

A CARGO COMPARTMENT FOR A LIGHTER-THAN-AIR VEHICLE

BACKGROUND OF THE INVENTION

Field of the Invention

The invention relates to the field of lighter-than-air vehicles and, in particular, to cargo compartments for such vehicles.

Description of Related Art

Lighter-than-air vehicles have either non-rigid or rigid gasbags. There are three general types of non-rigid vehicles: those comprising a single gas filled bag; several gasbags joined together in series; and, of course, those having a multiple number gasbags within a non-rigid envelope. Rigid airships have an internal structure defining the shape of the vehicle containing a plurality of gasbags with an aerodynamic cover there over. One of the problems with both rigid and non-rigid lighter-than-air vehicles is their limited ability to station keep and/or maneuver when docking, especially if there are any significant cross-winds. This is primarily due to their large cross-sectional area, which causes the vehicle to "weather vane" and "wave" with the wind. They are particularly difficult to control if the wind is gusting or when there are significant up or down drafts. In fact, docking has proven to be the most difficult portion of a flight for a lighter-than-air-vehicle. Thus the most common docking procedure is moor the vehicle by its nose and let it weather vane.

In non-rigid designs the cargo flight station and cargo compartments are suspended from the bottom of the vehicle in what is most often referred to as a gondola. In rigid designs, it is also common practice to mount the flight

1 station/passenger and cargo compartments under the gasbag.
2 Unlike a conventional aircraft, the lift forces developed by
3 the gasbag remains when docked. Thus as cargo is unloaded,
4 the net lift force increases. In the past, this increase in
5 net lift has been absorbed by docking restraints, for
6 example mooring lines. If the cargo weight is very large,
7 the force exerted on the mooring lines also becomes large
8 and "station keeping" when docked becomes even more
9 difficult. Therefore, unloading and reloading of cargo
10 sometimes must wait until any winds have sufficiently died
11 down or additional mooring lines must be used to "lock" the
12 vehicle in one position. It is therefore obvious that it is
13 always important to minimize the time spent in such
14 operations.

15
16 Thus conventional loading of cargo containers and the
17 like through doors located on the side of the vehicle is too
18 slow and it would be difficult to simultaneously load and
19 unload cargo in order to maintain the gross weight of the
20 vehicle constant. Cargo aircraft, such as the C-5 military
21 transport, have front and rear opening doors to the cargo
22 compartment. However, moving the cargo simultaneously in the
23 front and out the rear of a large lighter-than-air vehicle
24 would still be a difficult and time consuming operation,
25 especially if the cargo compartment is some 600 to 800 feet
26 long. In addition, requiring an uninterrupted passageway
27 over such a length would greatly complicate the design of
28 the gondola. The use of individual cargo compartments
29 located along either side of the vehicle can reduce the
30 cargo loading and unloading time, but does not address the
31 need to maintain a constant payload weight on the vehicle.
32 In U.S. Patent No. 5,143,323, "Airship Handling System" by
33 F. Husain, et al. a vehicle is disclosed having a
34 cargo/passenger module that is secured in a recess in the
35 gondola. However, properly securing such a module to the
36 gondola is believed to complicate the design of the gondola.
37 In addition, the cargo module would have to be flight

1 certified increasing its cost. In fact, no prior art cargo
2 compartment design has addressed the need to maintain a
3 constant payload weight during loading and unloading of
4 cargo and/or to provide a cargo loading system that
5 minimizes the docking time for unloading and loading cargo.
6
7

8 Therefore, it is a primary object of the invention to
9 provide a cargo compartment for a lighter-than-air vehicle
10 that allows a constant neutral buoyancy to be maintained on
11 the vehicle during loading and unloading thereof.
12

13 It is another primary object of the invention to
14 provide a cargo compartment for a lighter-than-air vehicle
15 that provides for simultaneous loading and unloading of
16 cargo while maintaining a constant neutral buoyancy on the
17 vehicle.
18

19 It is a further object of the invention to provide a
20 cargo compartment for a lighter-than-air vehicle wherein
21 the cargo can be loaded and unloaded using individual cargo
22 containers.
23

24 SUMMARY OF THE INVENTION

25

26 The invention is a cargo compartment for a lighter-
27 than-air vehicle, the vehicle having a longitudinal,
28 vertical and lateral axis. The cargo compartment includes
29 a cargo carrying structure mounted to the bottom of the
30 vehicle and which extends along at least a portion of the
31 longitudinal axis thereof. The cargo compartment has a
32 plurality of passageways extending along the longitudinal
33 axis of the vehicle. Each of the passageways is aligned
34 with the lateral axis of the vehicle and extends completely
35 through the cargo compartment, and is adapted to receive at
36 least one cargo container.
37

1 A cargo container moving system is mounted in the floor
2 of each passageway for moving the at least one cargo
3 container in one end and out the opposite end of the
4 passageway and to intermediate positions therebetween. The
5 container moving system includes a plurality of powered
6 rollers mounted in the floor of each of the passageways. In
7 addition, the cargo container moving system further includes
8 a plurality of non-powered (passive) rollers mounted in the
9 floor of each of the passageways for movably supporting the
10 at least one cargo container therein.

11

12 A cargo container securing system is provided for
13 releasable securing the at least one cargo container within
14 the passageway. The cargo container is provided with a
15 flange along the bottom of the front and rear ends thereof.
16 The cargo securing system further includes a pair of guide
17 rails mounted in a spaced relationship on the floor of the
18 passageway. Thus as the cargo containers are moved into and
19 out of the passageway and to intermediate positions
20 therebetween, the rails engage the flanges on the cargo
21 containers and restrain them from movement along the
22 longitudinal axis of the vehicle. The cargo container
23 securing system further includes a locking system to
24 releasable secure the cargo containers in the intermediate
25 positions along the floor of the passageway preventing
26 movement along the vertical and lateral axis. Although the
27 above described cargo moving and securing systems are
28 preferred, other systems are useable. For example cargo
29 pallets restrained by cargo nets tied down to the passageway
30 floor in combination or air cushion systems for movably
31 supporting the pallets instead of a passive roller system.

32

33

34 The novel features which are believed to be char-
35 acteristic of the invention, both as to its organization and
36 method of operation, together with further objects and
37 advantages thereof, will be better understood from the

1 following description in connection with the accompanying
2 drawings in which the presently preferred embodiment of the
3 invention is illustrated by way of example. It is to be
4 expressly understood, however, that the drawings are for
5 purposes of illustration and description only and are not
6 intended as a definition of the limits of the invention.

7 8 **BRIEF DESCRIPTION OF THE DRAWINGS**

9
10 Figure 1 is a perspective view of a lighter-than-air
11 vehicle, incorporating the subject cargo compartment, shown
12 in the docked position.

13
14 Figure 2 is partial perspective view partially broken
15 away of the vehicle shown in Figure 1 providing an interior
16 view of the subject cargo compartment.

