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BOUNDARY WALL STRUCTURE FOR EXHAUST STEAM CHAMBER

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2 Sheets-Sheet 1

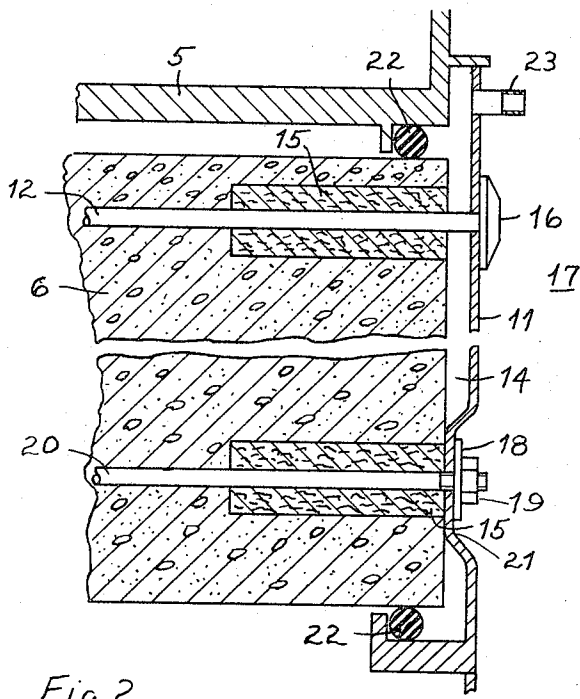
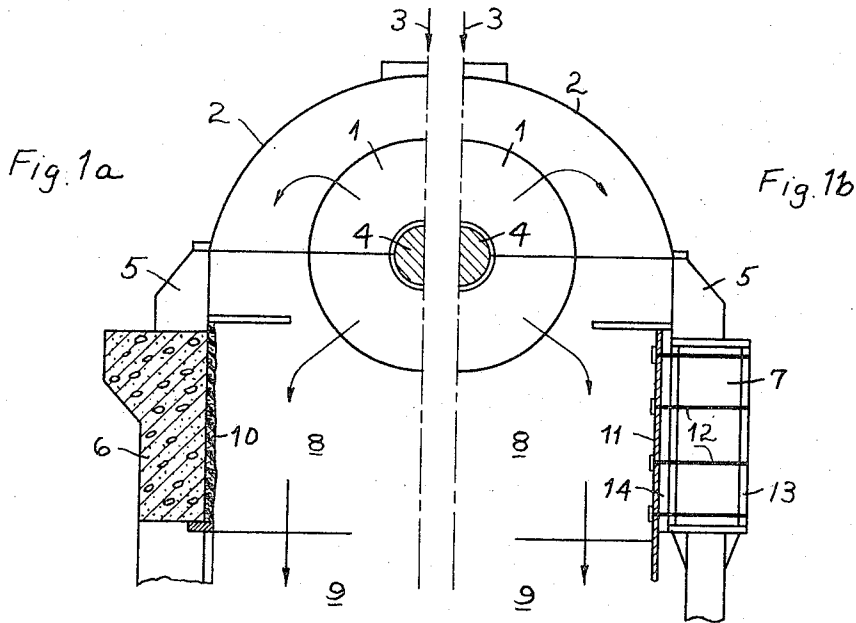


