

Nov. 19, 1968

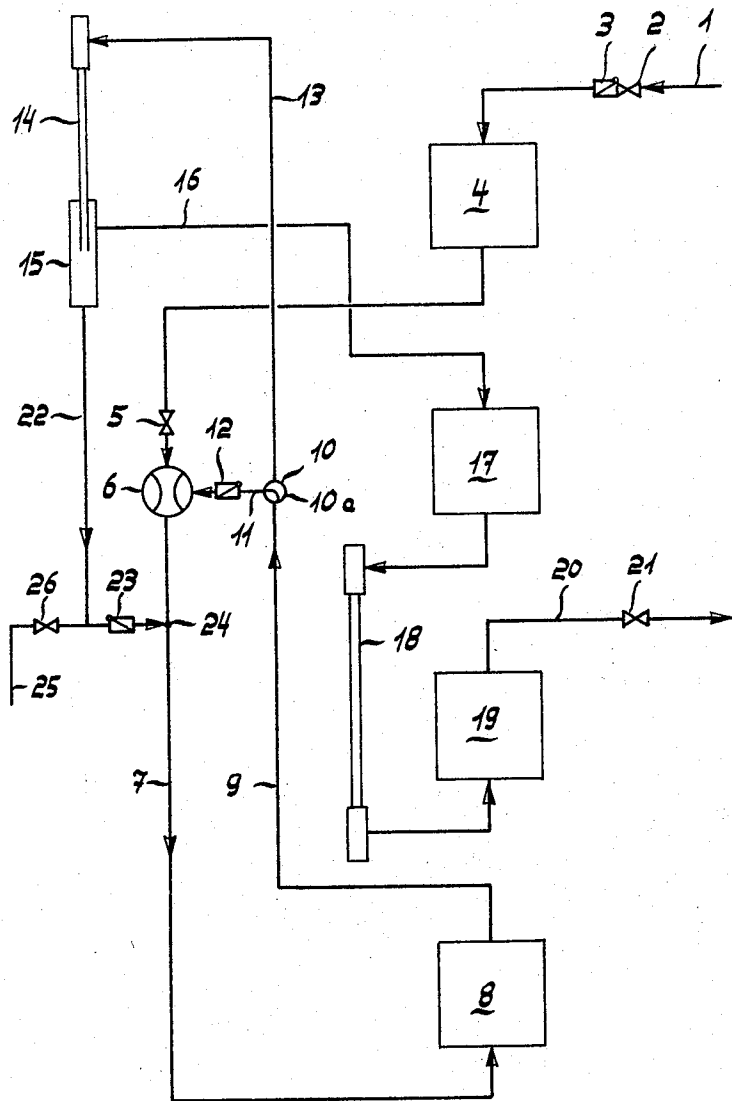
W. KRAUS
METHOD OF AND APPARATUS FOR STARTING AND STOPPING
FORCED CIRCULATION BOILERS

3,411,484

Filed March 3, 1967

4 Sheets-Sheet 1

Fig. 1.



