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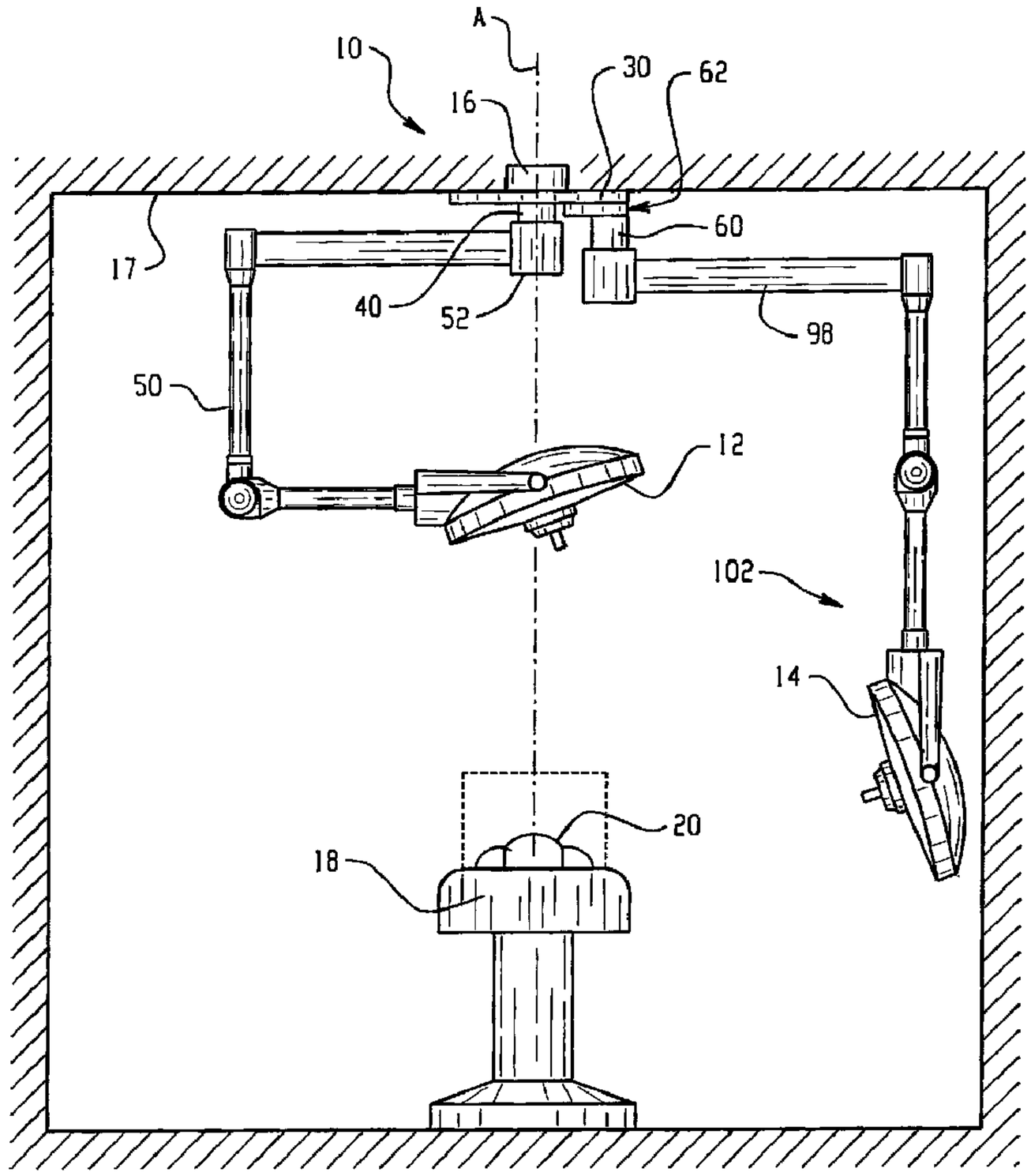

(57) Abrégé/Abstract:
A medical suspension system (10) includes a ceiling plate (30) configured for mounting to a support structure (16). The ceiling plate supports a device (12), such as a lighthead or video monitor, which is mounted to the ceiling plate via an articulated arm (50)

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(57) Abrégé(suite)/Abstract(continued):
and a spindle (40), which is centrally mounted to the ceiling plate. A second device (14) is mounted to the ceiling plate, not through the spindle (40), in the conventional manner, but via an adapter plate (62), which is mounted directly to the ceiling plate. This increases the number of devices which are readily carried by the support structure without extending the spindle length which conventionally occurs when additional hubs are added to the main spindle.

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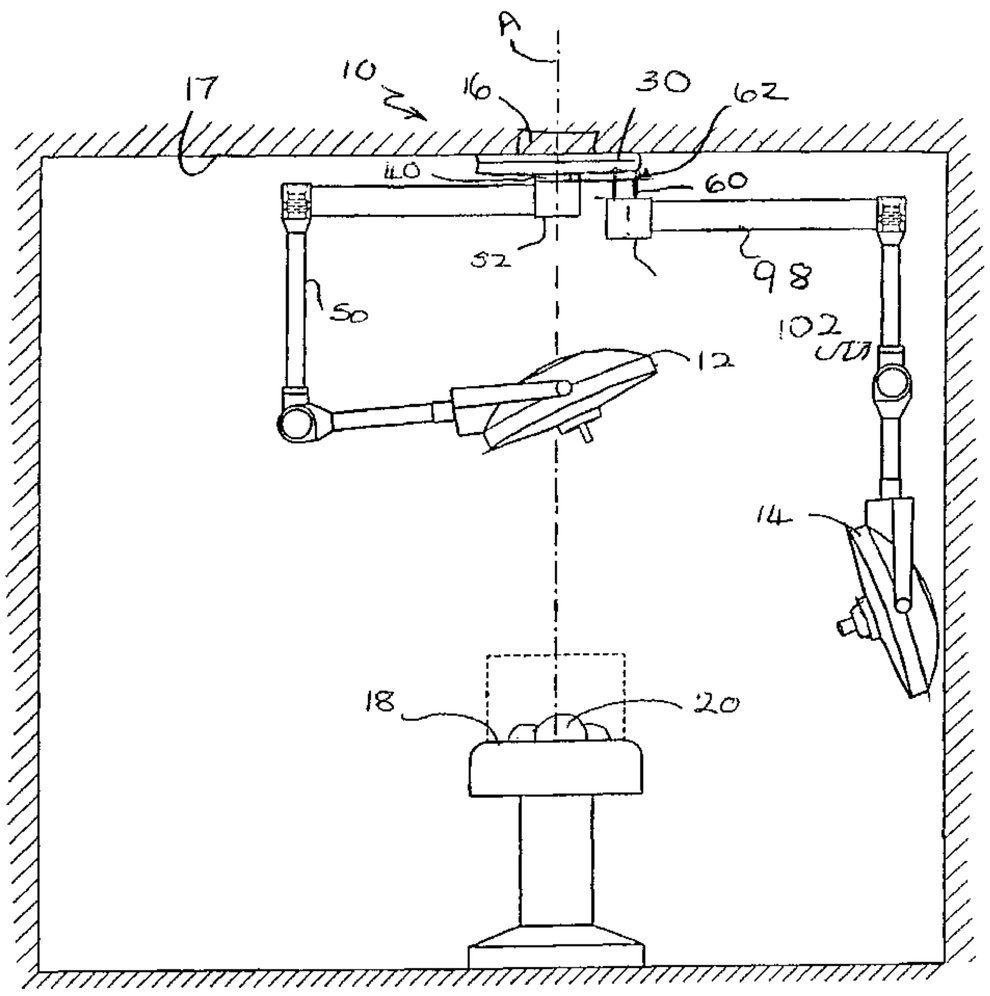
(54) Title: MEDICAL SUSPENSION SYSTEM WITH TWO SPINDLES



(57) Abstract: A medical suspension system (10) includes a ceiling plate (30) configured for mounting to a support structure (16). The ceiling plate supports a device (12), such as a lighthead or video monitor, which is mounted to the ceiling plate via an articulated arm (50) and a spindle (40), which is centrally mounted to the ceiling plate. A second device (14) is mounted to the ceiling plate, not through the spindle (40), in the conventional manner, but via an adapter plate (62), which is mounted directly to the ceiling plate. This increases the number of devices which are readily carried by the support structure without extending the spindle length which conventionally occurs when additional hubs are added to the main spindle.

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MEDICAL SUSPENSION SYSTEM WITH TWO SPINDLES

Background of the Invention

The present invention relates to the surgical lighting arts. It finds particular application in conjunction with mounting an auxiliary second spindle to a single ceiling plate supporting an existing first spindle in an operating room (OR) and will be described with particular reference thereto. It is to be appreciated, however, that the invention also finds application in conjunction with mounting other overhead secondary fixtures or devices to support systems that additionally support primary fixtures or devices and is not limited to the aforementioned OR application.

Typically, in an operating room setting, large, high lumen output lightheads are used to illuminate the surgical site. These rather large lightheads are supported on one or more jointed arms extending from a single central spindle attached to a ceiling plate. Each articulated arm is rotatable relative to the spindle and pivotable to allow independent positioning of the arms and their attached devices. The number of lightheads or other accessories (e.g., video monitors, EKG monitors) that can reasonably be supported in a stacked arrangement is limited by the height of the ceiling. Each additional support arm hub or accessory causes the central spindle to grow so that, the bottom end is lowered relative to the ceiling as additional arms are added. At some point,

the length of the spindle presents an obstacle or hazard to those working in the OR.

When additional lightheads or accessories are desired, one option is to remove the existing ceiling plate that supports the central spindle and install a new ceiling plate adapted to support both the original central spindle as well as an auxiliary satellite spindle. This is only possible, however, in rooms with ceiling structures designed in advance for supporting the weight and moment of a two spindle system. In any case, the above procedure involves a major construction job during which time the operating room is removed from service.

The present invention provides a new and improved method and apparatus that overcomes the above referenced problems and others to provide an additional spindle utilizing an existing ceiling support.

Summary of the Invention

In accordance with one aspect of the present invention, a suspension system for suspending a plurality of devices from a support structure is provided. The suspension system includes a ceiling plate configured for attachment to the support structure. A first spindle is carried by the ceiling plate. The first spindle is configured for supporting at least a first device thereon. An adapter plate is configured for mounting to the ceiling plate. A second spindle is carried by the adapter plate. The second spindle is configured for supporting at least a second device thereon.

In accordance with another aspect of the present invention, an auxiliary assembly is provided. The assembly includes an adapter plate configured for selective attachment to a ceiling plate. The ceiling plate supports a device for use in a surgical procedure. The adapter plate includes an inner surface which defines a hollow shaped to receive a spindle of the ceiling plate therethrough. An articulated arm is operably connected

with the adapter plate. A device is mounted to the articulated arm, such that when the adapter plate is attached to the ceiling plate, the device is suspended therefrom.

In accordance with another aspect of the present invention, a method of suspending a plurality of devices from a support structure is provided. The method includes suspending a first device from a ceiling plate mounted to the support structure, mounting an adapter plate to the ceiling plate, and suspending a second device from the adapter plate.

One advantage of the present invention is that it enables a plurality of devices to be added to an existing support assembly without increasing the length of the central spindle.

Still further advantages of the present invention will become apparent to those of ordinary skill in the art upon reading and understanding the following detailed description of the preferred embodiments.

Brief Description of the Drawings

The invention may take form in various components and arrangements of components, and in various steps and arrangements of steps. The drawings are only for purposes of illustrating a preferred embodiment and are not to be construed as limiting the invention.

