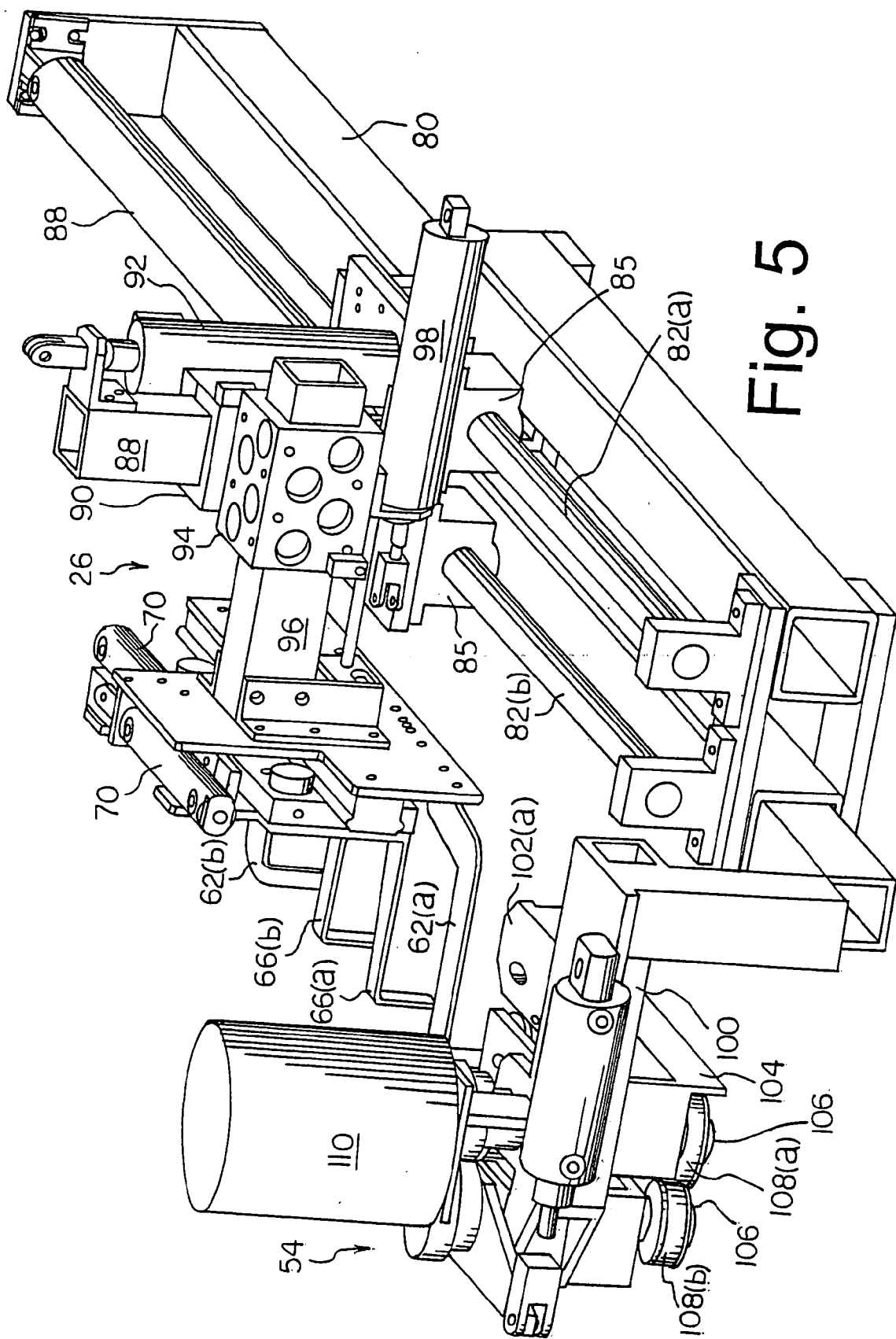
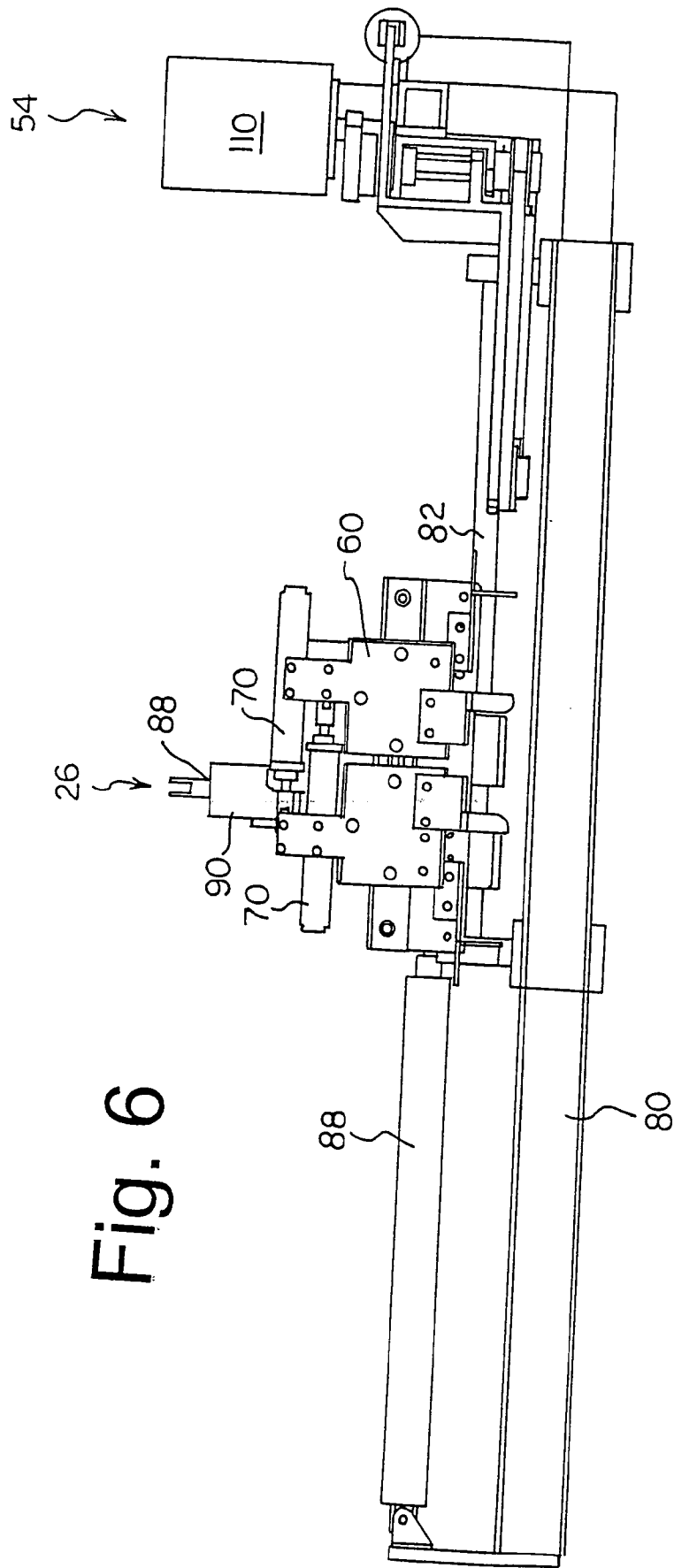
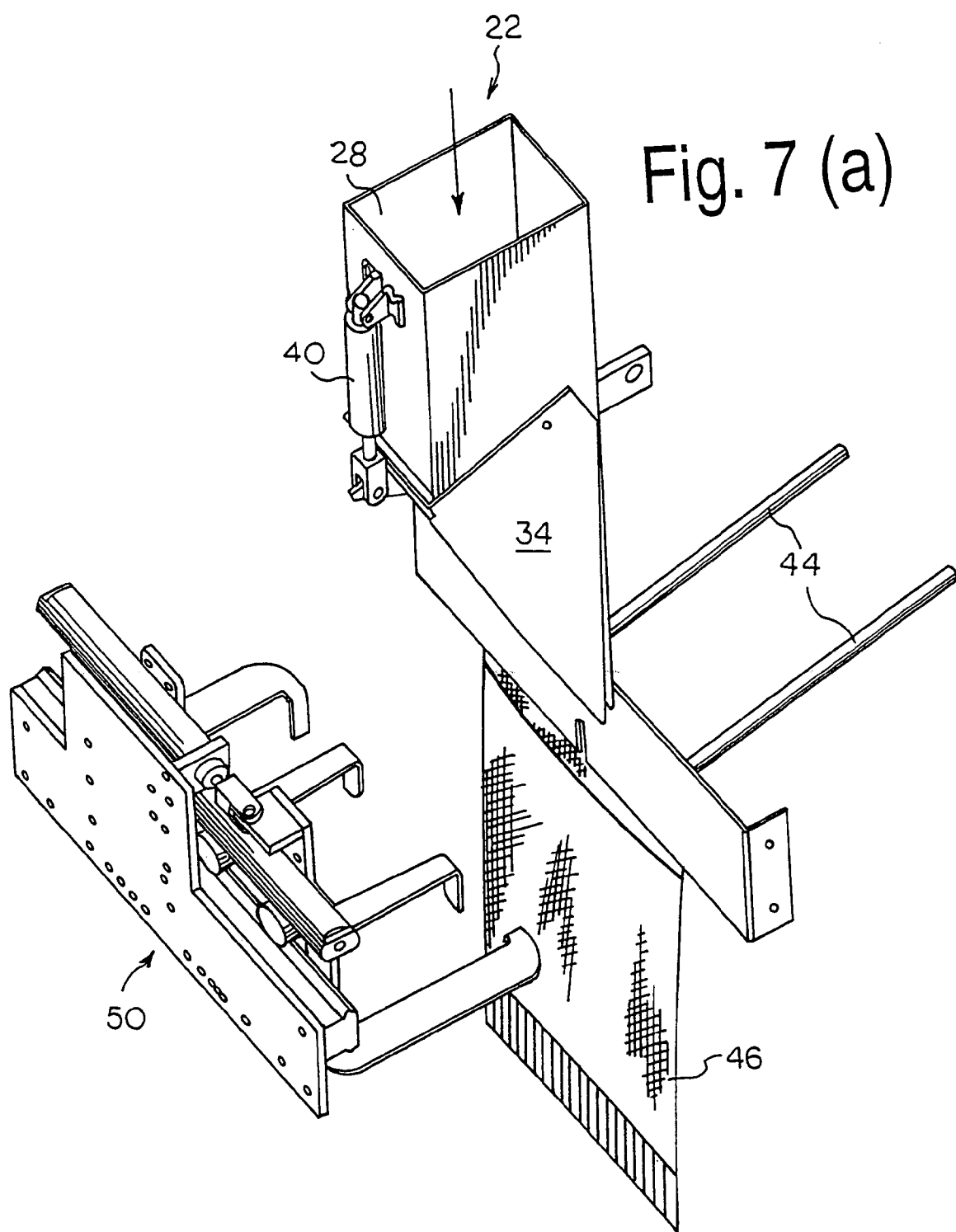
