United States Patent

Ducrocq et al.

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[54] TRANSPORTABLE TANKS

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[52] **U.S. Cl.** ..... **4/172.19,** 4/172, 4/177 IW

[51] **Int. Cl.** **E04h 3/18,** E04h 3/16

[58] **Field of Search** ..... 4/172, 172.19, 177, 177 IW; 52/2

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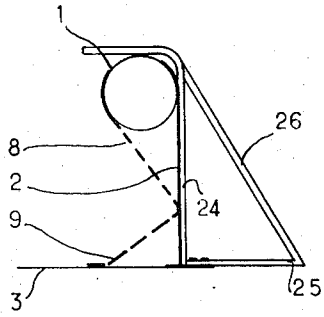
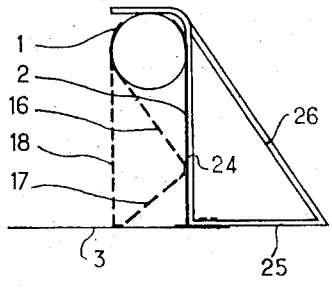
[57] **ABSTRACT**

This invention relates to transportable tanks that comprise a base, a wall and one or more inflatable tubes that form part of the wall. The invention is concerned with making the inflatable tube support the wall in a more efficient manner than hitherto and also to form the tank into a polygonal shape, such as a rectangle. The tubular member is reinforced or supported by flexible members which are so located and relatively crossed that the tube acts as a float when the tank is filled with water and thus maintains the polygonal shape of the tank. Additional supports may be used along the sides of the tank and the corners are supported differently from the rectilinear parts. Such a tank may be used as a transportable swimming pool.

