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(54) SLIDE GUIDE ASSEMBLY AND SLIDER KIT FOR FLOATING COVER OF DIGESTER TANK AND ASSOCIATED METHOD

(75) Inventors: **Miguel A. Vera**, Taylorsville, UT (US); **James R. Seale**, Murray, UT (US); **Terry R. Price**, Bountiful, UT (US)

Correspondence Address:
R. Neil Sudol
714 Colorado Avenue
Bridgeport, CT 06605-1601 (US)

(73) Assignee: **GL&V Management Hungary Kft.**, Egressy (HU)

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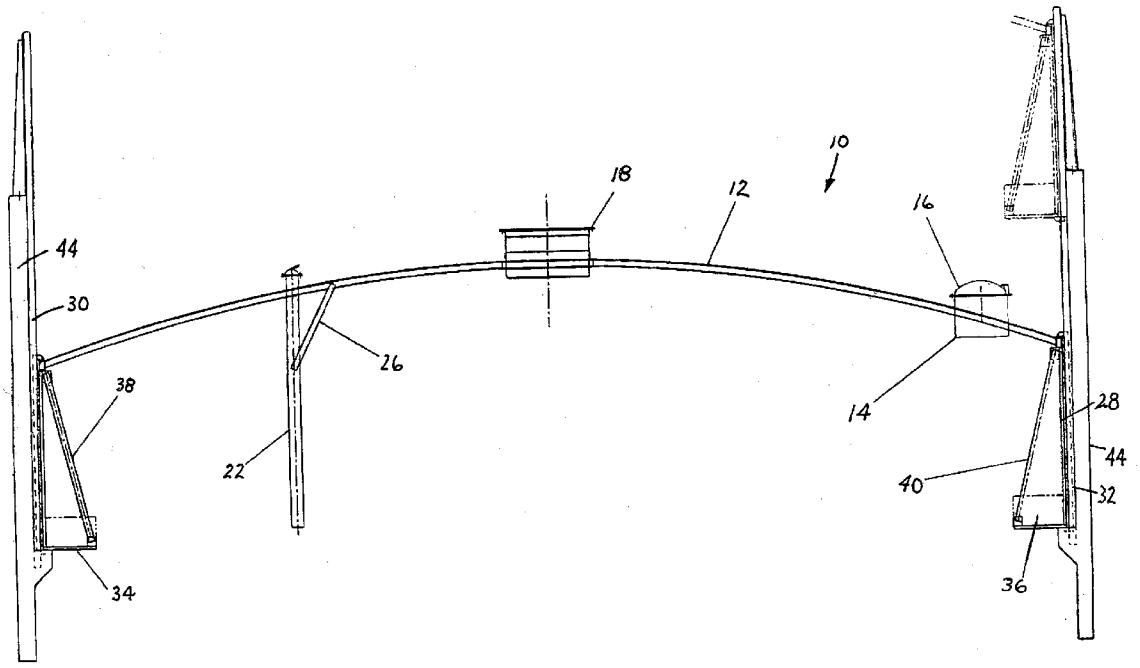
(57) **ABSTRACT**

A guide assembly for a floating cover of a sludge digester tank includes a track having a pair of opposing surfaces facing one another to define a vertical guide channel or track connected to the tank or the floating cover. At least one slider member is disposed in the channel for vertical motion therein. The slider member is connected to the other of the tank or the floating cover. Two bearing strips are attached to the slider member for engaging opposing surfaces of the track in a low-friction slidable contact. The bearing strips are vertically removable from the slider member, so that the bearing strips may be replaced without removing the slider member from the guide channel.



