FIELD

This invention relates to fire-fighting equipment; fire-fighting ships; and unmanned and remote-controlled surface vessels or robots.

REFERENCES CITED

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BACKGROUND OF THE INVENTION

1. Fire-fighting boats/ships are built to put out ship fires at sea or in harbour and may even be deployed to fight fires in buildings located along the seafront where access by land fire engines is limited. These vessels normally have deep draught that commensurate with its size and capability of the fire-fighting systems and operations under high sea state conditions. There are also small manned fire-fighting boats for use in rivers, lakes and other body of waters that are calm and relatively shallow. However, in all cases, these vessels need sufficient water under the keel to navigate safely and operate, and also for the fire pumps to suck in water and work properly. Typically, any water depth below 2 m will be a problem for even the smallest fire-fighting boat. In shallow depths, sea debris and bottom mud can easily get sucked and block the intakes thus rendering both the ship operations as well as fire-fighting systems useless.

2. There are situations where a boat is on fire after running aground on a reef and finds itself quickly on a dried out terrain especially in a gentle gradient seabed with a fast receding tide. When that happens, even small fire boats cannot get close enough for effective fire-fighting because of the lack of water under the boat. Some fire-fighting vessels carry a small dinghy to deal with shallow water situations. However, these boats also eventually run into shallow water difficulties as they use an outboard motor for propulsion. The firemen may then have to disembark from the dinghy and tread carefully on unknown terrain dragging the fire hose along over the remaining shallow waters with its unpredictable dangers. In some cases, the main fire-fighting vessel and the vessel that is on fire may be separated by several hundred metres making it nearly impossible for the fire-fighting vessel to do anything.

3. The present invention relates to the development of a remote-controlled unmanned fire-fighting vessel (herein called robot) that is attached via the fire hose to a motherfire-fighting vessel or any vessel that is normally manned and allows fire-fighting to take place on a ship on fire regardless of the depth of water and even in a dried reef. This robot uses the high pressure water from the fire boat's fire pumps to provide the thrust needed for the robot to get to the boat on fire. The robot is carried onboard the mother fire-fighting vesseland in the case of a purpose built fire-fighting vessel, is merely an extension of the fire-fighting vessel's capabilities by allowing high pressure water generated by that vessel's high pressure fire pumps to be used by the robot at a distance away. The robot is controlled via wireless communications focusing on the direction of travel of the robot as it gets to the boat on fire. The robot's electro mechanical system is then controlled wirelessly to direct the

water to the fire monitor for fire-fighting.. Images from the Cameras on the robot provide the fire fighters with a clear view of the situation.

BRIEF DESCRIPTION OF THE INVENTION

4. The present invention relates to the creation of a remote-controlled marine fire-fighting robot that is attached to a mother vessel or the main fire boat via a fire-fighting hose. High pressure water from the main fire pump is used to provide the thrust force needed to propel the robot forward using the principle of a water jet. The water is directed backwards via two outlet ports at the stern of the robot thus creating a water jet By changing the pressure setting on the fireboat's fire pump, the robot's speed forward can be changed in the same way as how waterjet works. Since the water providing the thrust is always coming from the fireboat, shallow water is never a concern. As the robot moves further away from the mother fire-fighting vessel, the robot drags the fire hose with it and a higher pressure is set at the fireboat fire pump to provide a larger thrust to deal with the increasing drag caused by the weight of the fire hose as well as the frictional losses due to the longer hose

5. When the robot has moved onto dried out terrain, the robot's wheels will first make contact with the shallow seabed and then the ground. These wheels are always turned by an internal paddle wheel as a result of the water from the fire hose. When the robot is already on land, all the water in the hose is now directed to the paddle wheel.. The force of the water on the paddle wheel causes it to turn which then turns the outside wheels of the robot to drive it over land/reef. The rate at which the robot now moves on land is dependent on the amount of force exerted on the paddle wheel.

6. When the robot arrives at the position needed for it to fight the fire, the valve and nozzle assembly is remotely changed to enable the water from the hose to be directed through the fire monitor nozzle onto the boat on fire. The operator on the mother vessel than controls the robot position and the fire monitor accordingly.

7. To alter the direction of the robot when it is traveling over water, the valve and nozzle assembly is adjusted such that a higher water flows occurs through one side of the jet and a reduced water flow occurs in the other outlet. The resulting differential pressure causes the robot to turn towards the side of lower water pressure. The adjustments in the valve and nozzle assembly will be done by software. The operator of the robot only needs to create a marker on the robot control screen that shows where the boat on fire is in order for the robot to self drive itself to the final point.

8. When the robot is moving over dry terrain/reef and moving on wheels, the alteration in heading of the robot will be by controlling the amount of water hitting the paddle wheel. To turn right, a strong force of water acts on the left side paddle wheel to move the left wheel more than on the right side. The control of the water is via the remote-control valve and nozzle unit. The robot may be turned to go in the opposite direction by making a turn so that it can move back away from the boat on fire.

