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Anderson

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(54) **THIEF HATCH ASSEMBLY WITH IMPROVED SEAL**

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B65D 90/10 (2006.01)
B65D 47/32 (2006.01)

(52) **U.S. Cl.**
CPC ***B65D 90/34*** (2013.01); ***B65D 47/32*** (2013.01); ***B65D 90/10*** (2013.01)

(58) **Field of Classification Search**
CPC B65D 90/34; B65D 47/32; B65D 90/10
See application file for complete search history.

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(57) **ABSTRACT**

A thief hatch assembly for a storage tank includes a housing and a cover that rests on an upper surface of the housing to seal and maintain a pressure within the storage tank. The thief hatch cover is configured to open at a predetermined set pressure to relieve excess pressure from the storage tank. The thief hatch assembly is attached to the storage tank using blind threaded mounting holes to prevent escape of gases from the storage tank through the mounting holes. In one embodiment, the blind threaded holes are provided in a flange adapter that mounts between the thief hatch housing and the storage tank. In another embodiment, the blind threaded holes are provided in a flange adapter that is welded to the storage tank. In another embodiment, the blind threaded holes are provided in the base of the thief hatch housing. Seals are provided between the mounting surfaces.

8 Claims, 7 Drawing Sheets

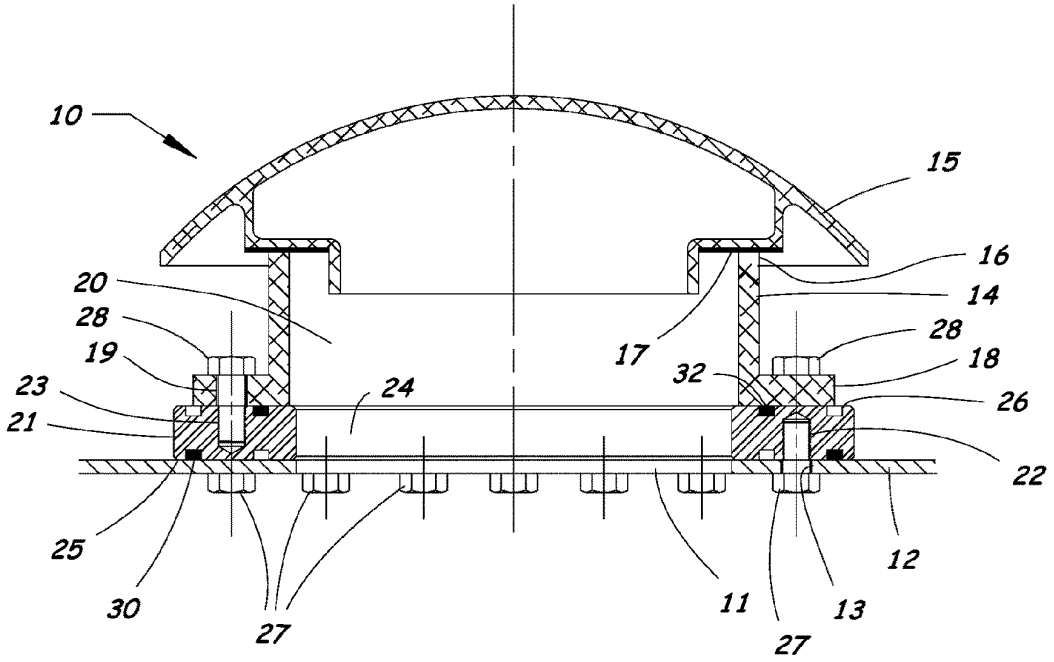


Fig. 1

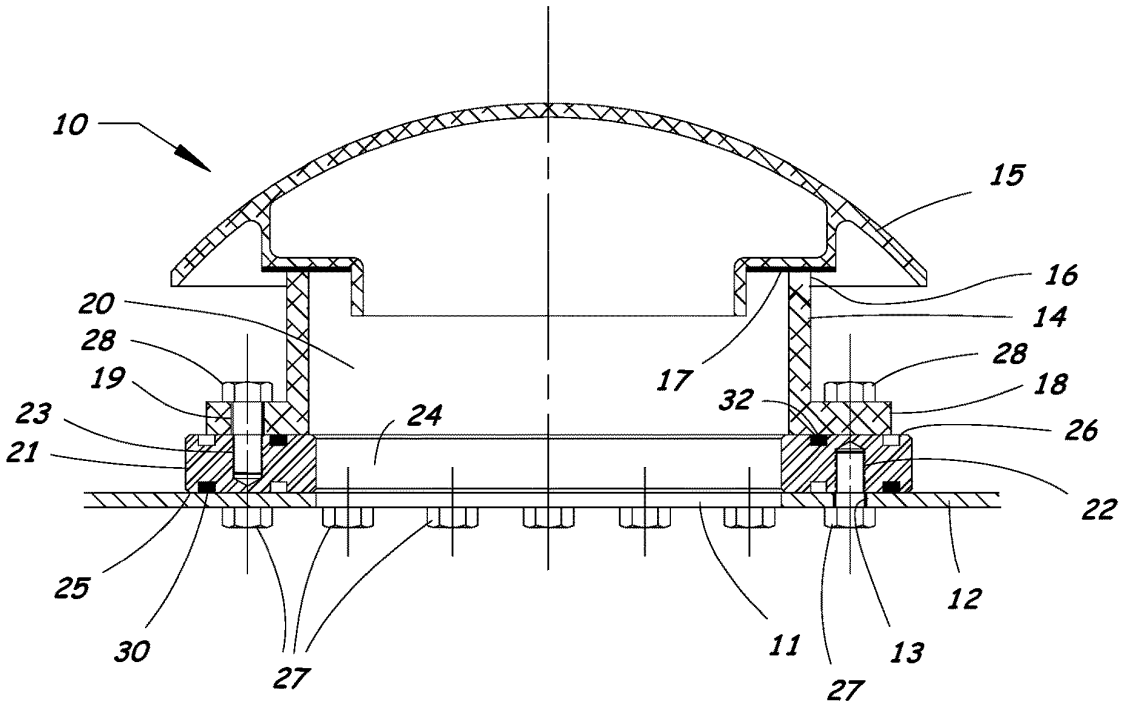


Fig. 2

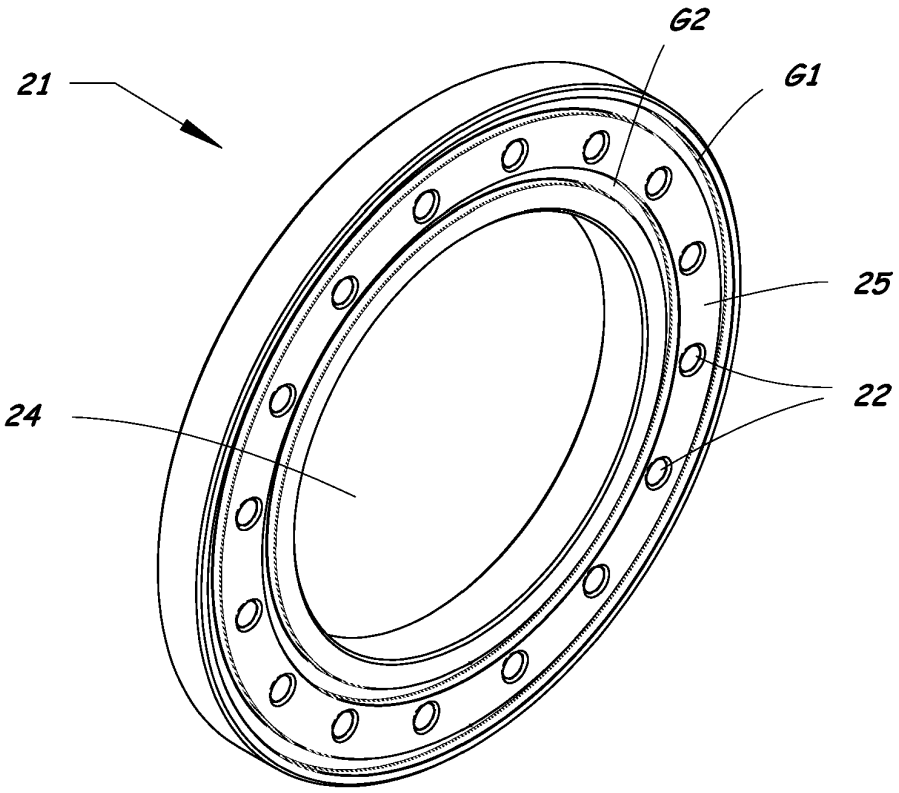
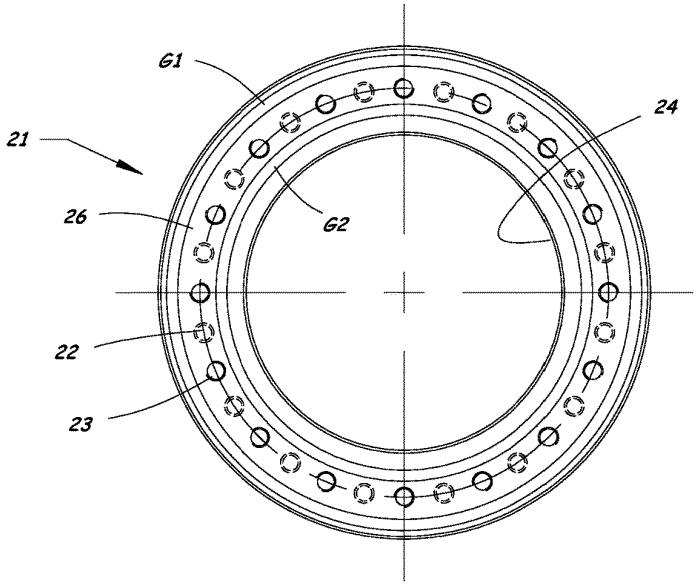


