Tracking Device for Detecting the Containers Lost Over Board

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Synopsis

A large number of containers (approximately 1500 containers) are fallen over board annually due to different reasons such as encountering heavy weather, collision with the other vessels or grounding which consequently cause serious problems and difficulties such as: (1) Endangering the safety of navigation, reducing the depth of the channels, (2) Damaging the environment (rocks, coral), (3) Endangering the life of fishes and underwater species, (4) Pollution, as numbers of containers are loaded with dangerous chemicals, (5) Debris washing up beaches making beaches dirty endangering environment and tourism industry, (6) Damaging the fishermen nets, (7) Wasting a lot of time and manpower, including the use of highly technical equipment, to find and recover them and (8) Unnecessary additional costs to the ship owners/charterers.The containers are loaded on the container ships/general cargo vessels by calculating several factors such as: stability of the vessel, lashing requirements of containers, stack loads, dangerous good compliance with International Maritime dangerous Good code (IMDG), wind effect, minimum visibility. A bay plan is the plan which describes the position of all containers on board a ship, whether inside cargo holds or on top of the hatch covers. It has come to author's mind of fitting a tracking device outside the container. The proposed device can be named "Container Automatic Tracking System (CATS)".

Keywords— Containers, Automatic Tracking System, Navigation, RADAR, Buoy

1. Introduction

A container which is loaded on the open deck of a vessel must be properly secured. The securing of containers is done by the use of container lashing materials such as twist locks, lashing bars and additionally on traditional general cargo ships with bridge fittings.

All these materials are approved and licensed by the classification societies, labelled and certified.
The lashings are to be done as instructions written in cargo securing manual which is also approved by classification societies and flag state.
Therefore, normally the containers are stowed in a secure manner on open decks in order to reach safely to the next port of call.
However, there are certain reasons that cause a container to fall overboard such as:

1- Extreme weather condition accompanied by high waves and swells, especially when the waves are coming from the side or quarter of the vessel which consequently make the vessel to roll largely and rapidly from one side to another. In some circumstances the rolling period reaches to such a high degree that was not expected for the lashing materials to tolerate and therefore they fail or break, causing the container, containers or blocks of containers to fall overboard. This condition, mostly happens in coastal waters and near to a port when a vessel maneuverability is restricted.
One the worst cases that can be referred is the loss of 900 containers that were lost overboard from M/V Rena on 2011 off the coasts of New Zealand (Hariesh 2018). Recently, on January 2019 around 270 containers were lost overboard from the container vessel "MSC Zoe" in the North Sea due to vessel encountering heavy weather (Mike 2019).

2- Human error:
   i- Upon the completion of loading in each port, the securing of containers by iron rods are to be carried out according to what is mentioned in the cargo securing manual. However, there might be cases that some lashing points are ignored by the stevedores.
   ii- As mentioned before a large part of container securing depends on the twist

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locks which attach tiers of containers together. The operation of twist locks is automatic, as they automatically lock while sitting on the upper corner of the below container. Each container has four pieces of twist locks attached to its lower corners before loading. These twist locks will be fixed by the stevedores ashore. There are some cases that these locks are not sitting properly in the upper corner of the below container which means loss of connectivity and securing.

In other case, there might be chance that the twist lock does not automatically lock. When loading small quantity of containers, these faults may be observed and rectified by the duty officer, but imagine a ship carrying 6000- 10000 TEU and she must leave the port within a short interval after the completion of loading. In such a case, it is too difficult to notice these non-compliances with lashing plan.

iii- Not securing cargo/ equipment which is loaded inside a single container:

In the rough sea the cargo inside the container tends to move according to the movement of the vessel. The cargo, boxes or equipment which are not lashed properly will start moving within the container and consequently damaging it or causing lashing material to fail under those stresses and impacts which may lead to loss of container overboard.

3- Miscalculation or loss of the stability during the passage:

According to load line rules, the stability of the vessel should be in a proper and safe limit within the whole stages of a voyage. However, the chief officer (first officer) may miscalculate it or fail to consider an important factor during the passage from one port to the other. It can be not considering the effect of consuming bunkers and fresh water or not taking enough ballast water into the ballast tanks.

The result is a change of the metacentric height of the vessel (GM) which leads to the high rolling degree and rolling period during the rough weather.

