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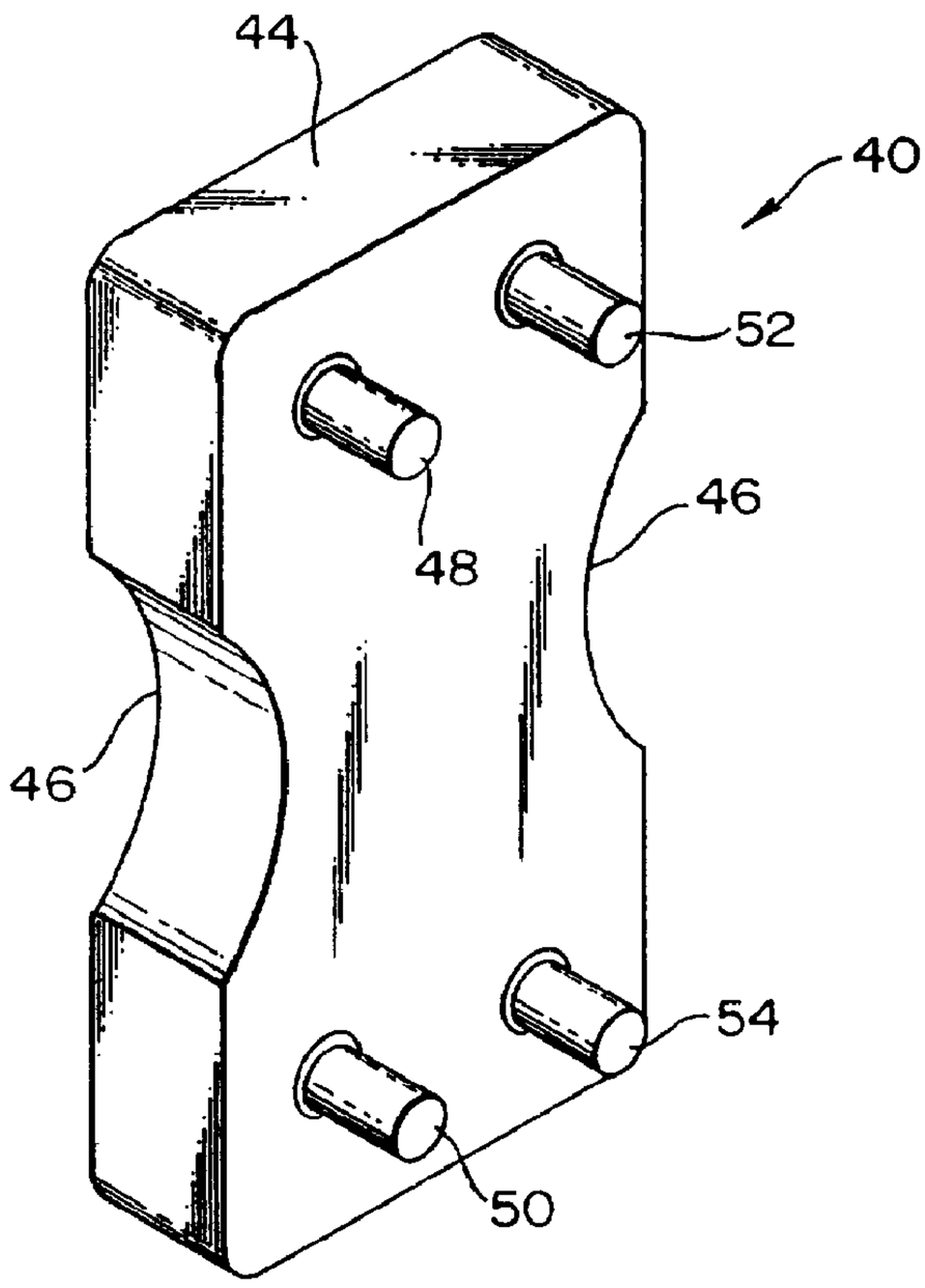
(54) Titre : OUTIL D'ALIGNEMENT D'ARBRES A CAMES EN TETE
(54) Title: DOUBLE OVERHEAD CAMSHAFT ALIGNMENT TOOL



(57) Abrégé/Abstract:
A camshaft alignment tool and method uses a main body having at least three projections to engage cogs on cog wheel driven double overhead camshafts. The tool is used to maintain the cog wheels in a fixed relationship with respect to one another during replacement of a cooperatively toothed timing belt. Use of the tool enables a single technician to change the timing belt on a high performance internal combustion engine employing double overhead camshafts even if the cam surfaces are aggressive and the valve return springs employ large spring constants.

ABSTRACT OF THE INVENTION

A camshaft alignment tool and method uses a main body having at least three projections to engage cogs on cog wheel driven double overhead camshafts. The tool is used to maintain the cog wheels in a fixed relationship with respect to one another during replacement of a cooperatively toothed timing belt. Use of the tool enables a single technician to change the timing belt on a high performance internal combustion engine employing double overhead camshafts even if the cam surfaces are aggressive and the valve return springs employ large spring constants.

DOUBLE OVERHEAD CAMSHAFT ALIGNMENT TOOL

TECHNICAL FIELD

The invention relates to tools and techniques for repairing internal combustion engines. More specifically, the invention relates to a method and apparatus for maintaining the timing position of double overhead camshafts during replacement or reinstallation of a toothed, timing belt.

BACKGROUND OF THE INVENTION

Overhead camshaft internal combustion engines have almost entirely replaced older style, overhead valve engines employing rocker arms, and connecting rods actuated by a camshaft adjacent to the crankcase of the internal combustion engine. In such prior technology engines, the camshaft was typically rotationally coupled to the crankshaft by intermeshed sprockets. Therefore, the timing of the camshaft with respect to the crankshaft was relatively fixed and capable of only minor adjustment by relative rotation and reattachment of the camshaft with its crankshaft engaging sprocket.

