March 9, 1926. 1,575,665

R. WAGNER

POWER PLANT

Filed Nov. 22, 1923

Fig. 1.

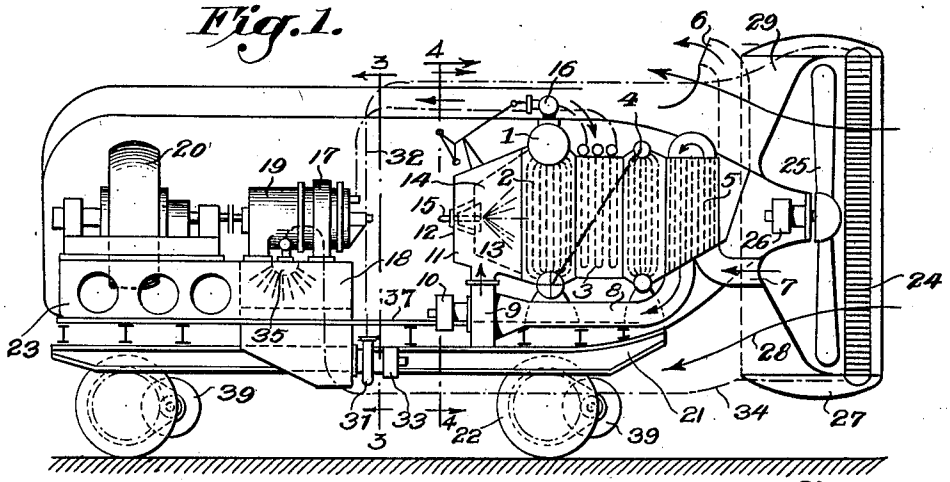


Fig. 2.

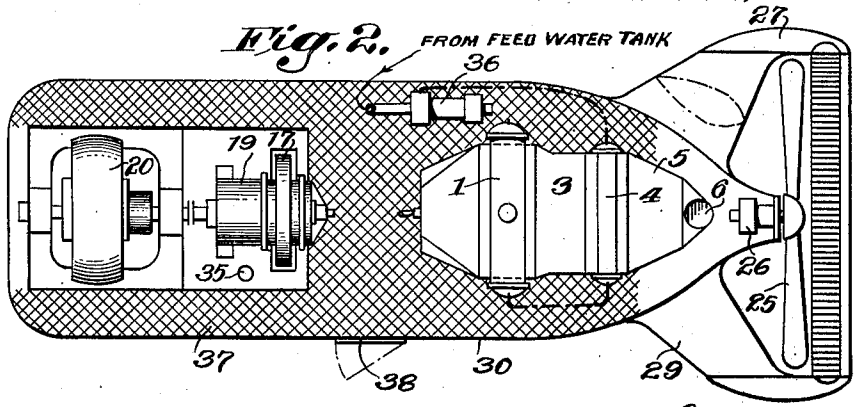


Fig. 3.

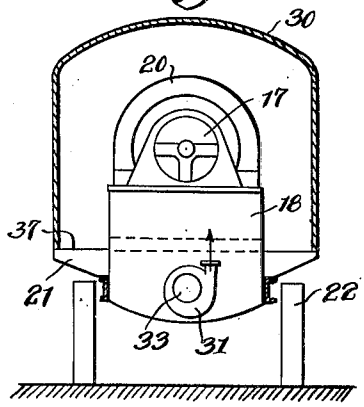
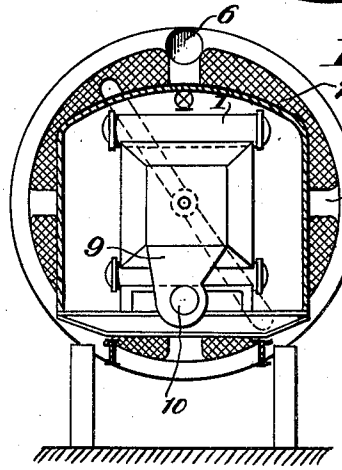


Fig. 4.



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UNITED STATES PATENT OFFICE.

RUDOLF WAGNER, OF HAMBURG, GERMANY, ASSIGNOR TO THE SUPERHEATER COMPANY, OF NEW YORK, N. Y., A CORPORATION OF DELAWARE.

POWER PLANT.

Application filed November 22, 1923. Serial No. 676,453.

To all whom it may concern:

Be it known that I, RUDOLF WAGNER, a citizen of the Republic of Germany, residing at Hamburg, 105 Bismarckstr., Germany, have invented certain new and useful Improvements in Power Plants (for which German application was filed October 27, 1919), of which the following is a specification.

