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(54) **APPARATUS FOR THE POSITIONING OF PIECES OF CLOTH ON SEWING MACHINES**

(57) The present invention refers to an apparatus for the positioning of pieces of cloth on sewing machines. In particular, this apparatus is capable of recovering a piece of cloth from a loader, disposing properly said piece of cloth and transporting the piece of cloth on the sewing machine. Said apparatus comprises a gripping element (36) which comprises a block (37) from which a first hook (40) and a second hook (42) protrude, which are spaced apart and movable relative to each other, so that the first

hook (40) and the second hook (42) move away or approach each other; said first hook (40) has a pointed end which faces the half-space opposite to that in which the second hook (42) rests, said second hook (42) has a pointed end which faces the half-space opposite to that in which the first hook (40) rests, so that when the gripping element (36) is placed adjacent to the cloth piece (P), the first hook (40) and the second hook (42) move away from each other and grasp the cloth piece (P).

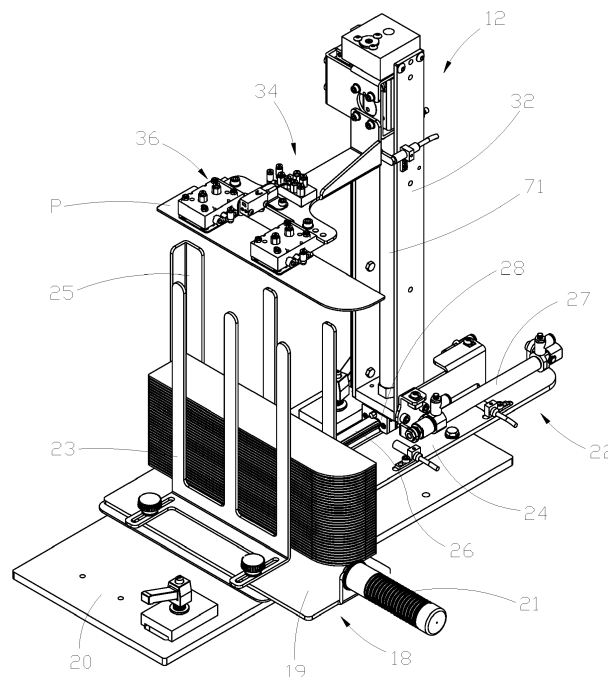


Fig. 2

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## Description

**[0001]** The present invention refers in general to an apparatus for the positioning of pieces of cloth on sewing machines. More particularly, this apparatus is capable of recovering a piece of cloth from a loader, disposing properly said piece of cloth and transporting the piece of cloth on the sewing machine.

**[0002]** As is known, the sewing machines require that the piece of cloth is disposed in the correct position in order to obtain a precise seam.

**[0003]** To this end, the automatic sewing machines are usually equipped with appropriate devices that position the piece of cloth correctly.

**[0004]** However, said devices do not always ensure an optimal positioning of the piece of cloth in a time fast enough. In fact, in the apparatuses according to the prior art it is not possible to ensure an exact repeatability of the positioning operations.

**[0005]** An aim and function of the invention is to obviate the above drawbacks and still others through the realization of an apparatus for the positioning of pieces of cloth on sewing machines.

**[0006]** In particular, an aim of the invention is to provide an apparatus that is capable of positioning a piece of cloth in a precise fast manner on a sewing machine. Another aim of the invention is to obtain a positioning apparatus for the positioning of a piece of cloth on a sewing machine that do not require specialized operators for the first arrangement of the cloth pieces.

**[0007]** The above aims and still others are achieved according to the invention through an apparatus for the positioning of a cloth piece on a sewing machine, comprising a loader with a movable arm comprising, in turn, at least one gripping element. The apparatus is characterized by the fact that the gripping element comprises a block from which a first hook and a second hook protrude, which are spaced apart and movable relative to each other, so that the first hook and the second hook move away or approach each other; said first hook has a pointed end which faces the half-space opposite to that in which the second hook rests and, likewise, said second hook has a pointed end which faces the half-space opposite to that in which the first hook rests, so that when the gripping element is placed adjacent to the cloth piece, the first hook and the second hook move away from each other and grasp the cloth piece.

**[0008]** Through the apparatus according to the invention, the gripping of the cloth to be transported is obtained by means of a relative distancing of the two hooks which engage the cloth piece by placing it under tension; thus, it is sufficient that an only hook moves away from the other hook.

**[0009]** In the apparatus according to the invention, the first hook may be fixed to a first cartridge movable within a first hollow cylindrical body received in the block, said first cartridge being adapted to be moved in a first direction by a first pressurized fluid.

**[0010]** In this way, one hook or both hooks may be moved by means of a pneumatic system that sends air under pressure and causes the movable cartridge with the hook fixed on it to be moved inside the corresponding hollow cylinder. Advantageously, the apparatus according to the invention may comprise a first elastic means which is connected to the first cartridge and is adapted to oppose the motion imparted by the first pressurized fluid so as to move the first cartridge in a second direction opposite to the first direction.

**[0011]** In this way, when the pneumatic system is not activated, each hook fixed to the cartridge with the elastic means is forced to position itself in an extreme position of rest. In so doing, the apparatus may provide a rest position for the hooks. This position is suitably determined without consuming energy from the pneumatic system.

**[0012]** Besides, a through hole may be formed in an end of the first hollow cylindrical body and is adapted to be passed through by at least one portion of the first cartridge when said first cartridge is moved in the first direction.

**[0013]** In this way, it is possible to know the position of the hooks which during the gripping phase would be hidden between the block and the cloth piece, simply looking sideways the gripping elements.

**[0014]** Advantageously, a hole is formed in the block in which hole the first hollow cylindrical body is fixed in a position adjustable by fixing means.

**[0015]** Through said feature it is possible to vary the extreme positions of the hooks depending on the gripping needs and transport of the cloth piece.

**[0016]** Besides, the apparatus may have a symmetrical structure in which also the second hook may be fixed to a second cartridge, movable within a second hollow cylindrical body, said second cartridge being adapted to be moved in a second direction by the first pressurized fluid, said second direction being opposite to the first direction.

**[0017]** In other words, by putting the first cartridge and the second cartridge adjacent to each other and movable on the same axis, it is sufficient to introduce air in the chamber included between the two cartridges in order to move the cartridges away from each other and to move the hooks away from each other.

**[0018]** Like the first cartridge, a second elastic means is comprised and is connected to the second cartridge and is adapted to oppose the motion imparted by the first pressurized fluid so as to move the second cartridge in the first direction. In this way, when the pneumatic system is not activated, both hooks are pushed in opposite directions so as to approach each other. Advantageously, the apparatus according to the invention may comprise a first blade which is movable relative to the block, a first through slot and a second through slot being formed in said first blade so that when the first blade is approached to the block, the first hook and the second hook protrude from the first slot and second slot, respectively, while

when the first blade is moved away from the block, the first hook and the second hook are sheltered by said first blade.

**[0019]** Through said first blade, it is possible to cover the two hooks and obtain a configuration of the apparatus that ensures the maximum safety because the operator is prevented from coming into contact, voluntarily or involuntarily, with both hooks.

**[0020]** In order to keep the apparatus in said configuration in the resting phase, elastic means may be comprised and are adapted to push the first blade away from the block.

**[0021]** Besides, a second blade may be comprised and is connected through at least one pin to the first blade, said second blade being adapted to be moved by at least one piston so as to approach the first blade to the block by protruding the first hook and the second hook from the first blade through the first slot and the second slot.

**[0022]** Advantageously, the apparatus according to the invention may comprise at least one adjustment screw which is adapted to adjust the minimum distance of the first blade from the block so as to adjust the maximum projection of the first hook and second hook from the first blade through the first slot and the second slot.

**[0023]** Further features and details of the invention will be better understood from the following specification which is provided by way of a non-limiting example as well as from the accompanying drawings, wherein:

Figure 1 is an axonometric view of an apparatus according to the invention;

Figures 2, 3 are an axonometric view and a side view, respectively, of a loader forming part of the apparatus in Figure 1;

Figure 4 is a bottom view of an arm forming part of the loader in Figure 2;

Figures 5a and 5b are axonometric bottom views of a gripping element forming part of the arm in Figure 4, according to two different working configurations; Figures 6a and 6b are side views in section of the gripping element shown in the Figures 5a and 5b, respectively, according to a first section plane;

Figures 7a and 7b are side views in section of the gripping element shown in Figures 5a and 5b, respectively, according to a second section plane;

Figure 8 is a side view in section of the gripping element shown in Figure 5a, according to a third section plane;

Figure 9 is a top view of the gripping element in Figures 5a to 8;

Figure 10 is an axonometric view of a plate forming part of a positioning device of the apparatus in Figure 1;

Figures 11, 12 are a side view and an axonometric view, respectively, of the positioning device on whose plate the piece of cloth is arranged which has to be positioned correctly;

Figure 13 is a side view of the apparatus in Figure 1

in a subsequent working phase in which the piece of cloth is disposed in correspondence of the plate in Figure 10;

Figure 14 is a side view of the apparatus in Figure 1 in a subsequent working phase in which pliers of a transport device grasp the piece of cloth disposed on the positioning device;

Figure 15 is an axonometric view of the positioning device in which the piece of cloth is positioned correctly;

Figure 16 is an axonometric view of the loader in Figure 2 in a first working phase in which the piece of cloth is gripped;

Figures 17, 18 are axonometric views of the apparatus in Figure 1 in the last working phases in which the transport device moves back and translates so as to bring the piece of cloth on the sewing machine.

