



(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
02.07.2008 Bulletin 2008/27

(51) Int Cl.:
B25B 23/04 (2006.01)

(21) Application number: **07025132.7**

(22) Date of filing: **27.12.2007**

(84) Designated Contracting States:
AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HU IE IS IT LI LT LU LV MC MT NL PL PT RO SE SI SK TR
Designated Extension States:
AL BA HR MK RS

(72) Inventors:
• **Ukai, Tomohiro**
Anjo-shi
Aichi-ken (JP)
• **Shibata, Yoshinori**
Anjo-shi
Aichi-ken (JP)

(30) Priority: **28.12.2006 JP 2006355108**

(71) Applicant: **Makita Corporation**
Anjo-shi, Aichi-ken (JP)

(74) Representative: **Kramer - Barske - Schmidtchen**
European Patent Attorneys
Landsberger Strasse 300
80687 München (DE)

(54) **Screwdrivers**

(57) A guide device (30) of a screw feeding device (20) has a guide member (31) defining a guide path for the movement of a screw strip (J) into a feeder (22) that can reciprocally move in a screw driving direction. A

clearance (31e) is provided between guide portions (31a) of the guide member (31), so that the screw strip (J) can be positioned to extend across the clearance (31e) and can move along the clearance (31e) as the position of the feeder (22) changes.

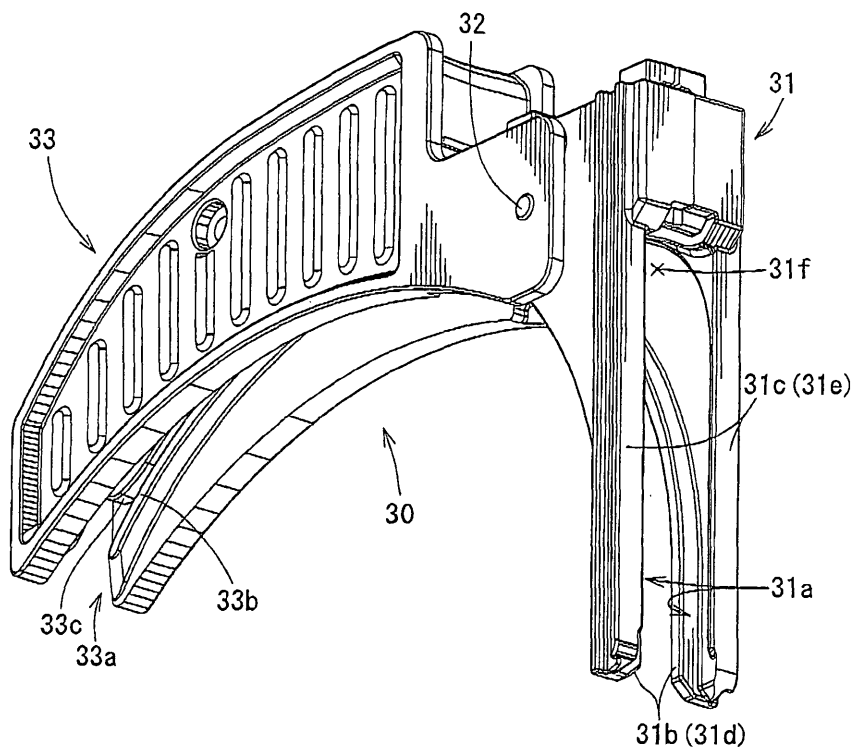


FIG. 4

Description

[0001] This application claims priority to Japanese patent application serial number 2006-355108, the contents of which are incorporated herein by reference.

[0002] The present invention relates to fastener feeding devices, such as screw feeding devices used for feeding screws to screw driving devices of screwdrivers.

[0003] In order to efficiently drive a number of screws, there has been proposed a screw feeding device that can automatically feed screws one after another to a driver bit in response to the driving operation (the operation performed by an operator for pressing a tool body downward in a screw driving direction).

[0004] In general, such a screw feeding device includes a casing attached to a front end of a tool body such that a driver bit is positioned inside of the casing, a feeder disposed inside of the casing and supported by the casing such that the feeder can reciprocally move along the driver bit, and a screw strip guide for guiding a screw strip to an entrance of the feeder. A ratchet mechanism is provided within the feeder in order to feed the screw strip by one pitch of the screws in response to the driving operation of the tool.

[0005] For the purpose of explanation, the upward movement of the feeder relative to the casing caused by the downwardly pressing operation of the tool body may be called a "retracting movement" of the feeder, and the downward movement of the feeder relative to the casing caused by the lifting operation of the tool body may be called an "advancing movement" of the feeder.

[0006] With the above conventional screw feeding device, as the feeder starts to make the retracting movement of the feeder by the downwardly pressing operation of the tool body, the ratchet mechanism operates to feed the screw strip by a distance of one pitch of the carries screws, so that the screw to be driven is supplied to the driver bit. Therefore, no troublesome operation is necessary for the operator to set the screw to the driver bit at each time the driving operation is performed. As a result, it is possible to efficiently perform the driving operations of a plurality of screws.

[0007] Conventionally, the screw strip guide is configured to support the screw strip such that the screw strip extends rearward by a large distance along the feeding direction from a position adjacent to the entrance of the feeder. Therefore, the screw strip can be prevented from hanging to reach a position where the screw is driven. As a result, the screw strip may not interfere with the driving operation. In addition, since the screw strip can be supplied while its posture is maintained to be unchanged, the ratchet mechanism can reliably feed the screw strip. Such a conventional screw feeding device is disclosed, for example, in U.S. Patent No. 7,032,482.

[0008] However, the conventional screw feeding device has the following problems. Thus, the screw strip guide is fixed in position relative to the tool body. On the other hand, the feeder having the ratchet mechanism dis-

posed therein reciprocates within the casing as the driving operation is performed. Therefore, when the feeder makes the retracting movement (upward movement) relative to the casing by the downwardly pressing operation of the tool body, the screw strip may be turned back so as to be caught by the front end along the feeding direction of the screw strip guide. When this occurs, the screw strip may not smoothly move to follow the feeder and may be tensioned between the feeder and the screw strip guide. This may cause a problem that the retracting movement and eventually the advancing movement of the feeder may not be smoothly performed.

[0009] In particular, as the length of the screws to be driven (i.e., the length of the screws carried on the screw strip) increases, the stroke of reciprocating movement of the feeder increases, causing increase of likelihood that the screw strip is turned back to be caught by the front end of the screw strip guide. As a result, the retracting and advancing movements of the feeder may be further inhibited.

[0010] Therefore, there has been a need for a technique that ensures smooth movement of a feeder that have a ratchet mechanism and reciprocally moves relative to a tool body of a screwdriver.

[0011] According to one aspect of the present invention, a guide member of a screwdriver includes a pair of guide portions opposing to each other for holding at least opposite edges with respect to a widthwise direction of a screw strip. A clearance is provided between the guide portions, so that the screw strip can be positioned to extend across the clearance and can move along the clearance as the position of an entrance opening of the feeder changes by the movement of the feeder in a retracting direction. Therefore, the length of the screw strip extending between the guide member and the entrance opening can be maintained irrespective of the position of the feeder along the moving axis.

[0012] Because the screw strip may not be folded or turned abruptly at the front end of the guide member as the feeder moves to retract relative to the feeder, it is possible to prevent or minimize accidental entangling of the sheet of the screw strip or accidental catching of the screws with respect to each other. As a result, the retracting movement of the feeder can be smoothly made without being interfered by the screw strip.

[0013] In addition, as the feeder advances relative to the feeder by the upward movement of the tool body, the screw strip gradually returns to be guided by the guide portions of the guide member, starting from the rear portion of the screw strip with respect to the feeding direction. When the feeder has moved to its advancing stroke end, the screw strip is brought to be guided by the guide member along the entire length of the guide member. Therefore, the guide function of the guide member can be fully performed during the feeding operation of the screw strip. As a result, it is possible to ensure the smooth movement of the screw strip.

[0014] In one embodiment, the screw feeding device

further includes a retracting side pushing member disposed on the feeder on a rear side of the entrance opening with respect to the retracting direction. The retracting side pushing member is operable to push in the retracting direction a part of the screw strip positioned between the entrance opening and the guide member in order to bring the screw strip to extend across the clearance between the guide portions and to move the screw strip along the clearance. Therefore, the screw strip can be reliably brought to extend across the clearance between the guide portions as the feeder retracts relative to the casing.

