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CA 2728811 A1 2011/07/26

(21) **2 728 811**

**(12) DEMANDE DE BREVET CANADIEN
CANADIAN PATENT APPLICATION**

(13) A1

(22) Date de dépôt/Filing Date: 2011/01/18

(41) Mise à la disp. pub./Open to Public Insp.: 2011/07/26

(30) Priorités/Priorities: 2010/01/26 (US61/298,420);
2011/01/14 (US13/006,551)

(51) Cl.Int./Int.Cl. *F24F 13/14 (2006.01)*

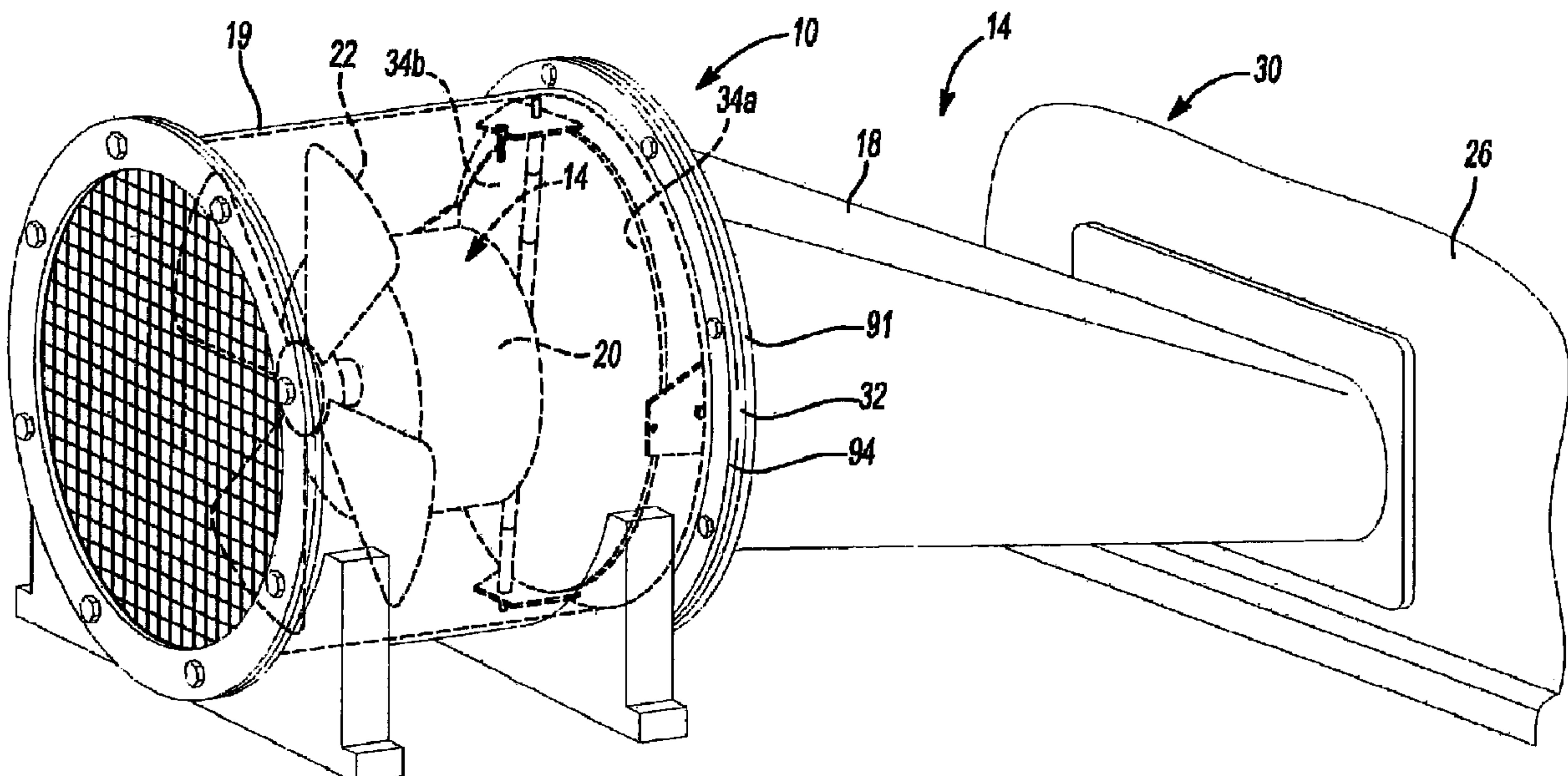
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(54) Titre : SYSTEME DE SOUPAPE ANTI-VIDE ET METHODE DE MONTAGE DE CELLE-CI

(54) Title: AIR CHECK VALVE SYSTEM AND METHOD OF MOUNTING SAME



(57) Abrégé/Abstract:

An air check valve system configured to be mounted for fluid communication with a fan can include a ring having a generally circular inner diameter that defines an air passage through a plane of the ring. A first and a second flange can extend from the ring. A rod can have a first end mounted to the first flange and a second end mounted to the second flange. The rod can define a pivot axis. A first and a second damper plate can be mounted to the rod for rotation around the pivot axis between an open and a closed position.

AIR CHECK VALVE SYSTEM AND METHOD OF MOUNTING SAME

ABSTRACT

An air check valve system configured to be mounted for fluid communication with a fan can include a ring having a generally circular inner diameter that defines an air passage through a plane of the ring. A first and a second flange can extend from the ring. A rod can have a first end mounted to the first flange and a second end mounted to the second flange. The rod can define a pivot axis. A first and a second damper plate can be mounted to the rod for rotation around the pivot axis between an open and a closed position.

AIR CHECK VALVE SYSTEM AND METHOD OF MOUNTING SAME

FIELD

[0001] The present teachings relate to ventilation systems, and 5 particularly to an air check valve system for fans operable to be mounted in structures.

BACKGROUND

[0002] This section provides background information related to the 10 present disclosure which is not necessarily prior art.

[0003] Various structures, such as grain bins or farmhouses, may use ventilation systems to maintain a selected environment. The ventilation systems can ensure that a supply of fresh air and acceptable levels of various materials are maintained within the structure. For example, a ventilation system 15 can assist in removing less desirable compounds, such as carbon dioxide emitted by livestock within a farmhouse or moisture from grain within a grain bin. Therefore, the ventilation system may be used to move volumes of air and may generally include various fan systems to move the air.

[0004] Grain bins may be any appropriate housing configured for grain 20 storage. Grain bins can be generally round structures that include a raised floor creating an air plenum beneath the grain. The floor can be perforated so that air can pass from the plenum through the floor and grain to remove moisture from

the grain. Multiple fans can be arranged around the grain bin to push air into the air plenum.

[0005] In a ventilation system for a grain bin that includes two or more fans back pressure can be created by an operating fan. This can result in air flow toward a non-operating fan, causing its propellers to turn in the opposite (i.e., reverse of normal) direction. Thus, the motor needs additional power to overcome the load caused by such backflow from other fans that may be already on, which can cause the fan motor to experience overload or over-current. Therefore, it is desirable to inhibit strong backflow air through the fans that are otherwise in the deactivated or "off" position.

[0006] Moreover, in such ventilation systems it is desirable to minimize or eliminate moving components that may tend to cease, clog, stick or otherwise inhibit smooth operation. Furthermore, in some instances it may be desirable to retrofit existing ventilation systems to incorporate various ventilation components, such as dampers and the like. In such circumstances, it may be desirable to add such supplemental components without requiring additional space around the existing components and/or mounting hardware.

SUMMARY

[0007] This section provides a general summary of the disclosure, and is not a comprehensive disclosure of its full scope or all of its features.

[0008] An air check valve system configured to be mounted for fluid communication with a fan can include a ring having a generally circular inner

diameter that defines an air passage through a plane of the ring. A first and a second flange can extend from the ring. A rod can have a first end mounted to the first flange and a second end mounted to the second flange. The rod can define a pivot axis. A first and a second damper plate can be mounted to the rod

5 for rotation around the pivot axis between an open and a closed position. The pivot axis of the rod can define a non-parallel angle with the plane of the ring, such that the first and second damper plates are influenced by gravity to locate at the closed position when the fan is in a deactivated state and air flow generated by the fan in an activated state urges the damper plates into the open position.

