Oct. 25, 1966 J. F. LEATHARD 3,280,778

SUPPORT IN SHIPS OF TANKS DESIGNED TO CARRY LOW TEMPERATURE LIQUIDS

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Fig. 1

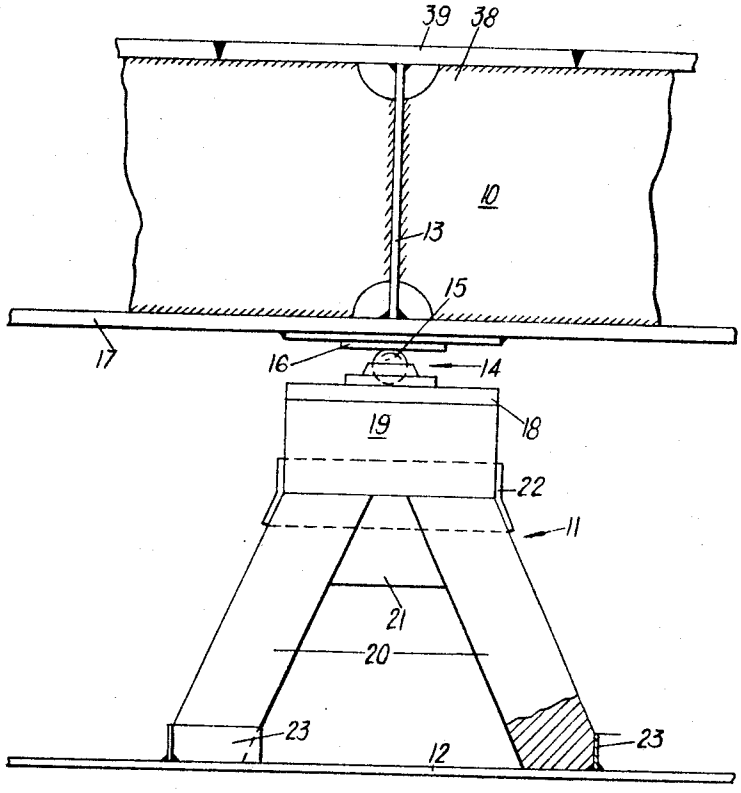

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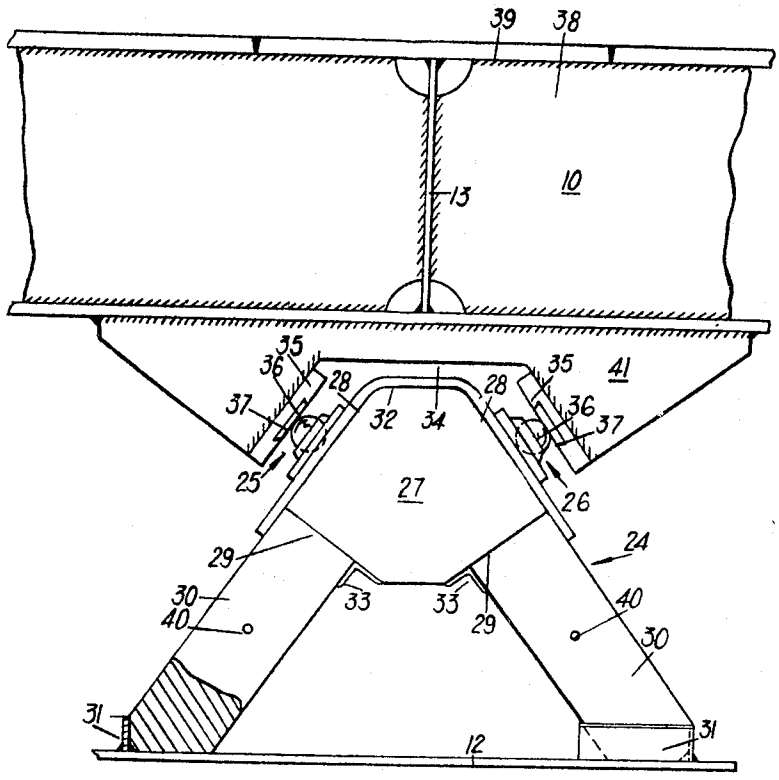
Fig. 2



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3,280,778

SUPPORT IN SHIPS OF TANKS DESIGNED TO CARRY LOW TEMPERATURE LIQUIDS

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6 Claims. (Cl. 114—74)

This invention concerns the support of large size cargo tanks in ships which are to carry low temperature liquids, and wherein the tanks are separated from the main structure of the ship.

