Dec. 17, 1946. H. J. DE N. McCOLLUM 2,412,825

JET PROPULSION APPARATUS

Filed July 30, 1943

Fig. 1.

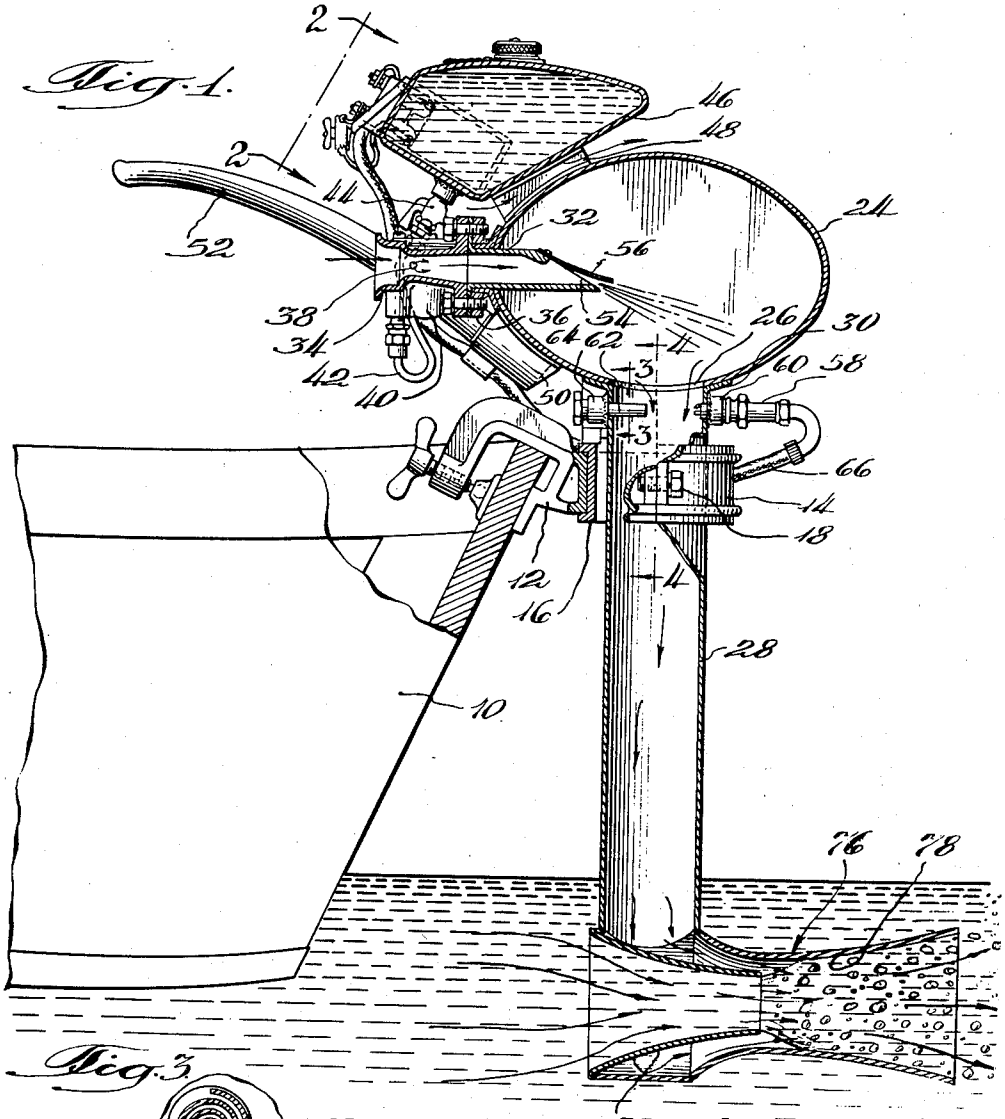


Fig. 3.

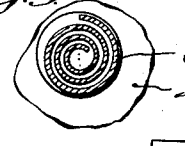


Fig. 2.

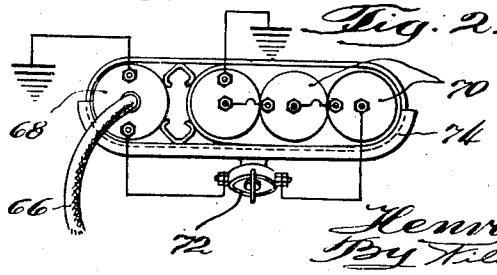
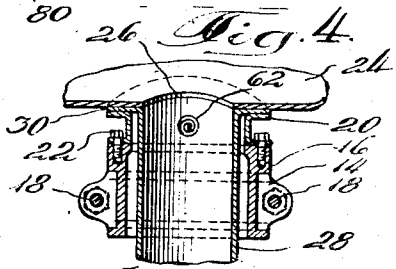


Fig. 4.



