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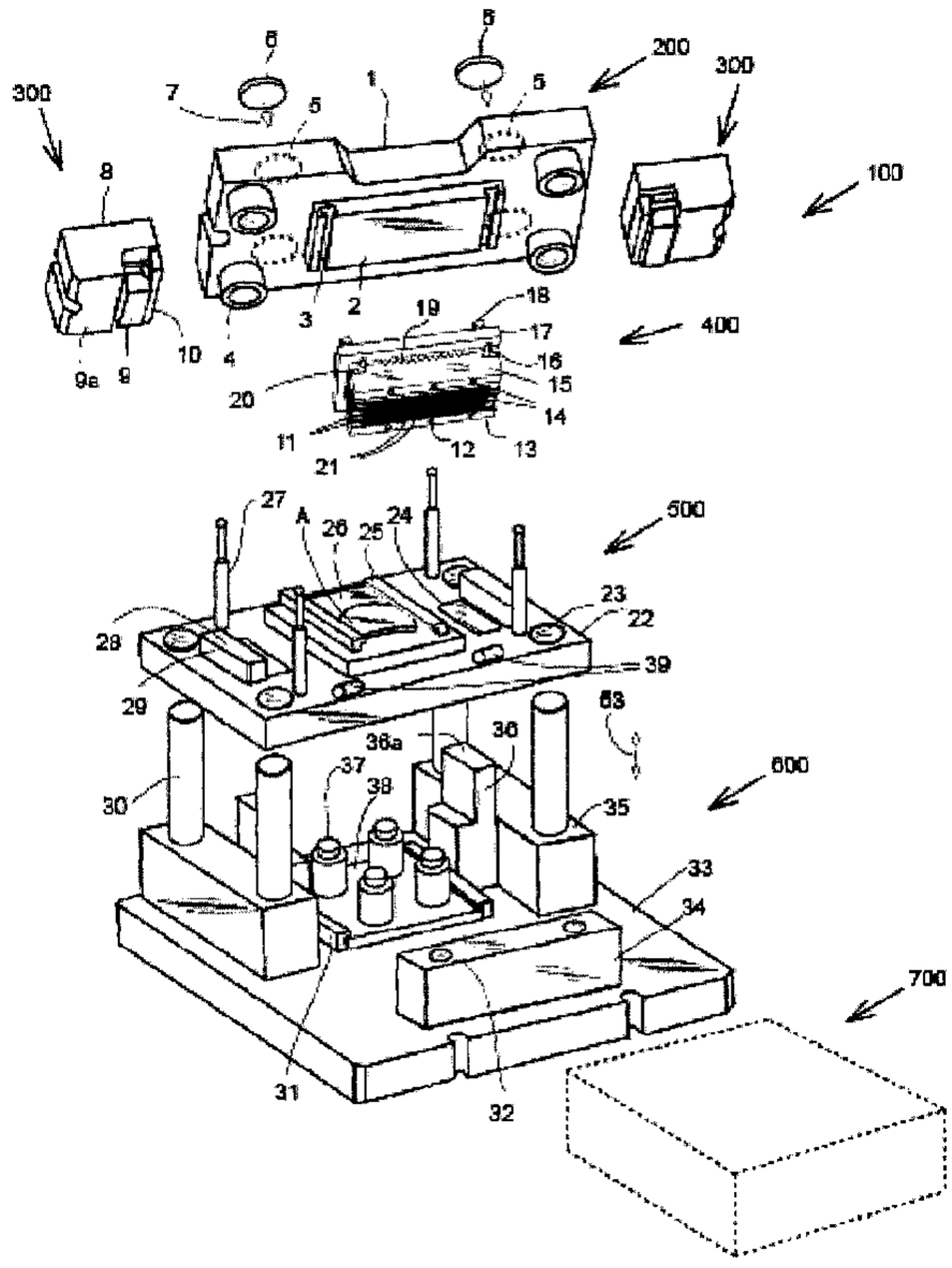
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(54) Titre : APPAREIL POUR TEXTURER LA SURFACE D'UNE PLAQUE DE FREIN
(54) Title: APPARATUS FOR TEXTURING THE SURFACE OF A BRAKE PLATE



(57) Abrégé/Abstract:
An apparatus is provided for texturing the surface of a brake plate has three die plates and spring supports therebetween. A toothed tooling mounts to the top die plate above an anvil on the centre die plate both of which ride on posts held by the lower die plate. The toothed tooling comprises multiple blades each with multiple replaceable toothed inserts are held in a cartridge arrangement. The anvil receives brake plates from a separately supported plate feed mechanism with greatly reduced reciprocating mass. The complete die set can be set up on the bench and inserted ready to use in any style of press where the press ram contacts the upper die plate.

ABSTRACT

An apparatus is provided for texturing the surface of a brake plate has three die plates and spring supports therebetween. A toothed tooling mounts to the top die plate above an anvil on the centre die plate both of which ride on posts held by the lower die plate. The toothed tooling comprises multiple blades each with multiple replaceable toothed inserts are held in a cartridge arrangement. The anvil receives brake plates from a separately supported plate feed mechanism with greatly reduced reciprocating mass. The complete die set can be set up on the bench and inserted ready to use in any style of press where the press ram contacts the upper die plate.

APPARATUS FOR TEXTURING THE SURFACE OF A BRAKE PLATE

FIELD OF THE INVENTION

The invention relates to apparatuses for texturing the surface of a brake plate.

BACKGROUND OF THE INVENTION

Secure brakes being all-important, the use of textured plates to anchor the friction pad is extremely desirable. However, the additional cost of plate texturing limits their real-world use to severe-service and high-end vehicles where the added cost is irrelevant. It would be desirable to lower the cost of texturing brake plates so that more widespread use could be made of this safety feature.

SUMMARY OF THE INVENTION

An apparatus is provided for texturing the surface of a brake plate having three die plates and spring supports therebetween. A toothed tooling mounts to the top die plate above an anvil on the centre die plate both of which ride on posts held by the lower die plate. The toothed tooling comprises multiple blades each with multiple replaceable toothed inserts which are held in a cartridge arrangement. The anvil receives brake plates from a separately supported plate feed mechanism. The complete die set can be set up on the bench and inserted ready to use in any style of press where the press ram contacts the upper die plate.

The three die plates of the present invention are all aligned on vertical posts. The posts are secured to the bottom or base die plate such that the centre and upper die plates are free to reciprocate thereon with the upper die plate uniquely carrying the texturizing tooling. In this way the entire die set installs as a free-standing one-piece assembly. The die set is mountable in a mechanical, hydraulic or servo type press.

This contrasts with prior apparatuses of this type in which texturizing tooling was attached to the press ram. This required that the lower, two-plate die set had to be precisely located beneath - a difficult task given the mass of the die set.

Certain support and actuation members are secured to the base die plate. Certain anvil structures are secured to the centre die plate. Certain cutting and press contact structures are secured to the upper die plate.

Accordingly, an apparatus is provided for texturing the surface of a brake plate. The apparatus comprises an independent and free-standing die set for use within a press. The die set has: a base die plate; a centre die plate; and an upper die plate. The base die plate is attachable to the press and has a series of fixed posts extending upward therefrom. The centre die plate is mounted above the base die plate on the posts and is also movable thereon. The centre die plate has an anvil portion for receiving a brake plate to be textured. The upper die plate is mounted above the centre die plate on the posts and is also movable thereon. The upper die plate has a tooling assembly with a plurality of oppositely acting blades located above the anvil portion. Opposing cam blocks are mounted below the upper die plate adjacent the oppositely acting blades. All of the plates are arranged in series such that downward force from the press urges the upper die plate into contact with the centre die plate, and the centre die plate downward toward the base die plate, and thereby actuates the cam blocks to drive teeth of the oppositely acting blades across and into the surface of the brake plate on the anvil. This action textures the surface of the brake plate. The base die plate is the only portion of the die set that attaches to the press.

For example, the base die plate may be built on a thick steel plate that bolts to the bolster of the press machine. Preferably, the plates are spring-biased apart. Four permanent vertical posts and four removable gas springs are arranged on the base. The springs may be manifolded together to equalize their spring rate and gas delivery so as to provide balanced support for the center die plate. By altering the gas pressure, the gas spring force can be adjusted for different sizes (surface areas or thicknesses) of brake plates to be textured (by providing more or less cutter action).

