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(11) **EP 1 170 230 A2**

(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
09.01.2002 Bulletin 2002/02

(51) Int Cl.7: **B65H 3/32**

(21) Application number: **01303519.1**

(22) Date of filing: **18.04.2001**

(84) Designated Contracting States:
**AT BE CH CY DE DK ES FI FR GB GR IE IT LI LU
MC NL PT SE TR**
Designated Extension States:
AL LT LV MK RO SI

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(30) Priority: **18.05.2000 GB 0012047**

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(54) **A punching apparatus**

(57) A punching apparatus comprises a feed section (4) for supplying sheets to a punch section (6) and a reception section (8) for receiving punched sheets from the punch section. In one embodiment, the apparatus includes a picker device for separating a pile of sheets from a stock of sheets supplied by the feed section so that the pile of sheets can be transported through the punch section. The picker device comprises a wedge

which is reciprocated horizontally a lift arm which reciprocates with the wedge to move an end thereof into the stack of sheets and a cam mechanism for causing the end of the lift arm to move first generally horizontally and then upwards. In another embodiment, at least two of the punch, feed and reception sections have at least one sheet aligner, the position of which is adjustable within the section and a common manual drive is provided for adjusting the positions of the sheet aligners.

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Description

[0001] This invention relates to an apparatus for punching holes in sheets of paper and other materials.

[0002] A wide variety of punching apparatuses are known ranging from the simple manually operated device generally referred to as a "hole punch" to sophisticated heavy duty equipment for performing high speed punching operations and producing multiple holes in stacks of sheets which may include, in addition to sheets of paper, sheets of other material such as plastic.

[0003] Many known automatic punching apparatuses have a feed section which supplies sheets to a punch section and a reception section for receiving punch sheets from the punch section. The punch section generally has a fixed die and one or more moving dies which engage the sheets therebetween to form the holes in the sheets.

[0004] It is of course important that a pile of sheets to be punched are aligned to give consistent hole formation therein and much time and effort has been spent on improving alignment of sheets in automatic punching apparatus. It is also important for consistent operation that the punch section is supplied with a constant thickness of sheets. In one known apparatus the feed section is arranged to index up a stock of sheets from which a section is lifted and transferred to a transport mechanism which carries it through the punch section. The transferral operation is carried out by a picker device comprising a horizontally reciprocal wedge which moves into the stock to separate off a pile, or "bite", of sheets, the bite then being transferred from above the wedge to the transport mechanism. The wedge may be used in conjunction with a lifting arm which positively raises up the bite to ensure that all the sheets are received, no matter the material from which they are made, above the wedge. In known devices the lifting arm is reciprocated with the wedge. In one device the arm has an upturned end to perform the lifting action whilst in another the arm has an essentially flat upper surface and is formed with a slot engaged by a fixed pin. The initial portion of the slot is downward angled so that as the arm is reciprocated it first moves upwardly and so performs the lifting action.

[0005] A punching apparatus in accordance with one aspect of the invention comprises a feed section for supplying sheets to a punch section and a reception section for receiving punched sheets from the punch section wherein the apparatus includes a picker device for separating a pile of sheets from a stock of sheets supplied by the feed section so that the pile of sheets can be transported through the punch section, the picker device comprising a wedge which is reciprocated horizontally, a lift arm which reciprocates with the wedge to move an end thereof into the stack of sheets and a cam mechanism for causing the end of the lift arm to move, firstly, generally horizontally and then, secondly, upwardly.

[0006] In a preferred embodiment, the cam mechanism

is arranged such that the speed of the upward movement is greater than that of the horizontal movement. It has been found that by arranging the lift arm to move firstly between the sheets and then to raise a pile of sheets, the height of the pile of sheets then transported to the punch section can be made more consistent particularly, if as is preferred, the second movement is relatively faster than the first. Furthermore the risk of damage to the sheets is reduced.

[0007] Suitably the lifting arm moves upwardly a height sufficient to raise the pile of sheets above the highest point of the wedge. This ensures a clean transfer of the pile of sheets to the transport mechanism.

[0008] The upper face of the lifting arm adjacent the end thereof may incline downwardly towards the end to an upward tooth at the end. This configuration has been found to further facilitate a clean transfer of the pile of sheets to the transport mechanism.

[0009] The cam mechanism may suitably comprise a fixed cam and a shaped under face of the lifting arm which acts as a cam follower.

[0010] A punching apparatus in accordance with another aspect of the invention comprises a feed section for supplying sheets to a punch section and a reception section for receiving punched sheets from the punch section, wherein at least two of the sections have at least one sheet aligner, the position of which within the section is adjustable and wherein the sheet aligners have a common manual drive for adjusting their positions.

[0011] The advantage of providing a common manual drive is that the apparatus can have a simple form which makes it economical to manufacture and is moreover economical in use. Economy is further enhanced if all three sections have at least one adjustable sheet aligner.

[0012] Each section may have a sheet aligner comprising two parallel guides with the manual drive being operative to adjust the spacing between the guides.

[0013] In preferred embodiments of a punching apparatus in accordance with either embodiment of the invention, the feed section and the reception section both have plates for supporting the sheets and an indexing mechanism for raising and lowering the plates. The indexing mechanisms may be essentially of identical construction. The identity of the indexing mechanisms of both the feed section and the reception section makes for economies in that the number of parts required is reduced.

[0014] The sheets to be punched may be fed horizontally through the punch section either past or through a set of punches and then inverted in the receiving section. Inversion may be achieved by path means which define a curved path for sheets received from the punch section. In one currently preferred embodiment the path means comprises a downwardly curved plate along a lower face of which the sheets are transported as they exit the punch section. The sheets then fall under gravity but due to the curvature of the plate are inverted.

[0015] The feed section may have a guide device comprising at least two guide pins suspended from an arm, with the arm extending from a mount and being connected thereto such as to be both movable in a horizontal plane and pivotable about an axis lying in the plane. The capability of the arm to move in a horizontal plane allows the pins to be set in a position where they will abut against an edge of a stack of sheets to be punched. However, by also making the arm pivotable the arm the pins can be moved away when the feed section is to be filled with a fresh stack of sheets. This facilitates operation of the punching apparatus.

