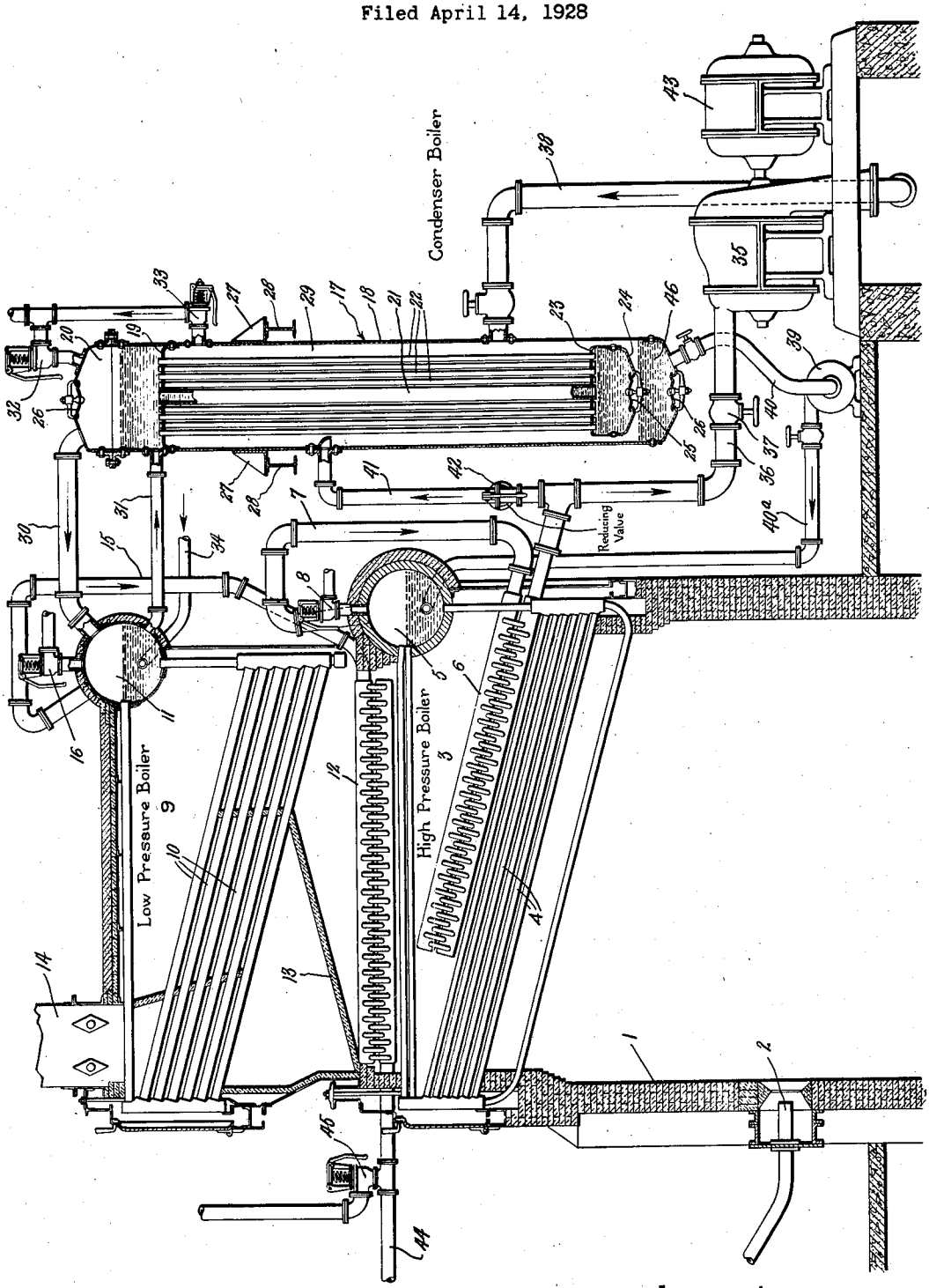
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POWER INSTALLATION

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POWER INSTALLATION

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In certain industrial plants, the condition is met with that there is a substantial demand for steam for power purposes, i. e., for driving prime movers such as steam turbines, and also a substantial demand for relatively low pressure steam for heating purposes.

To meet these conditions, an ideal arrangement is to generate high pressure steam in the boiler or boilers, utilize such steam in a suitable engine or engines such as a high pressure turbine or turbines, and then utilize the exhaust steam from the engine or engines for heating purposes, the engine or engines serving, so to speak, as reducing valves for the steam. Such an arrangement, however, requires a high percentage of make-up water for the boiler or boilers, and in instances where the supply of raw water available is of a character unsatisfactory for use in a high pressure boiler, the ideal arrangement just referred to becomes impractical because of the cost of treating the raw water to render it suitable for use in a high pressure boiler, for, as a matter of fact, a high pressure boiler must be supplied with practically pure water. Because of the foregoing conditions, there are industrial plants where it has been considered not feasible to install and utilize high pressure boilers.

