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(19) (CA) **CANADIAN PATENT** (12)

(54) Fire Fighting Bucket Assembly

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ABSTRACT

FIRE FIGHTING BUCKET ASSEMBLY

A collapsible fire fighting bucket 1 to be suspended from an aircraft and to be filled from an open body of water has adjusting means 150, 154 around the side wall for adjustably restricting the circumference thereof and thereby reducing the capacity of the bucket. A bucket assembly comprising a main bucket 1 and a booster bucket 160 is used for filling from shallow water. The booster bucket empties into the main bucket on lifting to give the main bucket a better fill.

FIRE FIGHTING BUCKET ASSEMBLY

The invention relates to a fire fighting bucket assembly to be suspended from an aircraft and to be filled from an open body of water, e.g. from a lake.

For this general purpose a fire fighting bucket is known which is made of a pliable material and is collapsible for easy storage during transport. When assembled, this bucket has a semi-rigid, circular upper rim. The bucket is suspended from a helicopter by a plurality of wires or ropes attached to a connector which contains a solenoid operated locking and releasing mechanism, which operates a dump valve in the bottom of the bucket by means of a wire or rope connected thereto.

The known bucket has stiffening battens in its side wall which are dimensioned such that the side wall remains essentially straight while submerged under a low pulling force, but will bulge outwards while submerged under a higher pulling force thereby adapting the capacity of the bucket to the load carrying capability of the helicopter.

While this feature works well in practice, it is nevertheless desirable under certain conditions to adjustably limit the

capacity of the bucket independent of the pulling force of the helicopter. This is e.g. desirable, when a big bucket is used with a weak helicopter. The pilot then adjusts the bucket to a certain capacity corresponding to the load carrying capability of his helicopter before starting the fire fighting operation. Thus he is no longer required to skillfully pull the bucket out of the water at a certain speed at every refill operation. This can speed up the whole operation considerably. Furthermore it is sometimes desirable to limit the capacity of the bucket even more than is possible by a very slow upwards pull.

Occasionally a fire fighting bucket has to be filled from an open body of water that is so shallow that the bucket is only partly submerged when hitting the ground. Under such circumstances the bucket will only be partly filled, and the fire fighting operation will be seriously impaired and will be very uneconomical because of more frequent refill operations necessary.

These problems are solved according to the invention by a fire fighting bucket comprising a bucket body made of pliable material and having an upper rim, a side wall, and a bottom; a dump valve in the bottom; upper rim stiffening means; means for suspending the bucket from the aircraft; and adjusting means around the side wall for restricting the circumference thereof for adjusting the capacity of the bucket.

A collapsible fire fighting bucket assembly

according to the invention comprises a main bucket having an upper rim, a side wall, and a bottom; a dump valve in the bottom; upper rim stiffening means; suspending means for suspending the main bucket from the aircraft; and a booster bucket having an upper rim, a side wall, a bottom, and an outlet in the bottom, the booster bucket being connected to the suspending means above the main bucket, so that the booster bucket empties into the main bucket, when the bucket assembly is pulled out of the water.

Examples of devices according to the invention will now be described, with reference to the accompanying drawings, in which:-

Figure 1 is a simplified diagrammatic side elevation of a known bucket;

Figure 2 is a simplified fragmented side elevation of part of the side wall of the bucket of Figure 1;

Figure 3 is a cross section of the bucket of Figure 1 along the line 3-3 of Figure 2;

Figure 4 is a simplified diagrammatic side elevation of the bucket of Figure 1 showing its approximate shape when filled;

Figure 5 is a simplified diagrammatic side elevation of a

bucket according to the invention with the side wall shown partly fragmented;

Figure 6 is a simplified diagrammatic side elevation showing a bucket assembly according to the invention with a main bucket and a booster bucket; and

Figure 7 is a simplified detail drawing of suspending means for the booster bucket.

Figures 1 to 3 show a bucket body 1 made of a pliable material, e.g. a vinyl impregnated woven synthetic fabric. It has a side wall 3, an upper rim 5 and a bottom 7. The bucket body 1 is suspended by a plurality of ropes or wires 11 and belts 15. Each rope is connected with the upper end to a crossbar 75 of a connector 9, and with the lower end to the upper end of a belt 15, the lower end of which is anchored on a circumferential rope 17, which supports the bottom 7 of the bucket.