[0016] The invention will now be further described by way of example with reference to the accompanying drawings in which:

Figure 1 is a prospective view of the front of a punching apparatus in accordance with the invention;

Figure 2 is a prospective view of the apparatus of Figure 1 from the rear;

Figure 3 is a front prospective view of the apparatus of Figure 1 at a first stage of assembly;

Figure 4 is a front prospective view of the apparatus of Figure 1 at a second stage of assembly;

Figure 5 is a rear prospective view of the apparatus of Figure 1 at the second stage of assembly;

Figure 6 is a front prospective view from one side of a further apparatus in accordance with the invention;

Figure 7 is a front prospective view from the opposite side of the apparatus of Figure 6;

Figure 8 is a front prospective view of the apparatus of Figure 7 in a first stage of assembly, and;

Figure 9 is a prospective view of a picker device forming part of the apparatus of Figures 1 and 6.

[0017] The punching apparatus 2 shown in Figures 1 and 2 has three sections: a feed section 4, a punch section 6 and a reception section 8. The feed section 4 supplies sheets to the punch section 6 and punched sheets from the punch section 6 are received by the reception section 8.

[0018] The feed section 4 comprises a plate or table 10 for receiving a stack of sheets to be punched. The stack is positioned with the edge in which holes are to be formed abutting the punch section 6. With rectangular sheets this is generally one longitudinal edge. The sheets of the stack are aligned by firstly a pair of guide pins 12 and secondly a pair of guide bars 14. The guide pins 12 are suspended at one end of an arm 16, the other end of which is connected to a mount 18 which in turn is carried on a side wall 19 of the feed section 4. The mount 18 is movable along a slide 20 secured to the side wall to adjust the distance between the pins 12 and the punch section 6 and hence accommodate stacks of different widths. The mount 18 is fixed at the appropriate position for a particular stack width along

slide 20 by rotating a handle 22 to force a screw (not shown) against an inner face of the slide 20.

[0019] The arm 16 is pivotably connected to the mount 18 at one end thereof such that the arm, and the pins 12, can be rotated upwardly around an axis running through the mount 18 and so parallel to the slide 20. This pivotal mounting of the arm 16 facilitates positioning of the stack of sheets on the table 10.

[0020] The guide bars 14 which take the form of L-shaped members, see Figure 4, are mounted on an endless screw such that rotation of the screw draws them together or moves them apart to accommodate sheets of different lengths. Accordingly, by adjustment of the spacing of the guide bars 14 and the positioning of the guide pins 12 a stack of sheets is held on all four sides and so presented to the punch section 6 in aligned form.

[0021] In use, table 10 with a stack of sheets thereon is indexed upwardly such that a pile or "bite" of sheets can be transferred from the top of the stack to the punch section 6. The table 10 is connected via slots 24 in the side wall 19 to a mount 26, see Figure 5, through which three rods 28 pass. The central rod 28 is in the form of an endless screw which engages with the mount 26 such that rotation of the central rod 28 causes the mount 26, and hence the table 10, to move along the rods 28. The two side rods 28 stabilize this movement. The central rod 28 is rotated by a stepper motor 30 such that the table 10 is indexed up to present bites of equal width successively to the punch section 6. A sensor 32 on the side wall senses the presence or absence of a stack of sheets on the table 10 and controls the stepper motor 30 accordingly.

[0022] A bite of sheets received by the punch section 6 from the feed section 4 is carried through the punch section 6 by a transport mechanism which comprises two sets of belts 34 and rollers 36, see Figures 3 and 4. The upper set of belts and rollers 34, 36 are positively driven and are carried on an upper car 38 which is mounted such that it can be raised from a driving to a non-driving position. In the driving position of the car 38 the belts and rollers 34, 36 transport a bite of sheets through the punch section 6, to the right in the sense of Figures 3 and 4. The bite is halted by raising the car 38 with the bite located with the edge to be punched between a fixed die 40 and a movable die 42 which carries a series of punch dies. The movable die 42 is linked to the car 38 such that raising of the latter causes lowering of the former and engagement with the fixed die 40 to cause punching of the sheets of the bite halted in the punch section 6.

[0023] The sheets of the bite are aligned for punching by a back jogger carried on the car 38 which comprises a frame 44 having a cross piece and three arms, each of which carries a back stop 46. The back stops 46 are driven to jog the bite of sheets at the rear by a solenoid (not visible). The back jogger 44 is movable along a slot 48 in the car 38 and is fixed in position by tightening a handle 50 against the upper face of the car 38.

[0024] The bite of sheets is also aligned laterally within the punch section by a pair of side lay gauges 52 (see Figure 3) which are mounted in a similar fashion to the guide bars 14 of the feed section 4, that is, on an endless screw such that rotation of the screws draws the side lay gauges 52 together or apart to accommodate stacks of sheets of different lengths.

[0025] Following punching, the movable die 42 is raised and so the car 38 lowered to again engage the transport mechanism consisting of the belts and rollers 34, 36. The punched sheets are moved from the punch section 6 to the reception section 8. The punched sheets are fed horizontally to the right in the sense of the Figures across and below a curved guide plate 54, see Figure 3. The curvature of the guide plate 54 is such that the sheets are inverted as they fall under gravity to a reception table 56 which as can be seen in Figure 2 is downwardly inclined. The reception table 56 has a pair of front flaps 58 carried on a mount 60 which can be fixed at any desired position along a slot 62 in the reception table 56. In Figure 2 the mount 60 shown at one extremity of the slot 62 but it will be appreciated that in normal use the mount 60 will normally be positioned towards the opposite end of the slot 62. A punched bite is received in the reception section 8 with the edge opposite that which has been punched against the flaps 58. The bite is again aligned in the reception section 8 by two lateral guide bars 64 which are mounted in a similar mechanism to the guide bars 14 of the feed section, i. e. such that they can be moved together or apart to accommodate sheets of different lengths. The endless screw 66 on which the reception section guide bars 64 are mounted can be seen in Figure 5. Figure 5 also shows the link 68 between the car 38 and the movable die 42.

