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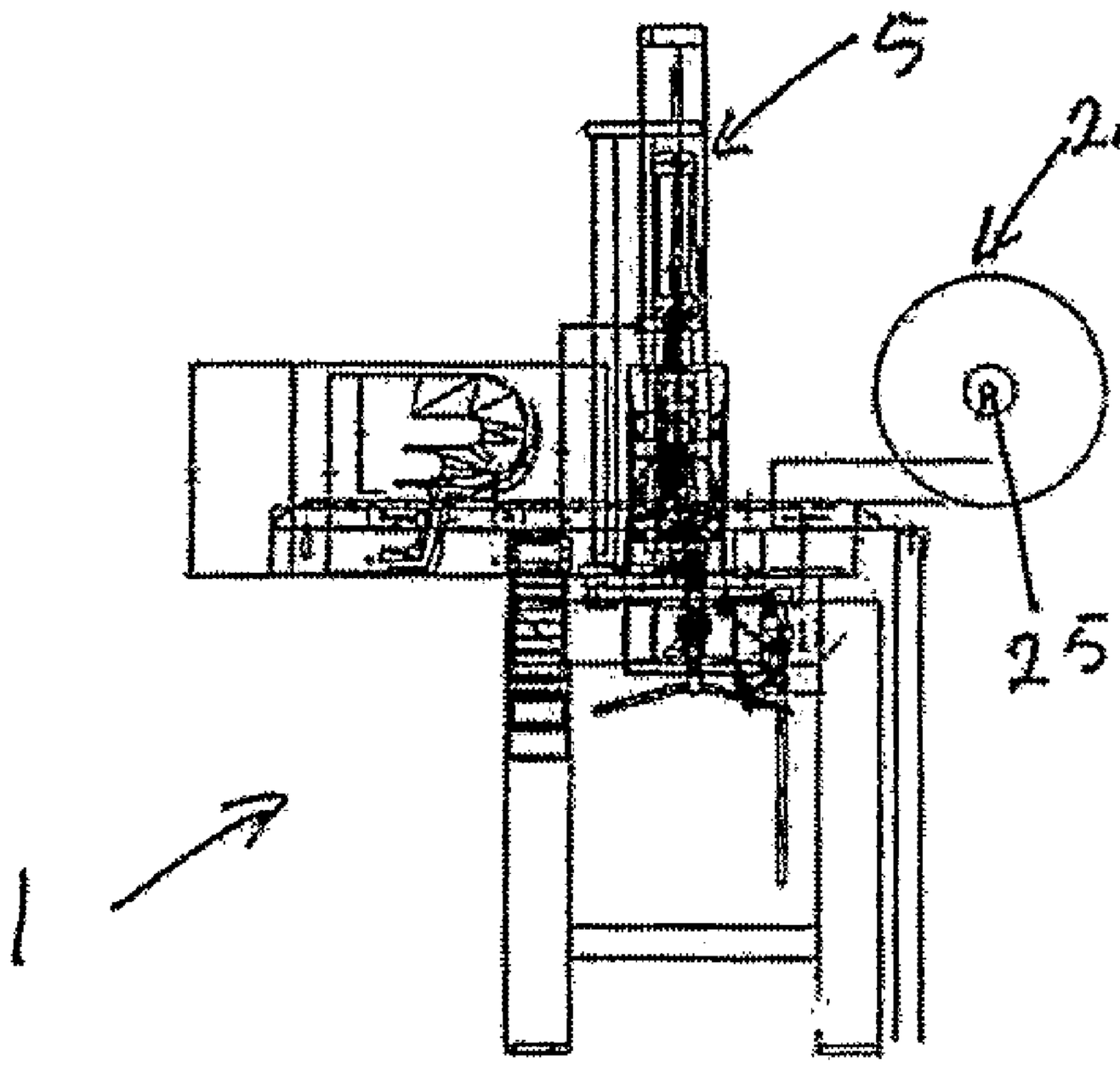

(57) Abrégé/Abstract:
An apparatus (1) for frame fabrication includes at least one nail gun (15) adapted to fire nails substantially in a selected plane of the frame and a sensor (40) and a corresponding interlock (41). The sensor is mounted on the at least one nail gun and the sensor and corresponding interlock is adapted to provide a sensor signal, detect the presence or absence of a return sensor signal, and prevent firing of nails from the at least one nail gun in response to the presence or absence of the return sensor signal.

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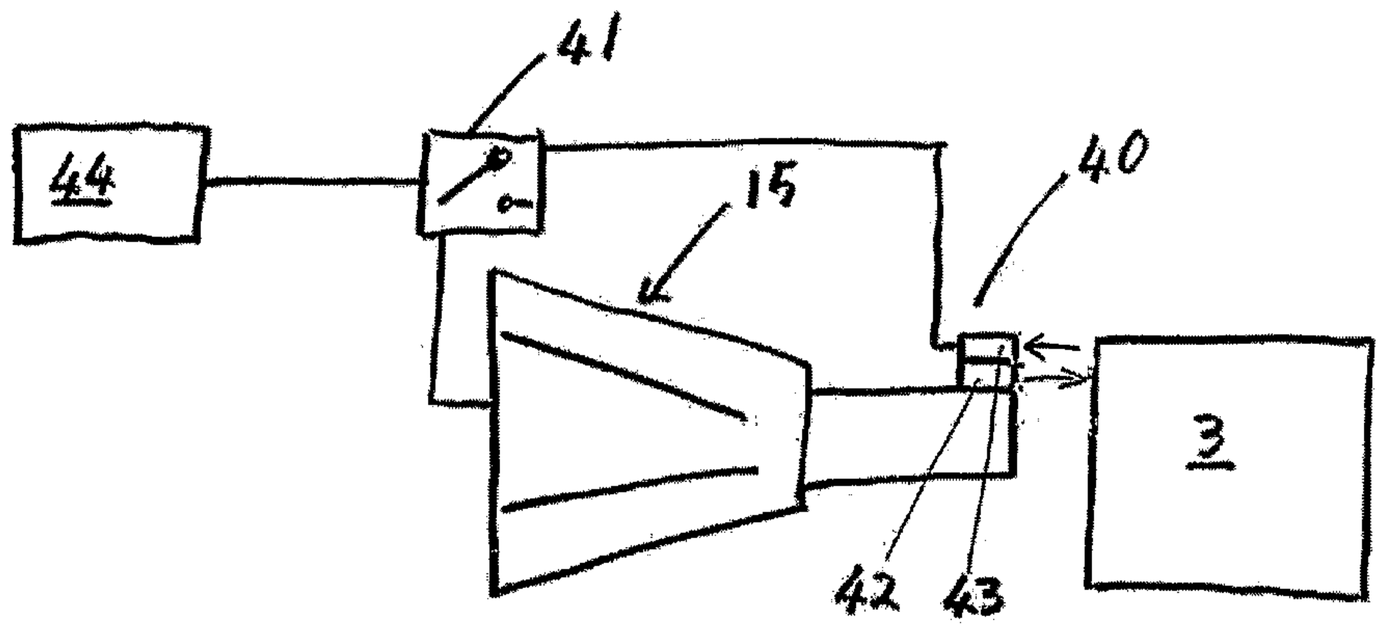

(57) Abstract: An apparatus (1) for frame fabrication includes at least one nail gun (15) adapted to fire nails substantially in a selected plane of the frame and a sensor (40) and a corresponding interlock (41). The sensor is mounted on the at least one nail gun and the sensor and corresponding interlock is adapted to provide a sensor signal, detect the presence or absence of a return sensor signal, and prevent firing of nails from the at least one nail gun in response to the presence or absence of the return sensor signal.

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IMPROVED APPARATUS FOR FRAME FABRICATION

TECHNICAL FIELD

The present invention relates to an apparatus for fabrication of frames in which plates or plate members are nailed to studs, braces or brace members separating opposite sides or plate members. In particular, the invention relates to an apparatus for fabrication of wall frames in which such members are nailed together. Further, in preferred embodiments, it relates to an apparatus for fabrication of timber wall frames.

BACKGROUND ART

Buildings are often constructed with prefabricated sections such as walls. The use of prefabricated walls allows for economies of scale from a production line to be brought to the construction of buildings.

Wall sections typically have top and bottom timber plates which are joined together by studs or braces. These braces are typically fixed to the plates with nails that pass through the plates into the braces in the axis of the braces. Typically, two or three nails will be used for each brace. The braces are typically rectangular in cross-section and the two nails are separated by approximately one third of the length of the rectangular cross-section of the brace.

The frames are also typically fabricated while lying flat on a fabrication bed. Therefore, the two positions of nails which fix the brace to the plate will correspond to two different elevations above the fabrication bed.

Nail guns are typically used in the fabrication of wall sections as nail guns provide a very rapid nailing operation.

One way to supply a large number of nails to a nail gun, as is suitable for a production line situation, might be via a hose through which the loose nails pass.

The hose would be supplied by a feeder which is in turn supplied by a bulk supply of loose nails which are vibrated or shaken in a 'tumbler'. The tumbler serves the purpose of rumbling or tumbling the nails into an alignment in which they fall down a feed chute for the hose. In this arrangement, the hose may require careful arrangement so that the flow of nails is not restricted, which can in turn place constraints on a design of the framing fabrication apparatus. The use of a nail feed hose may also place constraints on movement of the nail gun if the hose is to be unrestricted. Also, the 'tumbler' is likely to be large and bulky and this may also place constraints on the design of the apparatus.

Other types of nail guns might be supplied by a magazine of nails. A magazine may typically hold forty nails. This arrangement allows more flexibility in the design of framing fabrication apparatus and also allows ready adjustment of the position of the nail gun. However, a problem with magazine supplied nail guns is that the magazine may hold a relatively small amount of nails for production line applications. Frequent re-filling or replacement of the magazines may be required.

Walls are typically constructed by adding braces and other sections to the frame at one end. The frame is progressively moved away from that end as sections are added to the frame. Typically, roller supports are provided to support the frame at the outer edges by the plates. Rollers allow the frame to be moved easily.

Wall frames might be made of timber with various thicknesses. The variation in thicknesses may affect the spacing of nails in the braces if the apparatus is to cater for a range of timber thicknesses. For example, a framing apparatus adjusted to cater for a relatively thin timber will place the nails relatively close together in a relatively thick timber.

Some wall framing apparatus are known which use a hose feed nail gun apparatus with an adjustable height for the placement of nails in the braces relative to a fabrication bed. These apparatus have a ram which drives a nail which is dropped

in front of the ram into the timber. The nail hose is fed by a 'tumbler' which agitates a box supply of loose nails into a feeder for the nail supply hose. The nail ram is pivotally mounted with the pivot at some distance from the frame being ~~fabricated so the position of the nails in the brace can be adjusted by pivoting the~~ nail gun.

Apparatus for constructing wall frames are known.

GB1202278 relates to an apparatus for constructing wall frames incorporating a pair of pneumatically operated nail guns mounted on pivots at the side of the wall framing apparatus. The nail guns move approximately vertically but in an arc beside the frame. A vertical ram actuates the pivots to change the angle of the gun and the height at which the gun contacts a plate of the wall frame. The adjustment of the height of the nail gun at the plate allows a single gun to fire pairs of nails through the plate into a common brace.

US3848791 and US4031604 also relate to an apparatus for constructing wall frames in which plates are nailed with pairs of nails to braces. These documents also disclose a nail gun mounted on a pivot and actuated by a ram. In this case the pivot is parallel to the brace so the angle at which the nails are applied to the brace will be slightly off-parallel to the brace.