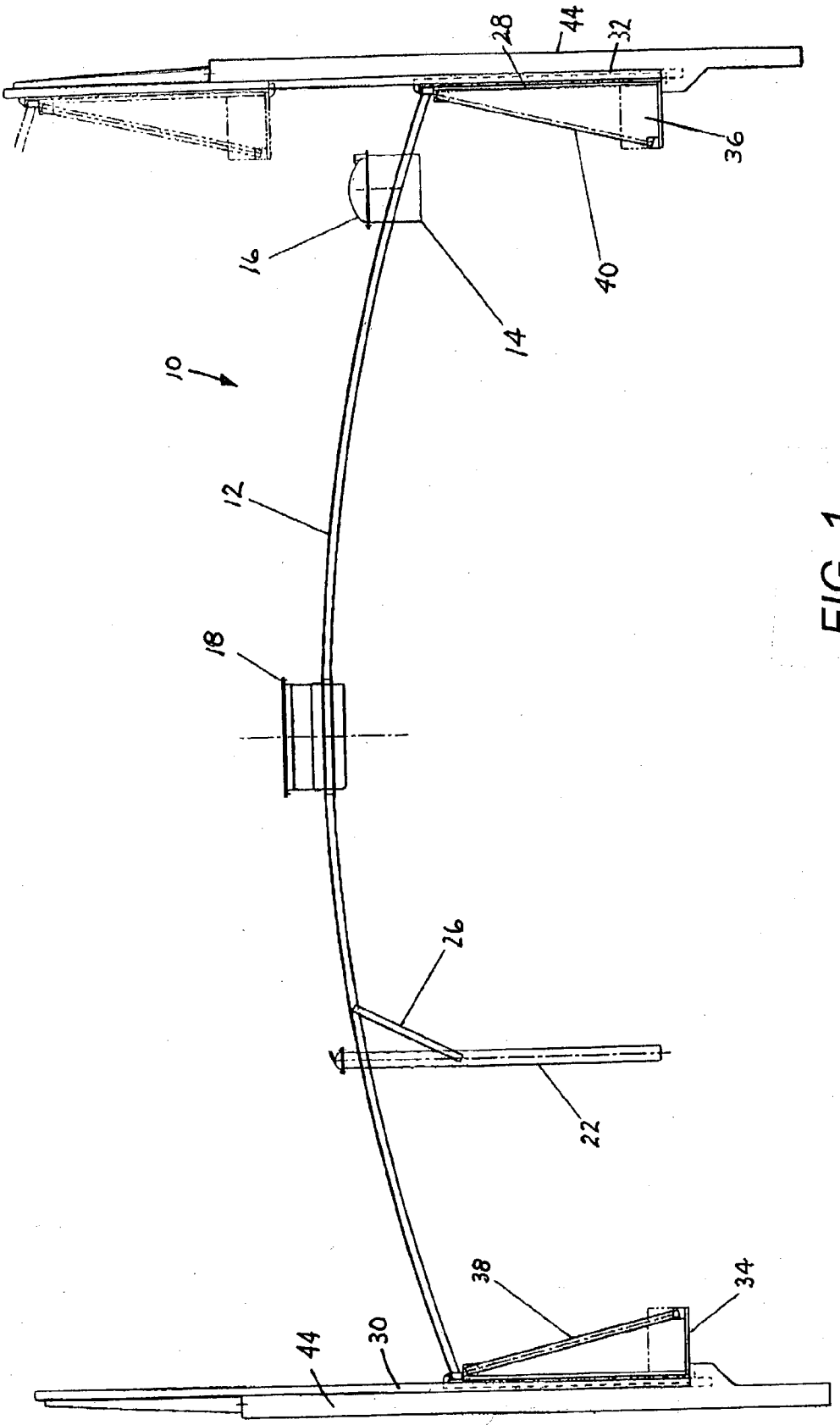


FIG. 1

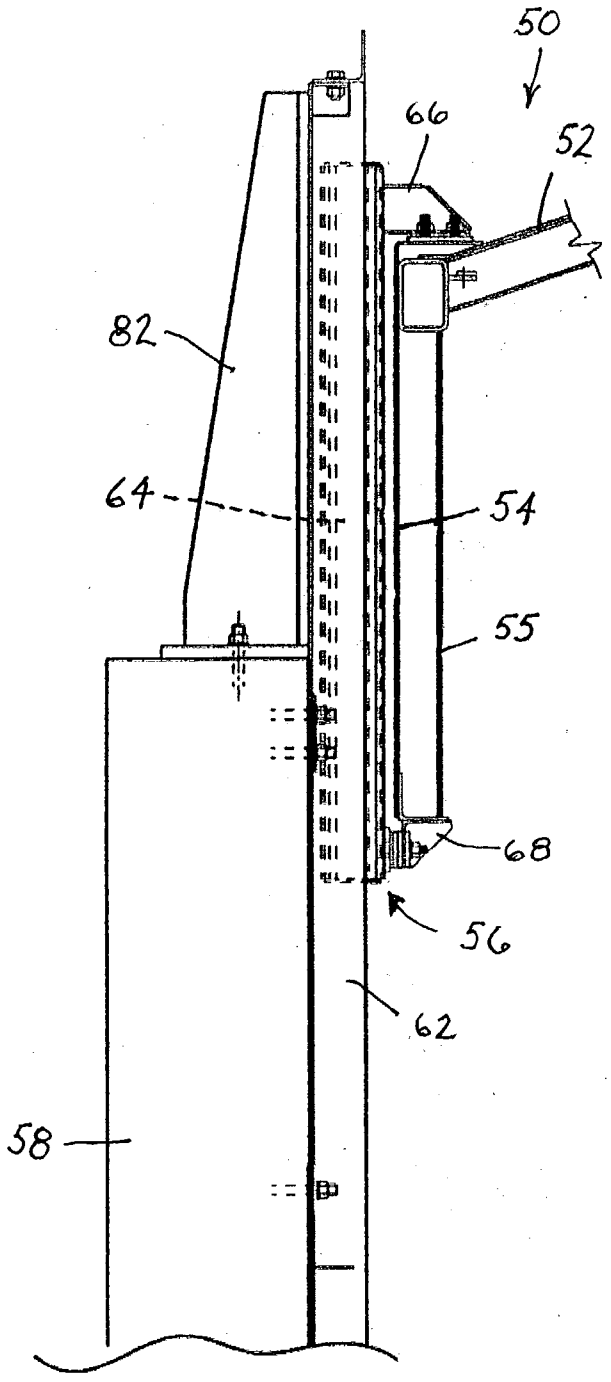


FIG. 2

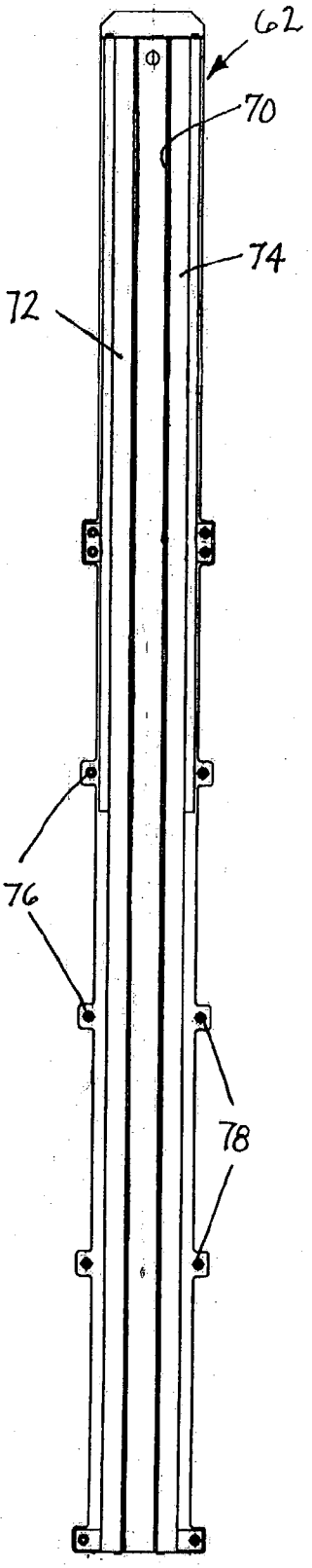


FIG. 3

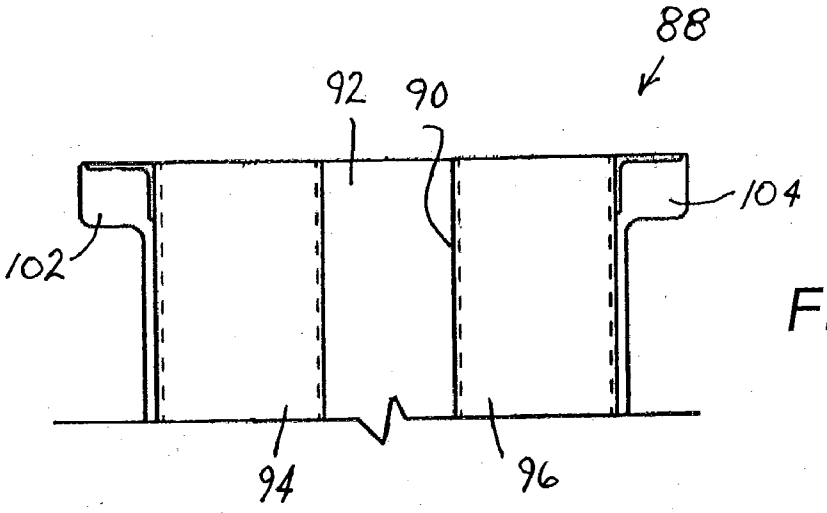


FIG. 4

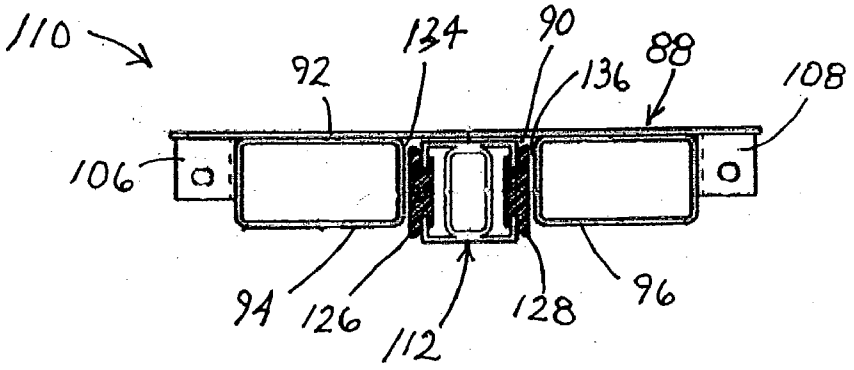


FIG. 5

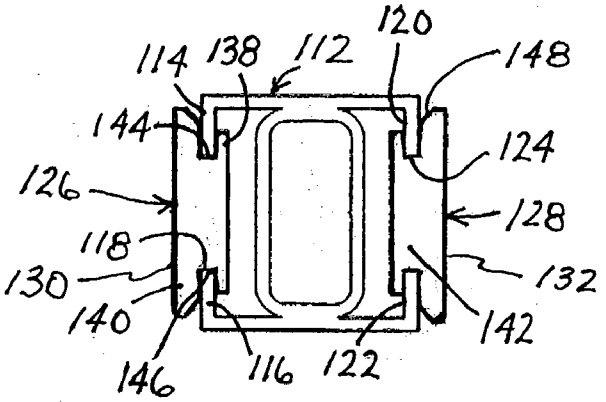


FIG. 6