17
18 Figure 3 is partial cross-sectional view of the vehicle
19 shown in Figure 1 taken along the line 3-3, providing a side
20 view of the subject cargo compartment.

21
22 Figure 4 is a view similar to Figure 3 illustrating the
23 loading and unloading of cargo containers.

24
25 Figure 5 is an enlarged perspective view of a cargo
26 container tie down device used to secure cargo containers
27 with the cargo compartment.

28 29 30 **DESCRIPTION OF THE PREFERRED EMBODIMENT**

31
32 Illustrated in Figure 1 is a lighter-than-air vehicle
33 incorporating the subject cargo compartment. The vehicle,
34 designated by numeral 10, is a non-rigid design having a
35 longitudinal axis 12, vertical axis 14, and lateral axis 16
36 and includes a helium bag 18 with a gondola 20, mounted at
37 the bottom. The vehicle 10 is shown in a docked position

1 tethered by its nose 22 to a tower 24. Thus it is free to
2 weather vane in the wind. The gondola 20 includes a flight
3 station 26, and cargo compartment 28 upon which are mounted
4 propulsion systems 30. Whereas a gondola type cargo
5 compartment (suspended cargo compartment) is necessary on a
6 non-rigid vehicle, it is certainly not required on a rigid
7 design. Thus a gondola style cargo compartment is also for
8 purposes of illustration only. A movable platform 32
9 mounted on a plurality of circularly configured rails 33 is
10 positioned under the vehicle 10 and is movable in a circle
11 about the tower 24. A plurality of cargo containers 34,
12 mounted on a portable loading cart 36, are positioned to be
13 loaded into the cargo compartment 28. Thus the platform 32,
14 with cargo containers 34 thereon, can rotate under power
15 with the vehicle 10, if it "weather vanes".

16

17 Still referring to Figure 1 and additionally to Figures
18 2 through 5, it can be seen that the cargo compartment 28
19 includes a plurality of passageways 40A-F extending along
20 the longitudinal axis 12. The passageway 40A-F are aligned
21 with the lateral axis 16 and extend completely through the
22 cargo compartment with first and second ends 42 and 44,
23 respectively, having fold up doors 45 attached thereto. The
24 passageways are configured to receive and hold one or more
25 of the cargo containers 34. Because all the passageways
26 40A-F are basically identical the following remarks shall be
27 directed at just one, 40A. The floor 46 of the passageway
28 40A contains a plurality of roller assemblies 50 that allow
29 the cargo containers 34 to be "rolled" on to the floor 46
30 and, in fact, in end 42 when loading and out end 44 when
31 unloading. Although the cargo containers 34 can be pushed
32 or pulled by hand, a plurality of powered roller assemblies
33 52 are provided in the floor 46 to assist in the movement of
34 the cargo containers 34 in and out of the passageway 40A and
35 intermediate positions therebetween. A suitable powered
36 roller assembly is manufactured by Lucus Western,
37 Incorporated, Electric Systems Division, Brea, California.

1 Referring to Figure 5, to lock the cargo container 34
2 within the passageway 46A, the container is provided with
3 flanges 60 on the ends thereof. These flanges 60 are
4 adapted to slidably engage guide rails 62 mounted on the
5 floor 46. Thus once the flanges 60 engage the rails 62, the
6 cargo container is restrained from moving along the
7 longitudinal axis 14 of the vehicle (forwards and
8 backwards). Additionally, retractable cargo restraints 66
9 are provided to restrain the containers 34 movement along
10 the vertical and lateral axis, 14 and 16, respectively
11 (upwards, downwards and from side to side). A suitable
12 cargo restraints 66 can be obtained from Ancra, Corporation,
13 El Segundo, California. a combination passive roller tray
14 and cargo restraint is manufactured by Pemco Engineering,
15 Stanton, California. Referring particularly to Figure 5 it
16 can be seen that the cargo restraint 66 includes two
17 restraining "hooks" 68 that engage the flanges 60 on two
18 adjacent cargo containers 34. Note again that this
19 particular restraint is only illustrative and there are
20 numerous other types that may be used in this application.

21
22 Referring back to figures 1-4, in operation, the
23 vehicle 10 is first docked with the nose 22 moored to the
24 tower 24 and positioned over the platform 32. The vehicle
25 10 is secured to the platform 32 by mooring lines (not
26 shown). Cargo containers 34A-D are positioned on a cart 36
27 in proximity to the end 42 of the passageway. The cart 36
28 includes cargo moving systems similar to those found in the
29 passageways 40. An empty cart 72 is shown positioned on the
30 opposite end 44 of the passageway 40. With the doors 45
31 opened, the cargo containers 34A-D are moved off the cart 36
32 into the passageway 40, while cargo containers 34E-H are
33 simultaneously removed from the passageway onto cart 72.
34 Note that, while only one cart 36 is shown, it is envisioned
35 that all the passageways 40A-F would be simultaneously
36 unloaded and loaded. Thus a constant payload weight is
37 always maintained, balancing the lift forces generated by

1 the airbag 18. Of course, the individual weight of the
2 loaded cargo containers must be known so that they can be
3 matched with the container being unloaded. In addition,
4 the normal center of gravity shifts must be considered, as
5 in the case of conventional aircraft. If the total weight
6 of the new cargo is dramatically different from that being
7 off loaded, then containers loaded with ballast (not shown)
8 may have to be used. Such a case would occur if the cargo
9 being unloaded were automobiles and cut flowers were being
10 loaded.

11

12 While the invention has been described with reference
13 to a particular embodiment, it should be understood that the
14 embodiment is merely illustrative as there are numerous
15 variations and modifications which may be made by those
16 skilled in the art. Thus, the invention is to be construed
17 as being limited only by the spirit and scope of the
18 appended claims.

19

20 **INDUSTRIAL APPLICABILITY**

21

22 The invention has applicability to the aircraft
23 industry and, in particular to manufactures of lighter-than-
24 air vehicles.



Claims

1 1. A cargo compartment for a lighter-than-air vehicle, the vehicle having a
2 longitudinal, vertical and lateral axis, the cargo compartment comprising:

3 a cargo carrying structure mounted to the bottom of the vehicle, said
4 structure extending along at least a portion of the longitudinal axis of the vehicle
5 and having a plurality of open ended passageways, each having a floor, and
6 extending along the longitudinal axis of the vehicle, each of said passageways
7 aligned with the lateral axis of the vehicle and extending completely through said
8 structure, said passageways adapted to simultaneously off load cargo from one
9 end of said passageway and to on load cargo from the opposite end;

10 first means mounted in each passageway for moving the cargo in one end
11 and out the opposite end of said passageway and intermediate positions
12 therebetween; and

13 second means for releasably securing the cargo within said passageway.

14 2. The cargo compartment as set forth in claim 1 wherein the cargo is
15 mounted within at least one cargo container, said compartment further
16 comprising:

17 - said first means adapted to move said at least one cargo container in one
18 end and out the opposite end of said passageway and intermediate positions
19 therebetween; and

20 said second means adapted to releasably secure the cargo container within
21 said passageway.

