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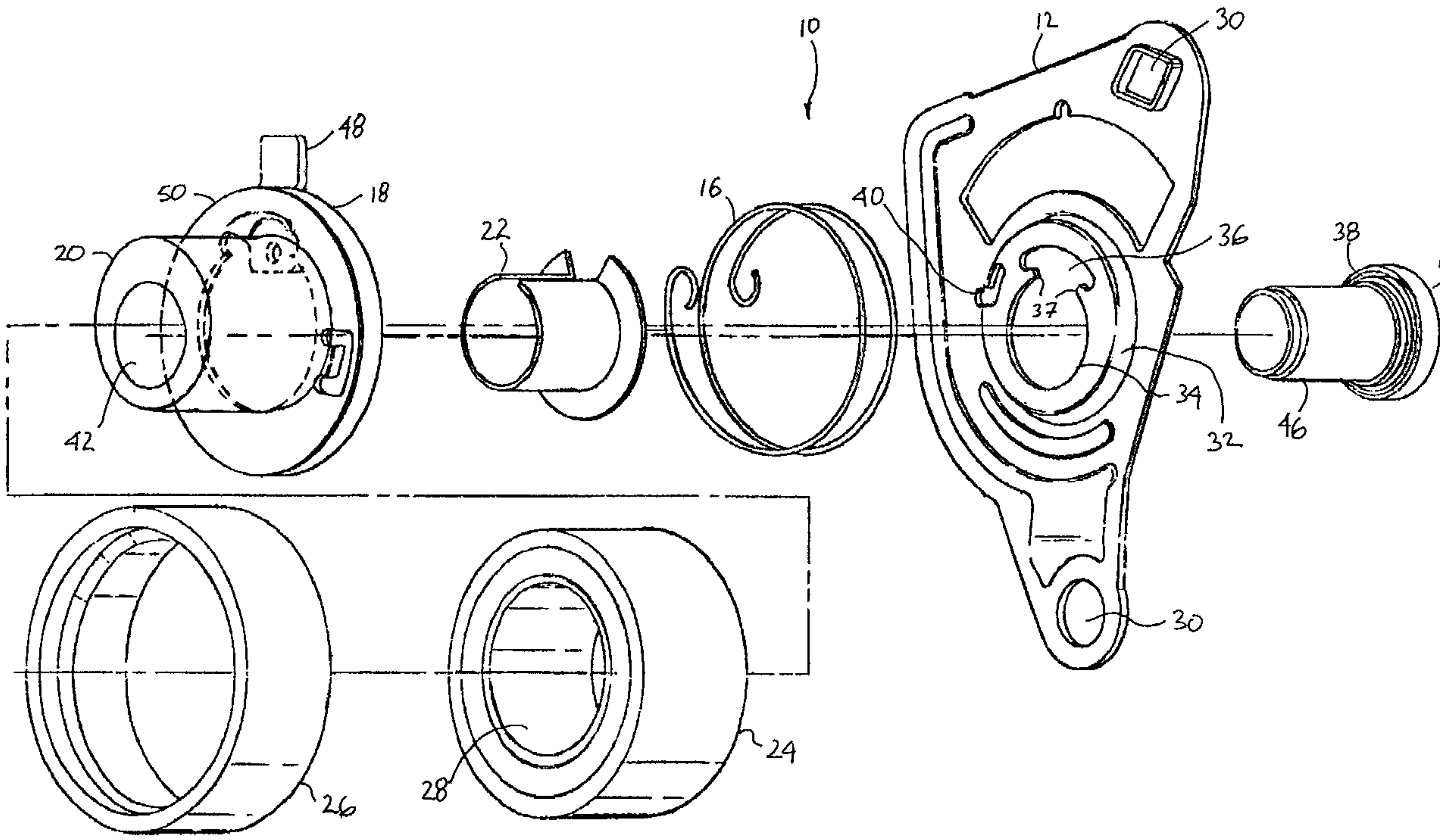
(54) Title: TIMING BELT TENSIONER AND METHOD OF MAKING SAME



(57) Abrégé/Abstract:
A belt tensioner has a hub rotatably mounted on a base plate. The hub has an arm extending from a circumferential edge. A pin extends from the hub and slidably engages the base plate limiting relative rotational movement therebetween. A spring is connected between the base plate and the hub for rotationally biasing the hub relative to the base plate. The arm indicates the relative rotational movement. A bearing is eccentrically mounted for rotation on the hub and a pulley is mounted on the bearing. The hub has a stamped cup portion connected to a cylindrical stub. The cup portion is stamped from sheet steel and the stub is machined from rolled steel allowing the pulley to rotate relatively close to the base plate.

ABSTRACT

A belt tensioner has a hub rotatably mounted on a base plate. The hub has an arm extending from a circumferential edge. A pin extends from the hub and slidably engages the base plate limiting relative rotational movement therebetween. A spring is connected between the base plate and the hub for rotationally biasing the hub relative to the base plate. The arm indicates the relative rotational movement. A bearing is eccentrically mounted for rotation on the hub and a pulley is mounted on the bearing. The hub has a stamped cup portion connected to a cylindrical stub. The cup portion is stamped from sheet steel and the stub is machined from rolled steel allowing the pulley to rotate relatively close to the base plate.

TIMING BELT TENSIONER AND METHOD OF MAKING SAME

Field of Invention

This invention relates to a belt tensioner utilized in a belt drive system. In particular, this invention relates to a timing belt tensioner and a method of making same.

Background of Invention

Timing belts are used on motor vehicle engines for rotating the crankshaft and the camshaft synchronously with each other. Belt tensioners are used for adjusting the tension on these timing belts.

Auto manufacturers have a tendency to redesign existing engines in order to improve performance, fuel efficiency and fuel consumption. As a result, the physical parameters of the existing engine dictate the physical characteristics of the part being replaced or re-designed.

In some engines, the timing belt is mounted for travel about the crankshaft, the camshaft and a pulley. On redesigning these engines, the engineers have specified that the pulley be replaced by a belt tensioner. However, the physical space which has been allotted for a pulley does not permit the use of a conventional belt tensioner. In particular, the travel path of the belt is normally very close ($\leq$ 3mm) to the engine block, which prevents the use of a conventional timing belt tensioner.

Conventional timing belt tensioners have a hub having a spindle for accepting pivot bushings internally and pulley bearings externally with a pulley mounted on the pulley bearings. The hub is normally manufactured from die cast aluminum blanks and then machined to accept the pivot bushings and pulley bearings. A tensioner arm extends from a circumferential edge of the base of the hub. The thickness of this arm restricts the spacing of the pulley from the engine block. The tensioner arm requires a minimum thickness to maintain adequate strength at the connection point between the arm and the hub. The minimum thickness of the arms prevents such conventional timing belt tensioners from being used in these applications.

Summary of the Invention

The disadvantages of the prior art may be overcome by providing a timing belt tensioner wherein the hub has a cup portion and arm made of a stamped sheet blank, minimizing the space between the pulley and a mounting bracket.

According to one aspect of the invention, there is provided a belt tensioner having a hub rotatably mounted on a base plate. The hub has a cup portion connected to a cylindrical stub. The cup has an arm extending from a circumferential edge. A pin extends from the hub and slidably engages the base plate limiting relative rotational movement therebetween. A spring is connected between the base plate and the hub for rotationally biasing the hub relative to the base plate. The arm indicates the relative rotational movement. A bearing is eccentrically mounted for rotation on the hub and a pulley is mounted on the bearing. The hub has a stamped cup portion connected to a cylindrical stub. The cup portion is stamped from sheet steel and the stub is machined from rolled steel allowing the pulley to rotate relatively close to the base plate.

According to another aspect of the invention, there is provided a method of manufacturing a hub for a belt tensioner. The belt tensioner has a hub rotatably mounted on a base plate. The hub has a cup portion connected to a cylindrical stub. The hub has an arm extending from a circumferential edge thereof. A pin extends from the hub and slidably engages the base plate limiting relative rotational movement therebetween. A spring is connected between the base plate and the hub for rotationally biasing the hub relative to the base plate. The arm indicates the relative rotational movement. A bearing is eccentrically mounted for rotation on the hub, and a pulley mounted on the bearing. The method comprises the steps of machining the stub and cutting the stub from a rolled steel, stamping the cup portion a sheet steel blank and joining the stub to the cup portion.