FIGURE 1 is a side elevational view of a medical suspension system according to the present invention;

FIGURE 2 is an expanded side view in partial section of a medical suspension system according to an alternate embodiment of the invention of FIGURE 1;

FIGURE 3 is an enlarged perspective view of the ceiling plate, adapter plate, and central spindle of the suspension system of FIGURE 1;

FIGURE 4 is a top plan view of the ceiling plate, adapter plate, and central spindle of the medical suspension system of FIGURE 3;

FIGURE 5 is a bottom plan view of the adapter plate of FIGURE 1;

FIGURE 6 is a bottom plan view of the adapter plate of FIGURE 5 attached to the ceiling plate of FIGURE 1;

FIGURES 7A, 7B, 7C, and 7D are bottom plan views of four alternative mounting positions for the adapter plate of FIGURE 5 on the ceiling plate of FIGURE 6;

FIGURE 8 is an exploded perspective view of the adapter plate, spindle, and associated articulated arm of FIGURE 1;

FIGURE 9 is a perspective view of the adapter plate, spindle, and associated articulated arm of FIGURE 8;

FIGURE 10 is a schematic view demonstrating the positioning of the second spindle;

FIGURE 11 is a cross sectional view of the adapter plate of FIGURE 1 mounted to the spindle without a telescoping transition piece;

FIGURE 12 is a cross sectional view of the adapter plate of FIGURE 11 mounted to the spindle with a telescoping transition piece in a collapsed position;

FIGURE 13 is a cross sectional view of the adapter plate of FIGURE 12 mounted to the spindle with the telescoping transition piece in an expanded position; and

FIGURE 14 is a perspective view of an alternative embodiment of a device suspended from an adapter plate according to the present invention.

Detailed Description of the Preferred Embodiments

With reference to **Figure 1**, a suspension system **10** suspends a plurality of medical devices **12, 14** from a rigid, immobile structural support **16**, such as a ceiling support. The ceiling support **16** is preferably carried above a ceiling **17** by beams (not shown) or other rigid structures which support the ceiling of the operating room (OR) or are located above it such that the suspension system **10** extends below the ceiling. The

medical devices **12, 14** illustrated in **Figure 1** are lightheads for illuminating a work surface **18**, such as an operating table and a surgical site on a patient **20** supported thereon. However, it will be appreciated that a variety of other devices **12, 14** such as video monitors, vital sign monitors, and the like, are alternatively or additionally mounted on the suspension system **10**.

With reference also to **Figures 2-4**, the suspension system **10** includes a generally circular ceiling plate **30**, which is secured to the ceiling support **16** or other immobile structural support by several suitable fixing members **32**, such as bolts, screws, rivets, or the like, which are mounted by suitably positioned holes **34** through the ceiling plate **30**. The ceiling plate **30** is formed from a rigid material such as iron or steel and is of sufficient strength to support the weight of the medical devices **12, 14**, which are supported therefrom.

With continued reference to **Figures 2-4**, a first or central spindle **40** is secured to the ceiling plate **30**. **Figures 2-4** show the spindle **40** as being generally cylindrical in shape and being centrally mounted to a lower surface of the ceiling plate via a cylindrical collar **42** of slightly larger diameter than the spindle, which may be welded or otherwise rigidly fixed to the ceiling plate **30**. The spindle **40** is bolted or otherwise rigidly attached to the collar **42**. Other methods of fixing the central spindle to the ceiling plate known in the art are also contemplated.

With particular reference to **Figures 1** and **2**, an adjustable arm **50**, such as a flexible and/or articulated arm is carried by the spindle **40** via a mounting hub **52**. At least a portion of the mounting hub is rotatable, relative to the spindle. The arm **50** is thus movable to a selected position about an axis **A** of the ceiling plate **30**. The first surgical support apparatus **12**, such as a lighthead (as illustrated), video monitor, EKG monitor, or other vital system monitor is

attached to a distal end of the arm **50**. The arm **50** and the spindle **40** allow the surgeon to position the first surgical support apparatus **12** in a plurality of different positions and orientations as needed. As shown in **Figure 2**, it is possible to extend the spindle **40** and add other devices **12** extending therefrom by stacking one or more additional spindle hubs along the axis **A** and thereby mounting one or more additional arms **50'** (it will be appreciated that a single hub **52** optionally accommodates two or more arms **50**). However, the number of devices **12** that can be added is generally limited by the length of the spindle **40** and the height of the ceiling **17** above the work surface **18**.

With reference to **Figures 1** and **5-6**, when it is desired to add a second spindle **60** to the system, an adapter plate **62** is attached directly to the existing ceiling plate **30**. The adapter plate **62** is preferably in the shape of an incomplete circle and preferably has a diameter **D** substantially equal to a diameter of the ceiling plate **30**. The adapter plate **62** defines an outer circumferential surface **64** which is preferably greater than 180° and less than 270° of an imaginary circle **C** of which it forms a part. This provides for the weight of the second device **14** to be distributed over a large area of the ceiling plate **30**, while providing room for the attachment of other devices **66, 68**, such as a control board and a fuse block, directly to the ceiling plate (see **Figures 3-4**). The adapter plate **62** defines an arcuately shaped hollow portion **70**, spaced radially inward from the circumferential surface **64**, that accommodates the main spindle **40** and collar **42** therethrough. In order to accommodate the spindle **40** and collar **42** and present a circumferential surface **64** which is larger than half of the ceiling plate **30**, an inner edge **72** of the adapter plate **62** preferably spans less than or equal to 180° around the spindle **40**, so that the adapter plate **64** may fit snugly against the spindle

collar **42** and partially surround the spindle **40** without obstructing its own access to the spindle **40**.

As shown in **Figures 2, 3 and 6**, the adapter plate **62** is fixed directly to the ceiling plate **30**. A lower surface **74** of the ceiling plate preferably lies flat against an adjacent, upper surface of the adapter plate although it is also contemplated that spacing members may be interposed between the ceiling plate and adapter plate. Suitable securement members **80**, such as nuts and bolts, screws, rivets, or other attachment mechanisms, are mounted through suitably positioned holes **82** in the adapter plate and corresponding holes **84** in the ceiling plate to secure the plates **30, 62** together.

Preferably, the adapter plate **62** is selectively positionable so that the second spindle **60** is locatable in one of a plurality (four in the illustrated embodiment) of possible positions around the main spindle **40**, each position being arcuately spaced (90° in the illustrated embodiment) from the next position around the main spindle **40**, as illustrated in **Figures 7a-7d**. Accordingly, the ceiling plate **30** is provided with sufficient mounting holes **84** to allow the adapter plate to be mounted in any one of the selected positions. This enables optimum positioning of the second spindle **62** and its associated device **14** with respect to the OR and equipment in the OR, e.g., where it will best benefit the surgeon, without interfering with positioning of devices **12** supported on the first spindle **40**. Additionally, when the adapter plate **62** is located in any one of the four selected positions, electrical wiring feed through holes **86** in the adapter plate are aligned with corresponding holes **88** in the ceiling plate **30** so that electrical wiring **89** and the like for providing power or communicating with the device **12** can be passed through both the adapter plate **62** and ceiling plate **30**. Other sizes or configurations of the adapter plate **62** are optionally provided, for example, auxiliary spindle positions at angular increments other than 90°.

The second spindle **60** is fixedly attached to the adapter plate **62** in a similar manner to the way in which the main spindle **40** is attached to the ceiling plate **30**. As best shown in **Figures 8** and **9**, the adapter plate includes a collar **90**, rigidly attached thereto, analogous to the collar **42** for the main spindle **40**. In the case of the auxiliary spindle **60**, the spindle is mounted exteriorly of the collar **90**, by securement members **92**, such as screws, bolts, or the like, although it will be appreciated that the collar **90** may be radially outward of the spindle **60**, as for the main spindle. In yet another embodiment, the collar is eliminated and the spindle is mounted directly to the adapter plate, for example by welding or with suitable securement means, such as bolts, screws, rivets, or the like.

The spindle may include a cylindrical mounting member **94**, which is received in an opposite end of the spindle **60** to the collar **90** and attached thereto by similar securement members **96**. A similar cylindrical mounting member (not shown) is optionally also associated with the main spindle. A second adjustable arm assembly **98**, analogous to arm assembly **50**, is mounted at a proximal end or hub **100** thereof to the spindle **60** via the cylindrical member **94**. At least a portion **101** of the hub **100** is rotatable relative to the spindle, as shown by arrow **R**, about an axis **D** through the spindle (**Figure 9**).

The second device **14** is mounted to a distal end of the arm **98**. As for the first spindle **40**, additional arms (not shown) are optionally mounted to the spindle **60** in a similar manner to that shown in **Figure 2**. The adapter plate **62**, device **14**, arm **98**, and interconnections therebetween comprise an auxiliary assembly **102**, which may be provided as an assembled unit for attachment to the ceiling plate **30**, or as separate components for assembly at the OR site.

As will be appreciated, the first device **12** is carried solely by the ceiling plate **30** (i.e., not by the adapter plate **62**) while the second device **14** is carried

by both the ceiling plate and the adapter plate. When the support system **10** is assembled, the two spindles **40, 60** are arranged generally side-by-side, i.e., the second spindle **60** is positioned generally parallel with and radially spaced from the main spindle **40**, such that at least a portion of each spindle **40, 60** lies on the same horizontal plane axially spaced from the ceiling plate **32.** In this way, as additional hubs **100** are added to the second spindle **60**, the length of the first spindle **40** is not increased and the available working height between the work surface **18** and the lowest hub **100** is maintained (unless several hubs are added to the second spindle, resulting in the second spindle and its associated hubs **100** being lower than that of the first spindle).

As shown in **Figures 3** and **4**, other devices **110, 112** are optionally mounted to the adapter plate using securement members **114**, such as bolts, screws, or the like, which are received through suitably positioned holes in the adapter plate and preferably also through corresponding holes in the ceiling plate **30**.

With reference now to **Figure 10**, to select the optimum position for the adapter plate **62** out of the plurality of possible positions (four in the illustrated embodiment), the arm **50** of the first device **12** is moved between its stop positions S_1 and S_2 and the midpoint **M** between the stop positions is determined as being the most typical operating position for the arm **50**. The second spindle **60** is then positioned at or about 180° from the midpoint (i.e., at an opposite end of a line **x-x** passing through the midpoint **M** and the first spindle **40**). In this way, the arms **50** and **98** will be in the positions least likely to interfere with each other during positioning.

In order to accommodate for variable ceiling heights, a telescopic transition piece **120** (**Figures 12-13**) is optionally used for installation concurrently with the adapter plate **62**. The transition piece **120** is extended fully for high ceilings (**Figure 13**), and extends

to varying lesser lengths for varying heights of lower ceilings between the extended position and a collapsed position (**Figure 12**). The transition piece **120** may not be needed if the ceiling in the application is low enough (**Figure 11**). In that case, the second spindle **60** is simply attached directly to the adapter plate collar **90**. The transition piece **120** enables the adapter plate **62** to be installed in a variety of different settings without having to adjust the dimensions of the support arm **98**.

As shown in **Figures 12** and **13**, the transition piece **120** includes a first attachment portion **122** at an upper end thereof, which is attached to the collar **90** in place of the spindle **60** by suitable securement means, such as bolts, screws, or the like (not shown). A second attachment portion **124** is attached to the spindle **60** in a similar manner. A telescoping midportion **126**, intermediate the two attachment portions **122, 124,** extends the length of the transition piece between that shown in **Figure 12** and that shown in **Figure 13**.

With reference to **Figure 14**, an alternative auxiliary assembly **130** comprising an adapter plate **62** an articulated arm **98** and a monitor **14'** is shown.

Having thus described the preferred embodiment, the invention is now claimed to be:

1. A suspension system for suspending a plurality of devices from an associated support structure comprising:

a ceiling plate configured for attachment to the associated support structure;

a first spindle, carried by the ceiling plate, the first spindle configured for supporting at least a first device thereon;

an adapter plate configured for mounting to the ceiling plate in a plurality of positions relative to the ceiling plate; and

a second spindle carried by the adapter plate, the second spindle configured for supporting at least a second device thereon.

2. The suspension system of claim 1, wherein the first spindle is not carried by the adapter plate.

3. The suspension system of claim 1, wherein the adapter plate includes a hollow portion which is shaped to receive the first spindle, the hollow portion defining an inner arcuate surface of less than about 180° of an imaginary circle inscribing the inner arcuate surface.

4. The system of claim 1, wherein at least one of the first and second devices is selected from the group consisting of video monitors, lightheads, vital sign monitors, and combinations thereof.

5. The system of claim 1, further including:

a first adjustable arm assembly mounted to the first spindle and rotatable relative thereto, which carries

the first device; and

a second adjustable arm assembly mounted to the second spindle and rotatable relative thereto, which carries the second device.

6. The system of claim 5, wherein the second adjustable arm assembly is mounted to the second spindle by a hub, at least a portion of the hub being rotatable relative to the spindle.

