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Modification of Braking system in vessel using ECDS & EBP

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Abstract: ***This paper aims to draw people's attention towards one of the major cause of accidents at sea, its impact and the methods we can adopt to reduce the chances of accidents considerably. The paper finds slow braking rate as the key cause of maximum accidents and suggests two systems designed to increase the deceleration rate of the ships. A detailed explanation about the working and the setting up of our proposed systems ECDS (Emergency Cargo Drop Stop) and EBP (Emergency***

Braking Propellers) has been provided in the course of the paper. It also draws a comparison between the pros and the cons of these systems. The study's conclusion indicates the significance of these two systems and how it paves the way for further study on the application and benefits of these systems.

Keywords: Braking system, Cargo, Collisions, Propellers.

1. INTRODUCTION

Any mode of transport is bound to have accidents. When it comes to shipping industry; the vast oceanic area, thousands of vessels, millions metric tons of cargoes, oil, gas et cetera, holding worth of 700 billion$ and millions of seafarers sailing around the globe makes it the most vital mode of transport and much more exposed to accidents. To an industry like this, safety plays the most pivotal role. Though safety aboard has significantly increased in the last decade as claimed by various maritime organizations but the statistics show scary figures. For one reason or the other merchant ships have continued to be involved in accidents. The accidents have not only resulted in financial losses but have also taken lives of officers and crew aboard. Moreover, the accidents at sea also damages seabed, sea depth, sea surface, flora and fauna, cause marine traffic and ultimately harm the marine ecosystem.

Its adverse impact can also be seen on the weather and livelihood of the people.

The paper deals with the idea to counter the major number of accidents of cargo ships by two proposed systems, **'ECDS AND EBP System'** for improved deceleration of the ships to avoid collisions at sea.

2. STATISTICS

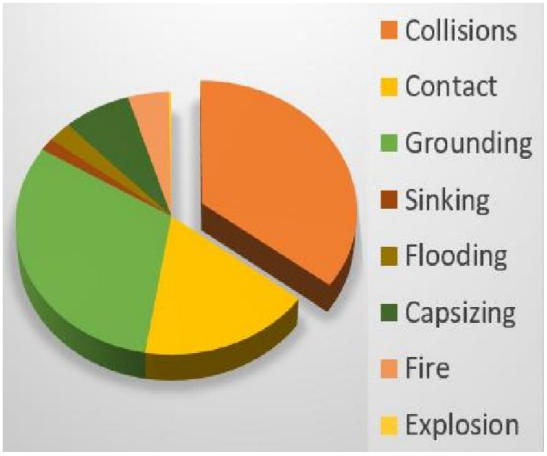
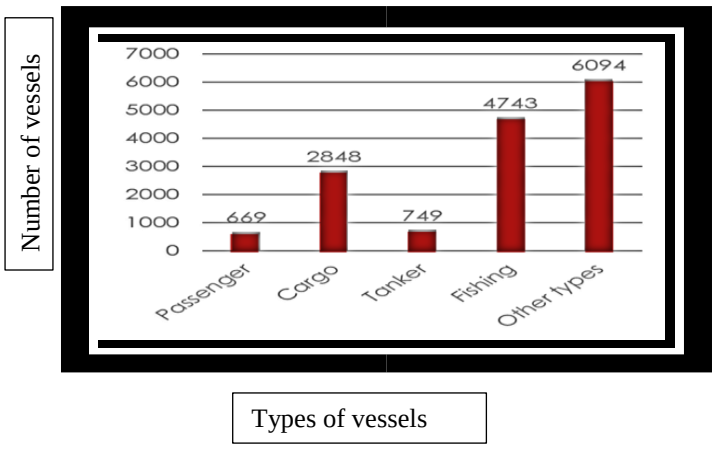


Figure 1. Reasons of marine accidents

Though many preventive measures are taken and many are worked upon, we get big numbers of accidents annually. When we go through the analysis of accidents, reasons such as the poor maintenance, lack of proper training, equipment failure, natural calamities and primarily collisions can be found. It was reported that approximately 21325 ships involved in accidents leading to 25000 deaths and 8000 injuries in the period (2007-2020).