My invention relates to power plants comprising a rotary engine such as a steam turbine and is especially adapted for land-vehicles of all kinds such as locomotives, portable engines, large motor cars, etc.

The object of my invention is to render such a power plant more suitable for use in larger units of say 50 to 2000 horse powers and to reduce the space occupied by such plant and its weight. This object is accomplished by choosing the parts of the power plant and arranging them in such a manner that the limited space available on vehicles of the kind mentioned will best be utilized without unduly increasing the weight to be carried.

With this object in view I arrange in combination with a steam turbine, preferably a high speed turbine, a transmission or reduction gear, a steam generator being adapted to generate steam at a pressure higher than now usually employed and being constructed in such a manner as to occupy but a limited space, and means for conveying the working medium or fluid in a continuous closed path through the whole plant. I prefer to employ as steam generator a water tube boiler having small pipes, as this type of boiler is especially adapted for high pressures and requires only a small space. A continuous closed path for the working medium is established in the most advantageous manner by condensing the medium after its passage through the turbine either by direct or by indirect condensation. In both cases air is employed as cooling means, in the first case the air cooling the medium directly in surface condensers, whereas in the second case the air is used in recoolers for recooling the water for injection or other condensers.

Attempts and experiments have repeatedly been made to adapt a steam turbine drive to the above mentioned purposes, especially to driving locomotives. These attempts, however, always contemplated the use of the usual heavy locomotive boiler, which on the one hand does not permit the generation of steam at such high pressures as is necessary for obtaining an essentially higher economy than hitherto. On the other hand when using the usual locomotive boiler there is not enough space available for the advantageous arrangement of an air-cooled condenser. Whereas in these attempts the condensation of the working medium was incomplete or whereas there was no condensation at all, the use of a water tube boiler with small pipes was impossible in practice, because the continuous service without interruption of such water tube boiler with small tubes is not feasible, particularly with locomotives or portable engines in their present form of construction when impure water must be used and the steam pressure is to be increased above the usual limits. On the other hand it is the essential increase of the steam pressure, especially when combined with a high superheat of the steam which results in such a decrease in steam consumption that sufficient space becomes available for the production of condensation by air without increasing the weight to be carried above the admissible limits.

In the drawing an embodiment of the invention is diagrammatically represented by way of an example. Fig. 1 shows the invention embodied on a portable engine in a longitudinal section. Fig. 2 is a plan view of the same, certain parts shown in Fig. 1 being omitted; Fig. 3 and Fig. 4 are cross-sections taken on the lines 3—3 and 4—4, respectively, of Fig. 1.

Referring to the drawing 1 is a water tube boiler which may be heated by burning oil or pulverized coal. Behind the water pipes 2 may be arranged a steam superheater 3 which may be followed by a feed water heater 4 in which the combustion gases are further utilized and behind which a pre-heater 5 for preheating the combustion air may be arranged. Through the

pipe 6 the combustion gases escape, whereas fresh air enters through the inlet 7. As this inlet 7 is situated behind the recooling apparatus for the injection water the air for combustion is already somewhat pre-heated and accelerated. After having passed the air heater the air for combustion is led through the channel 8 to the fan 9, which may be driven by a small steam turbine 10. From the fan 9 the air passes into the air chamber 11 and from that chamber through the shutting off and regulation member 12 and then through the air nozzle 13 into the combustion chamber 14 of the boiler. The numeral 15 indicates one or more oil sprayers or burners. 16 is the main throttle. From this device which may be a valve, the steam passes in the direction of the arrow at first to the superheater 3 and then to the turbine 17, which may be constructed as a so-called high speed turbine having only one turbine casing or, in the case of a large drop of pressure, a casing which is divided into several parts. From the exhaust steam chamber of the low pressure part the steam passes directly downwards into an injection condenser 18 which may be used as the foundation for the turbine and the transmission or reduction gear. 19 is this gear which, in order to make the arrangement as rigid as possible, is connected directly to the turbine. In the example represented in the drawing a dynamo 20 is driven by the turbine 17 which dynamo generates the current for the motors 39 of the driving wheels as well as for lighting or other purposes. The whole plant is mounted on the frame 21 with the driving wheels 22, which may be connected in known manner by a caterpillar drive. 23 is the frame for the dynamo, which frame is best connected to the part 18 in order to obtain a good setting for the shaft of the dynamo and for the driven shaft of the transmission gear 19 with relation to each other. 24 is an air-cooled recooling apparatus for the injection water which apparatus is mounted on the front portion of the whole plant and may be constructed in the usual way known in the art of coolers for motors. 25 is the fan for the cooler represented as a propeller which may be driven by a small steam turbine 26 with transmission gear. 27 is a ring carrying the cooler 24 which ring serves at the same time as a guide for the air flowing in the direction of the arrow 28 and is connected to the engine casing 30 by means of arms or brackets 29. The injection water to be cooled is led to the cooler 24 through the pipe 32 by means of the centrifugal pump 31 which draws the water from the mixing chamber 18. The pump 31 may likewise be driven by a small high speed steam turbine 33 with transmission gear. The cooled water flows from the cooler 24 through the pipe 34 to the injection member 35. 36 is a turbo-pump for the boiler feed water. 37 designates the floor of the engine room, 38 its entrance door and 39 the electric motors for the driving wheels.