7. The system of claim 1, wherein the second spindle is generally parallel with the first spindle and radially spaced from the first spindle.

8. A suspension system for suspending a plurality of devices from a support structure comprising:

a ceiling plate configured for attachment to the support structure; a first spindle, carried by the ceiling plate, the first spindle configured for supporting at least a first device thereon;

an adapter plate configured for mounting to the ceiling plate; and

a second spindle carried by the adapter plate, the second spindle configured for supporting at least a second device thereon, wherein the adapter plate and ceiling plate are configured for attachment of the adapter plate to the ceiling plate in a selected one of a plurality of arcuately spaced positions.

9. A suspension system for suspending a plurality of devices from a support structure comprising:

a ceiling plate configured for attachment to the support structure;

a first spindle, carried by the ceiling plate, the first spindle configured for supporting at least a

first device thereon;

an adapter plate configured for mounting to the ceiling plate, the adapter plate including a hollow portion which is shaped to receive the first spindle therethrough, wherein the hollow portion defines an inner arcuate surface of less than about 180° of an imaginary circle inscribing the inner arcuate surface; and

a second spindle carried by the adapter plate, the second spindle configured for supporting at least a second device thereon.

10. A suspension system for suspending a plurality of devices from a support structure comprising:

a ceiling plate configured for attachment to the support structure;

a first spindle, carried by the ceiling plate, the first spindle configured for supporting at least a first device thereon;

an adapter plate configured for mounting to the ceiling plate, wherein the adapter plate defines a sector of a circle having an inner arcuate surface and an outer arcuate surface, the outer arcuate surface being radially outward of the inner arcuate surface; and

a second spindle carried by the adapter plate, the second spindle configured for supporting at least a second device thereon.

11. The suspension system of claim 10, wherein the outer arcuate surface defines at least about 180° of an imaginary circle inscribing the outer arcuate surface.

12. The suspension system of claim 10, wherein the outer arcuate surface defines less than about 270° of an imaginary circle inscribing the outer arcuate surface.

13. A suspension system for suspending a plurality of devices from a support structure comprising:

a ceiling plate configured for attachment to the support structure;

a first spindle, carried by the ceiling plate, the first spindle configured for supporting at least a first device thereon;

a first adjustable arm assembly rotatably mounted to the first spindle and carrying the first device;

an adapter plate configured for mounting to the ceiling plate;

a second spindle carried by the adapter plate, the second spindle configured for supporting at least a second device thereon;

a second adjustable arm assembly mounted to the second spindle and rotatable relative thereto, which carries a second device; and

a telescoping transition piece mounted intermediate the second adjustable arm assembly and the second spindle.

14. A suspension system for suspending a plurality of devices from a support structure comprising:

a ceiling plate configured for attachment to the support structure;

a first spindle, carried by the ceiling plate, the first spindle configured for supporting at least a first device thereon;

an adapter plate configured for mounting to the ceiling plate, wherein the adapter plate includes a generally cylindrical collar and a second spindle is mounted to the collar; and

the second spindle being configured for supporting at least a second device thereon.

15. An auxiliary assembly in combination with a primary suspension arm and first spindle, the auxiliary assembly comprising:

an adapter plate configured for selective attachment to a ceiling plate of the primary suspension arm, the primary suspension arm supporting a first device for use in a surgical procedure, the adapter plate including an inner surface which defines a hollow shape to receive said first spindle;

an adjustable arm operably connected with the adapter plate;

a second device mounted to the adjustable arm, such that when the adapter plate is attached to the ceiling plate, the second device is suspended therefrom.

16. The auxiliary assembly of claim 15, wherein the second device includes at least one of a lighthead and a video monitor.

17. The auxiliary assembly of claim 15, further including:

a generally cylindrical spindle mounted at a first end to the adapter plate, the adjustable arm being connected to a second end of the spindle and rotatable relative thereto.

18. In a suspension system including a ceiling plate which is anchored to an underlying building structure, the ceiling plate having a centrally mounted spindle configured for supporting a first device, an adapter assembly comprising:

an adapter plate configured to overlay a portion of the ceiling plate and partially circumscribe the central spindle, the adapter plate having at least another spindle mounted thereto; and

fasteners to connect the adapter plate to the ceiling plate with the central spindle and the another spindle adjacent to each other.

19. In a suspension system including a ceiling plate which is anchored to an underlying building structure, the ceiling plate having a centrally mounted spindle configured for supporting a first device, an adapter assembly comprising:

an adapter plate configured to overlay a portion of the ceiling plate in a plurality of selectable positions relative to the central spindle, the adapter plate having at least another spindle mounted thereto; and

means connecting the adapter plate with the ceiling plate, the central spindle and the another spindle being adjacent to each other.

20. A suspension system for suspending a plurality of devices from a support structure comprising:

a ceiling plate configured for attachment to the support structure;

a first spindle, carried by the ceiling plate, the first spindle configured for supporting at least a first device thereon;

an adapter plate configured to overlay a portion of the ceiling plate and being mountable to the ceiling plate in a plurality of positions relative to the ceiling plate; and

a second spindle carried by the adapter plate, the second spindle configured for supporting at least a second device thereon.

