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(54) **ABOVE-GROUND FIRE-RESISTANT STORAGE TANK SYSTEM AND FABRICATION METHOD**

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Related U.S. Patent Documents

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(52) **U.S. Cl.** .... **219/73**; 219/126; 219/137 R; 220/612

(58) **Field of Search** .... 219/73, 126, 137 R; 220/612

(56) **References Cited**

U.S. PATENT DOCUMENTS

2,638,524	*	5/1953	Meyer	219/73
3,883,711	*	5/1975	Fischer et al.	219/73
5,035,926		7/1991	Jonas et al.	427/393.1
5,305,926	*	4/1994	Webb	220/464

OTHER PUBLICATIONS

Griffing, Len, ed., Welding Handbook, Sixth Edition, Section Four, Metals and their Weldabiltiy, 1972, pp. 63.1–63.5.*

Lyman, Taylor, ed. Metals Handbook, 8th Edition, vol. 6, Welding and Brazing, 1971, pp. 49–50.*

"Automotive and Marine Service Station Code", p. 30A–8, section 2–4.5.*

"Insulated Aboveground Tanks for Flammable Liquids", UL2085, Dec. 27, 1994.*

UL142 Standard for Steel Aboveground Tanks for Flamable and Combustible Liquids, Underwriters Laboratories, 1993.*

"Introducing a New Concept for on Site Storage and Dispensing of Fuel. Double Skin Cylindrical Tank Installations with the Maximum Advantages." E.W. Taylor Fuel Control Ltd., Harlow, Essex, Jan. 1988.

"Self Contained Portable Diesel Installation," E.W. Taylor Fuel Control Ltd., Harlow, Essex.

"Gasboy 390".

* cited by examiner

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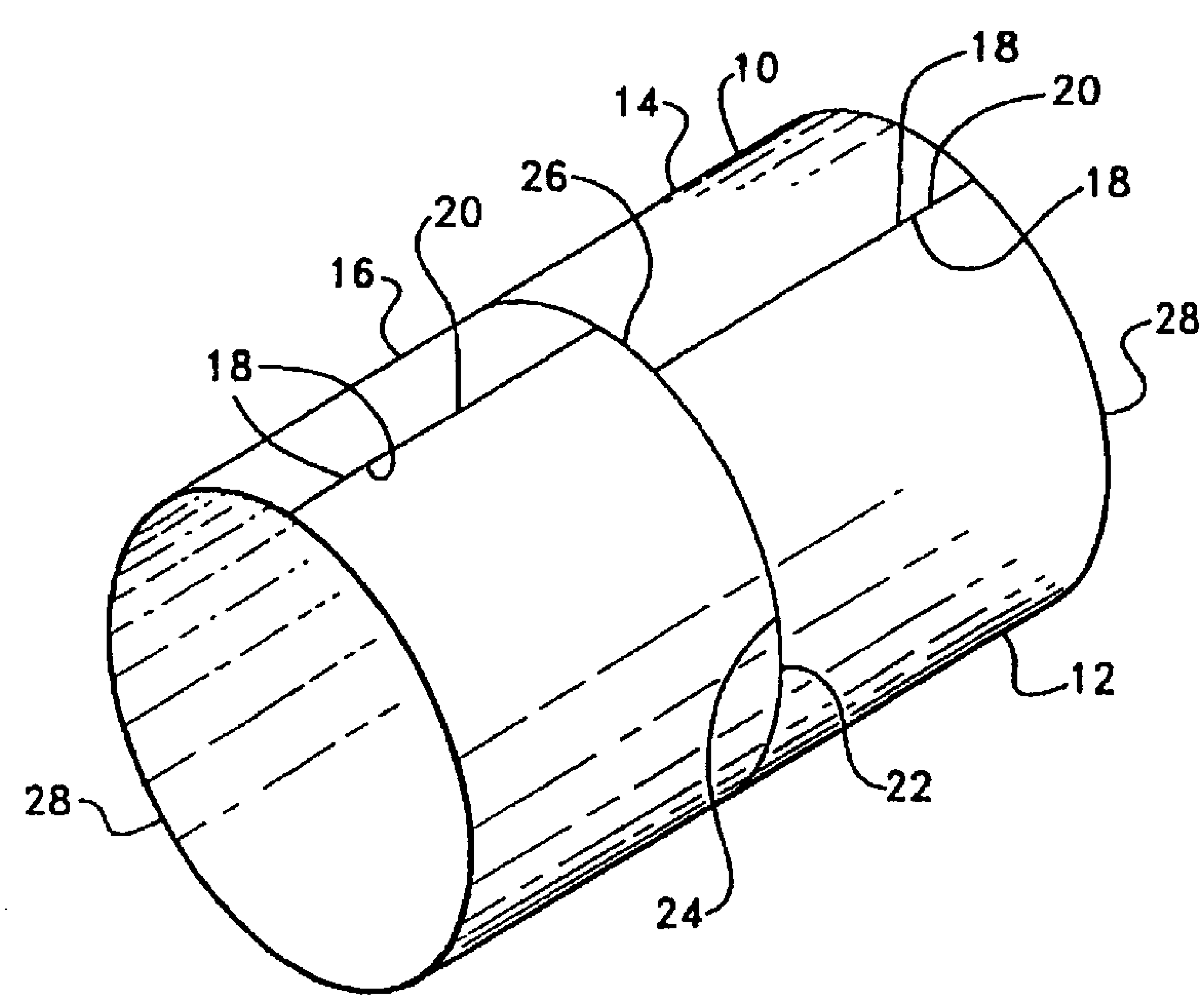
(57) **ABSTRACT**

An improved fire-resistant above-ground storage tank for flammable and combustible materials is fabricated from steel plates of at least 10 gauge, the sheets being made from a ferrous alloy having a maximum of approximately 0.15% carbon and a maximum of approximately 0.8% manganese and the steel plates welded in a specific way resulting in a tank that can withstand a 2000° F. environment for a minimum of two hours.

