

Protective Subsystem For Marine Diesel Engines Against Crankcase Explosion-Induced Fires Through Control Of Engine

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INTRODUCTION

The danger of explosion of crankcase vapours is always present due to the favourable conditions for this. They are high temperature of the vapours and the presence of a sufficient amount of oxygen. So far, with the cooled units and aggregates, it leads to the formation of the so-called oil mist/oil mist/. Contact of this mist with hot parts can cause an explosion and the hot spot will cause areas below the ignition point of the vapours. To date, several cases of latent explosions with fatal consequences have been recorded.

STATUS OF THE PROBLEM

There is a high risk of ignition of oil mist around the exhaust system due to heated surfaces – Fig. 1. It is also necessary increased control of the insulation of the main pipelines and the isobaric collector. The moment of operation of the safety valve is very important, with a long delay and slow engine shutdown, the probability of ignition of the released vapours in the surrounding area of the engine increases significantly. This requires the manufacturers of the safety valves to have their own certification. Despite the improved characteristics of the safety valves and systems, their inclusion in the overall control system is increasingly necessary. Based on the emergency situations that led to fatal damage and malfunctions, we propose a subsystem to the main diagnostic and control system that would also monitor the risk indicators in the engine crankcase and preventively terminate the working process until the causes leading to the explosion are eliminated.