4- All vessels are to leave the port and maintain a sufficient metacentric height (GM) which differs from vessel to vessel but the minimum should comply with load line rules.

Container ships, especially when loaded to maximum, are normally having a minimum amount of metacentric height (GM) which tends the vessel to be a Tender ship. It means if the vessel starts to roll, she likes to roll slowly and come back to mid-ship slowly. This is an additional factor during high seas which leads the containers to fall overboard.

Another situation is when the vessel turns with a high rate of turn. She then lists to the opposite side and with a low GM (tender ship), she tends to stay in the listed position more than expected giving rise to the failure of the lashing materials.

5- Stack load:

According to the stability criteria, and in order to comply with securing requirements, heavy containers are to be loaded in the lower tiers covered with lighter weight containers on the top tiers.

Not observing stack load requirement will easily cause the failure of the lashing material.

In case of containers having the same weight in a single tier, then the stack load (the weigh that each container is able to tolerate) must not exit the limit (for example, eight height stacking) otherwise the lower container will be damaged/ crushed under the load and therefore securing of the whole tier will be at risk.

6- Poor maintenance of lashing materials or use of damaged/ broken materials are also a reason for losing containers.

7- Not taking proper avoiding action when or before encountering bad weather by the Master of the ship.

8- In case of collision and because of the strong impact, the container securing device may fail and lead to falling it overboard.

9- Grounding of the vessel:

It occurs when a ship touches the ground, her stability reduces below the limit which cause her to list suddenly to one side for a long time. This loss of stability & listing may cause the failure of the securing materials and finally falling the container over board.

The most difficult part in recovering the lost containers is how to locate and find them, considering the tidal movements, currents, eddies, visibility of water and state of weather conditions.
Normally when the containers are lost, initial reports are to be sent by the ship's Captain to the nearest coastal authorities, coastguard and the ships in the vicinity indicating the position of the incident, number of containers, direction of the current and waves.
In addition, in some extreme cases the mariners realize the loss of containers from their vessel with a time delay, especially if only a few containers are lost during the storm in a dark night. Therefore, their position will not be very reliable.
Some of the lost containers sink, some float and start drifting with waves and current. But number of them partially sink which makes them difficult to be observed or detected by the other vessels transiting the area.
In all cases, the containers will certainly drift from their fallen position to another location by the effect of current and tidal movements. The containers are normally stuffed with different types of cargoes. Sometimes the cargo is steel coils or minerals, but they are also loaded with dangerous cargoes such as acids, paints, plastics, drums of oil and car batteries which are really harmful to the environment, if exposed to seawater. Therefore, it is required to find a way to detect these containers easier and faster.
When a ship loses her containers overboard, it is the Master's duty to inform several authorities, including the ship owner and the insurance company. Depending on the location of the incident, the ship owners shall take necessary action. In the instance of narrow channels, straits or in shallow water, the action requires to be precise due to the harms of those containers to the shipping, fisheries, environment and beaches.
In the early stages of the incident, coast guard together with their helicopters or airplane may only assist in locating those containers which are still floating.
Normally a salvage company will be nominated and salvage contract will be signed with the ship-owner. Salvage companies are having special types of vessels capable of locating and recovering the containers.

The salvage company is normally operated in following two methods:

i- To place tracking device and lights for those containers which are still floating and off course, causing a great danger to surface navigation.
ii- To detect and locate the submerged containers and finally recovering them.

Radio waves cannot travel inside salt water as salt water acts like a barrier to them. Therefore, RADAR is unable to track a submerged container.
The only way is to use the sound energy as it can travel through the seawater, hit the object and return back to the receiver.
Salvage vessels use side scan sonar to locate the submerged containers.
Both the above methods are time consuming, very expensive and also depends on the availability of a salvage vessel which is equipped with the required instruments & equipment (side scan sonar).
Notwithstanding the above, it is very interesting to know that it takes months to salve the containers lost overboard from the container vessel "M/V Zoe" in February 2019 and in author's opinion, many of them will be covered by mud and sand dunes as a result of this long delay (Kristen 2019).

2. Methodology

2.1 Proposed Technique

The outside of the bottom plating of a container is stiffened with "bottom cross members" (transverse webs) and two "bottom side rails" (longitudinal stiffeners).

The space between the bottom side rails is called "Gooseneck tunnel".