33 Claims, 4 Drawing Sheets



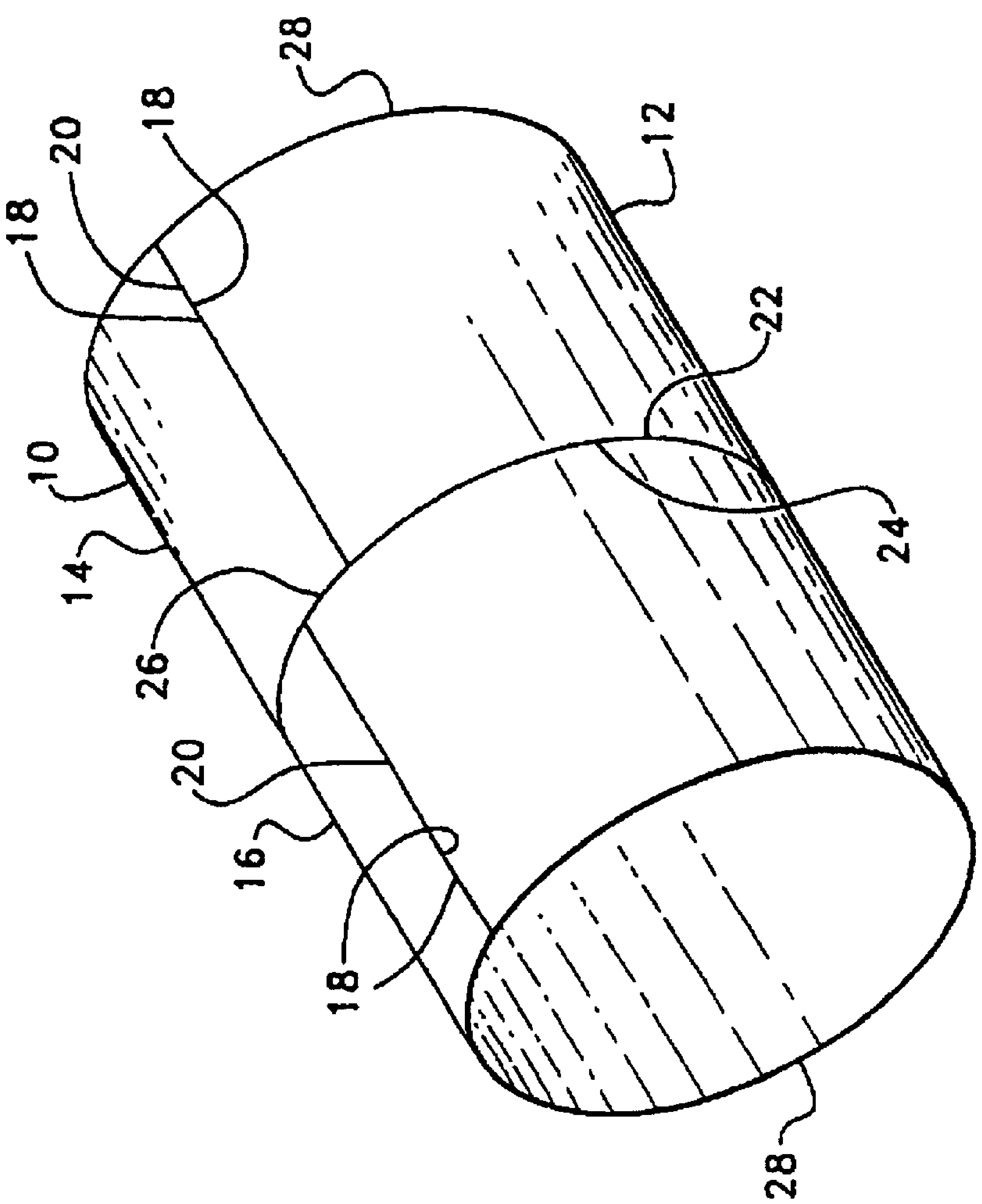


FIG. 1

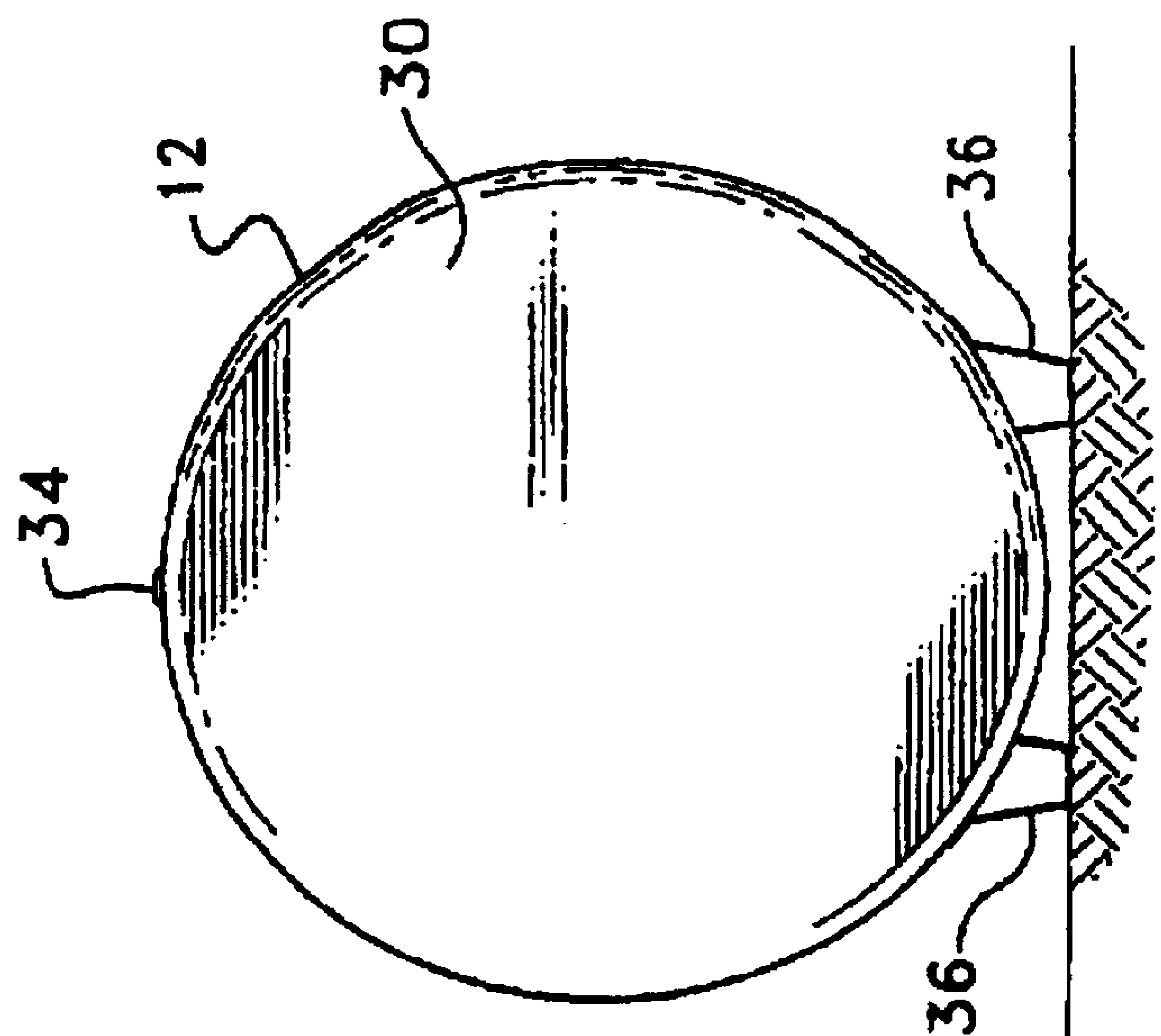


FIG. 3

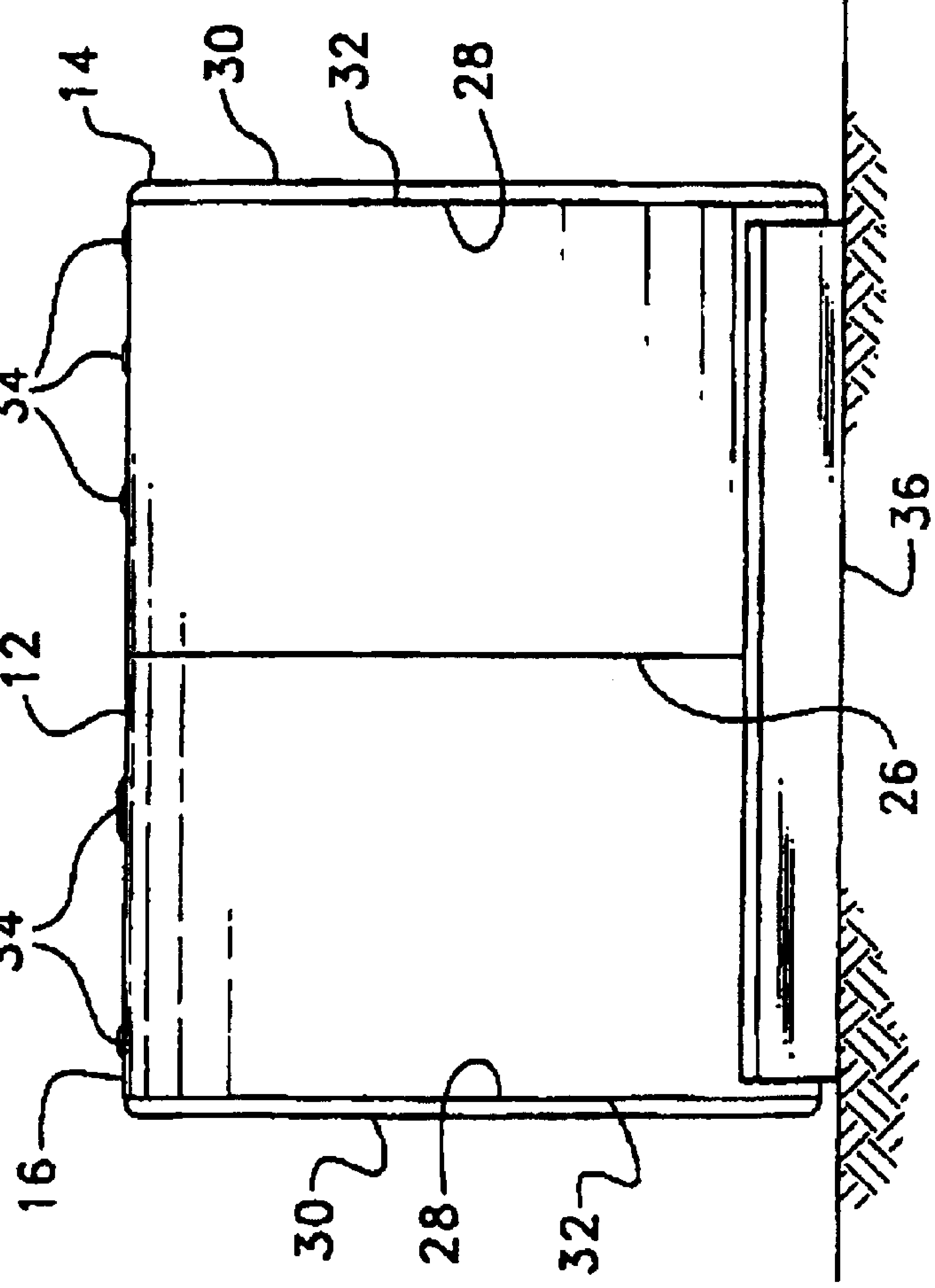


FIG. 2

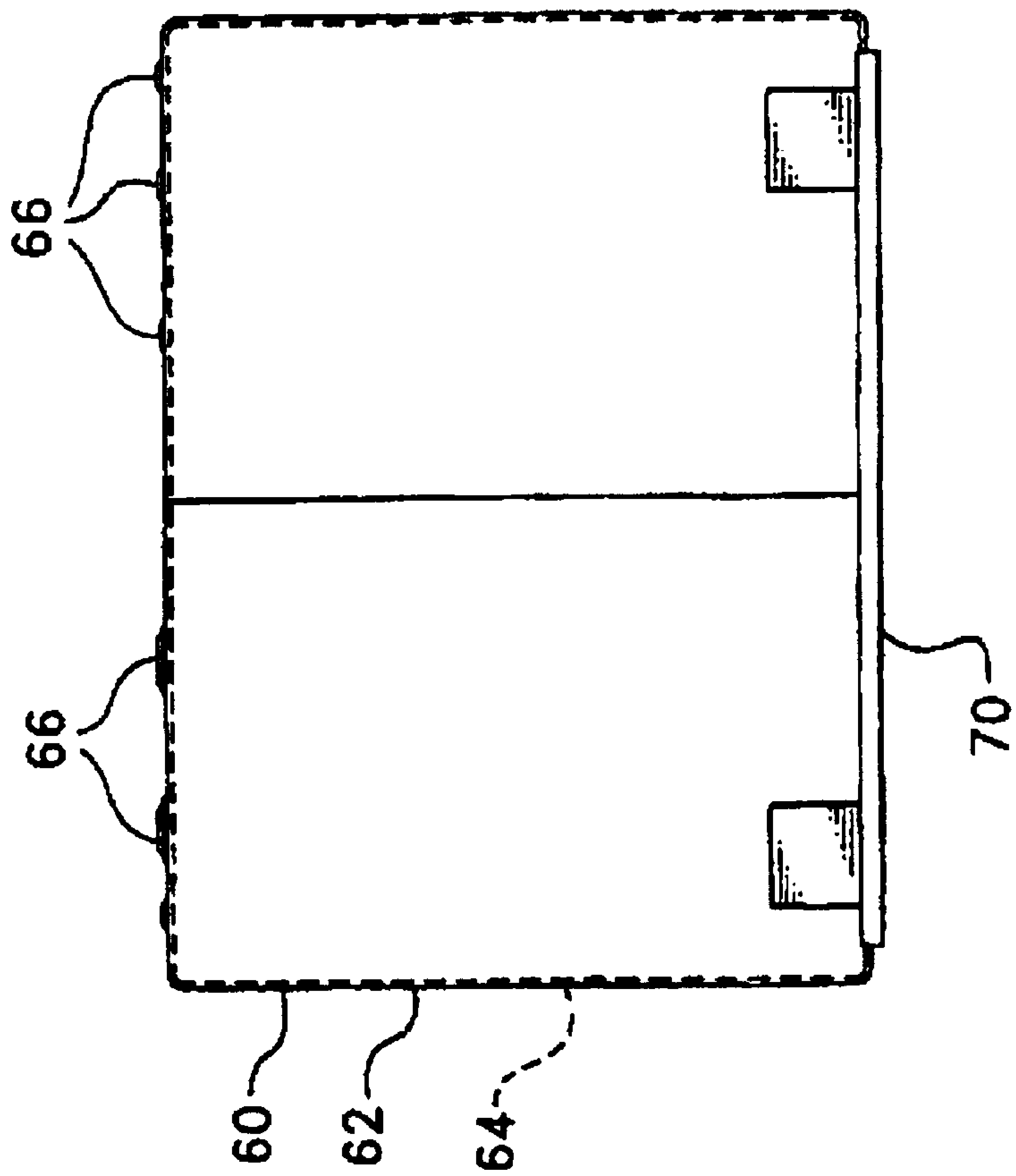


FIG. 5

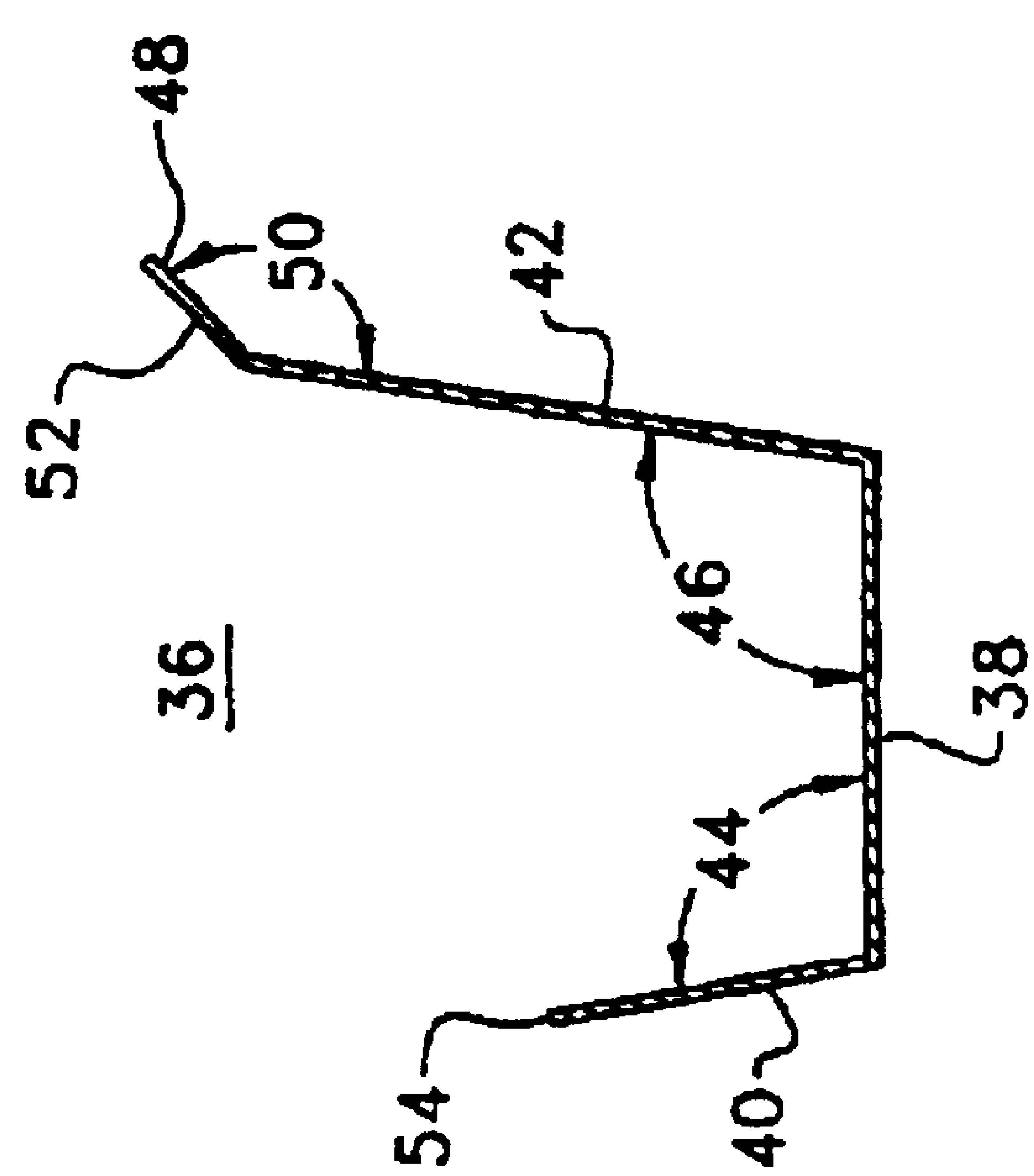


FIG. 4

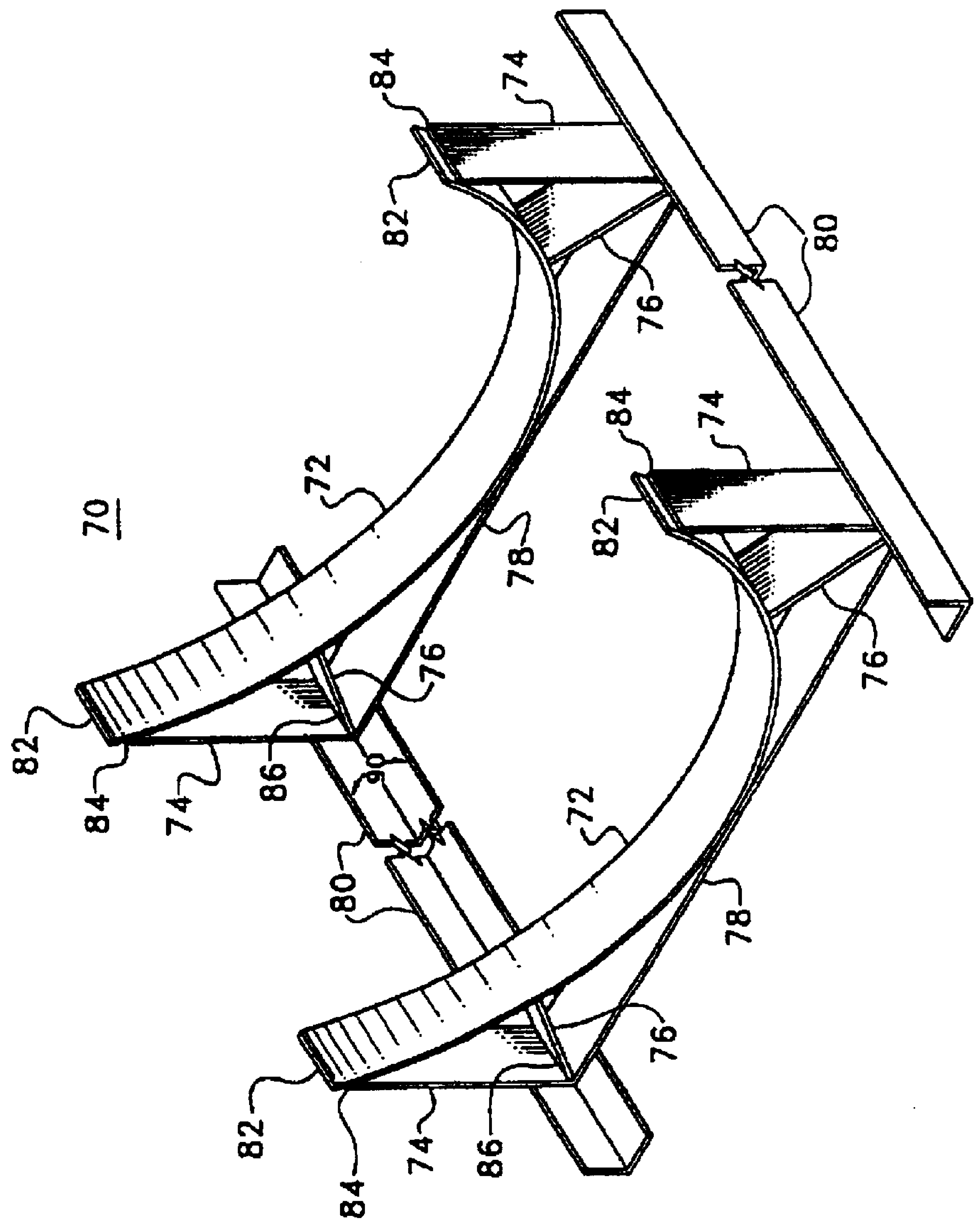

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FIG. 6

ABOVE-GROUND FIRE-RESISTANT STORAGE TANK SYSTEM AND FABRICATION METHOD

Matter enclosed in heavy brackets [ ] appears in the original patent but forms no part of this reissue specification; matter printed in italics indicates the additions made by reissue.

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to an above-ground fire-resistant tank system for flammable and combustible material. More specifically, the invention relates to a tank, fabricated from a specific metal of a minimum thickness which is welded in a specific manner, which can withstand 2000° F. environment for a minimum of two hours.

2. Description of the Related Technology

Numerous applications exist for above-ground tanks for flammable and combustible materials, i.e. gas stations, airports, and construction sites. In all these applications, and more, tanks storing flammable and combustible materials have a potential for fire and explosion, which should obviously be minimized. It has been determined that the risk is sufficiently minimized when a tank can withstand a 2000° F. environment for two hours, as per Underwriters Laboratories test procedure 2085.

A number of different designs of above-ground fire-resistant tanks have been developed which meet the Underwriters Laboratories test procedures. One type of tank is encased in a thickness of cement, which increases the cost of a tank. Besides the economic penalty of adding another component to the tank, the cement is a minimum six inches thick which decreases its maneuverability. Another design requires constructing a storage tank, surrounding the storage tank with insulation, and constructing a secondary containment tank around the insulation. The insulation adds material cost to the tanks and increases the construction labor costs.

