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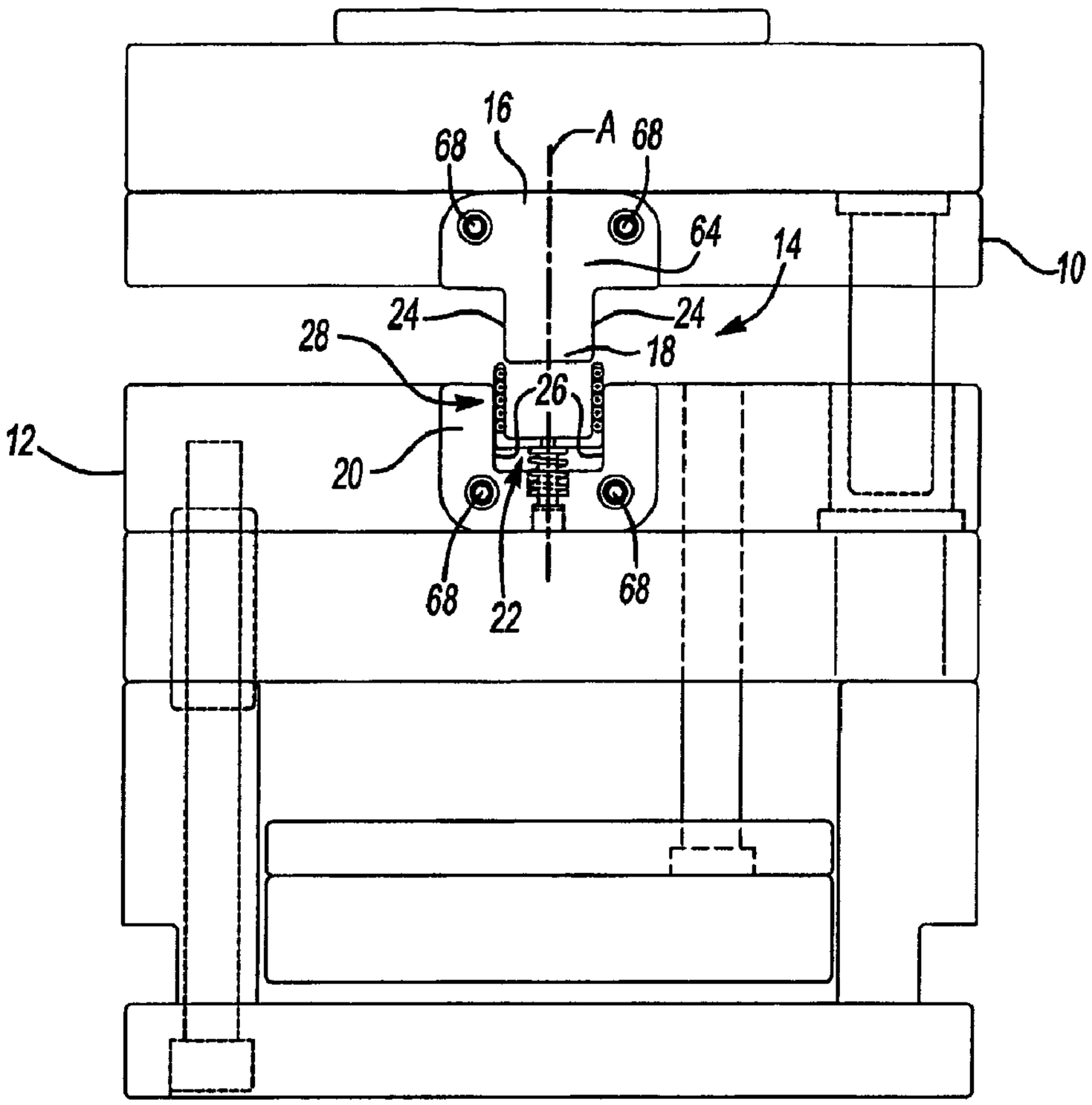
(54) Title: POSITIONING DEVICE WITH BEARING MECHANISM



(57) Abrégé/Abstract:
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(57) Abrégé(suite)/Abstract(continued):
member is separable from the first member and defines a female portion for mating with the male portion along the alignment axis to align the first and second mold halves together. The second member is mounted to the second mold half. The male portion presents a first bearing surface and the female portion presents a second bearing surface. A cage that rotatably supports a plurality of needle bearings reduces friction along the bearing surfaces when mating the members together along the alignment axis. A spring resiliently supports the cage.

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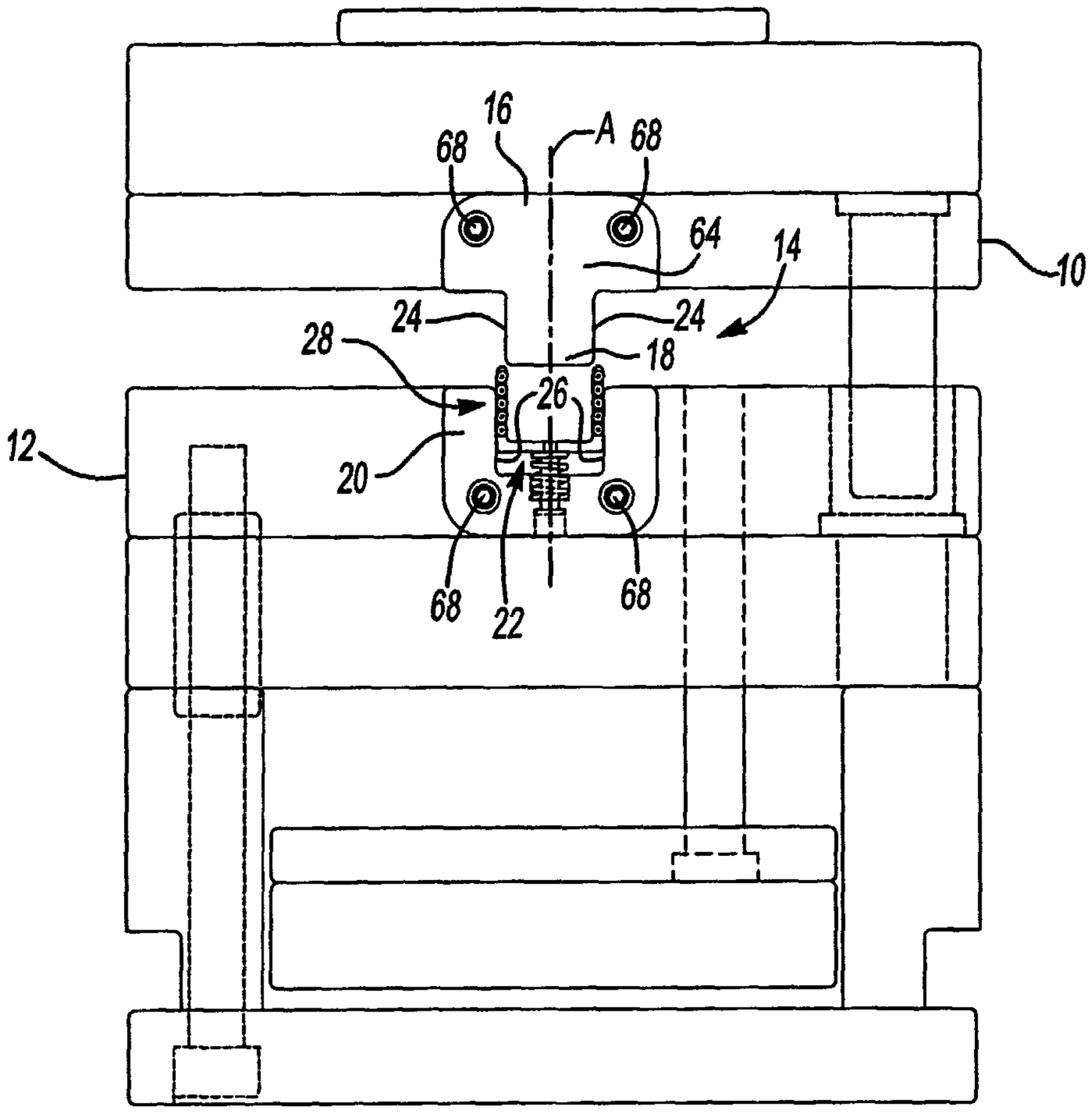
[Continued on next page]

(54) Title: POSITIONING DEVICE WITH BEARING MECHANISM



(57) Abstract: A positioning device for aligning and guiding first and second mold halves together is provided. The positioning device includes a first member defining an alignment axis and having a male portion. The first member is mounted to the first mold half. A second member is separable from the first member and defines a female portion for mating with the male portion along the alignment axis to align the first and second mold halves together. The second member is mounted to the second mold half. The male portion presents a first bearing surface and the female portion presents a second bearing surface. A cage that rotatably supports a plurality of needle bearings reduces friction along the bearing surfaces when mating the members together along the alignment axis. A spring resiliently supports the cage.

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POSITIONING DEVICE WITH BEARING MECHANISM

FIELD OF THE INVENTION

[0001] The present invention relates to a positioning device for aligning and guiding two halves of a mold together. More specifically, the present invention relates to the positioning device having a bearing mechanism to facilitate aligning and guiding the two halves while reducing wear of the positioning device.

BACKGROUND OF THE INVENTION

[0002] In a typical molding process, two halves of a mold are closed together to define a cavity and material is injected into the cavity to form a product. During the molding process, the two halves are repeatedly opened and closed to form multiple products. Molding processes are used in many industries. In many of these industries, the products being formed must meet rigorous standards and specifications. Hence, the tolerance for misalignment between the mold halves during the molding process is generally small.

[0003] Positioning devices are used to reduce tolerances between the mold halves to form products that meet the appropriate standards and specifications for each industry. A typical positioning device comprises a first member attached to one of the mold halves and a second member attached to the other mold half. The first member has a male portion that engages a female portion of the second member when the mold halves are closed together. An example of such a positioning device is shown in United States Patent No. 5,762,977 to Boskovic.

[0004] The fit between the male and female portions of the members determines the magnitude of misalignment between the mold halves. In prior art positioning devices, the male portion includes a first pair of bearing surfaces and the female portion includes a second pair of bearing surfaces. The bearing surfaces of the male portion slide against the bearing surfaces of the female portion to provide a better fit when aligning and guiding the mold halves together. As a result, these bearing surfaces are susceptible to wear. Consequently, as demand for higher productivity increases, the

speed of the molding process increases thereby increasing the wear along the bearing surfaces of prior art positioning devices.

[0005] Traditionally, when the bearing surfaces became worn, the positioning devices would be replaced. This resulted in increased cost and unacceptable delays in production. To solve this problem, the prior art has introduced the use of replaceable inserts in the positioning devices. This improvement is illustrated in United States Patent No. 6,558,145 to Wieder. Wieder discloses a positioning device for a mold having a pair of separable mold halves. The positioning device includes a base mounted to one mold half and a head extending from the base. A receptacle is mounted to the other mold half and a pocket is defined in the receptacle for receiving the head. The head defines a plurality of channels with needle bearings disposed therein. The needle bearings bear against a sidewall of the pocket when the head is inserted into the pocket thereby reducing friction in the mating engagement of the head and pocket. The needle bearings are replaceable to reduce down time and increase productivity.

BRIEF SUMMARY OF THE INVENTION

[0006] The present invention provides a positioning device for aligning and guiding first and second mold halves together. The positioning device comprises a first member defining an alignment axis and having a male portion. The first member is mounted to the first mold half. A second member that is separable from the first member is mounted to the second mold half. A female portion defined by the second member mates with the male portion of the first member along the alignment axis to align the first and second mold halves together. The male portion presents a first bearing surface and the female portion presents a second bearing surface. A bearing mechanism reduces friction along the bearing surfaces of the members when mating the members together along the alignment axis. As the members mate, the bearing mechanism moves between first and second positions relative to at least one of the members. A resilient member resiliently supports the bearing mechanism between the first and second positions.

