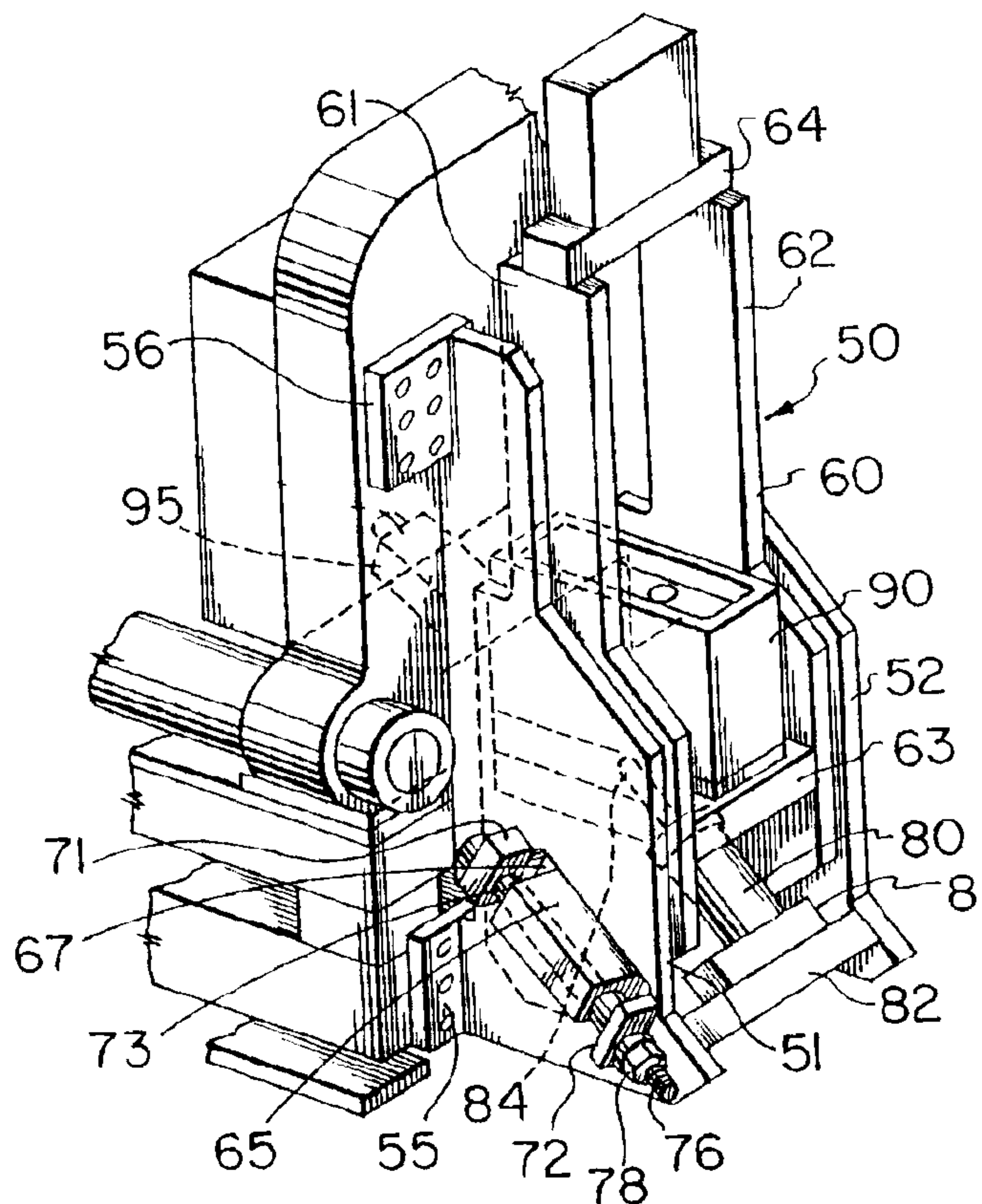




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(57) **Abrégé/Abstract:**

An injection unit for use with a die casting machine comprising an injection unit external frame, an internal frame, a die casting fluid container, an injection nozzle support and an injection nozzle characterized by an internal frame moveable at an oblique angle relative to said external frame and die casting machine, the die casting fluid container, the injection nozzle support and the injection nozzle are mounted on said internal frame.

ABSTRACT

An injection unit for use with a die casting machine comprising  
an injection unit external frame, an internal frame, a die casting fluid  
5 container, an injection nozzle support and an injection nozzle  
characterized by an internal frame moveable at an oblique angle  
relative to said external frame and die casting machine, the die casting  
fluid container, the injection nozzle support and the injection nozzle  
are mounted on said internal frame.

APPARATUS AND METHOD FOR INJECTING DIE CASTING FLUID IN  
A DIE CASTING MACHINE

This invention relates to an injection unit for use with a die casting machine and a method of injecting die casting fluid in a die casting machine.

In prior art die casting machines having a frame comprised of left hand side and right hand side platens, the platens are supported by four parallel tie bars connected between opposed corners of the left hand side and right hand side platens. A moving platen having a die on one surface thereof is mounted on said tie bars for movement towards and away from an opposing die on the face of one of the fixed platens.

The use of four tie bars between the right and left hand side platens as disclosed in United States Patent 3,734,673 leaves less than 90° between any adjoining tie bars in which to change dies on the faces of the platens or to remove castings after injection is completed and the dies open. The existence of four tie bars also limits the space available to adjust or remove core plates or ejector plates mounted behind the platens.

The tie bars used in existing machines are also relatively flexible flexing as much as 0.51 to 1.02 millimeters during clamping of the dies for injection. Extension of the tie bars of 0.51 to 1.02 millimeters or more can cause torsion forces in the frame of the die casting

machine which may result in misalignment of the die faces during clamping if at least four tie bars are not used between the platens.

In prior art die casting machines it is known to use hydraulic open and close cylinders to bring the dies into proximity and to use a toggle arrangement or a second hydraulic mechanism to clamp the dies together immediately preceding and during injection. Said open and closing mechanism and said clamping mechanism are not disposed directly on the longitudinal centerline of the die casting machine and the application of such closing forces other than directly behind the dies can result in torsional forces in the frame of the die casting machine which may result in improper alignment of the dies during clamping and injection of the die casting liquid.

In prior art die casting machines the injection of metal into the dies is most frequently made through the sides of the dies. The liquid metal is stored in the melting pot normally above or below the side of the dies where the liquid metal is injected into the side of the dies. In travelling from the melting pot to the injection nozzle the injection fluid must turn through 90° which results in turbulence in the casting liquid which can result in an inferior finish on the casting.

In order to reduce the time of the cooling cycle it is desirable to remove as much liquid metal as possible from the large inlet runner sections of the molds as soon as the metal in the gate solidifies. The positive withdrawal of molten liquid from the large inlet runner section

is only marginally assisted by gravity when injection of metal into dies is made through the side of the dies.

The die casting machine of this invention was designed to improve upon the problems with existing die casting machines described above.

The die casting machine described herein has a novel solid frame comprised of a left hand side and fixed right hand side platen connected solidly by two diagonally disposed connecting rods. A moving platen guided on the connecting rods is powered towards and away from the right hand side fixed platen. Mating faces of the moving platen and the right hand side platen support dies which dies are located on the faces of said platens in the plane between the diagonally disposed connecting rods.

The use of two diagonally disposed relatively inextensible connecting rods to connect the left hand and right hand side platens with the dies located in the plane between the two connecting rods decreases possible torsion in the die casting machine because the forces and counterforces are aligned and because the connecting rods used are relatively much stronger than tie bars used in the prior art and lower extension should result in less possible torsion in the die casting machine of this invention.

The use of two substantially inextensible connecting rods as frame members leaves the operators of the machine

approximately 180° between connecting rods to remove castings or to  
mount, repair and adjust dies on the moving platen and  
right hand side platen. In conventional machines as described  
earlier the operators had approximately 90° between respective  
5 tie rods in which to remove castings or to mount, repair or adjust dies.

In prior art die casting machines for large castings it is known  
to use one hydraulic mechanism to bring the dies into contact and to  
use a toggle arrangement or a second hydraulic mechanism to clamp  
the dies together. In the prior art die casting machines the  
10 mechanisms for bringing the dies into contact and for applying  
clamping pressure are not both applied along the longitudinal  
centerline of the machine. Another aspect of the die casting machine  
of this invention is the use of an open and close hydraulic mechanism  
to open and close the dies and the use of a clamping hydraulic  
15 mechanism to clamp the dies together during injection. Both the open  
and close hydraulic mechanism and the hydraulic clamping  
mechanism are mounted along the longitudinal centerline of the die  
casting machine which longitudinal centerline is bisected by a  
diagonal plane passing from end to end of the machine through said  
20 connecting rods.

By utilizing relatively inextensible connecting rods and  
maintaining the open and closing forces and the clamping forces in a  
common plane passing through the longitudinal centerline of the die

casting machine, possible torsion forces are reduced. Connecting rods have been used which do not elongate beyond 0.254 millimeters or 0.125 millimeters during die casting, one half to one quarter the extension of connecting rods on conventional machines.

5           In this invention the injection of casting liquid is made from the bottom of the right hand side die attached to the fixed right hand side platen as opposed to the central side of the dies in conventional die casting machines. Injecting casting liquid from the bottom of the dies enables gravity to assist in removing casting fluid from the larger inlet  
10 runners after the liquid metal in the gate has solidified to reduce the time of the injection cycle. The nozzle of the injection unit enters the bottom of the right hand side die at 45°. The casting fluid in the metal pot in which the casting fluid is maintained is only required to make a 45° turn before reaching the dies after leaving the melting pot. In  
15 conventional arrangements the casting fluid has to make a 90° turn which may cause turbulence and can result in a less polished appearance than can be obtained using the injection mechanism of this invention. In addition to less turbulence the use of a 45° connection between the metal pot and the dies enables the metal pot  
20 to be placed in close proximity to the right hand side fixed platen and die decreasing possible gas entrainment in the die casting fluid.

The right hand side die used with the injection system of this die casting machine includes a bottom having an oblique face or a face

at 45° relative to the bottom of the dies. The oblique face includes an injection seat to receive an injection nozzle. The injection nozzle is supported by an injection unit which may be moved at an oblique angle such that the injection nozzle and seat have a common axis.

