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(71) Applicant *(for all designated States except US)*: **WILSON TOOL INTERNATIONAL, INC.** [US/US]; 12912 Farnham Avenue, White Bear Lake, MN 55110 (US).

(72) Inventors; and

(75) Inventors/Applicants *(for US only)*: **PABICH, Terry, G.** [US/US]; 1081 100th Avenue, Roberts, WI 54023 (US). **DUPPONG, Thomas, Steven** [US/US]; 93 Midwest Avenue North, Lake Elmo, MN 55042 (US). **MOREHEAD, John** [US/US]; 4166 Parkrdige Drive, White Bear Lake, MN 55110 (US). **ROGERS, Bryan** [US/US]; 22452 Elston Avenue, Forest Lake, MN 55025 (US).

(74) Agents: **SNUSTAD, Eric, J.** et al.; FREDRIKSON & BYRON, P.A., 200 South Sixth Street, Suite 4000, Minneapolis, MN 55402-1425 (US).

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(54) Title: PRESS BRAKE TOOL INCORPORATING SEATING AND/OR LOCATING MECHANISM

(57) Abstract: Press brake tools suitable for punching and/or otherwise deforming workpieces, such as sheet metal. Provided in some embodiments are a press brake tool and a press brake tool holder, in combination. Methods of using press brake tools are also provided. In certain embodiments, the tool has a mechanism for locating and/or seating, such as a tool-seating mechanism adapted for moving the tool parallel to a pressing axis of a tool holder on which the tool is to be used.

PRESS BRAKE TOOL INCORPORATING SEATING AND/OR LOCATING MECHANISM

Field of Invention

The present invention relates generally to industrial presses. More particularly, this invention relates to press brakes and press brake tooling.

Background of Invention

Press brakes are commonly used to bend or otherwise deform sheet-like workpieces, such as sheet metal workpieces. A conventional press brake has an upper beam and a lower beam, at least one of which is movable toward and away from the other. Typically, the upper beam is movable vertically while the lower beam is fixed in a stationary position. It is common for a male forming punch and a female forming die to be mounted respectively on the upper and lower beams of a press brake.

Typically, the punch has a downwardly oriented, workpiece-deforming surface (or "tip"). The configuration of this surface is dictated by the shape into which it is desired to deform a workpiece. The die typically has a recess, bounded by one or more workpiece-deforming surfaces, that is aligned with the tip of the punch. The configuration of this recess corresponds to the configuration of the punch's tip. Thus, when the beams are brought together, a workpiece between them is pressed by the punch into the die to give the workpiece a desired deformation (e.g., a desired bend).

In order to accurately deform a workpiece, it is necessary for the tools to be mounted securely on the tool holder. This is accomplished by forcibly clamping the holder about each tool. Multiple steps are sometimes required, for example, to mount a punch on the upper beam of a press brake. The punch may be moved into an initial-mount position by lifting the shank of the punch upwardly between a support plate and clamp of the tool holder. In some cases, when the punch is moved into this position, a safety key of the punch engages a safety slot of the tool holder. In other cases, a safety groove on the punch is engaged by a lip on the clamp of the tool holder. Either way, the tool holder is subsequently clamped forcibly on the shank of the punch. Even at this point, the load-bearing surfaces of the tool holder and punch may not be securely engaged. Rather, additional steps may be required. For example, with many tool holder designs, the upper and lower tables of the press brake must subsequently be moved together until the punch comes into contact with a die on the lower table. By forcing the tip of the punch against

the die, the punch can be urged upwardly relative to the tool holder until the load-bearing surface(s) of the tool is/are moved into contact with the corresponding load-bearing surface(s) of the tool holder. When a punch is in this operative position, the load-bearing surfaces of the tool holder and punch are engaged and the tang of the punch is forcibly clamped, e.g., between a support plate and clamp of the tool holder. During pressing operations, the punch is maintained in this position. Thus, several steps may be required to operatively mount a punch on the upper table of a press brake.

It would be desirable to provide a tool that can be operatively clamped by a tool holder in such a way that the load-bearing surfaces of the tool and tool holder are engaged as an adjunct of the clamping action of the tool holder (e.g., without having to press the tip of a loosely-clamped punch against a die on the lower table of the press brake). The present invention provides new press brake tool technologies, in which a seating and/or locating mechanism is incorporated into the tool.

Summary of Invention

Press brake tool seating has been attempted in a few instances by building tool seating mechanisms into press brake tool holders. These tool holder mechanisms may be less than ideal in terms of their complexity, propensity to fail, etc. Furthermore, building a seating mechanism into the tool holder requires a machinist to possess a specialized tool holder in order to enjoy the benefits of tool seating. Some embodiments of the present invention provide a press brake tool wherein a seating mechanism is incorporated into the tool itself. Thus, a machinist can accomplish tool seating using any of a variety of conventional press brake tool holders.

In certain embodiments, the invention provides a press brake tool configured for being operatively mounted on a tool holder of a press brake having a pressing axis. The tool has a shank adapted for being positioned in a tool-mount channel of the tool holder such that the shank when clamped forcibly between confronting walls of the tool holder receives a force having a clamping component directed at least generally perpendicular to the pressing axis. In the present embodiments, the tool has a seating mechanism adapted for at least partially converting this force into a seating component directed at least generally parallel to the pressing axis. Preferably, the seating mechanism comprises a moveable body mounted on the tool so as to be moveable relative to a stationary portion of the tool's shank.

In certain embodiments, the invention provides, in combination, a press brake tool and a tool holder of a press brake having a pressing axis. In the present embodiments, the tool is operatively mounted on the tool holder. The operatively mounted tool has a shank positioned in a tool-mount channel of the tool holder such that the shank is clamped forcibly between confronting walls of the tool holder, the tool's shank thereby receiving from the tool holder a force having a clamping component directed at least generally perpendicular to the pressing axis. In the present embodiments, the tool has a seating mechanism at least partially converting this force into a seating component directed at least generally parallel to the pressing axis. In the present embodiments, the seating mechanism comprises a moveable body mounted on the tool so as to be moveable relative to a stationary portion of the tool's shank.

In certain embodiments, the invention provides a method of mounting a press brake tool on a tool holder (of a press brake) having a pressing axis. The tool holder has a tool-mount channel bounded by first and second confronting walls. In the present embodiments, the first confronting wall of the tool holder is moveable at least in part toward the second confronting wall of the tool holder. The tool holder has at least one load-delivering surface (in some embodiments, it is adapted for moving the tool, when operatively mounted on the tool holder, along the pressing axis). The tool has a shank and at least one load-receiving surface. In the present embodiments, the tool has a seating mechanism comprising a moveable body mounted on the tool so as to be moveable relative to a stationary portion of the tool's shank. The present method comprises positioning the tool's shank in the tool-mount channel and moving the first confronting wall at least in part toward the second confronting wall thereby forcibly clamping the tool's shank between these confronting walls so as to deliver to the shank a force that is at least partially converted by the tool's seating mechanism into a seating component directed at least generally parallel to the pressing axis. Preferably, the seating component of this force moves the tool relative to the tool holder so as to bring the load-receiving surface of the tool into engagement with the load-delivering surface of the tool holder.

In certain embodiments, the invention provides a press brake tool having a shank that is provided with a retractable safety key. Here, the safety key is moveable between an extended position and a retracted position. Preferably, the safety key is operably coupled with a moveable link member such that the safety key moves from its extended position to

its retracted position in response to the link member moving along a vertical axis of the tool.

In one group of embodiments, the invention provides a press brake tool having a shank adapted for being positioned in a tool-mount channel of a tool holder, and a ball member is mounted on the tool so as to be moveable relative to a stationary portion of the tool's shank. Here, the ball member is moveable between an extended position and a retracted position, and at least a portion of the ball member projects outwardly from the tool's shank when the ball member is in its extended position. In some embodiments of this nature, the ball member comprises a metal sphere. Optionally, the tool's shank has a lateral width and the ball member is a sphere having a diameter of at least about $1/5^{th}$ (perhaps more preferably at least about $1/4^{th}$) this lateral width. In some of the present embodiments, the tool's shank has two generally opposed sidewalls, a portion of the ball member projects outwardly from a first of these sidewalls when the ball member is in its extended position, and a second of these sidewalls is at least generally planar. Conjointly, the tool can optionally include a load-receiving surface that is at least generally planar, and this load-receiving surface can optionally be at least generally perpendicular to the second of the noted sidewalls of the tool's shank. An optional feature in the present group of embodiments (and in the other embodiments described throughout the present specification) is that the tool's shank has a non-cylindrical configuration. Optionally, the ball member is housed in a bore of the tool, at least part of a spring member is disposed in this bore, and the spring member is adapted for resiliently biasing, either directly or via one or more other bodies, the ball member toward its extended position. Conjointly, an elongated link member can optionally be housed in the bore, the elongated link member can optionally have opposed first and second end regions, the link member can optionally be slidable in the bore between first and second positions, the ball member can optionally assume its extended position when the link member is in its first position, the ball member can optionally be slidable in the bore between its extended and retracted positions, and the spring member optionally bears forcibly against the second end region of the link member to resiliently bias the link member toward its first position. The optional link member in the bore can, for example, be located between the ball member and the spring member. The tool can optionally include an actuator that can be operated so as to cause the link member to slide to its second position, thereby overcoming the resilient bias of the

optional spring member and allowing the ball member to move to its retracted position. When provided, the actuator can optionally comprise a moveable cam body that is adapted to bear forcibly against, and cam with, a cam surface of the link member (when the actuator is operated so as to cause the link member to slide to its second position). The optional link member can comprise (e.g., be) an elongated shaft having therein formed a notch that defines the cam surface of the link member. In some cases, the link member comprises an elongated shaft having a concave first end region in which a portion of the ball member is nested (at least when the ball member is in its extended position).

In certain embodiments, the invention provides a press brake tool configured for being operatively mounted on a tool holder of a press brake having a pressing axis (the tool holder in some, but not all, cases is adapted for moving the tool when operatively mounted on the tool holder along the pressing axis). The tool has a shank adapted for being positioned in a tool-mount channel of the tool holder such that the shank when clamped forcibly between confronting walls of the tool holder receives a force having a clamping component directed at least generally perpendicular to the pressing axis. In the present embodiments, the tool has a seating mechanism that is adapted for at least partially converting this force into a seating component directed at least generally parallel to the pressing axis. Preferably, the seating mechanism comprises a moveable body mounted on the tool so as to be moveable relative to a stationary portion of the tool's shank. In the present embodiments, this moveable body comprising a polymer.

In certain embodiments, the invention provides a press brake tool configured for being mounted on a tool holder of a press brake by moving a shank of the tool vertically into a tool-mount channel defined by the tool holder. In the present embodiments, the tool is adapted for being dismounted from the tool holder by moving the tool horizontally out of the channel, and the tool is not adapted for being dismounted from the tool holder by moving the tool vertically out of the channel. In these embodiments, the tool preferably has no externally accessible actuator for retracting the safety key such that once the tool's shank is moved into an operative position in the channel of the tool holder a press brake operator is prevented from retracting the safety key and removing the tool vertically from the tool holder. The press brake has a pressing axis. In the present embodiments, the tool's shank has a retractable safety key and is adapted for being positioned in the channel of the tool holder such that the shank when clamped forcibly between confronting walls of

the tool holder receives a force having a clamping component directed at least generally perpendicular to the pressing axis. The tool has a seating mechanism adapted for at least partially converting this force into a seating component directed at least generally parallel to the pressing axis, and the seating mechanism preferably comprises a moveable body mounted on the tool. In the present embodiments, the seating component of the noted force preferably is adapted to move the tool relative to the tool holder so as to bring a load-bearing surface of the tool into engagement with a load-bearing surface of the tool holder. In some embodiments of the present group, the tool is provided in combination with the tool holder, and the tool holder has no externally accessible actuator for causing the tool's safety key to retract such that once the tool's shank is moved into the operative position in the channel of the tool holder the press brake operator is prevented from retracting the safety key and removing the tool vertically from the tool holder. Further, in some of the present embodiments, the tool has a leading body portion that terminates at a tip (the leading body portion being that portion of the tool that is not concealed by the tool holder when the tool's shank is in its operative position in the channel of the tool holder), and the leading body portion of the tool is defined entirely by solid wall having no openings.

Brief Description of the Drawings

Figure 1 is a partially broken-away schematic side view of a press brake tool in accordance with certain embodiments of the invention;

Figure 2 is a partially broken-away schematic perspective view of a press brake tool in accordance with certain embodiments of the invention;

Figure 3 is a partially broken-away, partially exploded schematic perspective view of a press brake tool in accordance with certain embodiments of the invention;

Figure 4 is a partially exploded, schematic perspective view of a press brake tool in accordance with certain embodiments of the invention;

Figure 5 is a perspective view of a wedge member that is provided on a press brake tool in accordance with certain embodiments of the invention;

Figure 6 is a perspective view of another wedge member that is provided on a press brake tool in accordance with certain embodiments of the invention;

Figure 7 is a perspective view of a safety key that is provided on a press brake tool in accordance with certain embodiments of the invention;

Figure 8 is a perspective view of an actuator that is provided on a press brake tool in accordance with certain embodiments of the invention;

Figure 9 is a perspective view of a link member that is provided on a press brake tool in accordance with certain embodiments of the invention;

Figure 10 is a partially broken-away perspective view of a press brake tool in accordance with certain embodiments of the invention;

Figure 11 is a partially broken-away perspective view of a press brake tool in accordance with certain embodiments of the invention;

Figure 12 is a partially broken-away side view of a press brake tool, in combination with a press brake tool holder, in accordance with certain embodiments of the invention;

Figure 13 is a partially broken-away schematic side view of a press brake tool, in combination with a press brake tool holder, in accordance with certain embodiments of the invention;

Figure 14 is a partially broken-away schematic perspective view of a press brake tool in accordance with certain embodiments of the invention;

Figure 15 is a partially broken-away schematic side view of a press brake tool and a press brake tool holder, in combination, in accordance with certain embodiments of the invention;

Figure 16 is a partially broken-away perspective view of a press brake tool in accordance with certain embodiments of the invention;

Figure 17 is a partially broken-away schematic perspective view of a press brake tool in accordance with certain embodiments of the invention;

Figure 18 is a partially broken-away schematic perspective view of a press brake tool in accordance with certain embodiments of the invention;

Figure 19 is a partially broken-away schematic side view of a press brake tool and a press brake tool holder, in combination, in accordance with certain embodiments of the invention;

Figure 20 is a partially broken-away perspective view of a press brake tool in accordance with certain embodiments of the invention;

Figure 21 is a broken-away schematic side view of a press brake tool and a press brake tool holder, in combination, in accordance with certain embodiments of the invention;

Figure 22 is a partially broken-away schematic perspective view of a press brake tool in accordance with certain embodiments of the invention;

Figure 23 is a partially broken-away schematic side view of a press brake tool in accordance with certain embodiments of the invention;

Figure 24 is a partially broken-away schematic side view of a press brake tool in accordance with certain embodiments of the invention;

Figure 25 is a partially broken-away schematic side view of a press brake tool and a tool holder in accordance with certain embodiments of the invention;

Figure 26 is a partially broken-away, partially cross-sectional schematic side view of a press brake tool in accordance with certain embodiments of the invention;

Figure 27 is a partially broken-away perspective view of a press brake tool in accordance with certain embodiments of the invention;

Figure 28 is a partially broken-away, schematic perspective view of a press brake tool in accordance with certain embodiments of the invention;

Figure 29 is a broken-away, cross-sectional side view of a press brake tool in accordance with certain embodiments of the invention; and

Figure 30 is a partially exploded, cross-sectional perspective view of a press brake tool in accordance with certain embodiments of the invention.

Detailed Description of Preferred Embodiments

The invention in some embodiments provides a brake press tool in combination with a press brake tool holder. Generally, the tool holder TH defines a channel C configured for receiving the shank S of a press brake tool TL. This channel C is referred to herein as the tool-mount channel. In some embodiments, the tool-mount channel C has a generally T-shaped cross section, although this is by no means required. Preferably, at least part of the channel C is bounded by two confronting walls CW, CW' of the tool holder. In the illustrated embodiments, the confronting walls CW, CW' are at least generally vertical and/or each define at least one surface that is substantially vertical and planar. These features, however, are not required in all embodiments. For example, the

configuration and construction of the wall(s) bounding the tool-mount channel C will vary depending upon the particular style in which the tool holder is embodied.

The tool holder, when provided, will commonly be adapted for use with American style tools. However, the tool holder can take the form of various other tool holder styles known in the art, including those currently in less widespread use. In fact, it will be appreciated that the tool holder TH can be adapted for use with any desired tooling style, including styles not yet developed, that would benefit from the features of this invention. The tool holder, of course, can be a press brake beam, an adaptor mounted to a press brake beam, or any other type of press brake tool holder.

The press brake tool TL can be a male forming punch or a female forming die. Typically, the tool TL has generally opposed first and second ends (or sides). Preferably, the first end (or side) of the tool defines a workpiece-deforming surface TP (e.g., at a tip of the tool) configured for making a desired deformation (e.g., a bend) in a workpiece when this surface TP is forced against the workpiece (e.g., when a tip of the tool is forced against a piece of sheet metal or the like, and/or when a workpiece is forced against the tool's tip). The second end (or side) of the tool has a shank (or "tang") S configured for being mounted in (e.g., sized and shaped to be received in) the tool-mount channel C.

In some cases, the tool TL has a safety key SK. As shown in Figures 1-4, 10, and 15-18, the shank S of the tool TL can optionally have a safety key SK adapted for engaging a safety recess (or "safety groove") SR, and/or moving into alignment with a safety shelf SCS, defined by the tool holder TH. When provided, the safety key SK can be retractable or non-retractable. Safety keys of both types are described in U.S. patent 6,467,327 (Runk et al.), and U.S. patent application 10/742,439, entitled "Press Brake Tooling Technology", the entire contents of each of which are incorporated herein by reference.

In embodiments involving a tool TL with a safety key SK, the key preferably comprises an engagement portion 580 that is adapted to project into a safety recess SR (and/or into alignment with a safety shelf SCS) defined by the tool holder TH. In the case of a non-retractable safety key, the key will typically comprise a rigid projection from the tool's shank. When provided, the non-retractable safety key preferably is either integral to the tool's shank or rigidly joined to the tool's shank.

In the case of a retractable safety key, the key is mounted on the tool so as to be moveable between an extended position and a retracted position. In more detail, such a key preferably comprises a rigid engagement portion 580 that is moveable relative to (e.g., generally toward and away from) the tool's shank (or at least relative to stationary portions of the shank). Such retractable safety keys are described in U.S. patent 6,467,327 and U.S. patent application 10/742,439. In some cases, the safety key is part of a key assembly (e.g., mounted inside and/or on the tool) comprising at least one spring member resiliently biasing (directly or via one or more link members and/or other bodies) the safety key SK toward its extended position.

Thus, in some embodiments, the tool holder defines a safety recess SR. When provided, the safety recess SR preferably is sized to receive an engagement portion 580 of a desired safety key SK. In some embodiments involving a tool TL with its shank S received in the channel C of a tool holder TH, the tool holder has a safety recess SR that is at the same elevation as a safety key SK on the tool. Some embodiments of this nature (such as that shown in Figure 15) provide a tool TL having a safety key SK projecting generally away from the shank S of the tool and engaged with (e.g., extending into) the safety recess SR of the tool holder, such that an engagement portion 580 of the safety key is received in the safety recess (and/or is positioned directly above a safety shelf SCS of the tool holder).

Thus, certain embodiments provide a tool holder and tool in combination. In some of these embodiments, the second end of the tool has a shank S received in the tool holder's channel C. As noted above, the channel C is typically bounded at least in part by two confronting walls CW, CW' of the tool holder. In many combination embodiments, the tool's first end (which typically defines a tip) projects (e.g., generally vertically) away from the tool holder.

Typically, the tool holder TH has at least one load-delivering surface LD configured for engaging a load-receiving surface LR of a press brake tool TL. Preferably, the tool holder TH has one or more generally or substantially horizontal load-delivering surfaces LD each being adapted to engage and deliver force to (when the tool is operatively mounted on the tool holder) one or more corresponding generally or substantially horizontal load-receiving surfaces LR of the tool TL. In some embodiments involving a tool in combination with (and operatively mounted on) a tool holder, the tool

holder has a load-delivering surface LD engaged with (e.g., carried directly against) a load-receiving surface LR of the tool TL. Preferably, these engaged surfaces LD and LR are generally or substantially horizontal. In some cases, the tool holder TH has two horizontal load-delivering surfaces LD. For example, Figures 15, 19, and 21 depict tool holders of this nature, wherein two load-delivering surfaces LD are separated by an opening of the tool-mount channel C. Here, the channel C is depicted as being downwardly open. The invention, however, also provides embodiments where the channel C is upwardly open (e.g., embodiments where the tool holder is used to secure a die on the lower beam of a press brake). The terms load-delivering and load-receiving, where used in the present detailed description, can each be replaced with the term load-bearing.

The illustrated load-delivering surfaces LD of the tool holder are configured for engaging, and delivering force to, corresponding load-receiving surfaces LR of the tool TL. In the figures, the horizontal load-delivering surfaces LD of the tool holder TH are shown as being downwardly facing surfaces, and the horizontal load-receiving surfaces LR of the tool are shown as being upwardly facing surfaces. In other embodiments (e.g., where the tool holder is on a lower beam), the horizontal load-delivering surface(s) LD of the tool holder is/are upwardly facing, and the horizontal load-receiving surface(s) of the tool is/are downwardly facing. Thus, the invention provides various combination embodiments wherein the shank of a tool is operatively mounted in the channel of the tool holder such that each load-delivering surface of the tool holder is generally or substantially horizontal and is carried directly against a corresponding generally or substantially horizontal load-receiving surface of the tool.

In certain embodiments, the tool holder TH is adapted for forcing the tool TL (e.g., when the tool is operatively mounted on the tool holder) against a workpiece by delivering force from the load-delivering surface(s) LD of the tool holder to the load-receiving surface(s) LR of the tool. The tool holder may move the tool into contact with the workpiece, or it may hold the tool in a stationary position while the workpiece is forced into contact with the tool, e.g., the upper or lower beam of a press brake may be moveable depending upon the press brake used. Either way, the press brake will have a pressing axis. Moreover, a tool holder is to be considered to have a pressing axis, even if it holds the tool in a stationary position during pressing operations. In some preferred

embodiments, the tool holder TH is adapted for moving the operatively mounted tool TL along the pressing axis PA (shown in Figure 15), e.g., during a pressing operation. For example, the tool holder TH can optionally be adapted for moving the tool TL in a pressing direction PD (shown in Figure 19) that is generally or substantially normal to the load-delivering surface(s) LD of the tool holder. In preferred embodiments of this nature, each load-delivering surface LD of the tool holder TH is generally or substantially horizontal, and the tool holder is adapted for moving the tool TL in a generally or substantially vertical direction. Accordingly, the tool holder in these embodiments is adapted for moving the tool vertically into and out of engagement with a workpiece (e.g., when the workpiece is secured in a working position between the upper and lower tables of the press brake).