Fig. 3



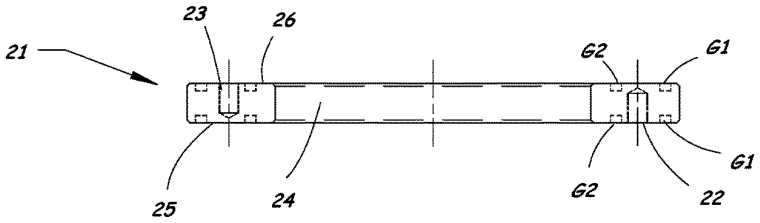


Fig. 4

Fig. 5

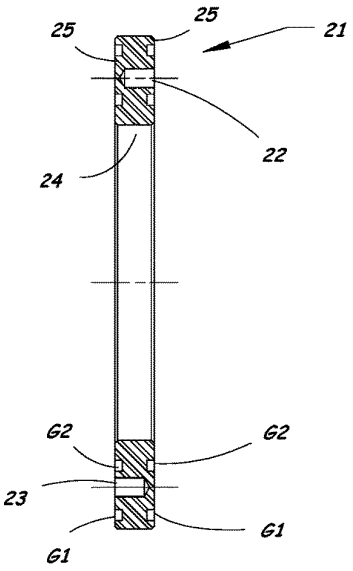


Fig. 6

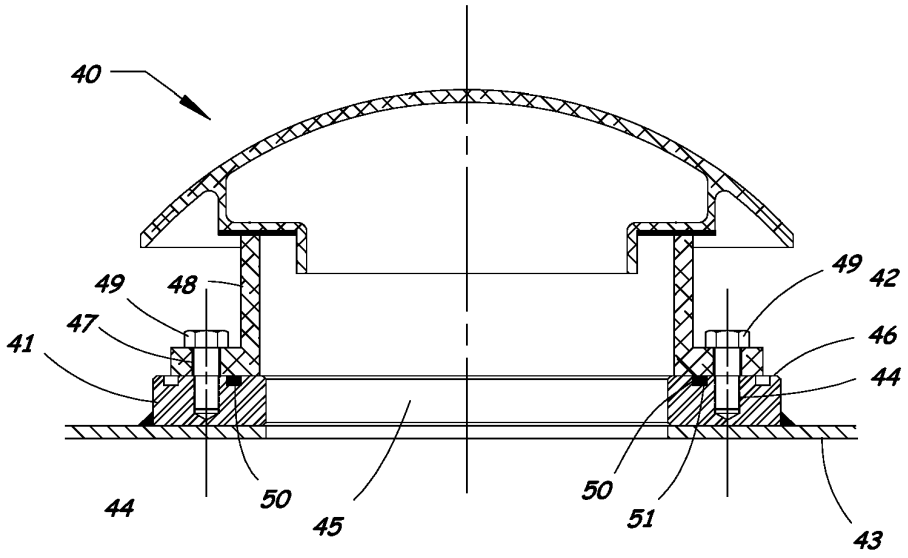


Fig. 7

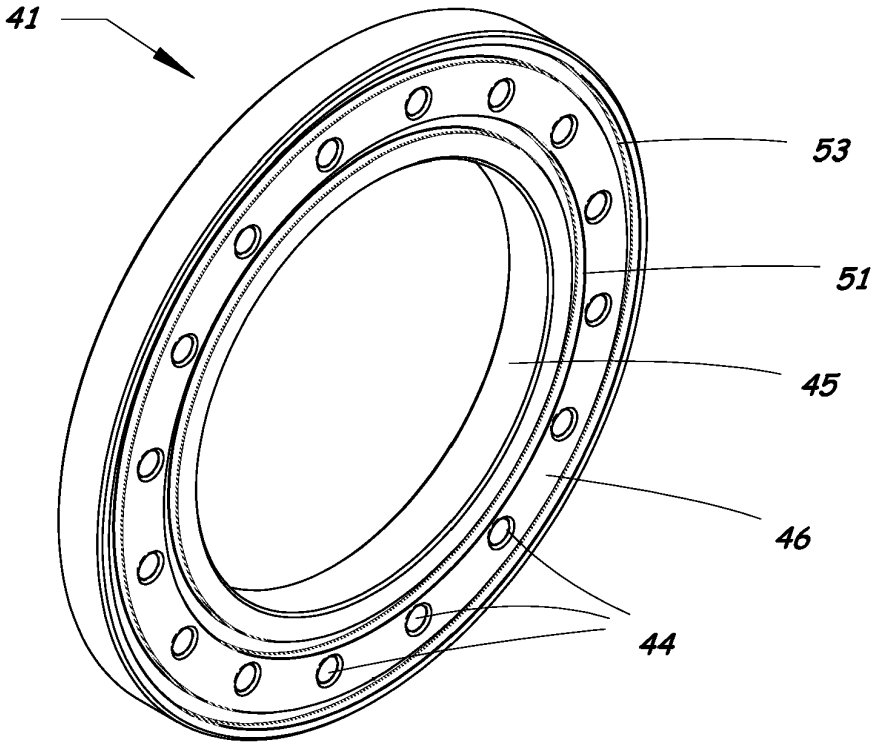


Fig. 8

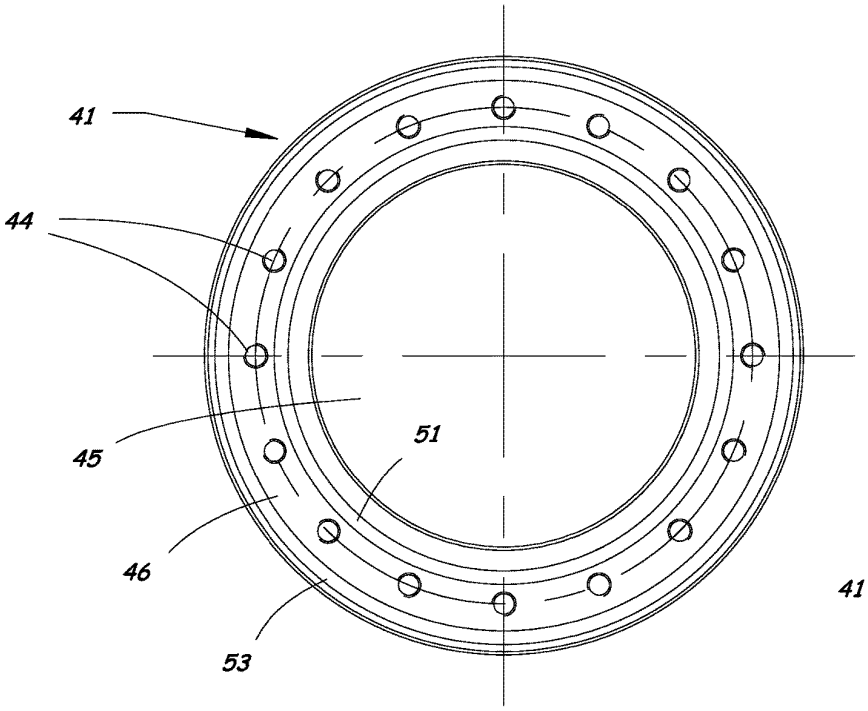
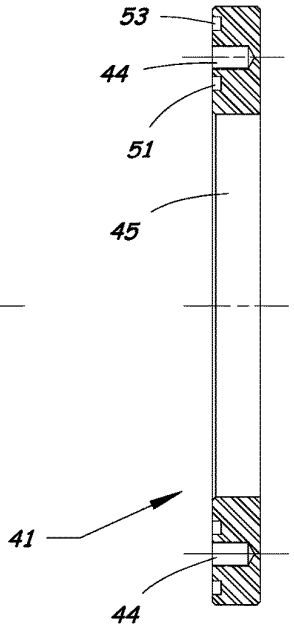


Fig. 10



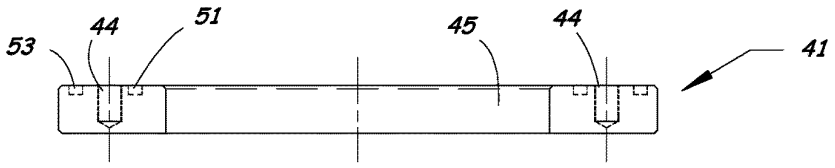