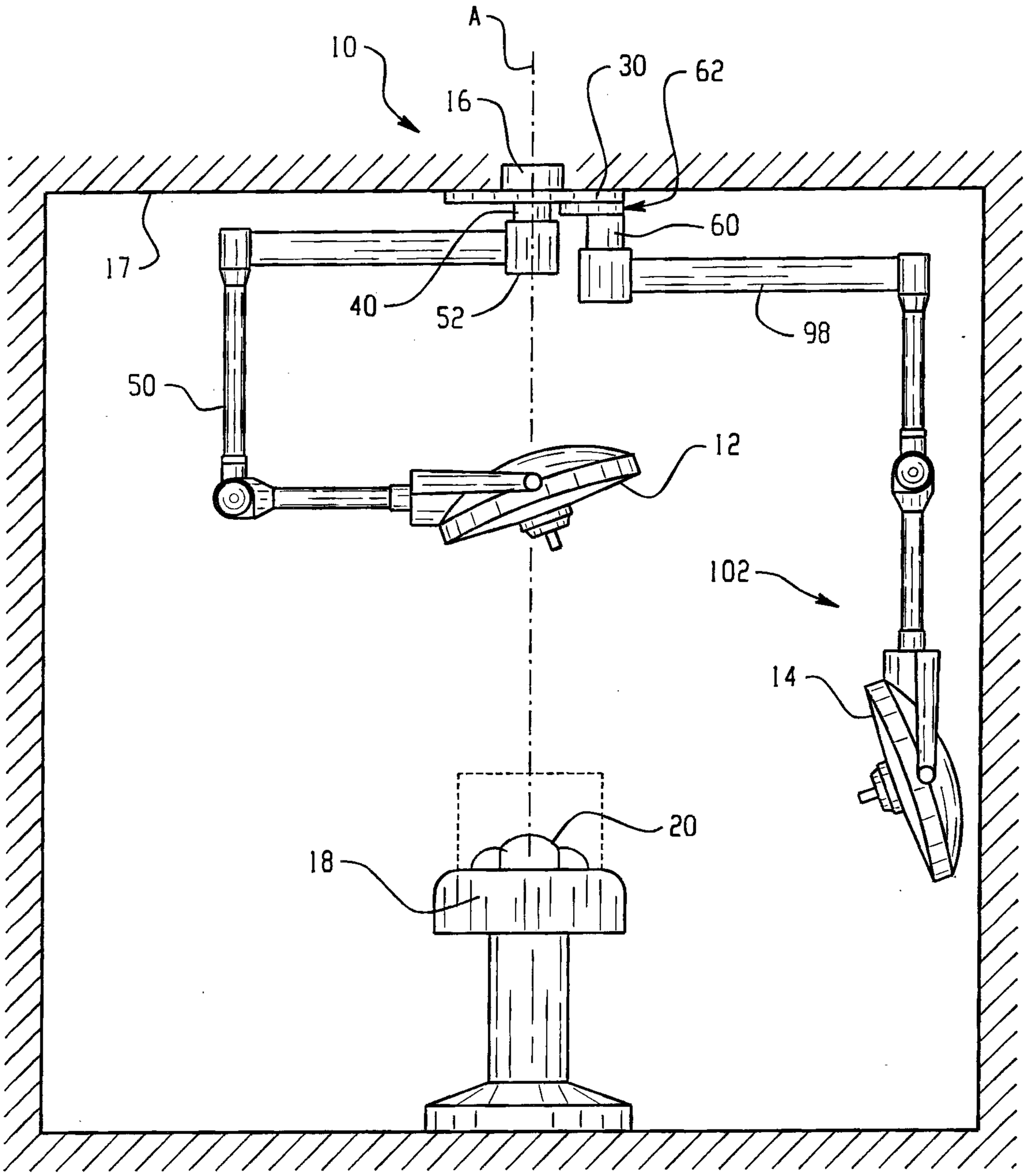


Fig. 1

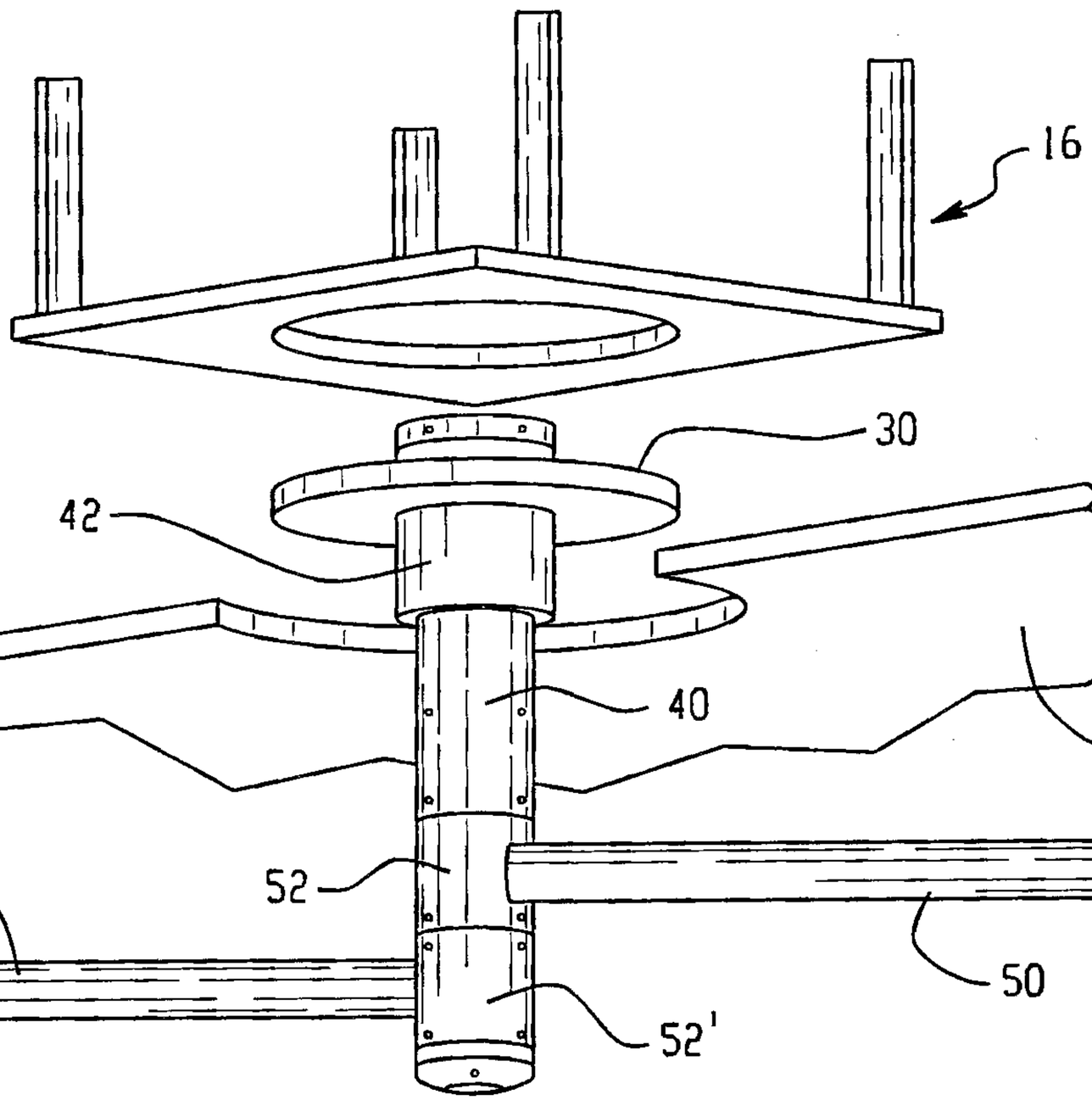


Fig. 2

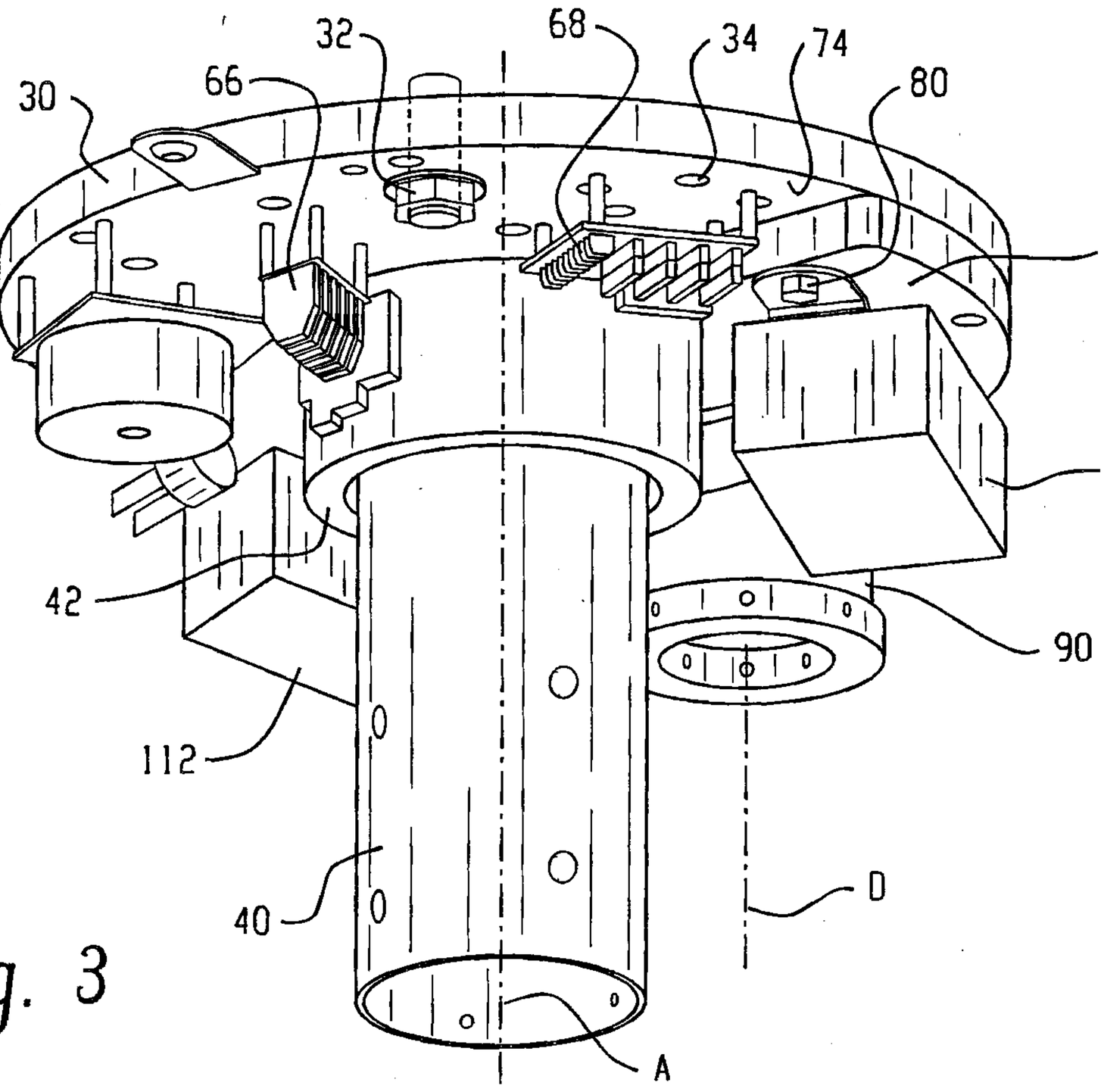


Fig. 3

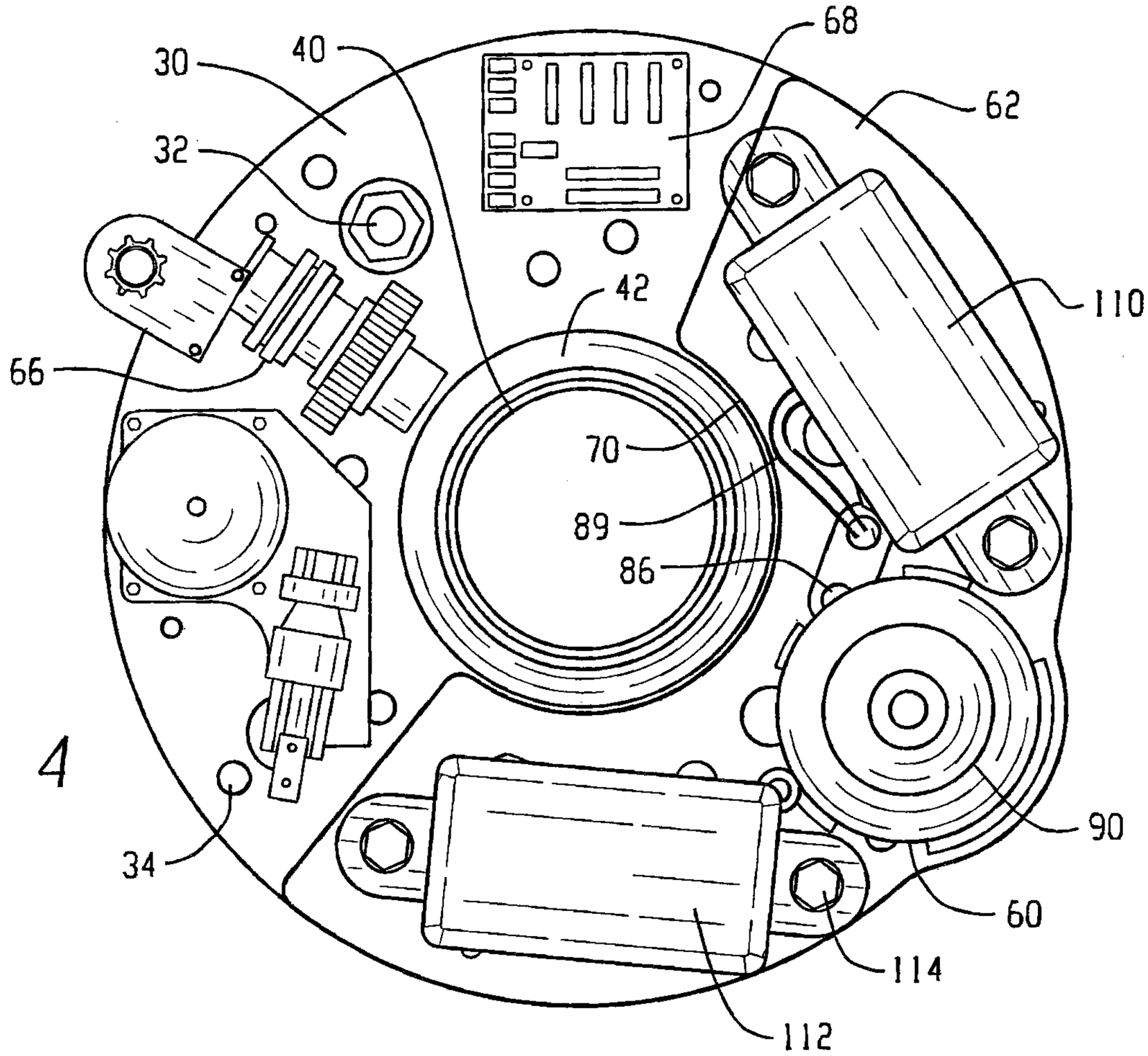