When indirect condensation of the steam is used a surface condenser being provided in the usual manner with pipes may be employed instead of the injection condenser 18; the cooling water of the surface condenser would then be recooled again and again in the cooler 24.

Among the advantages derived from the combination provided for by the invention, especially originating in the use of an entirely closed continuous path of the working medium, an essential increase in economy is to be named in the first place. Further the incommodities of repeated taking in of water and of repeated cleaning of the boiler as is required when working noncondensing are done away with, so that the locomotive is available for use for longer uninterrupted periods, which is obviously of great importance in the operation of railroads. The use of a high pressure boiler results in relatively small dimensions of the boiler as well as of the turbine with gear, so that with a given maximum weight a plant of much greater capacity than hitherto may be carried, a fact which is of special importance for portable engines. Or, in order to have an easily controllable drive of the driving wheels of the vehicle or of the machines to be driven, an electric current generator may be carried which drives the motors of the driving wheels or of the engines to be driven. Such indirect drive of the driving wheels is most advantageous for the reason that thus the detrimental effect of reaction of an irregular rotating speed (caused, e. g., by inaccuracies of the track) upon the thin turbine shaft and upon the shaft of the first high speed gear pinion are neutralized.

When a portable engine having the features of the invention is used, e. g., for intermittent stationary working the air condensation gives still another economic advantage, as the warm air of the condenser or recooler may be employed for heating or drying purposes, a fact of great importance especially for agricultural service. In such cases, where with respect to the short duration of working the plant the economy of the power plant proper is not of paramount importance and a utilization of the heat still contained in the cooling air is possible, or when a very simple turbine having but a few stages is desired, it is preferable, considering the high boiler pressure, to condense the steam at pressures which are substantially equal to atmospheric pressure or above atmospheric. This results in the further advantage that owing to the greater drop in temperature between steam and injection

water and cooling air on the one hand the surface condenser or recooler may be essentially smaller than when working with high vacuum and on the other hand the temperature of the escaping cooling air is higher and therefore more suitable for certain purposes (e. g., heating of rooms, drying, etc.).

I claim:—

1. A power plant for automotive vehicles comprising a high speed turbine, means connected with and driven by said turbine for propelling the vehicle, a high pressure steam generator for generating steam for said turbine, an air-cooled condensing means, connections between said generator, turbine and condensing means to provide a closed path for the continuous circulation of the working medium, the said high pressure steam generator including a water tube boiler having small pipes, a superheater, a feed water heater, and a preheater for the combustion air, all arranged one behind the other substantially in contacting relationship in the path of the combustion gases, the inlet to the preheater being arranged immediately behind the condensing means, an escape for the combustion gases connected to the preheater, and a fan for conveying the combustion air from said preheater to said generator.

2. A power plant for automotive vehicles comprising a high speed turbine, means connected with and driven by said turbine for propelling the vehicle, a high pressure steam generator for generating the working medium for said turbine, an air cooled condensing means arranged on the front part of the vehicle, the said generator including a water tube boiler, a superheater, a feed water heater, and a preheater for the combustion air, all compactly arranged one behind the other in the path of the combustion gases in close proximity to each other, a casing surrounding said generator elements to form a unitary construction, the inlet to the preheater being arranged immediately behind the condensing means, an escape for the combustion gases connected to the preheater, means for drawing the cooling air over the cooling surface of the condensing means, and a fan for conveying the combustion air from said preheater to said generator.

In testimony whereof I have hereunto set my hand.

RUDOLF WAGNER.