9 Claims, 9 Drawing Figures





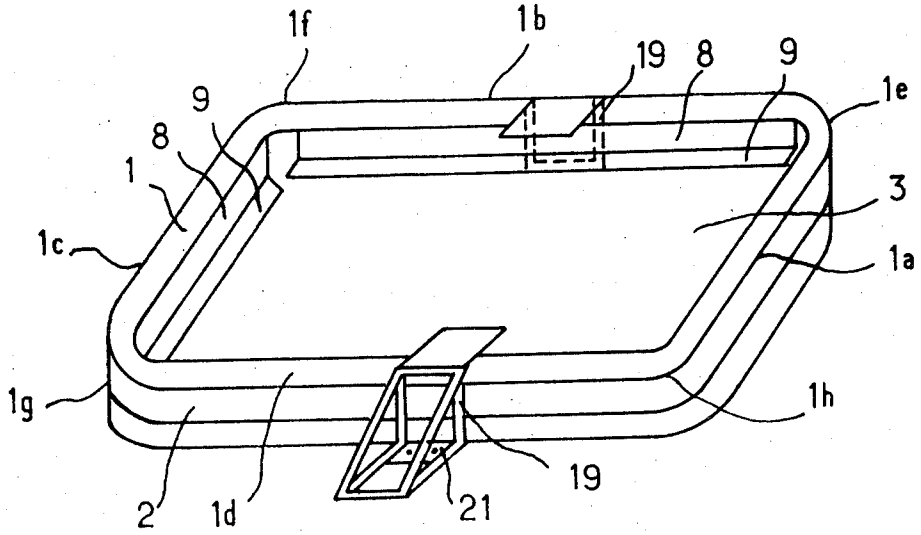


Fig: 1

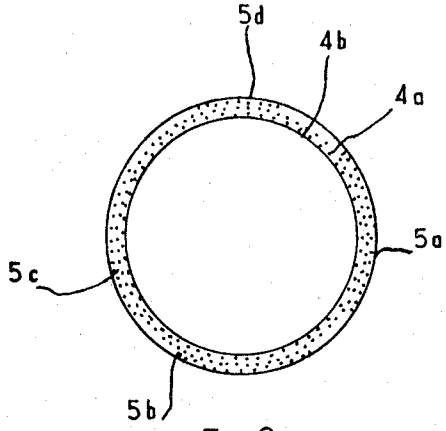


Fig: 2

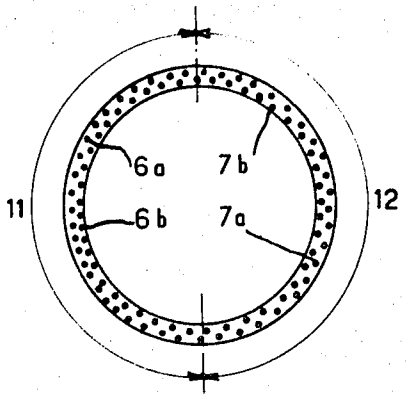


Fig: 3

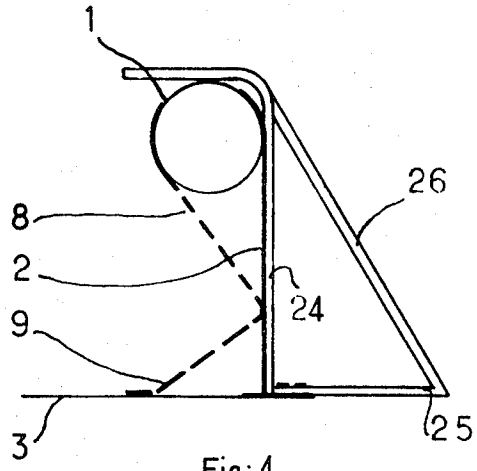


Fig: 4

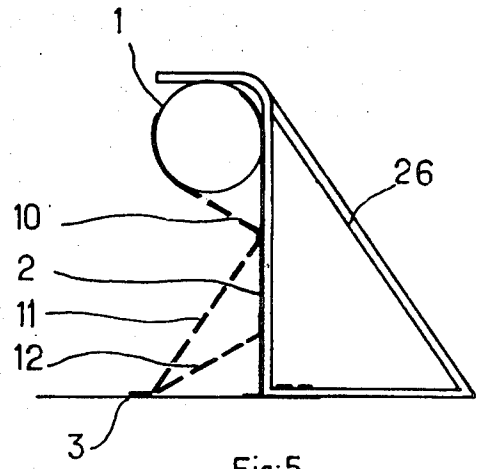


Fig: 5

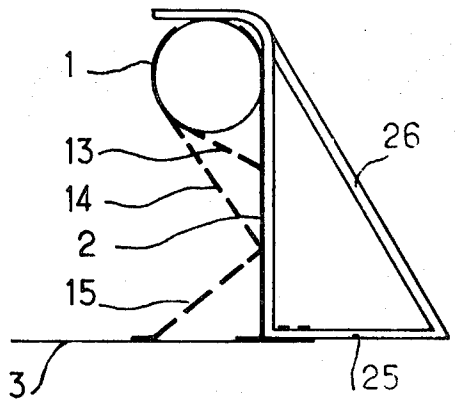


Fig: 6

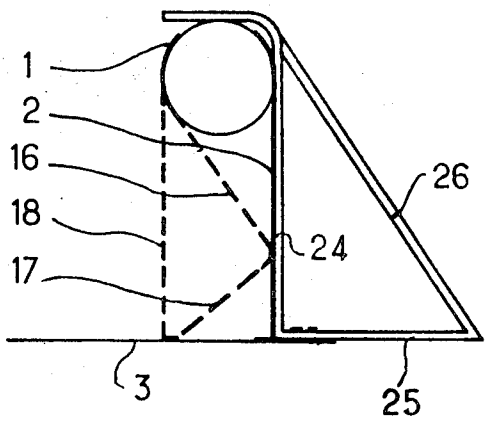
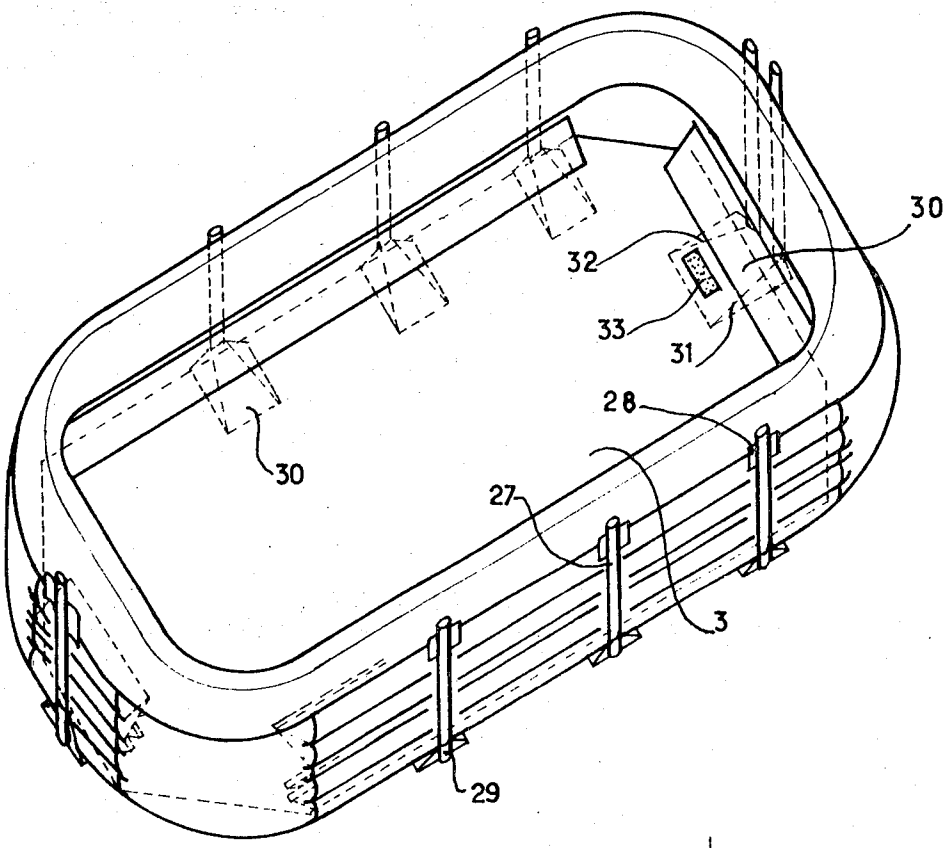


Fig: 7

Fig 9



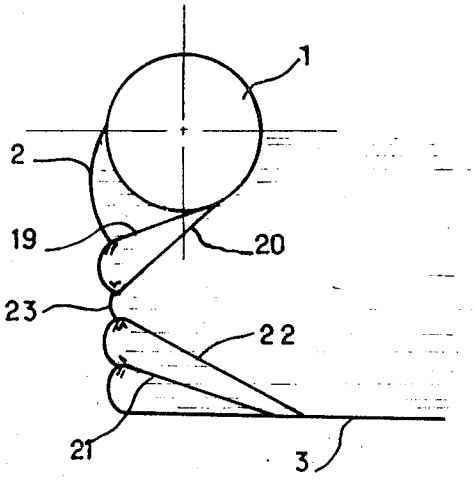


Fig 8

TRANSPORTABLE TANKS

The present invention relates to transportable tanks for example tanks which can be used as swimming pools. More particularly, the invention is concerned with such tanks which are formed by assembling flexible sheet materials and one or more inflatable tubular members which, when the tank contains water, act in the manner of floats and retain its walls in a vertical condition.

Tanks of this type which can easily be transported, are practical but, up to now, it has not been known to make them large enough to accommodate several swimmers. Moreover, all those which exist at present are circular; it results therefrom that the area usable at the same time by several swimmers is only a small part of the total available area.

