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BOILER CIRCULATING SYSTEM AND PUMP

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3 Sheets-Sheet 1

Fig. 1

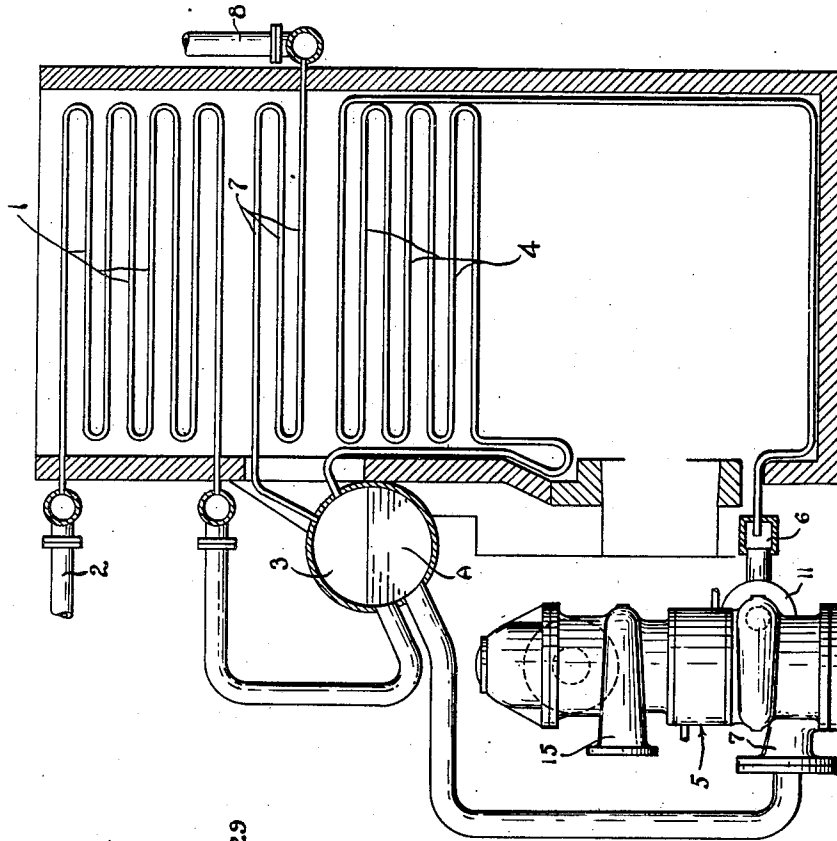
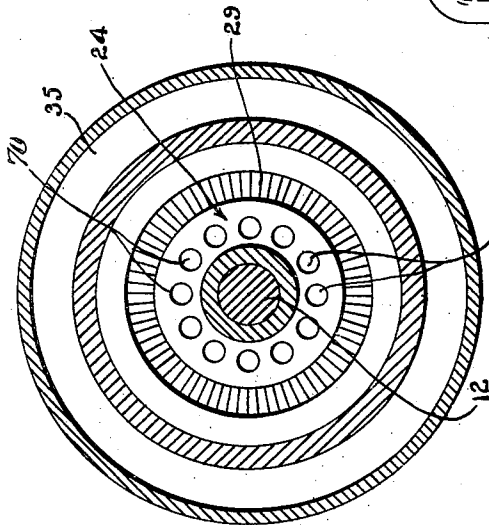


