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UNDERWATER PROPULSION SYSTEM

Filed March 20, 1962

2 Sheets-Sheet 1

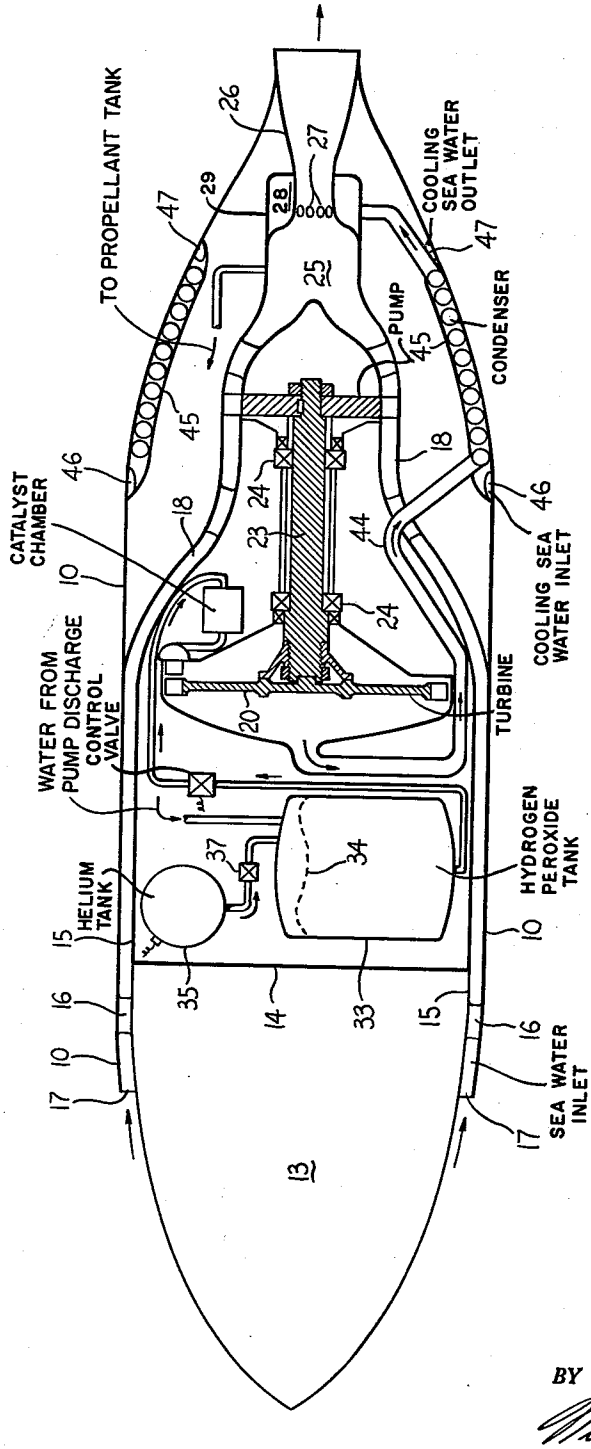


Fig. 1

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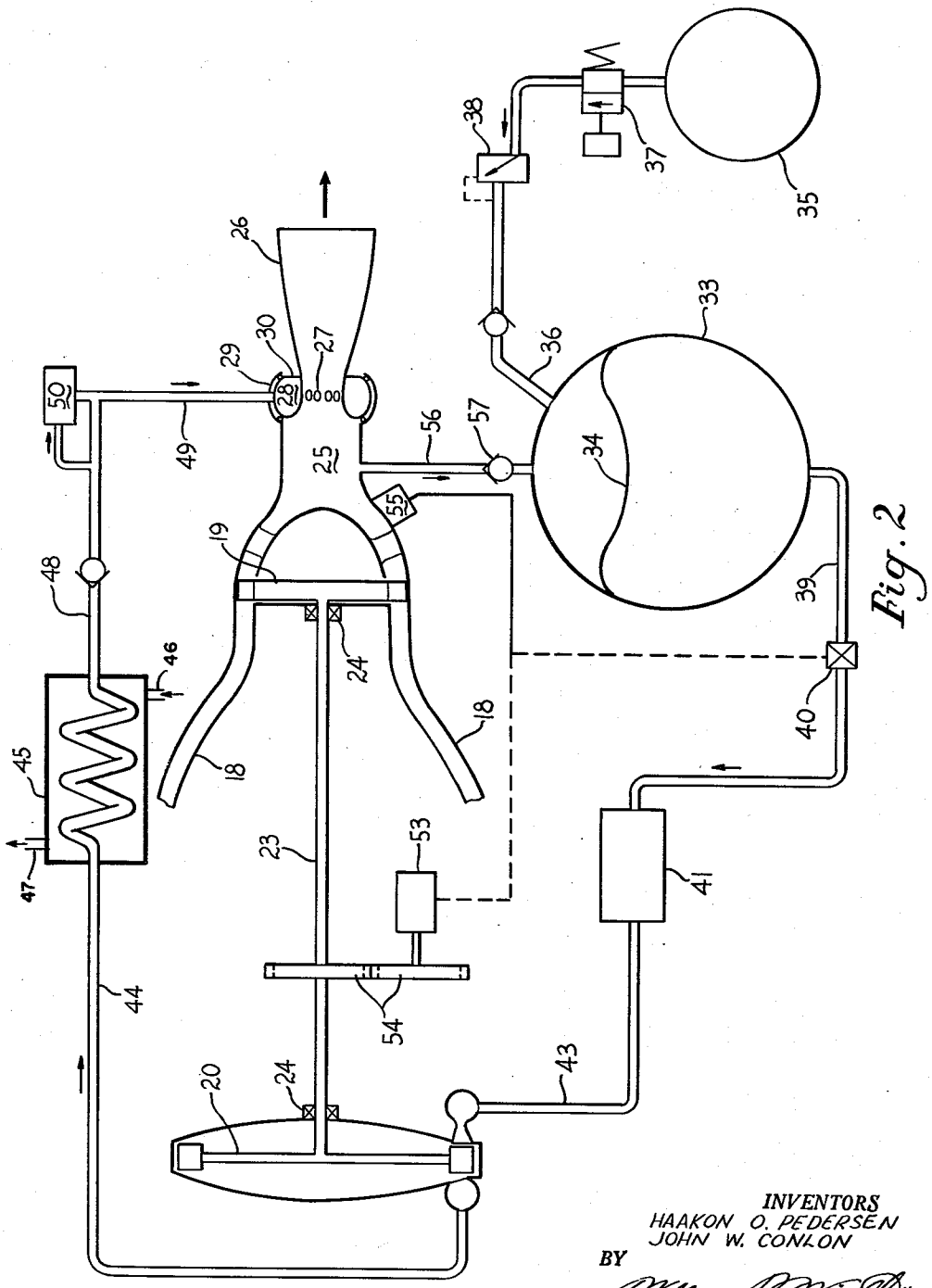


Fig. 2

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UNDERWATER PROPULSION SYSTEM

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This invention relates generally to a propulsion system for vehicles and more particularly to a hydrojet propulsion system which will enable vehicles to travel underwater at high speeds and descend to great depths.

Various types of systems have been devised for propelling vehicles such as submarines, torpedos, etc. underwater including that of pulling the sea water into a duct in the vehicle and forcing it out at the stern through a thrust nozzle. Also, while various means have been employed to force the water through the vehicle, all of these have the disadvantage of being handicapped in operation as to quality of overall performance because of back pressure which increases with depth. This is particularly true in a turbine drive system because the amount of the energy that can be extracted from the drive gas is directly limited by the back pressure.

Accordingly, the main object of the present invention is to provide an improved underwater propulsion system which eliminates the above and other disadvantages of known systems.

An important object of the present invention is to provide an improved underwater propulsion system employing a hydrojet for propulsion and steering which leaves a minimum wake to betray the passage of the vehicle.