Description of the Drawings

In drawings which illustrate an embodiment of the invention,

Figure 1 is an exploded perspective view of the timing belt tensioner of the present invention;

Figure 2 is a top plan view of the cup portion of the hub of the invention of Figure 1;

Figure 3 is a bottom view of the cup portion of the hub of the invention of Figure 1;

Figure 4 is an end elevational view of the cup portion of the hub of the invention of Figure 1;

Figure 5 is a partial sectional view of the cup portion of the hub of the invention of Figure 1;

Figure 6 is a top plan view of the stub shaft of the hub of the invention of Figure 1;

Figure 7 is a side sectional view of the stub shaft of the hub of the invention of Figure 1;

Figure 8 is a sectional view of the hub of the invention of Figure 1;

Figures 9-16 are perspective views of the steps of manufacturing the hub of the invention of Figure 1; and

Figure 17 is a bottom view of the hub of the invention of Figure 1.

Description of the Invention

The tensioner of the present invention is generally illustrated in Figure 1. The tensioner 10 generally comprises a base plate or bracket 12, a pivot pin 14, spring 16, hub 18, presenting a stub shaft 20, bushing 22, bearing 24 and pulley 26.

Bearing 24 is fitted within pulley 26 and attached by any suitable means, such as a friction or an interference fit. The inside diameter 28 of bearing 24 is fitted over stub shaft 20 using any suitable means, including a friction, a sliding or an interference fit.

Base plate 12 can be any desired shape. Normally, the shape of base plate 12 is dictated by the physical space allotment for the existing part. Base plate 12 has mounting apertures 30. The shape, spacing and location of the mounting apertures 30 depend on the external criteria of the engine block to which the base plate 12 is to be mounted.

Base plate 12 is also provided with a central embossment 32 having an aperture 34 and a slot 36 connecting therewith. Aperture 34 receives pivot pin 14 and engages with the base collar 38 thereof. Aperture 34 is sized to engage base collar 38 in a slide or an interference fit locking pivot pin 14 to base plate 12.

The height of embossment 32 allows the head of pivot pin 14 to lie substantially flush with the back surface of base plate 12. It is understood that in some applications the head of pivot pin 14 may extend beyond the base plate 12.

The edge of embossment 32 has a spring aperture 40 for receiving a bent end or spring tab of spring 16.

Hub 18 has an axially extending bore 42 which extends through stub shaft 20. Bushing 22 is placed inside of bore 42. The inside surface of hub 18 has a pin 44 for engaging slot 36 in a sliding fit. Bore 42 is presented to the pin portion 46 of pivot pin 14 and the hub 18 is rotated biasing spring 16 until pin 44 engages slot 36. Pin 44 and slot 36 limit the rotational movement between hub 18 and base plate 12.

Spring 16 is preferably of the torsional type and preferably has bent ends for operatively interconnecting hub 18 with base plate 12 for providing biased rotation. The selection of springs is well known in the art of tensioners.

In prior art tensioners, hub 18 would normally be a machined die cast aluminum part. Arm 48 would normally be die cast to the hub. As the requirements for mounting the pulley as close as possible to the engine block, the thickness of arm 48 becomes critical as arm 48 spaces the pulley 26 from the engine block. In a die cast part, reducing the thickness of arm 48 will reduce the amount of material which connects the arm 48 to the cup portion 50 reducing the integral strength of the arm below acceptable standards.

In the present invention, hub 18 manufactured from steel comprising two basic components. The hub 18 comprises a stamped steel cup portion 50 and the machined stub shaft 20.

Referring now to Figures 2, 3, 4 and 5, the cup portion 50 is more specifically illustrated. Cup portion 50 is stamped or pressed from sheet steel. The starting thickness of the sheet steel can be in the order of approximately 1.0 mm.

Cup 50 is stamped from a blank having an opening 52 presenting a tab portion 54 and a cut out 55. Extending outwardly from the circumference of the cup portion 50 is arm 48. Cup portion 50 is also provided with a U-shaped aperture 56, which when pressed, the inner portion thereof is bent inwardly to present spring hook up 58. Spring hook up 58 receives the bent end of spring tab of the opposite end of spring 16. Optionally, one side of the spring hook up 58 may be angled away from the bias of spring 16 to improve the holding ability of the hook up 58.

During pressing, tab 54 is pressed inwardly to extend substantially parallel to radially extending annular surface 60. Dimples 62 are also formed during stamping and are circumferentially spaced about annular surface 60 and extend outwardly from cup portion 50. Dimples 62 space bearing 24 from annular surface 60.

Referring now to Figures 6 and 7, the stub shaft 20 is more specifically illustrated. Stub shaft 20 is cut from standard bar stock of steel. Preferably, the bar stock has the outer surface ground to a journal finish.

As illustrated, stub shaft 20 has a bore 42 which has a central axis of rotation offset from the axis of rotation of the stub shaft 20. Bore 42 has an inside diameter having a journal finish and sized to engage the outside diameter of pivot pin 14 with sufficient clearance for bushing 22. The outside diameter of stub shaft 20 is machined to present journal surface 64 for receiving inside diameter 28 of bearing 24 and cup engaging lip 69.

End surface 66 of stub shaft 20 has two machined surfaces, presenting orienting surfaces 68 and 70. Orienting surfaces 68 and 70 are cut having a common centre. Orienting surface 68 is sized to engage with tab 54. The depth of machining corresponds with the depth of pressing of tab 54. Orienting surface 70 abuts against cut out 55.

As illustrated in Figure 8, stub shaft 20 is fitted into opening 52 by engaging lip 69 within opening 52. Tab 54 is presented to orienting surface 68 for aligning the rotational axis of the cup portion 50 with the rotational axis of bore 42.

Referring now to Figures 9 through 16, the method of manufacture of the hub 18 will be described.

In Figure 9, bar stock 72 is machined using a lathe to provide suitable outside diameters for a cup engaging lip 69, a journal surface 64 and an end chamfer. The bar stock is then cut to length presenting a solid cylindrical stub 74.

In Figure 10, the solid stub 74 is milled to produce orienting surfaces 68 and 70.

Referring to Figure 11, stub 74 is then bored to present bore 42.

Referring to Figure 12, the cup portion 50 is stamped. It is understood that the stamping of the cup portion 50 may take place at the same time as producing stub 74.

Referring to Figure 13, the stub 74 is presented to the cup portion 50 abutting the lip 69 of stub 74 with annular surface 60 seating the stub 74 within cup portion 50. Tab 54 is aligned with orienting surface 68. Stub 74 now becomes stub shaft 20. A multi-point stake joins the stub 74 to cup portion 50. In a staking operation, material from stub 74 is shaved against the cup portion 50, fully integrating the stub 74 with cup portion 50. It is understood that other types of integration methods, such as spot welding, may be also used.

A hole is drilled axially through tab 54 into stub shaft 20. The hole may be drilled to a predetermined depth or through the pin entirely. It is also understood that the drilling operation could be undertaken prior to the assembly operation. It is preferred that the drilling operation occur after the staking operation.

Pin 44 is inserted into the drilled hole in a friction fit. Pin 44 can be a lug, a standard dowel pin, a standard spring pin or a spring wire. In the preferred embodiment, the pin 44 is a split pin. Pin 44 acts as a locking device between the cup portion and the stub shaft 20 as well as a free arm stop/backstop of the tensioner as pin 44 travels within slot 36.

The belt tensioner 10 is then assembled in a manner well known in the art.

There are certain advantages in utilizing steel over cast aluminum. The steel components are significantly easier to manufacture and also to maintain the perpendicularity of the arm 48 relative to the cup portion 50. Further, tooling costs for pressing and stamping parts is dramatically less than the cost of tooling for a die cast.

