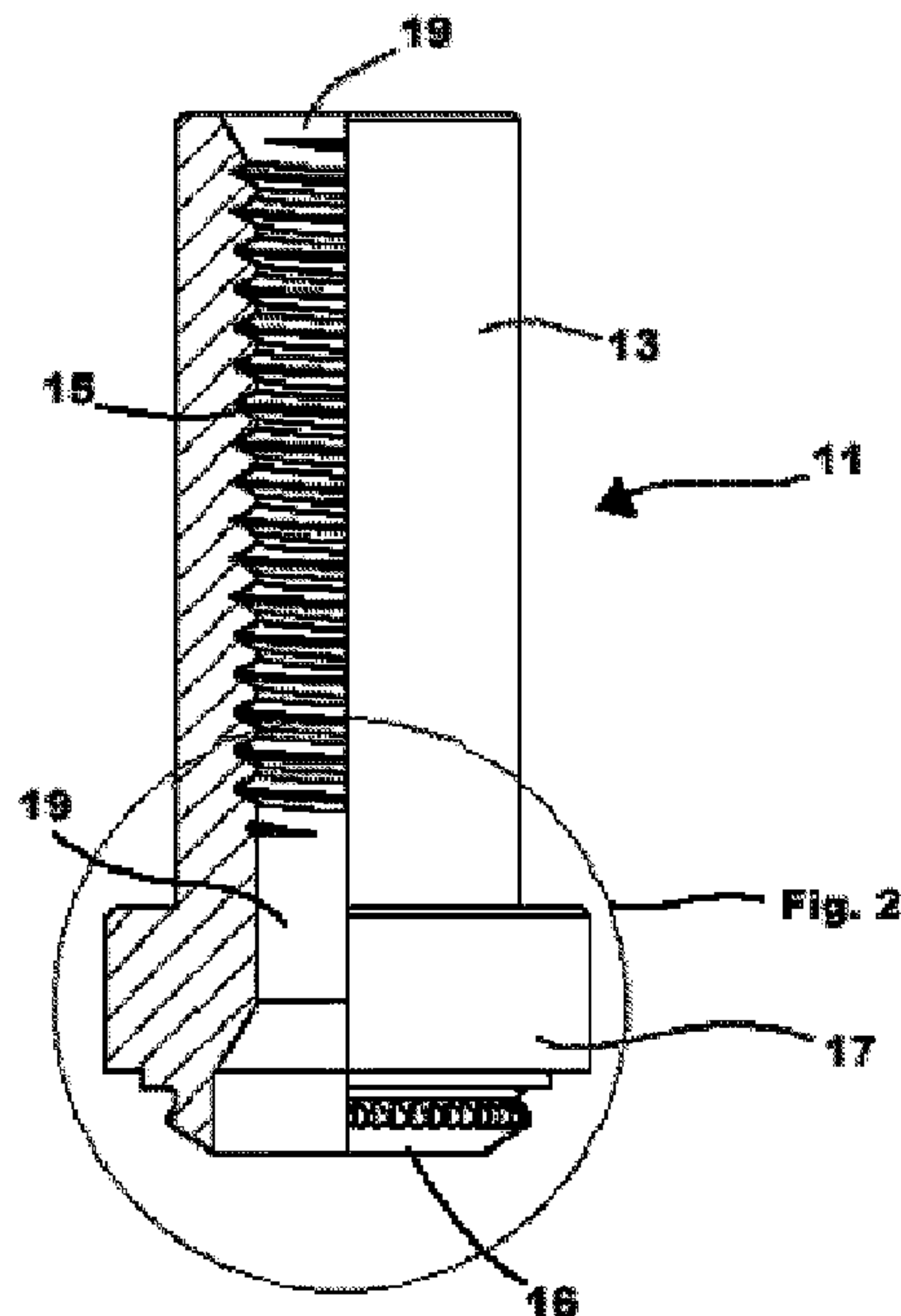




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(57) **Abrégé/Abstract:**

A piercing fastener is attachable to a panel without a hole by penetrating its surface. The fastener further includes means for attachment of a device to it so that the fastener acts as an intermediate component attaching the device to the panel. The fastener



(57) Abrégé(suite)/Abstract(continued):

has either male or female attachment means and further includes an outside surface extending from a top end to a bottom end. Near the bottom end, a reinforcement collar includes an annular top surface for receiving a downward pressing force to install the fastener into the panel. A displacer and undercut are located immediately below the collar to effect and receive a cold flow of deformed panel material to secure the fastener to the panel. A plurality of axially extending circumferential teeth are located immediately below the undercut and comprise triangular knurls with sharp edges which penetrate the sheet as the fastener is applied. The bottom of the fastener terminates in a sharp circular cutting edge for penetrating the panel.