For example, French Pat. No. 1,454,104 describes a swimming pool made of several tubes of a thermoplastics material comprising a longitudinal strip of non-extensible material in order to avoid these latter stretching in an irreversible manner under the action of pressure which could cause weakening of the said swimming pool and would put the user in the difficult position of not being able to use it again. Transportable tanks of this type where the tubes are formed in the same manner over their entire length are necessarily circular, even if they are manufactured from materials having a high mechanical resistance.

The invention has for an object a transportable tank formed from one or more flexible sheets assembled together with one or more tubes into any desired shape, for example a polygonal shape such as a rectangle, and of any size desired.

The invention consists in a transportable tank comprising a base, a wall and at least one inflatable tubular member forming part of said wall, said tank being of polygonal shape, and being braced or supported in the rectilinear parts of said tubular member by flexible members parallel to the axial direction thereof and comprising at least two layers of flexible members, each parallel to the other, the said layers covering the entire periphery of said tubular member and being crossed with respect one to the other, such that their members form with the axial direction of the tubular member equal angles and of opposite direction greater than 55°, and said tank being further supported at the corners for the part of the perimeter of the tubular member located externally of the tank by at least two layers of flexible members, each parallel to the other, the said layers being crossed with respect one to the other such that their members make with the axial direction of said tubular member, equal angles and of opposite direction greater than 55°, and furthermore wherein that part of the perimeter of said tubular member located inwardly of the tank is supported or braced by at least two layers of flexible members parallel each to the other, said layers being crossed one with respect to the other, such that their members make with the axial direction of said tubular member equal angles and of opposite direction less than 55°.

The invention may be used for making rectangular tanks of 13.5 m × 7 m forming a swimming pool with a depth of water of approximately 0.90 m.

Preferably the angles greater than 55° are between 70° and 80° and are advantageously 75° whilst the angles less than 55° are between 45° and 20° and are advantageously 35°.

In order that the invention may be more clearly understood reference will now be made to the accompanying drawings which show some embodiments thereof by way of example, and in which:

FIG. 1 shows a perspective view of a first embodiment of a tank according to the invention,

FIG. 2 shows a section through any one of the rectilinear parts 1*a*, 1*b*, 1*c*, or 1*d* of the tank of FIG. 1,

FIG. 3 shows a section through any one of the corner parts 1*e*, 1*f*, 1*g* or 1*h* of the tank of FIG. 1,

FIGS. 4 – 8 show cross sections through parts of other embodiments of tanks according to the invention, and

FIG. 9 shows a perspective view of a tank provided with additional supports.

Referring now to the drawings, FIGS. 1–9 show a tank which comprises a continuous tubular member 1, inflatable by means of valves of any known or desired kind. Since such valves are well known in the art, they are not shown. The tank also has side walls 2 and a base 3; as the tank is filled with water, the tubular member 1 acts as a kind of float and pulls the side walls into shape and when the tank is full, retains the walls in an upright position.

It will be noted that contrary to the majority of tanks of this type in existence today, that of the invention is rectangular and, thus, that its shape is particularly well adapted to accommodating the movements of several swimmers.

The rectangular shape of the inflated tubular member 1 is due to the way it is supported and holds itself. It can be said to be self-supporting or self-bracing.

In the rectilinear parts 1*a*, 1*b*, 1*c*, 1*d* of the tubular member 1, the bracing effect is constituted by an even number of layers shown as 4*a* and 4*b*, which layers are arranged one above the other and formed from supple, parallel members such as wire strands or textile, metal or glass cables, crossed in a manner to form with the axial direction equal angles but of opposite direction, greater than 55°, preferably between 70° and 80°, and usually approximately 75°, and from at least one layer of parallel members disposed according to the axial direction of the tubular member, the said layer covering the entire periphery of the member or only certain areas thereof.

Because the angle which the members of the two first layers make with the axial direction is greater than the equilibrium angle (55°), the tubular member tends to extend when it is inflated; this has the effect of tightening the members which are parallel to the axial direction, and thus creates a girder effect, which renders the tube rigid in the longitudinal direction.

