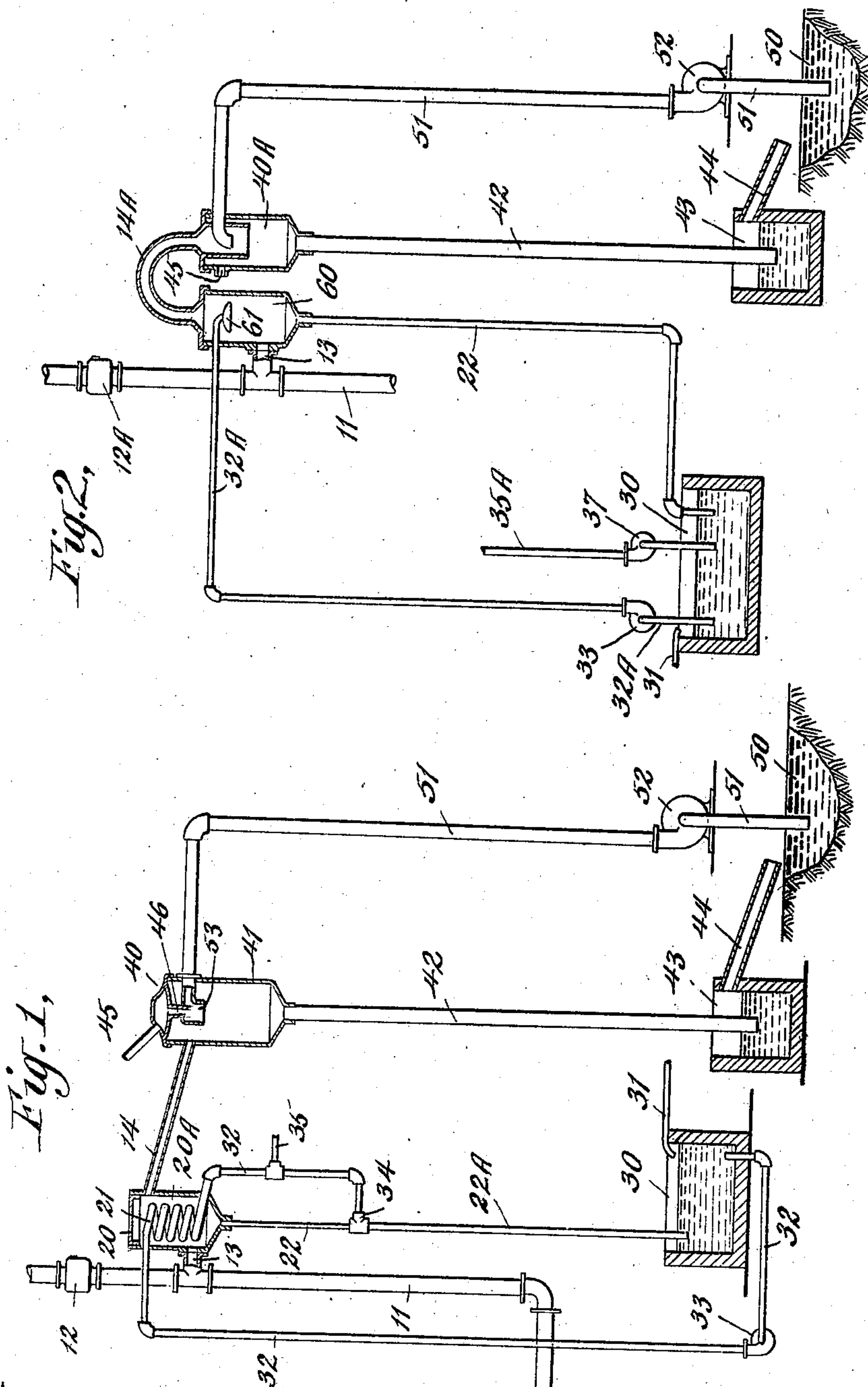


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G. RENNERFELT.  
STEAM CONDENSER.  
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WITNESSES:

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# UNITED STATES PATENT OFFICE.

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## STEAM-CONDENSER.

No. 847,605.

Specification of Letters Patent.

Patented March 19, 1907.

Application filed April 10, 1906. Serial No. 310,948.

*To all whom it may concern:*

Be it known that I, GUSTAF RENNERFELT, a subject of the King of Sweden, and a resident of Scranton, in the county of Lackawanna and State of Pennsylvania, United States of America, have invented certain new and useful Improvements in Steam-Condensers, of which the following is a specification.

My invention relates to improvements in steam-condensers; and it consists in novel construction and arrangement of parts, which are shown in the drawings.