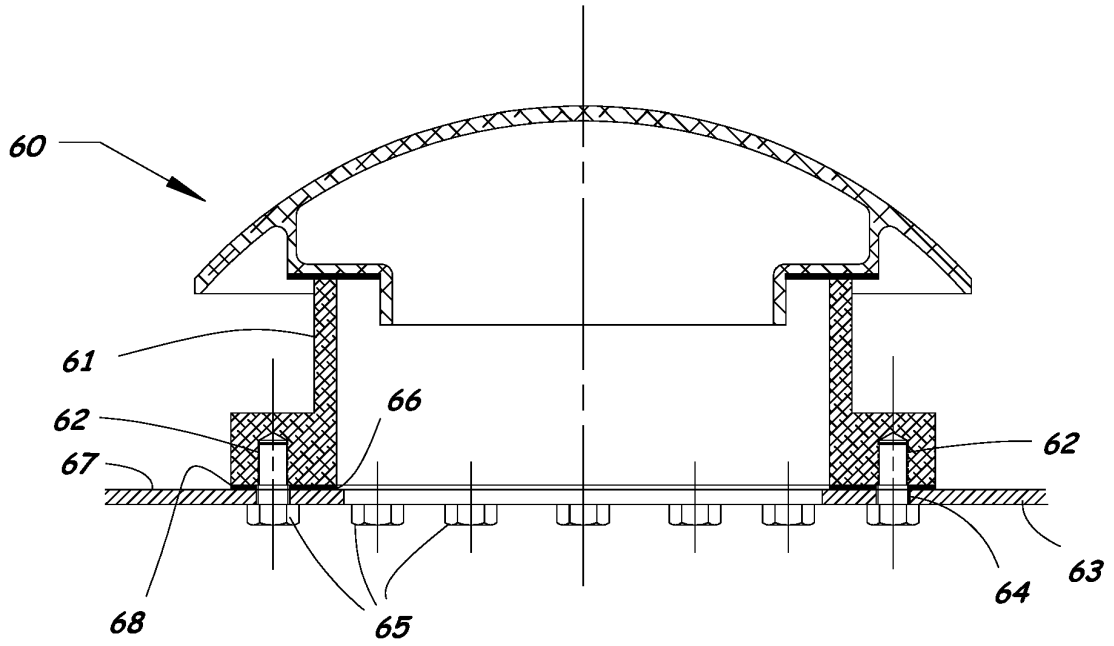


Fig. 9

Fig. 11



THIEF HATCH ASSEMBLY WITH IMPROVED SEAL

BACKGROUND OF THE INVENTION

Field of the Invention

The present invention relates generally to thief hatches for storage tanks, and in particular, to thief hatches with seals to minimizing the escape of gases from storage tanks.

