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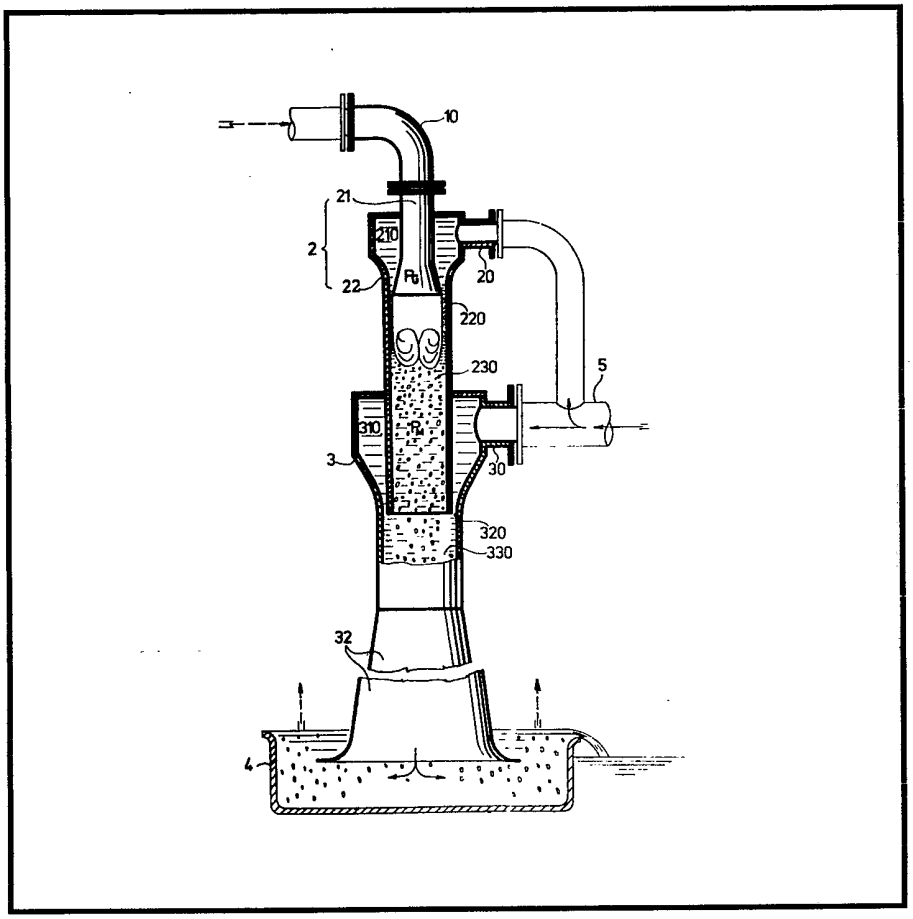
(54) Jet pump for sucking-off gases

(57) Arrangement for sucking-off gases, creating by means of water supplied to an annular nozzle 220 surrounding the outlet of the gas conduit 21, a hydraulic jump and a vortex, mixing thereby thoroughly the gas and water and sucking off the mixture by another annular water nozzle 320 into an ejector 3 extending into a diffuser 32, terminating below the level of water in a vessel, where separation of the gas and water is achieved.