10 [0009] According to additional features, the first flange can define a first flange mounting aperture that is located at a first distance from the ring. The second flange can define a second mounting aperture that is located at a second distance from the ring. The second distance can be greater than the first distance. A third and a fourth flange can extend from the ring. The third and

15 fourth flanges can have stops that extend therefrom and are adapted to engage the first and second dampers, respectively, when the first and second dampers are located in the closed position.

[0010] According to still other features, a first volume of air is urged through the air passage in the open position and a second volume of air is

20 permitted to flow through the air passage when the first and second dampers are in the closed position. The second volume of air is non-zero and less than the first volume of air. The first and second flanges can be diametrically opposed. The third and fourth flanges can also be diametrically opposed. The ring can be

adapted to be mounted relative to the fan, such that the second flange is closest to ground relative to the first, third and fourth flanges. In one example, the first and second flanges both have a generally semicircular shape.

[0011] A method of mounting an air check valve relative to a transition duct and a fan can include, disconnecting a fan collar extending from the fan from a transition duct collar extending from a transition duct. An outer ring of the check valve can be positioned between the fan collar and the transition duct collar. The air check valve can have a first and a second damper plate that are both rotatably mounted around a rod at a non-parallel angle relative to a plane of the ring. The outer ring can be coupled between the fan collar and the transition duct collar, such that the first and second damper plates are influenced by gravity to locate at a closed position when the fan is in a deactivated state and wherein airflow generated by the fan in an activated state urges the damper plates into an open position.

[0012] According to additional features, positioning the outer rod can include orienting the rod in a generally upright position relative to ground. Disconnecting the fan collar from the transition duct collar can comprise removing fasteners that extend through respective apertures formed through the fan collar and the transition duct collar. Positioning the outer ring of the air check valve can include aligning ring apertures formed through the ring with the apertures formed through the fan collar and the transition duct collar. According to one example, coupling the outer ring can comprise locating fasteners through

axially aligned apertures of the fan collar, ring and transition duct collar. The respective fasteners can then be threadably advanced into a secure position.

[0013] Further areas of applicability will become apparent from the description provided herein. The description and specific examples in this 5 summary are intended for purposes of illustration only and are not intended to limit the scope of the present disclosure.

DRAWINGS

[0014] The drawings described herein are for illustrative purposes only 10 of selected embodiments and not all possible implementations, and are not intended to limit the scope of the present disclosure.

[0015] Fig. 1 is a side perspective view of an aeration system having an air check valve system according to the present teachings and mounted between a fan and a transition duct that is attached to an exemplary grain bin;

15 [0016] Fig. 2 is a side perspective view of the air check valve system of Fig. 1;

[0017] Fig. 3 is an exploded view of the air check valve system of Fig. 2;

[0018] Figs. 4A-4C illustrates an exemplary installation sequence 20 where a fan is initially disconnected from a transition duct, the air check valve system coupled to the transition duct and the fan coupled back to the transition duct, thereby capturing the air check valve system between the transition duct and the fan;

[0019] Fig. 5 is a side view of an adapter ring and a pivot rod of the air check valve system of Fig. 2;

[0020] Fig. 6 is a side view of the air check valve system of Fig. 2 and shown with a pair of semicircular damper plates in an open position;

5 [0021] Fig. 7 is a side view of the air check valve system shown in Fig. 6 and with the damper plates in a closed position; and

[0022] Fig. 8 is a partial rear perspective view of the air check valve system illustrating a pair of stoppers that are configured to limit rotational movement of the damper plates in the closed position.

10 [0023] Corresponding reference numerals indicate corresponding parts throughout the several views of the drawings.

DETAILED DESCRIPTION

[0024] Example embodiments will now be described more fully with 15 reference to the accompanying drawings.

[0025] With initial reference now to Figs. 1 and 2, an air check valve system constructed as one example of an air check valve system in accordance with the present teachings is shown and generally identified at reference numeral 10. The air check valve system 10 is illustrated operatively assembled as part of 20 an aeration system 12 for a grain bin 30. The air check valve system 10 can be mounted between a fan assembly 14 and a transition duct 18. The fan assembly 14 can generally include a fan housing 19 that includes a fan motor 20 that rotationally drives a fan blade 22. While the fan assembly 14 can be an axial fan

as illustrated. Other configurations are contemplated. The transition duct 18 can generally take the shape of a cylindrical or oval cross-section that fluidly connects the fan housing with an enclosure wall 26 of an enclosure 30. In the particular example shown, the enclosure 30 is depicted as a grain bin although it

5 is contemplated that the air check valve system 10 is operable for connection to other enclosures such as farmhouses. Furthermore, it will be appreciated that while only one fan assembly 14 is illustrated as communicating with the grain bin 30, two or more fan assemblies 14 (e.g. identical to that illustrated in Fig. 1) can be arranged around the grain bin 30 for communication with an air plenum of the

10 grain bin 30.

[0026] In general, the air check valve system 10 can be utilized in such a grain bin such as the grain bin 30 where multiple aeration fans are communicating air into or out of the grain bin 30. The air check valve system 10 can minimize the potential for motor overload in instances where back flow from

15 the remaining fans may otherwise be causing the fan blade 22 to be rotating in an opposite (reverse) direction. Furthermore, the air check valve system 10 can be useful to minimize air leakage from the other fans when full aeration power is unnecessary. In particular, the air check valve system 10 can allow a user to decide how many fan assemblies 14 may be necessary to turn on for a given

20 application. As will be described, the air check valve system can be specifically configured as an accessory add-on system to a current axial fan transition. The air check valve system 10 is specifically arranged to allow semicircular shaped damper plates to close automatically and limit the volume of back flow air

passing through it when the other fans connected to the grain bin 30 are turned on.

[0027] With continued reference now to Fig. 2 and additional reference to Fig. 3, the air check valve system 10 will be described in greater detail. The 5 air check valve system 10 can include an outer, annular, substantially flat, ring 32, a pair of damper plates 34a and 34b, a pivot rod 36 and three stops 40. The ring 32 can be of a circular annular shape having an outer perimeter 44 and an inner perimeter 46. A series of flanges 50a, 50b, 50c and 50d can extend from the inner perimeter 46 of the ring 32. In one example, the flanges 50a-50d can 10 be integrally formed or monolithic with the ring 32. The ring 32 can be formed of a rigid material, such as metal including, but not limited to, stainless steel, steel and aluminum. As in the illustrated example, the flanges 50a-50d can each be formed having the same shape. For purposes of the following discussion the flange 50a will be referred to as an upper flange, the flange 50b will be referred 15 to as the lower flange and the flanges 50c and 50d will be referred to as side flanges. The terms "upper" and "lower" are denoted to establish the mounting locations of the respective flanges in relation to ground. Each of the flanges 50a- 20 50d can define an inner aperture 52a-52d and an outer aperture 54a-54d. The upper and lower flanges 50a and 50b can be diametrically opposed and the side flanges 50c and 50d can be diametrically opposed. The ring 32 also can define a plurality of adapter ring mounting apertures 60 formed therearound.

[0028] The damper plates 34a and 34b can each take the form of a semicircular shape, creating a butterfly valve. Both of the damper plates 34a and

34b can include hinge members 64a and 64b arranged on central lateral edges 66a and 66b of the respective damper plates 34a and 34b. The pivot rod 36 can define a pivot axis 70 and have a first (upper) end 73 and a second (lower) end 75. The stops 40 can include a pair of side stops 76a and 76b as well as an 5 upper stop 76c.