The object of my invention is to provide an improved power installation well adapted for use in industrial plants where conditions as described above are met with, whereby I am enabled to utilize a high pressure boiler or boilers and provide economically high pressure steam for power purposes and low pressure steam for industrial or heating purposes.

For a consideration of what I believe to be novel and my invention, attention is directed to the following description and claims appended thereto.

In the drawing the figure is a diagrammatic view partly in section of a power installation embodying my invention.

Referring to the drawing, 1 indicates a boiler setting to which heat may be supplied in any suitable manner, oil burners 2 being indicated in the present instance. In the hot zone of the boiler setting is located a high pressure boiler 3, the boiler tubes being indicated at 4, the steam drum at 5 and the superheater at 6. The steam drum 5 is connected to superheater 6 by a conduit 7. 8 indicates a safety valve for steam drum 5.

Located in the low temperature zone of the boiler setting is a low pressure boiler 9, the tubes of the low pressure boiler being indicated at 10, the steam drum at 11, and the superheater at 12. The flow of the gases over boiler tubes 10 is directed by baffle plates 13, which are shown in the present instance as dividing tubes 10 into three sections, the final section being directly adjacent to the furnace stack 14. By this arrangement the low pressure boiler tubes serve to cool the furnace gases to a quite low temperature. Low pressure boiler drum 11 is connected to superheater 12 by a conduit 15. 16 indicates a safety valve for steam drum 11.

Associated with the low pressure boiler and connected to it is a boiler condenser or reboiler comprising one or more units, one of such units being indicated at 17. It comprises an outer shell 18 provided with a tube plate 19 adjacent its upper end which serves to provide in the upper end of the casing a water and vapor space 20 which in substance is a steam drum. Connected with tube plate 19 is a larger central tube 21 surrounding which are a number of rows of small boiler tubes 22. The lower ends of tubes 21 and 22 are connected to a tube plate 23 which forms the top wall of a water space or drum 24. Water drum 24 is provided with an opening closed by a removable head 25. Tubes 21 and 22 and drum 24 are supported entirely by tube plate 19. This arrangement leaves them free to expand and contract. Casing 18 is provided with openings at its upper and lower ends which are closed by the removable cover plates 26. The unit as a whole may be supported in any suitable way. In the present instance it is shown as being supported by feet 27 which rest on transversely extending I-beams 28. Surrounding tubes 21 and 22 beneath tube plate 19 is a chamber 29 which may be termed the vapor chamber. Drum 20 stands about in line with steam drum 11 of the low pressure boiler and is connected to it

at its upper and lower ends by pipes 30 and 31. This arrangement serves to equalize the pressures in the boiler drum 11, and drum 20, and also to equalize the water levels therein. Connected with drum 20 and with chamber 19 are suitable safety valves 32 and 33. 34 indicates a conduit through which feed water is supplied to boiler drum 11.

35 indicates a steam engine here illustrated in the form of a steam turbine having its admission end connected by a conduit 36 to the discharge side of superheater 6. In conduit 36 is a suitable valve means 37 for regulating the admission of elastic fluid to the turbine. The exhaust conduit of the turbine is connected by conduit 38 to chamber 29. 39 indicates a boiler feed pump the suction side of which is connected by a conduit 40 to the lower end of casing 18 and the discharge side of which is connected by a conduit 40ª to boiler drum 5. 41 is a branch conduit connecting the discharge side of superheater 6 to chamber 29, a suitable reducing valve 42 being located in the conduit 41. 43 indicates a generator driven by turbine 35.

Connected to the discharge side of superheater 12 is a conduit 44 which is used to convey low pressure steam to any suitable point or points of consumption. Connected to the conduit 44 is a suitable safety valve 45.

In operation steam flows from boiler drum 5 through conduit 7, superheater 6 and conduit 36 to turbine 35 where it is utilized to generate power. From turbine 35 the exhaust steam flows through conduit 38 to chamber 29 of the boiler condenser where it is condensed and collects in the form of water in the bottom of casing 18 as is indicated at 46. From the bottom of casing 18 the condensate is withdrawn by means of the feed water pump 39 and supplied again to the high pressure boiler. By this arrangement, it will be seen that there is provided a closed system for the high pressure boiler, all the steam withdrawn from the boiler being condensed after it comes from the turbine and returned to the boiler. The high pressure boiler is thus provided always with pure water. A small amount of water will be lost from this closed system and from time to time a suitable amount of make-up water must be added. However, the amount required is small and the quantity of pure water actually required can be readily provided and introduced into the system at any suitable point.