INVENTOR

Willibald Kraus

By

Walter D. Buehler

Nov. 19, 1968

W. KRAUS

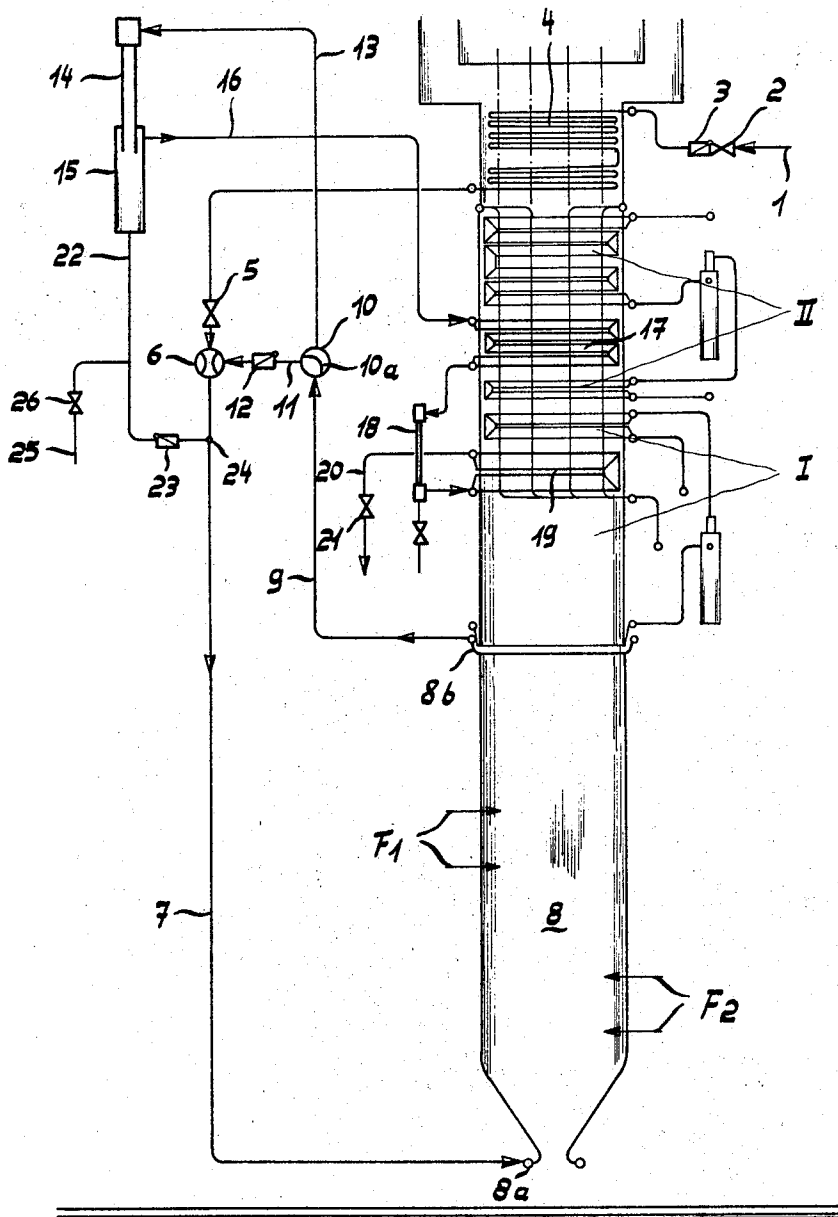
3,411,484

METHOD OF AND APPARATUS FOR STARTING AND STOPPING
FORCED CIRCULATION BOILERS

Filed March 3, 1967

4 Sheets-Sheet 2

Fig. 2.



INVENTOR

Willibald Kraus
By *Walter B. B. B.*

Nov. 19, 1968

W. KRAUS
METHOD OF AND APPARATUS FOR STARTING AND STOPPING
FORCED CIRCULATION BOILERS

3,411,484

Filed March 3, 1967

4 Sheets-Sheet 3

Fig. 3.

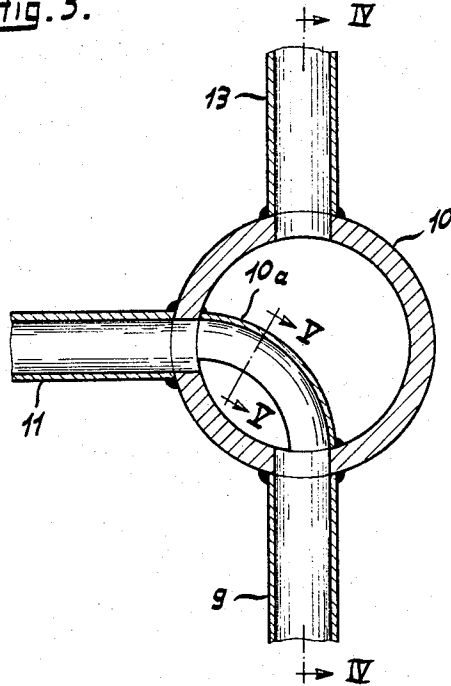


Fig. 4.