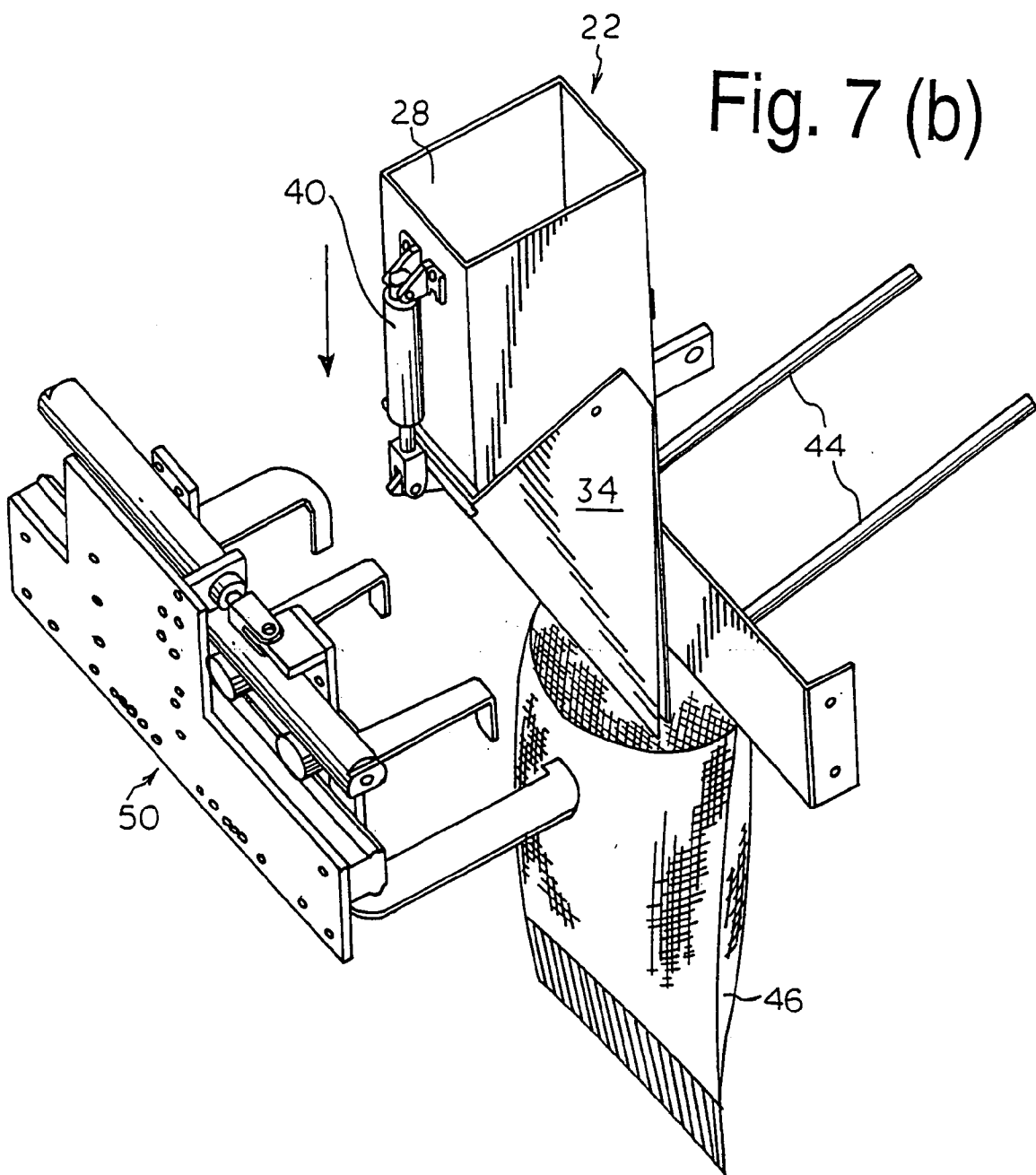
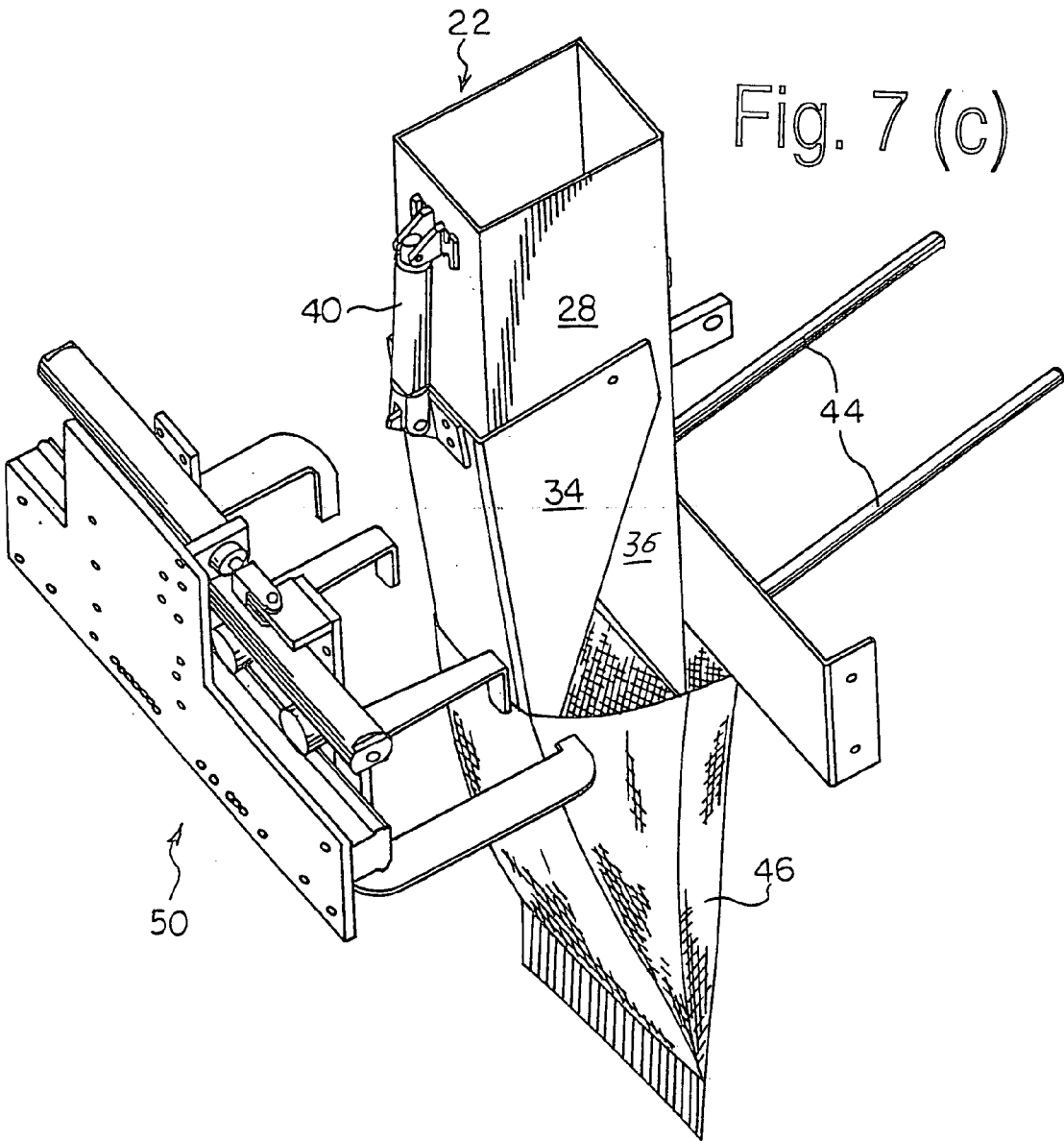