Fig. 4

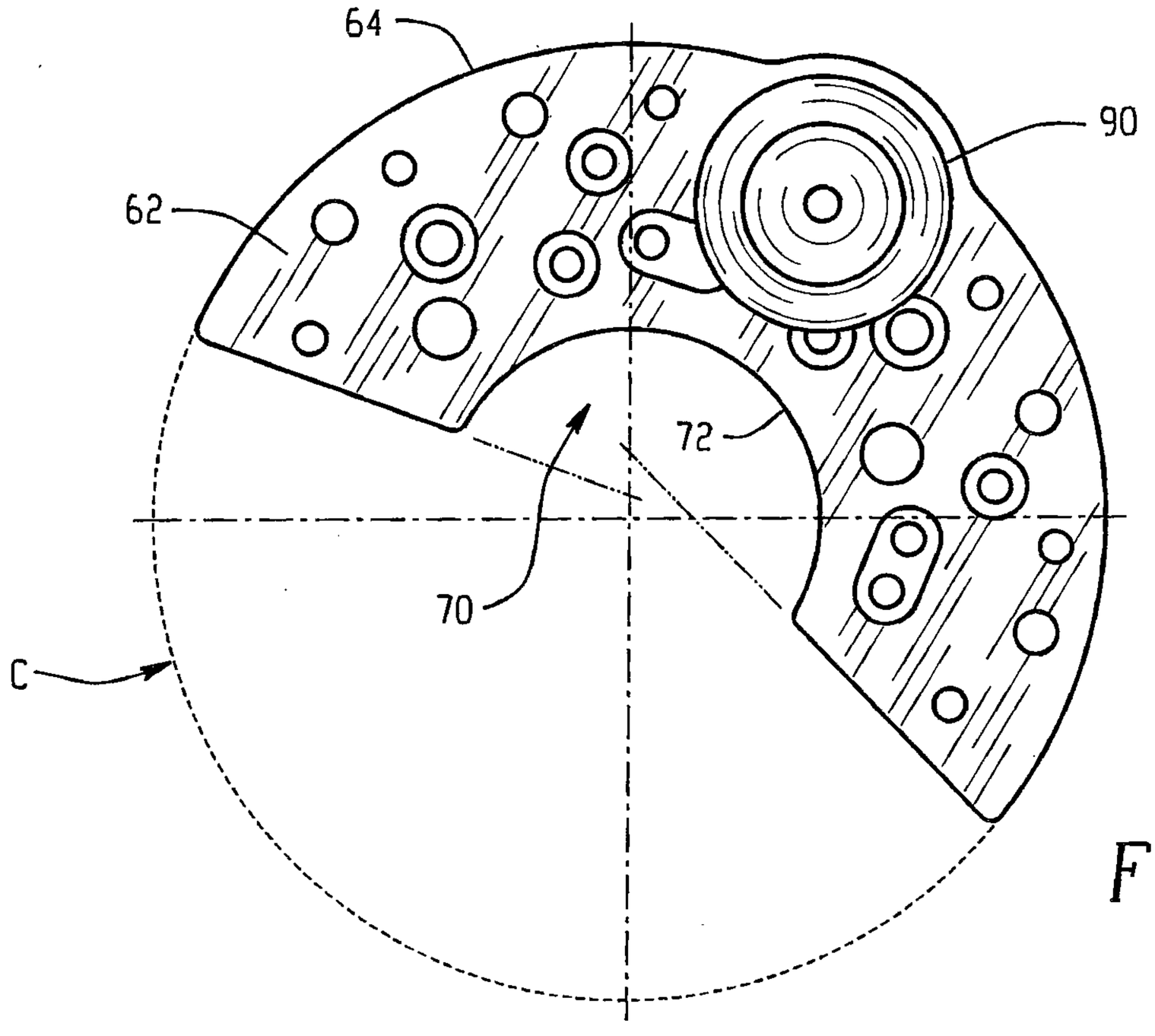


Fig. 5

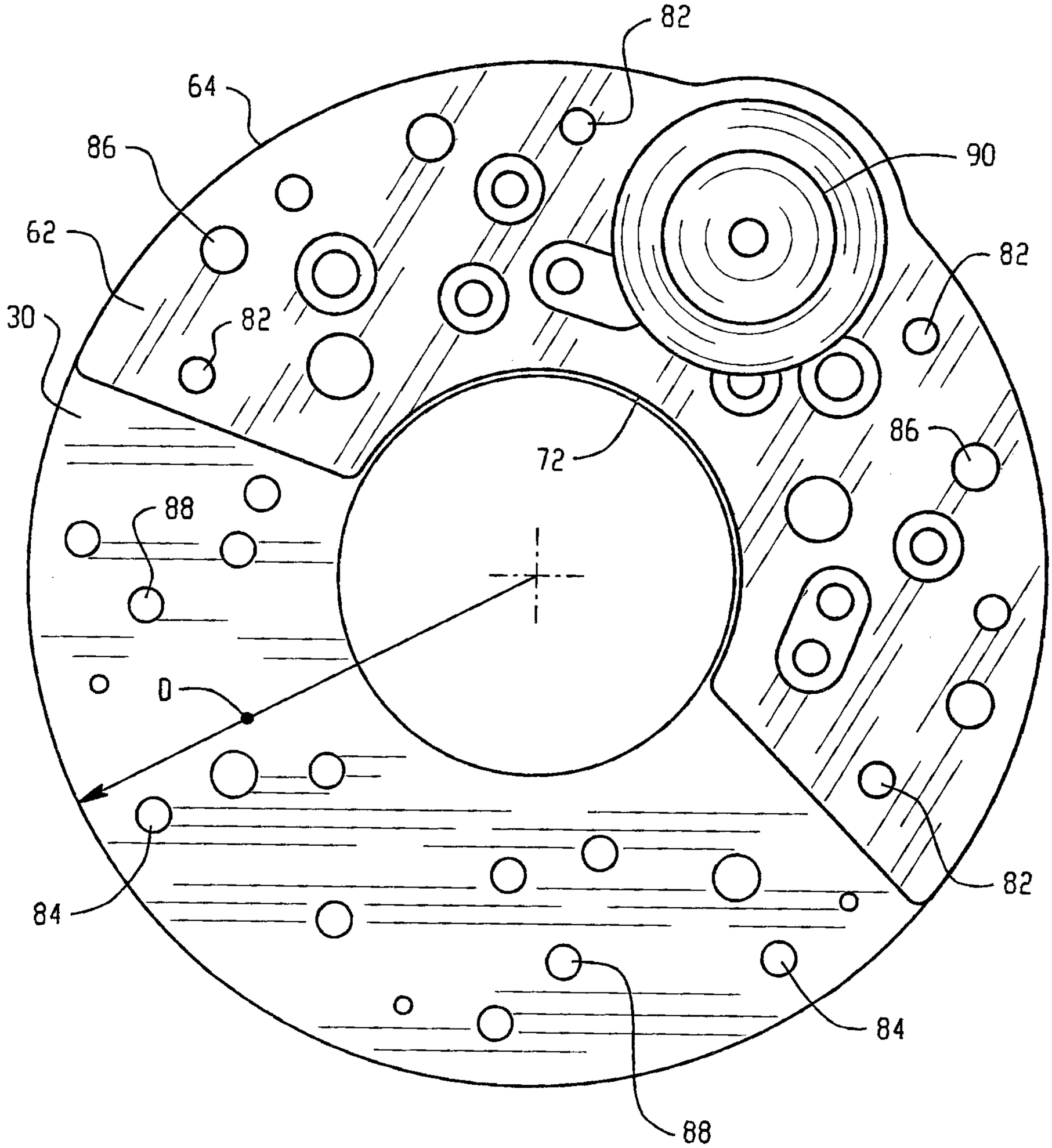


Fig. 6

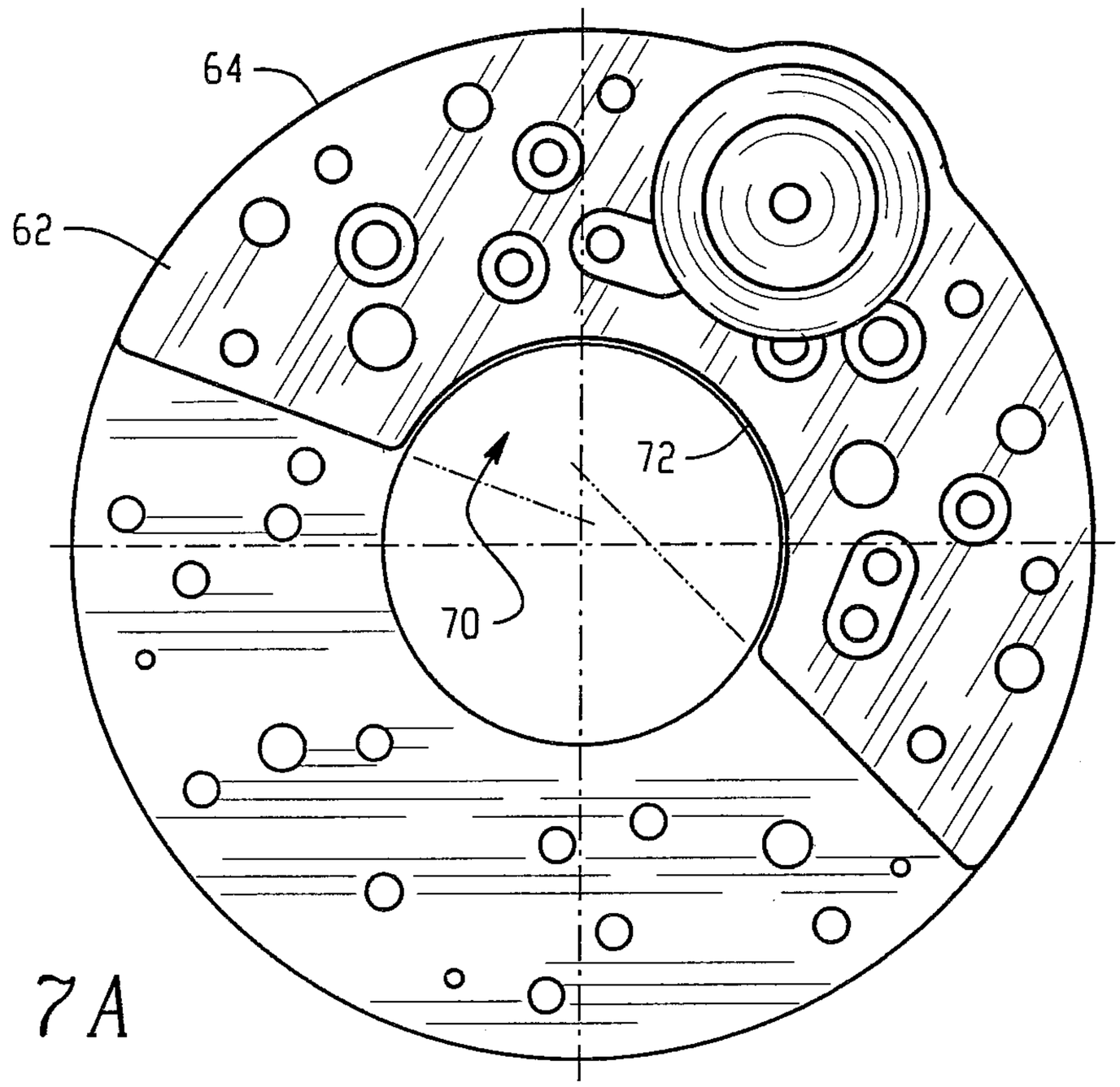


Fig. 7A

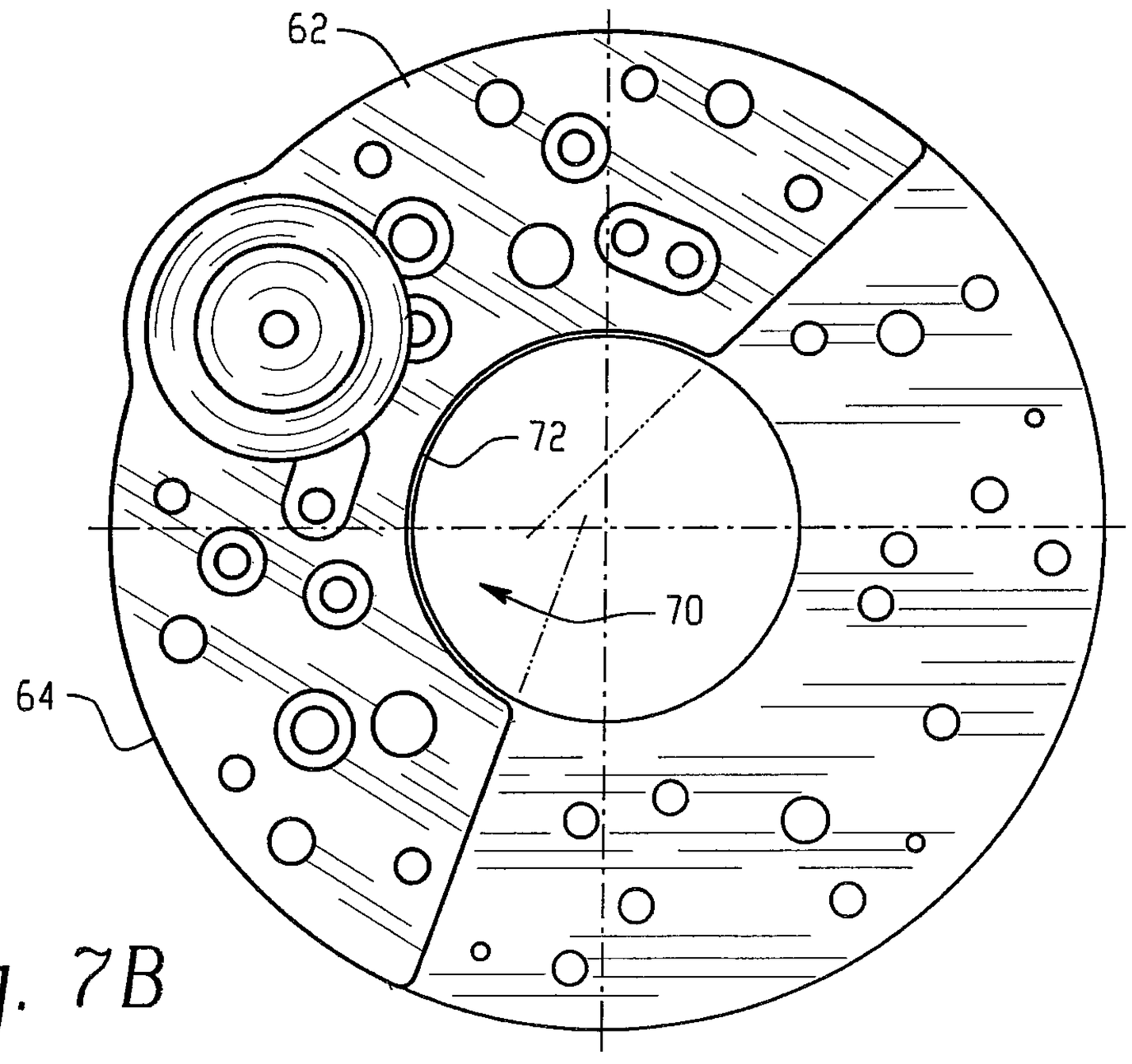