The belts 15 are received in open ended belt pockets 19, which are arranged around the side wall 3 of the bucket. The belt pockets 19 are formed by the side wall 3 and first longitudinal fabric cover strips 21 connected to the side wall by stitching or welding. Stiffener battens 23, e.g. made of fiberglass, are received in closed stiffener pockets 25 formed by the first cover strips 21 and second longitudinal fabric cover strips 27, stitched to the first cover strip 21 and narrower than these. Upper rim stiffener battens 29 are received in upper rim pockets 31.

An upper ballast pocket 33 closable by a zipper 35 and a lower ballast pocket 37 closable by a zipper 39 are positioned on one side only on the inside of the side wall 3 of the bucket. These pockets can be filled with ballast, e.g. chains 41 and 43.

A tubular extension 51 made of water impervious fabric is connected to the side wall 3 at the bottom 7 of the bucket. This tubular extension is shown in Figure 1 and Figure 3 (in broken lines) in its extended position for dumping the water from the bucket through the open discharge port 53, and in Figure 3 (in full lines) in its withdrawn position with the discharge port closed for holding the water. In Figures 1 and 3, the bucket is shown empty and consequently the side wall is essentially straight. Partly or completely filled, the side wall bulges outwards as shown in Figure 4 and for reasons to be explained below.

Around the discharge port 53 a sealing lip 57 is provided for sealing the discharge port in its withdrawn position, where it is below the water level in the bucket. This sealing lip is made of a resilient material, e.g. a synthetic rubber named Neoprene. The sealing lip 57 is fastened to the fabric of the tubular extension 51 by means of a plurality of grommets 59. The tubular extension is supported in its withdrawn position by a rope 61 branching into a plurality of ropes 63. The rope 61 is wound on a reel 65 of the connector 9, which connects the arrangement to a helicopter. The lower ends of the ropes 63 are slidably penetrating in an alternate fashion grommets on one sealing lip section and are terminated by

plastic balls 69 behind grommets on the opposite sealing lip section.

Figure 4 shows the approximate shape of the bucket when filled partly to a lower water level 55 or when filled to capacity to a high water level 56 in the manner explained below.

The bucket can be transported in the helicopter in its collapsed state like a folded umbrella. For assembling the bucket, the upper rim stiffener battens 29 are pushed into the upper rim pockets 31 to give the upper rim a semi-rigid circular shape. The tubular extension 51 is withdrawn into the bucket body 1 under the force of a recoil spring, which rotates the reel 65 until the rope 61 is wound up and keeps the tubular extension under tension, assisted by a solenoid operated locking and releasing mechanism 99. The bucket is now suspended from the helicopter and is ready for filling.

The helicopter flies with the empty bucket to a lake, and the empty bucket will angle back during forward flight. The one-sided ballast formed by the chains 41 and 43 prevents the bucket from spinning on the suspending line 11. The helicopter then hovers over the lake, dumping the bucket into the water and the ballast allows the bucket to submerge quickly for filling. When the helicopter pulls the filled bucket out of the water, the weight of the water of the tubular extension 51 keeps the ropes 63 and 61 under tension and the sealing lips 57 closed.

Apart from generally supporting the side wall 3 the stiffener battens 23 have the further function of limiting the

capacity of the bucket to a pre-determined amount. The load carrying capability of a helicopter depends greatly on the environmental conditions like altitude and temperature, which determine the air density. Generally, the load carrying capability decreases with increasing altitude and temperature, i.e. with decreasing air density. The stiffener battens 23 are dimensioned such that they remain essentially straight under water, thus keeping the side wall essentially straight, when the bucket is slowly pulled out of the water as by a helicopter in weak condition. When the bucket has been pulled out of the lake, the stiffener battens bulge outwards, under the water pressure, so that the bucket assumes a shape as shown approximately in Figure 4. Due to the slow pull, the bucket has a frusto-conical shape under water and therefore a limited capacity. The bucket will thus be only partly filled to a lower water level 55, after having been pulled out of the water.

When, however, the bucket is pulled out of the water with greater speed by a helicopter in strong condition, the side wall of the bucket will bulge outwards already under the lake surface, allowing maximum filling capacity. The bucket will then be filled to a high water level 56, after having been pulled out of the water.

