R. D'EQUEVILLEY-MONTJUSTIN.

METHOD OF GENERATING STEAM FOR SUBMARINE BOATS.

APPLICATION FILED MAY 12, 1909.

986,373. Patented Mar. 7, 1911.

2 SHEETS—SHEET 1.

Fig. 1.

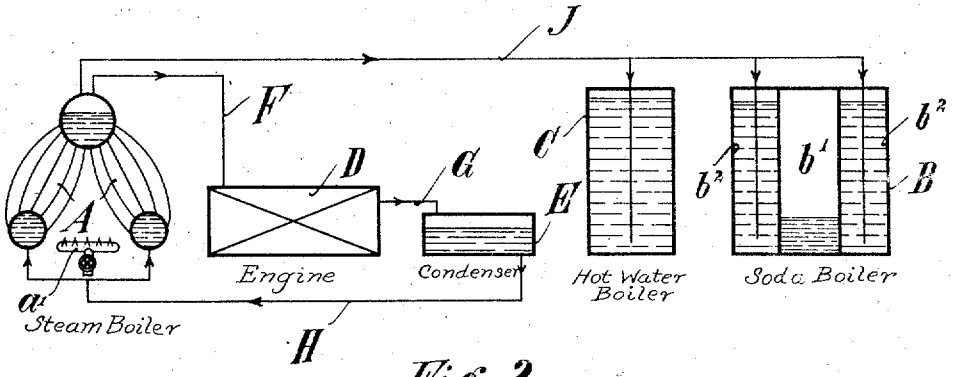


Fig. 2.

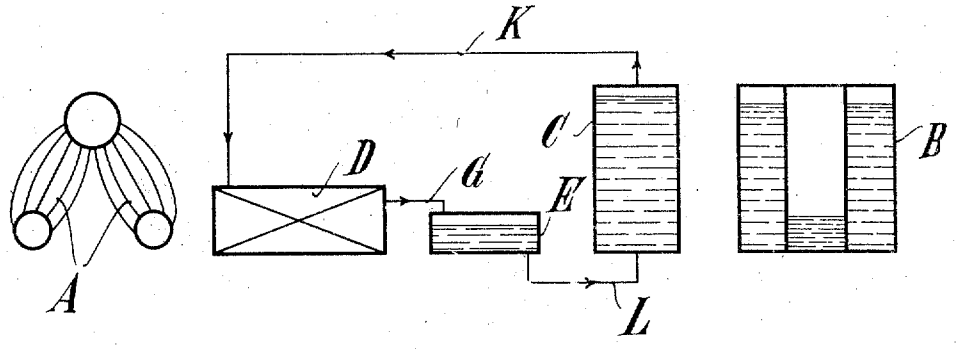
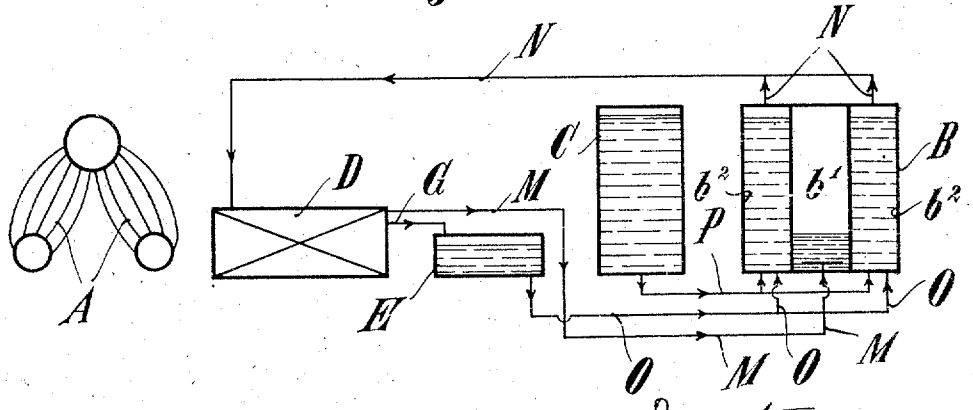


Fig. 3.



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2 SHEETS—SHEET 2.

Fig. 4.