Another important object of the present invention is to provide an improved self contained, underwater hydrojet propulsion system having a pressurized fuel system to drive a pump-driving turbine wherein after starting the pressurizing fluid is tapped from the pump discharge.

A further important object of the present invention is to provide an improved system of the type described which includes means to prevent starting of the turbine unless water is present in the pump to permit air launching of the vehicle.

A still further important object of the present invention is to provide an improved system of the type described wherein the products of combustion upon leaving the turbine are condensed and then discharged into a low pressure area to overcome the back pressure problem.

Other objects and advantages of the invention will become apparent during the course of the following description.

In the drawings we have shown one embodiment of the invention. In this showing:

FIGURE 1 is a central longitudinal sectional view of one form of underwater vehicle embodying the invention; and

FIGURE 2 is a schematic view of the propulsion system.

Referring to the drawings, numeral **10** designates a vehicle body which, as shown in FIGURE 1 for illustrative purposes only, is that of a torpedo or underwater missile having a warhead **13** mounted in the forward end thereof against a bulkhead **14** closing an inner vehicle body **15**, by augularly spaced streamlined struts **16**. The space between the forward end of the inner and outer bodies **15** and **10** defines an annular water inlet **17** merging into conduits **18** through which the water is pulled by the blades of a pump **19**.

The pump **19** and a turbine **20** by which it is driven are fixed to a shaft **23** rotatably mounted in bearings **24** and the conduits **18** deliver the water from the pump blades into the inlet portion **25** of a cavitating venturi

nozzle **26** whose peripherally spaced apertures **27** afford communication with an enclosing low pressure chamber **28**. As shown in FIGURE 2, this chamber may comprise two spherical portions **29** and **30** with adequate seals to enable universal pivoting of the aft section **30** which is integral with the hydrojet water exhaust or thrust nozzle **26** by control members (not shown) to effect steering of the vehicle.

While the system comprising the present invention may be operated with other types of monopropellants, hydrogen peroxide is preferred as a fuel because the steam in the exhaust of the turbine **20** may be condensed. As shown, a tank **33** of H_2O_2 including a flexible membrane **34** is mounted in the vehicle body **10** and pressurized by helium, etc. contained in a high pressure gas container **35** by means of a conduit **36** which is provided with a pressurizing valve **37** and a regulator **38**.

The H_2O_2 propellant is connected by a conduit **39** having a control valve **40** to a catalyst chamber **41** where the hydrogen peroxide decomposes into steam and oxygen at 1390° F. The products of decomposition pass by way of conduit **43** to the blades of the turbine **20** to rotate it and drive the pump **19** thus pulling sea water into the vehicle body through the inlet **17** and the conduits **18** and exhaust it to the chamber **25** and out through the hydrojet nozzle **26** to provide propulsion thrust to the vehicle.

Upon leaving the turbine, the products of decomposition pass by way of conduit **44** through a condenser **45** in which sea water is used as a coolant just as the water pumped through the inlet **17** cools the vehicle body. As seen in FIGURE 1, the conduit **44** includes a number of coils in the cooling chamber **45** arranged in the aft portion of the vehicle, the condenser chamber being provided with sea water inlet ports **46** and outlet ports **47**. It will be apparent that the decomposition products leaving the condenser by conduit **48** (water and free oxygen) have been significantly reduced in volume. This reduction in volume facilitates the disposal of the exhaust products by the conduit **49** through the chamber **28** and the throat section of the venturi **26** which is at low pressure.

In order to eliminate the wake of the vehicle, it is desirable to provide means shown diagrammatically at **50** in FIGURE 2, to absorb or combine with the free oxygen leaving the condenser **45**. This may comprise a compound having such characteristics or a burner and a source of hydrogen to burn with the oxygen, the resulting water being exhausted through the conduit **49**.

It will be noted that a conduit **56** having a one-way valve **59** connects the water exhaust chamber **25** with the fuel tank **33** so that once the turbine is started, water is used to pressurize the hydrogen peroxide by acting on the membrane **34**. This enables the use of the pressurizing gas such as helium for starting purposes only, reduces the amount which must be carried, and thus more fuel can be carried to increase the range of the vehicle.