[0015] In another embodiment, the screw feeding device further includes an advancing side pushing member disposed on the feeder on a rear side of the entrance opening with respect to the advancing direction. The advancing side pushing member is operable to push in the advancing direction a part of the screw strip positioned between the entrance opening and the guide member in order to bring the screw strip to return from the position extending across the clearance to the position guided along the first guide path. With this arrangement, it is possible to reliably return the screw strip from the position extending across the clearance to the position guided along the first guide path.

[0016] The guide portions may include a holding wall and an engaging wall opposing to each other. The holding wall extends along the first guide path and the engaging wall extends substantially parallel to the screw driving direction.

[0017] According to another aspect of the present invention, a guide device used in combination with a fastener feeding device includes a first guide member that defines a first path for the fastener strip and has a first clearance on one side in a direction substantially perpendicular to the first guide path. The first guide member is configured such that the fastener strip can be positioned between a first position and a second position. In the first position, the fastener strip extends along the substantially entire first guide path. In the second position, a part of the fastener strip extends out of the first guide member across the first clearance while the remaining part of the fastener strip extends along the first path.

[0018] In one embodiment, the fastener strip has a first edge and a second edge opposing to each other in a widthwise direction and a plurality of cutouts formed in each of the first and second edges and spaced from each other by a predetermined distance. The cutouts of the first edge oppose to the respective cutouts of the second edge in the widthwise direction of the fastener strip. The first guide member has a first end and a second end along the first path and includes first walls that define the first clearance therebetween and oppose to each other in a first direction corresponding to the widthwise direction of the fastener strip. The first clearance is set to be smaller than the width of the fastener strip but is greater than a distance between the cutouts of the first edge and the cutouts of the second edge of the fastener strip, so that

parts of the engaging walls at the first end of the guide member can enter one of opposing pairs of cutouts of the fastener strip to allow the fastener strip to move along the first walls, while the one of the opposing pairs of cutouts engage the first walls.

[0019] The first guide member may further include a pair of second walls disposed on the side opposite to the pair of first walls. The second walls define a second clearance therebetween, through which the fasteners of the fastener strip can extend.

[0020] The guide device may further include a second guide member that defines a second guide path and is pivotally attached to the first guide member.

[0021] Additional objects, features, and advantages, of the present invention will be readily understood after reading the following detailed description together with the claims and the accompanying drawings, in which:

FIG. 1 is a vertical sectional view of a screwdriver incorporating a screw feeding device according to an embodiment of the present invention and showing the state where a tool body of the screwdriver is not pressed downward and a feeder is positioned at a lower stroke end;

FIG. 2 is a vertical sectional view similar to FIG. 1, but showing the state where the tool body has been pressed downward and the feeder is in the midway of the retracting movement;

FIG. 3 is a vertical sectional view similar to FIG. 1, but showing the state where the tool body has been moved to an upward stroke end and a screw strip extends across a clearance formed between guide portions of a stationary member of a guide device;

FIG. 4 is a perspective view of the guide device;

FIG. 5 is a cross sectional view taken along line (5)-(5) in FIG. 2 and showing by chain lines the screw strip removed from the clearance between the guide portions;

FIG. 6 is a cross sectional view taken along line (6)-(6) in FIG. 2 and showing the screw strip held between guide portions of a movable member of the guide device; and

FIG. 7 is a plan view of the screw strip.

[0022] Each of the additional features and teachings disclosed above and below may be utilized separately or in conjunction with other features and teachings to provide improved fastener feeding devices, such as screw feeding devices, and fastener driving tools having such improved fastener feeding devices. Representative examples of the present invention, which utilize many of these additional features and teachings both separately and in conjunction with one another, will now be described in detail with reference to the attached drawings. This detailed description is merely intended to teach a person of skill in the art further details for practicing preferred aspects of the present teachings and is not intended to limit the scope of the invention. Only the claims

define the scope of the claimed invention. Therefore, combinations of features and steps disclosed in the following detailed description may not be necessary to practice the invention in the broadest sense, and are instead taught merely to particularly describe representative examples of the invention. Moreover, various features of the representative examples and the dependent claims may be combined in ways that are not specifically enumerated in order to provide additional useful embodiments of the present teachings.

[0023] An embodiment of the present invention will now be described with reference to FIGS. 1 to 7. As shown in FIG. 1, a screwdriver 1 of this embodiment generally includes a tool body 2 and a screw feeding device 20 attached to a lower end as viewed in FIG. 1 of the tool body 2. The screw feeding device 20 is adapted to feed screws S carried by a band-like sheet T (see FIG. 7). In this specification, the band-like sheet T having the screws S carried thereon will be hereinafter called a "screw strip." This embodiment is characterized in the construction of the screw feeding device 20. Therefore, the tool body 2 will not be described in detail. For the purpose of explanation, a direction of driving screws will be referred to as a vertical direction, and thus, screws S shown in FIG. 2 are driven into a workpiece M in a direction vertically downward.

[0024] In brief, an electric motor 3 as a power source is disposed within the tool body 2. The rotational output of the electric motor 3 is transmitted to a first intermediate gear 5 via a drive gear 4. A second intermediate gear 6 rotates in unison with the first intermediate gear 5 and is in engagement with a driven gear 7. The driven gear 7 supports a spindle 8 such that the spindle 8 can move relative to the driven gear 7 along an axial direction and can rotate relative to the driven gear 7 about an axis. A teethed clutch 9 and a compression spring 10 for biasing the teethed clutch 9 in a disengaging direction are interleaved between a flange portion 8a of the spindle 8 and the driven gear 7. The spindle 8 is also axially movably and rotatably supported by a bearing 13 attached to a body housing 12 of the tool body 2.

[0025] A driver bit 16 having a relatively long length is attached to the lower end of the spindle 8 and extends along the same axis as the spindle 8. More specifically, the spindle 8 extends downward from the lower end of the tool body 2 by a large distance such that the lower end is positioned proximally to a box-shaped feeder 22 of the screw feeding device 20.

[0026] A handle 11 is disposed on the upper side of the tool body 2. A trigger or a switch lever 14 is disposed within the handle 11 and partly extends therefrom. A battery pack 16 as a power source is attached to the left end of the handle 11. Pulling or squeezing the switch lever 14 starts the electric motor 3 to drive the driven gear 7. In the state shown in FIG. 1, the clutch 9 is in a disengagement position, and therefore, the spindle 8 and the driver bit 15 may not rotate. In the state where one of the screws S (the leading screw) of the screw strip J is po-

sitioned such that the head of the screw S axially opposes to the driver bit 15, an operator presses the tool body 2 downward toward the workpiece M, so that the screw S is pressed against the workpiece M. Then, the spindle 8 moves upward relative to the tool body 2 against the biasing force of the compression spring 10, so that the clutch 9 is brought to an engaging position to transmit the rotation of the driven gear 7 to the spindle 8. As a result, the driver bit 15 rotates in one direction. The rotating driver bit 15 drives the screw S into the workpiece M as the operator further presses the tool body 2 downward against the workpiece M.

[0027] In addition to the feeder 22, the screw feeding device 20 includes a casing 21 and a guide device 30. The feeder 22 is vertically reciprocally movably supported by the casing 21. The guide device 30 serves to guide the screw strip J toward the feeder 22. The casing 21 is fixedly mounted to the lower end of the tool body 2 by attaching the upper end of the casing 21 to the bearing 13 by means of a clamp device. The casing 21 has a tubular configuration having a rectangular cross section. The feeder 22 has a rectangular cross sectional configuration and is vertically movably received within the casing 21. The lower end of the spindle 8 extends into the casing 21 and the driver bit 15 extends through the casing 21.

[0028] A compression spring 23 is interleaved between the upper end portion of the casing 21 and the feeder 22 in order to bias the feeder 22 downward (i.e. in the advancing direction) relative to the casing 21. This direction of the advancing movement of the feeder 22 coincides with the direction for driving the screws S into the workpiece M.

[0029] A frame-like stopper member 40 is mounted to the lower portion of the feeder 22 and the lower portion of the stopper member 40 is adapted to contact with the workpiece M. The position of the stopper member 40 relative to the feeder 22 can be adjusted in a stepwise manner according to the length of the screws S to be driven.