5 The casting face of the right hand side die contains an opening extending from the casting face to the inside of the injection nozzle seat. The opening in the casting face of the right hand side die is adapted to receive a nose or protrusion extending from the face of the left hand side die which nose or protrusion extends into the space in  
10 the right hand side die when the dies are clamped together for injection. The nose or protrusion of the left hand side die serves to form part of one wall of the injection fluid inlet between the injection nozzle seat and the runner in the die. In addition the nose or protrusion of the left hand side die which extends across the parting  
15 line into the space in the right hand side die serves to remove the hollow sprue from the right hand side die when the left hand side die is withdrawn. The removal of the sprue with the left hand side die clears the space in the right hand side die down to the injection seat prior to the dies closing for the next injection.

20 Referring to another aspect of this invention, the improved die casting machine of this invention has a solid frame consisting of a base, a fixed right hand side platen attached to one end of the base, a left hand side platen at the opposite end of the base, said fixed right



hand side platen and the left hand side platen being connected by two relatively inextensible connecting rods mounted diagonally at opposed corners or sides of the fixed right hand side platen and left hand side platen. A moving platen is mounted on a sliding plate on the base and  
5 guided by the connecting rods for movement towards and away from the fixed platen.

The moving platen is closed and opened in two stages by two cylinders with respective pistons. One cylinder and piston called the opening and closing hydraulic cylinder is used to move the moving  
10 platen and the die on its face into contact with the die on the face of the right hand side fixed platen. The second hydraulic cylinder and piston is called the clamping mechanism and is used to clamp the dies together during injection and release the dies from clamping once the injection has ended and the casting has solidified.

15 The clamping cylinder is an integral part of the left hand side platen which platen together with the right hand side platen and two tie bars forms a solid frame. The clamping piston has a shape similar to the clamping cylinder but with a smaller diameter in order to fit within the clamping cylinder. The open and close cylinder is fastened  
20 along the longitudinal centerline of the machine to the back of the moving platen. The piston of the open and close cylinder is permanently attached to the central portion of the clamping piston. The piston of the open and close cylinder does not move during the

open and close cycle of the open and close cylinder but the open and close cylinder attached to the moving platen moves longitudinally backward and forward along the longitudinal centerline of the die casting machine relative to the piston of the open and close cylinder.

5           As the open and close cylinder and the moving platen which it moves approach the parting line, a clearance exists between the back of the open and close cylinder and the front of the clamping piston. In order for the clamping piston to drive the open and close cylinder, locking plates which are mounted on pistons disposed perpendicularly  
10           to the centerline of the machine just in advance of the open position of the clamping piston are moved towards the centerline of the die casting machine and interposed between the forward face of the clamping piston and back end of the open and close cylinder.

          The locking plates are interposed between the front face of the  
15           clamping piston and the rear face of the open and close cylinder during the clamping sequence so that the moving platen and its die is clamped against the fixed die mounted on the fixed right hand side platen with sufficient force to prevent any flashing during injection. Following injection the clamping piston is withdrawn from the locking  
20           plate, the locking plates are removed perpendicularly away from the centerline of the machine clear of the open and close cylinder, and the open and close cylinder is moved towards the left hand side of the die casting machine creating a clearance between the die attached to the

moving platen and the die attached to the fixed right hand side platen so that the casting may be removed.

The improved die casting machine of this invention includes a novel injection system in which the injection is made from the bottom of the mold as opposed to conventional machines in which injection occurs from the central side of the mold. Injecting material from the bottom of the mold enables gravity to assist in withdrawing zinc from the large inlet runner shortly after the gate to the cavity has solidified. The injection unit of this invention includes an injection unit terminating in an injection nozzle which fits into an oblique face in the bottom of the right hand die at an oblique angle, such as 45°. Because the injection nozzle enters the die at 45° rather than after a conventional 90° turn there is less turbulence created in the injected fluid as it enters the die. The minipot or other container for holding the injection fluid is maintained adjacent the injection nozzle and the injection fluid has a short distance to travel to the dies decreasing time for injection and possible air entrainment in the injection fluid.

According to a broad aspect of this invention there is disclosed an injection unit for use with a die casting machine comprising an injection unit external frame, an internal frame, a die casting fluid container, an injection nozzle support and an injection nozzle characterized by an internal frame moveable at an oblique angle relative to said external frame and die casting machine, the die

casting fluid container, the injection nozzle support and the injection nozzle are mounted on said internal frame.

According to another broad aspect of this invention there is disclosed a method of injecting die casting fluid in a die casting machine, the die casting machine having a fixed platen, a die  
5 connected to the fixed platen, an injection nozzle receiving means in the bottom of the die, an injection unit to inject casting fluid into said die, characterized by the injection unit having exterior frame members, interior frame members, means to move said interior frame  
10 members at an oblique angle relative to the exterior frame members to and away from the bottom of the die, a minipot and injection nozzle mounted on said interior frame members, including the steps of securing a die to the fixed platen, connecting said exterior frame members to said fixed platen in one of several predetermined  
15 positions, moving said interior frame members, minipot and injection unit obliquely upwards towards the bottom of said die until the injection nozzle seats in the injection nozzle receiving means.

In the Drawings:

Figure 1 is a perspective view of the machine base of the die  
20 casting machine.

Figure 2 is a front perspective view of a solid frame die casting machine having diagonally disposed first and second connecting rods without the injection system.

Figure 3 is a front perspective view of the solid frame die casting machine of Figure 2 with the addition of the locking plate mechanism.

Figure 4 is an end view of the left hand side of the solid frame die casting machine mounted on the machine base of Figure 1.

5 Figure 5 is a perspective view of the injection system of the solid frame die casting machine which is integrally connected to the fixed right hand side plenum of the solid frame die casting machine.

Figure 6 is a sectional view through injection nozzle support, the injection nozzle and the bottom central portion of the left hand and  
10 right hand dies.

Figure 7 is a top schematic view of the solid frame die casting machine in which the travelling platen and die are in the open position.

Figure 8 is a top schematic view of the solid frame die casting  
15 machine in which the travelling platen and die have been moved proximate the part line by the open-close cylinder.

Figure 9 is a top schematic view of the solid frame die casting machine in which the travelling platen and die are in clamped position for injection.

20 Figure 10 is a top schematic view of the solid frame die casting machine in which a bayonet type arrangement is used to engage or disengage the clamping piston and the open-close cylinder.

Figure 11 is a sectional view along the section 1-1 of Figure 10 showing detail of the bayonet engage-disengage arrangement.

Referring to the base for a die casting machine shown in Figure 1, the front of the machine base 1 includes lower horizontal member 2 and upper horizontal member 3 supported by front vertical side members 4 and 5 and front vertical interior members 6 and 7. The back of the machine base 1 (not shown) is identical to the front of the machine base shown in Figure 1 and the front and rear of the die casting machine are fastened to each other on the right hand side by horizontal member 9. As seen in Figure 4, the left hand side of the machine is supported by vertical left hand side members 10 and 11. The vertical left hand side members in turn are joined by horizontal left hand side members 12 and 13. Referring to Figure 1, lower intermediate cross members 14, 15 are disposed between and connect front horizontal member 2 and corresponding back horizontal member 23 at intermediate positions. The front lower horizontal member 2 and corresponding back horizontal member 23 sit on feet 16, 17, 18 which in turn are fastened to the floor. Front upper horizontal member 3 and the corresponding back upper horizontal member 24 have front sliding plate 20 and rear sliding plate 21 respectively mounted on top of said horizontal members. At the top left hand side of the machine base 1 a transverse horizontal plate 22 is

fastened to the tops of front upper horizontal member 3 and the corresponding back upper horizontal member 24.

Referring to Figure 2 there is shown a die casting machine 25 which is adapted to be mounted on machine base 1 or other suitable base. Die casting machine 25 includes a fixed right hand side platen 26, and an  
5 opposed left hand side platen 27. The fixed right hand side platen 26 is adapted to be fixedly connected to machine base 1 by bolts fixed in corresponding apertures in the footings 28 and 29 of fixed right hand side platen 26 and near the end of the right hand side of sliding plates 20 and  
10 21. The left hand side platen 27 is mounted on left hand side platen support member 30 which is best seen in Figure 4. The base of the left hand side platen support member 30 is welded to the top of the support base plate 31 which is bolted to transverse horizontal plate 22. As seen in  
15 Figure 4 the left hand side platen support member 30 sits under cylinder 32 of the left hand side platen 27. Cylinder 32 is fastened to the left hand side platen support member 30 by bolts not seen which are inserted and tightened through openings 34 in the left hand side platen support  
20 member 30. The openings 34 in which bolts fit are not round but are slightly elongated in the direction of the longitudinal centerline of the machine which enables the left hand side platen 27 to move relative to the left hand side platen support member 30 for a number of thousandths of

an inch to accommodate any expansion of the connecting rods which may occur during clamping of the dies.

The fixed right hand side platen 26 and the left hand side platen 27 are firmly interconnected by first connecting rod 35 and second connecting rod 36. The ends 37 of the first connecting rod 35 and the second connecting rod 36 fit through apertures 38 in the fixed right hand side platen 26 and the left hand side platen 27 and the ends 37 are secured to the fixed right hand side platen 26 and the left hand side platen 27 by fasteners 39. As seen in Figure 3, locking plate frame 40 is connected to the inside face of left hand side platen 27. The operation of the locking plates which are integrated with the clamping mechanism and shown schematically in Figures 7, 8 and 9 will be reviewed later. Mounted on the connecting rods 35, 36 between the fixed right hand side platen 26 and left hand side platen 27 is moving platen 45. Moving platen 45 includes first and second moving platen guides 46 and 47 which are integral with moving platen 45 and keep the moving platen 45 aligned so that the center of the moving platen 45 moves along the longitudinal centerline of die casting machine 25. The base of moving platen 45 is attached to slide plates 20a which run on slide plates 20 and 21 respectively of machine base 1. The right hand face 48 of moving platen 45 has a die 100 mounted thereon which is adapted to close with opposing die 101 mounted on the left hand side of the fixed right hand side platen 26.