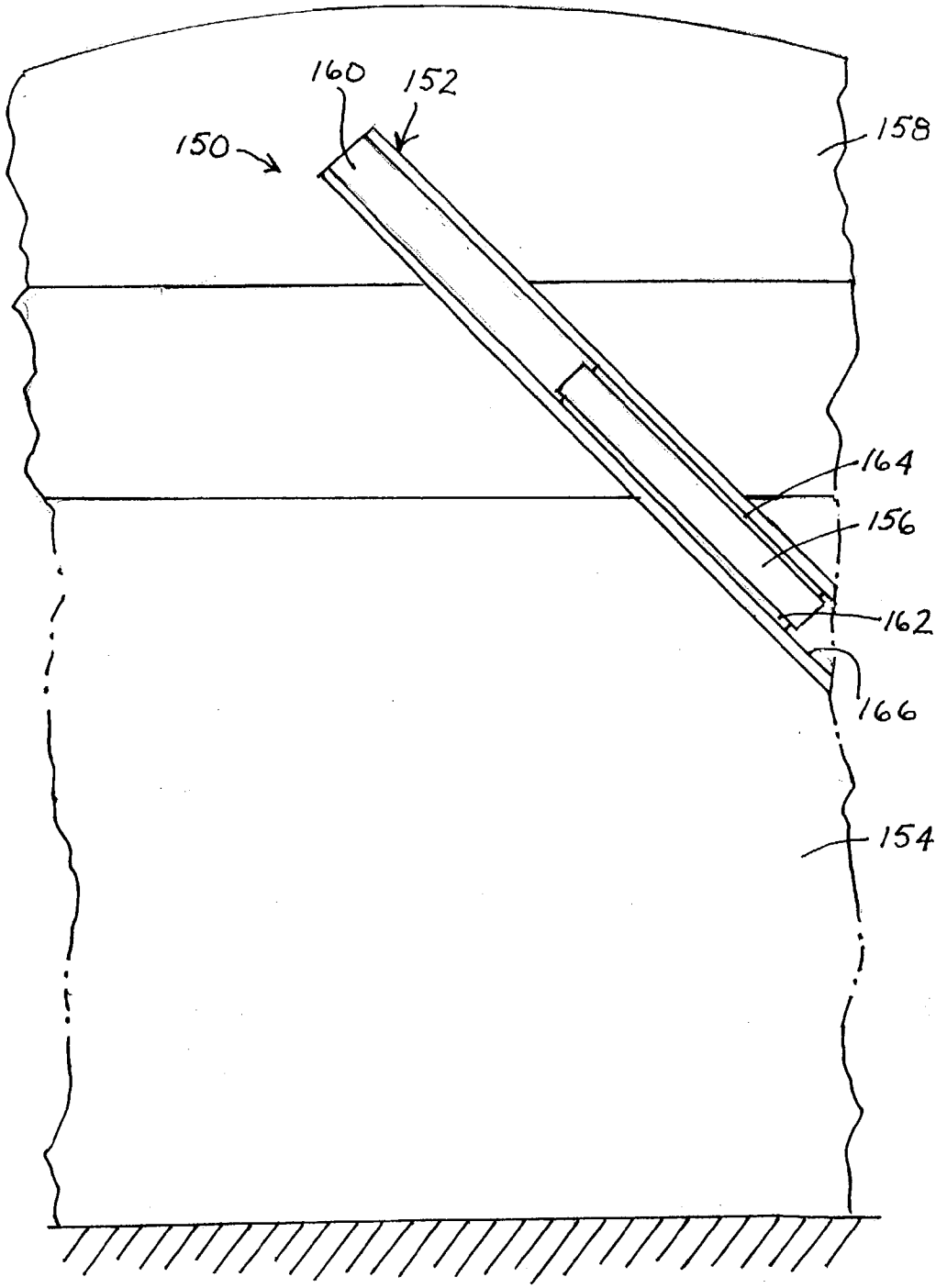


FIG. 7

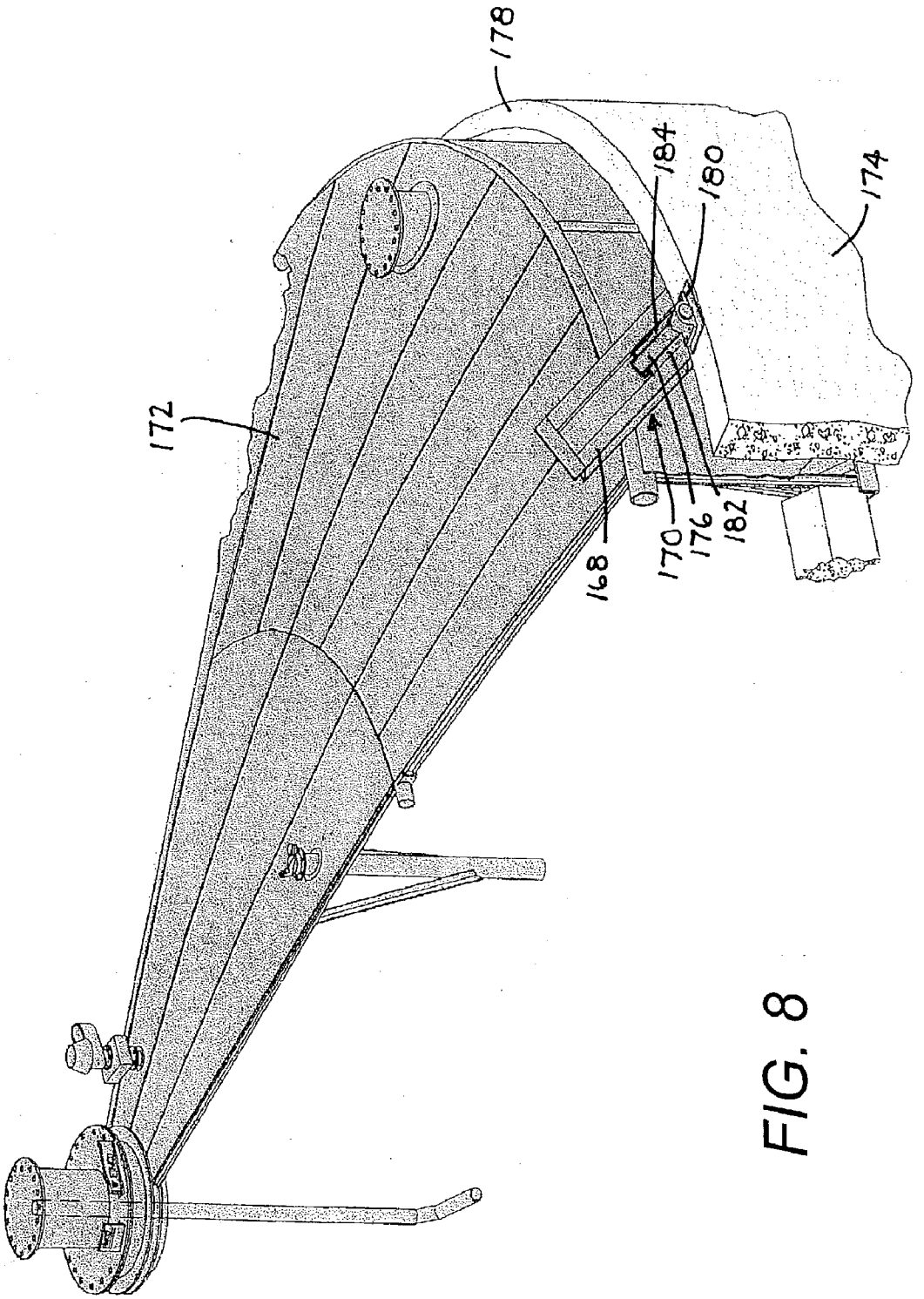


FIG. 8

SLIDE GUIDE ASSEMBLY AND SLIDER KIT FOR FLOATING COVER OF DIGESTER TANK AND ASSOCIATED METHOD

BACKGROUND OF THE INVENTION

[0001] This invention relates to sludge digester tanks. More specifically, this invention relates to slide guide assemblies for guiding floating covers of digester tanks. This invention also relates to an associated slider kit utilizable in constructing such a slide guide assembly. In addition, this invention relates to a method for maintaining such a slide guide assembly of a sludge digester tank.

