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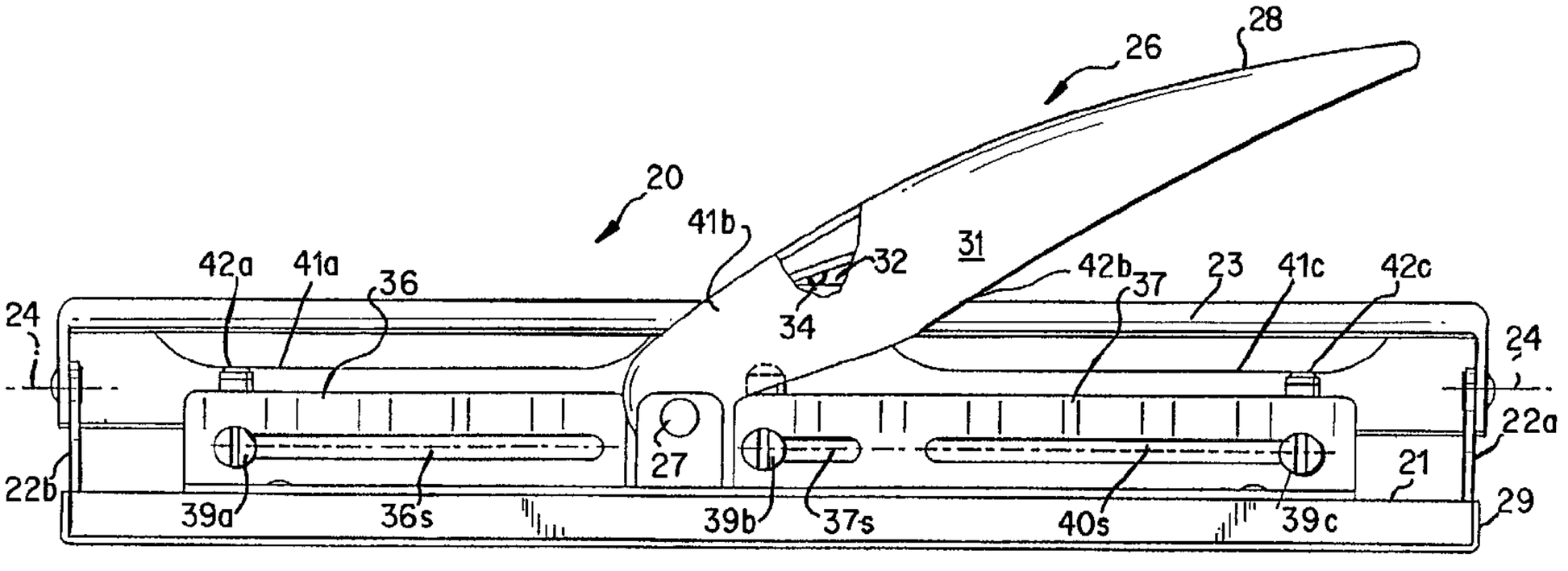

(57) Abrégé/Abstract:
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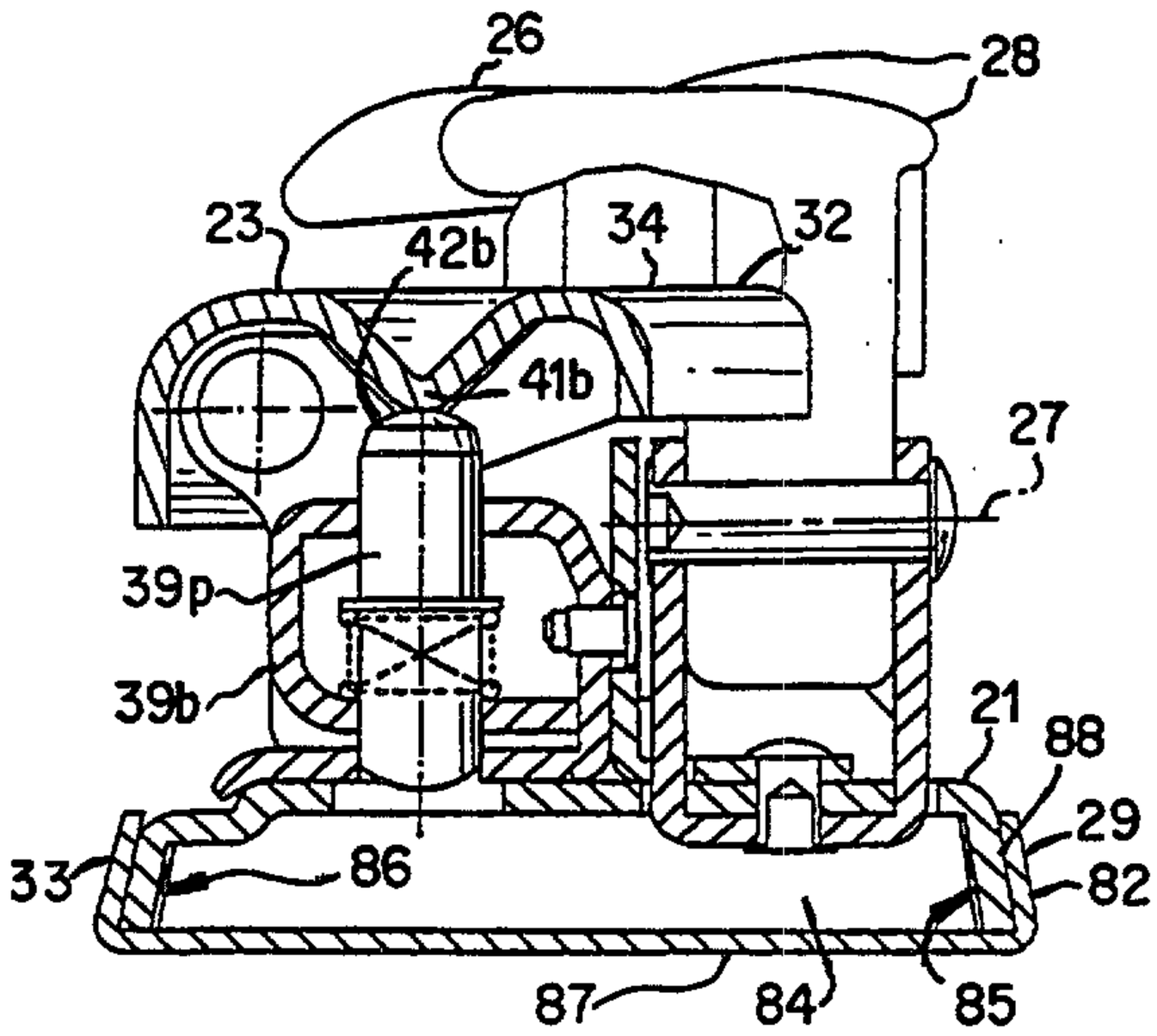


(57) Abstract

A manual sheet paper punch having an elongated pivotal flap (23) which drives punch dies to punch sheets and, in addition, a pivotal lever means (26) is positioned above the flap for hand operation to urge the elongated flap downwardly to punch sheets. Increased mechanical advantage is accomplished.

LEVER-OPERATED PUSH FLAP FOR MANUAL PUNCH

Background Of The Invention

Prior manual punches have included a handle and a pressure plate to accomplish perforating paper sheets (U.S. Patent No. 2,382,523). Extended longitudinal handles have also been proposed for hand punches (U.S. Patent No. 5,143,502). Punching machines have also included toggle arrangements (U.S. Patent No. 806,262).

Summary Of The Invention

Broadly, the present invention comprises a cam lever arrangement for applying force to the push flap of a manual punch. The flap pivotal about an axis on the punch is acted on through cam engagement by a cam lever means also pivotally mounted on the punch to increase the mechanical forces acting on the punches while allowing a reduction in the force required by the user. The punch includes a non-scuffing sliding chip scrap slipper.

It is a feature that the cam lever means may be pivotal about an axis parallel or perpendicular to a flap pivot axis.

It is a further feature that chip scraps from the hole punching operation may be removed from the punch assembly without the need for removing the slipper.

It is still a further feature that the punch assembly has a cam feature, integral to the push flap which allows operation of the punch pins by a rolling cam action rather than flat sliding surfaces thus eliminating the squeak associated with prior art.

Brief Description Of The Drawings

Fig. 1 is a front view of a prior art punch having its flap raised;

Fig. 1a is a cross sectional view of the prior art showing lever distances;

Fig. 2 is a back view of a slippered punch of the present invention with the flap raised and including a cam lever arrangement in its raised position;

Fig. 3 is the same view as Fig. 2 with the cam lever arrangement and flap lowered;

Fig. 4 is an end view of the punch with a portion shown in section and with the lever and flap raised;

Fig. 5 is the same view as Fig. 4 with the lever and flap lowered;

Fig. 6 shows an alternative embodiment having a raised lever arrangement mounted at the punch ends about axes perpendicular to the length of the punch;

Fig. 7 is the same view as Fig. 6 with the lever lowered;

Fig. 8 is an enlarged area of Fig. 7 with dimensions and angles therein;

Fig. 9 is an enlarged area of Fig. 6 with dimensions and angles therein;

Fig. 10 is the same view as Fig. 7 with the lever lowered and specific lengths shown;

Fig. 11 is a perspective view of the chip slipper showing the various elements;

Fig. 12 is a view of the punch base with the slipper shown partially extended.