Referring to Figure 5, the injection unit 50 is comprised of front and back exterior frame members 51 and 52. The bottom left hand side of front and back exterior frame members 51 and 52 are fastened near the base to a transverse frame member 55 which is fastened to the right hand side of machine base 1. The top left hand side of front and back exterior frame members 51 and 52 are fastened near their top to an upper plate 56 which in turn is fastened to the back of the fixed right hand platen 26. The front and back exterior frame members 51 and 52 are adapted to be fixed in one of two positions. The position chosen is based on the size of the dies. An interior moveable frame 60 is moveable at a 45° incline towards and away from fixed right hand platen 26 such that the injection nozzle may be inserted through an aperture in fixed right hand platen 26 and into engagement with an oblique face on the base of the right hand side die 101 attached to the fixed right hand side platen 26.

The interior moveable frame 60 of injection unit 50 is comprised of front and back interior frame members 61 and 62 which are aligned within and parallel to front and back exterior frame members 51 and 52. The front and back interior frame members 61 and 62 which are parallel to one another are maintained in parallel by horizontal base plate 63 fastened horizontally to the inside of both front and back interior frame members 61 and 62 at approximately one-third of the distance between the base and top of the front and back interior frame members 61 and 62.

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The top of the front and back exterior frame members 61 and 62 are connected by horizontal upper interior frame member 64. Connected at 45° to the outside of both front and back interior frame members 61 and 62 are inclined elongated rectangular guides 65 . The elongated rectangular guides 65 are disposed through elongated rectangular apertures 67 through the sides of front and back exterior frame members 51 and 52. The elongated rectangular guides 65 as they move upwardly or downwardly at 45° in elongated apertures 67 of front and back exterior frame members 51 and 52 cause the interior moveable frame 60 to move towards or away from the fixed right hand side platen 26 at a 45° incline.

Flanges 71 and 72 integral with the exterior of front exterior frame member 51 are disposed outwardly at either end of elongated rectangular aperture 67 which receives elongated rectangular guide 65. Elongated rectangular guide 65 has shafts 73 extending from either end along the longitudinal centerline of elongated rectangular guide 65. Both flanges 71 and 72 extending outwardly from the side of front exterior frame member 51 contain apertures which receive shafts 73 of each elongated rectangular guide 65. The back exterior frame member 52 includes an identical arrangement of flanges and apertures as described and shown with respect to the front exterior frame member 51. The shafts 73 feature threaded ends 76, and lock nuts 78 are threaded on the shafts 73.

As mentioned earlier the horizontal base plate 63 is fastened horizontally between the inside of both front and back interior frame members 61 and 62. A piston cylinder 80 is mounted on piston cylinder support 81 which in turn is mounted on lower transverse frame member 82 between the front bottom portion of front and back exterior frame members 51 and 52. Piston 84 is disposed in piston cylinder 80 and piston rod of piston 84 is integrally connected to the bottom of horizontal base plate 63. The piston cylinder 80 and piston 84 are disposed at 45° relative to the bottom of horizontal base plate 63 such that the horizontal base plate 63 and connected front and back interior frame members 61 and 62 and elongated rectangular guides 65 move upward or downward relative to the fixed right hand platen 26 at a 45° angle.

The minipot 90 containing liquid heated metal is mounted on the top of horizontal base plate 63. The minipot 90 is properly insulated so as not to cause any undue heating or distortion to the frames of the injection unit 50. Extending upwardly from the minipot 90 at 45° is injection nozzle support 95 which is integral with the minipot 90. In the event that hot metal is not the injecting fluid, another injection fluid container can be substituted for the minipot 90. Injection nozzle 96 extends from the top of injection nozzle support 95 at the same 45° angle. A runner 97 extends through the center of the injection nozzle 96 and injection nozzle support

95 to the bottom of injection nozzle support where the runner is connected through valving to the metal in the minipot.

The valving and arrangement between the minipot and the injection nozzle 96 and the sequence of steps in withdrawing liquid metal from the sprues after initial cooling is substantially as disclosed and described in Canadian Patent 1,117,270 to Perrella and Thompson issued February 2, 1982. However, the concept of introducing the injection nozzle at 45° at the bottom of the right hand side die results in faster removal of excess metal by gravitational assistance, less turbulence in the metal because the metal does not require a 90° turn before entering the molds, and finally less turbulence and more consistent heat in the casting fluid as the minipot 90 is very close to the fixed right hand platen 26 and the dies.

Figure 6 discloses the lower halves of the left hand side die 100 and the fixed right hand side die 101 meeting on the part line 102. Prior to commencement of die casting, the injection nozzle 96 is inserted at 45° into contact with the bottom of the right hand side die 101 which is fastened to the fixed right hand side platen 26. The end of the injection nozzle 96 has a spherical shape. The fixed right hand side die 101 includes a nozzle receiving face 103 disposed at 45° relative to the bottom of the die, the nozzle receiving face 103 includes a nozzle seat 104 having a concave shape adapted to receive the spherical end of the injection nozzle 96. In setting up prior to commencement of injection the right

hand side die 101 is fastened to the fixed right hand side platen 26. The interior moveable frame 60 which supports the minipot 90, the injection nozzle support 95 and injection nozzle 96 is raised by piston cylinder 80 until the spherical end of injection nozzle 96 is firmly seated in the nozzle seat 104. Once the injection nozzle 96 is firmly seated in nozzle seat 104 lock nuts 78 for interior moveable frame 60 are tightened to lock elongated rectangular guides 65 to front and back exterior frame members 51 and 52 to lock the injection nozzle 96 in injection nozzle seat 104 of fixed right hand die 101.

As seen in Figure 6, the fixed right hand side die 101 includes an opening 105. The left hand side die 100 includes a nose shaped protrusion 106 which extends across the part line 102 when the dies 100, 101 are closed. The bottom of protrusion 106 is completely surrounded by die casting fluid when injection occurs. The top 108 of the protrusion 106 forms the bottom of the inlet 109 from which the casting fluid proceeds from the opening 110 in injection nozzle 96 to runner 111 in left hand side die 100 to cavity 112. While the cavity 112 is shown in the face of the right hand side die 101, the cavity 112 may be machined out of the faces of both the left hand side die 100 and the right hand side die 101. The lines 113 and 114 are the sides of inserts in the left hand side die 100 and the right hand side die 101 respectively. While inserts 113 and 114 are not necessary, the portions of the dies 100 and 101 which are most likely to

require adjustment during location and tightening of the injection nozzle  
96 are in the area of inserts 113 and 114. In operation, the injection fluid  
is withdrawn from inlet 109 as soon as the metal in the gates solidifies.  
The withdrawal of injection fluid leaves a hollow sprue extending from the  
5 injection fluid inlet 110 through inlet 109 and runner 111. The sprue also  
surrounds the protrusion 106 of the left hand side die 100 so that when  
the left hand side die 100 is withdrawn from right hand side die 101 after  
each injection the sprue runner and casting are withdrawn with the left  
hand side die 100 leaving the opening 105 in the injection nozzle area of  
10 the right hand side die 101 clear prior to the return of left hand side die  
100 from which the sprue, runner and casting have been ejected.

Referring to Figure 7, commencing at the top of the drawing,  
connecting rod 35 connects left hand side platen 27 and fixed right hand  
side platen 26. At the bottom of the drawing connecting rod 36  
15 connects the bottom of left hand side platen 27 and fixed right hand side  
platen 26. The moving platen 45 and moving platen guides 46, 47  
are mounted on connecting rods 35 and 36 for movement towards  
and away from the fixed right hand side platen 26. Integral with the  
left hand side platen 27 is large clamping cylinder 32. The large

clamping cylinder has a cylindrical shape with the left hand side of  
the clamping cylinder 32 being closed by clamping cylinder head 120.  
Within clamping cylinder 32 and having substantially the same shape  
as clamping cylinder 32 is a very short clamping piston 121. The  
5 clamping piston 121 is comprised of a piston head 122 having  
substantially the same diameter as the interior of clamping cylinder  
32 and a short piston section 123 of slightly lesser diameter. The  
central portion of the clamping piston 121 is open and is adapted to  
receive the open and close cylinder 124 which is fastened to the left  
10 hand side of moving platen 45.

As seen in Figure 7, when the moving platen 45 is moved as far  
to the left hand side as possible the left hand end of open and close  
cylinder 124 fits within the interior of clamping piston 123. The open  
and close piston rod 125 and piston head 126 are permanently  
15 fastened to the clamping piston 121. The open and close cylinder 124  
and open and close piston 126 operate at 1000 p.s.i. and are utilized  
as shown in Figure 7 to move the moving platen 45 and the left hand  
side die 100 substantially into contact with the right hand side die  
101 fastened to the fixed right hand side platen 26. Immediately in  
20 front of clamping piston section 123 are locking plates 135 and 136.  
Locking plates 135 and 136 are mounted on piston rods 137 and 138  
of hydraulic cylinders 139 and 140. The hydraulic cylinders 139 and  
140 are attached by support members which are not shown to left

hand side platen 27. The locking plates 135 and 136 are moveable  
perpendicularly to the longitudinal centerline of the die casting  
machine and are shown in their open position in Figure 7 of the  
drawings. The ejector cylinders 142 and 143 and the core cylinder  
5 144 are mounted to the moving platen 45 and travel with the moving  
platen. The open and close cylinder 124, the locking plates 135 and  
136, clamping cylinder 32, and their related parts comprise the  
moving platen drive 127.

As seen in Figure 8 the open and close cylinder 124 and  
10 attached moving platen 45 and left hand side die 100 have been  
moved very close to right hand side die 101 attached to fixed right  
hand side platen 26. The left hand side of open and close cylinder  
124 has moved just beyond the locking plates 135 and 136 leaving a  
space for the locking plates 135 and 136 to move towards the  
15 longitudinal centerline of the die casting machine and towards open  
and close piston rod 125.