Description of the Related Art

Thief hatches have long been attached to the top of production tanks in oilfields. Production tanks are typically large upright storage tanks used to store both crude oil and produced water on an oilfield location. Thief hatches provide access to the tanks for sampling and gauging purposes, and also provide both a pressure relief and a vacuum relief to accommodate changing fluid levels in the tank and temperature changes throughout the day.

The conventional manner of attaching thief hatches to tanks is to use bolts that extend through holes in a mounting flange on the thief hatch and holes in the top of the tank. In a standard API arrangement, the tank manufacturer will cut an 8 inch diameter hole in the top of the tank and 16 mounting holes on a 10 inch bolt pattern surrounding the 8 inch hole. The thief hatch is then bolted directly to the storage tank. This attachment was typically made with a simple rubber gasket (e.g., a Viton or Buna gasket) between the thief hatch and the tank, and 16 half inch diameter bolts extending through the mounting holes with threaded nuts to secure the assembly.

Environmental concerns have led to close monitoring of petroleum vapors leaking from thief hatches. Government agencies have set minimum standards for petroleum vapor leakage, and in some cases have levied fines on operators not in compliance.

Infrared sensors are used to detect vapor leaks and to pin point the source of the leaks. The seal on the lid of the thief hatch is one issue, but another problem area has been gas vapors that leak to the outside around some or all of the bolts attaching the thief hatch to the tank. Attempts have been made to minimize the leaks by using rubber gaskets and by attempting to perfect the seal between the thief hatch and the tank, particularly in the area of the bolts.

However, there remains a need for a better solution to this problem.

SUMMARY OF THE INVENTION

An object of the present invention is to provide a thief hatch assembly for a storage tank that prevents escape of gases from the storage tank through the mounting holes.

A further object of the present invention is to provide an improved mounting arrangement for a thief hatch assembly that can be used with existing storage tanks.

A further object of the present invention is to provide an flange adapter for a thief hatch assembly that is inexpensive to manufacture, easy to install, universal to fit a variety of thief hatch and storage tank designs, and effective in operation to prevent escape of gases from storage tanks through the mounting holes.

A further object of the present invention is to provide a variety of thief hatch mounting options that can be used with existing thief hatches, existing storage tanks, and/or new thief hatch configurations to prevent escape of gases from the storage tanks through the mounting holes.

These and other objects of the present invention are accomplished by a thief hatch assembly for a storage tank that includes a housing and a cover that rests on an upper surface of the housing to seal and maintain a pressure within the storage tank. The thief hatch cover is configured to open at a predetermined set pressure to relieve excess pressure from the storage tank. The thief hatch assembly is attached to the storage tank using blind threaded mounting holes to prevent escape of gases from the storage tank through the mounting holes. In one embodiment, the blind threaded holes are provided in a flange adapter that mounts between the thief hatch housing and the storage tank. In another embodiment, the blind threaded holes are provided in a flange adapter that is welded to the storage tank. In another embodiment, the blind threaded holes are provided in the base of the thief hatch housing. Seals are provided between the mounting surfaces to prevent escape of gases from the storage tank.

According to one embodiment of the present invention, a combination of a storage tank having an access opening and a thief hatch assembly mounted over the access opening is provided, comprising: a plurality of through holes spaced around the access opening in the storage tank; and a flange adapter having a central opening, a bottom side and a top side, a first group of blind threaded holes formed in the flange adapter that are open to the bottom side, and a second group of blind threaded holes formed in the flange adapter that are open to the top side. The flange adapter is positioned on the storage tank with the first group of blind threaded holes in the bottom side of the flange adapter aligned with the holes in the storage tank, and a first group of threaded fasteners extending through the holes in the storage tank into threaded engagement with the first group of blind threaded holes in the flange adapter. A thief hatch housing with a base flange is positioned on the top side of the flange adapter. The base flange has a plurality of through holes that align with the second group of blind threaded holes in the flange adapter, and a second group of threaded fasteners extend through the holes in the base flange into threaded engagement with the second group of blind threaded holes in the flange adapter.

According to another embodiment of the present invention, a thief hatch assembly for a storage tank is provided, comprising: a thief hatch housing; a thief hatch cover that rests on an upper surface of the thief hatch housing to seal and maintain a pressure within the storage tank, the thief hatch cover being configured to open at a predetermined set pressure to relieve excess pressure from the storage tank; and a means for attaching the thief hatch housing to the storage tank using blind threaded mounting holes to prevent escape of gases from the storage tank through the mounting holes.

Numerous other objects of the present invention will be apparent to those skilled in this art from the following description wherein there is shown and described embodiments of the present invention, simply by way of illustration of some of the modes best suited to carry out the invention. As will be realized, the invention is capable of other different embodiments, and its several details are capable of modification in various obvious aspects without departing from the invention. Accordingly, the drawings and description should be regarded as illustrative in nature and not restrictive.

BRIEF DESCRIPTION OF THE DRAWINGS

The present invention will become more clearly appreciated as the disclosure of the present invention is made with reference to the accompanying drawings. In the drawings:

FIG. **1** is a cross section elevation view of a thief hatch assembly according to a first embodiment of the invention, in which a flange adapter with blind mounting holes is used to secure the thief hatch assembly to a storage tank.

