L. Y. SPEAR.

PROPELLING APPARATUS FOR VESSELS.

APPLICATION FILED MAR. 30, 1915.

1,200,997.

Patented Oct. 10, 1916.

3 SHEETS—SHEET 1.

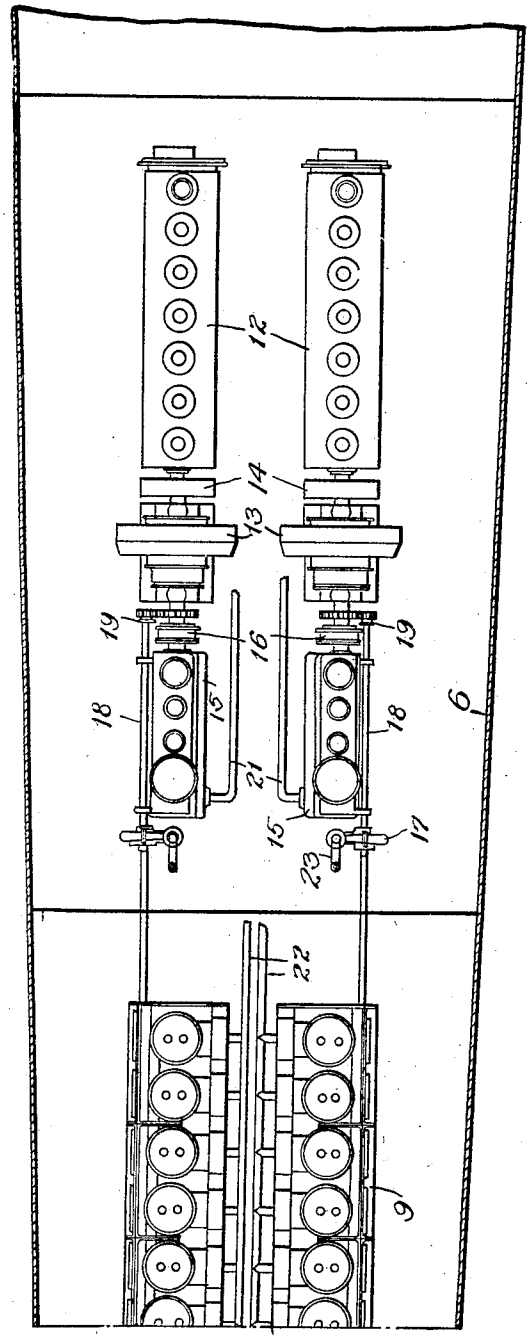

Fig. 1.

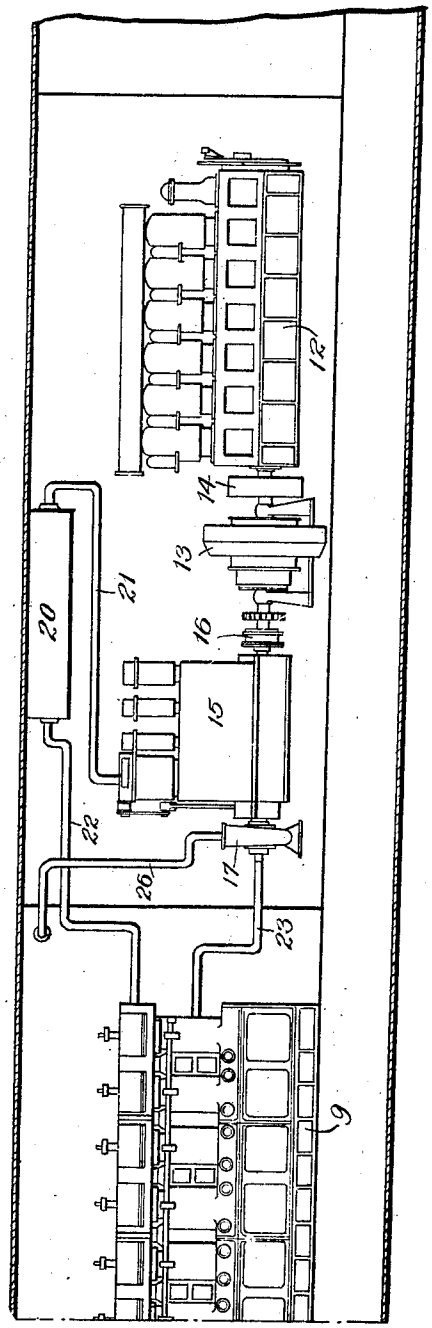

Fig. 2.