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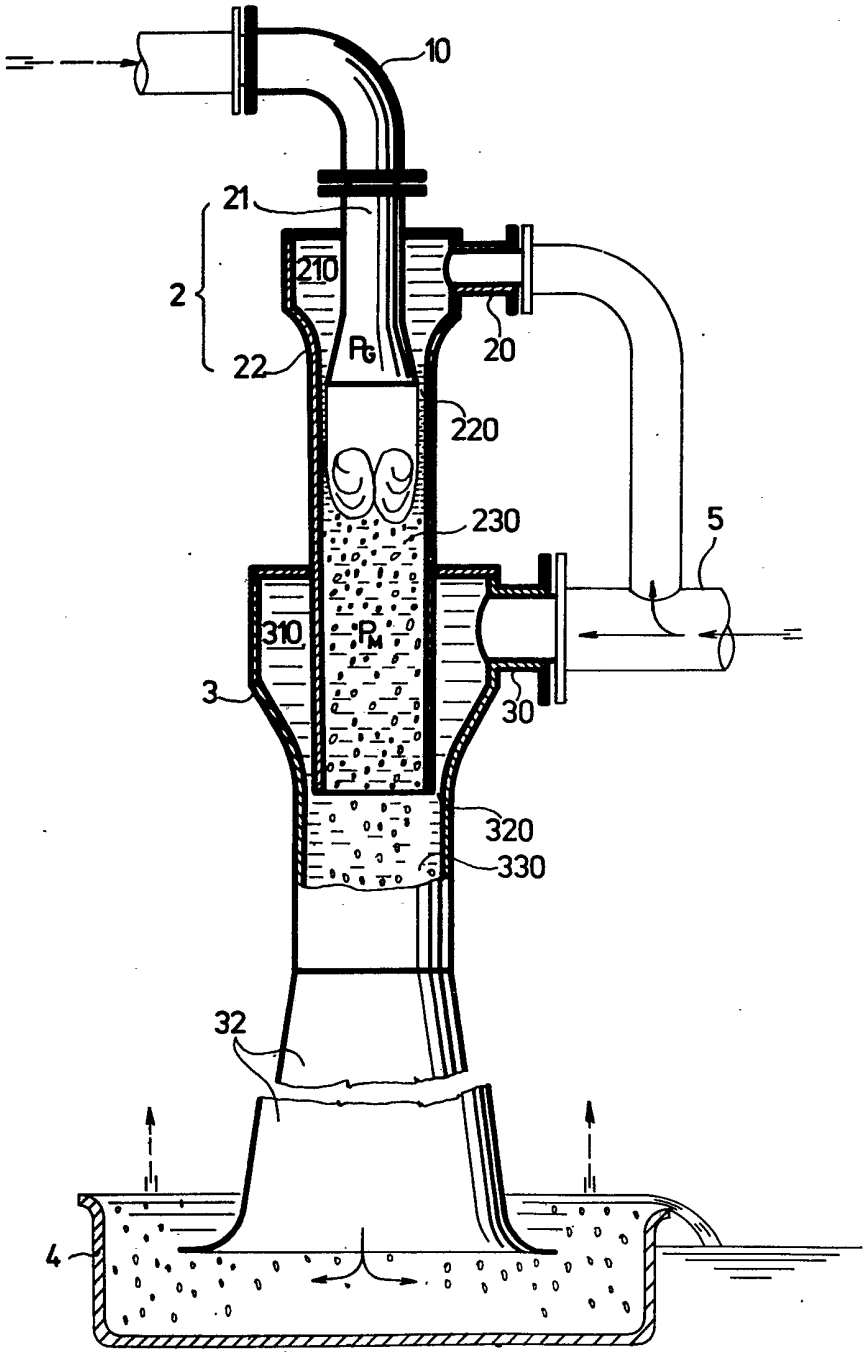

SPECIFICATION

Arrangement for sucking-off gases

The invention relates to an arrangement for sucking-off gases, particularly suitable for sucking-off air from a steam turbine condenser.

A number of solutions for sucking-off gases is known, which can be generally divided into jet arrangements and positive displacement arrangements. Jet arrangements usually are provided with one or several jets of a working liquid, which liquid is suitably mixed with the gas and due to the momentum transmitted by the working liquid to the mixture, this mixture is brought to a higher pressure level, which level is in arangements operating like exhaustors usually atmospheric pressure.

Another example of a novel jet arrangement for conveying gases is a channel with an annular hydraulic jump used in arrangements where for the mixing a large interphase surface between the gas and water is required as is for instance the case for aeration of water in outlets of water dams.

From recently proposed displacement arrangements for sucking off gases an arrangement having a rotating sealing water annulus and an eccentrically rotating system of working chambers is known.

All mentioned arrangements have some drawbacks. Jet arrangements have a low efficiency, which may be defined as a ratio of the product of the gas mass flow rate of the gas and of the difference of pressure potentials in spaces, between which the gas is conveyed, to the product of the mass flow rate and the required pressure potential of the working liquid. A drawback of the displacement arrangements is that they are too complex and expensive.

It is an object of this invention to provide an arrangement which would to a high degree eliminate these drawbacks and which would be relatively simple and have a substantially higher efficiency. The arrangement for sucking-off gases according to this invention comprises a gas nozzle, a tubular body and an ejector. The nozzle extends into the tubular body and forms within the space of the tubular body a liquid chamber connected to a liquid supply conduit, an annular nozzle and a chamber of a hydraulic jump. This tubular body extends in turn into the ejector, where it forms a chamber connected to a supply conduit, an annular nozzle and a mixing chamber, this ejector, terminating a diffuser, extending by the lower extremity of the diffuser below the level of liquid in a vessel.

An advantage of the arrangement according to this invention is its simplicity and high efficiency.

An embodiment of an arrangement for sucking-off gases according to this invention is shown, by way of example, in the accompanying diagrammatic drawing in front elevation with parts in longitudinal section, connected to a condenser of a steam turbine.