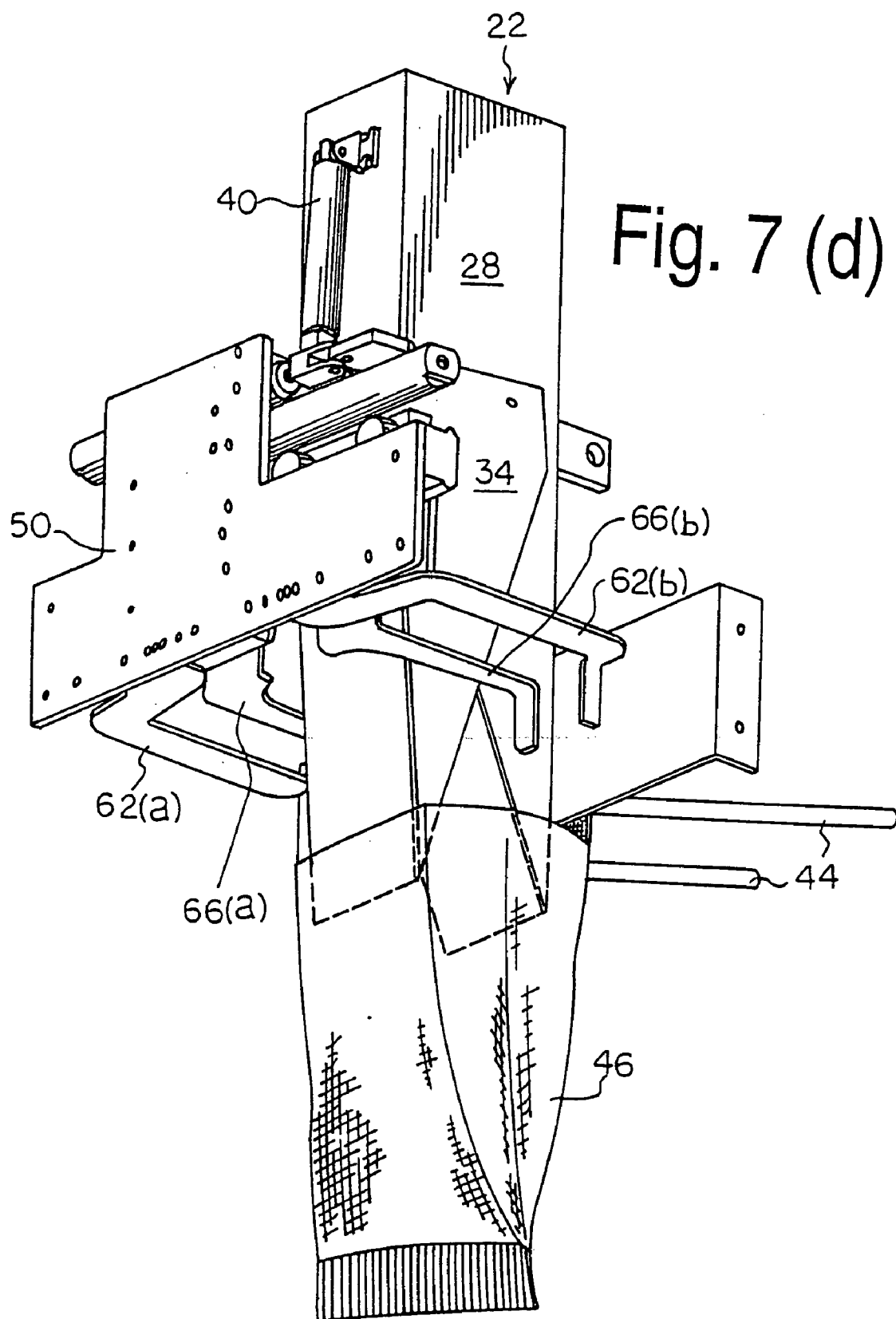
Fig. 5

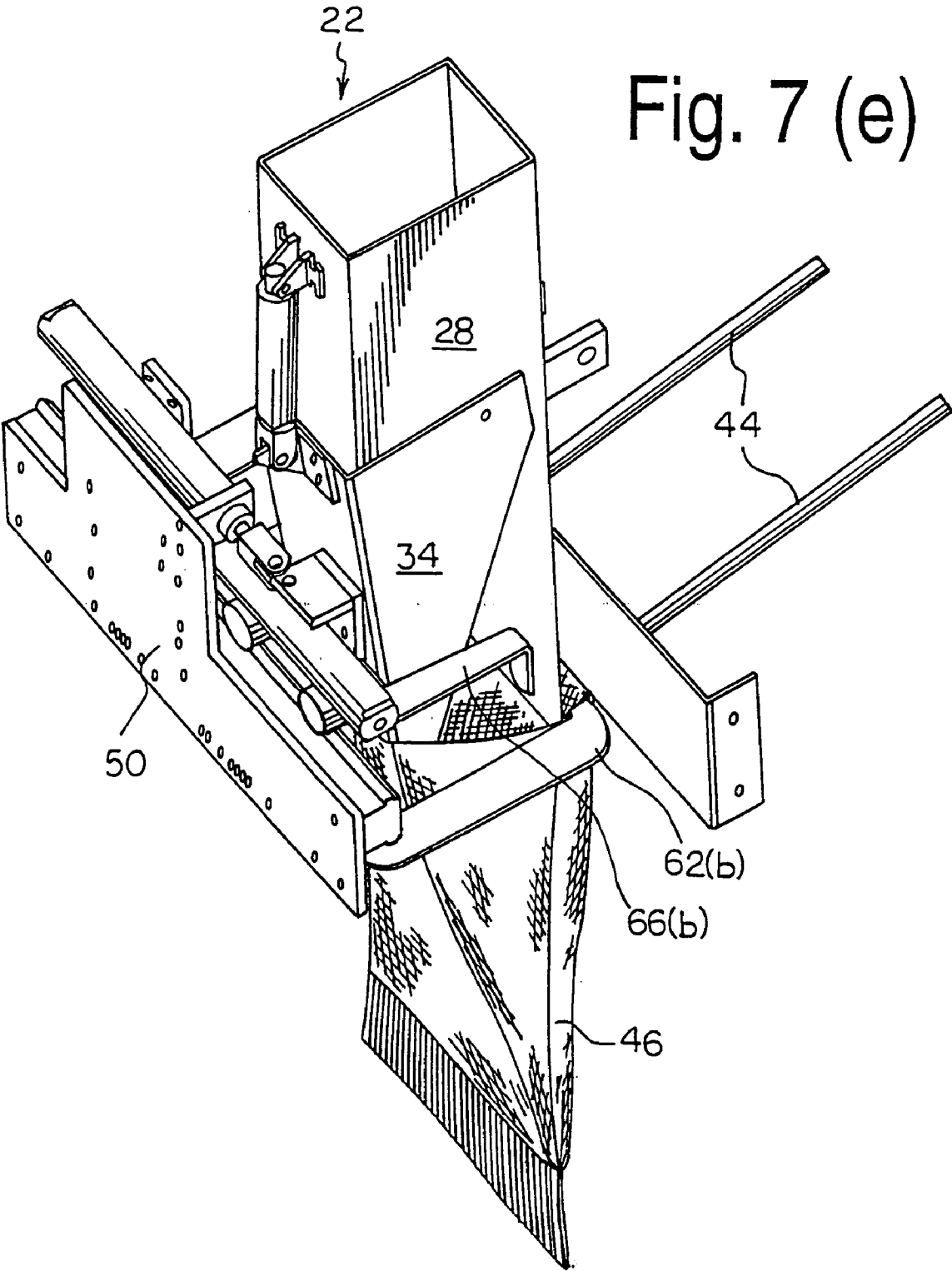


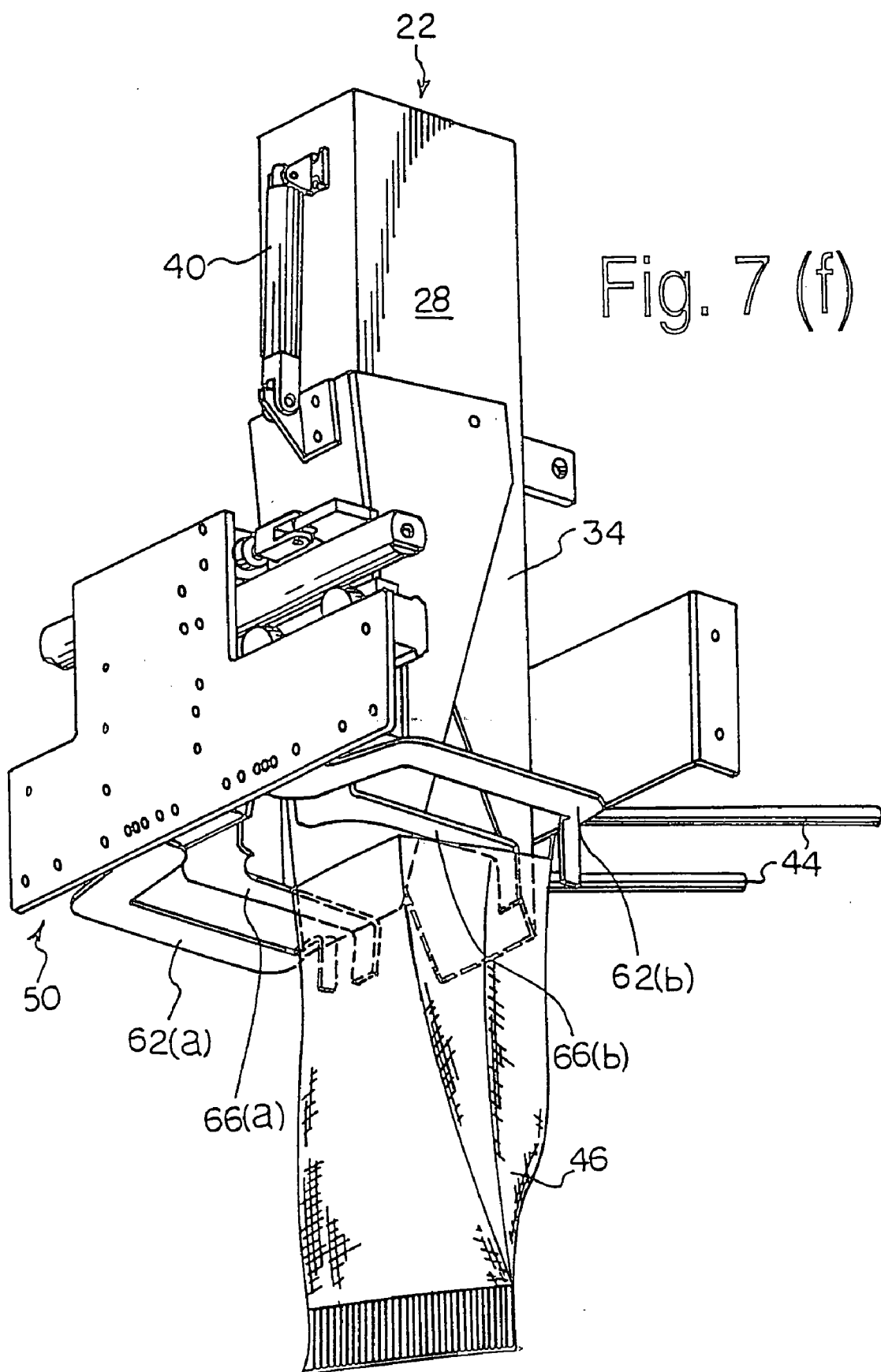