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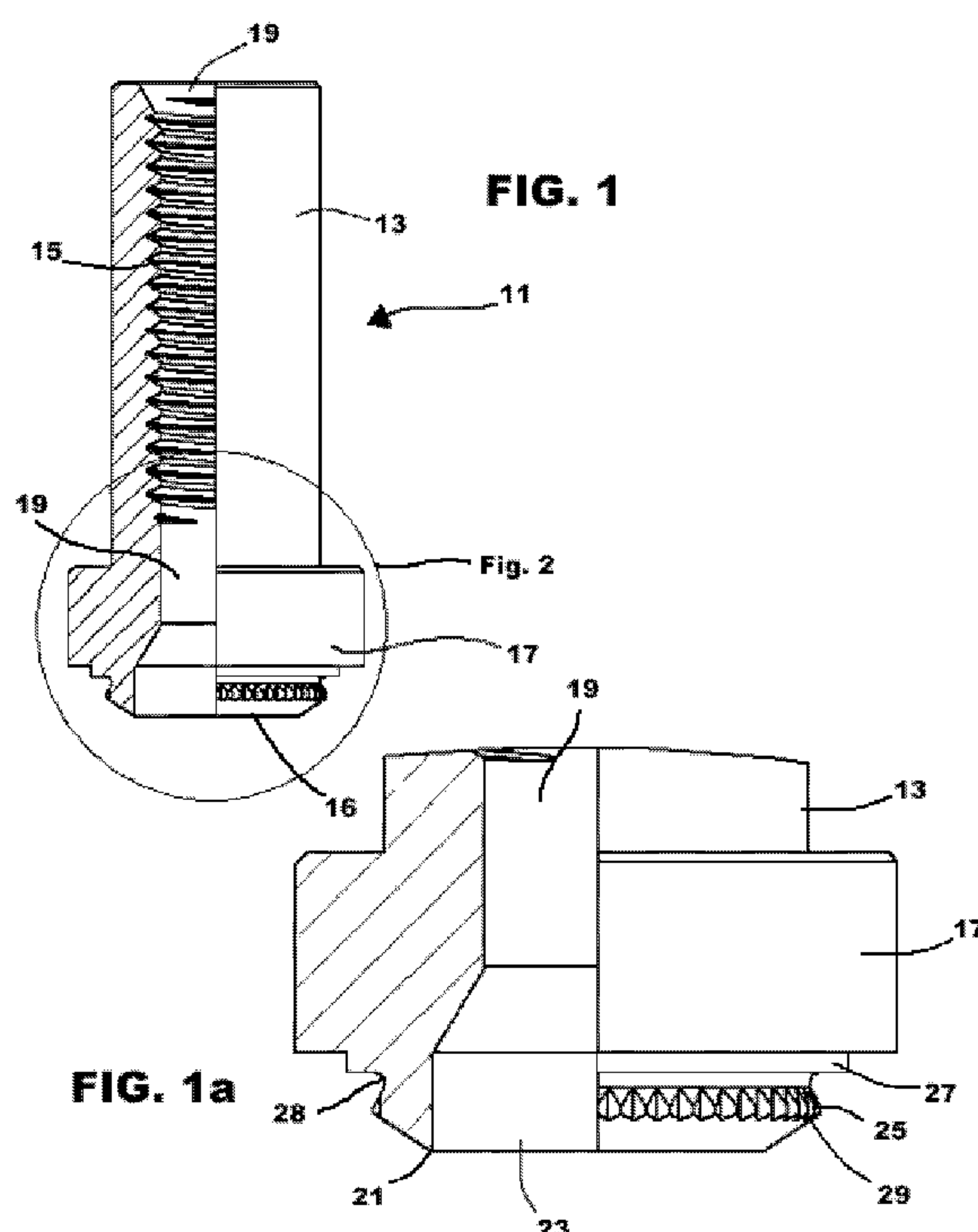
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(54) Title: **PIERCING STANDOFF**

(57) Abstract: A piercing fastener is attachable to a panel without a hole by penetrating its surface. The fastener further includes means for attachment of a device to it so that the fastener acts as an intermediate component attaching the device to the panel. The fastener has either male or female attachment means and further includes an outside surface extending from a top end to a bottom end. Near the bottom end, a reinforcement collar includes an annular top surface for receiving a downward pressing force to install the fastener into the panel. A displacer and undercut are located immediately below the collar to effect and receive a cold flow of deformed panel material to secure the fastener to the panel. A plurality of axially extending circumferential teeth are located immediately below the undercut and comprise triangular knurls with sharp edges which penetrate the sheet as the fastener is applied. The bottom of the fastener terminates in a sharp circular cutting edge for penetrating the panel.

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PIERCING STANDOFFFIELD OF THE INVENTION

This invention relates to fasteners which may be attached to a sheet by forcibly embedding them into the material of the sheet as the penetrating end of the fastener deforms
5 thereby resisting withdrawal of the fastener from the sheet.

BACKGROUND OF THE INVENTION

A significant shortcoming of concealed head self-clinching studs and standoffs is that a hole must first be counterbored using a flat end mill wherever a fastener is intended to be installed. Past efforts to design self-piercing or self-attaching fasteners which do not
10 require a hole in the substrate material include nails and rivets which can be driven into soft substrate material relative to the hardness of the fastener. In many cases, a special anvil is required to support the back side of the sheet which cooperates with the configuration of the driven, piercing end of the fastener so that the penetrating end deforms to clinch into the sheet. The penetrating end of the fastener may be heat treated to a hardness which is greater
15 than the hardness of the structural metallic member into which the fastener is driven. Despite the past efforts in this field, there still exists a need for an economical and effective self-attaching fastener which does not require a mounting hole or a specially configured supporting anvil to achieve secure attachment of the fastener to the supporting substrate.

SUMMARY OF THE INVENTION

The present invention can be embodied as either a standoff or a stud and has a clinching profile, but includes a cutting leading edge ahead of the clinching feature, and the center of the fastener is hollow to reduce the projected area being pressed into the metal, and to allow for metal flow into the center of the part. Knurling of the shank, rather than on the displacer, creates torque resistance, with the added benefit of reducing the projected area that needs to be pressed into the surface for installations without a hole. A much greater hardness differential between panel and clinching fastener is necessary due to the greater amount of material displacement and work hardening. Additionally, the effective depth of the displacer ring is very thin since not much material displacement is required, however reinforcement of this ring is necessary to keep it from shearing off during installation, either by hardening or the addition of supporting material adding to its thickness which does not get embedded into the sheet.