22 3. The cargo compartment as set forth in claim 2 wherein said first means is
23 mounted on said floor of each passageway.



1 4. The cargo compartment as set forth in claim 3 wherein said second means
2 is mounted on said floor of each passageway.

3 5. The cargo compartment as set forth in claim 4 wherein said first means
4 includes a plurality of powered rollers mounted in said floor of each of said
5 passageways for moving the at least one cargo container in one end and out the
6 other end of said passageway and intermediate positions therebetween.

7 6. The cargo compartment as set forth in claim 5 wherein said first means
8 further comprises a plurality of non-powered rollers mounted in said floor of each
9 of said passageways for movably supporting the at least one cargo container.

10 7. The cargo compartment as set forth in claim 2, or 3, or 4, or 5, or 6
11 further comprising said second means including a pair of guide rails mounted in a
12 spaced relationship on said floor of said passageway, such that at least one cargo
13 container is moved into and out of said passageway and to said intermediate
14 positions therein, said rails engage said at least one cargo container and restrain it
15 from movement along the longitudinal axis of the vehicle.

16 8. The cargo compartment as set forth in claim 7 further comprising said
17 second means including locking means to releasably secure at least one cargo
18 container in said intermediate positions along said floor of said passageway from
19 movement along the vertical and lateral axis of the vehicle.

20 9. The cargo compartment as set forth in claim 8 further comprising doors
21 mounted on each end of said passageways for sealing of the interior thereof.

22 10. A cargo compartment for a lighter-than-air vehicle, the vehicle having a
23 longitudinal, vertical and lateral axis, the cargo compartment comprising:

24 a cargo carrying structure mounted to the bottom of the vehicle, said



1 structure extending along at least a portion of the longitudinal axis of the vehicle
2 and having a plurality of open ended passageways, each having a floor, and
3 extending along the longitudinal axis of the vehicle, each of said passageways
4 aligned with the lateral axis of the vehicle and extending completely through said
5 structure, said passageways adapted to simultaneously off load cargo from one
6 end of said passageway and to on load cargo from the opposite end.

7 11. The cargo compartment as set forth in claim 10 comprising first means
8 mounted in each passageway for moving the cargo in one end and out the
9 opposite end of said passageway and intermediate positions therebetween.

10 12. The cargo compartment as set forth in claim 11 comprising second means
11 for releasably securing the cargo within said passageway.

12 13. The cargo compartment as set forth in claim 12 wherein the cargo is
13 mounted within at least one container, said compartment further comprising:

14 said first means adapted to move the at least one cargo container in one
15 end and out the opposite end of said passageway and intermediate positions
16 therebetween; and

17 said second means adapted to releasable secure the at least one cargo
18 container within said passageway.

19 14. The cargo system as set forth in claim 13 wherein said first means is
20 mounted on the floor of each passageway.

21 15. The cargo compartment as set forth in claim 14 wherein said second
22 means is mounted on the floor of each passageway.

23 16. The cargo compartment as set forth in claim 15 wherein said first means
24 includes a plurality of powered rollers mounted in said floor of each of said



1 passageways for moving the at least one cargo container in one end and out the
2 other end of said passageway and intermediate positions therebetween.

3 17. The cargo compartment as set forth in claim 16 wherein said first means
4 further comprises a plurality of non-powered rollers mounted in said floor of each
5 of said passageways for movably supporting the at least one cargo container.

6 18. The cargo compartment as set forth in claim 13, or 14, or 15, or 16, or
7 17 further comprising said second means including a pair of guide rails mounted
8 in a spaced relationship on said floor of said passageway, such that, as the at
9 least one cargo container is moved into and out of said passageway and to said
10 intermediate positions therein, said rails engage the at least one cargo container
11 and restrain it from movement along the longitudinal axis of the vehicle.

12 19. The cargo compartment as set forth in claim 18 further comprising said
13 second means including locking means to releasably secure the at least one cargo
14 container in said intermediate positions along said floor of said passageway from
15 movement along the vertical and lateral axis of the vehicle.

16 20. The cargo compartment as set forth in claim 19 further comprising doors
17 mounted on each end of said passageways for sealing of the interior thereof.

A CARGO COMPARTMENT FOR A LIGHTER-THAN-AIR VEHICLE

ABSTRACT

THIS SHEET HAS BEEN
REPLACED

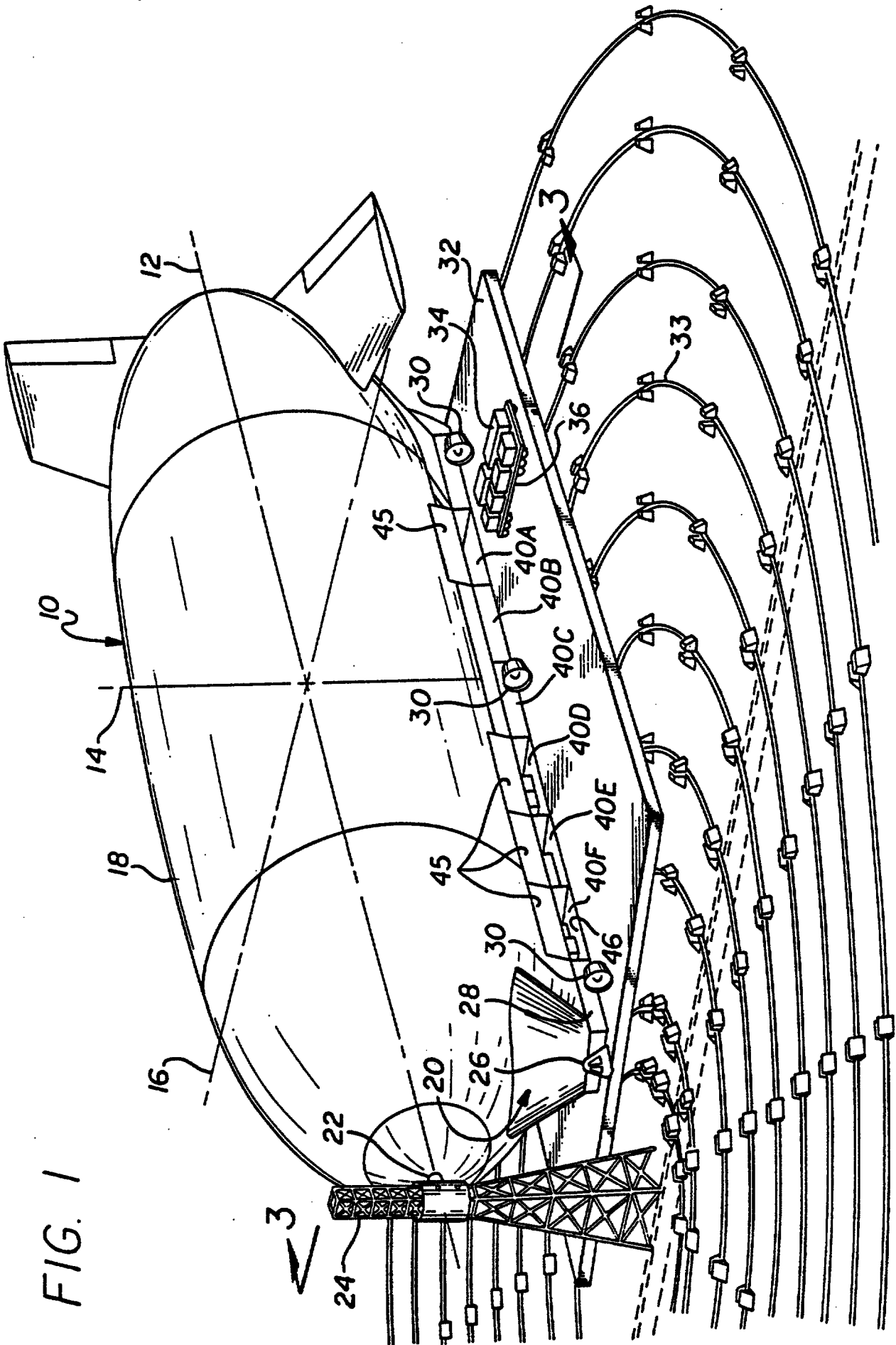
The invention is a cargo compartment for a lighter-than-air vehicle (10), the vehicle having a longitudinal (12) , vertical (14) and lateral axis (16). In detail, the cargo compartment includes a cargo carrying structure (20) mounted to the bottom of the vehicle (28), the structure extending along at least a portion of the longitudinal axis (12) of the vehicle and having a plurality of passageways (40A-F) extending along the longitudinal axis (12) of the vehicle. Each of the passageways (40A-F) is aligned with the lateral axis (16) of the vehicle and extend completely through the structure, and is adapted to simultaneously unload cargo (34) from one end (42) and load cargo from the opposite end (44). A cargo moving system (50,52) is mounted in the floor (46) of each passageway (40A-F) for moving the cargo (34) in one end (42) and out the opposite end (44) of the passageway and intermediate positions therebetween. A cargo securing system (60, 66) is mounted on the floor (46) of the passageway for releasable securing the cargo within the passageway at the intermediate positions.