It is clear that there has existed a long and unfilled need in the prior art for an above-ground fire-resistant tank for flammable and combustible liquids which does not require additional components in order to withstand 2000° F. for two hours.

SUMMARY OF THE INVENTION

Accordingly, is it an object of the invention to provide a fire-resistant above-ground tank system for storing flammable and combustible material, such as gasoline, by fabricating a tank from steel plates of at least 10 gauge, the steel having a maximum of approximately 0.15% carbon and a maximum of approximately 0.8% manganese. The plates being welded together either with joggle joints or butt weld joints. Further, at least one of the welds contains weld metal having a maximum of approximately 0.15% carbon and a maximum of approximately 1.4% manganese. The tank system contains tank fittings to transfer material into and out of the tank.

It is a further object to provide a double-wall fire-resistant above-ground tank system for storing flammable and combustible material, such as gasoline, by fabricating a product storage tank from steel plates of at least 7 gauge and nesting the storage tank within a secondary containment tank fabricated from steel plates of at least 10 gauge. Both tanks being made out of steel plates having a maximum of approximately 0.15% carbon and a maximum of approximately 0.8% manganese. The plates being welded together either with joggle joints or butt weld joints. Further, at least one of the welds contains weld metal having a maximum of approximately 0.15% carbon and approximately 1.4% manganese.

It is another object to provide a method to fabricate a fire-resistant above-ground tank system for storing flammable and combustible material, such as gasoline, by fabricating a product storage tank of at 10 gauge steel plates. The steel having a maximum of approximately 0.15% carbon and a maximum of approximately 0.8% manganese. The plates being welded together either with joggle joints or butt weld joints. The welds are made either using a submerged arc welder at 225 to 280 amps with L 61 wire and 761 flux or a hot gas metal arc welder with the gas shield being carbon dioxide, the wire feed being an AWS E71T-1 class, titania type flux cored wire designed for use with 100% carbon dioxide gas shielding, the wire having a maximum of approximately 0.15% carbon and a maximum of approximately 1.4% manganese, and the amperage used during welding is 180 to 220 amps. The tank system contains tank fittings to transfer material into and out of the tank.

It is another object to provide a method to fabricate a fire-resistant above-ground tank system for storing flammable and combustible material, such as gasoline, by fabricating a double wall tank with an inner product storage tank made from steel plates of at least 7 gauge and an outer secondary containment tank made from steel plates of at least 10 gauge. The steel for both tanks having a maximum of approximately 0.15% carbon and a maximum of approximately 0.8% manganese. The plates being welded together either with joggle joints or butt weld joints. The welds are made either using a submerged arc welder at 225 to 280 amps with L 61 wire and 761 flux or a hot gas metal arc welder with the gas shield being carbon dioxide, the wire feed being an AWS E71T-1 class, titania type flux cored wire designed for use with 100% carbon dioxide gas shielding, the wire having a maximum of approximately 0.15% carbon and a maximum of approximately 1.4% manganese, and the amperage used during welding is 180 to 220 amps. The tank system contains tank fittings to transfer material into and out of the tank.

In order to achieve the above and other objects of the invention, an above-ground fire-resistant storage tank system for storing combustible material, such as gasoline, is fabricated from steel plates of a minimum thickness, the sheets being made from a special metal alloy, and the plates welded in a specific way, in order to withstand a 2000° F. environment for a minimum of two hours.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** illustrates a perspective view of a single wall tank lacking end panels;

FIG. **2** illustrates an elevation of a single wall tank;

FIG. **3** illustrates an end view of a single wall tanks;

FIG. **4** illustrates an end view of a skid;

FIG. **5** illustrates an elevation of a double wall tank; and

FIG. **6** illustrates a perspective view of a skid for a double wall tank.

[FIGS. **7** and **8** illustrate a butt weld joint and a joggle joint, respectively.**]**

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT(S)

Referring to FIG. **1**, cylindrical wall **10** of single wall storage tank **12** is comprised of rolled metal sheet **14** and rolled metal sheet **16**. Both rolled metal sheets **14** and **16** are formed by cutting a rectangular piece of metal and rolling the metal until two opposite butted ends **18** come together to form a ring. Butted ends **18** are welded together by weld joint **20**. Rolled metal sheet **14** has a joggle joint rolled end **22** and an outside end **28**. The formation of a joggle joint rolled end **22** is discussed below. Rolled metal sheet **16** has an inside end **24** and an outside end **28**. When rolled metal sheets **14** and **16** are assembled, joggle jointed rolled end **22** is welded to inside end **24**, thus forming joggle joint **26**. Attention is drawn to the non-alignment of butt-welded joints **20** of rolled metal sheets **14** and **16**. The purpose of non-alignment of butt-welded joint **20** is to increase the strength of single wall storage tank **12**.

Rolled metal sheets **14** and **16** are comprised of a special ferrous alloy which provides fire-resistant support to single wall storage tank **12**. The ferrous alloy has a maximum of approximately 0.15% carbon and a maximum of approximately 0.8% manganese. The maximum limits on carbon and manganese is to limit the brittleness of the alloy. A brittle alloy will not as effectively withstand the stresses placed on the tank when exposed to an elevated temperature. In the preferred embodiment, the ferrous alloy also has a maximum of approximately 0.04% phosphorous, and a maximum of approximately 0.05% sulfur. Attention is drawn to the fact that this ferrous alloy composition is not a standard composition. The closest structural grade steel available to this composition is ASTM A 36, which has a carbon percent maximum of approximately 0.25%.

Referring now to FIGS. **2** and **3**, an assembled single wall storage tank **12** is comprised of cylindrical wall **10** and storage tank end panels **30**. Storage tank end panels **30** are cut from the same metal as used for rolled metal sheets **14** and **16**. Storage tank end panels are cut and flanged and attached to outside ends **28** forming joint **32**. In the preferred embodiment, joints **32** are joggle joints.

The thickness of rolled metal sheets **14** and **16** and storage tank end panels **30** are based on the size of the tank. Table I, Plate Thickness Chart for Single Wall Fire-Resistant Tanks, lists the plate thickness for various size tanks. The thickness of the steel is critical to the invention. When the tank is heated to over 1000° F., the outside of the steel becomes porous forming a protective "skin." As a result, the steel sheet must be thick enough and be of a consistent quality to allow the "skin" to form and have enough mass to support the skin and to provide maintain the integrity of single wall storage tank **12**. Further, the thickness affects the performance of the assembly when exposed to high temperatures by allowing for increased expansion without fatal stresses that result in tank rupture.

TABLE I

Single Wall Fire-Resistant Tanks
Plate Thickness Chart

Gallons	Size	Plate Thickness
300	38" .times. 5'	10 ga.
550	48" .times. 6'	10 ga.
1,000	48" .times. 12'	10 ga.
1,000	64" .times. 6'	10 ga.
2,000	64" .times. 12'	7 ga.
3,000	64" .times. 18'	7 ga.
4,000	64" .times. 24'	7 ga.
5,000	8' .times. 14'	¼"
6,000	8' .times. 16'	¼"
8,000	8' .times. 21'	¼"

TABLE I-continued

Single Wall Fire-Resistant Tanks
Plate Thickness Chart

Gallons	Size	Plate Thickness
10,000	8' .times. 27'	¼"
10,000	9' .times. 21'	¼"
12,000	9' .times. 25'	¼"
15,000	9' .times. 32'	¼"
20,000	10' .times. 34'	¼"
30,000	10' .times. 51'	¼"

Single wall storage tank **12** also comprises welded couplings **34** and tank skids **36**. FIGS. **2** and **3** depict couplings **34** on the top of single wall storage tank **12**. However, couplings can be placed where desired, depending on the application for which single wall storage tank **12** is used.