These members parallel to the longitudinal direction extend over the entire length of the rectilinear parts 1*a*, 1*b*, 1*c*, 1*d*, but it is not necessary for them to envelop the tube entirely. One may, for example, arrange them in the form of strips uniformly spaced over the entire periphery or only arrange them in the areas which will be stretched by reason of the bending which the different stresses to which the tube will be submitted will cause. In a general manner, it is advisable to arrange them in external, internal and lower areas of the tube and, also when the rectilinear parts attain a certain length, 8 m for example, in the upper areas; in fact in the absence of longitudinal members in their upper area, the rectilinear parts have a tendency to bend, which can be awkward if the length of these rectilinear parts exceeds a certain value. It is thus that in the embodiment, the tube comprises, in its rectilinear parts, four layers 5*a*, 5*b*, 5*c* and 5*d* of members parallel to the axial direction.

The layers of members parallel to the axial direction may be unequal in size and may be unequally spaced; their mechanical resistance is such that they can withstand, without damage, stresses of any normal kind to which they are subjected when the tank is in use. To this end, one can in a manner well-known to those skilled in the art, make use of the nature of the members and they can be selected for this purpose: for example, they may be made from a textile or metal (wires, cables or strands), in any desired quantity per unit of size and similarly the size of the layer may be selected to fulfil the use to which the tank is to be put.

In the corners 1*e*, 1*f*, 1*g*, 1*h* of the tank, the tubular member is braced or reinforced differently from the rectilinear parts.

In the outer areas 11 of the corners 1*e*, 1*f*, 1*g*, 1*h*, the support comes from two or any other even number of layers as at 6*a* and 6*b* formed on mutually parallel resilient members which are located one above the other and crossed with respect to the axial direction of the tube such that their members make with this latter an angle greater than the equilibrium angle (55°), preferably between 70° and 80° and usually approximately 75°. In fact, these layers are most often identical in their structure and position to those which are used in the rectilinear parts and may form extensions thereof.

In the internal areas **12** of the parts **1***e*, **1***f*, **1***g*, **1***h* the armature is also formed from two or any other even number of layers such as **7***a* and **7***b*, each formed from resilient parallel members which are located one above the other and crossed symmetrically with respect to the axial direction of the tube so that the members of each form with this latter equal angles and of opposite direction but in this case these angles are less than 55°, which is the value of the equilibrium angle, and are preferably between 45° and 20° and usually approximately 35°.

When the tubular member **1** is inflated, the outer areas **11** wherein the bracing or support members form an angle greater than the equilibrium angle to the direction of the tube axis are extended, whilst the inner areas **12** wherein the angle of the bracing members to the axial direction is less than the equilibrium angle are shortened; thus the parts **1***e*, **1***f*, **1***g* and **1***h* of the tube are curved to a very short radius.

Although its bracing might appear complicated, such a tube is in fact easy to manufacture by using the manufacturing methods commonly used in the rubber industry. For example, after having prepared a cord material, that is to say a layer of parallel members embedded in a material such as rubber which ensures adhesion of the assembly formed by the different members, this cord material may then be cut up into pieces of suitable length and located by juxtaposing them on a sheet of rubber of a size slightly greater than the circumference of the tube, such that the members of the cord material form an angle of between 70° and 80° to the longitudinal direction; on this support layer thus prepared, the other layer may be placed in the same manner but by crossing it with the first symmetrically with respect to the longitudinal direction. The parts corresponding to the zone **12** may then be cut up and removed; assemblies formed from two layers of the same cord material thus superposed and crossed the one with the other symmetrically, may then be placed in the cut-out parts thus made, however, this time, so as to make with the longitudinal direction an angle between 45° and 20°; these assemblies slightly overlap the two preceding layers.