[0026] As Figure 1 shows, the front wall of the apparatus 2 has a manually accessible and rotatable handle 70. Rotation of the handle 70 causes rotation of a drive rod 72 which is linked by drive bands 73 to the endless screws of the feed section guide bars 14, see rod 74, the side lay gauges 52, see rod 76 and the reception section guide bars 64, rod 66. Thus by simply rotating the handle 70 an operator is able to set the distance between the guide bars 14, 64 of the feed and reception sections 4, 8 and the side lay gauges 52 of the punch section 6 to an appropriate value for the length of the sheets to be punched. This makes the apparatus 2 economical both in terms of manufacture and use.

[0027] Figures 6 to 8 show a second apparatus 82 which can be considered as a more automated and heavy duty version of the apparatus 2 of Figures 1 to 5. The apparatus 82 has many features in common with the apparatus 2 and so only the differences will be described.

[0028] The apparatus 82 includes a feed section 84, a punch section 86 and a reception section 88. A significant difference between the apparatus 2 and the apparatus 82 is that in the latter bites of sheets are fed

through the punch section 86 past a punch rather than through a punch. Thus with rectangular sheets where a long edge is to be punched, the sheets are stacked on the feed table 90 of the feed section 84 with a top lateral edge abutting the punch section 86. The guide pins 92 abut the stack on the opposite long edge to that which is to be punched. Accordingly, they are carried on a cross piece 94 which is attached to arm 96 and whose position on the arm can be adjusted by releasing a screw 98.

[0029] The reception section 88 has a reception table 100 which is indexed downwardly as successive bites of punched sheets are received thereon. The reception table 100 can be detached from the reception section 88 and as shown in Figure 7 has wheels 102 to allow it to be rolled away with a stack of punched sheets thereon. Indexing downwardly of the table 100 is achieved by an identical mechanism to that which is used to index upwardly the feed table 90 which is that described above with respect to feed table 10 of apparatus 2. It is preferred that the two indexing mechanisms of the apparatus 82 be essentially identical which reduces the parts inventory for the apparatus 82.

[0030] Punched sheets received in the reception section 88 of the apparatus 82 are positively driven in that reception section 88 along a curved path, see 104, to again cause inversion of the sheets prior to reception on the reception table 100.

[0031] The interior of the punch section 86 can be seen in Figure 8. Bites of paper received between rollers 106 are transported to the punching position by two belts 108. In the punching position the sheets of a bite are aligned by side joggers 110 and head and foot joggers 112. The joggers 110 and 112 are automatically driven rather than being manually driven as in the apparatus 2. Suitable forms for the joggers 110, 112 and for their drives are well known to the skilled man.

[0032] The position of the dies in the apparatus 82 is indicated by arrow 114 in Figure 8. As discussed above, the dies are to the side of a halted bite of sheets and thus the bite passes by the dies rather than through them as in the die section 6 of the apparatus.

[0033] Figure 9 shows a picker device 116 which is used in both the apparatus 2 of Figures 1 to 5 and the apparatus 82 of Figures 6 to 8. The picker device 116 comprises a wedge 118 and a lift arm 120 which are connected together and mounted on a support 122 part of which only can be seen in Figure. The support 122 is motor driven to reciprocate backwards and forwards and so reciprocate the wedge 118 and lift arm 120. This reciprocation causes the angle nose of the wedge 118 to be inserted between sheets of the stack held in the feed section 4 or 84 to separate off a bite of sheets thereabove from the remainder of the stack. At the same time, the lift arm 120 also moves in between the lower sheet of the bite and the upper sheet of the remainder of the stack.

[0034] The lift arm 120 first moves generally horizon-

tally between the sheets and thereafter moves upwardly to raise the bite to lift it up and over the wedge 118. This movement occurs through the cooperation of a shaped cam 124 mounted on the forward edge of the feed section, see Figure 8 and the lower edge 126 of the lift arm which acts as a cam follower. It will be seen from Figure 9 the shaped lower edge 126 has a first generally flat portion followed by a relatively steeply inclined second portion. The cam 124 has a corresponding shape. The shaping causes the lift arm 120 to move relatively slowly in between the sheets and then rise relatively faster to lift the bite of sheets in order to cleanly raise it away from the remainder of the stack to allow it to be transferred to the transport mechanism of the punch section 6, 86. In this way damage to the sheets is minimised, which is particularly important with the apparatus 86 as any tearing of the edge which is grasped by the picker device 114 will be extremely visible as that edge is the top lateral edge of the sheet.

[0035] The thickness of the bites taken by the picker device 114 may be between 0.5 and 1 mm and indexing may be such that a bite of paper is taken every 1/70 or 1/80 minutes.

Claims

1. A punching apparatus comprising a feed section for supplying sheets to a punch section and a reception section for receiving punched sheets from the punch section wherein the apparatus includes a picker device for separating a pile of sheets from a stock of sheets supplied by the feed section so that the pile of sheets can be transported through the punch section, the picker device comprising a wedge which is reciprocated horizontally, a lift arm which reciprocates with the wedge to move an end thereof into the stack of sheets and a cam mechanism for causing the end of the lift arm to move firstly generally horizontally and then upwards.
2. A punching apparatus as claimed in Claim 1 wherein the cam mechanism is arranged such that the speed of the upward movement is greater than that of the horizontal movement.
3. A punching apparatus as claimed in either Claim 1 or Claim 2, wherein the lifting arm moves upwardly a height sufficient to raise the pile of sheets above the highest point of the wedge.
4. A punching apparatus as claimed in any preceding Claim, wherein the upper face of the lifting arm adjacent the end thereof inclines downwardly towards the end to an upward tooth at the end.
5. A punching apparatus as claimed in any preceding Claim, wherein the cam mechanism comprises a fixed cam and a shaped under face of the lifting arm which acts as a cam follower.
6. A punching apparatus as claimed in any preceding Claim, wherein the wedge comprises a bar having angled nose at the forward end and a flat upper face behind the nose.
7. A punching apparatus comprising a feed section for supplying sheets to a punch section and a reception section for receiving punched sheets from the punch section, wherein at least two of the sections have at least one sheet aligner, the position of which within the section is adjustable and wherein the sheet aligners have a common manual drive for adjusting their positions.
8. A punching apparatus as claimed in Claim 7, wherein all three sections have at least one adjustable sheet aligner.
9. A punching apparatus as claimed in either Claim 7 or Claim 8, wherein each section has a sheet aligner comprising two parallel guides and wherein the manual drive is operative to adjust the spacing between the guides.
10. A punching apparatus as claimed in any preceding Claim, wherein the feed section and the reception section both have plates for supporting sheets and an indexing mechanism for raising and lowering the plates, the indexing mechanisms being essentially of identical construction.
11. A punching apparatus as claimed in any preceding Claim, wherein the sheets to be punched are fed horizontally through the punch section either past or through a set of punches and then inverted in the receiving section.
12. A punching apparatus as claimed in Claim 11, wherein the sheets are inverted in the received section by path means which define a curved path for sheets received from the punch section.
13. A punching apparatus as claimed in any preceding Claim, wherein the feed section has a guide device comprising at least two guide pins suspended from an arm, the arm extending from a mount and being connected thereto such as to be both movable in a horizontal plane and pivotable about an axis lying in the plane.