In some embodiments, the tool holder is operably coupled to a press brake ram that is adapted for moving the tool holder and the operatively mounted tool together so as to force the workpiece-deforming surface of the tool against a workpiece. Preferably, the ram (which can be incorporated into, or otherwise operably coupled with, a bed BE of the press brake) is adapted for moving the tool holder TH and tool TL together in a pressing direction PD that is generally or substantially normal to the load-delivering surface(s) LD of the tool holder (e.g., in a vertical direction). In other embodiments, the tool holder is not adapted for moving the operatively mounted tool, but rather is designed for securing the tool in a stationary position during pressing operations.

Preferably, the tool holder TH has a closed configuration and an open configuration. When the tool holder TH is in its open configuration, the shank S of a press brake tool TL can be moved into and out of the tool holder's channel C. When the tool holder TH is in its closed configuration, the shank S of a tool TL mounted in the tool holder's channel C is clamped forcibly (and held rigidly) against a wall CW of the tool holder.

The tool holder TH can optionally have a moveable face plate MP, jaw, clamping pin, or the like, which preferably defines at least part of one CW' of the confronting walls CW, CW'. In moving such a tool holder to its closed configuration, the moveable plate MP, jaw, pin, etc. desirably moves toward the other CW of the confronting walls CW, CW'. When such a tool holder moves to its open configuration, the moveable plate MP, jaw, pin, etc. desirably moves away from the other wall CW. For example, the tool

holders shown in Figures 15 and 19 include a face plate MP that can be moved selectively toward or away from the tool holder body CB (which may or may not be moveable laterally) that defines the wall CW.

In certain embodiments, the invention provides a press brake tool TL configured for being operatively mounted on a press brake tool holder TH (optionally one that is adapted for moving the tool, when operatively mounted on the tool holder, along a pressing axis PA). The tool TL has a shank S that is adapted for being positioned in a tool-mount channel C of the tool holder TH such that the shank when clamped forcibly between confronting walls CW, CW' of the tool holder receives a force having a clamping component directed at least generally perpendicular to the pressing axis PA. In some of the present embodiments, the tool TL has a seating mechanism SM that is adapted for at least partially converting this force (during at least a certain period, such as an initial or middle period, of the clamping) into a seating component directed at least generally parallel to the pressing axis PA. The seating component can optionally be a generally or substantially vertical (e.g., upward) force component, and the clamping component can optionally be a generally or substantially horizontal force component. In some cases, once the tool's shank is fully clamped between the walls CW, CW' of the tool holder, the walls CW, CW' apply only a horizontal force on the tool's shank.

Thus, a seating mechanism SM can optionally be incorporated into the tool TL. Such embodiments extend to any press brake tool having a seating mechanism built into (and/or provided on) the tool itself. Embodiments of this nature can employ a variety of advantageous seating mechanisms. Preferably, the seating mechanism SM comprises a moveable body MB mounted on the tool TL (optionally so as to be moveable relative to a stationary portion SP of the tool's shank S). The moveable body MB in some embodiments is mounted on the tool so as to be moveable (at least in part) in both vertical and lateral directions relative to other portions (e.g., stationary portions SP) of the tool's shank S. The moveable body preferably bears forcibly against a portion (e.g., a cam surface) of the tool's shank, and thereby delivers at least the seating component of the noted force to the tool's shank, in response to the confronting walls of the tool holder being clamped forcibly on the tool's shank.

In some cases, the seating mechanism comprises a moveable body (and optionally two such moveable bodies) contacted directly by the tool holder when the confronting

walls CW, CW' clamp forcibly on the tool's shank. A moveable body of this nature can optionally have a dimension (e.g., a major dimension) that is at least $1/5^{th}$ (perhaps preferably at least $1/4^{th}$, perhaps more preferably at least $1/3^{rd}$, and in some cases at least ½) of the lateral width of the tool's shank S.

In certain embodiments, the seating mechanism SM includes a moveable body MB comprising a wedge member WM. The wedge member will commonly have two surfaces CS, WC that are generally opposed and oriented at an oblique angle (such as between 5 degrees and 45 degrees) relative to each other. The wedge member WM, for example, can optionally have at least one portion with a generally triangular cross-sectional configuration (optionally a cross section taken along a plane lying in both the "x" axis and the "y" axis of the tool). The wedge member WM can be mounted on the tool so that at least a portion (optionally a portion with a generally triangular cross section) of the wedge member is carried alongside a cam surface CM of the tool's shank. The wedge member preferably is adapted to (e.g., in response to the tool holder's confronting walls being clamped forcibly on the tool's shank) bear forcibly against, and cam with, a cam surface CM of the tool's shank (e.g., so as to cause relative movement of the wedge member and the cam surface CM). The cam surface CM can optionally be defined by a stationary portion (i.e., a portion that does not move relative to the load-receiving surface(s) LR of the tool and/or relative to a tip of the tool) SP of the tool's shank S. This surface CM can be offset from vertical by an angle of greater than 0 degrees but less than 30 degrees, if so desired.

When provided, the wedge member WM preferably is mounted on the tool TL so that a contact surface CS of the wedge member is adapted to be engaged by one of the confronting walls CW, CW' of the tool holder TH when the tool's shank S is forcibly clamped between these walls CW, CW'. In some cases, the contact surface CS is generally or substantially planar. The wedge member WM desirably also includes a cam surface WC. Preferably, this surface WC of the wedge member WM is carried against the cam surface CM of the tool's shank S. In Figures 1 and 3-6, the contact surface CS of the wedge member WM is generally opposed to the cam surface WC of the wedge member. A variety of wedge member configurations can be used, as described below in further detail.

In some embodiments, the seating mechanism SM comprises at least one rod member RM. Reference is made to Figures 27-30. Here, each rod member RM comprises an elongated rod, pin, shaft, and/or block. The rod member RM preferably is slidably mounted in a bore defined by the tool, optionally so as to be slidable axially between first and second positions. As shown in Figure 29, a rod member RM of this nature can be resiliently biased toward it first position (the exemplary rod member in Figure 29 is illustrated in such a first position), which can optionally be a position in which one end (e.g., an end that defines a contact surface CS) of the rod member protrudes/projects out of the bore. Here, when the rod member RM is in its second position (as it would be once the tool's shank is fully clamped by a tool holder), it preferably is fully retracted inside the bore. The rod member can be retained in the bore, for example, by virtue of a locking ring, clip, etc. In Figure 29, the rod member is mounted in a blind bore with a spring compressed between a back end of the rod member and a wall defining the blind end of the bore. These details, however, are by no means required.

In certain preferred embodiments, the seating mechanism SM comprises two moveable bodies MB mounted at least in part on opposite sides of the tool's shank S. In some cases, these two moveable bodies MB are mounted on the tool TL such that they can both be moved (e.g., in part or in their entirety) simultaneously toward or away from each other and/or in generally opposite directions (e.g., directions that are opposite at least in terms of their lateral/x axis component, if not directly opposite). Here, both bodies MB are optionally contacted directly by the tool holder TH when the tool's shank S is clamped forcibly between the confronting walls, CW, CW' of the tool holder. In some cases, the bodies MB define opposed contact surfaces CS (which optionally are at least generally planar) that are contacted respectively by the confronting walls CW and CW' of the tool holder during clamping. Figures 1, 3, 4, 12, 13, 16-18, 22-28, and 29 depict exemplary embodiments involving two moveable bodies MB mounted at least in part on opposite sides of the tool's shank S. In these embodiments, when the confronting walls of the tool holder clamp forcibly on the tool's shank, the moveable bodies desirably coact with the tool's shank so as to deliver to the shank a seating force component. Preferably, this clamping action causes both bodies MB to move relative to a stationary portion SP of the shank. In some cases, the moveable bodies move closer together (e.g., at least their contact surfaces may move closer together) in response to such clamping (while at the

same time optionally moving at least generally vertically relative to stationary portions of the tool's shank S). This is the case, for example, when both moveable bodies are wedge members of the type exemplified in Figures 1, 3, 4, 23, and 24. In some cases, at least one of the moveable bodies MB rotates in response to the tool's shank being clamped forcibly between the confronting walls of the tool holder. This is the case, for example, with the exemplary embodiments depicted in Figures 12-14, 16-18, and 25. In Figures 27-28 and 30, the seating mechanism SM comprises two rod members RM mounted so as to have contact surfaces CS on opposite sides of the tool's shank S.

In one group of embodiments, the seating mechanism SM comprises two wedge members WM. Reference is made to Figures 1, 3, 4, 23, and 24. Here, it can be appreciated that each wedge member preferably has a contact surface CS (optionally being at least generally planar) adapted for being engaged by one of the confronting walls CW, CW' of the tool holder TH when these walls clamp forcibly upon the tool's shank S. In Figure 1, the two wedge members WM are mounted on the tool so that the contact surfaces CS of the wedge members are disposed on (e.g., carried adjacent to) opposite sides of the tool's shank S. Preferably, the wedge members are adapted to bear forcibly against, and cam with, respective cam surfaces CM of the tool's shank S in response to the confronting walls CW, CW' of the tool holder TH clamping forcibly on opposite sides of the tool's shank. This camming action desirably results in the tool receiving a force with a seating component that is of a magnitude at least equal to the weight of the tool, such that if the tool is on the upper beam of the press brake this force component is sufficient to lift the tool upwardly until the load-receiving surface(s) of the tool come(s) into direct contact with the corresponding load-delivering surface(s) of the tool holder, at which point upward movement of the tool is stopped (due to the noted engagement of the load-bearing surfaces).

The seating mechanism in some embodiments can have an extended configuration and a retracted configuration. For example, the opposed contact surfaces CS of two wedge members WM may be further apart when the seating mechanism is in its extended configuration than when the seating mechanism is in its retracted configuration. Thus, when the confronting walls CW, CW' of the tool holder TH clamp forcibly on the tool's shank S, the opposed contact surfaces CS of such wedge members WM can be forced to move closer together.

In the illustrated wedge embodiments, each of the cam surfaces CM on the tool's shank S is defined by a slanted wall. Conjointly, each of the illustrated wedge cam surfaces WC is defined by a slanted wall of a wedge member WM. These features, however, are not required. If so desired, the tool's shank S can have a cam surface CM defined by a radiused or curved wall, and/or the wedge member can have a cam surface WC defined by a radiused or curved wall.

In some cases, each cam surface CM on the tool's shank S faces generally away from a vertical axis passing through a lateral midpoint of the tool's shank ("VAD" in Figure 23). For example, when the tool has two moveable bodies MB mounted at least in part on opposite sides of the tool's shank S, these bodies MB can advantageously be carried (at least in part) alongside respective cam surfaces CM of the tool's shank, and these cam surfaces CM can face generally away from the noted axis VAD and/or away from each other. These features, however, are by no means required.

As exemplified in Figures 12-14, 16-18, and 25, the seating mechanism SM can optionally comprise at least one wheel member WH. When provided, each wheel member WH can optionally be mounted on the tool's shank S so as to be moveable rotatably (optionally about a longitudinally-extending axis, i.e., an axis parallel to the tool's "z" axis) relative to a stationary portion SP of the tool's shank. Each wheel member, for example, can be mounted on an axle AX that provides a desired range of linear (e.g., lateral) movement for the wheel/axle. This is perhaps best appreciated with reference to Figure 25. Here, a spring member 299 is disposed between the respective axles AX of the two wheel members WH, and each axle AX is slidably received in a slot SOT defined by the tool's shank. Thus, the illustrated wheel members can be moved laterally (and in the process the axles slide laterally in the slots SOT). With this type of arrangement, the two wheel members WH are resiliently biased away from each other by the spring member 299. Preferably, when the tool's shank S is clamped forcibly between confronting walls CW, CW' of the tool holder TH, the force applied to the tool by the clamping of these walls CW, CW on the wheels WH has a seating component that is at least generally parallel to the pressing axis.

In some embodiments involving a rotatable member (e.g., a wheel, rotatable pin, etc.) mounted on the shank S of a press brake tool TL, the rotatable member has a

diameter. This diameter can optionally be at least $1/5^{th}$ the lateral width of the tool's shank, and perhaps more preferably at least $1/4^{th}$ of the lateral width of the tool's shank.

In Figures 12, 13, and 25, the illustrated tool TL is provided in combination with a tool holder TH having at least one wall portion CWA configured such that when it contacts a wheel member WH on the tool's shank (as an adjunct of the confronting walls CW, CW' clamping forcibly on the tool's shank), the force delivered to the shank via the wheel member has a seating component (e.g., an upward component) that causes the tool to move relative to the tool holder so as to bring the load-receiving surface(s) of the tool into direct contact with the load-delivering surface(s) of the tool holder. The wall portion CWA can optionally define an angled, radiused, or curved surface. In Figures 12, 13, and 25, the wall portion CWA extends at an angle relative to the adjacent load-delivering surface LD of the tool holder, and this angle is not 90 degrees, but rather is offset from 90 degrees (e.g., by at least about 2 degrees, at least about 3 degrees, or at least about 4 degrees).

With reference to Figure 14, it can be appreciated that some embodiments provide a seating mechanism SM that includes a wedge member WM and a wheel member WH. Here, the illustrated wedge member WM and wheel member WH project in part from opposite sides of the tool's shank. That is, the illustrated wedge member WM projects in part from one side of the tool's shank, and the illustrated wheel member WH projects in part from an opposite side of the shank (at least when the seating mechanism is in its extended configuration).

Thus, the seating mechanism SM preferably includes at least one moveable body MB that is adapted to bear forcibly against a portion of the tool's shank (thereby delivering at least a seating component of force to the tool's shank) in response to the confronting walls of the tool holder being clamped forcibly on opposite sides of the tool's shank. Preferably, the resulting seating component is of a magnitude at least equal to the weight of the tool, such that if the tool is on the upper beam of the press brake this force component is sufficient lift the tool upwardly until the load-receiving surface(s) of the tool come(s) into direct contact with the corresponding load-delivering surface(s) of the tool holder, at which point upward movement of the tool is stopped (due to the noted engagement of the load-bearing surfaces). Several embodiments of this nature have been described.

Figure 15 depicts an embodiment wherein the seating mechanism SM comprises a positioner PO mounted on the tool's shank S. The illustrated positioner PO has a generally "H"-shaped cross-sectional configuration, although this is by no means required. The illustrated positioner PO comprises an elongated neck portion NP connecting two web portions WPT. The neck portion NP extends through a lateral opening passing through the tool's shank, and each web portion WPT extends in a direction that is at least generally perpendicular to the neck portion NP. The neck portion connects respective midpoints of the two web portions WPT. The web portions WPT (by virtue of their connection to the neck portion NP extending through the lateral opening in the tool's shank) keep the positioner PO on the tool's shank. Preferably, the distance between the two web portions WPT (i.e., the length of the neck portion) is slightly greater than the lateral width of the tool's shank. This gives the positioner PO some freedom to move laterally relative to stationary portions of the tool's shank. The positioner PO preferably also has some freedom to move along the tool's "y" axis (which is also referred to herein as the tool's vertical axis) relative to stationary portions of the tool's shank. Thus, the neck portion NP of the positioner preferably has some play in the opening in which it is mounted.

The tool holder in Figure 15 has a moveable face plate MP defining an angled or radiused cam surface AS that is adapted to bear forcibly against, and cam with, a shoulder SH of the positioner PO. This camming action (when initiated at such time as the tool is retained loosely in the channel C by virtue of the safety key SK hanging on the safety shelf SCS) causes the positioner to move away from the tip of the tool (e.g., upwardly). This brings the neck portion NP of the positioner PO to bear forcibly upon a lifting surface LS of the tool's shank, which in turn causes the tool's shank to move in such a way that the load-receiving surfaces LR of the tool TL come into engagement with the load-delivering surfaces LD of the tool holder TH. In the embodiment of Figure 15, this involves the tool moving upwardly until the load-bearing surfaces LR, LD of the tool and tool holder are seated directly against one another.

In certain embodiments, the press brake tool TL has a seating mechanism SM and a retractable safety key SK. When provided, the retractable safety key SK is adapted for engaging a safety recess SR, and/or moving into alignment with a safety shelf SCS, of the tool holder TH.

In embodiments wherein the seating mechanism SM comprises a wedge member WM, the wedge member can be provided in a variety of configurations. One configuration is shown in Figure 3. Here, it can be appreciated that each wedge member WM includes a wedge portion WP and a neck portion WNP. Preferably, the wedge portion WP is that part of the wedge member WM that defines the contact surface CS and is adapted to be engaged by one of the confronting walls of the tool holder when such walls are clamped on the tool's shank S. With continued reference to Figure 3, it can be appreciated that the wedge portion WP has a small-thickness region and a large-thickness region. In some cases, the thickness (e.g., the lateral thickness) of the wedge portion WP gradually increases moving from the small-thickness region to the large-thickness region. The wedge portion WP in Figure 3, for example, has a generally triangular cross-sectional configuration. This particular wedge member WM is assembled on the tool so that the large-thickness region is located closer to the tool's tip than is the small-thickness region.

As noted above, each wedge member WM preferably has a contact surface CS adapted for being engaged by the tool holder. In the illustrated wedge embodiments, the contact surface CS is a generally planar surface which, when the wedge member WM is assembled on the tool, is generally parallel to the vertical axis of the tool and/or is generally perpendicular to the load-receiving surface(s) of the tool. The contact surface CS of each wedge member WM can optionally face generally away from a "y" axis passing through a lateral midpoint of the tool's shank. Each wedge member WM preferably has a cam surface WC that is oriented at an angle relative to the vertical axis of the tool and/or relative to the contact surface CS of the wedge member. Thus, in some wedge embodiments, each wedge member WM has a contact surface CS and a cam surface WC, and these surfaces are not parallel, but rather are offset from parallel by an acute angle, which preferably is at least about 2 degrees, more preferably at least about 3 degrees, and perhaps optimally at least about 4 degrees (e.g., greater than 5 degrees). In one particular embodiment, this angle is about 13 degrees.

In connection with the neck portion WNP of the wedge member designs shown in Figures 5 and 6, it can be appreciated that such a neck portion WNP can be provided to facilitate mounting the wedge member WM on the tool. Here, the neck portion WNP of the wedge member WM defines a groove WG. Referring to Figure 4, it can be appreciated that the illustrated tool TL has a link member LM extending along the tool's

"y" axis, and a portion LP of this link member LM is adapted to be received in the groove WG defined by the neck WNP of the wedge member WM. With continued reference to Figure 4, when the illustrated wedge members WM are assembled on the tool, the narrow portion LP of the link member LM is retained in the groove WG of each wedge member WM, and the relative dimensioning of the narrow portion LP of the link member LM and each groove WG is such that each wedge member WM has a desired range of freedom to move laterally until a lip WL of such wedge member WM butts up against the narrow portion LP of the link member LM. These and other optional link member features are described below in further detail.

Figures 5 and 6 provide detailed illustrations of two exemplary wedge members WM. Each of these wedge members WM has a wedge portion WP and a neck portion WNP. The neck portion WNP can be omitted if so desired. For example, the wedge portion can alternatively be mounted movably on the tool's shank by a key-like structure (e.g., extending from the wedge portion) that rides slidably in a slot, channel, etc. (e.g., defined by the tool's shank). The wedge portion in Figure 6 has a rounded bottom portion RBP, whereas the bottom of the wedge portion WP in Figure 5 is generally planar. It is to be appreciated that many other wedge configurations can be used to provide tool seating functionality.

Figure 11 depicts another wedge configuration that can be used to facilitate tool seating. Here, the shank S of the tool TL is provided with a single (i.e., only one) wedge member WM. This wedge member WM has a contact surface CS that is adapted to be engaged by one of the confronting walls CW, CW' of the tool holder TH when such walls clamp forcibly upon the tool's shank. This clamping action causes the wedge member WM to bear forcibly against, and cam with, a cam surface CM of the tool's shank, thereby delivering to the shank a force having a seating component. The contact surface CS forms an included angle (which can optionally be about 90 degrees) with another external surface ES of the wedge member WM. Both of these surfaces CS, ES can optionally be adapted to contact the tool holder TH when the tool TL is clamped operatively by the tool holder. In the illustrated embodiment, the contact surface CS is a generally vertical surface and the other external surface ES is a generally horizontal surface, although this is by no means required.

In Figure 11, the illustrated wedge member WM is mounted moveably on the tool TL by virtue of a male projection (e.g., a rod) RD, which extends from the wedge member and is received slidably in a bore extending into the body of the tool. If so desired, a plurality of wedge members WM of this type (or of any other type described herein) can be disposed at longitudinally spaced apart locations on the tool's shank. This may be particularly desirable for a long tool. Further, wedge members of the type shown in Figure 11 can be positioned on both sides of the tool's shank, if so desired. Still further, one or more wedge members of this type can be provided on the shank of a press brake tool in combination with one or more wheel members of the type described above. As yet another option, one or more wedge members of the type shown in Figure 11 can be disposed on the shank of a tool that also is provided with one or more wedge members of the type shown in Figures 1-4.

Figure 10 depicts an exemplary embodiment wherein the tool TL has a seating mechanism SM and a retractable safety key SK that is offset longitudinally (i.e., along the tool's longitudinal or "z" axis) from the seating mechanism SM. In other embodiments, the safety key SK is at substantially the same longitudinal location as the seating mechanism SM. In some cases, the tool TL is provided with a plurality of safety keys spaced apart longitudinally on the tool's shank, and respective seating mechanisms are provided at the same longitudinal locations as the safety keys.

Figures 1-4 depict one manner in which a link member LM can be used in a tool TL having both a seating mechanism SM and a retractable safety key SK. Here, the link member LM is mechanically linked with the illustrated wedge members WM in such a way that each wedge member WM has a limited range of freedom to move laterally. This can be accomplished with a variety of link member configurations.

In embodiments like those exemplified by Figures 1-4, the link member LM is operably coupled with the safety key SK so that the safety key (or a portion thereof) moves laterally along the "x" axis of the tool (e.g., horizontally) in response to the link member (or a portion thereof) moving along the "y" axis of the tool TL (e.g., vertically). For example, the safety key SK desirably retracts in response to the link member moving in a desired direction (e.g., toward the tip of the tool) along the "y" axis of the tool TL. In Figures 1-4, the safety key is movable between an extended position and a retracted position, the link member is moveable between a first position and a second position, the

safety key moves to its retracted position in response to the link member moving to its second position, and the safety key moves to its extended position in response to the link member moving to its first position. Various embodiments of this nature can be provided.

Figure 9 details one link member configuration that can optionally be used. Here, the link member comprises a rigid rod (optionally one adapted for axial movement relative to a stationary portion of the tool's shank). This particular link member has two portions: a base portion LBP and a narrow portion LP. Preferably, these two portions are machined from (and formed by) one integral piece of material (e.g., metal), although they can alternatively be separate components joined together to form the link member. The narrow portion LP of such a link member can be operably coupled with one or more wedge members (e.g., so as to limit the lateral range of movement of the wedge member(s), as noted above). The base portion LBP can be operably coupled with an actuator A that can be operated so as to cause the safety key SK to retract and/or extend, as described below.

The link member LM, when provided, can be resiliently biased toward a first position (e.g., away from the tip of the tool). For example, one or more spring members SPM can be provided to apply to the link member LM a spring force urging the link member toward its first position. This is perhaps best seen in Figures 1, 3, and 4, where the illustrated spring bears against the bottom surface LBS (shown in Figure 9) of the link member LM. This resilient biasing of the link member LM keeps the safety key SK in its extended position (unless the link member is forced out of its first position). Further, this resilient biasing can optionally keep the seating mechanism in an expanded configuration, as described below.