[0030] A screw feeding mechanism 50 is assembled within the feeder 22. The screw feeding mechanism 50 includes a drive wheel 51 and a feed wheel 52. The drive wheel 51 has engaging teeth formed along its outer circumference. The feed wheel 52 has a driven gear portion that is in engagement with the engaging teeth of the drive wheel 51. The drive wheel 51 and the feed wheel 52 are supported within the feeder 22 such that they can rotate about their respective rotational axes that are parallel to each other. An actuation arm 51a can pivot about the same axis as the rotational axis of the drive wheel 51. A guide roller 51b is attached to the tip end of the actuation arm 51a and is in engagement with a guide slot 21a formed in a side wall of the casing 21. The guide slot 21a is elongated vertically along the driver bit 15. The lower end portion of the guide slot 21a is bent to extend obliquely leftward as viewed in FIG. 1. The portion of the guide slot 21a that extends linearly along the axis of the driver bit

15 will be hereinafter called a linear portion 21b, and the portion of the guide slot 21 a extends obliquely from the lower end of the linear portion 21b will be hereinafter called an oblique portion 21c.

[0031] A ratchet mechanism or a one-way clutch (not shown) is provided between the actuation arm 51a and the drive wheel 51, so that the rotation is transmitted to the drive wheel 51 only in the feeding direction of the screw strip J.

[0032] As will be explained later, as the feeder 22 retracts upward relative to the casing 21, the guide roller 51b moves from the oblique portion 21c to the linear portion 21 b, so that the actuation arm 51a pivots by a predetermined angle in a counterclockwise direction as viewed in FIG. 1. This pivotal movement of the actuation arm 51a is transmitted to the drive wheel 51 via the ratchet mechanism, so that the drive wheel 51a rotates in the counterclockwise direction. Then, the feed wheel 52 rotates in a counterclockwise direction as viewed in FIG. 1 through gear engagement with the drive wheel 51. Therefore, as the feed box 22 reciprocates, the feed wheel 52 intermittently rotates in the counterclockwise direction.

[0033] A plurality of feed claws 52a are formed on the circumference of the feed wheel 52 and extend radially outwardly therefrom. The feed claws 52a are spaced equally from each other in the circumferential direction and are adapted to engage cutouts t formed in the screw strip J as will be described later, so that the screw strip J is fed in the feeding direction (right direction in FIG 1) by a distance corresponding to one pitch between two adjacent screws S carried on the screw strip J. Therefore, as the feeder 22 retracts upward relative to the casing 21 by the pressing operation of the tool body 2 performed by the operator, the leading screw S in the screw strip J is positioned directly below the driver bit 15.

[0034] Referring to FIG. 7, the band-like sheet T of the screw strip J has an appropriate resiliency or flexibility. The screws S are retained by the sheet T such that the screws S are spaced equally from each other along the length of the sheet T. The cutouts t are formed on opposite sides of the sheet T and are spaced equally from each other by a distance corresponding one pitch of the screws S. In this embodiment, the sheet T has a width WO, and two cutouts t opposing to each other in the widthwise direction of the sheet T are spaced from each other by a distance Wt.

[0035] In order to drive the screws S, the tool body 2 is positioned such that the stopper member 40 abuts to the workpiece M. Then, the operator presses the tool body 2 downward in the screw driving direction. As the tool body 2 moves downward, the leading screw S carried on the screw strip J is fed to be positioned directly below the driver bit 15, and the driver bit 15 moves downward to contact and engage the head of the screw S and to subsequently forcibly remove the screw S from the screw strip J, so that the screw S is pressed against the workpiece M. Then, the operator starts the electric motor 3 for rotatably driving the driver bit 15, so that the screw

S is driven into the workpiece M. FIG. 2 shows the leading screw S that is being driven into the workpiece M.

[0036] FIG. 3 shows the state where the leading screw S has been completely driven into the workpiece M. In this state, the feeder 22 has been moved to the retracting end (upper stroke end) relative to the casing 21. This retracting end is restricted by a stopper 27 attached to the casing 21. Thus, as the feeder 22 moves upward, the feeder 22 abuts to the stopper 27 and cannot move further upward. The stopper 27 can be adjusted to change the retracting end or the stroke of the feeder 22 in response to the length of the screws S to be driven. In addition, in the state shown in FIG 3, the guide roller 51 b is positioned proximally to the upper end of the linear portion 21 b of the guide slot 21a.

[0037] When the operator releases the pressing force applied to the tool body 2 after the tool body 2 has been pressed downward to complete the driving operation, the tool body 2 is forced to move upward relative to the feeder 22 by the biasing force of the compression spring 23 that biases the feeder 22 downward toward the advancing direction relative to the feeder 22. Therefore, the guide roller 51 b moves downward along the linear portion 21b of the guide slots 21a and further moves into the oblique portion 21c to return to its original position. As the guide roller 51b returns to the oblique portion 21c, the actuation arm 51a pivots in the counterclockwise direction as viewed in FIG. 1. However, due to the ratchet mechanism or one-way clutch, this pivotal movement of the actuation arm 51a may not be transmitted to the drive wheel 51. In addition, the drive wheel 51 is prevented from rotating in the counterclockwise direction by a detent pawl 53. Therefore, although the feeder 22 returns to its advancing stroke end and the actuation arm 51a pivots in the counterclockwise direction, the drive wheel 51 does not rotate in the counterclockwise direction, and therefore, the feeding wheel 52 does not rotate in the clockwise direction or the direction opposite to the feeding direction.

[0038] In this way, the screw feeding mechanism 50 serves to feed the screw strip J by a distance corresponding to one pitch of the screws S in response to the driving operation of the leading screw S (i.e., the downwardly pressing operation of the tool body 2).

[0039] A support 22a is disposed at the lower portion of the feeder 22 and serves to support opposite side edges of the sheet T of the screw strip J from their lower side. The screw strip J enters the feeder 22 via an entrance opening 22b formed in a side wall of the feeder 22 and then passes between the support 22a and the feed wheel 52.

[0040] With the aid of the guide device 30, the screw strip J is guided to a position proximally to the entrance opening 22b of the feeder 22 while the screw strip J is held to extend substantially horizontally. In this embodiment, the guide device 30 has a stationary member 31 and a movable member 33. The stationary member 31 is fixedly mounted to the tool body 2. The movable member 33 is pivotally supported by the stationary member

31 via a support shaft 32. Therefore, the movable member 33 can be folded on the stationary member 31 by pivoting the movable member 33 about the support shaft 32. The guide device 30 is best shown in FIG. 4 in which the movable member 33 is unfolded and positioned at an operative position. The stationary member 31 is configured to guide the screw strip J at a position on the front side of the movable member 33 with respect to the feeding direction, while the movable member 33 is configured to guide the screw strip J at a position on the rear side of the stationary member 31.

[0041] The stationary member 31 has a pair of holding portions 31a for guiding the screw strip J. Similarly, the movable member 33 has a pair of holding portions 33a. The pair of holding portions 31a and the pair of holding portions 33a respectively serve to hold the opposite side edges of the sheet T of the screw strip J. The two holding portions 31a oppose to each other and each has a substantially U-shaped configuration in cross section to define a substantially arc-shaped first path between the holding portions 31a. Similarly, the two holding portions 33a oppose to each other and each has a substantially U-shaped configuration in cross section to define a substantially arc-shaped second path between the holding portions 33a. When the movable member 33 is in the operative position, the first path defined by the holding portions 31a and the second path defined by the holding portions 33a are smoothly connected to each other to jointly define a substantially arc-shaped guide path. Therefore, when the screw strip J is set onto the guide device 30 such that the sheet T of the screw strip J is held between the holding portions 31a and between the holding portions 33a as shown in FIG 2, the sheet T of the screw strip J extends along a substantially semi-circular arc and the screws S carried on the sheet T are positioned to extend substantially in a radial direction with respect to a center of the semi-circular arc.