[0007] The positioning device of the present invention provides several advantages over the prior art. In particular, by allowing the bearing mechanism to move

between first and second positions relative to at least one of the members when the members mate together, the amount of wear along the bearing surfaces is substantially reduced thereby significantly increasing the cycles of operation for the positioning device. This results in less down time and increased productivity. At the same time, the magnitude of misalignment between the mold halves is sustained at a negligible level.

BRIEF DESCRIPTION OF THE SEVERAL VIEWS OF THE DRAWINGS

[0008] Advantages of the present invention will be readily appreciated as the same becomes better understood by reference to the following detailed description when considered in connection with the accompanying drawings wherein:

[0009] Figure 1 is a elevational view illustrating use of a positioning device of the present invention to align and guide first and second mold halves together;

[0010] Figure 2 is an exploded view of the positioning device;

[0011] Figure 3 is an assembly view of a cage of a bearing mechanism of the positioning device;

[0012] Figure 4 is a top view of the cage illustrating welding of the cage;

[0013] Figure 5 is a top view of the cage illustrating a chamfered bore within the cage;

[0014] Figure 6 is a perspective view of the cage having a reinforcement wall;

[0015] Figure 7 is a top view of the cage with the reinforcement wall;

[0016] Figure 8 is a partially cut-away elevational view of the positioning device with the bearing mechanism in a first position;

[0017] Figure 9 is a partially cut-away elevational view of the positioning device with the bearing mechanism between the first and second positions as a first member of the positioning device mates with a second member of the positioning device;

[0018] Figure 10 is a partially cut-away elevational view of the positioning device with the bearing mechanism in the second position;

[0019] Figure 11 is an elevational view of an alternative embodiment of the positioning device;

[0020] Figure 12 is an elevational view of a first alternative embodiment of the positioning device;

[0021] Figure 13 is an elevational view of a second alternative embodiment of the positioning device;

[0022] Figure 14 is an perspective view of a third alternative embodiment of the positioning device;

[0023] Figure 15 is an elevational view of a fourth alternative embodiment of the positioning device;

[0024] Figure 16 is an elevational view of an alternative bearing mechanism embodied in first and second side locks;

[0025] Figure 17 is a partially cut-away top view of the alternative bearing mechanism; and

[0026] Figure 18 is an elevational view of another alternative bearing mechanism embodied in first and second side locks.

DETAILED DESCRIPTION OF THE INVENTION

[0027] Referring to the Figures, wherein like numerals indicate like or corresponding parts throughout the several views, a positioning device for aligning and guiding first **10** and second **12** mold halves together is generally shown at **14**. The mold halves **10,12** could be used in injection molding processes, metal stamping processes, or any other forming process in which alignment between two portions is required for operation.

[0028] The positioning device **14** of the present invention can be embodied in several types of well-known locking systems. For purposes of illustration, the positioning device **14** shall be shown as side locks **14**, top locks **114**, rectangular locks **214**, guide locks **314**, and x-type side locks **414**. These types of locking systems are well known to those skilled in the art for aligning first **10** and second **12** mold halves together. However, as a starting point, those features of the positioning device **14** that are common to each locking system shall first be described.

[0029] Referring to FIGS. 1 and 2, the positioning device **14** includes a first member **16** defining an alignment axis **A** and having a male portion **18**. The first member **16** is mounted to the first mold half **10**. A second member **20** is separable from the first member **16** and defines a female portion **22** for mating with the male portion **18** along the alignment axis **A** to align the first **10** and second **12** mold halves together. The second member **20** is mounted to the second mold half **12**. The male portion **18** presents a first pair of bearing surfaces **24** and the female portion **22** presents a second pair of bearing surfaces **26**. The first **16** and second **20** members are preferably made from hardened tool steel.

[0030] A bearing mechanism **28** reduces friction along the bearing surfaces **24,26** when mating the members **16,20** together along the alignment axis **A**. The bearing mechanism **28** moves between first and second positions along the alignment axis **A** and relative to at least one of the members **16,20** when the members **16,20** mate together. Referring to FIGS. 3-5, the bearing mechanism **28** includes a cage **30**. The cage **30** has a bottom wall **32**, a first pair of columns **34** extending from the bottom wall **32**, and a second pair of columns **36** extending from the bottom wall **32**. The second pair of columns **36** are spaced from and parallel to the first pair of columns **34**. As appreciated by those skilled in the art, the cage **30** may be formed from steel or plastic material.

[0031] The bearing mechanism **28** further includes a first plurality of needle bearings **38** rotatably supported between the first pair of columns **34** and a second plurality of needle bearings **38** rotatably supported between the second pair of columns **36**. Each of the needle bearings includes pins **39** on opposing ends thereof. The pins **39** engage recesses **44** defined in the first **34** and second **36** pairs of columns. The recesses **44** do not extend entirely through the columns **34,36**. To do so would substantially weaken the cage **30**. Instead, the recesses **44** act as pockets for rotatably supporting the pins **39**. The first and second pluralities of needle bearings **38** are equidistant from the alignment axis **A**, as shown in FIGS. 4 and 5.

[0032] To manufacture the cage **30**, first **40** and second **42** halves of the cage **30** are brought together and welded. See FIGS. 3 and 4. This sandwiches the needle

bearings **38** for rotatable support within the recesses **44** and between the two halves **40**,**42**. The bottom wall **32** of the cage **30** is then bored with a chamfered bore **46**, as shown in FIG. 5.

[0033] Alternatively, the cage **30** could be injection molded plastic having one or two piece construction. In two piece construction, the cage **30** would be assembled as previously described, i.e., by molding the two halves **40**,**42** and joining the two halves **40**,**42** using any suitable welding process. In one piece construction, the cage **30** would be over-molded onto the needle bearings **38** using processes well known to those skilled in the injection molding arts. In this instance, steel inserts (not shown) could be added to fortify the recesses **44**.

[0034] Referring to FIGS. 6 and 7, a pair of reinforcement walls **56** extend between the first **34** and second **36** pairs of columns. The reinforcement walls **56** are used to fortify the cage **30** in certain applications. The reinforcement walls **56** may be positioned along an entire length of the first **34** and second **36** pairs of columns and extend to the bottom wall **32** of the cage **30**. Alternatively, the reinforcement walls **56** may be ribs (not shown) extending between only a portion of the length of the first **34** and second **36** pairs of columns thereby leaving a gap between the reinforcement walls **56** and the bottom wall **32** of the cage **30**.

[0035] Referring back to FIG. 2, the bearing mechanism **28** further includes a retaining pin **48** having a body portion **50** coupled to the cage **30** and a head portion **52** adjacent to the body portion **50**. The retaining pin **48** is coupled to the cage **30** by way of a fastener **53** such as a flat head screw or the like. The fastener **53** threadably engages a threaded bore (not shown) in the retaining pin **48** through the chamfered bore **46**.

[0036] A resilient member **54** resiliently supports the bearing mechanism **28** between the first and second positions. The resilient member **54** is preferably a spring **54** surrounding the retaining pin **48** and having first and second ends. The spring **54** may be made from steel or a polymer such as urethane. The resilient member **54** could also comprise a positive locating device operating by friction.

[0037] Referring to FIGS. 2 and 8, the cage **30** is preferably coupled to the

second member **20**. In this instance, the second member **20** defines a first bore **58** having a first diameter and the body portion **50** of the retaining pin **48** is slideably disposed therein. The second member **20** defines an annular chamber **60** surrounding the first bore **58** and the first end of the spring **54** is disposed in the annular chamber **60** about the retaining pin **48**. A support wall **61** partitions the first bore **58** and the annular chamber **60** to further support the retaining pin **48** in the first bore **58**. The second end of the spring **54** abuts the bottom wall **32** of the cage **30** about the retaining pin **48**. In addition, the second member **20** defines a second bore **62** adjacent to the first bore **58** and having a second diameter greater than the first diameter of the first bore **58**. The head portion **52** is slidably disposed in the second bore **62**. The fastener **53** couples the body portion **50** of the retaining pin **48** to the bottom wall **32** of the cage **30**.

[0038] Referring to FIGS. 8-10, operation of the positioning device **14** is illustrated. As shown, the male portion **18** of the first member **16** mates with the female portion **22** of the second member **20** when closing the mold halves **10,12** together. See FIG. 10. When this occurs, the cage **30** is sandwiched between the members **16,20** thereby moving the cage **30** between the first and second positions. The first and second positions are represented in FIGS. 8 and 10, respectively. Arrows on the cage **30** in FIGS. 9 and 10 illustrate movement of the cage **30**. FIG. 9 indicates that the cage **30** may move slightly relative to the second member **20** prior to mating contact with the male portion **18**. In other instances, however, the cage **30** may remain stationary relative to the second member **20** until engaged by the male portion **18**. In either instance, when the cage **30** moves from the first position to the second position, the spring **54** is compressed and the retaining pin **48** slides downwardly within the first bore **58**.

[0039] The male portion **18** of the first member **16** slides into the cage **30** along the alignment axis **A** and between the first and second pluralities of needle bearings **38** when the first **16** and second **20** members mate together. This is represented by arrows on the male portion **18** in FIGS. 9 and 10. As the members **16,20** mate and sandwich the cage **30** therebetween, the needle bearings **38** roll along the bearing surfaces **24,26** of the male **18** and female **22** portions. This action minimizes wear along the bearing surfaces **24,26**. At the same time, the needle bearings **38** snugly fit between the bearing surfaces

24,**26** to minimize the magnitude of misalignment between the members **16**,**20** and, consequently, the mold halves **10**,**12**. When the mold halves are opened, i.e., the members **16**,**20** are separated, the cage **30** is released back to the first position.

[0040] Referring to FIG. 11, the cage **30** may alternatively be coupled to the male portion **18**. In this instance, the first member **16** defines the first bore **58** and the body portion **50** of the retaining pin **48** is slidably disposed therein. The first member **16** also defines the annular chamber **60** and the first end of the spring **54** is disposed in the annular chamber **60** about the retaining pin **48**. The second end of the spring **54** abuts the bottom wall **32** of the cage **30** about the retaining pin **48**. In addition, the first member **16** defines the second bore **62** adjacent to the first bore **58**. The second bore **62** has a second diameter greater than the first diameter of the first bore **58**. The head portion **52** is slidably disposed in the second bore **62**. The fastener **53** couples the retaining pin **48** to the bottom wall **32** of the cage **30**. When the cage **30** is coupled to the male portion **18**, the cage **30** is inverted. Hence, the chamfer of the chamfered bore **46** is reversed in the bottom wall **32**.

[0041] In the preferred embodiment illustrated in FIGS. 1, 2, and 8-10, the first **16** and second **20** members are further defined as first **16** and second **20** side locks. Referring specifically to FIG. 2, the first side lock **16** comprises a unitary body having a main body portion **64** with the male portion **18** extending therefrom to form a generally T shape. The main body portion **64** defines two counterbores **66** perpendicular to the alignment axis **A** to receive fasteners **68** for mounting the first side lock to the first mold half **10**. The second side lock **20** comprises a unitary body having a generally U shape and defining two counterbores **66** perpendicular to the alignment axis **A** to receive fasteners **68** for mounting the second side lock **20** to the second mold half **12**.

[0042] A first alternative embodiment **114** is illustrated in FIG. 12. Here, the first **16** and second **20** members are further defined as first **116** and second **120** top locks. The first top lock **116** comprises a unitary body having a main body portion **164** with the male portion **18** extending therefrom to form a generally T shape. The main body portion **164** defines two counterbores (not shown) parallel to the alignment axis **A** to receive fasteners **168** for mounting the first top lock **116** to the first mold half **10**. The

second top lock **120** comprises a unitary body having a generally U shape and defining two counterbores (not shown) parallel to the alignment axis **A** to receive fasteners **168** for mounting the second top lock **120** to the second mold half **12**.