Fig. 13 is a perspective view of an alternative slipper; and

Fig. 13a is a sectional view taken through Fig. 13.

Description Of The Preferred Embodiments

In Fig. 1 prior art punch 10 has rectangular base 11, vertical end walls 12a, 12b and pivotal flap 13 having indentation 13a. Also shown are three (3) pin units 14a, 14, 14c and flap protrusion 13p. Turning to Fig. 1a, the mechanical advantage of the prior rt unit 11 is shown by the following:

d_3 = 1.5 *INCH Typ.*

d_2 = 1 *INCH Typ.*

d_1 = .5 *INCH Typ.*

$$\frac{d_3}{d_1} = \frac{1.5}{.5} = 3:1 \text{ RATIO}$$

Turning to Figs. 2-5, inventive paper sheet punch 20 has base 21, vertical end walls 22a, 22b, pivotal elongated flap 23 pivotal about flap axis 24, punch pin cams 41a, 41b, 41c, sliding slipper 29 and flap cam surface 32. Lever 26 includes hand-contact portion 28, neck portion 31, curved cam surface 34

(Fig. 2) makes a sliding line contact with flap cam surface 32 of flap 23 as lever 26 is operated to move pivotal elongated flap 23 (see Figs. 4 and 5). Lever 26 is shaped and positioned for rotation so it fits within the area of rectangular base 21 as viewed from above. Lever 26 adds to the height of the punch but not its width or length. Also shown are punch unit racks 36, 37 with horizontal slots 36s, 37s and 40s for longitudinally adjustable pin units 39a, 39b, 39c which carry punch pins 39p.

With reference to Figs. 3 and 10 and lever arm distances:

MECHANICAL ADVANTAGE LEVER DESIGN

d_4 = 1.447

d_5 = 4.470

d_6 = .380

d_7 = .887

$$\frac{d_5}{d_4} = \frac{5.47}{1.447} = 3.78{:}1\ RATIO$$

$$\frac{d_7}{d_6} = \frac{.887}{.380} = 2.33{:}1\ RATIO$$

ADVANTAGE 2.33 *x* 3.78 = 8.807

As curved cam surface 34 of lever 26 operates on flat cam surface 32 of flap 23 remote from axis 24 the mechanical advantage is based on the following equations (Figs. 8 and 9):

EQUATION SET 1

$$\angle BAE = \cos^{-1} \frac{AB^2+AE^2-BE^2}{2 \cdot AB \cdot AE}$$

where

$$AB = \sqrt{AF^2+FO^2} = \sqrt{\ell_1^2+\gamma_1^2}$$

$$AE = \sqrt{AF^2+FE^2} = \sqrt{\ell_1^2+\lambda_1^2}$$

$$BE = R = \gamma_1+\gamma_2$$

$$\angle \theta AF = tg^{-1} \frac{\gamma_1}{\ell_1}$$

$$\angle FAE = tg^{-1} \frac{\lambda}{\ell_1}$$

$$\theta = \angle BAE - \angle FAE$$

$$\alpha = \angle BAE - \angle FAE - \angle OAF$$

$$AC = AB \cdot \cos\theta$$

$$DE = AF - AC = \ell_1 - AB\cos\theta$$

$$BD = \sqrt{BE^2-DE^2} = \sqrt{R^2-DE^2}$$

$$\boxed{\cos\beta = \frac{BD}{BE} = \frac{\sqrt{R^2-(\ell_1-AB\cos\theta)}}{R}}$$

$$\boxed{\delta = \gamma_1 \cdot \cos\beta}$$

EQUATION SET 2

First Stage:

$$(\ell_1-\delta)\,p\cos\beta=(\ell_1+\ell_2)\,F_1$$

$$F_1=\frac{(\ell_1-\delta)}{(\ell_1+\ell_2)}\cos\beta\cdot P=G_1\cdot P$$

where

P is Punch Force

$$G_1=\frac{(\ell_1-\delta)}{(\ell_1+\ell_2)}\cos\beta$$

$\ell_1,\ell_2,\delta,\beta$ *are geometric realted factor (see page 2)*

Second Stage:

$$\ell_3F_2=(\ell_3+\ell_4)\,F\ input$$

$$F_2=\frac{\ell_3+\ell_4}{\ell_3}\,F\ input=\frac{1}{G_2}\,F\ input$$

where

F input is input force

$$G_2=\frac{\ell_3}{\ell_3+\ell_4}$$

$\because F_1=F_2$, *Combined* (1) *and* (2), *we obtain*

$$\boxed{F\ input=G_1\cdot G_2\cdot P}$$

During operation integral cam surfaces 41a, 41b, 41c of flap 23 being a radius surface rather than a flat angled surface operate upon surface 42a, 42b, 42c

of pin units 39a, 39b, 39c in a rolling action ratner than a sliding action. The result being a punch in which the squeak common to current designs is eliminated.

Turning to Figs. 6 and 7 and an alternative embodiment, punch 60 has base 61, end frame pieces 62, 63, flap 64, flap pivot 66, lever 67 and lever pivot 68. Flap 64 includes cam 64a adjacent to pivot 66 and remote cam 64b. Lever 67 includes cam 69 and remote surface 67a.

Fig. 7 shows lever arm distances:

$d_8 = .380$

$d_9 = 1.200$

$d_{10} = .400$

$d_{11} = 1.560$

$$\frac{d_9}{d_8} = \frac{1.200}{.380} = 3.158{:}1 \; RATIO$$

$$\frac{d_{11}}{d_{10}} = \frac{1.560}{.4} = 3.9{:}1 \; RATIO$$

$3.158 \times 3.9 = \underline{12.316}$

Turning to Figs. 11 and 12 construction and operation of the slipper 29 are shown including channel area 80, closed end 81, angled sides 82, 83, notched end 84 and slots 85, 86 and bottom surface 87. Slipper 29 is made of rubber, plastic or other

material that will not scratch or mar a finished wooden desk or similar surface.

Slipper 29 may be extended to a position so the paper chips can be poured free from the slipper holding channel 80. Movement of the slipper 29 from the captive position shown in Figs. 2 and 3 to the pouring position is accomplished by sliding the slipper 29 in a direction opposite from end 84. Slipper 29's retention on base 21 is accomplished forming angled sides 82, 83 of slipper 29 to complement the angled sides 88, 89 of base 21.

Turning to Figs. 13 and 13a and the alternative embodiment of slipper 100 which includes channels 101 and 102, cavity 103, closed ends 104, 105, angled sides 106, 107, inner angled surfaces 108, 109, and bottom surface 110. Channels 101, 102 may terminate at closed end 104 or closed end 104 may be slotted like end 105 to all channels 101, 102 to continue to the outer surface of end 104.

1. In a manual paper sheet punch having a base, an elongated flap pivotal about a flap axis, which flap has an upper cam surface, the improvement comprising

a) said flap having a first portion adjacent the flap axis and a second portion remote from the flap axis, which second portion includes said upper cam surface;

b) a plurality of spaced apart pins for punching paper sheets, said pins being positioned below the flap for engagement with said flap at a pin engaging location spaced between the first and second flap portions; and

c) cam lever means mounted on a lever axis fixed on the punch, said cam lever means including:
i) a first surface spaced from said lever axis to which a punch operating force is applied to move said lever means, and
ii) a second surface disposed between said lever axis and said first surface and positioned for cam engagement with said upper cam surface of the second portion of the flap,

whereby movement of the lever means about its lever axis by said force applied to said lever means causes the flap to pivot about said flap axis to punch paper sheets.

2. The punch of claim 1 in which the lever axis is parallel to the flap axis.

3. The punch of claim 1 in which the lever axis is perpendicular to the flap axis.

4. The manual paper punch of claim 1 having in addition a rectangular base having two parallel base pieces

and an anti-scuffing slipper having an open channel positioned on the parallel base pieces, such slipper having sides and ends, which sides permit the slipper to be slid along the base parallel to the push flap axis to expose the open channel where chip scraps are retained thus providing means of removing such chip scraps.

5. The paper punch of claim 4 in which said slipper sides include slots to accommodate the parallel base pieces.

6. In a manual paper sheet punch having a rectangular base, an elongated flap pivotal about a flap axis, which flap has an upper cam surface, the improvement comprising

a) said flap having a first portion spaced from the flap axis by a first distance and a second portion spaced from the flap axis by a second distance greater than said first distance, said second portion including said upper cam surface;

b) a plurality of spaced apart pins below said first portion of the flap for engagement by said flap under a first force for punching paper; and

c) cam lever means mounted on a lever axis spaced from said second portion by a third distance and having a remote surface spaced from said lever axis by a forth distance greater than said third distance, said cam lever means being fixed on the punch for cam engagement with the upper cam surface of the second portion of the flap upon movement of the lever means about its lever axis in response to a second force applied to said remote surface of said lever means to cause the flap to pivot to punch paper sheets, with the first, second, third and fourth distances being related to each other to produce said first force

against the punch pins at a level over eight times said second force applied to the lever means.