**[0024]** With reference to the enclosed drawings, in particular to Figure 1, number 10 denotes an apparatus for the positioning of pieces of cloth on sewing machines, comprising a loader 12, a positioning device 14 and a transport device 16.

**[0025]** The loader 12 is adapted to take a cloth piece P from a cart 18 for the transport of cloth pieces and to let the same cloth piece P on a plate 52 included in the positioning device 14.

**[0026]** The cloth piece P is arranged in the desired position by means of the positioning device 14 and is grasped from here by the pliers 78, 84 of the transport device 16 to be brought in the correct position on the sewing machine.

**[0027]** The loader 12, as shown in detail in Figures 2 and 3, includes a base support 20 on which the cloth piece cart 18 as well as a lifting device 22 are placed. The cloth piece cart 18 comprises a base tray 19 to which a handle 21 is fixed. A first lateral side 23 and a second lateral side 25 are attached to the base tray 19. Both lateral sides have vertical rods. The cloth pieces P are received between the first lateral side 23 and the second lateral side 25. The position of both lateral sides is adjustable so that it is possible to accommodate cloth pieces P having different shapes and sizes.

**[0028]** The lifting device 22 comprises a bottom 24 fixed to the base support 20 and comprising a slide 26 on which a movable base 28 can slide, the movable base 28 being moved by a first actuator 27 having a rod 30.

**[0029]** A vertical structure 32 is fixed to the movable base 28. An arm 34 can be moved vertically along the vertical structure 32 by means of a second actuator 71. The arm 34 spreads out in two ends which are provided with a gripping element 36, respectively.

**[0030]** The gripping element 36 comprises a block 37 from which a first pair of hooks, and precisely a first hook 40 and a second hook 42, protrude, as well as a second pair of hooks, also defined first hook 40 and second hook 42 protrude, as shown in Figure 5b.

**[0031]** The first hook 40 and the second hook 42 of

both pairs of hooks and of both gripping elements 36 are spaced apart and movable relative to each other so that the first hook 40 and the second hook 42 can move away from each other or approach each other.

**[0032]** Each first hook 40 has a pointed end which points towards the half-space opposite to that in which the corresponding second hook 42 rests and, in the same way, each second hook 42 has a pointed end which points towards the half-space opposite to that in which the corresponding first hook 40 rests so that when the gripping element is placed adjacent to the cloth piece P, the first hook 40 and the second hook 42 move away from each other and grasp the cloth piece P.

**[0033]** As shown in Figures 5a, 5b, 6a, 6b, 7a, 7b, a first blade 33 and a second blade 43 are arranged on the lower face and the upper face of the block 37, respectively. These blades are connected to each other at a fixed distance by means of pins 35 and are movable relative to the same block 37.

**[0034]** The distance between the first blade 33 and the second blade 43 is greater than the thickness of the block 37 so that according to two different configurations, the first blade 33 or the second blade 43 can move away from the block 37.

**[0035]** Four slots 45, 47 are obtained in the first blade 33 in correspondence of the hooks 40, 42 so that the same slots may be crossed by the hooks 40, 42. In particular, a first slot 45 and a second slot 47 are crossed by the first hook 40 and by the second hook 42, respectively.

**[0036]** Two pistons 31, connected by means of a connector 29 to a central pneumatic system, push, if actuated, the second blade 43 upwards and, consequently, the first blade 33 in contrast with springs arranged coaxially to the pins 35, not visible in the figures.

**[0037]** In other words, when the two pistons 31 are not actuated, the first blade 33 is in a lowered position as it appears from Figures 5a, 6a, 7a e 8 because the first blade 33 is pushed by the springs which are coaxial to the pins 35. In this way, the first blade 33 prevents the hooks 40, 42 from coming in contact with the cloth piece P accidentally.

**[0038]** When the two pistons 31 are actuated, the second blade 43 is pushed upwards and, consequently, also the first blade 33 moves close to the block 37 letting the hooks 40, 42 come out through the slots 45, 47.

**[0039]** As shown in the Figures 8 and 9, adjustment screws 55 are also received in the block 37. The adjustment screws 55 are contrasted in their motion of screwing by cup springs 57 which enable to adjust the minimum distance possible between the first blade 33 and the lower face of the block 37. In this way, it is possible to adjust the maximum projection of the hooks 40, 42 outwards, the position being adjustable according to the type of fabric to grab. Illustrating a single pair of hooks, as identical in structure and operation, the first hook 40 and the second hook 42 move away from each other and approach each other according to the requirements.

**[0040]** In the rest position, the first hook 40 and the second hook 42 are close together while when they are put in contact with the cloth piece P in order to grab it, they are moved away from each other so as to engage the fabric. The first hook 40 is fixed to a first cartridge 48 which is movable between two limit positions in a first hollow cylinder 38; in particular, the first cartridge 48 is formed by two cylinders having different diameters and the cylinder having the smaller diameter is received in a first spring 50 which counteracts the movement in a direction of the same first cartridge 48.

**[0041]** Likewise, the second hook 42 is fixed to a second cartridge 46 which is movable between two limit positions in a second hollow cylinder 51; in particular, also the second cartridge 46 is formed by two cylinders having different diameters and the cylinder having the smaller diameter is received in a second spring 49 which counteracts the movement in a direction of the same second cartridge 46.

**[0042]** Two through-holes 37 are formed in the block 37. Each of the two through-holes receives a first hollow cylinder 38 with the first cartridge on which the first hook 40 is fixed, and a second hollow cylinder 51 with the second cartridge on which the second hook 42 is fixed.

**[0043]** The first hollow cylinder 38 and the second hollow cylinder 51 are fixed in the block 37 at a distance between them by means of a first grain 39 and a second grain 53, respectively, and are disposed in a symmetric position so that the first spring 50 and the second spring 49 are facing outward.

**[0044]** The space between the first hollow cylinder 38 and the second hollow cylinder 51, inside each through-hole, is put into communication through a passage element 41 and appropriate ducts, not shown in the figures, with the pneumatic system.

**[0045]** In this way, through the so-described structure, when the pneumatic system is not actuated, and is in its rest configuration, the first spring 50 and the second spring 49 keep the first hook 40 and the second hook 42 in the closest position.

**[0046]** On the contrary, when air under pressure is supplied through the passage element 41, the first cartridge 48 and the second cartridge 46 are moved outwards, while in contrast with the respective springs 50, 49, and the first hook 40 and the second hook 42 move away from each other and make a movement that enables the taking of the cloth piece P.

**[0047]** The positioning device 14, shown individually in Figure 10, comprises a plate 52 having an essentially rectangular shape to which a first abutment element 54 and a second abutment element 56 are fixed which rise in a direction perpendicular to the plate 52 and are disposed on edges of a long side and a short side of the plate 52, respectively.

**[0048]** In correspondence of the first abutment element 54 there are through-openings of which only one is shown by reference number 58 in Figure 10. Three blowing devices 60 are arranged on the plate 52. The blowing de-

vices 60 have a swiveling blowing opening 62, respectively, and are connected to the pneumatic system of the apparatus.

[0049] The three blowing devices 60 are used to blow air on the surface of the plate 52. The air is conveyed toward the first abutment element 54 and the second abutment element 56 so as to go out through the slots 58.

[0050] Through this system, a cloth piece P, arranged casually on the plate 52 as shown in Figure 11, is sent in abutment against the first abutment element 54 and the second abutment element 56 so as to be positioned accurately with respect to the transport device 16 which intervenes later.

[0051] Besides, the plate 52 is also provided with a first oblong hollow 64 arranged adjacent to the second abutment element 56, and three second oblong hollows 66 which are closer to one another but are spaced apart from and parallel to the first hollow 64.

[0052] The first hollow 64 and one of the three second hollows 66 are used to receive the lower parts of eventual pliers of the transport device 16, so that the lower parts of these eventual pliers are disposed under the cloth piece P to be grasped, without lifting the cloth piece.

[0053] As shown in Figures 1 and 13, the transport device 16 comprises a support 68 which extends vertically from the base support 20. An actuator 70 is fixed perpendicular to the support 68. A body 74 is fixed to a rod 72 of the actuator 70. The body 74 is provided with a movable rack bar 76 which is movable relative to the same body 74 as visible in Figure 18.

[0054] First pliers 78 are fixed to an end of the rack bar 76 and comprise an upper rod 80 and a lower rod 82, the lower rod 82 being movable in a vertical direction relative to the upper rod 80.

[0055] Second pliers 84 are fixed to the same rack bar 76 and are spaced apart from the first pliers 78. The second pliers 84 correspond to the first pliers 78. In fact, the second pliers 84 comprise an upper rod 86 and a lower rod 88, the lower rod 88 being movable in a vertical direction relative to the upper rod 86. Besides, the second pliers 84 may be fixed in different positions at a variable distance from the pliers 78, depending on the width of the cloth piece P to be transported.

[0056] The operation of the apparatus 10 is described below.

[0057] When the apparatus 10 is in its resting phase, that is the pneumatic system is off, the apparatus 10 has the gripping elements 36 with their first hooks 40 and their second hooks 42 close to one another and, in any case, all the hooks are covered by the first blades 33 which are pushed downwards by the springs of the pins 35. This ensures optimal safety conditions because the operator is thus prevented from touching the hooks.