In one embodiment, the base die plate further includes opposing riser blocks, and the centre plate further includes opposing openings directly above the riser blocks. The riser blocks then extend through the openings to contact portions of the cam blocks to actuate the cam blocks as the upper and centre die plates descend. Preferably, each cam block has a vertical motion member and a horizontal blade moving member. The vertical motion member receives counterforce from the riser blocks, and engages into motion the horizontal blade moving member. The moving cams move the blades to carry out the texturing. (It will be appreciated that other methods of linear actuation of the blades are also possible.)

According to one embodiment, in operation, the press ram descends onto the upper die plate. The upper die plate then descends, engaging the two cams simultaneously. This initiates blade travel slightly prior to the cutting teeth inscribing the plate to create the required hooked burrs. In this way the cutting teeth are in horizontal motion before they drive down into the plate. The ram then ascends and the above the sequence of actions are reversed. The now textured plate is pushed off the anvil by a new incoming plate and the process repeats itself.

Smooth operation of the die set is desirable. The upper die plate may reciprocate on the posts via bushings. Its upper surface is contacted by the press ram. Preferably, the upper die plate

has at least one elastomeric shock absorber disposed on an upper surface thereof. Multiple (preferably urethane) shock absorbing pads may be disposed on the top surface of the upper die plate. These pads are held in counterbored recesses such that the descending press ram contacts these pads first, thus providing a smooth and silent initiation of downward motion of the upper die against the initial resistance offered by the small gas springs.

The apparatus may further include a plate feed mechanism engageable with the centre plate. The plate feed mechanism has a magazine for holding brake plates to be textured; and a reciprocating slide mechanism for pushing brake plates onto the anvil one by one as they descend from the magazine. Preferably, the load of the magazine is supported independently of the die set. Preferably, the plate feed mechanism is detachable from the die set. Preferably, the plate feed mechanism further includes a pawl for preventing rearward motion of the brake plate. Preferably, the reciprocating slide mechanism has a variable delivery angle.

The weight of the plate feed mechanism is preferably supported on a solid mounting block secured to the base die plate (or press bolster). This greatly reduces the reciprocating mass on the die set allowing a higher rate of reciprocation for faster plate texturizing and reduced cost. Reduced reciprocating mass also eliminates expensive wear from side thrust on the die set posts and bushings which would otherwise occur if the entire plate feed mechanism were cantilevered from- and made to reciprocate with the die plate, as is the case in the prior art. Such wear necessitates the tear down of the entire die set to replace the worn posts and bushings. The result is a long non-productive down-time to rebuild the dies and the attendant labour expense.

The plate feed apparatus comprises a plate magazine assembly, a plate feed slide assembly, and a pneumatic linear actuator for the slide, all supported by the solid mounting block on the

base die. The plate slide assembly uses long steel strips as slides in a laminated assembly which are separate from, but pass through and are guided by, the magazine assembly. The slides connect to a hinge block at their outboard (distal) end. This hinge block is separately supported on rods extending from that same solid mounting block (on base die plate die) along which rods it can reciprocate along with the plate slides. These rods also support the stationary actuating cylinder (pneumatic) which reciprocates the hinge block and slides. The inner (proximal) end of the lower plate slide rests on rollers secured to the edge of the centre die. The upper slide plate has features to receive a plate from the stack of plates held in the magazine above. Thus when the cylinder is activated, the reciprocating slides pick up plates on each rearward stroke and deliver the plates in a train-like flow to the anvil for texturing. Spring-loaded pawls or detents prevent the plates from moving backwards with the slide. In this way only a very small portion of the total weight of the plate feed mechanism is reciprocating with the centre die. Thus the posts and bushings do not experience the heavy wear known to be a serious problem with prior methods of plate delivery.

Various blade arrangements are possible. Preferably, the blades are opposingly arranged in the tooling assembly, such that adjacent blades have teeth oriented in opposed directions. The blades may be solid cutting knives, or may include modular inserts. Each blade preferably has at least one cut-out for receiving at least one insert. The insert has a first end on which is disposed a plurality of cutting teeth and a second end having a bulbous projection shaped to loosely engage a correspondingly shaped recess in the at least one cut-out. Preferably, the insert when inserted into the cut-out leaves a gap below the bulbous portion. Preferably, the insert is shaped to wedgingly engage the recess to narrow the gap under force of operation in the press.

Preferably, the inserts and cut-outs have corresponding side taper portions for seating and bulbous bottom portions for retention. The bulbous portion of the cut-out is slightly deeper that of the insert. Thus, there is a gap between the bottom surface of the insert and the bottom surface of the cut-out. In operation the incising force acting on the cutting edge is able to drive the insert a small distance into the tapered cut-out such that the insert wedges very tightly, effectively immobilizing the insert in the blade. Because carbide is very friable and fractures easily if allowed to shudder or vibrate under the high cutting forces required to incise steel, this rigidity greatly prolongs the life of the teeth which reduces costs and reduces press down-time for tooling change-out.

The blade cartridge comprises the cutter blades (with the aforementioned toothed inserts) slidingly held in precisely aligned rows between robust side supports that are secured to a common backing plate which has mounting rails to slidingly engage grooves in a plate attached to the top die. The blades and the side supports all have open slots at each end that are in alignment and through which slots are pins that extend outboard of each side support to provide attachment for return springs stretched between the two ends of the two pins. The rows of blades are off-set alternately such that the cams at each end actuate only half the blades which therefore move in opposite directions.

Preferably, the blades are spring-loaded such that each tooth makes a relatively short gouged inscription and a retention hook on the brake plate before retracting and disengaging from the brake plate.

The upper die plate may be spaced away from the centre die plate for permitting removal and re-insertion of the tooling assembly (e.g. by support from smaller gas springs). The blade cartridge is preferably constructed for easy tooling change-over and maintenance. Preferably, the tooling assembly is mounted to the upper die plate on rails for permitting removal and re-

insertion of the tooling assembly. Preferably, at least one sensor is provided on or near the die set proximate to the anvil for monitoring the texturing operation of the tooling assembly (e.g. to monitor hook formation). Sensors may detect the height of undersized burrs and/or ill-positioned plates and thereby provide input to machine controls to stop the texturing process preventing inferior plates from leaving the press.

BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1 shows a perspective view of the die set with the base, centre and upper die plates, the cam blocks and blade cartridge, and the location of the plate feed mechanism in dashed outline.

Figure 2 shows the plate feed mechanism from the side in its forward position of plate delivery.

Figure 3 shows the same as Figure 2 in the rearward position for plate pickup.

Figure 4 shows the blade and insert tooth arrangement and an enlargement thereof.

Figure 5 shows the prior art dies set in a press with the tooling secured to the ram face.

Figure 6 shows the instant three plate die set in the same press with the tooling secured to the upper die plate.

Figure 7 shows a simplified side view of the instant invention in its resting state so as to clearly disclose the blade movement sequence.

Figure 8 is an enlarged left portion of Figure 7 where the upper die plate contacts the centre die plate.

Figure 9 is the same as Figure 8 but with the two die plates moving in unison.

DETAILED DESCRIPTION OF THE INVENTION

Referring to the drawings, there are sometimes shown small gaps or spaces between components. This is for clarity of understanding but in actual fact most components fit tightly together except where otherwise noted.

In Figure 1 the instant three piece die set **100** has as its major components: upper die plate **200** with tooling assembly **400** and associated cam blocks **300**; centre die plate **500** with anvil **26**; base or lower die plate **600** with posts; and plate feed mechanism **700**, shown as a placement outline in Figure 1 and in greater detail in Figures 2, 3. Die set **100** installs in press **900** (Figure 6) where it is attached to its bolster plate **E**. Press **800** and **900** have base **F** and upper frame **B** connected together with tie rods **C**. Cylinder **G** has ram **D** that is reciprocated therein. The press **900** may be mechanical, hydraulic, or a servo type press.