The piercing function of the present fastener eliminates the need for counterboring or drilling a hole. As the fastener is pressed into a flat sheet of metal, the leading edge of the shank cuts the surface. The material of the sheet is permitted to flow upward within the fastener into its center. An undercut on the outside of the shank is filled when the displacer presses metal downward into the undercut. Torque resistance is achieved by knurls on the shank. As the part is being pressed into the sheet it is locked firmly in place as displaced metal fills the undercut, closing in above the knurls. Because the attachment features are located along the outside surface of the fastener where the surface area and diameter is the greatest, a very strong joint between the fastener and the panel is achieved.

More specifically, the inventor has created a piercing fastener being attachable to a panel and having means for attachment of a device thereto comprising a barrel having an

axial throughbore and an outside surface extending from a top end to an open bottom end thereof, said throughbore including an inner wall of increased diameter at a bottom portion thereof terminating at a sharp circular edge for penetrating said panel. A reinforcement collar extends radially from the barrel's outside surface near a bottom end thereof, said collar being
5 the largest diameter of said fastener and having an annular top surface adapted to receive a downward pressing force. An annular displacer is located immediately below the collar and includes an annular bottom surface for forcibly deforming the panel. An undercut groove is located on the outside surface immediately below the displacer for receiving a cold flow of deformed panel material. A plurality of axially extending circumferential teeth are located
10 immediately below the undercut on said external surface. The teeth extend to a greater diameter than the undercut but are of lesser diameter than the displacer. A chamfer extends downward and inwardly from said teeth terminating at a circular cutting lip at the bottom end of the fastener.

The present piercing fastener is preferably used with a panel which is a metal sheet.

15 The top portion of the throughbore may be threaded to provide attachment for a device which would therefore attach the device to the panel. The teeth can be triangular knurls with sharp edges which penetrate the sheet as the fastener is applied. The triangular shape of the knurls is provided by a flared lower surface of the undercut above and the chamfer directly below it. To facilitate piercing the sheet, the barrel inner wall is cylindrical along its bottom portion
20 which extends to the piercing edge of the cutting lip. Filling of the undercut with the deformed panel material is facilitated by an outwardly flared lower surface of the undercut.

In this respect, before explaining at least one embodiment of the invention in detail, it is to be understood that the invention is not limited in its application to the details of construction and to the arrangements of the components set forth in the following description

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or illustrated in the drawings. The invention is capable of other embodiments and of being practiced and carried out in various ways. Also, it is to be understood that the phraseology and terminology employed herein are for the purpose of description and should not be regarded as limiting.

According to another aspect of the present invention, there is provided a piercing
 5 fastener being attachable to a panel and having means for attachment of a device thereto, comprising:
 a panel; an elongate barrel having an axial throughbore and an outside surface extending from a top
 end to an open bottom end thereof, said throughbore including an inner wall of increased diameter
 and piercing means at a bottom portion thereof terminating at a bottom most sharp circular cutting
 10 edge for piercing a top surface of said panel; a reinforcement collar located at the base of the barrel
 extending radially from said barrel's outside surface, said barrel extending upwardly therefrom, said
 collar being the largest diameter of said fastener and having an annular top surface for receiving a
 downward pressing force and a bottom surface for abutting a top surface of the panel when the
 fastener is fully installed into the panel; an annular displacer flange located immediately below said
 15 collar and including an annular bottom surface for forcibly deforming said panel; an undercut groove
 located on said outside surface immediately below said displacer for receiving a cold flow of
 deformed panel material; a plurality of axially extending circumferential teeth located immediately
 below said undercut on said external surface, said teeth extending to a greater diameter than said
 undercut but being of lesser diameter than said displacer; and a frusto-conical chamfer extending
 20 downward and inwardly from said teeth terminating at said circular cutting edge wherein the length
 of the barrel below the reinforcement collar is less than the width of said panel.

According to still another aspect of the present invention, there is provided a piercing
 fastener being attachable to a panel and having means for attachment of a device thereto, comprising:
 a panel; an elongate barrel having an outside surface extending from a top end to an open bottom end
 thereof, a bore including an inner wall at a bottom portion thereof terminating at a sharp circular
 25 cutting edge for piercing a top surface of said panel; a reinforcement collar located at the base of the
 barrel extending radially from said external surface, said barrel extending upwardly therefrom, said
 collar being the largest diameter of said fastener and having an annular top surface adapted to receive
 a downward pressing force; an annular displacer flange located immediately below said collar and
 including an annular bottom surface for forcibly deforming said panel; an undercut groove located on
 30 said outside surface immediately below said displacer for receiving a cold flow of deformed panel
 material; a plurality of axially extending circumferential teeth located immediately below said

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undercut on said external surface, said teeth extending to a greater diameter than said undercut being of lesser diameter than said displacer; and a frusto-conical chamfer extending downward and inwardly from said teeth terminating at said circular cutting edge wherein the length of the barrel below the reinforcement collar is less than the width of said panel.

5 As such, those skilled in the art will appreciate that the conception, upon which this disclosure is based, may readily be utilized as a basis for the designing of other structures, methods, and systems for carrying out the several purposes of the present invention. It is important, therefore, that the claims be regarded as including such equivalent constructions insofar as they do not depart from the scope of the present invention.

10 BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a partial sectional front elevation view of the fastener of the invention.

FIG. 1a is an enlargement portion of Figure 1 as shown in that figure.

FIG. 2 is a partial sectional front elevation view of the installation setup for applying the fastener.

15 FIGS. 3a, 3b, 3c and 3d are partial sectional views of the installation sequence.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring now to Figure 1, a standoff fastener of the invention 11 is shown in a partial sectional view. The fastener includes a barrel portion 13 which has an internal bore 19 open at the top end and bottom end. The bore in this embodiment includes internal threads 15 to receive a
20 like-threaded fastener for attachment of an article. The base of the standoff includes a reinforcement collar 17 which provides the structural strength to receive the driving force necessary to install the standoff and to control the deformation of the penetrating end of the fastener 16 at the bottom.