9. The fire-fighting marine robot has a power pack in the form of a battery onboard to provide the power needed for the remote-control valve and nozzle assembly to work. This power pack can be recharged by the water turning another internal paddle wheel in order to run a small alternator that will provide the charging current to the power pack.

10. To keep the entire fire-fighting robot small and easy to handle, the base unit weight will comprise the fire monitor nozzle, the remote-control valve and nozzle assembly and the power pack. The weight of this will be less than 25 kg which enables the robot vehicle to be easily man handled onboard the fire boat and moved around the deck. To enable the robot to work with the water supplied from the fire hose, the weight of the robot is increased by adding augmented weight blocks to it just before launch. The weights will be secured into weight mounting racks on the robot frame. The all up weight of the robot will be about 100 kg.

11. The invention is adept to being used in correspondence with other compatible fire hose connectors so that there is commonality of parts and easy integration between the robot and its employment from the fire boat.

12. When the use of the robot for fire-fighting is completed, the water in the hose is shut off at the fire boat to allow the robot to be manually recovered by simply pulling on the fire hose to get the robot back to the fireboat. It is also possible to turn the robot using the pressurized hose so that the final position of the robot is to get back to the mother ship.

13. For recovery of the robot onboard the mother ship, the augmented weights are first removed from the robot before the rest of the robot is pulled onboard via the recovery line.

BRIEF DESCRIPTION OF THE DRAWINGS

14. An example of the invention will now be described with reference to the accompanying drawings.

Fig 1 shows the overall scheme of how the unmanned fire-fighting vessel works when it is connected to the mother fire-fighting vessel via a water hose.

Fig 2 is a stand alone illustration of the unmanned fire-fighting vessel depicted in Fig 1 and shows the front perspective view of the remote-controlled marine robot unit. The robot hull is specially designed to be highly stable even when pushed from behind by a water jet while dragging along a water hose filled with water and resting on the seabed. The robot hull is designed especially for shallow water operations while keeping the platform in a straight line as much as possible without the need to control the differential thrust at the outlets.

Fig 3 is the rear perspective view of the robot seen in Fig 2. The fire hose from the fire-fighting vessel is coupled to the robot at the rear via standard fire-fighting quick twist and lock hose connectors.

Fig 4 shows another section of Fig 2 and shows the removable weights added to the robot in order to give it stability and balance as the robot moves through the water pushed by the

force of water thrust from its rear end. Fig 4 also shows the electric junction box inside the robot.

Fig 5 is side perspective view of the robot seen in Fig 2. In that view the Rotary Valve is remotely controlled to turn until the water from the fire hose is connected directly to the fire monitor

Fig 6 shows the specially designed Rotary Valve that enables the water to be channeled either to the rear of the robot as water thrust or to propel the wheel or to the fire monitor.

Fig 7 is a working view of the rotary valve inside the hull of the robot.

Fig 8 further exemplifies the working principle of the rotary vane depicted in Fig 5 and Fig 6.

Fig 9 is an exploded view of the paddle wheel connection to the external view of the robot depicted in Fig 2. It shows that the paddle wheel is comprised of vanes like a turbine such that when water hits a vane it creates a force that causes the paddle wheel to rotate. The water vane is in turn connected to an external wheel located on the side of the robot hull. When the paddle wheel turns, the external wheel also turns thus enabling the robot to move on the ground using the wheels as the sole means of movement. The water that passes through the nozzle is controlled in intensity using a special valve controller. In this way, the amount of water falling on either side of the vanes is different and the difference results in one of the wheels moving faster than the other and therefore causing a turning movement and a change in the heading of the robot.

Fig 10 is a further illustration of Fig 8 inside the robot body depicted earlier in Fig 2. It further shows the water vane interaction and water flow that enables the wheel to move pushing the robot.

Fig 11 shows the robot body when the rear telescopic brakes are lowered

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

15. An exemplary embodiment of a preferred form of the invention will now be described with reference to Fig 1 to 11.

16. As shown in Fig 1, the robot is connected to the high pressure water pump onboard the mother vessel via a regular fire-fighting hose 65. Fig 1 also illustrates that the mother vessel is not necessarily a dedicated fire-fighting vessel but can also be any vessel as long as a high pressure fire pump is present. It is expected that the high pressure pump shall provide sufficient pressure and water flow for the unmanned fire-fighting vessel to work as described below.

17. The robot comprises a hull body 50 that is designed for good flotation to provide good hydrodynamic stability in water. The hull form is also designed to help the vessel keep to a straight path as it is pushed through the water towards the vessel on fire. The hull is designed like a catamaran to reduce drag in the water.

18. There are two buoyant wheels 40 on either side of the hull 50 that also provides extra buoyancy and stability to prevent the robot from tilting. These wheels 40 will also provide the

robot mobility when the water depth is too shallow and the robot wheels touch sea bottom or sea bed and can no longer move using just the reverse thrust from the hose 65.

