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**Straight taper dipper**

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ABSTRACT

A dipper having an inlet and an outlet, and an inlet reference plane being defined at the inlet. The dipper includes a front wall and an opposite back wall extending between the inlet and the outlet. A front wall reference plane extends from the inlet to the outlet and is positioned between the front wall and the back wall. The dipper further includes two side walls connected between the front wall and the back wall and extending between the inlet and the outlet. The inlet has an inlet area in the inlet reference plane, wherein the outlet has an outlet area in an outlet reference plane substantially parallel to the inlet reference plane. The front wall, the back wall, and the two side walls are arranged such that the outlet area is at least 3 percent and no more than 25 percent greater than the inlet area.

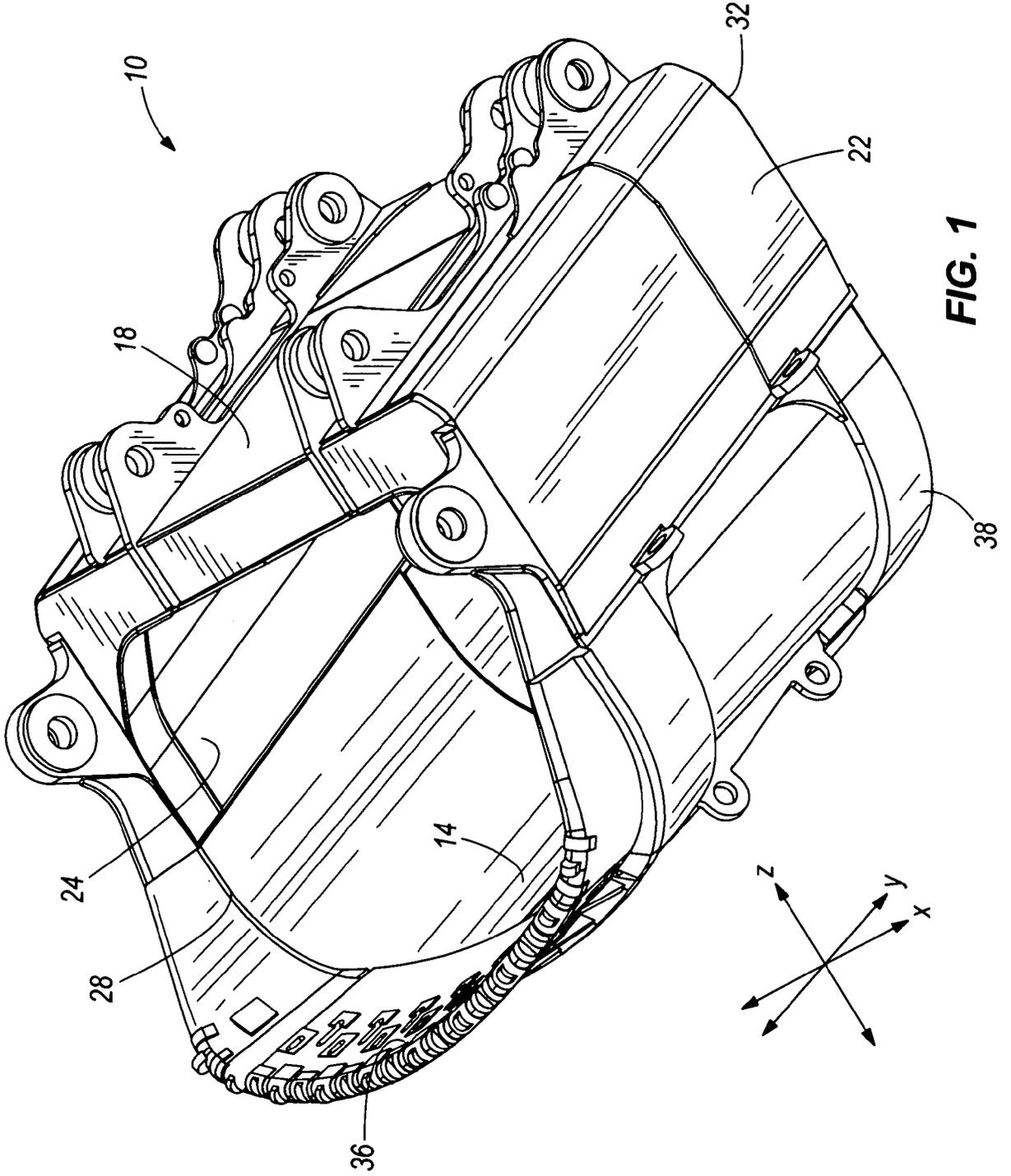


FIG. 1

2012202435 27 Apr 2012

P/00/011  
Regulation 3.2

AUSTRALIA

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*Patents Act 1990*

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**ORIGINAL  
COMPLETE SPECIFICATION  
STANDARD PATENT**

Invention Title:

"STRAIGHT TAPER DIPPER"

The following statement is a full description of this invention, including the best method of performing it known to me/us:

## STRAIGHT TAPER DIPPER

### FIELD OF INVENTION

[0001] The present invention generally relates to dippers for surface mining.

### SUMMARY

[0002] Typical power shovels or excavators use a bucket or dipper assembly to scoop earthen material from horizontal or vertical faces. A conventional power shovel has a boom, and the dipper is mounted on the boom via a crowd mechanism. The crowd mechanism includes a crowd pinion on the boom, and crowd rack as part of the dipper handle which pivots about the pinion and which moves translationally along the pinion. The dipper is mounted on the end of the handle. The bucket or dipper is normally provided with sharp teeth to provide a digging action against the surface being worked and further includes a cavity for collecting the material so removed. Once the earthen material is received within the dipper, the dipper is typically moved to another location for transfer of the material. The material is usually discharged into a dump truck, onto a conveyor, or merely onto a pile.

[0003] The invention provides a dipper having an inlet and an outlet, the dipper comprising: a front wall and an opposite back wall extending between the inlet and the outlet, a first reference plane extending from the inlet to the outlet and positioned between the front wall and the back wall, the front wall having a substantially linear inner surface, the front wall being arranged relative to the first reference plane at an angle of at least about 0 degrees and no more than about 3 degrees from the inlet toward the outlet two side walls connected between the front wall and the back wall and extending between the inlet and the outlet, a second reference plane extending from the inlet to the outlet and positioned between the side walls; and a lip coupled to at least the front wall and extending outwardly from the inlet, the lip defining opposite side surface, each of the side surfaces tapering outwardly from the inlet relative to the second reference plane at an angle greater than 0 degrees and no more than about 30 degrees so that an outer dimension of the lip is larger than a comparative outer dimension of the outlet, wherein at least one of the back wall tapers outwardly relative to the first reference plane from the inlet toward the outlet at an angle greater than about 0 degrees and no more than about 30 degrees, and each of the side walls tapers outwardly relative to the second reference plane from the inlet toward the outlet at an angle greater than about 0 degrees and no more than about 30 degrees..