[0002] Sewage plant sludge is often collected and subjected to anaerobic digestion in tanks with floating covers that are vertically movable with volumetric changes of the liquid, gas, or both in the digester tanks. In one kind of floating cover tank, the cover floats directly on the liquid sludge and gas produced by the digesting sludge is removed through a gas take-off housing or is vented to the atmosphere. In another type of tank, a so-called gasholder cover traps gas produced in the sludge digestion process, whereby the cover floats above the liquid sludge on the gas.

[0003] In many types of sludge digester tanks, the vertical movement of the floating covers is aided and stabilized by a plurality of circumferentially interspaced, vertical slide guide assemblies. Each slide guide assembly comprises a stationary vertical column slider defining a vertical track or channel in which a slider member is slidably installed. The slider members are rigidly fixed to the tank cover, generally indirectly via a cylindrical skirt depending from the disk or dome-shaped cover. As the amount of gas in the tank increases, the slider members move upwardly along their respective columns.

[0004] In one kind of conventional slide guide assembly, the movement of the slider members in the channels of the guide columns is facilitated by metal rollers. It has been found, however, that rollers can evince substantial maintenance problems. Rollers can break, seize or disengage, which may result in a tilting of the tank cover or an arresting of the vertical float motion.

[0005] In an alternative solution, a pair of slider brackets is provided instead of metal rollers. One bracket is disposed on top of the tank cover and in vertical alignment, while the other bracket is disposed at the bottom of the tank cover skirt. The motion of the slider brackets is eased by the provision of bolted low friction polymeric bearing strips that come in contact with the inner surfaces of the guide channels. The replacement of the bearing strips requires disassembly of the entire slide guide assembly and in the case of the bottom assembly requires a disruption of the sludge treatment and processing operation.

[0006] In yet another alternative solution, where a slider member moves along a vertical channel in a guide track, the motion of the slider member is eased by low-friction polymeric bearing strips. The slide guide track is provided in a pair of opposing faces with respective vertical slots formed by pairs of inwardly oriented vertical flanges. The bearing strips are inserted into the slots. The bearing strips are made of non-lubricated low-friction polymeric material and each comprise an inner flange and an outer flange connected to one another via a bight or bridging section to define a pair of oppositely facing vertical grooves. These grooves receive respective flanges of the slide guide track to hold the bearing strips to the slide guide track. Each slot of the guide track receives a plurality of bearing strips stacked one on top of the other. The repair and maintenance of this slide guide assembly and particularly of the bearing strips requires disruption of the sludge treatment process because it requires draining the tank to reach a level where the lower bearing strips can be pulled out of the guide track. This task necessitates reaching into the digester tank with long hooks to retrieve the bearing strips that are located in the submerged portion of the guide channel. Even then removal may be frustrated by dirt and debris lodged in the track. Moreover, this operation requires the use of safety equipment and/or multiple personnel.

SUMMARY OF THE INVENTION

[0007] The present invention is directed to a vertical slide guide assembly for a floating cover of a sludge digester tank and contemplates the provision of a slide guide assembly that may be more easily serviced and maintained than conventional slide guide assemblies.

[0008] A slide guide assembly for a floating cover of a sludge digester tank comprises, in accordance with the present invention, a track having at least one surface defining an at least partially vertical guide path and at least one slider member slidably engaged with the track for motion along the path. The track is connected at least indirectly to one of the floating cover and the tank, while the slider member is connected at least indirectly to the other of the tank and the floating cover. At least one bearing strip is attached to the slider member for engaging the surface of the track in a low-friction slidable contact. The bearing strip is removable from the slider member while the slider member remains in slidable engagement with the track.

[0009] In a particular embodiment of the present invention, the sliding surface of the slide guide track is one of a pair of opposing surfaces of the track facing one another to define the path as an at least partially vertical guide channel. The slider member is disposed in the channel for motion therein. The bearing strip is one of at least two bearing strips attached to the slider member for engaging the opposing surfaces of the track in a low-friction slidable contact. The bearing strips are both removable from the slider member while the slider member remains in slidable engagement with the track.

[0010] The bearing strip or strips may be adapted for removal from the slider member in a transverse direction relative to the slider member. Alternatively, the bearing strip or strips are removable in a longitudinal direction, i.e., parallel to a longitudinal axis of the slider member.

[0011] The track may be vertical, with the slider member being disposed for vertical motion along the path. In that case, the bearing strip or strips are preferentially removed vertically from the slider member. Alternatively, the track may be spiral and define an inclined or partially vertical path for the slider member.

[0012] Pursuant to specific features of the present invention, cooperating connector elements are provided on the slider member and the one or more bearing strips for enabling removal of each bearing strip from the slider

member by moving the respective bearing strip in a longitudinal direction along the slider member. The connector elements exemplarily include mating flanges and grooves disposed in parallel planes. The flanges may be disposed on the slider member and the grooves on the bearing strip or strips. Each bearing strip may be formed with two oppositely facing grooves, while the slider member is provided on a side with a pair of flanges inserted into respective ones of the oppositely facing grooves.

[0013] Where the slider member is formed with a pair of opposing flanges disposed in a common plane oriented vertically, a respective bearing strip is formed with a pair of oppositely facing vertical grooves receiving respective ones of the flanges.

[0014] Preferably, the bearing strip or strips are made of a non-lubricated polymeric material.