WITNESSES

K. Schulz

E. Katlan

INVENTOR

L. Y. Spear.

BY

Pennie Davis Marvin & Edmonds.

ATTORNEYS

L. Y. SPEAR.

PROPELLING APPARATUS FOR VESSELS.

APPLICATION FILED MAR. 30, 1915.

1,200,997.

Patented Oct. 10, 1916.

3 SHEETS—SHEET 2.

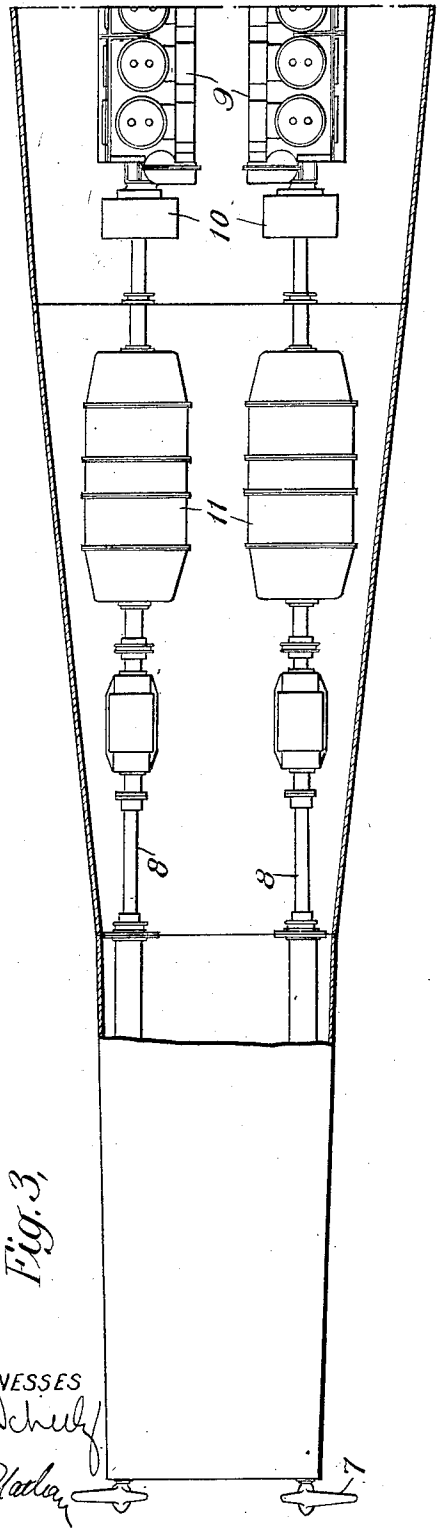

Fig. 3.