[0029] With specific reference now to Fig. 2, the exemplary air check valve system 10 is shown in an assembled configuration. As illustrated, the hinge members 64a and 64b of the respective damper plates 34a and 34b are mounted on the pivot rod 36 for rotational movement. Notably, in this example 10 the upper end 73 of the pivot rod 36 is mounted through the inner aperture 52a of the upper flange 50a while the lower end 75 of the pivot rod 36 is mounted through the outer aperture 54b of the lower flange 50b. In this way, the upper end 73 of the pivot rod 36 is mounted closer to the ring 32 than the lower end 75 of the pivot rod 36. The pivot rod 36 can have a length sufficient to extend 15 through apertures 52a and 54b and be secured in place. The rod 36 can be designed with a specific length to allow the fan transition duct 18 to capture the pivot rod 36 and hold the respective damper plates 34a and 34b (Fig. 4A). In other words the ends of the rod 36 can contact the interior surface of the fan 20 transition duct 18 or other duct into which it is mounted, thereby retaining the rod 36 within the apertures 52a and 54b. Therefore, no hardware is needed. As illustrated, the rod 36 can be positioned against the interior surface of a constant diameter portion of the transition collar 18. In another embodiment (not shown) ends of the pivot rod 36 can be threaded and a cooperating nut at each end can

be used to hold the pivot rod 36 in place. An upper stop 76c is shown mounted into the outer aperture 54a of the upper flange 50a. The upper stop 76c can have a nut 77c advanced thereon. Side stops 76a and 76b are shown mounted into the inner aperture 52c of the side flange 50c and the inner aperture 52d of 5 the side flange 50d, respectively. The side stops 76a and 76b can have nuts 77a and 77b, respectively advanced thereon.

[0030] As noted above, the pivot rod 36 can be mounted such that the pivot axis 70 is defined at a non-parallel angle relative to a plane 80 defined by the ring 32. In addition, the air check valve system 10 can be mounted such that 10 the plane 80 can be oriented substantially vertically. In this or other cases, the pivot rod 36 can be mounted such that the pivot axis 70 is defined at a non-parallel angle relative to both a vertical plane, and a horizontal plane. The angle of the pivot axis 70 (relative to plane 80, to a vertical plane, or to both) as described above can be selected based upon the specific needs of a particular 15 installation. In one example, the g_x force can be at least the minimum force to overcome internal friction force due to connections of the pivot rod 36, and the damper plates 34a and 34b. The maximum g_x can also greatly depend on the fan sizes. In some instances, this angle (e.g., Θ or angle 96) can be between about five degrees and about sixty degrees, or in other instances between about 20 five and about thirty degrees, or in still other instances, between about 5 degrees and about 15 degrees, or at about 7.25 degrees. This 7.25 degree angle may, for example, work well with the fans manufactured by CTB, Inc. and marketed under the name Brock® (as non-limiting examples).

[0031] As shown in Fig. 6, the angled orientation of pivot axis 70 results in the downward force of gravity g acting on each of the damper plates 34a and 34b in two components g_x and g_y . Both these component forces are shown perpendicular relative to each other, whereby the force g_x is parallel to the pivot axis 70. The gravity force component g_x operates on the damper plates 34a and 34b in the g_x direction which can tend to move them toward a closed position. Since gravity force component g_y is parallel to the pivot axis 70, it does not directly influence the movement of the damper plates 34a and 34b.

[0032] Briefly, during operation of the fan assembly 14, when the fan blade 22 is being driven by the motor 20 (i.e., "activated"), air is urged through the inner perimeter 46 of the ring 32 causing the damper plates 34a and 34b to be rotated toward each other (see also Figs. 6 and 8). The upper stop 76c will preclude the damper plates 34a and 34b from over-rotating or rotating generally more than 90 degrees from the closed position (see also Fig. 7). More specifically, the damper plates 34a and/or 34b can engage the upper stop 76c to limit over rotation. During movement of the damper plates 34a and 34b from a closed position to an open position, gravity force component g_x is overcome. Since gravity force component g_y does not need to be overcome during such movement, the damper plates 34a and 34b can be easily moved to an open position. In certain instances, the activated fan 14 is able to open the damper plates 34a and 34b with negligible static pressure losses. In other words, any resulting static pressure losses can be so small that they have essentially no impact on the overall efficiency of the ventilation system.

[0033] When the fan blade 22 is not being driven by the motor 20 (i.e., "deactivated") the gravity force component g_x can tend to move the damper plates 34a and 34b toward a closed position (see, e.g., Figs. 2 and 7). Thus, the air check valve system 10 does not require any supplemental mechanism (e.g., 5 such as a return spring) to urge the damper plates 34a and 34b to the closed position increasing reliability and reducing potential maintenance expenses. In the closed position, the damper plates 34a and 34b can be configured to engage the side stops 76a and 76b, respectively, to prevent further rotation.

[0034] Another force that can tend to move the damper plates 34a and 10 34b toward a closed position relates to stop 76c. Stop 76c can maintain the damper plates 34a and 34b in a "V" configuration that opens downstream, when they are in an open position. Thus, in the case where the illustrated fan assembly 14 is deactivated and experiencing backflow, for example, caused by 15 additional activated fan assemblies 14 communicating with the grain bin 30, this backflow impinges on the damper plates 34a and 34b in their open "V" configuration creating a force tending to move the damper plates 34a and 34b toward a closed position. In certain instances, it can be the combination of this backflow force and the gravity force component that together moves the damper plates 34a and 34b into a closed position.

20 **[0035]** With reference now to Figs. 4A-4D, an exemplary sequence for installing the air check valve system 10 will be described. Again, the air check valve system 10 can be particularly useful for mounting relative to an existing fan assembly 14 that is already coupled to a grain bin 30 by way of a transition duct

18. At the outset, a user can remove any fastening hardware 90 that are securely attached to a fan collar 92 of the fan housing 19 and a transition duct collar 94 of the transition duct 18. The hardware 90 can comprise a collection of nuts and bolts for example. However, any suitable attachment hardware may be 5 employed. Once the hardware 90 has been removed from fan collar apertures 91 of the respective fan collar 92 and transition duct apertures 93 of the transition duct collar 94, the fan assembly 14 can be moved away from the transition duct as illustrated in Fig. 4B.

[0036] Next, the air check valve system 10 can be placed onto the 10 newly exposed transition duct collar 94. Notably, the flange (i.e., the upper flange 50a) having the pivot rod 36 secured through its inner aperture (i.e., 52a, Fig. 3) is mounted towards an upper end (away from the ground) of the transition duct 18. Consequently, the flange (i.e., the lower flange 50b) having the pivot rod 36 mounted through its outer aperture 54b (Fig. 3) is arranged near a bottom 15 end of the transition duct 18 (closest to ground). At this point, the fan collar 92 can be moved against the ring 32 of the air check valve system 10. Fasteners such as the fasteners 90 can then be advanced through the fan collar apertures 91, the adapter ring mounting apertures 60 and the transition duct collar apertures 93. Thus, the substantially flat ring 32 can be sandwiched between fan 20 collar 92 and transition duct collar 94, thereby providing the only portion of the air check valve system 10 visible from the exterior of the aeration system 12. The substantially flat ring 32 has a thinness that can enable there to be no positional change to any existing mountings (e.g., 97) supporting the fan assembly 14, the

transition duct 18, or both. Similarly, the exemplary mounting method described can be accomplished without requiring any changes or modifications to an existing fan assembly 14 or transition duct 18.

[0037] With reference now to Figs. 5-8, the operation of the air check valve system 10 will be further described. As illustrated in Fig. 5, the pivot rod 36 is mounted such that it defines an angle 96 relative to the plane 80 of the ring 32. The angle 96 can be any suitable angle, such that the mass of the damper plates 34a and 34b can influence rotation around the pivot rod 36 to the closed position (Fig. 7) when the fan motor 20 is off. In general, when the fan motor 20 is turned off, the air check valve system 10 can be specifically designed to be automatically self-closing using gravity force component g_x as illustrated in Fig. 6. As mentioned above, gravity force component g_x acting on the damper plates 34a and 34b can be supplemented by a force that can be generated from backflow air impinging on the downstream face of the damper plates 34a and 34b that can be created when other fans connected to the grain bin 30 are turned on ("activated").

[0038] As illustrated in Fig. 8, a small air gap 98 still exists around the outer peripheral edges of the damper plates 34a and 34b when the damper plates 34a and 34b are in the closed position. The small gap 98 can permit a reduced volume of air to flow through the inner perimeter 46 of the ring 32. Depending upon the configuration, this gap 98 can have a minimum cross-sectional area defined by the space between the peripheral edges of the closed damper plates 34a and 34b and the ring 32. In many other instances, this gap

98 can have a minimum cross-sectional area defined by the space between the outer peripheral edges of the closed damper plates 34a and 34b and the adjacent inner surface of the transition duct. This minimal cross-sectional area of the gap 98 limits the small volume of air which is permitted to flow through the 5 small gap 98. Thus, the minimal cross-sectional area of the gap 98 can be smaller than that required to permit backpressure in the ventilation system 12 from generating enough airflow through the gap to impart counter-rotation to the blades 22 of fan 14 when the fan motor 20 is in an deactivated (inactive) state. In some cases, the minimal cross-sectional area of the gap 98 can be no more 10 than about twenty percent of the cross-sectional area of the transition duct at its collar 94, and in other cases no more than around five percent of such area.