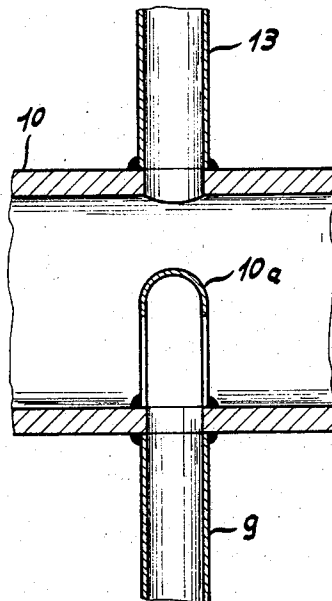


Fig. 5.

INVENTOR

Willibald Kraus
By *Walter Buehler*

Nov. 19, 1968

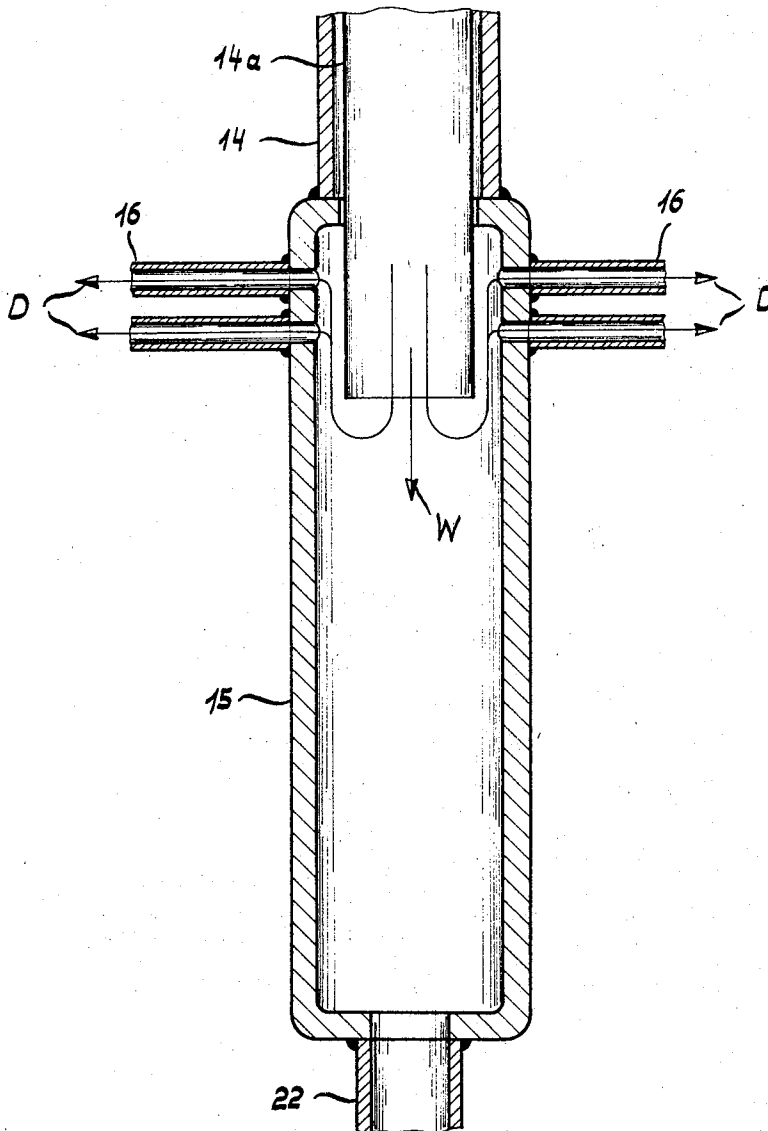
W. KRAUS
METHOD OF AND APPARATUS FOR STARTING AND STOPPING
FORCED CIRCULATION BOILERS

3,411,484

Filed March 3, 1967

4 Sheets-Sheet 4

Fig. 6.