[0058] As shown in Figure 12, at the beginning of the operations, after the operator has put the cloth piece cart 18, provided with the cloth pieces to be sewn, on the base support 20, the loader 12 lowers the arm 34 on approaching the two gripping elements 36 to the first cloth

piece P put at the top.

[0059] Thus, the two gripping elements 36 are disposed adjacent to the top cloth piece P.

[0060] The pistons 31 are actuated by lifting the second blades 43 so as to approach the first blades to the blocks 37 of the two gripping elements 36.

[0061] Thus, the first hooks 40 and the second hooks 42 protrude from the slots 45, 47 and are positioned closer to one another because the pneumatic system does not supply air under pressure through the passage element 41 yet.

[0062] In order to grab the cloth piece P, the pneumatic system supplies air between the first cartridge 48 and the second cartridge 46 so as to push them towards the outside of the block 37.

[0063] In this way, the first hook 40 and the second hook 42 move away from each other and, through this movement, the hooks grab the cloth piece P.

[0064] In particular, when the first cartridge 48 and the second cartridge 46 are pushed outwards, the cylinder of smaller diameter of each of the two cartridges goes out of a hole formed in the external end of each hollow cylinder 38, 51. In this way, the operator can easily know the position of the hooks 40, 42 with a simple observation of the gripping elements 36.

[0065] Then, the arm 34 is lifted, as shown in Figure 2, by operating the actuator 71 in the vertical structure 32.

[0066] The arm 34, together with the cloth piece P, advances towards the positioning device 14 by operating the actuator 27 the rod 30 of which displaces the movable base 28 on the slide 26.

[0067] Thus, the cloth piece P is left resting on the plate 52 of the positioning device 14, as shown in Figure 14.

[0068] Then, air is supplied to the three blowing devices 60 so as to blow air on the surface of the plate 52 in predetermined directions by orienting the same blowing devices 60 and relative blowing openings 62.

[0069] The air is conveyed to the first abutment element 54 and the second abutment element 56 so as to go out through the slots 58.

[0070] The air jet creates a vacuum on the plate 52 so that the cloth piece P abuts on the one side against the first abutment element 54 and on the other side against the second abutment element 56.

[0071] Through this system, the cloth piece P is arranged in the correct position without any deformation or wrinkling because the vacuum obtained on the plate 52 ensures that the same cloth piece P is disposed completely adjacent to the same plate 52.

[0072] In order to avoid that the piece P is involuntarily blocked or hindered by the hooks 40, 42 in its translational movement on the surface of the plate 52, the first blade 33 is lowered thanks to the action of the springs of the pins 35 without actuating the pistons 31 by means of the pneumatic system. In this way, the hooks 40, 42 are totally hidden between the first blade 33 and the block 37.

[0073] Thus, the cloth piece P is positioned accurately with respect to the transport device that intervenes later.

**[0074]** The first pliers 78 and the second pliers 84 are approached to the positioning device 14, the upper rod 80 and the lower rod 82 of the first pliers 78, as well as the upper rod 86 and the lower rod 88 of the second pliers being spaced apart.

**[0075]** In particular, the lower rod 82 of the first pliers 78 is received in the first hollow 64 while the lower rod 88 of the second pliers 84 is received in one of the three second hollows 66, depending on the fixing position of the same second pliers 84 to the rack bar 76.

**[0076]** In this way, the two lower rods are arranged below the cloth piece P without that the same is raised.

**[0077]** Subsequently, each lower rod is approached to the respective upper rod so as to grip the cloth piece P, as shown in Figure 16.

**[0078]** Then, the first pliers 78 and the second pliers 84 with the cloth piece P are moved away from the positioning device 14 thanks to the displacement of the body 74 obtained by operating the actuator 70.

**[0079]** Finally, the rack bar 76 is extracted from the body 74 to laterally translate the cloth piece P and to bring the same to the base of a sewing machine, not shown in the figures.

**[0080]** The perfect positioning of the cloth piece P, due to the displacement caused by the positioning device 14, is controlled by using a laser control system 90 that verifies the correct alignment of the cloth piece P by projecting a line on the cloth piece P itself.

**[0081]** A technician of the sector can provide changes or variants that are to be considered as included in the scope of protection of the present invention.

## Claims

1. Apparatus (10) for the positioning of a cloth piece (P) on a sewing machine, comprising a loader (12) with a movable arm (34) comprising, in turn, at least one gripping element (36);  
**characterized by** the fact that the gripping element (36) comprises a block (37) from which a first hook (40) and a second hook (42) protrude, which are spaced apart and movable relative to each other, so that the first hook (40) and the second hook (42) move away or approach each other; said first hook (40) has a pointed end which faces the half-space opposite to that in which the second hook (42) rests, said second hook (42) has a pointed end which faces the half-space opposite to that in which the first hook (40) rests, so that when the gripping element (36) is placed adjacent to the cloth piece (P), the first hook (40) and the second hook (42) move away from each other and grasp the cloth piece (P).
2. Apparatus (10) according to claim 1, wherein the first hook (40) is fixed to a first cartridge (48) movable within a first hollow cylindrical body (38) received in the block (37), said first cartridge (48) being adapted

to be moved in a first direction by a first pressurized fluid.

3. Apparatus (10) according to claim 2, wherein a first elastic means (50) is comprised and is connected to the first cartridge (48) and is adapted to oppose the motion imparted by the first pressurized fluid so as to move the first cartridge (48) in a second direction opposite to the first direction.
4. Apparatus (10) according to claim 2 or 3, wherein a through hole is formed in an end of the first hollow cylindrical body (38) and is adapted to be passed through by at least one portion of the first cartridge (48) when said first cartridge (48) is moved in the first direction.
5. Apparatus (10) according to one of claims 2 to 4, wherein a hole is formed in the block (37) in which the first hollow cylindrical body (38) is fixed in a position adjustable by fixing means (39).
6. Apparatus (10) according to one of claims 2 to 5, wherein the second hook (42) is fixed to a second cartridge (46), movable within a second hollow cylindrical body (51), said second cartridge (46) being adapted to be moved in a second direction by the first pressurized fluid, said second direction being opposite to the first direction.
7. Apparatus (10) according to claim 6, wherein a second elastic means (49) is comprised and is connected to the second cartridge (46) and is adapted to oppose the motion imparted by the first pressurized fluid so as to move the second cartridge (46) in the first direction.
8. Apparatus (10) according to one of the preceding claims, wherein a first blade (33) is comprised and is movable relative to the block (37), a first through slot (45) and a second through slot (47) being formed in said first blade (33) so that when the first blade (33) is approached to the block (37), the first hook (40) and the second hook (42) protrude from the first slot (45) and second slot (47), respectively, while when the first blade (33) is moved away from the block (37), the first hook (40) and the second hook (42) are sheltered by said first blade (33).
9. Apparatus (10) according to claim 8, wherein third elastic means are comprised and are adapted to push the first blade (33) away from the block (37).
10. Apparatus (10) according to claim 8 or 9, wherein a second blade (43) is comprised and is connected through at least one pin (35) to the first blade, said second blade (43) being adapted to be moved by at least one piston (31) so as to approach the first blade

(33) to the block (37) by protruding the first hook (40) and the second hook (42) from the first blade (33) through the first slot (45) and the second slot (47).

11. Apparatus (10) according to one of claims 8 to 10, 5  
wherein at least one adjustment screw (55) is comprised and is adapted to adjust the minimum distance of the first blade (33) from the block (37) so as to adjust the maximum projection of the first hook (40) and second hook (42) from the first blade (33) 10  
through the first slot (45) and the second slot (47).

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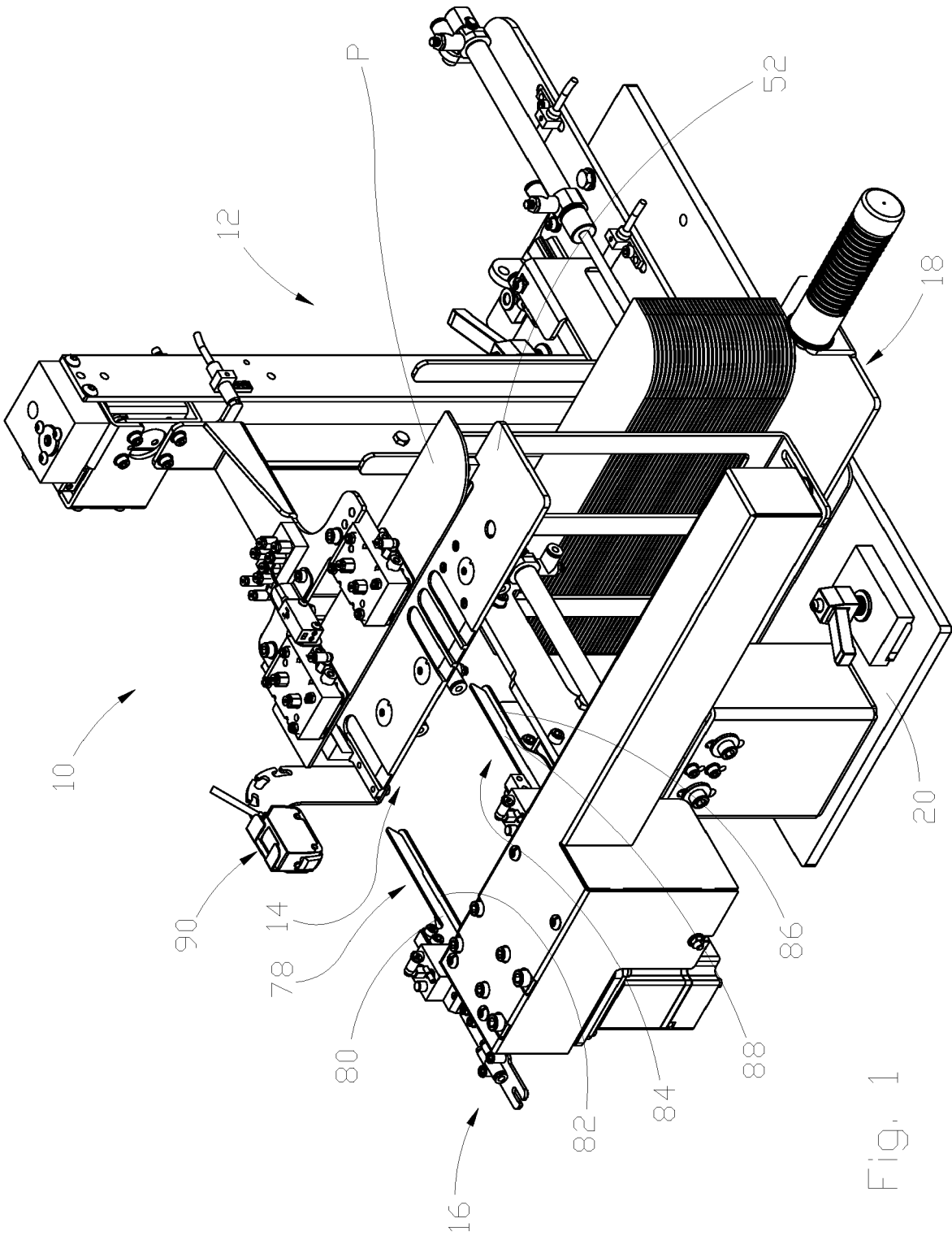