Additionally, corrosion of aluminum parts has been known to create a problem with foil type bushing which results in tensioner seize ups. Since steel is used as the pivot pin material, problems with corrosion will be minimized.

Further, since the pivot pin is made of steel, different types of bushings may be used. First, the pivot bushing could be turned inside out allowing the running surface to be the inside diameter of bore 42 rather than the outside diameter of pivot pin 14. By selecting the outside diameter, inside diameter or combination of both, the amount of damping may be increased or decreased, i.e. using the outside diameter will increase damping whereas using the inside diameter alone or in combination will decrease damping.

Further, other types of bushings may be used such as a floating bushing where both surfaces are used as running surfaces. This will increase the frictional damping of the tensioner. One example of such bushing material is available under the trade-mark NYLINER.

An additional advantage of the present invention is that the interior clearance of the bearing may be further minimized resulting in a smaller "free rock" value. Using conventional cast aluminum, tolerances must be increased in order to accommodate the high thermal expansion rate of aluminum which allows the pulley to "free rock". A higher "free rock" value tends to lead to bad belt tracking.

It is now apparent to a person skilled in the art that there are numerous other modifications and purposes of this invention. It is to be understood that certain changes in design, size and components may be effective without a departure from the spirit of the invention and within the scope of the appended claims.

I claim:

1. A belt tensioner comprising

a base plate

a hub rotatably mounted on the base plate, said hub having an arm extending from a circumferential edge thereof,

a pin extending from said hub and slidably engaging said base plate limiting relative rotational movement therebetween,

a spring connected between said base plate and said hub for rotationally biasing said hub relative to the base plate, said arm for indicating said relative rotational movement,

a bearing eccentrically mounted for rotation on said hub, and

a pulley mounted on said bearing,

wherein said hub comprises a stamped cup portion connected to a cylindrical stub.

2. A belt tensioner as claimed in claim 1 wherein said cup portion is stamped from sheet steel and said stub is machined from rolled steel.

3. A belt tensioner as claimed in claim 2 wherein said cup portion has an annular surface having an aperture for interconnecting with said stub.

4. A belt tensioner as claimed in claim 3 wherein said stub has an eccentric bore extending therethrough wherein said bore has an axis of rotation in substantial alignment with an axis of rotation of said cup portion.

5. A method of manufacturing a hub for a belt tensioner, said belt tensioner comprising a base plate, a hub rotatably mounted on the base plate, said hub having a cup portion connected to a cylindrical stub, said hub having an arm extending from a circumferential edge thereof, a pin extending from said hub and

slidably engaging said base plate limiting relative rotational movement therebetween, a spring connected between said base plate and said hub for rotationally biasing said hub relative to the base plate, said arm for indicating said relative rotational movement, a bearing eccentrically mounted for rotation on said hub, and a pulley mounted on said bearing, said method comprising the steps of

machining said stub and cutting said stub from a rolled steel,

stamping said cup portion from sheet steel,

joining said stub to said cup portion.

6. A method as claimed in claim 5 wherein said step of joining includes a step of drilling a hole through said cup portion into said stub and inserting a pin to interconnect said cup portion to said stub.

7. A method as claimed in claim 6 wherein said step of joining includes a step of staking said stub to said cup portion.

8. A method as claimed in claim 5 wherein said step of joining includes the step of drilling a hole in the stub and stamping a cooperating hole in the cup portion wherein upon alignment of said holes, a pin is inserted into said holes interconnecting said cup portion to said stub.

9. A belt tensioner comprising:

a base plate,

a pivot pin mounted to said base plate,

a hub rotatably mounted on the pivot pin, said hub having an arm extending circumferentially from a circumferential edge thereof,

a stop extending between said hub and base plate limiting relative rotational movement therebetween,

a spring connected between said base plate an said hub rotationally biasing said hub relative to said base plate, said arm indicating said relative rotational movement,

a bearing eccentrically mounted on said hub, and

a pulley mounted on said bearing,

wherein said hub comprises a cup portion connected to a stub shaft and said arm extends radially from said cup portion.

10. A belt tensioner as claimed in claim 9, wherein said stub shaft has an axially extending bore having a central axis of rotation offset from an axis of rotation of said stub shaft.

11. A belt tensioner as claimed in claim 9 or 10, wherein said pivot pin rotatably engages said bore of said stub shaft, rotatably mounting said hub.

12. A belt tensioner as claimed in claim 9, 10, or 11 wherein said cup portion is formed with dimples, said dimples spacing said bearing from said cup portion.

13. A belt tensioner as claimed in claim 12, wherein said cup portion has a hook up receiving an end of said spring.

14. A belt tensioner as claimed in claim 13, wherein said stub shaft and said cup portion are configured to complementarily fit together enabling said stub shaft to be oriented relative to said cup portion.

15. A belt tensioner as claimed in claim 14, wherein said stop extends through said cup portion interconnecting said cup portion relative to said stub shaft.

16. A belt tensioner as claimed in claim 15, wherein said stop is a pin.

17. A belt tensioner as claimed in claim 9 or 10, wherein said stub shaft and said cup portion are configured to complementarily fit together enabling said stub shaft to be oriented relative to said cup portion.

18. A belt tensioner as claimed in claim 17 wherein said stub shaft has an orienting surface sized to complementarily fit with a tab formed in said cup portion.

19. A belt tensioner as claimed in claim 17, wherein said stop is a pin that extends through said cup portion interconnecting said cup portion relative to said stub shaft.

20. A belt tensioner as claimed in claim 19, wherein said stub shaft is staked to said cup portion.

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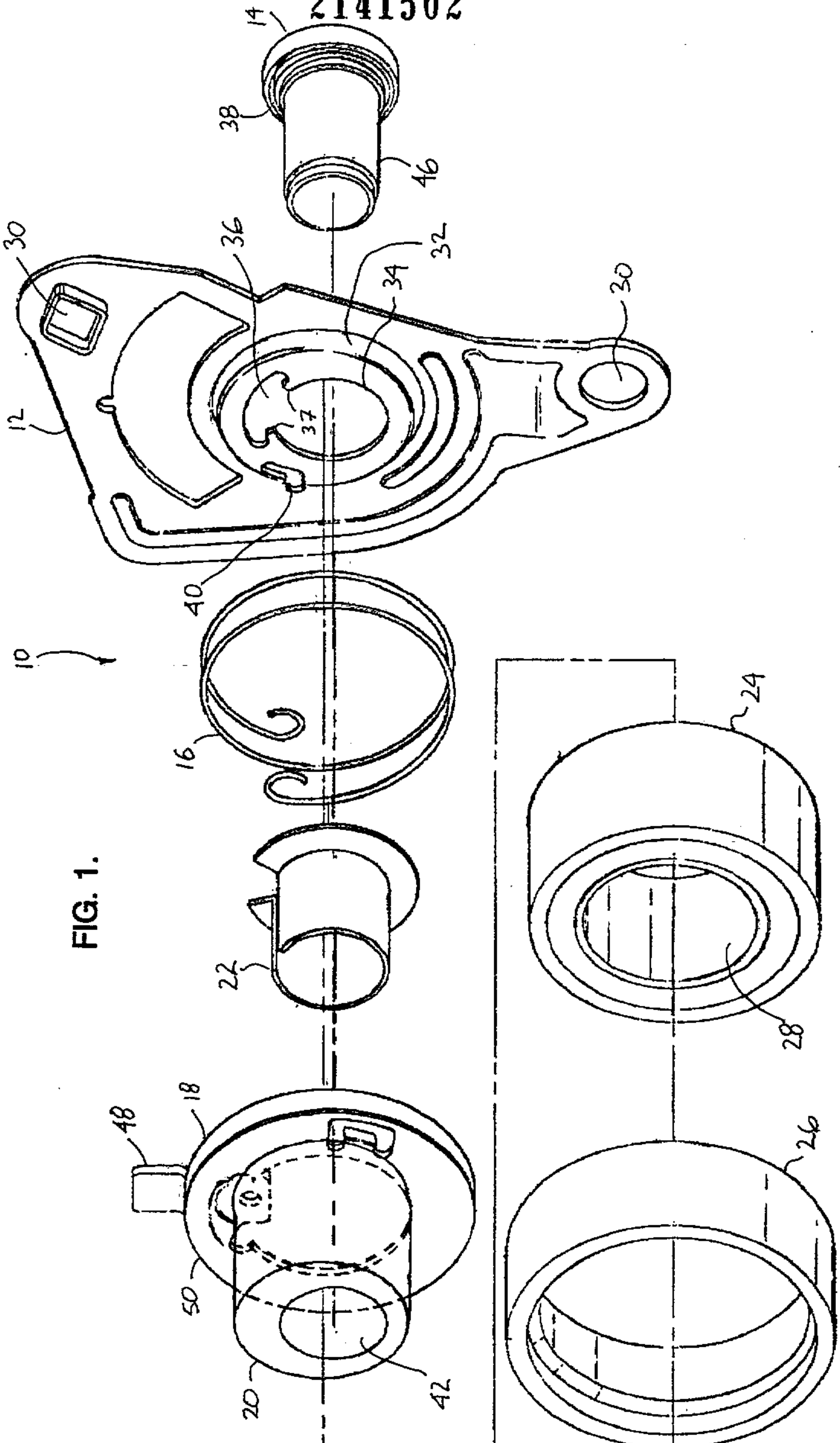