Looking back at the analysis, we find that collisions contribute to 36% of the mishaps while contact doing 17% of the damage. Summing them up, we get a huge figure of 53%. So, if we focus on avoiding collisions and contact, we would prevent more than half of maritime disasters. While going through data, we find that 20-25% of vessels involved in maritime accidents are cargo Out of 15,103 ships involved in accidents during (20072020) 2848 were cargo vessels as shown by the Graph.

3. PROBLEM FINDING:

- On an average, the length of cargo ship is 200-300 meters and the average speed is 20-30 knots and the average time to bring such a ship to rest is about 25-30 minutes.
- This period is more than enough for ships to collide with other ships, periphery of ports and icebergs. Here, the major problem occurs.

3.1 PROBLEM SOLVING:

- To cater to the problem as stated above, all we need to do is focus on reducing the collisions & contact type accidents on cargo containers ships by reducing the time to stop or decelerate a vessel.
- Our idea revolves around this very point.

4. PRINCIPLE INVOLVED IN DECELERATION/ BRAKING OF SHIPS:

The reason behind the collisions that is major part of accidents at sea is the slow deceleration of ship. When we look into the functioning of a ship, the ships are brought to rest with the help of propellers and varying function of engine. There are specifically two types of propellers

4.1 Fixed pitch propellers: In this case firstly the RPM is lowered, then it is brought to no thrust position and ultimately the propeller is rotated in reverse direction to acquire reversal or resistive thrust.

4.2 Controllable pitch propellers: In this case the propeller is brought to no thrust position by bringing the blades at parallel orientation and here the reversal thrust is acquired by reversing the angle of the blades.

The main concept behind the deceleration of ship is countering the forward thrust by the resistance of the ship. When a ship moves in water, there is a viscous drag generated between the submerged hull surface and water particles in contact with the hull.

The drag is generated due to the viscosity of water and is directly proportional to the wetted surface area of the ship and varies to the square of velocity of ship. **Viscous Drag ∝ (p)(S)(v^2)**

Where, p= density of water, S= wetted surface area, v= velocity of ship.

Therefore, the primary aim of stopping any moving object, is to increase the drag force experienced by the body. This can be done primarily in two ways:

- Increasing the wetted surface area of ship.
- Decrease the magnitude or change the direction of thrust on ship.
- Our idea focuses on executing both the ways. As a solution to the emergency deceleration problems, we give you the

- ECDS (Emergency Cargo Drop Stop) and
- EBP (Emergency Braking Propellers).

4.3 ECDS (Emergency Cargo Drop Stop): This system suggests some part of cargoes on ship (10-15%) to be kept in specially designed boxes that would be ferromagnetic in nature or coated with ferromagnetic substances with the ability to be water repellent. These boxes would be kept on a sliding platform in the hold hanged with ropes operated on free fall or hydraulic power system. The boxes would be designed such as that when hanged, these boxes would open into two halves making 45degree angle between them (Figure 2& Figure3), this would increase the exposed area and when allowed to touch the sea-bed (when length is approachable) could act as POOL type anchor.

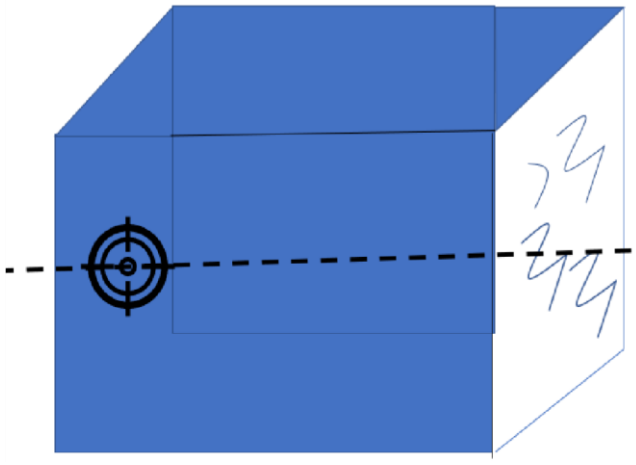


Figure2: This illustrates the way the ECDS containers would be hinged.

