Dec. 17, 1968 W. KRAUS 3,416,599

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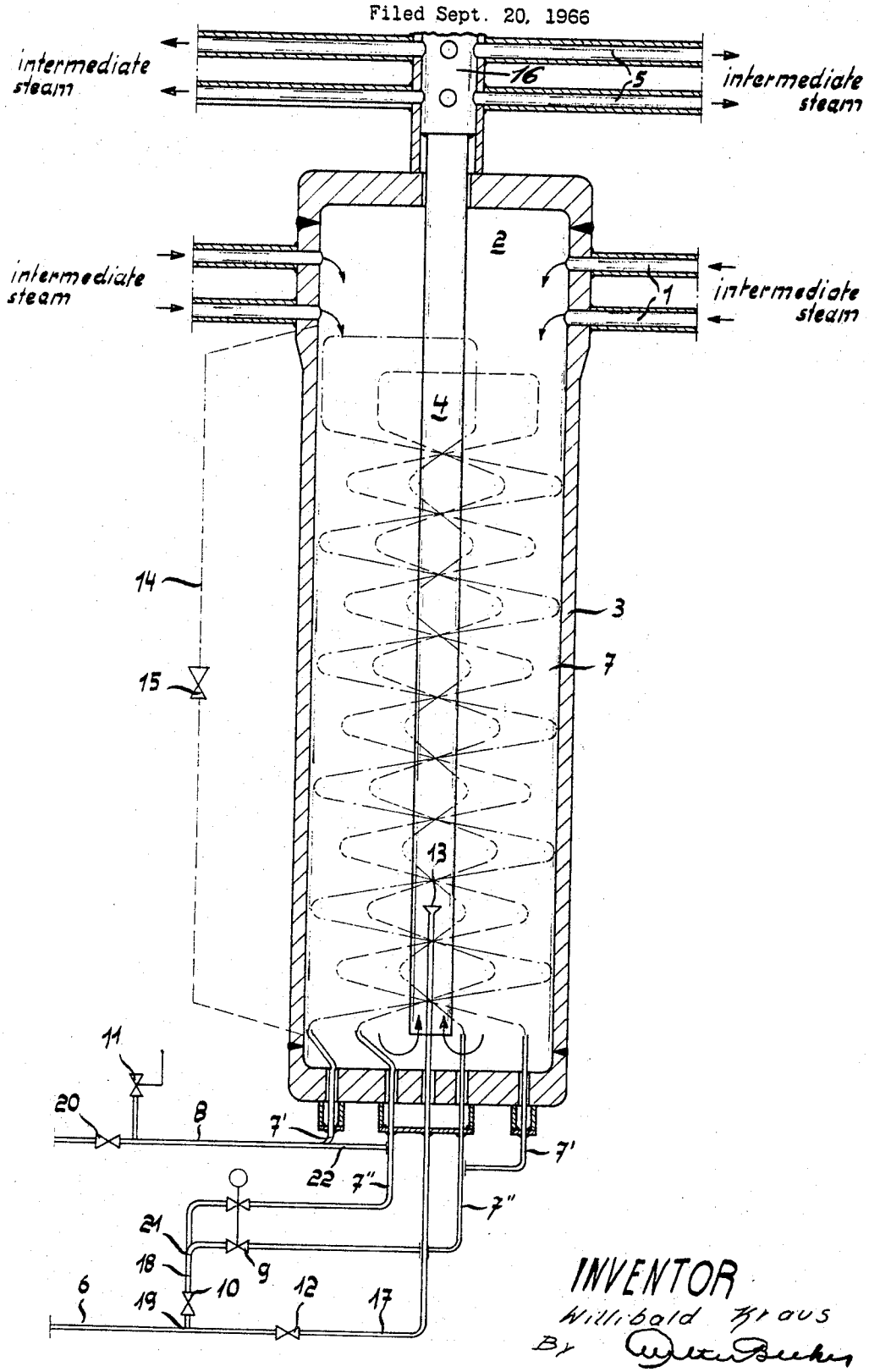
Filed Sept. 20, 1966



