Dec. 8, 1925. 1,564,716

J. RUTHS

STEAM GENERATION

Filed Dec. 27, 1924

Fig. 1.

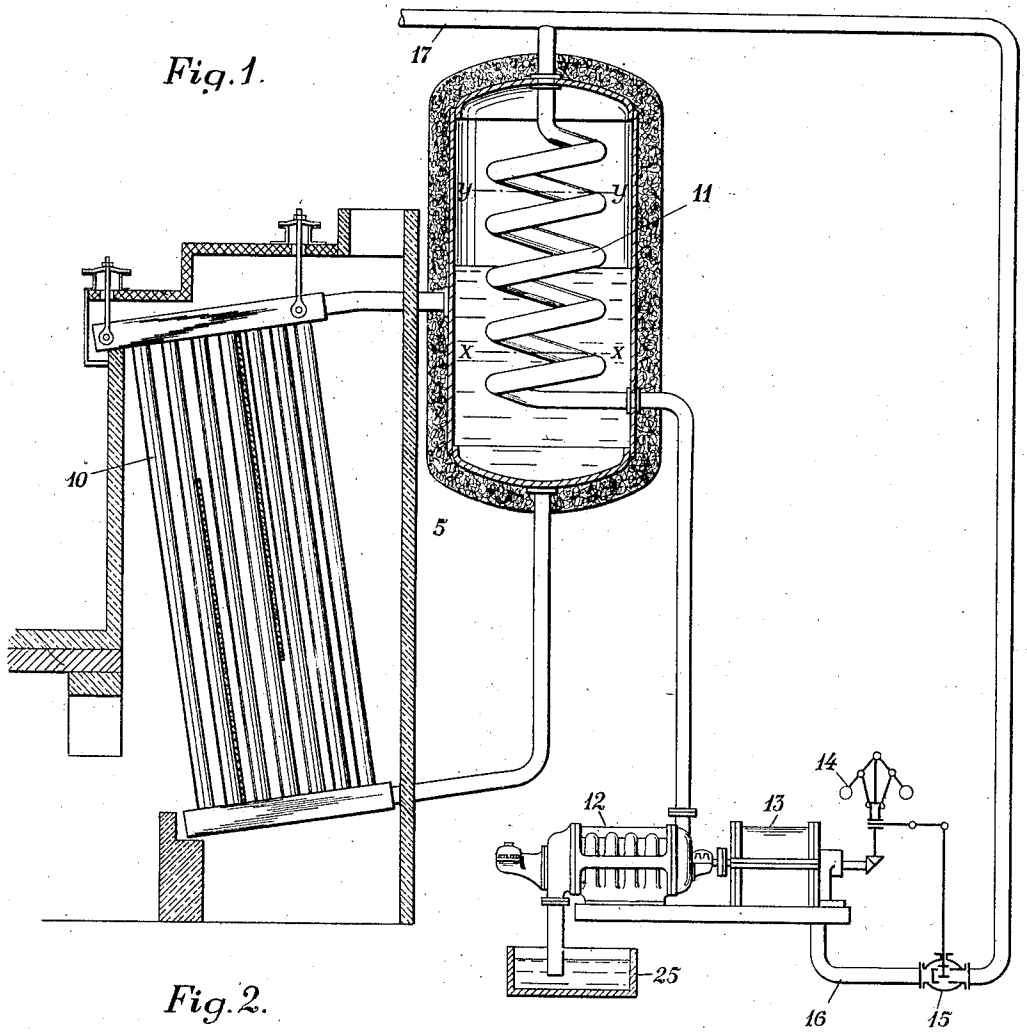
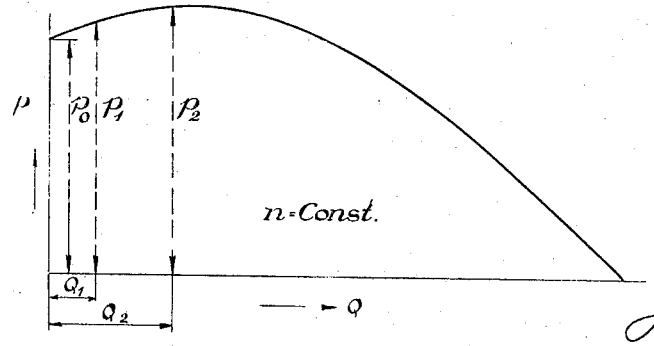



Fig. 2.




Inventor

Johannes Ruths

By Wm. T. Wedlund

Attorney

Patented Dec. 8, 1925. 1,564,716

# UNITED STATES PATENT OFFICE.

JOHANNES RUTHS, OF DJURSHOLM, SWEDEN.

## STEAM GENERATION.

Application filed December 27, 1924. Serial No. 758,439.

*To all whom it may concern:*

Be it known that I, JOHANNES RUTHS, a subject of the King of Sweden, and residing at Djursholm, Sweden, have invented certain new and useful Improvements in Steam Generation, of which the following is a specification.

My invention consists in an improvement in the art of generating steam whereby the operation of certain kinds of boilers is simplified, the said improvement consisting in determining the pressure of generated steam exclusively by the pressure of discharge of feed water supply apparatus, which apparatus preferably consists of a centrifugal pump driven at constant speed.

In the accompanying drawing which serves to illustrate my invention:

Fig. 1 shows apparatus for carrying out my invention.

Fig. 2 shows the characteristic of the pump illustrated.

In Fig. 1, 5 designates an indirectly heated steam generator comprising a primary boiler 10 shown as of water tube type in which a medium of low pressure at relatively high temperature is heated, the heat being transmitted to water in secondary boiler 11, preferably in the form of a coil, thereby transforming the water into steam. The particular features of the boiler are not of importance to the present invention except as hereinafter set out.

