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J. McCALLUM ET AL
STEAM POWER INSTALLATION

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Fig. 1.

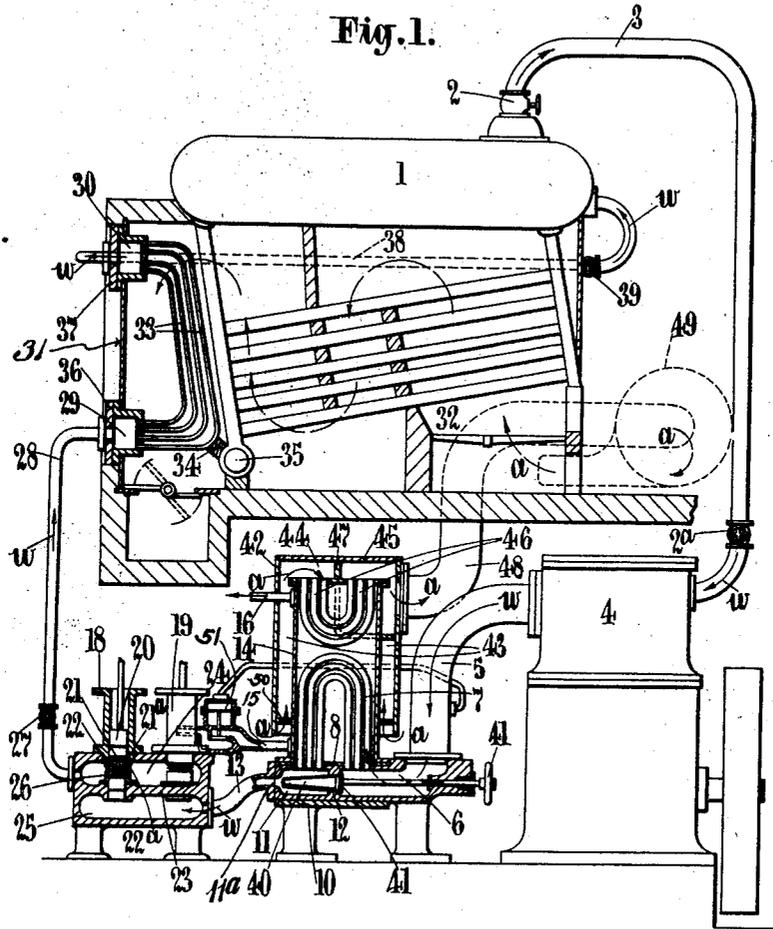
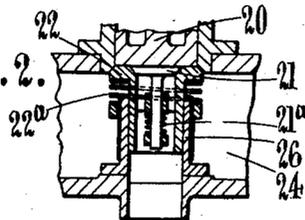


Fig. 2.



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STEAM-POWER INSTALLATION.

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This invention relates to steam power installations of the type set forth in the prior specification No. 97,472 filed 25th March, 1926, and its object is to improve the construction and the efficiency thereof.

According to the present invention, the steam power installation comprises, in combination, a steam generator, a steam power unit, means whereby the exhaust steam from the said unit is subjected simultaneously to positive heat abstraction and to the compressive effect of fresh quantities of further exhaust steam so as to be partially condensed to form a mixture of steam and water, and pumping means whereby the said mixture is passed into the water space of the steam generator, the said pumping means having a pump barrel (or each pump barrel) constituted by a valve structure, comprising automatic suction and delivery valves normally held closed by resilient means, the plunger coming into contact with the valve structure at or near the end of each outward stroke so as to force open the delivery valve and completely expel the fluid drawn into the said barrel through the suction valve at the preceding inward stroke.

According to a further feature of the invention, we provide a steam power installation in which the exhaust steam from the steam power unit of the installation passes into a chamber or chambers communicating, by means of tubes acted on by cooling water, with a second chamber or chambers having or each having a reduced outlet, the exhaust steam being thereby partially condensed to form a mixture of steam and water, and the water in the mixture entraining the steam therein as it issues through the said outlet and passes to pumping means, whereby the mixture is returned to the water space of a steam generator.

The means to partially condense the steam preferably comprises two sets of U tubes, through one of which sets the exhaust steam is drawn, and through the other of which cool air can be passed, the arrangement being such that about the two sets of U tubes cooling water can be constantly circulated.