Overhead camshafts have eclipsed the old style push rods engine primarily due to the increased performance of the overhead camshaft engine, and manufacturing economy. In this modern type of engine, the engine crankshaft is journaled to a cogged, crankshaft pulley which engages a cooperatively toothed belt. The toothed belt also engages a cog wheel on each camshaft which drives the same. Periodically, the toothed belt must be replaced so that timing between the camshaft and the crankshaft are not lost during engine operation due to belt breakage. In addition, the toothed belt is often removed and reinstalled during repair or replacement of water pumps, seals, and the like.

In a single overhead camshaft engine, such replacement is relatively straightforward. There is generally provided a timing mark on the engine itself

which is aligned with a corresponding timing mark on the camshaft cog wheel. A similar set of marks are typically provided for the crankshaft cog wheel as well. Rotating the crankshaft cog wheel to the correct timing position is relatively easy as the forces tending to rotate the crankshaft to any given position are relatively minor. However, depending on the strength of the valve springs which bias the overhead valves to a closed position, and the aggressiveness of the cam surfaces, the camshaft cog wheel is biased to a plurality of rest positions which typically do not cooperatively align the camshaft cog wheel timing mark with its attendant mark on the engine housing at top dead center, number one cylinder. Nevertheless, an automobile technician can relatively easily hold the camshaft cog wheel in place with one hand, while using the free hand to place the belt on the camshaft cog wheel, and the crankshaft cog wheel.

The repair procedure described above becomes somewhat more difficult in a double overhead camshaft engine. For example, in the conventional in-line, four cylinder double overhead camshaft engine 10 shown in Figure 1, two adjacent camshaft cog wheels 12, 14 must be maintained in the appropriate timing position, top dead center cylinder number one position while the timing belt 16 is replaced. In an engine employing a single exhaust and intake valve per cylinder, a technician can generally, if somewhat difficultly maintain both camshaft cog wheels in their appropriately timed position with the fingers of one hand, while the other hand replaces the belt. However, the difficulty of this task increases dramatically in an engine employing four valves (i.e., two intake and two exhaust) per cylinder, with aggressive cam surfaces and valve return springs having large spring constants as is typical of today's, high performance four cylinder engines. In fact, it is virtually impossible for a technician of ordinary strength to hold both camshaft cog wheels 12, 14 in place with one hand, while the free hand is used to replace the timing belt 16. Thus, two technicians are often necessary to effect such a timing belt replacement.

At least one automobile manufacturer has addressed this problem by modifying the forward camshaft bearing saddle 18 as shown in Figure 2 of the internal combustion engine 10. In contrast to the more rearwardly displaced camshaft bearing saddles 20, the forward saddles are provided with projections 22

having bores therethrough which cooperate with radial bores (not shown) in the camshafts 24. Individual, pin-like alignment tools 26 can be inserted through the bores in their projections 22 and the camshafts 24 to hold the cog wheels 12, 14 in their respective, timed positions. Unfortunately, due to the very large spring constants of the overhead valve springs, the aggressive surfaces of the cams 28, and the loose tolerances of the tools 26 with respect to the bores, it is possible for a technician to misalign the cog wheels 12, 14 with respect to one another by at least a single tooth, or cog, during the belt replacement procedure. Such a result is highly undesirable. Therefore, a need exists for a camshaft alignment tool and method for maintaining the timing positioning of adjacent cog wheels on internal combustion engines employing cog wheel equipped double overhead camshafts during replacement of the timing belt.

SUMMARY OF THE INVENTION

It is therefore an object of the present invention to provide a camshaft alignment tool for maintaining the timing positioning of adjacent cog wheels on internal combustion engines employing cog wheel equipped double overhead camshafts driven by a cooperatively toothed timing belt during replacement of the belt.

It is a further object of the invention to achieve the above object by employing a method for replacing a timing belt on an internal combustion engine employing cog wheels of the type described above by directly and simultaneously fixing the cog wheels to one another while the belt is replaced with a single fixation tool.

These objects, and other objects and advantages of the invention which will become apparent from the description which follows, are achieved by providing a camshaft alignment tool having a main body defining a reference plane. At least three cog engaging members project transversely from the reference plane and are spaced apart relative to one another so that at least two of the projections can positively engage two pairs of cogs in one of the cog wheels, and so that the remaining projection can engage a pair of cogs on the remaining cog wheels whereby relative positioning of the cog wheel is maintained against torque induced

on the camshaft by the valve springs during replacement of the timing belt. The tool is applied to the cog wheels before the timing belt is removed, and is removed from the cog wheel after the timing belt has been replaced. A single technician can perform this operation without assistance.

In the preferred embodiment of the invention, four projections are used. The projections are arranged in two pairs with the first pair positioned for engagement of a first cog wheel, and a second pair positioned for engagement of a second cog wheel. The spacing and positioning of the projections are selected appropriately for the mechanical dimensions of different sized cog wheels and engines.

BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1 is an isometric, environmental view of a modern, double overhead camshaft engine employing two cog wheel driven camshafts and a cooperatively toothed timing belt.

Figure 2 is a partial isometric view of a double overhead camshaft alignment tool technique presently employed in certain automobiles.

Figure 3 is an isometric, full scale view of an alignment tool of the present invention.

Figure 4 is a schematic representation illustrating the tool shown in Figures 3-10 positioned on adjacent camshaft cog wheels of an internal combustion engine.

Figure 5 is a front elevational view of the tool shown in Figure 3.

Figure 6 is a left side elevational view of the tool of Figure 3.

Figure 7 is a rear elevational view of the tool of Figure 3.

Figure 8 is a right side elevational view of the tool shown in Figure 3.