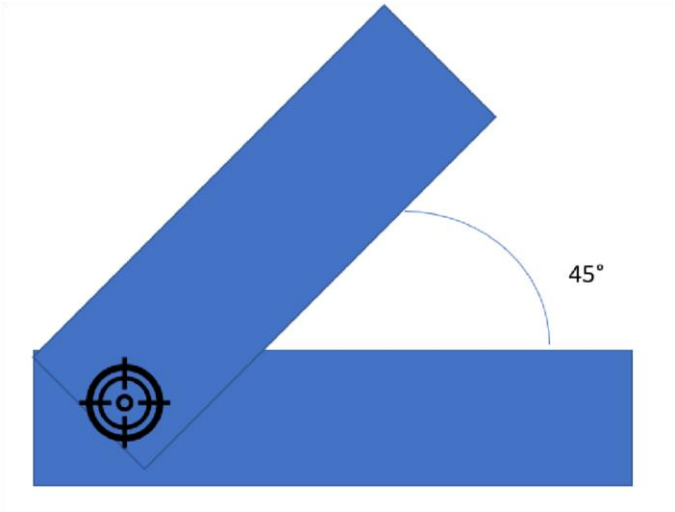


Figure 3. This is the 2 D view of how the ECDS containers would open up into two parts. Black circle symbolizes the hinge point in both figures 2 & 3

This system also suggests the incorporation of the thick electromagnetic strips running across the hull below the water line. The strip will activate when the ECDS containers are dropped off through strings or any rope in the sea water, precisely it will activate as soon as the ECDS system starts acting. When situation suggest a condition of extreme emergency and urgency to decelerate the ship, the boxes with the platform would slide outwards the hull depicting fin like structures and the platforms would fall and stick to the hull and the boxes will be dropped. As soon as the boxes are made to drop into the water, the electromagnets running across the hull will be activated and the boxes would be made to stick to the electromagnetic strips. The boxes would enhance the amount of the area exposed to the water exponentially adding up the drag force, ultimately increasing the resistive force.

When the ship's speed is lowered as per the need, the electromagnets will be deactivated and the cargoes will be heaved up thereafter.

The specially designed ECDS boxes can also be dropped under free fall to the sea bed when the sea bed is at an approachable distance and thus can act as anchors.

This ECDS system would come into function with the help of gear box (installation of this should be near the tail shaft of propeller as per our idea) Which will be designed in such a way that the translational motion of the platform with ECDS containers starts as soon as the propeller's RPM is set for lowering (in the case of fixed pitch) or when the blades start orienting themselves in parallel direction (in case of controllablepitch).

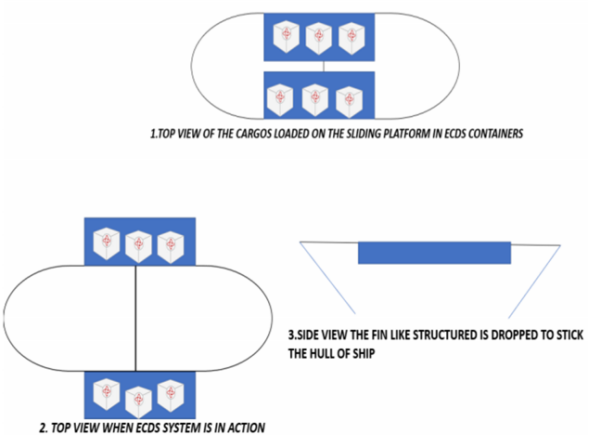


Figure 4. This shows the mechanism of the sliding platform that would be used to keep and dispose ECDS containers in the sea as per our design. White boxes depict ECDS containers and blue structures is the sliding platform

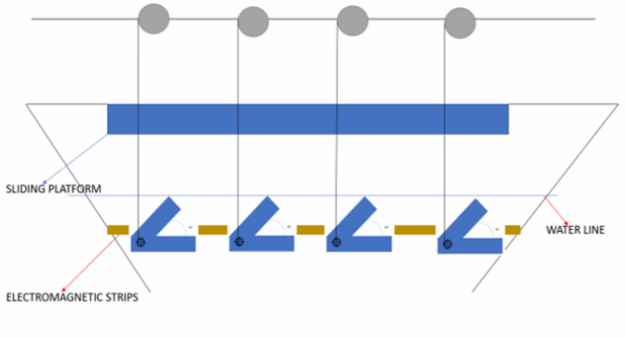


Figure 5: This is shown how operated ECDS system would look like. Brown strip symbolizes the electromagnetic strip while the grey structures could be either some pulley operated system, any mechanical load lifting or lowering device or some hydraulic crane type machinery.