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United States Patent Office 3,416,599 Patented Dec. 17, 1968

3,416,599

BRANCH CURRENT HEAT EXCHANGE WITH INJECTION COOLER

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Filed Sept. 20, 1966, Ser. No. 580,673
Claims priority, application Germany, Sept. 23, 1965, St 24,420
9 Claims. (Cl. 165—145)

ABSTRACT OF THE DISCLOSURE

A heat exchanger in which steam is introduced into one end of a tubular housing and is withdrawn from adjacent the other end by a tubular member extending into the housing through the said one end thereof.

Spiral pipes in the space inside the housing and surrounding the tubular member are connected to supply and discharge pipes through said other end of the housing and which supply and discharge pipes have control valves therein.

A water injector is located in the open end of the tubular member and is connected to the supply pipe via a control valve.

The present invention relates to a branch current heat exchanger with injection cooler.

The influencing of the intermediate steam temperature by the injection of water reduces the efficiency of the thermal precision cycle. Therefore, methods are customary according to which the intermediate steam temperature is affected by a heat exchange of the intermediate steam with fresh steam, boiling or a feed water.

With the branch current method, the heat excessively absorbed in the over-dimensioned intermediate superheater is transferred by the intermediate steam to a branch current of the high pressure system. The branch current is branched off within the range of the preheater or already ahead of the steam producer, and within the range of the high pressure superheater, for instance in the injection cooler, is again admixed to the main current. Thus, the branch current is preheated, evaporated, and is superheated and, consequently, is of the same magnitude as the injection water current of an injection cooler.

Frequently, in connection with the employment of a standard method for affecting the intermediate steam temperature, for operational reasons, additionally an emergency section is built in. The employment of such emergency injection section requires a subdivision of the intermediate superheater with corresponding accumulators and connecting pipes which on one hand causes additional costs and on the other hand brings about an additional pressure loss on the intermediate steam side. If, for purposes of avoiding the above-mentioned drawbacks, the so-called emergency injection section were omitted operational drawbacks would be encountered, since for instance it would be necessary to stop the entire arrangement when the main control device fails, and it would also be necessary to redesign the entire arrangement when the heat exchanger is in range and/or the temperature control is incomplete.

It is, therefore, an object of the present invention to provide a branch current heat exchanger with injection cooler, which will overcome the above-mentioned drawbacks.

It is a further object of this invention to provide a branch current heat exchanger as set forth above, which will assure a stable flow in the pipes which are, for instance, arranged parallel to each other.

It is a further object of this invention to provide a branch current heat exchanger as set forth in the preceding paragraphs, which will permit a temperature control by the branch current heat exchanger alone or also by the emergency injection section.

A still further object of this invention consists in the provision of a branch current heat exchanger with injection cooling, which will permit maintaining the entire arrangement in operation even if one of the pipes through which the branch current flows should break.

These and other objects and advantages of the invention will appear more clearly from the following specification in connection with the accompanying drawing diagrammatically illustrating a longitudinal section through a branch current heat exchanger according to the present invention.

The present invention is based on the finding that the about outlined drawbacks of heretofore known arrangements of the type involved can be obviated by correspondingly associating with each other the heat exchanger and injection cooler elements required for carrying out the control operation. More particularly, the present invention is characterized in that the heat exchanger elements and the injection cooler elements are built into a housing common thereto.

The installation of the heat exchanger elements and injection cooler elements in a housing common thereto is possible with the branch current method in connection with which the device according to the present invention can be employed, and this is due to the fact that the branch current through the heat exchanger elements and the injection current are of the same magnitude.

According to a preferred embodiment of the invention, a pipe is introduced into the housing, which pipe ends directly above one of the inner end faces of the housing while between the outer metal of the pipe and the inner surface of the housing there are provided spirally or helically guided high pressure branch current pipes, preheater pipes, evaporating pipes, and overheating pipes; the pipe centrally extending into the housing has a water injection device inserted into its free lower end.