Figure 1a is an enlargement taken from Figure 1. It shows greater detail of the penetrating end of the standoff of the invention. The internal bore 19 opens into an enlarged area 23 at the bottom or attachment end of the standoff. At the bottom-most edge of the fastener, an inward tapering of the base material along surface 29 creates a circular cutting lip 21. The features of the fastener which provide the mutual deformation of the fastener and the substrate material so that the tight clinch attachment is achieved include displacer collar 27 and an undercut 28 of reduced diameter which lies between the displacer 27 and outwardly flared teeth 25 that bite into the substrate material to resist rotation of the fastener once it has been installed. In an alternate embodiment (not shown), the bore does not extend upward beyond the reinforcement collar and the outside surface of the barrel is threaded, providing a mounting stud to receive an internally threaded part such as a nut.

Figure 2 depicts the installation setup for applying the fastener of the invention. The fastener 11 is forcibly applied to a sheet 33 by pressing fixture 31 that applies downward force F to a reinforcement collar 17 at the base of the insert. If force F continues to be applied, the cutting lip 21 begins to penetrate into the surface of sheet 33 which is supported on the backside by anvil 37.

The installation sequence is shown in Figures 3a-3d. As illustrated in these figures, the cutting lip 21 at the leading edge of the shank cuts into the surface of the sheet 33. The softer material of the sheet is permitted to flow upward in the center of the fastener and also around the outside surface of the shank which includes radially projecting triangular shaped knurls 25. The outside of the shank also includes an undercut 28 which is filled when the displacer 27 presses the metal downward into the undercut as it closes in over the knurls thus locking the part in place.

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Therefore, the foregoing is considered as illustrative only of the principles of the invention. Further, since numerous modifications and changes will readily occur to those skilled in the art, it is not desired to limit the invention to the exact construction and operation shown and described, and accordingly, all suitable modifications and equivalents may be resorted to,
5 falling within the scope of the invention.

REPLACEMENT SHEET

CLAIMS

What is claimed is:

1. A piercing fastener being attachable to a panel and having means for attachment of a device thereto, comprising:
 - a panel;
 - an elongate barrel having an axial throughbore and an outside surface extending from a top end to an open bottom end thereof, said throughbore including an inner wall of increased diameter and piercing means at a bottom portion thereof terminating at a bottom most sharp circular cutting edge for piercing a top surface of said panel;
 - a reinforcement collar located at the base of the barrel extending radially from said barrel's outside surface, said barrel extending upwardly therefrom, said collar being the largest diameter of said fastener and having an annular top surface for receiving a downward pressing force and a bottom surface for abutting a top surface of the panel when the fastener is fully installed into the panel;
 - an annular displacer flange located immediately below said collar and including an annular bottom surface for forcibly deforming said panel;
 - an undercut groove located on said outside surface immediately below said displacer for receiving a cold flow of deformed panel material;
 - a plurality of axially extending circumferential teeth located immediately below said undercut on said external surface, said teeth extending to a greater diameter than said undercut but being of lesser diameter than said displacer; and
 - a frusto-conical chamfer extending downward and inwardly from said teeth terminating at said circular cutting edge wherein the length of the barrel below the

REPLACEMENT SHEET

reinforcement collar is less than the width of said panel.

2. The fastener of claim 1 wherein a top portion of said throughbore is threaded.
3. The fastener of claim 1 wherein said teeth are outwardly convergent triangular knurls.
4. The fastener of claim 1 wherein said panel is a metal sheet.
5. The fastener of claim 1 wherein said inner wall is cylindrical and coaxial with said barrel at said bottom portion thereof and extends to the edge of said cutting lip.
6. The fastener of claim 1 wherein said undercut has an outwardly flared lower surface.
7. A piercing fastener being attachable to a panel and having means for attachment of a device thereto, comprising:
 - a panel;
 - an elongate barrel having an outside surface extending from a top end to an open bottom end thereof,
 - a bore including an inner wall at a bottom portion thereof terminating at a sharp circular cutting edge for piercing a top surface of said panel;
 - a reinforcement collar located at the base of the barrel extending radially from said external surface, said barrel extending upwardly therefrom, said collar being the largest diameter of said fastener and having an annular top surface adapted to receive a downward pressing force;
 - an annular displacer flange located immediately below said collar and including an annular bottom surface for forcibly deforming said panel;
 - an undercut groove located on said outside surface immediately below said