Tank **12** is supported by skids **36**. In the preferred embodiment, there are two skids **36** which run longitudinally on the bottom of single wall storage tank **12**. Skids **36** on single wall storage tank **12** perform multiple functions. Skids **36** stabilize the tank **12** during its normal use. Skids **36** provide structural support to single wall storage tank **12** as the temperature of the tank increases and the "skin" develops. The structural strength of single wall storage tank **12** diminishes as the temperature of the tank increases beyond 1000° F. Skids **36** help give structural support to the steel in this temperature range. In the preferred embodiment, skids **36** have a similar coefficient of expansion as tank **12**, thereby expanding at a similar rate as tank **12** when exposed to elevated temperatures, further reducing the chance of tank rupture.

Now referring to FIG. **4**, skid **36** has a generally unshaped cross section comprising a base **38**, short vertical member **40**, and tall vertical member **42**. Generally, skid **36** is designed such that single wall storage tank **12** rests on both short vertical member **40** and tall vertical member **42**, as is shown in FIG. **3**. Short vertical member **40** is at an angle **44** from base **38**. In the preferred embodiment, angle **44** is approximately 100.degree. Similarly, tall vertical member **42**, which is taller than short vertical member **40**, is at an angle **46** from base **38**. In the preferred embodiment, angle **46** is approximately 100°. Extending from the top of tall vertical member **42** is tank resting element **48**. Tank resting element **48** is a band of metal which extends the entire length of tall vertical member **42**. Tank resting element **48** makes angle **50** with the outside surface of tall vertical member **42**. In the preferred embodiment, angle **50** is approximately 142.degree. Tank resting element **48** has an upper surface **52**, which, along with edge **54** of short vertical member **40**, comprises the two points upon which single wall tank **12** rests. This configuration of skids **36** allows two parallel skids to be placed equally distant from the center of single wall tank **12** and supports single wall tank **12**.

Referring to FIG. **5**, double wall storage tank **60** is comprised of a secondary containment tank **62** and a product storage tank **64**. Double wall storage tank **60** is fabricated in the same manner as single wall storage tank **12**, except that product storage tank **64** is nested inside secondary containment tank **62**. In the preferred embodiment, the diameter of secondary containment tank **62** is a half inch larger than the diameter of product storage tank **64**. Additionally, secondary containment tank **62** has a length which is four inches longer than the length of product storage tank **64**. These differences in diameter and length allow for expansion and contraction without rupturing either secondary containment tank **62** or product storage tank **64**. Additionally, the chance of tank rupture caused by thermal expansion is reduced by fabricating secondary containment tank **62** and product storage tank **64** from metal sheets having similar coefficients of expansion, so that both tanks expand at similar rates when exposed to elevated temperatures.

In order to maintain structural integrity during elevated temperatures, the walls of both secondary containment tank **62** and product storage tank **64**, which are listed on Table II, Plate Thickness Chart of Double Wall Fire Resistant Tanks.

TABLE II

Double Wall Fire-Resistant Tanks Plate Thickness Chart

		Plate Thickness	
Gallons	Size	Product Storage Tank Tank	Secondary Containment Tank
300	38" .times. 5'	7 ga.	10 ga.
550	48" .times. 6'	7 ga.	10 ga.
1,000	48" .times. 12'	7 ga.	10 ga.
2,000	64" .times. 6'	7 ga.	10 ga.
3,000	64" .times. 18'	7 ga.	10 ga.
4,000	64" .times. 24'	7 ga.	10 ga.
5,000	8' .times. 14'	¼"	7 ga.
6,000	8' .times. 16'	¼"	7 ga.
8,000	8' .times. 21'	¼"	7 ga.
10,000	8' .times. 27'	¼"	7 ga.
10,000	9' .times. 21'	¼"	7 ga.
12,000	9' .times. 25'	¼"	7 ga.
15,000	9' .times. 32'	¼"	7 ga.
20,000	10' .times. 34'	¼"	7 ga.
30,000	10' .times. 51'	¼"	7 ga.

Double wall storage tank **60** has couplings **66** mounted through secondary containment tank **62** to product storage tank **64**. As in single wall storage tank **12**, couplings **66** are found on the top of double wall storage tank **60**, but can be located anywhere depending on the use of the tank. Double wall storage tank **60** also rests up and is supported by skid **70**.

Other embodiments of the invention include a double wall multiple product tank, with double bulk heads (not shown) welded inside the primary storage tank or multiple primary storage tanks nested inside a secondary containment tank (not shown). An additional embodiment of the invention includes a single wall multiple product tank with double bulk heads (not shown) welded inside the tank.

Now referring to FIG. **6**, skid **70** comprises belly bands **72**, vertical support members **74**, 45.degree. support members **76**, horizontal members **78**, and angle member **80**. Belly bands **72** are constructed of a curved band of steel that conforms to the underside of double wall storage tank **60**, thus stabilizing it. Belly bands **72** have belly bands ends **82** which are supported by vertical support members **74**. Vertical support members have an upper end **84** and a lower end **86**. Upper end **84** is adjacent to the convex surface of belly band **72** near belly band end **82**, respectively. Lower ends **86** are directly below upper ends **84** and are on the ends of horizontal member **78** at a 90.degree. angle to horizontal member **78**. Horizontal member **78** is a flat band of metal that extends between lower ends **86** of each belly band **72** and upon which the center of belly band **72** rests. Belly bands **72** are also supported by 45.degree. support members **76**. 45.degree. support members **76** are flat bands of steel which extend at a 45.degree. angle to horizontal member **78** and extend from lower end **86** to the convex surface of belly bands **72**, respectively. To further support belly bands **72**, the corner formed from vertical member **74** meeting horizontal member **78** rests in the inside angle **90** of angle support **80**. An angle support **80** runs along each side of secondary containment tank **62**, providing additional support to structures which support belly bands **72**. Angle support **80** is illustrated with a gap to represent that angle **80** extends between belly bands **72** regardless of how far apart they are. Further, skids of other embodiments of the invention may have more than two belly bands **72** to sufficiently support longer or heavier tanks. Additionally, skid **70** performs the similar functions as skid **36**.

The single wall storage tank **12** and double wall storage tank **60** are constructed per UL 142—Standard for Steel Aboveground Tanks for Flammable and Combustible Liquids. All joints are either butt weld joints **94** or joggle joints **94**. Butt weld joints **96** are so named because the weld **96** fuses edges of plates that "butt" up against each other. In the present invention, a weld is made by welding both sides with a hot gas metal arc welder to ensure complete and thorough fusion. When using the hot gas metal arc welder, the gas shield is carbon dioxide. Additionally, the wire feed for the hot gas metal arc welder is an AWS E71T-1 class, titania type flux cored wire designed for use with 100% carbon dioxide gas shielding, the wire in the preferred embodiment having a typical composition of approximately 0.05% carbon and approximately 1.28% manganese. However, the wire can have a maximum of approximately 0.15% carbon and a maximum of approximately 1.4% manganese, of which excess manganese will be burnt off due to excess heat used during welding. Further, in the preferred embodiment, the wire has approximately 0.05% carbon, 1.28% manganese, 0.50% silicon, 0.013% phosphorus, and 0.009% sulfur. Further, the amperage used during welding is 180 to 220 amps. Also of importance is the relative tensile strength, yield strength, coefficient of expansion, and composition of the steel alloy in relation to the weld metal.