[0004] The invention also provides a dipper having an inlet and an outlet, the dipper comprising: a front wall and an opposite back wall extending between the inlet and the outlet; two side walls connected between the front wall and the back wall and extending between the inlet and the outlet, a reference plane extending from the inlet to the outlet and positioned between the side walls, each of the side walls tapering outwardly relative to the reference plane from the inlet toward the outlet at an angle greater than about 0 degrees and no more than about 30 degrees; and a lip coupled to at least the front wall and extending outwardly from the inlet to an outer surface, the lip having opposite side surfaces, each of the side surfaces tapering outwardly relative to the reference plane from the inlet toward the outer surface at an angle greater than about 0 degrees and no more than about 30 degrees.

[0005] The invention also provides dipper having an inlet and an outlet, an inlet reference plane being defined at the inlet, the dipper comprising: a front wall and an opposite back wall extending between the inlet and the outlet, a front wall reference plane extending from the inlet to the outlet and positioned between the front wall and the back wall, the front wall having a substantially linear inner surface, the front wall being arranged relative to the front wall reference plane at an angle of at least about 0 degrees and no more than about 3 degrees from the inlet toward the outlet; two side walls connected between the front wall and the back wall and extending between the inlet and the outlet, a side wall reference plane extending from the inlet to the outlet and positioned between the two side walls; and a lip coupled to at least the front wall and extending outwardly from the inlet, the lip defining opposite side surfaces, each of the side surfaces tapering outwardly from the inlet relative to the side wall reference plane at an angle greater than about 0 degrees and no more than about 30 degrees; wherein the inlet has an inlet area in an inlet reference plane, wherein the outlet has an outlet area in an outlet reference plane substantially parallel to the inlet reference plane, and wherein the front wall, the back wall, and the two side walls are arranged such that the outlet area is at least about 3 percent and no more than about 25 percent greater than the inlet area

[0006] In another independent embodiment of a dipper, each of the side walls of the dipper may taper outwardly relative to the second reference plane from the inlet toward the outlet at an angle greater than 0 degrees and no more than 30 degrees. The lip has opposite side surfaces, and each of the side surfaces of the lip may taper outwardly relative to the second reference plane from the inlet toward the outer surface at an angle greater than 0 degrees and no more than 30 degrees.

[0007] In yet another independent embodiment of the dipper, an inlet reference plane is defined at the inlet, and a front wall reference plane extends from the inlet to the outlet and is positioned between the front wall and the back wall. The front wall may have a substantially linear inner surface and be arranged relative to the front wall reference plane at an angle of at least 0 degrees and no more than 3 degrees. The inlet has an inlet area in the inlet reference plane, and the outlet has an outlet area in an outlet reference plane substantially parallel to the inlet reference plane. The front wall, the back wall, and the two side walls may be arranged such that the outlet area is at least 3 percent and no more than 25 percent greater than the inlet area.

[0008] Other independent aspects of the invention will become apparent by consideration of the detailed description and accompanying drawings.

#### BRIEF DESCRIPTION OF THE DRAWINGS

[0009] Fig. 1 is a perspective view of a dipper according to the invention.

[0010] Fig. 2 is a top view of the dipper shown in Fig. 1.

[0011] Fig. 3 is a right side view of the dipper shown in Fig. 1.

[0012] Fig. 4 is a front view of the dipper shown in Fig. 1.

[0013] Fig. 5 is a section view taken along line 5-5 in Fig. 3.

[0014] Fig. 6 is a section view taken along line 6-6 in Fig. 4.

[0015] Fig. 7 is a representative view comparing an inlet area to an outlet area of the dipper shown in Fig. 1.

#### DETAILED DESCRIPTION

[0016] Before any independent embodiments of the invention are explained in detail, it is to be understood that the invention is not limited in its application to the details of construction and the arrangement of components set forth in the following description or illustrated in the following drawings. The invention is capable of other independent embodiments and of being practiced or of being carried out in various ways.

[0017] Fig. 1 shows a dipper 10 for use with a power shovel or another piece of mining equipment. The dipper 10 includes a front wall 14, a back wall 18, a left side wall 22, and a right side wall 24 and defines an inlet 28 and an outlet 32. A lip 36 is coupled to the front wall 14, the left side wall 22, and the right side wall 24 and extends forward of the front wall 14. A heel 38 of the dipper is defined on the front wall 14 adjacent the outlet 32 and includes a latch portion 39 (see Figs. 2 - 6) for receiving the latch of a dipper door (not shown). Figs. 2 - 4 show alternate views of the dipper 10.

[0018] Figs. 1 - 6 show an x-axis in a side-to-side direction, a y-axis in an inlet-to-outlet direction, and a z-axis in a front-to-back direction. These directions will be referenced throughout this description for the purpose of illustration and should not be regarded as limiting.

[0019] With reference to Fig. 5, a side wall reference plane 40 is defined in the y-z plane and intersects the front wall 14 and the back wall 18 (e.g., in the center). The left side wall 22 defines (see Fig. 2) a planar portion and two curved portions that connect the planar portion of the left side wall 22 to the front wall 14 and the back wall 18. As shown in Fig. 5, the left side wall 22 is tapered or skewed outwardly from the inlet 28 to the outlet 32 and defines a left wall plane 44 that parallels the planar portion and that is angled with respect to the side wall reference plane 40 at a left wall angle 46. The left wall plane 44 may be angled with respect to the side wall reference plane 40 at between about zero degrees and about thirty degrees ( $0^\circ \leq x \leq 30^\circ$ ). In some embodiments, the left wall plane 44 may be angled with respect to the side wall reference plane 40 at between about one degree and about ten degrees ( $1^\circ \leq x \leq 10^\circ$ ). In the illustrated embodiment, the left wall angle 46 is about three degrees ( $3^\circ$ ).

[0020] The right side wall 24 defines (see Fig. 2) a planar portion and two curved portions that connect the planar portion of the right side wall 24 to the front wall 14 and the back wall 18. As shown in Fig. 5, the right side wall 24 is tapered or skewed outwardly from the inlet 28 to the outlet 32 and defines a right wall plane 48 that parallels the planar portion and that is angled with respect to the side wall reference plane 40 at a right wall angle 52. The right wall plane 48 may be angled with respect to the side wall reference plane 40 at between about zero degrees and about thirty degrees ( $0^\circ \leq x \leq 30^\circ$ ). In some embodiments, the right wall plane 48 may be angled with respect to the side wall reference plane 40 at between about one degree and about ten degrees ( $1^\circ \leq x \leq 10^\circ$ ). In the illustrated embodiment, the right wall angle 52 is about three degrees ( $3^\circ$ ).