REPLACEMENT SHEET

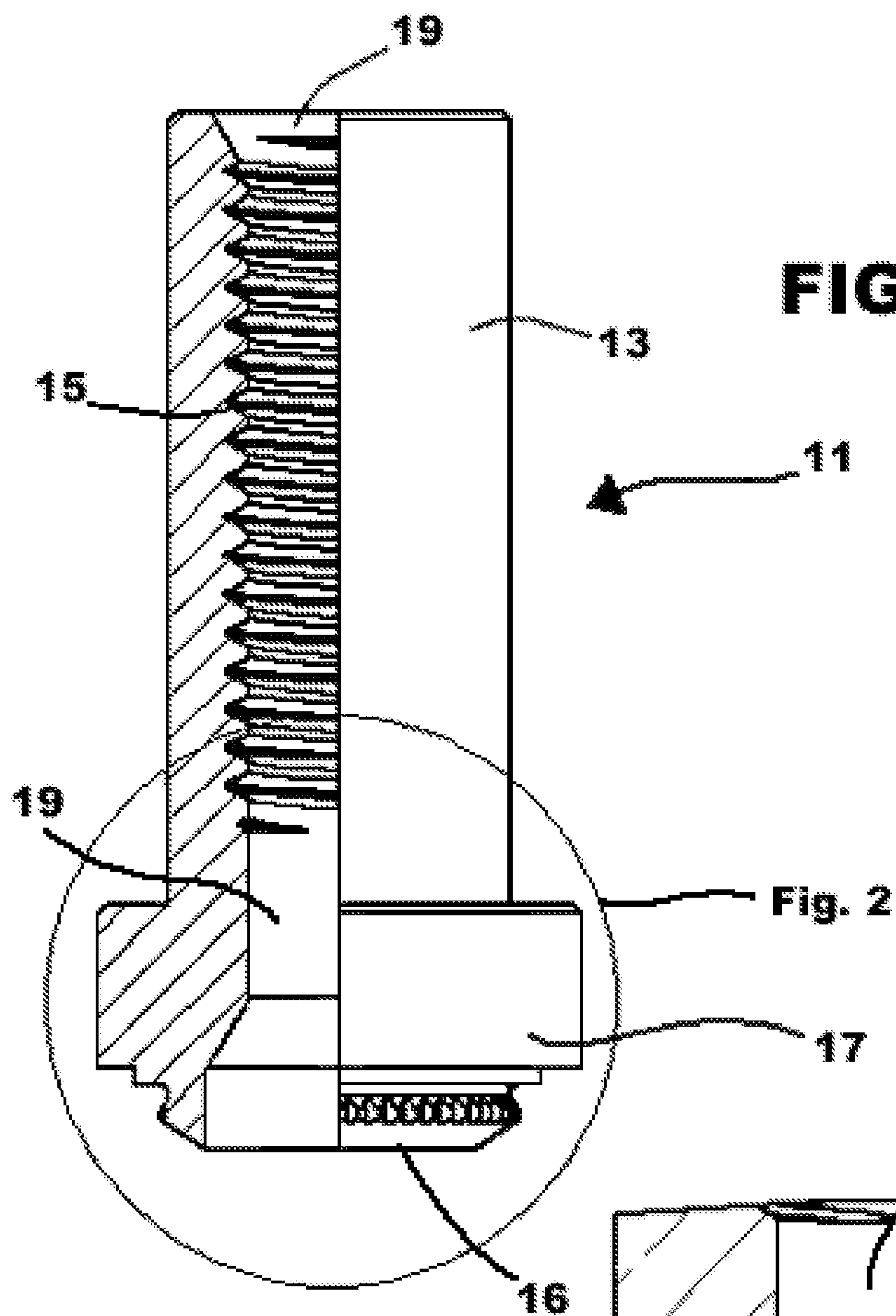
displacer for receiving a cold flow of deformed panel material;

a plurality of axially extending circumferential teeth located immediately below said undercut on said external surface, said teeth extending to a greater diameter than said undercut being of lesser diameter than said displacer; and

a frusto-conical chamfer extending downward and inwardly from said teeth terminating at said circular cutting edge wherein the length of the barrel below the reinforcement collar is less than the width of said panel.

8. The fastener of claim 7 wherein said outside surface is threaded.
9. The fastener of claim 7 wherein said teeth are triangular knurls.