All the joints in tanks **12** and **60** which are not butt weld joints are joggle joints. Unlike a butt weld joint, in joggle joint, an edge overlap portion one overlaps an edge portion of another plate **112**. Further, weld **120**, which fuses joggle joint **94** together, is between edge **122** of plate **112** and plate **114** such that surface **124**, which is on the opposite side of plates **112** and **114** from edge overlap portion **116**, is substantially flat. A submerged arc welder is used to weld all joggle joints **94**. Additionally, and L 61 wire is used with a 761 flux and the amperage used during welding is 225 to 280 amps.

AS per UL 142, the tank is pressure tested by soaping all the welds, observing any leaks while the tank is under pressure, and rewelding when necessary.

The present invention may be embodied in other specific forms without departing from the spirit or essential attributes thereof, and accordingly, reference should be made to the appended claims, rather than to the foregoing specification, as indicating the scope of the invention.

What is claimed is:

1. An improved above-ground fire-resistant storage tank system for storing flammable and combustible material, such as gasoline, comprising:

a plurality of storage tank sheet steel pieces assembled to form a storage tank, with each said storage tank sheet steel piece having at least one edge, each said edge being adjacent to a neighboring edge, said storage tank sheet steel pieces being approximately 10 gauge or thicker, having a maximum of approximately 0.15%

carbon and a maximum of approximately 0.8% manganese, one or more joints where each said edge is in contact with said neighboring edge, said joints being selected from the group consisting of joggle joints and butt weld joints and at least one weld contains weld metal having a maximum of approximately 0.15% carbon and a maximum of approximately 1.4% manganese; and

at least one tank fitting.

2. The storage tank system according to claim 1, wherein:

said storage tank sheet steel pieces having approximately 0.04% phosphorus and approximately 0.05% sulfur, and

said weld metal having approximately 0.05% carbon, approximately 1.28% manganese, approximately 0.5% silicon, approximately 0.013% phosphorus, and approximately 0.009% sulfur.

3. The storage tank system according to claim 1, wherein:

said storage tank sheet steel pieces are approximately 7 gauge or thicker; and

said system further comprises:

a plurality of secondary containment tank sheet steel pieces constructed to form a secondary containment tank, each said secondary containment tank sheet steel piece having at least one edge, each said edge fabricated to be adjacent to a neighboring edge, said secondary containment tank sheet steel pieces being approximately 10 gauge or thicker, having a maximum of approximately 0.15% carbon and a maximum of approximately 0.8% manganese, at least one joint where each said edge is in contact with said neighboring edge, said joint being selected from the group consisting of joggle joints and butt weld joints; and at least one weld contains weld metal having a maximum of approximately 0.15% carbon and a maximum of approximately 1.4% manganese; and

said storage tank and said secondary containment tank constructed and arranged such that said storage tank can reside inside said secondary containment tank, thereby forming an interstitial space between said storage tank and said secondary containment tank.

4. The storage tank system according to claim 1, wherein:

said storage tank sheet steel pieces having approximately 0.04% phosphorus and approximately 0.05% sulfur;

said weld metal of said storage tank having approximately 0.05% carbon, approximately 1.28% manganese, approximately 0.5% silicon, approximately 0.013% phosphorus, and approximately 0.009% sulfur;

said secondary containment tank sheet steel pieces having approximately 0.04% phosphorus and approximately 0.05% sulfur; and

said weld metal of said secondary containment tank having approximately 0.05% carbon, approximately 1.28% manganese, approximately 0.5% silicon, approximately 0.013% phosphorus, and approximately 0.009% sulfur.

5. A method of fabricating an improved above-ground fire-resistant storage system for storing combustible material, such as gasoline, comprising the steps of:

providing sheet steel of approximately 10 gauge or thicker, said sheet steel having a maximum of approximately 0.15% carbon and a maximum of approximately 0.8% manganese;

cutting and shaping from said sheet steel into a plurality of storage tank sheet steel pieces with at least one edge, said storage tank sheet steel pieces constructed such that when assembled and welded they form a storage tank with each said edge in contact with a neighboring edge to form at least one joint, said joint being selected from the group consisting of joggle joints and butt weld joints, at least a weld fusing each said joint;

assembling and welding said storage tank sheet steel pieces to form said storage tank, said welding being performed with a welding technique selected from the group consisting of:

submerged arc welding using a L 61 weld wire and a 761 flux, operating with 225 to 280 amps; and

dual shielded wire feed welding shielded by carbon dioxide and operating with 180 to 220 amps, using a flux core weld wire having a maximum of approximately 0.15% carbon and approximately 1.4% manganese;

installing a test fitting to said continuous storage tank wall; and

pressure testing said storage tank, identifying and rewelding any leaks.

6. A system made according to the method of claim 5.

7. The method according to claim 5, wherein:

said storage tank sheet steel pieces having approximately 0.04% phosphorus and approximately 0.05% sulfur, and

said weld metal having approximately 0.05% carbon; approximately 1.28% manganese, approximately 0.5% silicon, approximately 0.013% phosphorus, and approximately 0.009% sulfur.

8. The method according to claim 7, wherein:

said storage tank is of a substantially cylindrical shape having a storage tank circumference and a storage tank diameter;

said cutting and shaping further comprises cutting said sheet steel such that at least one of said storage tank sheet steel pieces is a rectangular storage tank sheet having two side edges approximately equal in length to said storage tank circumference and two end edges and rolling said rectangular storage tank sheet into a storage tank ring, thereby butting said end edges;

said cutting and shaping further comprises cutting said sheet steel such that at least one of said storage tank sheet steel pieces is a storage tank end panels of substantially circular shape having a storage tank end panel diameter approximately equal to said storage tank diameter, and

said assembling and welding further comprising assembling said storage tank rings and said storage tank end panels into said storage tank such that said end edges of said storage tank ring are not adjacent to said end edges of a neighboring storage tank ring.

9. A system made according to the method of claim 8.

10. The method according to claim 5, wherein:

said storage tank sheet steel pieces are approximately 7 gauge or thicker, and

said cutting and shaping further comprising cutting from said sheet steel a plurality of secondary containment tank sheet steel pieces with at least one edge, said secondary containment tank sheet steel pieces constructed such that when assembled and welded they form a secondary containment tank with each said edge in contact with a neighboring edge to form at least one joint, said joint being selected from the group consisting of joggle joints and butt weld joints, at least a weld fusing each said joint;

said assembling and welding further comprising welding said secondary containment tank sheet steel pieces to form said secondary containment tank which surrounds said storage tank, thereby forming an interstitial space between said storage tank and said secondary containment tank, said welding being performed with a welding technique selected from the group consisting of:

submerged arc welding using a L 61 weld wire and a 761 flux, operating with 225 to 280 amps; and

dual shielded wire feed welding shielded by carbon dioxide and operating with 180 to 220 amps, using a flux core weld wire having a maximum of approximately 0.15% carbon and approximately 1.4% manganese; and

installing said tank fitting to said storage tank such that said tank fitting protrudes through said secondary containment tank wall and said storage tank and said secondary containment tank are substantially leak-free when said tank fitting is closed.

11. A system made according to the method of claim **10**.

12. The method according to claim **10**, wherein:

said storage tank sheet steel pieces having approximately 0.04% phosphorus and approximately 0.05% sulfur;

said weld metal of said storage tank having approximately 0.05% carbon, approximately 1.28% manganese, approximately 0.5% silicon, approximately 0.013% phosphorus, and approximately 0.009% sulfur;

said secondary containment tank sheet steel pieces having approximately 0.04% phosphorus and approximately 0.05% sulfur; and

said weld metal of said secondary containment tank having approximately 0.05% carbon, approximately 1.28% manganese, approximately 0.5% silicon, approximately 0.013% phosphorus, and approximately 0.009% sulfur.