[0021] Fig. 5 shows the lip 36 coupled to the front wall 14, the left side wall 22, and the right side wall 24. The lip 36 defines an outer dimension 56 along the x-axis, a left lip plane 60 running parallel to the left side of the lip 36, and a right lip plane 68 running parallel to the right side of the lip 36.

[0022] The left lip plane 60 is arranged at a left lip angle 64 with respect to the side wall reference plane 40. The left lip angle 64 may be between about zero degrees and about thirty degrees ( $0^\circ \leq x \leq 30^\circ$ ). In some embodiments, the left lip angle 64 is between about one degree and about ten degrees ( $1^\circ \leq x \leq 10^\circ$ ). In the illustrated embodiment, the left lip angle 64 is about zero degrees ( $0^\circ$ ).

[0023] The right lip plane 68 is arranged at a right lip angle 72 with respect to the side wall reference plane 40. The right lip angle 72 may be between about zero degrees and about thirty degrees ( $0^\circ \leq x \leq 30^\circ$ ). In some embodiments, the right lip angle 72 is between about one degree and about ten degrees ( $1^\circ \leq x \leq 10^\circ$ ). In the illustrated embodiment, the right lip angle 72 is about zero degrees ( $0^\circ$ ).

[0024] Further, in some embodiments, the lip 36 may be arranged with the outer dimension 56 of the lip 36 larger than a comparative outer dimension at the outlet 32 of the dipper 10 so that the outlet 32 or heel 38 of the dipper 10 does not plow or rake though the material being mined, which would increase the wear on the dipper 10 and increase the force required to move the dipper 10 through the material. The left and right lip angles 64, 72 affect the outer dimension 56 and can be manipulated to provide clearance for the outlet 32, as desired.

[0025] With respect to Fig. 6, a floor reference plane 76 is defined in the x-y plane. A front/back wall reference plane 80 is positioned between the front wall 14 and the back wall 18, and angled with respect to the floor reference plane 76 at about ten degrees ( $10^\circ$ ).

[0026] The front wall 14 defines a straight surface from the inlet 28 to the outlet 32 (as shown in Fig. 6). In the x-axis (generally), the front wall 14 is curved (as shown in Fig. 2). In the illustrated construction, throughout the curved portion of the front wall 14, the line from the inlet 28 to the outlet 32 is substantially straight, as shown in Fig. 6. A front wall line 84 is arranged relative to the front/back wall reference plane 80 at a front wall angle 88. The front wall angle 88 may be greater than or equal to zero degrees ( $x \geq 0^\circ$ ). In some embodiments, the

front wall angle 88 is between about zero degrees and about three degrees ( $0^\circ \leq x \leq 3^\circ$ ). In the illustrated embodiment, the front wall angle 88 is about zero degrees ( $0^\circ$ ).

[0027] In the illustrated embodiment (see Fig. 6), the lip 36 is in line or parallel with the front wall 14. In other embodiments, the lip 36 could be skewed or angled relative to the front wall 14, as desired.

[0028] The back wall 18 defines (see Fig. 2) a planar portion, and two curved portions that connect the back wall 18 to the left side wall 22 and the right side wall 24. A straight surface is defined from the inlet 28 to the outlet 32 (as shown in Fig. 6). A back wall line 92 is angled or skewed relative to the front/back wall reference plane 80 at a back wall angle 96. The back wall angle 96 may be between about zero degrees and about thirty degrees ( $0^\circ \leq x \leq 30^\circ$ ). In some embodiments, the back wall angle 96 is between about one degree and about ten degrees ( $1^\circ \leq x \leq 10^\circ$ ). In the illustrated embodiment, the back wall angle 96 is about five degrees ( $5^\circ$ ).

[0029] With continued reference to Fig. 6, an inlet plane 100 is defined generally perpendicular to the floor reference plane 76 at the inlet 28. An inlet area 104 for the dipper 10 is defined in the inlet plane 100. That is to say, the front wall 14, the back wall 18, the left side wall 22, and the right side wall 26 define an inlet perimeter in the inlet plane 100, and the area within the inlet perimeter defines the inlet area 104 in the inlet plane 100.

[0030] An outlet plane 108 is defined parallel to the inlet plane 100 (and generally perpendicular to the floor reference plane 76) at the outlet 32. An outlet area 112 for the dipper 10 (e.g., at the door) is defined in the outlet plane 108. That is to say, the front wall 14, the back wall 18, the left side wall 22, and the right side wall 26 define an outlet perimeter in the outlet plane 108, and the area within the outlet perimeter defines the outlet area 112 in the outlet plane 108.

[0031] As a result of arrangement of the front wall 14, the back wall 18, the left side wall 22, and the right side wall 24, the outlet area 112 is larger than the inlet area 104 (see Fig. 7). The outlet area 112 may be between about three percent and about twenty-five percent ( $3\% \leq x \leq 25\%$ ) larger than the inlet area 104. In some embodiments, the outlet area 112 may be more than about four percent (4%) larger than the inlet area 104. In other embodiments, the outlet area 112 may be about eight percent to about nine percent ( $8\% \leq x \leq 9\%$ ) larger than the inlet

area 104. In the illustrated embodiment, the outlet area 112 is about ten percent (10%) larger than the inlet area 104.

**[0032]** The inventive arrangement provides a dipper 10 that improves performance in digging. For example, the dipper 10 may have improved fill, dump and/or full/dump cycle time. The dipper 10 may have reduced drag during digging.

**[0033]** The dipper 10 may be advantageous for oil sands digging. Oil sands expand after being unearthed. The increased volume of the dipper 10 toward the outlet 32 of the dipper 10 allows the oil sands to expand within the dipper 10 while a digging action is occurring, and the oil sands will not be compacted within the dipper 10. Typically, oil sands expand about four percent (4%) in volume during a digging action (e.g., 30 seconds). The straight tapered design of the dipper 10 allows expansion without compaction and/or improves digging characteristics and efficiency. The dipper 10 may also be used to remove/mine other materials, such as, for example, copper, iron ore, overburden material, etc.

**[0034]** In the claims which follow and in the preceding description of the invention, except where the context requires otherwise due to express language or necessary implication, the word “comprise” or variations such as “comprises” or “comprising” is used in an inclusive sense, i.e. to specify the presence of the stated features but not to preclude the presence or addition of further features in various embodiments of the invention.