The low pressure boiler is supplied with raw water from any suitable source through conduit 34. It circulates first in the low pressure boiler when it is heated to a considerable extent and from the low pressure boiler it is supplied through conduit 31 to the reboiler or condenser-boiler unit or units. In each of the condenser boiler units there will be a continual circulation of water down through tube 21, and up through the surrounding tubes 22. This is because tube 21 being larger than tubes 22, the water in it will be less quickly heated and hence will be somewhat heavier than the water in tubes 22. As a result circulation will be effected by convection. The exhaust steam supplied to chamber 29 through conduit 38 is condensed therein and in condensing serves to boil the water in tubes 22 and generate low pressure steam along with that generated in the low pressure boiler 9. The low pressure steam generated is conveyed from low pressure boiler drum 11 through conduit 15 and superheater 12 to conduit 44, and thus to the point or points of consumption for low pressure steam.

With the described arrangement, it will be seen that the exhaust steam from turbine 35, instead of being used directly for industrial and heating purposes is used in the boiler condenser unit or units as a heating medium for generating steam from raw water, the exhaust steam being condensed in the boiler condenser and providing a supply of pure water for the high pressure boiler.

The raw water is supplied first to the low pressure boiler 9 and in circulating through it the scale forming material will settle out in the tubes 10 and hence will be removed before the water is supplied to the condenser boiler. This arrangement is desirable because it is substantially easier to remove the scale forming materials from the low pressure boiler 9 than it would be to remove them from the boiler condenser unit or units.

In case the demand for low pressure steam is in excess of that which can be supplied by the low pressure boiler and that generated by the exhaust from the turbine, the pressure reducing valve 42 is operated to admit steam through pipe 41 directly to the condenser boiler casing, thereby augmenting the steam generated by the condenser boiler. Also in case the engine 35 is shut down for repairs or other purposes, high pressure steam can be admitted through pipe 41 directly to the condenser boiler for generating low pressure steam.

In accordance with the provisions of the patent statutes, I have described the principle of operation of my invention, together with the apparatus which I now consider to represent the best embodiment thereof, but I desire to have it understood that the apparatus shown is only illustrative and that the invention may be carried out by other means.

What I claim as new and desire to secure by Letters Patent of the United States is:

1. In combination, a boiler setting, a high pressure boiler and a low pressure boiler mounted in said setting, an engine utilizing steam from said high pressure boiler, a condenser boiler connected in parallel with said low pressure boiler, a conduit for conveying exhaust from said engine to said condenser boiler, and water supply conduit means and

steam discharge conduit means for the low pressure boiler and the condenser boiler.

2. In combination, a boiler setting, a high pressure boiler and a low pressure boiler mounted in said setting, an engine utilizing steam from said high pressure boiler, a condenser boiler connected to said low pressure boiler, a conduit for conveying exhaust from said engine to said condenser boiler, water supply conduit means and steam discharge conduit means for the low pressure boiler and the condenser boiler, and a conduit for conveying steam from the high pressure boiler directly to said condenser boiler.

3. In combination, a high pressure boiler, a closed system utilizing steam from said high pressure boiler, said closed system including a condenser boiler in which the steam is condensed, a low pressure boiler connected in parallel with said condenser boiler, and water supply conduit means and steam discharge conduit means for the low pressure boiler and the condenser boiler.

4. In combination, a high pressure boiler, a closed system utilizing steam from said high pressure boiler, said closed system including a condenser boiler in which the steam is condensed, a low pressure boiler connected in parallel with said condenser boiler, a conduit for supplying water to said low pressure boiler, and water supply conduit means and steam discharge conduit means for the low pressure boiler and the condenser boiler.

5. In combination, a boiler setting, a high pressure boiler located in a higher temperature zone of said setting, a low pressure boiler located in a lower temperature zone of said setting, a closed steam utilizing system connected to said high pressure boiler, said system comprising an engine and a condenser boiler connected to the exhaust end of said engine, conduit means connecting the boiler condenser in parallel with the low pressure boiler, and water supply conduit means and steam discharge conduit means for the low pressure boiler and the condenser boiler.

6. In combination, a boiler setting, a high pressure boiler and a low pressure boiler mounted therein, a closed system utilizing steam from said high pressure boiler, said closed system including a condenser boiler in which the steam is condensed, conduits connecting the steam spaces and the water spaces of the low pressure boiler and the condenser boiler, and conduit means for conveying water to and steam away from said low pressure boiler and said condenser boiler.

In witness whereof, I have hereunto set my hand this 13th day of April, 1928.

ARTHUR R. SMITH.