19. A remote-controlled fire monitor 10 sits on top of the robot hull 50 in Fig 2 and is further connected inside the hull 50 to a rotary valve 90 described in Fig 5 and Fig 6. This enables water from the incoming hose Fig 65 to be provided to the fire monitor 10.

20. Electrical wiring connects the fire monitor to the electrical junction box 68 inside the robot hull 50 as seen in Fig 4. The electrical junction box contains hardware controls for controlling the fire monitor 10, the rotary valve 90, camera and floodlight 20 and signal antenna 30 as shown in Fig 2.

21. LED floodlight 20 is installed on the robot hull 50 to provide the floodlighting of the boat on fire. A day/night pan tilt camera 25 is also installed to provide the imagery that is sent to the mother vessel for on scene management. A wireless radio 30 enables the communications of between the robot and the mother vessel. LED headlights 60 mounted at the front of hull 50 provides lighting forward of the robot so that the operator on the mother vessel can see what is ahead of the robot should there be an obstacle.

22. Fig 3 shows the fire hose 65 attached at the rear of the robot hull 50. This fire hose 65 is further connected to the mother vessel as shown in Fig 1. The fire hoses are normal fire-fighting hoses and can be extended by using hose couplings.

23. Fig 4 describes the location where augmented weights are to be manually placed into the hull 50 before launching off the mother vessel. The weights are appropriately secured to the hull body by a locking mechanism so it can be firmly held when handled. The augmented weights serve to increase the overall weight of the robot unit for it to work successfully when pushed through the water by the water thrust generated via the fire hose. The weights are divided into different smaller pieces for ease of handling.

24. Fig 5 shows side view of the robot and specifically how a remote-controlled rotary valve 90 is now set to allow the water flow to be channeled from water hose inlet 80 to the fire monitor 10. A servo controlled gearing system 85 located in front of the rotary valve 90 causes it to turn to align different ports shown in Fig 6 and depicted by 105, 16, 88 and 75.

25. Fig 6 shows the rotary valve 90 in more detail. The valve is like a cylindrical shaped object with a spindle through its centre and it is turned by the servo gear 85 that is electronically triggered by the electrical junction box 68. The valve has two openings on the inlet facing the water hose connector 80 in Fig 5. These openings are sized to be of the same diameter as the fire hose to ensure smooth water flow. When water from the fire hose 65 enters the opening 88 via the piping 80, it comes out of the opening 105 and is directed to the fire monitor 10 to allow fire-fighting to take place. At any time, only one of these openings are connected to the fire hose like a bullet chamber in a revolver gun.

26. In Fig 6b, the rotary valve is now turned by an angle to connect opening 75 to the piping 80 and in turn to the fire hose 65. Water is then channeled to come out of two outlets as shown in Fig 6 b and Fig 6 c and flows out from the hull 50 from outlet 70 and 71 as shown in the exploded picture in Fig 7 of the hull 50. The water coming out of outlet 70 and 71 in Fig 3 is what produces the thrust to propel the robot forward. Fig 8 shows the side view of the robot and how the water is channeled to the outlets 70 and 71. By adjusting the angle of rotation of

the rotary valve 90 further it is possible to control the amount of water flowing out of outlet 70 and 71 thereby creating differential thrust. The differential thrust causes the robot's heading direction to change left or right as it moves forward.

27. When the water depth becomes shallow, the robot's hull 50 will get closer to the seabed. Before that happens, the wheels 40 that are on either side of the hull 50 and will first touch the seabed. The wheels 40 are connected by a spindle to a paddle wheel 45 Fig 9. Water flowing through the rotary valve openings 70 and 71 also flow through a narrow outlet 74 and 76 as shown in Fig 10. The narrow outlets 74 and 76 causes water to speed up and impact the paddle wheel 45 on either side of the robot to cause rotation. The internal paddle wheel rotation then causes the external wheels 40 to rotate. When the wheels 40 touches the seabed and gains traction, the wheels 40 are what continues to propel the robot forward. When this happens, the operator on the mother vessel can increase the volume of water going to the outlets 74 and 76 and reduce the flow going to the outlets 70 and 71. In this way, the wheels have more driving force to move forward on land.

28. Further controls of the water exiting the outlets 74 and 76 enables one external wheel 40 to move faster on one side than the other so as to generate differential movement and alter the heading of the robot on land.

29. When the robot arrives on scene where the vessel on fire is located, the rotary valve 90 is rotated to enable water flow to be directed to the fire monitor 10 for fire-fighting. Depending on the reactionary forces generated by water exiting the fire monitor, it may be necessary to counter this force so that the robot is not pushed backwards. Two telescopic arms are released from under the hull 50 as shown in Fig 11 to act as brakes preventing the robot from sliding backwards. If there is a need to alter the heading of the robot, the wheels 40 can be rotated by redirecting water to the water paddle 45 accordingly.

30. A power pack inside the robot comprising mainly a battery, provides the power needed to control the junction box 68 to control all the functions mentioned above. The power pack also provides power for the radio connection to enable the robot to be controlled.