This Sheet Has Been Replaced





FIG. 1



is Sheet Has Been Recycled

2

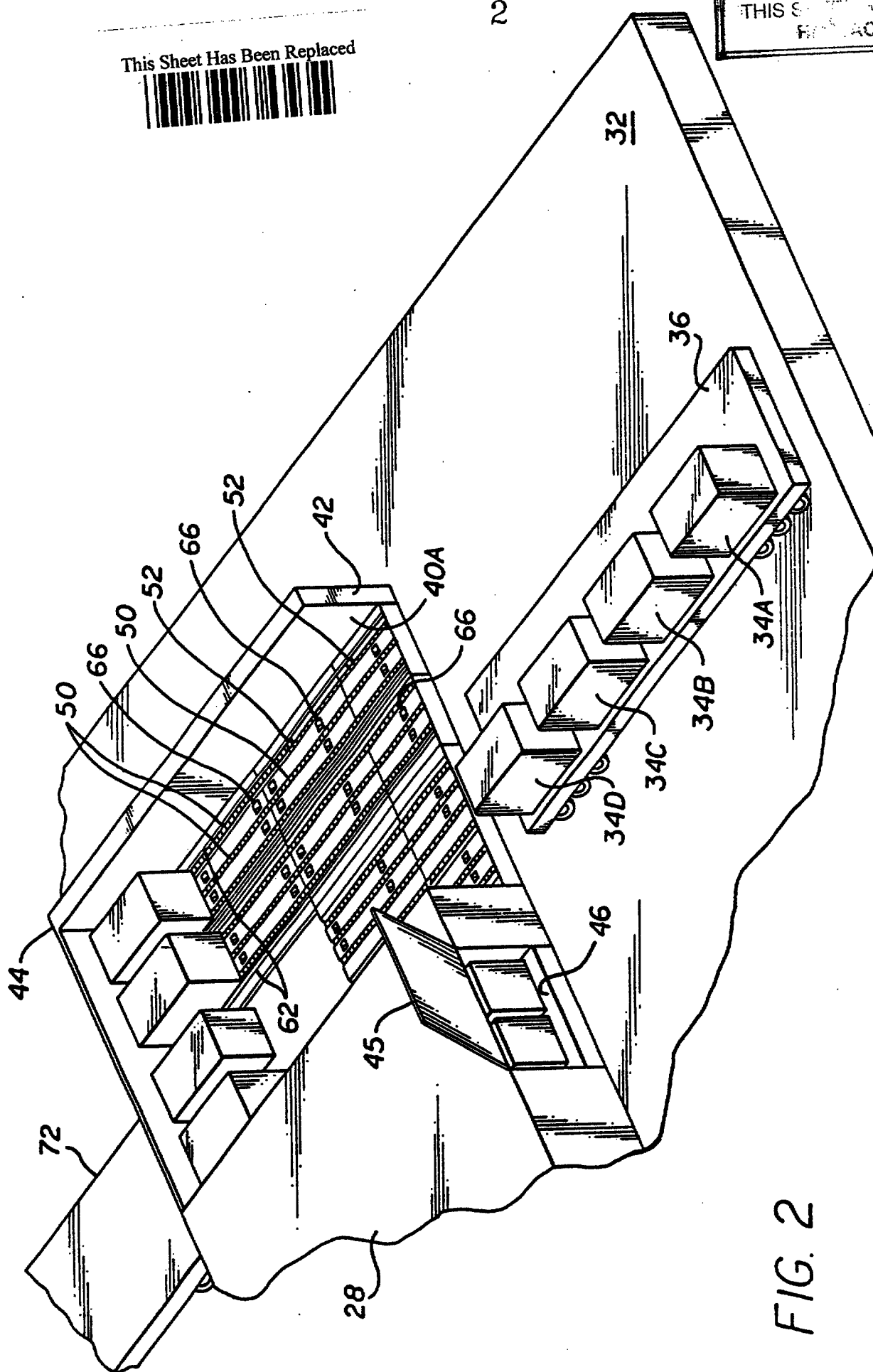


FIG. 2