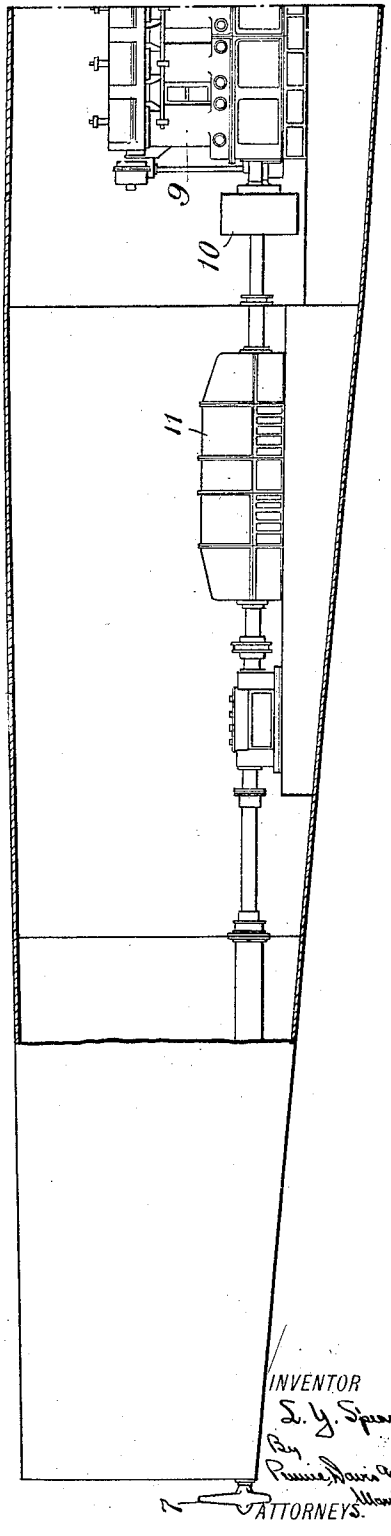

Fig. 4.

WITNESSES

K. Schultz

E. Nathan

INVENTOR

L. Y. Spear,

By Pierce, Howard & Hovey

ATTORNEYS.

L. Y. SPEAR.

PROPELLING APPARATUS FOR VESSELS.

APPLICATION FILED MAR. 30, 1915.

1,200,997.

Patented Oct. 10, 1916.