INVENTOR

Willibald Kraus

By *Walter D. ...*

1

3,411,484

METHOD OF AND APPARATUS FOR STARTING AND STOPPING FORCED CIRCULATION BOILERS

Willibald Kraus, Gummersbach, Germany, assignor to L. & C. Steinmuller, G.m.b.H., Gummersbach, Rhineland, Germany

Filed Mar. 3, 1967, Ser. No. 620,425

Claims priority, application Germany, Mar. 5, 1966, St. 25,075

4 Claims. (Cl. 122—406)

ABSTRACT OF THE DISCLOSURE

Steam generating installation with wall pipes and superheater having forced circulation of working medium and with means to supply only dry steam to the outlet during firing-up and shutting-down operations, said means comprising; a separator following the wall pipes to remove the liquid phase from the medium discharge from the wall pipes while the vapor phase is directed to the superheater and preferably is passed through another separator prior to reaching the superheater, and a method of operating such an installation.

The present invention relates to a method of and arrangement for starting in dry condition and stopping forced circulation boilers, particularly boilers with superimposed agitation and boilers with vertical wall pipes.

Fundamentally, there are known two methods for starting forced circulation boilers, namely the wet starting and the dry starting. According to the wet starting method, the forced circulation boiler is filled with water to the superheater exit and passed through by said water. The start expansion device is arranged at the end of the boiler. However, if ahead of the superheater there is installed a separator vessel the water phase in the superheater can be avoided. With this arrangement, in addition to the well defined starting operation, in flow technical respect, the most economic and careful starting of a forced circulation boiler will be made possible. This is the case in particular when employing highly alloyed superheat-resistant material with reference to the block power plant, the dry starting method with interposed separator vessel results in a considerable reduction in the starting period. The starting losses remain particularly low when the working medium for cooling the heating surfaces located ahead of the separator vessel is circulated by means of a pump and the feeding starts only when the steam delivery starts.

The drawbacks of the wet starting method have been referred to above. With the heretofore known dry starting method, the starting circulating device comprising the separator vessel, the circulating pump, the fittings and the connecting conduits represent considerable expenses. In particular, with high construction perimeters (Auslegungsparametern)—pressure and temperature and output—the separator vessel represents a difficult structural element with considerable wall thickness which not only is expensive but also unfavorably influence the boiler dynamics.

It is, therefore, an object of the present invention to provide a method for dry starting and stopping boilers with forced circulation which will permit the cold start as well as the warm start from any possible conditions of operation and will also be suitable for stopping.

It is a further object of this invention to provide a method and device as set forth in the preceding paragraph which can be carried out in a reliable and highly economic manner.

These and other objects and advantages of the invention will appear more clearly from the following specifica-

2

tion in connection with the accompanying drawings, in which:

FIGURE 1 illustrates the fundamental principles of the method according to the present invention.

FIGURE 2 diagrammatically illustrates a boiler installation for carrying out the method according to the invention.

FIGURE 3 is a section through a possible design of a collector which is preferably located on the same level as the jet apparatus or injector.

FIGURE 4 is a section taken along the line IV—IV of FIG. 3.

FIGURE 5 is a section along the line V—V of FIG. 3.

FIGURE 6 is a section through a lower portion of the injection cooler with exit head for carrying out the method according to the invention.

The present invention is characterized primarily in that the wall pipes during the starting and stopping phase of the boiler are cooled by the working medium which circulates in a natural way. Preferably, the boiler water which is carried along in the direction toward the superheater is separated in a cooler exit head forming water separator, and is returned to the feed water drop pipes.

The method according to the present invention may be realized by various devices. According to a preferred embodiment of such device, the pipe system which during the starting and stopping phase is operated with natural circulation has provided therein a collector preferably at the same level as the jet device, said collector being equipped with means for separating steam and water. This separation of steam and water is made possible by one or more downwardly opening troughs or passages installed in the collector.

The present invention also includes a preferred embodiment of the lower portion of the cooler with adjacent cooler exit head in such a way that the cooler protective pipe is extended downwardly into the cooler exit head, and more specifically, to such an extent that the pipes which feed the steam from the cooler exit head to the superheater inlet group branch off above the lower marginal portion of the protective pipe means.

According to a further development of the invention, the feed water drop pipes for supporting the water return are designed in the manner of nozzles.