Fig. 1



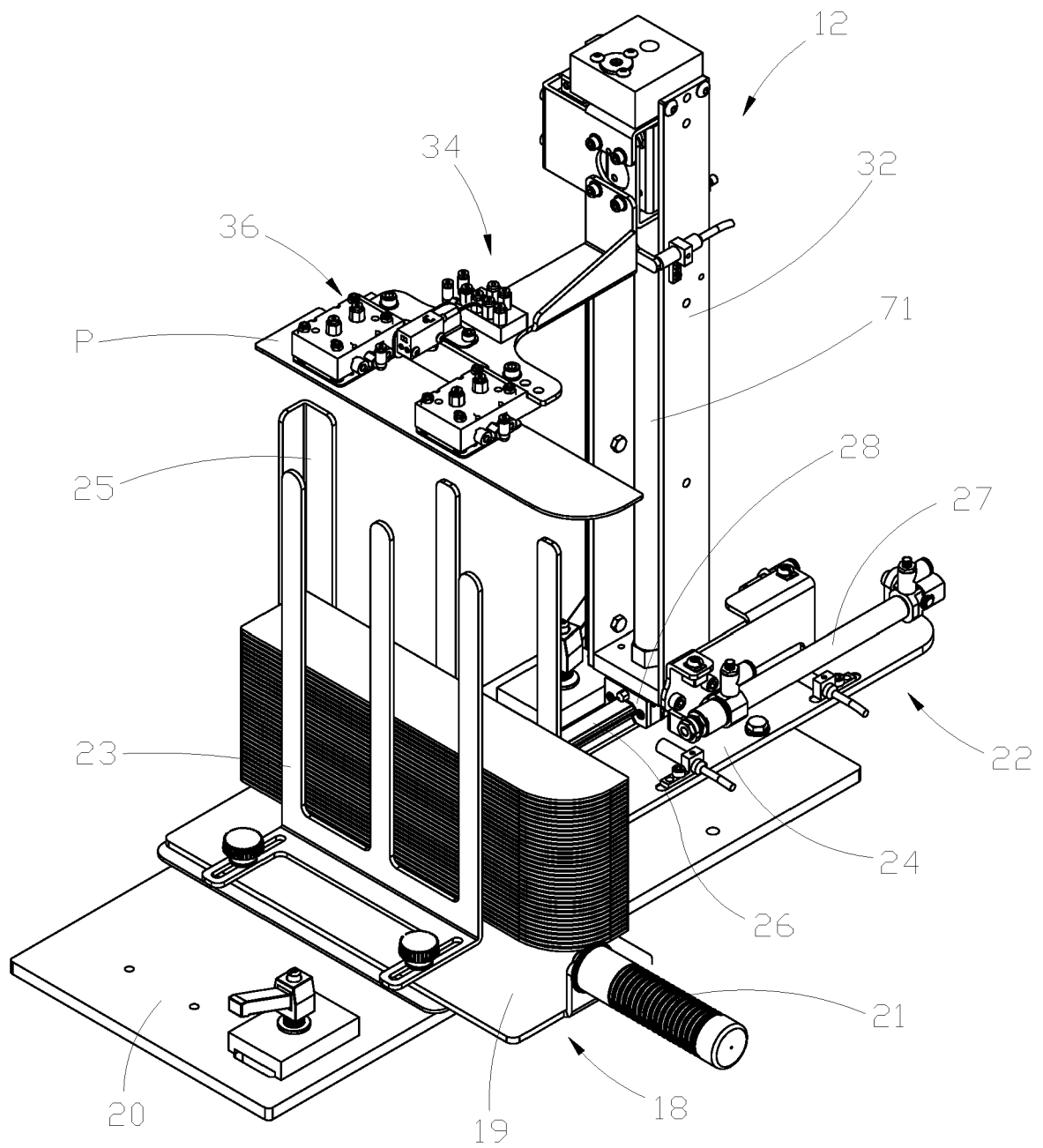
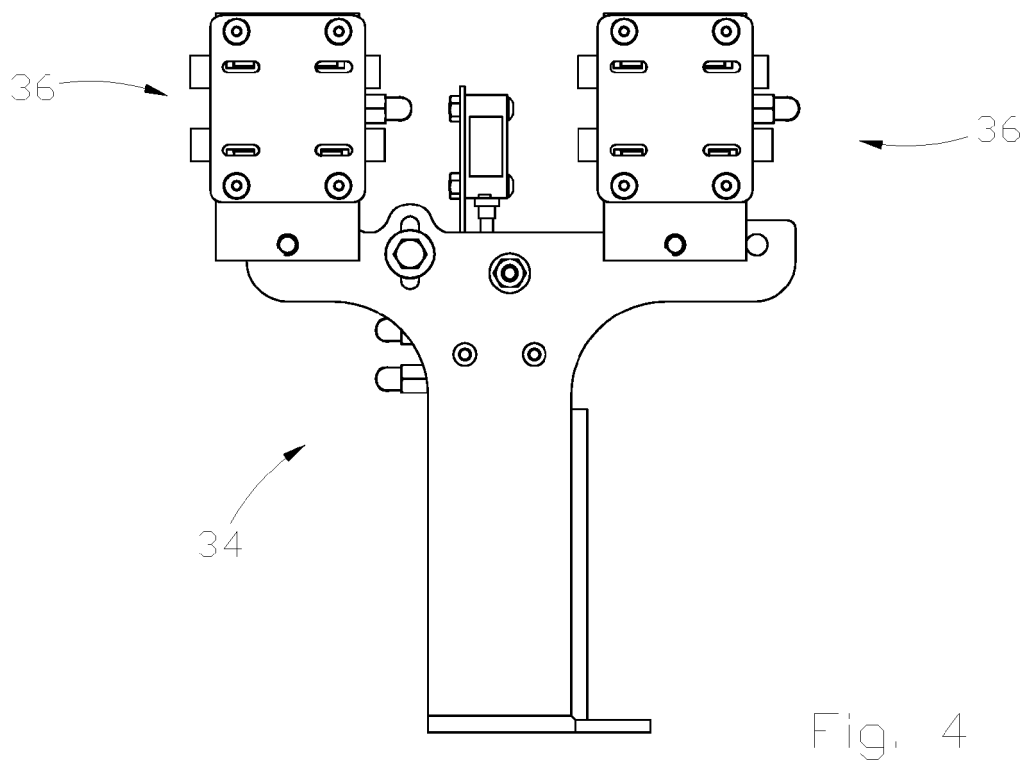
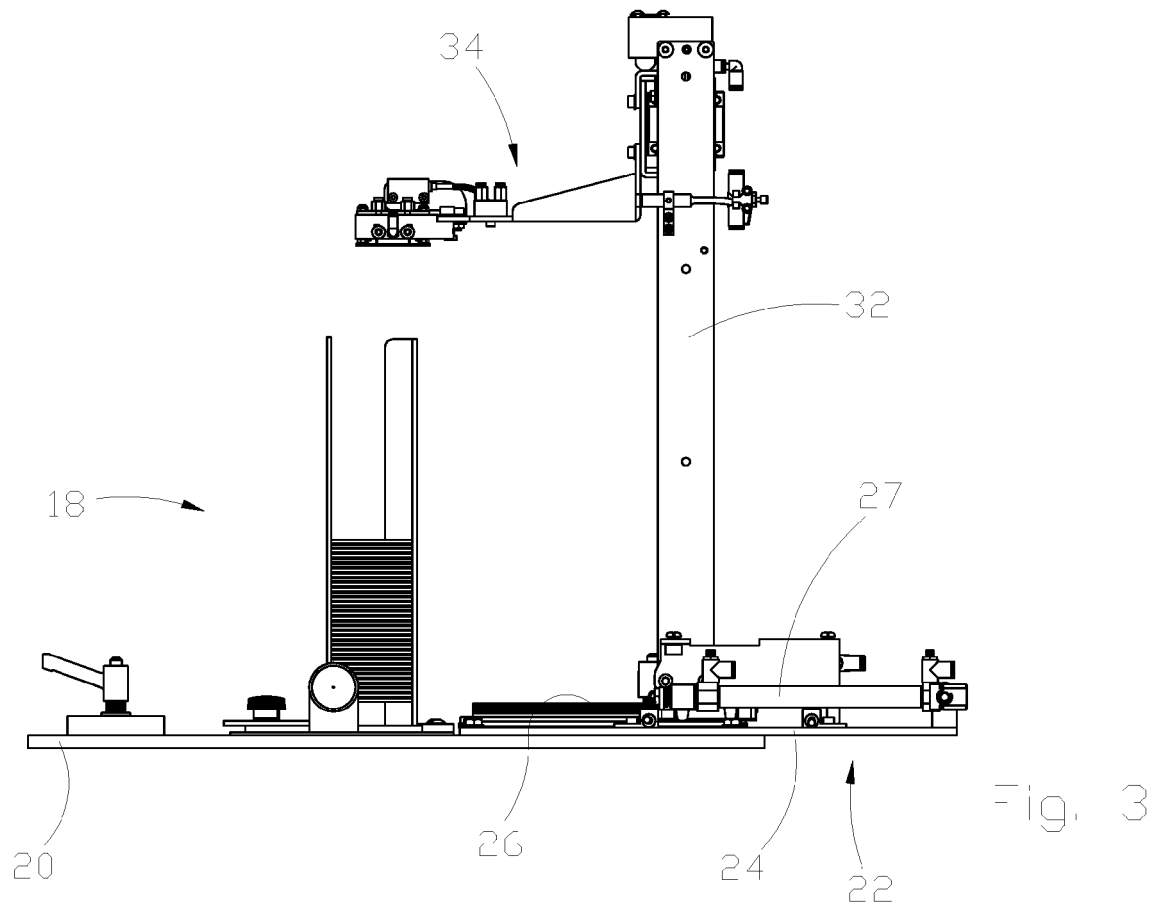