3 SHEETS—SHEET 3.

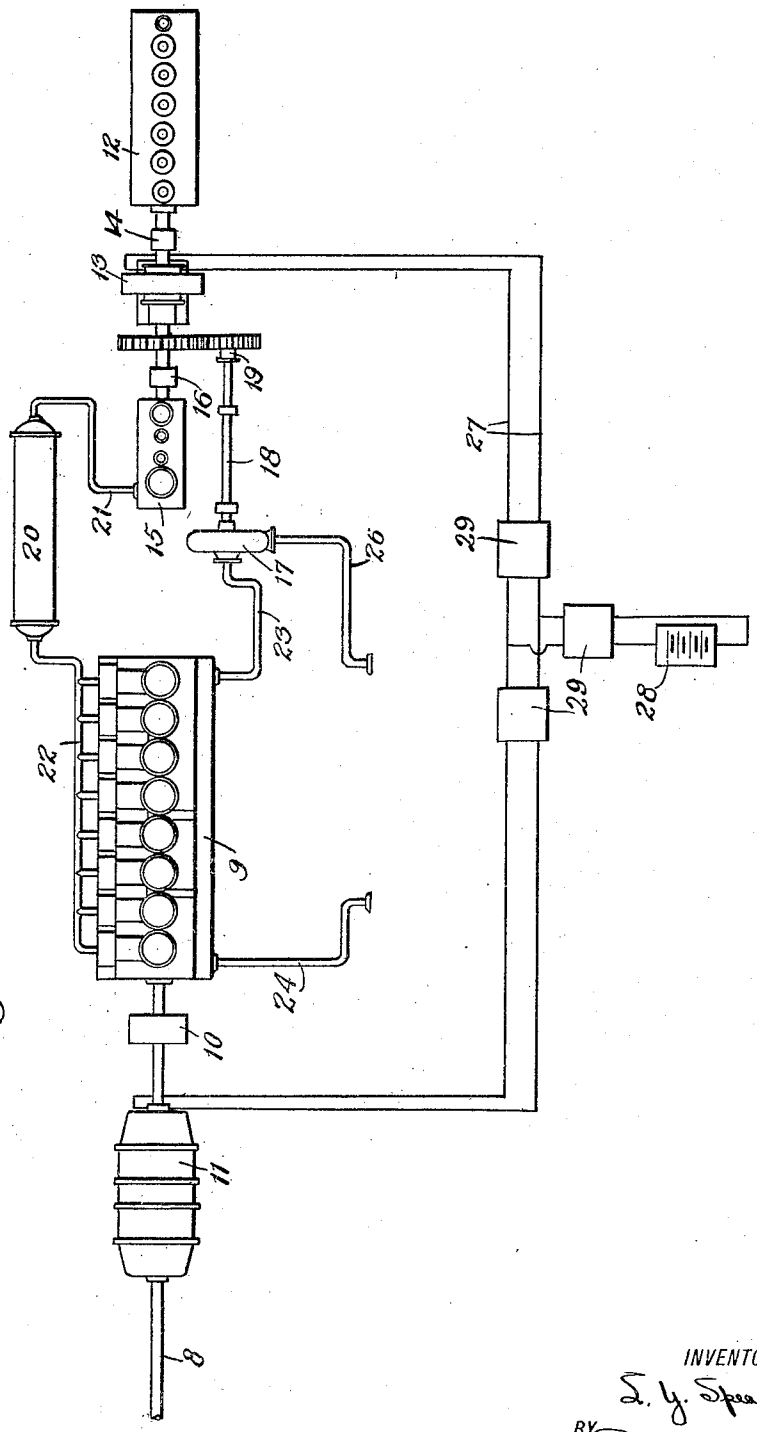

Fig. 5.

WITNESSES

L. Schulz

E. Nathan

INVENTOR

L. Y. Spear,

BY Pennie Davis Marvin & Marvin

ATTORNEYS

UNITED STATES PATENT OFFICE.

LAWRENCE YORK SPEAR, OF GROTON, CONNECTICUT, ASSIGNOR TO ELECTRIC BOAT COMPANY, OF NEW YORK, N. Y., A CORPORATION OF NEW JERSEY.

PROPELLING APPARATUS FOR VESSELS.

1,200,997. Specification of Letters Patent. Patented Oct. 10, 1916.

Application filed March 30, 1915. Serial No. 17,972.

To all whom it may concern:

Be it known that I, LAWRENCE Y. SPEAR, a citizen of the United States, residing at Groton, in the county of New London and State of Connecticut, have invented certain new and useful Improvements in Propelling Apparatus for Vessels; and I do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same.

This invention is directed to the provision of an improved form of apparatus for use in the propulsion of vessels. While the invention may be employed in the propulsion of vessels of various descriptions, it is of special utility in the propulsion of submarine boats wherein the maximum cruising radius obtainable with a given supply of fuel is a consideration of great importance.

As is well known, engines for the propulsion of vessels operate at their best economy only when running at a particular speed and developing a given amount of power. By reducing the speed of the propelling engine and hence the rate of movement of the vessel, the resistance offered to movement of the vessel is generally reduced to a greater degree than is the speed of the engine; therefore, if the engine operated with its maximum efficiency at the reduced speed, such reduction in the speed of the engine would result in increasing the cruising radius obtainable with a given supply of fuel. The fact is, however, that the efficiency of the engine falls off very considerably when its speed is reduced and as a result, the cruising radius with a given supply of fuel cannot be materially increased in this way.

This invention involves the provision of a plurality of engines of different sizes for propelling the vessel, and means whereby these engines may be utilized in the propulsion of the vessel under such conditions as will result in operating the engines at high efficiency so that the cruising radius of the vessel obtainable with a given supply of fuel will be increased.

In accordance with the invention, the propeller shaft is adapted to be driven by an engine or by an electric motor supplied with current from a storage battery, as is usual in the propulsion apparatus of submarine boats. In addition to these parts, a second engine, preferably of a smaller size, is provided and also a second dynamo-electric machine, this machine being arranged to be connected to the second engine so as to be driven thereby as a generator and also to be connected to the motor on the propeller shaft so as to supply current thereto. Thus, the propeller shaft may be driven mechanically by the main engine or electrically by the motor supplied with current from the storage battery or electrically by the motor supplied with current from the generator driven by the second engine. Furthermore, the auxiliary mechanism usually employed in connection with the main engine, such for instance, as the air compressor and the water pump used with an internal combustion engine of the Diesel type, is so arranged as to permit of connecting them to the second engine or disconnecting them therefrom as desired, whether the second engine be utilized for actuating the generator or not. With such apparatus, the vessel may be propelled at high speed by the main engine with the latter operating at that speed at which it develops its highest economy. Compressed air and cooling water are supplied to the main engine by the compressor and pump, these being driven by the second engine, which is also arranged to operate at the speed at which it is most efficient. For propelling the vessel at a slightly reduced speed, the load of the auxiliary apparatus for the main engine, that is the air compressor and pump, is transferred from the second engine to the main engine to permit of discontinuing the operation of the second engine. This may be done by employing the motor on the propeller shaft as a generator driven by the main engine and supplying current to the dynamo-electric machine which is normally driven as a generator by the second engine. This machine is disconnected from the second engine and is operated as a motor connected in driving relation to the air compressor and pump. For propelling the vessel at a further reduced speed, the main engine is disconnected from the propeller shaft and its operation discontinued; the second engine is then started in operation and connected electrically in driving relation to the propeller shaft by employing it