In many localities it is difficult to obtain pure water for steam-boilers or for surface condensers; but water containing acids or other impurities may be readily obtained. Such impure water may be used for condensing the steam in a jet-condenser; and the object of this invention is to provide means to recover and use again a part of the water condensed from the steam which would otherwise be lost in the jet-condenser.

Other objects of the invention are to secure a high temperature of the water thus recovered and also to provide means whereby the feed-water tank may be used as a settling-tank for impurities contained in the feed-water.

I will now describe my invention in the following specification and point out the novel features thereof in claims.

Referring to the drawings, Figure 1 represents diagrammatically my improved system of condensers in side elevation, some of the parts being shown in section. Fig. 2 is a similar view of certain apparatus which embody a modification of my invention.

Like characters of reference designate corresponding parts in all of the figures.

10 designates a steam-engine of the turbine type; but it may be of any other form.

11 is the exhaust-pipe leading from the engine.

12 is a relief-valve in the exhaust-pipe.

13 is a connection from the exhaust-pipe into a feed-water heater of closed type 20. This feed-water heater comprises a casing 20<sup>A</sup>, in which is the pipe-coil 21. A tail-pipe 22 leads from the bottom of this casing 20<sup>A</sup> down to a feed-water tank 30. The pipe-coil 21 is connected by a circulating-pipe 32 to the tail-pipe 22 at 34. The portion 22<sup>A</sup> of the tail-pipe below the connection 34 is preferably

of a larger diameter than that of the portion above the connection 34. A branch pipe 35 is connected to the pipe 32 between the pipe-coil 21 and the connection 34, and this may be led to the boilers or economizers, if the latter are used. The circulating-pipe 32 connects the feed-water tank 30 to the upper portion of the pipe-coil 21. Interposed in this pipe 32 is a circulating-pump 33.

31 designates a pipe from a source of pure-water supply connecting with the feed-water tank 30.

14 designates a steam-pipe which connects the feed-water heater 20 to a condenser 40, which is a jet-condenser of well-known construction. This jet-condenser comprises a shell or casing 41, into which a pipe 51 is led, which pipe terminates in a nozzle 53 near the upper portion of the casing 41. The tail-pipe 42 leads from the bottom of the condenser 40 to a tank 43 at a suitable distance below the jet-condenser. This tank 43 is provided with an overflow 44.

50 designates a supply of impure water—for example, a stream of acid-water or mine-water, such as is common in mining regions, and which on account of its various impurities is not adaptable for use as feed-water or for operating a surface condenser. A circulating-pump 52 is interposed in the pipe 51 and serves the function of carrying this impure water into and through the jet-condenser 40.

46 designates a nozzle in the upper portion of the jet-condenser, which may be connected by means of a pipe 45 to an air-pump.

The tail-pipes 22 and 42 are each arranged to contain a barometric column of water. The height of such a column is generally estimated at thirty-four feet, but varies, as is well known, with the altitude and with the barometric pressure.

Before proceeding with the description of the parts in the modification of my invention shown in Fig. 2 I will describe the operation of the various apparatus which I have just pointed out.

The steam from the exhaust of the engine 10 passes through the pipe 11 and into the feed-water heater 20. The pump 33 causes feed-water to circulate through pipe 32 and to pipe-coil 21. This operation causes the temperature of the feed-water to be raised and at the same time causes a part of the exhaust steam to be condensed and to flow



down through the tail-pipe into the feed-water tank 30. A part of the feed-water may be diverted through pipe 35 and led to the boilers. The area of the tail-pipe 32 is made  
 5 small and the parts arranged, as already described, so that the top of the barometric column of water in this pipe does not reach up into the feed-water heater 20, so that the surface from which reëvaporation of the  
 10 feed-water in vacuum may occur is minimized. It is not necessary to connect the circulating-pipe 32 to the tail-pipe 22; but it may be led back directly to the feed-water tank 30. It is, however, a matter of economy  
 15 and simplification to connect it to the tail-pipe 22, as shown. In this case the lower portion 22<sup>A</sup> of the tail-pipe should have a larger diameter than the upper part. The remainder of the steam which passes through  
 20 feed-water heater 20 will be led through pipe 14 into the jet-condenser 40. A stream of water from the source of supply 50 is forced by the pump 52 through pipe 51 and into jet-condenser 40, condensing the remainder of  
 25 the steam and returning with the condensed steam through the tail-pipe 42 and overflow 44 to the source of supply 50 at a point which may be farther downstream than the intake 51.

30 It is well known that a condenser of this type will maintain a fairly good vacuum without the addition of an air-pump. Although an air-pump is therefore not necessary, it will, however, materially improve the  
 35 vacuum. Moreover, it will reduce the head against which the pump 52 is to work when the apparatus is first started, and therefore assist in starting the apparatus. For these reasons then, it is often desirable to use an  
 40 air-pump, and when such a pump is used it is connected by the pipe 45.