FIG. 1



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Fig. 2

FIG. 1a

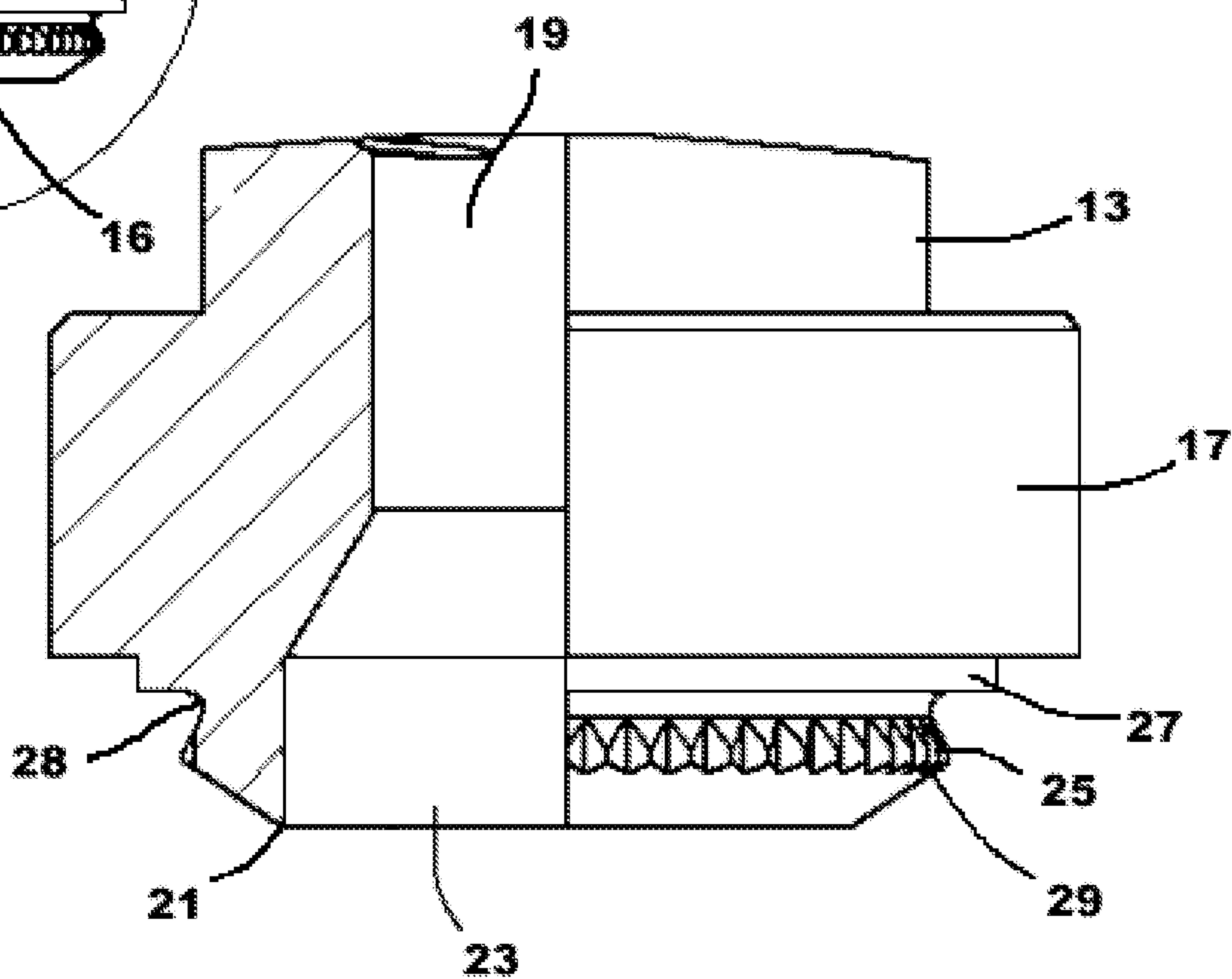