The present invention relates to a boiler installation in which the method according to the invention and also the devices according to the invention for carrying out said method are employed. This boiler installation is preferably so designed that the collector built into the pipe system is preferably at the same level as the jet device. Preferably, the collector located at the same level as the jet apparatus is arranged above the upper collector of the wall pipe system. Furthermore, the cooler exit head is in conformity with the present invention arranged that much above the jet apparatus that the separated water will automatically flow into the feed water drop pipe.

Referring now to the drawings in detail, FIG. 1 illustrates the fundamental principle of the present invention. More particularly, the feed water is conveyed to the preheater 4 through a conduit 1 with a shutoff valve 2 and a check valve 3. The working medium passes through the control valve 5 to the jet apparatus 6 and through the feed water drop pipe 7 into the wall pipes 8. Behind said wall pipes 8 the working medium passes through conduit 9 to the branch point 10 with built-in devices 10a. From branch point 10, a branch flow of the working medium, the so-called return flow, is through conduit 11 and the interposed check valve 12 conveyed back to the jet apparatus 6. The steam flow corresponding to the feed water flow is from the branch point 10 through conduit 13 conveyed to the first injection cooler 14. Thereupon the working medium passes through the cooler exit head 15

forming a water separator, and through conduit 16 to the first superheater group 17 and further through connecting lines to the second injection cooler 18 and finally to the superheater exit group 19 into the fresh steam conduit 20 with shutoff valve 21.

The principle of the invention consists primarily in that during the starting and stopping phase with closed or partially opened valves 2, 5, and 21 in the circuit 6-7-8-9-10-11-12 the wall pipes 8 are cooled by the natural circulation of the working medium, and furthermore in that the boiler water carried along in the direction toward the superheater is separated in the cooler exit head 15 forming a water separator, said boiler water being returned through conduit 22 with check valve 23 at 24 into the said feed water drop pipe 7 which at this section are preferable nozzle-shaped. As a result thereof the steam will preferably flow off through pipes 16 in the direction indicated by the arrow D, whereas the water will preferably flow off through conduit 22 as indicated by the arrow W. In addition thereto, it is possible to empty the cooler head 15 and conduit 22 through the emergency discharge conduit 25 with the valve 26.

FIG. 2 shows the principle of the invention in connection with a specific device, and more particularly, in connection with a forced circulation boiler with jet returned feed. The numerals employed in FIG. 2 correspond to those of FIG. 1 and so does the path of the working medium. The cooler exit head 15 is arranged so high above the jet apparatus 6 that the separated water will automatically flow off into the feed water drop pipe. The geodetical difference in height between the branch point 10 and the lower collectors 8a of the wall pipe system 8 is high. In addition thereto, the branch point 10 is still higher than upper collector 8b of the wall pipe system 8. In this way there are presented good conditions for the natural circulation. Inserts 10a at the branch point 10 see to it that the water preferably flows off into conduit 11 while the steam preferably flows off into conduit 13. The heating surfaces not numbered in FIG. 2 and the branch flow heat exchanger with emergency injection form the intermediate heaters I and II. Furthermore, the drawing shows a preferred burner arrangement with a boiler plant according to the invention, said burner arrangement being indicated by the arrows F1 and F2.

FIGS. 3 to 5 respectively illustrate a preferred embodiment of the branch point or collector 10 with inserts 10a, the operation and purpose of which has been described above. FIG. 6 illustrates a preferred embodiment of the lower part of collar 14 with adjacent cooler head 15. As will be seen from FIG. 6 the cooler protective pipe 14a extends downwardly into the cooler head 15 to such an extent that the pipes 16 branch off above the lower marginal area of the protective pipe means.

As will be evident from the above, the present invention brings about a number of important advantages. The heretofore required separator vessel which in the above mentioned example would have to be installed in conduit 9 behind the wall pipe system 8 had to be sufficiently dimensioned in order to be able during the starting of the boiler to separate a steam water mixture according to approximately 40 percent of the maximum continuous output. In contrast thereto, according to the present invention, it is necessary in the cooler exit head 15 merely to separate the water carried along by the steam. Therefore, the head 15 can be dimensioned considerably smaller than a separator vessel. Moreover, the calculating temperature for the head 15 is in view of the preceding injection station 14 defined in an unequivocal manner and lower than conduit 9 in which furthermore a temperature addition is to be considered as a safety factor. The quantity of water obtained during the starting in the cooler exit head 15 flows automatically, i.e., without pump, solely due to gravity back into feed drop pipe 7 when the exit head 15 is arranged at a higher level than the jet apparatus 6, because the pressures in the jet apparatus

6 and in the head 15 are approximately of the same magnitude.