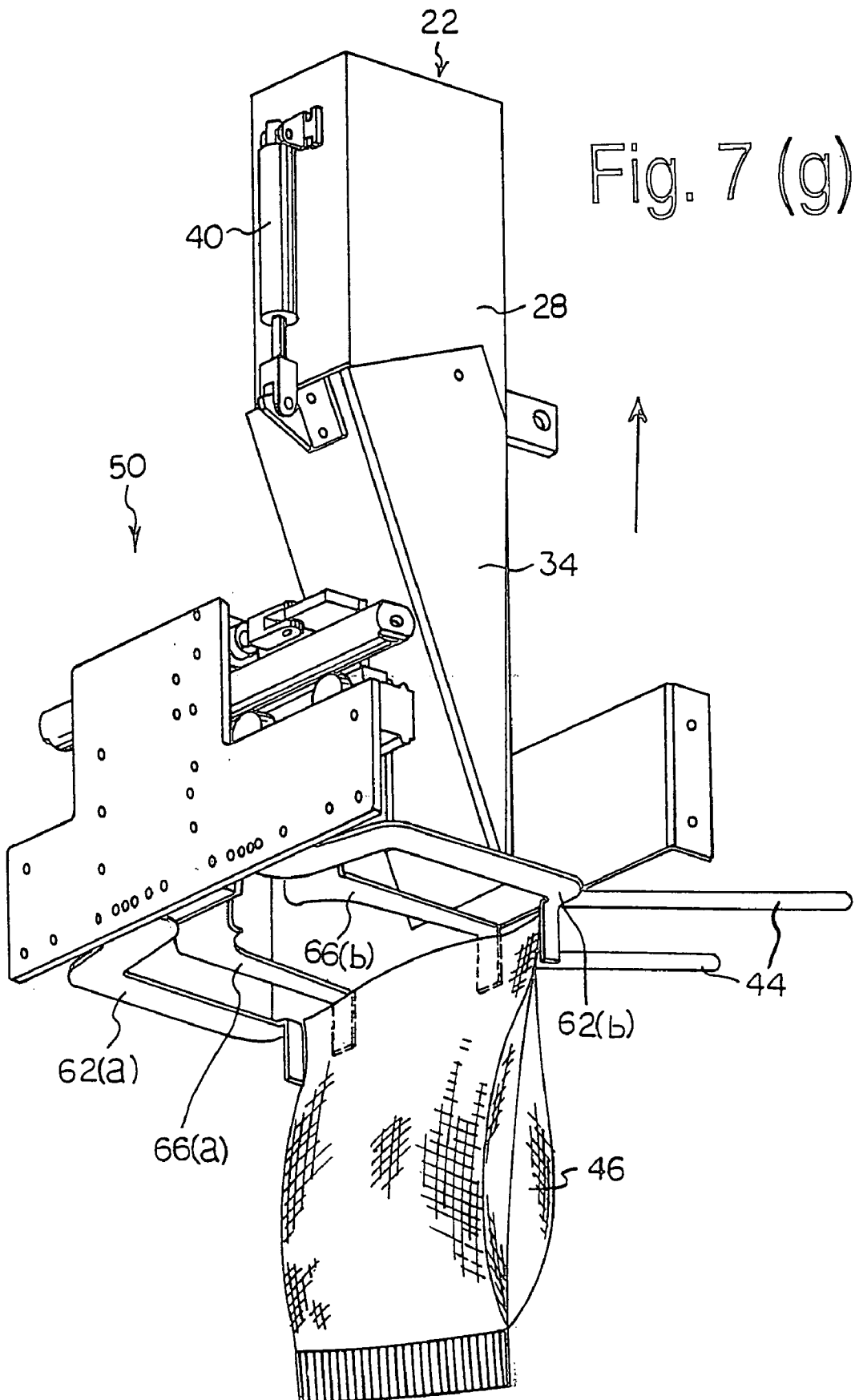


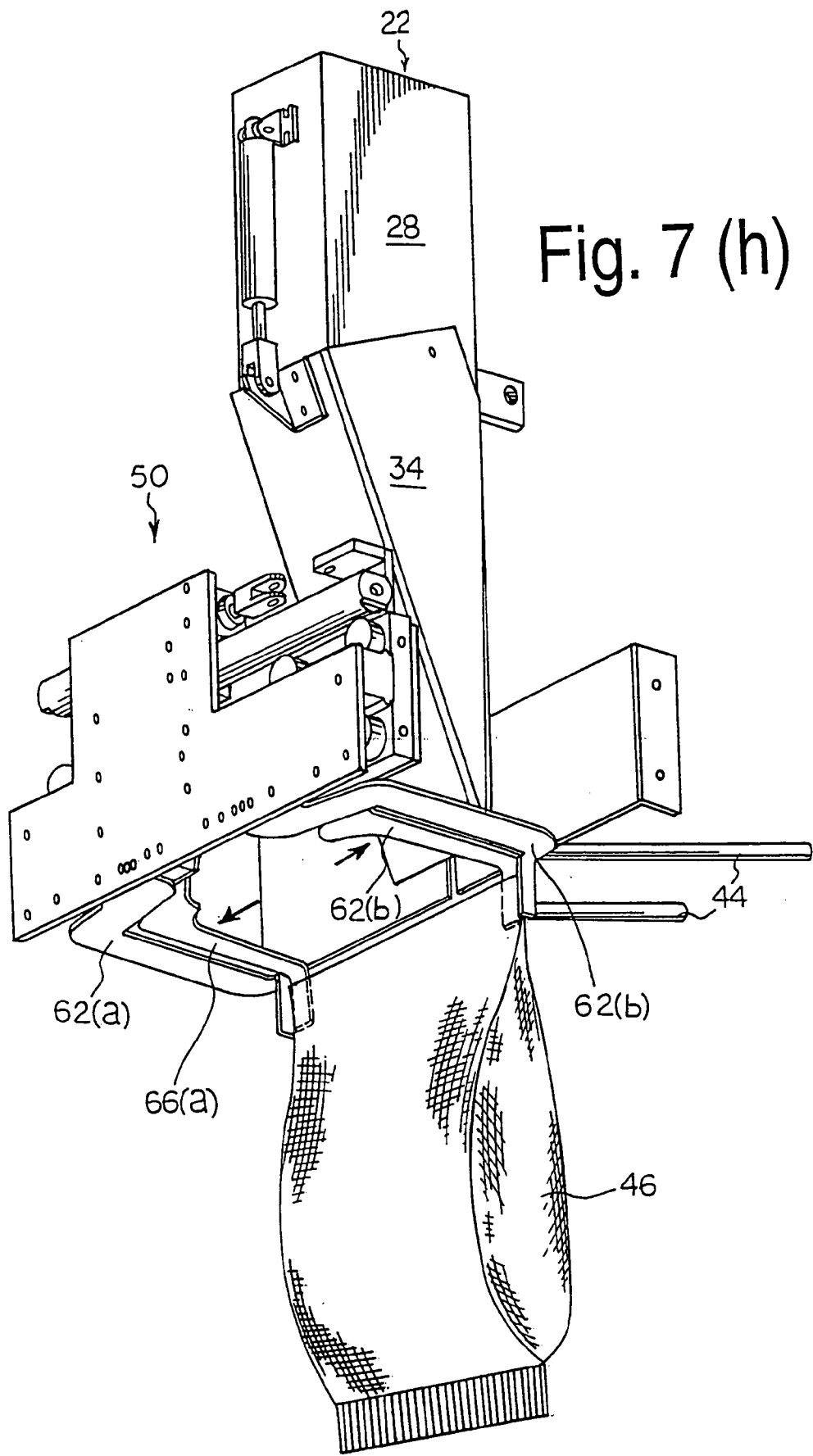