Figure 9 is a top plan view of the tool shown in Figure 3 as well as a mirror image of a bottom plan view of the tool of Figure 3.

Figure 10 is an isometric, full scale view of an alternate embodiment of the invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

A camshaft alignment tool, in accordance with the principles of the invention is generally indicated at reference numeral 40 in Figures 3-9. The tool is adapted

for use on an automobile engine 10 of the type employing double overhead camshafts 24 journaled for rotation with cog wheels 12, 14 which are themselves driven by a toothed timing belt 16 in a manner well known by those or ordinary skill in the automotive repair art.

The tool 40 has a main body 44 of generally rectangular shape having a height of approximately 3 inches, a width of approximately 1 7/16 inches, and a depth of approximately 1/2 inch. The body is preferably made of a relatively rigid yet inexpensive material such as aluminum. The body may be provided with sculpted out portions 46 which are primarily ornamental in nature, although such portions may provide clearance for bolts 47 used to secure the cog wheels 12, 14 on the camshaft 24. Moreover, portions 46 may also serve as an indication of source to the relevant consuming public.

The main body 44 is preferably provided with four transverse protrusions 48, 50, 52, and 54 in the form of cylindrical steel pins having a length of approximately 5/16 inch and a diameter of approximately 3/16 inch. Although four projections are shown and preferred, at least three would suffice. As best shown in Figure 4, these protrusions engage pairs of adjacent cogs or teeth (62, 64 for example) on each cog wheel such that the relative positions of the cog wheels 12, 14 are fixed while the tool remains installed and the timing belt 16 is replaced.

It is preferred that the relative positioning of the protrusions 48, 50, 52, and 54 be selected so as to closely and frictionally engage adjacent pairs of teeth on the cog wheels 12, 14 precisely so as to avoid slipping of the cog wheels or relative movement of the cog wheels. To this end, and as best seen in Figure 5, projections 48 and 50 are arranged as a first pair having a first pair separation distance 70 of 54mm, and wherein the projections 52, 54 form a second pair defining a second pair separation distance 72 also of 54mm. A first reference line connecting projections 40-50 is substantially parallel to a second reference line connecting the projections 52, 54 wherein the reference lines are substantially parallel and define a reference line separation distance 74 of approximately 17mm. It is also preferred for certain automobile brands that the first and second pairs be vertically offset as shown in Figure 5 by a "misalignment distance" 76 of approximately 3mm. All distances are measured on center of the projections 48, 50, 52 and 54 which as described above

are cylindrical steel pins. The dimensions described above for the embodiment of Figures 3-9 are selected to closely engage the cogs or teeth, such as teeth 62, 64 of an Accura brand 1986-1989 Integra model automobile.

To use the tool 40, the camshaft 24 should be aligned at top dead center, cylinder number one thereby positioning the cog wheels 12, 14 in a respective correctly timed position. The tool 40 is then applied to the cog wheels so that protrusions 48, 50, 52 and 54 engage cogs on the cog wheels. The timing belt 16 can then be removed and/or replaced using both hands while the cog wheels remain stationary. The tool 40 can also be used to maintain the relative position of the cog wheels while the bolts 47 are loosened or tightened thereby avoiding stressing the belt 16 or disturbing the relative position of the camshaft 24 which are journaled by keys to the cog wheels. Such operation frequently occurs during camshaft seal replacement.

As shown in Figure 10, an alternate embodiment 40′ can be provided wherein like reference numerals refer to similar structure as for the preferred embodiment shown in Figures 4-9. In the alternate embodiment 40′ shown in Figure 10, the first and second pair separation distances 70, 72 are both approximately 28mm, the reference line separation distance 74 is approximately 26mm, and the misalignment distance 76 is approximately 3mm. The dimensions described hereinabove for the alternate embodiment 40′ are selected to positively engage cog wheels 12, 14 of a 1988-1989 Honda brand Prelude SI model automobile. The method of use of the alternate embodiment 40′ shown in Figure 10 is identical to that described for the embodiment shown in Figures 4-9.Upon further review and contemplation of this disclosure and the accompanying drawings, those of ordinary skill in the art will be able to devise other dimensional relationships between the projections 48, 50, 52 and 54 to engage the cog wheels on other double overhead camshaft engines.

In addition, those of ordinary skill in the art will devise other embodiments and variations of the invention which although not shown fall within the spirit of this disclosure. For example, the main body 44 need not be solid as shown but may be of a spider or truss configuration. Therefore, the invention is not to be limited by the above description, but is to be determined in scope by the claims which follow.

CLAIMS

I claim:

1. A camshaft alignment tool for maintaining timing positioning of adjacent cog wheels on internal combustion engines employing cog wheel equipped double overhead camshafts driven by a cooperatively toothed timing belt during replacement of the belt, comprising:

a main body defining a reference plane; and,

at least three projections directed transversely to the reference plane and spaced apart relative to one another so that two of the projections can positively engage two pairs of cogs on one of the cog wheels and so that the third projection can engage a pair of cogs on the remaining cog wheel whereby relative positioning of the cog wheels is maintained against torque induced on the camshafts by valve spring tension during replacement of a timing belt on the cog wheels.

2. The alignment tool of claim 1, including a fourth projection directed transversely to the reference plane.

3. The alignment tool of claim 2, wherein the four projections are arranged in first and second pairs, the first pair having a first separation distance and defining a first reference line, the second pair having a second separation distance and defining a second reference line, wherein the reference lines are substantially parallel and define a reference line separation distance.

4. The alignment tool of claim 3, wherein the first and second separation distances are approximately 54 mm and wherein the reference line separation distance is approximately 17mm.

5. The alignment tool of claim 3, wherein the first and second separation distances are approximately 28 mm and wherein the reference line separation distance is approximately 26mm.