Water is supplied to coil 11 by means of centrifugal pump 12 driven, for example, by a turbine 13 which is so controlled by means of centrifugal governor 14 controlling valve 15 in conduit 16 which supplies steam to the turbine that the number of revolutions of the turbine and pump per unit of time is held constant.

In steam generators hitherto used the fluctuations of boiler pressure are dependent on 4 particulars, namely on the quantity of steam discharged, on the quantity of heat received by the boiler, and on the temperature and the volume of the water fed into the boiler at the same time. The present arrangement is characterized by the fact that the boiler pressure is not dependent on the particulars mentioned above with ordinary steam generators, but is exclusively determined by the discharge pressure of the centrifugal pump, a certain relation existing between the quantity of water delivered and the pressure produced by the pump if the number of revolutions is constant, such relation being known as the characteristic of the pump.

Fig. 2 shows such a relation.

The pressure of the discharged steam is exclusively determined by the pump pressure which varies in accordance with the characteristic of the pump in accordance with the actual water or steam volume. For instance, if the temperature of the low pressure medium in primary boiler 10 is 850° Fahrenheit and the pressure of discharge of the centrifugal pump is 3000 pounds per square inch the steam pressure will not correspond with a temperature of 850° but with a temperature of about 685° Fahrenheit, corresponding with the saturation temperature at 3000 pounds pressure, and the steam in that part of the boiler which is not in contact with the water, is superheated up to nearly 850°.

If the steam discharge from the boiler is decreased, the water level will be lower and the heating surface in contact with the water will accordingly decrease. However, the pressure of the steam generated is always determined by the pressure of the centrifugal pump. If the steam discharge entirely ceases, the boiler remains filled with superheated steam of 3000 lbs. but with a temperature of 850° Fahrenheit.

With this arrangement, care should be taken that the heating surface must be so large that even with the greatest steam discharge, the corresponding water volume can without doubt evaporate within the boiler.

A further characteristic feature of the invention is the fact that the water surface in the boiler, as far as there may be spoken of a real water surface, automatically rises at increasing steam discharge but sinks at decreasing steam discharge. Especially for this reason the indirect heating described, namely by means of an indirect medium, is particularly to be recommended, as otherwise that part of the boiler which only contains steam, would be destroyed by the fire.

The centrifugal pump 12 sucks the water from the receptable 25 and brings the same to the steam pressure needed, forcing it into the steam generator 11. The water is gradually evaporated in the coil, and the steam

thus generated is discharged through the piping 17 and supplied to consumers. In Fig. 2 the pressure generated by the pump is indicated as a function of the water volume or, what in this case amounts to the same, the steam volume.

This figure shows that if no steam discharged takes place, a certain pressure $p_0$ will exist, and this pressure varies according to the characteristic of the pump in relation to the steam discharge.

Thus if a state of equilibrium exists the pump pressure exactly corresponds with the steam pressure needed, losses of pressure in the piping being neglected.

If, for instance, a steam volume is discharged from the boiler, corresponding to a water volume Q supplied by the pump, the steam pressure ignoring the losses in the pipings, is $p_1$.

If more steam is taken out from the boiler, for instance a steam volume corresponding to the water volume $Q_2$, the steam pressure in the conduit decreases. Consequently, the flow of water through the boiler will accelerate owing to the decreased counter-pressure, so that a greater water volume will flow through the pump (position: water volume $Q_2$, pressure $p_2$).

If only a small quantity of steam is discharged, the greater part of the coil will be filled with steam and the water level will be very low, for instance on the line $x$—$x$. If the greatest possible steam quantity is discharged, the water level will rise, for instance to the line $y$—$y$. The water level in the coil together with the heating surface in contact with the water, therefore, vary in accordance with the boiler load, and this makes an indirect heating of the boiler, as indicated above, appear necessary.

It might be supposed that by an increase of the temperature of the medium or of its vapor in the primary boiler, the steam production of the coil would also increase. This is, however, not the case. If the temperature is in some way increased, for instance from 850 to 900° Fahrenheit, the only consequence would be that the water level of the secondary boiler would be lowered to a corresponding degree, that is, the heating surface which is in contact with the water would be decreased and the superheating of the steam would be increased to a certain degree. The steam production and the steam pressure, however, remain exclusively dependent on the quantity of water supplied by the pump which is not influenced by this increase of temperature. If, however, more steam is taken from the secondary boiler, the quantity of water supplied will automatically increase to a corresponding degree, as also will the heat discharge from the primary boiler, for which reason more heat must be supplied to this boiler, for instance by means of combustion gases.

If we desire to take into consideration possible losses of pressure, all that is necessary is to observe that at all times the pressure of the steam discharged is equal to the pump pressure less any losses of pressure in the pipings. By carefully selecting the characteristic of the pump, it is even possible to arrive at an increase of steam pressure, when more steam is needed, in order to make up for the losses of pressures incurred in the steam conduits.

It is to be noted that the centrifugal pump 13 has a free discharge into coil 11.

Having thus described my invention what I claim as new and desire to secure by Letters Patent of the United States is:

1. In combination, a steam generating element indirectly heated by means of a heat transmitting medium, a centrifugal pump, an uninterrupted connection between said centrifugal pump and said steam generating element through which said pump forces all the water passing through the pump into said steam generating element and means to maintain said pump at constant speed.

2. That improvement in the art of generating steam by means of an indirectly operating heat transfer medium which comprises generating steam by means of an indirectly operating heat transfer medium of low pressure at relatively high temperature and determining the pressure of generated steam exclusively by the pressure exerted on feed water by feed water apparatus.

In testimony whereof I hereunto affix my signature.

JOHANNES RUTHS.