In Figures 1-4, the illustrated link member LM is operably coupled with a selectively-operable actuator A. Preferably, the actuator A is adapted for being operated at a desired time so as to move the link member to its second position, thereby moving the safety key SK to its retracted position. Here, the actuator A comprises an externally-accessible portion AA, which preferably is manually operable (e.g., manually depressible). The illustrated actuator A has a cam surface PCS that is adapted to bear forcibly against, and cam with, the link member in response to the actuator A being operated (e.g., in response to a press brake operator depressing the externally-accessible portion AA of the actuator). This camming action forces the link member LM to move to its second position

(overcoming the force of the optional spring SPM), which in turn causes the safety key SK to retract.

As is perhaps best seen in Figure 1, the illustrated actuator A has a tapered end region TP. When the tool is assembled, this tapered end region TP projects into a slot LSL defined by the link member LM. Preferably, when the actuator A is operated, at least a portion thereof moves (e.g., axially) inside, or further inside, the body B of the tool TL. With reference to Figure 1, it can be appreciated that depressing the externally-accessible portion AA of the illustrated actuator A causes at least part of that portion AA to move inside the body B of the tool (e.g., into a lateral bore formed in the tool's body). This causes a plunger portion PP of the actuator A to move (e.g., further inside the body B of the tool) in such a way that the cam surface PCS of the actuator A (which in the illustrated embodiment is defined by the tapered end region TP) bears forcibly against, and cams with, a corner/edge LCR of the link member LM, thereby causing the link member to move (e.g., axially and/or toward the tip of the tool) to its second position. While this type of arrangement is advantageous, various link member/actuator arrangements can be used.

The link member LM, when provided, can optionally be configured for biasing the seating mechanism SM toward its extended configuration. For example, a portion of the link member can have a ridge with an apex and sloped side surfaces diverging respectively away from the apex. The apex of such a ridge can optionally be that portion of the ridge that is furthest from the tool's tip. When such a link member moves toward its first position (e.g., due to the bias of a spring SPM), the sloped side surfaces of the ridge can engage respective lips WP of two wedge members WM. As the link member LM continues moving to its first position, the wedge members WM ride on the respective sloped side surfaces of the ridge, forcing the wedge members outwardly (e.g., away from each other). With such an arrangement, the seating mechanism SM is kept in its extended configuration unless the actuator A is operated (e.g., depressed), or the tool holder is clamp forcibly on the tool's shank, or the wedge members are otherwise forced to move inwardly toward each another. This type of arrangement tends to keep the wedge members in a default position where they are located as far from the tool's tip as is allowed by their range of movement. These features, however, are by no means required.

Reference will now be made to a group of embodiments involving a press brake tool that may or may not include a seating and/or locating mechanism. Here, the invention

provides a tool having a shank that is provided with a retractable safety key. The safety key, which is moveable between an extended position and a retracted position, is operably coupled with a moveable link member such that the safety key moves from its extended position to its retracted position in response to the link member moving (e.g., axially) along a vertical axis of the tool. Exemplary embodiments including a seating and/or locating mechanism have been described. However, some embodiments in the present group do not have such a mechanism.

In the present group of embodiments, the link member can optionally comprise at least one rigid rod member. For example, a link member LM of the type shown in Figure 9 can be used. Here, the link member LM has a base portion LBP (which optionally has a generally circular or oval cross section) and a narrow portion LP (which optionally has a generally square or rectangular cross section). A link member of this nature can optionally define a notch LSL to facilitate operably coupling the link member LM with an actuator A, as noted above.

Preferably, the link member is moveable between a first position and a second position, the safety key moves to its retracted position in response to the link member moving to its second position, and the safety key moves to its extended position in response to the link member moving to its first position. If so desired, the link member can be resiliently biased by a spring member SPM toward its first position. Conjointly, the link member can be operably coupled with a selectively-operable actuator. As noted above, an actuator A of this nature can be adapted for being operated at a desired time so as to overcome the resilient bias of the spring member SPM and move the link member to its second position thereby moving the safety key to its retracted position.

In certain embodiments of the present group, the safety key SK is operably coupled with the link member LM by virtue of a male projection RD of the link member that is slidably received in a slot SLT defined by the safety key. When provided, this slot can advantageously be configured to extend at an angle relative to both the "x" axis and the "y" axis of the tool. The angle of such a slot SLT can be varied as desired. In one embodiment, the slot SLT extends at an angle of about 45 degrees relative to the "x" axis of the tool. Alternatively, the slot SLT can be parallel, or substantially parallel, to the vertical axis of the tool, such that the safety key stays in an extended position as the link member moves along the vertical axis of the tool. The noted male projection can be a pin

PN (e.g., extending from the link member) slidably received in the elongated slot defined by the safety key. If so desired, the safety key SK can be resiliently biased by a spring member 199 in such way that the safety key SK is urged toward its extended position. Reference is made to Figures 23 and 24.

The invention provides one group of embodiments wherein the tool TL has a seating mechanism and/or a locating mechanism (e.g., of any type described above) in combination with a click-in/slide-out design. Here, the tool is adapted for being mounted on a tool holder by moving the tool vertically into a channel defined by the tool holder, and for being dismounted from the tool holder by moving the tool horizontally (i.e., by sliding the tool lengthwise) out of the channel. Press brake tools of this nature are referred to herein as click-in/slide-out tools. Preferably, when these tools are mounted in the tool holder they produce an audible "click" sound upon reaching their operative position. In preferred embodiments, this sound results when the safety key(s) on the tool snaps into place in a safety slot defined by the tool holder. It is to be understood that this audible clicking is an optional feature, which is by no means required.

Some existing press brake tools are adapted for both vertical mounting (i.e., mounting by moving the tool vertically into the channel of the tool holder) and vertical dismounting (i.e., dismounting by moving the tool vertically out of this channel). Vertical dismounting has the disadvantage that it suddenly releases the full weight of the tool on the operator. This can be less than ideal in some cases, such as when particularly heavy tools are used. In contrast, the embodiments of the present group provide a tool that is not adapted for being dismounted by moving the tool vertically out of the tool holder's channel. Rather, this tool is adapted to prevent vertical dismounting.

In the present embodiment group, the tool has a retractable safety key, and the tool T is not adapted for being dismounted from the tool holder by moving the tool vertically out of the channel. Rather, the tool is adapted to prevent such vertical dismounting. In certain embodiments, this is accomplished by providing a tool that has no externally accessible actuator for retracting the safety key. Further, some embodiments provide a tool of this nature in combination with a tool holder that has no device for retracting the safety key (once it has been extended into/engaged with a safety groove/recess of the tool holder). Thus, once the tool's shank is moved into its operative position in the channel of the tool holder a press brake operator is prevented from retracting the safety key and

removing the tool vertically from the tool holder. As a result, the tool T is designed to prevent vertical removal and to only allow removal by sliding the tool lengthwise (i.e., longitudinally) out of the channel C of the tool holder. Further details of click-in/slide-out tools are described in U.S. Patent No. 7,021,116, the entire contents of which are incorporated herein by reference.

Figure 30 depicts one exemplary embodiment of a click-in/slide-out tool having a seating mechanism SM. Here, the seating mechanism comprises a plurality of rod members RM. The seating mechanism, however, can alternatively comprise one or more wedge members and/or any other type(s) of moveable seating bodies described above. For example, another embodiment involves an arrangement like that shown in Figure 30 with the exception that at least one of the rod members RM (optionally each rod member) is replaced with a wedge member (or a pair of wedge members) adapted to provide the seating functionality described herein. Many other variants will be apparent to skilled artisans given the present disclosure as a guide.

The invention provides a variety of methods for operating a press brake. Some embodiments, for example, provide a method of mounting a press brake tool TL on a tool holder TH of a press brake having a pressing axis. The tool holder has a tool-mount channel C bounded by first and second confronting walls CW, CW'. Here, the first confronting wall CW' is moveable at least in part toward the second confronting wall CW. The tool holder TH, in some embodiments, has at least one load-delivering surface LD and is adapted for moving the tool TL when operatively mounted on the tool holder along the pressing axis PA. The tool TL has a shank S and at least one load-receiving surface LR. The tool TL in the present method also has a seating mechanism SM. The method comprises positioning the tool's shank S in the tool-mount channel C and moving the first confronting wall CW' at least in part toward the second confronting wall CW thereby forcibly clamping the tool's shank between the confronting walls CW, CW' so as to deliver to the shank a force that is at least partially converted into a seating component directed at least generally parallel to the pressing axis PA. The seating component of this force moves the tool TL relative to the tool holder TH so as to bring the load-receiving surface LR of the tool into engagement with the load-delivering surface LD of the tool holder.

The seating mechanism SM in the present method optionally comprises a moveable body MB mounted on the tool TL so as to be moveable relative to a portion (e.g., a stationary portion SP) of the tool's shank S, such that forcibly clamping the tool's shank between the confronting walls CW, CW' causes the moveable body to bear forcibly against a portion of the tool's shank thereby delivering at least the seating component of the force to the tool's shank (and desirably moving the tool in the manner described above).

The moveable body MB in the present method can optionally be a wedge member WM carried (at least in part) alongside a cam surface CM of the tool's shank S. Here, forcibly clamping the tool's shank S between the confronting walls CW, CW' causes the wedge member WM to bear forcibly against, and cam with, the cam surface CM of the tool's shank so as to cause relative movement of the wedge member and the cam surface CM.

In the present method, the seating mechanism SM can optionally comprise two moveable bodies MB mounted at least in part on opposite sides of the tool's shank S. The two moveable bodies MB can be wedge members, if so desired. Forcibly clamping the shank S of such a tool TL between the confronting walls CW, CW' of the tool holder TH causes the wedge members WM to bear forcibly against, and cam with, respective cam surfaces CM on the tool's shank. As noted above, this clamping can optionally cause opposed contact surfaces of the two wedge members to move closer together.

In some of the present method embodiments, the moveable body MB is a wheel member WH and forcibly clamping the tool's shank S between the confronting walls CW, CW' of the tool holder TH involves the wheel member engaging one of the confronting walls thereby causing the wheel to rotate.

In some embodiments of the present method, the tool holder TH defines a safety groove SR open to the tool-mount channel C, the tool TL further comprises a retractable safety key SK, and the method includes moving the tool's safety key into the tool holder's safety groove.

When provided, the safety key SK can optionally be operably coupled with a moveable link member LM such that the safety key moves along a lateral axis of the tool TL in response to the link member moving along a vertical axis of the tool. In some methods involving a press brake tool TL of this nature, moving the tool's safety key SK

into the tool holder's safety groove SR involves the safety key moving along the lateral axis of the tool in response to the link member moving along the vertical axis of the tool.

In some embodiments of the present method wherein the tool TL includes both a retractable safety key SK and a link member LM, the safety key SK is moveable between an extended position and a retracted position, the link member LM is moveable between a first position and a second position, the safety key moves to its retracted position in response to the link member moving to its second position, the safety key moves to its extended position in response to the link member moving to its first position, and moving the tool's safety key into the tool holder's safety groove SR involves the safety key moving to its extended position in response to the link member moving to its first position.

Figures 19 through 22 exemplify a further embodiment wherein a moveable ball member BA is provided on the tool TL so as to facilitate tool locating (i.e., so as to facilitate locating the shank S of the tool in the channel C of the tool holder TH). Here, the confronting walls CW, CW' of the tool holder TH each define a recess SRE bounded by a curved wall portion SSF. The shank S of the tool TL has a ball member BA that is resiliently biased toward a first position. When the ball member BA is in its first position, a portion of the ball member projects outwardly through an opening BO in the tool's shank. Thus, when the tool's shank S is positioned in the tool holder's channel C, the ball member BA engages a recess SRE of the tool holder TH and is thereby wedged between a curved wall portion SSF of the tool holder and a stationary portion of the tool's shank. Referring to Figure 19, it can be appreciated that the ball member BA is mounted in a bore BOB extending through at least a portion of the tool. The bore has an outlet BO, which opens through a wall of the tool's shank. This is perhaps best seen in Figure 20. Referring again to Figure 19, it can be appreciated that a link member LM is slidably disposed in the bore BOB and has one end region LMER against which the ball member BA is received. In Figure 19, it can be appreciated that this end region LMER can optionally have a concave end surface that is adapted to cradle the ball member BA. The illustrated link member LM also has a base end LMBE against which a spring member (not shown, but optionally mounted in a blind end region PCK of the bore BOB) is adapted to bear forcibly so as to resiliently bias the link member LM toward its first position. The tool TL shown in Figure 19 has an actuator A that can be operated so as to move the link member LM out of its first position (in the process overcoming the resilient

bias of a spring in the blind end region PCK of the bore BOB), which in turn allows the ball member BA to move entirely inside the bore BOB and out of engagement with the tool holder TH.

In Figure 19, the illustrated actuator A and link member LM are adapted to coact by virtue of a camming action. In particular, when the actuator A is operated (e.g., by depressing its externally-accessible portion AA), an end region AAL of the actuator bears forcibly against, and cams with, a cam surface LMC of the link member LM. The illustrated link member LM has a notch formed in its side surface, and this notch is bounded by the cam surface LMC.

In some of the present ball member embodiments, the ball member BA has a diameter that is at least about one-fifth of the lateral width of the tool's shank, and perhaps more preferably is at least about one-fourth the lateral width of the tool's shank.

Thus, the tool TL can be provided with a seating mechanism comprising one or more moveable bodies (e.g., wedge members, rod members, wheel members, and/or ball members) of various different designs. In one group of embodiments, the tool holder includes a moveable body having at least one part (optionally the whole moveable body) comprising a polymer, optionally with a filler. In some of these embodiments, the moveable body consists essentially of the polymer and the filler. One useful polymer is nylon, such as nylon 66. Torlon or ultra high molecular weight polyethylene may also be suitable. If so desired, the polymer can comprise a filler that provides increased hardness, increased durability, and/or decreased flexibility. Glass fibers are an advantageous filler. One embodiment involves a nylon polymer with a glass filler (e.g., nylon 66 with 20% glass filler). Other useful fillers may include fumed silica or talc. When provided, each moveable body comprising polymer can be produced by conventional molding methods. Suitable polymer components can also be obtained commercially from companies like The ProtoMold Company (Maple Plain, Minnesota, U.S.A.).

In certain embodiments involving a moveable body MB comprising a polymer, the moveable body comprises (e.g., optionally is) a wedge member WM at least a portion of which is carried alongside a cam surface CM of the tool's shank. Here, the wedge member WM comprises the polymer and is adapted to bear forcibly against, and cam with, the cam surface CM so as to cause relative movement of the wedge member and the cam surface. The cam surface can optionally be defined by a slanted and/or radiused wall of

the tool's shank. Seating mechanisms of this nature are described above in more detail. Some embodiments provide the cam surface CM in the form of metal (e.g., steel) over which a coating is provided. The coating, for example, can comprise nitrogen and/or carbon (e.g., it can be a nitride and/or nitrocarbide enhancement, as described below).

Certain embodiments involving polymer technology provide a seating mechanism that includes two moveable bodies MB mounted at least in part on opposite sides of the tool's shank. The two moveable bodies, for example, can be wedge members WM that bear forcibly against, and cam with, respective cam surfaces CM on the tool's shank in response to the confronting walls of the tool holder clamping forcibly on opposite sides of the tool's shank. In the present embodiments, each wedge member WM comprises the polymer. The seating mechanism in some of these embodiments has an extended configuration and a retracted configuration, where opposed contact surfaces CS of the two wedge members are further apart when the seating mechanism is in its extended configuration than when the seating mechanism is in its retracted configuration, and where the opposed contact surfaces of the two wedge members move closer together in response to the confronting walls of the tool holder clamping forcibly on the opposite sides of the tool's shank. Each cam surface CM can optionally be defined by a slanted and/or radiused wall of the tool's shank. Seating mechanisms of this nature are described above in more detail.

The invention provides a number of embodiments wherein the seating mechanism comprises at least one moveable body formed of one material while the tool's shank (or at least a cam surface thereof and/or a stationary portion thereof) is formed of another (different) material. The seating mechanism, for example, can include a moveable body comprising a polymer while the tool's shank (or at least a cam surface thereof, and/or a stationary portion thereof, optionally a major portion thereof) comprises metal (e.g., steel).

In one group of embodiments, the tool TL is provided with a coating 907 over at least one surface. In some embodiments of this group, a coating 907 is provided on a cam surface CM (e.g., a surface against which a moveable body MB of the seating mechanism is adapted to cam during clamping of a tool holder on the tool's shank) of the tool's shank. Here, the cam surface CM is not a surface that comes into contact with the tool holder or the workpiece during operation. The coating 907, however, can be provided on such a cam surface to minimize or reduce any binding that may otherwise occur between the

moveable body or bodies of the seating mechanism and the cam surface(s) CM of the tool's shank. Reference is made to Figure 26.

In some embodiments, the tool TL is provided with a coating 907 over at least a majority of its shank's surface area (optionally over substantially all of its surface area, over substantially all of its surface area excluding at least some internal surfaces, over substantially all of its surface area including internal surfaces, over substantially all of its surface area excluding surfaces of a safety key and/or link member, etc.). The coating can be provided to increase surface hardness, to increase lubricity, and/or to otherwise protect against wear, corrosion, sticking, and/or galling.

When provided, the coating can optionally be a dry lubricant coating. For example, the coating can comprise nickel (e.g., nickel alloy) and/or a low friction polymer. In some cases, the coated surface has one or more of the following features: (i) a coefficient of static friction below 0.35, below 0.3, or even below 0.2; (ii) a coefficient of dynamic friction below 0.3, below 0.25, below 0.18, or even below 0.1. Useful dry lubricant coatings are available commercially from, for example, General Magnaplate Corporation (Linden, New Jersey, USA) and Poeton Industries, Ltd. (Gloucester, England). As one example, the coating can be a NEDOX® coating.

In one subgroup of the present embodiments, the coating comprises a nitride and/or a carbide. One commercially available nitride coating is the Nitrex® coating, which is a high endurance surface enhancement available commercially from Nitrex, Inc. (Aurora, Illinois, USA). Particularly useful nitriding and nitrocarburizing enhancements are described in U.S. Patent 6,327,884, the entire teachings of which are incorporated herein by reference.

Nitriding and nitrocarburizing processes are known in the field and need not be described in great detail. Reference is made to U.S. Patent Nos. 4,790,888 and 4,268,323, the teachings of which regarding such enhancements are incorporated herein by reference. The latter patent refers to the use of a fused salt bath to enable nitrogen and carbon to diffuse into the surface of a steel piece suspended in the bath to form a carbonitride case. Reference is made also to U.S. Patent No. 5,234,721 (referring to methods of forming carbonitride coatings), the teachings of which regarding such coatings are incorporated herein by reference.

Nitriding processes, both plasma (ion) nitriding and liquid nitriding, are described in detail in the ASM Handbook prepared under the direction of the ASM International Handbook Committee, Revised vol. 4: *Heat Treating*, pp. 410-424 (1994), the teachings of which concerning nitriding enhancements are incorporated herein by reference. Plasma or ion nitriding involves the use of glow discharge technology to provide nascent nitrogen to the surface of a heated steel part. Here, the part is subjected to a nitrogen plasma in a vacuum chamber. Nascent nitrogen diffuses into the surface of the part to form an outer "compound" zone containing γ (Fe_4N) and ε ($Fe_{2,3}N$) intermetallics, and an inner "diffusion" zone which may be described as the original core microstructure with some solid solution and precipitation strengthening. Liquid nitriding involves immersing a steel part in a molten, nitrogen-containing fused salt bath containing cyanides or cyanates, e.g., NaCN or NaCNO. Tool components can be enhanced by liquid nitriding through a wide variety of commercial coating manufacturers, such as Metal Treaters Inc. of St. Paul, Minnesota, USA.

While preferred embodiments of the present invention have been described, it is to be understood that numerous changes, adaptations, and modifications can be made to the preferred embodiments without departing from the spirit of the invention and the scope of the claims. Thus, the invention has been described in connection with specific embodiments for purposes of illustration. The scope of the invention is described in the claims, which are set forth below.

WHAT IS CLAIMED IS:

1. A press brake tool configured for being operatively mounted on a tool holder of a press brake having a pressing axis, the tool having a shank adapted for being positioned in a tool-mount channel of the tool holder such that the shank when clamped forcibly between confronting walls of the tool holder receives a force having a clamping component directed at least generally perpendicular to the pressing axis, wherein the tool has a seating mechanism that is adapted for at least partially converting said force into a seating component directed at least generally parallel to the pressing axis, and wherein the seating mechanism comprises a moveable body mounted on the tool so as to be moveable relative to a stationary portion of the tool's shank.

2. The press brake tool of claim 1 wherein the moveable body bears forcibly against a portion of the tool's shank and thereby delivers at least the seating component of said force to the tool's shank in response to said confronting walls of the tool holder clamping forcibly on the tool's shank.

3. The press brake tool of claim 1 wherein the moveable body comprises a wedge member at least a portion of which is carried alongside a cam surface of the tool's shank, the wedge member being adapted to bear forcibly against, and cam with, the cam surface so as to cause relative movement of the wedge member and the cam surface.

4. The press brake tool of claim 3 wherein said cam surface is defined by a slanted and/or radiused wall of the tool's shank.

5. The press brake tool of claim 1 wherein the seating mechanism comprises two moveable bodies mounted at least in part on opposite sides of the tool's shank.

6. The press brake tool of claim 5 wherein said two moveable bodies are wedge members that bear forcibly against, and cam with, respective cam surfaces on the tool's shank in response to said confronting walls of the tool holder clamping forcibly on said opposite sides of the tool's shank.

7. The press brake tool of claim 6 wherein the seating mechanism has an extended configuration and a retracted configuration, and wherein opposed contact surfaces of said two wedge members are further apart when the seating mechanism is in its extended configuration than when the seating mechanism is in its retracted configuration.

8. The press brake tool of claim 7 wherein said opposed contact surfaces of said two wedge members move closer together in response to said confronting walls of the tool holder clamping forcibly on said opposite sides of the tool's shank.

9. The press brake tool of claim 1 wherein the moveable body is a rod member mounted slidably for axial movement relative to the stationary portion of the tool's shank.

10. The press brake tool of claim 1 wherein the moveable body is a wheel member mounted on the tool so as to be rotatably moveable relative to said stationary portion of the tool's shank.

11. The press brake tool of claim 1 wherein the tool further comprises a retractable safety key adapted for engaging a safety groove and/or shelf of the tool holder.

12. The press brake tool of claim 11 wherein the safety key is operably coupled with a moveable link member such that the safety key moves along a lateral axis of the tool in response to the link member moving along a vertical axis of the tool.

13. The press brake tool of claim 12 wherein the link member comprises a rigid rod.

14. The press brake tool of claim 12 wherein the safety key is moveable between an extended position and a retracted position, wherein the link member is moveable between a first position and a second position, wherein the safety key moves to its retracted position in response to the link member moving to its second position, and wherein the safety key moves to its extended position in response to the link member moving to its first position.