The longitudinal bracing members intended to reinforce the rectilinear parts of tube may then be positioned (or they could be placed on the first sheet of rubber before the two bracing layers) and a second sheet of rubber may be applied. The tubular member may then be produced by forming a tube which will be obtained by folding the sheet in itself in the longitudinal direction and by causing one end to overlap the other slightly, and finally, by joining the end of this tube.

Inflation of the tube, such as described above, imparts the rectangular shape thereto and this shape is maintained: it thus enables rectangular tanks to be produced which preserve their shape when they are full of water.

In tanks according to the invention, other means may also be used which have the effect of improving their conditions of use, more particularly when they are deep and of quite large dimensions.

As soon as the water reaches a certain height, say 25 to 30 cm, the wall **2** bulges under the effect of the pressure; this has numerous drawbacks, one of which is of diminishing the useful height of the wall and thus, the useful depth of the tank.

In order to prevent the wall from bulging in this exaggerated fashion, at least two reinforcements may be arranged within the tank along the entire length of the rectilinear parts, one being connected to the tube and to the wall and the other being connected to the wall and to the bottom.

FIGS. **4** to **8** show different ways of positioning these reinforcements.

In the case of FIG. **4**, a reinforcement **8** is fixed to the tube **1** and to the wall **2**, and approximately at a third of the height of this latter and a reinforcement **9** is fixed to the wall **2** and to the base **3**. The reinforcement **8** prevents the tube **1** from springing partly downwardly when the swimming pool is full of water and this means that the vertical force directed upwardly, exerted by the tube on the wall, is always maximum. Moreover, the tube **1**, being rigid, the reinforcement **8** fixes the wall **2** and prevents it from bulging to an exaggerated extent; the reinforcement **9** also retains the wall **2** and prevents bulging thereof.

In the case of FIG. **5**, a reinforcement **10** is connected to the tube **1** and to the wall **2** and two reinforcements **11** and **12** are connected to the base **3** and to the wall **2**; in the case of FIG. **6**, two reinforcements **13** and **14** are connected to the tube **1** and to the wall **2** and one reinforcement **15** is connected to the base **3** and to the wall **2**. The wall **2** is thus fixed at two points which also reduce bulging thereof.

In the case of FIG. **7**, two reinforcements **16** and **17** are arranged like those of FIG. **4**, and moreover another reinforcement **18** directly connects the tube **1** and the base **3**. Such a construction has the same effect as the preceding ones and, moreover, securing the tube **1** directly to the base **3**, it imparts to the assembly better rigidity. Naturally, the reinforcements **16** and **17** could be replaced by three reinforcements arranged as in FIG. **5** or **6**.

As regards FIG. **8**, two reinforcements **19** and **20** are connected to the tube **1**, whilst two other reinforcements **21** and **22** substantially symmetrical to the preceding reinforcements with respect to one wall portion **23** of small height, are connected to the base **3** of the tank. In the same manner as FIG. **7**, the reinforcement **18** can directly connect the tube **1** to the base **3**.

All these reinforcements extend over the entirety of the rectilinear parts **1***a*, **1***b*, **1***c*, **1***d* and are interrupted in the corner parts **1***e*, **1***f*, **1***g*, **1***h*. Thus, the channels which they define with the wall **2**, and possibly the tube **1** or the base **3**, are open at both ends which enables water to penetrate evenly therein, which is an essential condition in order that filling of the tank is effected under good conditions. It can happen, however, more particularly at the beginning of filling, that the water from the tank penetrates these channels with difficulty. Therefore, if desired in certain constructions, they may be provided with uniformly distributed orifices, as is shown on FIGS. **4** to **7**. They can alternatively be made from a cloth having a large mesh or even a net.

The support of the rectilinear parts of the tube **1** enables a true girder to be made therefrom, so that it is extremely rigid when inflated. However, for certain reasons, more particularly for decreasing the stresses on the ends, it may be preferred to inflate the tube to a lesser extent and to make do with less rigidity therefor, which thus has the tendency to bend. In order to limit its curvature, vertical supports such as those shown at **24** in FIGS. **1**, **4**, **5**, **6** and **7** can be arranged from place to place.