Fig. 2



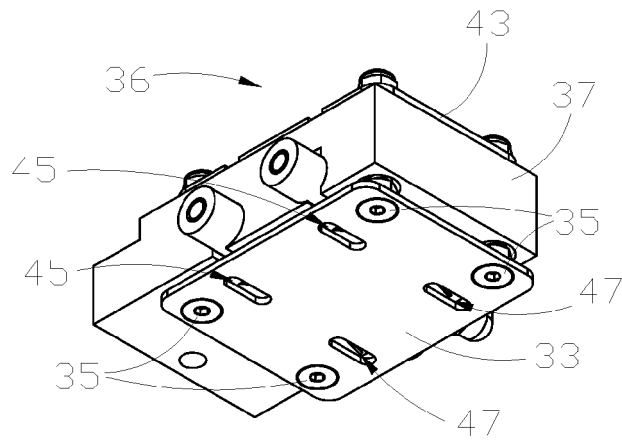


Fig. 5a

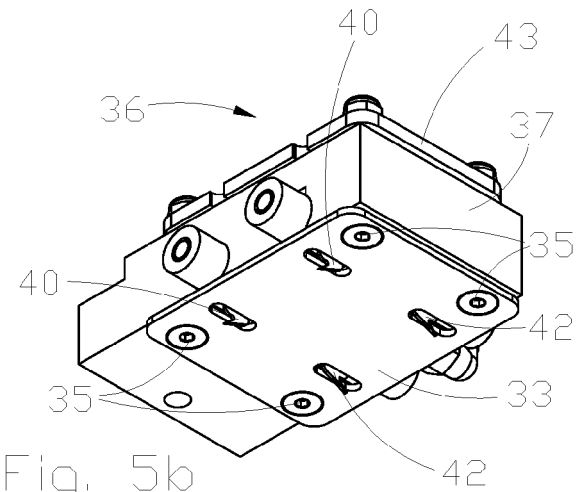


Fig. 5b

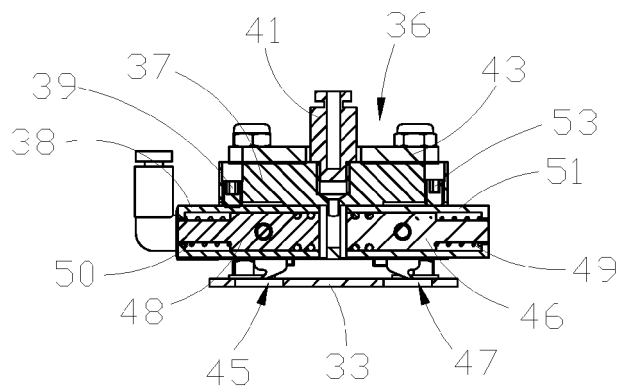


Fig. 6a

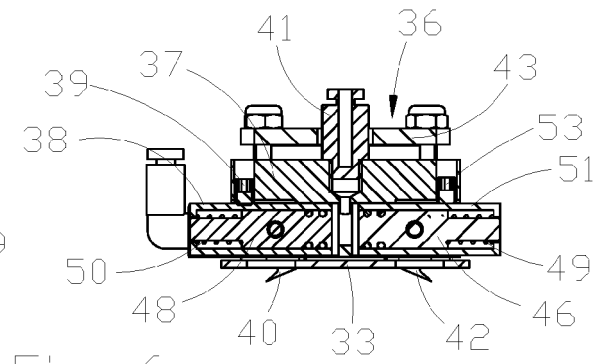


Fig. 6b

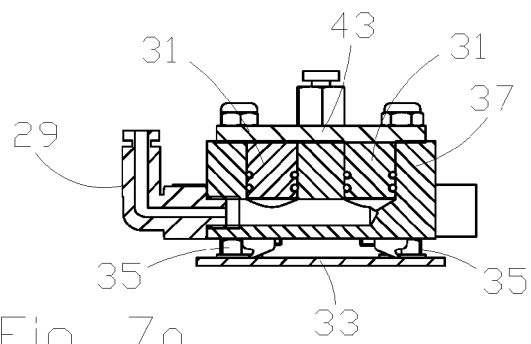


Fig. 7a

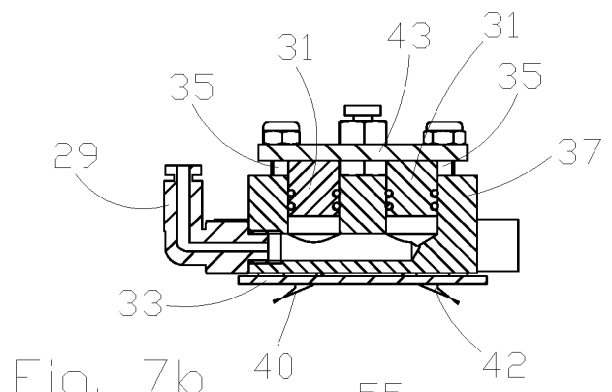


Fig. 7b

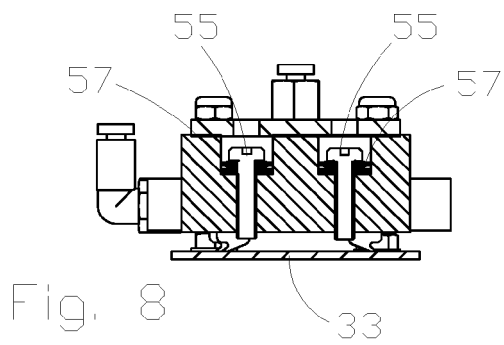


Fig. 8

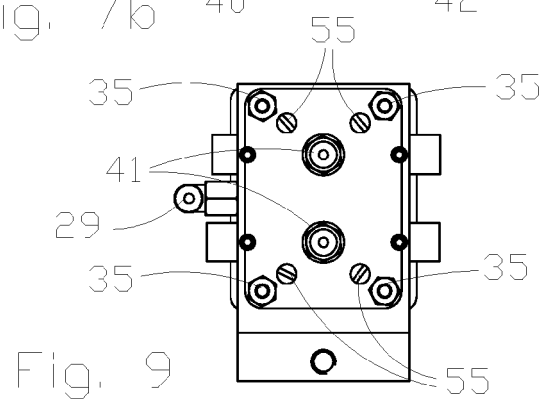
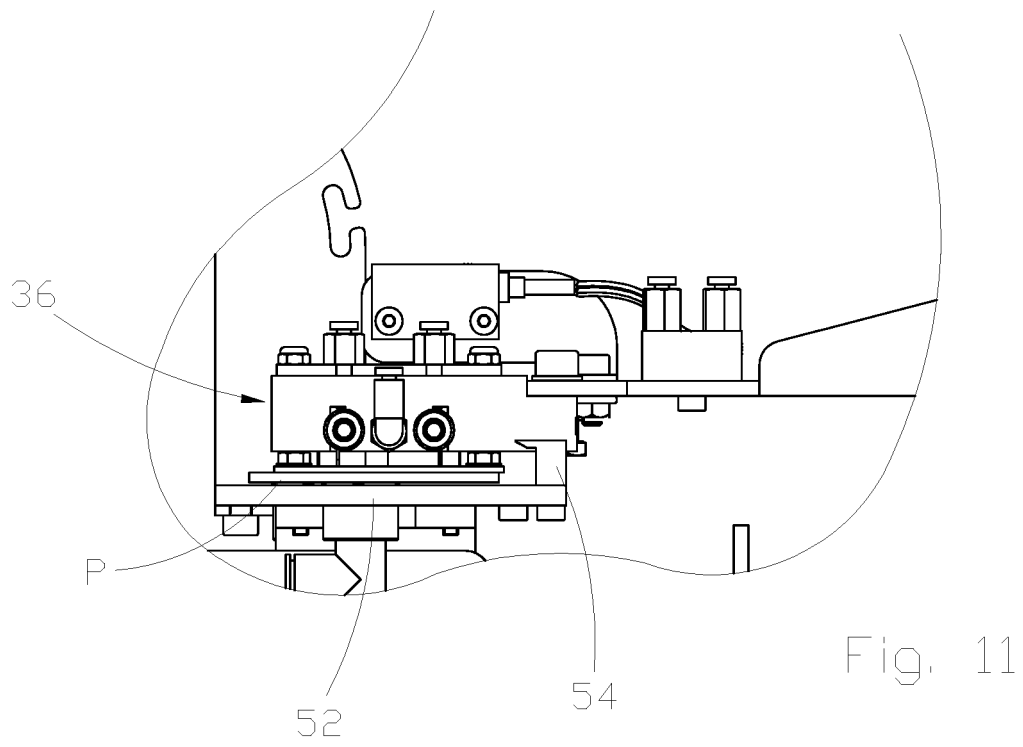
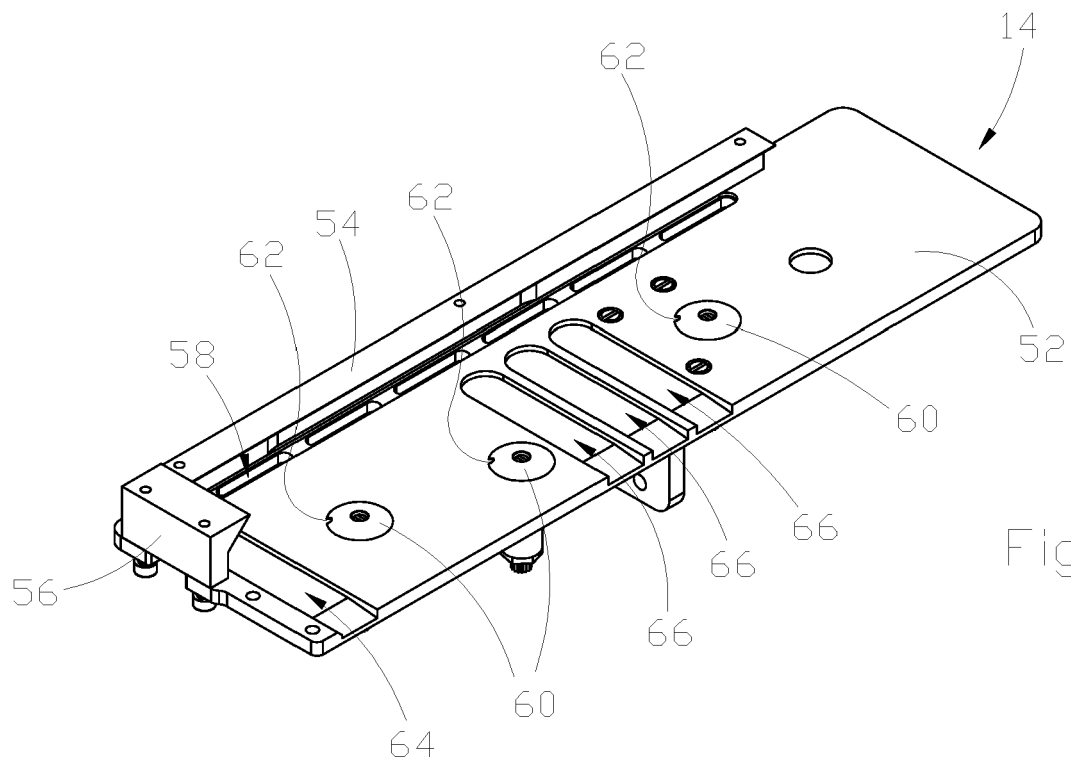