In order that a predetermined speed may be maintained by the vehicle, a governor **53** is connected to the turbine shaft **23** by gears **54** and is suitably connected to the control valve **40** in the conduit **39** leading from hydrogen peroxide supply tank **33**. A safety control **55** for the fuel valve **40** is mounted on the exhaust chamber **25** and is provided with contacts closable by sea water. This ensures that the turbine will not start unless water is present in the pump **19** and enables the air launching of the vehicle.

The operation of the underwater propulsion system is believed to be apparent. The propellant tank **33** is pressurized upon the opening of the pressurizing fluid valve **37** to force the fuel to the catalyst chamber **41** as soon

as the valve **40** is opened by the presence of water in the pump exhaust chamber **25**. The decomposed gases then pass to and drive the turbine **20** to drive the pump **19** which forces the sea water at great velocity through the vehicle and out the jet nozzle **26** to furnish high speed propulsion.

It is to be noted that the described system enables the condensed exhaust gases from the turbine to be discharged to a low pressure area—the chamber **25** surrounding the throat of the nozzle **26**—and pass through the apertures **27** and out of the nozzle. Obviously, additional cavitating venturi can be used if required to provide additional capacity for lowering the turbine back pressure during initial start and as required at great depth.

It is to be understood that the form of our invention herewith shown and described is to be taken as a preferred example of the same and that various changes in the shape, size and arrangement of parts may be resorted to without departure from the spirit of the invention or the scope of the subjoined claims.

What is claimed is:

1. A propulsion system for propelling vehicles underwater comprising water inlet conduits leading to a hydrojet venturi exhaust nozzle, a turbine, a pump driven thereby for forcing water through said conduits and said nozzle to produce propulsive thrust, means for generating and delivering high pressure gases to said turbine to drive said pump, and means for reducing the back pressure on the exhaust gases from said turbine at any water depth.

2. The system as recited in claim 1 wherein a condenser is provided to condense the exhaust gases before exhausting through said nozzle.

3. The system recited in claim 2 wherein said condenser is provided with inlet and outlet ports arranged to force coolant water through said condenser upon movement of the vehicle.

4. The system as recited in claim 1 wherein means are connected to said gas generating means to prevent operation of the latter until water is present in said pump.

5. The system as recited in claim 1 wherein said turbine includes governor means connected with an operative means to control said gas generating means.

6. The system as recited in claim 1 wherein said gen-

erating means comprises a source of hydrogen peroxide fuel, a catalyst chamber for effecting the decomposition of the hydrogen peroxide into steam and free oxygen, conduits connecting said source, said chamber, said turbine, and said nozzle, and means for pressurizing said source to force said hydrogen peroxide to said catalyst chamber.

7. The system as recited in claim 6 wherein said pressurizing means comprises a source of gas under pressure.

8. The system as recited in claim 6 wherein said pressurizing means comprises a conduit connecting said source of hydrogen peroxide to the exhaust of said pump to expose said hydrogen peroxide to pump pressure.

9. The system as recited in claim 6 wherein said conduit between said fuel source and said chamber includes a control valve, and a control member connected with said valve, and mounted in said pump and operative upon the presence of water in said pump to open said valve and permit flow of fuel through said conduit.

10. The system as recited in claim 6 wherein means are provided for removing free oxygen as such from the exhaust gases before passing through said venturi nozzle.

11. The system as recited in claim 1 wherein said pressure reducing means comprises a plurality of apertures formed peripherally about the throat of said venturi nozzle, a chamber encloses the apertured portion thereof, and a conduit connected to said chamber for discharging exhaust gases therein.

12. The system as recited in claim 1 wherein said exhaust nozzle is swivelly connected to the exhaust of said pump to effect steering of the vehicle.

13. The combination with the system as recited in claim 1, of a marine vehicle body enclosing and supporting the elements of said system for high speed, streamlined underwater movement.

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