The prior art show in block outline in Figure 5 uses a two plate die set with tooling attached to the press ram. This makes it difficult to install, adjust, test and change-out the tooling. Critically, the alignment of the tooling with the die set is also difficult given the mass of the die set (many hundreds of pounds) and the need for its precise location beneath the separately mounted tooling. Figure 6 shows the same press with the three plate die set of the instant invention and how the tooling alignment is pre-set prior to installing on the press where the die set location is not critical and therefore much easier and faster.

Referring back to Figure 1, base die plate **600** has base die plate **33** (with means to secure it to press bolster **E**), four rigid posts **30** secured in stop blocks **35**, two stepped riser blocks **36** with

upper contact faces **36a**. A removable slide **38** carries four manifolded gas springs **37** and is located by two guides **31**. On base die plate **33** is rigid block **34** with attachment means **32** to secure plate feed mechanism **700** thereto.

Upper die plate **200** has elastomeric pads **6** secured in recesses **5** in the top surface of plate **1** as shown by arrow **7**. These pads are compressed by the descending ram **D** making for a cushioned, silent contact with top die plate **1** and which also initiate the descent of upper plate **200**. Four through-bushings **4** slide on posts **30**. Cam blocks **300** attach to the underside and are separated by pressure plate **2** which has guides **3** to receive tooling rails **18** on tooling assembly **400**.

Referring to Figure 1 and Figures 7-9 (where Figures 8, 9 show simplified left half views of Figure 7 for enlarged clarity) left and right cam blocks **300** have secured body portions **8** with guided, spring-return moving elements. When die plate **200** descends each vertical moving element **9** contacts surface **36a** of riser block **36**. Elements **9** have angular contact surfaces **9a**. Each horizontal moving element **10** has a matching angular contact surface **10a**. As die plate **200** descends, these angular surfaces engage in a sliding contact such that the horizontal moving elements **10** move towards each other. Toothed blades **11**, **14** held in tool assembly **400**, are arranged to move under the force of horizontal moving elements **10**. Horizontal blade motion is timed to begin just slightly before the teeth contact the brake plate A. In this way, the teeth skate (**21a** in Figure 8) into plate **A** to avoid unwanted sudden impact that would damage the sharp tooth tips. After a certain distance of vertical descent of die plate **200**, shown change in gaps **67** and **67a** in Figures 8, 9, secured body portions **8** contact secured blocks **29** causing centre die plate **500** to thereafter descend with descending die plate **200**. As descent of the upper and centre die plates continues, gap **66** between die plate **200** and die plate **600** is reduced to gas **66a**, the descent being resisted by the adjustable force of gas springs **37** which

allows teeth **21** to continue incising controllably across and into plate **A**, as indicated by buried teeth **21b** in Figure 9. Removable shims **68** in riser blocks **36** allow precise adjustment to compensate for varying thicknesses of plate **A** and for manufacturing/specification tolerances.

Centre die plate **500** has plate **22** with four post through-bushings **23** (to slide on posts **30**) an anvil plate **26** on which brake plate **A**, is delivered between guides **25** for texturing. Openings **24** enable stepped riser blocks **26** to protrude through plate **22** and to contact vertical moving element **9** mounted in cam block **8**. Centre die plate **500** also has four gas springs **27** of sufficient strength to hold upper die plate **200** open over centre die plate **500** for rapid tooling change-out. Pressure blocks **29** have upper contact surfaces **28** that contact cam block contact surfaces **9a** and transfer downward motion of upper die plate **200** to centre die plate **500** such that both move downwards together compressing first gas springs **27** then gas springs **37**. On the edge of plate **22** are two roller supports **29** on which rests and pivots the inboard end of plate feed slides **44**, **44a**.

Upper die plate **200** holds quick-change tooling assembly **400** which includes left blades **11** and right blades **14** having shorter and longer slots **20** formed in end portions. Blades **11** and **14** are arranged in alternating rows and are slidingly held between rigid side fences **13**, **15**. The arrangement is such that the blades are offset horizontally and their respective teeth **21** are pointing in opposite directions. Spring loaded left and right pins **16** engage the blades' slots and co-operating slots in the side fences **15**. Pins **16** are tensioned towards each other via outboard springs **19**. In this way blades **11**, **14** are made to move in opposite directions so as to cancel out their inscribing forces making it unnecessary to clamp brake plate **A** which speeds production. The side fences **13**, **15** are bolted **12** to a pressure plate **17** and the plain backs of the blades also contact plate **17**. Pressure plate **17** has rails **18** secured to its top surface that slidingly engage guide slots **3**.

Attention is now drawn to Figures 2, 3 which show a side view representation of plate feed mechanism **600** at each end of its operational stroke. Figure 2 shows the brake plate delivery position while Figure 3 shows the rearward brake pick up position. Main magazine member **41** includes brake plate support rods **42** and is mounted rigidly to rigid block **34** on base die plate **33**. Brake plates **A** drop through an opening in member **41** onto reciprocating slide **44** with sub-slide **44a** beneath. Both slides pass freely through member **41** and are guided by same. Extending from rigid block **34** are rigid support rods **51** along whose length slide block **50** can be adjustably secured. Slide block **50** holds a separate hinge plate **50a** pivoted thereon via cross pin **45** and shown by arced arrow lines **43**. Slides **44**, **44a** are secured to hinge plate **50a**. Also adjustably secured to rods **51** is a pneumatic cylinder **49** with mounting boss **48** and piston rod **47** which is secured to hinge block **50** such that rod **47**, slides **44** and **44a**, hinge block **50**, and hinged plate **50a**, all reciprocate together along support rods **51**. In this way, brake plates **A** drop by gravity onto upper slide **44** and are moved one by one onto anvil **26** by the reciprocating action of pneumatic cylinder **49** which is timed to the reciprocating movement of the press **900**. Rollers **39** support the inboard ends of slides **44**, **44a** and brake plates in conveyance, and allow free reciprocation left to right on anvil **26** as brake plates are successively delivered thereon. Rollers **39** also move the slides up and down as the center die plate so moves.

Slides **44**, **44a** are made extra long which serves a very important function, namely, it reduces the variation in delivery angle **46** of the brake plate to the anvil **26** between guides **26a**. This means that the brake plate can be delivered with only a small variation in height. This avoids a jamming condition frequently encountered in prior apparatuses which reciprocate the entire brake plate feed mechanism with the centre dies plate. Attached to magazine member **41** are pawls **40**, one of which is shown, which serve as one way controllers to prevent the rearward movement of brake plates resting on the slide **44** which necessarily must travel rearwards.

Referring now to Figure 4, blades **11**, **14** have end slots **20** and cut-outs **63**. Cut-outs **63** receive inserts **61** such that enlarged or bulbous portions prevent the insert from falling from the blade. Certain inserts have cutting teeth **21**. Certain inserts may also have no teeth (not shown). These are used as non-cutting spacers. All inserts have angled side portions **62**. Cut-outs have matching angled sides **64** to provide a close fit with the inserts. It is desirable to prevent relative motion between the inserts and their respective cut-outs which can lead to tooth breakage and expensive production stops to correct. As can be seen in the magnified view in Figure 4 there is provided a cut-out having a slightly deeper bulbous portion indicated by **65**. Each insert **61** can then be driven by forces of operation **70** into a jammed tight condition whereby intimate contact between the walls of the insert and cut-out cannot be interfered with by their bulbous portions contacting first.

Although the invention has been shown and described with respect to detailed embodiments thereof, it should be understood by those skilled in the art that various changes in form and detail thereof may be made without departing from a broad purposive construction of the claimed invention. For instance, although brake plates have been used as an example throughout the foregoing disclosure, it will be appreciated that the methods and apparatus described herein may be equally applicable to texturing other workpieces.

CLAIMS

What is claimed is:

1. An apparatus for texturing the surface of a brake plate, comprising:

an independent and free-standing die set for use within a press, the die set having:

a base die plate attachable to the press, the base die plate having a series of fixed posts extending upward therefrom;

a centre die plate mounted above the base die plate on the posts and movable thereon, the centre die plate having an anvil portion for receiving a brake plate to be textured;

an upper die plate mounted above the centre die plate on the posts and movable thereon, the upper die plate having a tooling assembly with a plurality of oppositely acting blades located above the anvil portion; and

opposing cam blocks mounted below the upper die plate adjacent the oppositely acting blades;

all of the plates being arranged in series such that downward force from the press urges the upper die plate into contact with the centre die plate, and the centre die plate downward toward the base die plate, and thereby actuates the cam blocks to drive teeth of the oppositely acting blades across and into the surface of the brake plate on the anvil, thus texturing the surface of the brake plate;

wherein the base die plate is the only portion of the die set that attaches to the press.