CLAIMS

What is claimed is:

1. A dipper having an inlet and an outlet, the dipper comprising:
  - a front wall and an opposite back wall extending between the inlet and the outlet, a first reference plane extending from the inlet to the outlet and positioned between the front wall and the back wall, the front wall having a substantially linear inner surface, the front wall being arranged relative to the first reference plane at an angle of at least about 0 degrees and no more than about 3 degrees from the inlet toward the outlet
  - two side walls connected between the front wall and the back wall and extending between the inlet and the outlet, a second reference plane extending from the inlet to the outlet and positioned between the side walls; and
  - a lip coupled to at least the front wall and extending outwardly from the inlet, the lip defining opposite side surface, each of the side surfaces tapering outwardly from the inlet relative to the second reference plane at an angle greater than 0 degrees and no more than about 30 degrees so that an outer dimension of the lip is larger than a comparative outer dimension of the outlet,wherein at least one of
  - the back wall tapers outwardly relative to the first reference plane from the inlet toward the outlet at an angle greater than about 0 degrees and no more than about 30 degrees, and
  - each of the side walls tapers outwardly relative to the second reference plane from the inlet toward the outlet at an angle greater than about 0 degrees and no more than about 30 degrees.
2. The dipper of claim 1, wherein the front wall is arranged relative to the first reference plane at an angle of about 0 degrees.
3. The dipper of claim 1 or claim 2, wherein the back wall tapers outwardly relative to the first reference plane from the inlet toward the outlet at an angle greater than about 1 degree and no more than about 10 degrees.

4. The dipper of claim 3, wherein the back wall tapers outwardly relative to the first reference plane from the inlet toward the outlet at an angle of about 5 degrees.
5. The dipper of any one of the preceding claims, wherein each of the side walls tapers outwardly relative to the second reference plane from the inlet toward the outlet at an angle greater than about 1 degree and no more than about 10 degrees.
6. The dipper of claim 5, wherein each of the side walls tapers outwardly relative to the second reference plane from the inlet toward the outlet at an angle of about 3 degrees.
7. The dipper of any one of the preceding claims, wherein the lip defines opposite side surfaces, each of the side surfaces tapering outwardly relative to the second reference plane from the inlet toward the outer surface at an angle greater than about 0 degrees and no more than about 30 degrees.
8. The dipper of claim 7, wherein the lip defines opposite side surfaces, each of the side surfaces tapering outwardly relative to the second reference plane from the inlet toward the outer surface at an angle greater than about 1 degree and no more than about 10 degrees.
9. The dipper of any one of claims 1 to 6, wherein the lip defines opposite side surfaces, each of the side surfaces tapering outwardly relative to the second reference plane from the inlet toward the outer surface at an angle of about 0 degrees.
10. The dipper of any one of the preceding claims, wherein the front wall is curved in a plane tangential to the first reference plane.
11. A dipper having an inlet and an outlet, the dipper comprising:
  - a front wall and an opposite back wall extending between the inlet and the outlet; two side walls connected between the front wall and the back wall and extending between the inlet and the outlet, a reference plane extending from the inlet to the outlet and positioned between the side walls, each of the side walls tapering outwardly relative to the reference plane from the inlet toward the outlet at an angle greater than about 0 degrees and no more than about 30 degrees; and
  - a lip coupled to at least the front wall and extending outwardly from the inlet to an outer surface, the lip having opposite side surfaces, each of the side surfaces tapering outwardly

relative to the reference plane from the inlet toward the outer surface at an angle greater than about 0 degrees and no more than about 30 degrees.

12. The dipper of claim 11, wherein each of the side walls tapers outwardly relative to the reference plane from the inlet toward the outlet at an angle greater than about 1 degree and no more than about 10 degrees.

13. The dipper of claim 12, wherein each of the side walls tapers outwardly relative to the reference plane from the inlet toward the outlet at an angle of about 3 degrees.

14. The dipper of any one of claims 11 to 13, wherein each of the side surfaces taper outwardly relative to the reference plane from the inlet toward the outer surface at an angle greater than about 1 degree and no more than about 10 degrees.

15. The dipper of any one of claims 11 to 13, wherein each of the side surfaces taper outwardly relative to the reference plane from the inlet toward the outer surface at an angle of about 0 degrees.

16. The dipper of any one of claims 11 to 15, wherein another reference plane extends from the inlet to the outlet and is positioned between the front wall and the back wall, and wherein the front wall is arranged relative to the other reference plane at an angle of at least about 0 degrees and no more than about 3 degrees from the inlet toward the outlet.

17. The dipper of claim 16, wherein the front wall is arranged relative to the other reference plane at an angle of at about 0 degrees.

18. The dipper of claim 16 or claim 17, wherein the front wall is curved in a plane tangential to the other reference plane.

19. The dipper of any one of claims 16 to 18, wherein the back wall tapers outwardly relative to the other reference plane from the inlet toward the outlet at an angle greater than about 0 degrees and no more than about 30 degrees.

20. The dipper of claim 19, wherein the back wall tapers outwardly relative to the other reference plane from the inlet toward the outlet at an angle greater than about 1 degree and no more than about 10 degrees.

21. The dipper of claim 20, wherein the back wall tapers outwardly relative to the other reference plane from the inlet toward the outlet at an angle of about 5 degrees.

22. A dipper having an inlet and an outlet, an inlet reference plane being defined at the inlet, the dipper comprising:

a front wall and an opposite back wall extending between the inlet and the outlet, a front wall reference plane extending from the inlet to the outlet and positioned between the front wall and the back wall, the front wall having a substantially linear inner surface, the front wall being arranged relative to the front wall reference plane at an angle of at least about 0 degrees and no more than about 3 degrees from the inlet toward the outlet;

two side walls connected between the front wall and the back wall and extending between the inlet and the outlet, a side wall reference plane extending from the inlet to the outlet and positioned between the two side walls; and

a lip coupled to at least the front wall and extending outwardly from the inlet, the lip defining opposite side surfaces, each of the side surfaces tapering outwardly from the inlet relative to the side wall reference plane at an angle greater than about 0 degrees and no more than about 30 degrees;

wherein the inlet has an inlet area in an inlet reference plane, wherein the outlet has an outlet area in an outlet reference plane substantially parallel to the inlet reference plane, and wherein the front wall, the back wall, and the two side walls are arranged such that the outlet area is at least about 3 percent and no more than about 25 percent greater than the inlet area.

23. The dipper of claim 22, wherein the outlet area is at least about 8 percent and no more than about 9 percent greater than the inlet area.