Fig. 3

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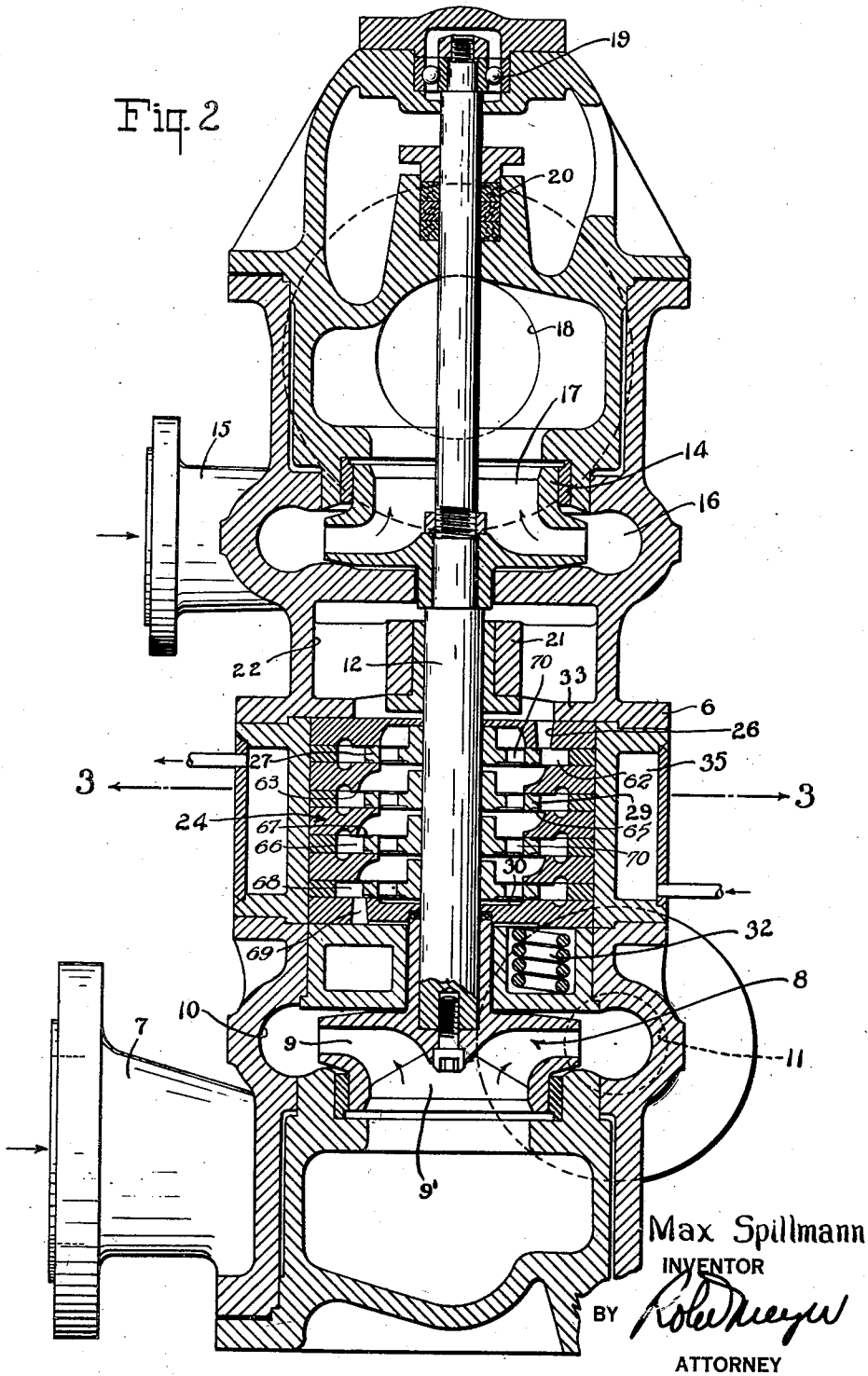
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3 Sheets-Sheet 2



Jan. 27, 1942.