Referring to Figure 9, the locking plates 135 and 136 have been  
moved towards the longitudinal centerline of the machine between the  
open and close cylinder 124 by locking plate hydraulic cylinders 139  
20 and 140. After the locking plates 135 and 136 are introduced between  
clamping piston 121 and open and close cylinder 124, hydraulic fluid  
is applied in the space between clamping cylinder head 120 and  
clamping piston head 122 causing the clamping piston 122 to clamp



the left hand side die 100 to right hand side die 101 with required clamping tonnage so that metal injection can proceed. The clamping force is applied through clamping piston 121, locking plates 135, 136, open and close cylinder 124, moving platen 45 and left hand side die 100. Once the dies are closed core cylinder 144 is activated and core rods are inserted into the dies. Following injection the clamping piston 121 is returned to its open position shown in Figure 8 and the locking plates 135 and 136 are moved to their open position shown in Figure 8 by locking plate hydraulic cylinders 139 and 140. Locking plate hydraulic cylinders 139 and 140 and locking plates 135 and 136 suspended therefrom are free to move laterally a very short distance during the application of clamping pressure by the clamping cylinder 121. Upon release of the clamping pressure the locking plate hydraulic cylinders 139 and 140 are returned laterally towards the left hand side of the machine by springs which are not shown. After withdrawal of clamping pressure and withdrawal of the locking plates 135 and 136 the moving platen and left hand side die 100 will be substantially in the position shown in Figure 8. Immediately after the release of clamping pressure from clamping cylinder 121 hydraulic pressure is applied to the left hand side of open and close cylinder 124 to cause open and close cylinder 124 to move towards left hand side platen 27 and into the position shown in Figure 7. While the open and close cylinder 124 and moving platen 45 and left hand side die

100 are moving left, the ejector cylinder 143 is activated to cause ejector rods which are not shown to eject the casting from the right hand side die 101.

Referring to Figure 10 an alternative arrangement is shown for connecting and disconnecting the clamping piston 121 and the open close cylinder 124 in order to apply, maintain and release clamping pressure on the moving platen 45 and dies 100, 101 is shown. A bayonet 150 having exterior grooves 151 and teeth 152 is connected to the end of the open-close cylinder 124 opposite the end connected to the moving platen 45. A bayonet ring 154 having grooves 155 which are slightly larger than the teeth 152 of the bayonet 150 is connected to the front of the clamping piston 121. When the teeth 152 of the bayonet 150 are aligned with the grooves 155 of the bayonet ring 154 the open-close cylinder 124 may be opened and the bayonet 150 and open-close cylinder 124 will move into the central open portion of the clamping piston 121. When the open-close cylinder is in this position the dies 100, 101 will be open. The bayonet ring 154 includes gear teeth 156 on a portion of its circumference. A gear motor 157 and drive gear 158 are mounted on the left hand side platen 27. The gear motor 157 and drive gear 158 which is connected to the gear teeth 156 on the circumference of the bayonet ring 154 are designed to rotate the bayonet ring 154 when desired.

In order to clamp the dies 100, 101 for injection the following sequence occurs. The open-close cylinder 124 is energized, driving the moving platen 45 and die 100 proximate the parting line on which the dies 100, 101 will ultimately clamp. The end of the open-close cylinder including bayonet 150 is clear of the bayonet ring 154  
5 connected to the clamping piston 121. The gear motor 157 turns the drive gear 158 which in turn rotates the gear teeth 156 on bayonet ring 154 rotating bayonet ring 154 so that the teeth 159 of bayonet ring 154 are aligned with the teeth 152 of bayonet 150. The teeth 159 of the  
10 bayonet ring 154 and the teeth 152 of the bayonet 150 are engaged when the clamping cylinder 32 is energized, the clamping piston 121 and bayonet ring 154 move the bayonet 150 and open-close cylinder 124, moving platen 45 and die 100 and clamping the left hand side die 100 with the right hand side die 101 of the right hand side fixed  
15 platen 26 ready for injection of the casting fluid. Following injection, the clamping cylinder 32 is deenergized and the clamping piston 121 is energized to return the clamping piston 121 to the back of the clamping cylinder 32. The gear motor 157 is energized to rotate the drive gear 158 which is connected to the gear teeth 156 on the exterior of bayonet  
20 ring 154. The bayonet ring 154 is rotated until the teeth 159 of the bayonet ring 154 are opposite the grooves 151 of the bayonet 150. The open-close cylinder 124 is then energized to move part of the open-

close cylinder 124 into the open interior portion of the clamping piston 121 opening the dies 100, 101 so that the casting may be ejected.

Figure 11 is a cross-sectional view along the line 1-1 of Figure 10 showing the teeth 152 of the bayonet 150 aligned with the grooves 155 in the bayonet ring 154. With the teeth 152 of the bayonet 150 aligned with the grooves 155 of the bayonet ring 154 the left hand end of open-close cylinder 124 is moved into the open central portion of the clamping cylinder 121. In the clamping sequence, the open-close cylinder 124 is moved out of the open central portion of the clamping piston 121, the bayonet ring 154 is rotated by the gear motor 157 through 45° so that the teeth 159 of the bayonet ring 154 and the teeth 152 of the bayonet 150 are aligned. When the clamping cylinder 32 is energized the clamping piston 121 and bayonet ring 154 drive the bayonet 150 and open-close cylinder 124 towards the right hand side fixed platen 26 until the dies 100, 101 are clamped together ready for injection.

One element of a linear velocity displacement transducer is mounted on the main moving platen and a second element of the linear velocity displacement transducer is mounted on the left hand side platen 27. When the two elements are aligned full clamping has been achieved, the linear velocity displacement transducer allows injection to commence. If the die is not completely closed or for some other reason the two elements of the linear velocity displacement

transducer do not achieve alignment injection will not proceed and the machine cycle will be interrupted until the die casting machine has been checked.

In the above description the applicant has disclosed the use of locking plates 135 and 136 and a bayonet arrangement 150, 154 to fill the space between the clamping cylinder and the open and close cylinder during the application for clamping pressure to the moving platen. It will be recognized by those skilled in the art that other mechanical or hydraulic means may be substituted for the locking plates 135 and 136 or the bayonet arrangement 150, 154.

While the invention has been described with respect to a horizontal die casting machine it will be recognized by those skilled in the art that vertical die casting machines may be manufactured using first and second connecting rods disposed at 180° relative to one another to provide easy access to the dies, core mechanisms, ejector mechanisms and castings. Conventional types of hydraulic or mechanical mechanisms may be used to close and retract the moving platen with the die casting machines of the invention. The slight longitudinal movement allowed the left hand platen lessens any torsional forces caused during expansion of the connecting rods during clamping of the dies. The use of first and second moving platen guides assists in maintaining the molds square during clamping and injection of the casting material.

While the frame and die casting machine have been disclosed with the fixed right hand side platen, moving platen and opposed left hand side platen arranged vertically, it will be appreciated by those skilled in the art that the frame and die casting machine may be  
5 utilized with the fixed right hand side platen, moving platen and opposed left hand side platen arranged horizontally in small die casting machines.

While the invention is described with respect to a frame having two relatively inextensible connecting rods it will be realized that some  
10 of the benefits of this frame and die casting machine may be obtained with a frame and die casting machine having three connecting rods.

**CLAIMS**

1. An injection unit for use with a die casting machine, the injection unit comprising:
  - an external frame adapted to be mounted to the die casting
  - 5 machine;
  - an internal frame movable at an oblique angle relative to the external frame; and
  - an injection nozzle supported by the internal frame and thus obliquely movable relative to the external frame to enable the injection
  - 10 nozzle to engage and disengage a nozzle seat disposed at the same oblique angle in a bottom portion of a fixed die of the die casting machine.
  
2. The injection unit as claimed in claim 1 further comprising a minipot for containing molten die casting fluid, the minipot being supported by, and movable with, the internal frame.
  
- 15 3. The injection unit as claimed in claims 1 or 2 further comprising a piston-cylinder mechanism interconnecting the internal frame and the external frame, the piston-cylinder mechanism being obliquely disposed to displace the internal frame and injection nozzle relative to the external frame.

4. The injection unit as claimed in any one of claims 1 to 3 further comprising a pair of rectangular guides inclined at the oblique angle and extending outwardly from the internal frame through inclined rectangular apertures in the external frame and running on respective inclined shafts  
5 fixed to the external frame, the guides constraining movement of the internal frame relative to the external frame such that the internal frame can only move at the oblique angle over a limited range of motion between a first position where the injection nozzle is engaged into the nozzle seat and a second position where the injection nozzle is disengaged from the  
10 nozzle seat.

5. The injection unit as claimed in claim 4 wherein each inclined shaft comprises a threaded end portion for receiving a lock nut for locking the guides to the exterior frame so as to secure the injection nozzle in the nozzle seat.

15 6. The injection unit as claimed in any one of claims 1 to 5 wherein the injection nozzle has a spherical end and wherein the nozzle seat has a concave nozzle-receiving face for receiving the spherical end of the injection nozzle.

7. The injection unit as claimed in any one of claims 1 to 6 wherein the  
20 oblique angle is 45 degrees.



8. A method of injecting die casting fluid in a die casting machine, the method comprising steps of:

securing an injection unit to the die casting machine, the injection unit including an external frame adapted to be fastened to a fixed platen supporting a fixed die and further including an internal frame movable at an oblique angle relative to the external frame, the internal frame supporting a minipot and an injection nozzle; and

moving the internal frame, minipot and injection nozzle obliquely upwards and towards the fixed die until the injection nozzle is inserted into a nozzle seat disposed at the same oblique angle in a bottom portion of the fixed die.

9. The method as claimed in claim 8 wherein the step of moving the internal frame, minipot and injection nozzle comprises displacing the internal frame relative to the external frame using a piston-cylinder mechanism such that motion of the internal frame is constrained by a pair of rectangular guides inclined at the oblique angle and extending outwardly from the internal frame through inclined rectangular apertures in the external frame whereby the guides run on respective inclined shafts fixed to the external frame.

10. The method as claimed in claim 9 further comprising a step of tightening lock nuts on threaded end portions of the shafts for locking the

internal frame to the external frame to thus secure the injection nozzle in the injection seat.

11. The method as claimed in any one of claims 8 to 10 wherein the internal frame, minipot and injection nozzle move obliquely at an angle of  
5 45 degrees relative to the external frame and fixed die.