With the boiler structure shown in FIG. 2, the required differences in height are present in particular, the desired heights between the branch point 10 and the lower collectors 8a of the wall pipe system 8 are present with the magnitude required in order to maintain an intensive natural circulation. Thus, with a boiler according to the invention, no circulating pumps are required for the starting and stopping phase. In view of the fact that no circulating devices are necessary with the control circuit pertaining thereto, a considerable simplification with the automation of the starting operation has been made possible by the present invention.

With further reference to jet apparatus 6, it will be understood that this is an inductor device in which the working medium is passed through a jet and whereby a suction is created at the exit side of check valve 12 so the liquid phase separated out at collector means 10 will be drawn through conduit 11 into the supply of working medium leaving the inductor.

A similar device is disposed in conduit 7 at the exit and of conduit 22 but can be smaller because of the smaller amount of liquid to be handled.

The collector means 10, shown in FIGURES 3, 4 and 5, receives the wet steam, or steam-water mixture from the wall pipes 8 via the pipe header 8b and the conduit 9. The liquid phase is guided by trough 10a toward conduit 11 while the vapor phase can pass out the open sides of the trough to conduit 13 through which it flows to jet cooler 15 wherein further water is extracted from the steam before it is delivered to the first superheater stage 17.

It will be appreciated that the described arrangement provides for the supply of dry steam only to the discharge pipe 20 even when first firing the installation or during the period of shutting the boiler down.

It is, of course, to be understood that the present invention is, by no means, limited to the particular arrangements shown in the drawings, but also comprises any modifications within the scope of the appended claims.

What is claimed is:

1. A steam generating installation having serially arranged wall pipes and superheater means and means for supplying working medium to said system for forced circulation therein in a direction from one side of said wall pipes therethrough toward said superheater means, and collector means on the discharge side of said wall pipes operable for diverting the liquid phase of effluent from said wall pipes away from said superheater means while permitting the vapor phase of the effluent to pass on toward said superheater means; said collector means having an inlet connected to the discharge side of said wall pipes, a first outlet in said collector means connected to the inlet side of said superheater means, a second outlet for receiving the liquid phase from said inlet and for directing the liquid phase out of said collector means, said second outlet being displaced angularly in said collector means from said inlet; said collector means also having a guide trough leading from said inlet to said second outlet and being open on the side to divert the liquid phase from said inlet to said second outlet while the vapor phase can pass from said inlet to said first outlet.

2. An installation according to claim 1 which includes an injection cooler between said collector means and said superheater means for further extraction of liquid phase from vapor phase and comprising; a head forming a chamber, an inlet pipe extending vertically downwardly into said chamber from the top, a conduit leading from the bottom of said chamber for the liquid phase, and conduit means for the vapor phase leading from said chamber at a level above the lower end of said inlet pipe.

3. An installation according to claim 2 in which said means for supplying working medium to said system comprises an inductor through which the working medium

5

passes which is at substantially the same level as said collector means, said inductor having a port on which suction is developed by the flow of working medium through the inductor, said port being connected to said collector means to receive the liquid phase therefrom, said injection cooler being located at a higher level than said inductor, and said conduit leading from the bottom of said chamber being connected to the discharge side of said inductor.

4. An installation according to claim 3 in which said conduit leading from the bottom of said chamber is con-

6

nected to a conduit leading from the discharge side of said inductor and said last mentioned conduit comprises a nozzle adjacent the exit end of the first mentioned conduit.

References Cited**UNITED STATES PATENTS**

2,170,345	8/1939	Bailey et al. -----	122—448	XR
2,255,612	9/1941	Dickey.		
2,989,038	6/1961	Schwarz -----	122—406	

KENNETH W. SPRAGUE, *Primary Examiner.*