[0015] The present invention is directed in part to a slider kit for use in a slide guide assembly for a floating cover of a sludge digester tank. The kit comprises at least one slider member and at least one bearing strip. The slider member is disposable along an at least partially vertical guide track for at least partially vertical motion therealong. The slider member has a longitudinal axis and is connectable at least indirectly to the tank or the floating cover. Each of the one or more bearing strips is attachable to the slider member along a side thereof for engaging a surface of the track in a low-friction slidable contact. The bearing strip or strips are attachable to and removable from the slider member while the slider member remains in slidable engagement with the track.

[0016] As discussed above, the bearing strip or strips may be slidably attachable to the slider member for relative motion parallel to the longitudinal axis of the slider member. In that case, cooperating connector elements are provided on the slider member and the bearing strip(s) for enabling a removal of the bearing strip(s) from the slider member by moving the bearing strip(s) parallel to the longitudinal axis of the slider member. The connector elements may include flanges and grooves, provided, for example, on the slider member and the bearing strip(s), respectively. More particularly, each bearing strip may be formed with two oppositely facing grooves, while the slider member is provided with a pair of flanges insertable into respective ones of the oppositely facing grooves.

[0017] Alternatively, the bearing strip or strips may be removable transversely from the slider member.

[0018] A method for repairing or maintaining a slide guide assembly for a floating cover of a sludge digester tank comprises, in accordance with the present invention, removing a first bearing strip from a slider member of the slide guide assembly, the slider member being rigidly attached at least indirectly to the floating cover or the sludge digester tank, providing a second bearing strip, and attaching the second bearing strip to the slider member at a location previously occupied by the first bearing strip.

[0019] The removing of the first bearing strip from the slider member preferably includes sliding the first bearing strip longitudinally along the slider member until the first bearing strip is completely removed from the slider member. The attaching of the second bearing strip to the slider member preferably includes inserting a lower end of the second bearing strip into the slider member, and thereupon sliding the second bearing strip longitudinally along and into the slider member. The floating cover is maintained in an operative position in the sludge digester tank during the sliding of the first bearing strip, the inserting of the lower end of the second bearing strip, and the sliding of the second bearing strip.

[0020] A sludge digester tank system, comprises, in accordance with the present invention, a tank, a floating cover slidably mounted to the tank, and at least one slide guide assembly connected to the tank or the cover. The guide assembly includes a track defining an at least partially vertical guide path and at least one slider member slidably engaged with the track for at least partially vertical motion therealong, the track being connected at least indirectly to the tank or the cover while the slider member is connected at least indirectly to the cover or the tank. The guide assembly further includes at least one bearing strip attached to the slider member for engaging a surface of the track in a low-friction slidable contact. The bearing strip is removable from the slider member while the slider member remains in slidable engagement with the track. The various features of the slide guide assembly are discussed above.

[0021] The present invention provides a slide guide assembly for a floating cover of a sludge digester tank, which is more easily serviced and maintained than conventional slide guide assemblies. This is particularly the case for digester covers with a long range of travel, where the replaceable bearing strips are mounted to the slider member.

[0022] In a slide guide assembly, in accordance with the present invention, for a floating cover of a sludge digester tank, repair and maintenance operations may be effectuated by a single individual, without interrupting the sludge digestion process.

BRIEF DESCRIPTION OF THE DRAWINGS

[0023] **FIG. 1** is a vertical cross-sectional view of a gas holding digester cover with a slide guide assembly in accordance with the present invention.

[0024] **FIG. 2** is a side elevational view of a slide guide assembly in accordance with the present invention, showing the slide guide assembly connected to a skirt of a digester tank cover.

[0025] **FIG. 3** is a front elevational view of a track in the slide guide assembly of **FIG. 4**.

[0026] **FIG. 4** is a partial front elevational view, on a larger scale, of a modified track in accordance with the present invention.

[0027] **FIG. 5** is a top plan view of the track of **FIG. 4**, showing a slider member disposed in a guide channel of the track.

[0028] **FIG. 6** is a top plan view, on a larger scale, of the slider member of **FIG. 5**, showing removable bearing strips in accordance with the present invention.

[0029] **FIG. 7** is a schematic partial elevational view of a digester tank cover and a spiral slide guide assembly in accordance with the present invention.

[0030] **FIG. 8** is a schematic broken-away perspective view of a digester tank wall, floating tank cover and a spiral slide guide assembly in accordance with the present invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0031] The term "floating cover" is used herein to denote sludge digester tank covers that are either floating digester covers or gas holding digester covers.

[0032] The phrase "at least partially vertical" is used herein to denote a direction of extension that is either entirely vertical or inclined with respect to the vertical and the horizontal. An "at least partially vertical" track or channel may be linear or arcuate, for instance, spiral. In the latter case, the track or channel is necessarily partially vertical.

[0033] The term "longitudinal direction" as used herein refers to a direction along or parallel to an elongate member or channel.

[0034] As depicted in **FIG. 1**, a gas holding digester cover **10** includes a dome-shaped cover plate **12** supporting a manhole conduit **14** with a lid **16**, a center ring **18**, and a sample well **22**. Well **22** is braced by an angle support **26**. Cover plate **12** is provided along its periphery with a downwardly depending skirt **28**. Along an outer side of skirt **28** is provided a plurality of circumferentially spaced slide guide assemblies **30**, **32** which are connected to the skirt for enabling a vertical movement of cover plate **12** during a sludge processing operation. Along an inner side of skirt **28** are provided a series of concrete ballast blocks **34**, **36** suspended in part by respective angle supports **38**, **40**. The tank wall **42**, **44** buttresses slide guide assemblies **30**, **32** and skirt **28**.