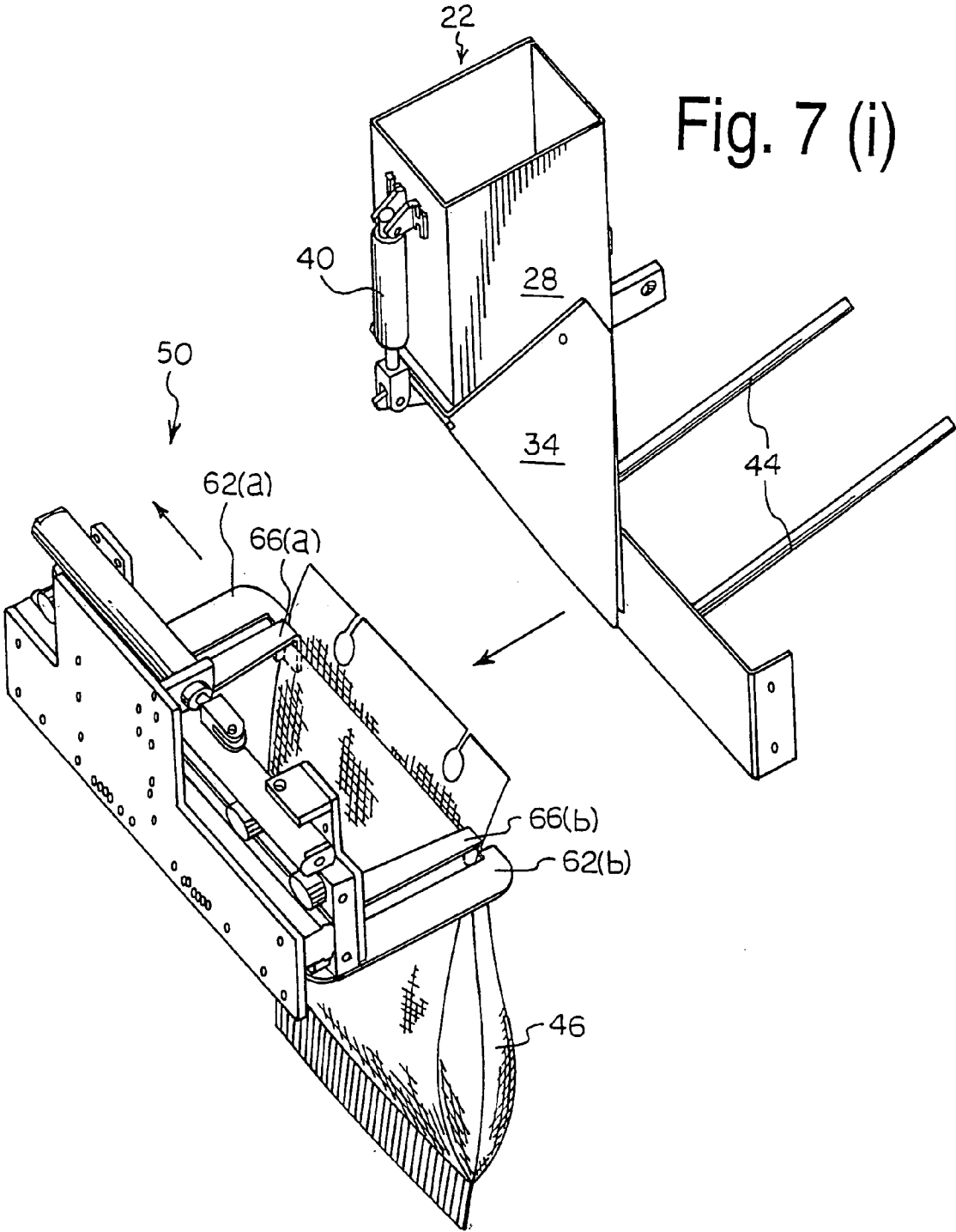


Fig. 8

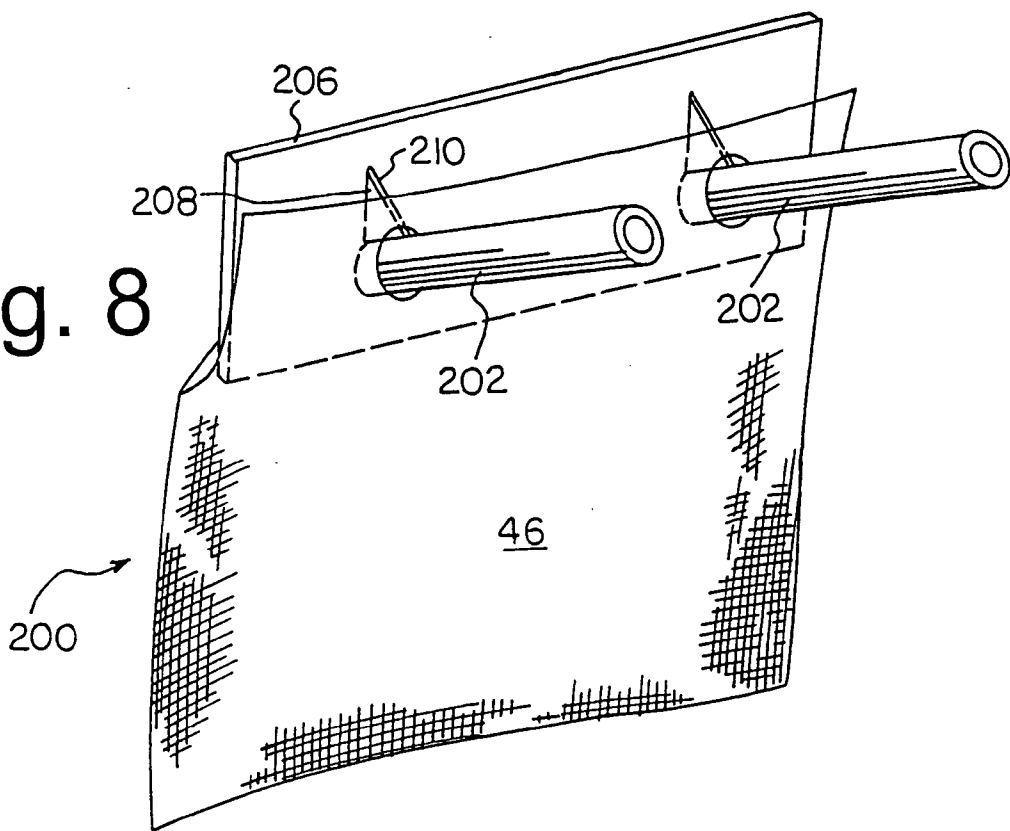
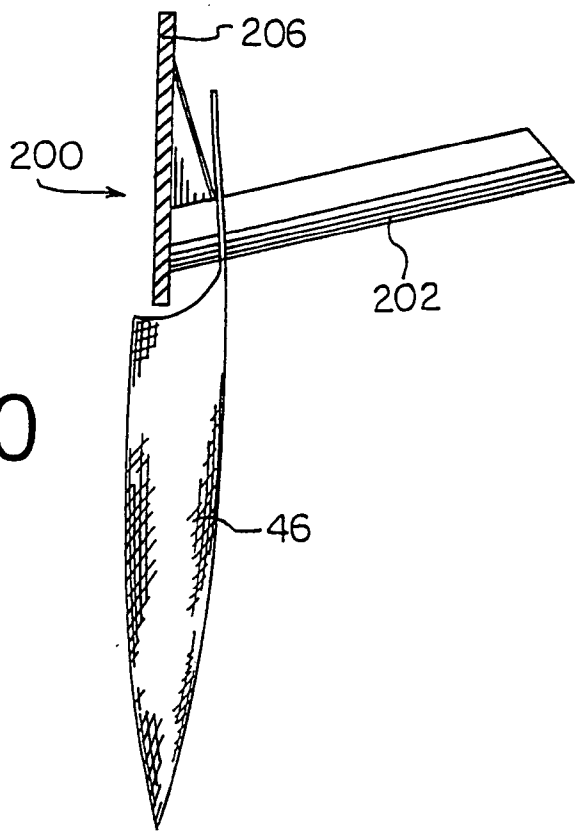