7. The paper punch of claim 6 in which the the first, second, third and fourth distances are related to each other to produce said first force at a level which is twelve times the second force applied to the cam lever means.

8. The paper punch of claim 3 in which the rectangular base has a rectangular area and cam lever means is positioned within such area as viewed from above.

9. The paper punch of claim 1 in which the flap has a convex surface and each of said pins has a convex surface, which flap convex surface and pin convex surface engage during punching.

10. The paper punch of claim 4 in which said slipper sides and parallel base pieces frictionally engage one another.

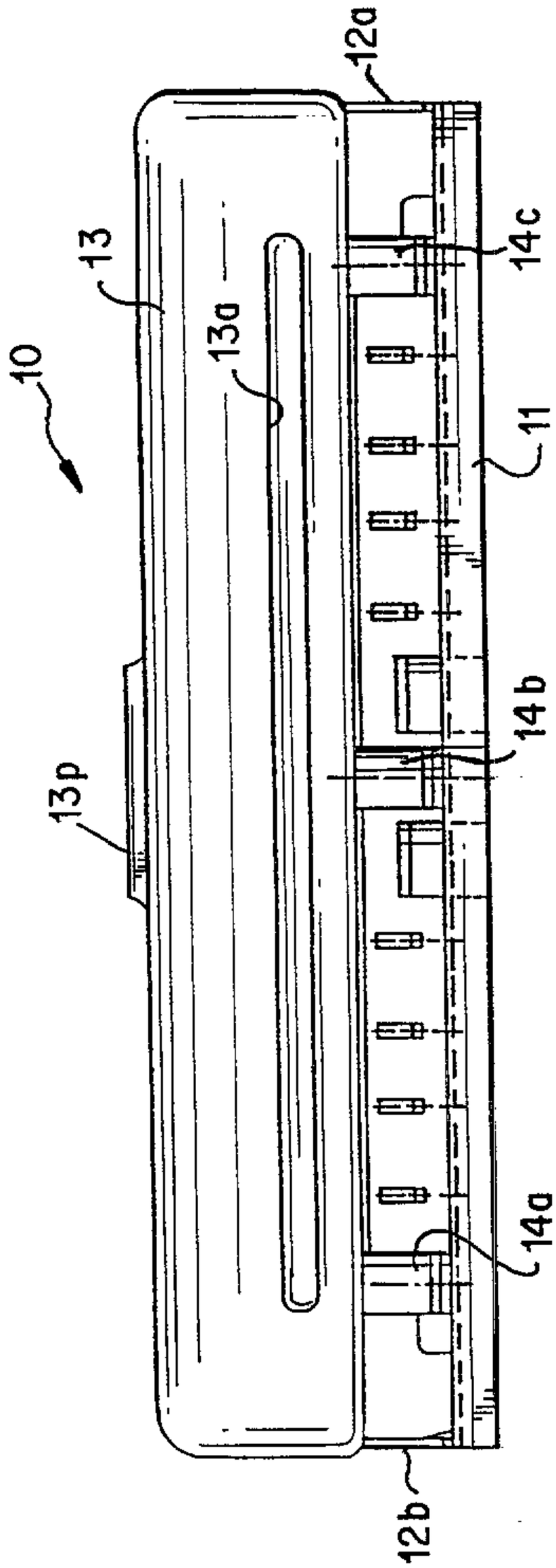


FIG. 1 PRIOR ART

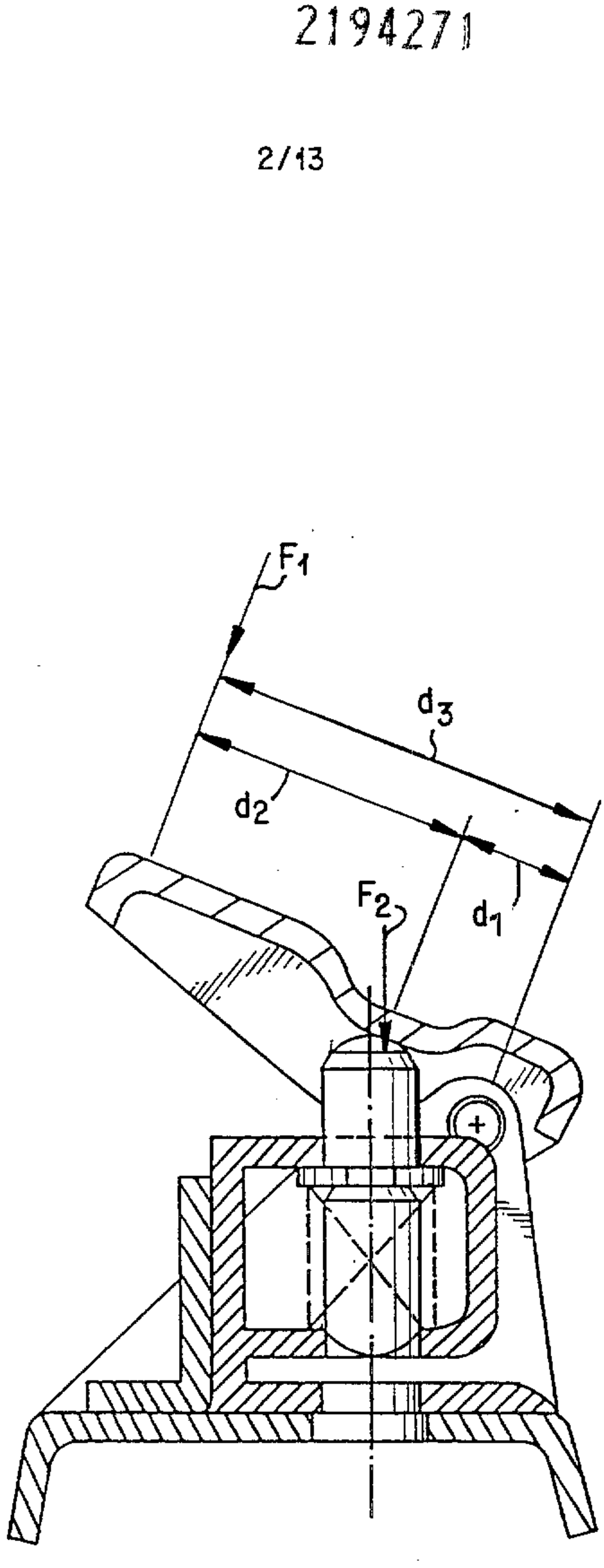


FIG. 1a PRIOR ART

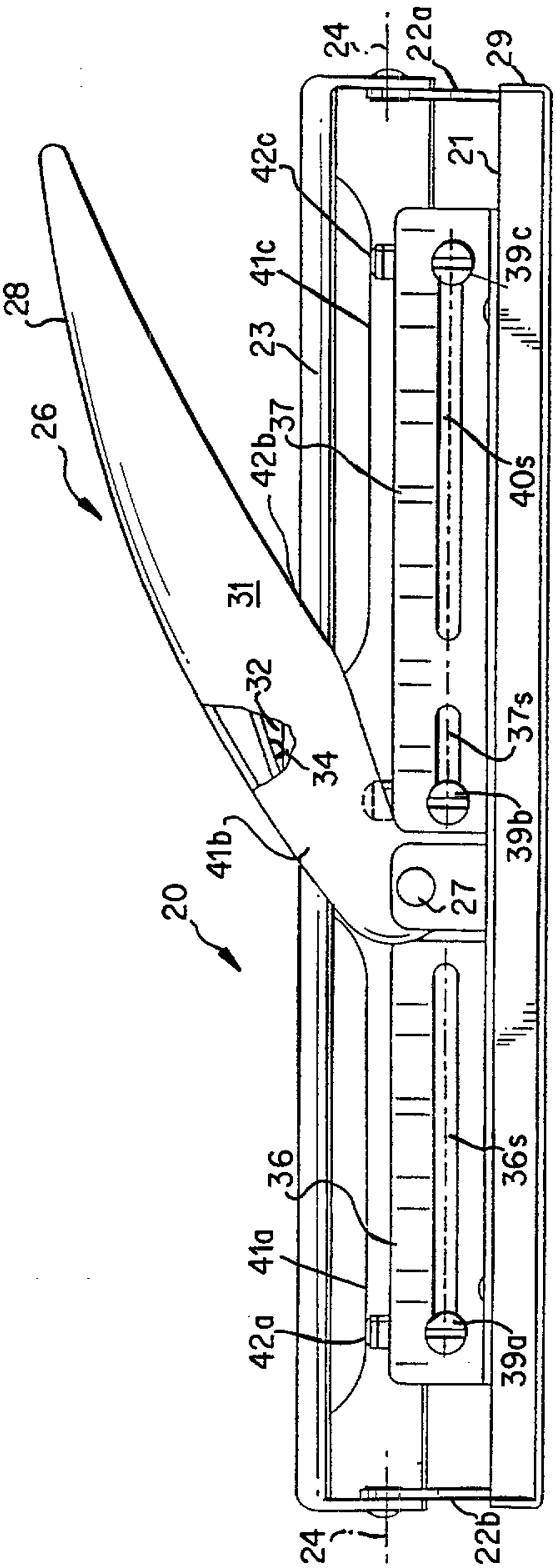

24
22a
29
42c
21
41c
39c
28
23
26
37
42b
40s
31
32
37s
34
39b
41b
Q
27
20
36
36s
41a
42a
39a
24
22b