Fig. 7B

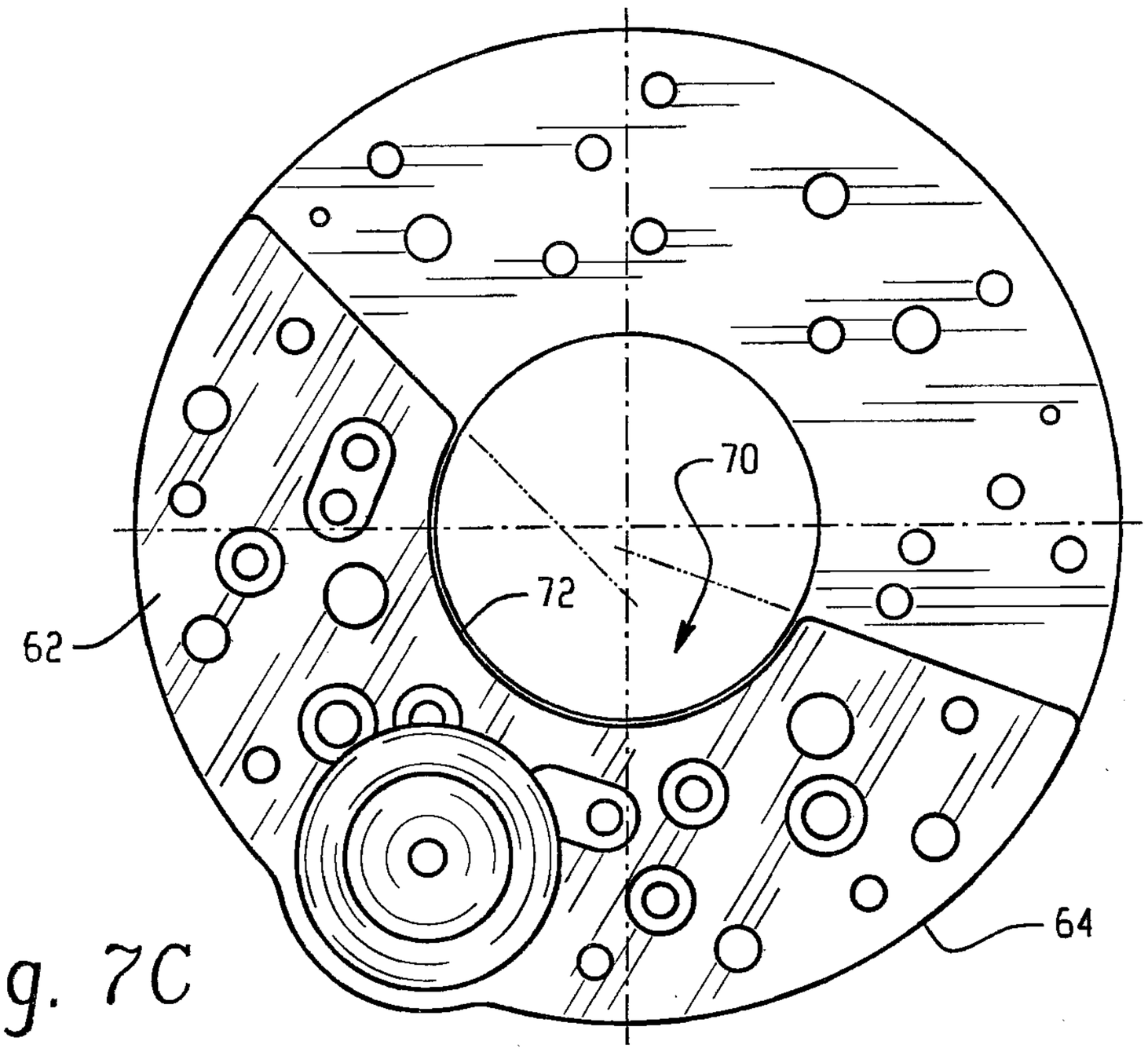


Fig. 7C

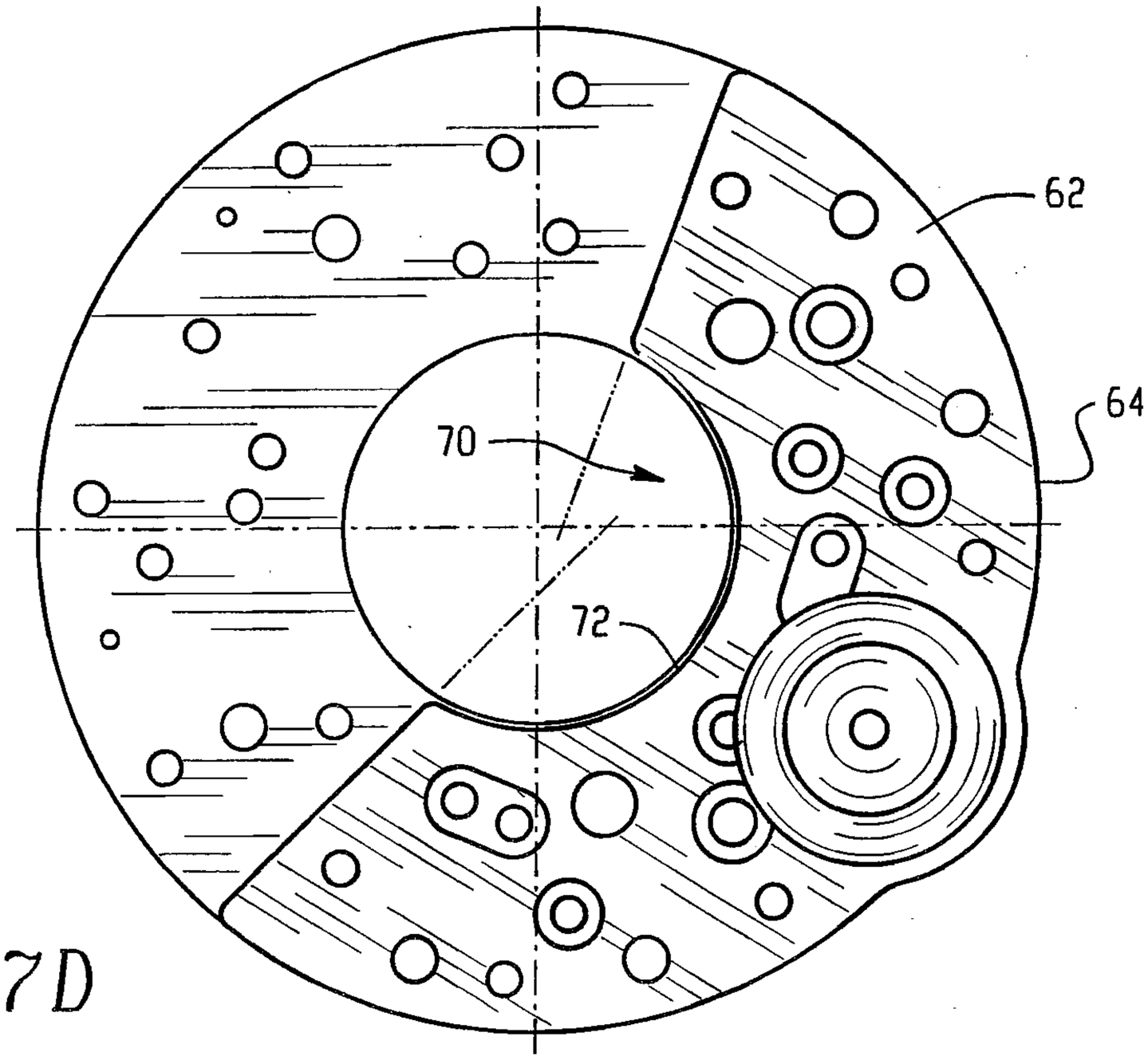


Fig. 7D

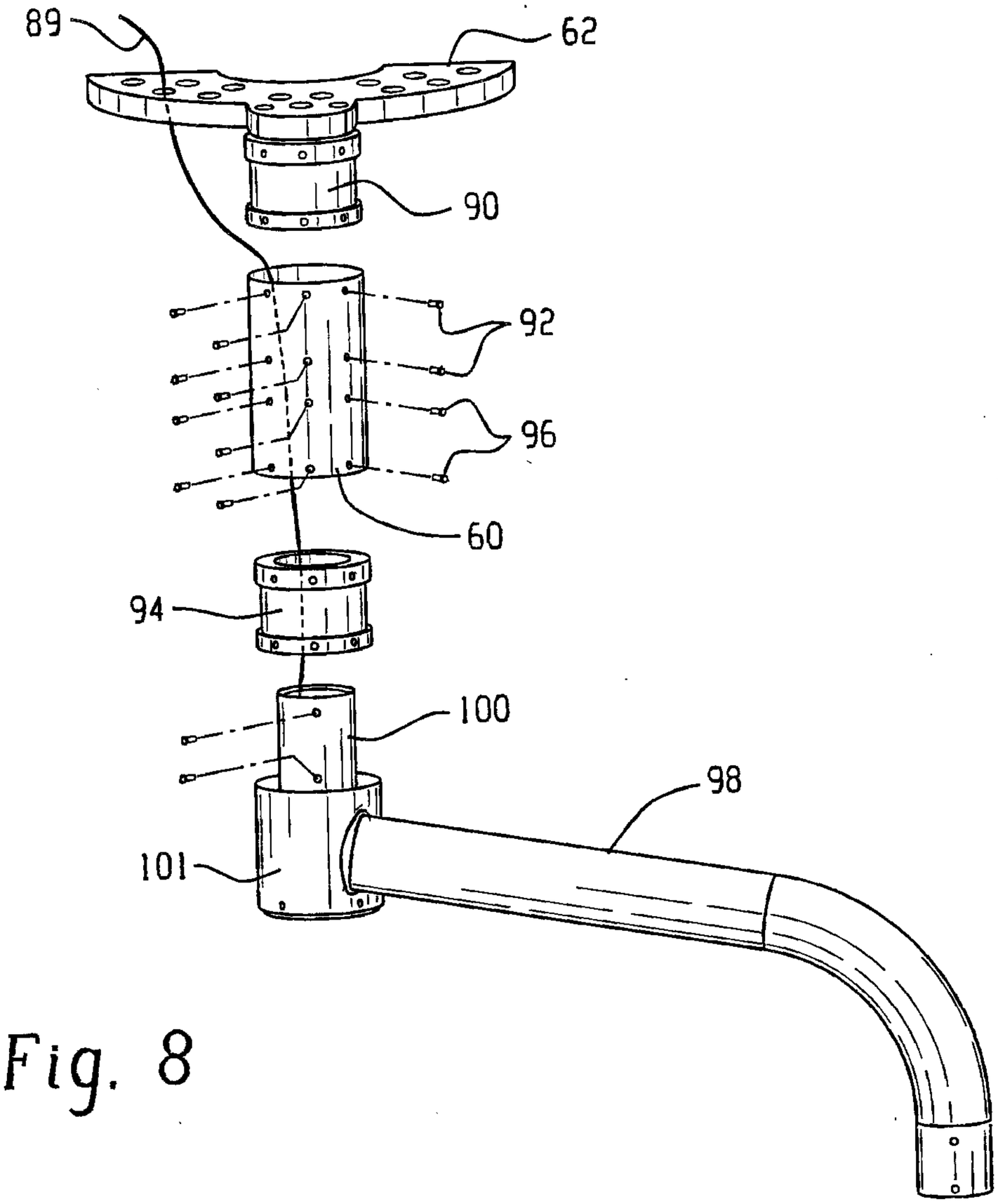


Fig. 8