Fig. 9



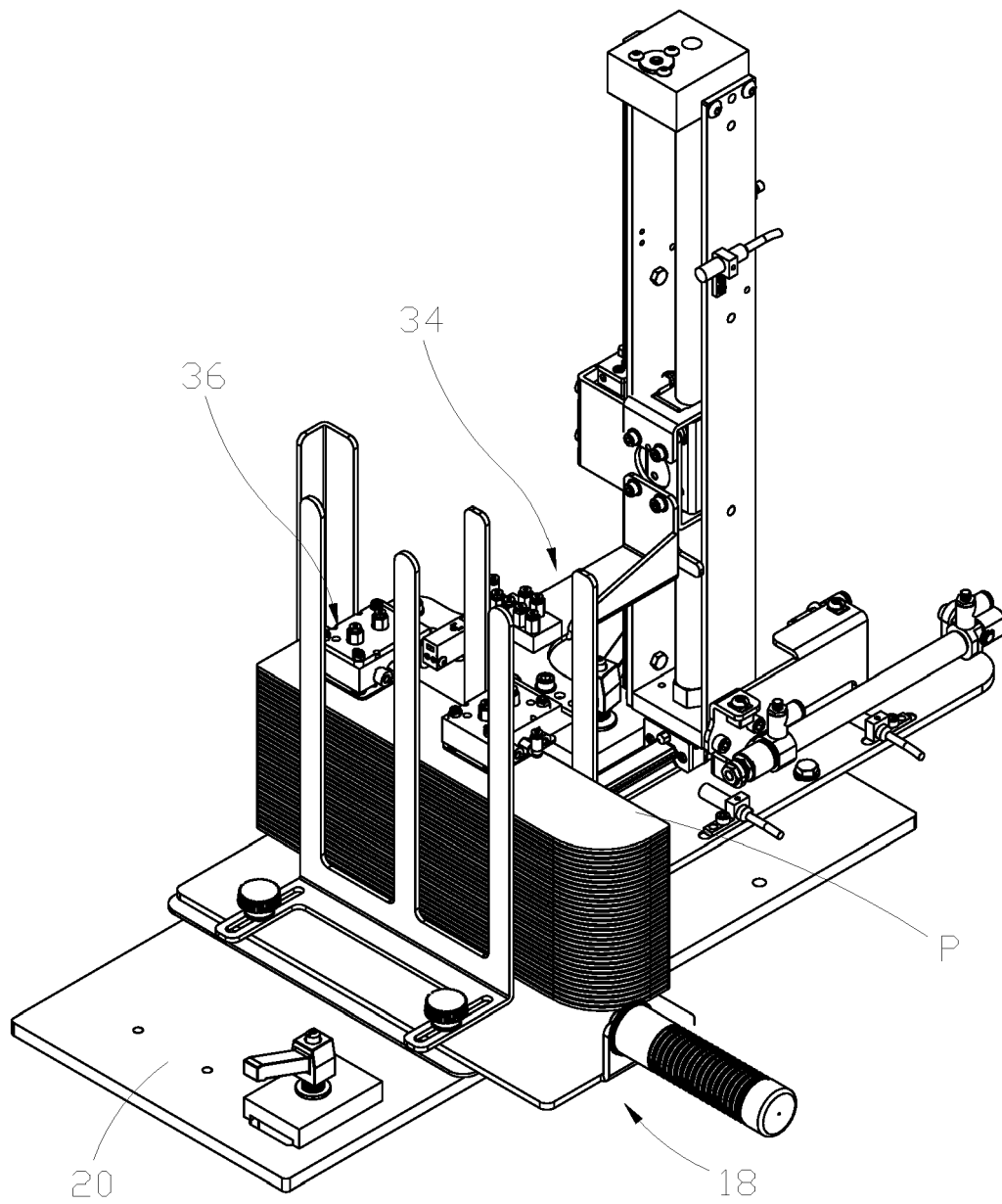


Fig. 12

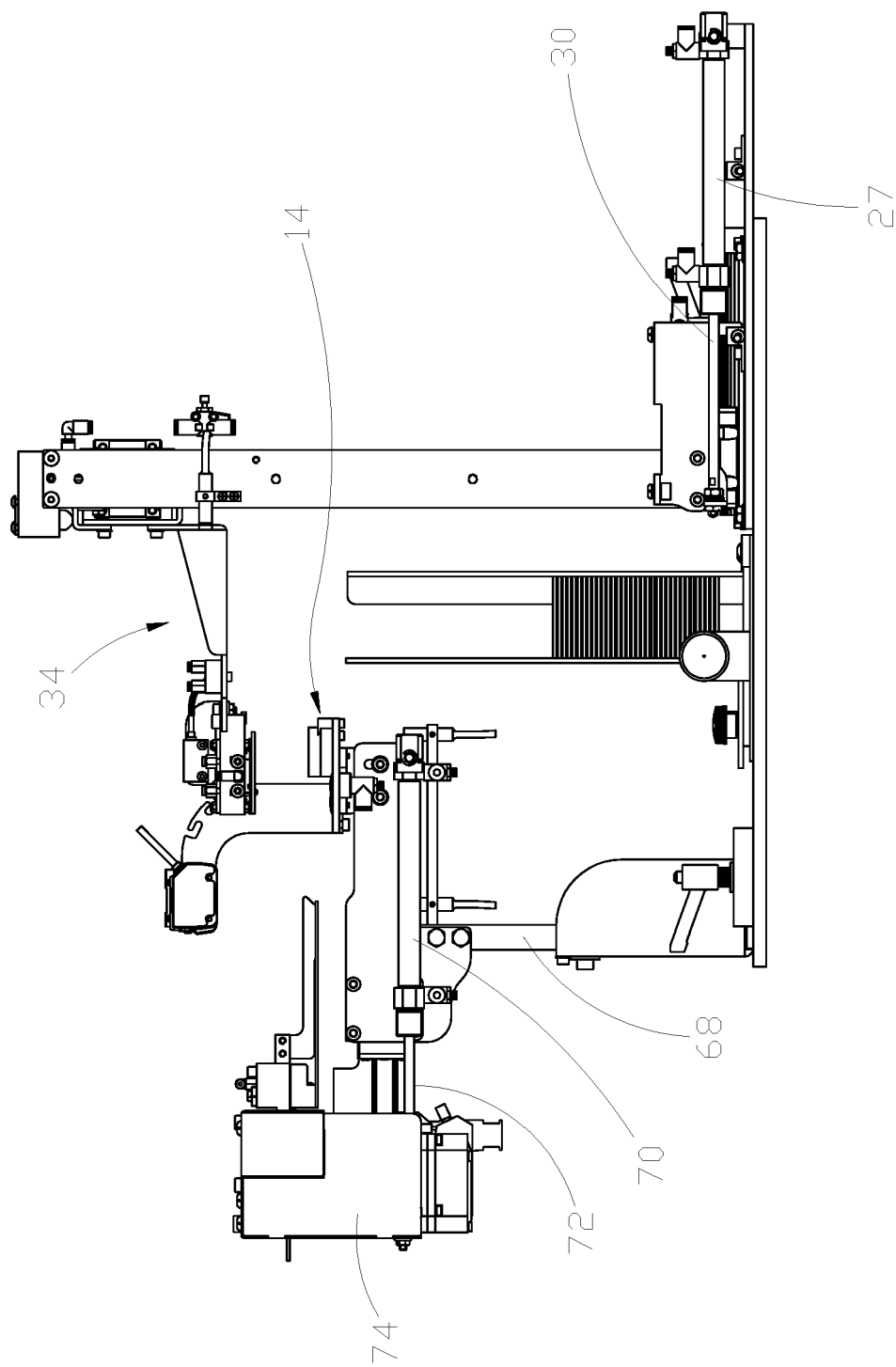