Fig. 10



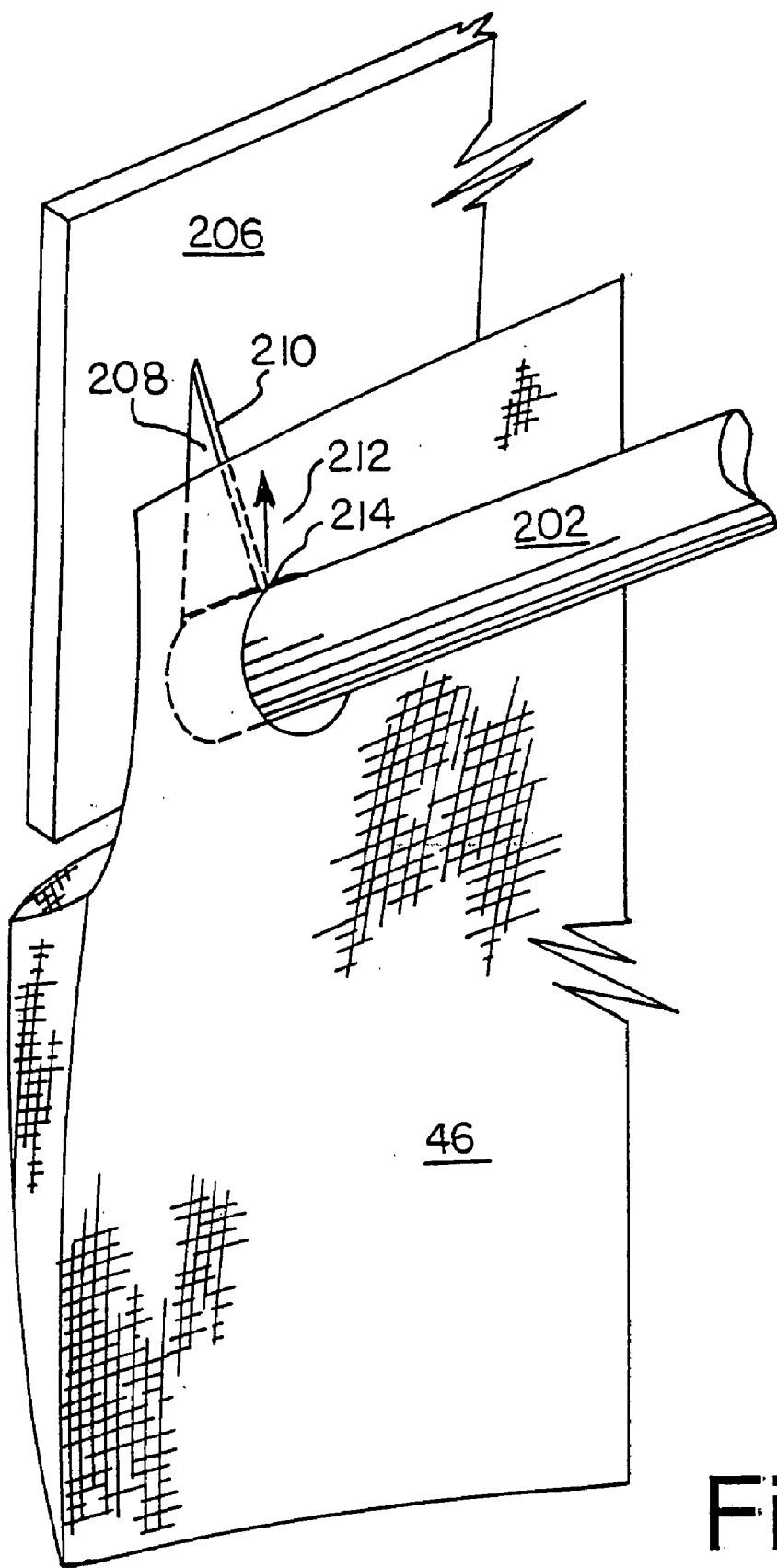


Fig. 9

BAG FILLING APPARATUS AND METHOD

FIELD OF THE INVENTION

[0001] This invention relates to packaging technology, and in particular to an apparatus and method for filling bags with a loose commodity such as seed or grain, by means of an automated apparatus, and carrying the filled bags to a bag sealing station or other processing means.

BACKGROUND OF THE INVENTION

[0002] The bagging of bulk commodities such as seed or grain requires automated equipment for sequentially dispensing a measured quantity or weight of a commodity into an open-topped bag, and transferring the bag to a heat sealing station or other bag-sealing means. Typically in apparatus of this nature, the bulk commodity is dispensed from a hopper into an open-topped bag. After a measured amount is dispensed, the bag is removed from the hopper and discharged from the apparatus. Typically, individual bags are positioned beneath the hopper sequentially. Modern commodity-handling operations require bag filling machines that are-capable of operating rapidly and effectively, that is, with a minimum of skipped bags (wherein a bag is missing when the hopper discharges its load), torn or damaged bags, or doubled-up bags.

[0003] Typically, rapidity and precision are achieved by means of an automated device having moveable fingers or other gripping members for manipulation of individual bags before, during and after the filling operation. For example, published Canadian Application 2,091,471 (Huwelmann) discloses a bag-filling apparatus having opposed clamping mechanisms for gripping the open upper end of the bag, and holding the bag open for filling by a hopper or the like. Similarly, U.S. Pat. No. 4,172,349 (Lipes) discloses opening of a bag by means of a pair of opposed gripping members that grip opposing sides of the bag and hold it open at its mouth. A similar arrangement is disclosed in U.S. 4,651,506 (Lerner et al.).

[0004] One requirement is that such apparatus accurately and rapidly transfer individual bags from a bag supply to a filling station and subsequently to a conveyor for transferring the bag to a heat-sealing mechanism or other bag-handling subsystem. This sequence may be efficiently carried out if the bags are transferred efficiently between the various stations.

[0005] A further specific requirement that is not adequately addressed in the prior art is for a simple, effective and rapid means whereby empty bags are individually engaged and positioned in an open-topped position to receive a bulk commodity from a hopper or other filling means.

[0006] In general terms, it is desirable to provide a mechanism whereby empty bags may be sequentially engaged and transferred in an open position to a bag-filling station, and subsequently transferred to a bag conveyor. Conveniently, the individual bags may be drawn closed as they are being fed to the downstream conveyor. Since typically the downstream conveyor feeds the bags into a heat-sealing station comprising a pair of heated rollers or belts, it is desirable that the mechanism draws the sides of the bags together to form a flattened upper region of the bag to receive a heat seal.

OBJECTS OF THE INVENTION

[0007] In light of the foregoing, it is an object of the present invention to provide an improved bag filling apparatus and method, whereby individual bags are selectively engaged and positioned for individual filling and subsequently are withdrawn from the filling station in a generally lateral direction for transfer to a downstream conveyor. It is a further object to provide a means whereby the filled bags are generally substantially closed at their upper ends as the bags are transferred to the downstream conveyor, in such a manner as to permit the bags to be conveniently heat sealed at their upper ends.

SUMMARY OF THE INVENTION

[0008] In accordance with the foregoing objects, the invention comprises in one aspect an apparatus for filling bags with a loose commodity and transferring filled bags to a processing means, comprising:

[0009] a bag filling station for dispensing a measured quantity of the commodity into bags;

[0010] a wicket for receiving empty bags in a stacked and interconnected array whereby the bags form a continuous web; and

[0011] filled bag transfer means incorporating a releasable clamp for engaging an open mouth of a bag upon filling the bag with the commodity and withdrawing the filled bag away from the hopper.

[0012] The interconnection of the bags may be achieved by a mechanical interconnection, for example interlocking edge regions of adjacent bags, or surface effects such as surface tension or electrical attraction between contacting bags.

[0013] The releasable clamp draws the open mouth of the bag into a taut position upon engaging the bag. The direction of transfer of the filled bags permits removal of a filled bag from the filling station to draw a subsequent empty bag from said wicket to the filling station and detach the full bag from the subsequent bag. The transfer means then transfers the filled bags from the filling station to the processing means.

[0014] Preferably, the transfer means sequentially transfers the bag in a first direction generally perpendicular to the elongate axis of the apparatus for detaching a filled bag from a subsequent bag, and subsequently in a second direction generally parallel to the elongate axis for delivering filled bags to the processing means.

[0015] The clamp of the preferred version comprises a pair of laterally moveable fingers associated with drive means for moving the fingers between converged and diverged positions. The reciprocating fingers engage opposed corresponding fixed fingers, whereby opposed ends of the bag are clamped between respective pairs of moveable and fixed fingers when the moveable fingers are diverged, and the bag is released from the clamp member when the moveable fingers are converged. The position of the fixed fingers may be laterally adjusted to converge or diverge to accommodate a selected size of bag.