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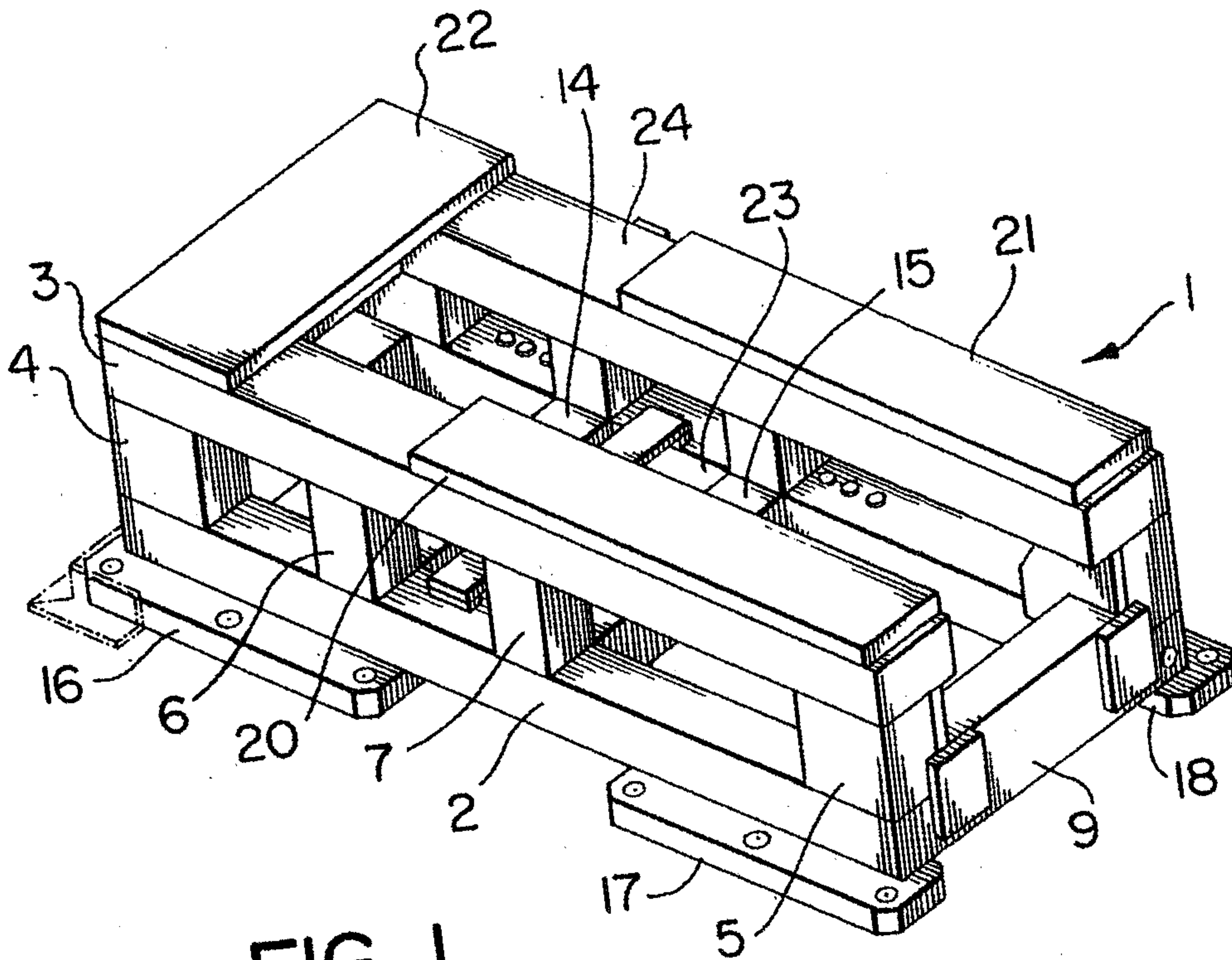


FIG. 1

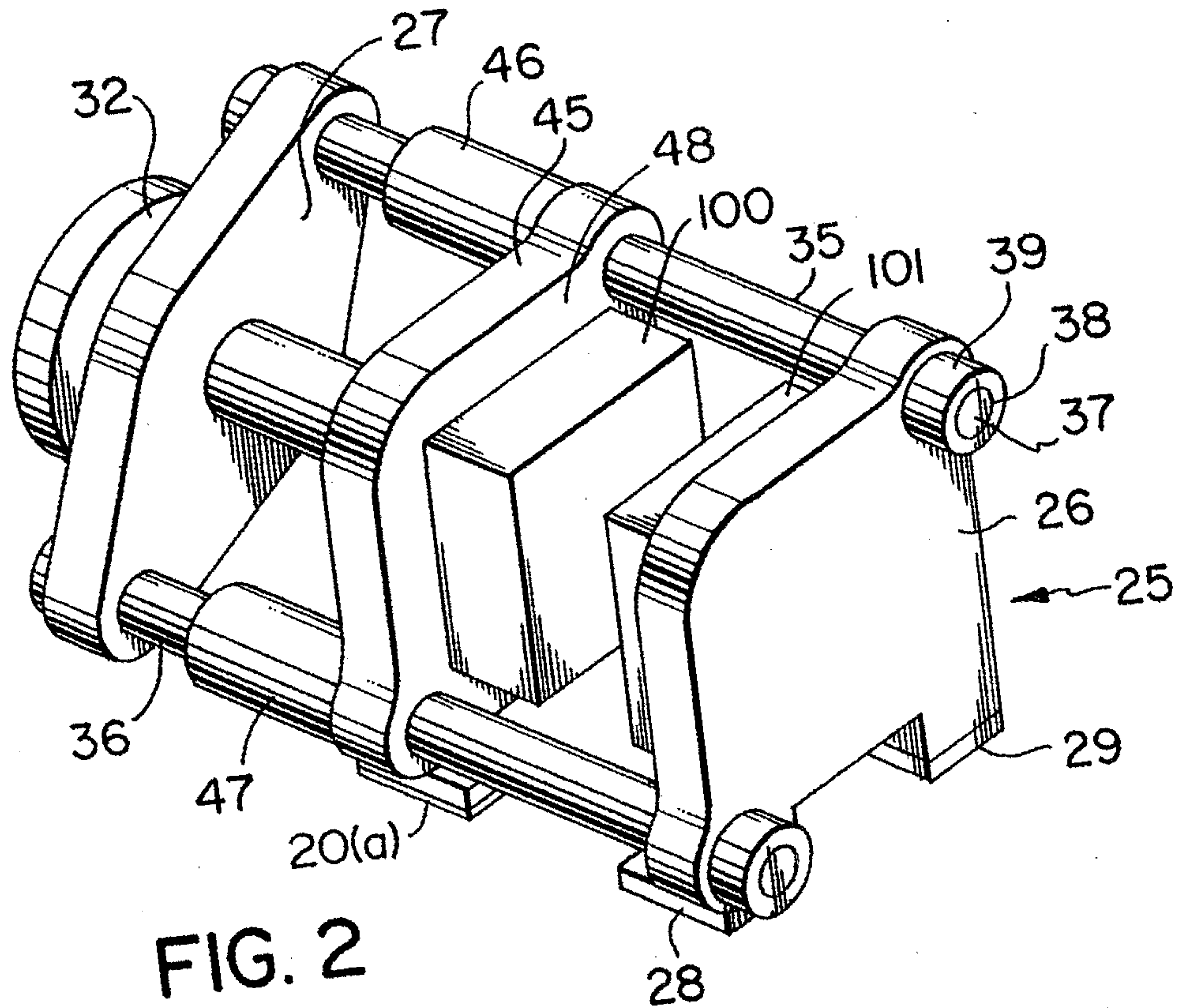


FIG. 2

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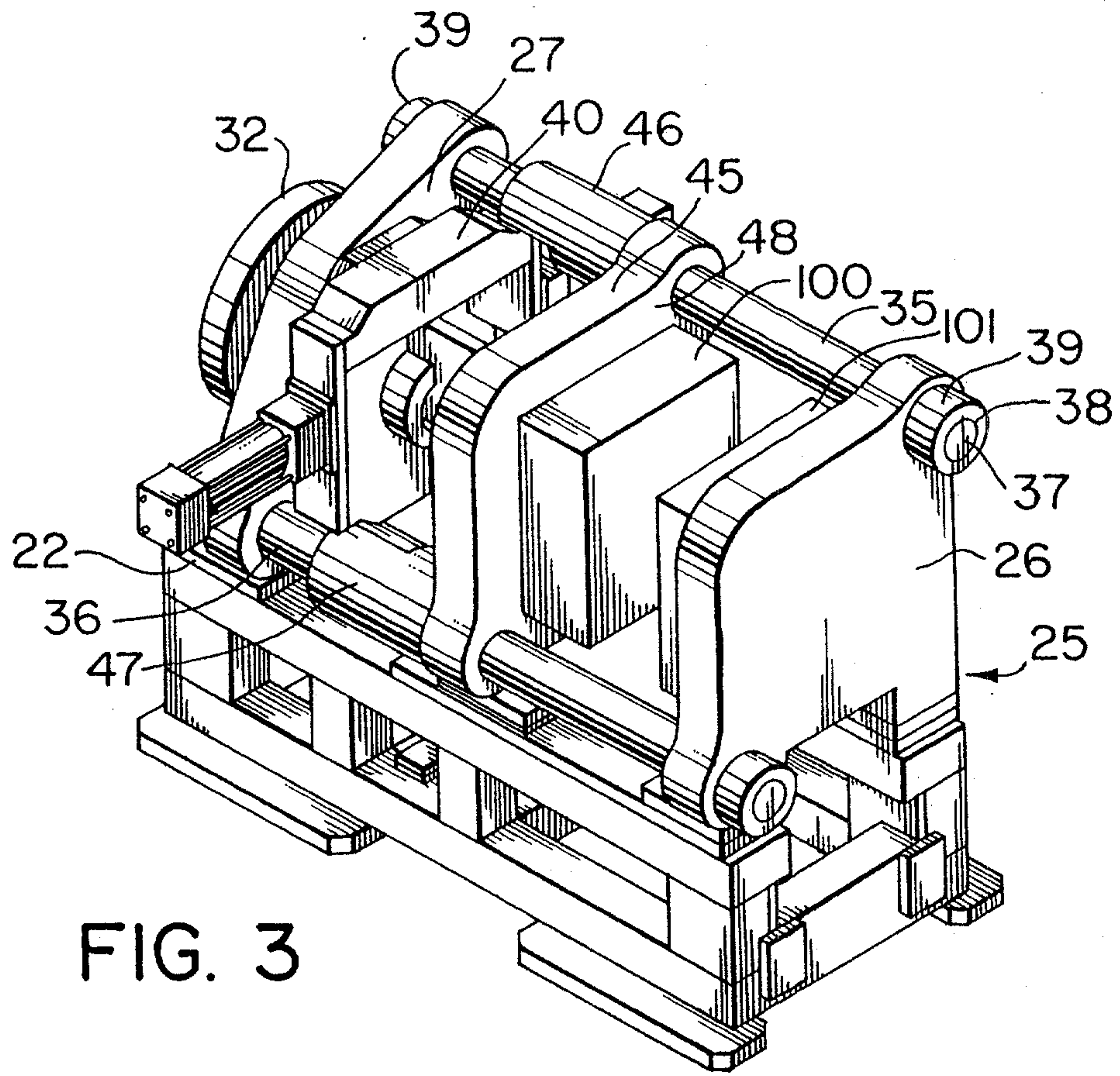