[0039] The foregoing description of the embodiments has been provided for purposes of illustration and description. It is not intended to be exhaustive or to limit the disclosure. Individual elements or features of a 15 particular embodiment are generally not limited to that particular embodiment, but, where applicable, are interchangeable and can be used in a selected embodiment, even if not specifically shown or described. As but a few non-limiting examples, the hinge between the damper plates could be formed as a living hinge (which can have a tendency to move the damper plates toward a 20 closed position), or the stops could be provided by bending the flanges inwardly (rather than providing pins extending from the flanges). Countless other variations are possible and such variations are not to be regarded as a departure

from the disclosure, and all such modifications are intended to be included within the scope of the disclosure.

CLAIMS

What is claimed is:

1. An air check valve system configured to be mounted for fluid communication with a fan, the air check valve system comprising:
 - a ring having a generally circular inner diameter that defines an air passage through a plane of the ring;
 - a first and a second flange that extend from the ring;
 - a rod having a first end mounted to the first flange and a second end mounted to the second flange, the rod defining a pivot axis;
 - a first and a second damper plate that are mounted to the rod for rotation around the pivot axis between an open and a closed position; and
 - wherein the pivot axis of the rod defines a non-parallel angle with the plane of the ring such that the first and second damper plates are influenced by gravity to locate at the closed position when the fan is in a deactivated state and airflow generated by the fan in an activated state urges the damper plates into the open position.
2. The air check valve system of claim 1 wherein the first flange defines a first flange mounting aperture located at a first distance from the ring and the second flange defines a second mounting aperture located at a second distance from the ring, the second distance being greater than the first distance.

3. The air check valve of claim 2, further comprising a third and a fourth flange that extend from the ring, the third and fourth flanges having stops extending therefrom adapted to engage the first and second dampers, respectively, when the first and second dampers are located in the closed 5 position.

4. The air check valve of claim 3 wherein a first volume of air is urged through the air passage in the open position and a second volume of air is permitted to flow through the air passage when the first and second dampers are 10 in the closed position.

5. The air check valve of claim 4 wherein the second volume of air is non-zero and less than the first volume of air.

15 6. The air check valve of claim 3 wherein the third and fourth flanges are diametrically opposed and the first and second flanges are diametrically opposed.

7. The air check valve of claim 6 wherein the ring is adapted to be 20 mounted relative to the fan such that the second flange is closest to ground relative to the first, third and fourth flanges.

8. The air check valve of claim 1 wherein the first and second flanges both have a generally semicircular shape.

9. A method of mounting an air check valve relative to a transition 5 duct and a fan, the method comprising:

disconnecting a fan collar extending from the fan from a transition duct collar extending from the transition duct;

positioning an outer ring of the air check valve between the fan 10 collar and the transition duct collar, the air check valve having a first and a second damper plate that are rotatably mounted around a rod at a non-parallel angle relative to a plane of the outer ring; and

coupling the outer ring between the fan collar and the transition duct collar such that the first and second damper plates are influenced by gravity to locate at a closed position when the fan is in a deactivated state and wherein 15 airflow generated by the fan in an activated state urges the damper plates into an open position.

10. The method of claim 9 wherein positioning the outer ring comprises:

20 orienting the rod in a generally upright position relative to ground with an upper portion of the rod located closer to the outer ring than a lower portion of the rod.

11. The method of claim 10 wherein disconnecting the fan collar from the transition duct collar comprises:

removing fasteners that extend through respective apertures formed through the fan collar and the transition duct collar.

5

12. The method of claim 11 wherein positioning the outer ring of the air check valve comprises:

aligning ring apertures formed through the ring with the apertures formed through the fan collar and the transition duct collar.

10

13. The method of claim 12 wherein coupling the outer ring comprises:

locating fasteners through axially aligned apertures of the fan collar, ring and transition duct collar; and

threadably advancing the respective fasteners into a secure

15 position.

14. An air check valve system configured to be mounted for fluid communication with a fan, the air check valve system comprising:

a ring having a generally circular inner diameter that defines an air 20 passage through a plane of the ring;

a first and a second flange that extend in a diametrically opposed relationship from the ring, wherein the first flange defines a first flange mounting aperture located at a first distance from the ring and the second flange defines a

second mounting aperture located at a second distance from the ring, the second distance being greater than the first distance;

5 a rod having a first end positioned through the first flange mounting aperture and a second end positioned through the second flange mounting aperture;

a first and a second semi-circular damper plate that are mounted for rotation around the rod between an open and a closed position; and

wherein the second flange mounting aperture is located further away from the plane of the ring compared to the first flange mounting aperture
10 such that the first and second damper plates are influenced by gravity to locate at the closed position when the fan is in a deactivated state and airflow generated by the fan in an activated state urges the damper plates into the open position.

15. The air check valve of claim 14, further comprising a third and a
15 fourth flange that extend from the ring, the third and fourth flanges having stops extending therefrom adapted to engage the first and second dampers, respectively, when the first and second dampers are located in the closed position.

20 16. The air check valve of claim 15 wherein a first volume of air is urged through the air passage in the open position and a second volume of air is permitted to flow through the air passage when the first and second dampers are in the closed position.

17. The air check valve of claim 16 wherein the second volume of air is non-zero and less than the first volume of air.

5 18. The air check valve of claim 15 wherein the third and fourth flanges are diametrically opposed.

19. The air check valve of claim 18 wherein the ring is adapted to be mounted relative to the fan such that the second flange is closest to ground
10 relative to the first, third and fourth flanges.

20. The air check valve of claim 14 wherein the rod defines a pivot axis that is non-parallel relative to the plane of the ring.

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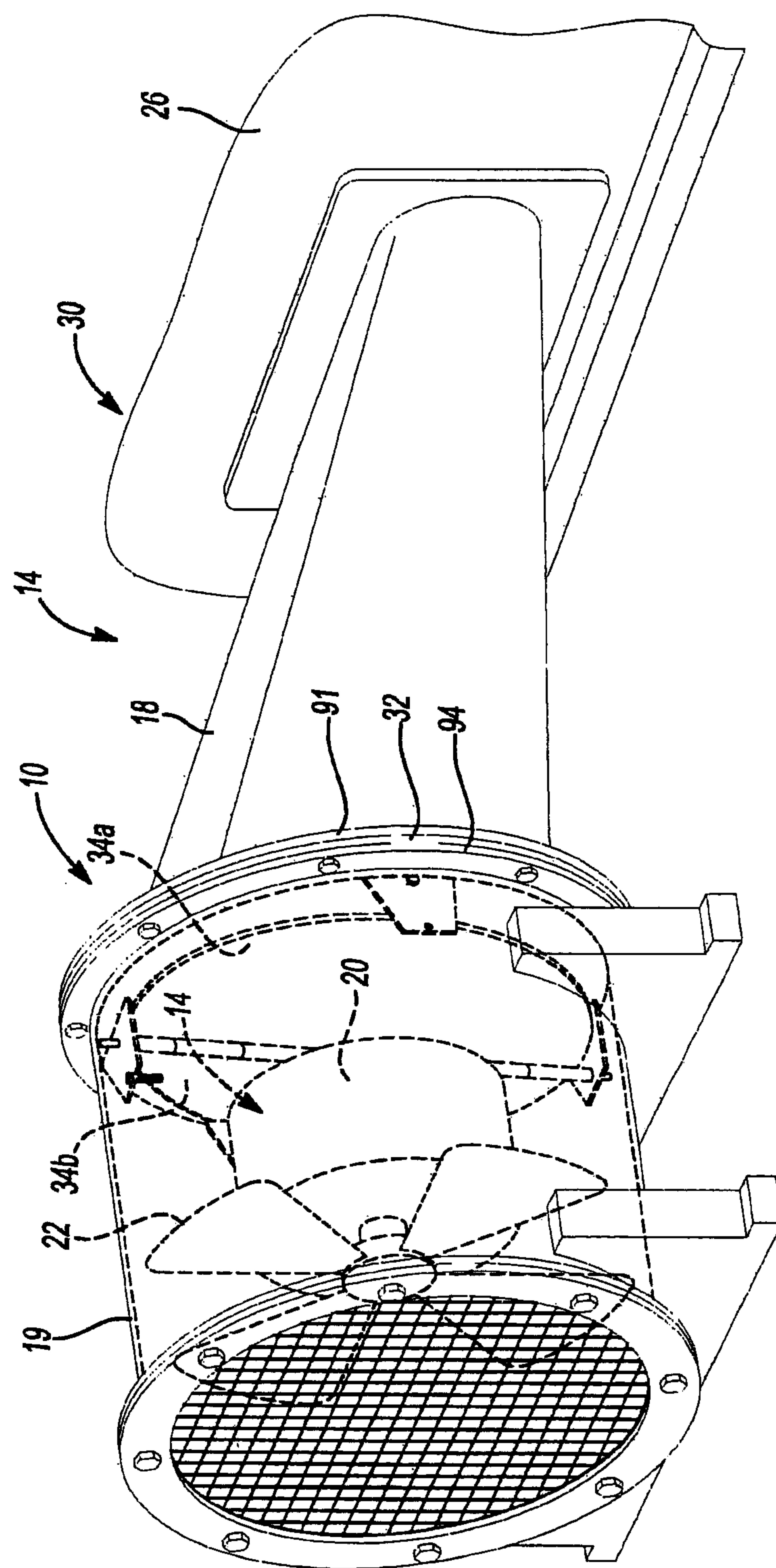