[0035] **FIG. 2** is a partial depiction of a gas holding digester cover **50** including a dome-shaped cover plate **52** provided along its periphery with a downwardly depending skirt **54** and, radially inwardly thereof, a side sheet stiffener **55**. A plurality of circumferentially spaced slide guide assemblies **56** (only one shown) along an outer side of skirt **54** are connected to the skirt for enabling a vertical movement of cover plate **52** in response to variations in the amount of sludge and gas in the sludge digester tank. The tank wall **58** buttresses slide guide assemblies **56** and skirt **54**. Slide guide assemblies **56** each include a track **62** and a slider member **64**. Slider member **64** is fixed to skirt **54** via coupling brackets **66** and **68** and is slidably disposed in a vertical channel **70** (**FIG. 3**) defined between two extruded profile elements **72** and **74** of track **62**. Track **62** is bolted at spaced locations **76** and **78** to tank wall **58** and to a brace **82** (**FIG. 2**) atop the column.

[0036] **FIG. 4** depicts a track **88** wherein a vertical channel **90** is formed by a backing plate **92** and two extruded beams **94** and **96**. Track **88** is provided with vertical flanges or tongues **102**, **104** and horizontal flanges or tongues **106**, **108** (**FIG. 5**) to provide an anchoring surface for a travel limiting member (not shown) of the slider assembly.

[0037] **FIG. 5** depicts a slide guide assembly **110** include track **88** and a slider member **112** slidably disposed in channel **90** for vertical movement with a floating or gas holding digester tank cover as discussed above reference to **FIGS. 1 and 2**. **FIG. 6** depicts a slider member **112** having a first pair of opposing vertical flanges **114**, **116** defining a vertical slot **118** on one side and a second pair of opposing vertical flanges **120**, **122** defining a vertical slot **124** on an opposite side. Received in slots **118** and **124** are respective bearing strips **126** and **128**.

[0038] Bearing strips **126** and **128** are made of a non-lubricated polymeric material and have low-friction contact surfaces **130** and **132** (see **FIG. 6**) which face inwardly oriented surfaces **134** and **136** of guide member beams **94** and **96** (**FIG. 5**). As shown in **FIG. 6**, bearing strips **126** and **128** each comprise an inner flange **138** and an outer flange **140** connected to one another via a bight or bridging section **142** to define a pair of oppositely facing vertical grooves **144** and **146**. Grooves **144** and **146** receive flanges **114**, **116** or **120**, **122** in mating cooperation to hold bearing strips **126** and **128** to slider member **112**. Flanges **140** may be provided along an inwardly facing side with beveled edges **148** for facilitating insertion or removal procedures.

[0039] Bearing strips **126**, **128** may be removed from slider member **112** by sliding the bearing strips in a vertically upward direction relative to the slider member **112** and guide member or track **88** (**FIG. 5**). Removal of bearing strips **126**, **128** may be executed by a single individual, while the digester tank cover plate **12** (**FIG. 1**), **52** (**FIG. 2**) and the associated skirt **28** (**FIG. 1**), **54** (**FIG. 2**) are maintained in an operational position. New bearing strips **126**, **128** may then be inserted into the upper ends of slots **118** and **124**, so that flanges **114**, **116** and **120**, **122** are inserted into the grooves **144**, **146** of the respective new bearing strips.

[0040] As illustrated in **FIG. 7**, a slide guide assembly **150** may include a track or rail **152** that spirals around a digester tank **154**. One or more spiral slider members **156** fixed to a floating cover **158** of the digester tank are slidably disposed in a spiral channel **160** of the guide track **152**. Each slider member **156** is fixed to the top of the cover **158** and is preferably 2 to 3 feet long. Each slider member **156** is provided on a lower side with at least one bearing strip **162** of a non-lubricated low-friction material such as polytetrafluoroethylene. Bearing strip **162** contacts an upwardly facing sliding surface **166** of track **152**. Each slider member **156** may also be provided along an upper side with one or more bearing strips **164** of a non-lubricated low-friction material. Bearing strips **162** and **164** may be arcuate, with a curve matching that of slider member **156**. Alternatively, bearing strips **162** and **164** may possess a certain flexibility for bending along an arcuate extent of slider member **156**.

[0041] As illustrated in **FIG. 8**, a track **168** of a slider assembly **170** may be fastened to a tank cover **172** rather than a tank wall **174**. In that event, a slider member **176** is mounted to the tank wall **174**, for instance, on a rim **178** thereof via a bracket **180**. Slider member **176** is provided with bearing strips **182** and **184** removable by simply sliding the bearing strips along the track **168** while the slider member **176** remains in position in the track.

[0042] Although the invention has been described in terms of particular embodiments and applications, one of ordinary skill in the art, in light of this teaching, can generate additional embodiments and modifications without departing from the spirit of or exceeding the scope of the claimed invention. For instance, a low-friction bearing strip of a slider assembly in accordance with the invention may take another form such as a channel or U-shaped member in which a slider member is inserted. Accordingly, it is to be understood that the drawings and descriptions herein are proffered by way of example to facilitate comprehension of the invention and should not be construed to limit the scope thereof.

What is claimed is:

1. A slide guide assembly for a floating cover of a sludge digester tank, comprising:

a track having at least one surface defining an at least partially vertical guide path, said track being connected at least indirectly to one of the floating cover and the tank;

at least one slider member slidably engaged with said track for motion along said path, said slider member being connected at least indirectly to the other of the floating cover and the tank; and

at least one bearing strip attached to said slider member for engaging said surface of said track in a low-friction slidable contact, said bearing strip being removable from said slider member while said slider member remains in slidable engagement with said track.

2. The slide guide assembly defined in claim 1 wherein said surface is one of a pair of opposing surfaces of said track facing one another to define said path as an at least partially vertical guide channel, said slider member being disposed in said channel for motion therein, said bearing strip is one of at least two bearing strips attached to said slider member for engaging said opposing surfaces of said track in a low-friction slidable contact, said bearing strips being removable from said slider member while said slider member remains in slidable engagement with said track.