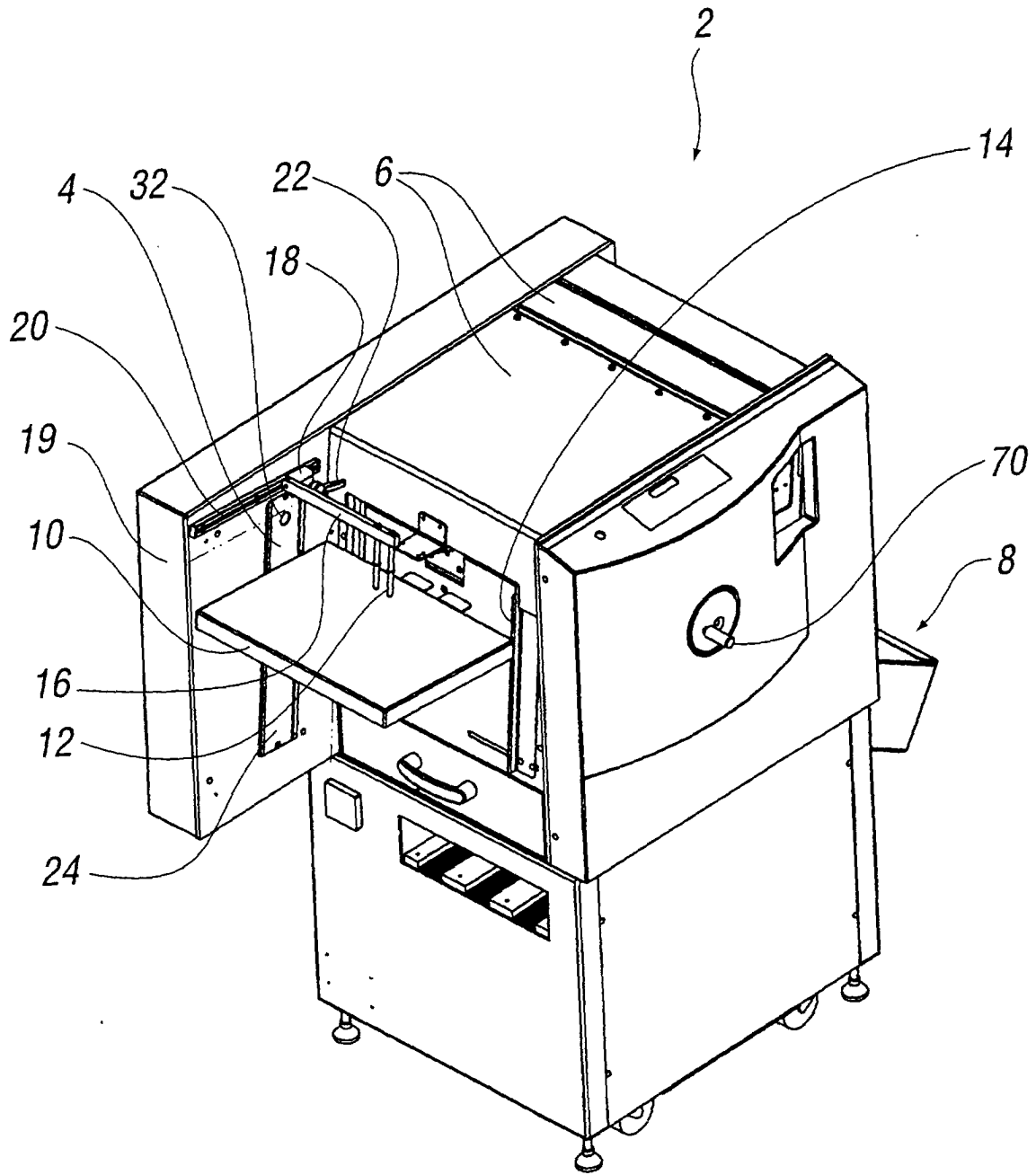


FIG. 1

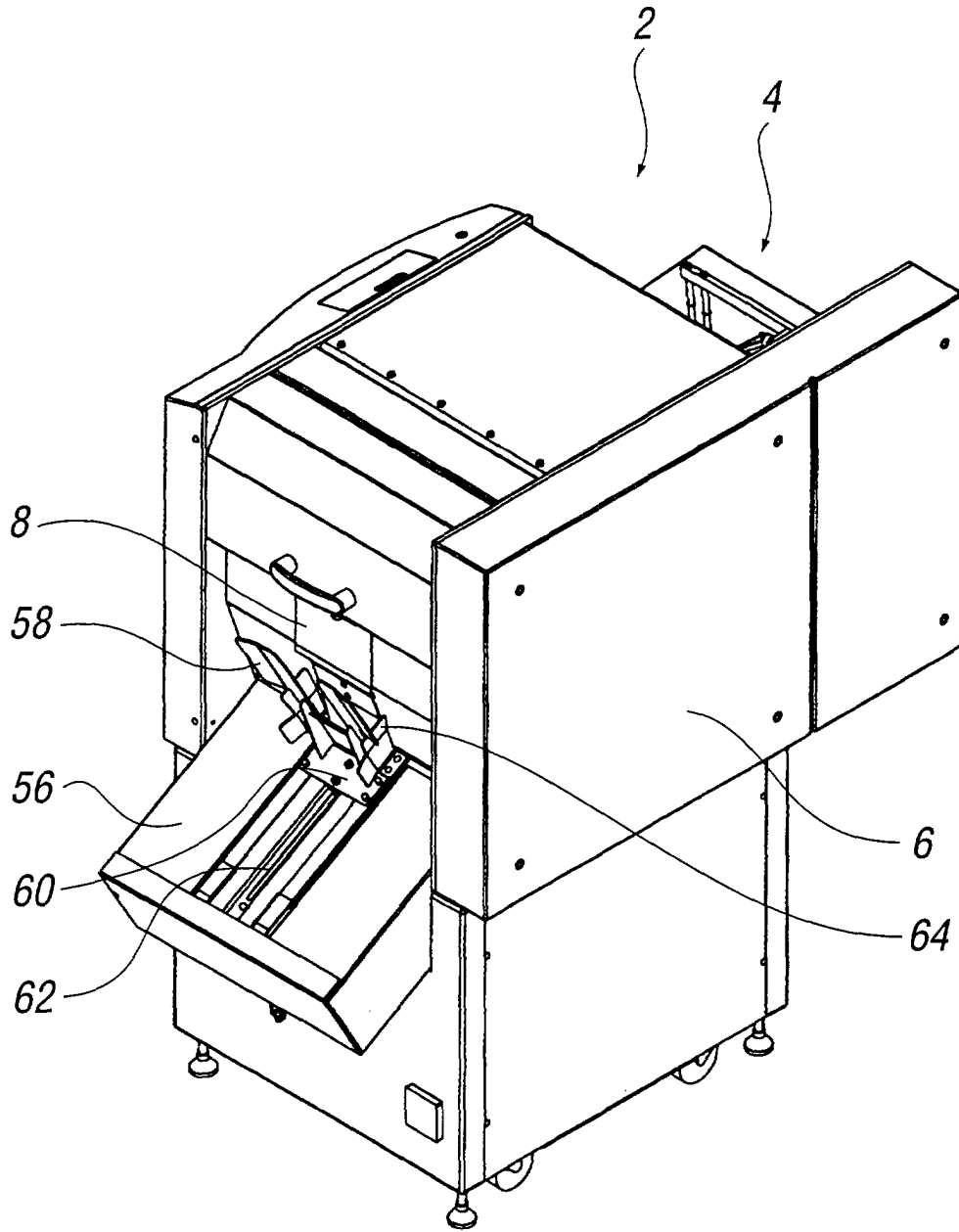