FIG. 1.

FIG. 2.

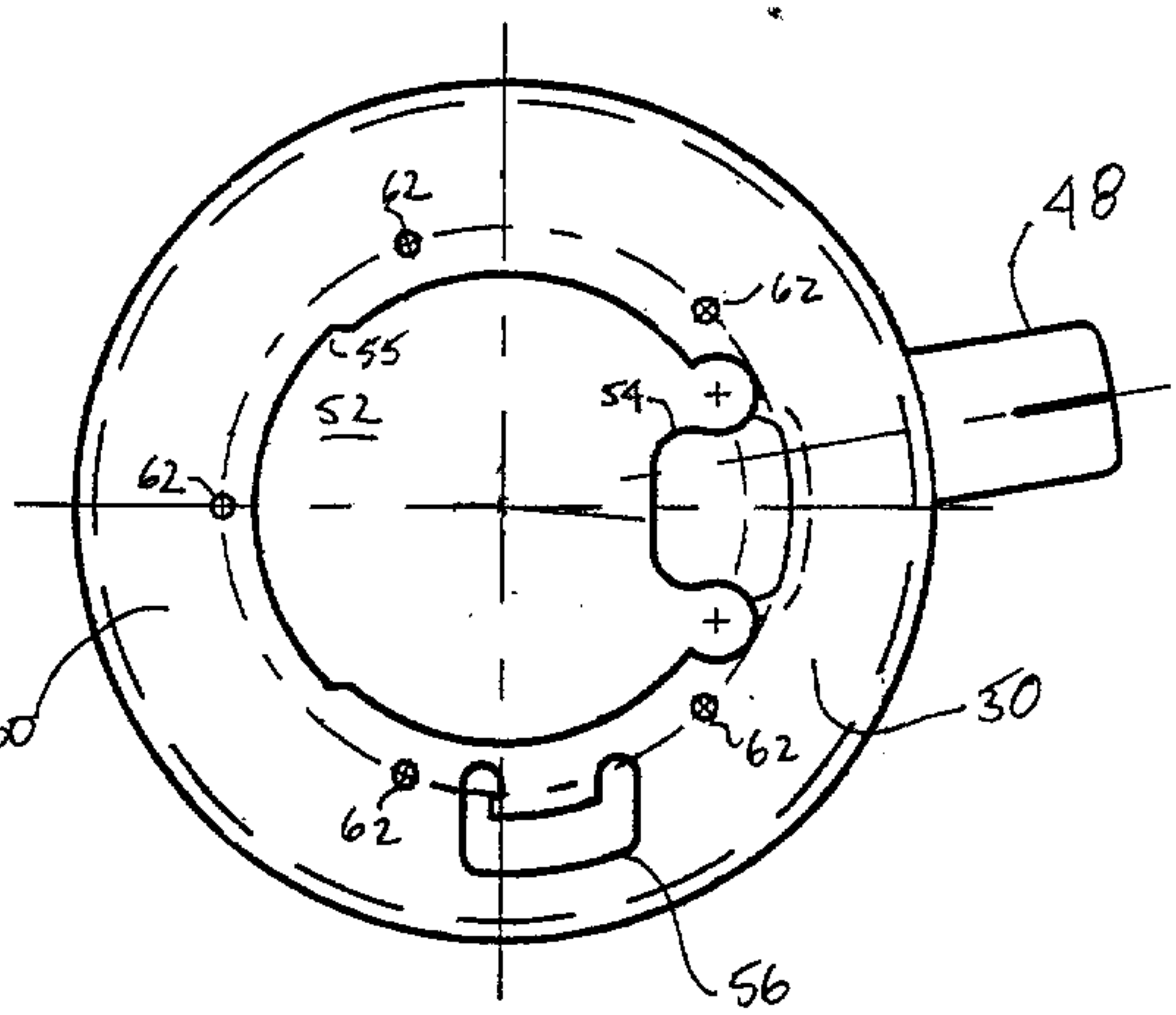

FIG. 3

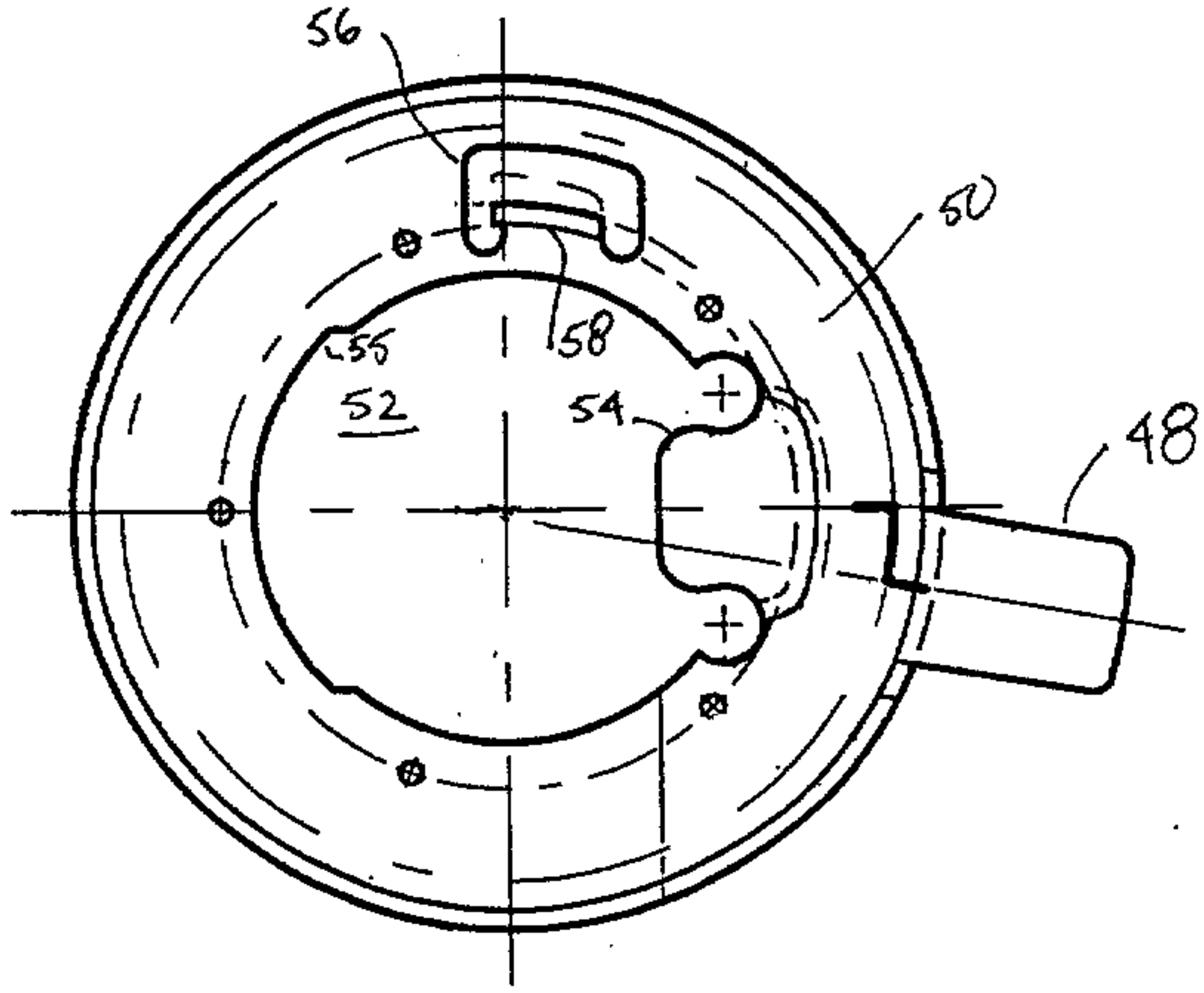

FIG. 4.