The problem that exists is to anchor the tanks securely so that they will not shift as the ship heaves and pitches, while at the same time allowing the tanks to undergo the considerable thermal movements that occur when the cargo is, for example, a low temperature liquefied gas like liquid methane.

If the case of an upright cylindrical tank be taken, vertical expansion and contraction of the tank may be considered to take place with respect to a horizontal plane represented by the bottom of the tank. Radial expansion and contraction of the tank structure may be considered to take place with respect to a vertical line represented by the vertical axis of symmetry of the tank.

According to the present invention, each tank is constrained from lateral bodily movement with respect to the ship's hull structure, while being left free to expand and contract laterally, by means of at least two substantially horizontal keys that connect the tank bottom to the hull structure by being secured to one and received in key-ways or channels of the other, the two keys extending across the tank bottom at an angle to one another.

Although in what follows it is assumed that the tank is symmetrical and mounted vertically in the ship, the invention is not limited to tanks of this shape but the principles involved may be applied to tanks of almost all shapes. A necessary requirement, however, is that the bottom structure of the tank should be designed so that the supports to be described are located at strong places in the structure. In the case of cylindrical tanks this implies that the stiffening in the bottom of the tank should be radial in form.

It is unlikely that loads other than vertical loads would require to be accepted by the supports when thermal movements are taking place. When the ship is at sea the tank is at virtually constant temperature and consequently no thermal movements take place. It is then that the supports must be capable of providing lateral restraint because of ship movement, as well as vertical support to accept the weight of the tank. Vertical loads may be taken on a series of heat-insulating stools erected on the inner bottom of the ship's structure. Various ways of carrying the invention into effect will now be described by way of example, reference being had to the accompanying drawings in which:

FIGURE 1 is a diagram showing the arrangement of a vertical load bearing tank support for a ship's liquefied gas cargo tank, and

FIGURE 2 is a diagram of the arrangement of a key and cooperating keyway or channel connecting the tank bottom to the ship's hull structure.

In FIGURE 1, a large ship's cargo tank of upright cylindrical form to contain liquefied gas, such as liquid methane or natural gas, rests on stools **11** that stands on the ship's inner bottom plating **12** and one of which is shown. These stools **11** are designed to provide acceptable insulation between the tank bottom structure **10** and the ship structure from the point of view of heat leakage.

Each stool **11** is arranged below a radial web **13** of the tank bottom and contact between the tank bottom and the stool is through the medium of a ball-dolly **14** which will allow for radial movements of the bottom of the tank relative to its central axis, while at the same time providing vertical support and minimising the heat leakage path. The ball **15** of the ball-dolly **14** engages a bearing plate **16** on the underside of the tank bottom plating **17**.

The ball-dolly **14** is carried on a steel plate **18** overlying a block of hard insulating material **19**, such as that known under the registered trademark "Permali," and this block is in turn supported by timber stool legs **20**. The legs **20** can be of pinewood for example, and they are splayed and joined near their converging upper ends by wood gussets **21**. A plate ring **22** encircles the joint between the tops of the legs **20** and the block **19** for reinforcing purposes, while the lower ends of the steel legs **20** are received in steel foot bearers **23**.

Lateral restraint for the tank is provided by two key members, preferably, but not necessarily, set at 90° to each other and extending diametrically across the bottom of the tank. The angle between the two keys and the angle at which each key is set in relation to the fore and aft centre line of the ship, are to be determined from consideration of the relative lateral restraints required due to heaving, and due to pitching, or a combination of such ship movements.

A particular arrangement of such a key is shown in FIGURE 2 in which contact between the tank bottom structure **10** and a stool **24** is provided through the medium of inclined ball-dollies **25**, **26**, whilst the stool is designed as before to provide adequate insulation between the tank and the inner hull structure of the ship. The two series of ball-dollies **25**, **26** are set at an angle to the vertical, for example 35 to 40°, that is selected so that lateral expansion of the tank is permitted while at the same time the desired lateral restraint is provided.