A problem with these apparatus is that while pivoting of a nail gun allows adjustment of the position of entry of nails into a brace, it suffers a problem that the nails will not be aligned with the brace. Instead, the nails will radiate from the pivot.

Another problem with these apparatus is that the pivot needs to be some distance from the frame being fabricated if the nail is not to be at too obtuse an angle of the axis of the brace. This pivot arrangement requires a considerable amount of space which places design constraints on the fabrication apparatus and may

require a considerable amount of factory floor space.

A further disadvantage with these apparatus relates to the lack of a robust sensor system whereby the sensor is mounted on the nail guns so that the sensor and nail gun move as a combination to prevent misfiring of the said nail guns in situations where an object is not in close proximity to the nail guns and fouling of the sensor by debris. Such misfiring events can present a safety hazard to the operator of the apparatus.

Accordingly the present invention seeks to provide an apparatus for fabricated frames which overcomes or mitigates some of the aforementioned problems with existing apparatus for fabrication of frames, or at least to provide the public with a useful choice in apparatus for fabrication of frames.

Further, the present invention seeks to provide an apparatus for fabrication of frames which allows vertical translation of the position of the nail gun relative to a fabrication and uses a nail belt to supply the nail gun.

As used herein the term "brace" should be understood to refer to any framing perpendicular to the plate(s) of the frame.

Still further, the present invention seeks to provide an apparatus for fabrication of frames which incorporates a sensor mounted on the nail guns to prevent misfiring and subsequent fouling of the nail guns and to improve the safety of operation of the apparatus.

Further still, the present invention seeks to provide an apparatus for fabrication of frames in which the nailing of braces to frames is provided and which utilises a minimal number of nail guns and also allows relatively large scale supply of nails without the need for frequent replacement of nail supplies.

It is a further aspect of the present invention to provide an apparatus for fabrication

of frames that allows a relatively large supply of nails to be supplied to nail guns in a relatively compact form.

As used herein the term 'nail belt' refers to a plurality of nails attached together for feeding and handling purposes but suitable for supplying the nails to a nail gun.

As used herein the term 'coil' used in conjunction with 'nail belt' includes a roll, spool, reel or such like of the nail belt. It is envisaged that the term also includes the nail belt being flaked. Here flaked refers to a zigzag stacking of successive layers of the belt.

As used herein a 'single nailing operation' includes the addition of nails in combination to a frame even if the nails are added sequentially. For example, pairs of nails may be used to provide additional strength.

As used herein, the terms 'horizontal' and 'vertical' mean substantially horizontal and substantially vertical so that minor variations or deviations from horizontal or vertical are included. Also, the terms refer to alternative alignments or orientations to 'horizontal' or 'vertical' where alternative provisions for gravity are apparent to those skilled in the art.

As used herein, the term 'planar' and 'selected plane' refers to a plane in which a frame or a side of a frame might be considered to lie. A frame formed from members is considered to be able to lie in a given plane even though the members have finite width and spaces are formed between members in that frame.

As used herein, the term 'processor' refers to a computer, microprocessor, microcontroller, programmable logic device or any other processor known to those skilled in the art. The term 'processor executable instructions' stored on a processor readable medium is intended to include any instructions or configurable information that is readable by the 'processor'. This may include a medium as simple as gates or switches of a programmable logic device circuit.

It is acknowledged that the term 'comprise' may, under varying jurisdictions, be attributed with either an exclusive or an inclusive meaning. For the purpose of this specification, and unless otherwise noted, the term 'comprise' shall have an inclusive meaning - i.e. that it will be taken to mean an inclusion of not only the listed components if directly references, but also other non-specified components or elements. This rationale will also be used when the term 'comprised' or 'comprising' is used in relation to one or more steps in a method or process.

Further aspects and advantages of the present invention will become apparent from the ensuing description which is given by way of example only.

DISCLOSURE OF THE INVENTION

The invention, in a broad aspect, provides an apparatus for fabrication of a frame. The apparatus comprises at least one nail gun adapted to fire nails substantially in a selected plane of the frame, a sensor mounted on the at least one nail gun for providing a sensor signal and detecting the presence or absence of a return sensor signal. An interlock is coupled to the sensor for preventing firing of nails from the at least one nail gun in response to the presence or absence of the return sensor signal. A nail supplier supplies nails from a coiled nail belt, which is rotatable about a horizontal axis, to the at least one nail gun. The nail supplier comprises a frictional braking system for preventing the coiled nail belt from unraveling itself under its weight, and the braking system comprises an adjustable friction clutch.

According to one aspect of the present invention there is provided an apparatus for frame fabrication which includes:

- at least one nail gun adapted to file nails substantially in a selected plane of the frame;
- a sensor and a corresponding interlock

characterised in that the sensor is mounted on the at least one nail gun and the sensor and corresponding interlock is adapted to:

- provide a sensor signal;
- detect the presence or absence of a return sensor signal; and
- prevent firing of nails from the at least one nail gun in response to the presence or absence of the return sensor signal.

This arrangement of sensor and corresponding interlock ensures that an object is in close proximity to the nail gun before a nail can be fired. This avoids the possibility of a nail being fired if there is not an object to receive the nail. This in turn prevents nails being projectile hazards. In addition, by mounting the sensor on the at least one nail gun there is a reduced risk of fouling of the sensor with debris.

Preferably, the sensor and corresponding interlock is adapted to detect the absence of a return sensor signal.

Preferably, the sensor signal may be provided and detected in the proximity of a part of the nail gun from which nails emerge.

Preferably, the sensor may be selected from the group: photo electric sensor, capacitor sensor, or similar.

It would be apparent to one skilled in the art that the corresponding interlock may be positioned in close proximity to the sensor and utilise reflection of the sensor signal from a non-proximal reflector or in a corresponding non-proximal position to the sensor to receive the sensor signal.

According to another aspect of the present invention there is provided an apparatus for frame fabrication which includes:

- at least one nail gun adapted to fire nails substantially in a selected plane of the frame;

- a nail supply means to supply nails to the at least one nail gun, the nail supply being adapted to supply a belt of nails to the at least one nail gun;
- a sensor and a corresponding interlock, and
- at least one mounting for the at least one nail gun

characterised in that the at least one mounting for a nail gun is adapted to translate the nail gun vertically and the sensor is mounted on the at least one nail gun and the sensor and corresponding interlock is adapted to:

- provide a sensor signal;
- detect the presence or absence of a return sensor signal, and
- prevent firing of nails from the at least one nail gun in response to the presence or absence of the return sensor signal.

It will be apparent to those skilled in the art that the mounting of the sensor on the nail gun means that the sensor will move with the nail gun when the gun translates in a vertical direction.

Preferably, the at least one mounting for a nail gun may be adapted to translate the nail gun perpendicular to said selected plane of the frame by at least one actuator.

Preferably, the at least one actuator may be at least one hydraulic double ram.

The use of a double ram allows for a greater number of preset vertical positions to be achieved. This allows the nail gun to place nails at a number of different elevations to be used to drive in pairs of nails into the same position down the length of the frame but at slightly different elevations. This allows for the apparatus to apply various building standards to the wall frame.

Preferably, said selected plane of the frame may be horizontal.

Preferably, the apparatus for frame fabrication includes at least one support for framing members.

Preferably, at least one portion of the support may be adapted to provide a predetermined degree of friction between said support and said framing member.

Preferably, said portion of said support comprises embossed paint.

Preferably, the apparatus for frame fabrication includes a nail supply means to supply nails to the at least one nail gun, the nail supply being adapted to supply a belt of nails to the at least one nail gun.

Preferably, the nail supply means includes a coiled nail belt.

Preferably, the coiled nail belt comprises more than approximately 1000 nails.

Preferably, the coiled nail belt comprises approximately 2500 or more nails.

Preferably, the nail supply means may be adapted to rotate about a central axis which is horizontal to allow said coiled nail belt to unravel.

Preferably, the apparatus includes a nail belt feeder to feed the nail belt to the at least one nail gun, the feeder adapted to force nails in the belt towards the at least one nail gun.

Preferably, the nail belt feeder may be adapted to absorb any tension in the nail belt in a direction away from the nail gun.

Preferably, the nail belt feeder includes at least one engagement means and at least one actuator for said engagement means, said engagement means and actuator being adapted so that the engagement means may be reciprocated over the nail belt by the actuator such that the engagement means engages nails in the

belt in a direction towards the nail gun.

Preferably, the at least one engagement means comprises at least one claw.

Preferably the apparatus includes a mounting for the coiled nail belt.

Preferably, the mounting for the coiled nail belt includes a barrel on which the coiled nail belt may be mounted.

Preferably, the barrel may be arranged to rotate around an axis which lies substantially in a horizontal plane.

Preferably, said mounting for the coiled nail belt includes a means for providing resistance to the rotation of said coiled nail belt at least in the unravelling rotational direction of the coil.

This resistance allows a coil to be mounted with its central axis in a horizontal plane. This, in turn, allows the vertical position of the nail gun to be adjusted while still being fed by a coiled nail belt. If resistance was not provided for the coiled nail belt, the coil would unravel due to the weight of the nails.

Preferably, the apparatus for frame fabrication includes at least one primary clamping surface adapted to clamp the frame in a selected plane of orientation of the frame.

Preferably, said selected plane may be horizontal and the at least one primary clamping surface may be adapted to act horizontally.

The primary clamping surface clamps a brace in place between two plates.

Preferably, the apparatus for frame fabrication includes at least one secondary clamping surface adapted to clamp members of the frame into alignment into a selected plane of orientation of the frame.

Preferably, said plane may be horizontal and the secondary clamping surface may be adapted to clamp members of the frame into vertical alignment.

Preferably, the secondary clamping surface may be adapted to clamp a brace and plate into vertical alignment so they both lie flush in the horizontal plane of the frame.

Preferably, the apparatus for frame fabrication includes a controller adapted to control at least one of:

- the at least one nail gun;
- the at least one nail gun mounting;
- the at least one primary clamping surface, and
- the at least one secondary clamping surface.

Preferably, the apparatus for frame fabrication includes a control input device for the controller.

Throughout the present specification the term 'control input device' should be understood to mean a mechanism to activate the machine by an operator. It is envisaged the control input device may come in a variety of different forms such as an infrared beam, bar, or the like.

Preferably, said control input device includes a bar provided with an eccentric pivot and detectors adapted to detect when said bar has been pivoted to an activation position.

Throughout the present specification the term 'bar' should be understood to mean a rigid, substantially straight length of material that extends across most of the width of the wall framing apparatus. The bar is used to trigger the controller to arrange a sequence of clamping or unclamping, nail gun translation and firing

operations if programmed as determined by the operator. These operations nail the plate to the brace.

For ease of reference the bar may simply be referred to as a control bar, kick bar, activation bar and/or clamping bar.

Preferably, the control bar is actuated by an operator's knee (hands free) at the position where an operator might stand to place the brace. Hands free operation of the control bar also allows the operator to place and nail noggins.

However, this should not be seen as a limitation on the present invention as conceivably a hand or any other part of the body may be used by the operator, to activate the control bar.

Preferably, the control bar is returned to the deactivation (down) position by gravity and triggers an industrial micro switch when lifted to activate the apparatus as aforesaid. In this way it acts as a double safety mechanism with the sensor as the machine is not live and will not fire unless the control bar has been engaged.

Preferably, said at least one pivot is provided with a stopper which limits the pivotal motion under gravity.

Preferably, the controller may be adapted to store at least one preset translation position of the nail gun.

Preferably, the preset translation position includes pairs of translation positions that correspond to pairs of nails to be added to a frame substantially in a single nailing operation.