FIG. **2** is a perspective view of the flange adapter from the thief hatch assembly shown in FIG. **1**.

FIG. **3** is a plan view of the flange adapter shown in FIG. **2**.

FIG. **4** is a side view of the flange adapter.

FIG. **5** is a cross section view of the flange adapter.

FIG. **6** is a cross section elevation view of a thief hatch assembly according to a second embodiment of the invention, in which a flange adapter with blind mounting holes is welded to the storage tank.

FIG. **7** is a perspective view of the weld-on flange adapter from the thief hatch assembly shown in FIG. **6**.

FIG. **8** is a plan view of the weld-on flange adapter shown in FIG. **2**.

FIG. **9** is a side view of the weld-on flange adapter.

FIG. **10** is a cross section view of the weld-on flange adapter.

FIG. **11** is a cross section elevation view of a thief hatch assembly according to a third embodiment of the invention, in which blind mounting holes are provided in a housing of the thief hatch assembly.

DETAILED DESCRIPTION OF THE INVENTION

A thief hatch assembly according to the present invention will be described in detail below with reference to FIGS. **1** to **11** of the accompanying drawings.

A thief hatch assembly **10** according to a first embodiment of the present invention will be described with reference to FIGS. **1** to **5**. The thief hatch assembly **10** is mounted over an access opening **11** on a top side of a storage tank **12**. The access opening **11** in the storage tank **12** can be, for example, an API standard access opening having an 8-inch diameter central opening and a pattern of 16 mounting holes **13** surrounding the central opening. The mounting holes **13** can be arranged in a 10-inch diameter circular pattern around the central opening. The mounting holes **13** extend through the top wall of the storage tank **12**.

The thief hatch assembly **10** includes a thief hatch housing **14** and a thief hatch cover **15** that rests on an upper surface **16** of the thief hatch housing **14**. A cover seal **17** is provided at the interface between the thief hatch cover **15** and the upper surface **16** of the thief hatch housing **14**. The thief hatch cover **15** is configured to open at a predetermined set pressure to relieve excess pressure from the storage tank **12** to accommodate changing fluid levels and temperature changes in the storage tank **12**. A vacuum relief (not shown) can also be provided in the thief hatch assembly **10** to provide a secondary vent for the storage tank **12**.

The thief hatch housing **14** has a base flange **18** with a plurality of mounting holes **19** arranged around a central opening **20**. For example, the mounting holes **19** in the base flange **18** can have the same pattern of 16 mounting holes in a 10-inch diameter circular pattern surrounding an 8-inch diameter central opening **20** to correspond with a common API standard for storage tank access openings.

A flange adapter **21** provides a means for attaching the thief hatch housing **14** to the storage tank **12** using blind threaded mounting holes **22**, **23**. The blind threaded mounting holes **22**, **23** are offset from one another on each side of the flange adapter **21** and are not drilled completely through the flange adapter **21**. By using blind threaded mounting holes **22**, **23** instead of through holes to attach the thief hatch housing **14** to the storage tank **12**, gases can be prevented from escaping from the storage tank **12** through the mounting holes **22**, **23**.

The flange adapter **21** has a central opening **24**, a bottom side **25**, a top side **26**, a first group of blind threaded holes **22** that are open to the bottom side **25**, and a second group of blind threaded holes **23** that are open to the top side **26**. The blind threaded holes **22**, **23** are tapped/threaded (e.g., ½" diameter NC threads) and arranged so that the flange adapter **21** can be bolted to the storage tank **12** from one side, and the thief hatch assembly **10** can be bolted to the flange adapter **21** from the other side. In this way, there can be no communication of vapor through a bolt hole from one side to the other.

The flange adapter **21** is positioned on the storage tank **12** with the first group of blind threaded holes **22** in the bottom side **25** of the flange adapter **21** aligned with through holes **13** in the storage tank **12**. A first group of threaded fasteners **27** (e.g., ½ inch diameter bolts) extend through the holes **13** in the storage tank **12** into threaded engagement with the first group of blind threaded holes **22** in the flange adapter **21**. The flange adapter **21** is thus secured to the storage tank **12** without using mounting holes that extend all the way through the flange adapter **21**.

The base flange **18** of the thief hatch housing **14** is positioned on the top side **26** of the flange adapter **21**. The base flange **18** has a plurality of through holes **19** that align with the second group of blind threaded holes **23** in the flange adapter **21**. A second group of threaded fasteners **28** (e.g., ½ inch diameter bolts) extend through the holes **19** in the base flange **18** into threaded engagement with the second group of blind threaded holes **23** in the flange adapter **21**. The base flange **18** is thus secured to the flange adapter **21** without using mounting holes that extend all the way through the flange adapter **21**.

A first groove G**1** is formed in the bottom side **25** of the flange adapter **21**, and a first seal ring **30** is positioned in the first groove G**1**. The first seal ring **30** is arranged to form a seal between the storage tank **12** and the bottom side **25** of the flange adapter **21** radially outward of the through holes **13** in the storage tank **12** and the first group of blind holes **22** in the flange adapter **21**.