According to a further feature of the present invention, the inlet and outlet pipes for the heat absorbing medium are passed through lower housing confinements.

The connecting pipes through which the heat emanating medium passes are according to the present invention introduced into the annular chamber of the housing at the upper and outer housing confinement at the end face of the housing. After the said emanating heat medium has passed through the heat exchanger section and the injection pipe and a distributor head adjacent said injection pipe, the said medium is discharged through the discharge pipes.

The supply of the heat absorbing medium, which is effected at the bottom side of the housing may be effected according to the invention by one pipe or by a plurality of pipes arranged in parallel to each other, and is continued spirally or helically in the annular chamber formed by the outer surface of the injection pipe and the inner surface of the housing.

In order to assure a stable flow in the pipes which may, for instance, be arranged in parallel to each other, it is possible according to a further feature of the present invention to install a control device in each of the individual branch current feeding pipes, said control devices being controlled in synchronism.

In order to permit the temperature control by the branch current heat exchanger alone or also by the emergency injection section, it is suggested in conformity with the present invention to provide from the main line of the heat absorbing medium, a conduit which com-

municates with the injection device, while a conduit branches off from the branching point and is connected for communication with the pipes of the heat exchanger system. The respective conduits branched off from the main conduit have interposed therein shutoff and control members which make it possible to vary the flow therethrough.

In order to be able in case of a break of a pipe through which the branch current flows, to further maintain the entire device in operation, it is suggested according to the present invention to provide a shutoff valve in the common branch current discharge conduit and to provide a safety valve ahead of said shutoff valve when looking in the direction of flow of the branch current.

When the temperature control is effected by means of the emergency injection device, the present invention also provides to guide the heat emanating medium in such a way that directly above the pipes for the heat absorbing medium, there may be passed toward the outside one or a plurality of conduits which are then directly below said pipes introduced into the interior of the housing.

If the temperature control is effected by means of a heat exchanger, a flowing over of the heat emanating medium through the above-mentioned pipes is prevented by the provision of a shutoff valve.

It has proved particularly advantageous to arrange the emergency injection section behind the heat exchanger path when looking in the direction of flow. It is self-understood that also the reverse way may be followed, namely, the emergency section may, when looking in the direction of flow, precede the heat exchanger section.

Referring to the drawing in detail, the apparatus described therein comprises a housing **3** into which centrally leads the so-called injection pipe **4**. The injection pipe **4** is followed at its upper free end by a distributor head **16** to which are connected the discharge pipes **5** for the heat emanating medium. The pipes **1** through which passes the heat emanating medium are introduced into housing **3** above the pipes **7** forming the heat exchanging section. At the lower end of the housing **3** there are provided the corresponding conduits for the supply and discharge of the branch current and for the emergency injection. The emergency injection device **13** extends into the housing chamber to such an extent that it is surrounded by the lower end of the injection pipe **4**.

The intermediate steam passes through pipes **1** into the annular cross sectional chamber **2** formed by the outer surface of the injection pipe **4** and the inner surface of housing **3**. The intermediate steam then passes through said chamber **2** and the subsequent heat exchanger section **7**, and after being reversed in the lower housing portion passes into the injection pipe **4** and flows further to the distributor head **16** from where it passes into the intermediate steam discharge pipes **5**. The branch current is fed through the pipeline **6** which at **19** is subdivided into a conduit **17** and a conduit **18**. Conduit **17** serves as supply conduit for the emergency injection device **13**, whereas conduit **18** as shown in the drawing is at **21** again divided into two parallelly arranged pipes **7'**. The pipes **7'** are within the heat exchanger formed spirally and helically in counter current to the heat emanating medium and leave the housing in the form of pipes **7''** while being united at **22** to a common discharge conduit **8**.