2. The apparatus of claim 1, wherein the plates are spring-biased apart.

3. The apparatus of claim 1, wherein the upper die plate has at least one elastomeric shock absorber disposed on an upper surface thereof.

4. The apparatus of claim 1, further comprising a plate feed mechanism engageable with the centre plate, the plate feed mechanism having:

a magazine for holding brake plates to be textured; and

a reciprocating slide mechanism for pushing brake plates onto the anvil one by one as they descend from the magazine.

5. The apparatus of claim 4, wherein the load of the magazine is supported independently of the die set.

6. The apparatus of claim 4, wherein the plate feed mechanism is detachable from the die set.

7. The apparatus of claim 4, further comprising a pawl for preventing rearward motion of the brake plate.

8. The apparatus of claim 4, wherein the reciprocating slide mechanism has a variable delivery angle.

9. The apparatus of claim 4, wherein the blades are opposingly arranged in the tooling assembly, such that adjacent blades have teeth oriented in opposed directions.

10. The apparatus of claim 1, wherein each blade has at least one cut-out for receiving at least one insert, the insert having:

a first end on which is disposed a plurality of cutting teeth; and

a second end having a bulbous projection shaped to loosely engage a correspondingly shaped recess in the at least one cut-out.

11. The apparatus of claim 10, wherein the insert when inserted into the cut-out leaves a gap below the bulbous portion.

12. The apparatus of claim 11, wherein the insert is shaped to wedgingly engage the recess to narrow the gap under force of operation in the press.

13. The apparatus of claim 1, wherein the base die plate further comprises opposing riser blocks, and the centre plate further comprises opposing openings directly above the riser blocks, the riser blocks extendable through the openings to contact portions of the cam blocks to actuate the cam blocks as the upper and centre die plates descend.

14. The apparatus of claim 13, wherein each cam block has a vertical motion member and a horizontal blade moving member, the vertical motion member receiving counterforce from the riser blocks, and engaging into motion the horizontal blade moving member.

15. The apparatus of claim 1, wherein the blades are spring-loaded such that each tooth makes a relatively short gouged inscription and a retention hook on the brake plate before retracting and disengaging from the brake plate.

16. The apparatus of claim 1, wherein the die set is mountable in a mechanical, hydraulic or servo type press.

17. The apparatus of claim 1, wherein the upper die plate is spaced away from the centre die plate for permitting removal and re-insertion of the tooling assembly.

18. The apparatus of claim 1, wherein the tooling assembly is mounted to the upper die plate on rails for permitting removal and re-insertion of the tooling assembly.

19. The apparatus of claim 1, further comprising a sensor proximate to the anvil for monitoring the texturing operation of the tooling assembly.