FIG. 2

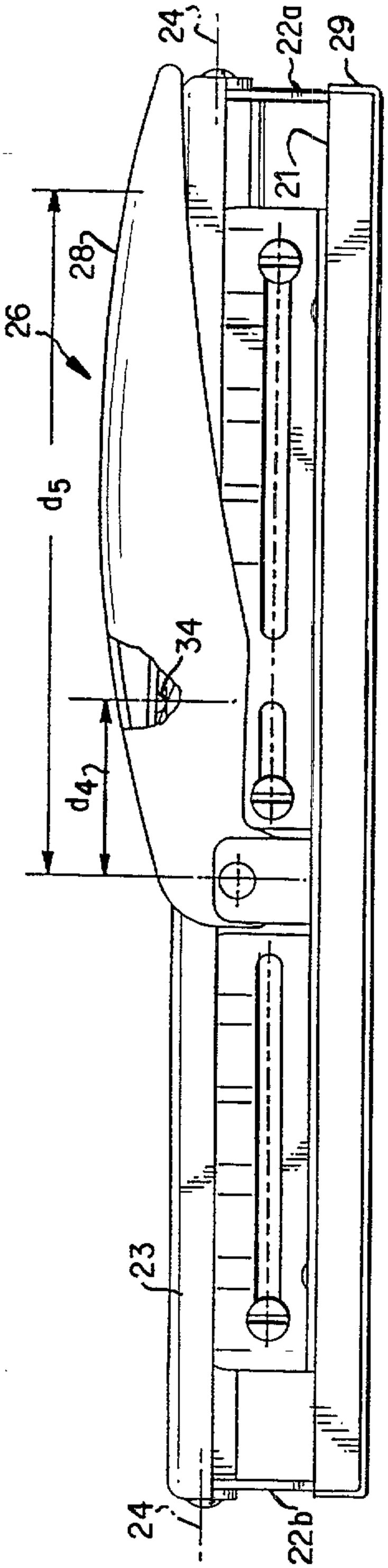


FIG. 3

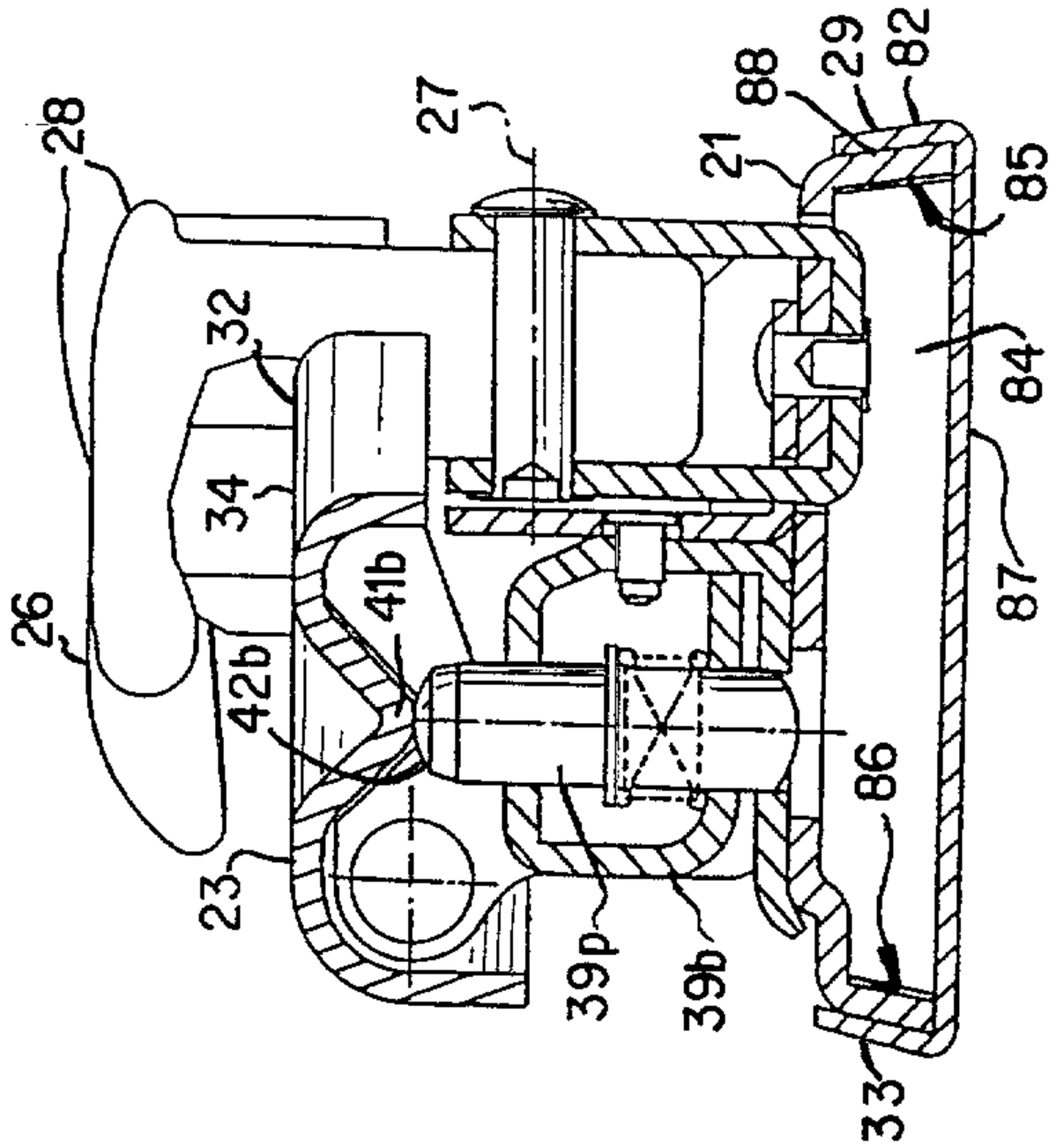

28
27
88
29
82
21
85
32
84
34
87
26
41b
42b
86
23
39p
39b
33

FIG. 5