FIG. 2

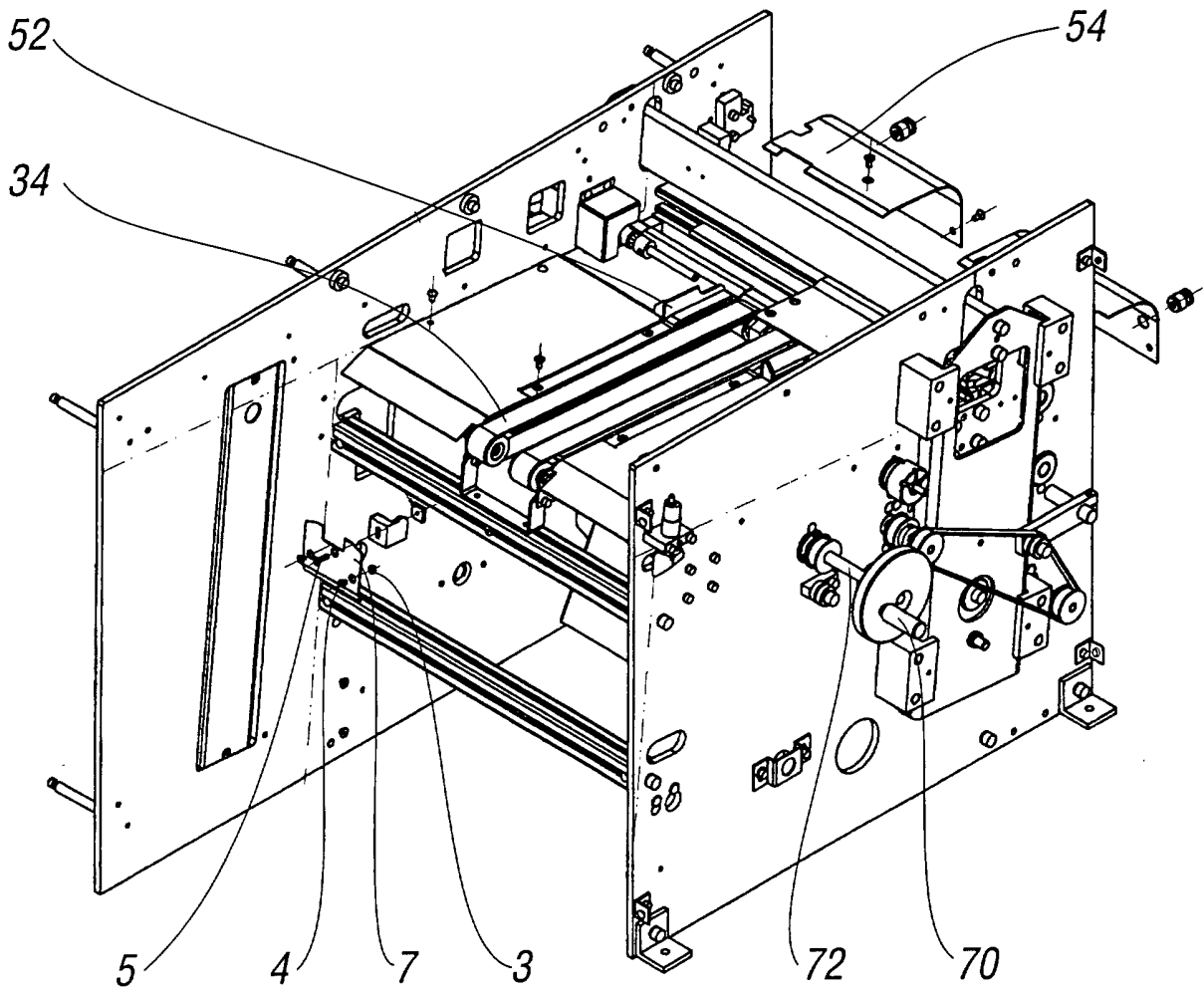


FIG. 3

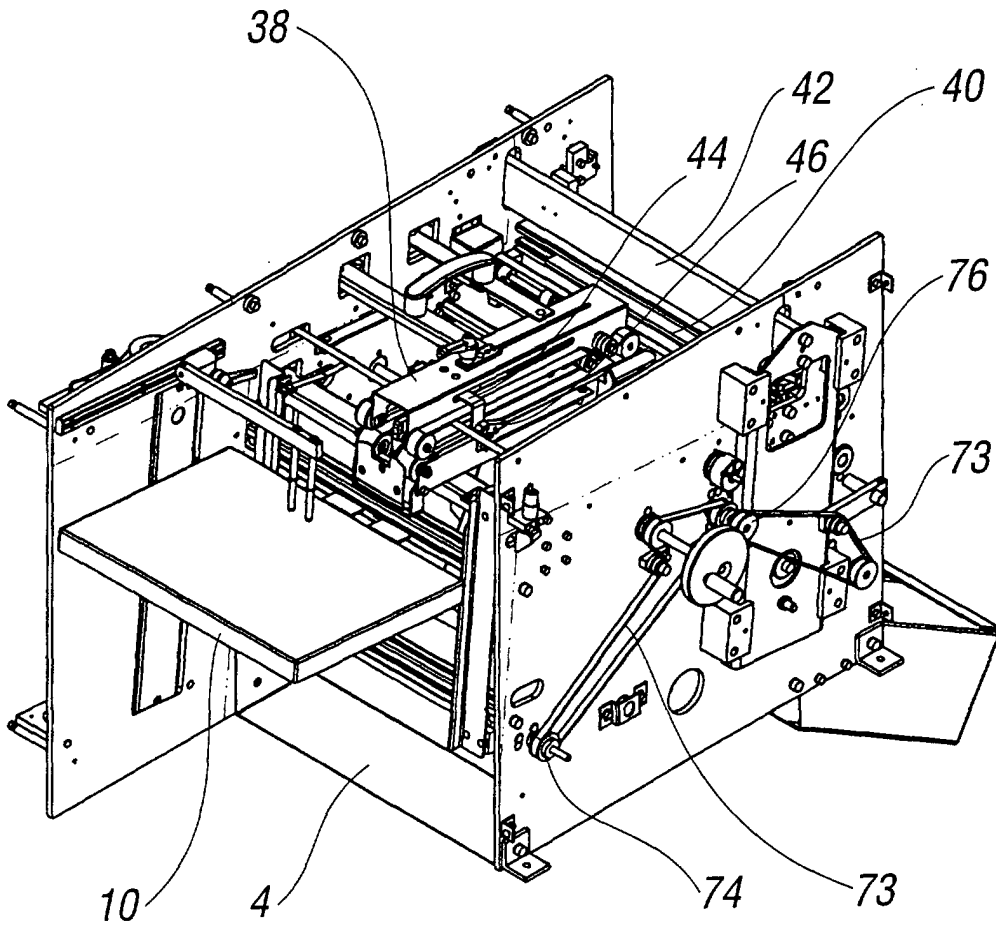