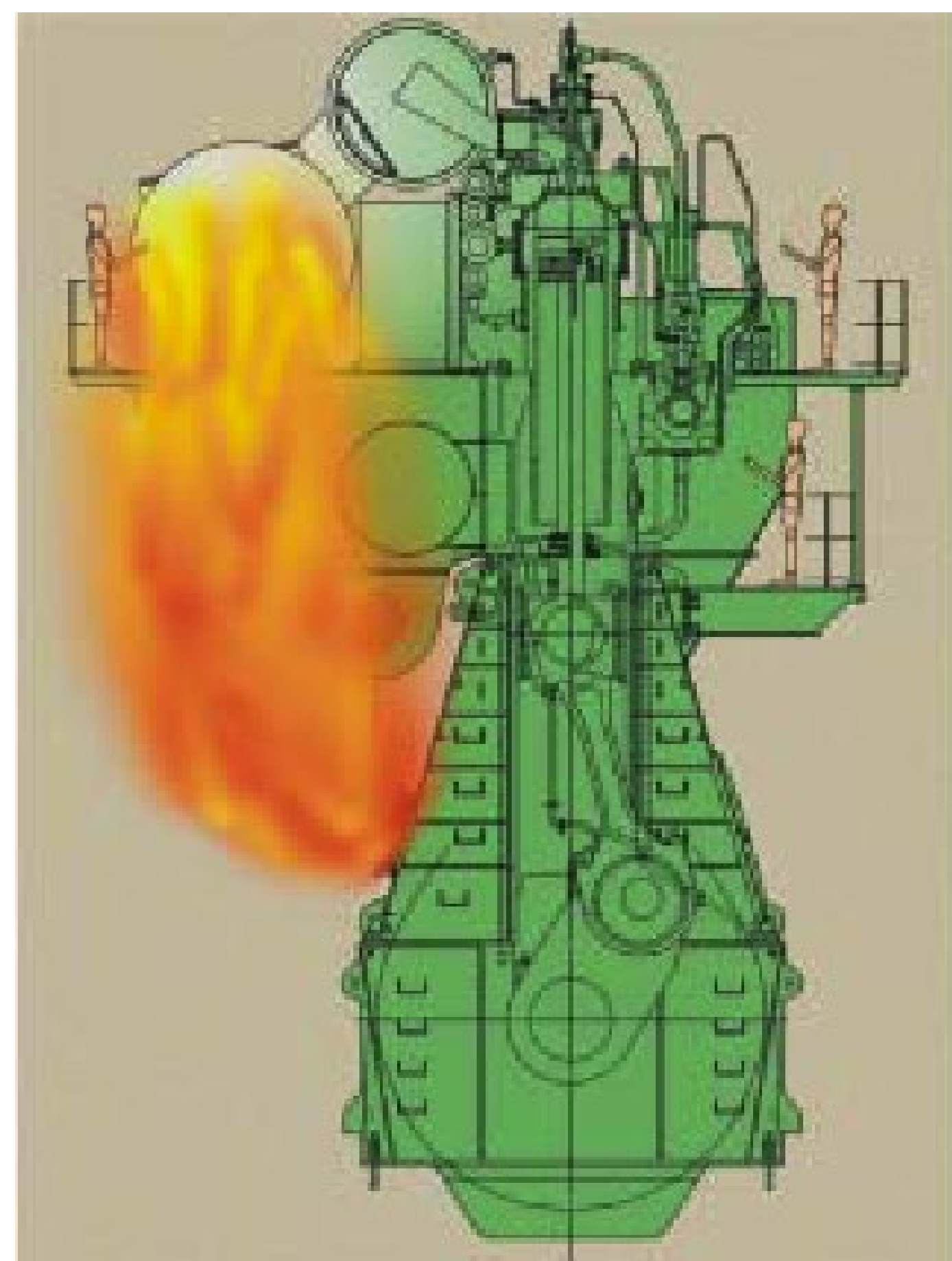


Fig. 1. Oil mist blast

SUBSYSTEM FOR PROTECTING MARINE DIESEL ENGINES FROM FIRE IN THE EVENT OF AN EXPLOSION IN THE CRANKCASE THROUGH PROCESS CONTROL