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Patented Dec. 17, 1946

2,412,825

UNITED STATES PATENT OFFICE

2,412,825

JET PROPULSION APPARATUS

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Application July 30, 1943, Serial No. 496,814

1 Claim. (Cl. 60—35.6)

1

My invention relates generally to jet propulsion apparatus, and more particularly to an improved from of apparatus of this character, usable for the propulsion of marine vessels, for example, as an outboard motor.

It is an object of my invention to provide an improved jet propulsion apparatus particularly usable for propulsion of marine vessels, such as small boats.

A further object is to provide a jet propulsion apparatus for boats, which has a minimum number of moving parts, is simple in construction and operation, and which may be economically manufactured.

Other objects will appear from the following description, reference being had to the accompanying drawing, in which:

Fig. 1 is a central vertical sectional view of the apparatus;

Fig. 2 is a plan view showing the electrical parts of the apparatus, including a wiring diagram, and taken on the line 2—2 of Fig. 1; and

Figs. 3 and 4 are fragmentary sectional views taken on the lines 3—3 and 4—4 of Fig. 1.

In general, the apparatus of the invention operates in a pulsating manner to draw a charge of a combustible mixture of fuel and air into a combustion chamber, ignite the charge, permit the products of combustion to discharge through a jet propulsion nozzle, and thereby through reaction, propelling the boat or other marine vessel forwardly. A simplified form of the apparatus is shown in the drawings, as attached to a small boat 10, in the manner of an outboard motor, by means of a screw clamp 12. The clamp 12 may be formed integrally with a bearing ring 14, within which there is supported a flanged ring 16, the latter being rotatable within the bearing ring 14 for steering purposes. The bearing ring 14 is preferably made in halves, secured to each other by bolts 18, while the ring 16 has a flanged mounting plate 20 secured thereto by cap screws 22. A combustion chamber 24, which is preferably in the form of an elliptical cylinder or a spheroid, has an outlet opening 26 communicating with a vertical conduit 28, the latter having a flange 30 welded to the combustion chamber 24 and also welded, or otherwise suitably secured, to the mounting plate 20. As shown by Figs. 1 and 4, the volume of conduit 28 is less than the volume of combustion chamber 24.

The combustion chamber 24 has an opening to receive an induction tube 32 which, together with a Venturi tube 34, is secured to a mounting ring

2

36 which may be welded or otherwise suitably joined to the combustion chamber 24. The Venturi tube 34 has its inlet end open to the atmosphere, and is provided with a plurality of ports 38 through which liquid fuel, such as gasoline, is sprayed, the liquid fuel being supplied from a float bowl 40 which is connected by a conduit 42 and a stop cock 44 with a fuel tank 46, the latter being secured to the combustion chamber 24 by suitable mounting brackets 48 which space the tank sufficiently from the combustion chamber to permit cooling air to flow around the fuel tank and thus prevent it from being excessively heated by the combustion chamber. The combustion chamber 24 has a handle socket 50 welded or otherwise secured thereto, adapted to receive a tiller arm 52.

The end of the induction tube 32 is preferably beveled to provide a seat 54 for a reed valve 56. This valve is very resilient and flexible, so as to operate rapidly and under a small pressure differential.

A spark plug 58 is secured in a socket 60 and has its points projecting into the vertical pipe 28. A reigniter 62 is secured in a socket 64 which may be welded to the pipe 28, this reigniter being shown in enlarged section in Fig. 3, and preferably comprising a spirally coiled thin sheet of heat and corrosion resisting metal such as "Inconel." The details of a reigniter of this type are more fully disclosed in my copending application, Serial No. 410,039, filed September 8, 1941 now Patent No. 2,396,868 of March 19, 1946.

The spark plug 58 is connected by a suitably insulated conductor 66 with the high tension winding of a spark coil 68, the primary winding of the spark coil 68 being connected in series with a plurality of dry cells 70, and a switch 72. The spark coil and batteries are preferably mounted in a suitable case 74, which may be suitably secured to, and supported by, the fuel tank 46.