Preferably, the controller may be adapted to initiate a series of events in a nailing operation upon activation of said control input device.

Preferably, the controller may be adapted to initiate the following series of events

in a nailing operation:

- said mounting for the nail gun translates the nail gun to a first preset nailing position;

- said nail gun fires a nail.

Preferably, said series of events may then be followed by:

- the said mounting for the nail gun translating the nail gun to a second preset nailing position;

- firing a second nail.

Preferably, said series of events may be preceded with clamping of the frame by said primary and/or secondary clamping surfaces.

Preferably, the frame may be substantially planar having a primary plane and the selected plane may be substantially the primary plane of the frame.

Preferably, the controller is provided with a set of processor executable instructions stored on a processor readable medium adapted to carry out the following steps:

- receive a user control input;

- provide control signals for a mounting for a nail gun to adjust the position of a nail gun to a first preset position;

- provide control signals to a nail gun to fire a nail;

- communicate with a sensor indicating that a return signal meets predetermined criteria; and

- inhibit any control signal to a nail gun to fire a nail if said predetermined

criteria are not met.

Preferably, the processor executable instructions are further adapted to carry out the steps of:

- providing a control signal to the mounting for a nail gun to move the nail gun to a second preset position; and
- providing a control signal to the nail gun to fire a nail.

Preferably, the processor executable instructions are further adapted to carry out the following steps of:

- providing control instructions to activate a first and/or second clamp in a predefined order or simultaneously.

According to another aspect of the present invention there is provided a method for frame fabrication using the frame fabrication apparatus of the present invention including the steps of:

1. providing at least one nail gun adapted to fire nails substantially in a selected plane of the frame;
2. positioning a plate at a desired point along a length of the frame fabrication apparatus;
3. positioning a brace in relation to the plate and fabrication apparatus, and
4. configuring a sensor and corresponding interlock to prevent misfiring of the nail guns

characterised by the steps of:

5. providing a sensor signal;

6. detecting the presence or absence of a return sensor signal, and

7. preventing firing of nails from the at least one nail gun in response to the presence or absence of the return sensor signal.

Preferably, the method of frame fabrication is further adapted to carry out the following steps:

8. activating a control input device of the apparatus which is provided with a controller to initiate a set of processor executable instructions, and

9. allowing the control input device to deactivate.

Preferably, the control input device of the aforementioned method is a control bar.

Preferably, the method of frame fabrication wherein the steps 8 and 9 of the aforementioned method comprise:

8. lifting the control bar to activate the apparatus and to trigger a controller which initiates a set of processor executable instructions, and

9. allowing the control bar to fall back to its original position under gravity thereby deactivating the apparatus.

The apparatus has the advantage of:

- reduced risk of misfiring of the nail gun with resulting improvement in safety, ease of operation and efficiency of the apparatus;

- allowing two or more height presets to be applied so that a variety of building code standards can be applied to a wall frame;

- the frame can be clamped from any location due to the length of the control

bar switch;

- the switch can be hand or knee operated;

- the operator is able to keep both hands free for positioning of timber which improves accuracy of work by allowing the operator to line up marks on the timber;

- keeping both hands free speeds up the process by reducing the need to reposition timber after clamping as it is generally positioned and clamped correctly the first time;

- the operator saves travel time around the working area by reducing the need to return to the centre position of the machine to activate the clamping and nailing process;

- nails are aligned parallel with brace members;

- the machine is not live and will not fire until the control bar has been engaged, thus it is a double safety mechanism with the sensor, and

- the vertical translation of the nail gun facilitates feeding a gun by a nail coil and also facilitates a compact wall framing machine that is easy to reload with a large number of nails.

The present invention addresses the problems identified in the prior art above of misfiring of the nail guns, restricted flow of nails to the nail guns, constraints on movement of the nail guns, nail magazines which hold a relatively small amount of nails for production line applications, nails not aligned with the brace members, position of entry of nails into a brace which are not aligned, nail guns in a relatively bulky form, misfiring and subsequent fouling of the nail guns which can lead to safety risks for the operator of the apparatus.

BRIEF DESCRIPTION OF DRAWINGS

Further aspects of the present invention will become apparent from the following description which is given by way of example only and with reference to the accompanying drawings in which:

Figure 1 shows a schematic plan view of a frame fabrication apparatus according to a preferred embodiment of the present invention;

Figure 2 shows a side elevation of a section of a framing fabrication apparatus according to the same preferred embodiment of the present invention as Figure 1;

Figure 3 shows an end elevation of a section of a frame fabrication apparatus centred on a nail gun according to the same preferred embodiment of the present invention as Figures 1 and 2;

Figure 4 shows a plan view of a section of a frame fabrication apparatus according to the same preferred embodiment of the present invention as Figures 1 to 3;

Figure 5 shows a view of Figure 2 showing detail of the frame fabrication apparatus according to the same preferred embodiment of the present invention as Figures 1 to 4;

Figures 6 and 6A show a control interface bar of a frame fabrication apparatus according to the same preferred embodiment of the present invention as Figures 1 to 5;

Figure 7 shows a plan view of a mounting for a nail gun according to the same preferred embroilment of the present invention as Figures 1 to 6;

Figure 8 shows a front elevation of a mounting of a nail gun according to the

same preferred embroilment of the present invention as Figures 1 to 7;

Figure 9 shows a side elevation of a mounting for a nail belt according to the same preferred embodiment of the present invention as Figures 1 to 8;

Figure 10 shows a plan view of a mounting for a nail belt according to the same embodiment as Figures 1 to 9;

Figure 11 shows a closer plan view of Figure 4 showing detail of the frame fabrication apparatus according to the preferred embodiment of the present invention as Figures 1 to 10;

Figure 12 shows an actuator for a nail belt feeder for a nail gun according to the same preferred embodiment of the present invention as Figures 1 to 11; and

Figure 13 shows a schematic view of a sensor interlock according to the same preferred embodiment of the present invention as Figures 1 to 12.

BEST MODES FOR CARRYING OUT THE INVENTION

Referring to Figure 1, there is shown a frame fabrication apparatus as generally indicated by arrow 1. The apparatus 1 has a work area 1a for an operator (not shown) who would move a frame (not shown) in direction A as it is being fabricated.

The apparatus 1 has a pair of frame supports 34 at either side of the apparatus 1.

The apparatus also has a pair of clamping and nailing stations 5a and 5b part way down the length of the apparatus 1. The primary purpose of the clamping and nailing stations is to nail braces (not shown) to plates (not shown) in a frame.

Referring to Figure 2 there is shown an end elevation of the same frame fabrication apparatus 1. A frame 2 is shown in place on the apparatus. The frame has a plate 3 and a brace 4. The frame fabrication apparatus 1 has a clamping and nailing station 5 at one side of the apparatus. This clamping and nailing station 5 is positioned approximately mid way down the length of the frame fabrication apparatus 1. The clamping and nailing station 5 is adjustable in direction B to accommodate different widths of frame 2. A dolly 6 is provided to support the clamping and nailing station 5 and allow movement in the direction B.

Figure 3 shows a side elevation of a portion of the frame fabrication apparatus 1 centred on the clamping and nailing station 5. Figure 3 shows a mounting 24 for a coiled nail belt (not shown). The nail belt mounting 24 spins on a horizontal axis 25.

Figure 4 shows a plan view of a clamping and nailing station 5.

Figure 5 shows a close-up end elevation of the clamping and nailing station 5. This station has a horizontal clamping surface 10 which is driven by a horizontal clamping actuator 11 and moves in the direction indicated by arrow A. The action of this clamping surface 10 and actuator 11, in conjunction with a reciprocal clamping surface (not shown) at clamping and nailing station 5 is to compress plates 3 against braces 4 prior to nailing. The clamping and nailing station 5 also has a vertical clamping surface 12 and a vertical clamping actuator 13 to clamp the plate 3 and brace 4 into position prior to nailing.

The nails that fix the plate 3 to the brace 4 are provided by a nail gun 15. The nail gun 15 is bolted to a nail gun mounting 16. The nail gun mounting 16 is provided with a tandem pair of actuators 17 and 18 which allow the mounting 16 or translate the nail gun 15 vertically. The mounting 16 has a pair of vertical rails (not shown) along which part of the nail gun mounting slides (also not shown). The use of a tandem pair of actuators allows for a greater number of preset vertical positions to

be achieved. The vertical adjustment feature of the nail gun mounting 16 allows the elevation of the nail gun mounting to be adjusted.

This allows the nail gun 15 to place nails at a number of different elevations to be used to drive in pairs of nails into the same position down the length of the frame but at slightly different elevations. Pairs of nails might simply be used to add strength to the frame.

The frame fabrication apparatus 1 also has a controller (not shown) for the nail gun mounting actuators 17 and 18, horizontal press actuator 11, and vertical press actuator 13.

The frame fabrication apparatus 1 also has an activation bar 19 which is provided to activate a pressing and nailing sequence for the clamping and nailing station 5. The activation bar 19 is shown in Figure 2 as extending across a large part of the width of the frame fabrication apparatus 1. The activation bar 19 is located at a suitable height and position for a person operating the apparatus 1 to control the bar with their knees.

Typically, the person operating the apparatus 1 would lift the upper bar 19A and then let it fall back to its original position under gravity. The upper bar 19A or part of its hinge typically includes micro switches which act as a control input for the controller (not shown). The activation bar 19 is shown in more detail in Figure 6. The bar 19a is connected by a pair of members 20a and 20b to a pair of pivots 21a and 21b. In a resting (deactivated) position the bar sits against a pair of stoppers 22a and 22b.

The operation of the clamping and nailing station 5 is illustrated by the following example given in reference to Figure 2. An operator of the frame fabrication apparatus 1 can position the plate 3 at a desired point along the length of the frame fabrication apparatus 1. The operator can then add a brace 4 and satisfied

that the brace 4 is in the correct position, the operator would bump the kick bar 19 with their knee, for example.

This would initiate the controller (not shown) to move the clamping surface 10 inwards against an opposite pressing surface (not shown). This action compacts the plate 3 against the brace 4.

The controller then activates the pressing surface 12 actuated by the actuator 13 to press downward on the adjacent edges of the plate 3 and brace 4. This action ensures that the plate 3 and brace 4 are properly aligned vertically so that they both lie flush in the desired plane of the frame. The controller then activates the nail gun mounting 16 to move the nail gun 15 to a first elevation (which might be one third the height of the plate 3 from the bottom of plate 3). The controller then activates the nail gun to fire a nail which penetrates the plate 3 and the brace 4 to fasten same.

The controller then activates the nail gun mounting 16 to move the nail gun to a position corresponding to a second position (which might be two thirds the height of the plate 3 from the bottom of plate 3) and activates the nail gun 15 to place a nail in that position. At this point, there are two nails approximately one third and two third the height of the plate 3 extending through the plate 3 into the brace 4. The controller then activates the pressing surface 10 driven by the actuator 11 to move outward and the clamping surface 12 driven by the actuator 13 to move upwards so that the frame is released and the operator is able to move the frame further down the frame fabrication apparatus to place the next brace 3, for example.

Referring to Figures 7 and 8 we see a side elevation and plan view of a nail gun mounting 16. The mounting 16 has a pair of vertical rails 51a and 51b. A movable stage 52 of the nail gun 16 slides along the rails 51a and 51b. The movable stage 52 has tracks 53a and 53b which are shaped to accommodate the rails 51a and

51b.

Figure 8 shows an elevation of the mounting 16 with rails 51a and 51b and movable stage 52. The circle 53 depicts the position a mounted nail gun might take.