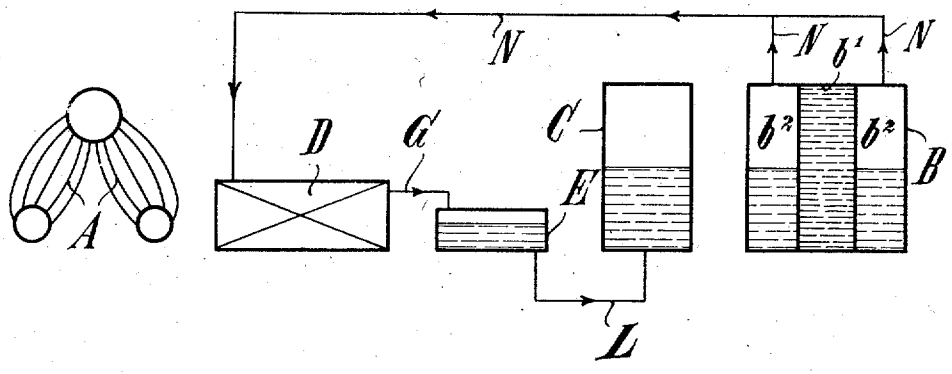
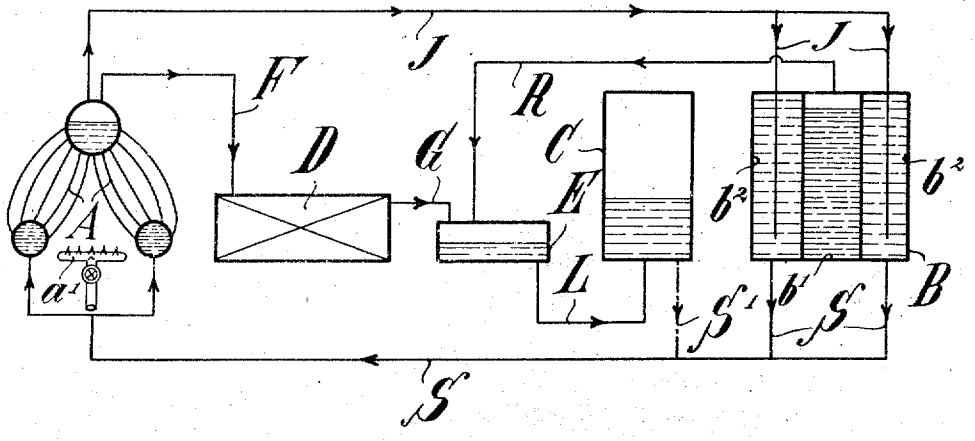


Fig. 5.



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METHOD OF GENERATING STEAM FOR SUBMARINE BOATS.

986,373. Specification of Letters Patent. Patented Mar. 7, 1911.

Application filed May 12, 1909. Serial No. 495,491.

To all whom it may concern:

Be it known that I, RAYMOND D'EQUEVILLEY-MONTJUSTIN, a subject of the King of Spain, and resident of 94 Feldstrasse, Kiel, Germany, have invented certain new and useful Improvements in Methods of Generating Steam for Submarine Boats, of which the following is a specification.

The present invention relates to a steam power plant for the type of submarine boats which are driven by a steam engine which has its driving steam generated in a fired steam boiler during the surface travel while, during the submerged travel, the driving steam is generated in a hot water boiler. These steam power plants, which were first used by Nordenfelt, do not meet the modern requirements to be complied with for a submarine boat in as far as the hot water boiler alone can only give off steam for a comparatively short time so that travel under water can only take place for a short time.

The object of the present invention is to improve this type of steam power plants and the process of operating the same in such a manner that the duration of the submerged travel can be considerably prolonged; and that it will furthermore be possible to obtain the water carried along for evaporation, which water is so valuable in submarine boats by reason of the available space, without necessitating special tanks for feed water and water of condensation.

The accompanying drawings show, by way of example and diagrammatically, an embodiment of a steam power plant in accordance with the present invention. The several figures of the drawings merely differ from one another in having the essential parts of the steam power plant connected with one another by means of steam-pipes and water-pipes in different ways corresponding to the possibilities of operation during the surface travel and the submerged travel.