20. The apparatus of claim 15, further comprising a sensor proximate to the anvil for monitoring hook formation.

Fig 1

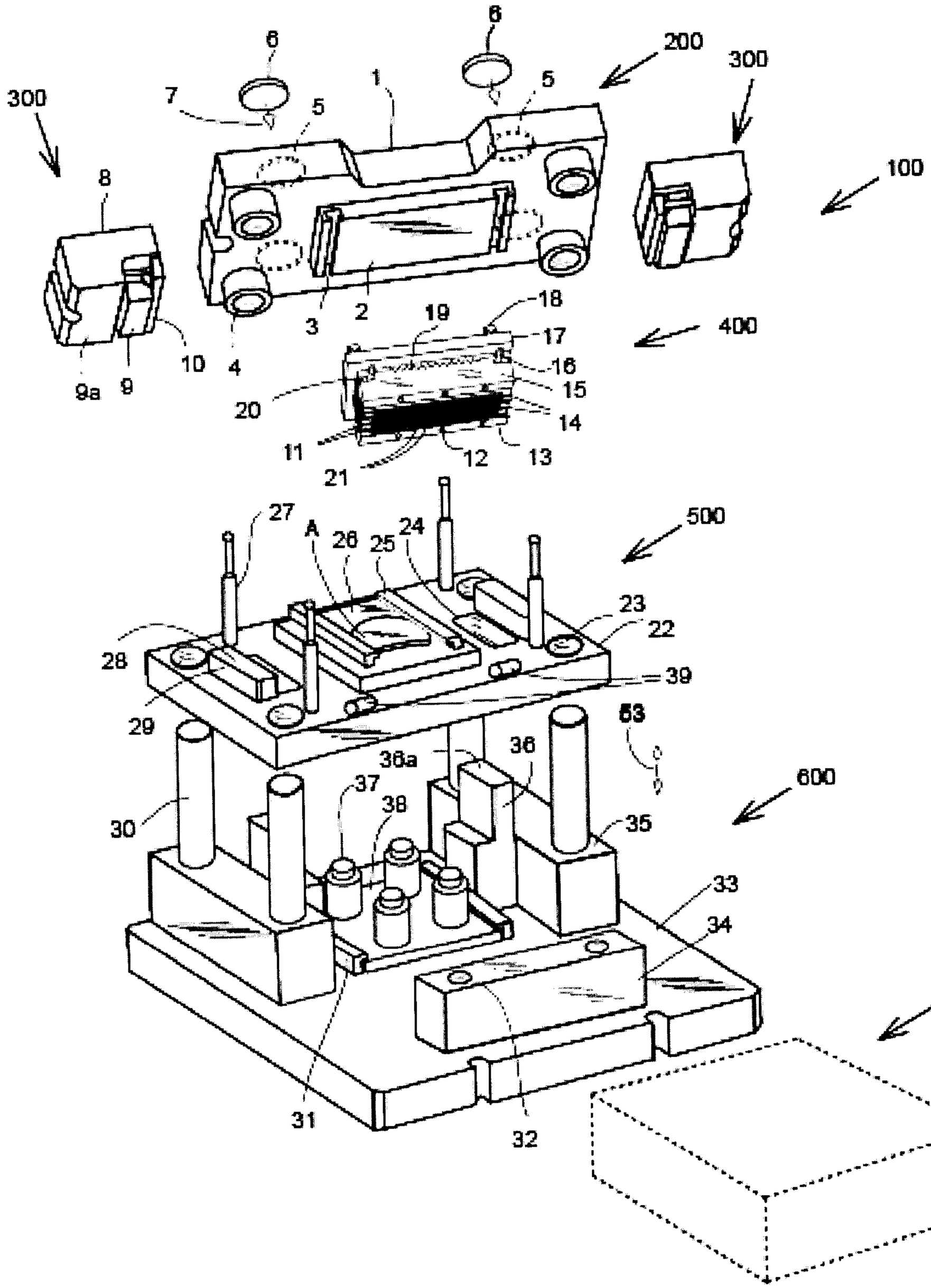

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Fig 2