FIG. 3

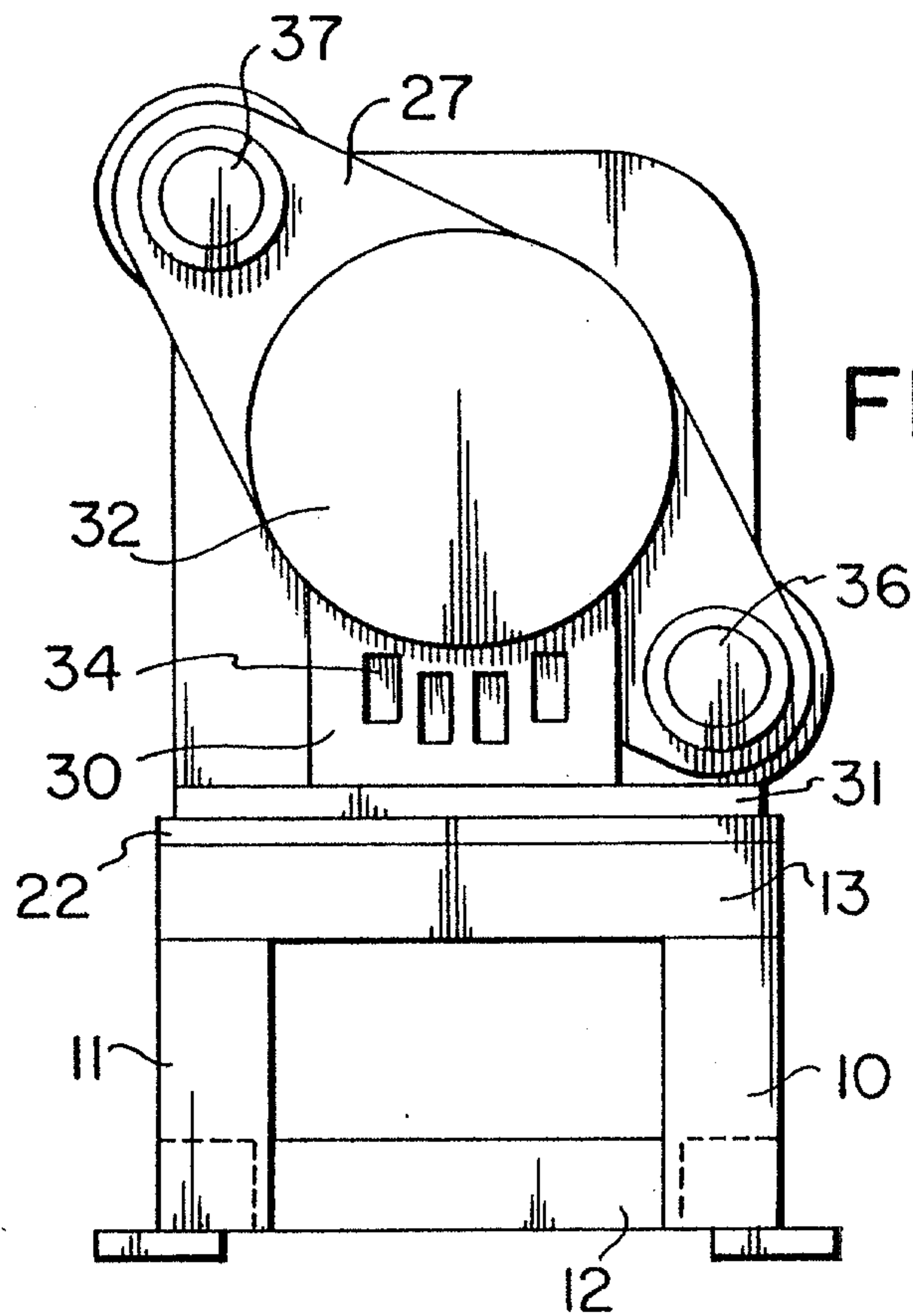


FIG. 4

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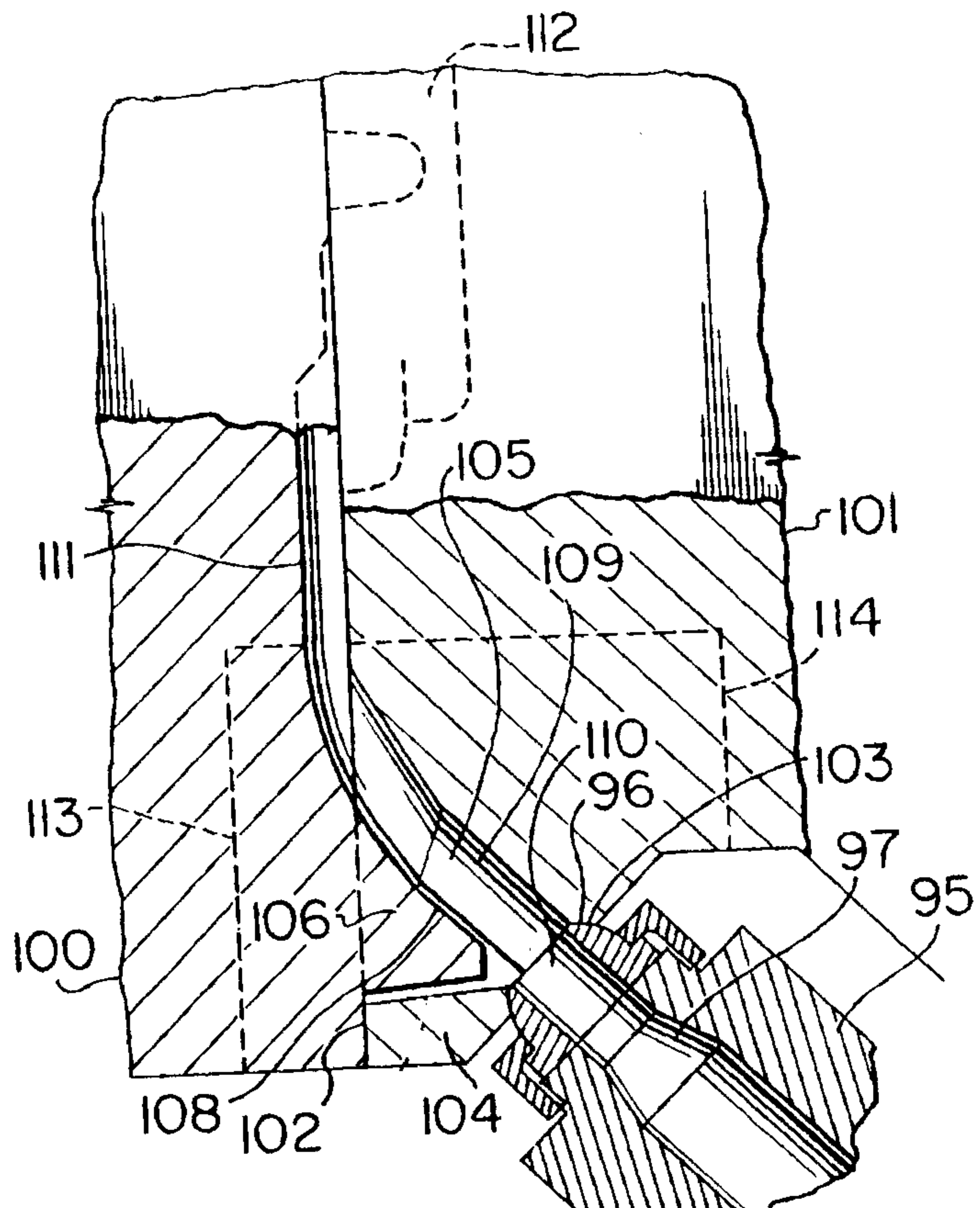
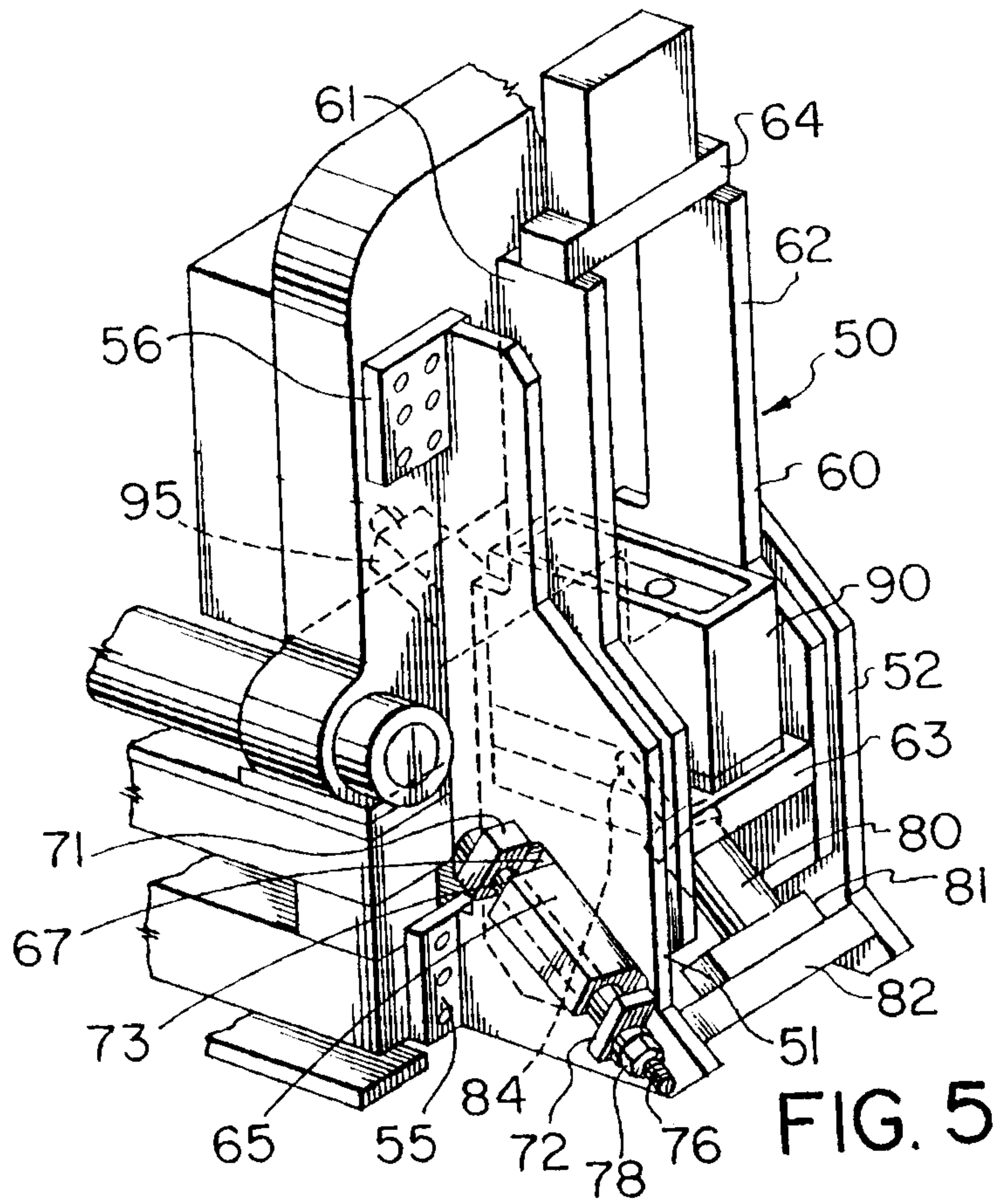