The full bucket is now flown to the location of the fire. For dumping the water, the pilot releases the solenoid operated mechanism 99. This brings the tubular extension 51 into its extended position under the pressure of the water, as shown in broken lines in Figure 3 and allows the bucket to be emptied completely. The pilot now again activates the solenoid operated mechanism 99 and the rope 61 is wound up on the reel 65 under the torquing force of the recoil spring 77. This brings the tubular extension 51 back into its

withdrawn position and the bucket is ready to be filled again.

Figure 5 shows a bucket according to the invention with the front portion of the side wall fragmented in order to show part of the inside of the rear portion of the sidewall. The suspending means and the dump valve are not shown for clarity reasons. Similar parts have the same reference numbers used in Figures 1 to 4.

The bucket comprises a bucket body 1 having a side wall 3, an upper rim 5, and a bottom 7. Around the inside of the side wall 3 adjusting means are provided for adjustably restricting the circumference of the side wall for adjusting the capacity of the bucket. The adjusting means comprise a circumferential flexible tension link in the form of a cinch belt 150 slidably received in belt loops severally designated 152, which are connected inside the side wall 3 by stitching or bolting. The ends of the cinch belt 150 are connected by a clamping member in the form of a buckle or a pair of so called D-rings 154, and by operating the cinch belt and the buckle, the effective circumferential length of the cinch belt can be adjusted as desired. Calibration markings severally designated 156 are provided on the cinch belt to allow easy and fast adjustment for the desired load capacity. In Figure 5 the cinch belt 150 is tightened to such an extent, that the volume of the bucket body is restricted and creases 158 are formed in the side wall 3. In a practical design the full capacity of a bucket was approximately 1600 liters giving a gross weight of approximately 1650 kg. Pulling this bucket out of the water at slow speed without using the cinch belt but using side wall stiffener battens 23 (not shown in Figure 5) to control the shape of

the bucket, the gross weight could be reduced to approximately 1200 kg. With the cinch belt used additionally to the side wall stiffeners, the gross weight of the bucket could be reduced to approximately 900 kg regardless of the speed by which the bucket was pulled out of the water.

Although the capacity adjusting means are preferably used with a collapsible bucket having side wall stiffener battens, it should be clearly understood that the adjusting means can also be used with collapsible buckets having no side wall stiffener battens. Also the cinch belt could be on the outside of the side wall 3, where it could, however, be entangled in obstacles on the ground or be subject to chafing. Therefore the protected inside location is preferred.

Figure 6 shows a bucket assembly according to the invention, which assembly is used for filling from a shallow open body of water, such as a shallow pond. Identical reference numbers from preceding figures are used for similar parts. The bucket assembly comprises a main bucket 1 and a booster bucket 160 having a side wall 163,an upper rim 165, and a bottom 167. The booster bucket 160 is essentially built like the main bucket 1 with upper rim stiffener battens and side wall stiffener battens. However instead of a dump valve in the form of the tubular extension 51 (not shown) of the main bucket, the booster bucket 160 has only an open outlet 169 in the bottom 167. This outlet is located off centre and diametrically opposite of that part of the side wall 163 that has an upper ballast pocket 173 and a lower ballast pocket 177 to be filled with ballast, like e.g. lead shot.

It should be noted that the lower ballast need not be off center as shown in Figure 6. The lower ballast can be arranged symmetrically relative to the bottom of the bucket. The circumferential rope 17 (Figure 2 and 3) e.g. can be replaced by a chain serving as ballast means for the main bucket. The lower ballast can also be located centrally on the bottom of the booster bucket.

The booster bucket 160 is suspended above the main bucket 1 and is connected to suspending wires severally designated 181 by means of shackles engaging grommets along the upper rim 165 and thimbles 183, which are connected to the suspending wires 181 by intermediate wires 185 and so called nicopress fittings 187 and 189, or by other suitable means. The booster bucket 160 is suspended above the main bucket in such a way, that the ballast pockets 33, 37, 173, 177 are suspended one pair above the other pair as shown in Figure 6. The rope 61 operating the dump valve of the main bucket 1 passes through the outlet 169; the rope 61 is not shown in Figure 6.

When the helicopter dumps the bucket assembly of Figure 6 into a shallow body of water, both buckets are probably only partly submerged. When the buckets are pulled from the water, the booster bucket 160, rising a moment earlier, empties into the main bucket 1, which just starts to rise. The booster bucket thus gives the main bucket a better fill, and the location of the ballasts relative to the off center outlet 169 of the booster bucket 160 ensures that the water pouring from the booster bucket flows into the main bucket during the starting phase of the lifting operation. The requirements of water tightness for the booster bucket are not stringent, as the booster bucket has to hold the water only for a few seconds.