Advantageously, these supports, which can be used as a ladder or as a diving board, are not fixed to the ground but are secured to the base **3** of the tank, due on the one hand to an external part or foot **25**, integral with or secured to the base, and on the other hand to a plate **26** to which the part **25** is fixed.

Moreover, if accidentally the tube begins to deflate, the support **24** will continue to maintain the wall in place and prevent all the water contained in the tank from escaping forcefully: they thus form, also, a safeguard.

In FIG. **9**, a swimming pool is shown in perspective provided with additional supports; each such support is formed from vertical elements **27** in the shape of beams possibly provided, partially or over their entire length with support plates **28**. These beams may on their upper part comprise a protection member, for example rubber, whilst their lower part is placed in a receiving and support socket **29**, which is integral with or secured to a plate **30**, grooved on its inner face and smooth on its upper face, placed between the ground and the base **3** of the tank; thus, the weight of the water opposite to that of the beam **27** holds the beam upright by reason of the pressure which is exerted thereon.

These supports have the double advantage of being attractive, of not being awkward nor bulky and also of being easy to mount and dismount and of occupying the minimum space in a transporting vehicle.

Moreover, the presence of reinforcing grooves **31** and **32**, of the retaining plate **20**, which means that this latter is separated from the ground, enables devices for evacuating and supplying the tank with water to be produced; for example, an orifice **33** is made in the plate **30**, and another corresponding orifice is made in the base of the tank, the links between the plate **30** and the base being produced by any sealed means.

Although the specification has referred to the use of a single tubular member **1**, it will be clear that two or more such members may be provided and arranged one above the other over the developed height of the side walls, or even one within the area defined by another, or indeed in any configuration.

We claim:

1. A transportable tank comprising a base, a wall and at least one inflatable tubular member forming part of said wall, said tank being of polygonal shape, means supporting the rectilinear parts of said tubular member constituted by at least two layers of flexible members parallel to the axial direction of said tubular means and each parallel to each other, the said layers covering the entire periphery of said tubular member and being crossed with respect one to the other, such that their members form with the axial direction of said tubular member equal angles and of opposite direction greater than 55°, and means supporting the corners of said tubular member for the part of the perimeter of said tubular member located externally of the tank, said supporting means being constituted by at least two layers of flexible members, each parallel to the other, the said layers being crossed with respect one to the other such that their members make with the axial direction of said tubular member, equal angles and of opposite direction greater than 55°, and furthermore wherein that part of the perimeter of said tubular member located inwardly of the tank is supported by at least two layers of flexible members parallel each to the other, said layers being crossed one with respect to the other, such that their members make with the axial direction of said tubular member equal angles and of opposite direction less than 55°.

2. A tank according to claim **1**, wherein said angles greater than 55° lie between 70° and 80°, and wherein said angles less than 55° lie between 45° and 20°.

3. A tank according to claim **1**, wherein said angles greater than 55° are approximately 75° and said angles less than 55° are approximately 35°.

4. A tank according to claim **1**, wherein the longitudinal supporting members situated in said rectilinear parts of the tank are arranged in the inner, lower and external areas thereof.

5. A tank according to claim **1**, wherein reinforcements situated within the tank connect said wall to said tubular members and to said base along said rectilinear parts.

6. A tank according to claim **5**, wherein an additional reinforcement, situated within the tank, is connected to said tubular member and to said base.

7. A tank according to claim **1**, wherein vertical supports are located along the tank, said supports being secured to said base, and disjunct from the ground upon which the tank rests.

8. A tank according to claim **1**, wherein supports formed by vertical members are arranged along the tank, said supports being secured to plates located beneath said base of the tank.

9. A tank according to claim **8**, wherein at least one of said supports is hollow and used as a means of circulation for water to be contained in the tank, the retaining plate being apertured to communicate with said base of the tank, said base also being apertured to correspond to said apertured retaining plate.

* * * * *