Figure 9 shows a side elevation of the nail belt mounting 24 which has a mounting member 26 for an axle 27 in the horizontal axis 25 of the nail belt mounting 24. Figure 10 shows a plan view of the same nail belt mounting 24. The nail belt mounting 24 has a braking system 28 which prevents the weight of the nail belt (not shown) unravelling itself from the mounting 24 by simply spinning the barrel 23 on the axle 27.

The braking system 28 has an adjustment bolt 29 which is fitted inside a coil spring (not shown). Adjusting the adjustment bolt 29 will cause the face of the barrel 23 closest to the mounting member 26 to press, with varying pressure on a brake pad 30. Therefore, the adjustment bolt 29, spring (not shown), barrel 23 and brake pad 30 form an adjustable friction clutch. This clutch allows the nail belt coil (not shown) to be mounted with a horizontal rotational axis 25 rather than having to have a vertical axis rotation to avoid the nail belt coil (not shown) unravelling under its own weight. This in turn allows a nail belt coil to be used to supply a nail gun 15 which moves vertically while firing nails horizontally. This has the advantage of a single nail gun being used to place pairs of nails into each brace.

Figure 11 shows a plan view of the same clamping and nailing station 5 as depicted in the previous figures. Figure 11 shows the actuator 13, for the vertical pressing surface 12 (not shown), and the clamping surface 10. The nail gun 15 which is mounted on the nail gun mounting 16 which has an upper vertical actuator 18 and lower vertical activator (not shown). The nail belt 31 extends from a nail belt coil mounted on a barrel 23 of the nail coil (not shown) mounting 24. Vertical movement of the nail gun 15 does not affect the feed of the nail belt 31 to the nail

gun 15.

The frame fabrication apparatus 1 has a support rail 34 at one side of the clamping and nailing station 5 into which the plates are feed. The purpose of the rail is to support the plates 3 as they are fed into the clamping and nailing station 5. The support 34 has a surface 35 which is provided with embossed paint. This creates a suitable level of friction between the plate 3 and the surface 35 for the plates to be slid by an operator towards the clamping and nailing station 5 yet avoid overrun of the plates past a desired position in respect to the clamping and nailing station 5. Suitable embossed paint will be apparent to those skilled in the art and/or from routine experimentation. Support rail 34 extends below the clamping and nailing station 5 to the side from which the nailed brace emerges. Typically, this side of the support is provided with rollers 36 to facilitate movement.

Figure 12 shows an actuator 32 which is used to feed the nail belt 31 from the nail coil mounting 24 to the nail gun 15. This actuator is provided with a standard nail belt feed claw mechanism which pulls on the nails in a direction towards the nail gun 15 each time the actuator is extended in direction C and which slide over the nails when the actuator 32 is retracted in the opposite direction to C. By extending and retracting the actuator 32, the nails in the nail belt 31 are progressively pulled towards the nail gun 15. The controller also activates the nail belt feed actuator 32 and it will be apparent to the skilled addressee when such activation is required. For example, it may be immediately after each firing of a nail.

Figure 13 shows a schematic diagram of a nail gun 15 provided with a sensor 40 and sensor interlock 41. The sensor 40 has a transmitter 42 and receiver 43. The transmitter transmits a signal which is reflected from an object to be nailed such as a plate 3, for example. The reflected signal is detected by the receiver 43 which activates the interlock 41 to allow a signal from part of the controller 44. If a return signal is not detected by the receiver 43, the controller will not be allowed to fire the nail gun 15. It will be apparent to the skilled addressee that the mounting of

the sensor 40 on the nail gun 15 means that in operation the sensor 40 will move with the nail gun as it translates between firing positions. Thus, referring to Figure 13, if for example the nail gun is translated in a vertical direction such that the sensor 40 is above plate 3, a return signal will not be detected by the receiver 43, interlock 41 will not be activated and the controller will not be able to send a signal to the nail gun 15 to fire. This sensor arrangement ensures that an object is in close proximity to the nail gun 15 before a nail can be fired. This avoids the possibility of a nail being fired if there is not an object 3 to receive the nail. This in turn prevents nails being projectile hazards. It will be understood by those skilled in the art that the interlock may be integral with the controller (not shown). It will be apparent to the skilled addressee when and how the controller (not shown) should communicate with the sensor. For example, the sensor may continually update a controller register which is rolled before any firing signal is sent to a nail gun 15. Alternatively, an interlock and type functionality may be introduced between the controller and the nail gun to block signals when the sensor does not receive a satisfactory return signal.

Also apparent to the skilled addressee how the return signal is evaluated. In one example, the transmitter 42 and receiver 43 might be calibrated and thereby locally determine whether the return signal is satisfactory. Alternatively, the controller (not shown) may receive raw data from the receiver 43 and compare it with stored criteria.

Aspects of the present invention have been described by way of example only and it should be appreciated that modifications and additions may be made thereto without departing from the scope of the appended claims.

WHAT IS CLAIMED IS:

1. An apparatus for fabrication of a frame said apparatus comprising:

at least one nail gun adapted to fire nails substantially in a selected plane of the frame;

a sensor mounted on the at least one nail gun for providing a sensor signal and detecting the presence or absence of a return sensor signal;

an interlock coupled to the sensor for preventing firing of nails from the at least one nail gun in response to the presence or absence of the return sensor signal; and

a nail supplier for supplying nails from a coiled nail belt, which is rotatable about a horizontal axis, to the at least one nail gun;

wherein said nail supplier comprises a frictional braking system for preventing the coiled nail belt from unraveling itself under its weight; and

wherein the braking system comprises an adjustable friction clutch.

2. An apparatus for fabrication of a frame, said apparatus comprising:

at least one nail gun adapted to fire nails substantially in a selected plane of the frame;

a sensor mounted on the at least one nail gun for providing a sensor signal and detecting the presence or absence of a return sensor signal;

an interlock coupled to the sensor for preventing firing of nails from the at least one nail gun in response to the presence or absence of the return sensor signal; and

a nail supplier for supplying nails from a coiled nail belt, which is rotatable about a horizontal axis, to the at least one nail gun;

wherein said nail supplier comprises

a frictional braking system for preventing the coiled nail belt from unraveling itself under its weight;

a mounting support; and

a barrel supported by the mounting support to be horizontally rotatable and adapted to support thereon the coiled nail belt; and

wherein said braking system comprises:

a brake pad pressed against a face of the barrel; and

wherein said braking system comprises:

a brake pad pressed against a face of the barrel; and

an adjustment bolt for adjusting a pressure with which the brake pad is pressed against the face of the barrel.

3. The apparatus of claim 2, wherein said face of the barrel is the closest to the mounting support.

4. The apparatus of claim 1, wherein said selected plane of the frame is horizontal.

5. The apparatus of claim 1, wherein the sensor and the interlock are adapted to detect and respond to the absence of a return sensor signal.

6. The apparatus of claim 1, wherein the sensor is adapted to provide and detect the sensor signal in a proximity of a part of the at least one nail gun from which nails emerge.

7. The apparatus of claim 1, wherein the sensor is selected from the group consisting of: photo electric sensor and capacitor sensor.

8. The apparatus of claim 1, wherein the coiled nail belt comprises more than approximately 1000 nails.

9. The apparatus of claim 1, wherein the coiled nail belt comprises approximately 2500 or more nails.

10. The apparatus of claim 1, further comprising:

a nail belt feeder adapted to force nails in the nail belt towards the at least one nail gun.

11. The apparatus of claim 10, wherein the nail belt feeder is adapted to absorb any tension in the nail belt in a direction away from the nail gun.

12. The apparatus of claim 10, wherein the nail belt feeder includes at least one engagement member and at least one actuator for said engagement member,

said engagement member being reciprocable over the nail belt by the at least one actuator to engage nails in the nail belt in a direction towards the at least one nail gun.