Fig-1

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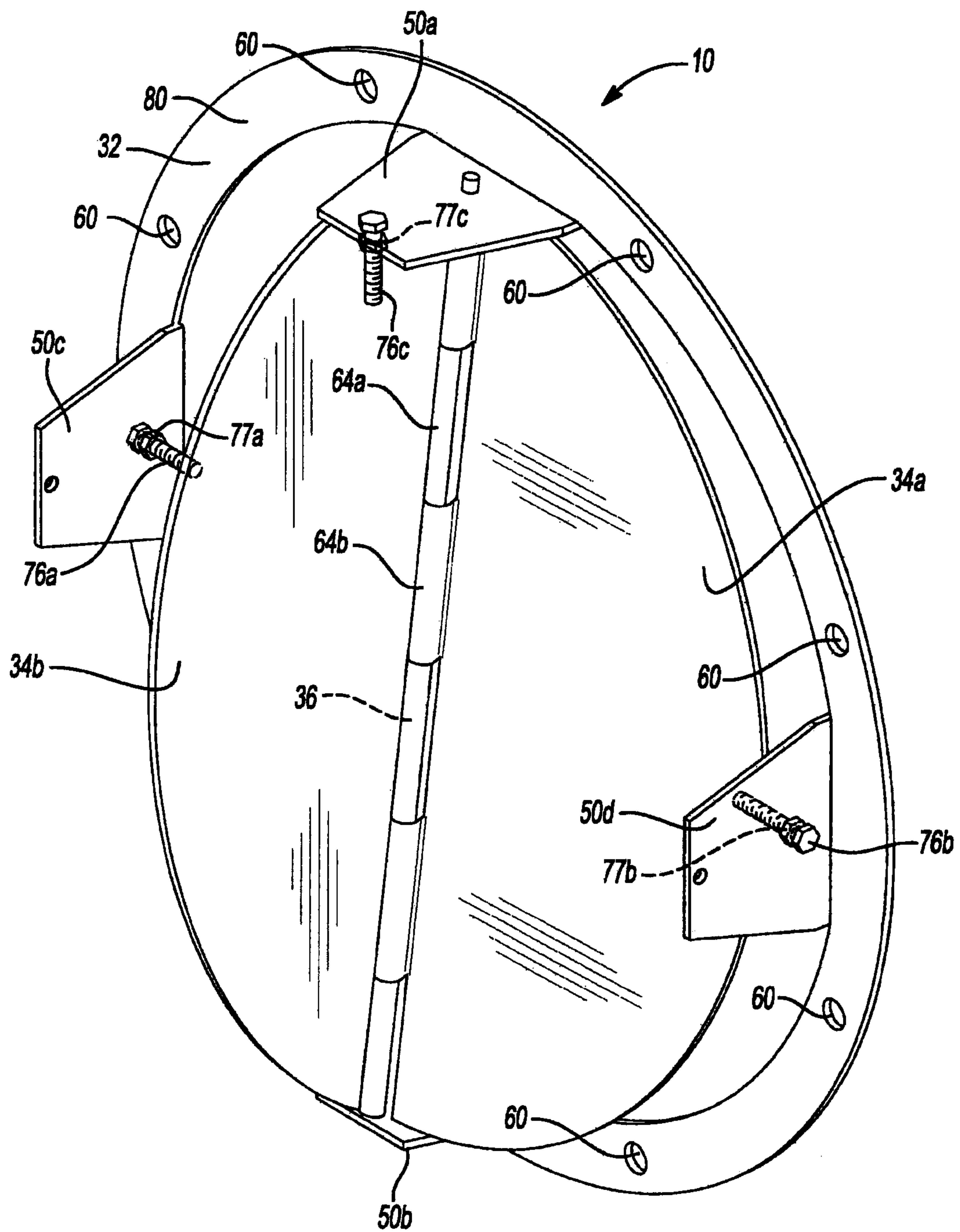
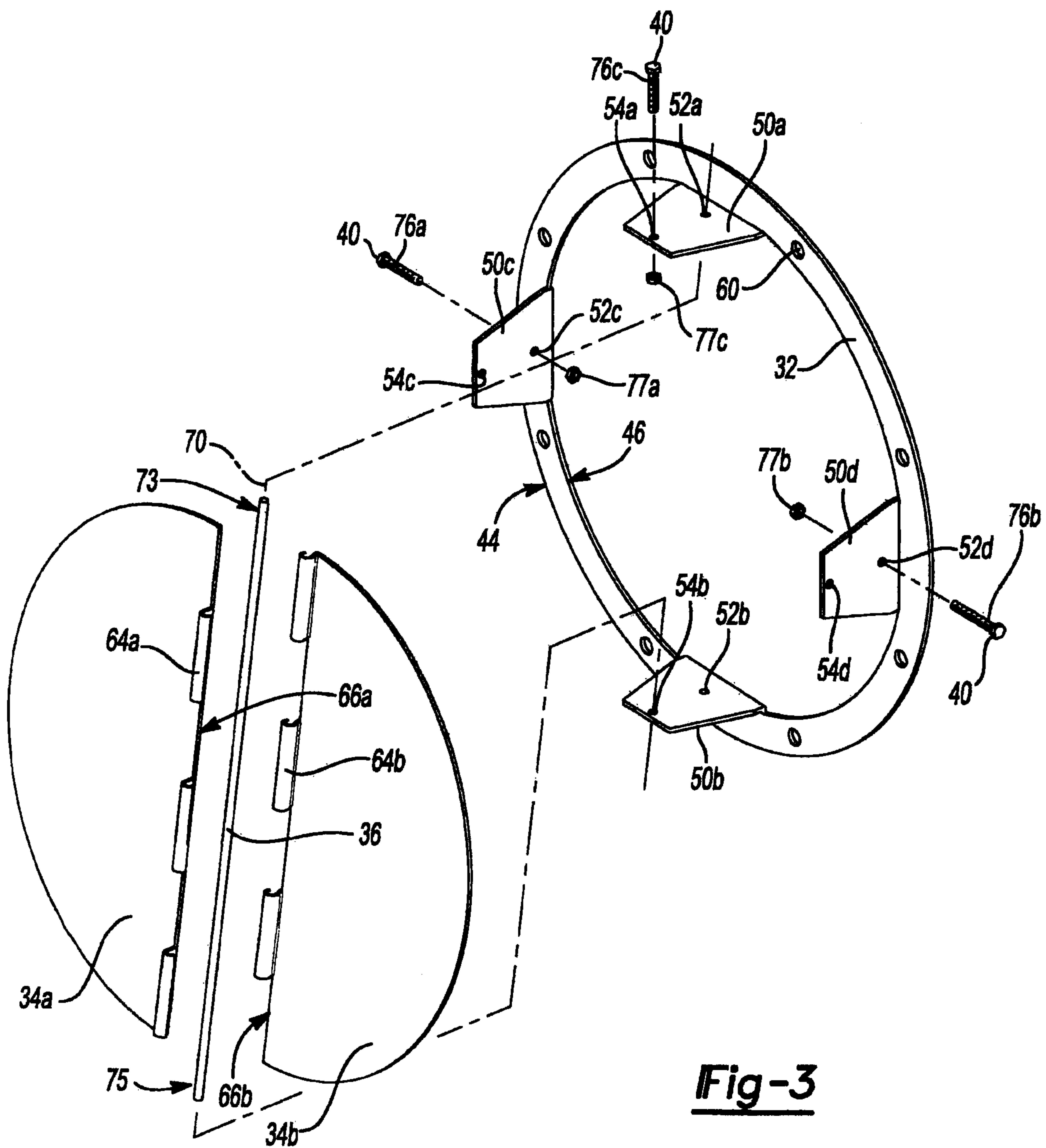