[0043] A second alternative embodiment **214** is illustrated in FIG. 13. Here, the first **16** and second **20** members are further defined as first **216** and second **220** rectangular locks. The first rectangular lock **216** comprises a unitary body having a generally T shape and defining two counterbores (not shown) parallel to the alignment axis **A** to receive fasteners **268** for mounting the first rectangular lock **216** to the first mold half **10**. The second rectangular lock **220** comprises a unitary body having a generally U shape and defining two counterbores (not shown) parallel to the alignment axis **A** to receive fasteners (not shown) for mounting the second rectangular lock **220** to the second mold half **12**.

[0044] A third alternative embodiment **314** is illustrated in FIG. 14. Here, the first member **16** is further defined as a top guide block **316** and the second member **20** is further defined as a pair of bottom guide blocks **320** spaced from one another to define the female portion **22** therebetween. In this embodiment, the spring **54** is positioned in the second mold half **12** to resiliently support the cage **30** when mating the top guide block **316** with the pair of bottom guide blocks **320**. Each of the blocks **316**,**320** define a pair of counterbores (not shown) parallel to the alignment axis **A** to receive fasteners **368** for mounting the blocks **316**,**320** to the first **10** and second **12** mold halves. Of course, as with all other embodiments, the cage **30** could be supported by the male portion **18** of the top guide block **316**, as shown in the first side lock **16** of FIG. 11.

[0045] A fourth alternative embodiment **414** is illustrated in FIG. 15. Here, a third member **400** is added and the first **16**, second **20**, and third **400** members are further defined as first **416**, second **420**, and third **400** x-type side locks. The third member **400** defines a female portion **22** and the first side lock **416** includes a second male portion **18** for mating with the female portion **22** of the third member **400**. A second bearing mechanism **28**, identical to the first **28**, is interposed between the first **416** and third **400** side locks. A second resilient member **54** resiliently supports the second bearing mechanism **28** between first and second positions.

[0046] In this embodiment, the first side lock **416** comprises a unitary body having a main body portion **464** with the first and second male portions **18** extending therefrom to form a generally cross shape. The main body portion **464** defines two counterbores (not shown) perpendicular to the alignment axis **A** to receive fasteners **468** for mounting the first side lock **416** to the first mold half **10**. The second **420** and third **400** side locks each comprise a unitary body having a generally U shape and defining two counterbores (not shown) perpendicular to the alignment axis **A** to receive fasteners **468** for mounting the second side lock **420** to the second mold half **12** and mounting the third side lock **400** to a third mold half **402**. The first **416** and second **420** side locks align and guide the first **10** and second **12** mold halves together and the first **416** and third **400** side locks align and guide the first **10** and third **402** mold halves together.

[0047] In the alternative embodiments illustrated in FIGS. 12-15, the bearing mechanisms **28** (e.g., cages **30**, retaining pins **48**, and fasteners **53**), and springs **54** are substantially identical in configuration and positioning as the preferred embodiment of FIGS. 1, 2, and 8-10.

[0048] Alternative bearing mechanisms **528a,528b** are illustrated in two alternative embodiments **514a,514b** in FIGS. 16-18. The alternative bearing mechanisms **528a,528b** are shown in first **516** and second **520** side locks. In the embodiment **514a** of FIG. 16, the second side lock **520** defines semi-circular recesses **586**. In the embodiment **514b** of FIG. 18, the first side lock **516** defines the semi-circular recesses **586**. The bearing mechanisms **528a,528b** comprise a plurality of roller bearings **588** rotatably supported within the semi-circular recesses **586**. As illustrated in FIGS. 16 and 17, the roller bearings **588** are rotatably supported in the semi-circular recesses **586** of the second side lock **520**. Alternatively, in FIG. 18, the roller bearings **588** are rotatably supported within the semi-circular recesses **586** in the first side lock **516**. Each of the roller bearings **588** define a bore (not shown) therethrough for receiving a support pin **590**. Each support pin **590** provides for rotation of the roller bearings **588** about an axis. In the embodiment of FIGS. 16 and 17, the roller bearings **588** co-act with a female portion **522** to reduce friction along first bearing surfaces **524** of a male portion **518**. In the embodiment of FIG.

18, the roller bearings **588** co-act with the male portion **518** to reduce friction along second bearing surfaces **526** of the female portion **522**.

[0049] In a typical molding operation, several of the positioning devices **14** may be used to align and guide the first **10** and second **12** mold halves together. In addition, each of the embodiments described herein are for illustrative purposes only. Additional embodiments of the present invention can be contemplated that keep with the spirit of the present invention. Obviously, many modifications and variations of the present invention are possible in light of the above teachings. The invention may be practiced otherwise than as specifically described within the scope of the appended claims.

CLAIMS

What is claimed is:

1. A positioning device for aligning and guiding first and second mold halves together, comprising;

a first member defining an alignment axis and having a male portion,

a second member separable from said first member and defining a female portion for mating with said male portion along said alignment axis to align the first and second mold halves together,

said male portion presenting a first bearing surface and said female portion presenting a second bearing surface,

a bearing mechanism for reducing friction along said bearing surfaces when mating said members together along said alignment axis as said bearing mechanism moves between first and second positions relative to at least one of said members, and

a resilient member for resiliently supporting said bearing mechanism between said first and second positions.

2. A positioning device as set forth in claim 1 wherein said bearing mechanism includes a cage having a bottom wall, a first pair of columns extending from said bottom wall, and a second pair of columns extending from said bottom wall and spaced from and parallel to said first pair of columns.

3. A positioning device as set forth in claim 2 wherein said bearing mechanism further includes a first plurality of needle bearings rotatably supported between said first pair of columns and a second plurality of needle bearings rotatably supported between said second pair of columns wherein said first and second pluralities of needle bearings are equidistant from said alignment axis.

4. A positioning device as set forth in claim 3 wherein said male portion of said first member is slidable within said cage along said alignment axis and between said first and second pluralities of needle bearings.

5. A positioning device as set forth in claim 4 wherein said bearing mechanism further includes a retaining pin having a body portion coupled to said cage and a head portion adjacent said body portion.

6. A positioning device as set forth in claim 5 wherein said resilient member is further defined as a spring surrounding said retaining pin and having first and second ends for resiliently supporting said cage between said first and second positions.

7. A positioning device as set forth in claim 6 wherein said second member defines a first bore having a first diameter and said body portion of said retaining pin is slideably disposed therein.

8. A positioning device as set forth in claim 7 wherein said second member defines an annular chamber surrounding said first bore and said first end of said spring is disposed in said annular chamber about said retaining pin and said second end of said spring abuts said bottom wall of said cage about said retaining pin.

9. A positioning device as set forth in claim 8 wherein said second member defines a second bore adjacent to said first bore and having a second diameter greater than said first diameter of said first bore with said head portion being slidably disposed in said second bore.

10. A positioning device as set forth in claim 9 further including a fastener coupling said body portion of said retaining pin to said bottom wall of said cage.

11. A positioning device as set forth in claim 10 further including a pair of reinforcement walls extending between said first and second pairs of columns.

12. A positioning device as set forth in claim 10 wherein said first and second members are further defined as first and second side locks and said first side lock comprises a unitary body having a main body portion with said male portion extending therefrom to form a generally T shape and said main body portion defines two counterbores perpendicular to said alignment axis for mounting said first side lock to the first mold half and said second side lock comprises a unitary body having a generally U shape and defining two counterbores perpendicular to said alignment axis for mounting said second side lock to the second mold half.

13. A positioning device as set forth in claim 10 wherein said first and second members are further defined as first and second rectangular locks and said first rectangular lock comprises a unitary body having a generally T shape and defining two counterbores parallel to said alignment axis for mounting said first rectangular lock to the first mold half and said second rectangular lock comprises a unitary body having a generally U shape and defining two counterbores parallel to said alignment axis for mounting said second rectangular lock to the second mold half.

14. A positioning device as set forth in claim 10 wherein said first and second members are further defined as first and second top locks and said first top lock comprises a unitary body having a main body portion with said male portion extending therefrom to form a generally T shape and said main body portion defines two counterbores parallel to said alignment axis for mounting said first top lock to the first mold half and said second top lock comprises a unitary body having a generally U shape and defining two counterbores parallel to said alignment axis for mounting said second top lock to the second mold half.

15. A positioning device as set forth in claim 6 wherein said first member defines a first bore and said body portion of said retaining pin is slidably disposed therein.

16. A positioning device as set forth in claim 15 wherein said first member defines an annular chamber and said first end of said spring is disposed in said annular chamber about said retaining pin and said second end of said spring abuts said bottom wall of said cage about said retaining pin.

17. A positioning device as set forth in claim 16 wherein said first member defines a second bore adjacent to said first bore and having a second diameter greater than said first diameter of said first bore and said body portion is slidably disposed in said second bore.

18. A positioning device as set forth in claim 17 further including a fastener for coupling said retaining pin to said bottom wall of said cage.

19. A positioning device as set forth in claim 18 wherein said first member is further defined as a top guide block and said second member is further defined as a pair of bottom guide blocks spaced from one another to define said female portion therebetween whereby said spring is coupled to said top guide block to resiliently support said cage in mating engagement with said pair of bottom guide blocks.

20. A positioning device as set forth in claim 18 wherein said first and second members are further defined as first and second side locks and said first side lock comprises a unitary body having a main body portion with said male portion extending therefrom to form a generally T shape and said main body portion defines two counterbores perpendicular to said alignment axis for mounting said first side lock to the first mold half and said second side lock comprises a unitary body having a generally U shape and defining two counterbores perpendicular to said alignment axis for mounting said second side lock to the second mold half.

21. A positioning device as set forth in claim 18 wherein said first and second members are further defined as first and second rectangular locks and said first rectangular lock comprises a unitary body having a generally T shape and defining two counterbores parallel to said alignment axis for mounting said first rectangular lock to the first mold half and said second rectangular lock comprises a unitary body having a generally U shape and defining two counterbores parallel to said alignment axis for mounting said second rectangular lock to the second mold half.

22. A positioning device as set forth in claim 18 wherein said first and second members are further defined as first and second top locks and said first top lock comprises a unitary body having a main body portion with said male portion extending therefrom to form a generally T shape and said main body portion defines two counterbores parallel to said alignment axis for mounting said first top lock to the first mold half and said second top lock comprises a unitary body having a generally U shape and defining two counterbores parallel to said alignment axis for mounting said second top lock to the second mold half.

23. A positioning device as set forth in claim 6 wherein said first member is further defined as a top guide block and said second member is further defined as a pair of bottom guide blocks spaced from one another to define said female portion therebetween whereby said spring is coupled to one of said mold halves to resiliently support said cage when mating said top guide block with said pair of bottom guide blocks.

24. A positioning device as set forth in claim 9 further including a third member defining a female portion wherein said first member includes a second male portion for mating with said female portion of said third member.

25. A positioning device as set forth in claim 24 further including a second bearing mechanism interposed between said first and third members and a second resilient

member for resiliently supporting said second bearing mechanism between first and second positions.

26. A positioning device as set forth in claim 25 wherein said first, second and third members are further defined as first, second, and third side locks and said first side lock comprises a unitary body having a general cross shape and a main body portion defining two counterbores perpendicular to said alignment axis for mounting said first side lock to the first mold half and said second and third side locks each comprise a unitary body having a generally U shape and defining two counterbores perpendicular to said alignment axis for mounting said second side lock to the second mold half and mounting said third side lock to a third mold half such that said first and second side locks align and guide the first and second mold halves together and said first and third side locks align and guide the first and third mold halves together.