FIG. 6

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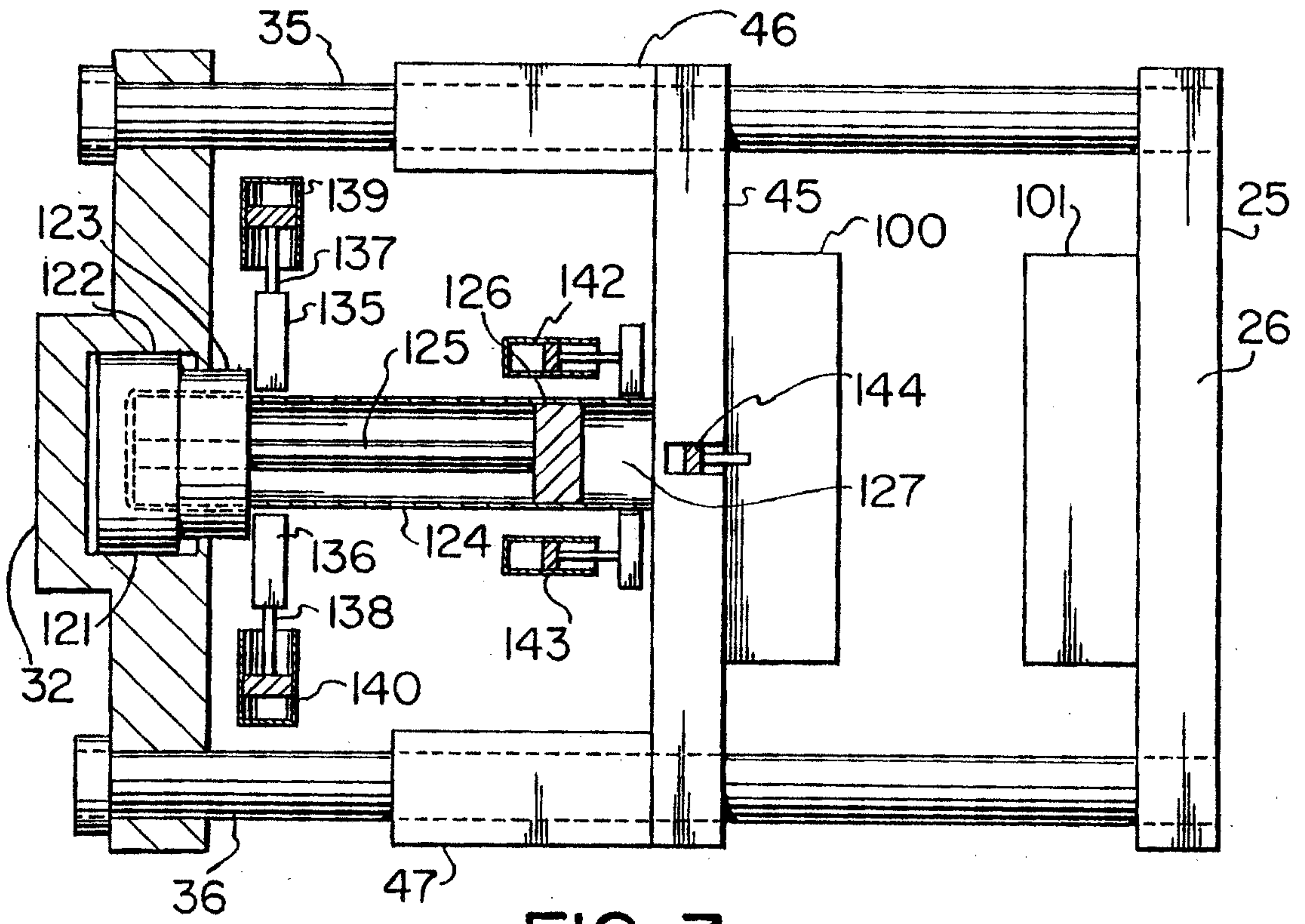