24. The dipper of claim 22, wherein the outlet area is at least about 10 percent greater than the inlet area.

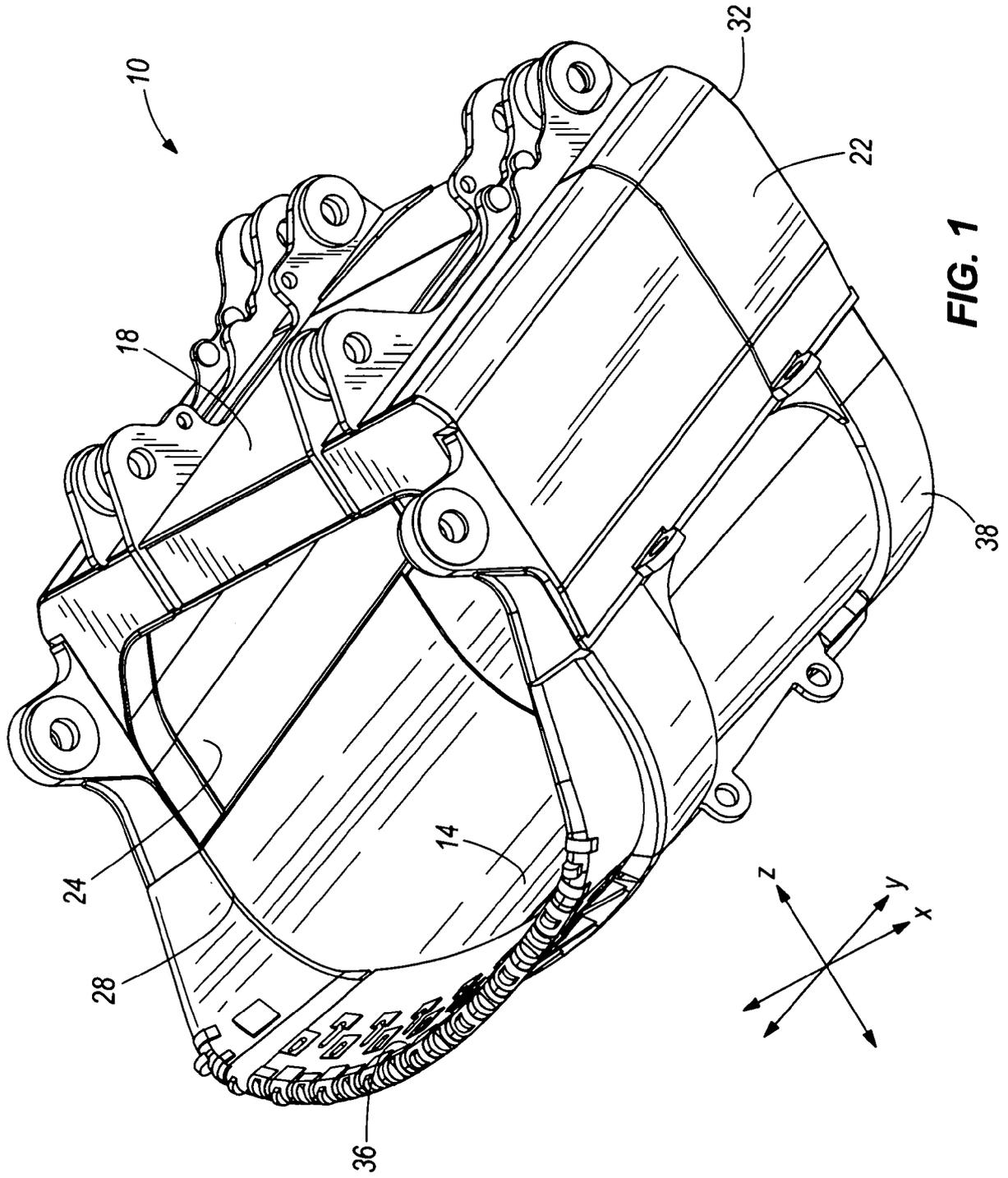


FIG. 1

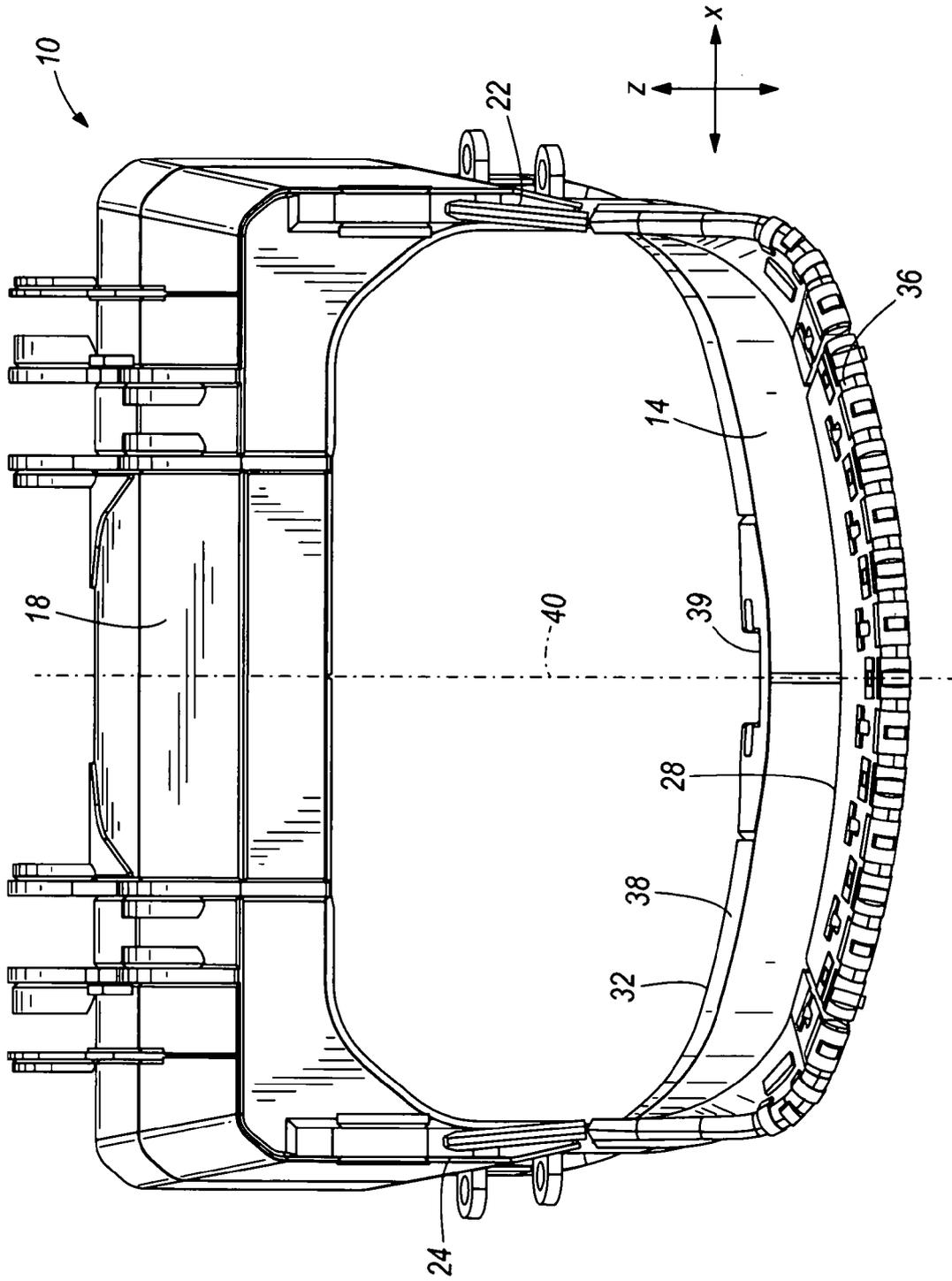


FIG. 2

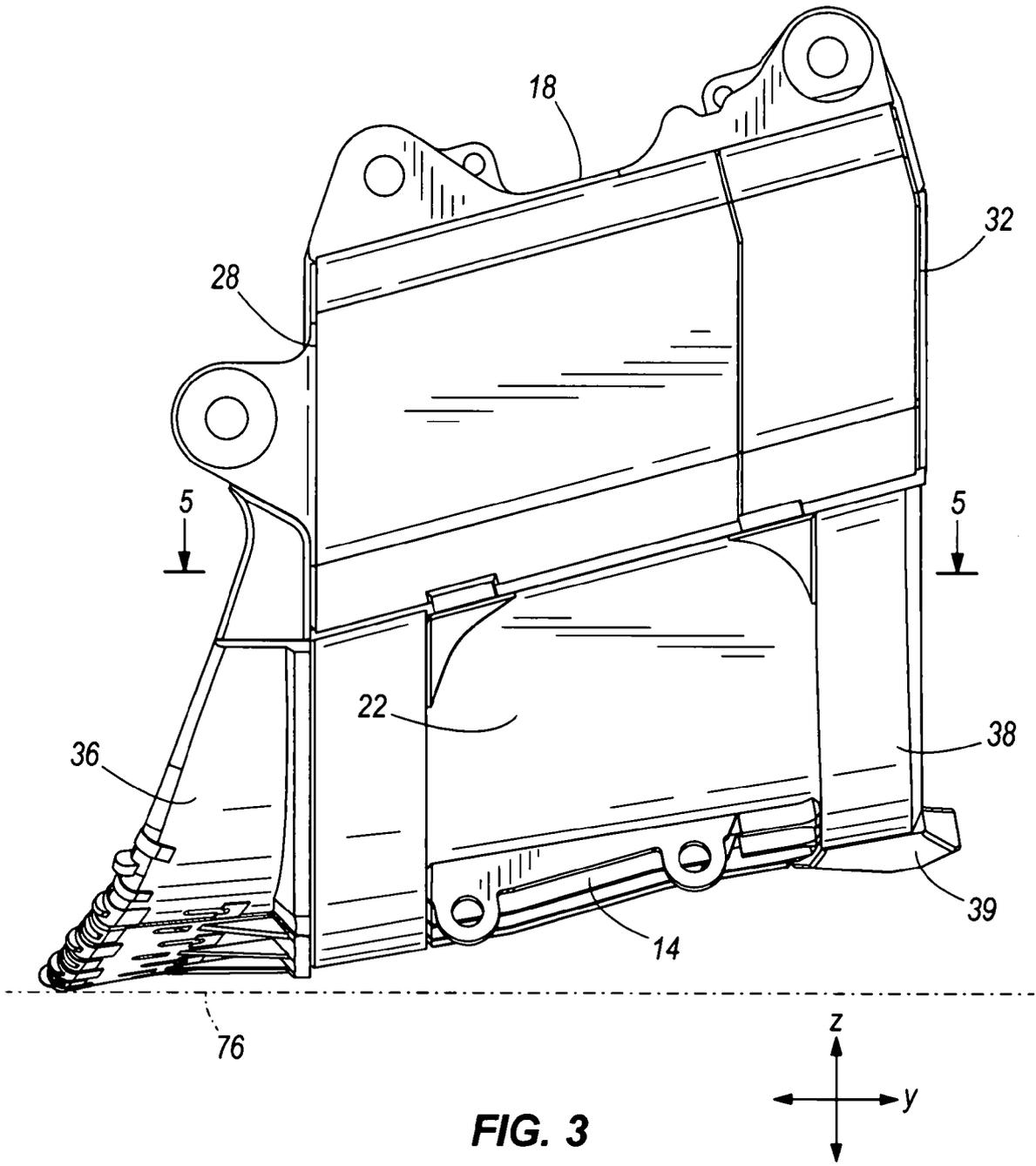