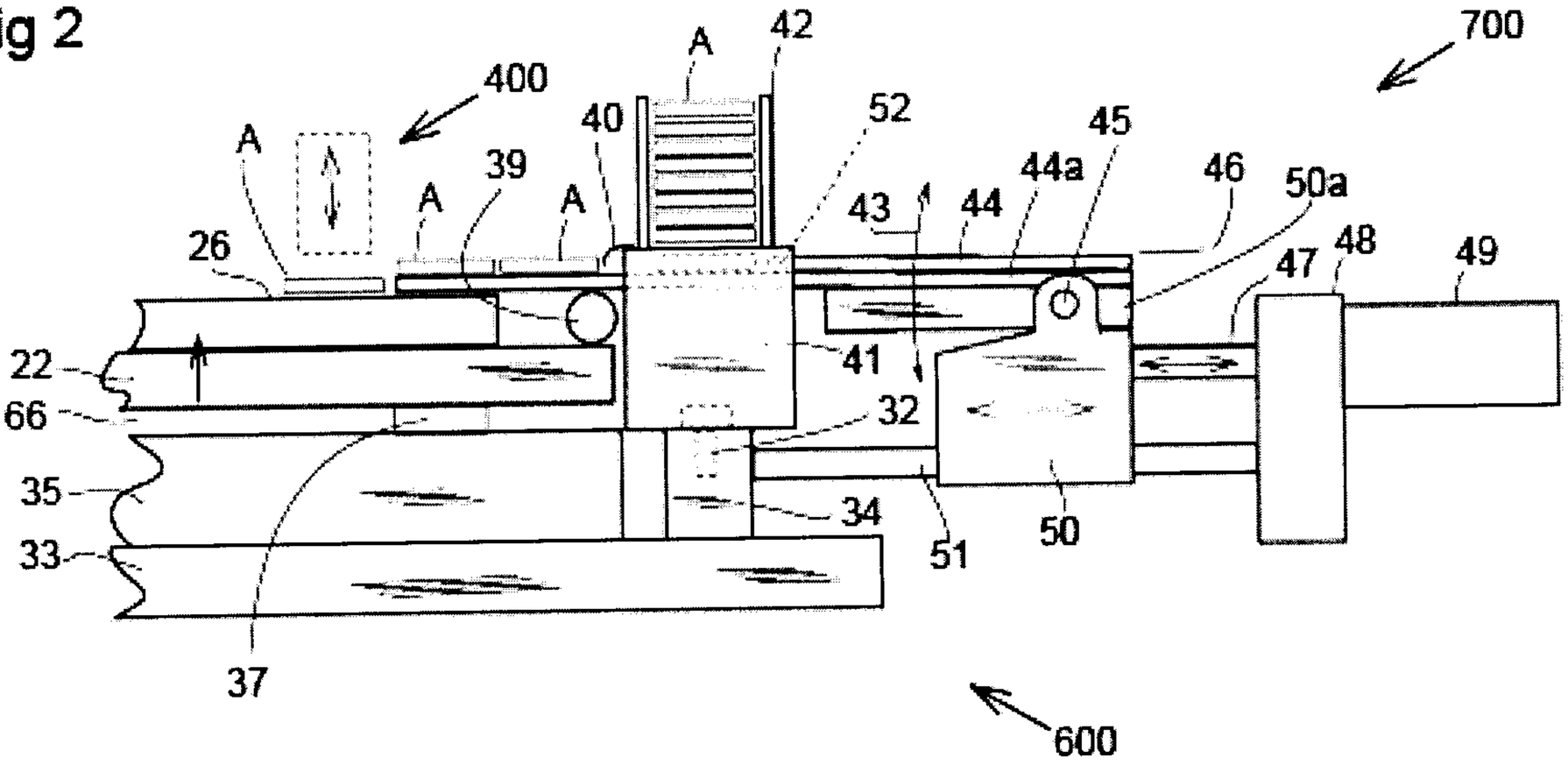


Fig 3

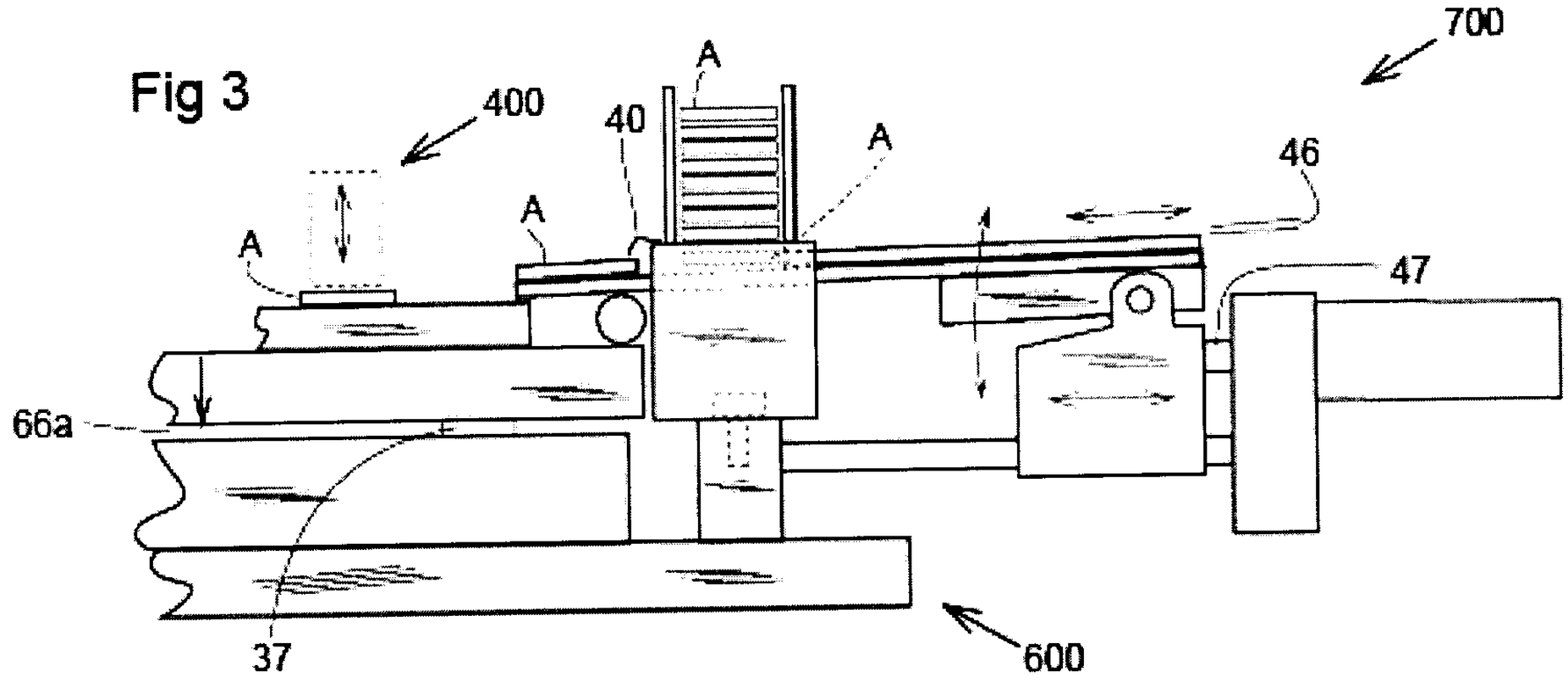


Fig 4

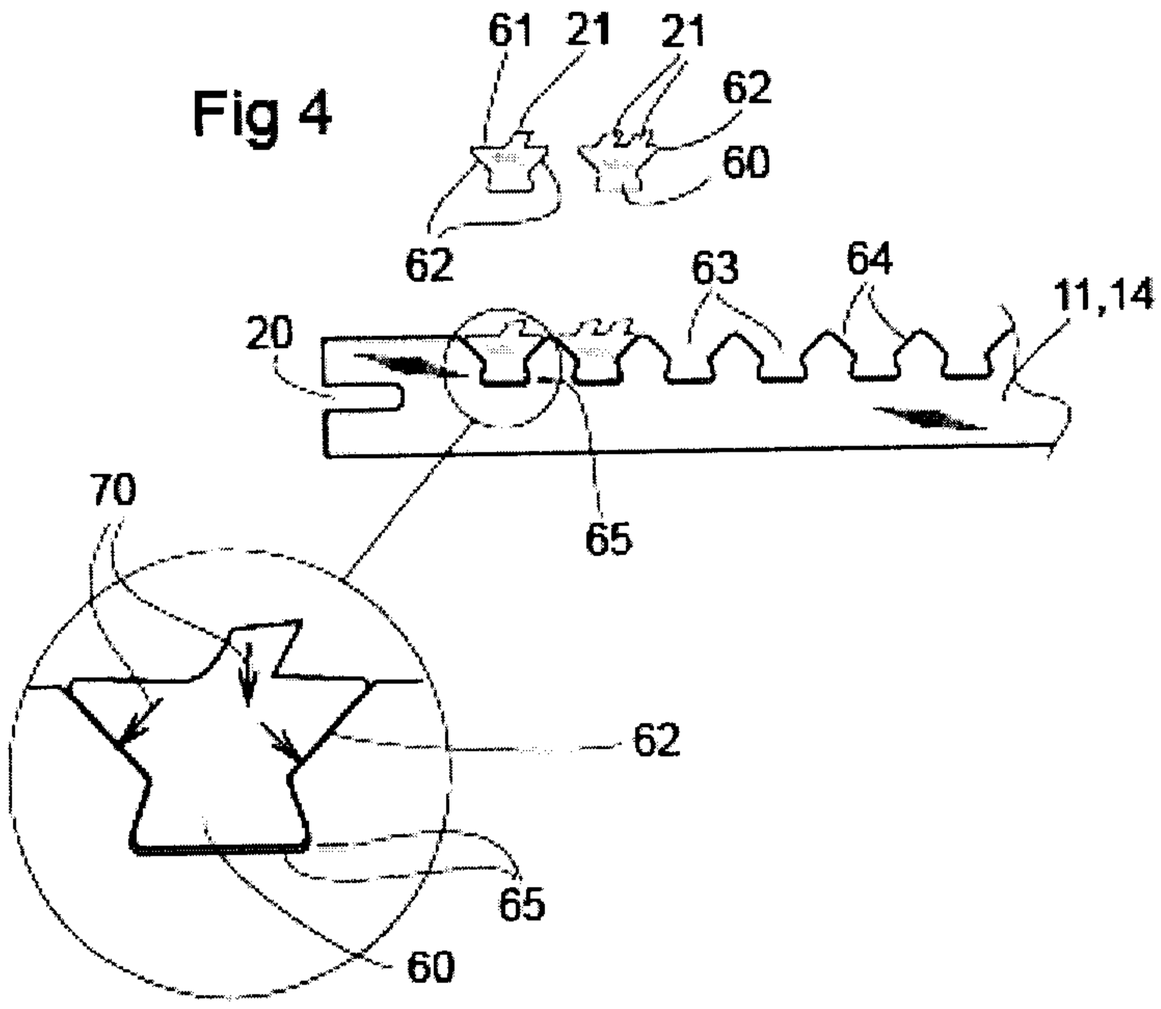


Fig 5 Prior Art

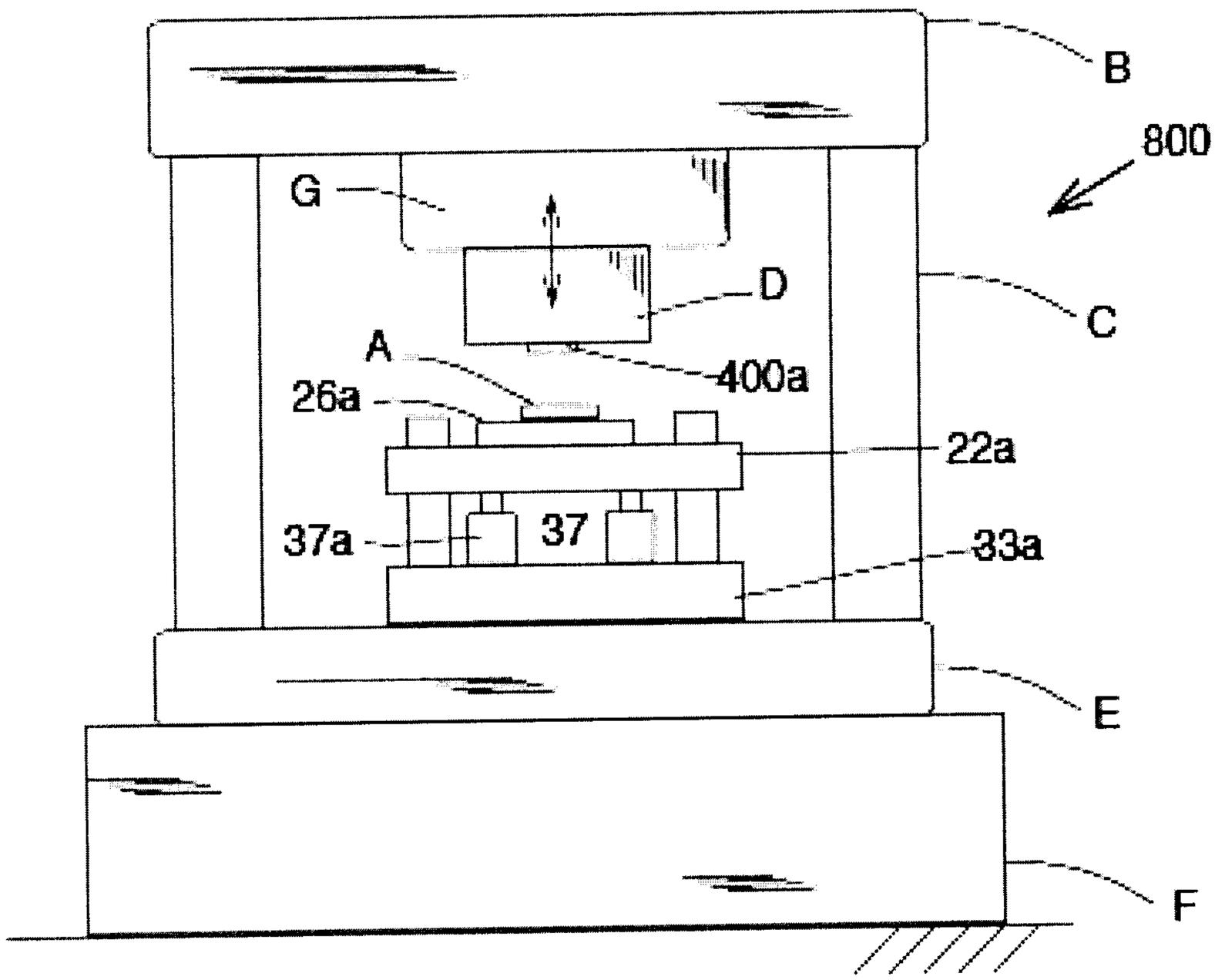