It is well understood by those versed in the art that the parts of the apparatus which are in contact with the acid-water must be constructed in such a manner that they will not  
 45 be corroded. The circulating-pump 52, for example, may be made of bronze rich in copper, and the pipe 51, which connects it to the jet-condenser, may be made of lead or  
 50 concrete or of cast-iron lined with wood. The jet-condenser 40 and the tail-pipe 42 may be similarly constructed of iron and wood or other suitable material, which will not be affected by the impurities in the water.

55 When jet-condensers are used, the condensed steam is wasted; but by my invention a large part of the condensed steam may be recovered and used over again. No part of the impure water which would be apt to corrode  
 60 the boilers is permitted to mix with and thus contaminate the feed-water. Neither is any part of the pure water allowed to waste with the acid-water. This arrangement has the further advantages of causing the tempera-  
 65 ture of the feed-water to be raised to a high

temperature and of permitting the large feed-water tank 30 to be used as a settling-chamber for solid impurities contained in the warm feed-water. The amount of water used in the jet-condenser will also be some-  
 70 what less than otherwise necessary.

In the modification shown in Fig. 2 the feed-water is taken from the feed-water tank 30 and is pumped through a circulating-pipe 32<sup>A</sup> by a pump 33 and is led into an open  
 75 feed-water heater or jet-condenser 60 through a spraying device 61. The steam in this case enters as before through a pipe 11 and connection 13 and is partly condensed by contact with the water through the spraying de-  
 80 vice 61. It is then led through tail-pipe 22 into the feed-water tank 30. That part of the steam which is not condensed in this manner is led by a pipe 14<sup>A</sup> into a second jet-condenser 40<sup>A</sup>, similar to that previously de-  
 85 scribed, through which a stream of impure water from a supply 50 is forced by a pump 52 through a pipe 51. This impure water with the remainder of the condensed steam is led into tank 43 through tail-pipe 42 and is  
 90 allowed to flow back to the stream or river 50 through overflow-pipe 44. If desired, an air-pump may be connected at 45, as in the former case. The feed-water in this case is forced by a pump 37 from the feed-water  
 95 tank 30 to the boilers through a pipe 35<sup>A</sup>. The operation of this form of my invention is similar to that already described, except, of course, that the open feed-water heater or jet-condenser 60 is used for the first condensa-  
 100 tion of the steam instead of the closed feed-water heater 20.

I have described two forms of my invention for the purpose of showing that it is not limited to any specific construction and ar-  
 105 rangement of parts, and therefore I do not limit myself to those herein shown and described.

It is important that the parts should be so arranged that the impure water cannot mix  
 110 with the feed-water. For this reason the jet-condenser 40 in Fig. 1 is placed considerably below the surface condenser 20, and in Fig. 2 the two condensers are connected by a pipe 14<sup>A</sup>, which is carried up above both of  
 115 them in the manner shown.

What I claim is—

1. In combination with a steam-engine, an exhaust therefor, a surface condenser, a jet-condenser in the exhaust, said jet-condenser  
 120 being arranged to be operated by mine-water, and means for preventing the contamination of the exhaust-steam by the mine-water.

2. In combination with a steam-engine, an exhaust therefor, a jet-condenser operated by  
 125 mine-water, and means intermediate the engine and the condenser for condensing and recovering a part of the exhaust-steam without contamination by the mine-water.

3. In combination with a steam-engine, an  
 130



exhaust therefor, a feed-water heater, means for obtaining a vacuum in said heater, a jet-condenser operated by mine-water, and connections between the exhaust, the feed-water heater and the jet-condenser, said connections being so arranged as to prevent contamination of the feed-water by the mine-water, and means for preventing feed-water from being wasted with the mine-water.

4. In combination with a steam-engine, an exhaust therefor, a surface-condenser operated by feed-water, a jet-condenser operated by mine-water, both of said condensers being in the exhaust, means for preventing the contamination of the feed-water by the mine-water, and means for preventing feed-water from being wasted with the mine-water.

5. In combination with a steam-engine, an exhaust therefor, a jet-condenser operated by mine-water, a feed-water heater intermediate the engine and condenser, said feed-water heater being arranged to condense and recover a part of the exhaust-steam, and means for preventing the contamination of the recovered portion of the exhaust-steam by the mine-water.

6. In combination with a steam-engine, an exhaust therefor, a feed-water tank, a feed-water heater above said tank, a tail-pipe between the feed-water heater and the feed-water tank, a jet-condenser operated by mine-water, connection between the exhaust, the feed-water heater and the condenser, and means for circulating water between the tank and the feed-water heater.