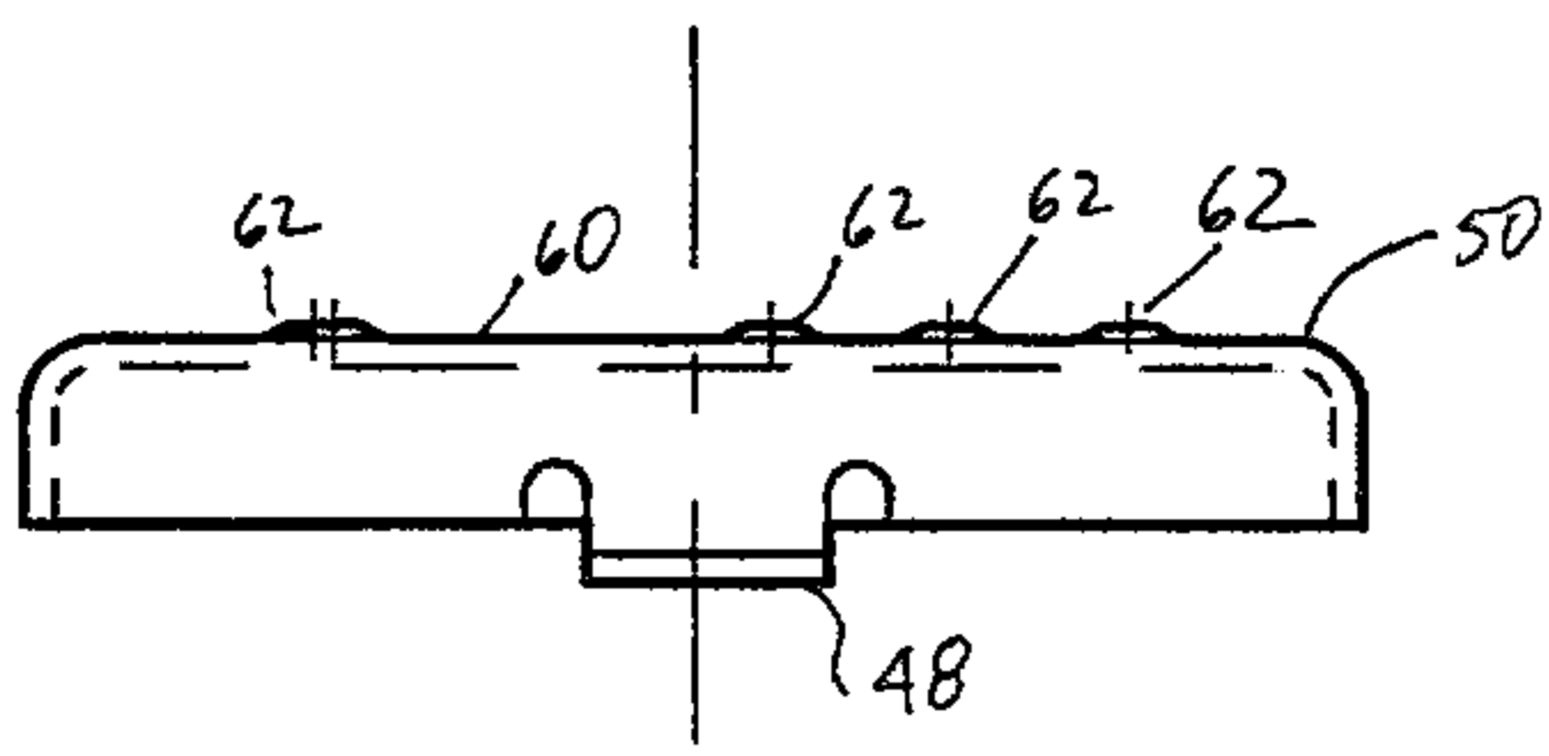

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FIG. 5.

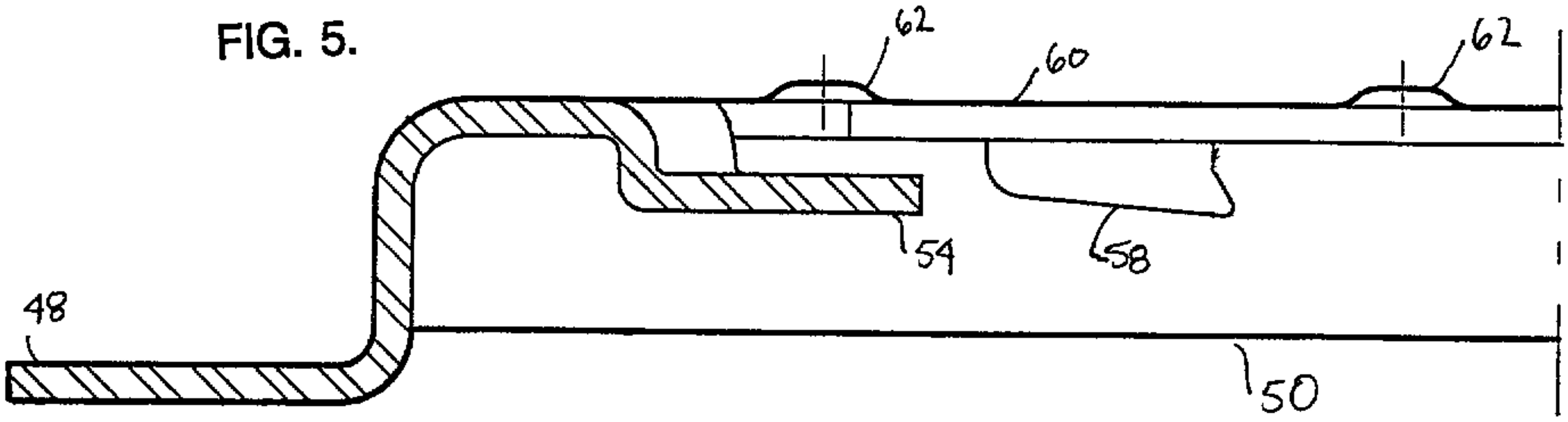


FIG. 6.