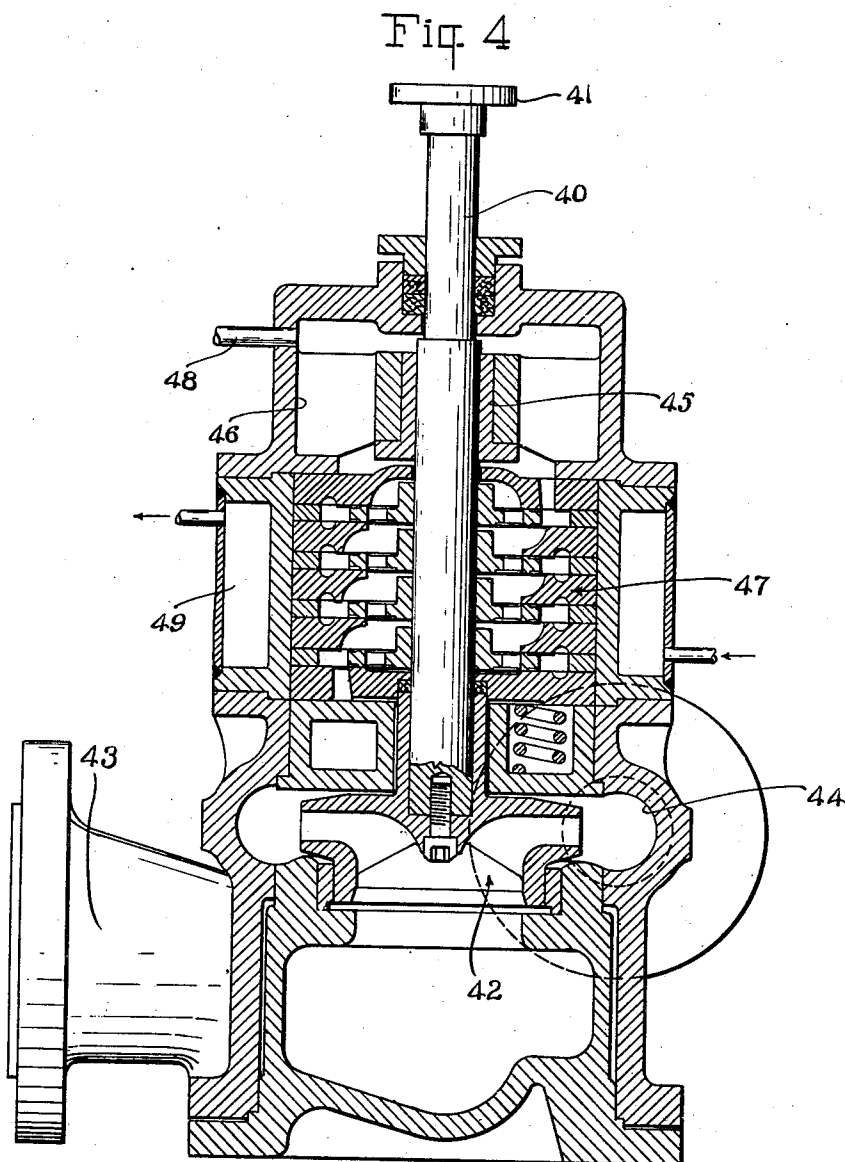
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3 Sheets-Sheet 3



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BOILER CIRCULATING SYSTEM AND PUMP

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7 Claims. (Cl. 103—105)

This invention relates to boiler feed systems and more particularly to a forced circulating system for circulating the water through the boiler and a pump for providing such circulation.

In forced circulation boiler feed systems, such as the "La Mont," etc., the water is circulated through the economizer or part of the boiler tubes of a boiler and is picked up from this set of tubes by a circulating pump and forced under increased pressure through the evaporator section or remaining tubes of the boiler. The tubes in the boiler of such a system are arranged, together with the circulation arrangement of the water, in such a manner that each tube receives the correct amount of water according to its steam generating capacity, as determined by its position in the system.

Such forced circulation system boilers have many advantages over natural circulation types, especially in installations where maximum steam generation per unit of space and weight is required, which facts have been recognized in the field. However, considerable difficulty has been experienced in providing an efficient, practical pump for circulating the water at the temperatures and pressures necessary to provide the proper operation of such a forced circulation of water through the boiler.