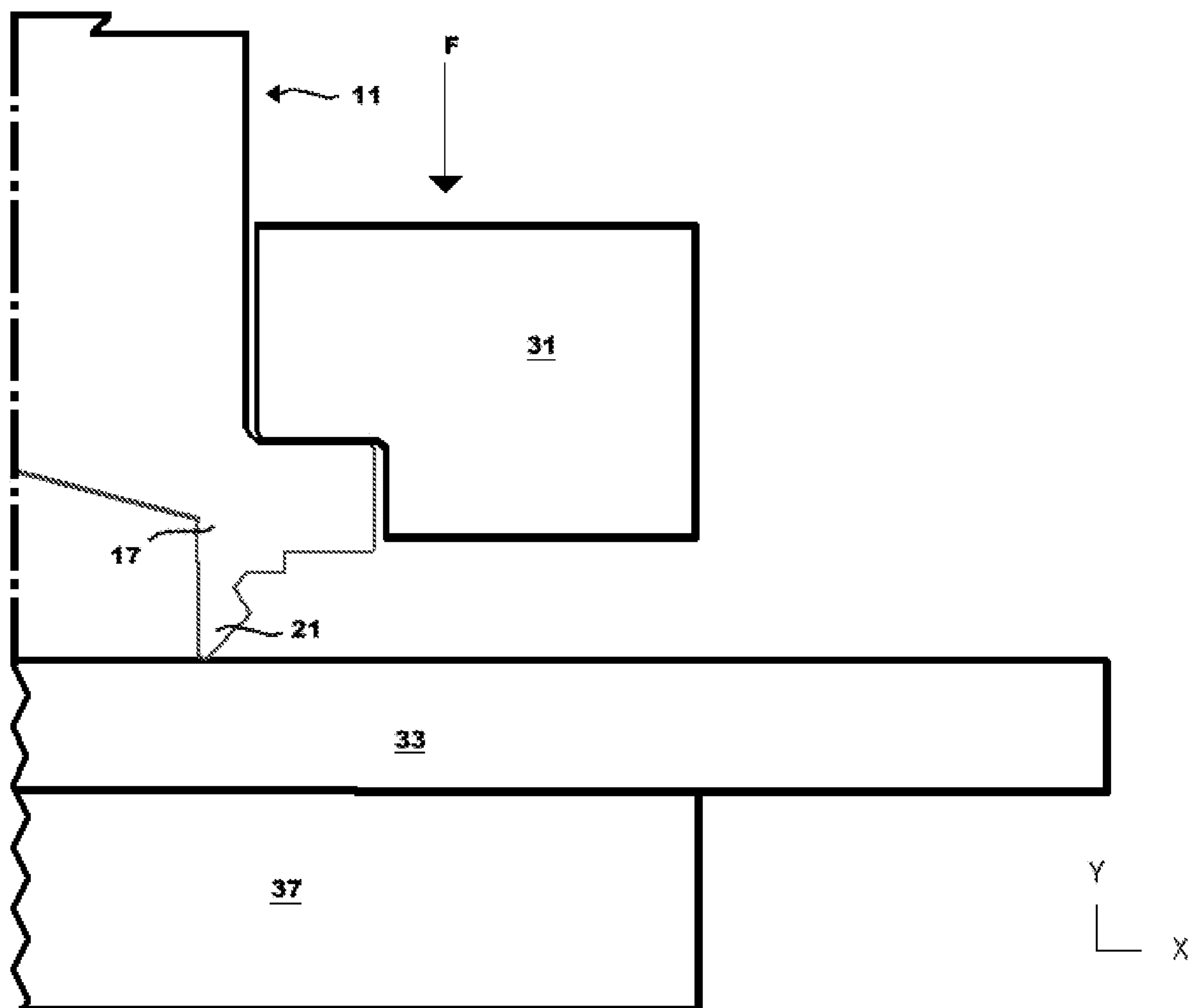
FIG. 2

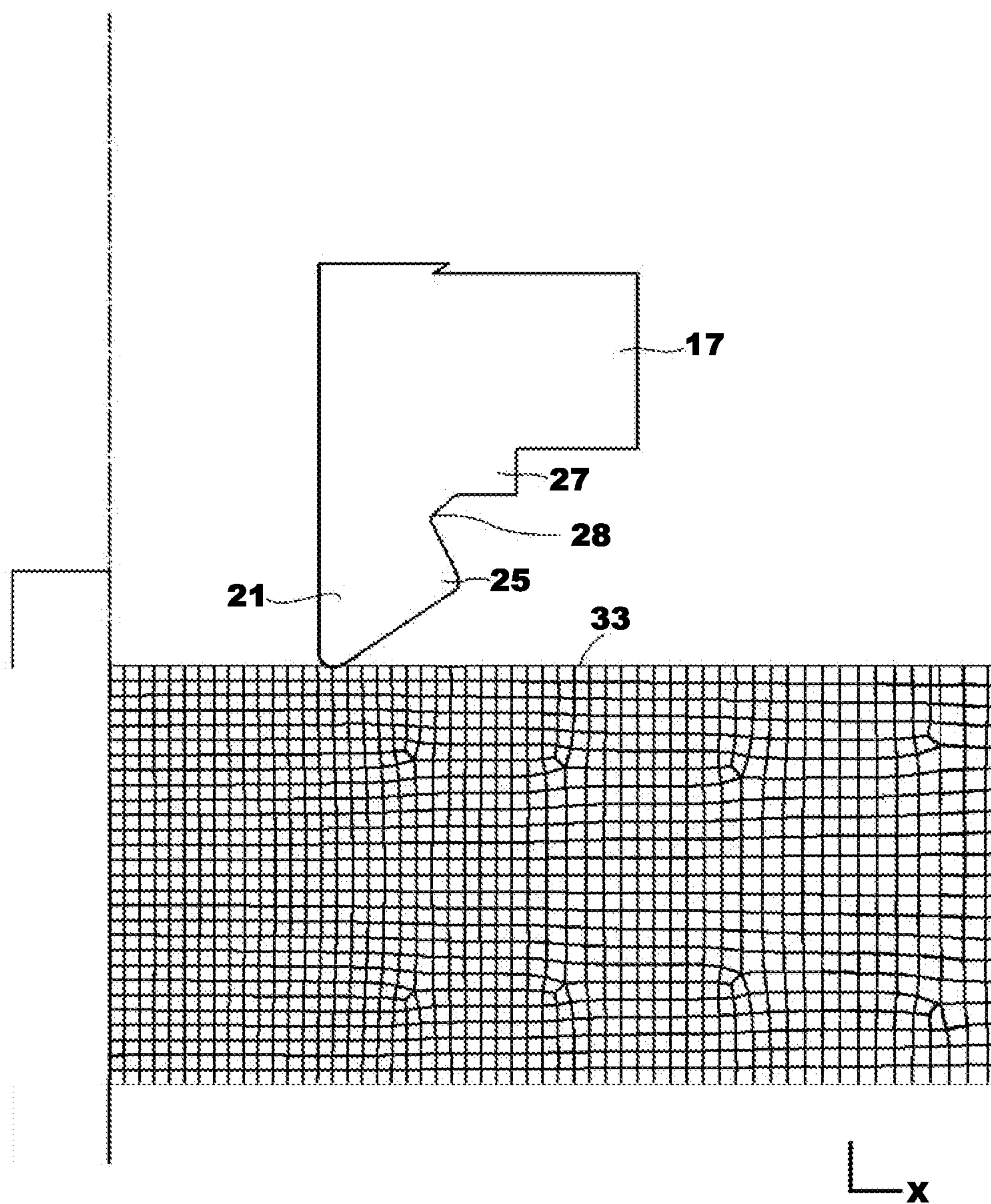
Fig. 3a