15. The press brake tool of claim 14 wherein the link member is resiliently biased toward its first position.

16. The press brake tool of claim 15 wherein the link member is operably coupled with a selectively-operable actuator adapted for being operated at a desired time so as to move the link member to its second position thereby moving the safety key to its retracted position.

17. A method of mounting a press brake tool on a tool holder of a press brake having a pressing axis, the tool holder having a tool-mount channel bounded by first and second confronting walls, wherein the first confronting wall is moveable at least in part toward the second confronting wall, the tool holder having at least one load-delivering surface, the tool having a shank and at least one load-receiving surface, wherein the tool has a seating mechanism comprising a moveable body mounted on the tool so as to be moveable

relative to a stationary portion of the tool's shank, the method comprising positioning the tool's shank in the tool-mount channel and moving the first confronting wall at least in part toward the second confronting wall thereby forcibly clamping the tool's shank between said confronting walls so as to deliver to the shank a force that is at least partially converted by the tool's seating mechanism into a seating component directed at least generally parallel to the pressing axis, the seating component of said force moving the tool relative to the tool holder so as to bring the load-receiving surface of the tool into engagement with the load-delivering surface of the tool holder.

18. The method of claim 17 wherein said forcibly clamping the tool's shank between said confronting walls causes the moveable body to bear forcibly against a portion of the tool's shank thereby delivering at least the seating component of said force to the tool's shank.

19. The method of claim 17 wherein the moveable body is a wedge member carried alongside a cam surface of the tool's shank, wherein said forcibly clamping the tool's shank between said confronting walls causes the wedge member to bear forcibly against, and cam with, the cam surface of the tool's shank so as to cause relative movement of the wedge member and the cam surface.

20. The method of claim 17 wherein the seating mechanism comprises two moveable bodies mounted on opposite sides of the tool's shank, wherein said two moveable bodies are wedge members, and wherein said forcibly clamping the tool's shank between said confronting walls causes said two wedge members to bear forcibly against, and cam with, respective cam surfaces on the tool's shank.

21. The method of claim 20 wherein said forcibly clamping the tool's shank between said confronting walls causes opposed contact surfaces of said two wedge members to move closer together.

22. The method of claim 17 wherein the moveable body is a wheel member and said forcibly clamping the tool's shank between said confronting walls involves the wheel member engaging one of the confronting walls thereby causing the wheel to rotate.

23. The method of claim 17 wherein the tool holder defines a safety groove that is open to the tool-mount channel, wherein the tool further comprises a retractable safety key, and the method includes moving the tool's safety key into the tool holder's safety groove.

24. The method of claim 23 wherein the safety key is operably coupled with a moveable link member such that the safety key moves along a lateral axis of the tool in response to the link member moving along a vertical axis of the tool, and wherein said moving the tool's safety key into the tool holder's safety groove involves the safety key moving along said lateral axis in response to the link member moving along said vertical axis.

25. The method of claim 24 wherein the safety key is moveable between an extended position and a retracted position, wherein the link member is moveable between a first position and a second position, wherein the safety key moves to its retracted position in response to the link member moving to its second position, wherein the safety key moves to its extended position in response to the link member moving to its first position, and wherein said moving the tool's safety key into the tool holder's safety groove involves the safety key moving to its extended position in response to the link member moving to its first position.

26. A press brake tool having a shank that is provided with a retractable safety key, the safety key being moveable between an extended position and a retracted position, wherein the safety key is operably coupled with a moveable link member such that the safety key moves from its extended position to its retracted position in response to the link member moving along a vertical axis of the tool.

27. The press brake tool of claim 26 wherein the link member comprises a rigid rod member.

28. The press brake tool of claim 26 wherein the link member is moveable between a first position and a second position, wherein the safety key moves to its retracted position in response to the link member moving to its second position, and wherein the safety key moves to its extended position in response to the link member moving to its first position.

29. The press brake tool of claim 28 wherein the link member is resiliently biased toward its first position.

30. The press brake tool of claim 29 wherein the link member is operably coupled with a selectively-operable actuator adapted for being operated at a desired time so as to overcome such resilient bias and move the link member to its second position thereby moving the safety key to its retracted position.

31. The press brake tool of claim 30 wherein the safety key is operably coupled with the link member by virtue of a male projection of the link member being slidably received in an elongated angled slot defined by the safety key, said slot extending at an angle relative to said vertical axis of the tool.

32. The press brake tool of claim 31 wherein said angle is between about 5 degrees and about 85 degrees.

33. The press brake tool of claim 31 wherein said male projection of the link member is a pin slidably received in the elongated angled slot defined by the safety key.

34. A press brake tool having a shank adapted for being positioned in a tool-mount channel of a tool holder, wherein a ball member is mounted on the tool so as to be moveable relative to a stationary portion of the tool's shank, the ball member being moveable between an extended position and a retracted position, wherein at least a portion of the ball member projects outwardly from the tool's shank when the ball member is in its extended position.

35. The press brake tool of claim 34 wherein the ball member comprises a metal sphere.

36. The press brake tool of claim 34 wherein the tool's shank has a lateral width and the ball member is a sphere having a diameter of at least about $1/5^{th}$ said lateral width.

37. The press brake tool of claim 34 wherein the tool's shank has two generally opposed sidewalls, wherein a portion of the ball member projects outwardly from a first of said sidewalls when the ball member is in its extended position, and wherein a second of said sidewalls is at least generally planar.

38. The press brake tool of claim 37 wherein the tool includes a load-receiving surface that is at least generally planar, said load-receiving surface being at least generally perpendicular to said second of said sidewalls of the tool's shank.

39. The press brake tool of claim 34 wherein the tool's shank has a non-cylindrical configuration.

40. The press brake tool of claim 34 wherein the ball member is housed in a bore of the tool, and wherein at least part of a spring member is disposed in said bore, said spring member being adapted for resiliently biasing, either directly or via one or more other bodies, the ball member toward its extended position.

41. The press brake tool of claim 40 wherein an elongated link member is also housed in said bore, said elongated link member having opposed first and second end regions, the link member being slidable in said bore between first and second positions the ball member being slidable in said bore between its extended and retracted positions, wherein the ball member is in its extended position when the link member is in its first position, said spring member bearing forcibly against the second end region of the link member thereby resiliently biasing the link member toward its first position.

42. The press brake tool of claim 41 wherein the link member in the bore is located between the ball member and said spring member.

43. The press brake tool of claim 41 wherein the tool includes an actuator that can be operated so as to cause the link member to slide to its second position, thereby overcoming said resilient bias of the spring member and allowing the ball member to move to its retracted position.

44. The press brake tool of claim 43 wherein the actuator comprises a moveable cam body that is adapted to bear forcibly against, and cam with, a cam surface of the link member when the actuator is operated.

45. The press brake tool of claim 44 wherein the link member comprises an elongated shaft, the shaft having therein formed a notch that defines said cam surface of the link member.

46. The press brake tool of claim 41 wherein the link member comprises an elongated shaft having a concave first end region in which a portion of the ball member is nested at least when the ball member is in its extended position.

47. A press brake tool configured for being operatively mounted on a tool holder of a press brake having a pressing axis, the tool having a shank adapted for being positioned in a tool-mount channel of the tool holder such that the shank when clamped forcibly between confronting walls of the tool holder receives a force having a clamping component directed at least generally perpendicular to the pressing axis, wherein the tool has a seating mechanism that is adapted for at least partially converting said force into a seating component directed at least generally parallel to the pressing axis, and wherein the seating mechanism comprises a moveable body mounted on the tool, the moveable body comprising a polymer.

48. The press brake tool of claim 47 wherein the moveable body comprises the polymer and a filler.

49. The press brake tool of claim 48 wherein the moveable body consists essentially of the polymer and filler.

50. The press brake tool of claim 48 wherein the polymer is nylon and the filler is glass.

51. The press brake tool of claim 48 wherein the moveable body comprises a wedge member at least a portion of which is carried alongside a cam surface of the tool's shank, the wedge member comprising the polymer and being adapted to bear forcibly against, and cam with, the cam surface so as to cause relative movement of the wedge member and the cam surface.

52. The press brake tool of claim 51 wherein the cam surface is defined by a metal over which a coating is provided.

53. The press brake tool of claim 52 wherein the cam surface is defined by steel over which the coating is provided.

54. The press brake tool of claim 52 wherein the coating comprises nitrogen and/or carbon.

55. The press brake tool of claim 47 wherein the tool is a punch.

56. The press brake tool of claim 47 wherein the seating mechanism comprises two moveable bodies mounted at least in part on opposite sides of the tool's shank, wherein said two moveable bodies are wedge members that bear forcibly against, and cam with, respective cam surfaces on the tool's shank in response to said confronting walls of the tool holder clamping forcibly on said opposite sides of the tool's shank, wherein each wedge member comprises the polymer, wherein the seating mechanism has an extended configuration and a retracted configuration, wherein opposed contact surfaces of said two wedge members are further apart when the seating mechanism is in its extended configuration than when the seating mechanism is in its retracted configuration, and wherein said opposed contact surfaces of said two wedge members move closer together in response to said confronting walls of the tool holder clamping forcibly on said opposite sides of the tool's shank.

57. The press brake tool of claim 51 wherein the cam surface is defined by a slanted and/or radiused wall of the tool's shank.

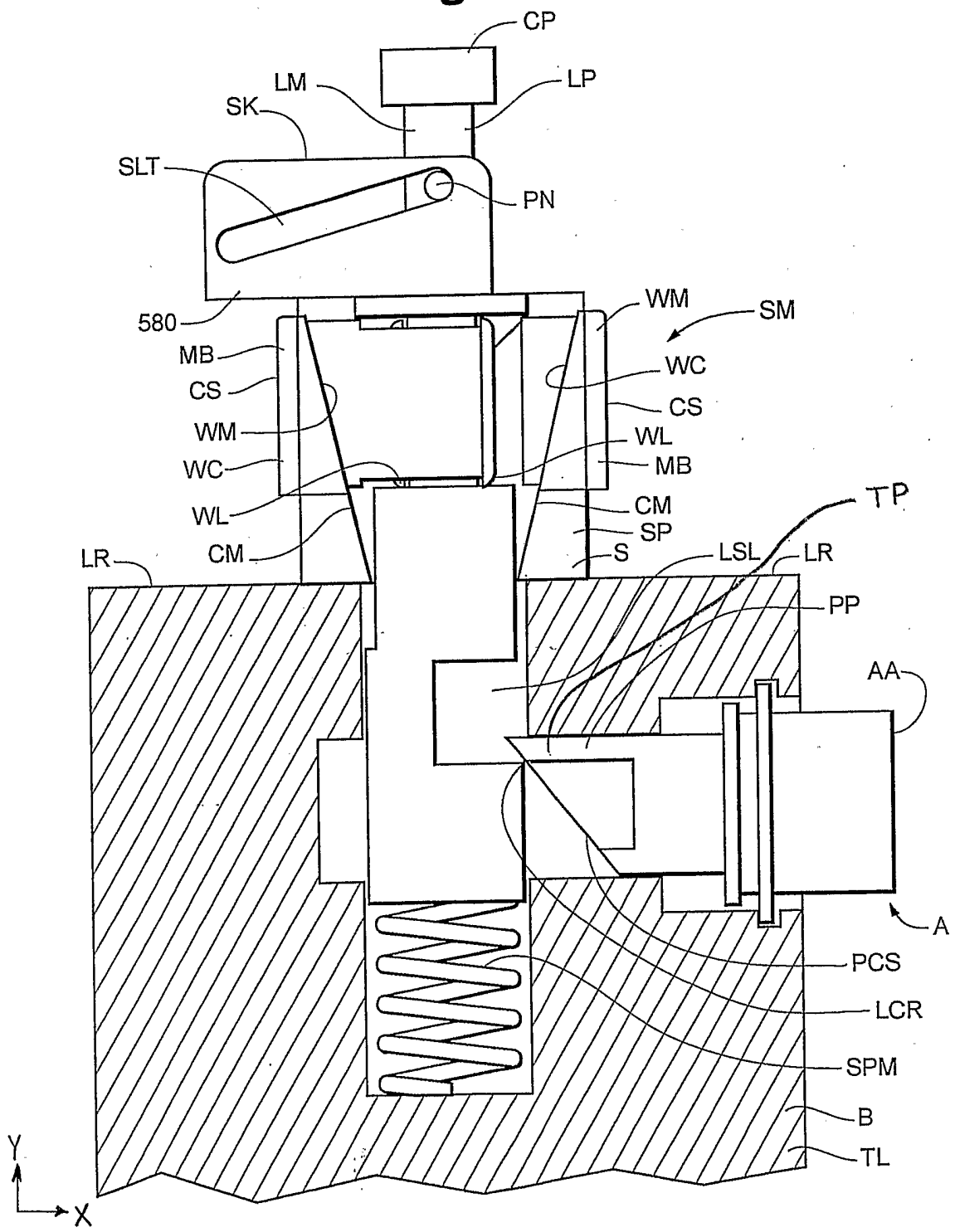
58. A press brake tool configured for being mounted on a tool holder of a press brake by moving a shank of the tool vertically into a tool-mount channel defined by the tool holder, wherein the tool is adapted for being dismounted from the tool holder by moving the tool horizontally out of the channel, and wherein the tool is not adapted for being dismounted from the tool holder by moving the tool vertically out of the channel, the tool having no externally accessible actuator for retracting the safety key such that once the tool's shank is moved into an operative position in the channel of the tool holder a press brake operator is prevented from retracting the safety key and removing the tool vertically from the tool holder, the press brake having a pressing axis, the tool's shank having a retractable safety key and being adapted for being positioned in the channel of the tool holder such that the shank when clamped forcibly between confronting walls of the tool holder receives a force having a clamping component directed at least generally perpendicular to the pressing axis, wherein the tool has a seating mechanism adapted for at least partially converting said force into a seating component directed at least generally parallel to the pressing axis, and wherein the seating mechanism comprises a moveable body mounted on the tool.

59. The press brake tool of claim 58 wherein the seating component of said force is adapted to move the tool relative to the tool holder so as to bring a load-bearing surface of the tool into engagement with a load-bearing surface of the tool holder.

60. The press brake tool of claim 58 wherein the tool is provided in combination with the tool holder, and wherein the tool holder has no externally accessible actuator for causing the tool's safety key to retract such that once the tool's shank is moved into the operative position in the channel of the tool holder the press brake operator is prevented from retracting the safety key and removing the tool vertically from the tool holder.

61. The press brake tool of claim 60 wherein the tool has a leading body portion that terminates at a tip, the leading body portion being that portion of the tool that is not concealed by the tool holder when the tool's shank is in its operative position in the channel of the tool holder, the leading body portion of the tool being defined entirely by solid wall having no openings.

Fig. 1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WM
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Y
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Fig. 2

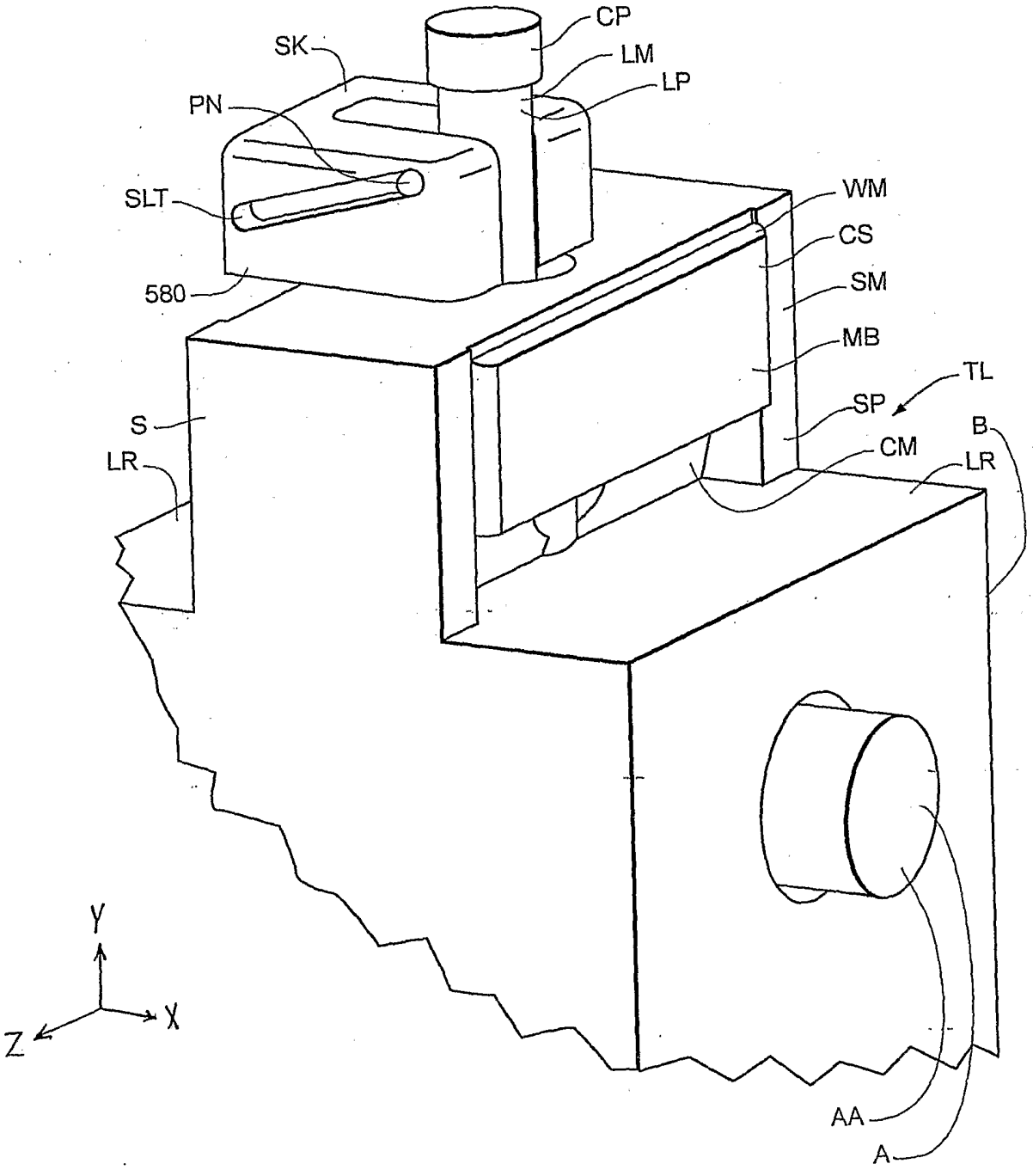

Fig. 3

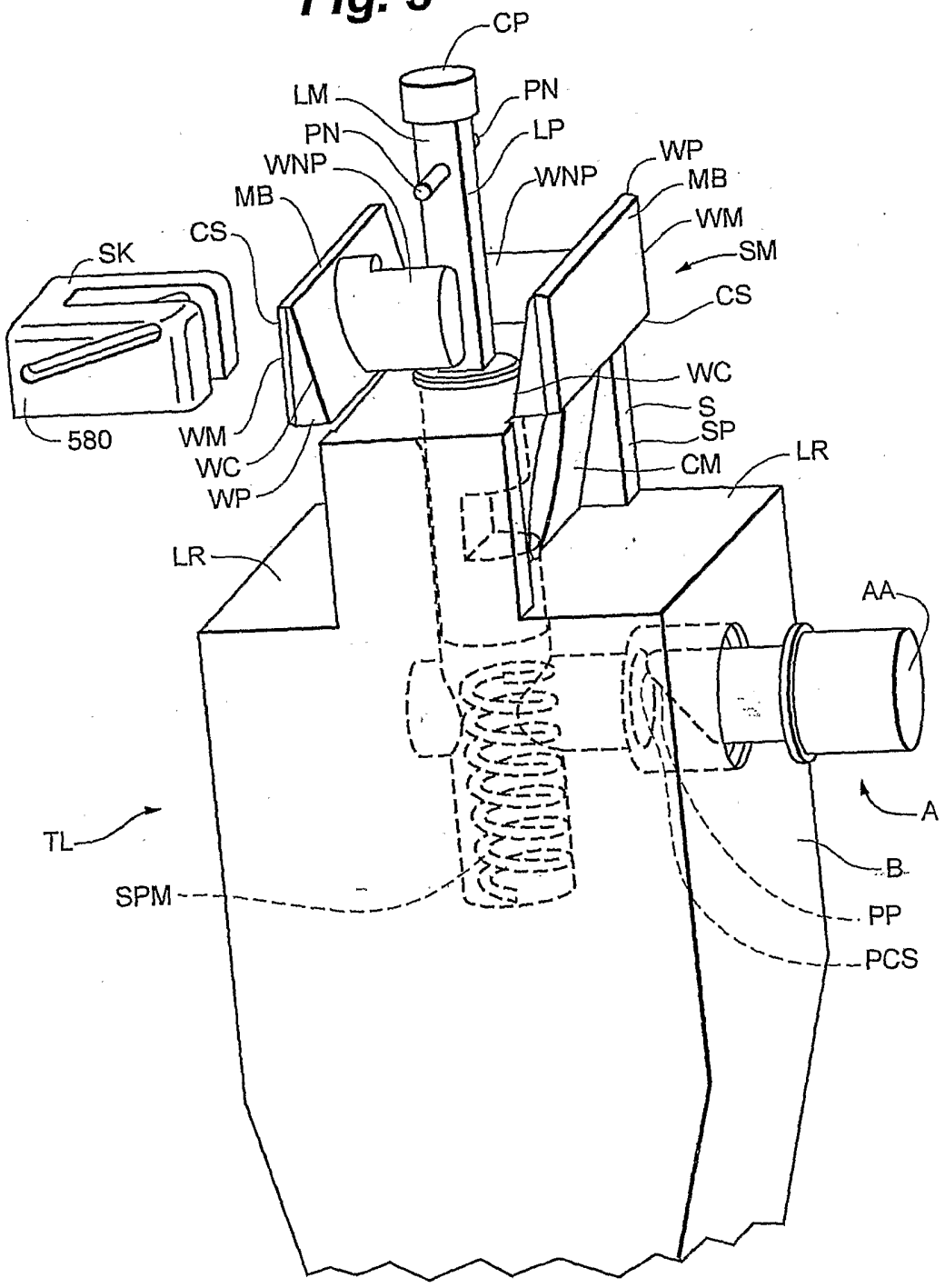
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Fig. 4