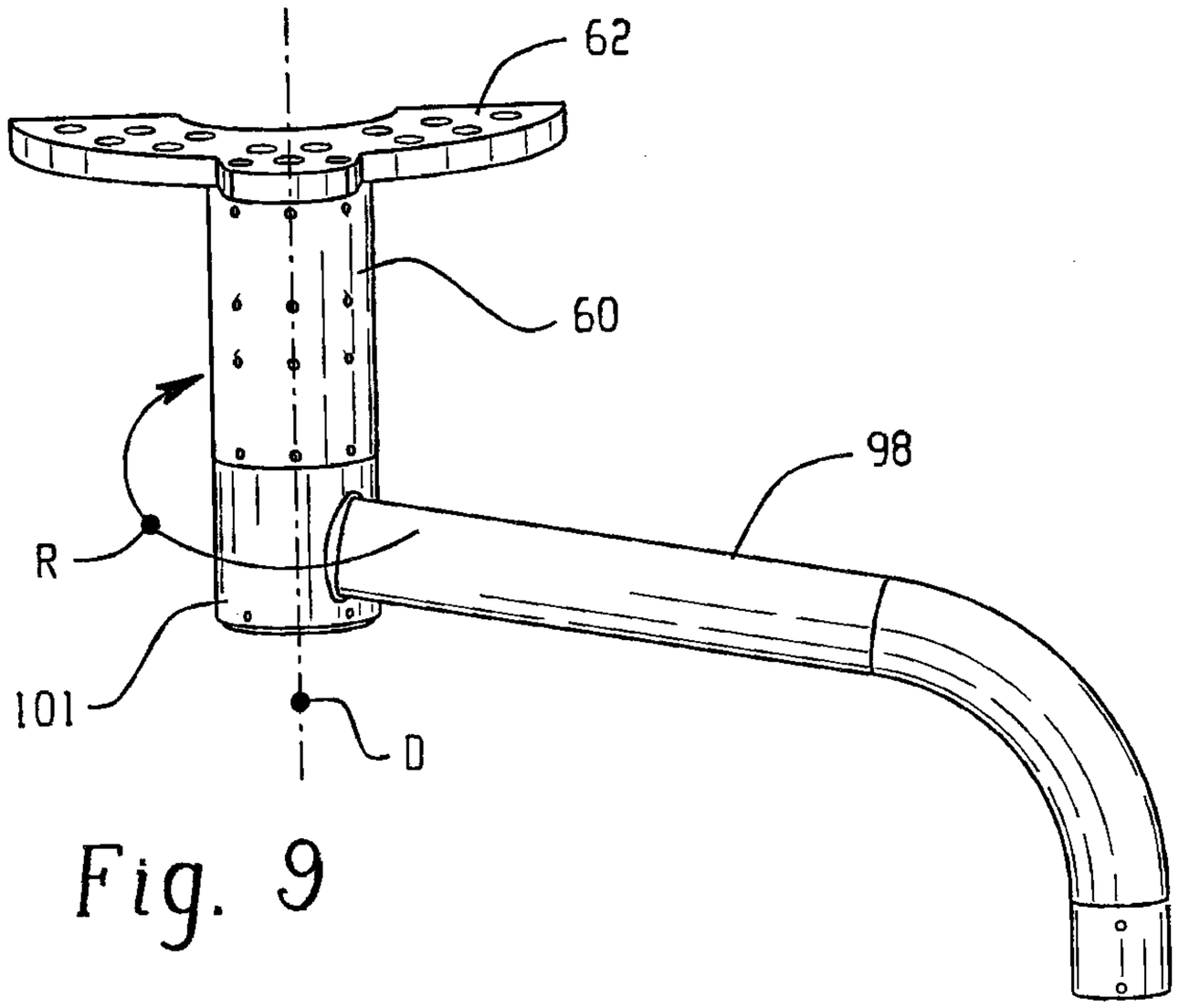


Fig. 9

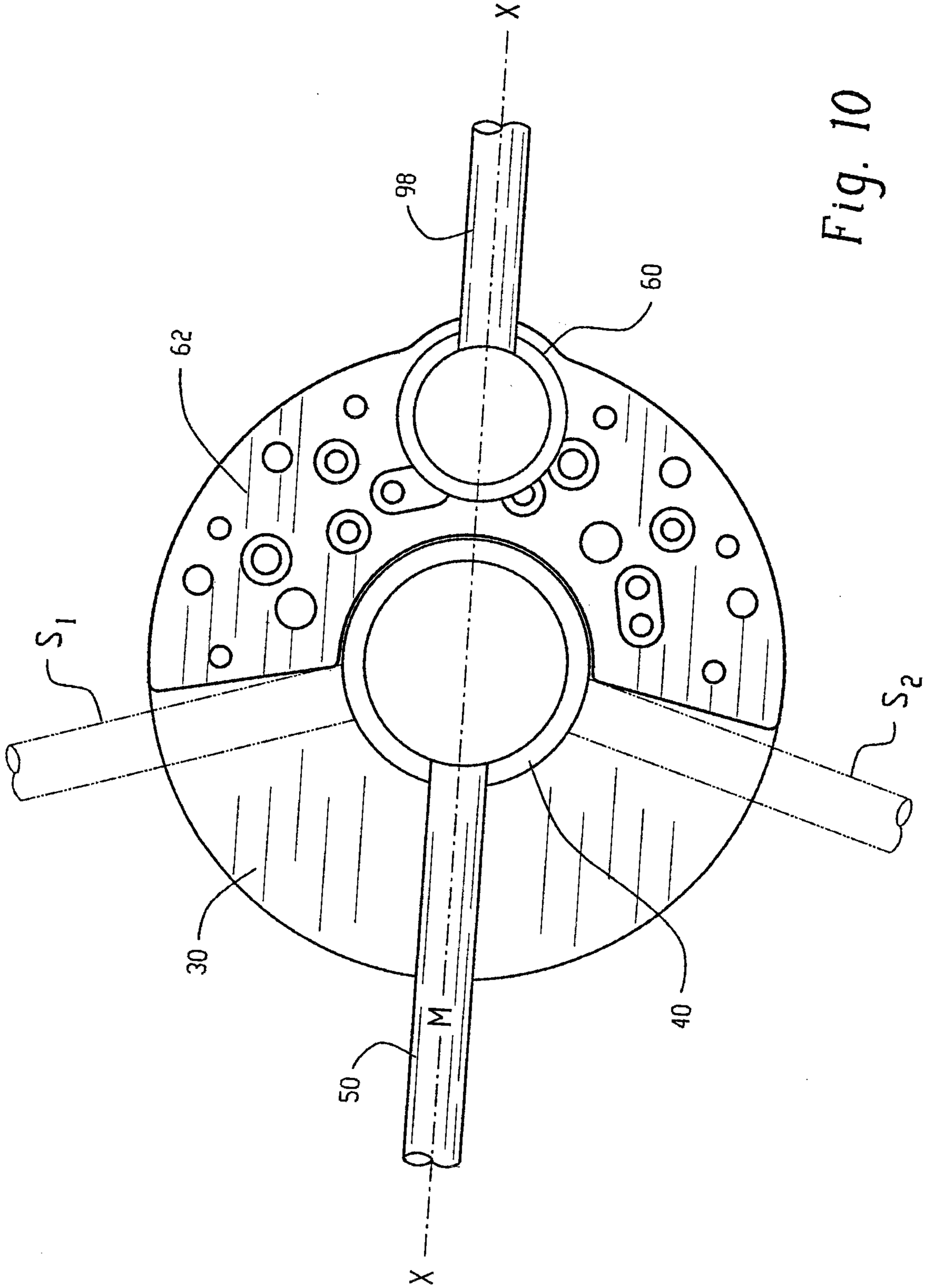


Fig. 10

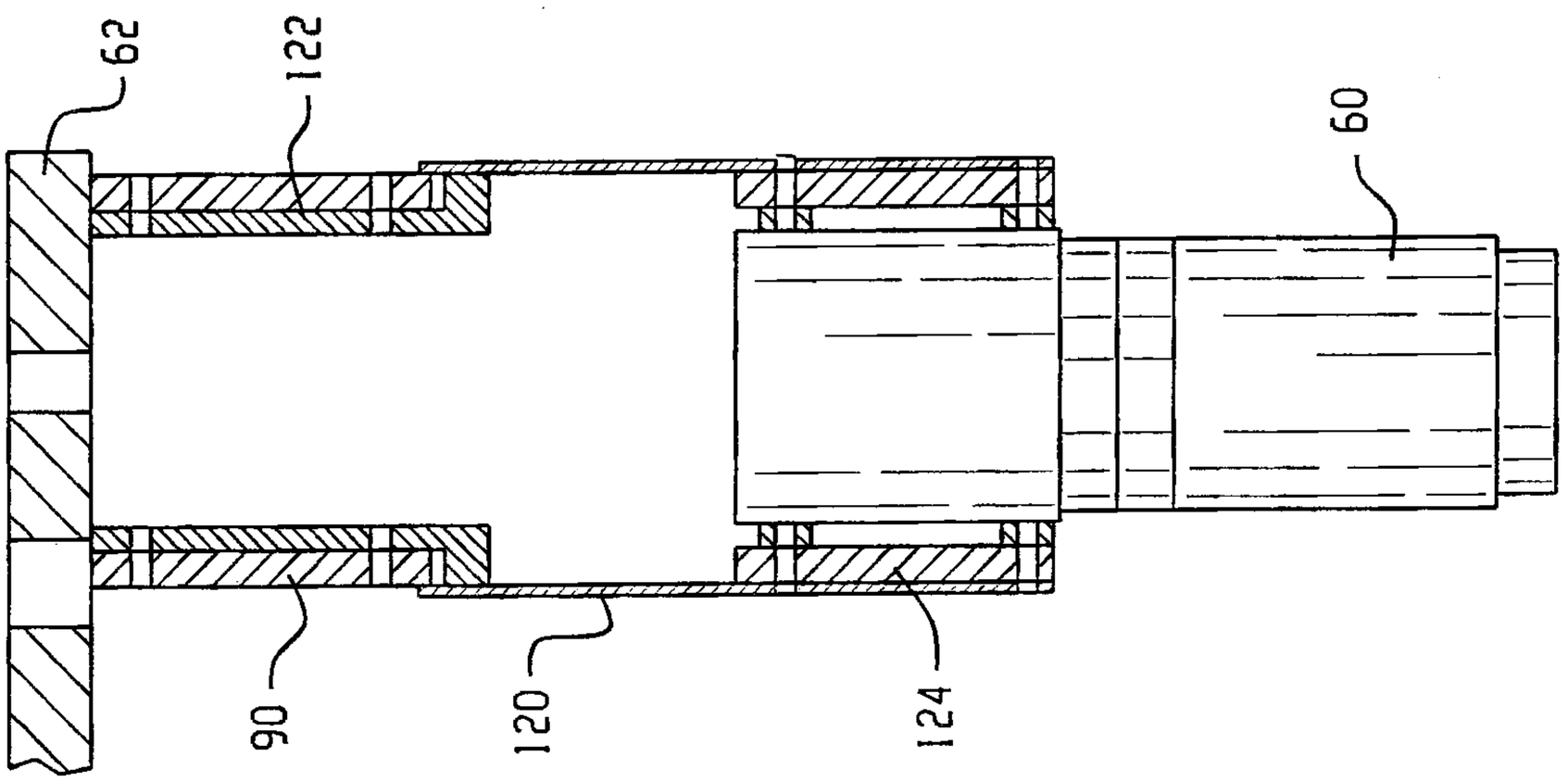


Fig. 13

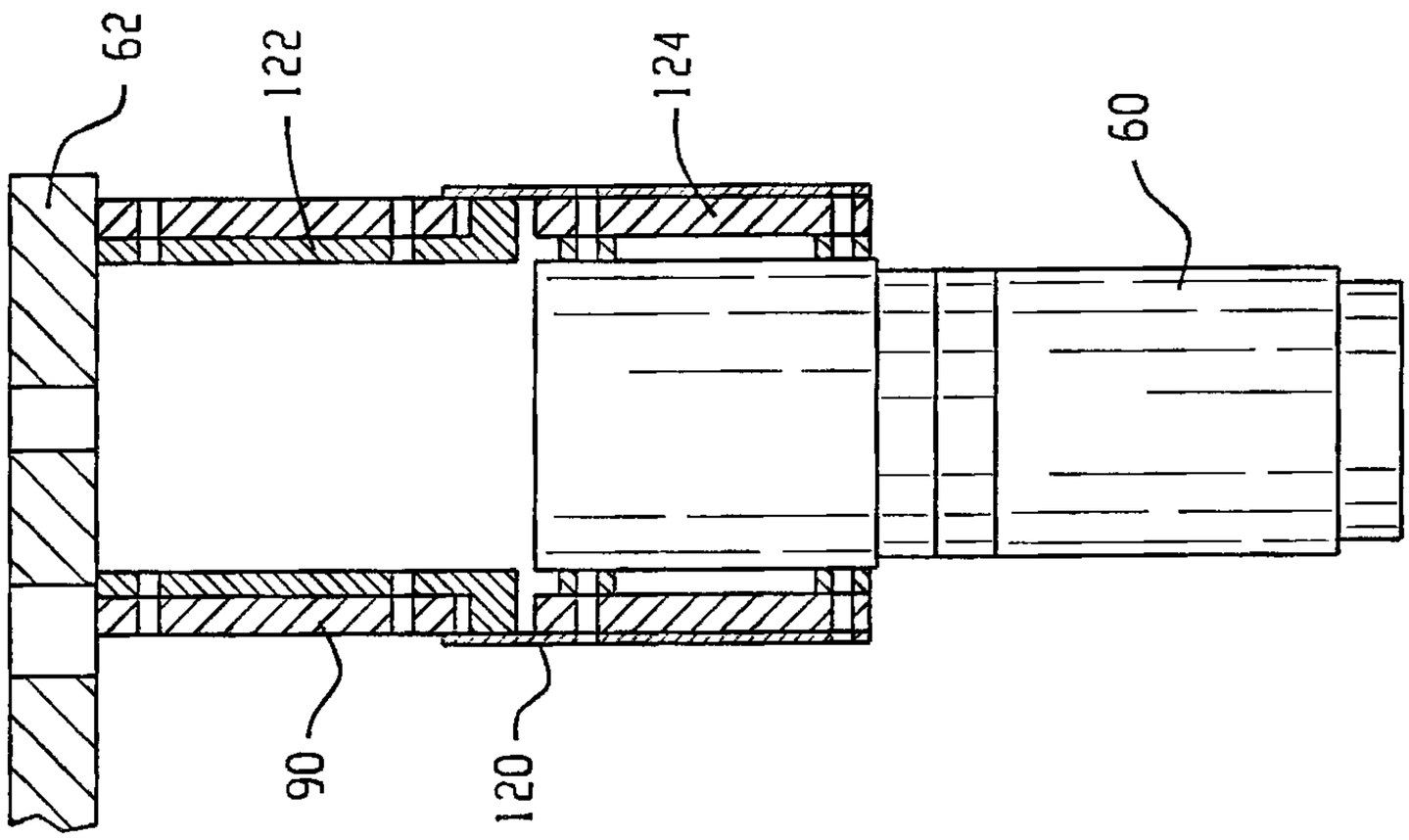


Fig. 12