27. A positioning device for aligning and guiding first and second mold halves together, comprising:

a first member defining an alignment axis and having a male portion,

a second member separable from said first member and defining a female portion for mating with said male portion along said alignment axis to align the first and second mold halves together,

a cage separable from said first and second members and engagable by said first and second members, and

a plurality of needle bearings rotatably supported by said cage for reducing wear of said members when mating said members together along said alignment axis,

wherein said cage includes a bottom wall, a first pair of columns extending from said bottom wall, and a second pair of columns extending from said bottom wall and said plurality of needle bearings are further defined as a first plurality of needle bearings rotatably supported between said first pair of columns and a second plurality of needle bearings rotatably supported between said second pair of columns.

28. A positioning device as set forth in claim 27 further including a spring resiliently supporting said cage.

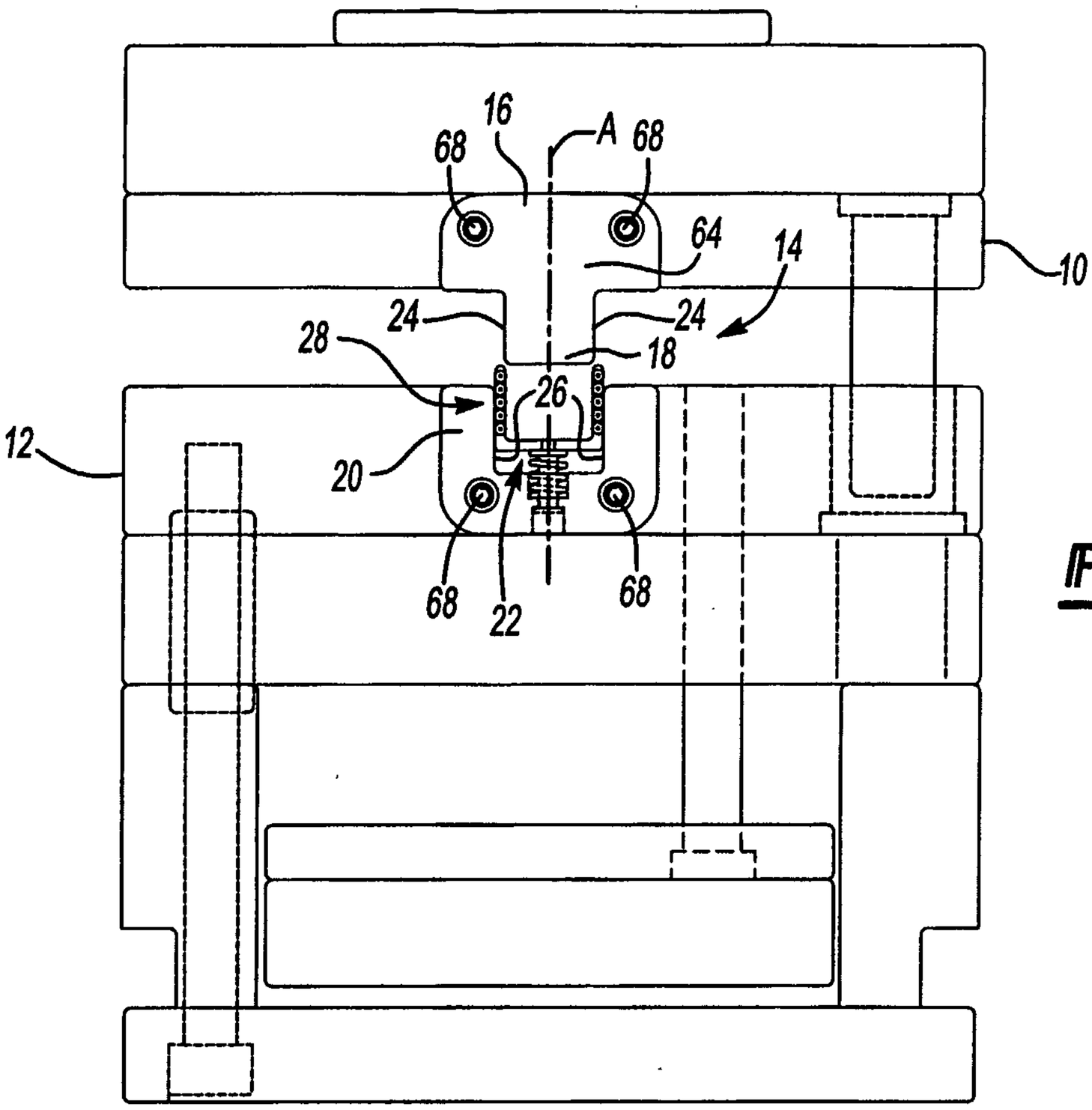
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Fig-1

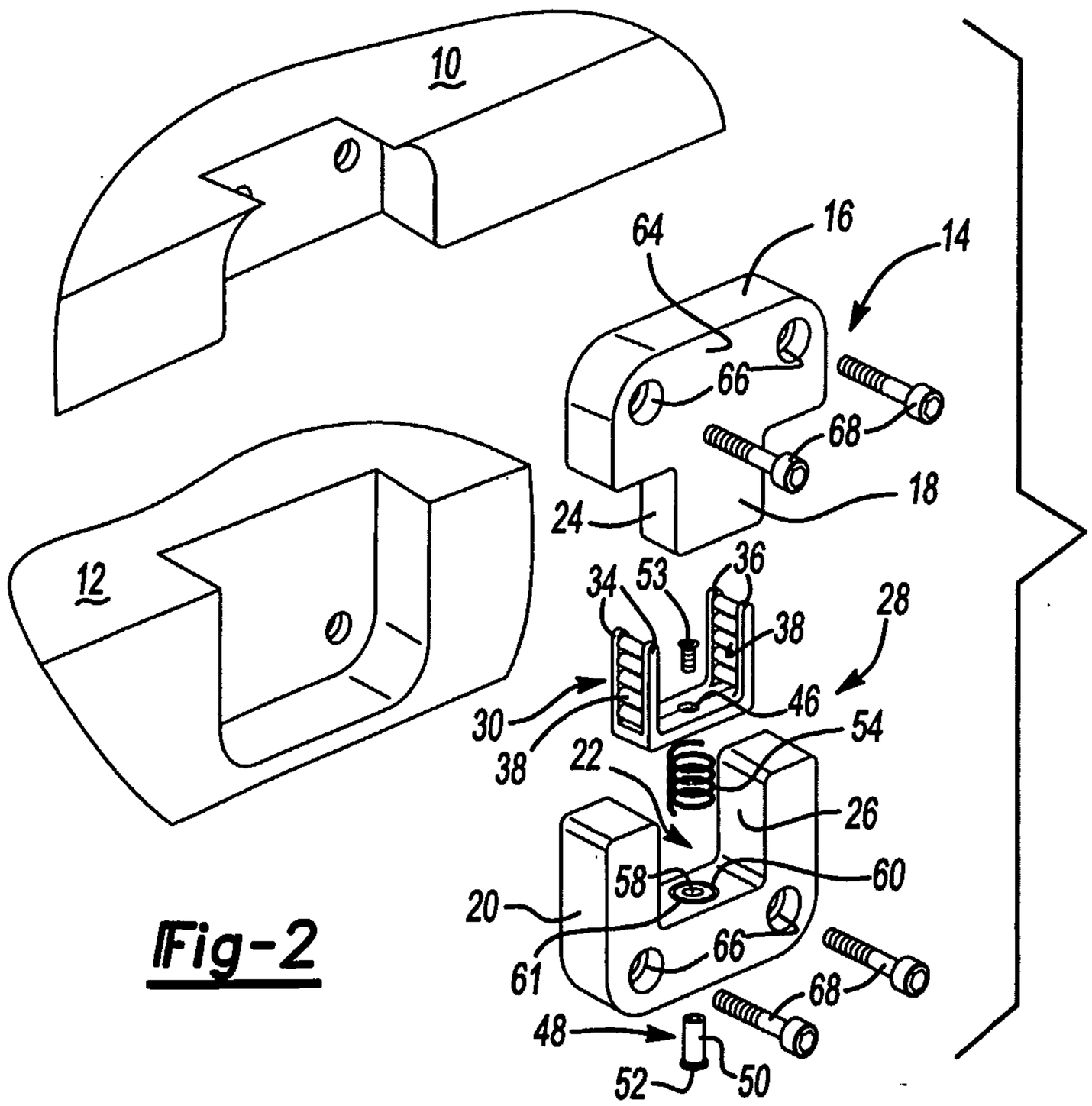
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Fig-2