Fig 6

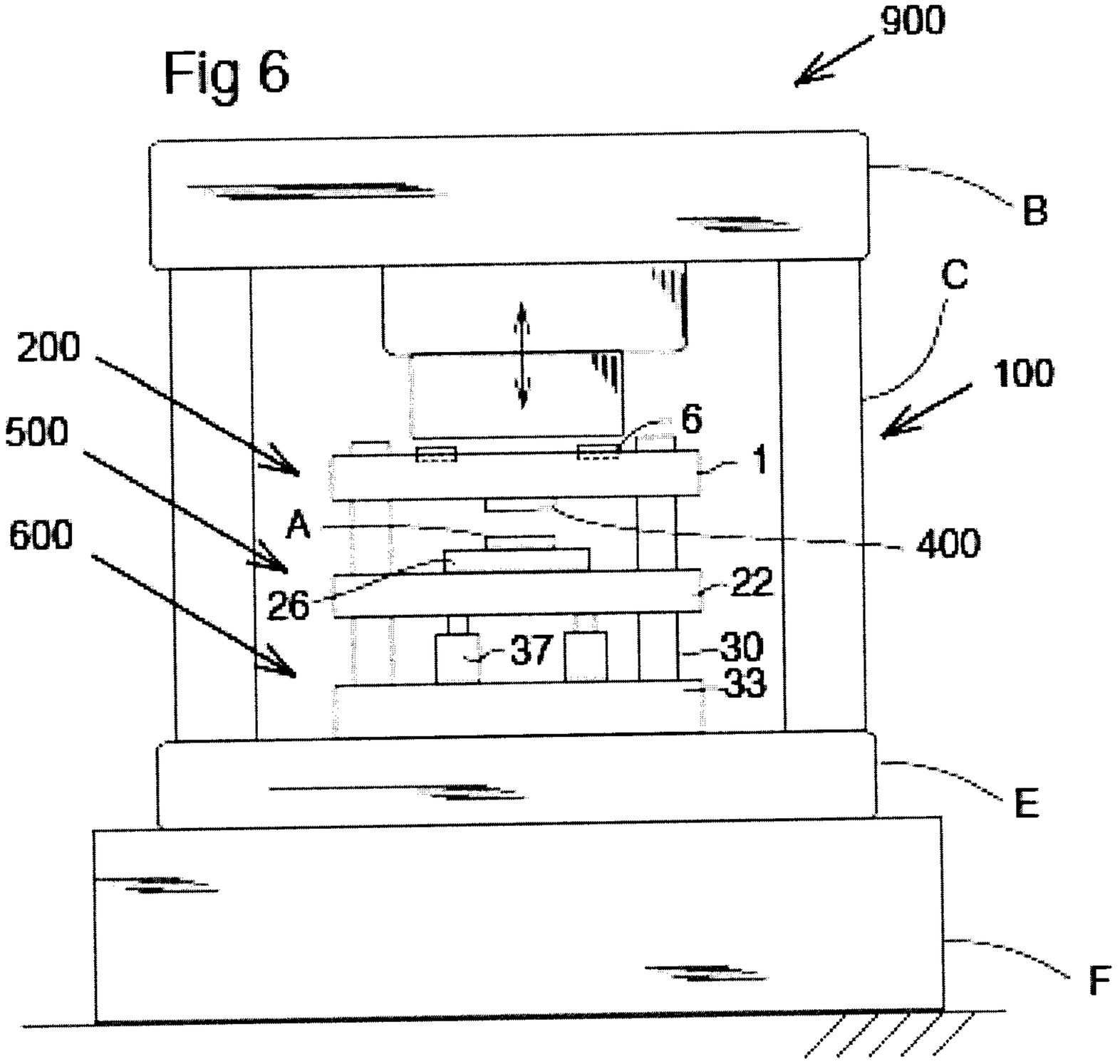


Fig 7

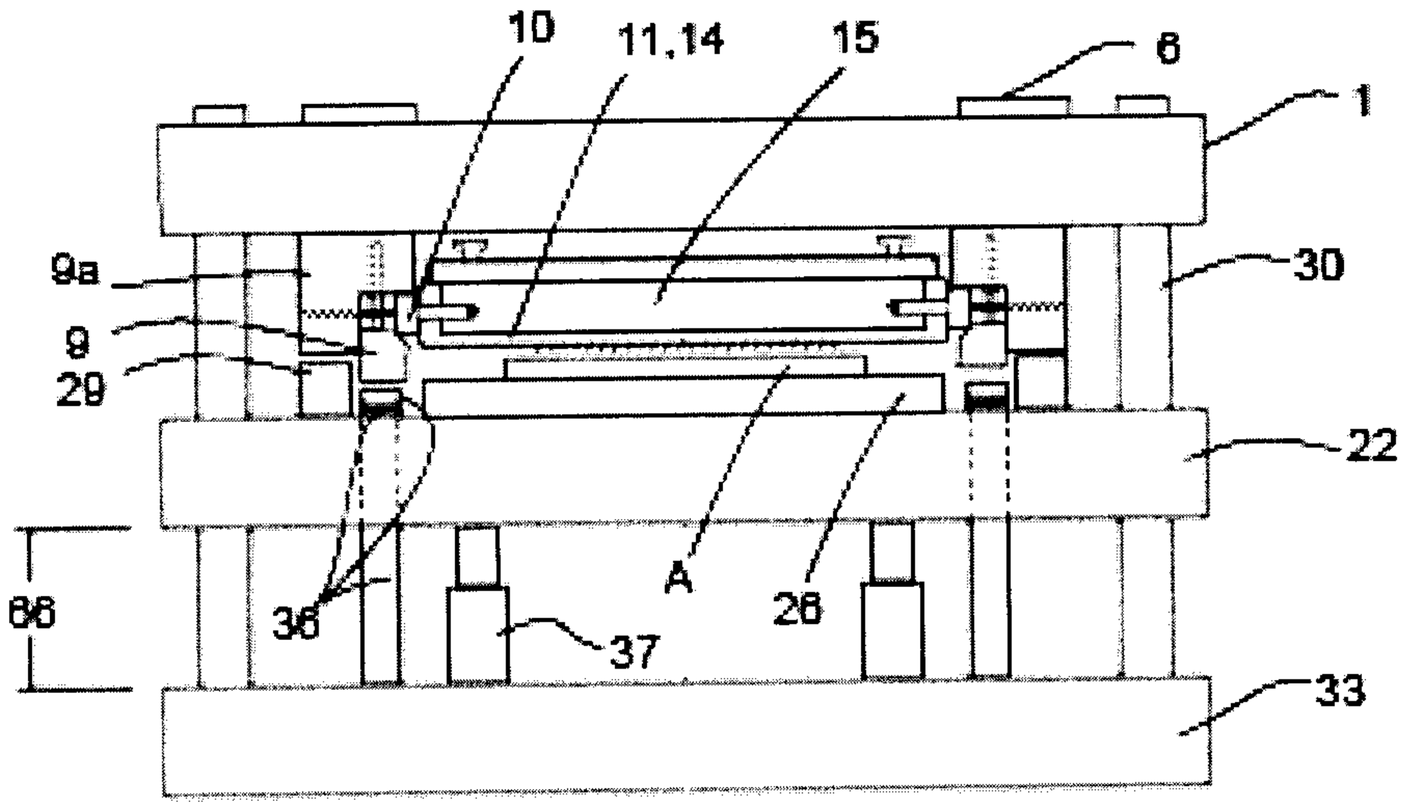


Fig 8

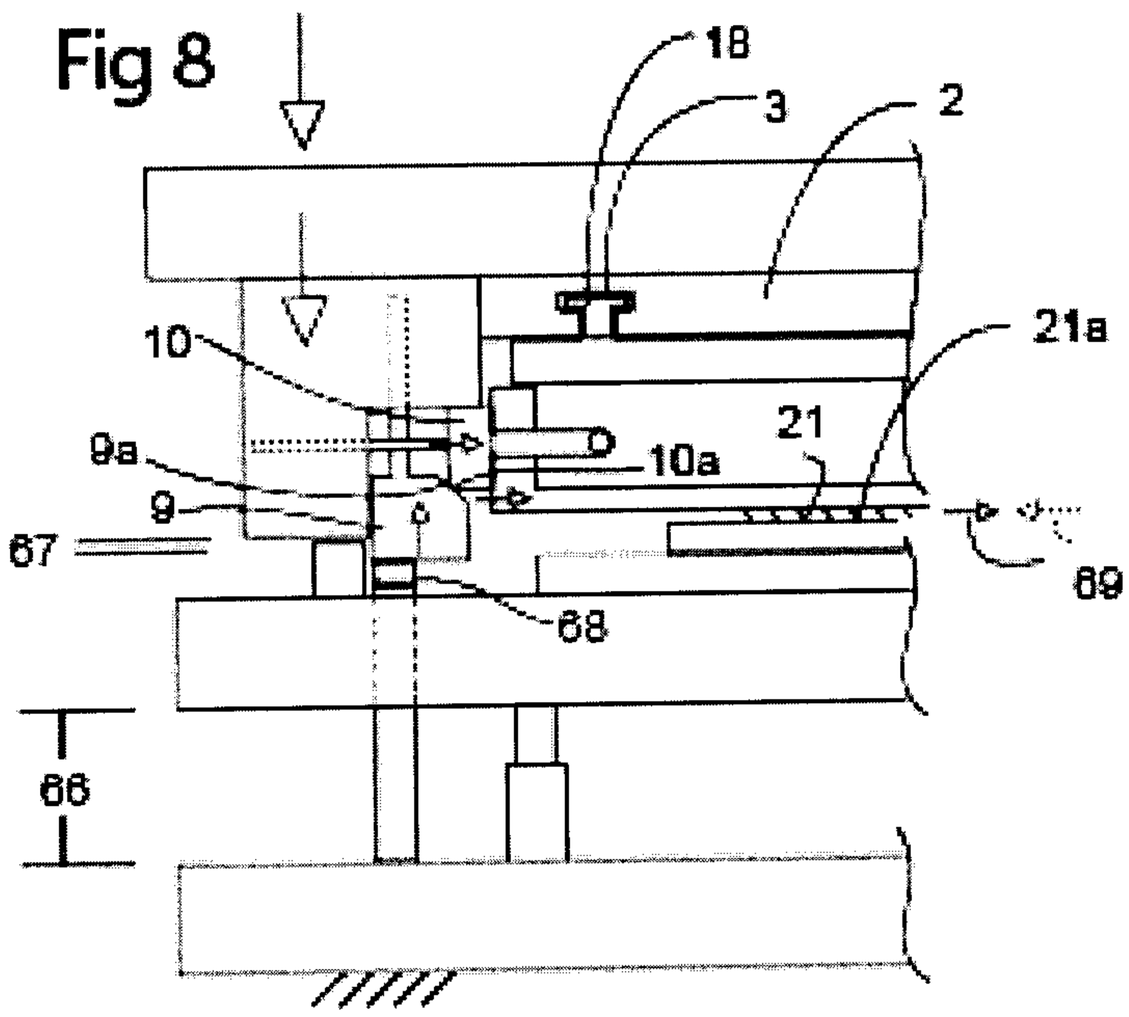
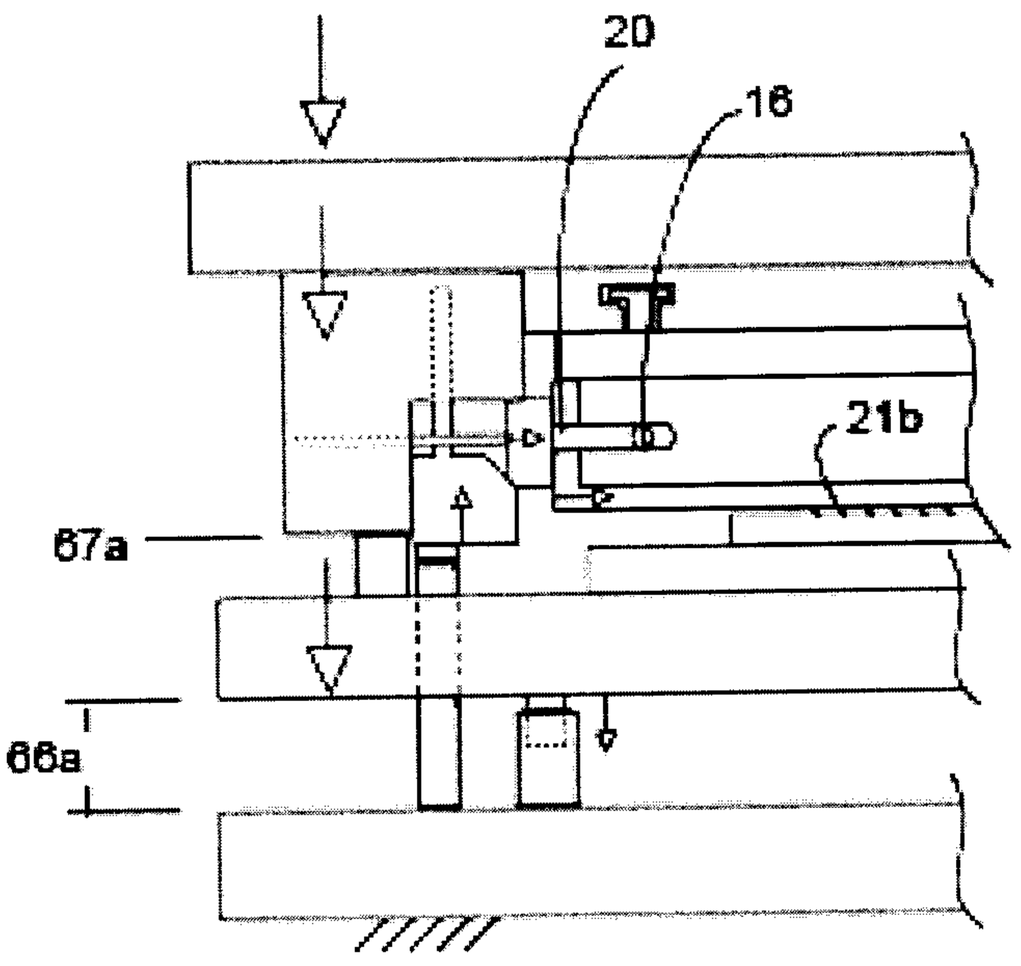