The mixture of steam and water resulting from the partial condensation of the exhaust steam may be passed to the steam generator either directly or by way of an auxiliary heater. The said heater comprises a number of manifolds connected in series

with one another by tubular members exposed to the furnace gases of the steam generator, the mixture of steam and water aforesaid being led into the manifold at one end of the series and being withdrawn from the manifold at the other end.

Preferably the air passed through the means to partially condense the steam is afterwards forced by a fan of known design into the combustion space of the steam generator.

In order that the invention may be fully understood, reference will now be made to the annexed drawing which shows, by way of example, one embodiment thereof.

On the drawing,

Fig. 1 is a diagrammatic (partly sectional) view of the installation.

Fig. 2 is a sectional detail.

The numeral 1 designates the upper drum of a steam generator of the Babcock and Wilcox type. From the said upper drum live steam is passed by way of the valves 2 and 2^a and the pipe 3 to the steam engine or motor 4. The steam exhausted from the engine 4 passes by the pipe 5 into a chamber 6, after which it passes through a set of inverted U tubes 7 mounted on a circular tube plate 8. This plate rests on a base 10 which is divided diametrically into two chambers 6 and 11 by a partition 12. The tubes 7 are arranged in the plate 8 so as to bridge the partition 12 and form the normal means of communication between the chambers 6 and 11. By this device the exhaust steam entering the chamber 6 is compelled to pass through the U tubes 7 before being allowed to escape from the other chamber 11 by the reduced outlet 11^a thereof. The tubes 7 are enclosed by a metal casing 14 through which cooling water is constantly circulated by means of inlet and outlet pipe connections 15 and 16 respectively.

The mixture of steam and water formed in the cooling apparatus is withdrawn through a pipe 13 by means of pumping elements 18 and 19 of the plunger type, either or both of which may be put in operation. For the sake of clearness, reference will be made to the pumping element 18 which is shown in section. The element 18 comprises a plunger 20, and the lower end of the corresponding pump barrel is formed by concentric suction and delivery valves 21 and 22 respectively. The barrel of the pumping

element 18 is mounted on a casing 23 having an upper chamber 24 and a lower chamber 25 communicating with each other through the suction valve 21, the said pump barrel, and delivery valve 22. On the delivery valve 22, a bevelled seating is provided for the suction valve 21 as shown, and a larger seating of the same kind is formed on the adjacent annular edge of the pump barrel for the delivery valve 22. The said delivery valve is slidably mounted in a gland 26 in the casing 23, and a compressed spring 22^a is provided between the delivery valve 22 and the said gland 26 for the purpose of holding the said delivery valve firmly against its seating on the end of the pump barrel. The suction valve 21 is slidably carried inside the delivery valve 22 and held against its respective seating by a coiled tension spring 21^a. During the upward stroke of the pump plunger 20, the suction valve 21 is drawn upwards against the pressure of its tension spring 21^a so as to admit the mixture of steam and water to the pump barrel. Throughout this stroke the delivery valve 22 is held against its seating by its compressed spring 22^a. On the downward stroke of the plunger 20, the delivery valve 22 is forced off its seating against the pressure of the compressed spring 22^a and the aforesaid mixture is forced out of the pump barrel through the delivery valve 22, the suction valve 21 being held closed by its tension spring 21^a.

The stroke of the plunger 20 is such that slightly before the end of the outward stroke, the end of the plunger comes into contact with the plane or flush upper surface of the valve structure constituted by the concentric suction and delivery valves 21 and 22, thereby completely expelling all the mixture of steam and water, drawn into the pump barrel at the preceding stroke. The valve structure aforesaid, under the action of the spring 22^a, follows up the plunger 20 until the structure is brought to rest by contact of the delivery valve 22 with its bevelled seating on the pump barrel.

From the delivery chamber 24 of the casing 23 the mixture of steam and water passes through the valve 27 and pipe 28 to a feed water heater comprising a pair of manifolds 29 and 30 carried by a plate 31 forming part of the back wall of the steam generator furnace 32. The manifold 29 constitutes the supply chamber of the heater and the manifold 30 the delivery chamber, and the two manifolds are connected together by a series of tubes 33. Additional support is given to the tubes 33 by a bridge 34 extending between the tubes and the lower drum 35 of the steam generator. In order that the feed water heater may be readily inspected or repaired, the covers 36, 37 of the manifolds 29, 30 are made removable.