[0042] As shown in FIG. 5, each of the holding portions 31a of the stationary member 31 has a holding wall 31b on the side of the shanks of the screws S carried on the screw strip J (left side as viewed in FIG 5 or the radially inner side) and an engaging wall 31c on the side of the heads of the screws S (right side as viewed in FIG. 5 or the radially outer side). A clearance 31d between the holding walls 31b of the two holding portions 31a is set to allow the passage of the shanks of the screws S but to be smaller than the widthwise distance W_t between the opposing cutouts t of the sheet T of the screw strip J.

[0043] On the other hand, a clearance 31e between the engaging walls 31c of the two holding portions 31a is set to be smaller than the width W_O of the sheet T but larger than the widthwise distance W_t between the opposing cutouts t. In other words, the thickness of each engaging walls 31c along a radial direction of the arc of the first guide path (i.e., the thickness along the vertical direction as viewed in FIG 5) is set to be smaller than the size of the cutouts t along the widthwise direction of the sheet T. With this setting, it is possible to position the

screw strip J such that the screw strip J extends from the first guide path defined between the holding portions 31a via the clearance 31e. This can be made by positioning the cutouts t on opposite sides of the screw strip J such that the engaging walls 31c enter the cutouts t on the corresponding sides. Hence, it is possible to position the screw strip J such that the screw strip J extends from the stationary member 31 toward the side of the casing 21 via the clearance 31e as shown in FIG 3. With the screw strip J positioned to extend across the clearance 31e in this way, the screw strip J can change the position along the reciprocating direction of the feeder 22 as indicated by an outline arrow in FIG. 7, while the engaging walls 31 c in engagement with the opposing cutouts t serve as guide rails along which the screw strip J moves.

[0044] The engaging walls 31c respectively have end portions 34 on the front side in the feeding direction of the screw strip J. As will be described later, as the feeder 22 retracts or moves upward relative to the casing 21, a portion of the screw strip J moves upward together with the feeder 22, so that the end portions 34 of the engaging walls 31c enter the opposing cutouts t of the screw strip J, which are the closest to the end portions 34. On the other hand, as the feeder 22 advances or moves downward, a portion of the screw strip J moves downward together with the feeder 22, so that the opposing cutouts t of the screw strip J, which have entered the engaging walls 31 c, are removed from the engaging walls 31c at the end portions 34 of the engaging walls 31c.

[0045] As shown in FIGS. 1 to 3, in this embodiment, the engaging walls 31c extend substantially vertically and in parallel to the reciprocating direction of the feeder 22. On the other hand, each of the holding walls 31 b extends along an arc. Therefore, the distance between the engaging walls 31c and the holding walls 31b increases in a direction opposite to the feeding direction (upward as viewed in FIGS. 1 to 3), so that a flexure absorbing region 31f is defined within the upper portion of the stationary member 31. Within the flexure absorbing region 31f, the screw strip J can be flexed, so that potential loosening of the screw strip J can be absorbed.

[0046] Although the guide portions 33a also have the U-shaped cross section, the walls of the guide portions 33a on the side of the heads of the screws S closely contact with each other to define a bottom wall 33c. Therefore, the movable member 33 is closed on the side of the heads of the screws S by the bottom wall 33c. On the other hand, similar to the holding walls 31b of the stationary member 31, holding walls 33b on the side of the shanks of the screws S are spaced from each other by a clearance 33d that is sized to allow passage of the shanks of the screws S and to be smaller than the width W_O of the sheet T.

[0047] Next, as shown in FIGS. 1 to 3, the feeder 22 has a retracting side pushing member 25 and an advancing side pushing members 26 for pressing the screw stick J toward the retracting direction and the advancing direction, respectively. The retracting side pushing mem-

ber 25 is disposed on the rear side of the entrance opening 22b for the screw strip J with respect to the retracting direction, i.e., the lower side as viewed in FIGS. 1 to 3, and protrudes laterally from the feeder 22. The advancing side pushing member 26 is disposed on the rear side of the entrance opening 22b with respect to the advancing direction, i.e., the upper side as viewed in FIGS. 1 to 3 and protrudes laterally from the feeder 22 on the same lateral side as the retracting side pushing member 25. The configurations and the protruding distances of the retracting side and advancing side pushing members 25 and 26 are determined such that the retracting side and advancing side pushing members 25 and 26 do not interfere with the engaging walls 31c of the stationary member 31 during the reciprocating movement of the feeder 22.

[0048] The screw strip J enters the entrance opening 22b after passing through a space defined between the retracting side and advancing side pushing members 25 and 26. Therefore, during the driving operation, the retracting side pushing member 25 is positioned on the side of the shanks of the screws S and the advancing side pushing member 26 is positioned on the side of the heads of the screws S.

[0049] The retracting side pushing member 25 has a pair of parallel pressing plates 25a spaced from each other by a clearance in order to allow the passage of the screws S of the screw strip J. The clearance between the pressing plates 25a is determined to be smaller than the width WO of the sheet T. Therefore, the screw strip J is guided into the entrance opening 22b, while the screws S extend downward through the clearance between the pressing plates 25a and the sheet T straddles over and between the upper edges of the pressing plates 25a. Thus, the opposite sides with respect to the widthwise direction of the screw strip J can slidably contact the upper edges of the pressing plates 25a as the screw strip J moves in the feeding direction.

[0050] As will be explained later, as the feeder 22 retracts upward, the retracting side pushing member 25 pushes a portion of the screw strip J, which opposes to the pressing plates 25a, in the retracting direction (upward as viewed in FIGS. 1 to 3). Therefore, the end portions 34 of the engaging walls 31c of the stationary member 31 enter the closest opposite cutouts t of the sheet T as described above, so that the screw strip J extends across the clearance 31e and can move in the retracting direction. Thus, the engaging walls 31c serve as guide rails for the screw strip J for the movement of the screw strip J along the clearance 31c between the engaging walls 31c of the stationary member 31.

[0051] The advancing side pushing member 26 has a pair of pressing plates 26a that can slidably contact the opposite sides with respect to the widthwise direction of the screw strip J from the side opposite to the pressing plates 25a of the retracting side pushing member 25. A recess (not shown) is defined between the pressing plates 26a in order to allow the passage of the heads of

the screws S of the screw strip J. Therefore, as the feeder 22 advances, the advancing side pushing member 26a pushes a part of the screw strip J, which opposes to the pressing plates 26a, in the advancing direction (downward as viewed in FIGS. 1 to 3). Therefore, the screw strip J that has brought to extend across the clearance 31e by the pushing operation of the retracting side pushing member 25 can return to the original state, where the screw strip J extends along the entire length (i.e., the entire first path) of the guide portions 31a along the feeding direction.

[0052] The operation of the screwdriver 1 incorporating the screw feeding device 20 described above will now be described. In order to drive the screws S, the operator positions the tool body 2 of the screwdriver 1 such that the stopper member 40 abuts to the workpiece M. Then, the operator presses the tool body 2 against the workpiece M, so that the feeder 22 retracts or moves upward relative to and within the casing 21. As the feeder 22 retracts, the screw strip J is fed by a distance corresponding to one pitch of the screws S by the screw feeding mechanism 50 of the screw feeding device 20, so that the leading screw S is positioned directly below the driver bit 15. As the feeder 22 further retracts by the pressing operation of the tool body 2, the driver bit 15 contacts and engages the leading screw S to remove the leading screw S from the screw strip J and to press it against the workpiece M. Thereafter, the operator starts the motor 3 to rotate the driver bit 15, so that the screw S is driven into the workpiece M. After the screw S has been completely driven into the workpiece M, the operator releases the pressing force applied to the tool body 2, so that the feeder 22 advances relative to and within the casing 21 by the biasing force of the compression spring 23. As a result, the tool body 2 moves upward.

[0053] As the feeder 22 retracts into the casing 21, the retracting side pushing member 25 that is fixedly attached to the feeder 22 pushes a part of the screw strip J upward, so that the end portions 34 of the engaging walls 31c enter the opposing cutouts t of the screw strip J, which are the closest to the end portions 34, and the screw strip J extends across the clearance 31e. Therefore, the screw strip J can extend from the movable member 33 of the guide device 30 to the entrance opening 22b of the feeder 22 along substantially the shortest route.

[0054] As the screw strip J further moves upward, a portion of the screw strip J on the rear side of the clearance 31e with respect to the feeding direction may be loosened or flexed in a direction opposite to the feeding direction as indicated by an outline arrow in FIG. 3. However, such loosening can be absorbed by the flexure absorbing region 31f.