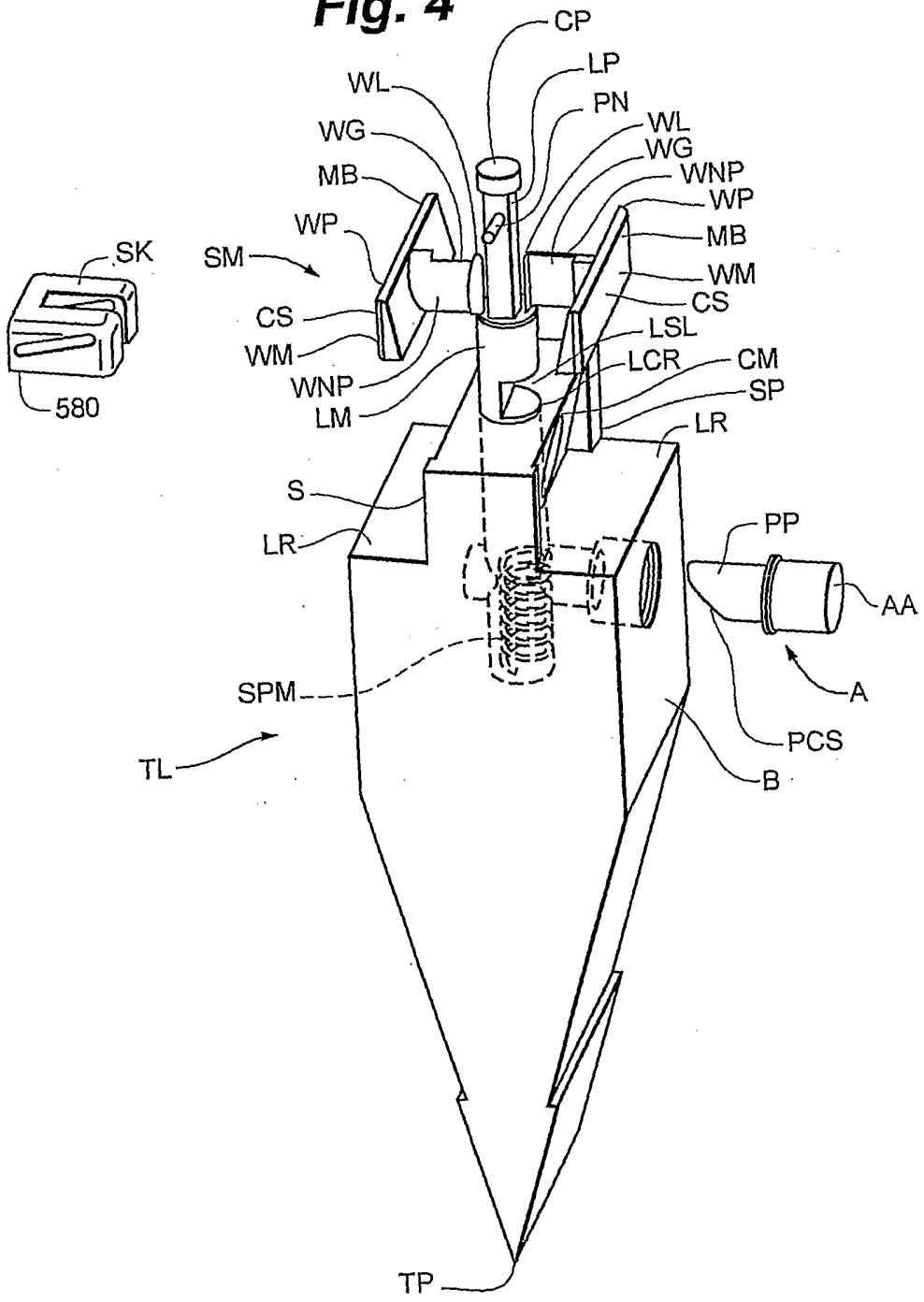
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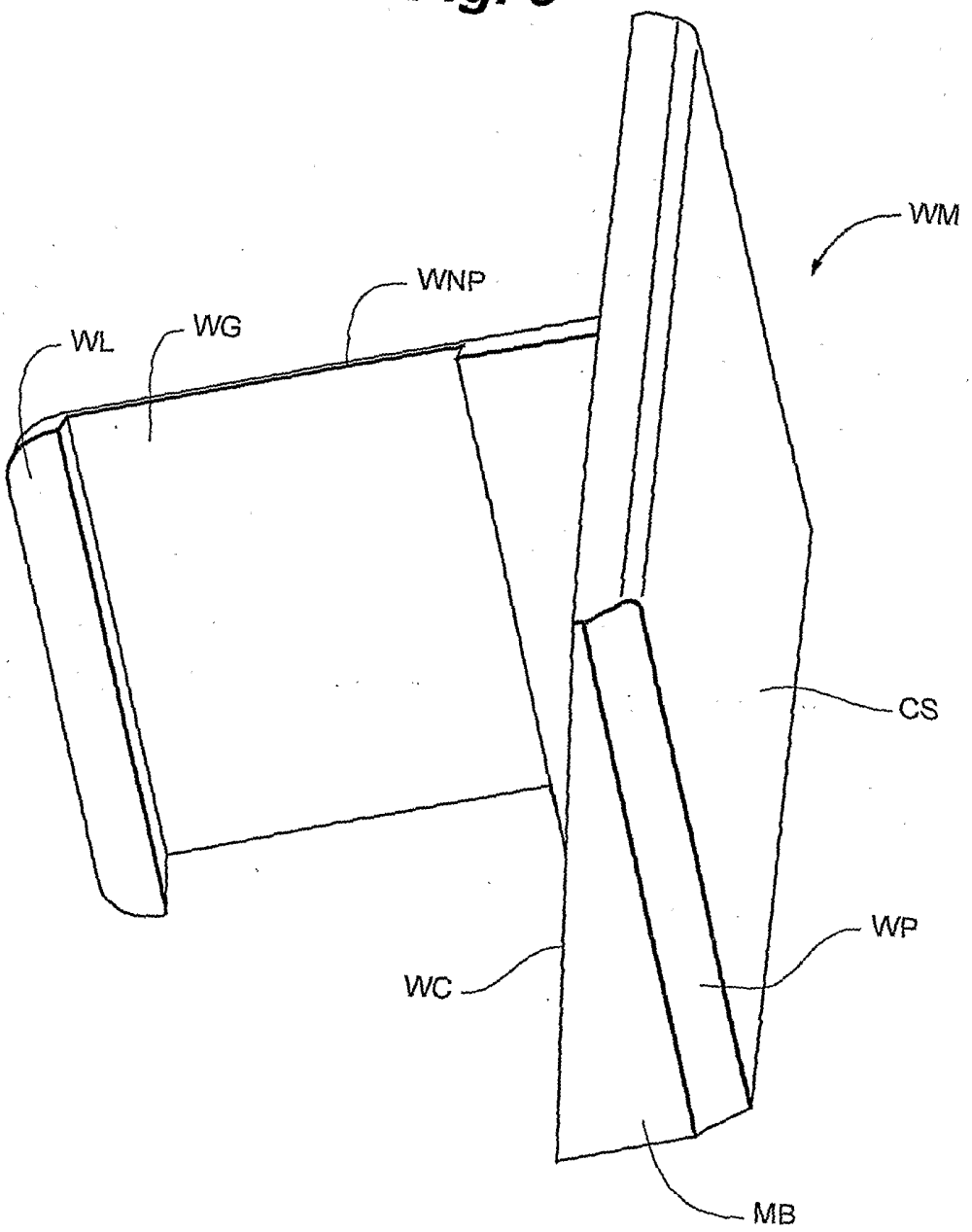
Fig. 5



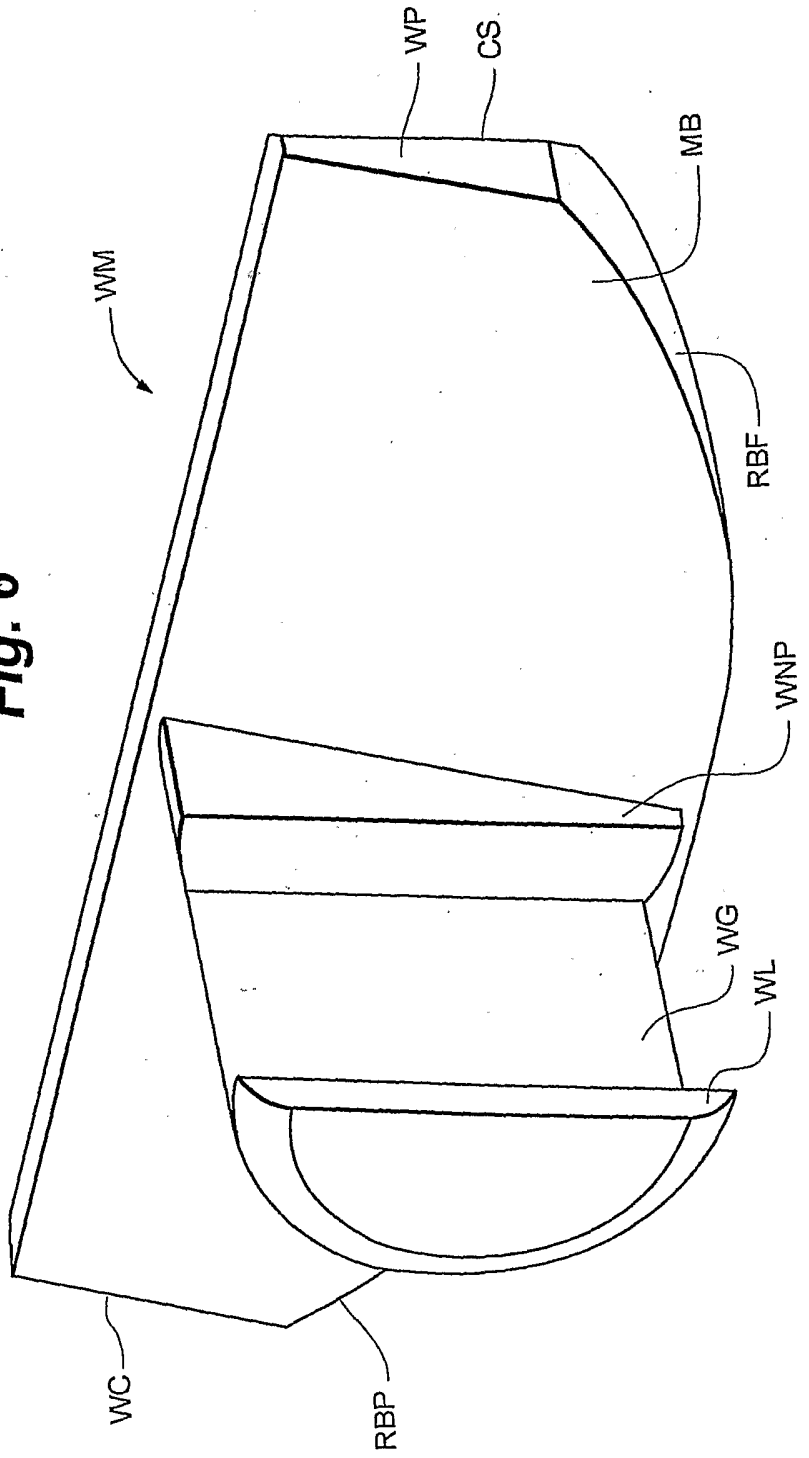


Fig. 6

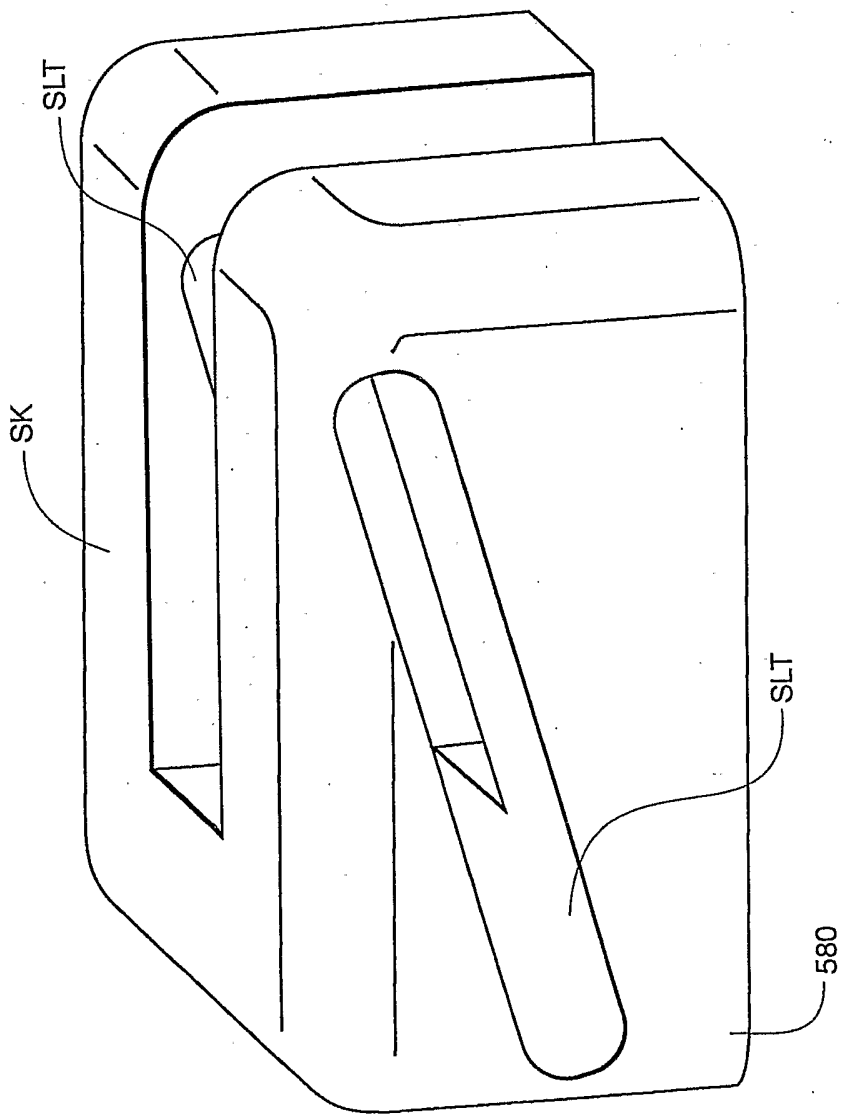


Fig. 7

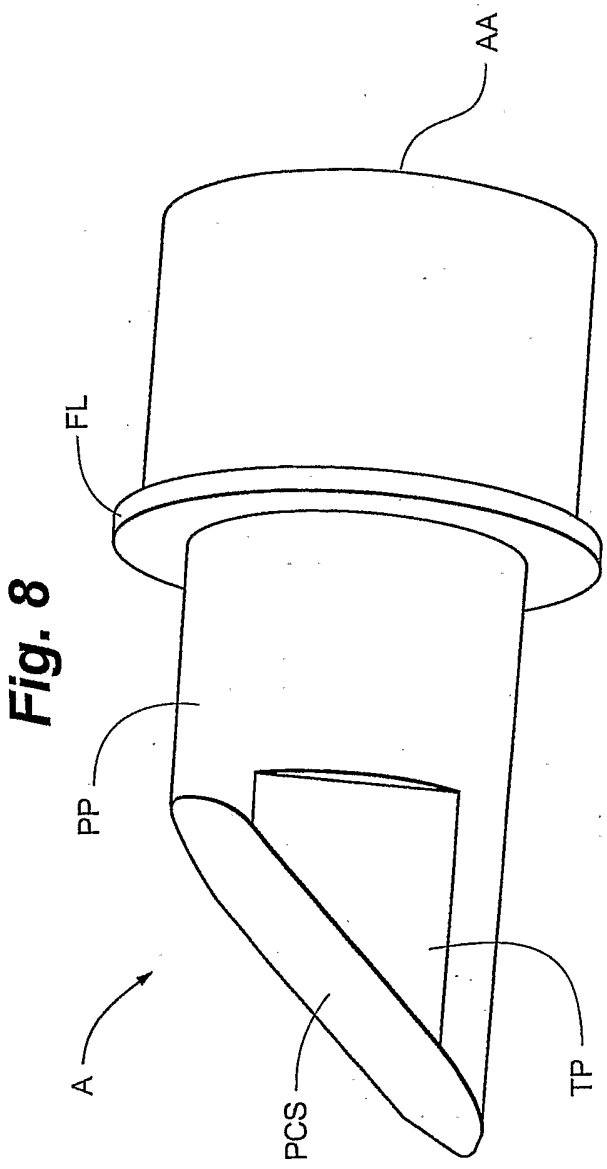


Fig. 8

Fig. 9

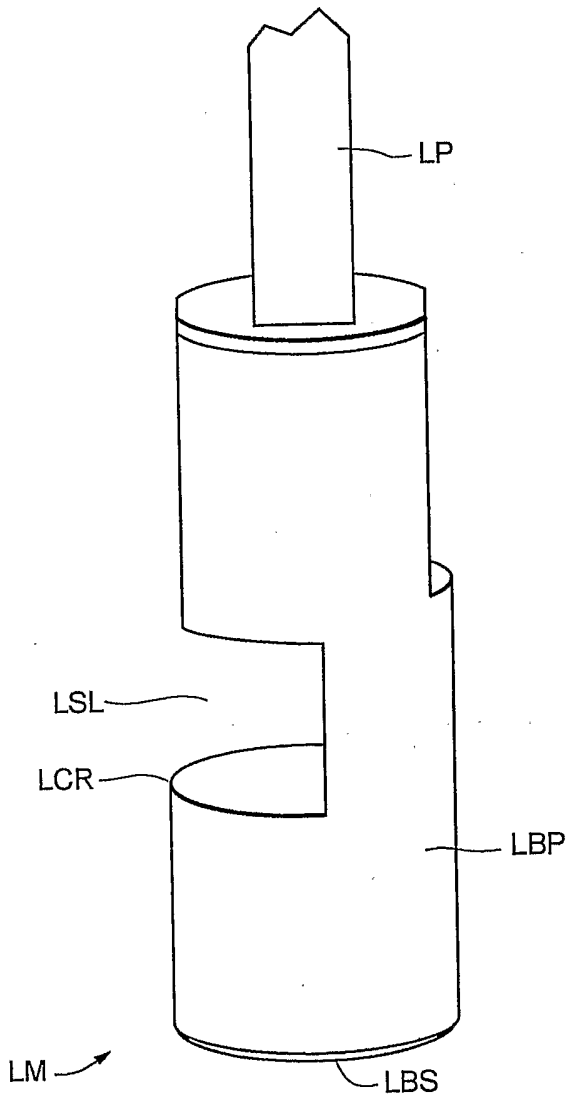
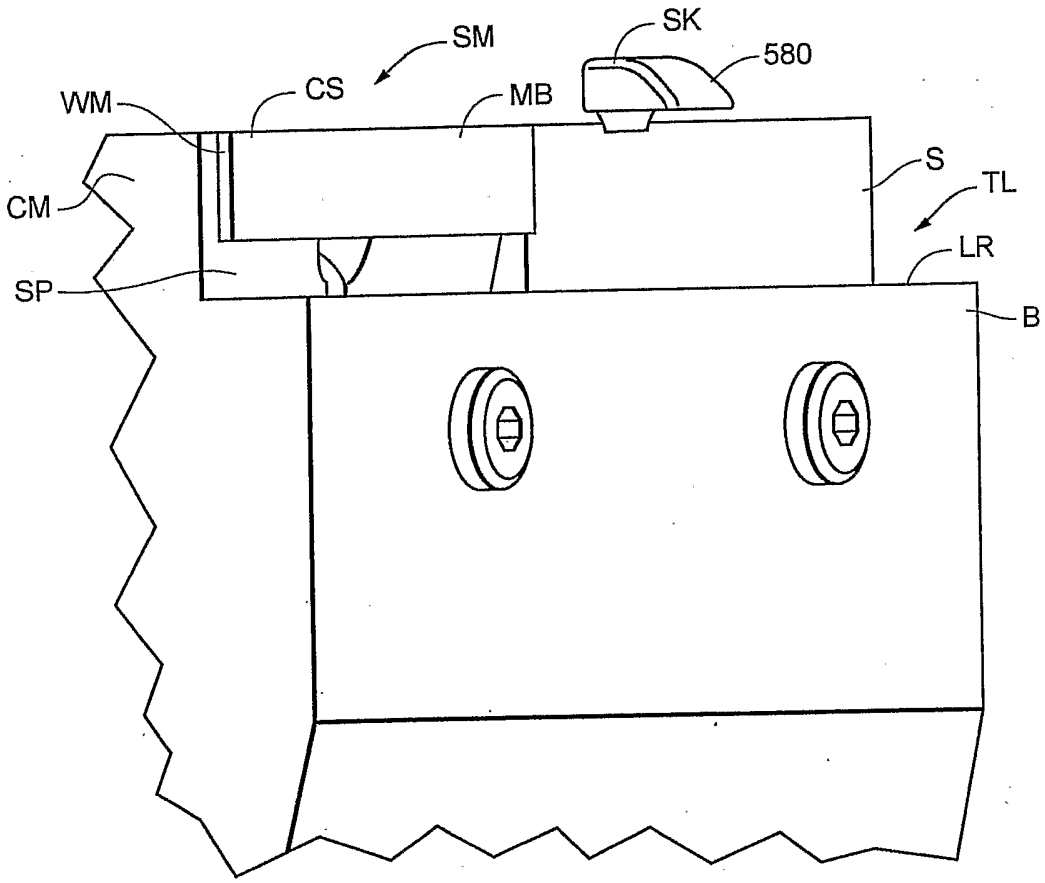