A second groove G**2** is formed in the top side **26** of the flange adapter **21**, and a second seal ring **32** is positioned in the second groove G**2**. The second seal ring **32** is arranged to form a seal between the flange adapter **21** and the bottom surface **33** of the thief hatch housing **14** radially inward of the through holes **19** in the base flange **18** and the second group of blind holes **23** in the flange adapter **21**.

The first and second seal rings **30**, **32** can be, for example, rubber seal rings with rectangular (e.g., ¼ inch square) cross sections to fit within the first and second grooves G**1**, G**2**, respectively.

The flange adapter **21** can be made with the bottom and top sides **25**, **26** substantially the same so that the flange adapter **21** can be positioned with either side facing up. Thus, a first pair of annular grooves G**1**, G**2** are formed in the bottom side **25** of the flange adapter **21**, and a second pair of annular grooves G**1**, G**2** are formed in top side **26** of the flange adapter **21**. Each of the first and second pairs of

annular grooves G1, G2 includes an outer groove G1 located radially outward of the blind holes **22**, and an inner groove G2 located radially inward of the blind holes **23**. By providing the flange adapter **21** with a pair of annular grooves on both sides, the flange adapter **21** is nondirectional in installation.

The first seal ring **30** is configured to fit into one of the outer grooves G1 for providing a seal between the storage tank **12** and the flange adapter **21**. The second seal ring **32** is configured to fit into the inner groove G2 on the opposite side of the flange adapter **21** from the first seal ring **30** for providing a seal between the flange adapter **21** and the base flange **18** of the thief hatch housing **14**. By positioning the first and second seal rings **30**, **32** in the outer and inner grooves G1, G2, respectively, an effective seal can be provided to prevent escape of gases from the storage tank **12** through the mounting holes. Additional seal rings (not shown) can be placed in the other grooves on the flange adapter, if desired, but would generally not be necessary.

The flange adapter **21** can be produced from many different materials and can be used with various other types of gaskets and seals. For example, a conventional flat rubber gasket can be used on each side of the adapter **21**, instead of seal rings **30**, **32** that fit into grooves G1, G2. The blind drilled and tapped mounting holes **22**, **23** on each side of the flange adapter **21** is what allows to adapter **21** to provide a positive and effective seal with conventional gaskets without vapor leakage through the mounting holes **22**, **23**.

The concepts disclosed herein could also be used to mount a fixture other than a thief hatch to a tank with a compatible bolt pattern. For example, the flange adapter **21** can be used to mount any fixture to a tank with a compatible bolt pattern using a flat gasket with aligned bolt holes to eliminate communication of vapor through the bolt holes.

A thief hatch assembly **40** according to a second embodiment of the present invention will be described with reference to FIGS. **6** to **10**. In this embodiment, a weld-on flange adapter **41** is used to provide a means for attaching the thief hatch housing **42** to a storage tank **43** using blind threaded mounting holes **44** to prevent escape of gases from the storage tank **43** through the mounting holes **44**.

The flange adapter **41** is welded to the storage tank **43** to secure the flange adapter **41** and to seal against any leakage between the flange adapter **41** and the storage tank **43**. The weld-on flange adapter **41** has a central opening **45**, a top side **46**, and a group of blind threaded holes **44** formed in the flange adapter **41** that are open to the top side **46**. The blind threaded holes **44** are aligned with through holes **47** in the base flange **48** of the thief hatch housing **42**. A plurality of threaded fasteners **49** extend through the holes **47** in the base flange **48** into threaded engagement with the blind threaded holes **44** in the flange adapter **41**.

A seal member **50**, such as a rubber seal ring, is received in an inner groove **51** on a top side of the flange adapter **41**. The seal member **50** is positioned between the top side **46** of the flange adapter **41** and a bottom surface **52** of the base flange **48** to form a seal between the flange adapter **41** and the thief hatch housing **42** radially inward of the holes **47** in the base flange **48**. By positioning the seal member **50** radially inward of the holes **47** in the base flange **48**, an effective seal can be provided to prevent escape of gases from the storage tank **43** through the mounting holes. An additional seal ring (not shown) can be placed in the outer groove **53** on the weld-on flange adapter **41**, if desired, but would generally not be necessary.

A thief hatch assembly **60** according to a third embodiment of the invention will be described with reference to FIG. **11**. In this embodiment, a thief hatch housing **61** with blind mounting holes **62** is used to provide a means for attaching the thief hatch housing **61** to a storage tank **63** without allowing gases to escape through the mounting holes **62**.

The blind mounting holes **62** in the thief hatch housing **61** open downwardly and are aligned with a plurality of through holes **64** in the storage tank **63**. A plurality of threaded fasteners **65** (e.g., ½ inch diameter bolts) extend through the holes **64** in the storage tank **63** into threaded engagement with the blind threaded holes **62** in the thief hatch housing **61**.

A seal member **66** is positioned between a top side **67** of the storage tank **63** and a bottom surface **68** of the thief hatch housing **61**. The seal member **66** provides a seal between the top side **67** of the storage tank **63** and the thief hatch housing **61** radially outward of the through holes **64** in the storage tank **63**. The seal member **66** can be in the form of a seal gasket that covers the bottom surface of the thief hatch housing **61**, as shown in FIG. **11**. Alternatively, the seal member **66** can be a seal ring that fits within a groove (not shown) in the bottom of the thief hatch housing **61** located radially outward of the through holes **64** in the storage tank **63**.