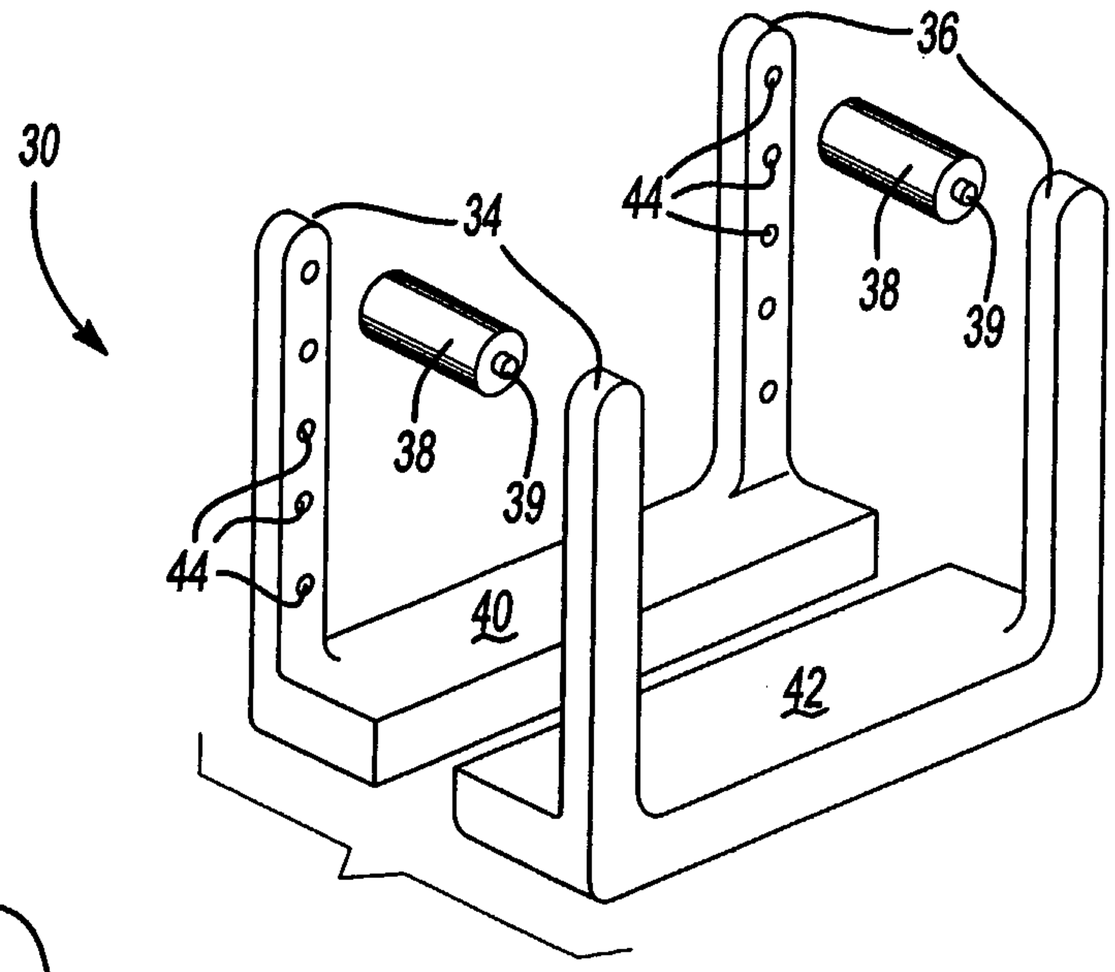


Fig-3

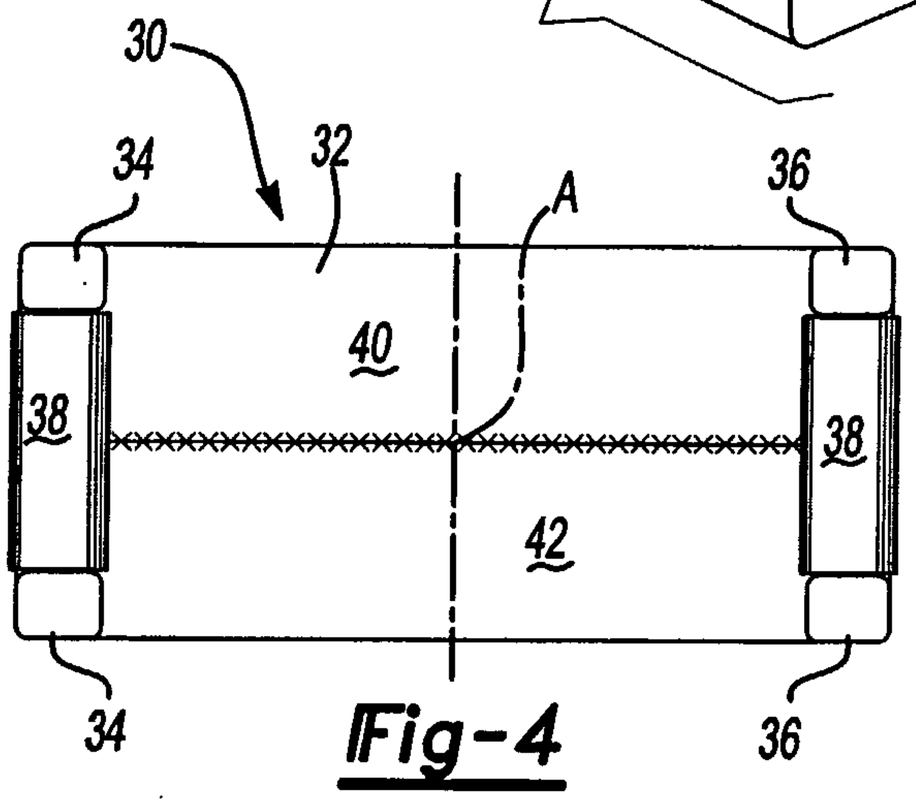
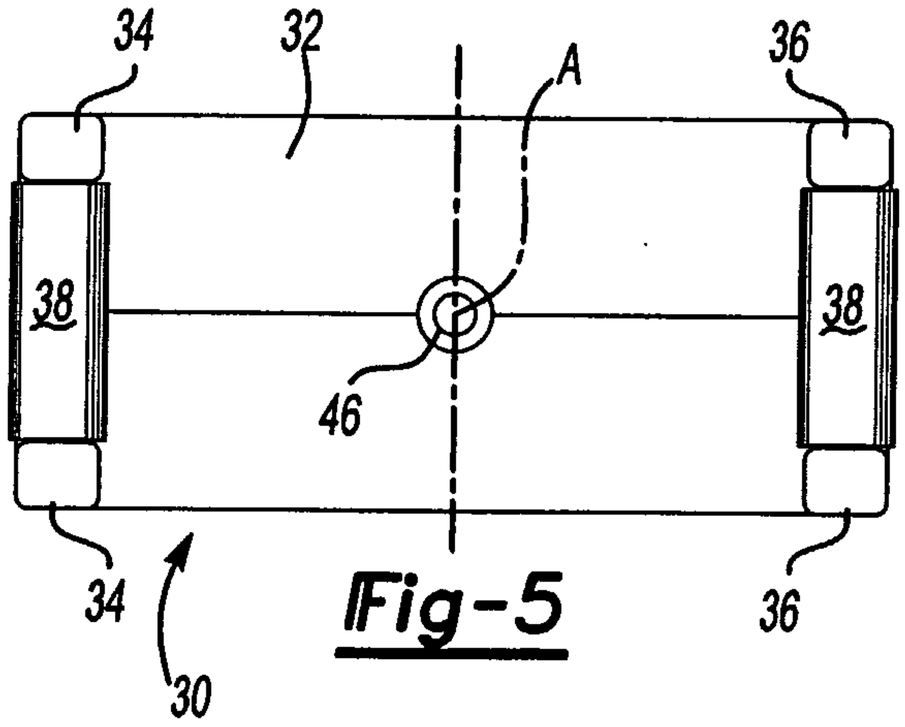


Fig-4



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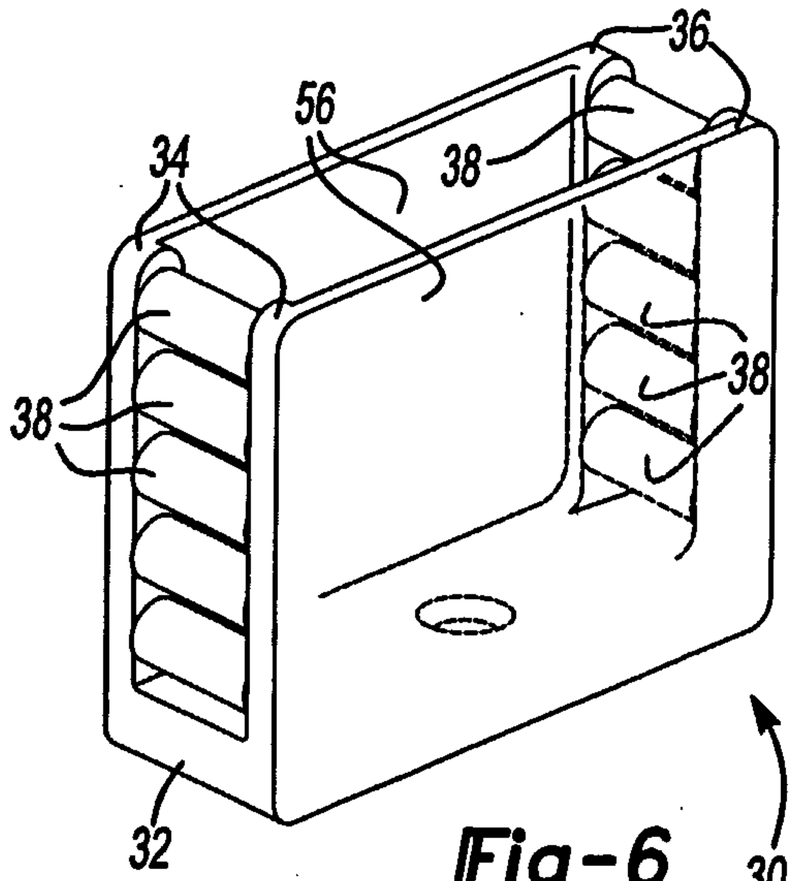

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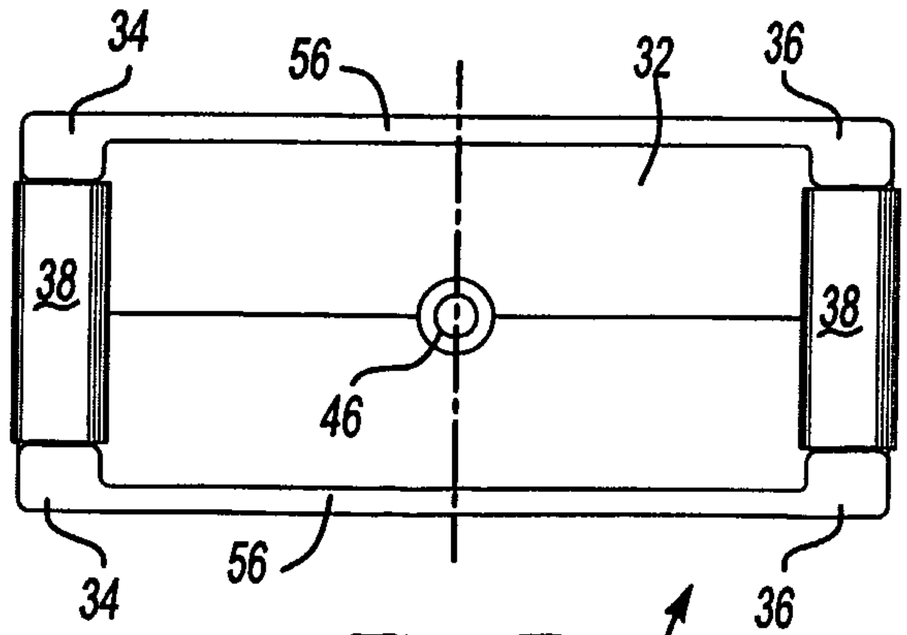

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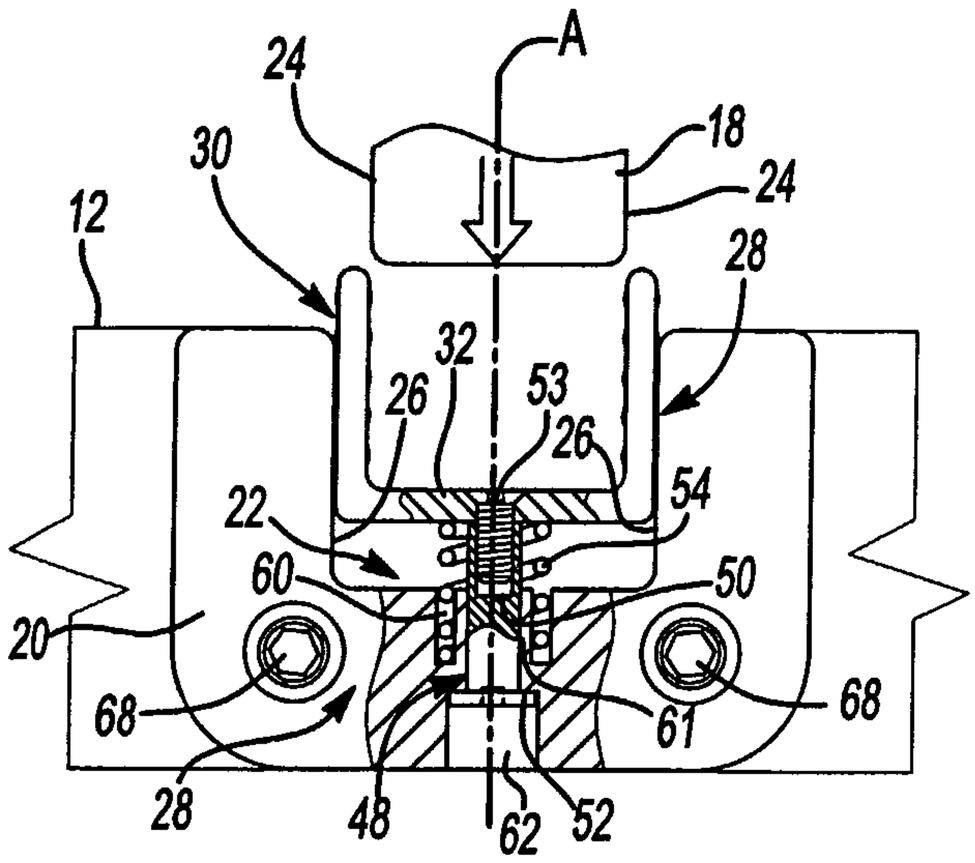