FIG. 3

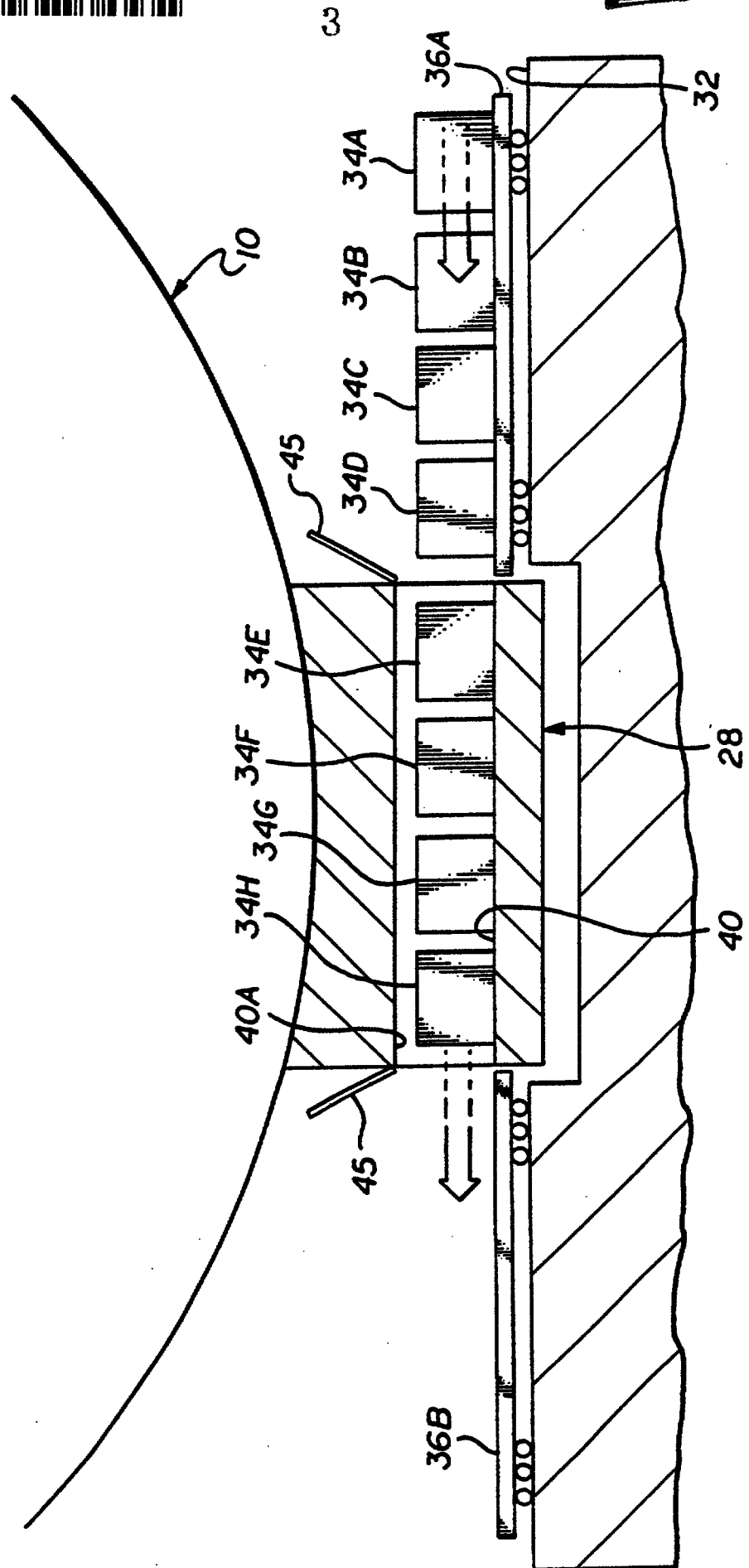
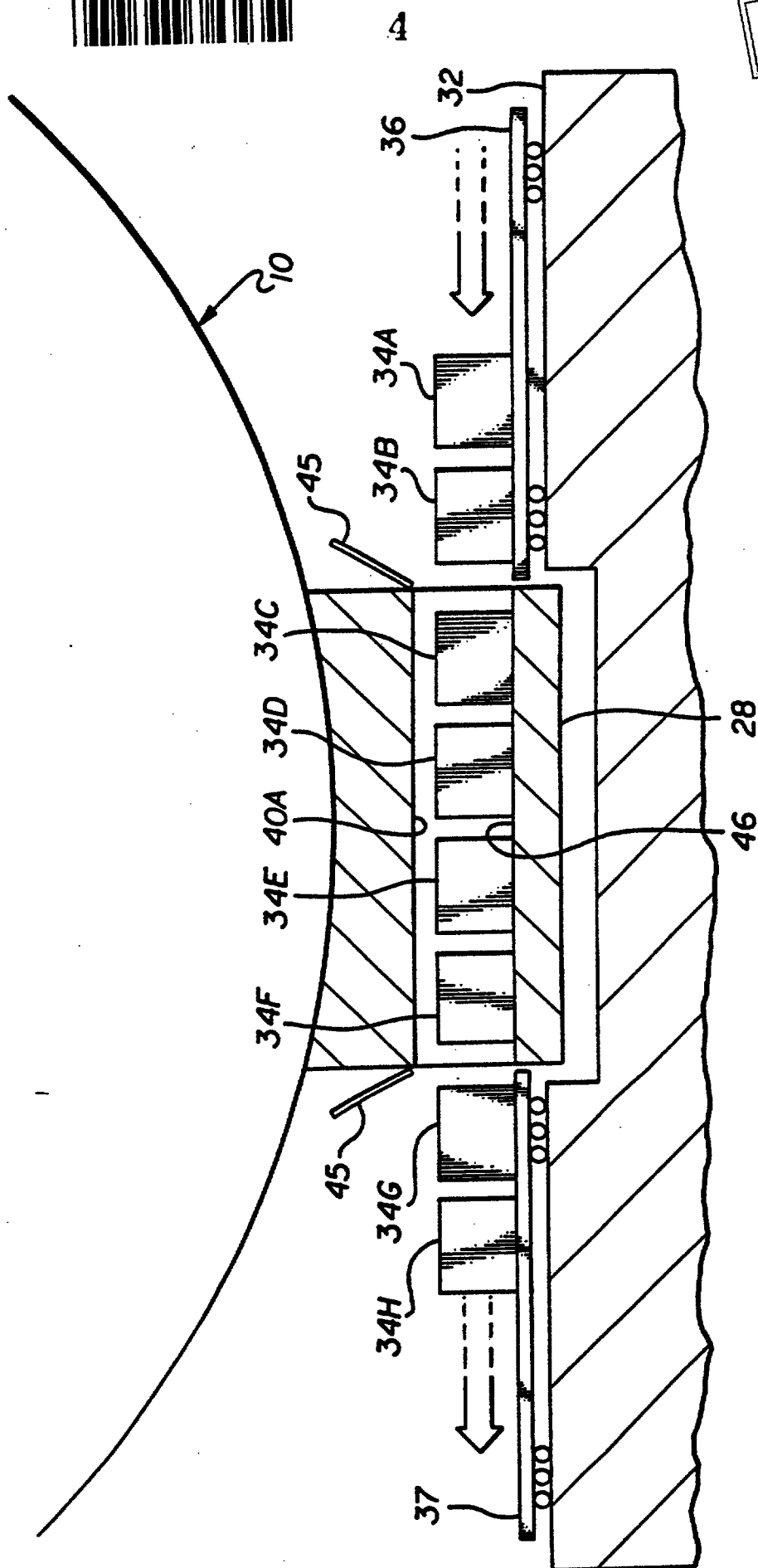
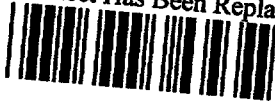