FIG. 4

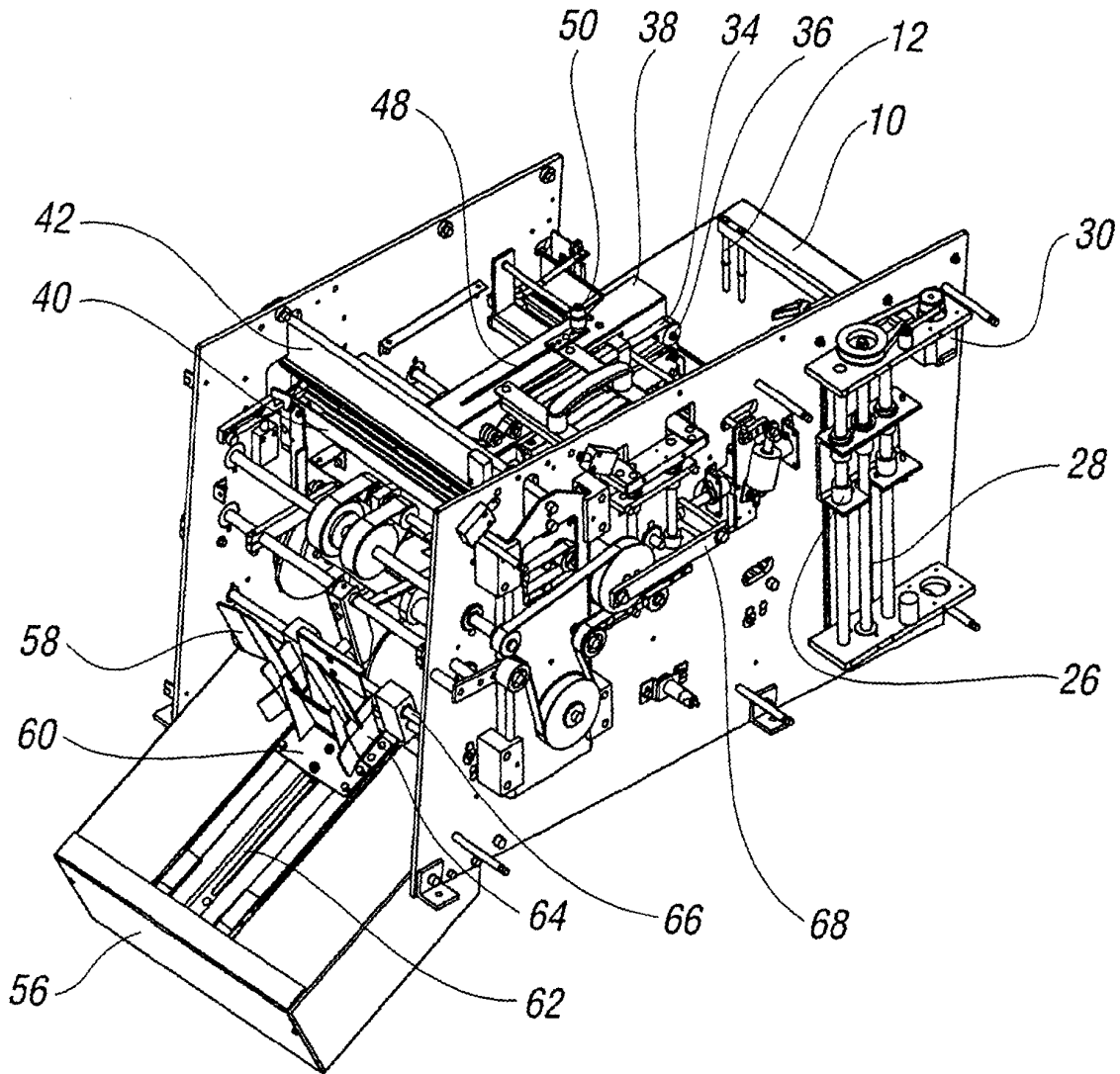


FIG. 5