THE EMBODIMENTS OF THE INVENTION IN WHICH AN EXCLUSIVE PROPERTY OR PRIVILEGE IS CLAIMED OR DEFINED AS FOLLOWS:

1. A collapsible fire fighting bucket to be suspended from an aircraft and to be filled from an open body of water, the bucket comprising:

   (a) a bucket body made of pliable material and having an upper rim, a side wall, and a bottom;

   (b) a dump valve in the bottom;

   (c) upper rim stiffening means;

   (d) means for suspending the bucket from the aircraft;

   (e) capacity adjusting means around the side wall for adjustably restricting the circumference thereof and thereby reducing the capacity of the bucket.

2. A bucket as claimed in Claim 1, wherein the capacity adjusting means is a circumferential flexible tension link arranged around the side wall of the bucket and a clamping member for adjusting the effective length of the flexible tension link.

3. A bucket as claimed in Claim 2, wherein the circumferential flexible tension link is a cinch belt slidably received in belt loops around the side wall of the bucket and the clamping member is a buckle.

4. A bucket as claimed in Claim 2, wherein the tension link is arranged inside the bucket.

5. A bucket as claimed in Claim 2, wherein the tension link has calibration markings.

6. A bucket as claimed in Claim 1, further comprising side wall stiffening means dimensioned such that the side wall remains essentially straight while submerged under a low pulling force, but will bulge outwards while submerged under a higher pulling force, so as to adapt the capacity of the bucket to the load carrying capabilities of the aircraft.

7. A bucket as claimed in Claim 6, wherein the side wall stiffening means are a plurality of ribs cooperating with the side wall and extending longitudinally and spaced apart from one another between the upper rim and the bottom.

8. A bucket as claimed in Claim 7, wherein the ribs are received in pockets on the side wall of the bucket.

9. A bucket as claimed in Claim 1, wherein the means for suspending the bucket from the aircraft comprise a connector adapted to be connected to the aircraft, and a plurality of flexible tension links connected between the bucket and the connector.

10. An apparatus as claimed in Claim 1 further including ballast means positioned adjacent the upper rim on one side of the bucket for achieving fast submersion during filling.

11. A bucket as claimed in Claim 10 further including ballast means positioned adjacent the bottom of the bucket for achieving fast submersion while filling.

12. A bucket as claimed in Claim 10 or 11 wherein the ballast is received in closable pockets.

13. A bucket as claimed in Claim 3 wherein the cinch belt is arranged inside the bucket.

14. A bucket as claimed in Claim 3 wherein the cinch belt has calibration markings to indicate capacity of the bucket when filled.