[0055] Therefore, the screw strip J may not be folded upward at the end portions 34 of the engaging walls 31c but may extend across the clearance 31e to move into the entrance opening 22b along a substantially shortest route during the retracting movement of the feeder 22.

For this reason, the length and the number of the screws S of a portion of the screw strip J extending between the movable member 33 and the feeder 22 can be kept to be constant during the retracting movement of the feeder 22. As a result, it is possible to prevent or minimize accidental entangling of the sheet T or accidental catching of the screws S by each other. Hence, it is possible to ensure the smooth movement of the feeder 22.

[0056] On the other hand, as the feeder 22 moves upward after completion of the driving operation, the advancing side pushing member 26 presses downward a part of the screw strip J that extends across the clearance 31e. Therefore, the engaging positions of cutouts t of the screw strip J with the engaging walls 31c move downward along the engaging walls 31c. Immediately before the feeder 22 reaches the advancing stroke end, the cutouts t reach the front ends 34 of the engaging walls 31c so as to be disengaged from the engaging walls 31c. Therefore, the screw strip J returns to the state where the screw strip J is guided along the entire length of the first path defined by the guide portions 31 a of the stationary member 31.

[0057] In this way, before the screw strip J is fed by the distance of one pitch of the screws S by the screw feeding mechanism 50, the screw strip J returns to the state where the screw strip J is guided along the entire length of the first path defined by the guide portions 31a. Therefore, during the feeding operation of the screw strip J performed by moving the feeder 22 into the casing 21, the guide device 30 can reliably sufficiently perform its guide function for guiding the screw strip J.

[0058] The construction of the above embodiment can be advantageously incorporated in particular in the case that the length of the screws S is long, because the stroke required for the feeder 22 increases as the length of the screws S increases.

[0059] The above embodiment may be modified in various ways. For example, the retracting side pushing member 25 and/or the advancing side pushing member 26 may be omitted. In the case that both the retracting side pushing member 25 and the advancing side pushing member 26 are omitted, a feeder of the existing screwdriver can be used as the feeder 22. In addition, the movable member 33 of the guide device 30 may be omitted. In such a case, the present invention may be applied to an existing screwdriver having a guide device by providing a clearance corresponding to the clearance 31e to the guide device.

[0060] Although the present invention has been described in connection with a screwdriver for driving screws, the present invention also may be applied to any other power tools for driving fasteners other than screws, which are fed in forms of fastener strips having band-like carriers and fasteners carried thereon. For example, the present invention may be applied to power tools for driving nails and rivets.

It is explicitly stated that all features disclosed in the description and/or the claims are intended to be disclosed

separately and independently from each other for the purpose of original disclosure as well as for the purpose of restricting the claimed invention independent of the compositions of the features in the embodiments and/or the claims. It is explicitly stated that all value ranges or indications of groups of entities disclose every possible intermediate value or intermediate entity for the purpose of original disclosure as well as for the purpose of restricting the claimed invention, in particular as limits of value ranges.

Claims

1. A screw feeding device (20) for a screwdriver (1), the screw feeding device (29) being operable to feed a screw strip (J) having a band-like sheet (T) and a plurality of screws (S) carried on the sheet (T) in response to a driving operation of the screws (S), so that the screws (S) are positioned one after another to a position opposing to a driver bit (15) to be attached to a spindle (8) of a tool body (2) of the screwdriver (1), the screw feeding device (20) comprising:

a casing (21) attached to the tool body (2), wherein the driver bit (15), when attached, extends through the casing (21);

a feeder (22) supported by the casing (21) and movable relative to the casing (21) in a retracting direction and an advancing direction opposite to the retracting direction along an axis in a screw driving direction;

wherein the feeder (22) includes a ratchet mechanism having a ratchet wheel (52), the ratchet wheel (52) intermittently rotating in response to the movement of the feeder (22), so that the screw strip (J) can intermittently move by a distance corresponding to one pitch between two adjacent screws (S) of the screw strip (J); and a guide device (30) comprising a first guide member (31) supported by the tool body (2) and defining a first guide path for the movement of the screw strip (J) into an entrance opening (22b) formed in the feeder (22);

wherein the first guide member (31) includes a pair of guide portions (31a) opposing to each other for holding therebetween at least opposite edges with respect to a widthwise direction of the screw strip (J); and

wherein a clearance (31e) is provided between the guide portions (31a), so that the screw strip (J) can be positioned to extend across the clearance (31e) and can move along the clearance (31e) as the position of the entrance opening (22b) changes by the movement of the feeder (22) in the retracting direction.

2. The screw feeding device (20) as in claim 1, further

comprising a retracting side pushing member (25) disposed on the feeder (22) on a rear side of the entrance opening (22b) with respect to the retracting direction, wherein the retracting side pushing member (25) is operable to push in the retracting direction a part of the screw strip (J) positioned between the entrance opening (22b) and the first guide member (31) in order to bring the screw strip (J) to extend across the clearance (31e) between the guide portions (31a) and to move the screw strip (J) along the clearance (31e).

3. The screw feeding device (20) as in claim 1 or 2, further comprising an advancing side pushing member (26) disposed on the feeder (22) on a rear side of the entrance opening (22b) with respect to the advancing direction, wherein the advancing side pushing member (26) is operable to push in the advancing direction a part of the screw strip (J) positioned between the entrance opening (22b) and the first guide member (31) in order to bring the screw strip (J) to return from the position extending across the clearance (31e) to the position guided along the first guide path.
4. The screw feeding device (20) as in any one of claims 1 to 3, wherein each of the guide portions (31a) includes a holding wall (31b) and an engaging wall (31c) opposing to each other, and the holding wall (31b) extends along the first guide path and the engaging wall (31c) extends substantially parallel to the screw driving direction.
5. The screw feeding device (20) as in any one of the preceding claims, wherein the guide device (30) further comprises a second guide member (33), and the second guide member (33) defines a second guide path and is pivotally attached to the first guide member (31).
6. A screwdriver (1) comprising the screw feeding device (20) as in any one of the preceding claims.
7. A guide device (30) used in combination with a fastener feeding device (20), the fastener feeding device (20) being operable to feed a fastener strip (J) carrying a plurality of fasteners (S) arranged in a lengthwise direction of the fastener strip (J), the guide device (30) comprising:

a first guide member (31) defining a first guide path for the fastener strip (J) and having a first clearance (31e) on one side in a direction substantially perpendicular to the first guide path; wherein the first guide member (31) is configured such that the fastener strip (J) can be positioned between a first position where the fastener strip (J) extends along the substantially

entire first guide path and a second position where a part of the fastener strip (J) extends out of the first guide member (31) across the first clearance (31e) while the remaining part of the fastener strip (J) extends along the first guide path.

8. The guide device (30) as in claim 7, wherein:

the fastener strip (J) has a first edge and a second edge opposing to each other in a widthwise direction and a plurality of cutouts (t) formed in each of the first and second edges and spaced from each other by a predetermined distance, the cutouts (t) of the first edge opposing to the respective cutouts (t) of the second edge in the widthwise direction, the first guide member (31) has a first end (34) and a second end along the first guide path; the first guide member (31) includes a pair of first walls (31c) defining the first clearance (31e) therebetween and opposing to each other in a first direction corresponding to the widthwise direction of the fastener strip (J); and the first clearance (31e) is set to be smaller than the width of the fastener strip (J) but is greater than a distance between the cutouts (t) of the first edge and the cutouts (t) of the second edge of the fastener strip (J), so that parts of the first walls (31c) at the first end (34) of the first guide member (31) can enter one of opposing pairs of cutouts (t) of the fastener strip (J) to allow the fastener strip (J) to move along the first walls (31c), while the one of the opposing pairs of cutouts (t) engage the first walls (31c).

9. The guide device (30) as in claim 8, wherein the first guide member (31) further includes a pair of second walls (31b) disposed on the side opposite to the pair of first walls (31c), and the second walls (31b) define a second clearance (31d) therebetween, through which the fasteners (S) of the fastener strip (J) can extend.

10. The guide device (30) as in any one of claims 7 to 9, wherein the guide device (30) further comprises a second guide member (33), and the second guide member (33) defines a second guide path and pivotally attached to the first guide member (31).