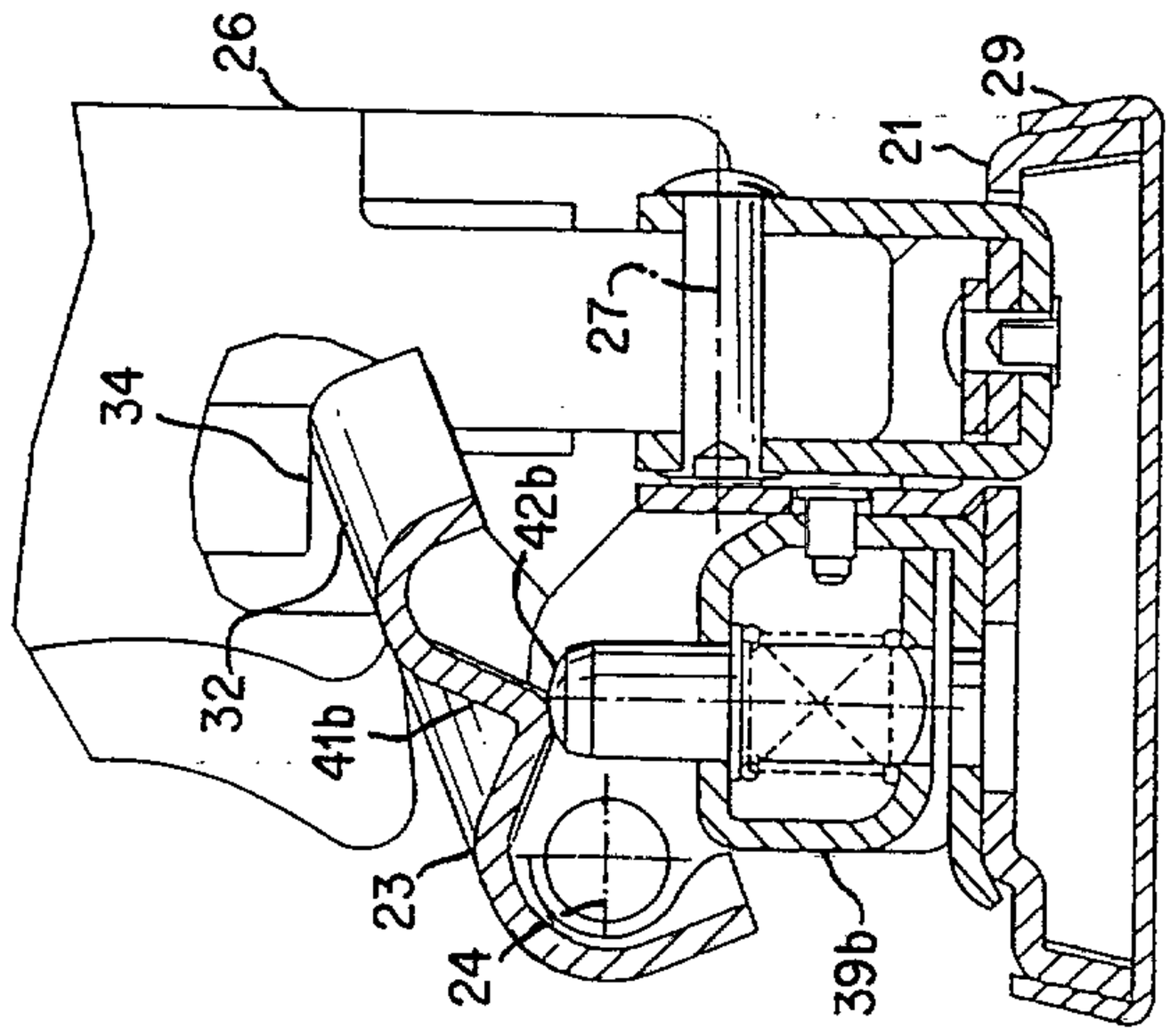

26
29
21
27
34
42b
32
41b
23
24
39b

FIG. 4

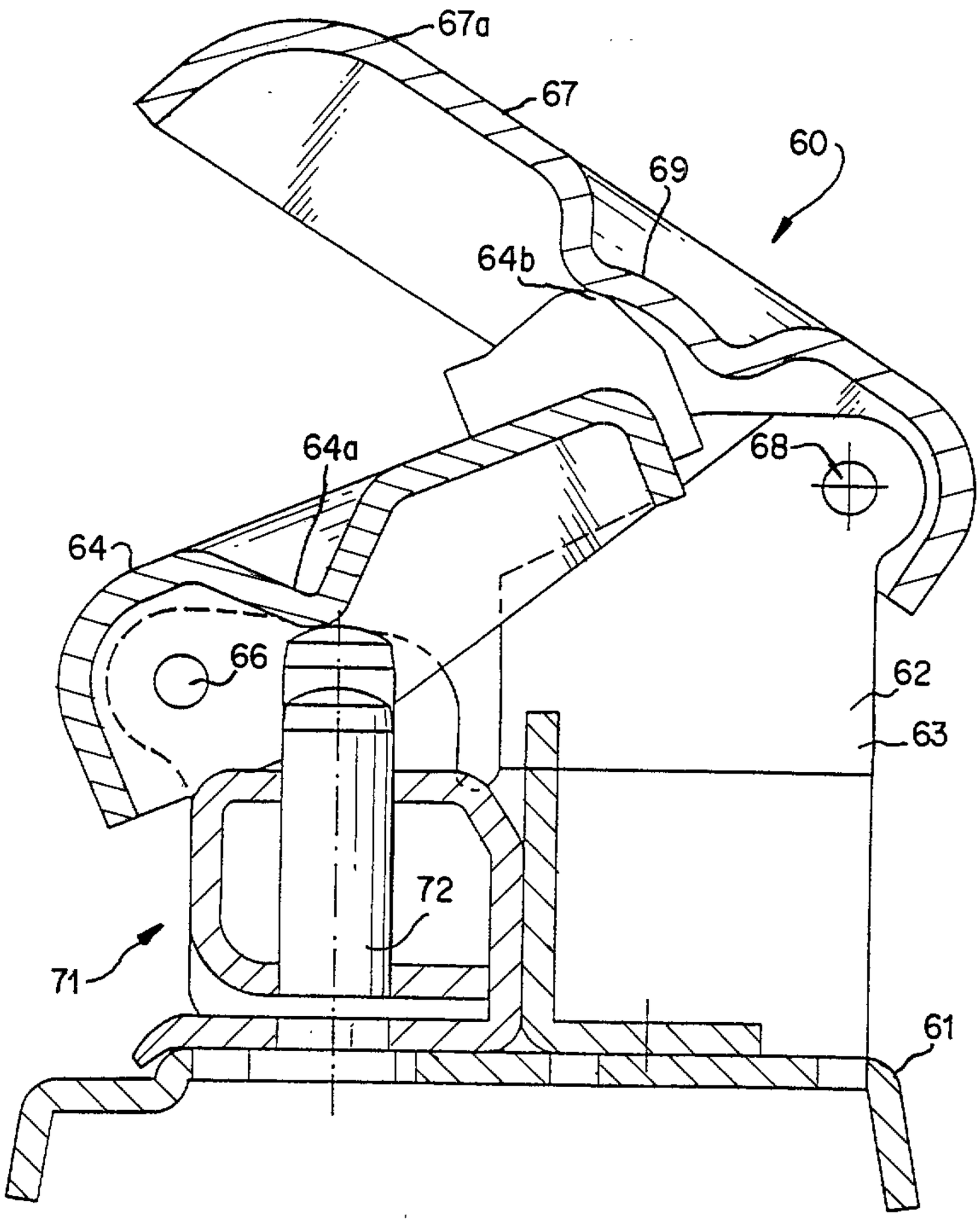


FIG. 6

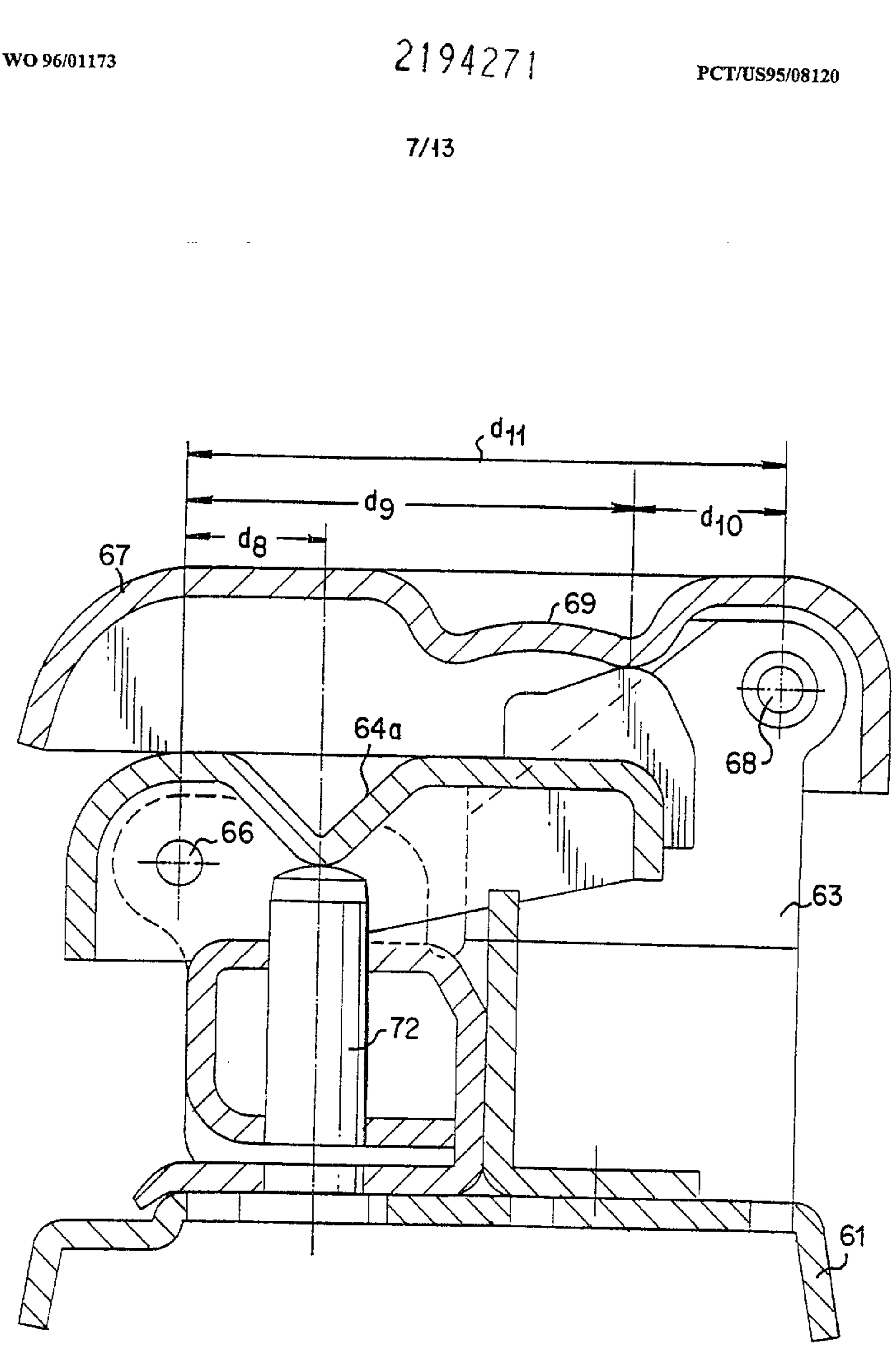


FIG. 7