Fig. 2

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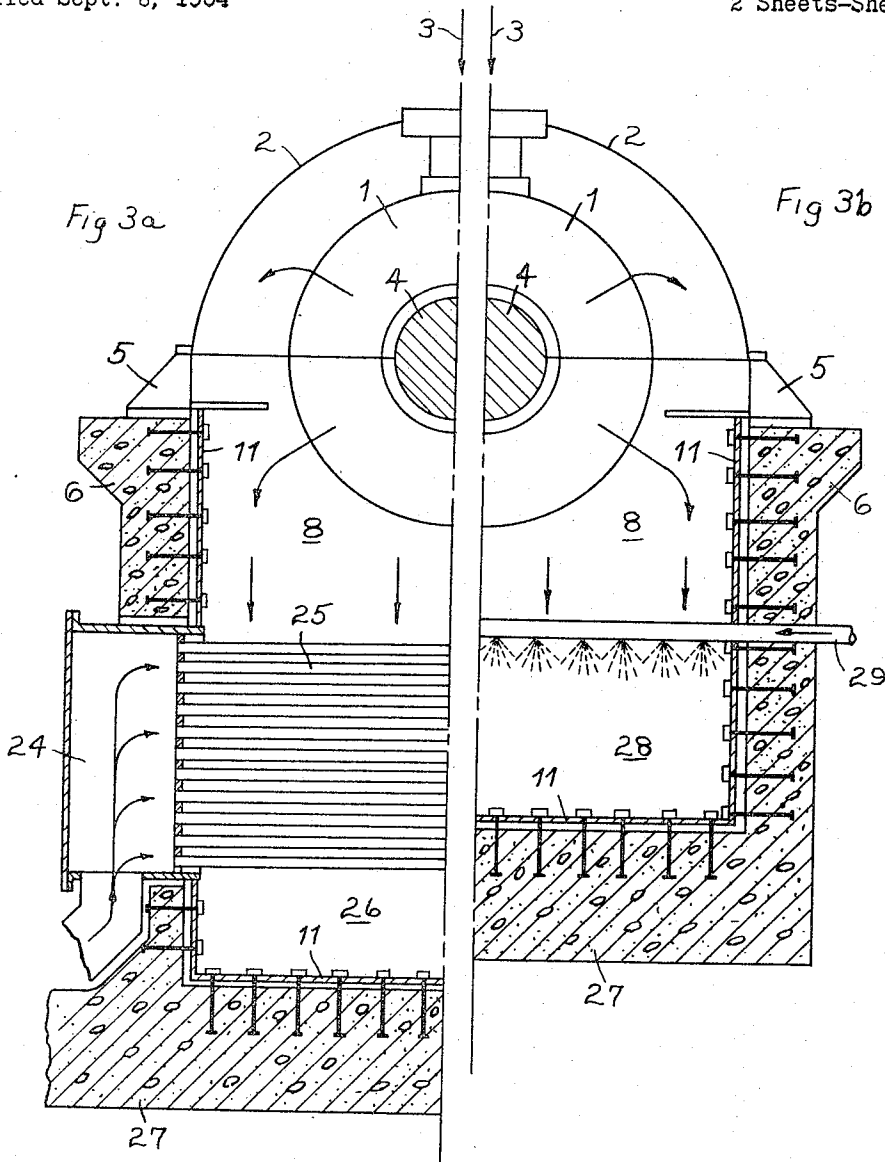
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BOUNDARY WALL STRUCTURE FOR EXHAUST STEAM CHAMBER

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1 Claim. (Cl. 253—39)

The present invention is directed to an improvement in a boundary wall construction for a low-pressure chamber arranged behind a low-pressure steam turbine on the exhaust steam side, and which is operated at an under-pressure or at a slight over-pressure. One understands by it to be the exhaust chamber with the exhaust steam connection, and if necessary, also the condenser, or a line to a heat exchanger in which steam is condensed.

Low-pressure exhaust chambers are made, if at all possible, of grey iron. With increasing powers for the turbine group, these chambers have assumed increasingly greater dimensions, so that it is no longer economically possible to make them from grey iron. They are therefore fabricated from sheet metal plates which are welded together.

Since the unit output of steam turbines has increased in the course of time, and will further increase in the future, manufacture of these exhaust chambers is meeting with increasing difficulties. The very great dimensions require tooling machines with correspondingly wide production halls and powerful hoisting devices, which lead to considerable investment costs.

Transportation of the difficult-to-handle parts in the factory and even on the road becomes more and more difficult and more expensive. Even highways are only a partial solution because of limitations in height at underpasses and feed roads to and from the highway are rather narrow.

The primary object of the present invention is to avoid the disadvantages of past constructions for these exhaust chambers and resides in the novel concept of utilizing the supporting foundation of the turbine itself to provide the exhaust chamber, the chamber being constituted by a break-through i.e. an opening through the foundation which connects with the exhaust steam passage from the turbine and which is lined in a suitable manner to serve as the boundary walls of the chamber.