The key is constituted by a row of insulating blocks **27** of "Permali" or the like each having upwardly-converging inclined side faces **28** and downwardly-converging inclined under faces **29**. Each block **27** is supported on widely splayed pairs of timber stool legs **30** joined to the faces **29** and with their lower ends received by foot bearers **31** on the ship's inner bottom **12**. Adjacent pairs of stool legs **30** are tied to one another by clamping bolts **40**.

A bent steel plate **32** forms a reinforcing cladding for the top and inclined sides **28** of the block **27**, and its lower edges are extended beyond the block so as to make, together with angle bars **33** at the inside of the upper ends of the legs, the joints between the block **27** and the stool legs **30**. The ball-dollies **25**, **26** are borne on the inclined faces of the plate **32**.

A series of brackets **41** welded to the underside of the tank bottom plating **17** are formed with recesses **34** and carry oppositely-inclined plates **35** within these recesses at opposite sides thereof to form the keyway or channel for the key. The balls **36** of the ball-dollies **25**, **26** engage bearing plates **37** borne by the plates **35**. As in the case of the weight-bearing stools **11**, the rows of stools **24** are disposed under radial webs **13** of the tank bottom structure **10**, which structure also comprises circumferential webs **38** and top plating **39**.

An alternative arrangement consists in providing two metallic or hard wood keys set at suitable angles on the underside of the tank bottom which engage in channels provided in solid balsawood, or some similar form of insulation, lining the inner bottom of the vessel. Or again, the outside of the bottom of the tank may be lined with solid balsawood or other suitable insulation and similar keys may engage in channels in the balsawood, these keys being attached to the inner bottom of the vessel, or

if access is required, set on stools on the inner bottom of the vessel.

I claim:

1. The combination in a ship of a cargo tank to contain bulk low temperature liquid and a tank mounting to constrain said tank from lateral bodily movement with respect to the ship while leaving the tank free to expand and contract thermally, comprising two series of stools anchored on the ship's inner bottom in rows extending in two horizontal directions at an angle to each other and diametrically of the bottom of the tank thereby to constitute two discontinuous keys, each stool having side faces that are each inclined to the vertical at an angle of about 35 to 40° whereby said discontinuous keys constituted by said stools each have sides that converge upwardly toward a key apex, two series of tunnel-form brackets secured to the underside of said tank in two horizontal rows parallel to and in substantial alignment vertically with said keys and having downwardly-opening recesses with sides that diverge downwardly, said recesses being in alignment along the rows to define two keyways having downward divergence corresponding to the upward convergence of said keys, each row of said tunnel-form brackets being directly over a respective one of said keys with an upper portion of the key including the apex thereof entering the keyway defined by said row, antifriction ball means mounted on said inclined side faces of said stools just below the apices thereof, and hard plates secured to said diverging sides of the recesses of said tunnel-form brackets which plates bear on said antifriction ball means and transmit lateral and vertical forces between the tank and said stools.

2. A tank according to claim 1, wherein said keys extend beneath radial stiffeners of the tank bottom.

3. A tank according to claim 1, wherein each stool comprises a block of a hard heat-insulating material with inclined faces and supported on timber stool legs.

4. A tank according to claim 1, and wherein the tank weight is borne by stools upstanding from the ship's inner bottom and disposed under radial stiffeners of the tank bottom structure.

5. A tank according to claim 4, wherein each stool is of a heat-insulating character and bears at its top face anti-friction means, such as a ballbearing, interposed between the stool and the underside of the tank.

6. A tank according to claim 5, wherein each weight-bearing stool comprises a block of a hard heat-insulating material supported on timber stool legs.

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UNITED STATES PATENT OFFICE

CERTIFICATE OF CORRECTION

Patent No. 3,280,778 October 25, 1966

John Frederick Leathard

It is hereby certified that error appears in the above numbered patent requiring correction and that the said Letters Patent should read as corrected below.

In the heading to the printed specification, lines 5 and 6, for "assignor to Wm. Cory & Son, Limited, London, England" read -- assignor, by mesne assignments, to -- Conch International Methane Limited, Nassau, The Bahamas, a company of The Bahamas. --.

Signed and sealed this 5th day of September 1967.

(SEAL)
Attest:

ERNEST W. SWIDER
Attesting Officer

EDWARD J. BRENNER
Commissioner of Patents