7. In combination with a steam-engine, an exhaust therefor, a feed-water tank, a feed-water heater above said tank, a tail-pipe between the feed-water heater and the feed-water tank, a jet-condenser operated by mine-water, said jet-condenser being situated at a lower level than that of the feed-water heater, a tail-pipe for the condenser, connection between the exhaust, the feed-water heater and the condenser, and means for circulating water between the tank and the feed-water heater.

8. In combination with a steam-engine, an exhaust therefor, a feed-water tank, a feed-water heater above said tank, a tail-pipe of small area between the feed-water heater and the feed-water tank, said tail-pipe arranged to contain a barometric column of water, a jet-condenser, a tail-pipe for the condenser, said tail-pipe arranged to contain a barometric column of water, and connections between the exhaust, the feed-water heater and the condenser.

9. In combination with a steam-engine, an exhaust therefor, a feed-water tank, a feed-water heater above said tank, a pipe-coil in the feed-water heater, a circulating-pipe connecting the feed-water tank and the pipe-coil, a pump in said circulating-pipe, a tail-pipe between the feed-water heater and the

feed-water tank, the upper part of said tail-pipe having a small area, a connection between the circulating-pipe and the tail-pipe, the tail-pipe having a larger area below said connection, and a barometric column of water in the tail-pipe.

10. In combination with a steam-engine, an exhaust therefor, a feed-water tank, a feed-water heater above said tank, a pipe-coil in the feed-water heater, a circulating-pipe connecting the feed-water and the pipe-coil, a pump in said circulating-pipe, a tail-pipe between the feed-water heater and the feed-water tank, the upper part of said tail-pipe having a small area, a connection between the circulating-pipe and the tail-pipe, the tail-pipe having a larger area below said connection, a barometric column of water in the tail-pipe, a jet-condenser and connections between the exhaust, the feed-water heater and the condenser.

11. The combination of a steam-engine, a casing 20<sup>A</sup>, a pipe 21 within the casing, said pipe having a branch pipe 35 adapted to be connected to a boiler, a feed-water tank, connection between the engine and the casing, means for circulating water between the tank and the pipe, and means for maintaining a vacuum in the casing.

12. The combination of a steam-engine, a casing, a coiled pipe within the casing, a branch pipe connected with said coiled pipe and arranged to be connected to a boiler, a feed-water tank, connection between the engine and the casing, connection between the casing and the feed-water tank, means for circulating water between the tank and the coiled pipe, and means for maintaining a vacuum in the casing.

13. The combination of a steam-engine, a casing, a pipe within said casing, an independent feed-water tank, a jet-condenser, connection between the engine and the casing, connection between the casing and the jet-condenser, and means for circulating water between the tank and the pipe.

14. The combination of a steam-engine, a casing, a pipe within said casing, an independent feed-water tank, a jet-condenser, connection between the engine and the casing, connection between the casing and the jet-condenser, means for circulating water between the tank and the pipe, and a pipe for draining from the bottom of the casing into the tank.

15. The combination of a steam-engine, a feed-water heater, an independent feed-water tank, means for circulating water between the tank and the heater, means for draining from the bottom of the heater into the tank, a condenser, and connection between the heater and condenser.

16. The combination of a steam-engine, a condenser, a feed-water tank, means for circulating water between the tank and the con-



denser, means for diverting a part of said circulating water to a boiler, and means for conveying water of condensation from the condenser to the tank.

5 17. The combination of a steam-engine, a condenser, a feed-water tank, a pipe passing through the condenser, means for circulating water through said pipe between the tank and the condenser, and a branch pipe connected with said pipe and arranged to divert  
10 a part of the circulating water to a boiler.

18. The combination of a steam-engine, a condenser, a feed-water tank, means for circulating water between the tank and the condenser, and means located between the condenser and the tank for diverting a part of  
15 said circulating water to a boiler.

19. The combination of a steam-engine, a condenser, a feed-water tank, means for circulating water between the tank and the con-  
20

denser, means for diverting a part of such circulating water to a boiler, a second condenser, connection between the engine and the first condenser, and connection between the first and second condensers.

20. The combination of a steam-engine, a condenser, an independent feed-water tank, means for circulating water between the tank and the condenser, a second condenser, connection between the engine and the first condenser, a connection between the first and second condensers, and means for maintaining a vacuum in the condensers. 25

In testimony whereof I have signed my name to this specification in the presence of  
35 two subscribing witnesses.

GUSTAF RENNERTFELT.

Witnesses:

ROBT. J. MURRAY,  
FRED. H. LINTON.