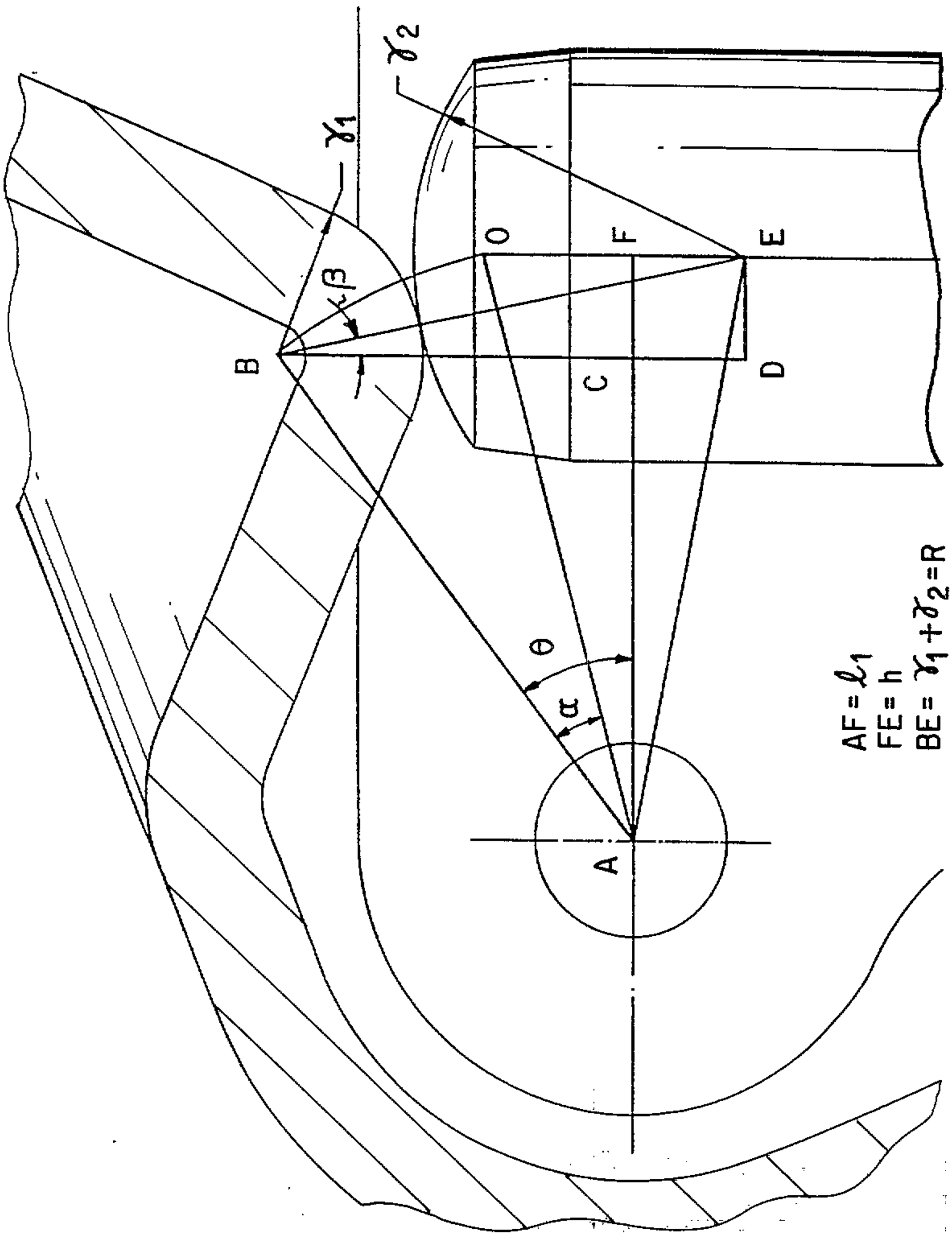

γ_2
γ_1
O
F
E
B
β
C
D
θ
α
A
AF = ℓ_1
FE = h
BE = $\gamma_1 + \gamma_2 = R$

FIG. 8

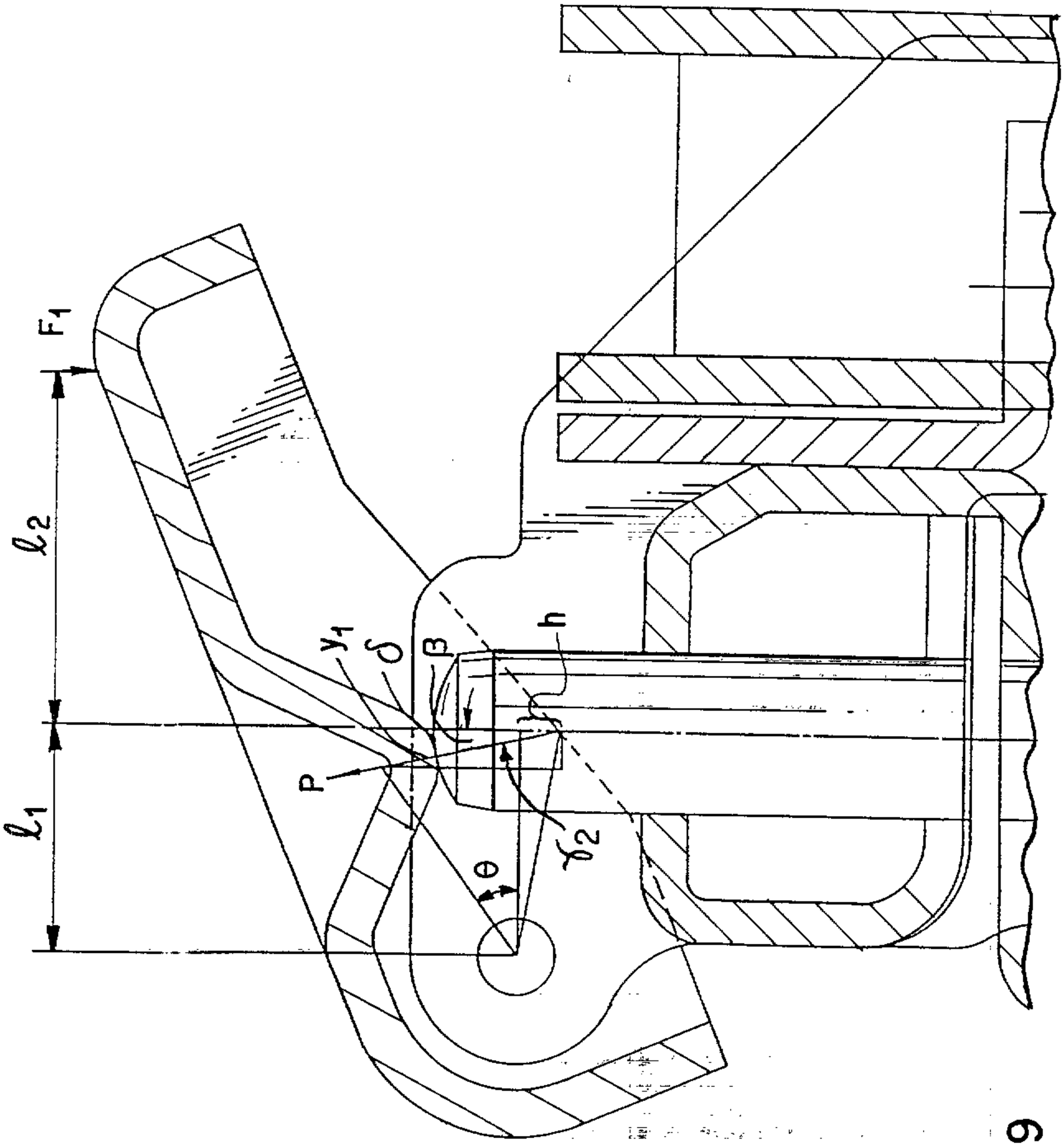


FIG. 9

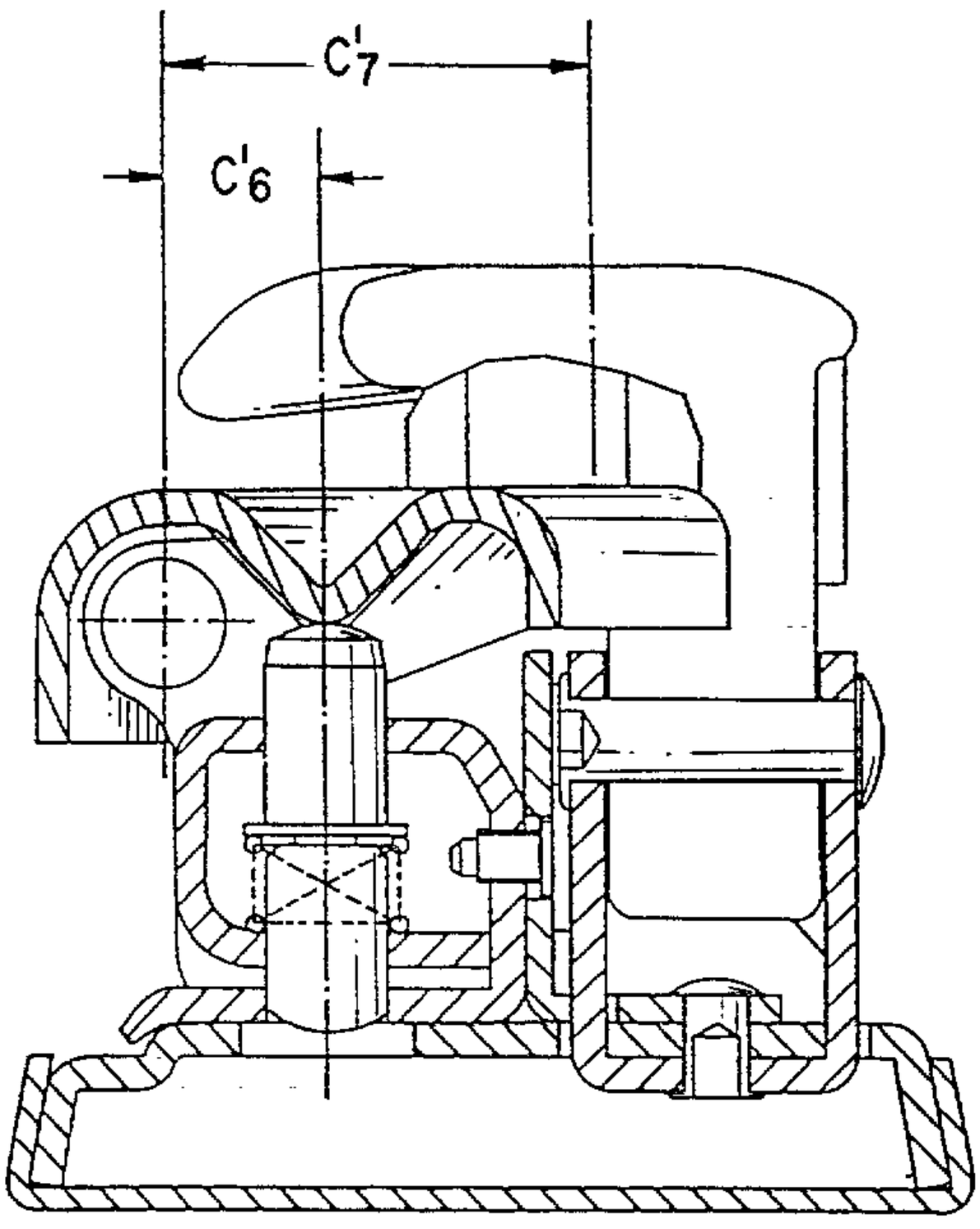