3. The slide guide assembly defined in claim 2 wherein cooperating connector elements are provided on said slider member and each one of said bearing strips for enabling removal of said bearing strips from said slider member by moving said bearing strips in a longitudinal direction along said slider member.

4. The slide guide assembly defined in claim 3 wherein said connector elements include mating flanges and grooves.

5. The slide guide assembly defined in claim 4 wherein said flanges and said grooves are disposed in parallel planes.

6. The slide guide assembly defined in claim 5 wherein said flanges are on said slider member and said grooves are on said bearing strips.

7. The slide guide assembly defined in claim 6 wherein each of said bearing strips has two oppositely facing grooves and wherein said slider member is provided on the respective side with a pair of flanges inserted into respective ones of said oppositely facing grooves.

8. The slide guide assembly defined in claim 2 wherein said slider member is formed with a pair of opposing flanges disposed in a common plane oriented vertically and parallel to said opposing surfaces, each of said bearing strips being formed with a pair of oppositely facing vertical grooves receiving respective ones of said flanges.

9. The slide guide assembly defined in claim 1 wherein said path extends vertically, said slider member being disposed for vertical motion along said path.

10. The slide guide assembly defined in claim 9 wherein said bearing strip is vertically removable from said slider member.

11. The slide guide assembly defined in claim 1 wherein said bearing strip is made of a non-lubricated polymeric material.

12. A slider kit for use in a slide guide assembly for a floating cover of a sludge digester tank, comprising:

at least one slider member disposable along an at least partially vertical guide track for at least partially vertical motion therealong, said slider member being connectable at least indirectly to one of the floating cover and the digester tank, said slider member having a longitudinal axis; and

at least one bearing strip attachable to said slider member along a side thereof for engaging a surface of said track in a low-friction slidable contact, said bearing strip being removably attachable to said slider member.

13. The slider kit defined in claim 12 wherein said bearing strip is slidably attachable to said slider member for removal motion in a direction parallel to said longitudinal axis.

14. The slider kit defined in claim 13 wherein cooperating connector elements are provided on said slider member and said bearing strip for enabling a removal of said bearing strip from said slider member by moving said bearing strip parallel to said longitudinal axis.

15. The slider kit defined in claim 14 wherein said connector elements include flanges and grooves.

16. The slider kit defined in claim 15 wherein said flanges are provided on said slider member and said grooves are provided on said bearing strips.

17. The slider kit defined in claim 16 wherein said bearing strip has two oppositely facing grooves and wherein said slider member is provided with a pair of flanges insertable into respective ones of said oppositely facing grooves.

18. The slider kit defined in claim 13 wherein said slider member is formed with a pair of opposing flanges disposed in a common plane oriented parallel to said longitudinal axis, said bearing strip being formed with a pair of oppositely facing grooves for receiving respective ones of said flanges.

19. The slider kit defined in claim 12 wherein said bearing strip is made of a non-lubricated polymeric material.

20. A method for repairing or maintaining a slide guide assembly for a floating cover of a sludge digester tank, comprising:

removing a first bearing strip from a slider member of the slide guide assembly, said slider member being attached at least indirectly to one of the floating cover and the sludge digester tank, said slider member being disposed in slidable engagement with a track fastened to the other of said floating cover and said sludge digester tank, the removing of said first bearing strip being executed while said slider member remains in slidable engagement with said track;

providing a second bearing strip; and

while said slider member remains in slidable engagement with said track, attaching said second bearing strip to said slider member at a location previously occupied by said first bearing strip.

21. The method defined in claim 20 wherein the removing of said first bearing strip from said slider member includes sliding said first bearing strip longitudinally along said slider member until said first bearing strip is completely removed from said slider member, and wherein the attaching of said second bearing strip to said slider member includes:

inserting a lower end of said second bearing strip into said slider member; and

upon inserting of said lower end, sliding said second bearing strip longitudinally along and into said slider member.

22. The method defined in claim 21, further comprising maintaining said floating cover in an operative position in said sludge digester tank during the sliding of said first bearing strip, the inserting of said lower end of said second bearing strip, and the sliding of said second bearing strip.

23. A sludge digester tank system, comprising:

a tank;

a floating cover movably mounted to said tank; and

at least one slide guide assembly operatively connected to said tank and said cover, said guide assembly including:

a track defining an at least partially vertical guide path, said track being connected at least indirectly to one of the tank and the cover;

at least one slider member slidably engaged with said track for at least partially vertical motion therealong, said slider member being connected at least indirectly to the other of the tank and the cover; and

at least one bearing strip attached to said slider member for engaging a surface of said track in a low-friction slidable contact, said bearing strip being removable from said slider member while said slider member remains in slidable engagement with said track.

24. The sludge digester tank system defined in claim 23 wherein said surface is one of a pair of opposing surfaces of said track facing one another to define said path as an at least partially vertical guide channel, said slider member being disposed in said channel for at least partially vertical motion therein, said bearing strip being one of at least two bearing strips attached to said slider member for engaging said opposing surfaces of said track in a low-friction slidable contact, said bearing strips being vertically removable from said slider member.

25. The sludge digester tank system defined in claim 24 wherein cooperating connector elements are provided on said slider member and each one of said bearing strips for enabling removal of said bearing strips from said slider member by moving said bearing strips in a vertical direction relative to said slider member.

26. The sludge digester tank system defined in claim 25 wherein said connector elements include mating flanges and grooves.

27. The sludge digester tank system defined in claim 26 wherein said flanges and said grooves are disposed in vertical planes.

28. The sludge digester tank system defined in claim 26 wherein said flanges are on said slider member and said grooves are on said bearing strips.

29. The sludge digester tank system defined in claim 23 wherein said slider member is formed with a pair of opposing flanges disposed in a common plane oriented vertically and parallel to said opposing surfaces, said bearing strip being formed with a pair of oppositely facing vertical grooves receiving respective ones of said flanges.

* * * * *