Fig. 10



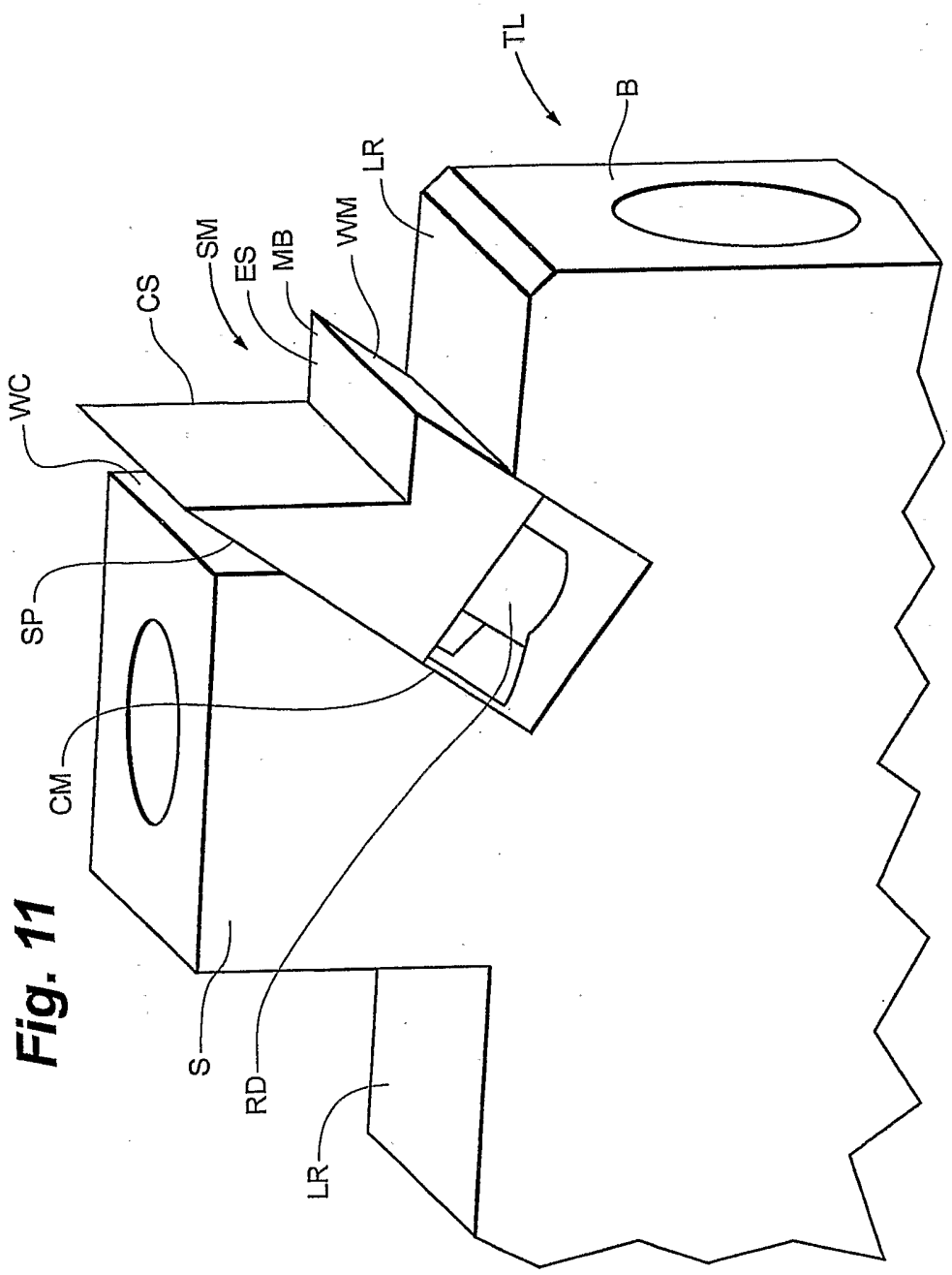
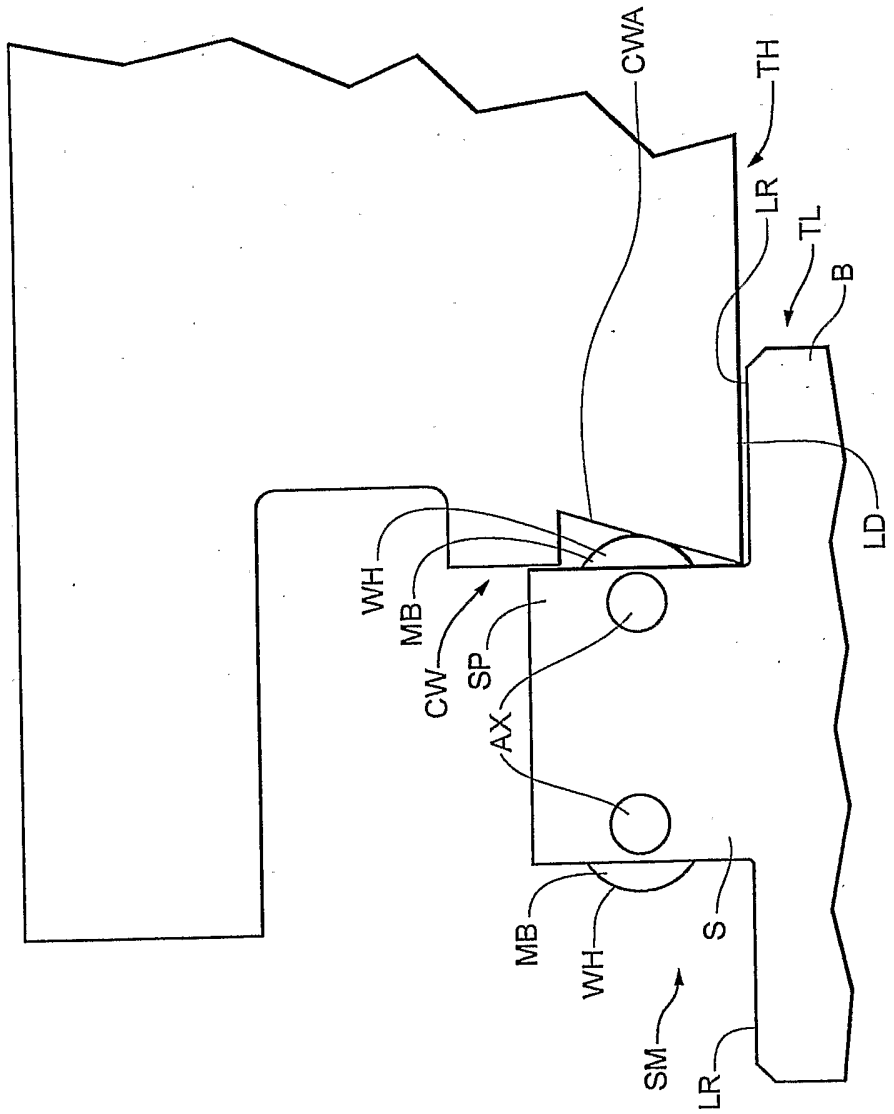


Fig. 11

Fig. 12



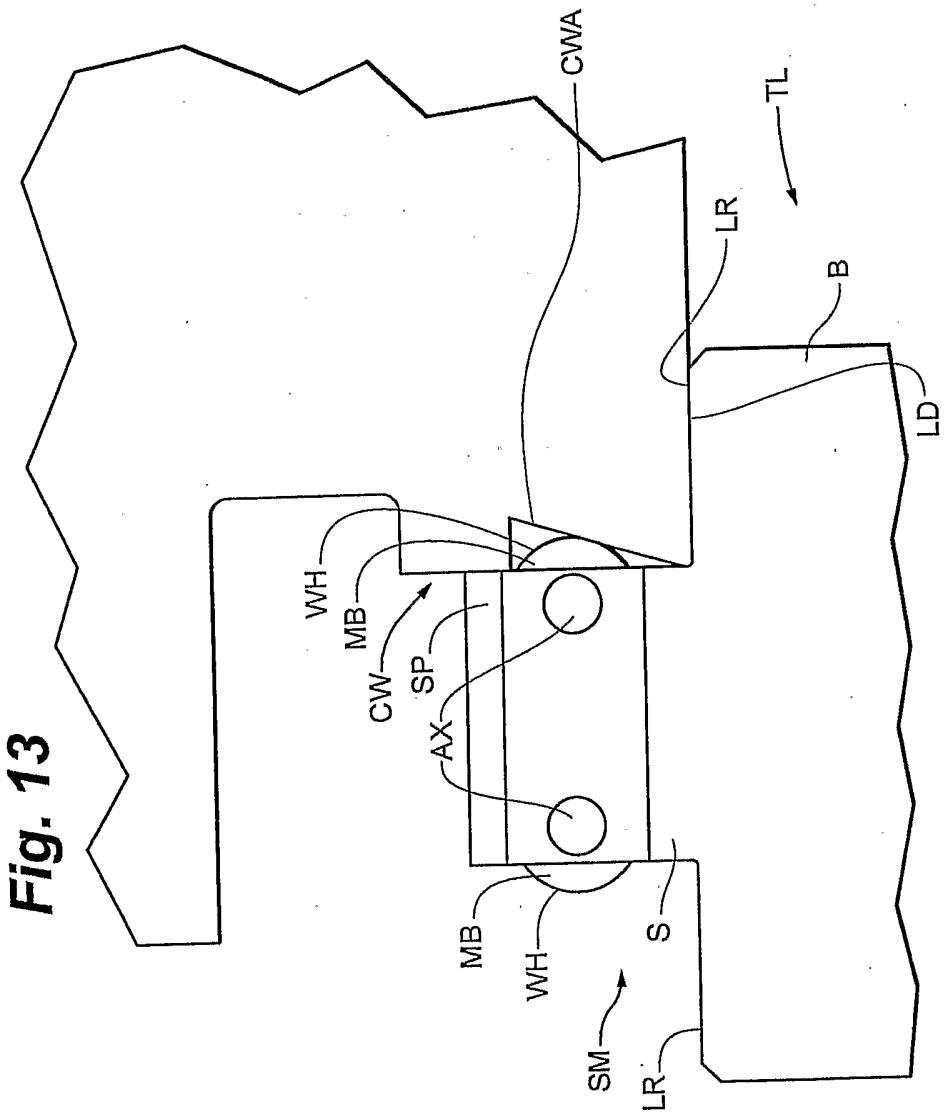


Fig. 13

Fig. 14

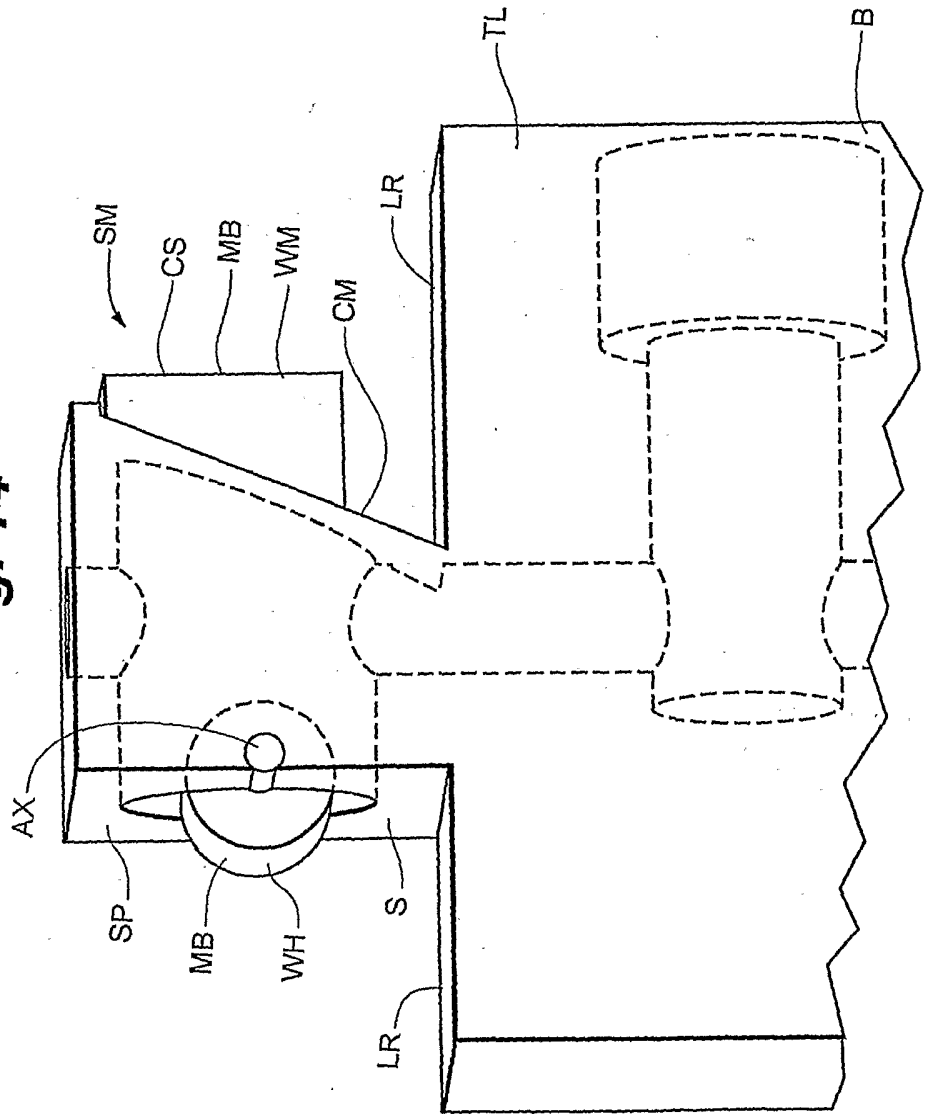


Fig. 15

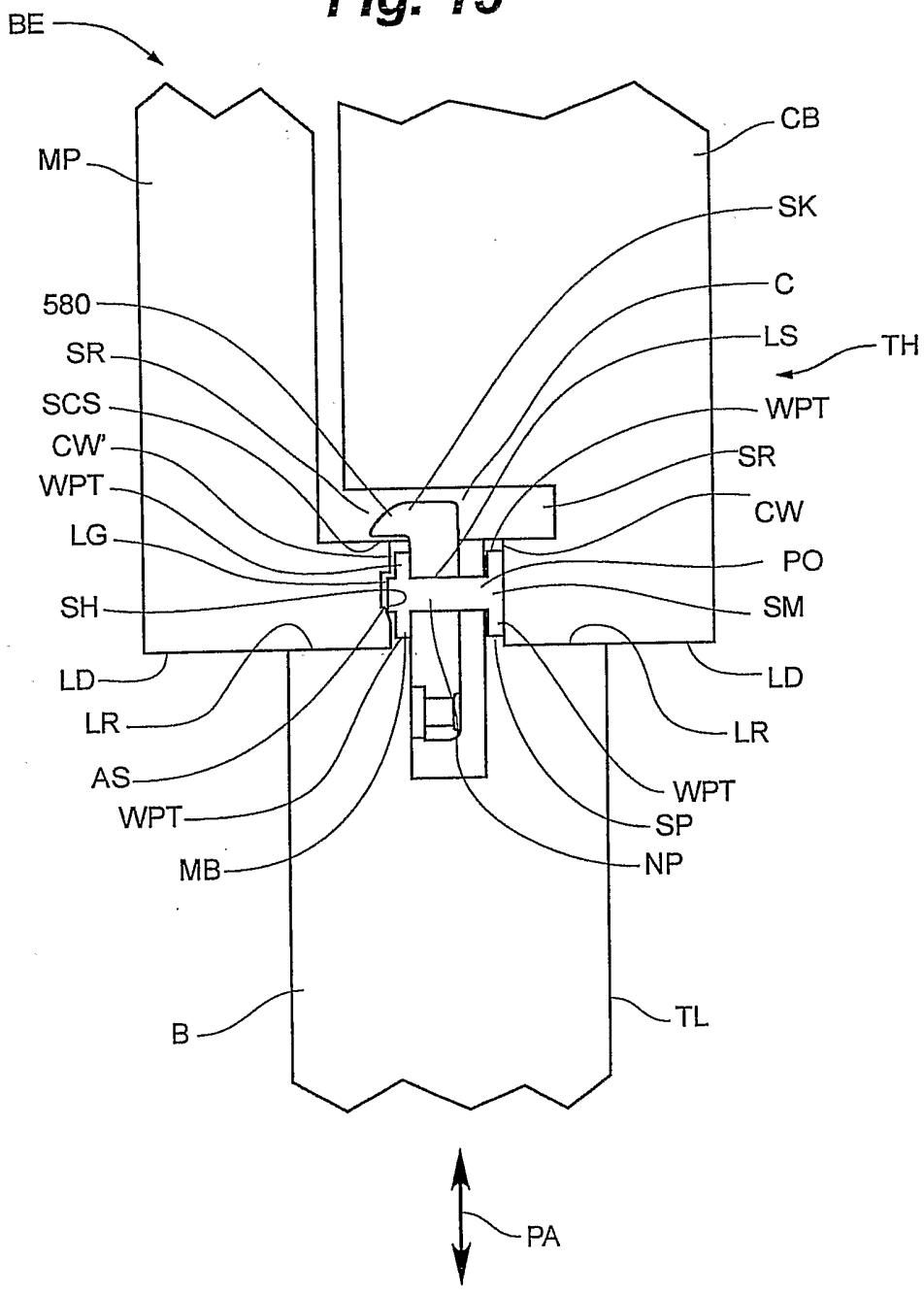

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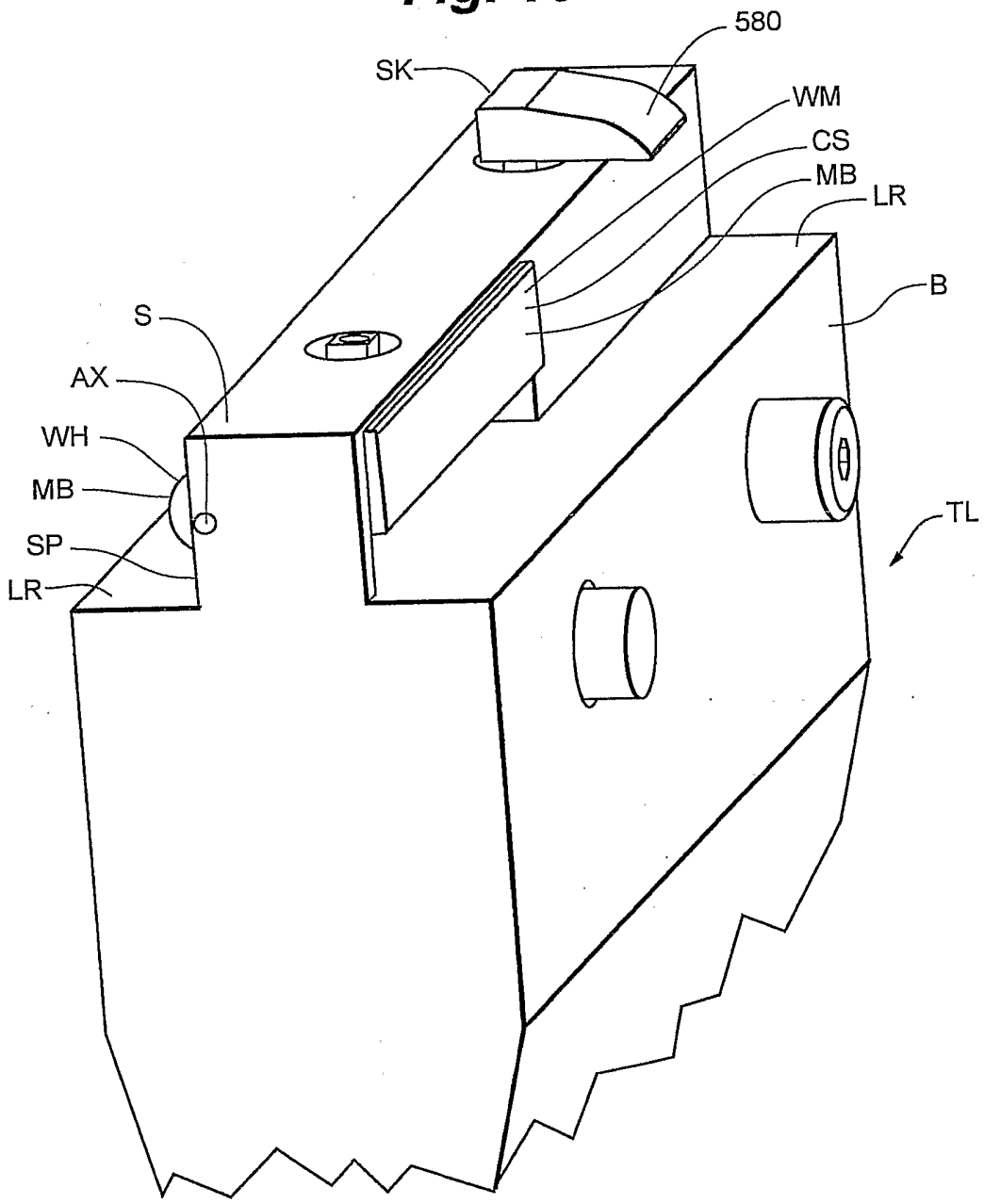
Fig. 16



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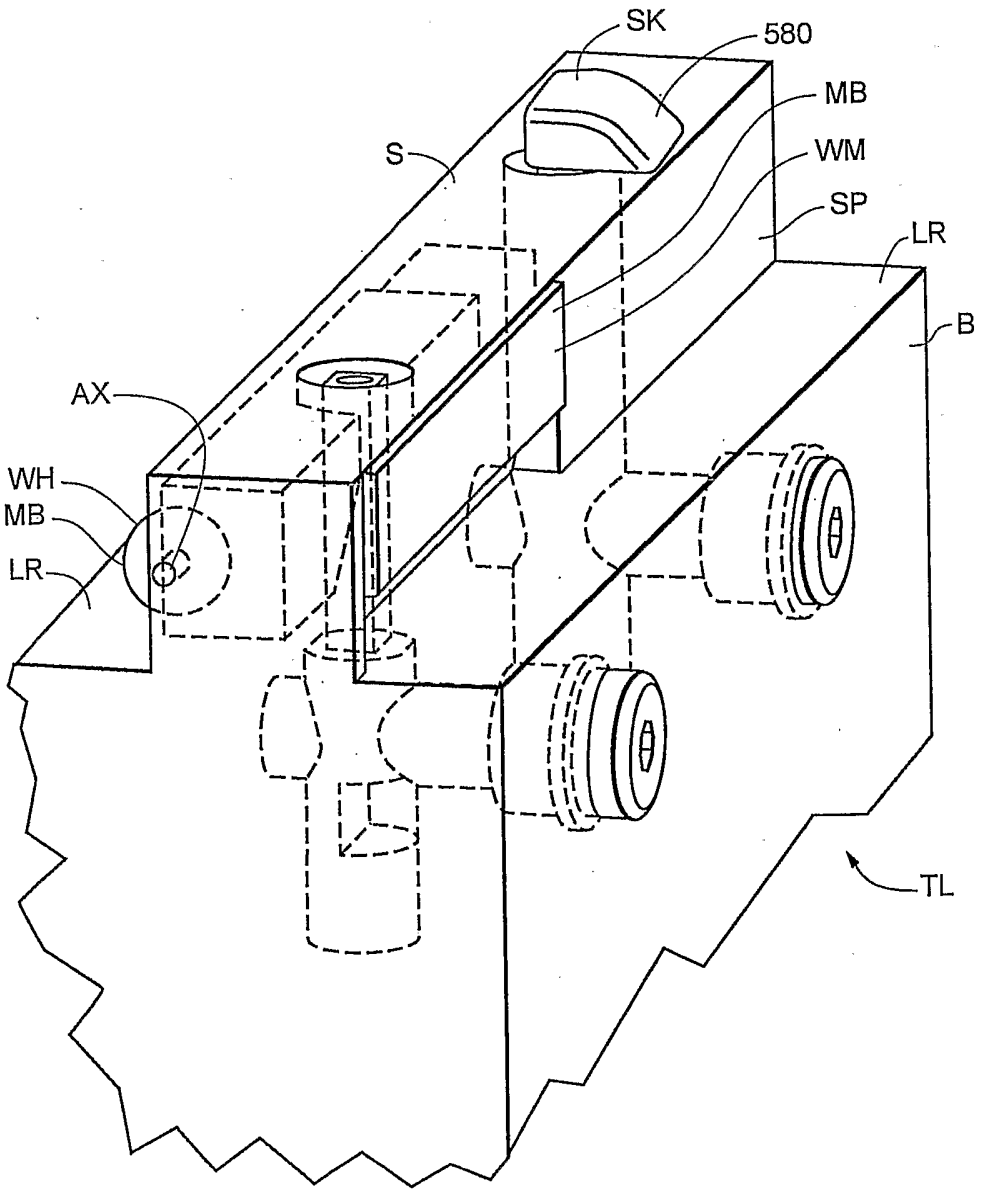