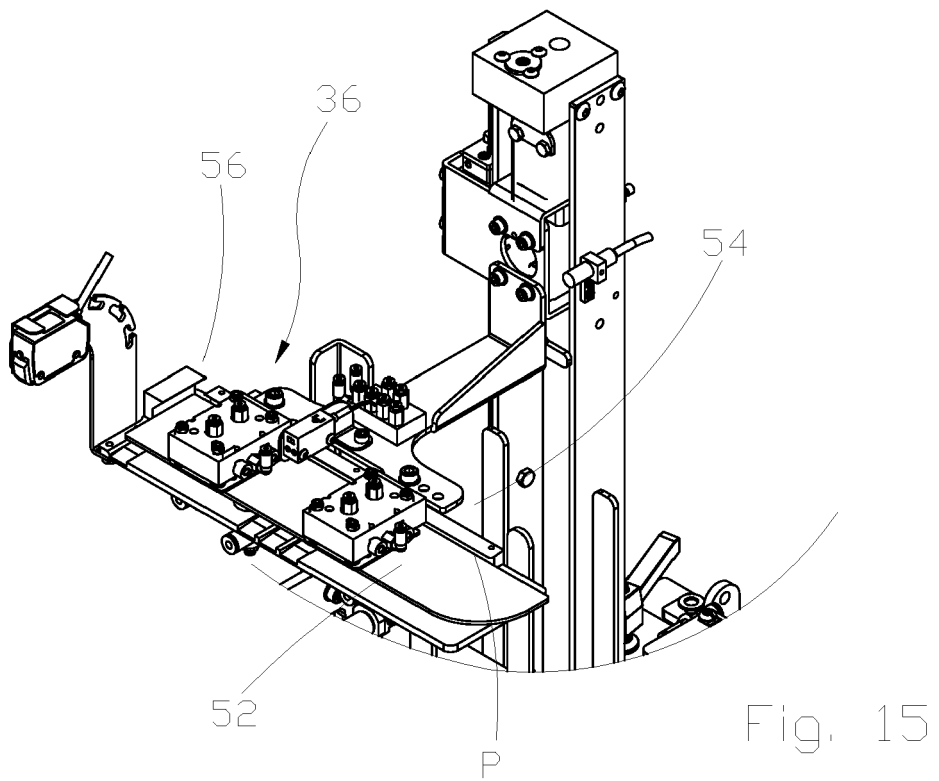
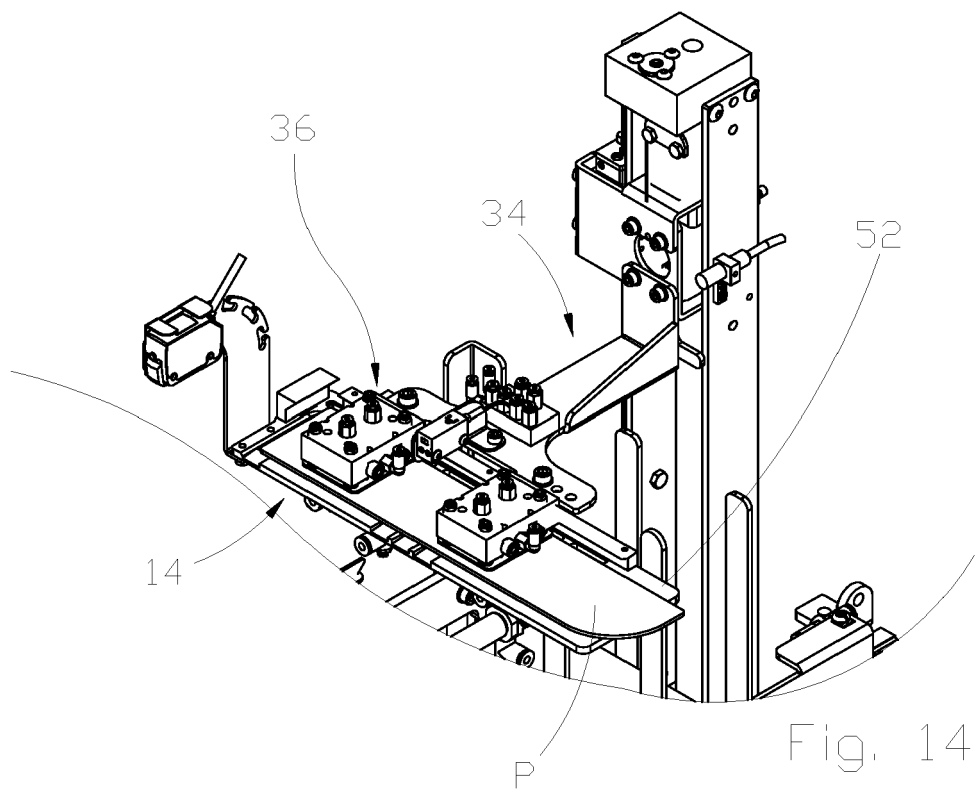