The primary object of the present invention is to provide a pump which will meet all of the requirements of such a boiler feed system and which is particularly designed to overcome the packing and leakage difficulties which have been prevalent in pumps heretofore employed in such systems.

More specifically, the present invention comprises a circulating pump and a pump of the vortex type, that is, a pump of low capacity capable of developing a high pressure, in the same casing, with the vortex type pump interposed between the circulating pump and the stuffing box on the driving end of the shaft. The vortex type pump is of such nature as to be capable of developing a pressure equal to or in excess of the discharge pressure of the circulating pump and has its discharge arranged to form a counter pressure for preventing leakage from the circulating pump.

With these and other objects in view, as may appear from the accompanying specification, the invention consists of various features of construction and combination of parts, which will be first described in connection with the accompanying drawings, showing a boiler circulating

system and pump, of the preferred form embodying the invention, and the features forming the invention will be specifically pointed out in the claims.

5 In the drawings:

Figure 1 is a diagrammatic view of a forced circulation system for steam generation.

Figure 2 is a vertical section through the circulating pump structure.

10 Figure 3 is a cross-section on the line 3—3 of Figure 2.

Figure 4 is a vertical section of a modified form of the circulating pump.

Referring more particularly to the drawings, 15 in Figure 1 a steam generating unit of "La Mont" forced circulation type is shown. In this system the boiler feedwater enters the economizer or first section 1 of the boiler through the feed pipe 2, which has connection with any approved type of boiler feed pump (not shown). The water utilized for the generation of steam first passes through the economizer or first section 1 of the tubes, leaving the outlet of this section of tubes and entering the steam drum 3. From the steam 20 drum 3 the water, which is at such time under a relatively high temperature and pressure, developed by the boiler feed pump (not shown), is drawn from the drum by means of the circulating pump 5, which is shown in vertical section in 30 Figure 2 of the drawings. The circulating pump 5 discharges the water through a distributing head 6, if desired, into the evaporator section 4 of the tube system of the boiler. From the evaporator section 4 of the tube system of the boiler 35 the steam and any water left is forced under the action of the circulating pump 5 back into the steam drum A, from which the steam either passes through a superheater 7 to the steam outlet 8 of the steam generator or boiler structure or, if desired, may pass directly to the steam outlet 8 without passing through a superheater. Any water which passes from the evaporator section 4 of the tube system of the boiler, into the drum A, is picked up by the circulating pump 5 45 and again forced through the evaporator section 4.

The principle and operation of this and analogous types of forced circulation steam generator plants is well-known and has been used in practice, where desirable. While the present invention relates generically to such a system, in its particular features it relates to the circulating pump 5.

The circulating pump 5 is shown in vertical section in Figure 2 of the drawings. It is partic-

ularly designed to provide an efficient, economical pump, capable of handling the water for forced circulation through the evaporator tube section of the boiler under the temperatures and pressures at which such water is received from the steam drum 3.

The pump structure 5 includes a casing, which has the inlet 7 for the water to be circulated through the evaporator section 4 at its bottom. The water to be circulated is picked up by the circulating pump structure 8 through the impeller inlet 9' and discharged by the impeller into the volute 10 and out through the outlet 11 into the evaporator tubes. The impeller 9 is driven by a shaft 12, which extends longitudinally through the casing 6 and has a turbine or driving impeller 14 mounted thereon in spaced relation to the driven pump impeller 9. The turbine or driving impeller 14 is driven by water or other liquid under suitable pressure, from any suitable source (not shown), such as the power station water supply. The driving fluid enters the turbine structure through the inlet 15, passing from the volute 16 into and through the impeller 14 in the direction indicated by the arrows A. It leaves the turbine impeller 14 through the central eye 17 and then passes out to any suitable location (not shown) through the discharge outlet 18. Suitable bearings and packing structures shown at 19 and 20 are provided for the tail or driving end of the shaft 12 and a bearing structure 21 is interposed between the driven pump impeller 9 and the driving turbine impeller 14. This stuffing box 12 is contained in a closed chamber 22, which chamber receives any leakage from the turbine structure.