Fig. 18

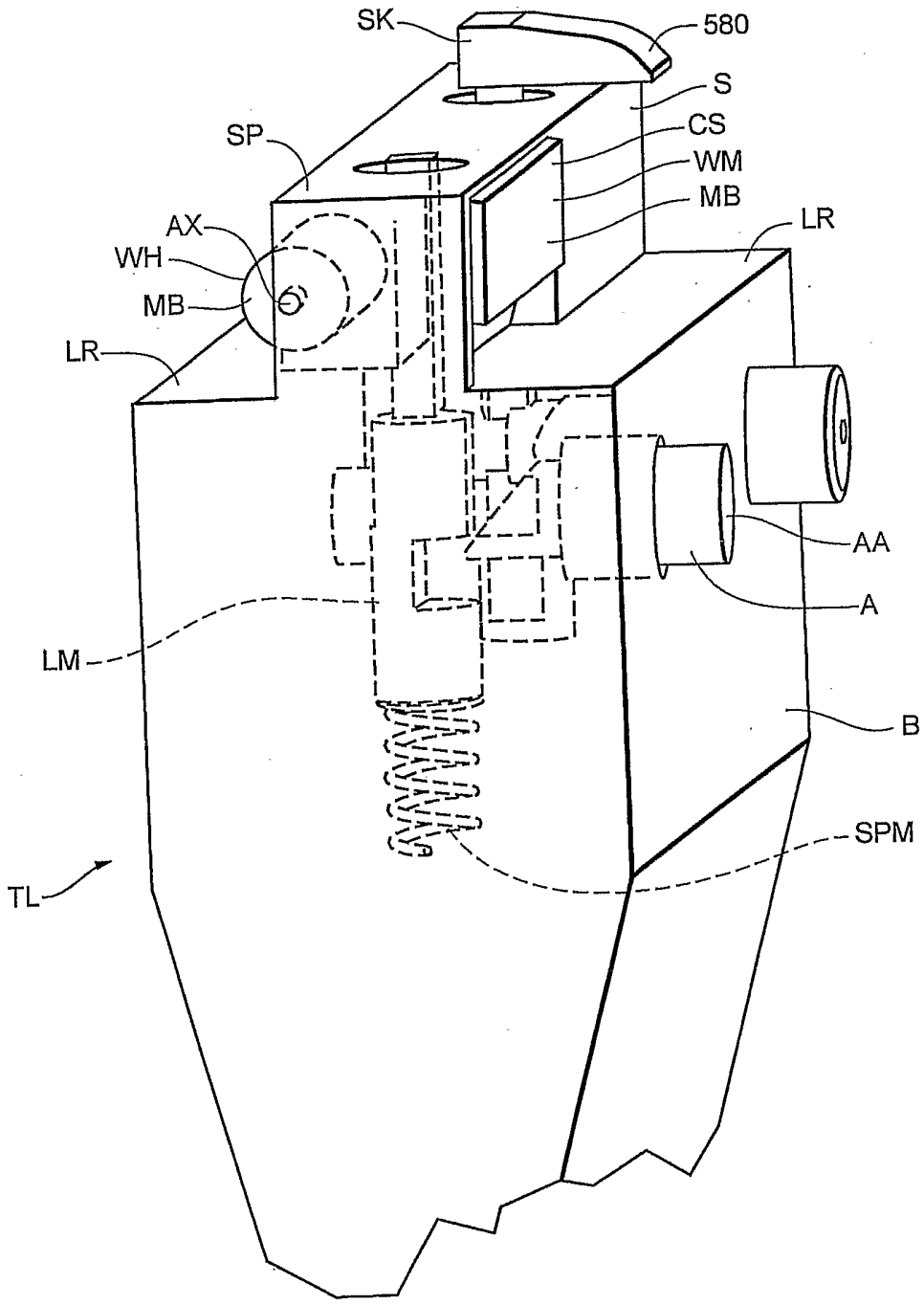
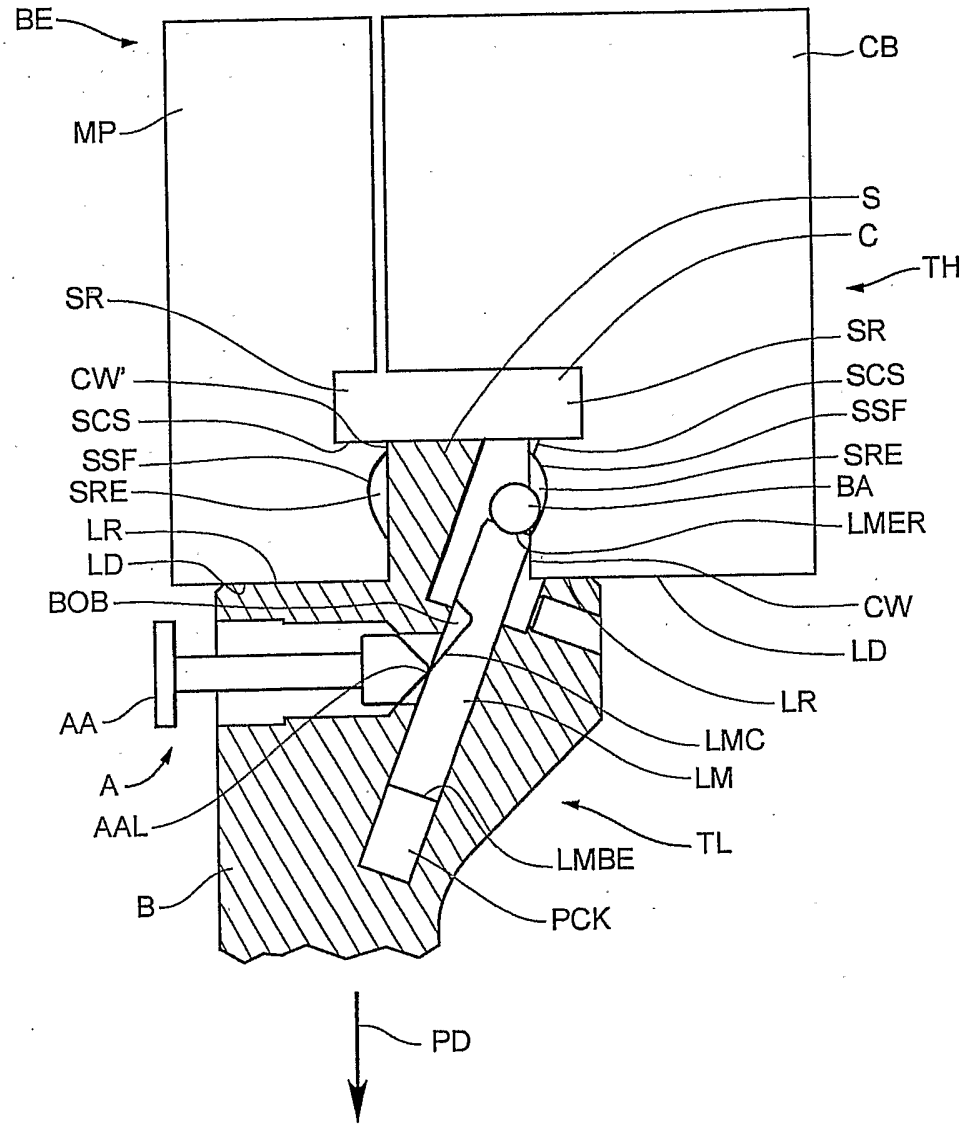


Fig. 19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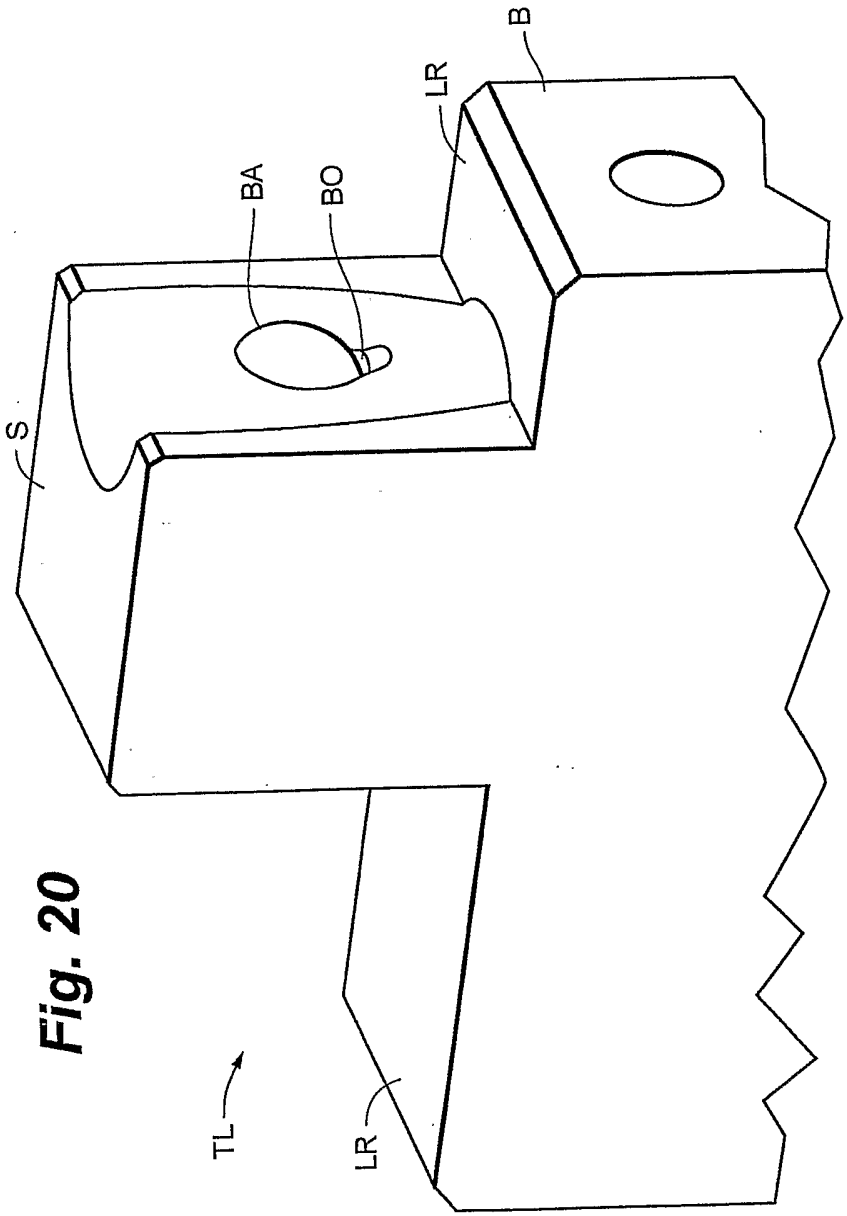