Various embodiments in accordance with the invention are possible and these will be described and are illustrated in the accompanying drawings wherein:

FIG. 1a is a half radial section through the exhaust chamber of a low-pressure unit of a steam turbine wherein the boundary wall of the chamber is constituted by a coating applied to the wall of the break-through in a concrete foundation;

FIG. 1b is also a half radial section similar to FIG. 1a but showing a somewhat different construction wherein the chamber walls are established by means of an arrangement of sheet steel plates secured in the proper positions by means of bolts set into the foundation;

FIG. 2 is a view drawn to an enlarged scale showing the details of construction of an embodiment utilizing sheet steel plates for the boundary walls of the exhaust chamber;

FIG. 3a is a half radial section through the exhaust chamber of the low-pressure unit of a steam turbine using sheet steel plates as the boundary walls and which further includes a condenser of the water tube type; and

FIG. 3b is also a half radial section similar to FIG. 3a

but wherein the condenser unit is of the spray chamber type.

In all of the views presented in the drawings, like structural parts have been given the same reference numerals.

With reference now to FIG. 1a in particular, the low-pressure unit of the steam turbine is indicated at 1, and this is covered by a housing part 2. Steam enters the turbine at 3, is expanded and delivers power to shaft 4 which is journalled in the main frame 5 of the machine. Frame 5 is supported on a concrete foundation 6. The exhaust steam flows through a break-through 8 provided in the foundation and thence through pipe 9 to the condenser unit below the same. In FIG. 1a, the condenser has been omitted. The break-through 8 in the foundation serves as the exhaust chamber for the steam and the boundary walls of such chamber are established by a coating 10 applied to the concrete, the coating being, for example, a plastic material which is sprayed on or glued on, or applied in any other known manner so as to establish a steam-tight lining. The coating material 10 should preferably be elastic, abrasion-resistant and of low thermal conductivity. The elasticity characteristic is necessary so that the steam-tightness is preserved even though the foundation becomes deformed or develops cracks at the break-through. The coating should also be abrasion-resistant so as to be able to withstand erosion which might otherwise take place by virtue of the passing water droplets. The low thermal conductivity serves to prevent unnecessary heating of the underlying machine foundation. The coating 10 can be used both with concrete and also with steel foundations.

In the embodiment of FIG. 1b, the steam-tight lining for the break-through 8 of the foundation is established by a lining sheet 11 of metal. In this case, the foundation 7 is seen to be of steel construction, and the liner sheets 11 are secured in place and anchored to the foundation by means of set bolts 12 secured to box girders 13 of the steel foundation. The liner sheets 11 are preferably not applied directly against the steel foundation, whether the latter be concrete or steel, but rather a certain distance is observed so that a gap 14 is established therebetween which is usually filled with air. This gap prevents direct heat transmission by conduction from the hot sheet to the underlying foundation. If an air gap cannot be provided because of manufacturing reasons, gap 14 is preferably filled with a material having a low thermal conductivity coefficient. Such material should also be elastic in order to be able to yield to thermal expansions of the liner sheets 11, or to deformations of the foundation. However, the filler material in the gap must also be porous for reasons to be explained later.

FIG. 2 illustrates at a somewhat enlarged scale one suitable manner in which the sheet steel liner serving as walls of the exhaust chamber may be secured in place at the breakthrough in a foundation made of concrete. The set bolts 12 are so anchored in the concrete foundation 6 that a considerable portion of the shanks of these bolts—in the direction towards the sheet steel 11—is not embedded in the concrete. These non-embedded portions of the set bolts 12 have a length considerably longer than the width of the gap 14, and the spaces between the concrete and the non-embedded shank portions of bolts 12 are then filled with a packing material 15 which permits elastic deformations of the bolts 12 over those portions of their total lengths which are represented by the non-embedded length portions. The head 16 of one such bolt 12 is secured to the liner sheet 11, for example, by welding.

Gap 14 is normally operated at ambient pressure, which thus also acts on one side of the liner sheet 11;

the other side of sheet 11 is subjected to action of the steam pressure, which is below ambient pressure with the condenser connected in series. If the exhaust steam is used further, it is occasionally also above ambient pressure. The forces resulting from the pressure differences which obtain at opposite sides of the liner sheeting 11 are transmitted by the set bolts 12 to the machine foundation 6. When the steam condenses, the lower pressure prevails in the interior 17, and the bolts are stressed for tension in this case. Thermal expansions in the liner sheeting 11 can produce forces which stress the bolts 12 for bending. In both cases, the non-embedded shank portions of the bolts, which can also be provided in a steel foundation, has an advantageous effect.