13. The apparatus of claim 12, wherein the at least one engagement member comprises at least one claw.

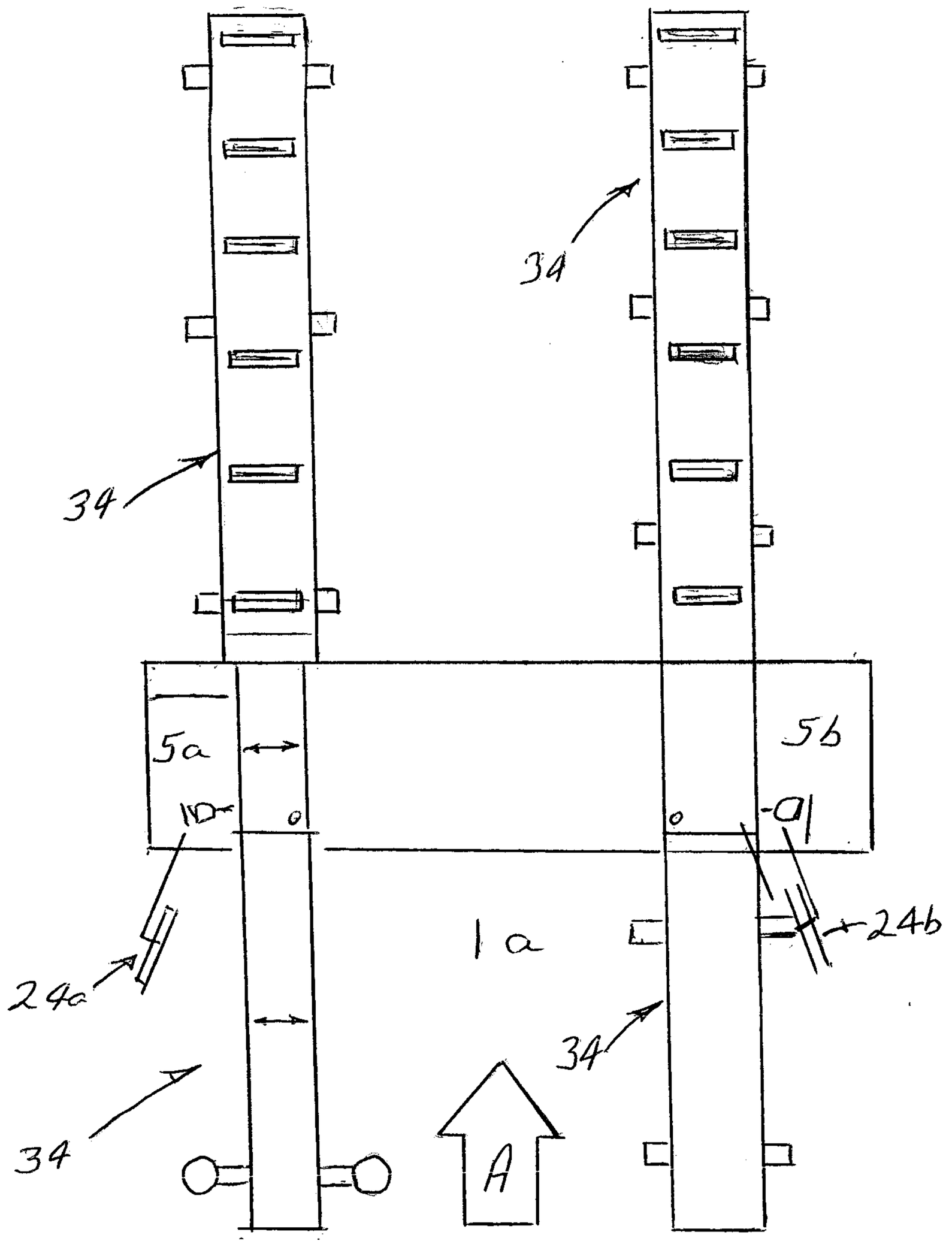

FIGURE 1

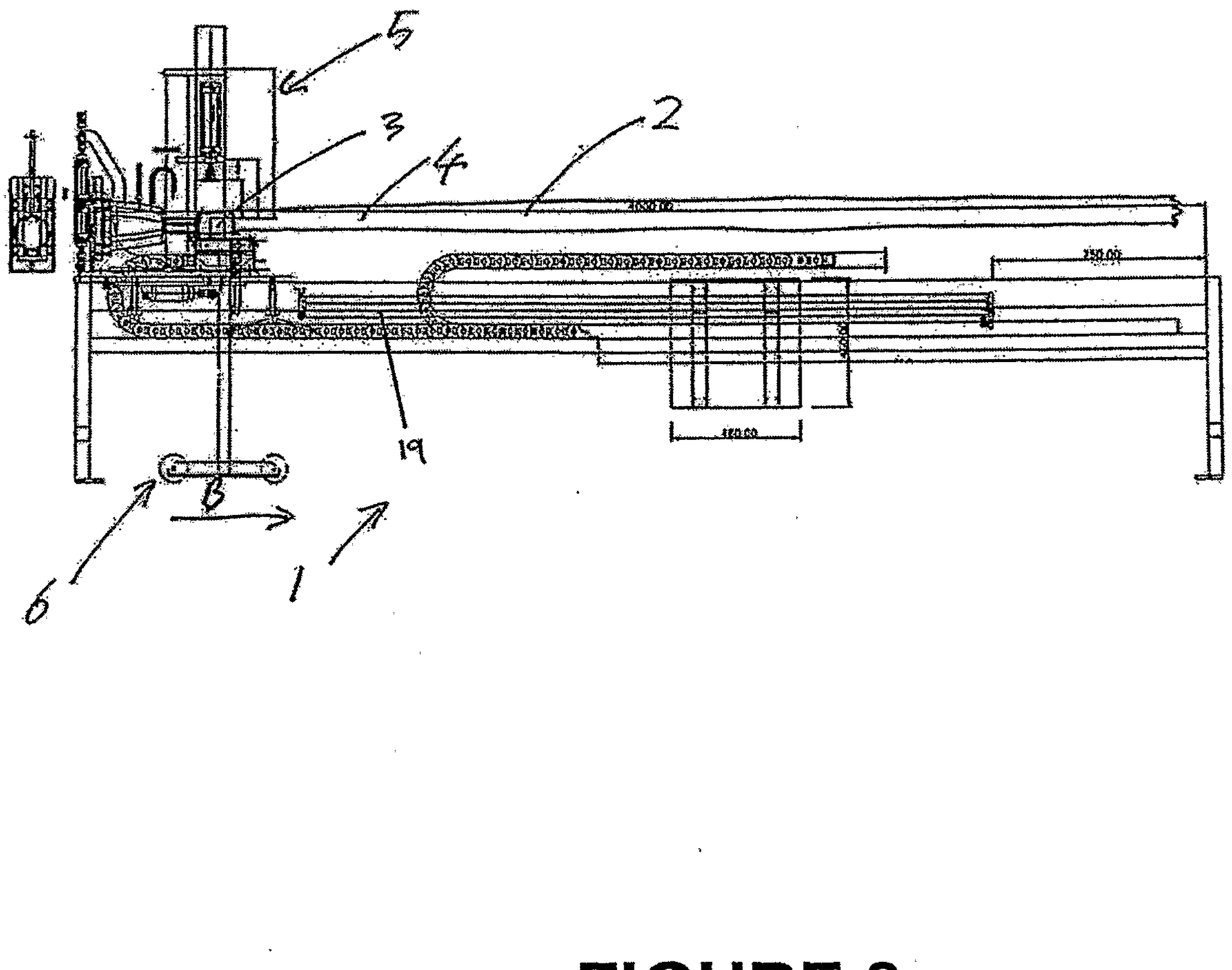

FIGURE 2

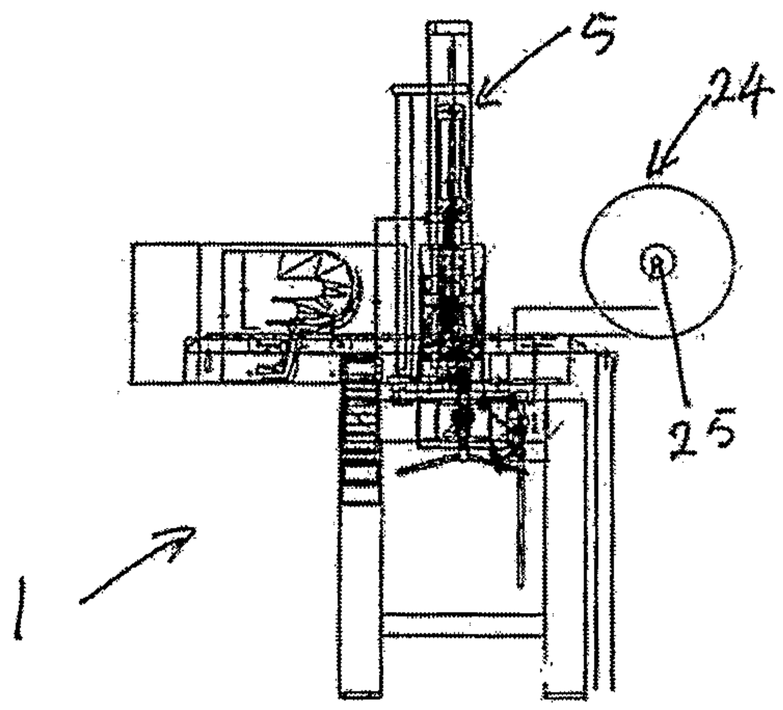

FIGURE 3

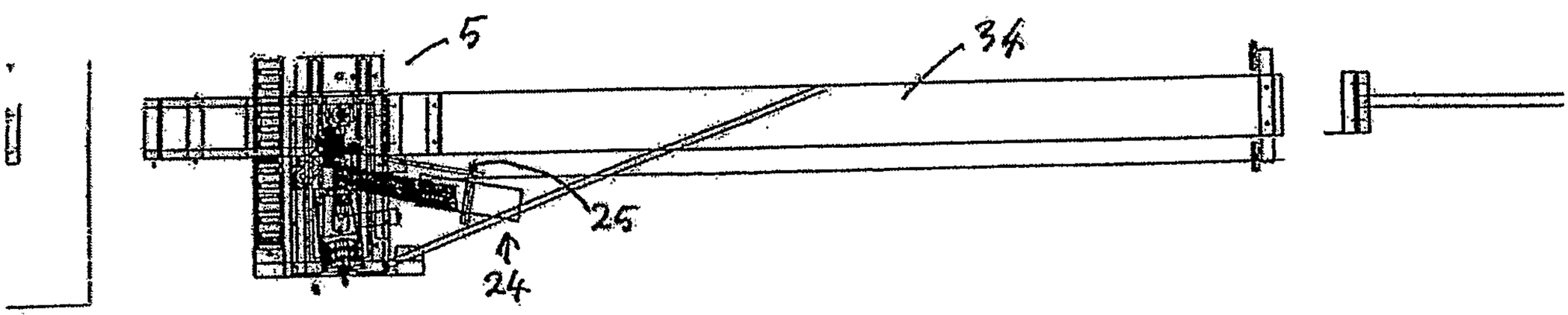