FIG. 4



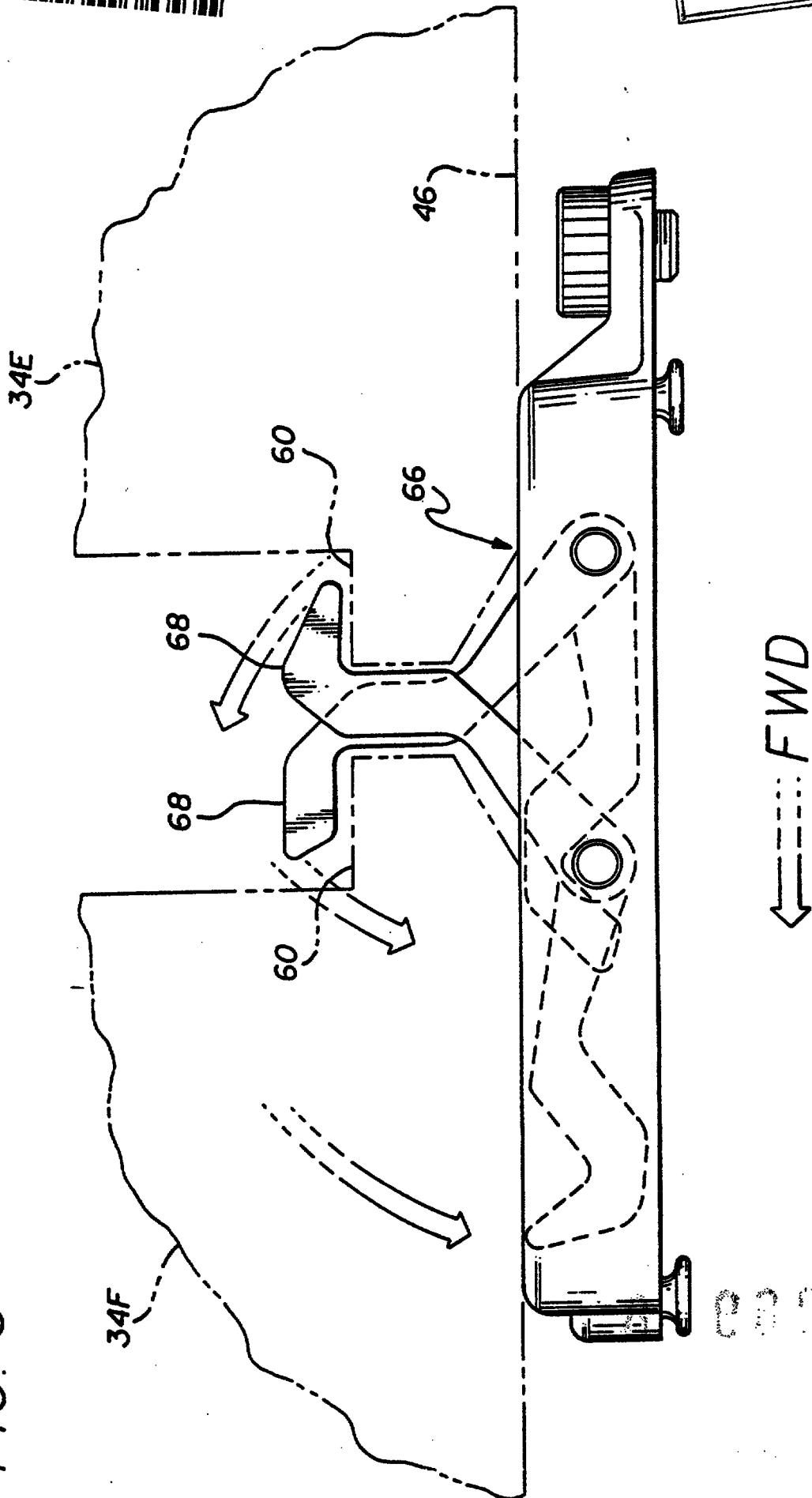
This Sheet Has Been Replaced



5

THIS SHEET HAS BEEN
REPLACED

FIG. 5



20 AUG 1996

Date

13

A CARGO COMPARTMENT FOR A LIGHTER-THAN-AIR VEHICLE

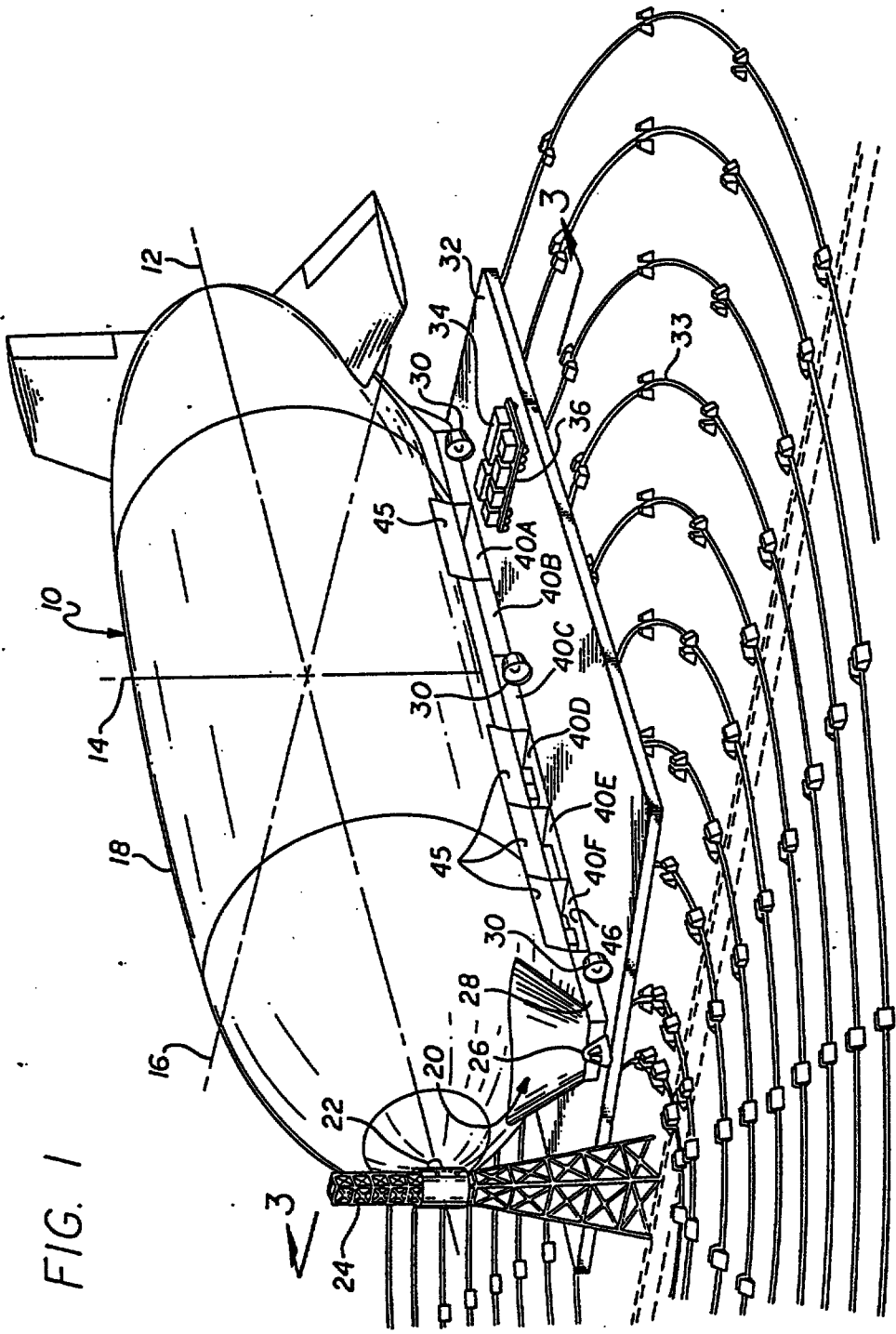
ABSTRACT

The invention is a cargo compartment for a lighter-than-air vehicle (10), the vehicle having a longitudinal (12), vertical (14) and lateral axis (16). In detail, the cargo compartment includes a cargo carrying structure (20) mounted to the bottom of the vehicle (28), the structure extending along at least a portion of the longitudinal axis (12) of the vehicle and having a plurality of passageways (40A-F) extending along the longitudinal axis (12) of the vehicle. Each of the passageways (40A-F) is aligned with the lateral axis (16) of the vehicle and extend completely through the structure, and is adapted to simultaneously unload cargo (34) from one end (42) and load cargo from the opposite end (44). A cargo moving system (50, 52) is mounted in the floor (46) of each passageway (40A-F) for moving the cargo (34) in one end (42) and out the opposite end (44) of the passageway and intermediate positions therebetween. A cargo securing system (60, 66) is mounted on the floor (46) of the passageway for releasable securing the cargo within the passageway at the intermediate positions.