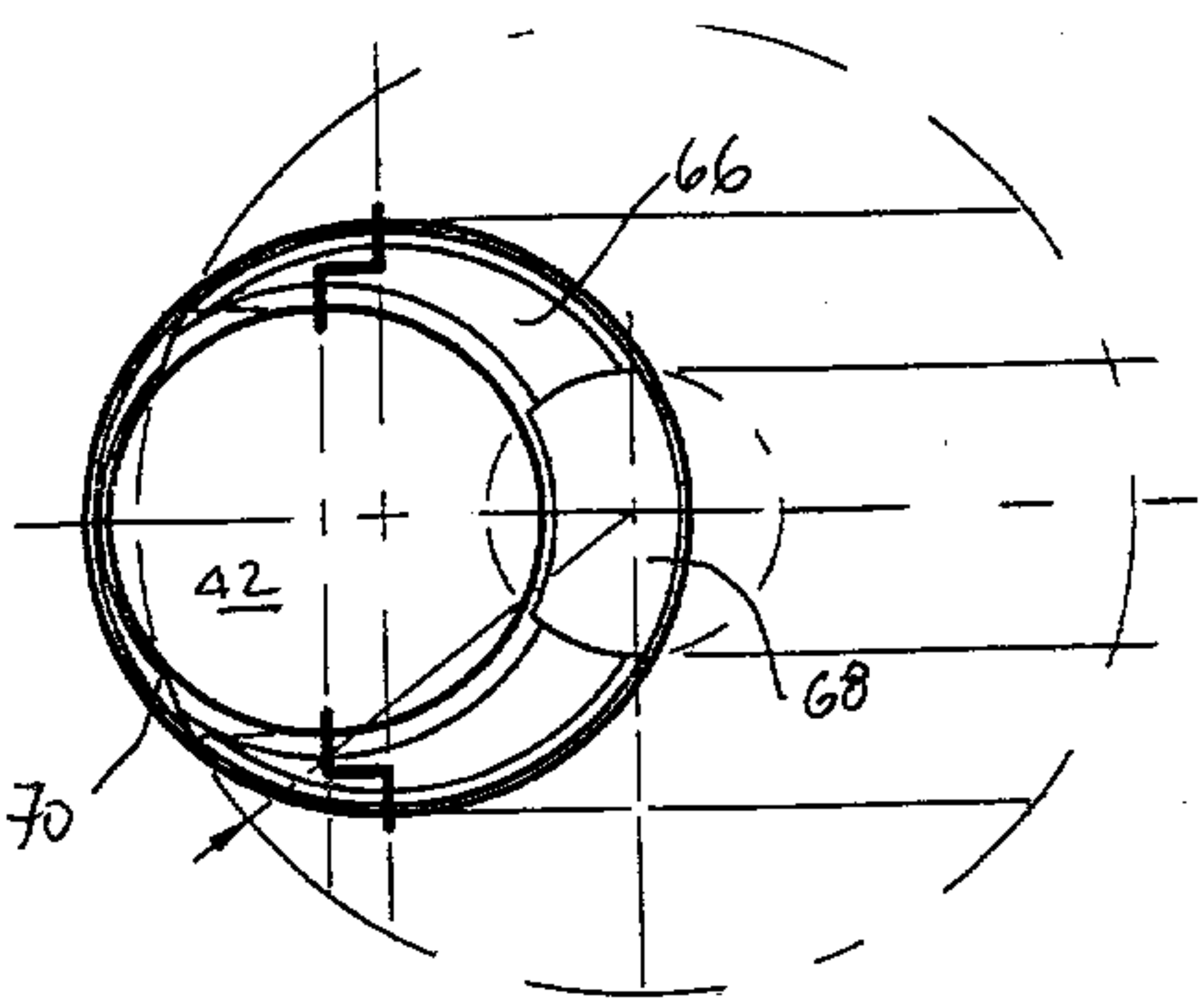


FIG. 7.

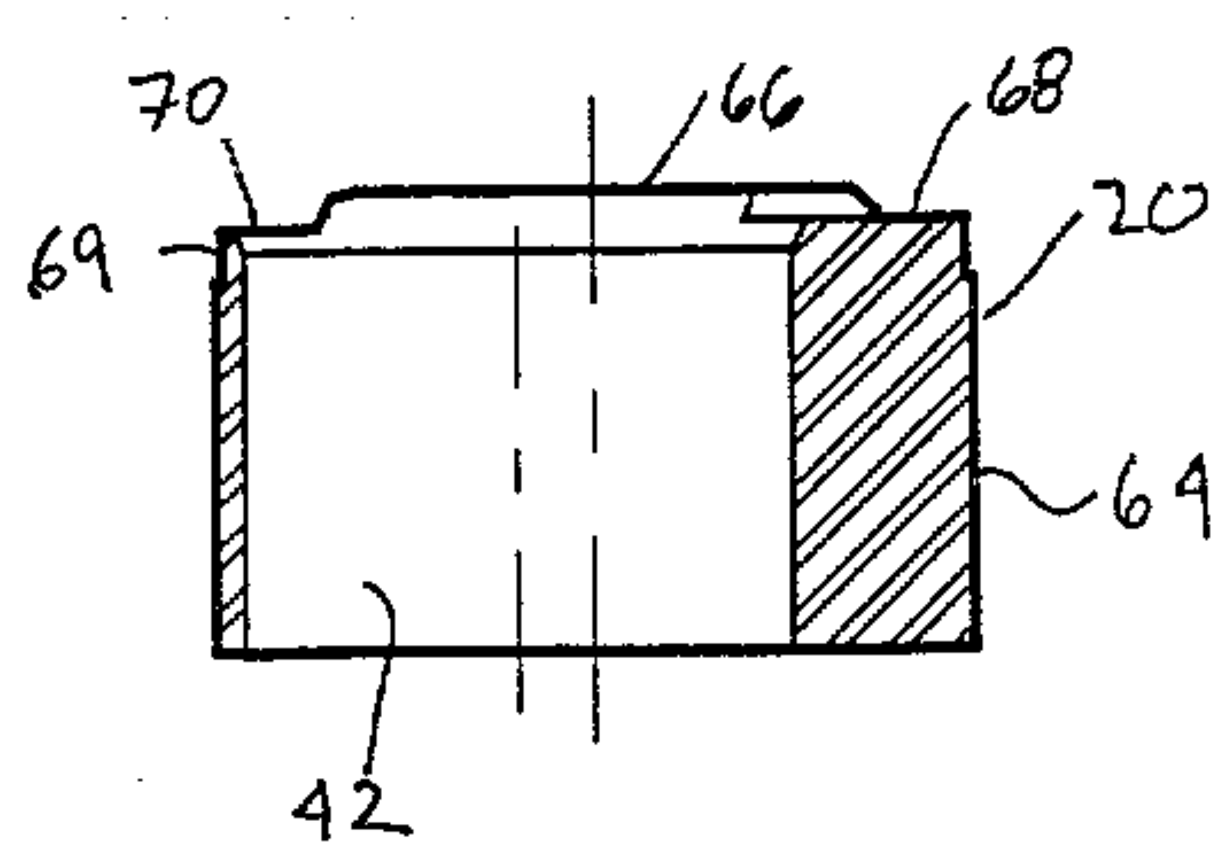
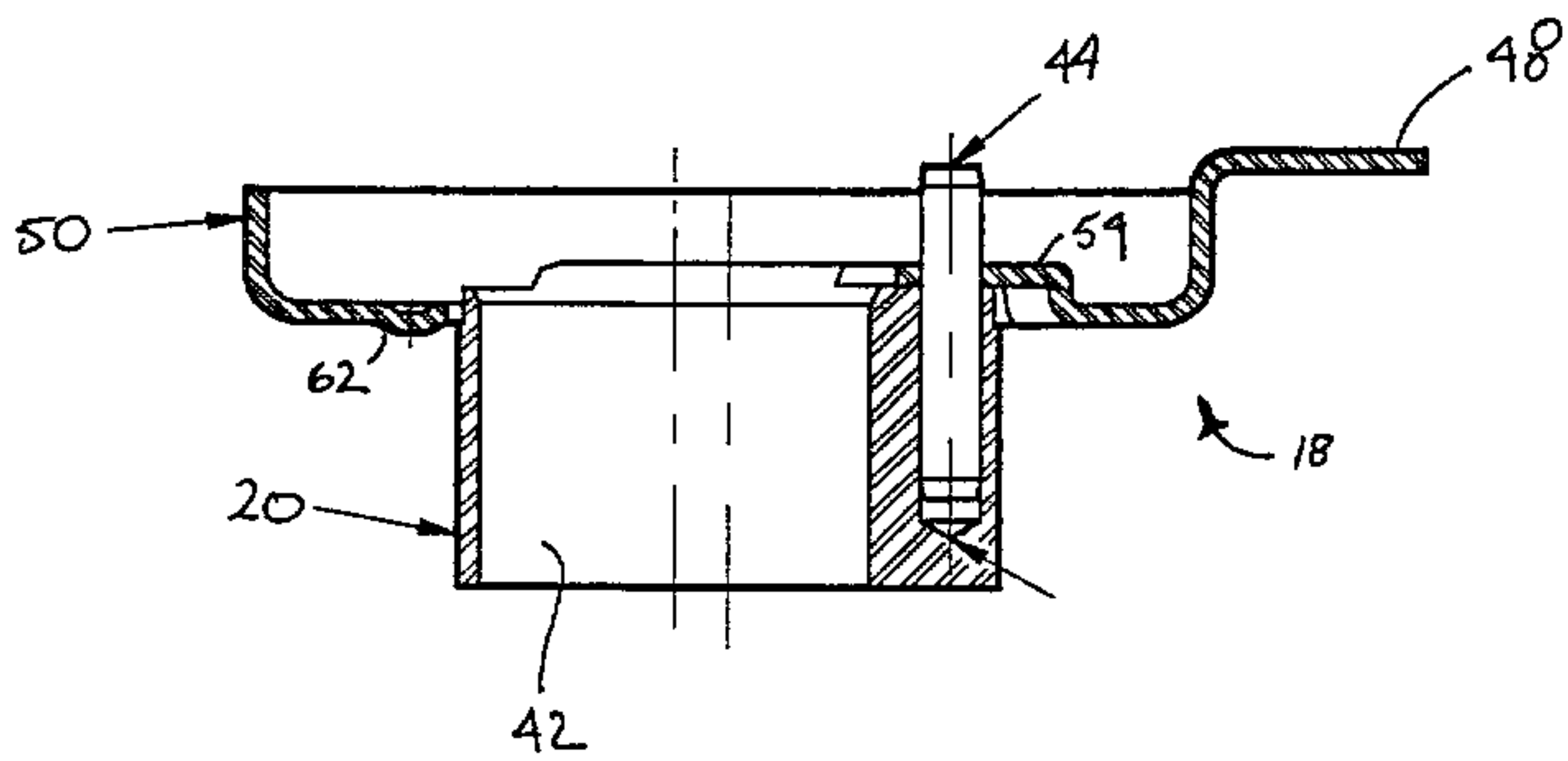