FIG. 3

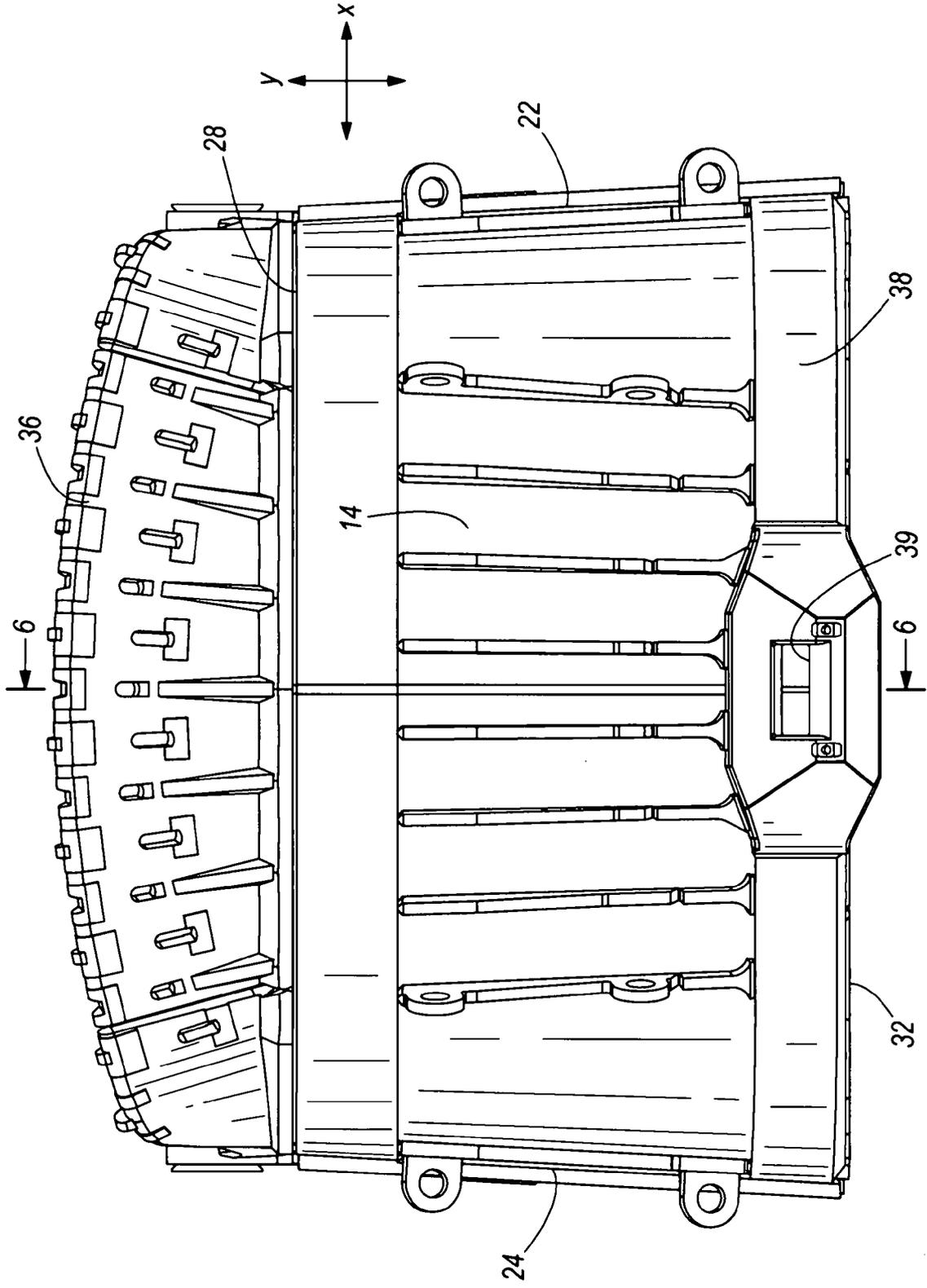


FIG. 4

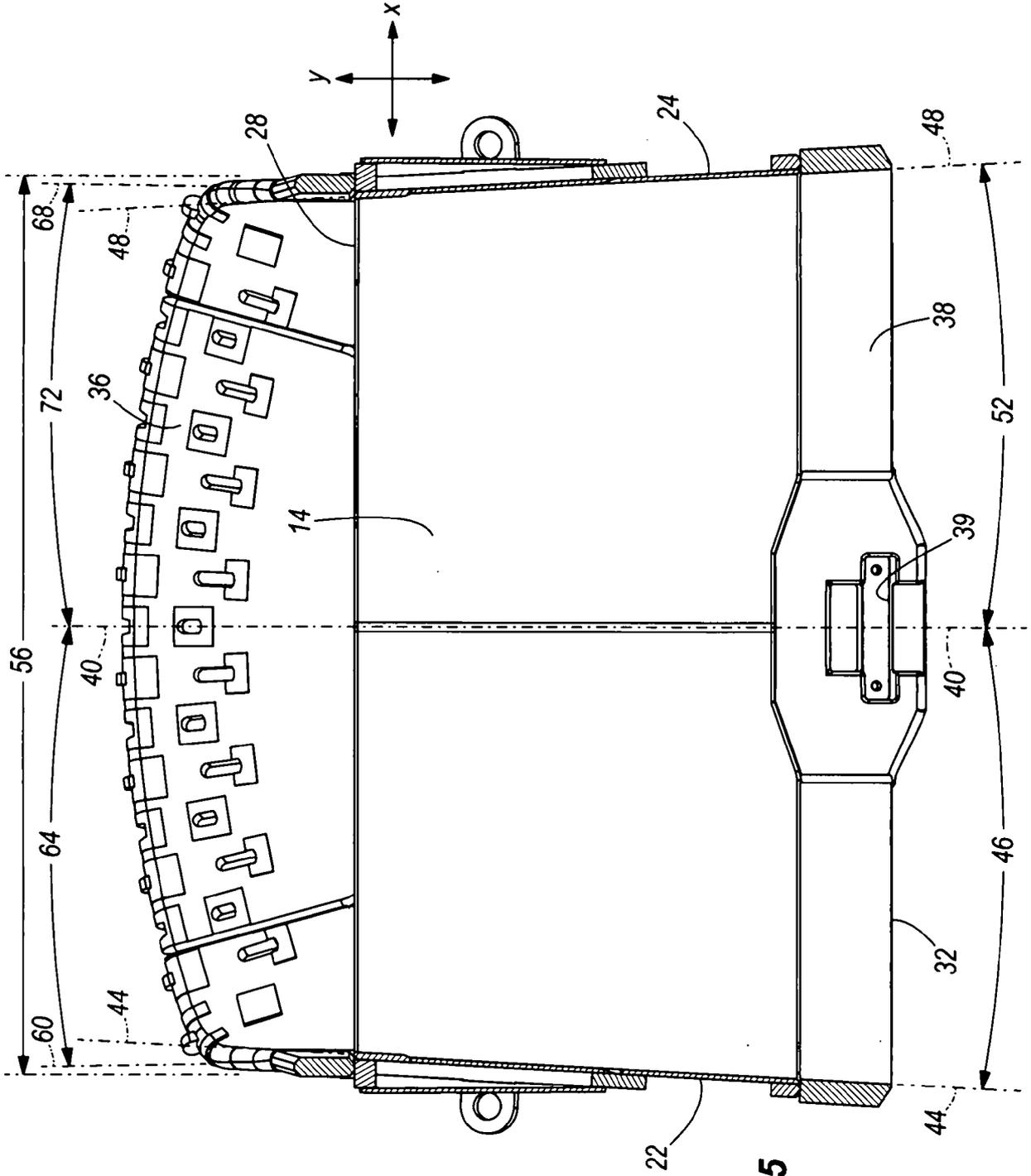