Figure 1

1

FIG. 1



Date : **20 AUG 1996**

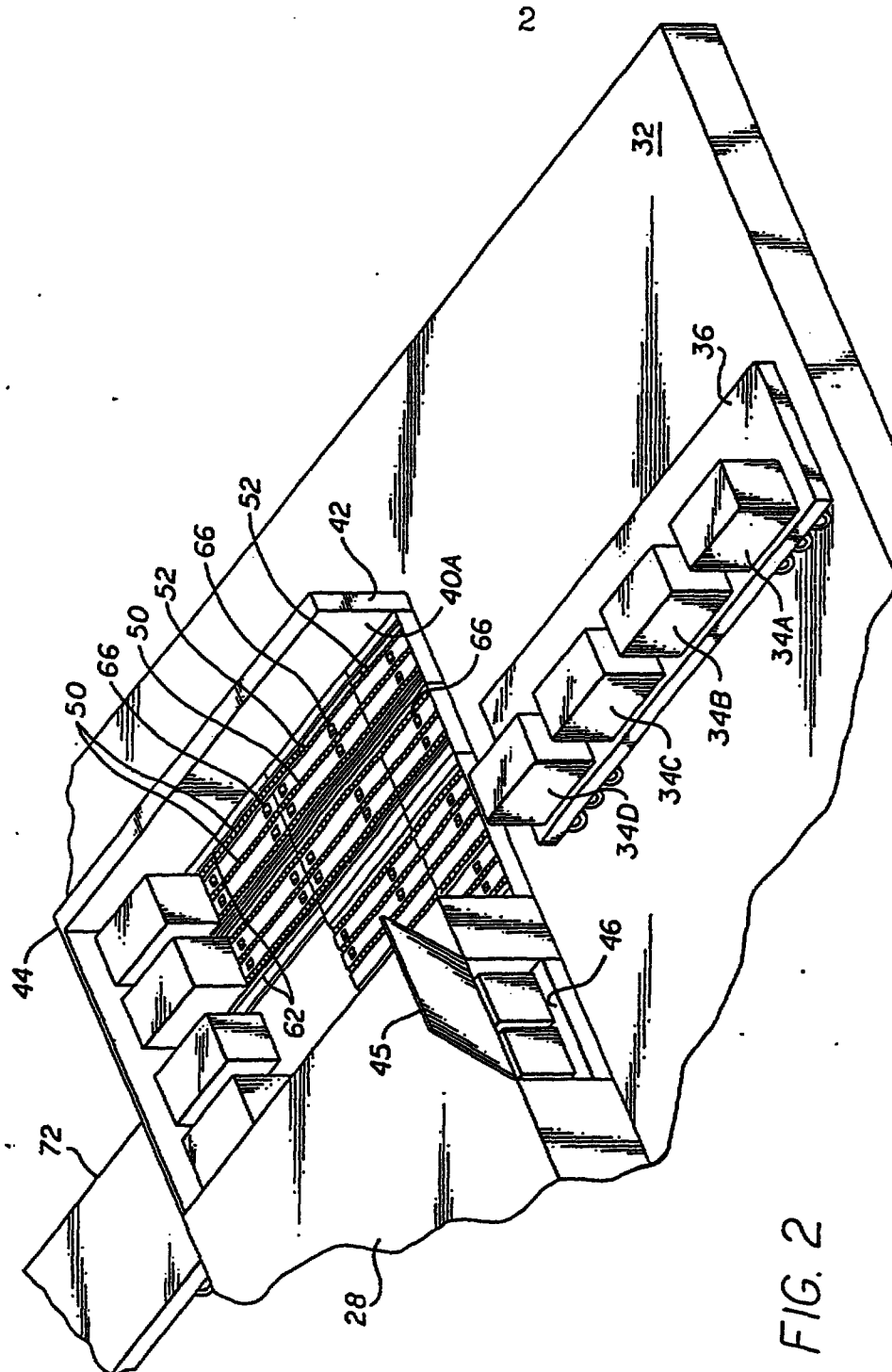


FIG. 3