FIG. 8.



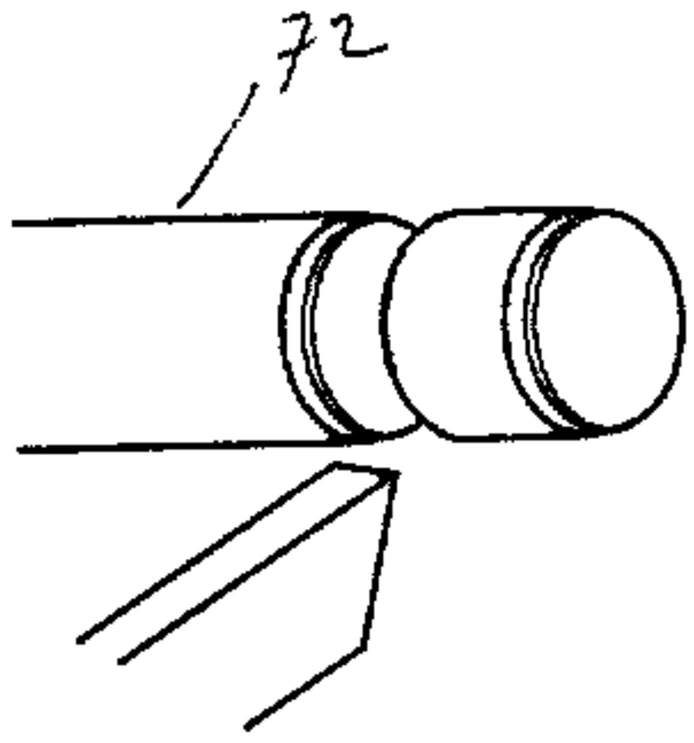


FIG. 9.

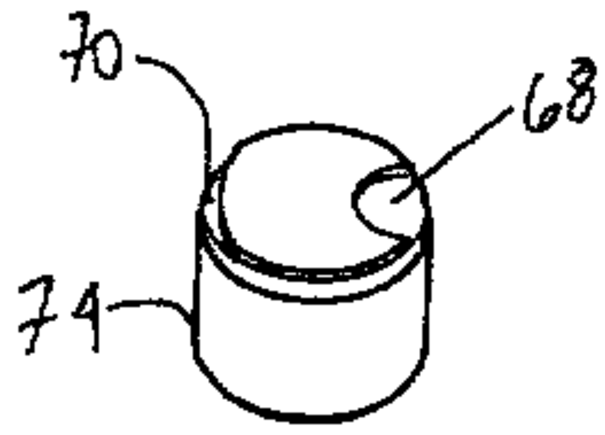


FIG. 10.

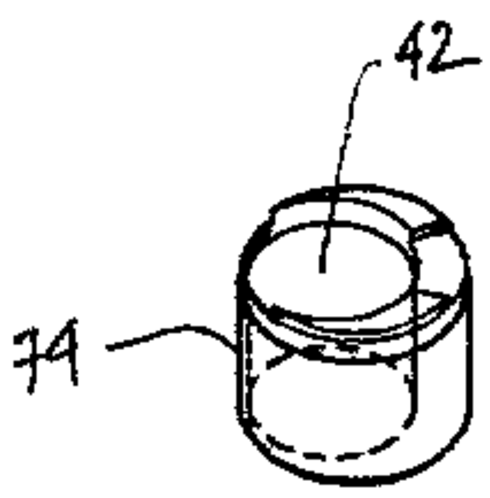
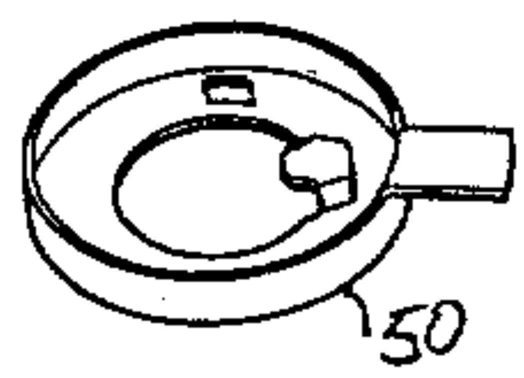


FIG. 11.

FIG. 12.



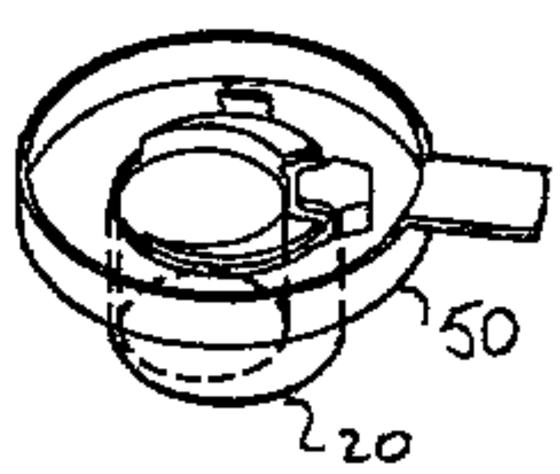


FIG. 13.