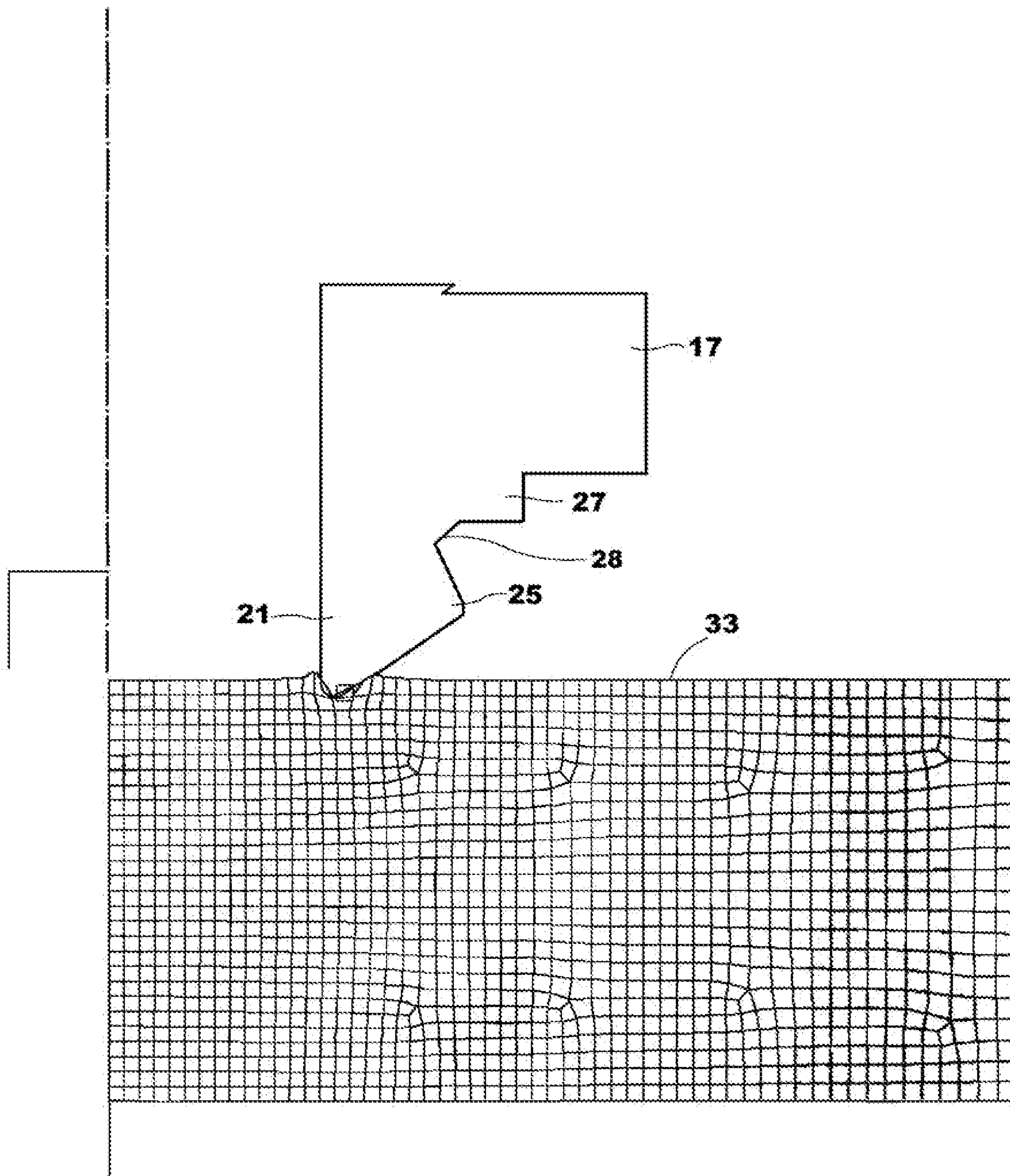
FIG. 3b

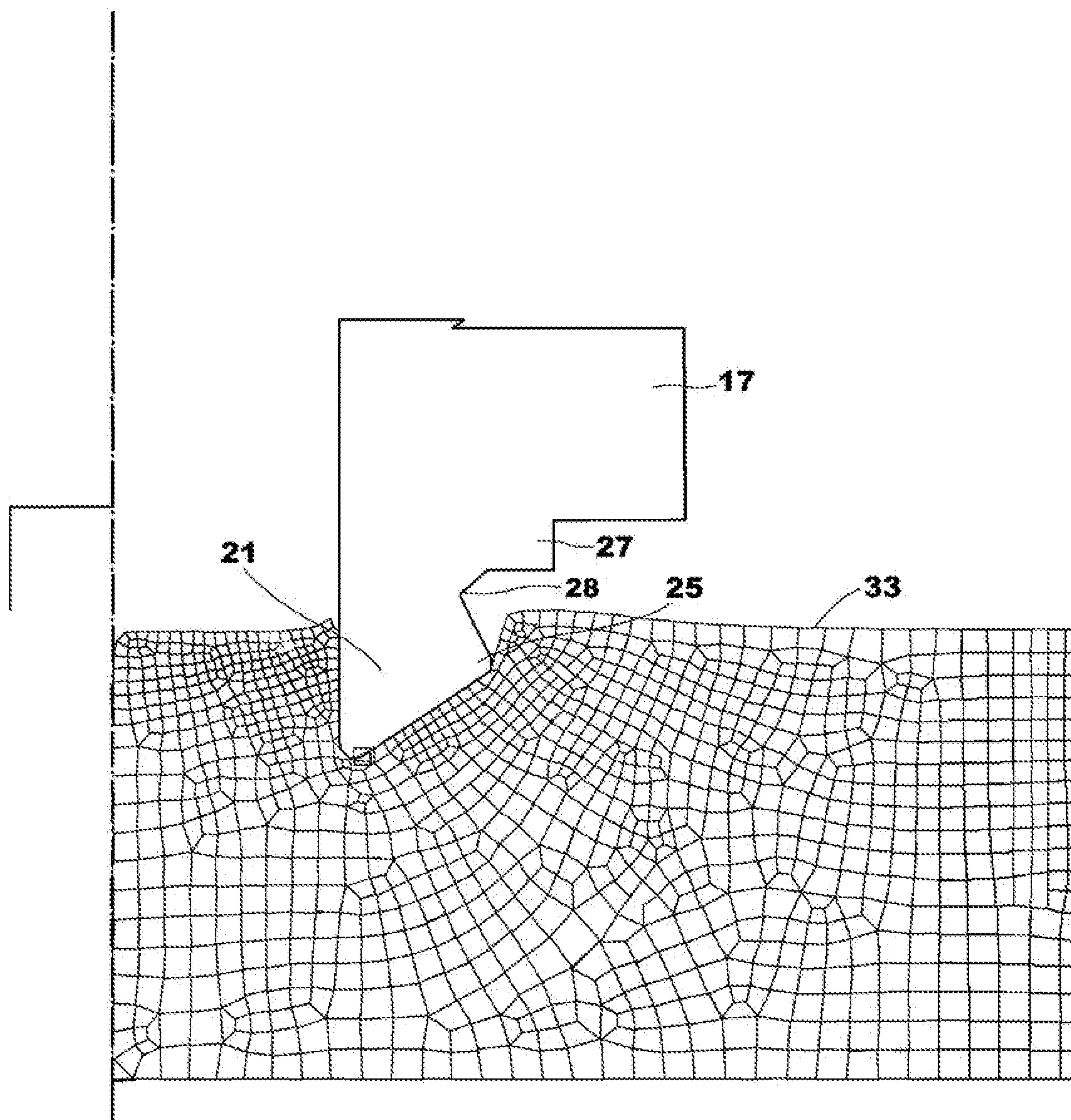
FIG. 3c

FIG. 3d