FIG. 5

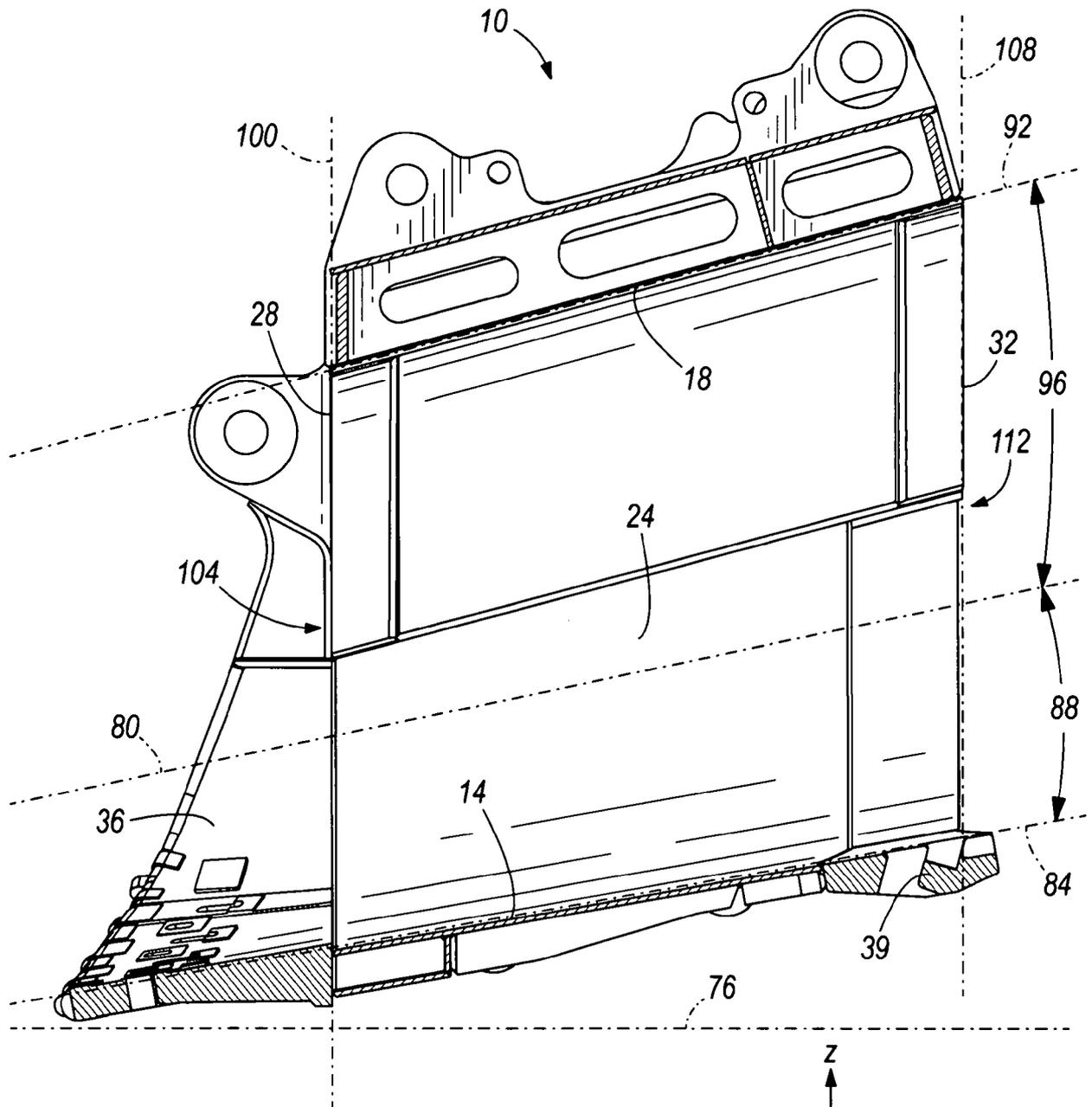
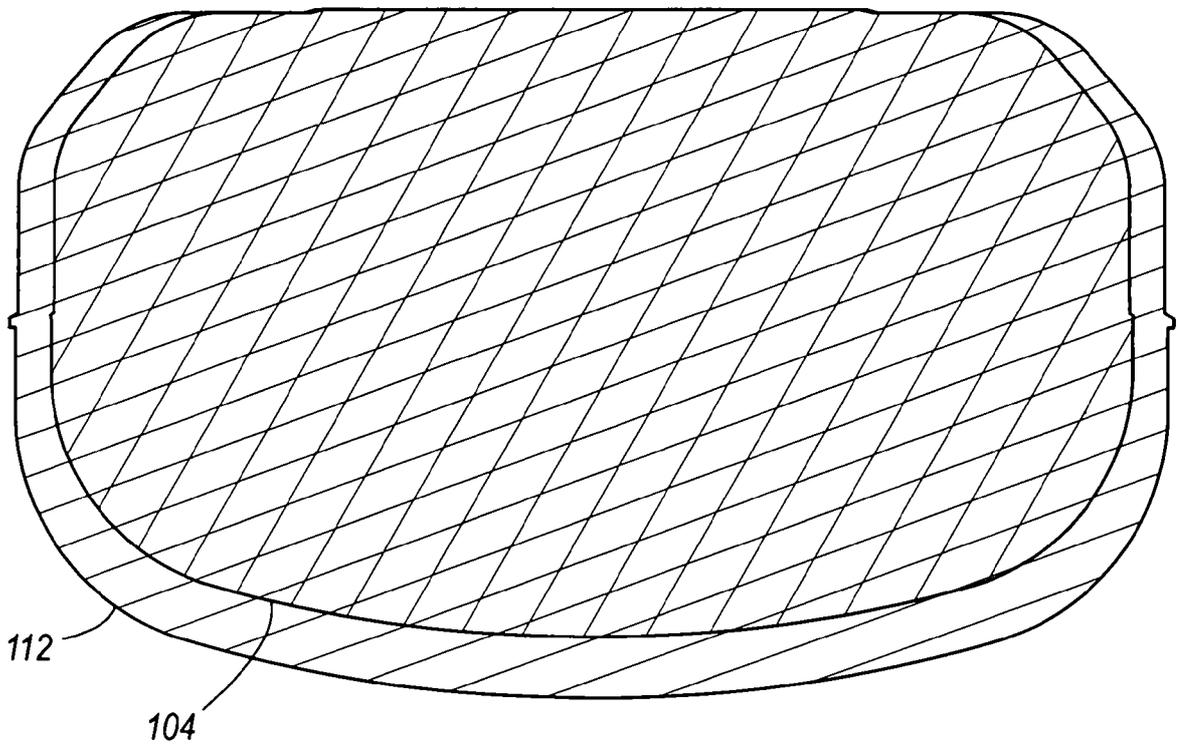


FIG. 6



**FIG. 7**