FIG. 10

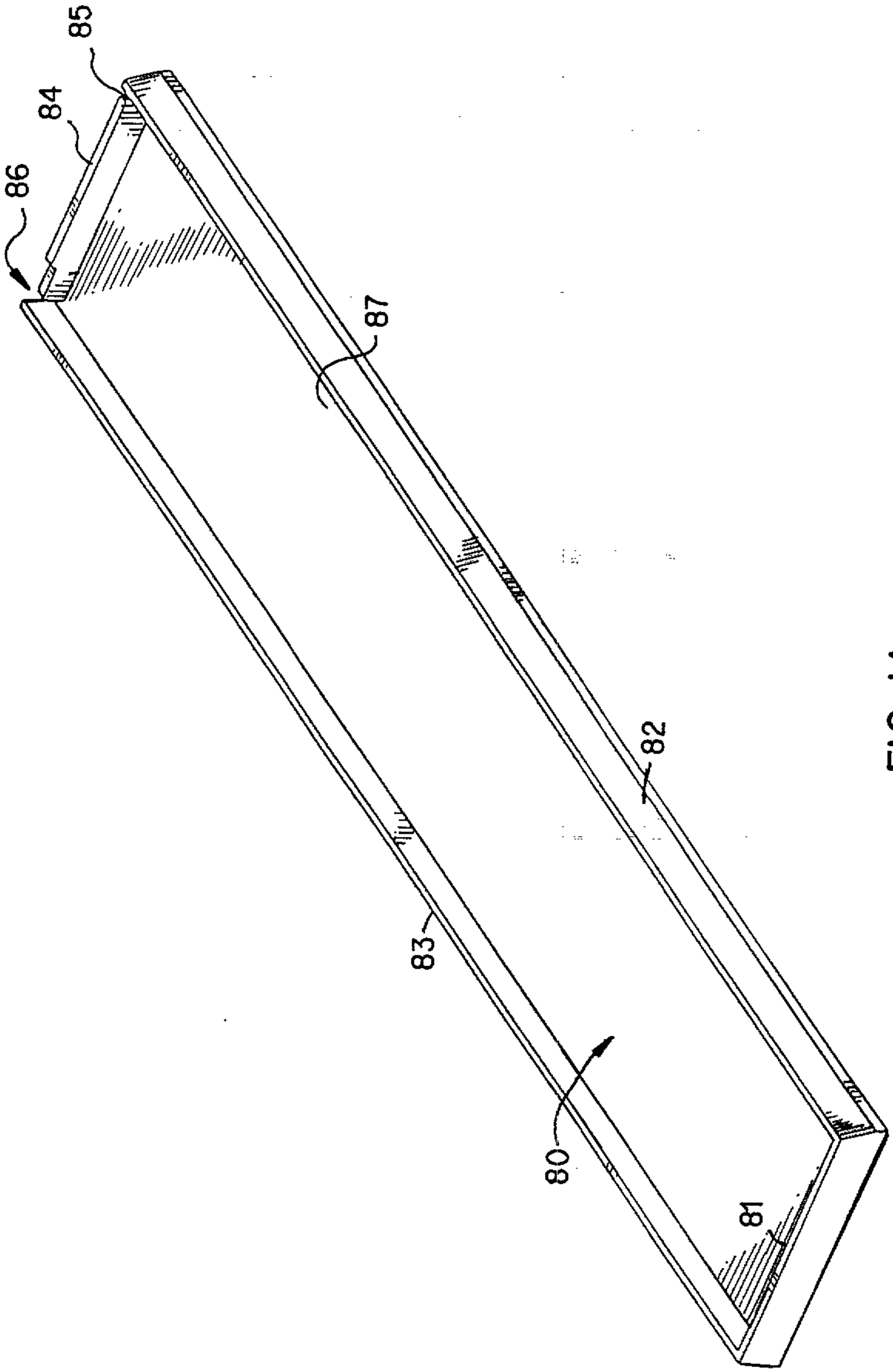


FIG. 14

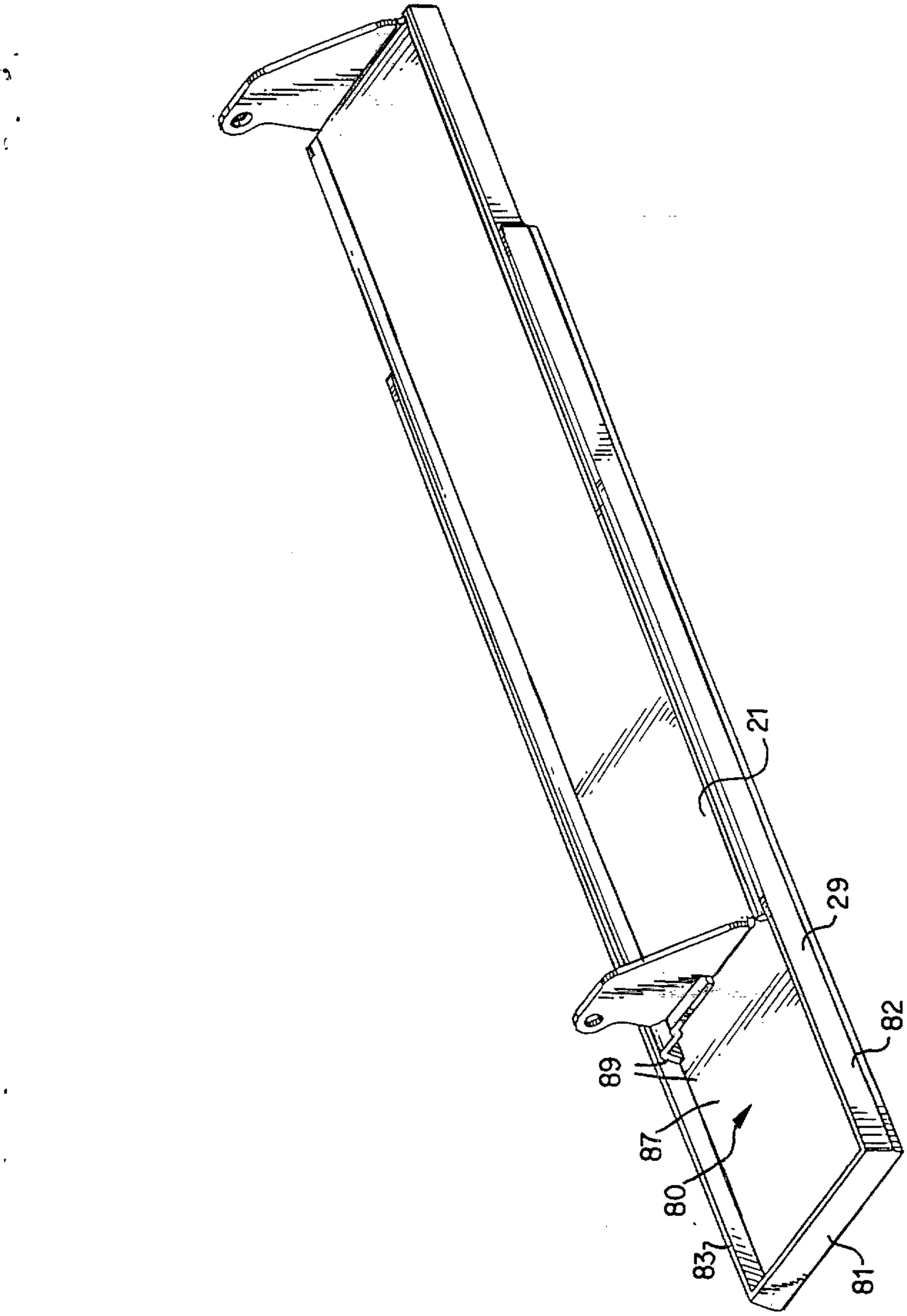


FIG. 12

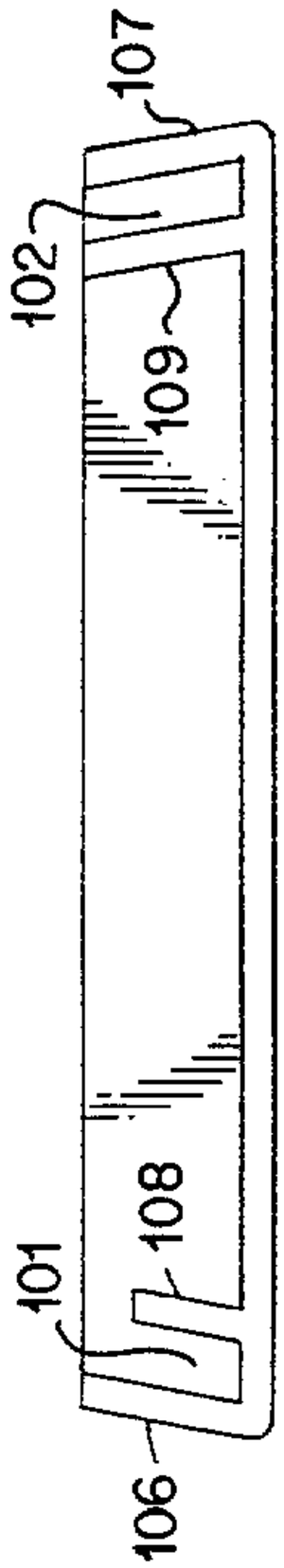


FIG. 13a