11. A fastener driving tool (1) comprising the guide device (30) as in any one of claims 7 to 10.

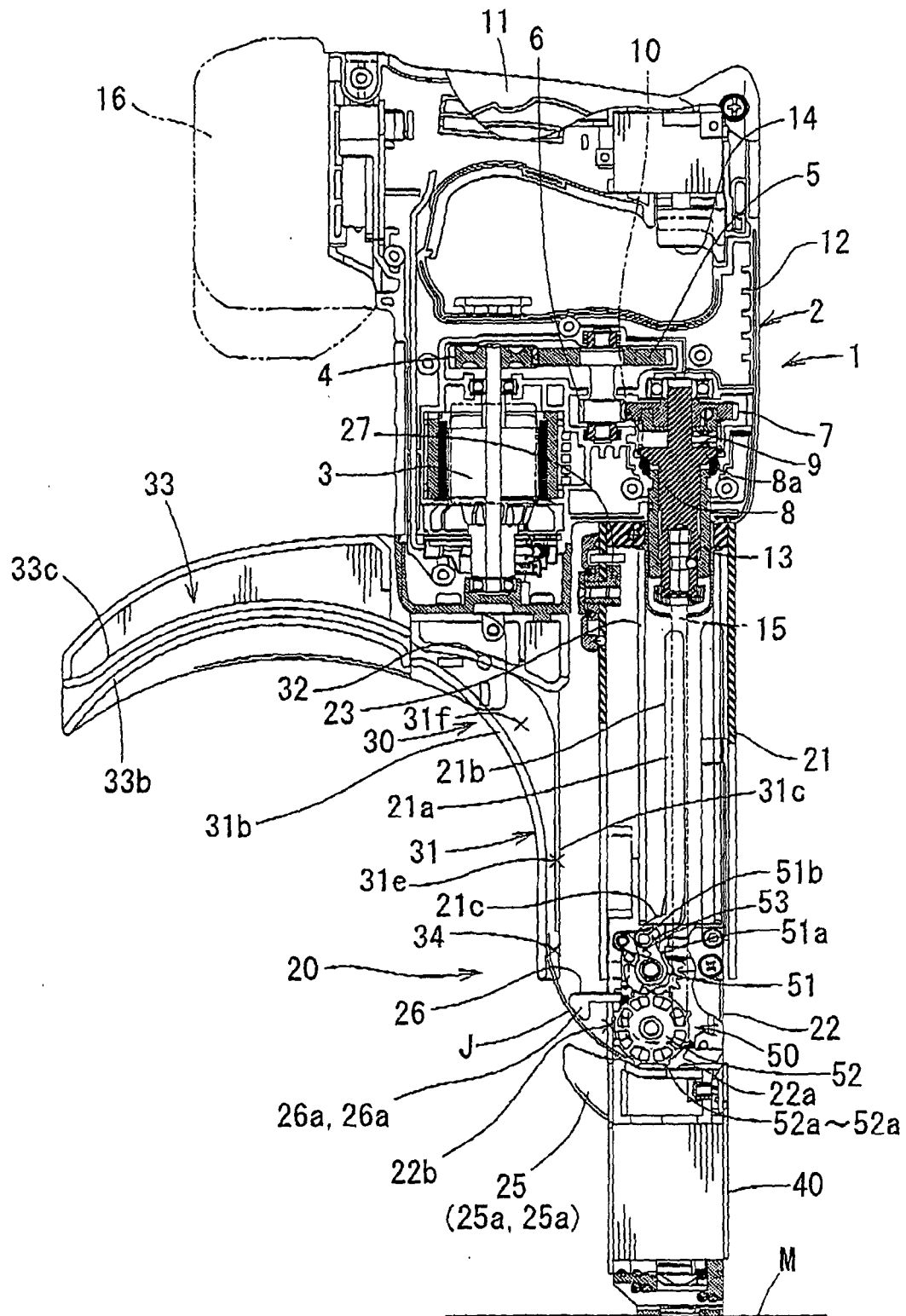


FIG. 1

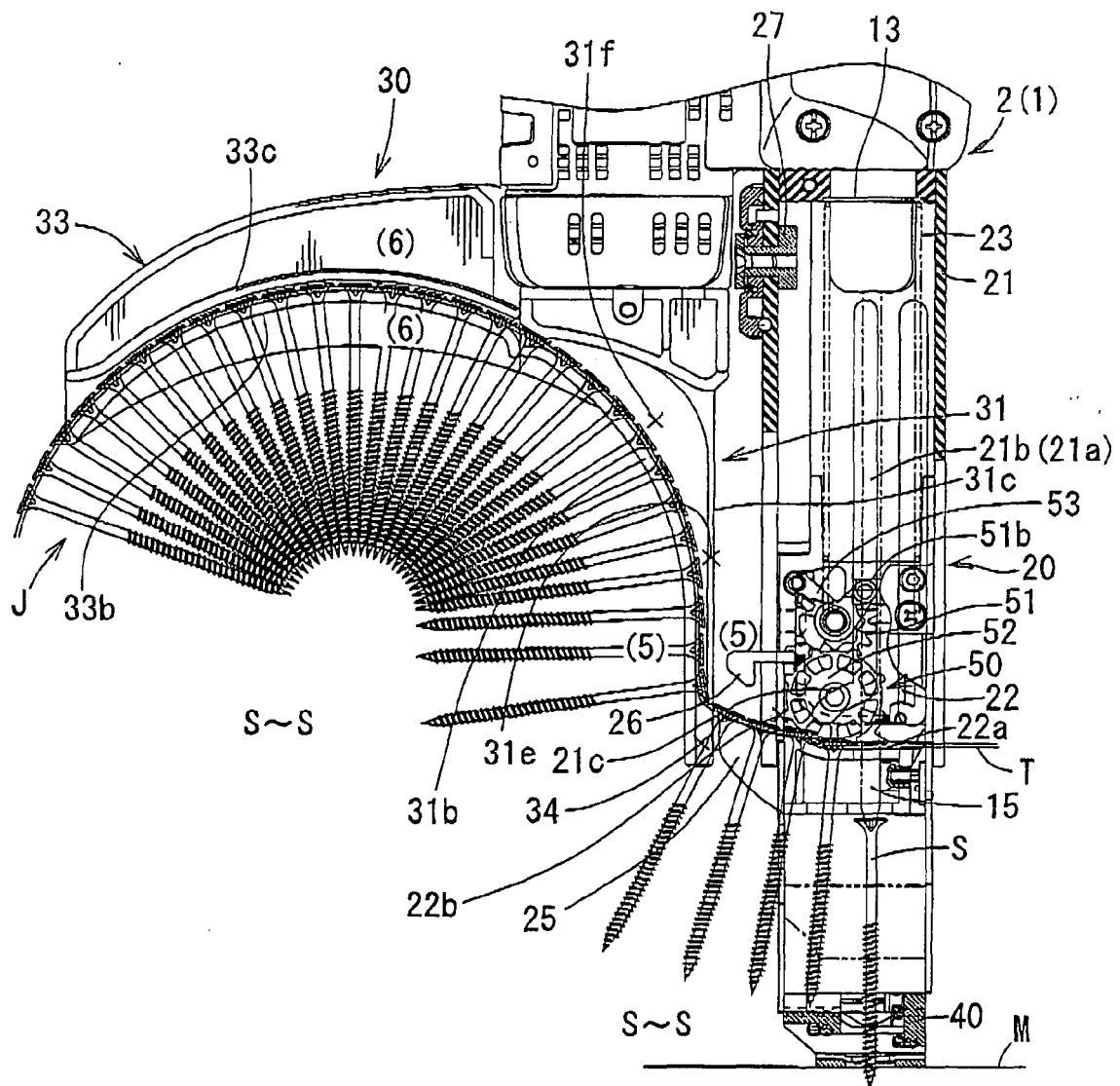


FIG. 2

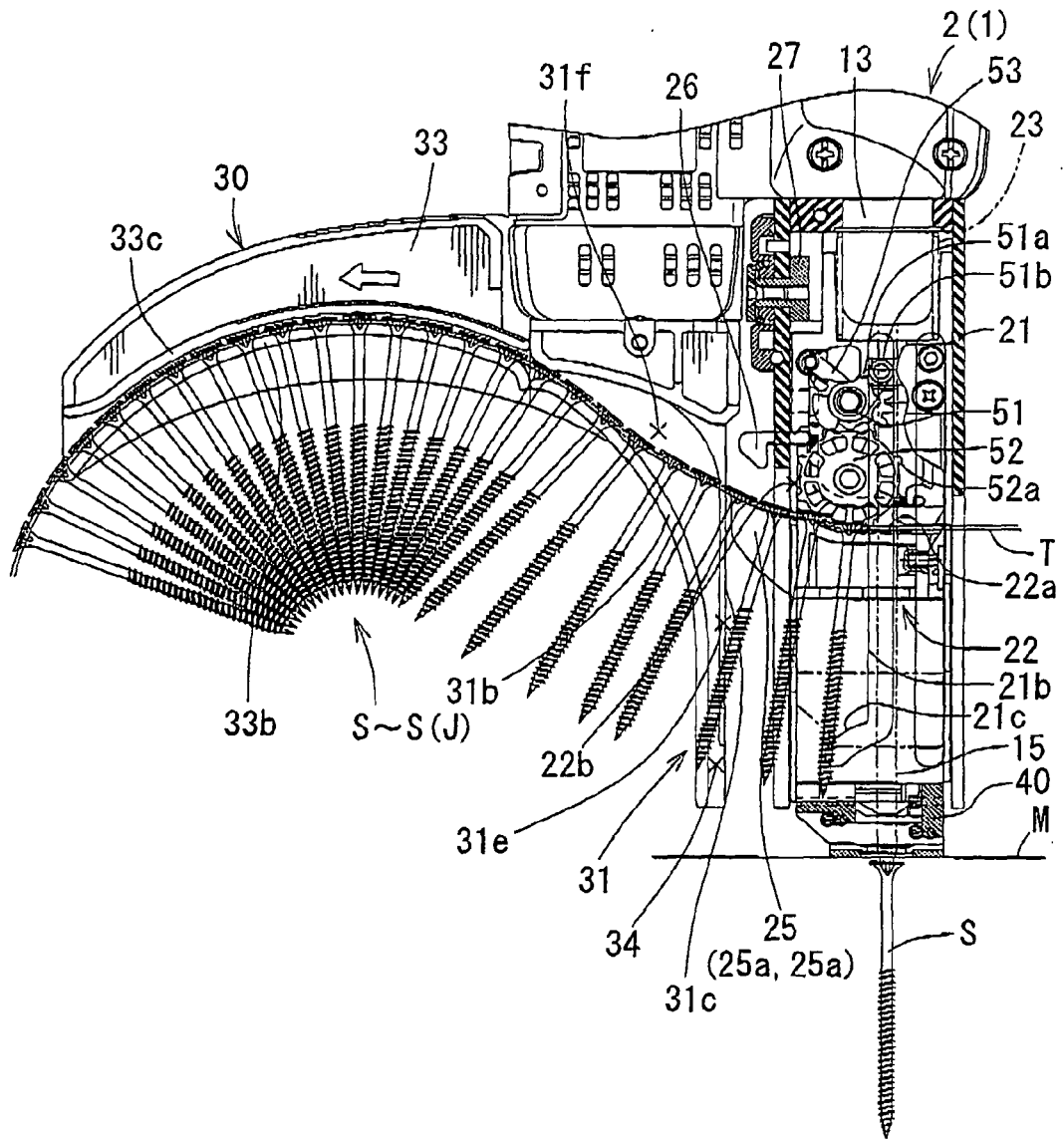


FIG. 3

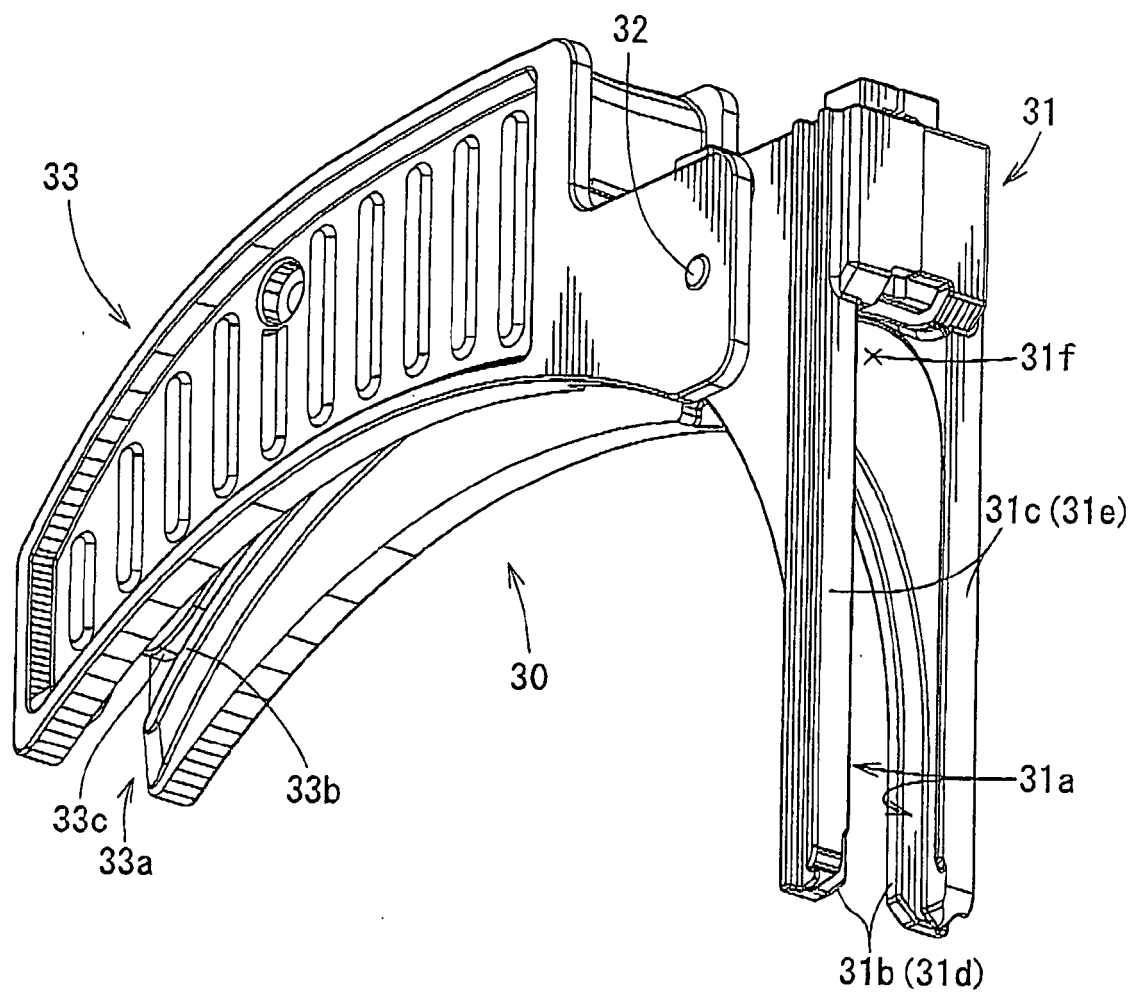


FIG. 4

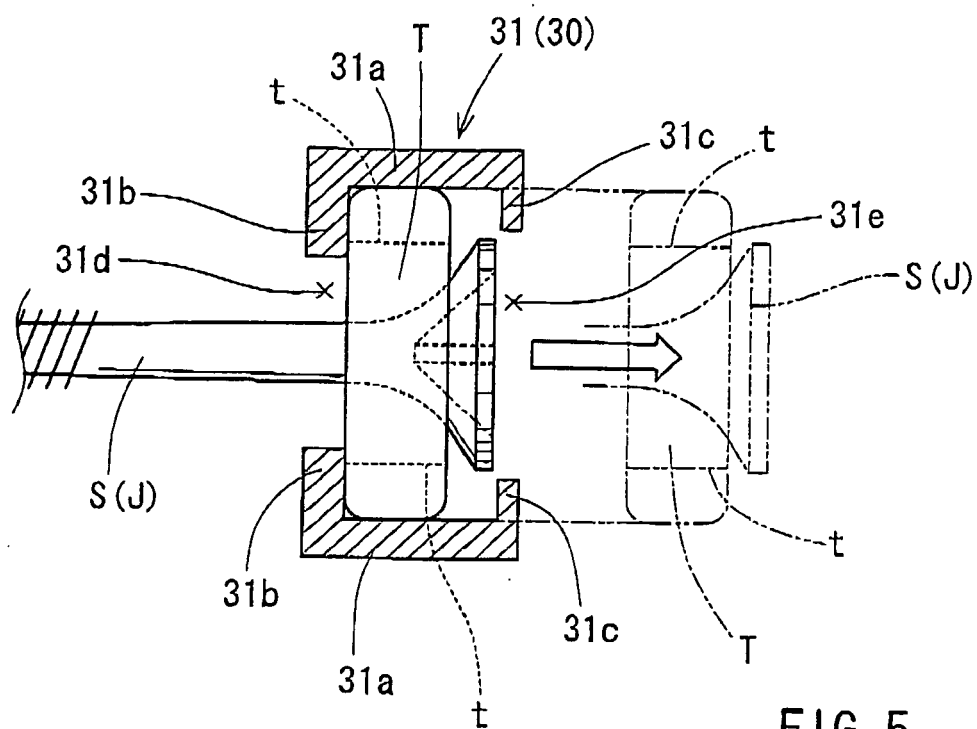


FIG. 5

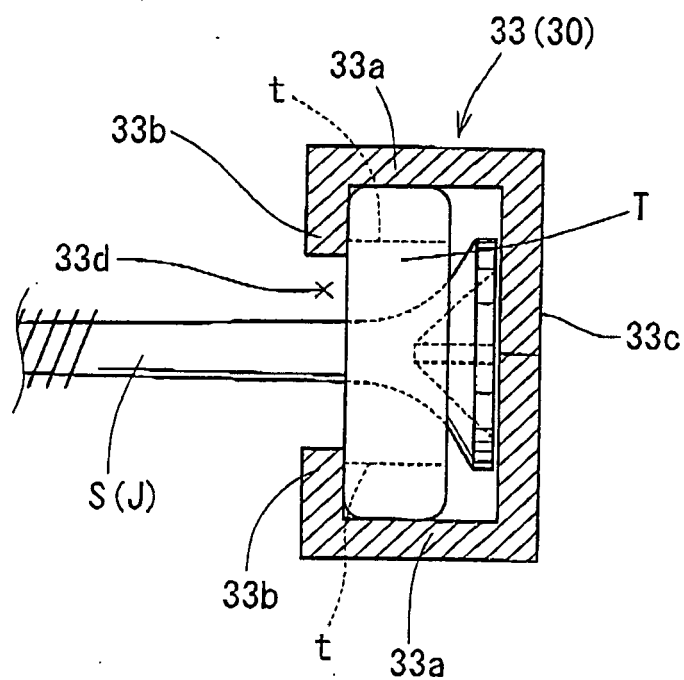


FIG. 6

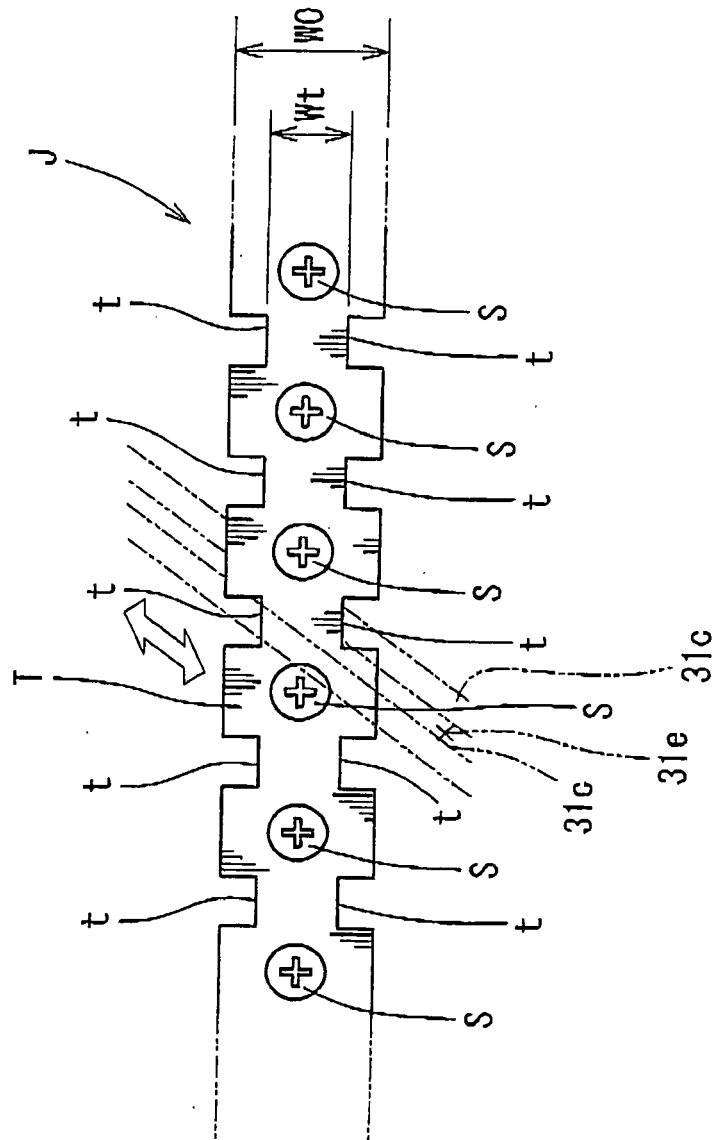


FIG. 7



European Patent
Office

EUROPEAN SEARCH REPORT

Application Number
EP 07 02 5132

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
D,A	US 7 032 482 B1 (HOFFMAN WILLIAM H [US]) 25 April 2006 (2006-04-25) * column 5, line 52 - column 6, line 12; figures 2,3,7,8 *	1,6,7,11	INV. B25B23/04
A	DE 199 11 706 A1 (HITACHI KOKI KK [JP]) 23 September 1999 (1999-09-23) * figures 3-5,11a,12a *	1,6,7,11	