In order to be able to employ the branch current heat exchanger with injection cooler according to the present invention as heat exchanger and also as injection cooler, the various conduits have interposed therein control devices, shutoff devices, and safety devices in conformity with the respective purposes for which the device according to the invention is intended. For the conduit **17** which is connected to the injection device **13** merely the insertion of a control device **12** is necessary. By installing a shutoff valve **10** ahead of each heat exchanger and by further installing a shutoff valve **20** behind each heat exchanger while providing therebetween safety valve

means **11**, the heat exchanger can be separated from the system. If a pipe **7** should break, the installation can be maintained in operation. The control of the intermediate over-heating temperature will then, after opening the injection control valve **12**, be effected by means of the emergency injection section. For this emergency, for purposes of reducing the pressure loss in the intermediate steam, it is possible to provide one of a plurality of connecting lines **14** with shutoff valves **15**. The emergency injection section may also be employed in addition to the branch current heat exchanger, if a higher cooler output is desired.

It is, of course, to be understood, that the present invention is, by no means, limited to the particular embodiment of the invention illustrated in the drawing, but also comprises any modification within the scope of the appended claims. Thus, while in the illustrated embodiment of the invention, the emergency injection section controls the branch current heat exchanger, also the reverse arrangement is possible, which means that the emergency injection section may be arranged ahead of the branch current heat exchanger. The injection device **13** will then be installed merely in the other end of the injection pipe **4** while the entry of steam will be effected through pipe **5** and the discharge of the steam will be effected through pipe **1**. The pipe **7** will then be passed through in the reverse direction.

I claim:

1. In a heat exchanger; a tubular housing having closed first and second ends, a tubular member substantially centrally extending into said housing through the first end thereof and having one end portion open and arranged in spaced relationship to the second end of the housing, the other end portion of said tubular member outside said housing being provided with at least one opening, at least one further opening in said housing adjacent said first end thereof, steam supply and discharge pipes connected to said openings, pipe means arranged spirally within said housing between the outside of said tubular member and the inner wall of said housing and adapted to be connected at one end to a supply of fluid and at the other end to a discharge conduit, and fluid injection means extending through the lower end of said housing into said one end of said tubular member for selectively injecting water thereinto.

2. An arangement according to claim **1**, in which said pipe means are of a helical shape and include high pressure branch current pipes and preheater pipes and also include evaporating pipes and superheater pipes.

3. An arrangement according to claim **1**, which includes first and second conduit means connected to opposite ends of said pipe means for respectively supplying a heat absorbing medium thereinto and conducting a heated-up heat absorbing means therefrom, said first and second conduit means extending through the second end of said housing.

4. An arrangement according to claim **2**, which includes an annular chamber defined by the first end of said housing and the adjacent outer wall of said tubular member as well as the upper portion of said pipe means, said opening in said housing communicating with said annular chamber.

5. An arrangement according to claim **2**, in which the first end of said tubular member includes a distributor head mounted thereon into which said other end of said tubular member extends and having outlet means communicating with the opening in said other end of said tubular member and to which outlet means the respective said pipe is connected.

6. An arrangement according to claim **3**, in which said pipe means comprises a pair of individual pipes in parallel and said first conduit means comprises a pair of conduits, each connected to a respective one of said individual pipes, a control valve means respectively arranged in each of said last mentioned conduits for controlling the

flow of fluid therethrough, means for controlling said valve means in synchronism, and said second conduit means including a second conduit connected to each of said individual pipes.

7. An arrangement according to claim 3, in which said first conduit means includes a main line adapted to be connected with a source of a heat absorbing medium, and in which said first conduit means includes a first branch line communicating with said fluid injection means and a second branch line communicating with said pipe means, first control valve means in said first branch line, second control valve means in said second branch line, and shutoff valve means in said second branch line between said second control valve means and said main line.

8. An arrangement according to claim 3, which includes a discharge line common to and communicating

with said second conduits, a shutoff valve in said discharge line, and safety valve means connected to said discharge line between said last mentioned shutoff valve and said second conduits.

9. An arrangement according to claim 2, which includes auxiliary conduit means leading from the interior of said housing at one end to the outside of the housing and then to the interior of the housing at the other end and a shutoff valve in said auxiliary conduit.

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