as a generator supplying current to the motor on the propeller shaft.

A construction embodying the invention is illustrated in the accompanying drawings, in which—

Figures 1 and 2 are horizontal and vertical sections of a portion of a submarine boat; Figs. 3 and 4 are views similar to Figs. 1 and 2, respectively, and forming extensions thereof; and Fig. 5 is a diagrammatic view showing the connections between the several elements of the apparatus.

Referring to these drawings, the hull of a submarine boat is indicated diagrammatically at 6. Twin propellers 7 are provided for the propulsion of the boat, these being mounted at the stern on the projecting ends of the propeller shafts 8, which rotate in suitable bearings mounted upon the frame of the boat. In the drawings, duplicate propelling apparatus is shown, each involving a main engine and a motor connected to the propeller shaft, a second engine, a generator driven thereby, and auxiliary apparatus for the main engine, and as the two are alike in all respects a description of one will suffice.

The main engine is indicated at 9, this being an internal combustion engine of the type employing liquid oil as the fuel and operating upon the Diesel cycle. The shaft of this engine is mounted in alinement with the propeller shaft 8 and is adapted to be connected to the propeller shaft and disconnected therefrom at will by a clutch 10. The propeller shaft also carries the armature of a motor 11, which may be employed for propelling the vessel, current being supplied to it from storage batteries in the usual way or from a generator as hereinafter described.

Cooling water is supplied to the jackets of the engine 9 by a pump and compressed air is supplied to the inlet valves of the engine by an air compressor. These two auxiliary devices are arranged to be driven by a second engine, which engine is moreover so arranged that it may be utilized for propelling the vessel at low speed. The second engine is shown at 12. For utilizing this engine in propelling the vessel, the connection to the propeller shaft is made electrically by employing the engine 12 in driving a dynamo-electric machine 13 as a generator and conducting the current from the generator to the motor 11 to operate the latter. The shaft of the generator 13 is arranged in alinement with the shaft of the engine 12 and the two may be connected and disconnected at will by a clutch 14. The air compressor above referred to is shown at 15. This air compressor is preferably mounted with its shaft in alinement with the shaft of the engine 12 and with the generator 13 between it and the engine 12 and a clutch 16 is provided whereby the shaft of the air compressor may be connected to and disconnected from the shafts of the generator 13 and engine 12 at will. The water pump 17 is arranged adjacent to the air compressor 15 and driven by a back-geared shaft 18 from the shaft of the air compressor. The shaft 18 is connected to its driving gear by a clutch 19 so that the operation of the water pump may be controlled as desired.

A reservoir 20 for compressed air is connected to the outlet from the compressor 15 by a pipe 21 and to the inlet valves of the several cylinders of the main engine 9 by a pipe 22 so as to supply air to the inlet valves for forcing the liquid fuel into the cylinders. The water pump 17 is connected by a pipe 23 to the cooling jackets of the cylinders and the outlet for the cooling system is connected by a pipe 24 leading to the sea and the latter is connected by a pipe 26 to the pump 17. Also, wires 27 connect the generator 13 to the motor 11, and connect the circuit of these parts to the storage battery 28, suitable switching and protecting devices 29 being inserted in these connections as is indicated in Fig. 5.