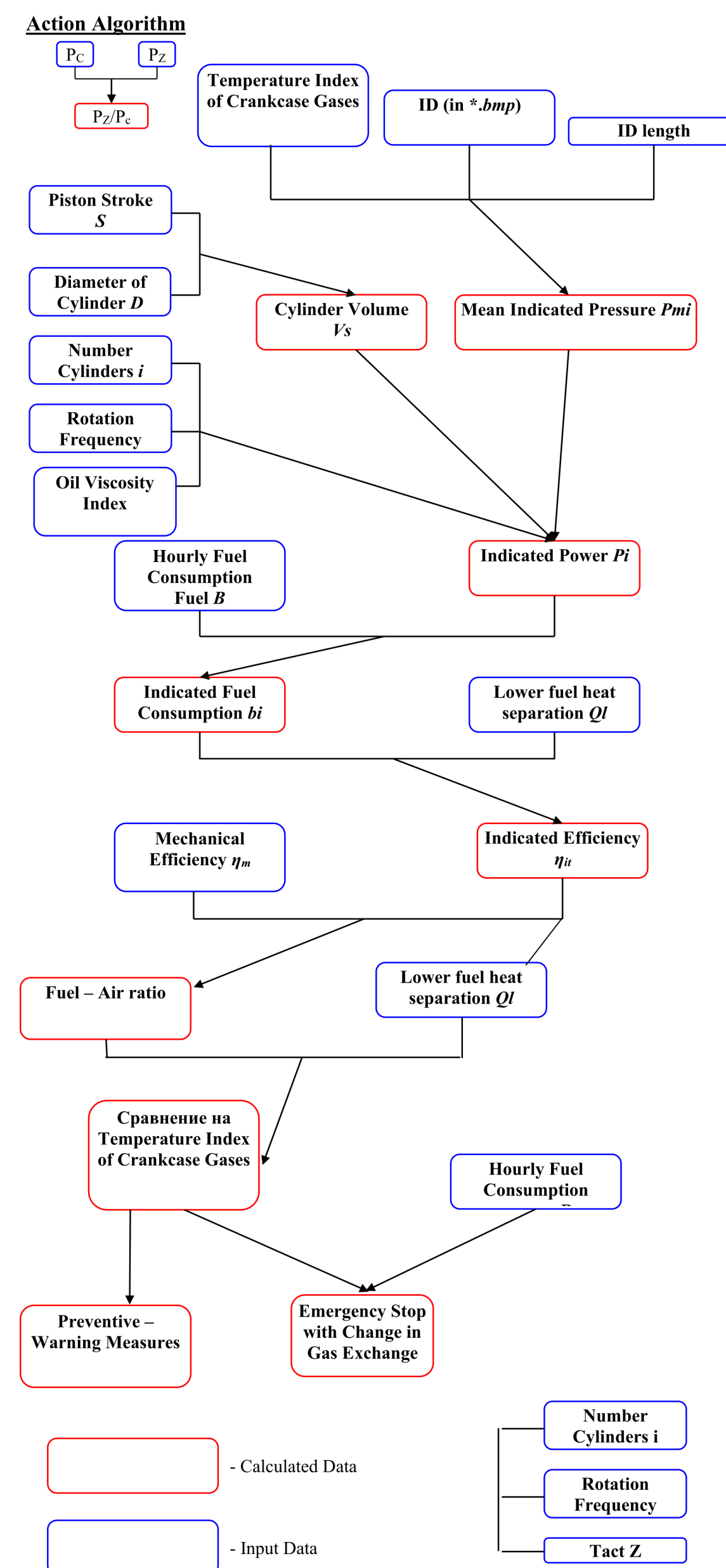


Fig. 2. Action algorithm

CONCLUSIONS

The subsystem of a typical complex system for diagnostics and control, considered and described in the paper, does not require special capital investments in terms of hardware and control and measuring instruments. The result is a method for fighting fires in the engine room, protecting ship diesel engines from major accidents and protecting human life at sea during operation in risky conditions. Additional protections have also been introduced for optimization of the work process, automation of systems directly connected to the lubricating oil system and alleviation of the work done by the subjective factor.

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The subsystem has the main goal to ensure reliable stopping of the main engine and to protect the power system from an accident. The system monitors the indicators in the cylinder and crankcase of the engine. In case of deviations from the set values, two types of measures are taken, preventive and immediate. The basic algorithm is specified in Fig. 2. Fluid enters the crankcase with mass flow rates G_1' , G_2' , G_3' kg/s and temperatures T_1' , T_2' , T_3' K and fluid exits through pipeline systems with mass flow rates G_1'' , G_2'' , G_3'' , G'' kg/s and temperatures $T_1''=T_2''=T_3''=T''=T$ K as shown in Fig. 3. The temperature of the fluid contained in the crankcase is determined provided that the specific heat capacities of all fluids involved are given by the formula:

$$T' = \frac{V \cdot T + \left(\sum_{i=1}^n G_i' \cdot T_i' - \sum_{j=1}^m G_j'' \cdot T_j'' \right) \Delta t}{V + \left(\sum_{i=1}^n G_i' - \sum_{j=1}^m G_j'' \right) \Delta t}$$

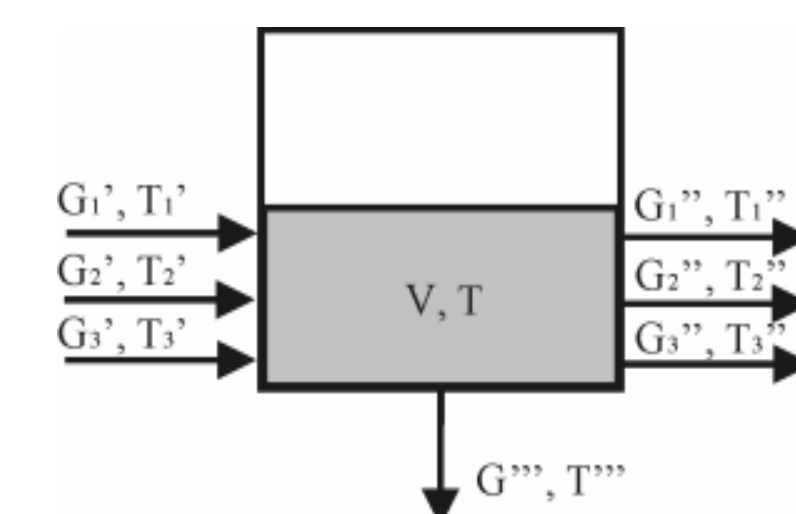


Fig. 3. Action algorithm