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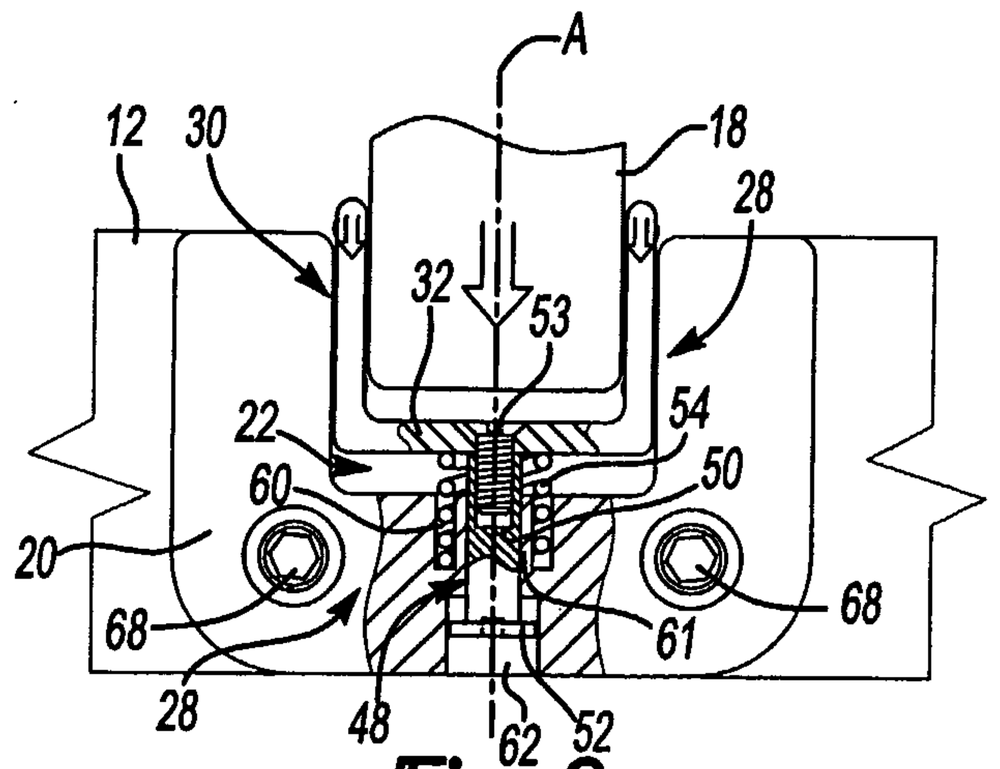

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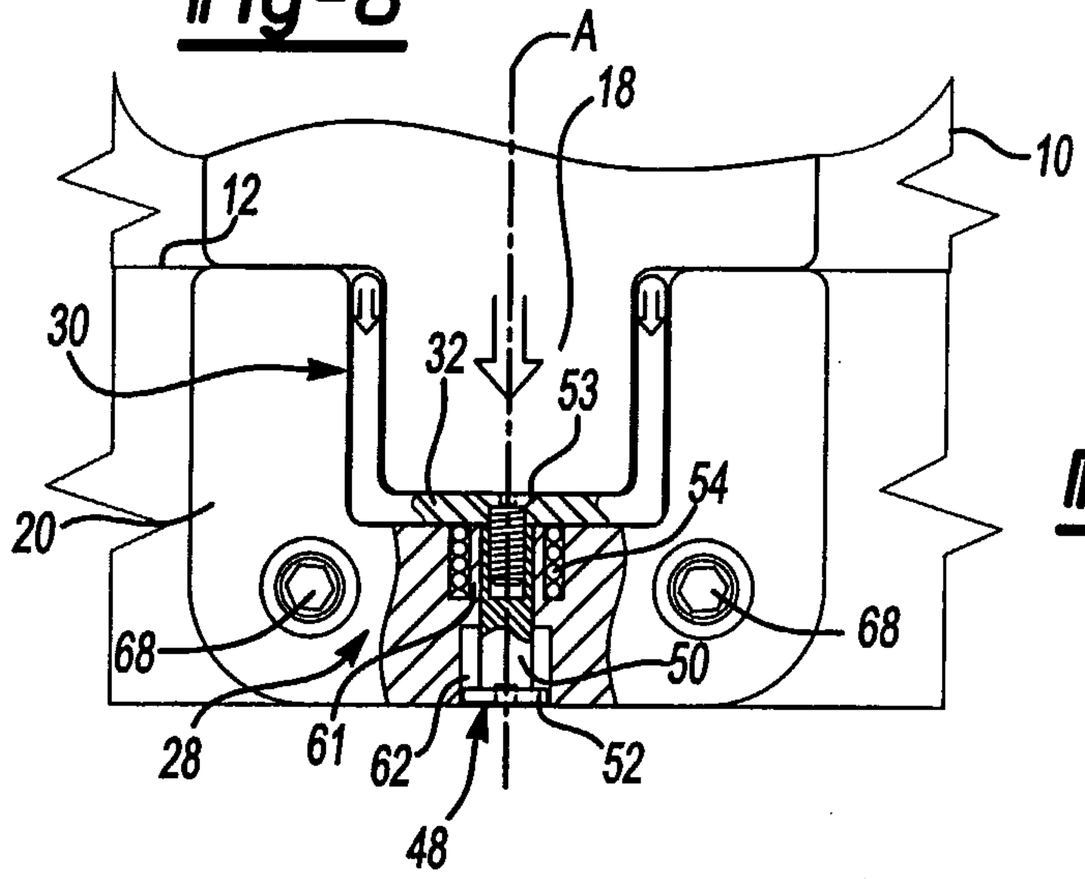

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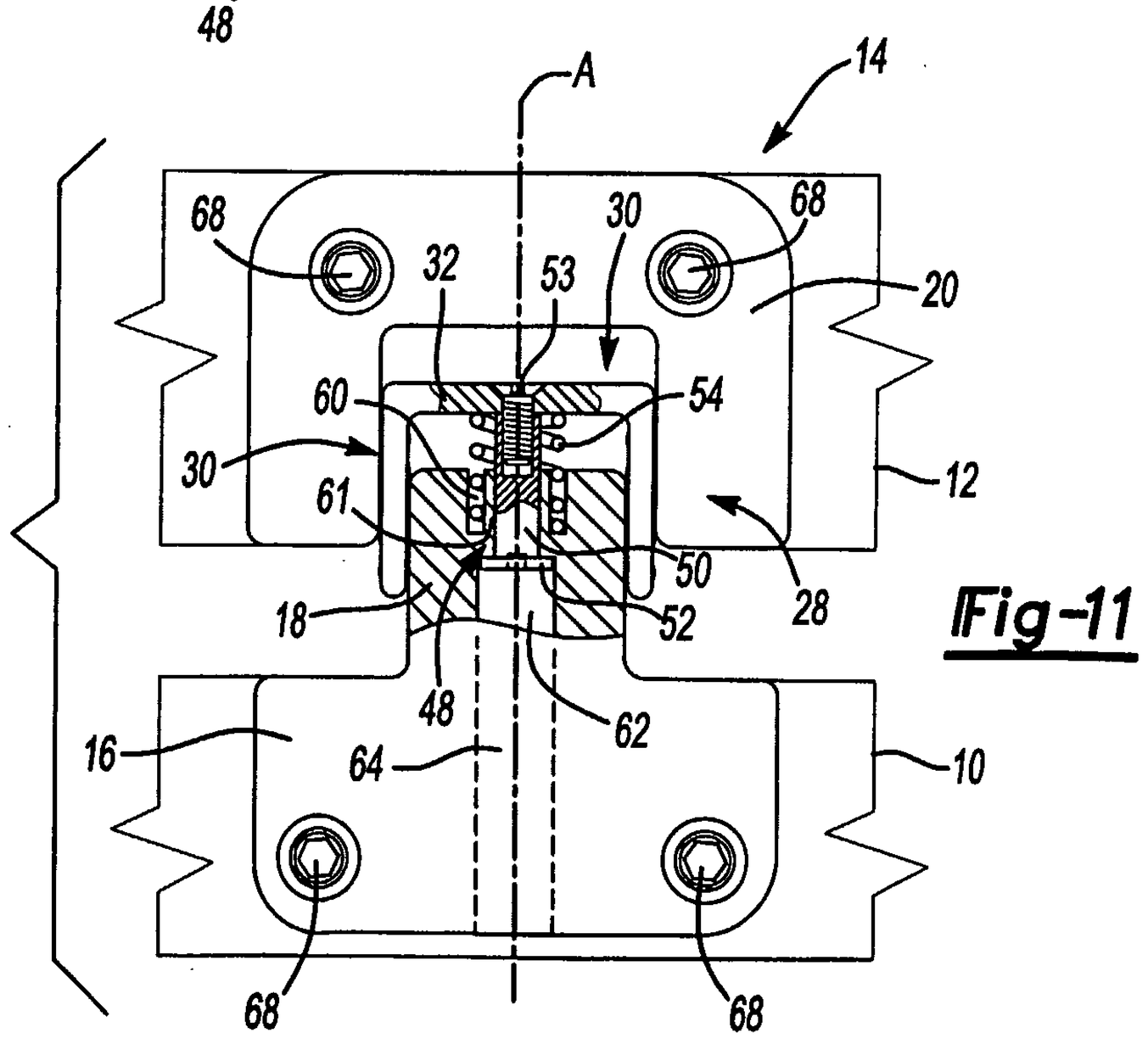