A	EP 1 293 299 A (LIN CHAO-WEI [TW]) 19 March 2003 (2003-03-19) * figure 5 *	1,6,7,11	
A	EP 0 732 177 A (MAX CO LTD [JP]) 18 September 1996 (1996-09-18) * abstract; claims; figures 1,2 *	1,6,7,11	
A	DE 41 19 925 A1 (MAX CO LTD [JP]) 16 January 1992 (1992-01-16) * column 5, line 9 - line 52; figures 1,2,5,6,8 *	1,6,7,11	
A	DE 203 09 492 U1 (TECHWAY IND CO LTD [TW]) 2 October 2003 (2003-10-02) * figures 1,3 *	1,6,7,11	B25B
The present search report has been drawn up for all claims			
Place of search The Hague		Date of completion of the search 25 March 2008	Examiner Majerus, Hubert
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			

3
EPO FORM 1503 03.82 (P04C01)

**ANNEX TO THE EUROPEAN SEARCH REPORT
ON EUROPEAN PATENT APPLICATION NO.**

EP 07 02 5132

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.
The members are as contained in the European Patent Office EDP file on
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

25-03-2008

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 7032482	B1	25-04-2006	NONE
DE 19911706	A1	23-09-1999	TW 412465 B 21-11-2000 US 6062113 A 16-05-2000
EP 1293299	A	19-03-2003	CN 2497935 Y 03-07-2002
EP 0732177	A	18-09-1996	DE 69600646 D1 22-10-1998 DE 69600646 T2 12-05-1999 JP 2904336 B2 14-06-1999 JP 8252777 A 01-10-1996 US 5664468 A 09-09-1997
DE 4119925	A1	16-01-1992	CA 2044088 A1 19-12-1991 US 5167174 A 01-12-1992
DE 20309492	U1	02-10-2003	NONE

REFERENCES CITED IN THE DESCRIPTION

This list of references cited by the applicant is for the reader's convenience only. It does not form part of the European patent document. Even though great care has been taken in compiling the references, errors or omissions cannot be excluded and the EPO disclaims all liability in this regard.

Patent documents cited in the description

- JP 2006355108 A [0001]
- US 7032482 B [0007]