[0016] The filling station preferable includes a hopper having a downwardly-depending nozzle for discharge of the loose commodity, and further comprising reciprocating

drive means for elevating the hopper during the bag removal stage and lowering the hopper during the bag filling stage.

[0017] An intermediary conveyor means may receive the filled bags from the transfer mean, to convey the bags by their upper rim to a heat sealing station or the like. The intermediary conveyor may comprise a pair of opposing elongated conveyor members, such as a pair of endless belts driven by pulleys, that diverge to receive a bag and converge to engage and transport the bag.

[0018] In a further aspect, the invention comprises a method for filling a bag with a loose commodity and transferring the filled bags to a processing means, comprising the steps of:

[0019] providing a bag-filling apparatus featuring a bag filling station, a wicket, and filled bag transfer means;

[0020] loading a supply of empty bags on the wicket in a stacked and interconnected array to form a continuous web;

[0021] opening the mouth of a first bag on the wicket;

[0022] filling the first empty bag with loose commodity at the filling station;

[0023] transferring the filled bag, away from the filling station towards the processing means thereby drawing a second connected bag into said filling station, opening the mouth of the empty bag and detaching said first bag from said second bag; and transferring the filled bag to the processing means.

[0024] The step of transferring the filled bag away from the filling station may comprise transferring the filled bag in a first direction for detaching the filled bag from the subsequent bag, and subsequently in a second direction towards the processing means. Alternatively, transfers within the first and second directions may occur essentially simultaneously.

[0025] The step of transferring the filled bag may include the step of drawing the open mouth of the bag to a substantially closed configuration, by drawing apart opposed ends of the upper region of the bag, thereby drawing together the opposed sides of the bag, and delivering the substantially closed bag to the processing means.

[0026] Having thus described the invention in general terms, the invention will now be further characterized by reference to a description and illustrations of a preferred embodiment.

[0027] The directional references employed throughout this specification are in relation to the longitudinal axis of the machine comprising the direction the general direction of movement of the bags subsequent to the filling stage, i.e., from the filling station to the heat sealing station or other downstream processing means.

BRIEF DESCRIPTION OF THE DRAWINGS

[0028] FIG. 1 is a plan view, from above, showing-the apparatus according to the present invention;

[0029] FIG. 2 is a perspective: view of the apparatus, illustrating the: conveyer within the closed position;

[0030] FIG. 3 is a further perspective view, illustrating the conveyer within an open position;

[0031] FIG. 4 is a further perspective view of the apparatus;

[0032] FIG. 5 is a further perspective view of the apparatus;

[0033] FIG. 6 is a side elevational view of a portion of the apparatus;

[0034] FIGS. 7a through i comprise a series of perspective views, of a portion of the apparatus, illustrating operation of the apparatus;

[0035] FIG. 8 is a perspective view of a portion of the device, illustrating a further embodiment of one aspect thereof;

[0036] FIG. 9 is a further perspective view as in FIG. 8;

[0037] FIG. 10 is a side elevational view of the portion shown in FIG. 8.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0038] Referring to the figures, the apparatus globally denoted by reference 10 is supported on a frame 16. The apparatus comprises a bag-filling station 20, having associated therewith a bag wicket station 22 and a bag transfer station 26. The bag-filling station comprises a vertically reciprocating hopper 28, which is driven for a reciprocal vertical movement by a pneumatic drive cylinder 30. A supply conduit 32 feeds grain or other loose, bulk commodity (not shown) into the hopper 28. Release of commodity from the hopper 28 is controlled by means of an openable jaw structure 34 which defines the lower portion of the hopper and comprises a fixed jaw member 36' and a moveable jaw member 38 which pivots about a horizontal axis. The moveable jaw member 38 is driven for a reciprocal movement diverging and converging with the fixed jaw member 36 by a pneumatic cylinder 40 mounted to the hopper 28. In the closed position, shown in FIG. 2, the respective jaw structure 34 closed and commodity cannot escape from the hopper 28. Within the open position, shown in FIG. 7(c), the jaw structure 34 is opened for the discharge of a measured amount of commodity from the hopper 28.

[0039] The bag wicket station 22 comprises a generally box-like support structure 43 mounted to the frame 16, and which slidably engages the hopper 28. The pneumatic cylinder 30 driving the hopper is mounted to an upper portion of the support structure 43. The wicket station 22 features a pair of wicket members 44, from which may be hung a flattened stack of empty bags 46 for filling with the commodity. The wicket members are angled downwardly to urge the bags towards the filling station via gravity. A pair of holes 48 extend through the upper rim portion of the bags 46 adjacent opposed sides thereof, to engage the wicket members 44. The bags 46 are interconnected to form an endless web or chain.

[0040] In a further aspect, an alternative arrangement of the wicket station is shown in FIGS. 8 through 10. Within this version, a wicket station 200 comprises paired wicket arms 202, which are angled downwardly towards the feeding station to feed the bags 46 via gravity towards the

feeding station. The wicket arms **202** terminate at a plate like wicket knife assembly **206**, mounted to the wicket station **22**. A wicket knife **208** forms a gusset like web between the plate **206** and the wicket arms **202**. The wicket knife has a knife edge **210** for slicing the bags as the same are drawn forwardly for removal from the wicket. Use of the wicket knife assembly, and consequent cutting of the bag, permits easier removal of the bags from the wicket with less stretching than a simple tearing action against the rounded wicket arms. **FIG. 9** illustrates with arrow **212** the direction of tearing of the bag as the same is pulled forwardly off the wicket, with the tear origin occurring at point **214** on the bag.

[0041] Conveniently, the interconnection may result from surface tension, static or electrical forces between the bags or mechanical forces achieved by deformation of a portion of the bags surrounding the holes, which permits each bag to lightly grip its neighbours. The interconnection between the bags is sufficient to permit each bag to draw it's neighbour forwardly and open the mouth of the neighbouring bag, as each bag is removed from the wicket upon filling. The term "interconnection" encompasses a physical connection formed by eg. deformation of adjacent bags forming an interlocking structure, or surface effects such as surface tension forming a connection between adjacent bags.

[0042] The bag transfer station **26** comprises in general terms a bag gripper assembly **50**; a gripper carriage assembly **52**; and a bag conveyer station **54**. The gripper assembly **50** is adapted to grip individual bags **46** and position each bag sequentially beneath the hopper **28** for filling with the commodity. Upon filling of the bag **46**, the gripper assembly **50** and its associated carriage assembly **52** carry the bag to the conveyer station **54** which in turn receives the filled bag for conveyance to a heat sealing station **56** or other downstream processing means.

[0043] The gripper assembly **50** comprises a generally plate-like vertical base **60**. A pair of fixed arms **62(a)** and **(b)** extend laterally from either end of the base **60** towards the hopper **26**. Each of the outer arms **62** terminates in a downwardly-extending finger **64**. The fingers **64** are a dustable on the arms **62** to accommodate bags of differing sizes requiring a greater or lesser spread of the fingers **64** to hold the bags generally taut. Positioned between the fixed outer arms **62** and parallel thereto is a pair of moveable inner arms **66(a)** and **(b)**, having a similar configuration and each terminating in a downwardly depending finger **67**. The inner arms **66** are each mounted to the base **60** for slideable movement relative to the base **60**. The inner arms **66** are each connected to a corresponding pneumatic cylinder **70** mounted to the base **60**, with the cylinders adapted to drive the inner arms **66** between reciprocating converging and diverging positions. The inner arms **66** are reciprocate between a converged first position, shown in **FIG. 7(a)**, wherein the fingers **67** of the inner arms **66** are spaced substantially apart from the fingers **64** of the fixed outer arms **62**, and a second diverged position; shown in **FIG. 7(b)**, wherein the respective fingers **64** and **67** of the inner and outer arms meet to clampingly engage a bag **46** therebetween.

[0044] It will be understood that the linear reciprocating motion of the cylinders **70**, as well as all other like drive means, may be replaced by any suitable drive means includ-

ing rotary drive means such as a revolving wheel, with the driven member being pivotally mounted at a position adjacent the wheel perimeter for reciprocating sinusoidal movement.

[0045] The carriage assembly **52** is adapted to carry the gripper assembly **50** in three axis of movement, namely laterally, longitudinally and vertically. The carriage assembly **52** comprises a carriage frame **80**, mounted to the apparatus frame **16**. The carriage frame includes a pair of spaced apart parallel bars **82(a)** and **(b)** which are fixedly mounted to the frame **16** along a longitudinal axis. A carriage **84** engages the bars **82**, and includes a pair of sleeves **85** for slideable receiving the bars to permit the carriage **84** to slide longitudinally along the bars **82**. A reciprocating pneumatic cylinder **88** mounted at one end to the carriage **84** and at the opposing end to the apparatus frame **16** drives the carriage **84** within a longitudinal direction. Extending upwardly from the carriage **84** is a rectangular pillar **88'**. A corresponding rectangular sleeve **90** is slideably received on the pillar and is driven vertically relative to the support by means of a reciprocating pneumatic cylinder **92** mounted to the respective members. Mounted to a side of the sleeve **90** is a second, horizontally-oriented rectangular sleeve **94**, the axis of which is in the lateral direction. The second sleeve **94** slidably receives a beam **96**, one end of which in turn is mounted to the base of the gripper assembly **50**. Lateral reciprocating movement of the gripper assembly **50** relative to the carriage **52** is achieved by means of slidably movement of the beam **96** within the second sleeve **94**, which in turn is driven by a pneumatic cylinder **98** linking the respective members. Vertical movement of the gripper assembly **50** is achieved by operation of the pneumatic cylinder **92**.