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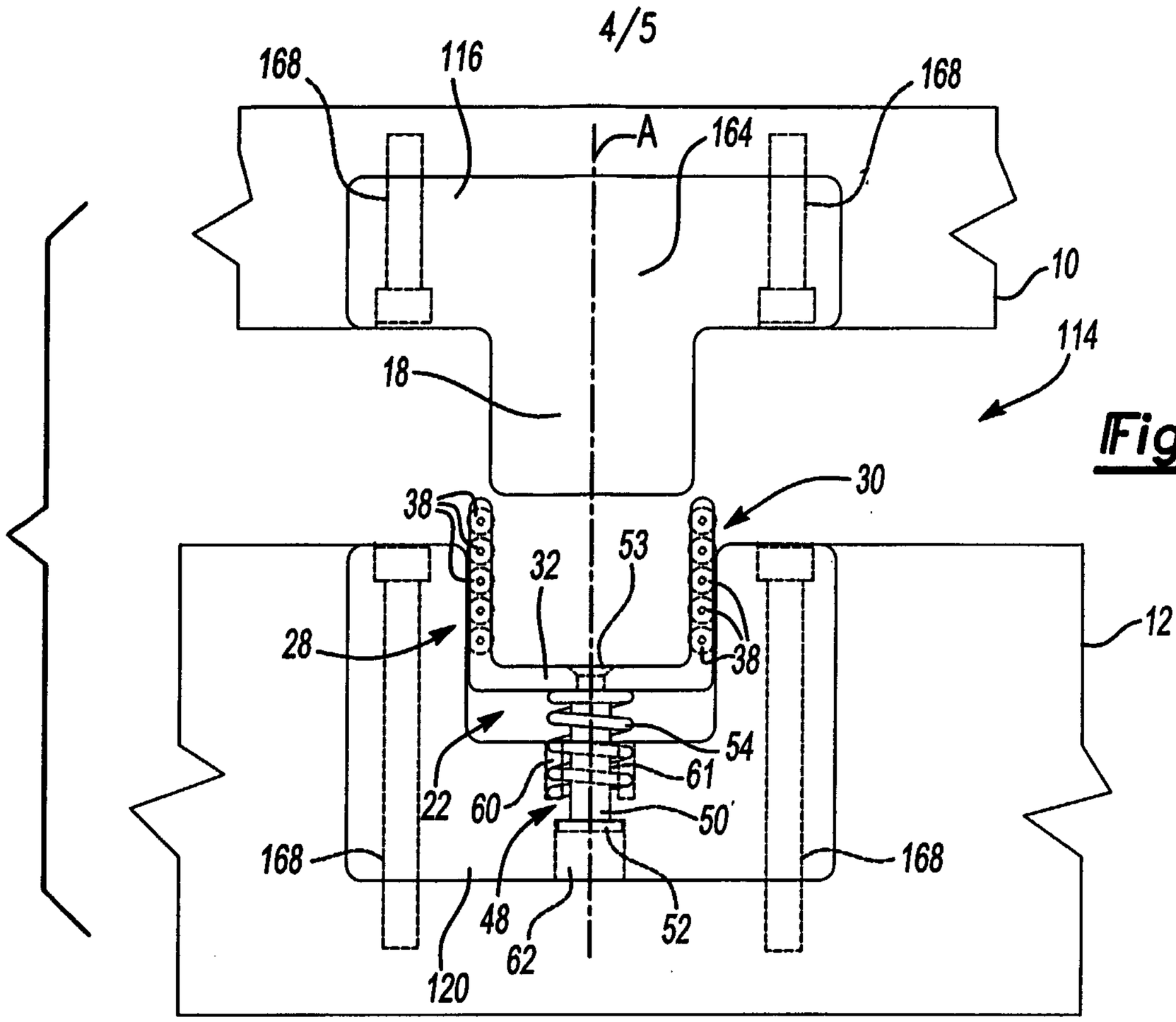
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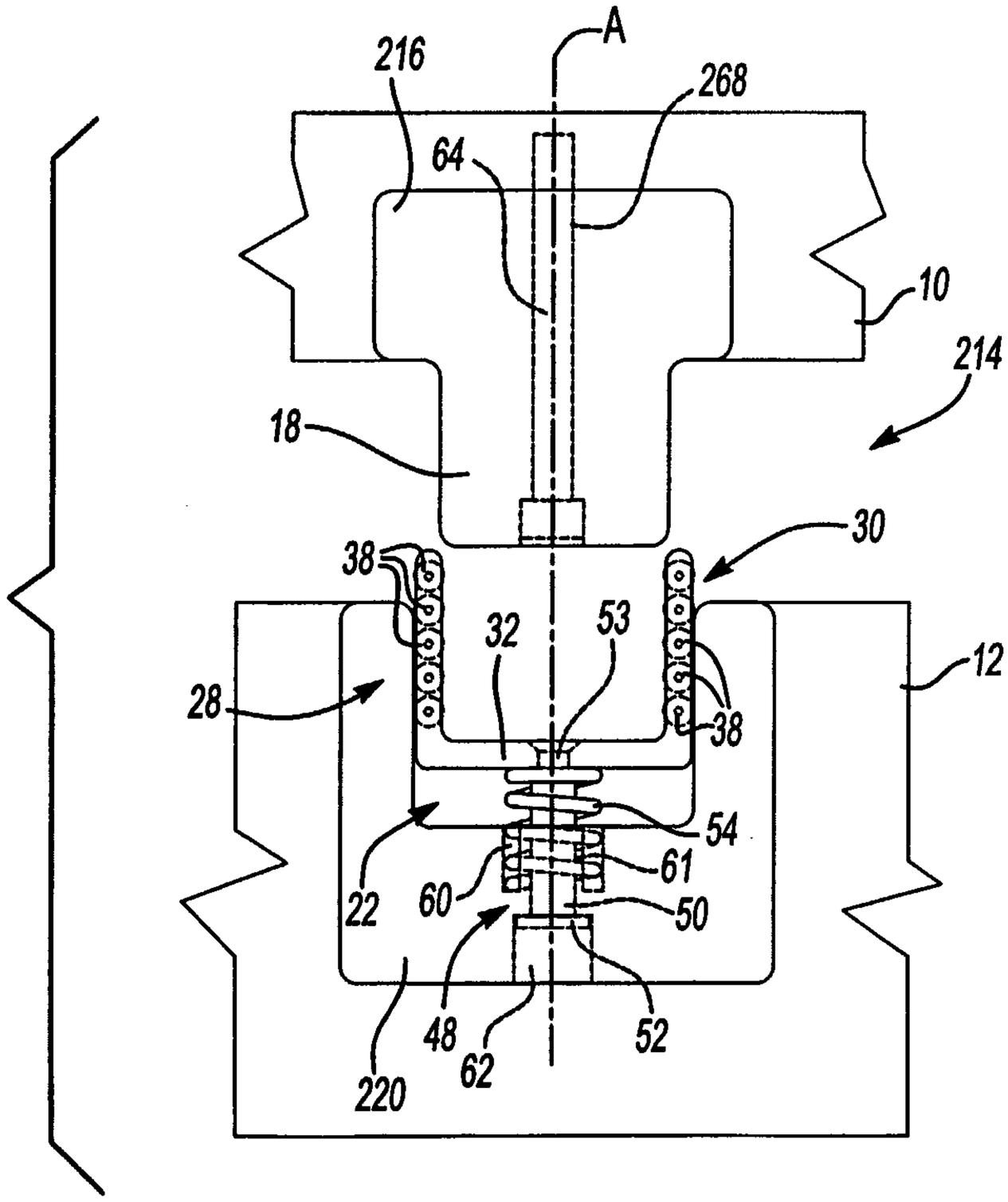
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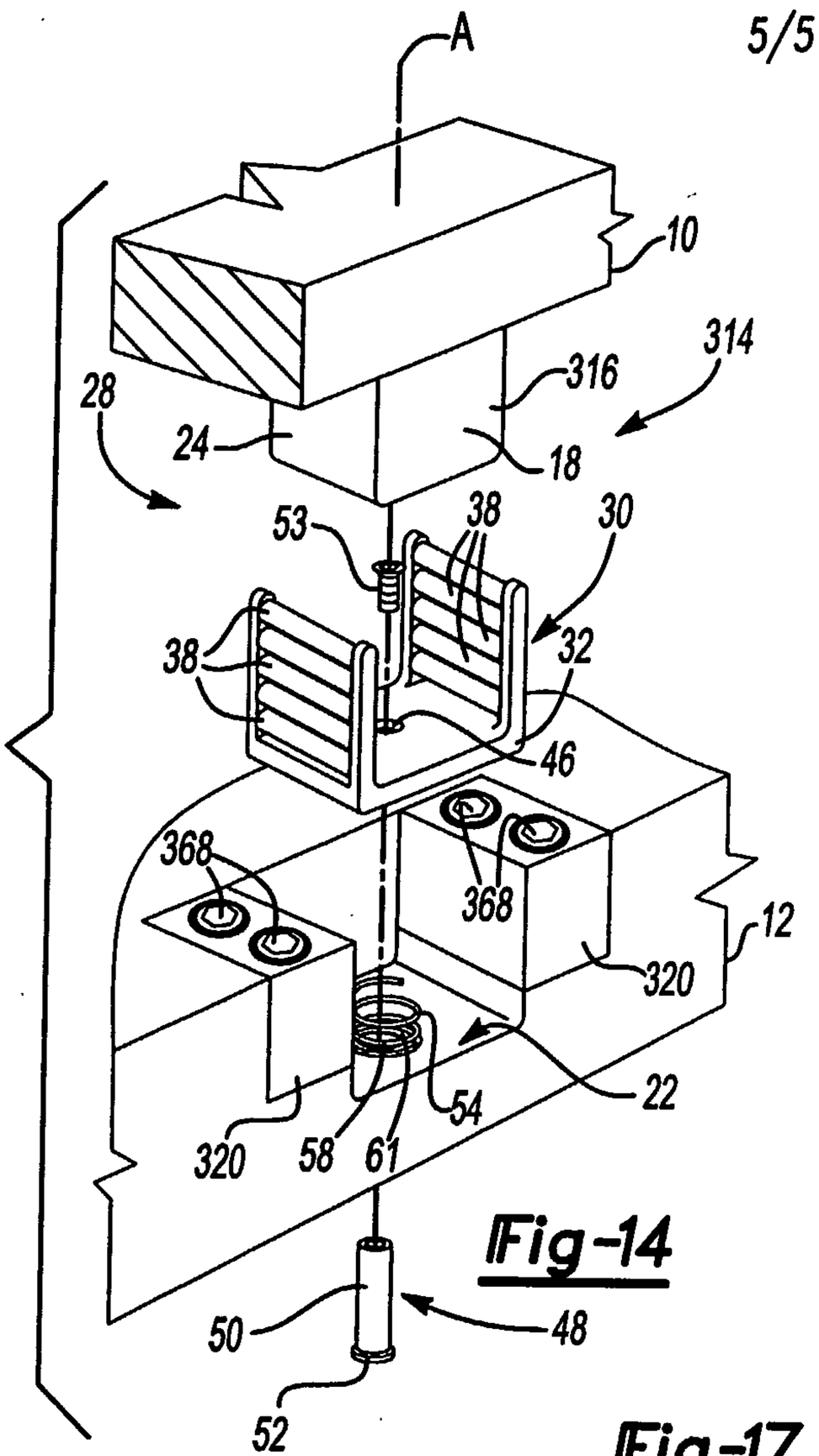
Fig-13