13. The method of according to claim **12**, wherein:

said storage tank is of a substantially cylindrical shape, having a storage tank circumference and a storage tank diameter;

said secondary containment tank is of a substantially cylindrical shape, having a secondary containment tank circumference and a secondary containment tank diameter;

said cutting and shaping further comprises cutting said sheet steel such that at least one of said storage tank sheet steel pieces is a rectangular storage tank sheet having two side edges approximately equal in length to said storage tank circumference and two end edges and rolling said rectangular storage tank sheet into a storage tank ring, thereby butting said end edges;

said cutting and shaping further comprises cutting said sheet steel such that at least one of said secondary containment tank sheet steel pieces is a rectangular secondary containment tank sheet having two side edges approximately equal in length to said secondary containment tank circumference and two end edges and rolling said rectangular secondary containment tank sheet into a secondary containment tank ring, thereby butting said end edges;

said cutting and shaping further comprises cutting said sheet steel such that at least one of said storage tank sheet steel pieces is a storage tank end panel of substantially circular shape having a storage tank end panel diameter approximately equal to said storage tank diameter;

said cutting and shaping further comprises cutting said sheet steel such that at least one of said secondary containment tank sheet steel pieces is a secondary containment tank end panel of substantially circular shape having a secondary containment tank end panel diameter approximately equal to said secondary containment tank diameter;

said assembling and welding further comprising assembling said storage tank rings and said storage tank end panels into said storage tank such that said end edges of said storage tank ring are not adjacent to said end edges of a neighboring storage tank ring; and

said assembling and welding further comprising assembling said secondary containment tank rings and said secondary containment tank end panels into said secondary containment tank such that said end edges of said secondary containment tank ring are not adjacent to said end edges of a neighboring secondary containment tank ring and said secondary containment tank surrounds said storage tank.

14. A system made according to the method of claim **13**.

15. An improved noninsulated above-around fire-resistant storage tank system for storing flammable and combustible material, such as gasoline, comprising:

a plurality of storage tank sheet steel pieces assembled to form a storage tank, each of said storage tank sheet steel pieces having at least one edge, each said edge being adjacent to a neighboring edge, said storage tank sheet steel pieces having thicknesses that are sufficient to have enough mass to maintain the integrity of the storage tank in an environment of at least 2000 degrees F. for a period of time of at least two hours, said sheet steel pieces being fabricated of a steel that has a brittleness that is substantially no more than a brittleness of a steel having a maximum of approximately 0.15% carbon and a maximum of approximately 0.8% manganese; one or more joints where each said edge is in contact with said neighboring edge, said joints being selected from the group consisting of joggle joints and butt weld joints; and at least one weld comprising a weld metal that has a coefficient of expansion that is similar to that of the steel from which the sheet steel pieces are fabricated; and

at least one tank fitting.

16. A system according to claim 15, wherein said storage tank sheet steel pieces have a thickness of at least 10 gauge.

17. A system according to claim 15, further comprising at least one skid member attached to said storage tank for supporting the storage tank with respect to an underlying surface, said skid member being fabricated from a material having a similar coefficient of expansion as the steel from which the sheet pieces are fabricated.

18. A system according to claim 15, wherein said sheet steel pieces are assembled to form a storage tank and a secondary containment tank, and wherein said sheet steel pieces forming the storage tank have a similar coefficient of expansion as said sheet steel pieces forming the secondary containment tank.

19. An improved noninsulated above-ground fire-resistant storage tank system for storing flammable and combustible material, such as gasoline, comprising:

a plurality of storage tank sheet steel pieces assembled to form a storage tank, each of said storage tank sheet steel pieces having at least one edge, each said edge being adjacent to a neighboring edge, said storage tank sheet steel pieces having a minimum thickness that is *sufficient to have enough mass to maintain the integrity of the storage tank in an environment of at least 2000 degrees F. for a period of time of at least two hours, one or more joints where each said edge being in contact with said neighboring edge, said joints being selected from the group consisting of joggle joints and butt weld joints and at least one weld, said weld comprising a weld metal that has a coefficient of expansion that is similar to that of a steel from which the sheet steel pieces are fabricated; and*

at least one tank fitting.

20. A system according to claim 19, wherein said sheet steel pieces are assembled to form a storage tank and a secondary containment tank, and wherein said sheet steel pieces forming the storage tank have a similar coefficient of expansion as said sheet steel pieces forming the secondary containment tank.

21. A system according to claim 19, wherein said storage tank sheet steel pieces have a thickness of at least 10 gauge.

22. A method of making a noninsulated above-ground fire-resistant storage tank for storing combustible material such as gasoline, comprising steps of:

(a) providing a plurality of sheet steel pieces, each of said sheet steel pieces having a minimum thickness;

(b) assembling and welding the sheet steel pieces to form a storage tanks said assembling and welding being performed so as to form at least one joint that is selected from the group consisting of joggle joints and butt weld joints;

(c) installing a fitting on the storage tank; and

(d) pressure testing the storage tank,

and wherein said minimum thickness of said sheet steel pieces is sufficient to have enough mass to maintain the integrity of the storage tank in an environment of at least 2000 *degrees F. for a period of time of at least two hours.*

23. A method according to claim 22, wherein step (a) is performed with each of said sheet steel pieces having a thickness of at least 10 gauge.

24. A method according to claim 22, wherein the welding in step (b) is performed with a welding metal that has a similar coefficient of expansion as said sheet steel pieces.

25. A method according to claim 22, further comprising a step of attaching at least one skid member to the storage tank for supporting the storage tank with respect to an underlying surface, said skid member being fabricated from a material having a similar coefficient of expansion as the steel from which the sheet pieces are fabricated.

26. A method according to claim 22, wherein step (b) is performed so that said sheet steel pieces are assembled to form a storage tank and a secondary containment tank, and wherein said sheet steel pieces forming the storage tank have a similar coefficient of expansion as said sheet steel pieces forming the secondary containment tank.

27. A method of making a noninsulated above-ground fire-resistant storage tank for storing combustible material such as gasoline, comprising steps of:

(a) providing a plurality of sheet steel pieces having a composition, each of said sheet steel pieces having a minimum thickness;

(b) assembling and welding the sheet steel pieces into joints with at least one weld metal to form a storage tank; and

(c) installing at least fitting on the storage tank; and wherein

the configuration of said joints, the composition and thickness of said sheet steel pieces and the composition of the weld metal are selected and combined such that the storage tank is able to withstand an environment of at least 2000 degrees F. for a period of time of at least two hours.

28. A method according to claim 27, wherein said sheet steel pieces being fabricated of a steel that has a brittleness that is substantially no more than a brittleness of a steel having a maximum of approximately 0.15% carbon and a maximum of approximately 0.8% manganese.

29. A method according to claim 27, wherein step (b) is performed so as to form more than one butt joint extending longitudinally with respect to an axis of the storage tank, and wherein said butt joints are positioned so as to be nonaligned.

30. A method according to claim 27, wherein said joints are is selected from the group consisting of joggle joints and butt weld joints.

31. A method according to claim 27, wherein step (a) is performed with each of said sheet steel pieces having a thickness of at least 10 gauge.

32. A method according to claim 27, wherein the welding in step (b) is performed with a welding metal that has a similar coefficient of expansion as said sheet steel pieces.

33. A method according to claim 27, further comprising a step of attaching at least one skid member to the storage tank for supporting the storage tank with respect to an underlying surface, said skid member being fabricated from a material having a similar coefficient of expansion as the steel from which the sheet pieces are fabricated.

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