Fig. 20

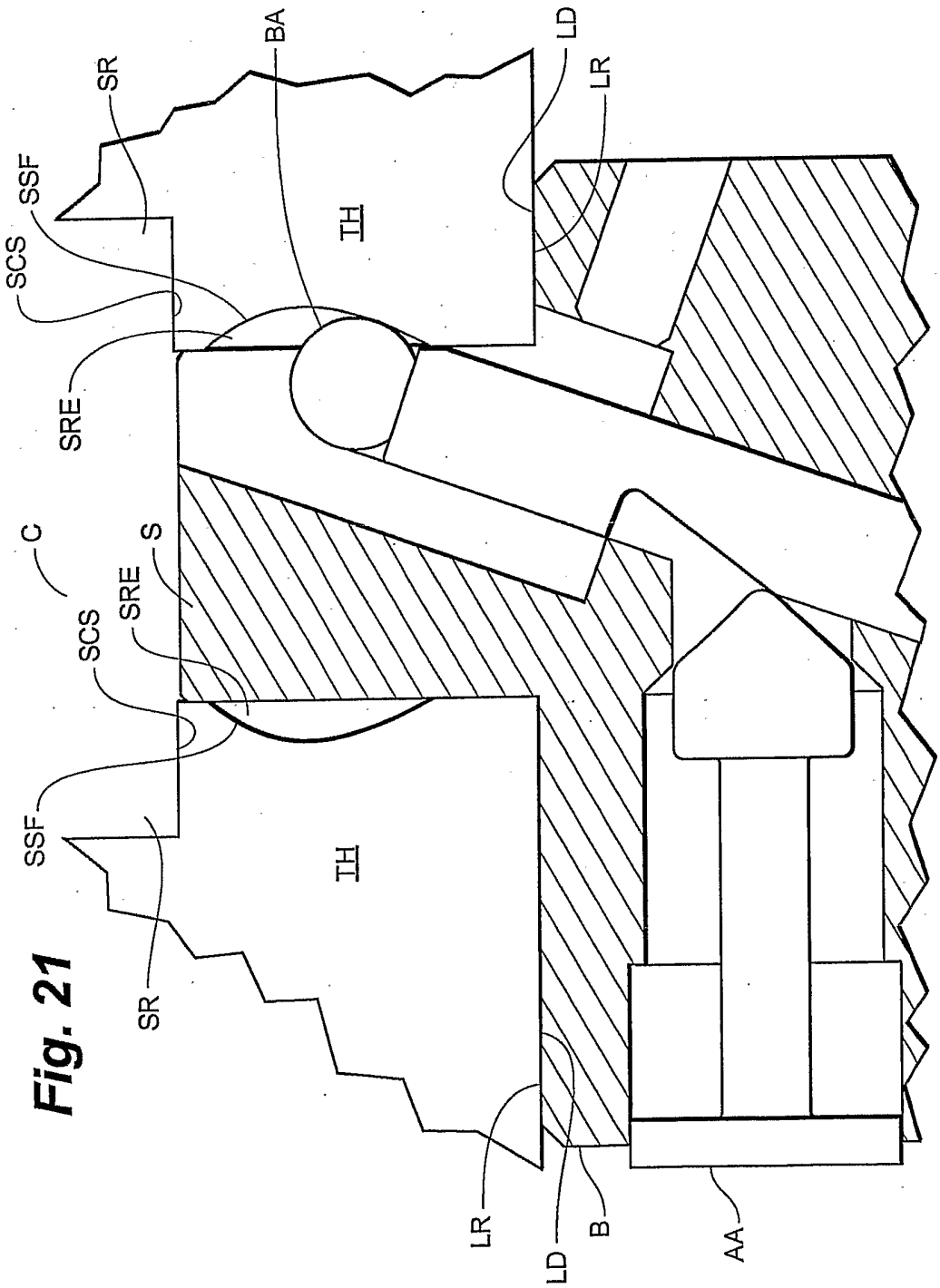


Fig. 21

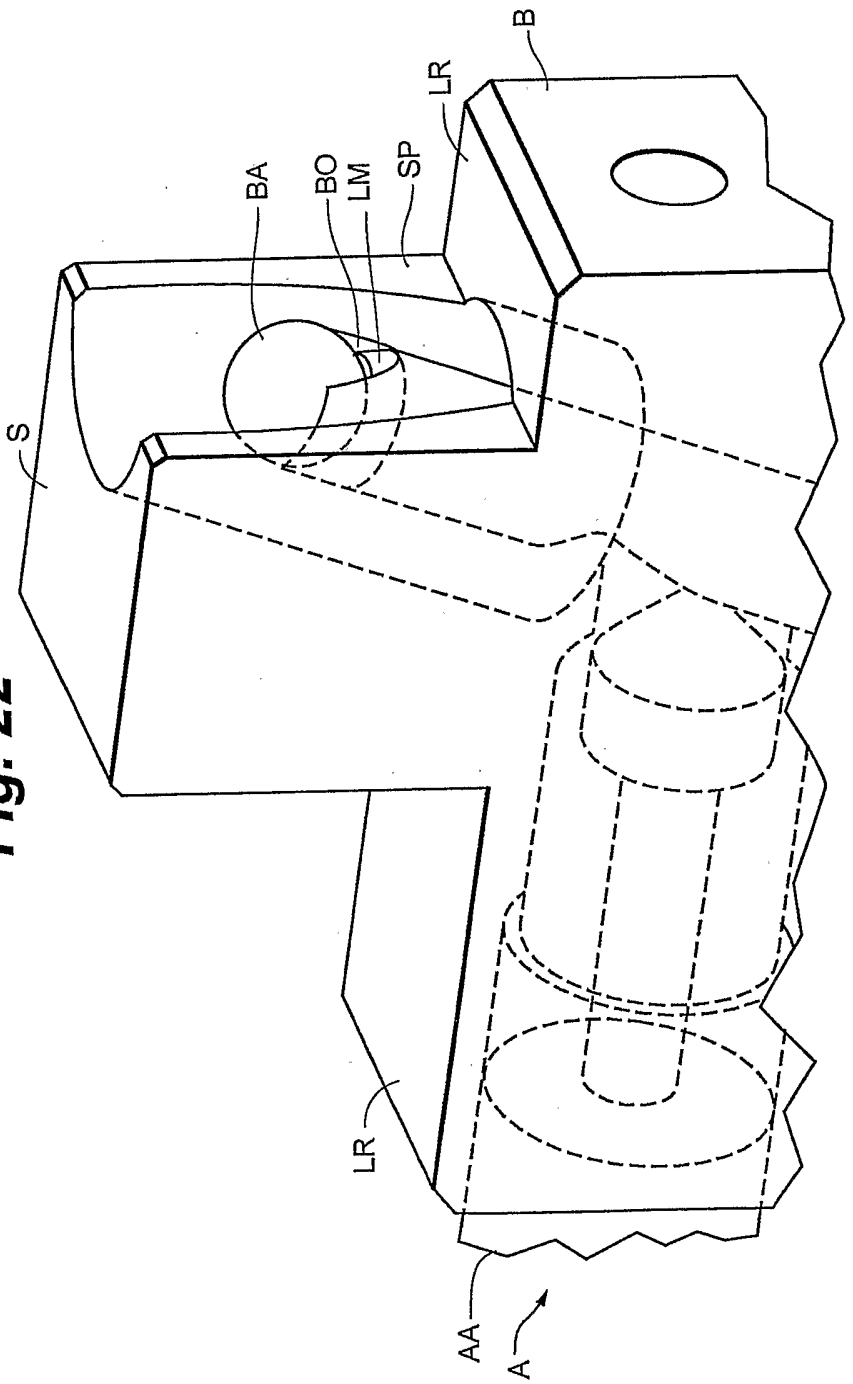


Fig. 22

Fig. 23

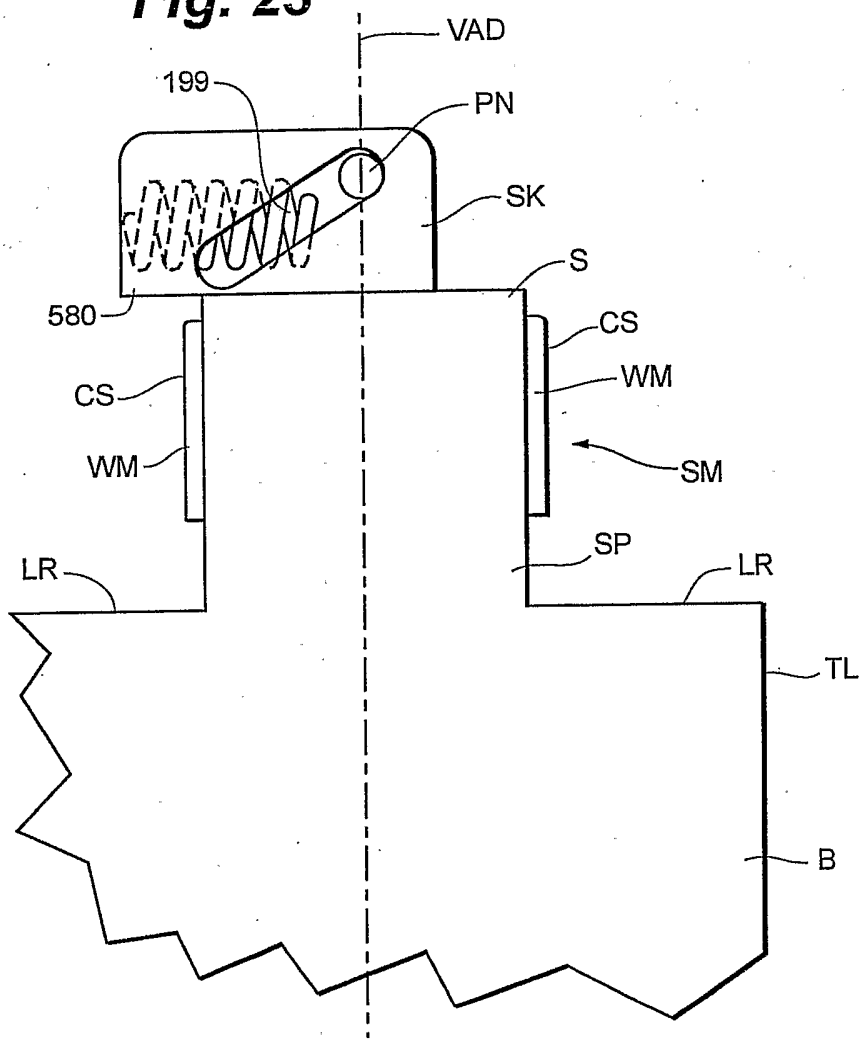


Fig. 24

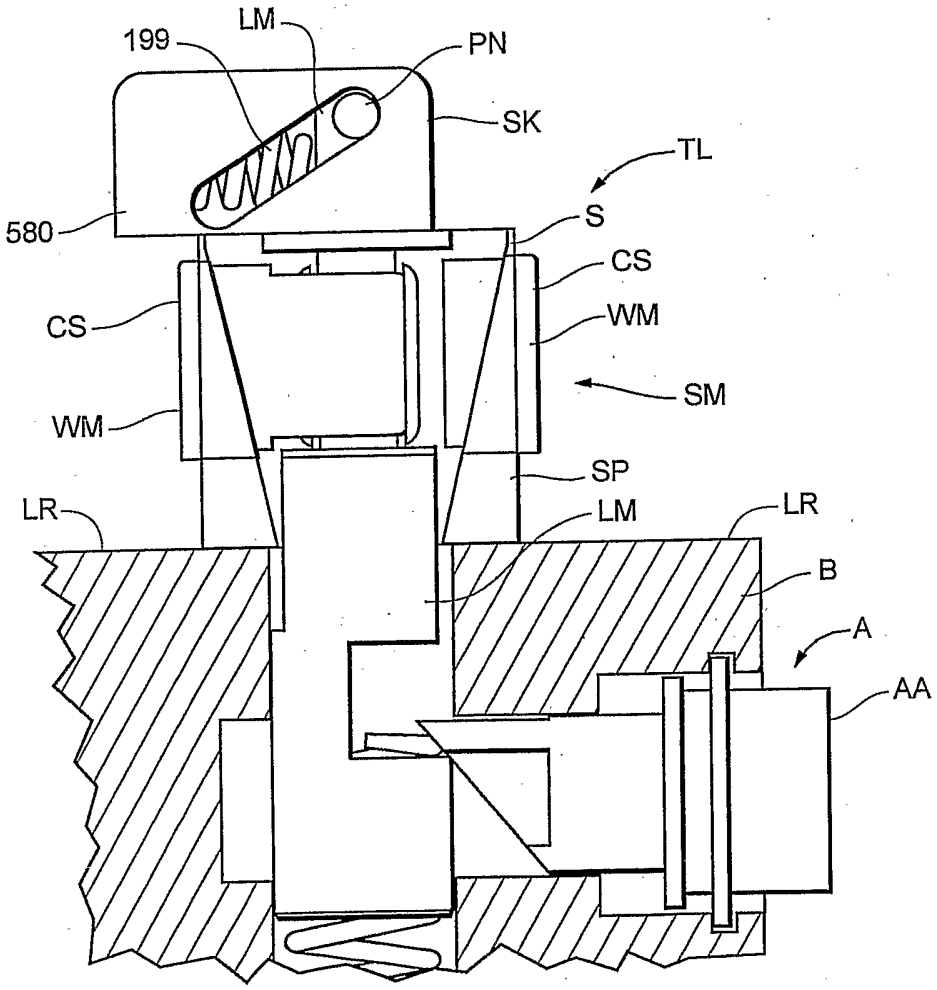


Fig. 25

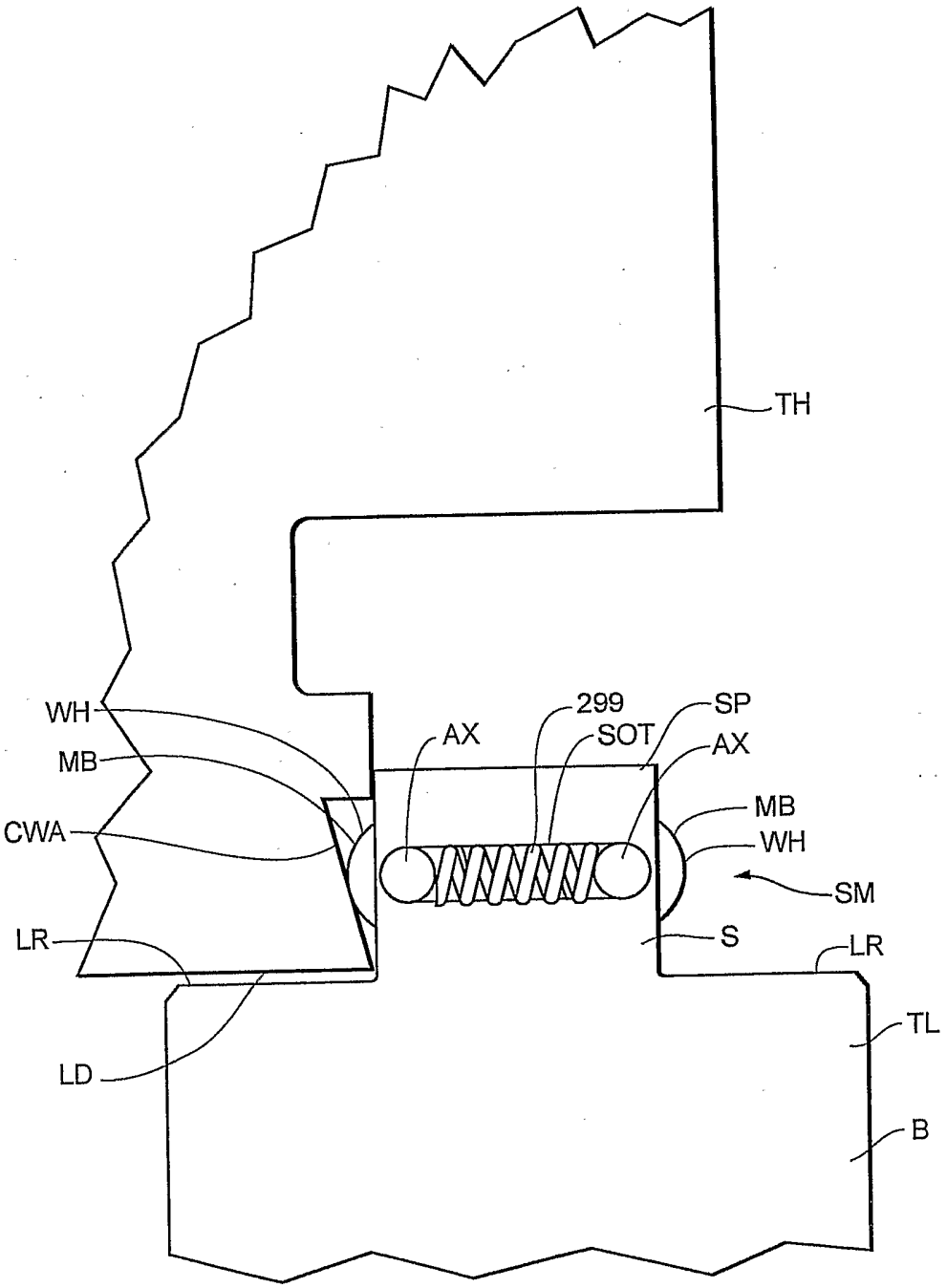


Figure 26

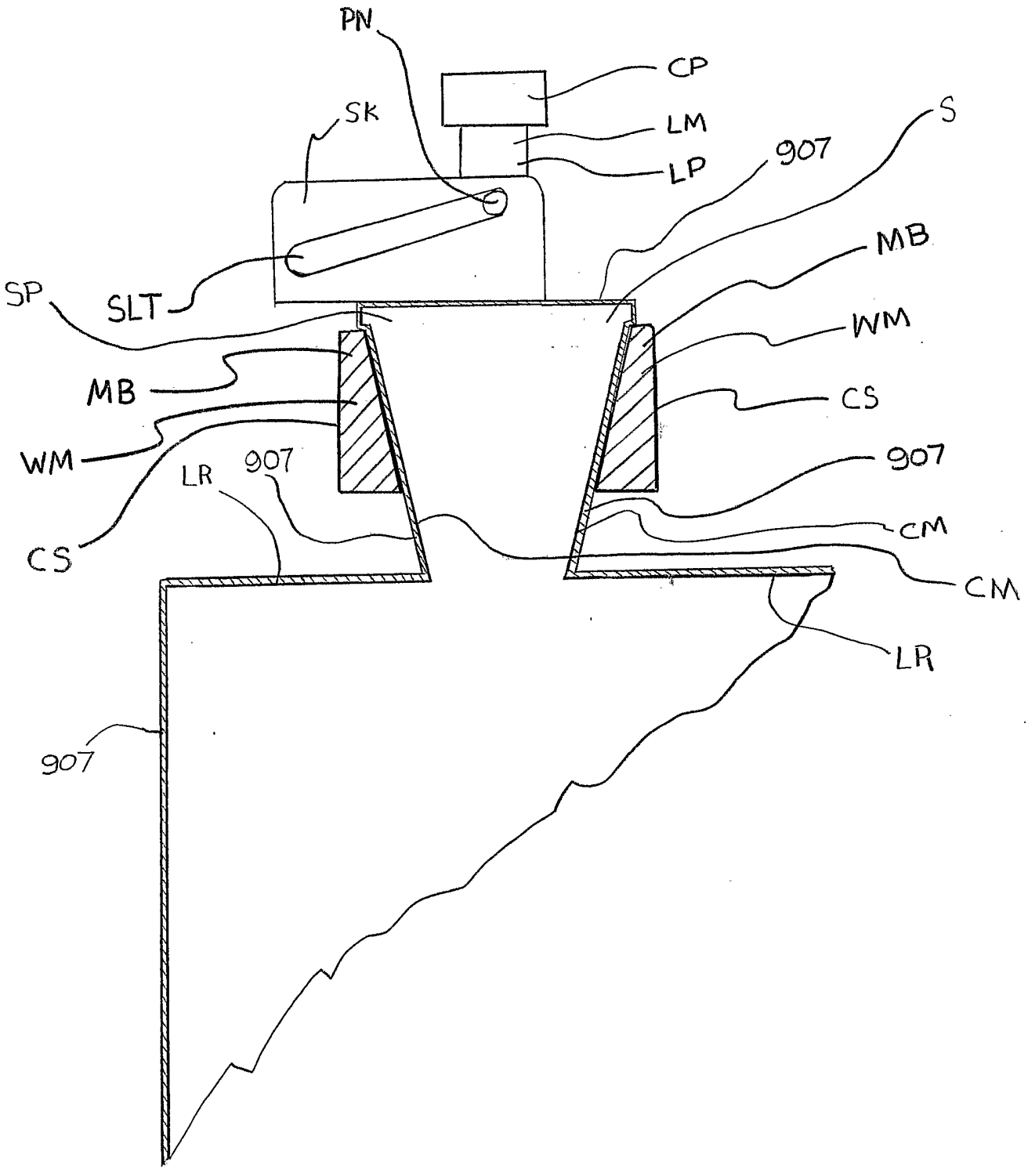


Figure 27

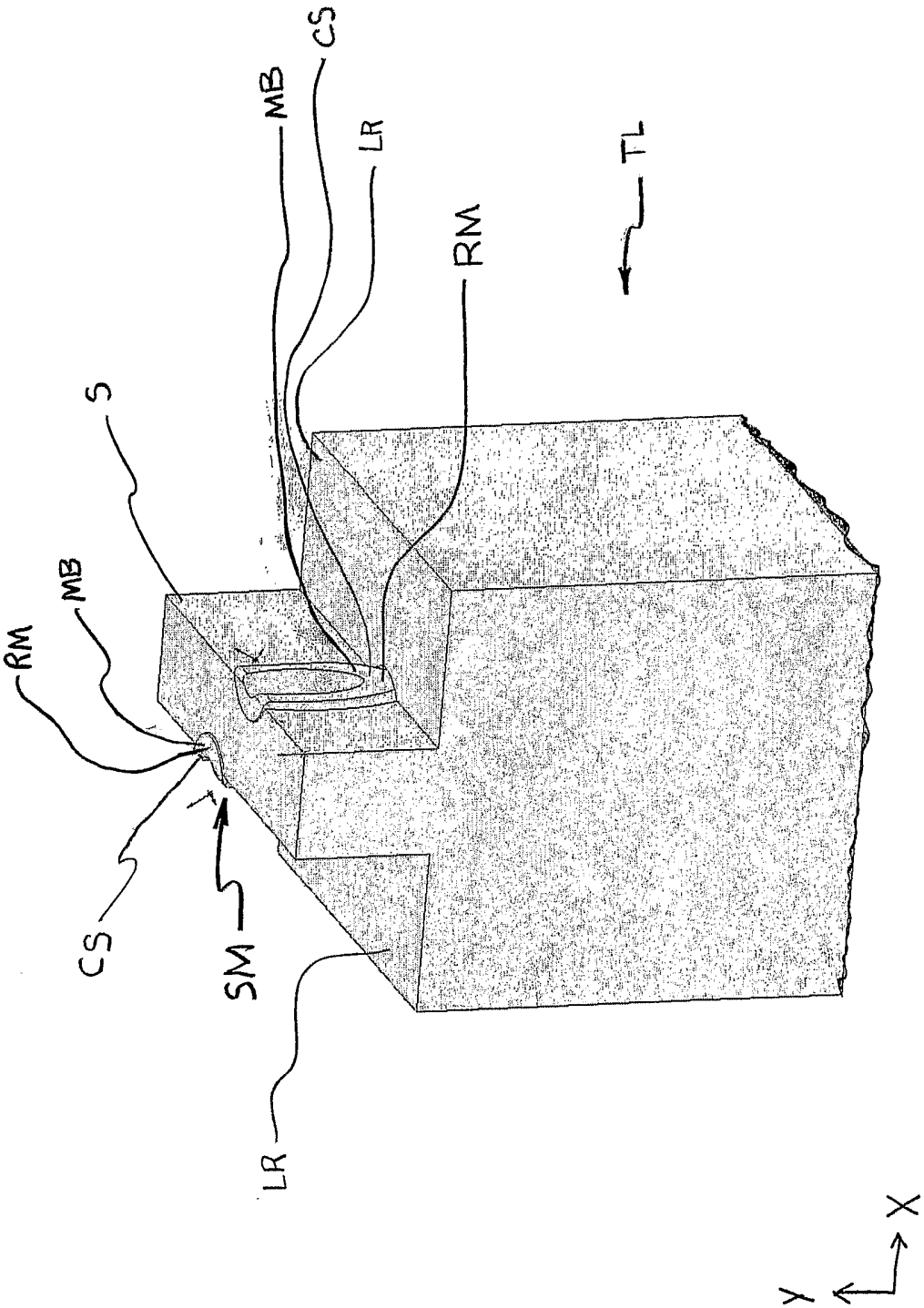


Figure 28

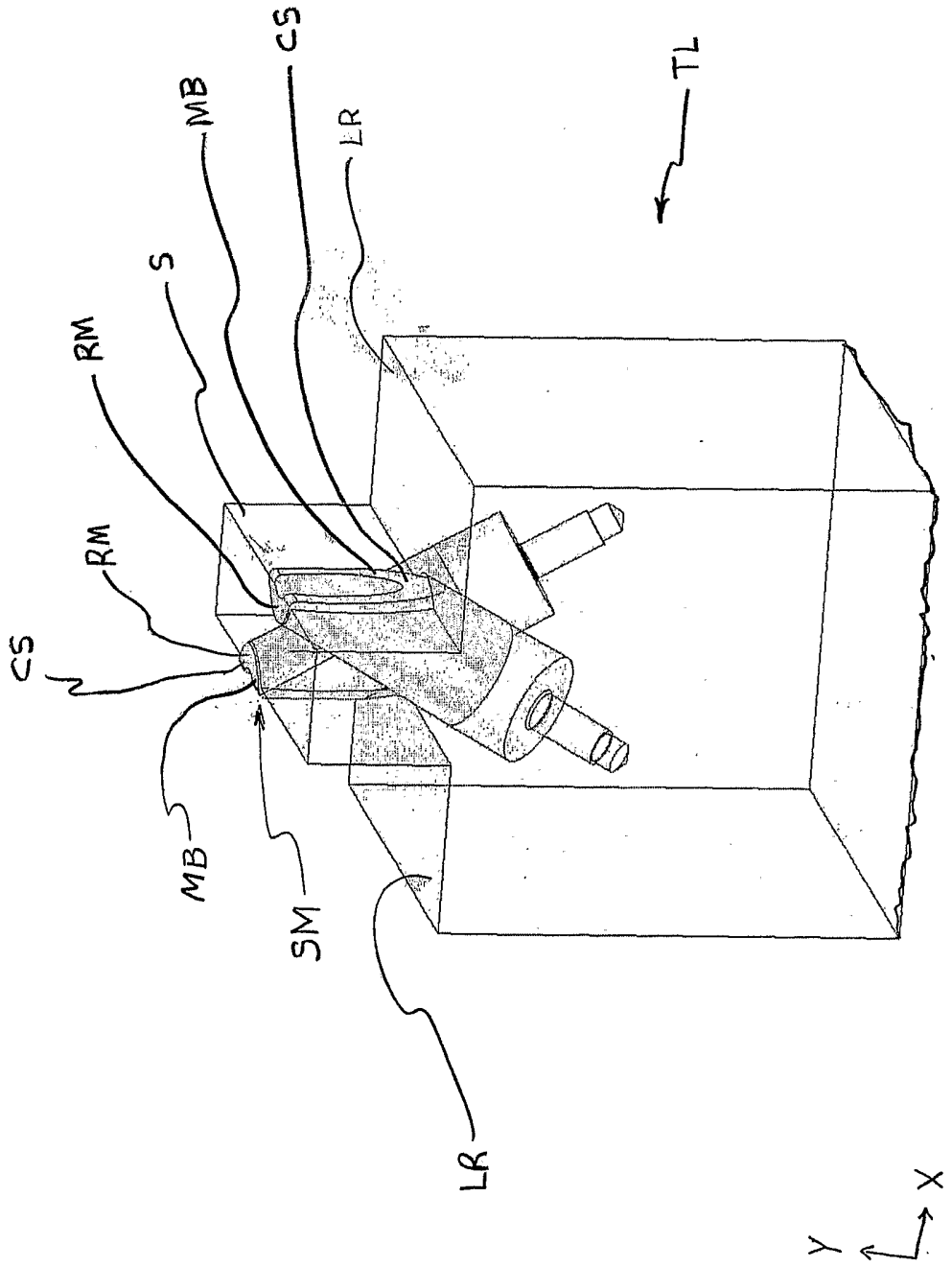


Figure 29

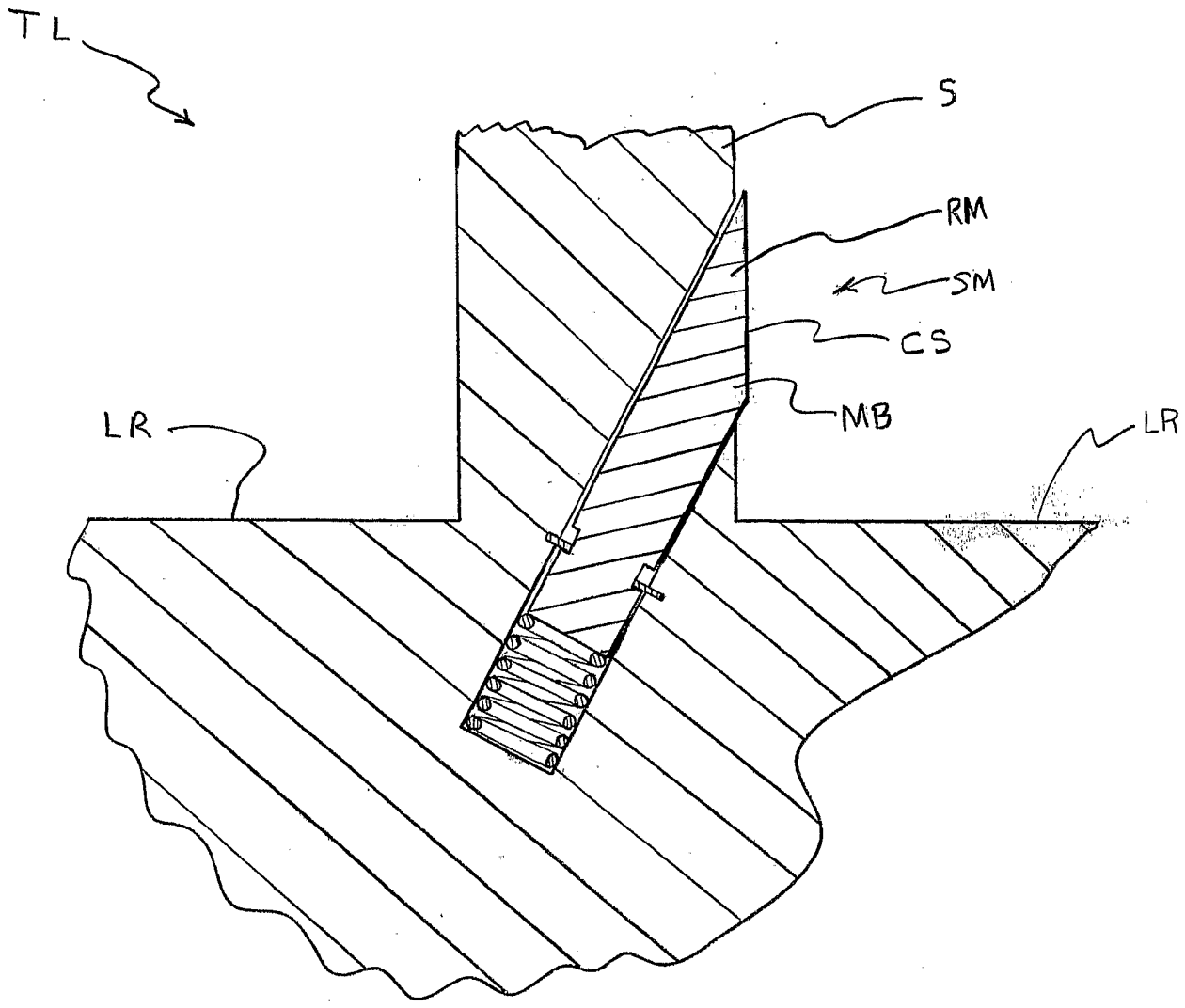
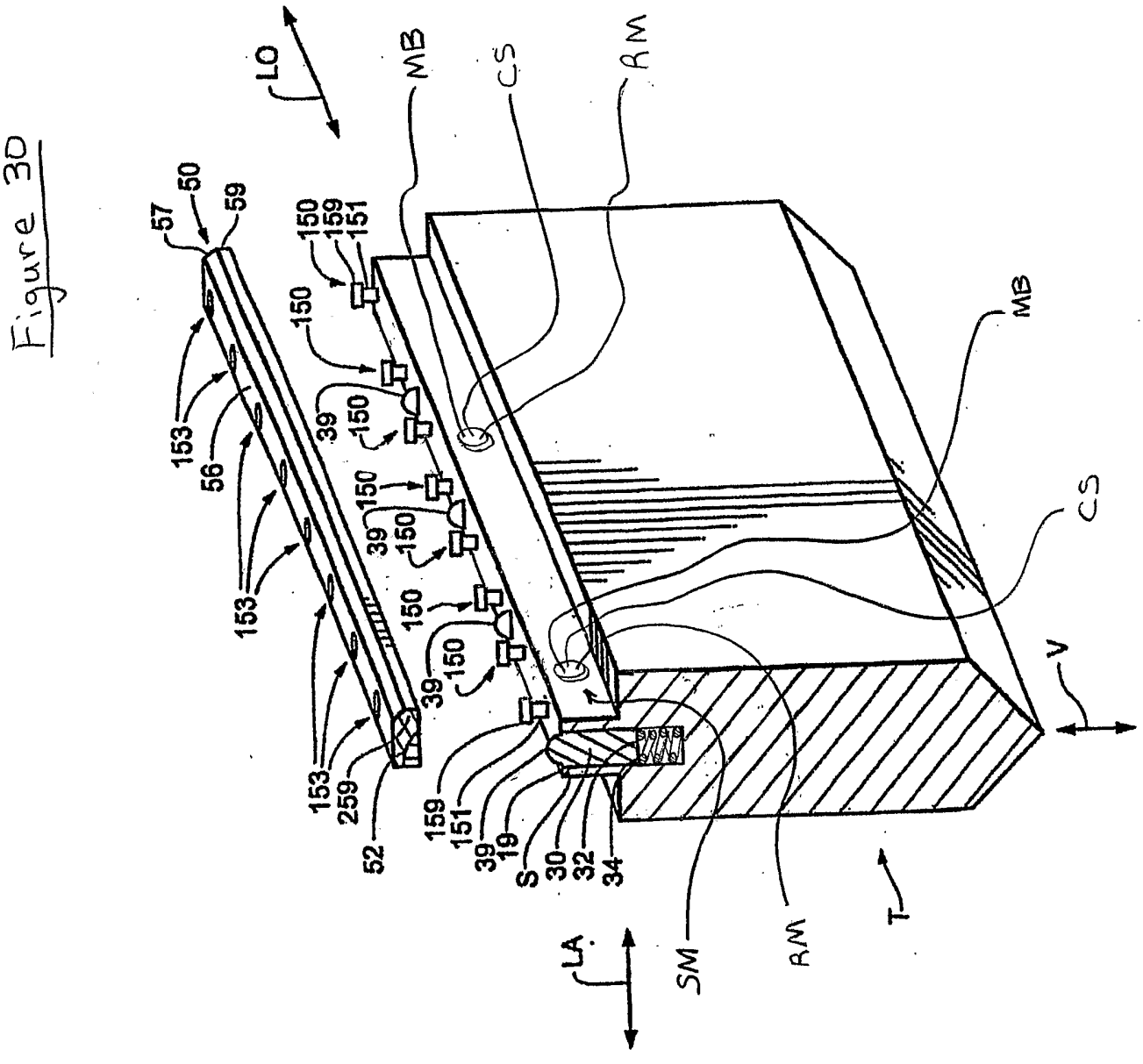


Figure 3D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