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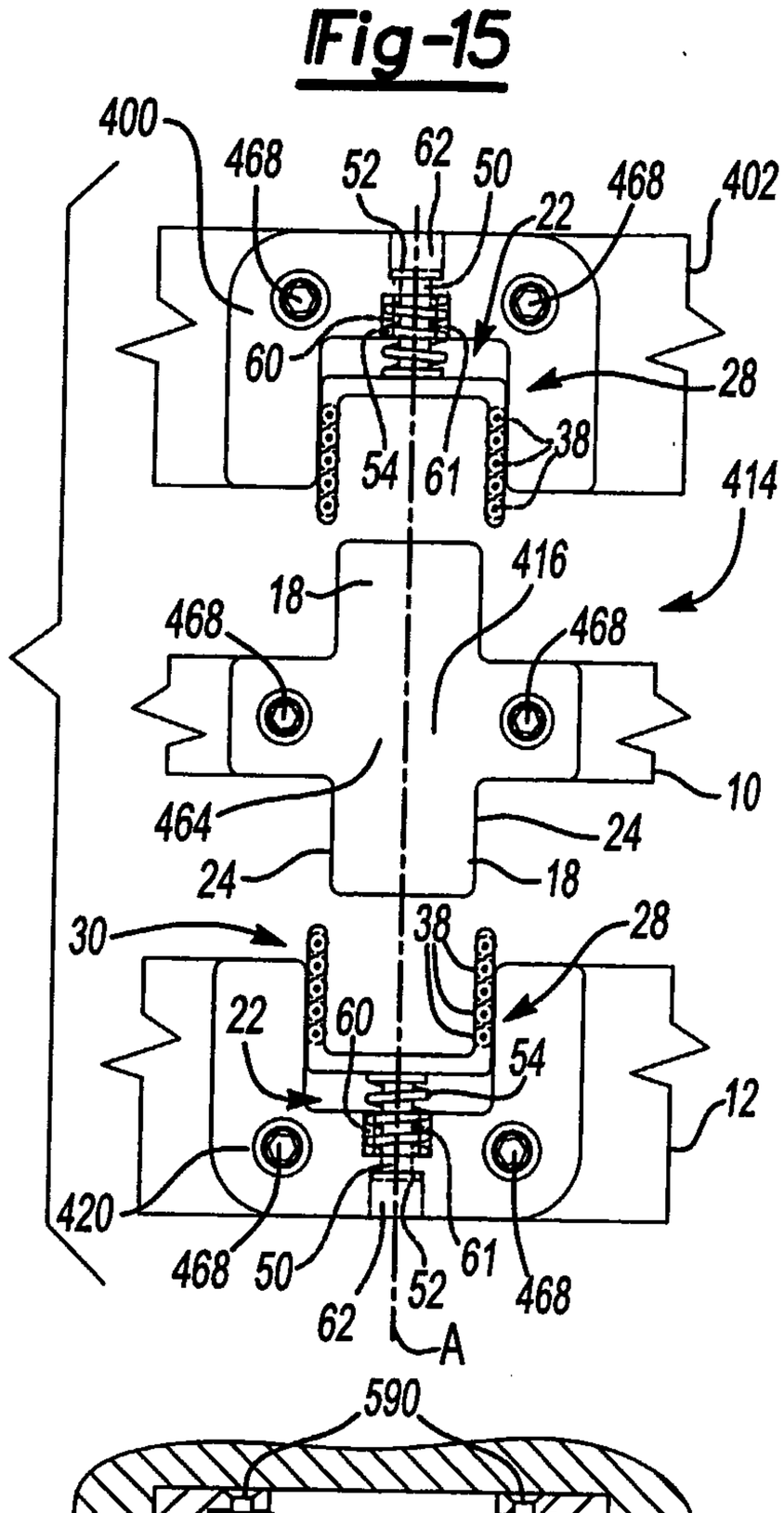
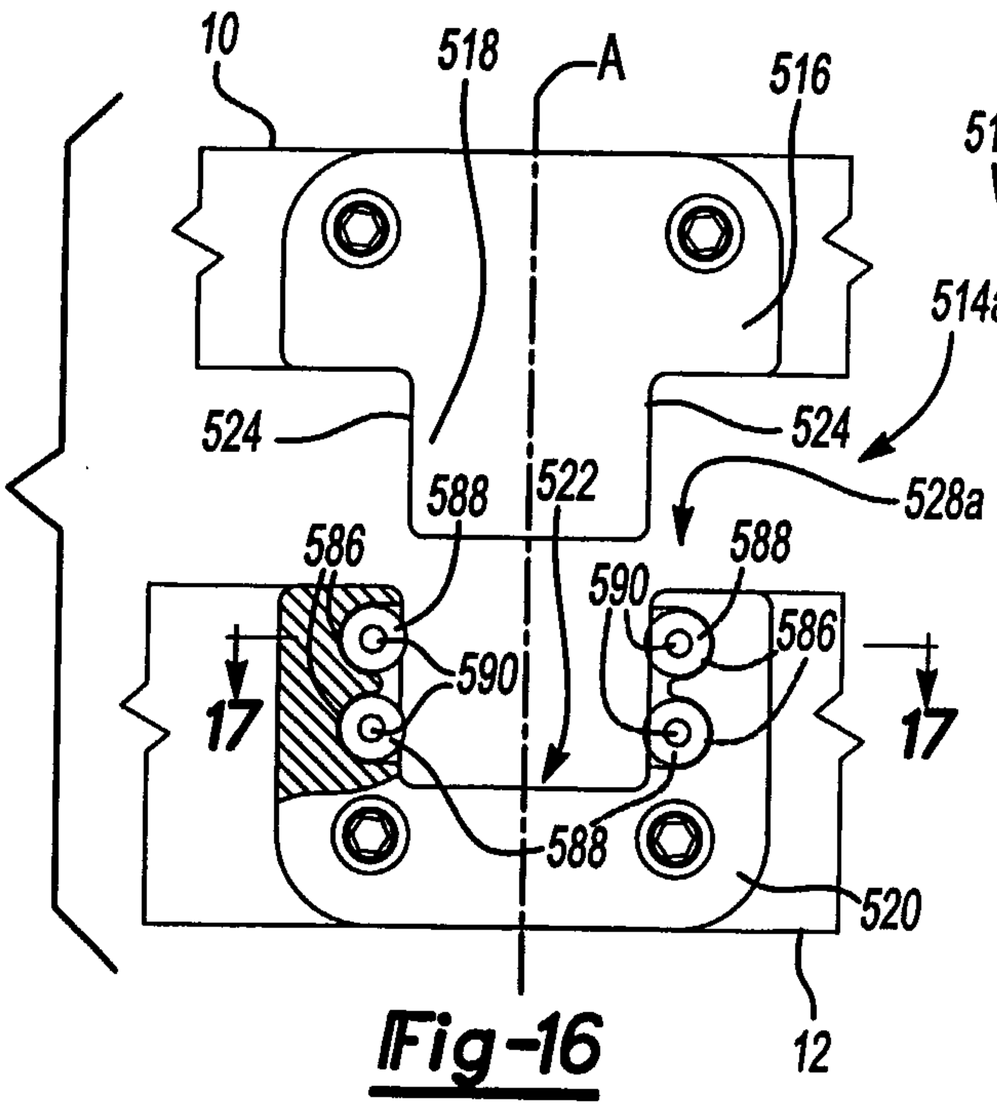


Fig-15

Fig-17



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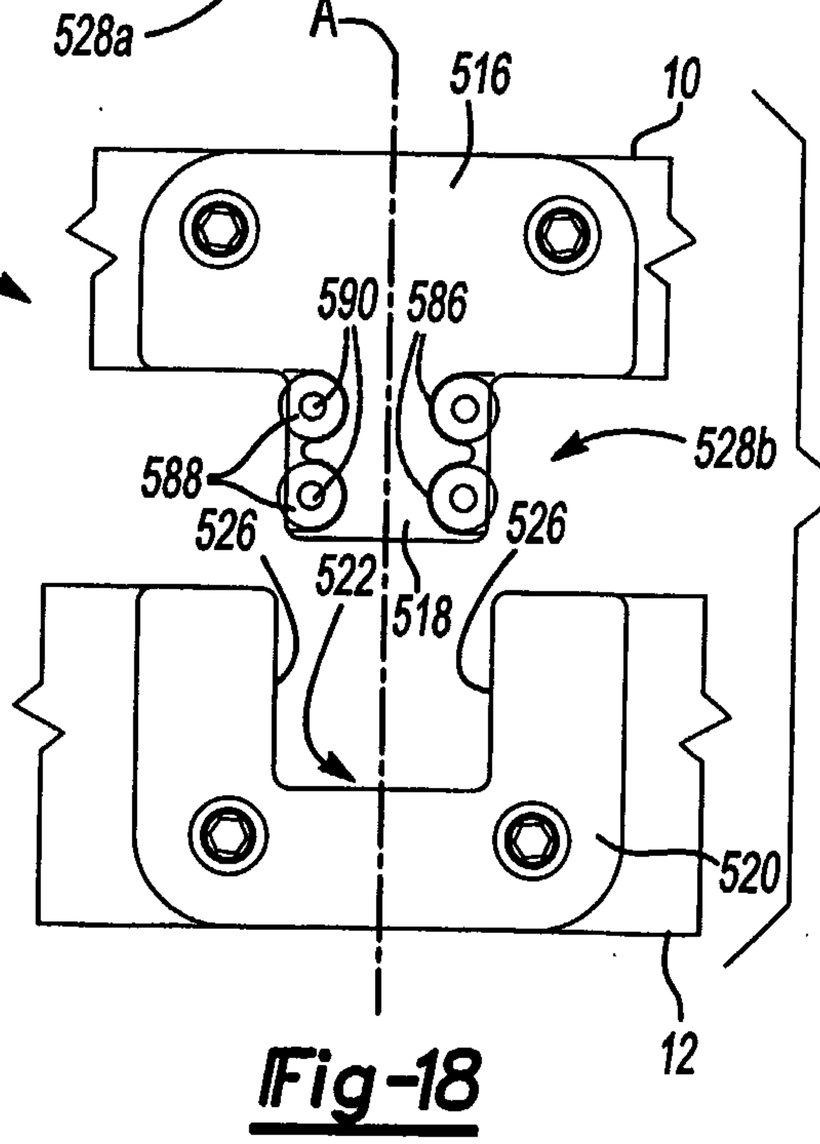
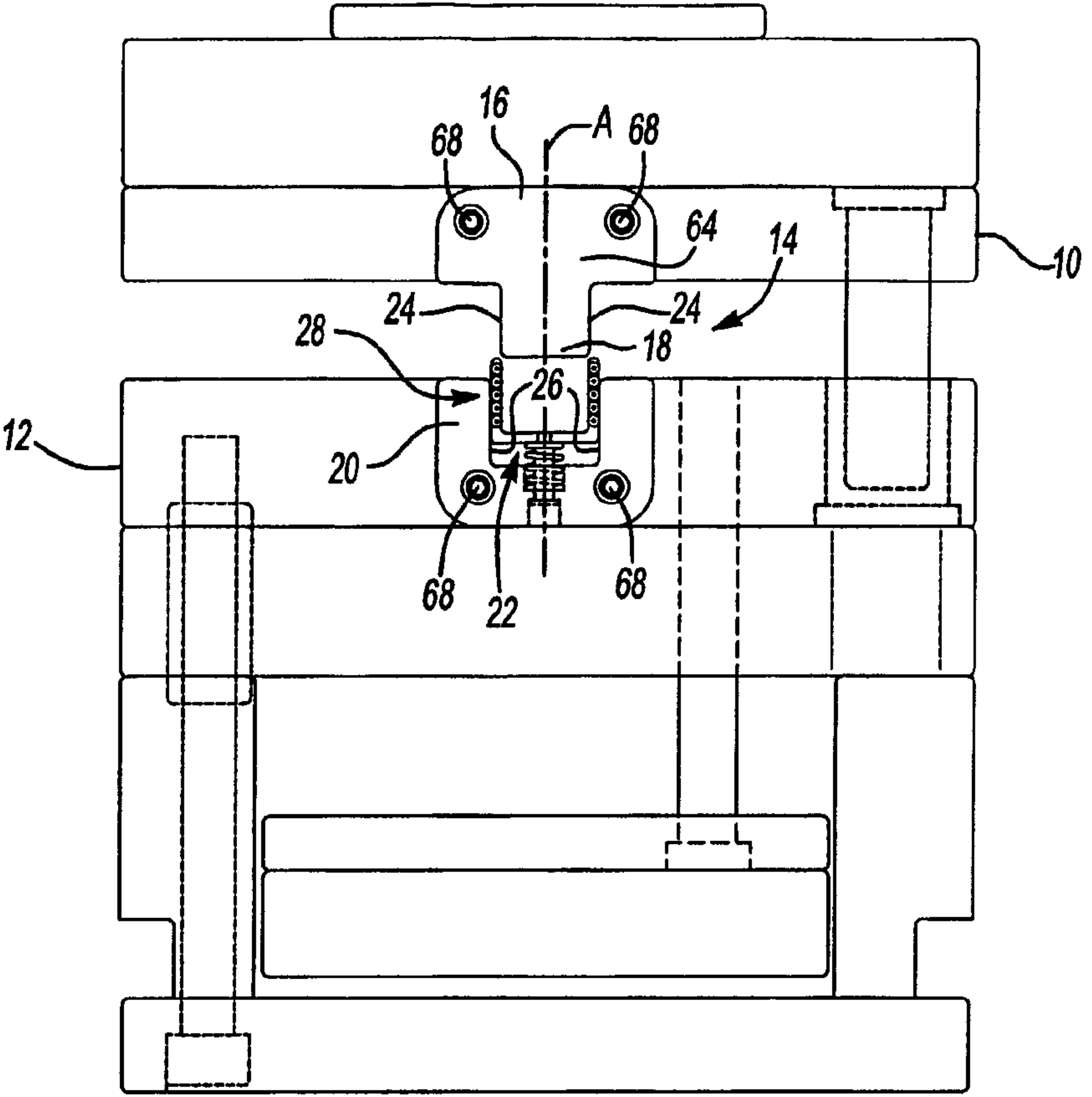


Fig-18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