FIGURE 4

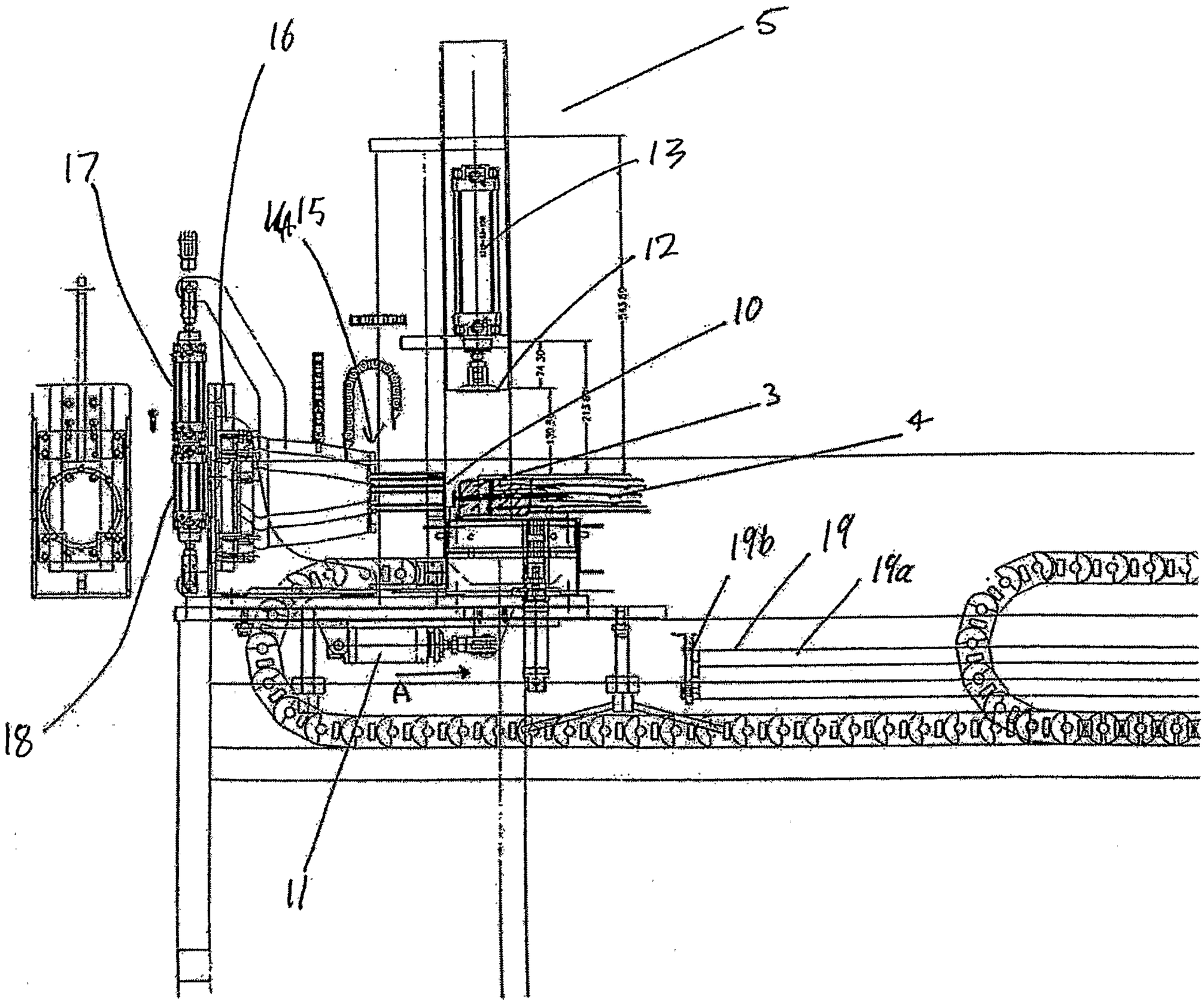

FIGURE 5

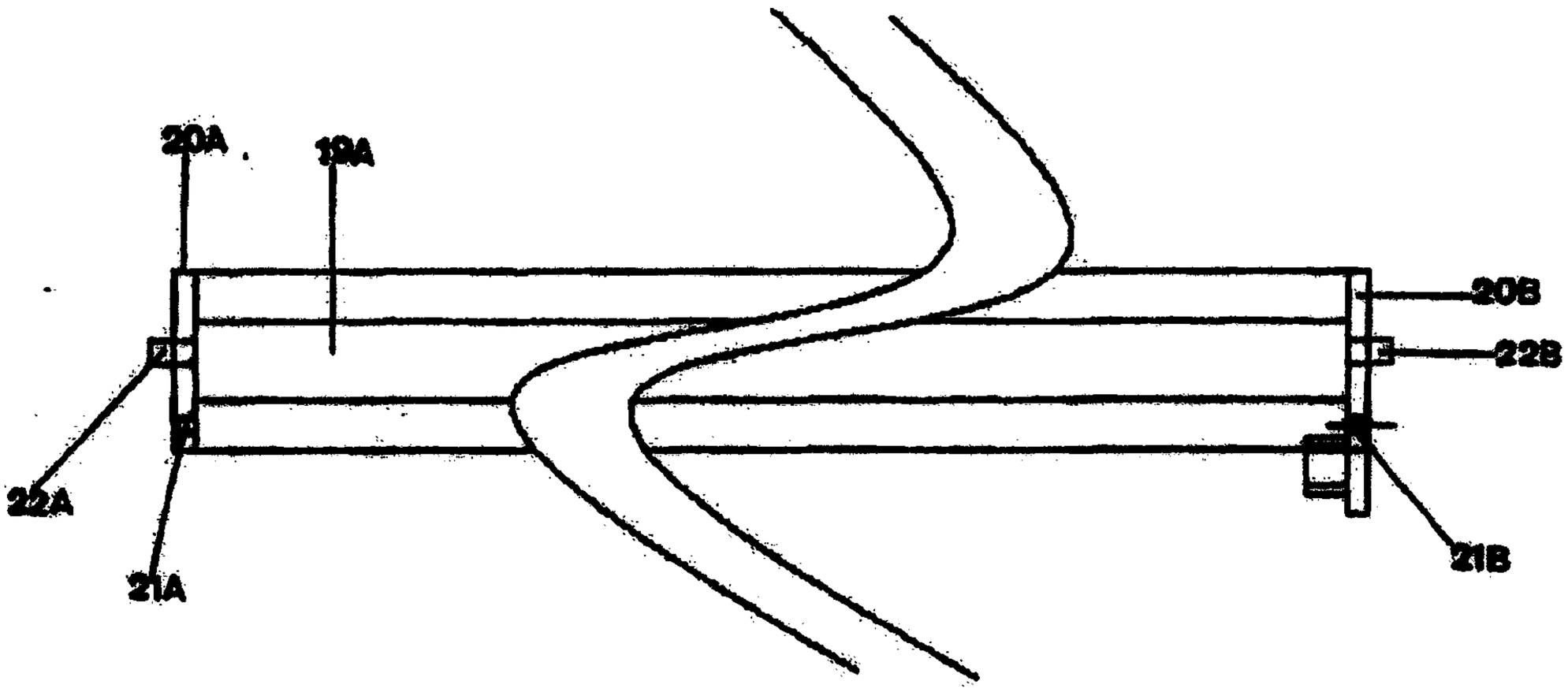

FIGURE 6

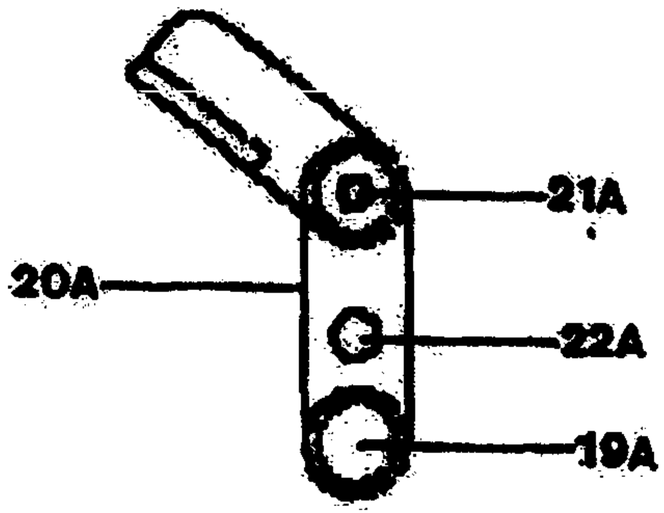

FIGURE 6A

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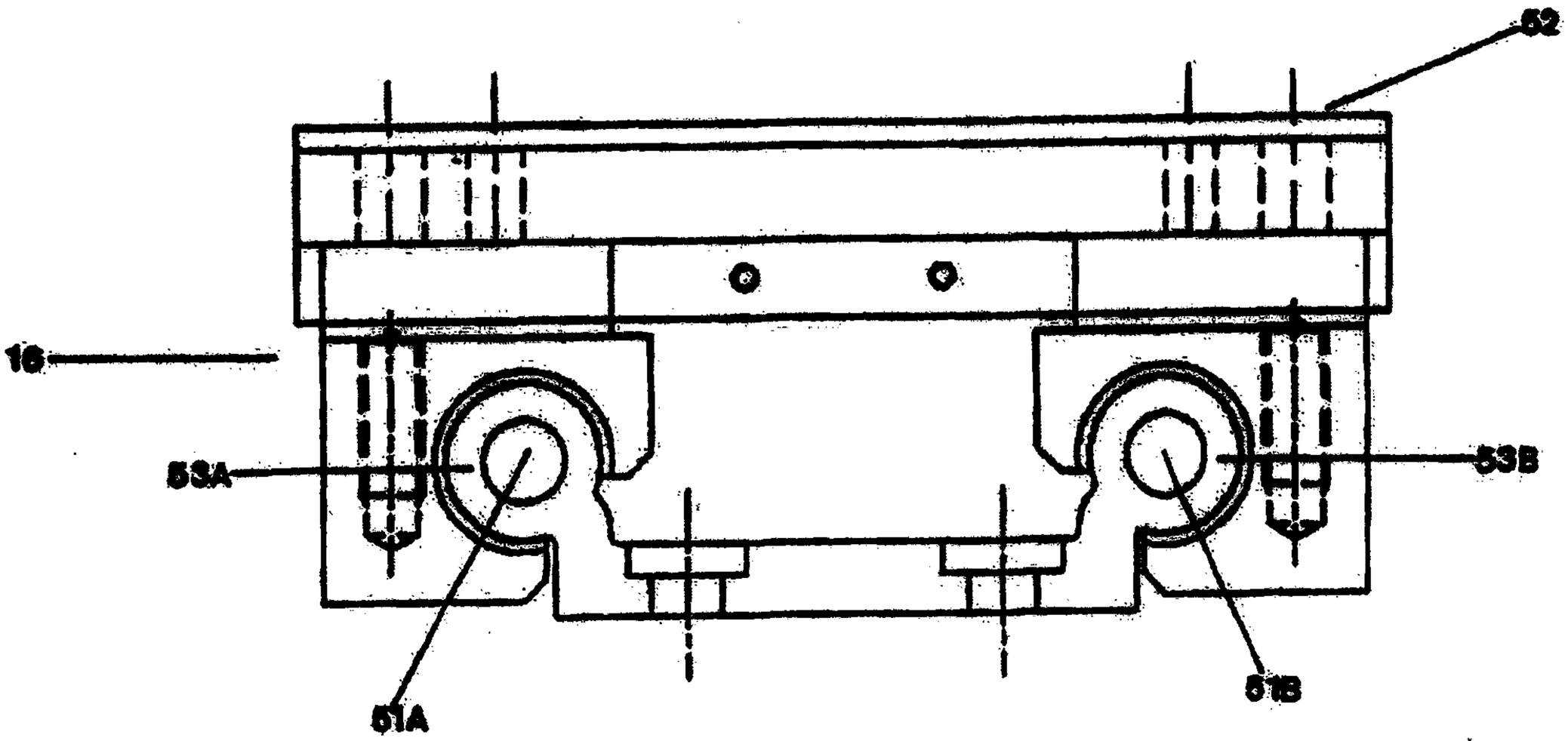