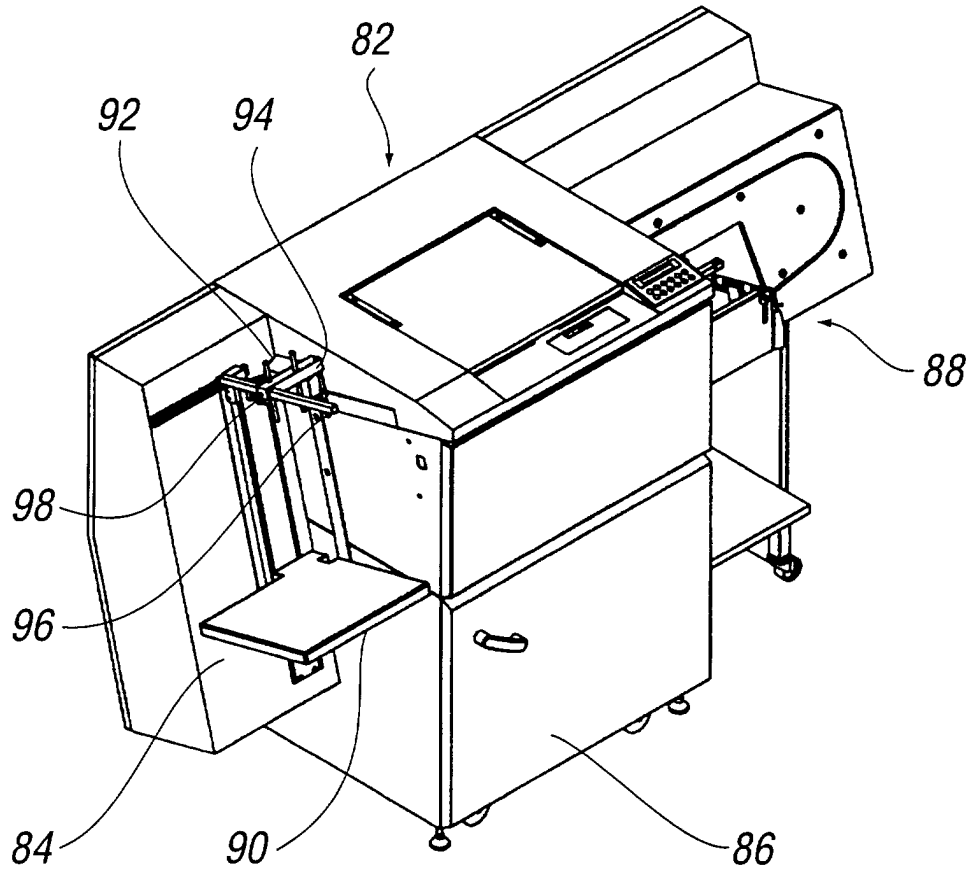


FIG. 6

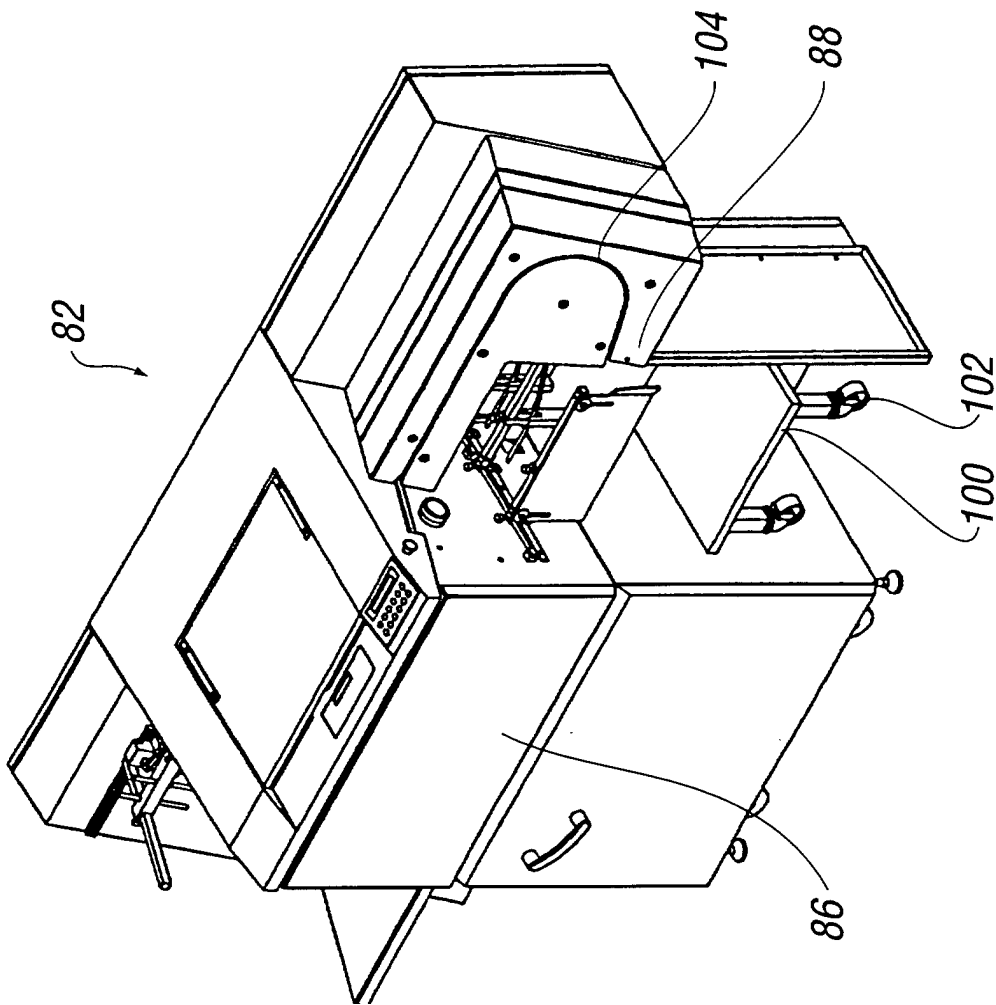


FIG. 7