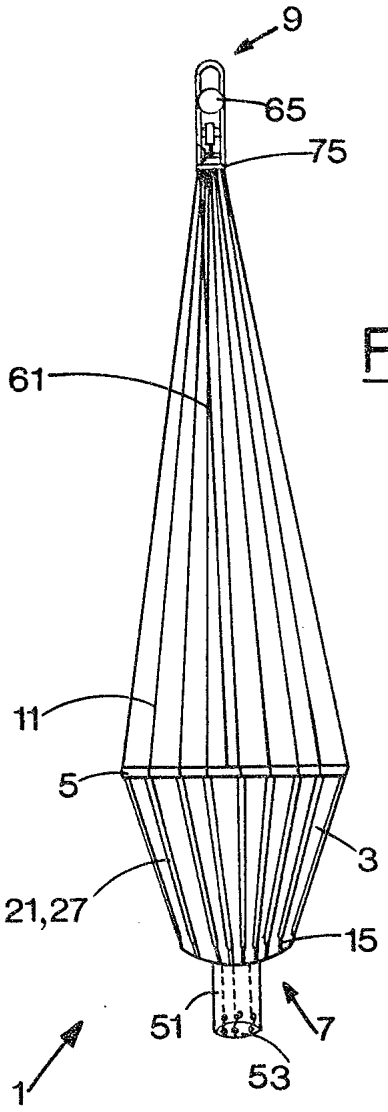

FIG 1

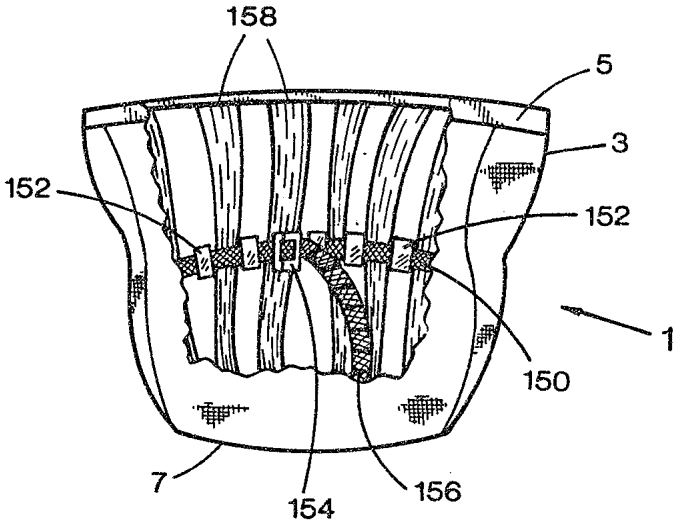

FIG 5

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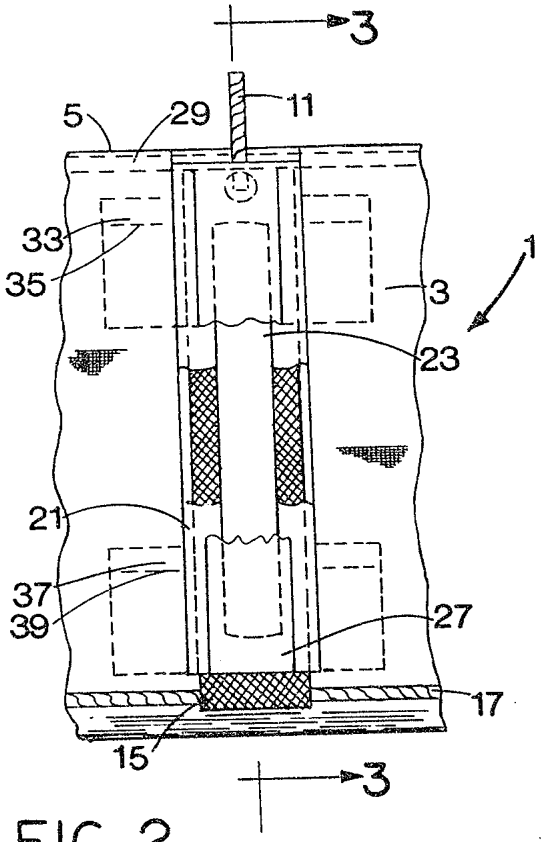