The vertical height of a cross member is 122mm and for the bottom side rails is 162mm.

The gooseneck tunnel specifications as per rules of the classification society is:3266 x 1030 x 120 mm

The author's idea is to install a floater (Buoy), rectangular shape of sufficient buoyancy, with a dimension of 2000 x 500 x 60 mm inside the gooseneck tunnel.

The bottom of the buoy should be heavier in order to make it stand vertically when at the surface of the water.

Additionally, a group of 3-4 small radar reflectors can be fixed on top of the buoy enabling it to be detected by the RADAR and it will be made more visible by having retro reflective tapes on it.

The container's number will also be written in the top corner of this buoy which makes it easier for the identification.

The buoy can be a foam filled material or a hollow steel rectangle.

It is secured to the bottom of container by means of straps and the straps connect to a hydrostatic release unit.

At the four corners of this buoy and between the container bottom plating, spring loaded umbrellas will be installed.

The bottom of the buoy is connected to a long steel wire of approximately 1000 meters which fits in a tube. Each 20 meters length of this wire is connected by a weak link to the cylinder. The other end of steel wire is permanently secured to bottom stiffeners by means of a stainless steel shackle.

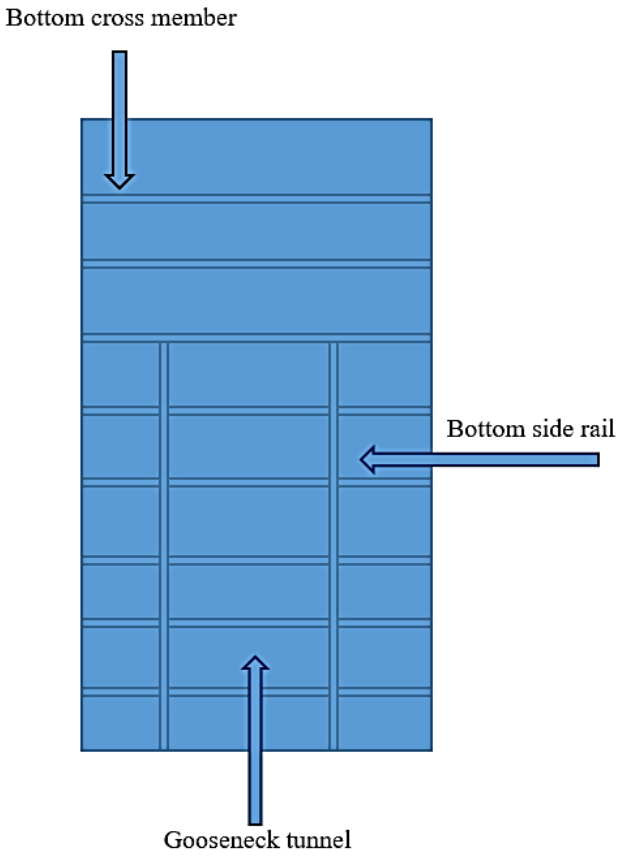

Figure 1: Schematic illustration of a sample container

2.1 Expected outcome

When a sinking container submerges to a depth of 1-2 meters, the hydrostatic release unit triggers and cause the lashing straps around the buoy to open.

The spring loaded umbrellas are now acting as jumper pushing the buoy away from the bottom of the container making sure it will not get trapped below the container.

The buoy which has enough buoyancy starts its upper movement toward the surface of the water and when reaches to the surface stands vertically enabling the others to detect it visually and by RADAR. The radar reflectors will return the RADAR signals from search and rescue vessels, salvage vessels and other vessels in the vicinity.

The weak links attached to the wire, avoids releasing its full length immediately, which consequently prevents the buoy to drift away from the container location by wind, sea or current.

Similar to all the other equipment and instrument used in the marine industry, classification approval and license will also be taken from the recognized classification societies.

3. Conclusion

In summary, locating lost containers overboard requires a lot of time which is expensive and may finally be unsuccessful. The author's idea of the proposed detecting system is quite simple and relatively cheap, but with a good result which let all involved parties to carry out a successful, shorter and cheaper operation. In the beginning, this system can be installed for the containers nominated to carry dangerous cargoes which are affecting the environment and later can be expanded for all the other containers. The proposed device can be later upgraded by installing a small satellite transponder on the buoy, enabling it to communicate with satellites.

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