The steam power plant mainly consists of the following parts: a water-tube boiler A which can be heated by means of an oil-burner a^1; a soda-boiler B which is divided into a compartment b^1 for a solution of caustic-soda and two compartments b^2 for water to be evaporated; a hot water boiler C; a steam engine D and a condenser E. These parts of the steam power plant are connected with one another in the manner shown in the several figures by means of steam-pipes and water-pipes which are indicated by the reference characters F to S and through which, during the operation of the steam power plant, steam or water circulates in the directions indicated by the arrows.

During the surface travel the operation of the steam power plant takes place in the manner shown in Figure 1. The live steam required for driving the steam engine D is then generated in the water-tube boiler A which is heated by means of the oil-burner a^1. The steam is conducted through a pipe F into the steam engine D and after the steam has performed its work in the engine it is conducted through a pipe G into the condenser E. After the steam has become condensed in the condenser the water of condensation is conducted as feed-water to the water-tube boiler A through the pipe H.

Prior to the change to submerged travel a part of the live steam generated is conducted through the pipe J into the hot water boiler C and into the water-compartments b^2 of the soda-boiler, whereby the contents of the hot water boiler and of the soda-boiler is brought to such a temperature (the hot water boiler to a temperature of about 200°) that these boilers are immediately ready for operation when the change to submerged travel takes place. When it is desired to dive with the boat, the oil-burner a^1 of the water-tube boiler A is extinguished. The operation of the steam power plant now preferably takes place in the manner shown in Fig. 2. In this instance the boiler C is used as hot water boiler, that is the steam generated in the boiler C is conducted directly to the steam engine D through the pipe K. The exhaust steam from the steam engine passes through the pipe G into the condenser E from which the water of condensation returns as feed-water to the boiler C through the pipe L.

When the steam generated in the hot water boiler C is not any longer of sufficient tension I proceed to the operation of the soda-boiler as illustrated in Fig. 3. The exhaust steam from the engine is not any longer conducted exclusively to the condenser E but a part of the exhaust steam is conducted through the pipe M into the soda-solution in the compartment b^1 and is absorbed by the solution. The solution is thereby heated and gives off its heat to the water in the compartments b^2 and generates live steam

in these compartments. This live steam is then conducted through the steam-pipe N into the steam engine D.

As experience has demonstrated that the heat in the soda-boiler, especially at the start of the operation, increases to a considerable extent and as the capability of absorption of the soda-solution decreases with the increasing temperature, the water of condensation, which is formed from the part of the exhaust steam of the machine conducted to the condenser, is, especially at the start of the operation, conducted through the pipe O into the water compartments b^2 of the soda-boiler. This fact enables the operator to regulate the temperature of the water to be evaporated and therefore also the temperature of the soda-solution in such a manner that the capability of absorption of the soda-solution remains approximately the same. During the operation the feed to the water-compartments b^2 takes place from the boiler C through the pipe P and in this instance the boiler C is used in its second capacity, viz. as feed water receptacle for the soda-boiler B. The provision of special feed water tanks is therefore made unnecessary.

If, after a protracted submarine travel, the dilution of the solution caused by the absorption of the exhaust steam from the engine has caused the level of the soda-solution to become so high that the solution completely fills the compartment b^1, or if before that time the dilution of the solution has reached such an extent that the soda-solution is not any longer capable of absorbing any steam, the duration of the submerged travel of the boat can be further prolonged by using the method of operation illustrated in Fig. 4. This method consists in the further utilization, to the greatest practicable extent, of the heat present in the soda-solution for the generation of live steam in the water compartments b^2. The live steam is conducted to the engine D through the pipe N as in the mode of operation shown in Fig. 3. However in the method according to Fig. 4 the exhaust steam from the engine D is not any longer conducted into the soda-solution, but it is conducted exclusively into the condenser E. The water of condensation is now conducted through the pipe L into the boiler C and is stored therein. The boiler C then serves in a third capacity, viz. as a receptacle for the water of condensation so that the provision of special tanks for the water of condensation is made unnecessary.