Owing to the fact that the water handled by the circulating pump impeller 9 is at a very high temperature and under a high pressure, leakage of such water about the shaft 12 is difficult to control with any known approved type of packing, and as a consequence the circulating pumps of such forced circulation steam generator units have been unsatisfactory in the past. The present invention includes the provision of a low capacity, high pressure pump on the shaft 12 and driven thereby, located between the pump impeller 9 and the bearing 21. This low capacity high pressure pump may be of any preferred construction. However a centrifugal pump of what is commercially known as the vortex or turbine type many kinds of which may be purchased upon the open market is shown at 24 in the drawings. This vortex or turbine type centrifugal pump 24 is made up of any desired number of stage sections, indicated by the bracket and numeral 24, depending upon the pressures developed by the pump impeller 9. The first stage of the vortex or turbine type centrifugal pump 24 has its suction through suitable ports 26 into the chamber 22 so that the low capacity, high pressure vortex type pump receives the small quantity of water necessary for its effective operation by leakage from the turbine structure of the pumping unit. In operation the water enters the first stage of the pump 24 through the passage 26, where it is picked up by the blades of the impeller 27 and is squeezed laterally from the impeller through the discharge passage 62 and through the inlet passage 63 to the second stage impeller 29. From the second stage impeller 29 the water is discharged through the lateral discharge passage 65 into the third stage impeller 66 through its lateral inlet 67 and so on through the subsequent stages of the pump until it is finally discharged

by the last or final stage 68 through the outlet 69. The openings 70 in the various impellers are merely pressure balancing ports and have nothing to do with the pumping flow of water through the pump. The discharge from the final stage of the pump 24 is directed in any suitable manner, such as by the channel grooves 30, so that it will provide a counter-acting pressure against any leakage from the circulating pump structure 8 and thus prevent the leakage of water from the circulating pump structure 8. It is understood, of course, that the pump structure 24 is capable of developing a pressure equal to or greater than the pressure developed by the circulating pump structure 8.

Springs 32 are carried by the casing 6 and engage against the lowermost or final spacer section of the final stage of the pump 24, and act to press the various stage sections of the pump 24 together in such manner as to compensate for expansion and contraction within the pump 24. A suitable flange 33 is provided in the casing which engages the outer side of the uppermost stage section of the pump 24.

If it is so desired, a cooling jacket 35 may be provided about the pump 24, which may have suitable inlets and outlets for circulating water, to provide cooling of the pump structure 24.

While a particular type of vortex pump is shown in the drawings, it is to be understood that the particular construction of such pump forms no part of the present invention and that any one of the many types of vortex pumps on the market may be employed in lieu of that shown, without departing from the spirit of the present invention.

In Figure 4 of the drawings, a modified construction of the circulating pump is shown, which is similar in all respects to the preferred form shown in Figures 2 and 3 of the drawings, excepting only that the turbine structure is eliminated. This modified form of circulating pump may be driven by any suitable type of driver, such as an electric motor or the like, which is connected to the driving shaft 40 in any suitable manner, as by a coupling 41. The circulating pump structure 42 is placed at the end of the shaft 40 remote from the driving end, that is, remote from the end of the shaft to which the driver is connected, and it receives its suction through any suitable type of suction inlet 43. This suction inlet 43 is connected to the steam drum of the steam generator structure. The pump 42 discharges through its discharge 44 back to the evaporator and/or radiant section of the tubes of the steam generator. The shaft 40 has a bearing 45 mounted thereon and enclosed in a suitable chamber 46. Interposed between the pump structure 42 and the bearing 45 is a low capacity, high pressure pump structure 47 of the same type as the pump structure 24. Like the pump 24, this pump structure 47 is capable of developing a pressure equal to or in excess of the pressure developed by the circulating pump 42. Its discharge is arranged to discharge against leakage from the pump 22 to set up a counter-acting pressure for preventing leakage of the high temperature, high pressure liquid from the pump structure 42. Since the low capacity, high pressure pump 47 cannot receive its liquid to be acted upon by its impellers from the driver, as in the structure shown in Figure 2 of the drawings, a suitable water supply, from any suitable source, is provided, as shown at 48, which delivers a relatively small quantity of water to the cham-