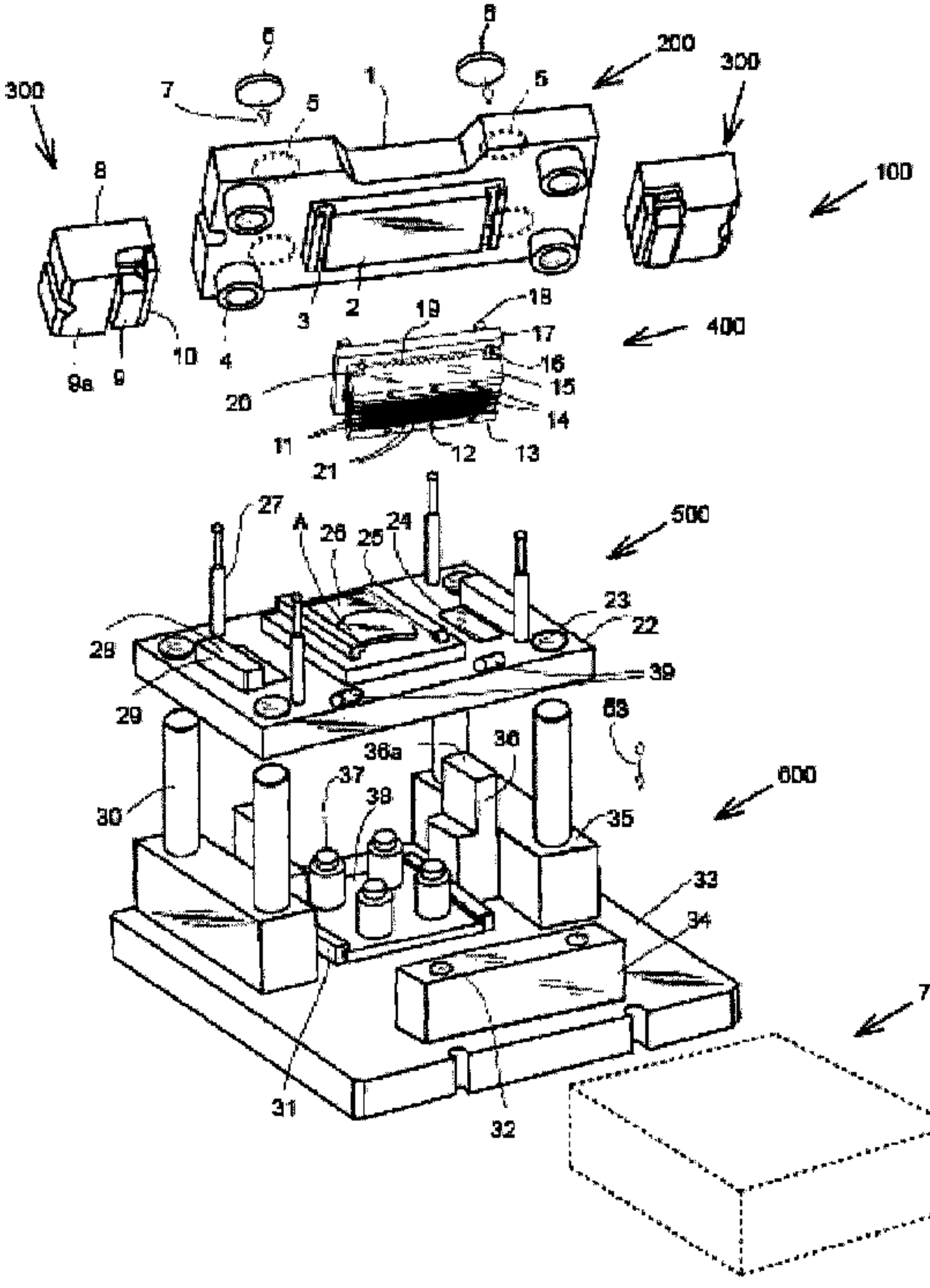


Fig 9




6
6
200
300
300
7
5
1
5
100
8
400
19
18
17
16
15
14
13
12
11
10
9a
9
4
3
2
20
21
9
27
A
26
25
24
500
23
22
28
39
29
63
36
36a
37
38
600
30
35
33
34
700
31
32