On the change to surface travel the burner a^1 is again put into operation. The method of operation shown in Fig. 5 is then first made use of and serves to once more put the soda-boiler B and the hot water boiler C in condition for operation. The live steam required for driving the steam engine D is in this instance again taken from the water-tube boiler A and is conducted through the pipe F to the engine D whence the total exhaust steam passes through the pipe G into the condenser E. Simultaneously herewith another part of the generated live steam is conducted from the water-tube boiler A through the pipe J into the water compartments b^2 of the soda-boiler B, whereby the diluted soda-solution is evaporated, and in order to facilitate the evaporation the compartment b^1 for the soda-solution is placed in communication with the condenser E through the steam-pipe R. The water of condensation which is formed in the condenser E from the exhaust steam of the steam engine D and from the steam arriving from the compartment b^1 is conducted to the boiler C which serves as tank for the water of condensation and which in that manner becomes gradually refilled, the amount of the water in the boiler C having become greatly decreased during the operation according to Fig. 3. The surplus of hot water resulting from the introduction of live steam through the pipe J into the water compartments b^2 is conducted as feed water through the pipe S into the water-tube boiler A or in the opposite direction through the pipe P (Fig. 3) into the boiler C (Fig. 3); when the boiler C is sufficiently refilled the water-tube boiler A may be supplied with water therefrom through the pipe S^1. When the soda-solution has become sufficiently concentrated by the evaporation and when the boiler C has become sufficiently refilled I once more revert to the method of operation shown in Fig. 1 (the cycle A D E A).

Having thus described my invention and what I claim as new therein and desire to secure by Letters Patent is:

1. In the method herein described for propelling vessels of the submarine type which consists in using a fired steam boiler to propel the vessel during surface travel, using a hot water boiler to generate steam during submerged travel, and using a soda boiler in connection with the fired steam boiler to supply the necessary steam generating power upon the exhaustion of the hot water boiler, and in conducting the heated water remaining in the hot water boiler to the soda boiler as feed water, whereby to prolong the submerged travel.

2. In the method herein described for propelling vessels of the submarine type which consists; first, in using a fired steam boiler to propel the vessel during surface travel; second, in conveying steam therefrom into a hot water boiler for generating steam to be utilized during submerged travel; and third, in the utilization of a soda-boiler wherein a part of the exhaust

steam from the engine is conducted into the soda solution for generating live steam, while the remaining portion of the exhaust steam after condensation, and after reduction to a lower temperature than the water in soda boiler, is introduced therein for keeping within permissible limits the undesirable increase of heat in the soda boiler, whereby to prolong the duration of operation of the soda boiler.

3. In the method herein described for propelling vessels of the submarine type which consists; first, in using a fired steam boiler to propel the vessel during surface travel; second, in conveying steam therefrom into a hot water boiler for generating steam to be utilized during submerged travel; third, in the employment of a soda boiler having its soda compartment connected with the exhaust of the engine and adapted to generate the necessary steam power upon the exhaustion of said hot water boiler generating means; fourth, in discontinuing the use of the soda boiler means when the increasing dilution causes the soda solution to completely fill its receptacle or makes it incapable of further absorption; fifth, in then conducting the exhaust steam aforesaid into a condenser and thence storing the same in the hot water boiler aforesaid; and sixth, in utilizing the heat remaining in the soda solution for generating live steam in the water compartment of the soda boiler until the heat of the soda boiler is practically exhausted.

4. In the method herein described for propelling vessels of the submarine type which consists; first, in using a fired steam boiler to propel the vessel during surface travel; second, in conveying steam therefrom into a hot water boiler for generating steam to be utilized during submerged travel; third, in the employment of a soda boiler connected with the aforesaid means and adapted to supply the necessary steam generating power upon the exhaustion of said hot water boiler generating means; fourth, in conducting the heated water remaining in said hot water boiler to the soda boiler as feed water, whereby to prolong the submerged travel; and fifth, in conveying the water of condensation from the fired steam boiler during the next surface travel, to the hot water boiler for utilization during the next submerged travel.

5. In the method herein described for propelling vessels of the submarine type which consists in using a fired steam boiler to propel the vessel during surface travel, supplying a hot water boiler with live steam direct from the fired steam boiler to quickly generate steam therein for submerged travel, using a soda boiler in connection with the fired steam boiler to supply the necessary steam generating power upon the exhaustion of the hot water boiler, and in conducting the heated water remaining in the hot water boiler to the soda boiler as feed water whereby to prolong the submerged travel.

The foregoing specification signed at Paris, France, this 21st day of April, 1909.

RAYMOND D'EQUEVILLEY-MONTJUSTIN.

In presence of—

DEAN B. MASON,

JOHN BAKER.