Fig-2

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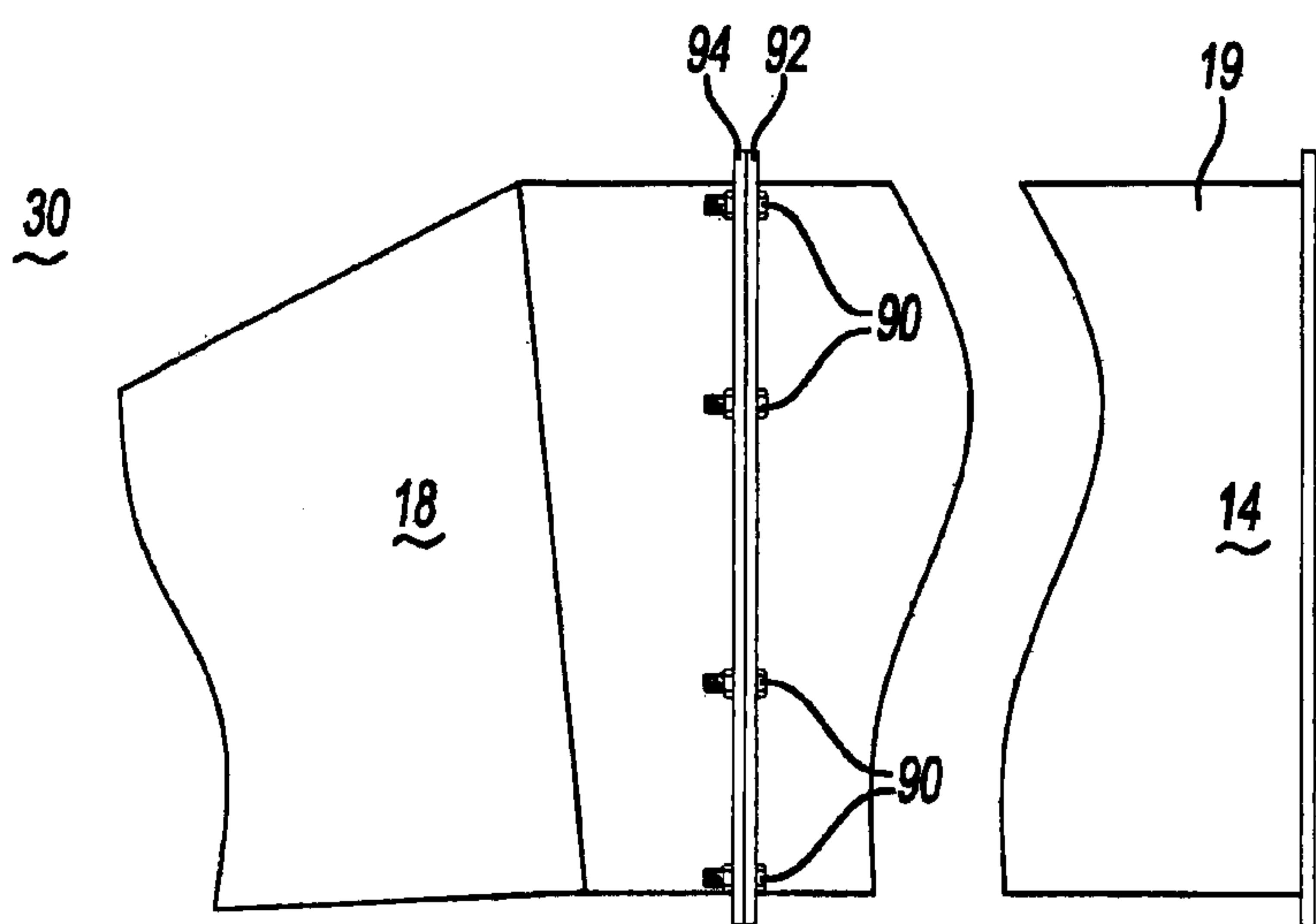