At the bottom of the vertical pipe 28, and normally below the water level, there is located a nozzle 76 providing a generally Venturi shaped passageway 78 and a water induction tube 80, which has the shape of the mouth portion of a Venturi passageway, and which terminates substantially at the throat of the Venturi passageway 78.

In operation, the ignition switch 72 is turned on, whereupon the spark lug 60 will commence continuous sparking. The boat 10 is then given an initial push in the forward direction, or is propelled initially by means of oars, whereupon water entering the induction tube 90 will, due to

the ejector action of the Venturi tube 78, create a partial vacuum in the vertical pipe 28 and in the combustion chamber 24, thus drawing into the combustion chamber a combustible mixture of fuel and air past the valve 56. As soon as this mixture has filled the combustion chamber 24 and commences passing downwardly through the vertical pipe 28, it will be ignited by the spark plug 58 and explode, with rapid expansion of the gases, causing violent ejection of the products of combustion downwardly through the pipe 28 and outwardly through the Venturi tube 78. Since the latter tube will be substantially filled with water, the expanding products of combustion will act as a piston against this water, thus effecting a very efficient coupling between the gases and the water, and producing a powerful reaction, propelling the boat forwardly. When the explosion takes place, the valve 56 closes and remains closed until the products of combustion are substantially exhausted therefrom, whereupon water flowing through the Venturi tube 78 will again create a partial vacuum within the combustion chamber and be effective to draw the products of combustion therefrom and to draw in a fresh charge of the combustible mixture, to cause a repetition of the cycle of operation described.

After a short time, the reigniter 62 will become heated sufficiently to ignite the combustible mixture so that the electrical ignition system may be turned off by means of the switch 72 to conserve the charge in the dry cell 70.

It will be noted that the apparatus is self-timing with respect to ignition, since during the initial warmup period the spark plug 58 emits sparks continuously and during normal running operation the reigniter plug 62 is maintained above the temperature necessary to ignite the mixture. Thus, as soon as the combustion chamber becomes filled with a fresh charge of the mixture of fuel and air, and this charge begins downwardly through the vertical pipe 28, ignition will take place. As a result, while there is no actual separation of the products of combustion from the charge of combustible mixture, ignition takes place only when the combustion chamber contains a sufficiently rich and combustible mixture of fuel and air to cause explosive combustion. Because of the relatively large volume of the vertical pipe 28, pressures developed within the combustion chamber do not become excessive and the combustion chamber need, therefore, not be of very heavy construction.

In steering the boat, the propulsion nozzle 76 acts partly as a rudder, but its steering effect is primarily due to the fact that the direction of the propulsive force is changed so that the steering of the boat may be very easily accomplished.

The operation of the apparatus is stopped merely by shutting off the supply of fuel by means of the stop cock 44. The apparatus can also be stopped by placing the hand over the air inlet opening of the Venturi jet tube 34, and its speed of operation may be controlled to some extent by partially obstructing this air inlet opening. The apparatus will also automatically cease operation if the motion of the boat is stopped, as by running it on a beach. The apparatus is thus operable with a minimum of attention on the part of the user.

While the invention is shown herein as embodied in an outboard motor, it will be clear that the principles thereof may be embodied in various other types of jet propulsion devices, as, for example, pumping mechanism for large volume delivery against a low head.

While I have shown and described a particular embodiment of my invention, it will be apparent to those skilled in the art that numerous modifications and variations may be made without departing from the underlying principles of the invention. I therefore desire, by the following claim, to include within the scope of my invention all such variations and modifications by which substantially the results of the invention may be obtained by the use of substantially the same or equivalent means.

I claim:

In a jet propulsion apparatus for marine vessels, the combination of means forming a combustion chamber of relatively large volume, check valve means for admitting the combustible mixture of fuel and air into said combustion chamber, means for igniting the combustible mixture in said chamber after said chamber is substantially filled therewith, a discharge tube projecting downwardly from said chamber into the water surrounding the vessel, the volume of said tube being substantially less than that of said combustion chamber, an ejector connected to the lower end of said tube, said ejector comprising a Venturi tube having a hollow conical water inlet portion set therein for conducting water to substantially the throat portion of said Venturi tube, whereby flow of water through said ejector upon relative movement of the ejector in a body of water will be effective to draw the products of combustion from said combustion chamber and draw a combustible mixture charge into said combustion chamber.

HENRY J. DE N. McCOLLUM.