FIG. 7

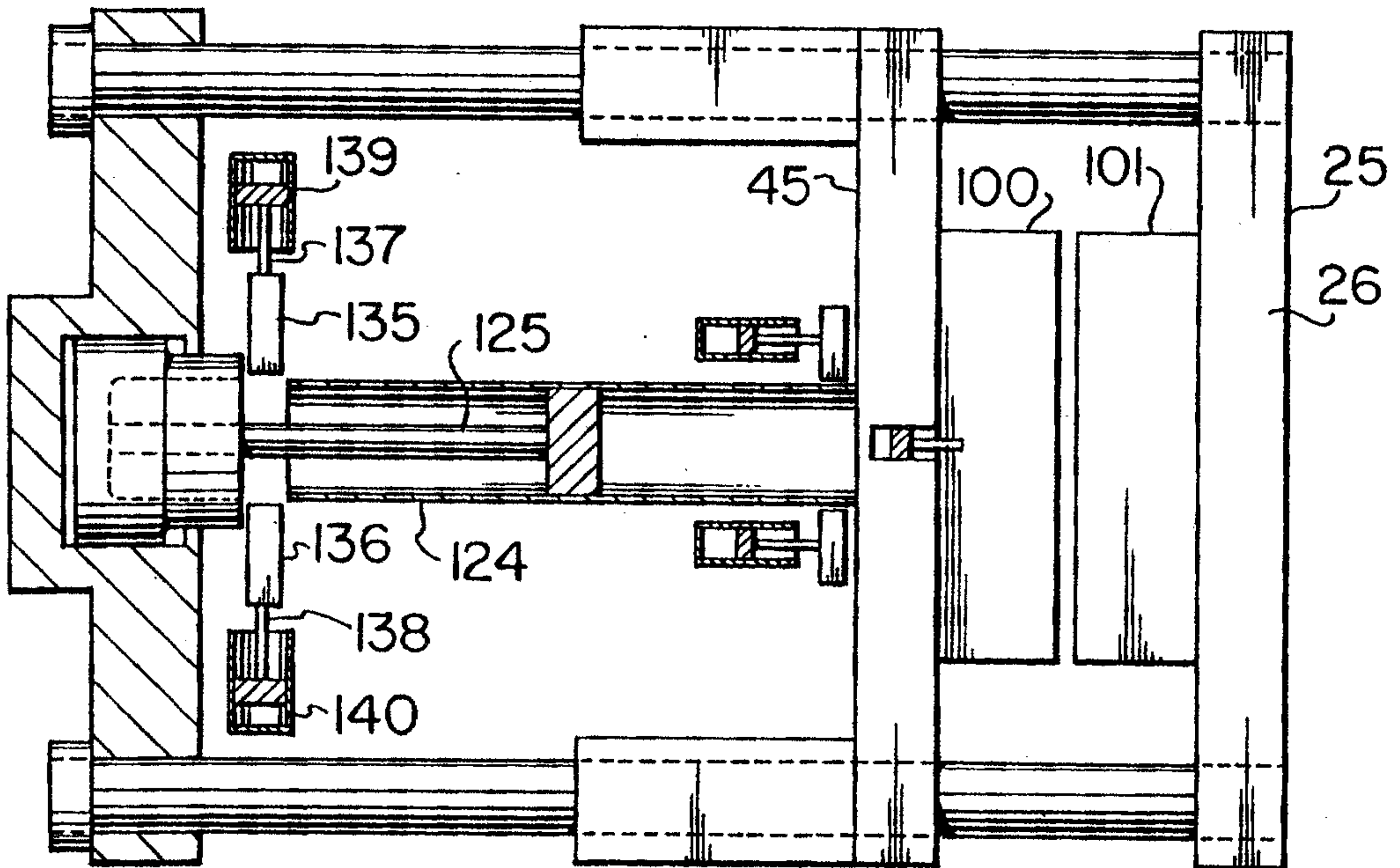


FIG. 8

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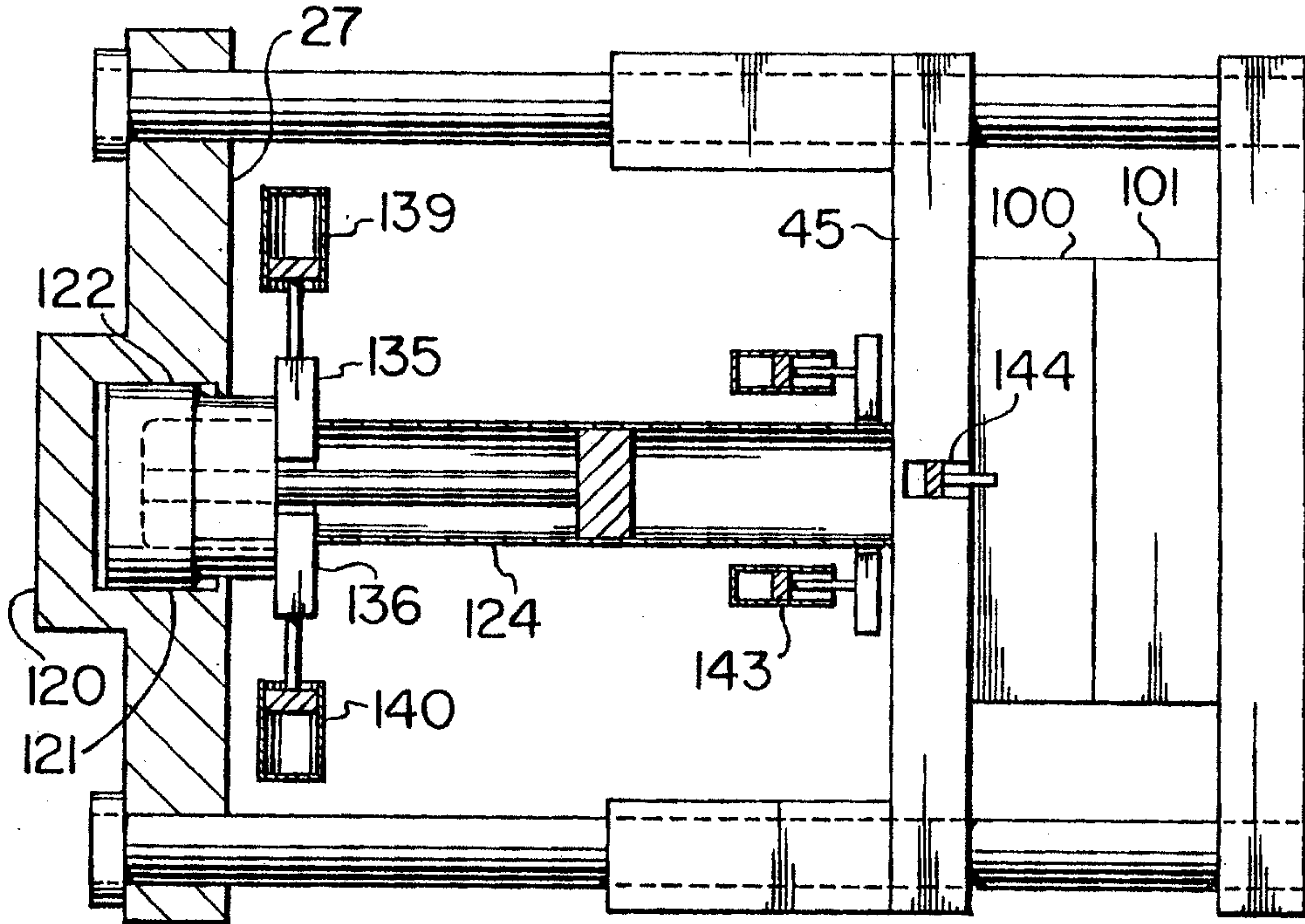


FIG. 9

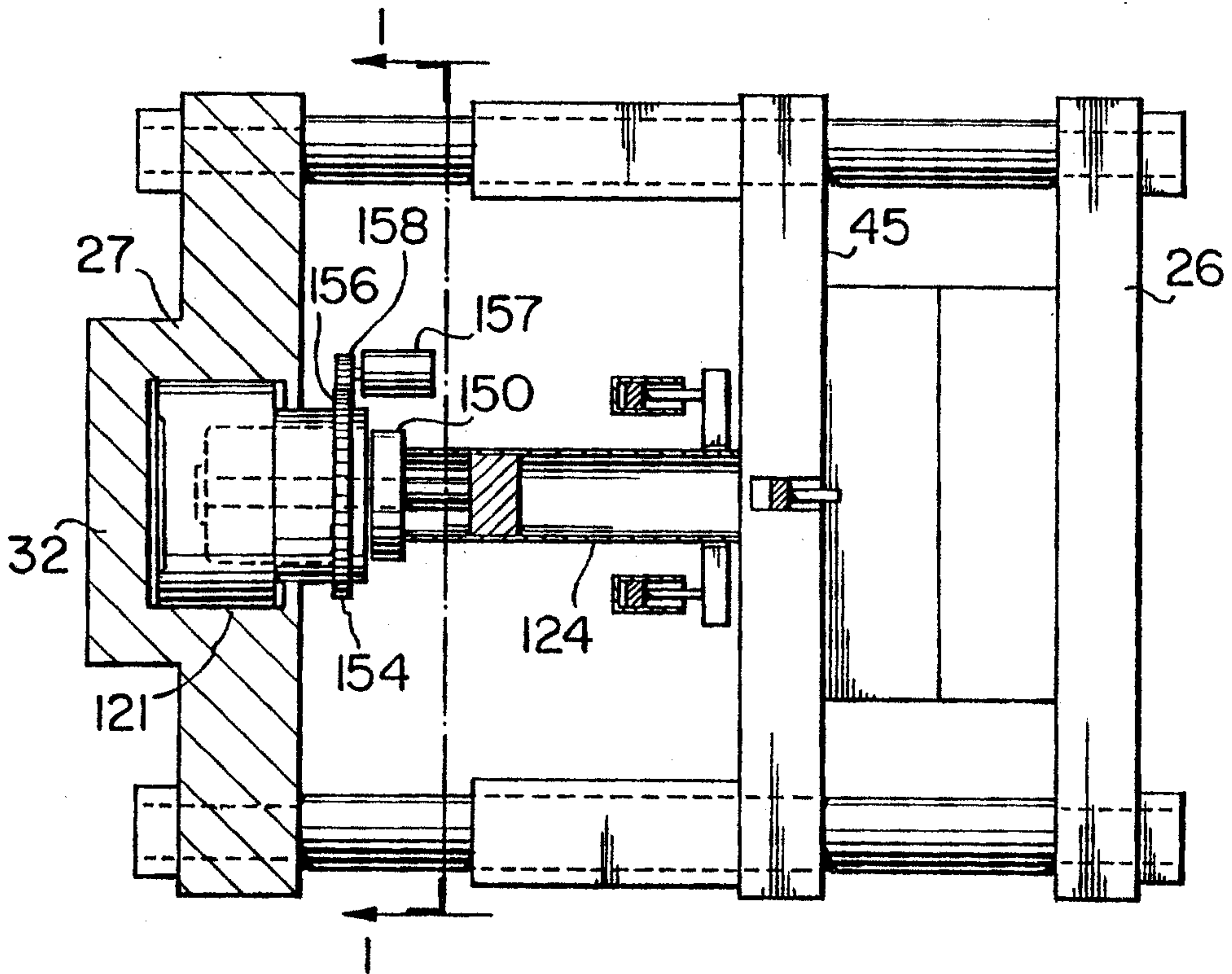


FIG. 10

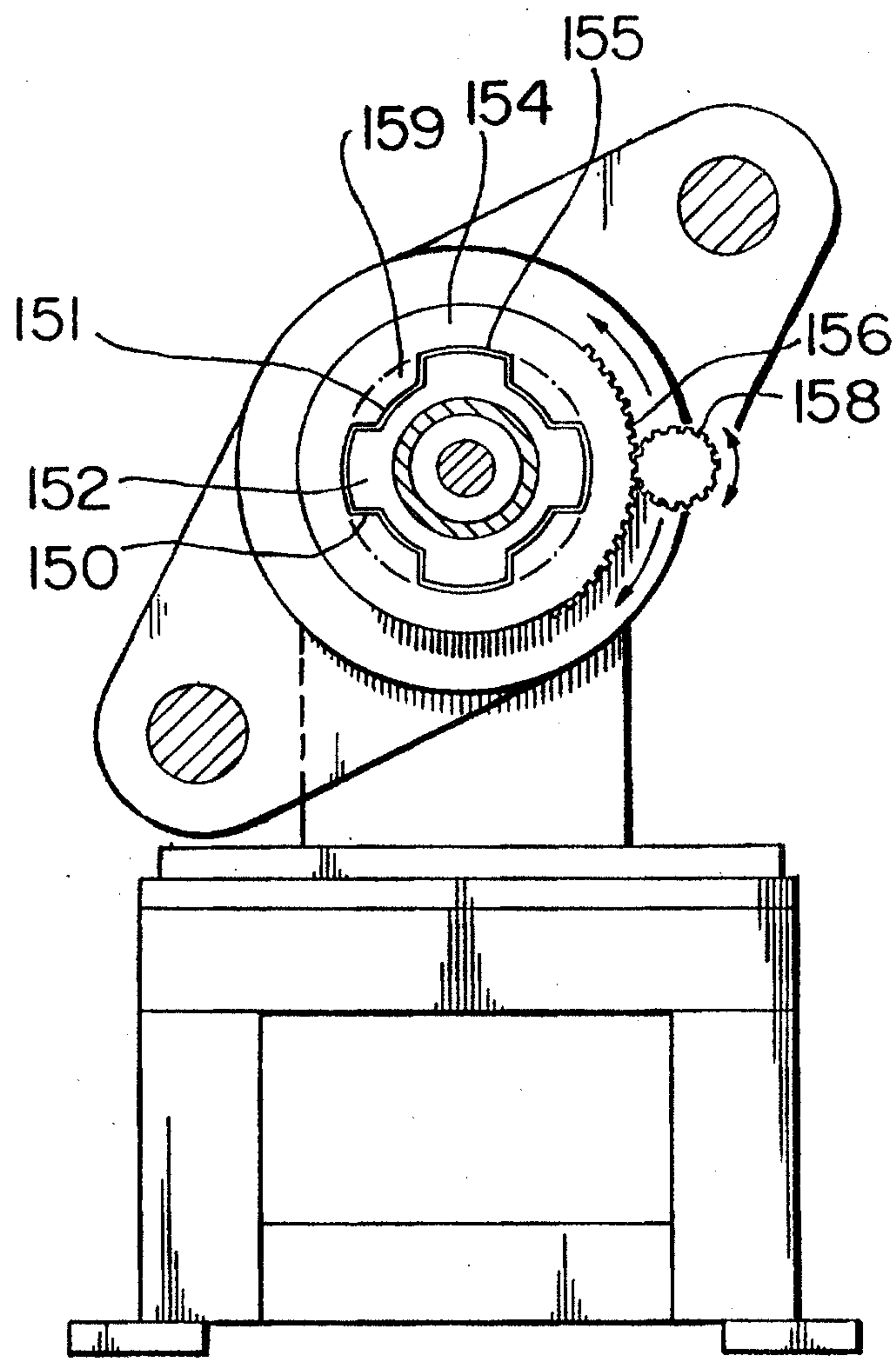


FIG. II