Fig-4A

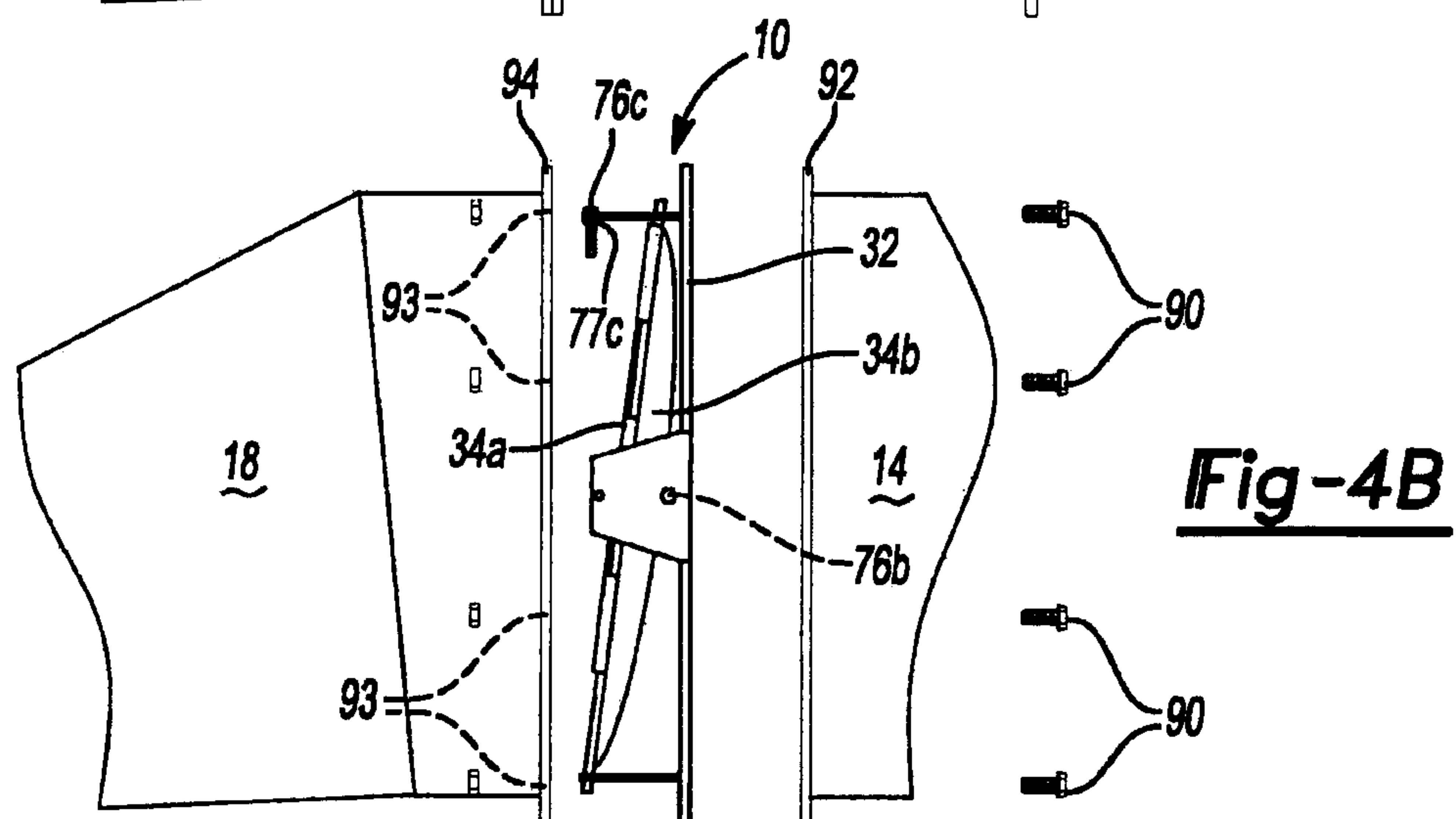


Fig-4B

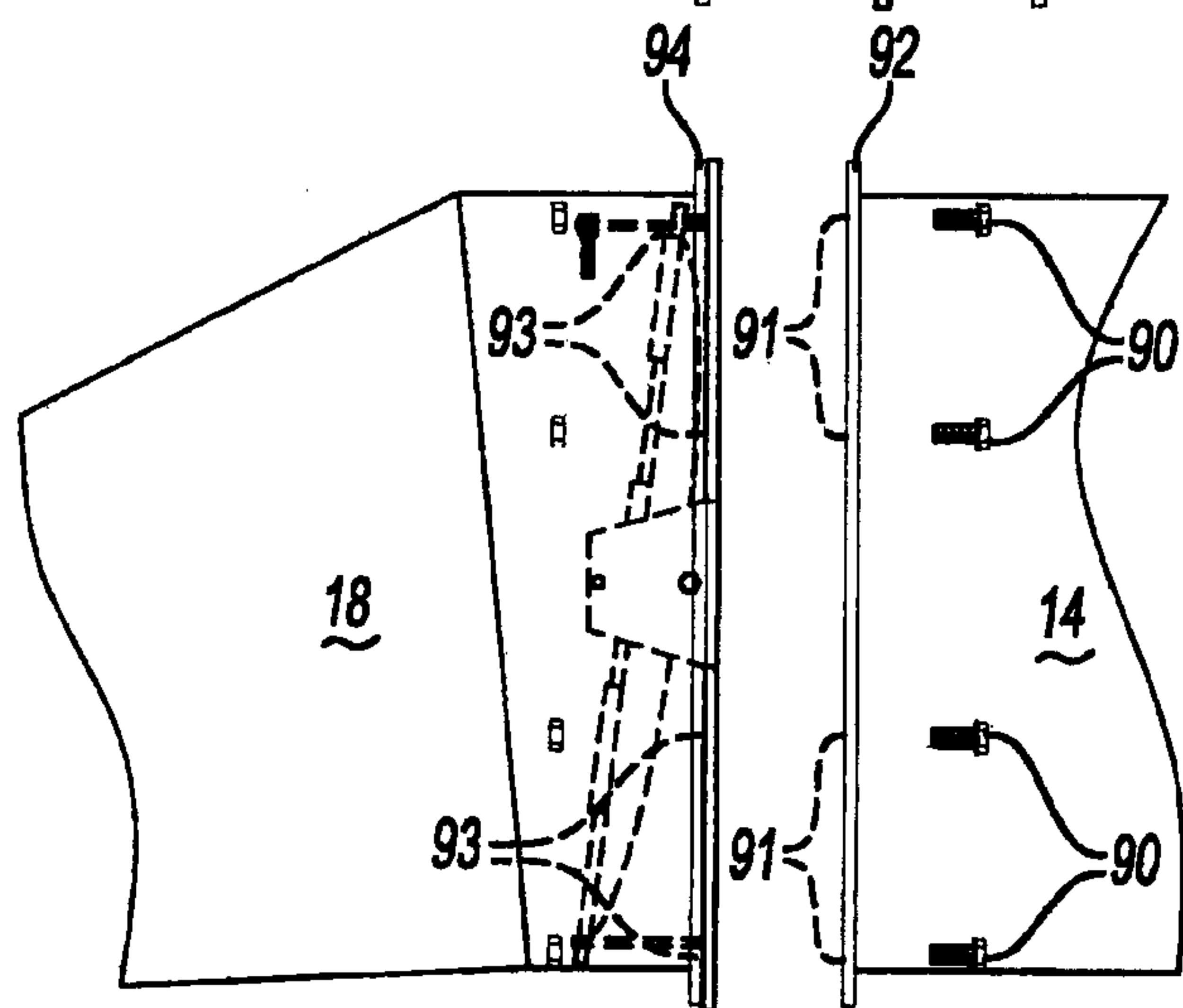
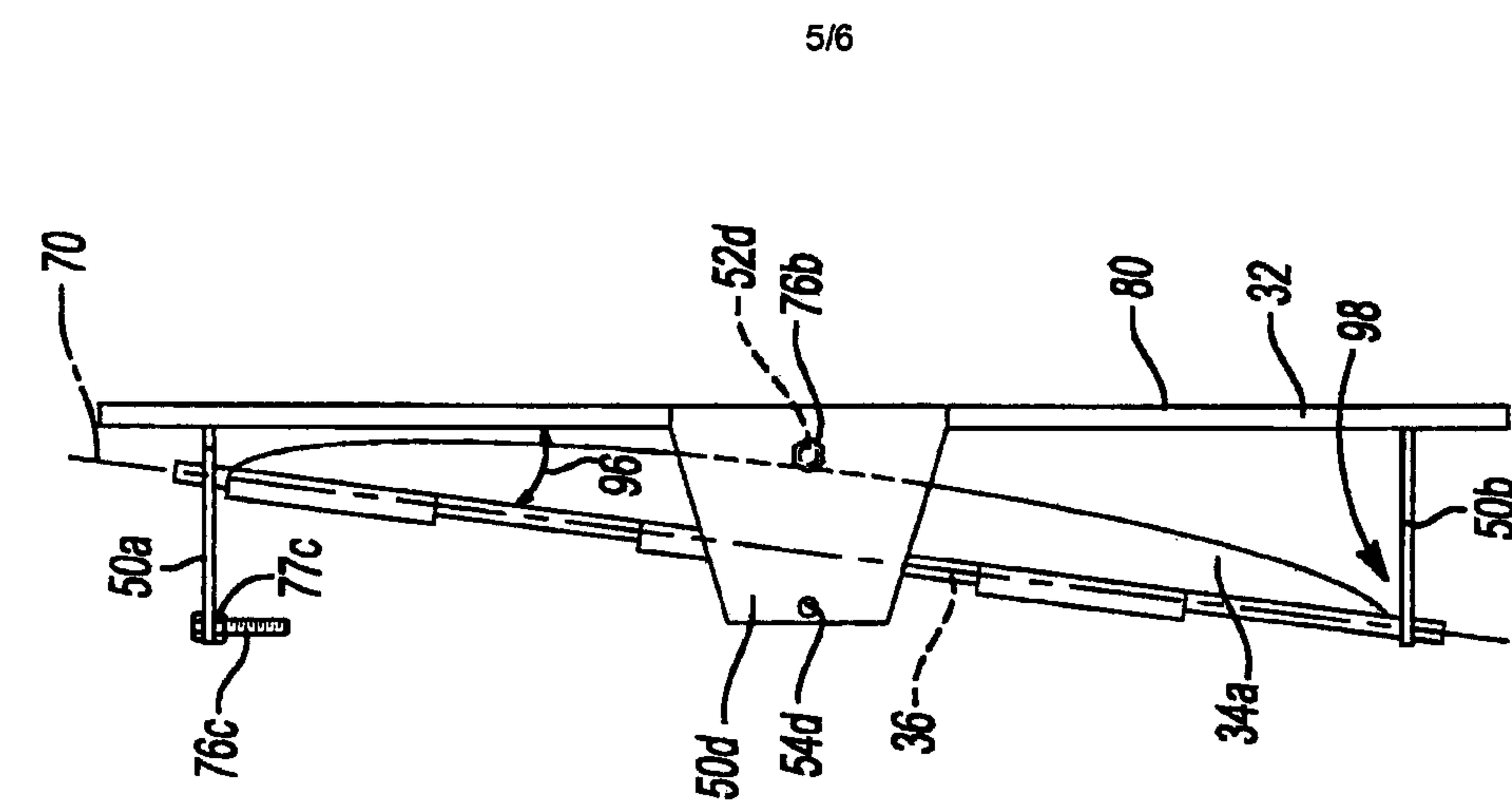