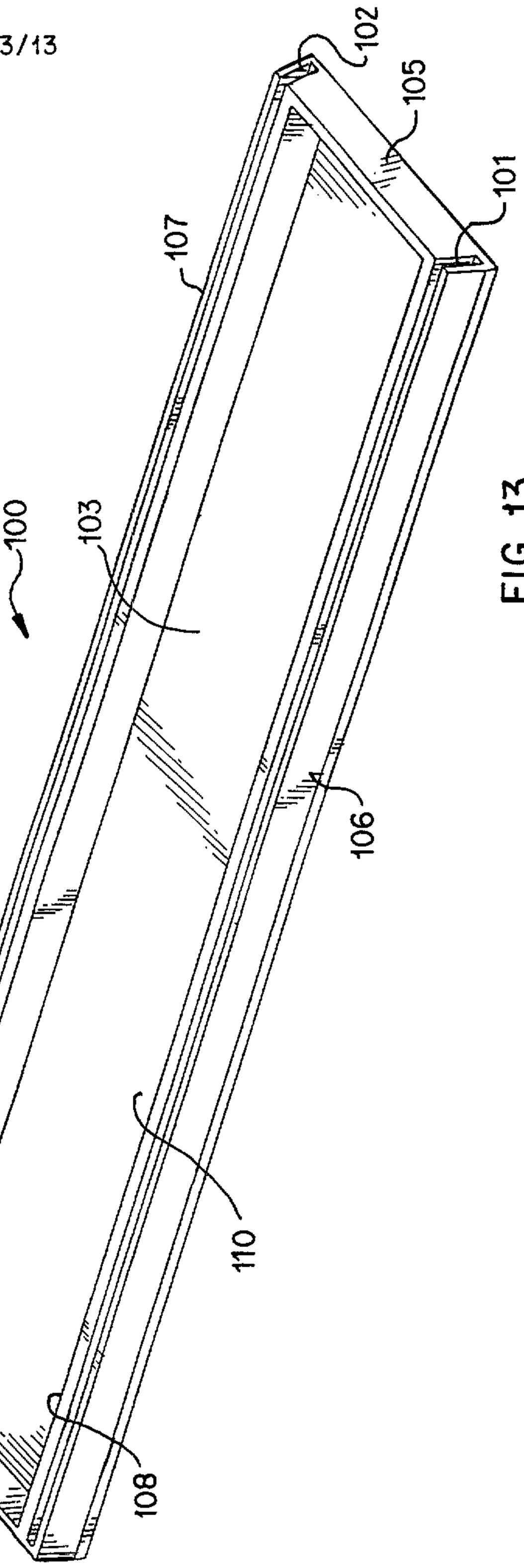
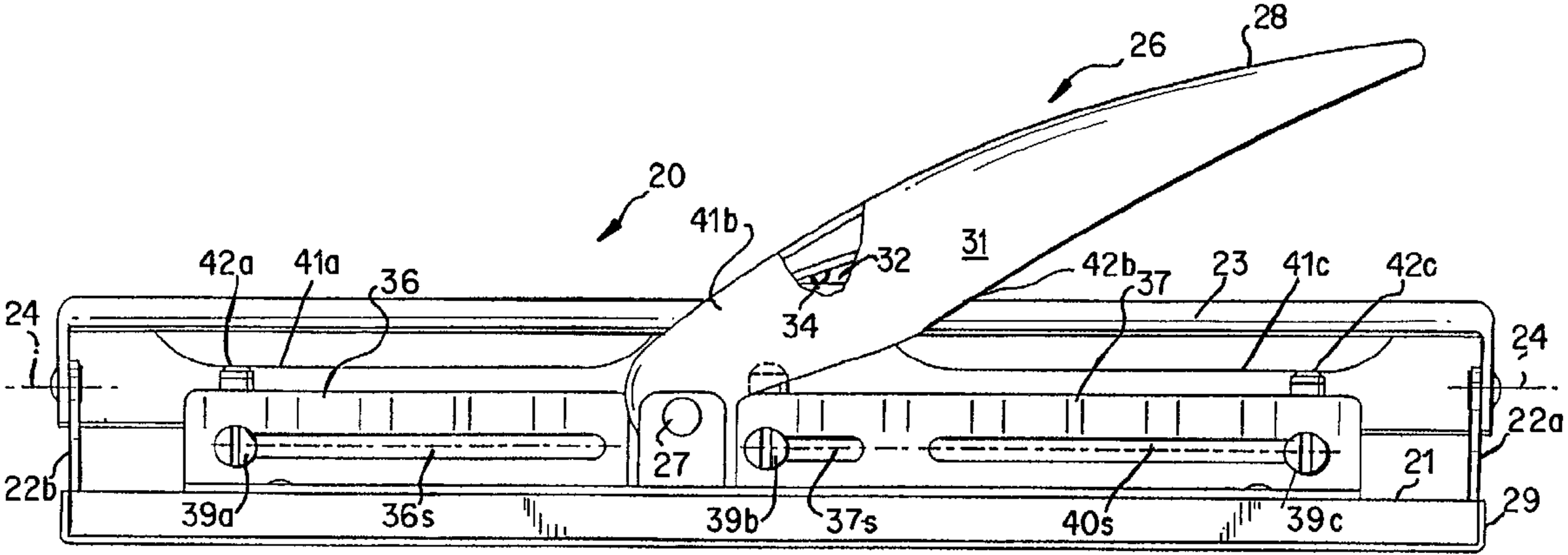


FIG. 13


28
26
20
41b
31
42a
41a
36
32
42b
37
23
41c
42c
24
34
24
22a
22b
27
21
39a
36s
39b
37s
40s
39c
29