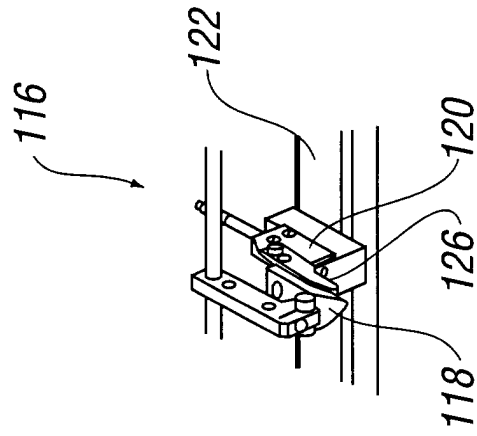


FIG. 9

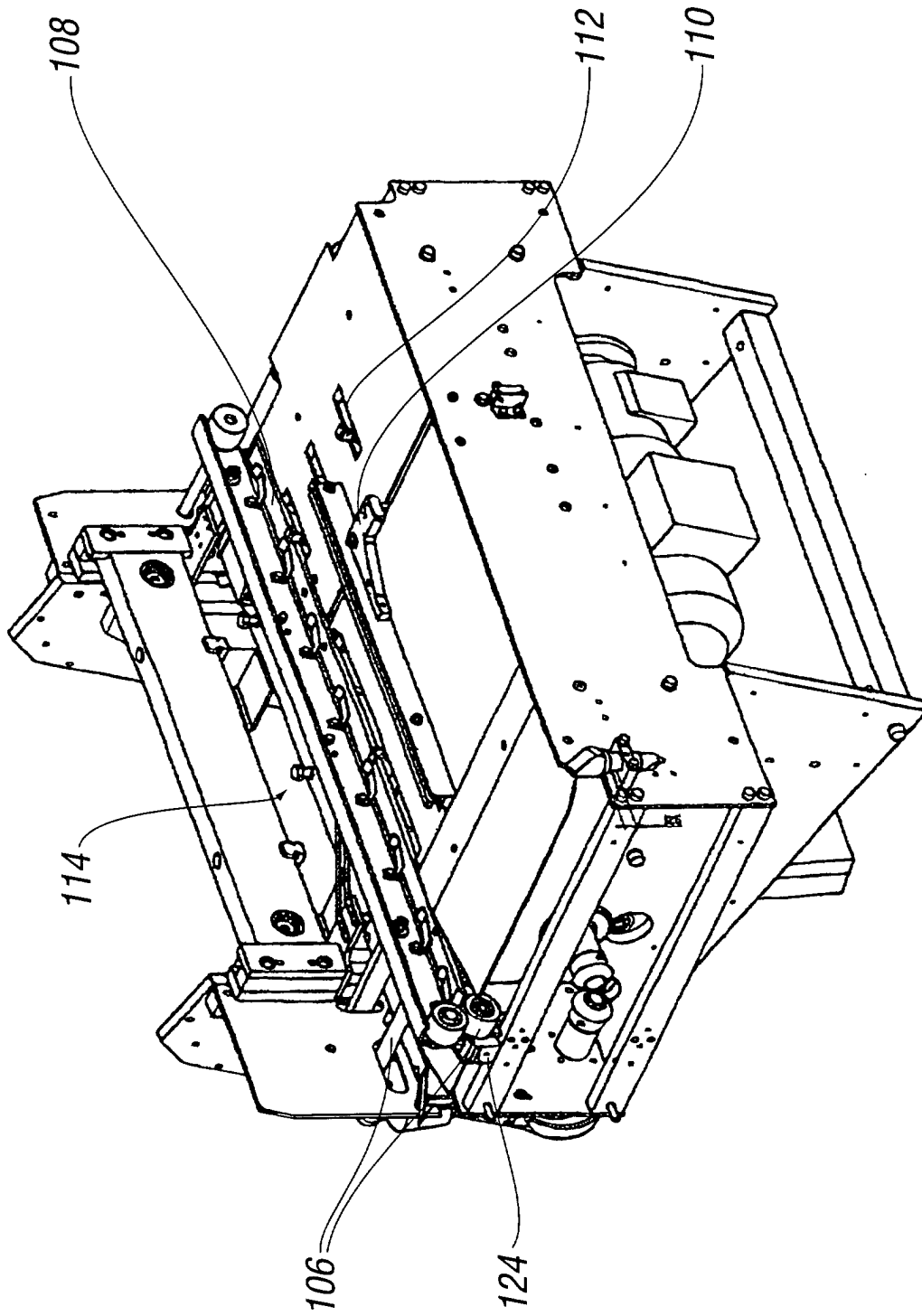


FIG. 8