4.4EBP (Emergency Braking Propellers):

The second part of our solution suggest installation of addons propeller (Figure 5) to the already existing propellers but these propellers will be placed in the front region of ships. These will completely fit into ship's side walls maintaining the streamline shape of ships and will only come out when EBP mechanism is initiated. They will then drop into sea to the level of stern propeller (figure 6) and will start to operate in a direction so as to oppose the motion of ships. This will increase the resistance offered to the ships motion. The sterns propeller rpm will be then reduced and direction reversed so that it reaches no thrust position. The speed of stern propeller will be then increased in opposite direction so that it matches the speed of EBP

and both the propellers end up having the same RPM thus maintaining the stability of ship. After the successful deceleration, these EBP can be retracted back to their original position.

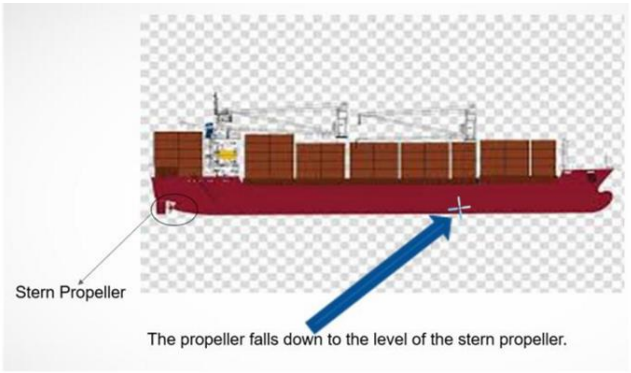


Figure 6: This figure shows the mechanism of Emergency breaking propellers System

A ship's hull design will be altered so as to provide space for a compartment which can accommodate a propeller on each side along with the hydraulics and which will open up when EBP is initiated.

The EBP is a safe, quick and a reusable method of emergency braking.

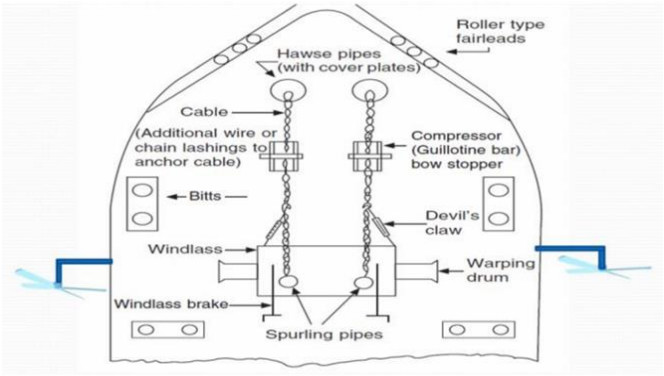


Figure 7: This shows the suggested installation of add on propellers. Blue structures depicts those add on propellers.

5. ADVANDAGES

- Avoid collisions by fast deceleration.
- These ideas if implemented can prove to be crucial in life threatening situations.
- Reduced number of collisions implying greater profit for the owners.
- Effective even in extreme weather conditions.
- Quick and effective braking system with low initiation time.
- Option of using one braking method at a time or combining them according to the situations demand.

6. SCOPE FOR FURTHER WORK

We are further deliberating upon the use of the EBP (Emergency Braking Propellers) as add on propellers for steering ships in regions involving sharp turns. This will increase the overall maneuverability of the ship. We are also concentrating on the financial part of the entire project. Efforts are being put into making these designs as economical as possible. The mechanism for the simultaneous use of ECDS and EBP, which offers a benefit of further reduction of breaking time which can prove to be of immense importance when faced with crucial situations of life and death is also a point of discussion.

7. CONCLUSION

This paper clearly shows the ill impacts that an accident has on our industry and also holds slow rate of braking as the major cause of accidents at sea. The above discussed designs are means to counter the slow deceleration rate of ships. These can prove to be very promising in dangerous situations of collision and could be helpful in developing an effective and more efficient crash maneuvering system. Though the installation of such system might currently be a bit heavy on the purse, the primary concern and motive of this project is development of a safer environment and finding solutions to a situation which is life threatening. Major Economies and global maritime leaders should come forward to work on this project as the project has a scope for further developments.

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