6. The alignment tool of claim 3, wherein the first and second pairs of projections are transversely misaligned from each other along their respective reference lines by a misalignment distance.

7. The alignment tool of claim 6, wherein the misalignment distance is approximately 3 mm.

8. A method for replacing a timing belt on internal combustion engines employing cog wheel equipped double overhead camshafts driven by a cooperatively toothed timing belt while maintaining positioning of adjacent cog wheels, comprising the steps of:

positioning a removable fixation tool between the adjacent cog wheels so that projections on the fixation tool positively engage at least two pairs of adjacent cogs on one of the cog wheels and at least one pair of cogs on the remaining cog wheel so as to directly and simultaneously immobilizing the cog wheels and fix the relative positions of the cogwheels;

removing the belt;

replacing the removed belt with a new belt; and,

removing the fixation tool.

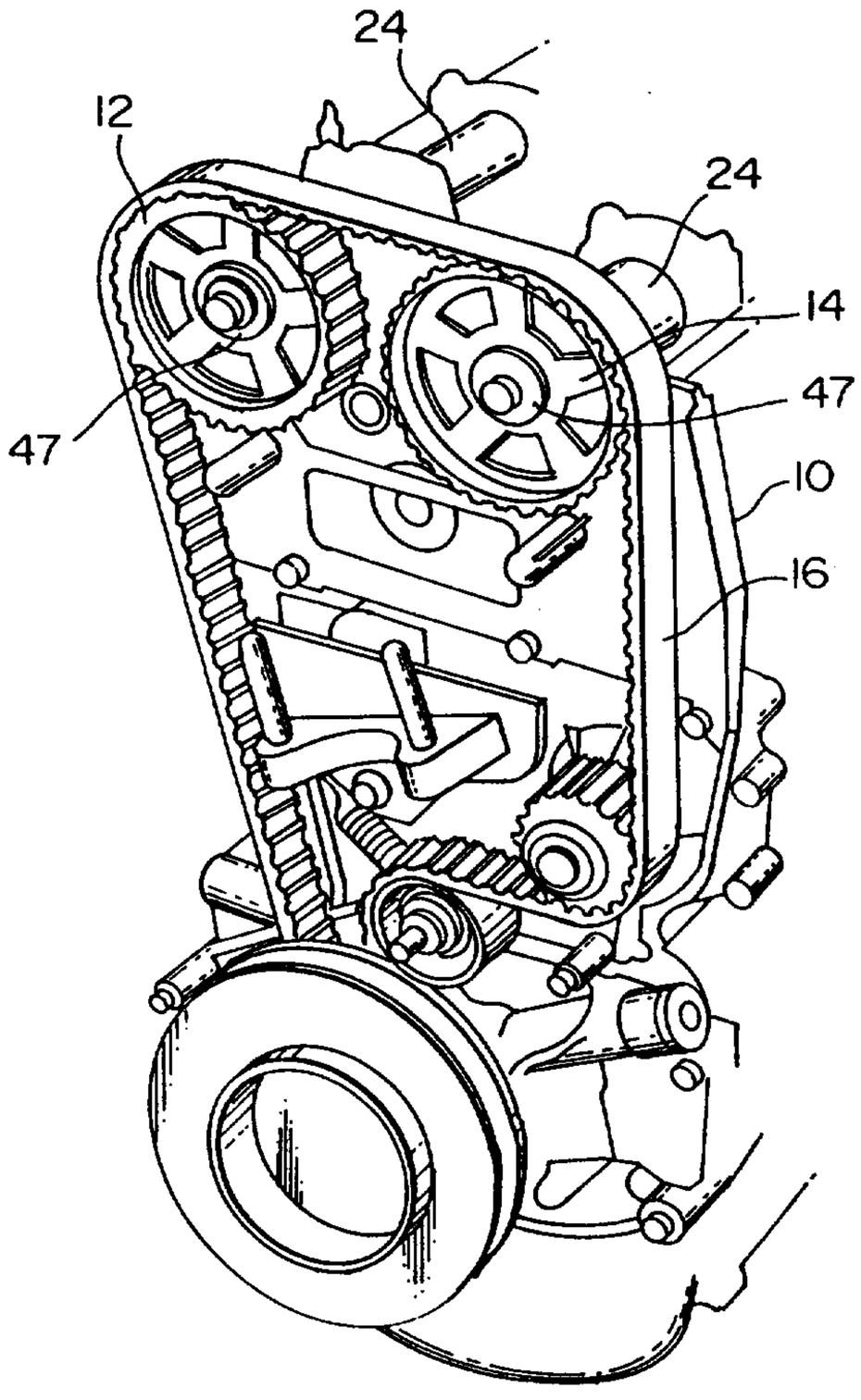


FIG. 1

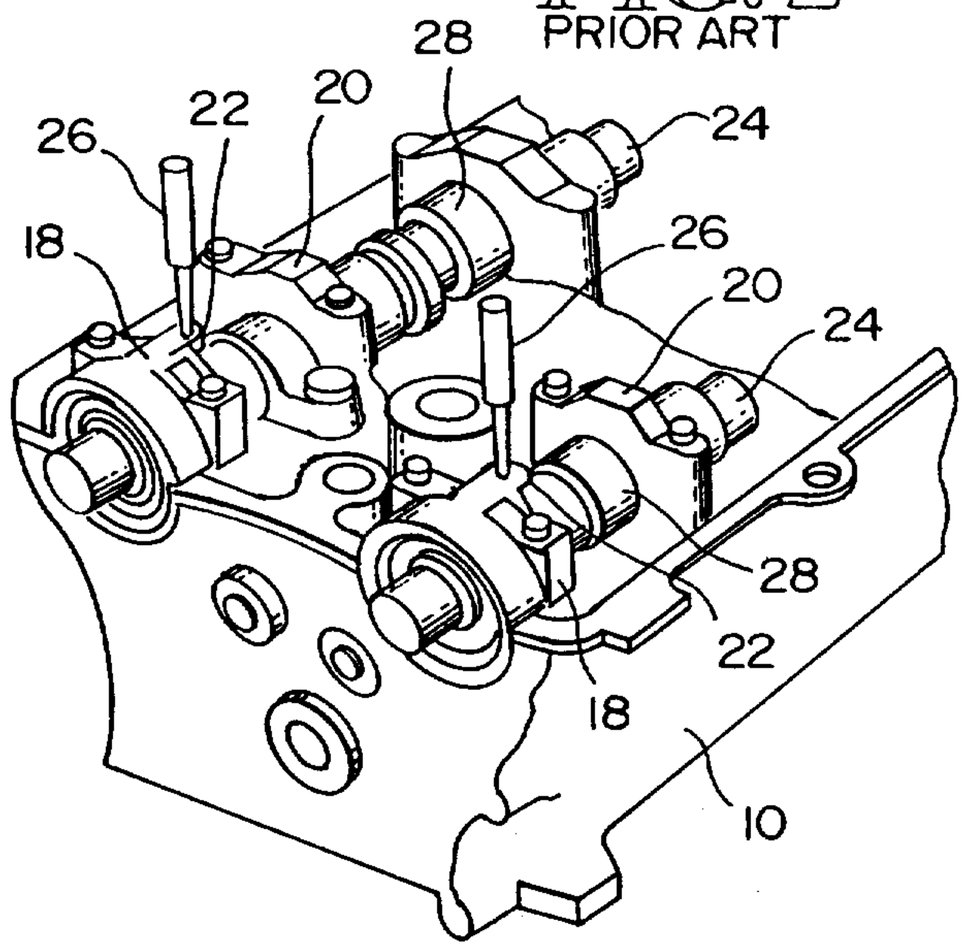


FIG. 2
PRIOR ART

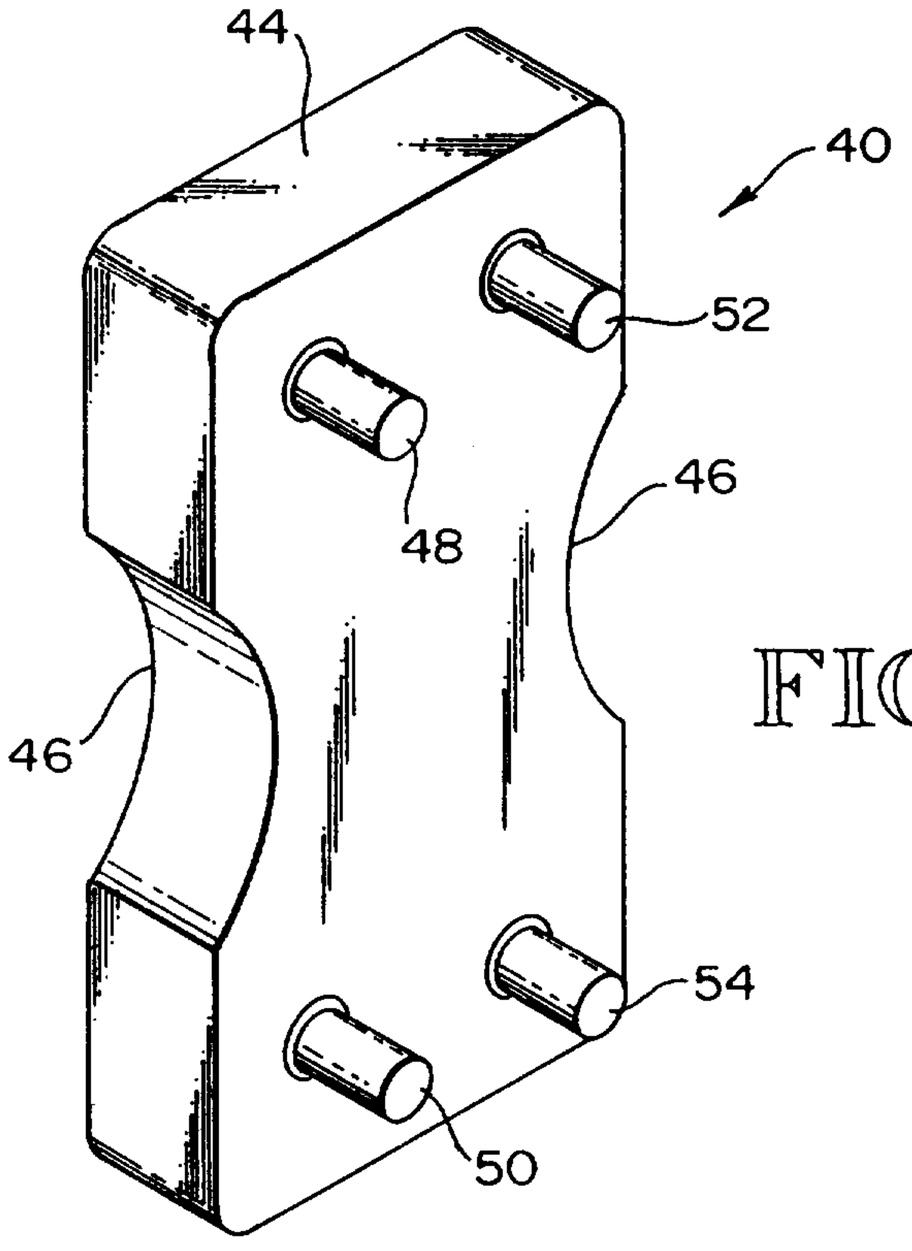


FIG. 3

FIG. 5

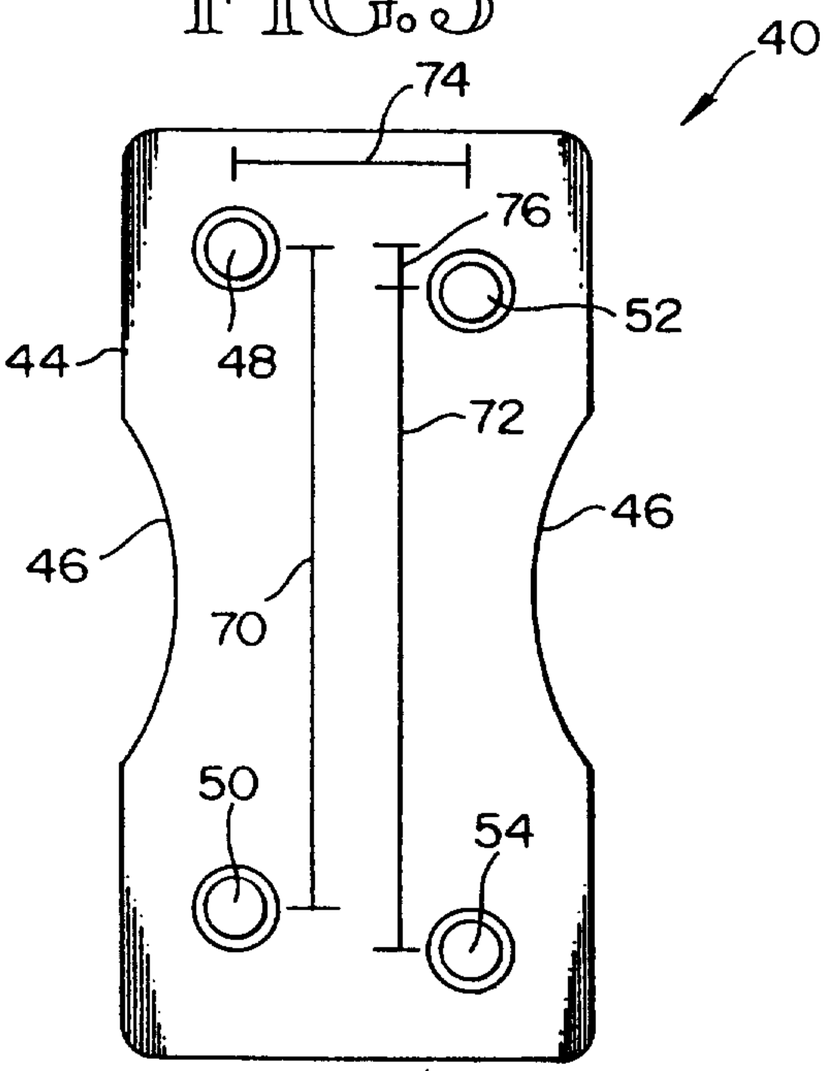


FIG. 6

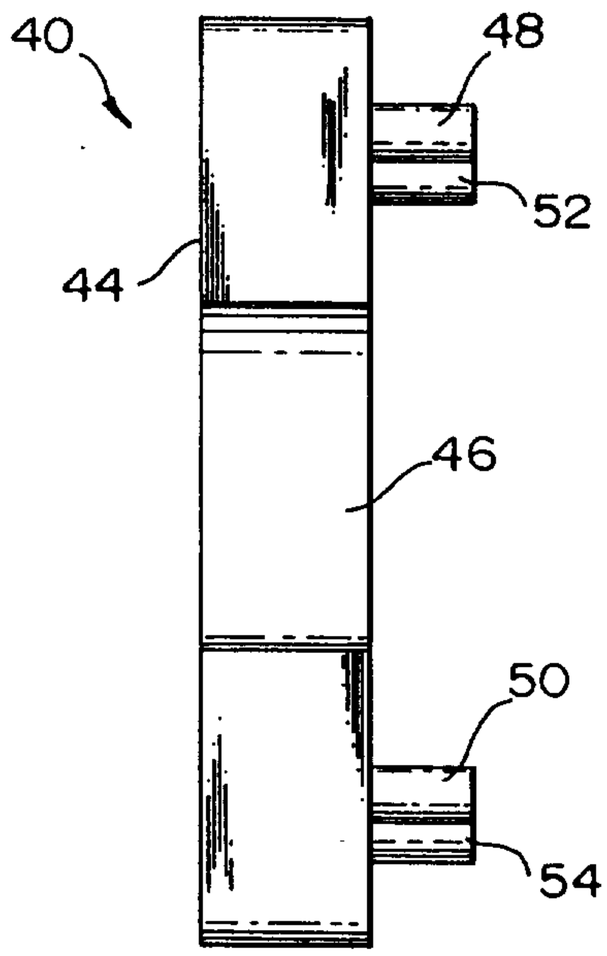


FIG. 7

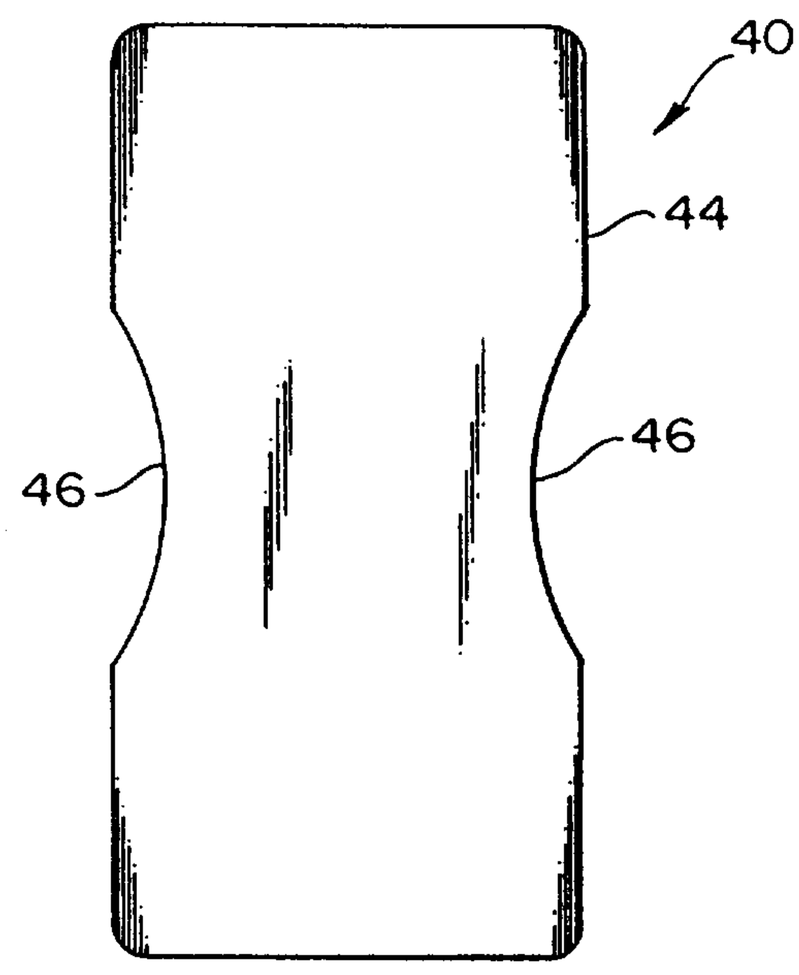
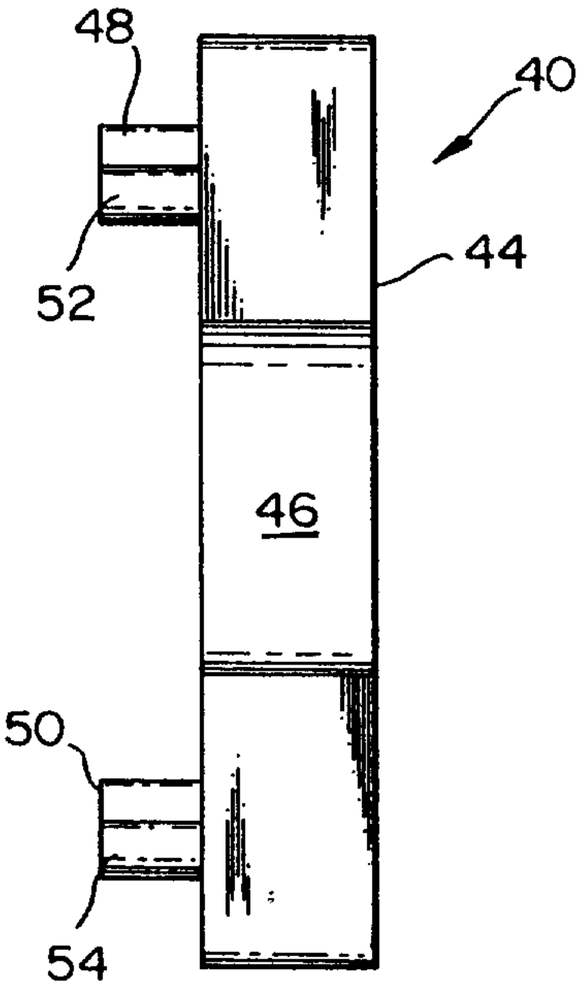