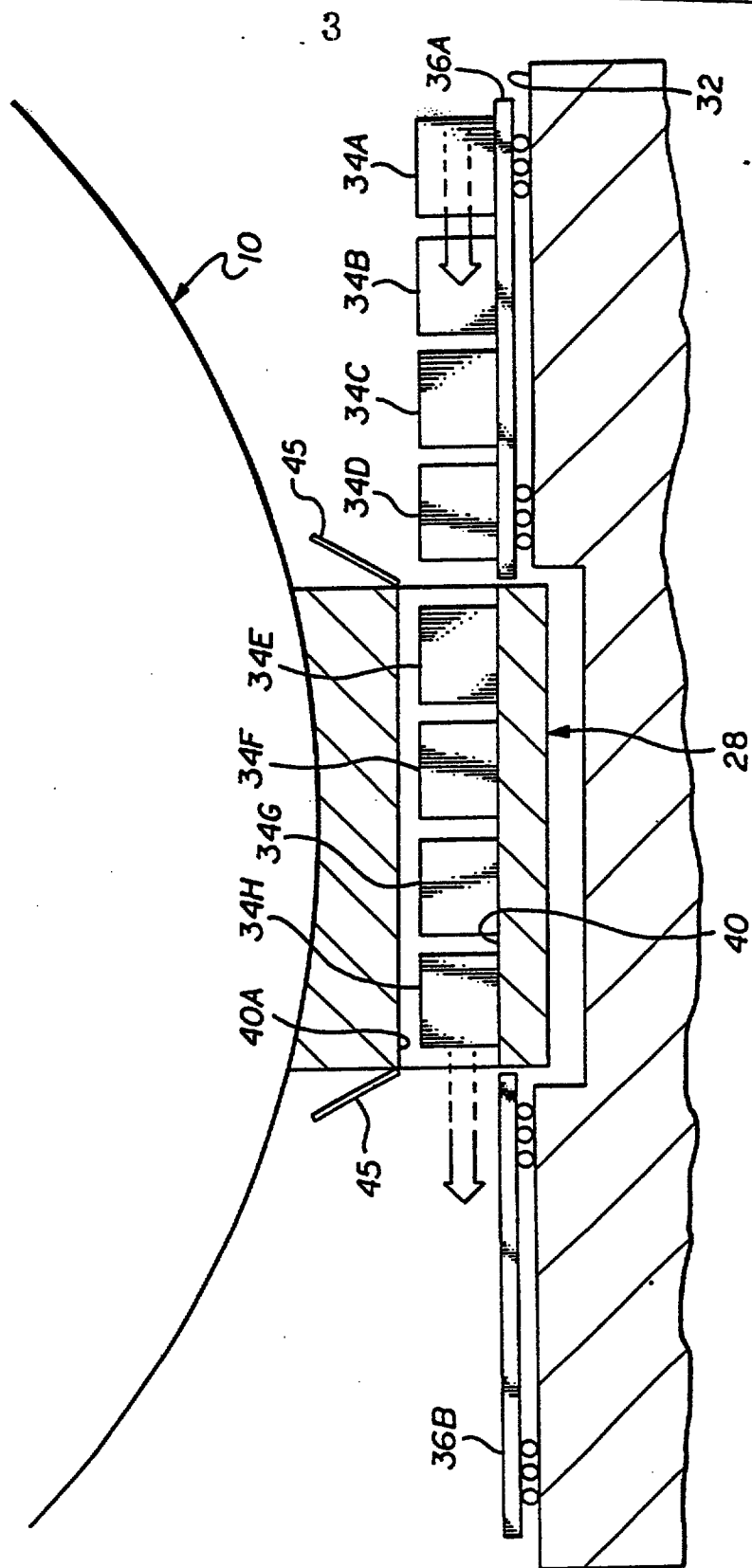
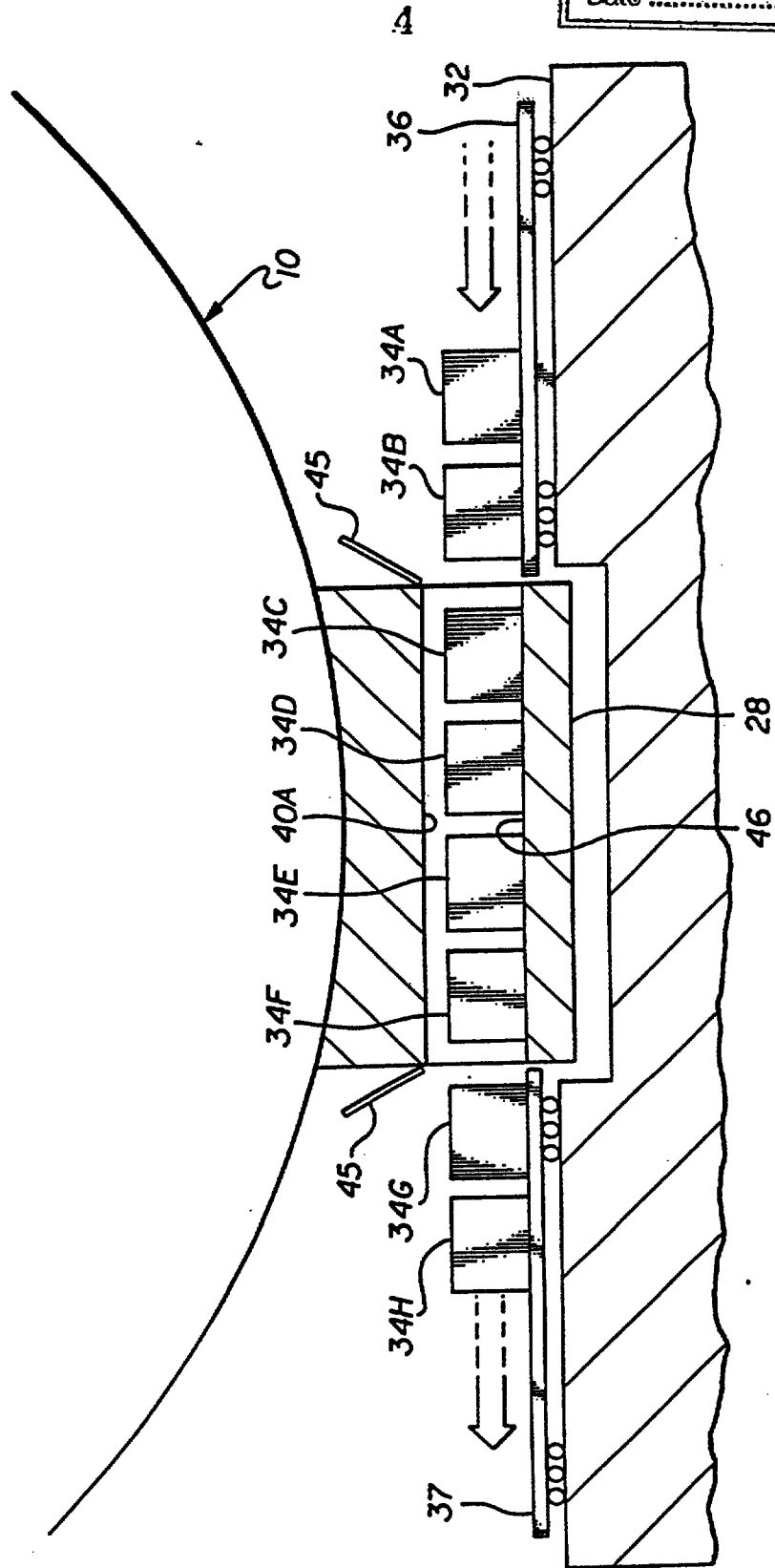


FIG. 4



5

FIG. 5