FIGURE 7

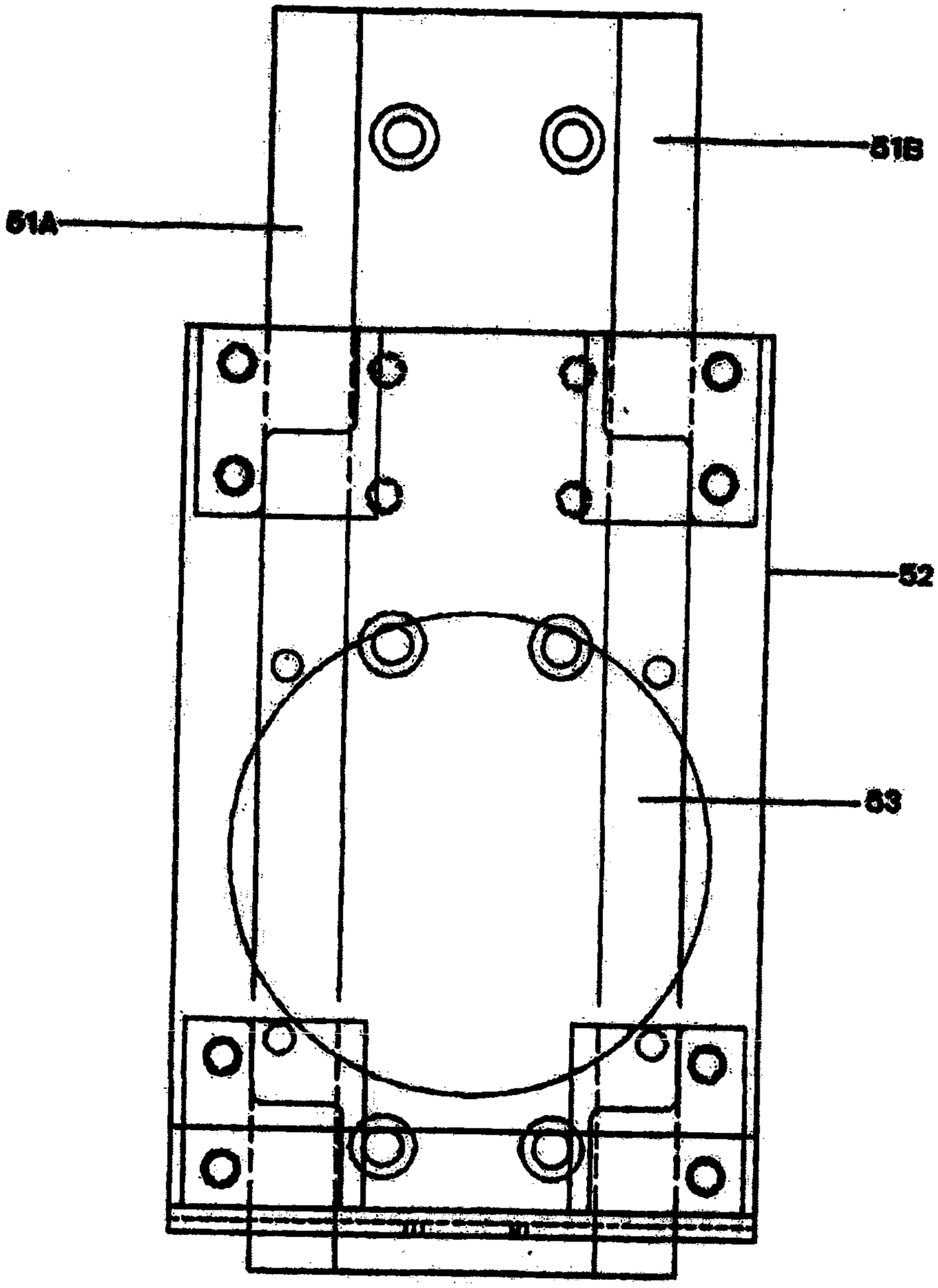

FIGURE 8

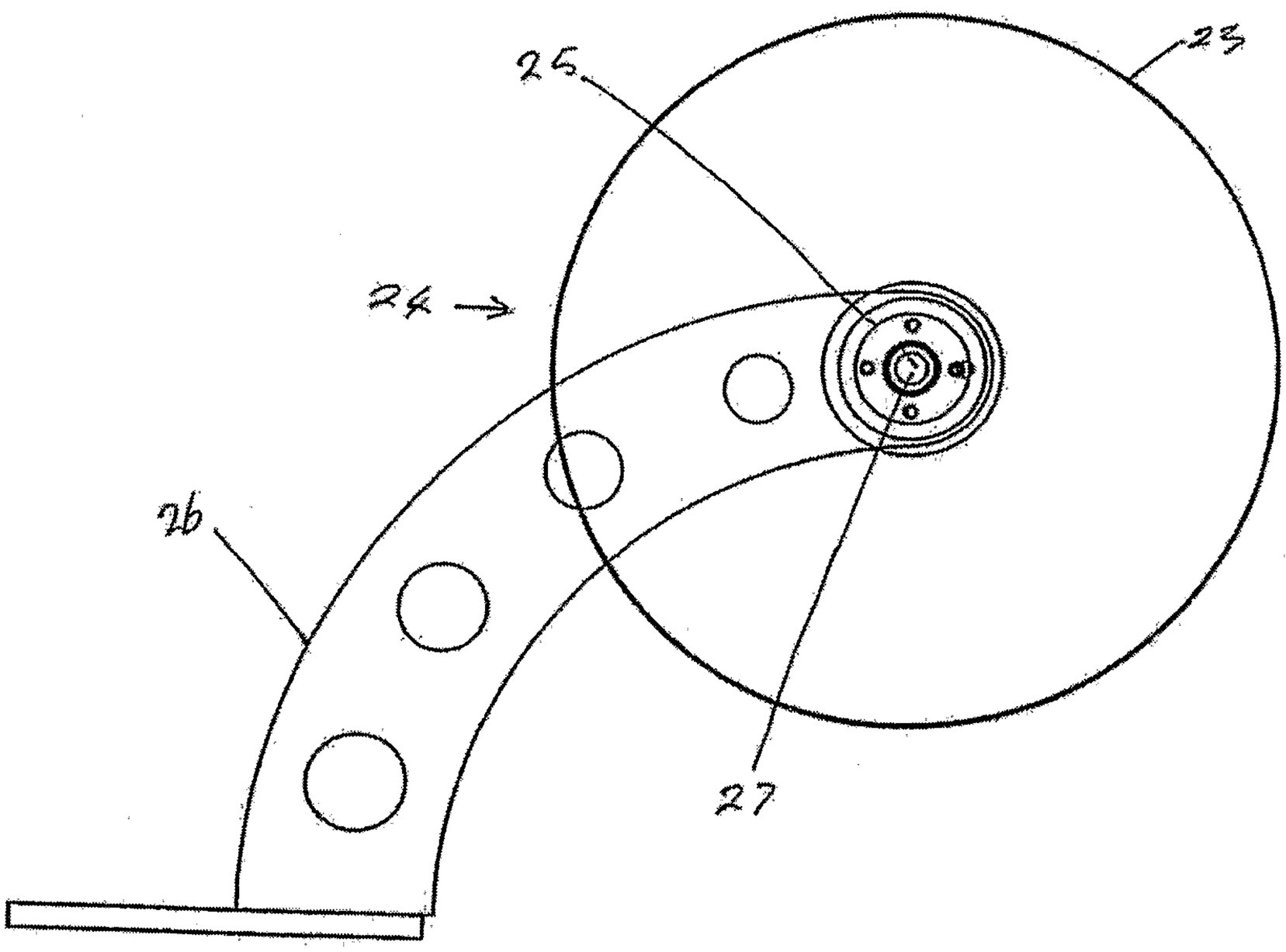

FIGURE 9

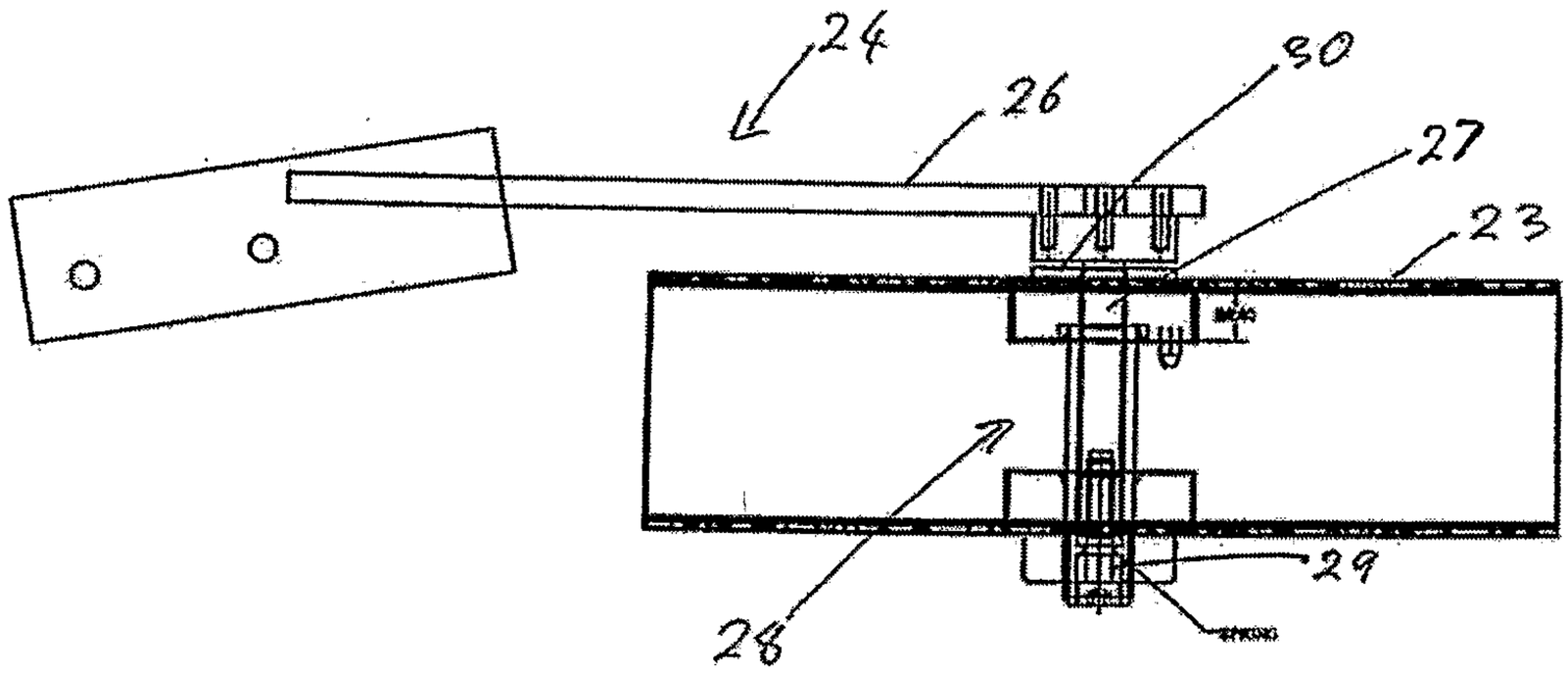

FIGURE 10

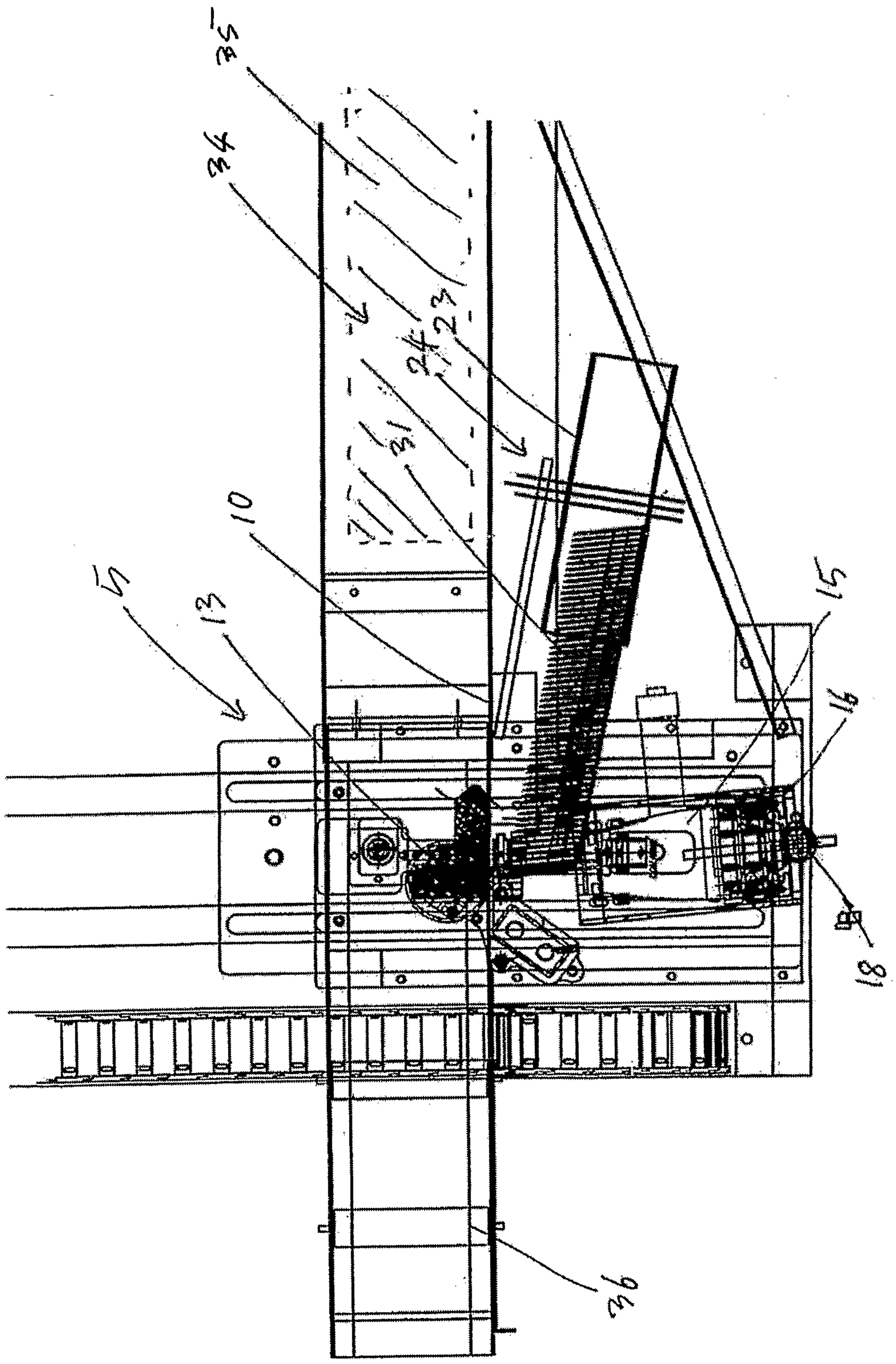

FIGURE 11