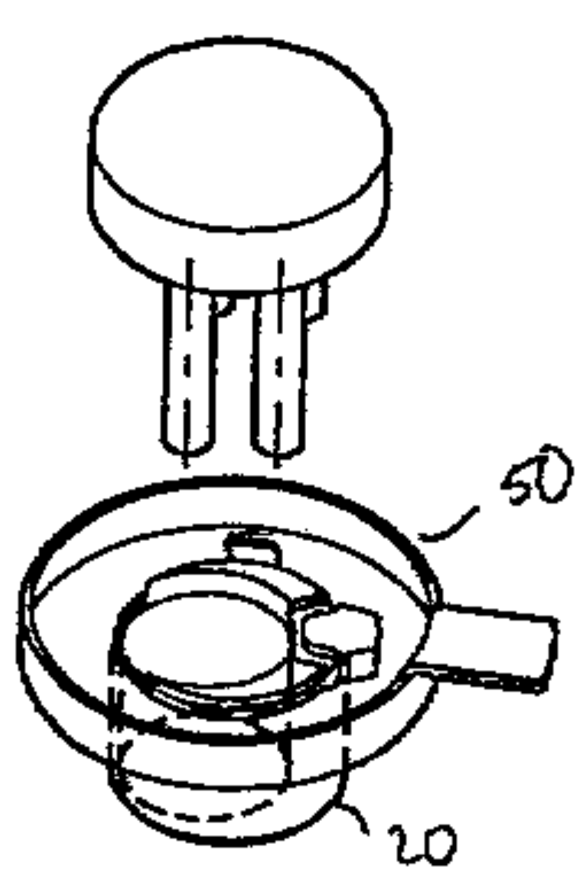


FIG. 14.

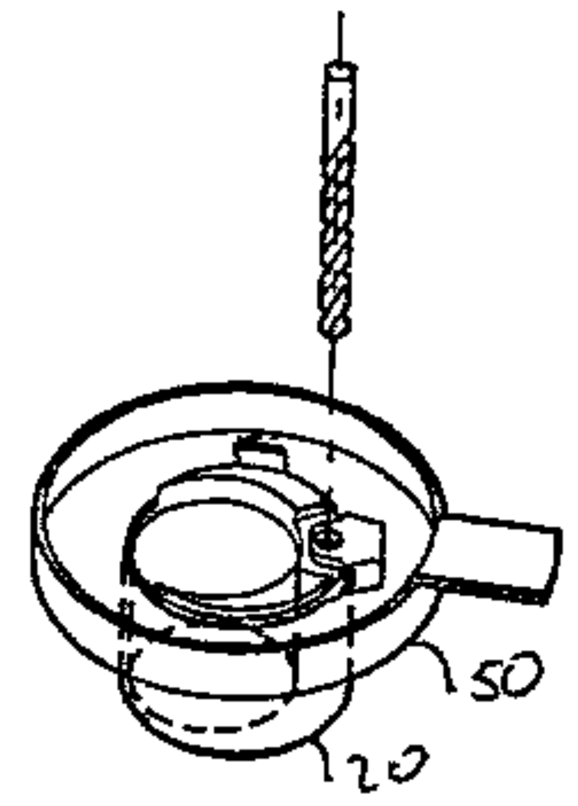


FIG. 15.

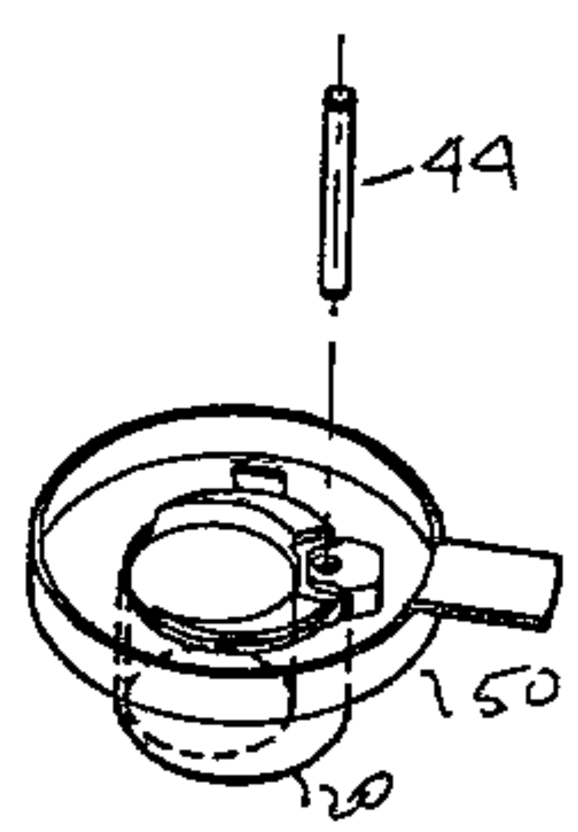
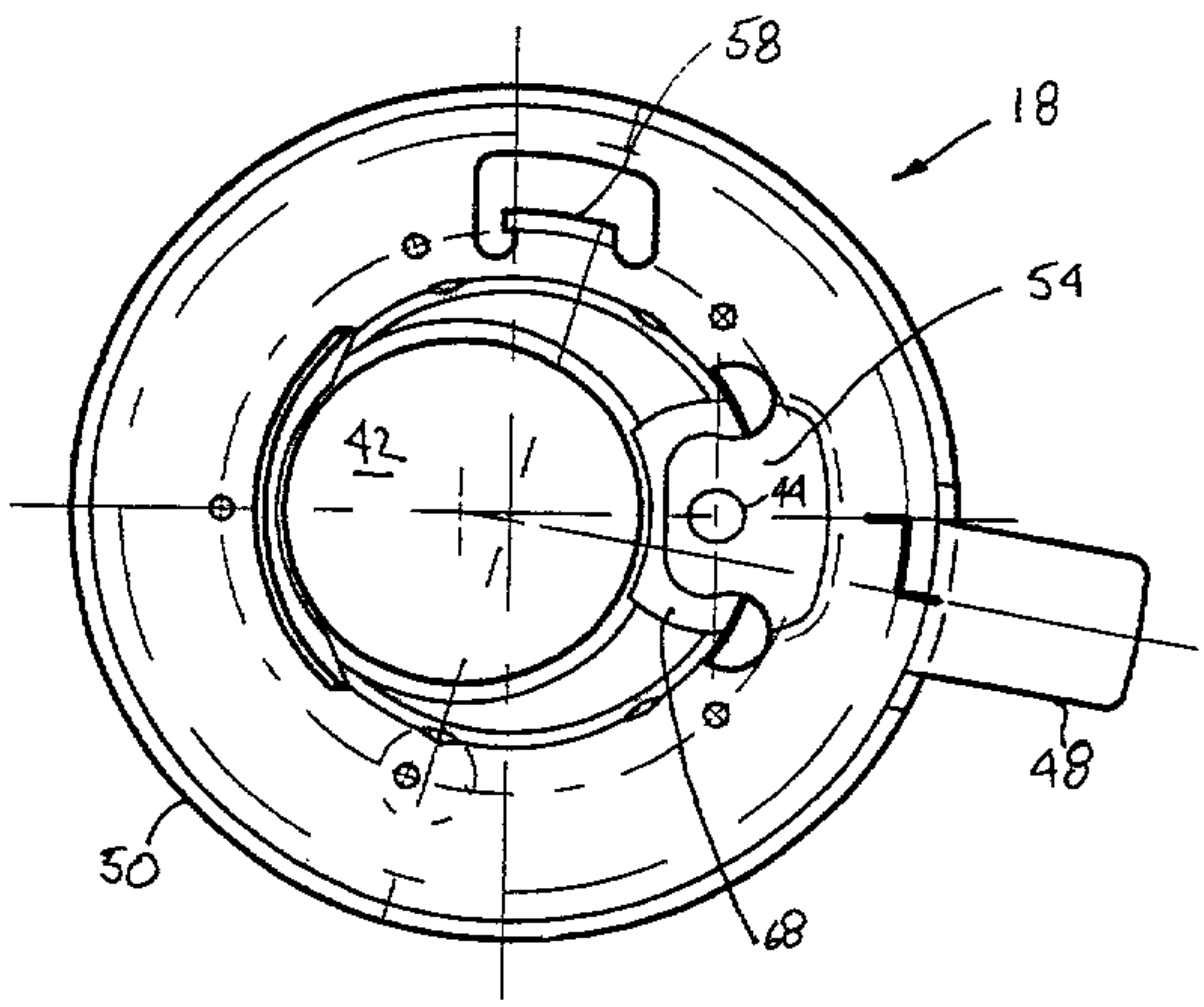


FIG. 16.

FIG. 17.

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