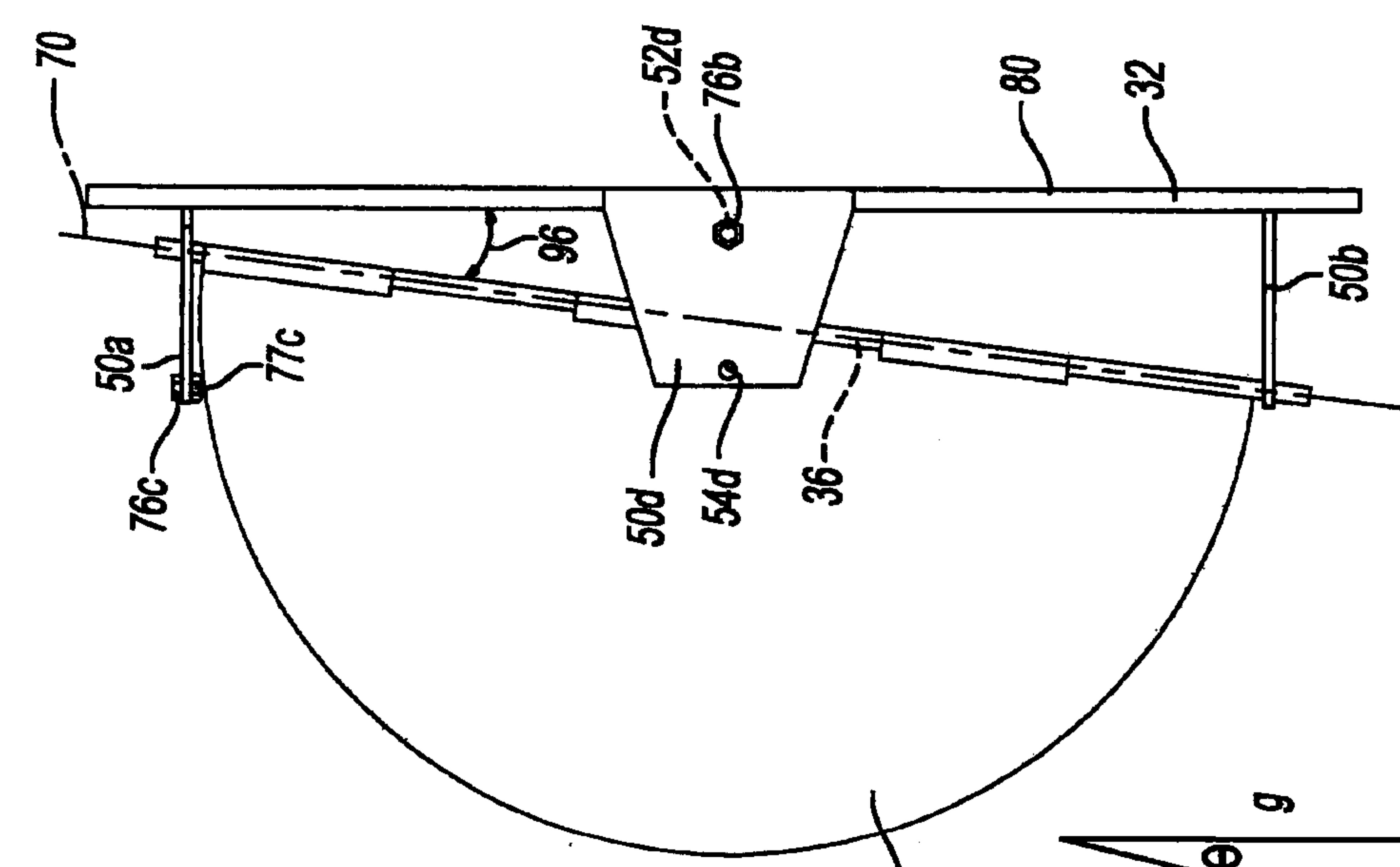
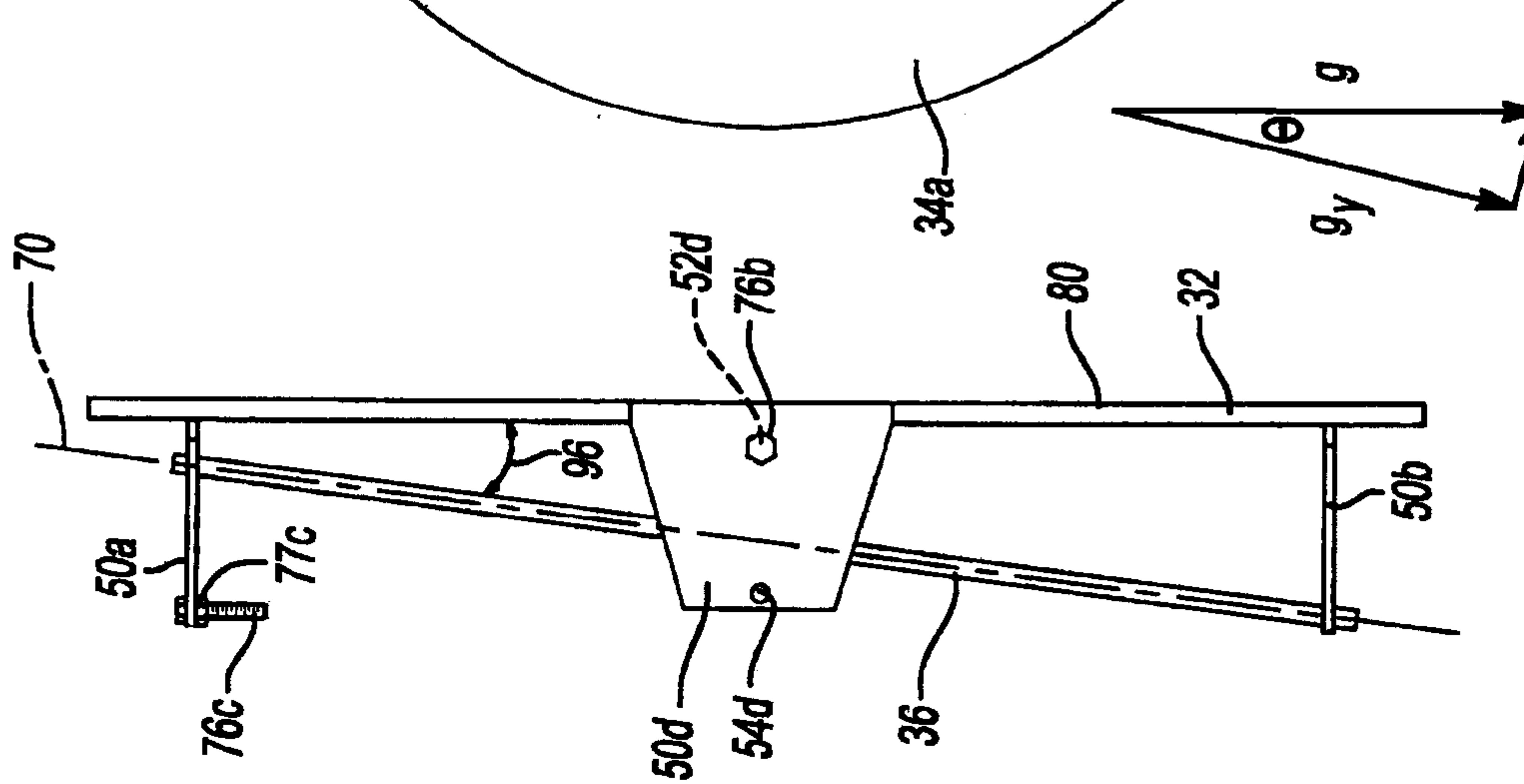


Fig-4C

Fig-7Fig-6Fig-5

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