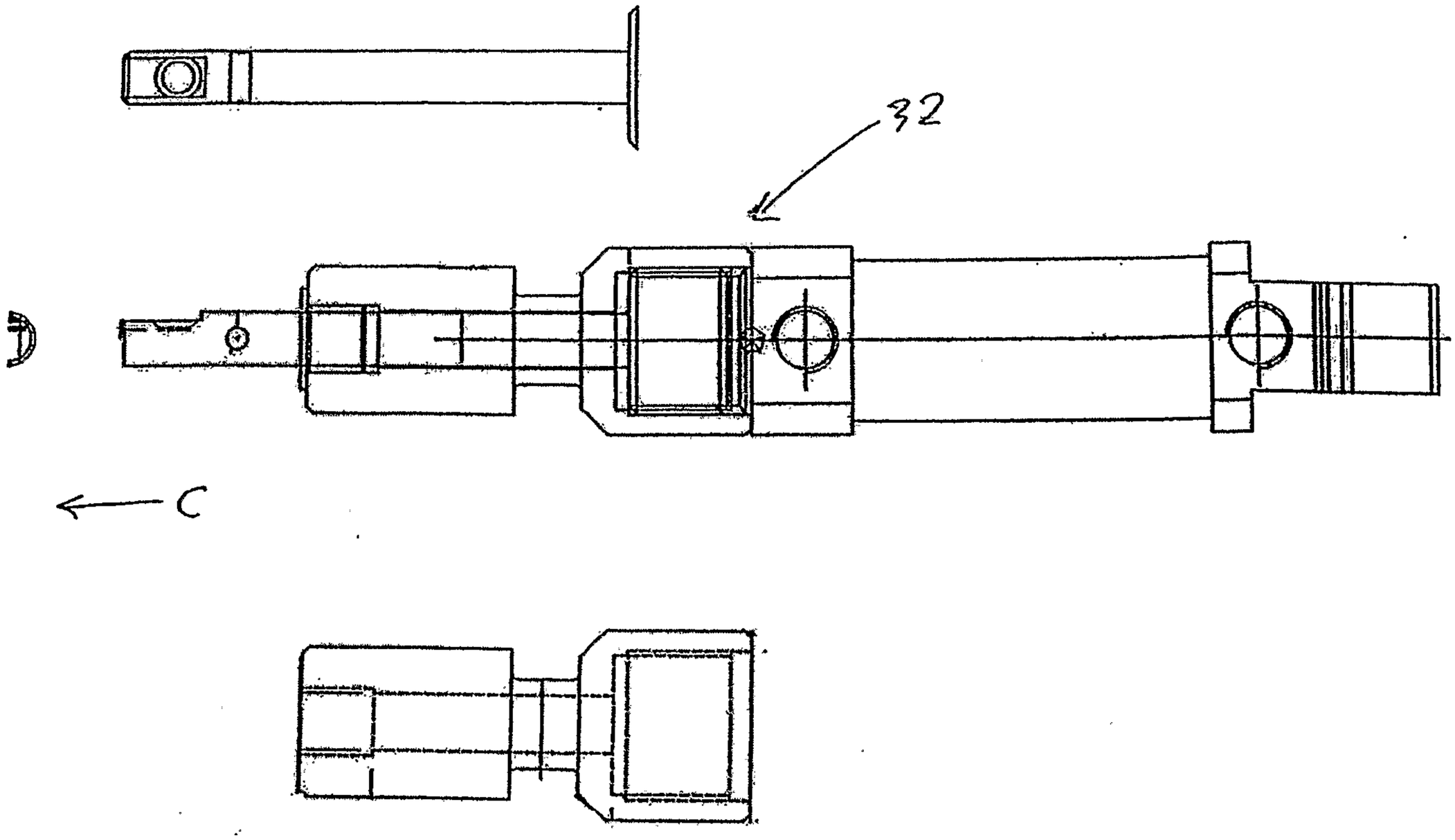

FIGURE 12

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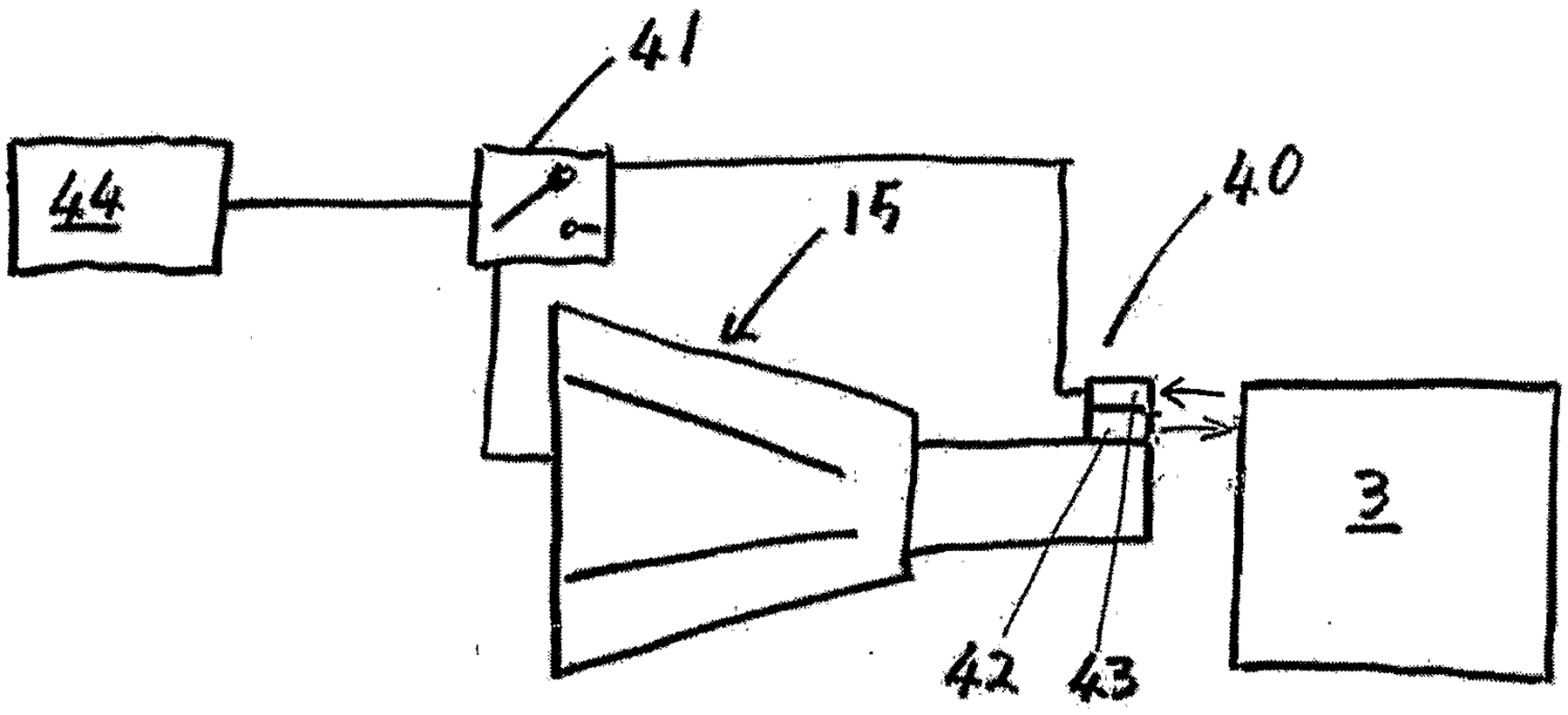
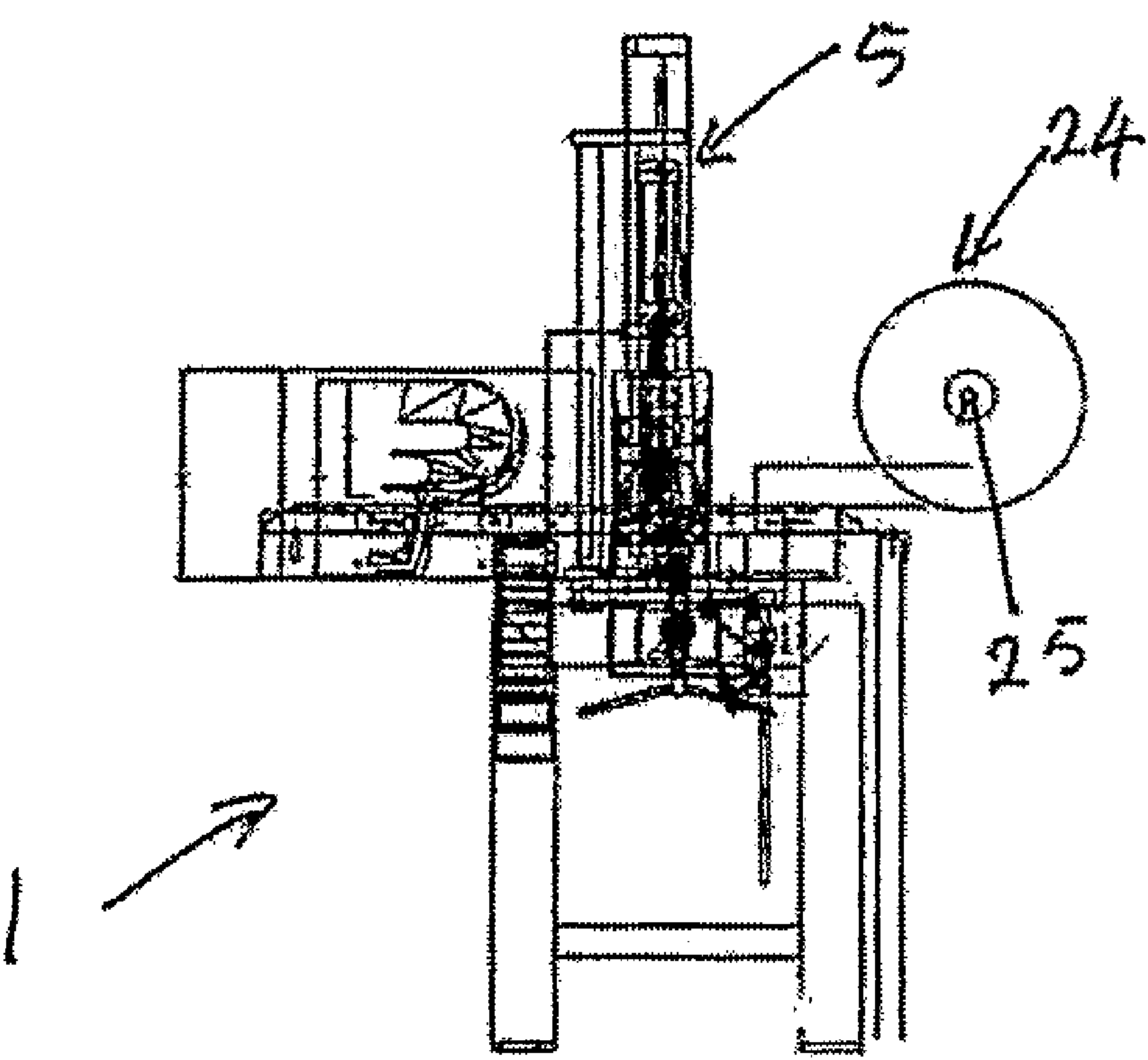


FIGURE 13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