FIG. 8



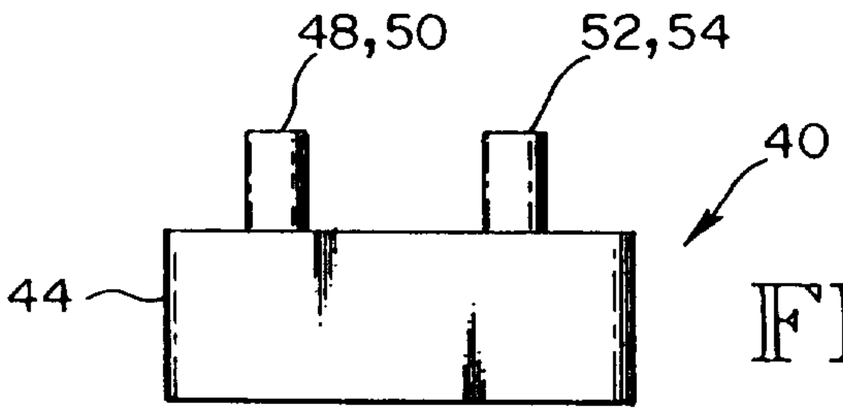


FIG. 9

FIG. 10

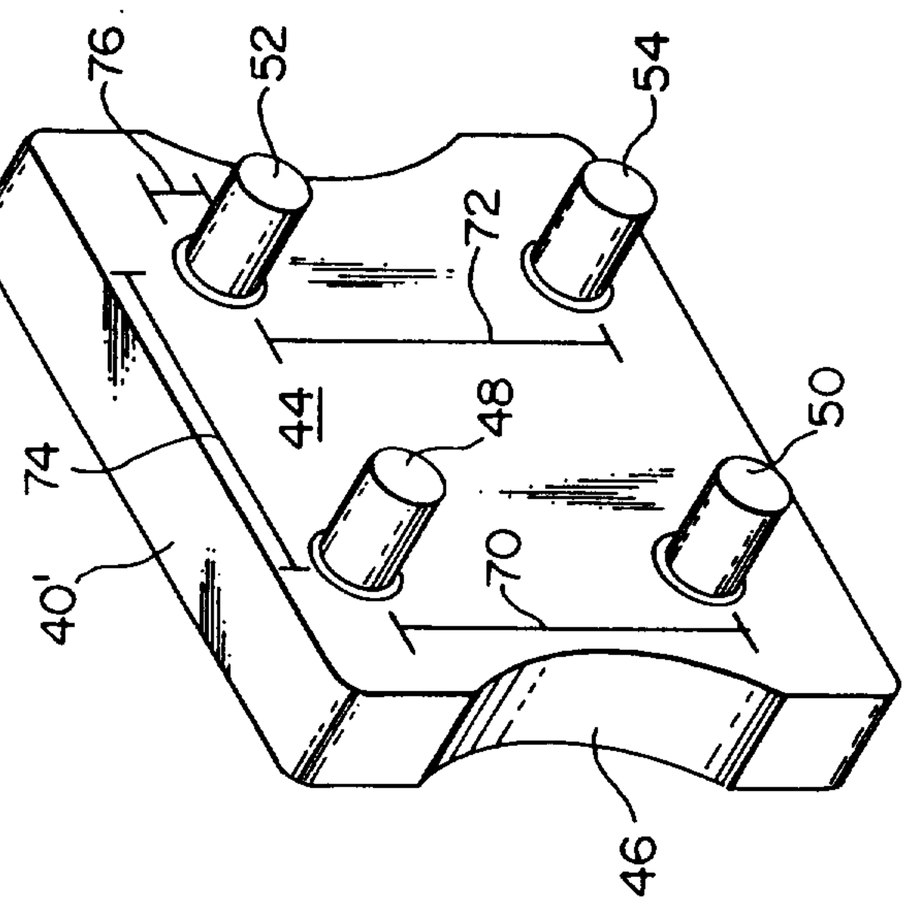
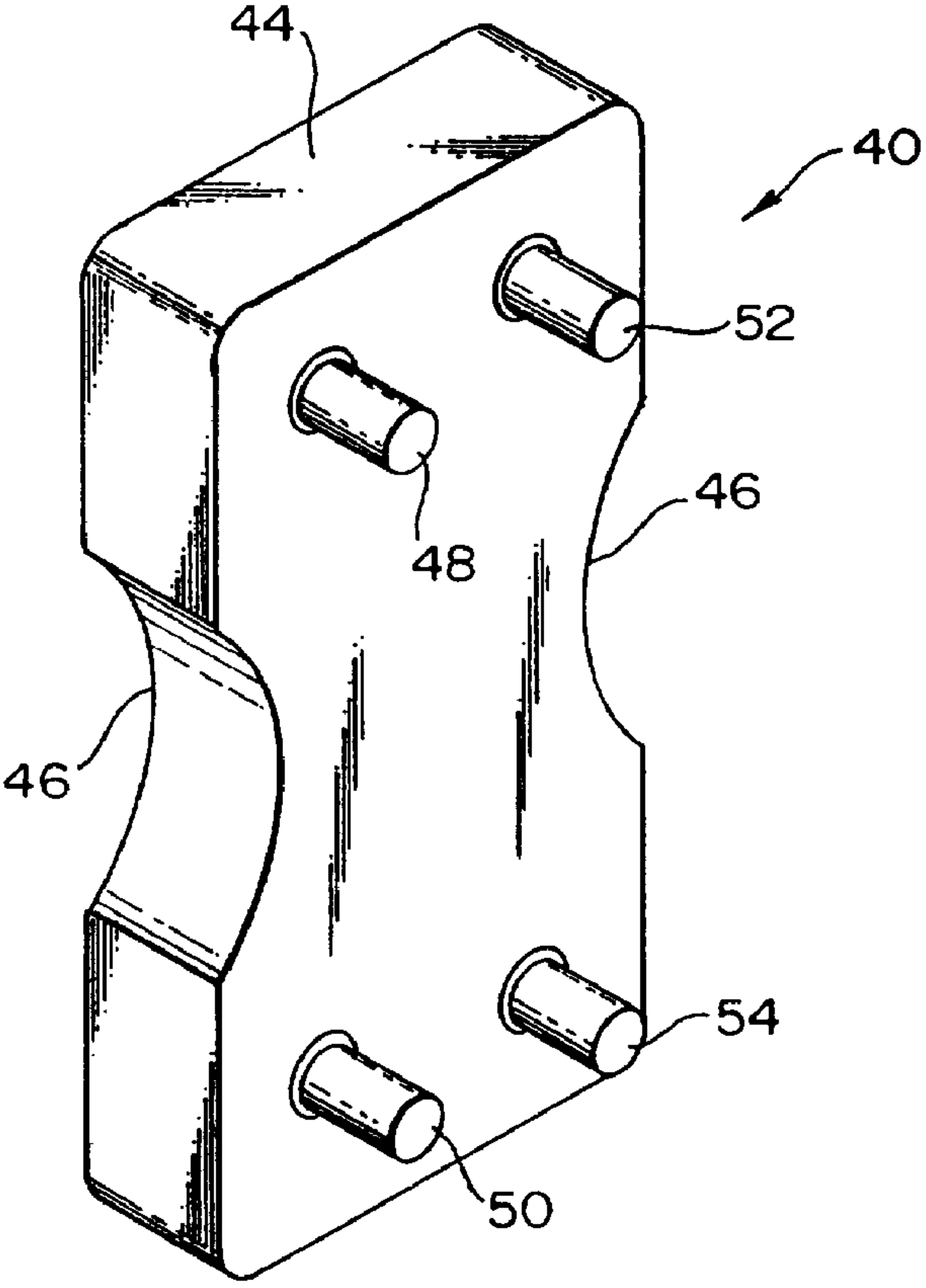


FIG. 4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