In the embodiment shown in the upper part of FIG. 2, subsequent mounting of the liner sheeting 11 is only possible if the bolt head 16 is detachable. Another possibility is shown in the lower part of FIG. 2 where it will be seen that liner sheeting 11 is secured to set bolt 20 by means of a washer 18 and nut 19. If the sheeting is flat, a spacer ring, not illustrated, is inserted in this type of assembly in order to obtain the correct width for gap 14. The liner sheeting 11 can also be provided at the pass-through aperture provided in the sheeting for set bolt 20 with a dish-shaped depression 21. This has the advantage that the sheeting can easier deform as a result of thermal expansions without stressing the set bolts excessively for bending; besides, it yields a simple support on the foundation. If necessary, an insulating intermediate layer can be provided at the contact point of the depression 21 with the foundation to avoid direct heat transmission.

Anchoring of set bolts in a steel foundation presents no particular problems. In a concreted foundation, the set bolts are arranged in their proper positions, surrounded with the packing 15, then the foundation is poured and the liner sheeting 11 applied.

The liner sheeting 11 has additional advantages; it can serve in the production of the foundation by functioning as a form for the concrete. For this purpose, the entire metal sheeting 11 construction is set up on the site, set bolts are brought into proper positions and the sheeting covered on the outside with an elastic insulating material whose thickness corresponds to the desired width of gap 14. This latter material is compressed slightly during pouring of the concrete foundation, but it retains approximately its original state during drying when the concrete shrinks. In such an embodiment, the set bolts can be provided with heads, as illustrated in the upper part of FIG. 2.

When the sheet construction is set up at the site provided for the turbine installation, the lining sheet is joined tightly with the adjoining steam carrying parts, i.e. it is welded or screwed into place. This sealing is very important, particularly in condensation plants, in order to prevent any access of air. A check for tightness is therefore indispensable before the plant is put into operation. For this purpose, elastic inserts 22 are arranged at suitable locations, which seal the gap 14 against the surrounding atmosphere. Air, a halogen gas, or water are fed under pressure through at least one connecting pipe 23 which passes through sheeting 11 into gap 14 to check the tightness of the plant. This can also be done

if the gap is filled with insulating material, but the latter must be porous, as mentioned above, to permit the impressed fluid medium to flow through.

Any machine foundation which surrounds a steam carrying chamber that is operated at an under-pressure or at a slight over-pressure can be constructed to provide an exhaust chamber with boundary walls in the above described manner. Primarily, the foundation break-through or opening for the discharge of the exhaust steam is used for the exhaust chamber, but the condenser which is directly associated with the foundation break-through in accordance with the constructions shown in FIGS. 3a and 3b can also be used. Both of the latter figures show a lining, or boundary wall in the form of metallic sheeting 11 but this could just as well be a steam-tight coating similar to the coating 10 seen in FIG. 1a.

In accordance with the embodiment of FIG. 3a, the water chamber 24 bears with the cooling tubes 25 of a surface condenser 26 on foundation 27, which at the same time forms the widened shell and adjoins immediately the foundation break-through 8. The boundary wall is constructed in the same manner as shown in FIG. 2. The embodiment of FIG. 3b employs a mixer type condenser 28 characterized by the water spray tubes 29.

The construction of the foundation for the turbine in such a manner that a lined opening through the foundation serves as an exhaust steam chamber results in considerable savings in both weight and costs. The metallic sheet type liner can be substantially thinner than was possible in the conventional self-supporting construction for the lower part of the turbine casing. The sheet type liner need not be ribbed since stresses caused by difference in pressure are taken over by the set bolts and transmitted to the machine foundation. No transport of over-sized machine parts is necessary since everything can be assembled at the job site. If the condenser is also included in the above described construction of the boundary walls for the exhaust steam chamber established within the foundation, there is an additional gain in the necessary basement height and heavy housing becomes unnecessary.

We claim:

In a steam turbine installation wherein a steam turbine machine is installed on a foundation and includes a low-pressure steam turbine unit, the improvement wherein said foundation includes an opening extending downwardly therethrough connected to receive the exhaust steam from the low pressure turbine, said opening being provided with a steam tight lining and which serves as the boundary walls of an exhaust steam chamber, said lining being constituted by an elastic plastic material applied to the wall surface which defines said opening and which is vapour-proof, abrasion-resistant and has a low thermal conductivity characteristic.

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