With the parts thus constructed, the vessel may be propelled at high speed by means of the main engines 9 operating those engines at their most economical speed and connecting the engines to the propeller shafts 8 by means of the clutches 10. During such operation, compressed air and cooling water would be supplied to the main engines by the auxiliary devices 15 and 17, these being driven by the small engines 12. For this purpose, the clutches 14, 16 and 19 would be connected to permit the small engines to drive the auxiliaries. The circuit 27 would be open so that though the armatures of the dynamo-electric machines 13 and 11 would be rotated, they would not impose loads upon the driving engines.

If it were desired to proceed at lower speed or to discontinue the operation of the smaller engines for purposes of inspection, repair, etc., the load of the auxiliary devices would be transferred from the smaller engines 12 to the larger engines 9. This would be done by disconnecting the smaller engines 12 at the clutches 14 and closing the circuits of the machines 11 and 13 so that the machines 11 would be driven as generators by the engines 9 and would supply current to the machines 13 so as to operate the latter as motors which would drive the auxiliaries through the clutches 16 and 19.

For propelling the vessel at low speed, the main engines 9 may be discontinued and the auxiliary engines 12 utilized for propelling the vessel with the engines 12 operating at the speed at which high efficiency is attained. For proceeding in this manner, the main engines 9 are disconnected from the propeller shafts by the clutches 10 and the auxiliaries are disconnected from the smaller engines 12

by the clutches 16 and 19. The smaller engines are then operated to drive the machines 13 as generators supplying current through the wires 27 to the motors 11 on the propeller shafts. It is thus apparent that whether the vessel be propelled at high speed by the main engines 9 or at low speed by the smaller engines 12, the propelling engines will be run at the speeds at which they operate with the greatest efficiency and as a result the maximum cruising distance will be obtained with a given supply of fuel.

What I claim is:

1. In a vessel, propelling apparatus comprising the combination of a propeller shaft, a main engine, means for connecting the engine to and disconnecting it from the shaft, a dynamo-electric machine adapted to drive the shaft, a second engine, a dynamo-electric machine adapted to be connected to the second engine, apparatus adapted to be driven by the last named dynamo-electric machine when the latter is operating as a motor, and electric connections between the two machines for operating either as a generator and the other as a motor; substantially as described.

2. In a vessel, propelling apparatus comprising the combination of a propeller shaft, a main engine, means for connecting the engine to and disconnecting it from the shaft, a dynamo-electric machine adapted to drive the shaft, a second engine, a dynamo-electric machine adapted to be connected to the second engine, electric connections between the two machines for operating either as a generator and the other as a motor, and auxiliary apparatus for the main engine adapted to be connected to the dynamo-electric machine which is driven by the second engine; substantially as described.

3. In a vessel, propelling apparatus comprising the combination of a propeller shaft, a main engine, means for connecting the engine to and disconnecting it from the shaft, an electric motor adapted to drive the shaft, a second electric motor, means for connecting the same electrically to the first motor when the latter is operated as a generator by said shaft, and auxiliary apparatus for the engine driven by said second motor; substantially as described.

4. In a vessel, propelling apparatus comprising the combination of a propeller shaft, a main engine, means for connecting the engine to and disconnecting it from the shaft, a second engine, auxiliary apparatus for the main engine, means for connecting the second engine to the auxiliary apparatus to drive the latter, and means whereby the second engine may drive the propeller shaft; substantially as described.

5. In a vessel, propelling apparatus comprising the combination of a propeller shaft, a main engine, means for connecting the engine to and disconnecting it from the shaft, an electric motor adapted to drive the shaft, a second electric motor adapted to be operated by said motor when the latter is driven as a generator by the propeller shaft and auxiliary apparatus for the engine adapted to be connected to the second motor; substantially as described.

6. In a vessel, propelling apparatus comprising the combination of a propeller shaft, a main engine, means for connecting the engine to and disconnecting it from the shaft, an electric motor adapted to drive the shaft, a second engine, a generator for supplying current to said motor, auxiliary apparatus for the main engine, and means whereby the second engine may drive either the generator or the auxiliary apparatus; substantially as described.

In testimony whereof I affix my signature, in presence of two witnesses.

LAWRENCE YORK SPEAR.

Witnesses:

F. L. Brake,

W. D. Fesler.