The mixture of steam and water passes from the manifold 30 of the feed water heater by way of a pipe 38 which communicates through a valve 39 with the water space of the upper drum 1 of the steam generator. This completes the cycle of the working fluid. Throughout the drawing this cycle is shown by arrows *w*.

In place of the heater specified above, any known economizer may be employed. To enable the exhaust steam or a portion thereof to flow directly to the pumping elements 18 and 19 without passing through the inverted U tubes 7, a by-pass 40 controlled by a screw down valve 41 is provided.

The apparatus for partially condensing the exhaust steam serves as a preheater for air for combustion purposes in the steam generator furnace 32. It will be observed that the casing 14 of the aforesaid apparatus is surrounded by a jacket 42 which is of wood or like material, the said jacket being arranged so as to provide an air space 43. The said air space is open at its lower end at 50 and, at its upper end, communicates with an air chamber 44 formed by a cover 45 which encloses the ends of the U tubes 46, which latter are similar in construction to the cooling water U tubes 7 but oppositely arranged. With this arrangement, air is drawn in at the open end 50 of the jacket 42 and by a partition 47 is caused to pass through the U tubes 46 before escaping from the jacket by an outlet pipe 48 connected to a suction and delivery fan 49. The air in its passage through the U tubes 46 is somewhat raised in temperature by the transfer of heat from the cooling water in the casing 14. From the fan 49 the heated air is discharged into the furnace 32 of the steam generator.

In order that the rate of heat abstraction may be regulated in accordance with the variations of the exhaust steam pressure, the flow of cooling water through the pipe 15 is regulated by means preferably comprising a control valve provided with a diaphragm 51 which is located in a valve chamber connected by a pilot tube with the exhaust steam pipe 5 of the engine 4 so that the valve will be controlled automatically by the action of the diaphragm under the varying pressures of the exhaust steam.

The cooling water is circulated by a centrifugal pump (not shown) of known design the said pump discharging the cooling water through the pipe 16 controlled by a relief valve (not shown).

Moreover, the cooling water, if fresh and otherwise suitable, may be used for the boiler feed.

The whole installation is compact and may be arranged in conjunction with any well known type of steam generator.

Having now fully described our inven-

tion, what we claim and desire to secure by Letters Patent is:—

1. A steam power installation comprising a steam generator, a steam power unit, means for subjecting the exhaust steam simultaneously to positive heat abstraction and to the compressive effect of fresh quantities of further exhaust steam, the aforesaid steam being thereby partially condensed to form a mixture of steam and water, said means comprising a chamber into which exhaust steam from the steam power unit passes, a set of U tubes, a second chamber communicating with the first chamber by means of the said set of U tubes, a second set of U tubes, means for circulating cooling water around said sets of U tubes, means whereby cool air is drawn through said second set of U tubes and forced into the combustion space of said steam generator, and a reduced outlet for said second chamber, and pumping apparatus for passing the said mixture into the water space of said steam generator.

2. A steam power installation comprising a steam power unit, a steam generator, means for subjecting the exhaust steam from said power unit simultaneously to positive heat abstraction and to the compressive effect of fresh quantities of further exhaust steam, the aforesaid steam being thereby partially condensed to form a mixture of steam and water, said means comprising a chamber into which exhaust steam from the steam power unit passes, a set of U-tubes, a second chamber communicating with the first chamber by means of the said set of U-tubes, a second set of U-tubes,

means whereby cool air is drawn through said second set of U-tubes and forced into the combustion space of said steam generator, pumping apparatus for passing the said mixture into the water space of said steam generator, and an auxiliary heater for said mixture comprising a number of boxes and tubular members connecting said boxes in series with one another.

3. A steam power installation comprising a steam generator, a steam power unit, means for subjecting the exhaust steam simultaneously to positive heat abstraction and to the compressive effect of fresh quantities of further exhaust steam, the aforesaid steam being thereby partially condensed to form a mixture of steam and water, said means comprising a chamber into which exhaust steam from the steam power unit passes, a set of U-tubes, a second chamber communicating with the first chamber by means of the said set of U-tubes, a second set of U-tubes, means whereby cool air is drawn through said second set of U-tubes and forced into the combustion space of said steam generator, an auxiliary heater for said mixture comprising a pair of troughs, a plate carrying said troughs and adapted to form part of the back wall of the steam generator furnace, removable covers for said troughs, and C-shaped tubes connecting said troughs in series, and pumping apparatus for passing the said mixture into the water space of said steam generator.

In testimony whereof we affix our signatures.

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