[0046] The conveyer station **54** is mounted to the carriage assembly **52** by means of a beam arrangement **100**. The conveyer station **54** comprises a pair of generally co-planer belt assemblies **102(a)** and **(b)**. The belt assemblies **102** each comprise a housing **104**, having journaled therein a pair of rotatable pulleys **106** at either end thereof, supporting the opposing ends of a rotatably driven belt **108**. A motor **110** drives both the first of the belts **108(a)** and **108(b)**. The respective belts are geared together through meshing spur gears mounted on corresponding belt drive shafts. The first housing **104(a)**, with the motor **110** mounted thereto, is fixed to the beam arrangement **100**. The second housing **104(b)** is pivotally mounted to the beam arrangement **100** for pivoting about a vertical axis. When the respective housings **104(a)** and **(b)** are swung together within the closed position, the respective belts **108(a)** and **(b)** are parallel to and in substantial contact with each other. Within the open position shown in **FIG. 3**, the belts **108** diverge. When in the diverged position, the belts are able to receive a filled bag, and subsequently swing together in to the closed position for conveyance of the bag away from the apparatus.

[0047] Operation of the devise will now be described by reference to **FIGS. 107(a)-(i)**.

[0048] Operation of the apparatus commences with an individual bag **110**, comprising the first bag in the interconnected array of bags **46**, being supported by the wicket members **44** and positioned directly below the hopper **28**. An air nozzle **112** mounted to the wicket support **43** directs a stream of air into the at least partly open mouth of the bag

110, to open the bag sufficiently for filling and to hold the bag open as the jaws 36 and 38 of the hopper 28 descend into the bag 110, as shown in FIG. 7(b). The hopper 28 then discharges a measured amount of the commodity into the bag 110. As the hopper is discharging the commodity, the bag gripper assembly 50 advances laterally towards the hopper 28, as seen in FIG. 7(c)-(e), and subsequently downwardly, as seen in FIG. 7(f), such that the downwardly-depending fingers 67 of the inner arms 66 extend into the open mouth of the bag 110. The jaws 36 and 38 of the hopper 28 then close and the hopper moves upwardly, as shown in FIG. 7(g) and (h). Simultaneously, the inner arms 67 of the gripper diverge, thereby drawing taut the mouth of the bag 110 and gripping opposing corners of the bag between the respective inner and outer fingers 64 and 67, as seen in FIG. 7(h). The gripper assembly 50 then retracts laterally, as seen in FIG. 7(i), and transfers the bag 110 longitudinally to the conveyer station 54. Retraction of the first bag 110 away from the interconnected array of bags 46 draws the subsequent bag 111 in the array forwardly in position beneath the hopper 28. The filled bag 110 is then conveyed longitudinally along the paired bars 82, towards the conveyer station 54. The paired belts 108 of the conveyer station 54 within the open position receive the bag 110, and subsequently converge to grippingly engage the bag between the respective belts 108, for conveyance towards a heat sealing station 120 or the like. Conventionally, the heat sealing station comprises a pair of heated belts 122 which may receive the bag directly from the conveyer to perform a heat sealing operation on the bag.

[0049] Operation of the device, and in particular, operation of the various pneumatic cylinders, is controlled by a central control unit, which includes sensors for detecting the positions of the various components referred to above, and ensuring the various pneumatic actuators operate in a coordinated fashion.

[0050] It will be seen that although the present embodiment employs reciprocating pneumatic actuators for driving the various components of the apparatus, any known drive means may be substituted, including hydraulic rams, electric linear actuators or other like means.

[0051] It will be further understood, that although the present invention has been described in detail by way of a preferred embodiment thereof, persons skilled in the art to which this invention pertains will be able to make numerous modifications and variations to the invention. These variations and modifications will still remain within the spirit and scope of the invention, which is described and characterized within the appended claims.

We claim:

1. Apparatus for filling bags with a loose commodity and transferring filled bags to a processing means, comprising:

- a bag filling station comprising a source of loose commodity and an outlet for depositing a predetermined amount of said commodity into said bags;
- a wicket for receiving empty bags arranged in interconnected array and positioning said bags sequentially beneath said filling station;
- bag transfer means comprising reciprocating clamp members for releasably engaging an open mouth of a filled bag, said clamp-members being mounted to a frame

and associated with drive means for reciprocal lateral movement of said clamp members, whereby upon lateral movement of said gripping member and said bag laterally away from said hopper the subsequent of said bags is drawn along said wicket and is advanced to a filling position at said filling station.

2. An apparatus as defined in claim 1, wherein said clamp members comprise a first pair of parallel arms each terminating in a downwardly-depending finger; and a second pair of parallel arms positioned between said first pair and each terminating in a corresponding downwardly-depending finger, said second pair of arms being driven by drive means for reciprocal diverging and converging movement whereby within a converged position said-fingers of said second arms are positioned for insertion within an open mouth of a bag, and in said diverged position, said fingers are positioned to draw the mouth of said bag into a taut position whereby opposing corners of the bag are clampingly gripped between the fingers of respective inner and outer arms.

3. An apparatus as defined in claim 1 wherein there is further provided an air nozzle for directing a stream of air into the mouth of each of said bags as they are sequentially positioned at said filling station, for opening the mouths thereof.

4. An apparatus as defined in claim 1, wherein said clamp members are mounted to a carriage means, said carriage means being mounted for reciprocal longitudinal movement to a carriage frame, and drive means for driving said carriage means in a reciprocating longitudinal movement.

5. An apparatus as defined in claim 1, wherein said clamp means are mounted to a frame for reciprocating vertical movement.

6. An apparatus as defined in claim 1, further comprising a conveyer means for receiving filled bags from said gripping means, said conveyer means comprising: a pair of substantially co-planar rotatable belt means, said belt means mounted for reciprocal converging and diverging movement whereby in a diverged position the belt means are spaced apart from each other to receive said bag, and in a converged position said belt means are substantially in contact with each other to convey said bag therebetween;

a first drive means for rotatably driving at least one of said belts; and

a second drive means for actuating at least one of said belt means between said converged and diverged positions.

7. An apparatus as defined in claim 6 wherein said belt means are mounted within a substantially horizontal plane, and each comprise a pair of spaced apart pulley members supporting a belt therebetween, a first of said belt means being mounted for pivotal movement about a vertical axis.

8. An apparatus as defined in any of claims 2 through 7, further comprising a controller for controlling the apparatus to perform the following sequence of events:

downward movement of said, whereby said jaws extend at least partly into an open mouth of a first of said bags for deposition of a measured quantity of said commodity therein;

movement of said clamp members laterally towards said hopper whereby said fingers are positioned substantially over the mouth of said bags;

downward movement of said clamp members whereby by said inner fingers extend into said bag;

upward movement of said hopper away from said bag;
diverging movement of said inner arms whereby said inner fingers draw the mouth of said bag taut and grippingly engage said bag between respective inner and outer fingers;

lateral movement of said bag away from the hopper in a direction substantially perpendicular to the axis of said wicket members, thereby removing the filled bag from the wicket and drawing a second bag laterally into position beneath said hopper, and separating said first and second bags.

9. An apparatus as in claim 8, wherein said controller further controls the apparatus to perform the subsequent step of transferring said filled bag laterally into said conveyor means.

10. An apparatus as in claim 1, wherein said wicket angles downwardly to at least partly feed said bags to said filling station via gravity.

11. A method for filling a bag with a loose commodity and transferring the filled bags to a processing means, comprising the steps of:

providing a bag-filling apparatus featuring a bag filling station, a wicket, and bag transfer means;

providing empty bags on said wicket in a stacked and interconnected array to form a continuous web;

opening the mouth of a first bag on said wicket;

filling a first empty bag with said loose commodity at said filling station;

transferring said filled bag away from said filling station along a generally horizontal plane towards said processing means, thereby drawing a second connected bag into said filling station and detaching said first bag from said second bag; and transferring the filled bag to the processing means.

12. A method as in claim 11, wherein said step of transferring the filled bag away from said filling station comprises transferring the filled bag in a first direction for detaching the filled bag from the subsequent bag, and subsequently in a second direction towards the processing means.

13. A method as in claim 11, wherein the step of transferring the filled bag includes the step of drawing the open mouth of the bag substantially closed, by drawing apart opposed ends of the upper region of the bag, thereby drawing together the opposed sides of the bag, and delivering the substantially closed bag to the processing means.

14. A method as in claim 11, wherein said bags are interconnected to form a continuous web by means of generating between the bags a static electrical charge, or surface tension for releasably holding neighbouring bags together.

15. A method as in claim 11, wherein said bags are interconnected to form a continuous web by means of mechanical connection between said bags.

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