UNITED STATES PATENT OFFICE

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INTERSTAGE SUPERHEATING IN STEAM POWER PLANTS

Application filed April 20, 1926, Serial No. 103,263, and in Germany April 23, 1925.

This invention relates to improvements in interstage super- or reheating in steam power plants. Methods have been proposed to heat an interstage-superheater or reheater arranged between the high-pressure and low-pressure stages of a steam engine by means of steam generated in the working steam boiler or in a separate boiler used solely for the particular purpose indicated. Further, it has been proposed to generate high-pressure working steam in a boiler by heating the water in said boiler either directly or indirectly by superheated or saturated high-pressure steam. (In the direct heating method the heating steam is directly introduced into the water of the boiler, whereas in the indirect heating method the heating steam is conducted through heating coils or the like located in the said water.)

The object of this invention is to raise the degree of superheat, to which the intermediate steam is reheated, in an extraordinary manner. With this object in view the invention consists in a method of and apparatus for interstage-superheating according to which the steam which serves as the heating medium for the intermediate steam in the interstage superheater is taken from the high-pressure heating steam for the working steam boiler before its entrance into the latter.

The accompanying diagrammatic drawing shows one illustrative form of the invention.

Working steam for the high-pressure stage, \( \lambda \), of the steam engine is generated at a pressure for example of 60 atmospheres in a working steam boiler, \( a \), while heating steam of about 100 to 120 atmospheres is generated in a heating steam boiler, \( b \). This heating steam boiler, \( b \), comprises a setting, 1, a furnace, 2, and a pipe system, 3, in which the heating steam is generated by the heat of the fire gases. The boiler setting 1, encloses a second flue, 4, in which a superheater, \( e \), for the working steam is located. The fire gases leave the boiler by the exit 5 leading to the stack. The heating steam is conducted from the heating boiler, \( b \), through a conduit, 6, to one end of a pipe system, 7, located in the water space of the boiler, \( a \). Another conduit, 8, connects the other end of the pipe system, 7, to the generating system, 3, located in the boiler, \( b \). The heating steam in the present example therefore generates the working steam in boiler, \( a \), indirectly and the pipes 3, 6, 7, 8 form a closed circuit for the steam generated in the system 3 and the water resulting from the condensation of such steam in the pipes 7, 8.

The working steam generated in the boiler, \( a \), is led through a conduit, 9, to the superheater, \( e \), in which it is superheated to say 450° C. Thence, a conduit, 10, leads the working steam to the high-pressure stage, \( \lambda \), of the engine. Between this high-pressure stage, \( \lambda \), and the low-pressure stage, \( \eta \), of the engine an interstage superheater is inserted comprising a casing, \( d \), and a heating coil, \( c \), or a similar heating member suitable for indirect heating. The steam coming from the high-pressure stage, \( \lambda \), is led through conduit, 11, into the casing, \( d \), in which it is reheated and which it leaves by conduit, 12, connecting the casing with the low-pressure stage, \( \eta \). The heating medium to be used in coil, \( c \), for reheating the intermediate steam is conducted to coil, \( c \), through a conduit, 13, which is branched off, at 14, from the conduit, 6, i.e. from the main steam pipe leading from the heating steam boiler, \( b \), to the working boiler, \( a \). A pump, \( p \), returns the steam which has given up its heat in the interstage superheater, \( d \), to the heating-steam generator, \( b \), by means of a pipe, 15, which preferably is connected to conduit, 8, as at 16.

Thus, it will be seen that part of the heating steam generated in boiler, \( b \), at a high pressure of 100 to 120 atmospheres is branched or taken off at 14, i.e. at a point before the heating steam is introduced into the working steam boiler, \( a \). This branched off part of the heating steam is then used in the interstage superheater coil, \( c \), as the heating medium. The intermediate steam can thus be reheated to a superheat of 300° C. and more.

The working steam boiler, \( a \), is shown as situated outside of the boiler setting, 1. It may be located at a distance from the boiler, \( b \).
The heating steam generated in the heating steam boiler, \( b \), may either be saturated or superheated.

It will be noted that inasmuch as the superheater \( c \) for heating the working steam on its way to the engine, is heated by means of furnace gases, a considerably higher temperature can be obtained at this point than in the interstage superheater \( a \), where the heating steam generated in the boiler \( b \) is employed as the heating medium. The live steam admitted to the high pressure stage of the engine is thus heated to a higher temperature than the intermediate steam passing from said stage to the next.

Claims:

1. A steam power plant comprising a steam engine having several expansion stages, an interstage superheater between two of such stages, a working steam boiler for generating the high-pressure working steam for said engine and connected to said engine, a heating steam boiler adapted to generate heating steam to be used in the working steam boiler as heating medium for the indirect generation of the working steam, a heating coil in said working steam boiler immersed in the liquid of the boiler, means for conducting the heating steam from said heating steam boiler to said heating coil in the working steam boiler, means for diverting part of said heating steam before its introduction into the coil in the working steam boiler, and means for conducting said part of steam into the interstage superheater to be used therein as heating medium.

2. A steam power plant comprising a steam engine having two expansion stages, an interstage superheater arranged between said expansion stages and having a heating coil, a working steam boiler for generating high pressure working steam for said engine and connected to said engine, a heating steam boiler having a furnace and adapted to generate heating steam at a pressure considerably higher than that of said working steam, a coil located in the water space of said working steam boiler, a conduit connecting said heating steam boiler to one end of said coil and adapted to conduct said heating steam into said coil, another conduit connecting the other end of said coil to said heating steam boiler and adapted to conduct said heating steam back to it, and a branch conduit connecting a point of said first conduit before its connection with the coil of the working steam boiler with the heating coil of said interstage superheater.

3. In a steam power plant according to claim 1, means for conducting the heating medium from the superheater back to the heating steam boiler.

4. In a steam power plant according to claim 1, a superheater situated in heat-exchange relation to the highly-heated fluid used for heating the heating steam boiler for producing a working steam temperature higher than that of the heating steam, said superheater being associated with the connection conveying the working steam from the working steam boiler to the engine.

In testimony whereof I have hereunto set my hand.

CARL WAGNER,
Administrator of the Estate of Hermann Eisner, Deceased.