While the invention has been described in connection with specific embodiments thereof, it is to be understood that this is by way of illustration and not of limitation, and the scope of the appended claims should be construed as broadly as the prior art will permit.

What is claimed is:

1. In combination, a storage tank having an access opening and a thief hatch assembly mounted over said access opening, comprising:

said storage tank having a plurality of through holes spaced around the access opening;

a flange adapter having a central opening, a bottom side and a top side, a first group of blind threaded holes formed in the flange adapter that are open to the bottom side, and a second group of blind threaded holes formed in the flange adapter that are open to the top side;

said flange adapter being positioned on said storage tank with the first group of blind threaded holes in the bottom side of the flange adapter aligned with the holes in the storage tank, and a first group of threaded fasteners extending through the holes in the storage tank into threaded engagement with the first group of blind threaded holes in the flange adapter; and

a thief hatch housing with a base flange positioned on the top side of said flange adapter, said base flange having a plurality of through holes that align with the second group of blind threaded holes in said flange adapter, and a second group of threaded fasteners extending through the holes in the base flange into threaded engagement with the second group of blind threaded holes in the flange adapter;

further comprising a first seal ring positioned between a top surface of said storage tank and the bottom side of said flange adapter;

wherein said first seal ring is arranged to form a seal between said storage tank and said flange adapter radially outward of the through holes in the storage tank and the first group of blind holes in the flange adapter;

further comprising a second seal ring positioned between the top side of said flange adapter and a bottom surface of the base flange of the thief hatch housing;

wherein said second seal ring is arranged to form a seal between said flange adapter and said base flange radially inward of the through holes in the base flange and the second group of blind holes in the flange adapter; and

wherein said flange adapter comprises a first annular groove formed in said bottom side for receiving said first seal ring, said first groove being located radially outward of said first group of blind holes.

2. The combination according to claim **1**, wherein said flange adapter comprises a second annular groove formed in said top side for receiving said second seal ring, said second groove being located radially inward of said second group of blind holes.

3. The combination according to claim **2**, wherein said thief hatch assembly further comprises a thief hatch cover that rests on an upper surface of said thief hatch housing to seal and maintain a pressure within said tank.

4. In combination, a storage tank having an access opening and a thief hatch assembly mounted over said access opening, comprising:

said storage tank having a plurality of through holes spaced around the access opening;

a flange adapter having a central opening, a bottom side and a top side, a first group of blind threaded holes formed in the flange adapter that are open to the bottom side, and a second group of blind threaded holes formed in the flange adapter that are open to the top side;

said flange adapter being positioned on said storage tank with the first group of blind threaded holes in the bottom side of the flange adapter aligned with the holes in the storage tank, and a first group of threaded fasteners extending through the holes in the storage tank into threaded engagement with the first group of blind threaded holes in the flange adapter; and

a thief hatch housing with a base flange positioned on the top side of said flange adapter, said base flange having a plurality of through holes that align with the second group of blind threaded holes in said flange adapter, and a second group of threaded fasteners extending through the holes in the base flange into threaded engagement with the second group of blind threaded holes in the flange adapter;

wherein said flange adapter comprises a first annular groove formed in said bottom side and a first seal ring received in said first annular groove to provide a seal between said storage tank and said flange adapter, said first groove being located radially outward of said first group of blind holes.

5. The combination according to claim **4**, wherein said flange adapter comprises a second annular groove formed in said top side and a second seal ring received in said second annular groove to provide a seal between said flange adapter and said base flange of the thief hatch housing, said second groove being located radially inward of said second group of blind holes.

6. The combination according to claim **4**, wherein the bottom and top sides of said flange adapter are substantially the same so that the flange adapter can be positioned with either side facing up.

7. In combination, a storage tank having an access opening and a thief hatch assembly mounted over said access opening, comprising:

said storage tank having a plurality of through holes spaced around the access opening;

a flange adapter having a central opening, a bottom side and a top side, a first group of blind threaded holes formed in the flange adapter that are open to the bottom side, and a second group of blind threaded holes formed in the flange adapter that are open to the top side;

said flange adapter being positioned on said storage tank with the first group of blind threaded holes in the bottom side of the flange adapter aligned with the holes in the storage tank, and a first group of threaded fasteners extending through the holes in the storage tank into threaded engagement with the first group of blind threaded holes in the flange adapter; and

a thief hatch housing with a base flange positioned on the top side of said flange adapter, said base flange having a plurality of through holes that align with the second group of blind threaded holes in said flange adapter, and a second group of threaded fasteners extending through the holes in the base flange into threaded engagement with the second group of blind threaded holes in the flange adapter;

wherein the bottom and top sides of said flange adapter are substantially the same so that the flange adapter can be positioned with either side facing up; and

wherein a first pair of annular grooves are formed in the bottom side of said flange adapter, and a second pair of annular grooves are formed in the top side of said flange adapter, each of said pairs of annular grooves comprising an outer groove located radially outward of said blind holes, and an inner groove located radially inward of said blind holes.

8. The combination according to claim **7**, further comprising a first seal ring configured to fit into one of said outer grooves for providing a seal between said storage tank and said flange adapter, and a second seal ring configured to fit into one of said inner grooves for providing a seal between said flange adapter and the base flange of said thief hatch housing.

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