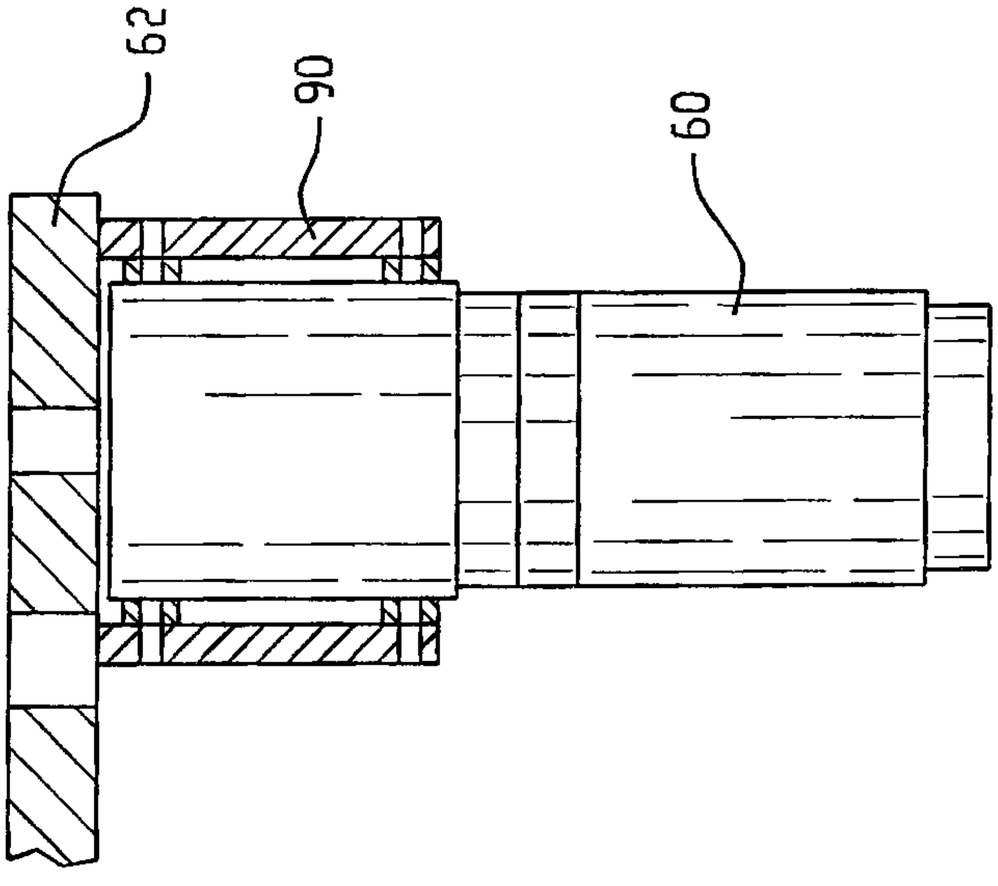


Fig. 11

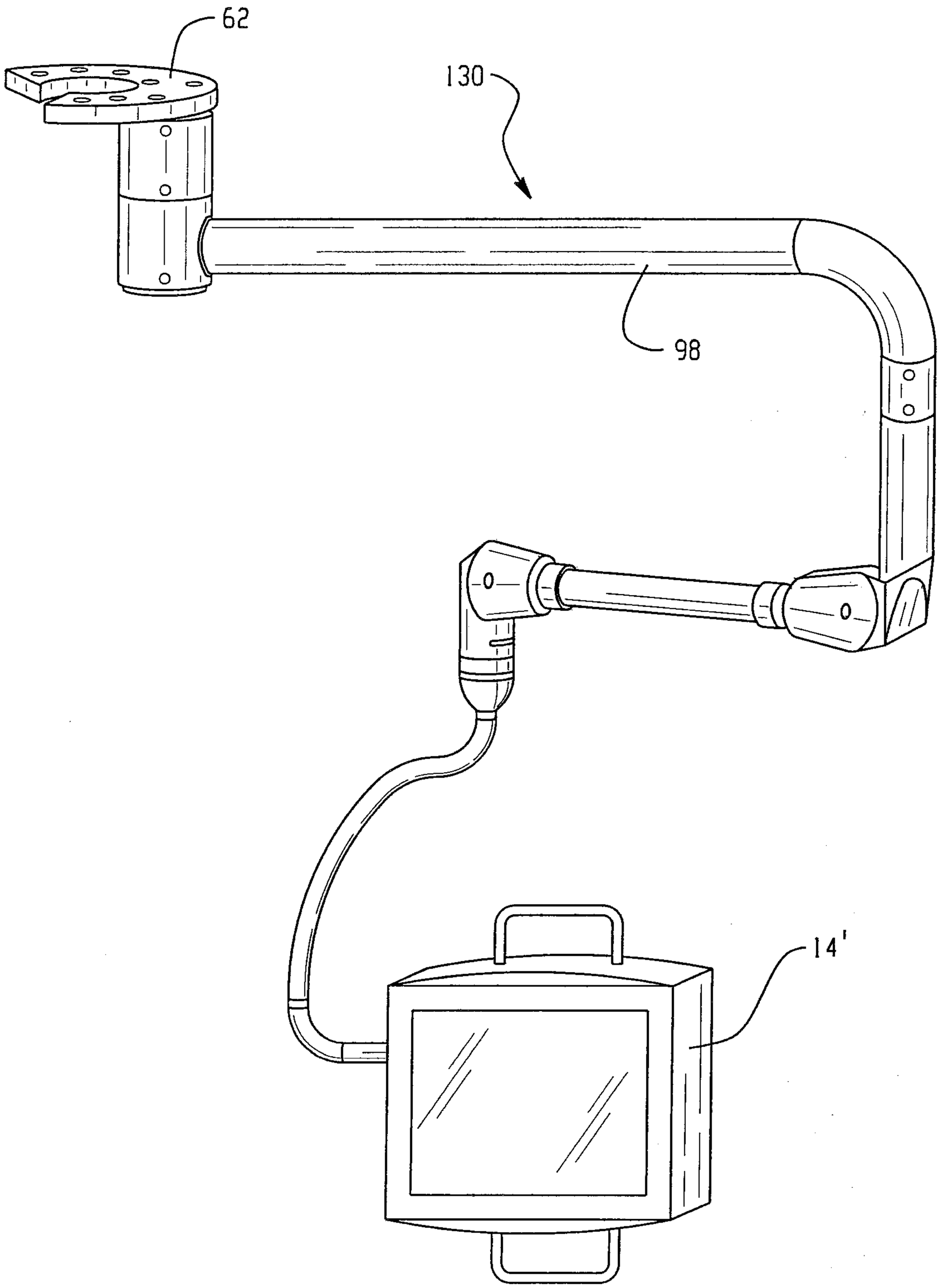
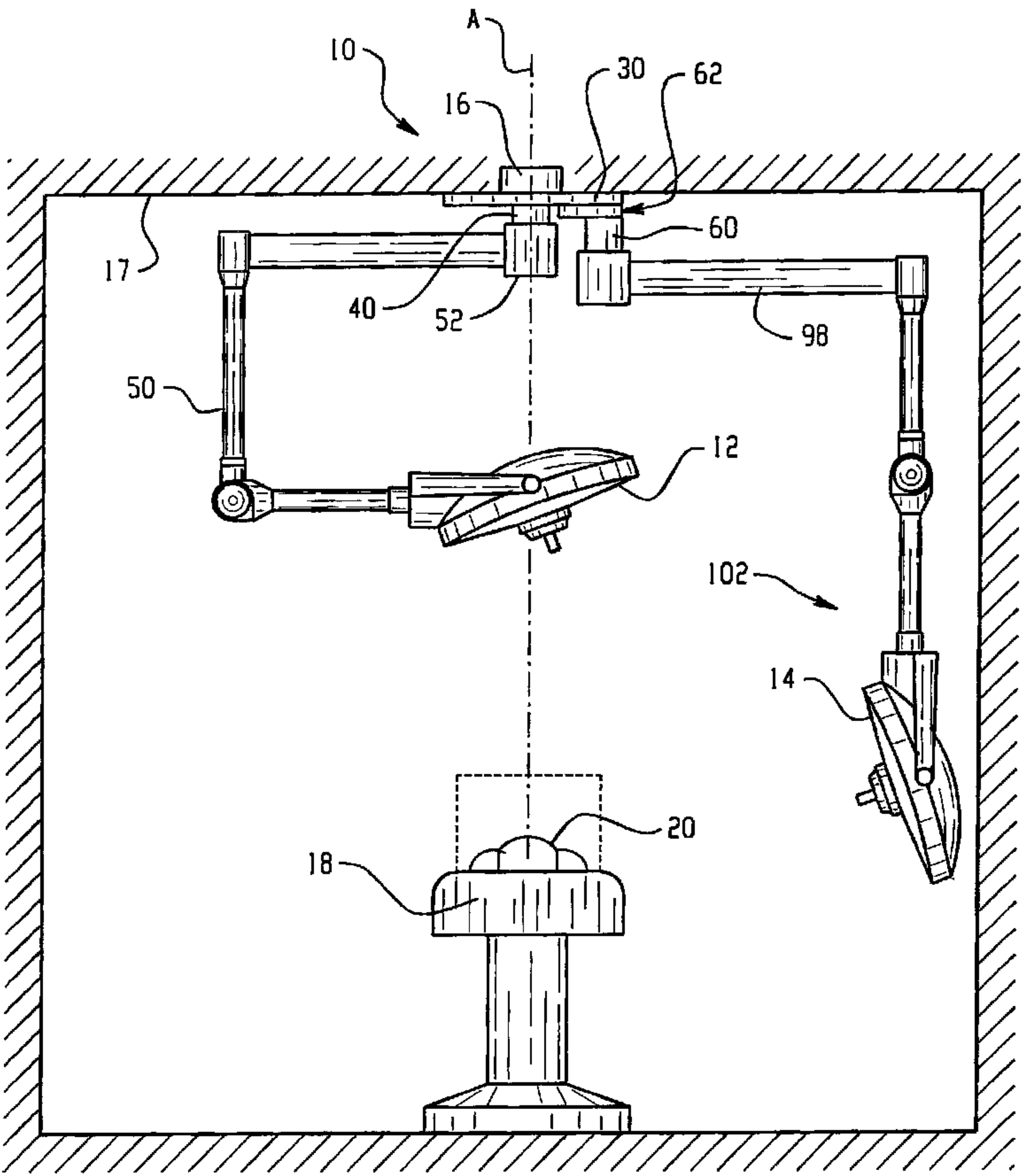


Fig. 14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