Fig. 13



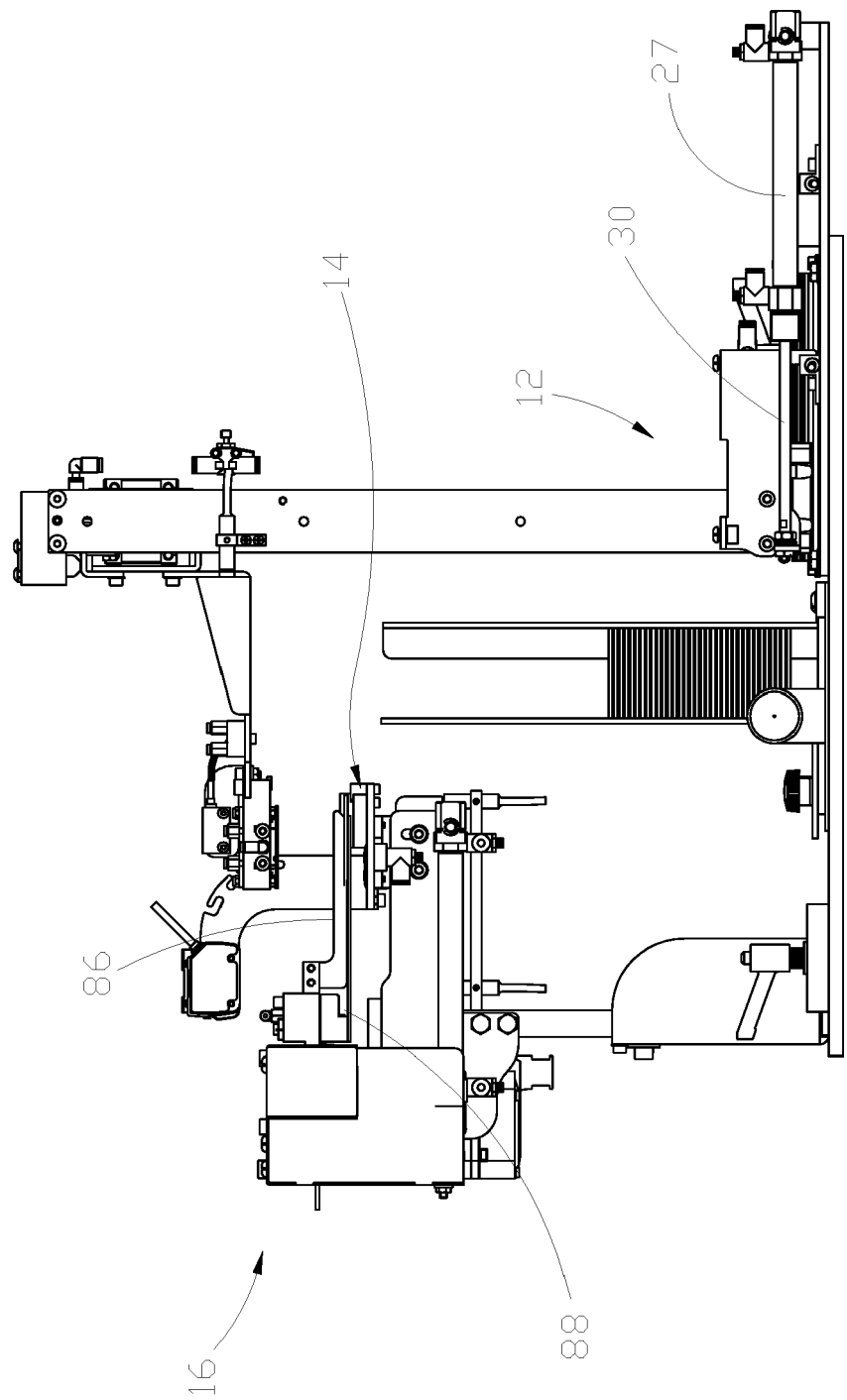


Fig. 16



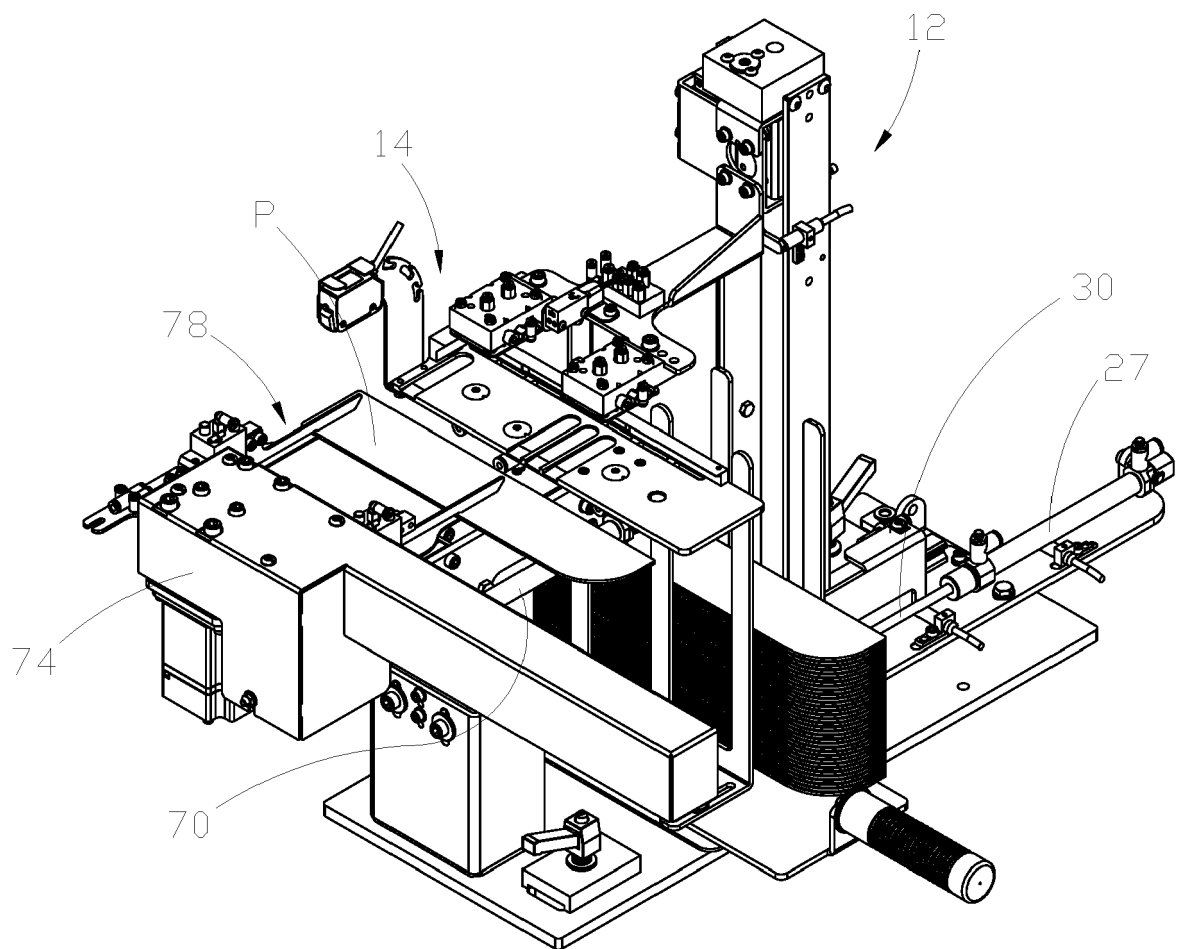


Fig. 17

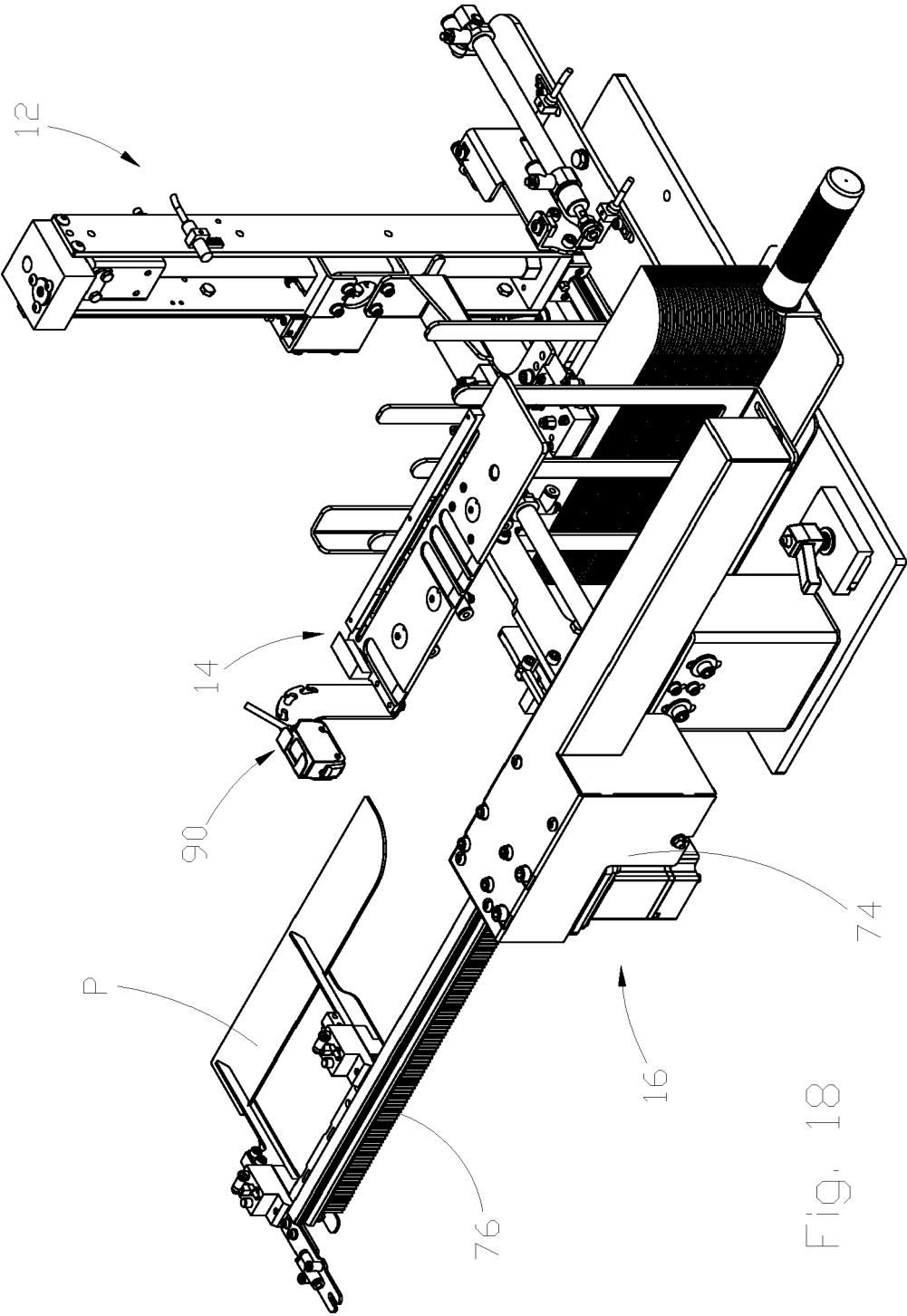


Fig. 18



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CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			

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