FIG 2

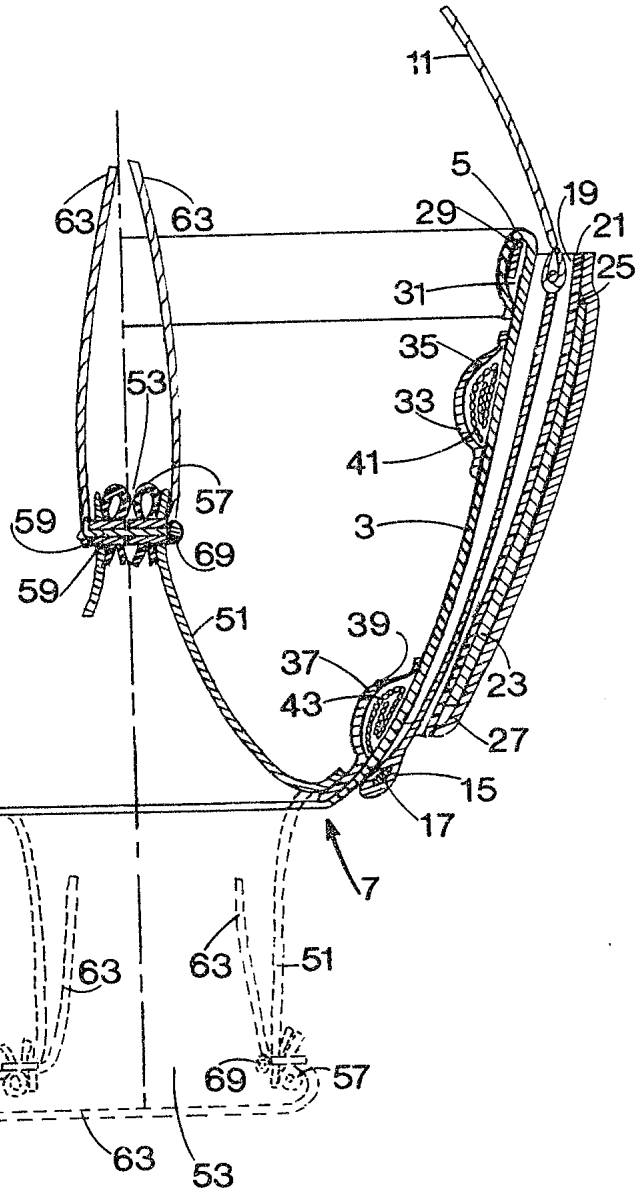

FIG 3

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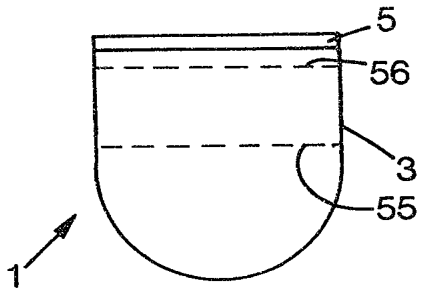

FIG 4

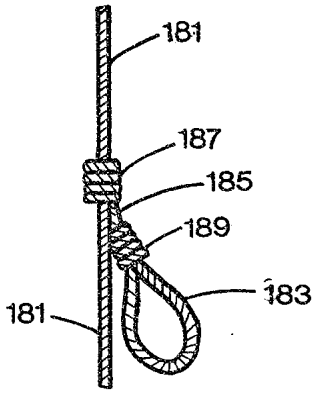

FIG 7

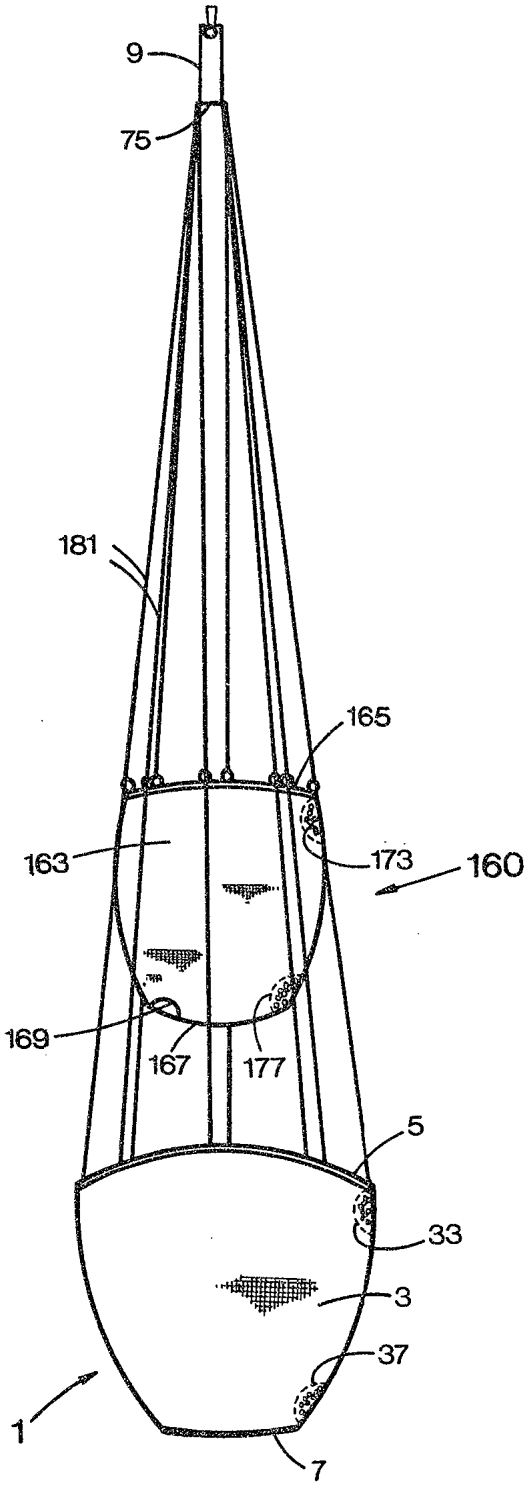

FIG 6

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