ber 46. This water enters the inlet of the pump structure 47 and is acted upon by this pump. Any water which passes from either of the pumps 24 or 47 through into the pump structure 42 will serve as make-up water for the steam generating system and will be absorbed in the water circulated through the system. As in the structure shown in Figure 2, a cooling jacket 49 may be provided for the pump structure 47, although the use of such a cooling jacket is optional and depends upon the conditions in each respective installation.

It will be understood that the invention is not to be limited to the specific construction or arrangement of parts shown, but that they may be widely modified within the invention defined by the claims.

What is claimed is:

1. In a circulating pump for forced circulation steam generators, a casing, a circulating pump in said casing, a driving shaft having a driving end, a stuffing box about said shaft between said circulating pump and driving end, and a high pressure multi-stage pump between said circulating pump and stuffing box and being capable of developing a pressure equal to or greater than the discharge of said circulating pump said casing having ports and passages to direct the discharge from said high pressure pump to set up a counter-acting pressure to prevent leakage from said circulating pump.

2. In a circulating pump for forced circulation steam generators, a casing, a circulating pump in said casing, a driving shaft having a driving end, a stuffing box about said shaft between said circulating pump and driving end, and a multi-stage low capacity pump between said circulating pump and stuffing box and driven by said shaft, said multi-stage low capacity pump being capable of developing a pressure equal to or greater than the discharge of said circulating pump said casing having ports and passages to direct the discharge from said multi-stage low capacity pump to set up a counteracting pressure to prevent leakage from said circulating pump.

3. In a circulating pump for forced circulation steam generators, a casing, a circulating pump in said casing, a driving shaft for said circulating pump, a driver, a stuffing box between the circulating pump and driver, a low capacity high

pressure pump within said casing between the circulating pump and stuffing box and having its final discharge pressure directed against leakage of the circulating pump to provide a counter-acting pressure against leakage from the circulating pump.

4. In a circulating pump for forced circulation steam generators, a casing, a circulating pump in said casing, a driving shaft for said pump, a turbine on said driving shaft and in said casing for driving said circulating pump, and a multi-stage low capacity pump in said casing between said turbine and circulating pump and receiving leakage from said turbine said casing having ports and passages to direct the discharge from said low capacity pump to set up counter-acting pressure fluid against leakage from the circulating pump.

5. In a pump for forced circulation steam generators, a casing, a circulating pump in said casing adapted to receive fluid at its suction at high pressures, a driving shaft, a stuffing box between said shaft and casing, and a plurality of pump impellers between said circulating pump and stuffing box and being capable of developing a pressure equal to or greater than the discharge of said circulating pump and having their total discharge directed against leakage of the circulating pump to set up a counteracting pressure against leakage from the circulating pump.

6. In a pump, a casing, an impeller in said casing for receiving liquids at high inlet pressures and temperatures, and a plurality of impellers in said casing said casing provided with ports and passages to direct the final discharge from said impellers for developing counteracting pressures against leakage of said first-named impeller.

7. In a pump, a casing, a shaft, sealing means between said shaft and casing, an impeller in said casing for receiving liquid at high inlet pressures and temperatures, and an impeller between said first-named impeller and sealing means and being capable of developing a pressure equal to or greater than the discharge pressure of said first-named impeller said casing having ports and passages to direct the discharge from said intermediate impeller to set up a counteracting pressure against leakage from said first-named impeller.

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