The illustrated arrangement for sucking-off gases comprises a mixing part 2, connected by a connecting conduit 10 to a condenser of a steam turbine, and an ejector 3, terminating by its diffuser 32 in a vessel 4. The mixing part 2 comprises an air nozzle 21, into which the connecting conduit 10 opens and which extends by its widened lower extremity into a chamber 230 of the hydraulic jump, formed within the lower internal part of the tubular body 22. The ejector 3 is arranged so that it forms in its upper part a chamber 310, in the central part a mixing chamber 330 and in the lower part said diffuser 32. The interconnection of the mixing part 2 and of the ejector 3 is arranged so that the lower part of the tubular body 22 extends into the chamber 310 of the ejector 3.

A water chamber 210 is provided within the upper part of the tubular body 22 provided with a socket 20 for a water supply conduit 5. The chamber 310, in the upper part of the ejector 3 is provided with a supply socket 30 connected with a lower branch of the water supply conduit 5. The air nozzle 21 is situated in the water chamber 210 coaxially and so, that an annular gap, forming an annular nozzle 220 is provided between the external surface of this air nozzle 21 and the internal surface of the water chamber 210. Both the annular nozzle 220 and the air nozzle 21 terminate in the upper part of the chamber 230 of the hydraulic jump. This chamber 230 of the hydraulic jump opens into the mixing chamber 330 coaxially and so that between the external surfaces of the chamber 230 of the hydraulic jump and the internal surface of chamber 310 an annular gap is formed, representing an annular nozzle 320.

Both the annular nozzle 320 and the chamber 230 of the hydraulic jump terminate in the upper part of the mixing chamber 330 of the ejector 3. The diffuser 32 terminates by its widened lower extremity below the water level in the vessel 4.

The operation of the arrangement according to this invention utilizes of a hydraulic jump for homogenizing by its vortex the mixture of water and air in the mixing part 2 and ensures an efficient transfer of the thus formed mixture by the action of the ejector 3 to the level of atmospheric pressure. The air sucked off from the condenser of a steam turbine via the connecting conduit 10 passes through the air nozzle 21 into the mixing part 2 at a level where the nozzle 21 terminates. Water supplied by the supply conduit 5 passes through the annular nozzle 220 at high speed. By maintaining conditions for generation of a hydraulic jumnp determined by the pressure

condition in the water chamber 210 and in the chamber 230 of the hydraulic jump, i.e. upstream and downstream of the hydraulic jump by interaction of the annular water jet determined by the dimensions of the annular nozzle 220 with the wall of the chamber 230 of the hydraulic jump and the amount of air supplied to the hydraulic jump by the air nozzle 21 a highly turbulent vortex is created characterizing the hydraulic jump, which suckes-on and perfectly mixes the incoming air at a pressure P_0 with water passing through the annular nozzle 220 and compresses the formed mixture to a separating pressure P_M. The process taking place in the chamber 230 of the hydraulic jump has a highly dissipative character and is connected with a substantial loss of the mechanical energy of water flowing from the annular nozzle 220. The effect of the hydraulic jump is therefore in the arrangement for sucking-off gases according to this invention limited to the creation of a homogenous mixture of water and air and to the achievement of a suitable separating pressure P_M so as to secure an optimum efficiency of the ejector 3. The overall efficiency of the arrangement is thus higher than in conventional ejectors, reducing thereby substantially the consumption of working water. The mixture of water and air supplied to the ejector 3 from the chamber 230 of the hydraulic jump is in the mixing chamber 330 of the ejector 3 accelerated on the basis of the momentum of water passing through the annular nozzle 320 of ejector 3, into which nozzle 320 water is supplied from chamber 310 connected to the supply conduit 5 of water.

A further additional homogenization of the original mixture of air with water passing through the annular nozzle 320 of ejector 3 is achieved. The formed mixture with increased kinetic energy and specific mass is through the lower part of the mixing chamber 320 brought to the diffuser 32. Due to the geometric arrangement of this diffuser 32 the kinetic energy is gradually transformed to static pressure, which together with the relative hydrostatic height secures the discharge of the mixture of air and water over the lower part of the diffuser 32 below the water level in the vessel 4. A separation of air from the mixture of water and air supplied via the diffuser 32 takes place in the water in the vessel 4 and air escapes through the surface of the water in the vessel 4 into the atmosphere.

The invention can be utilized not only in condensers of steam turbines, but everywhere, where non-condensable gases have to be conveyed and simultaneously compressed.

CLAIMS

1. Arrangement for sucking-off gases comprising a gas nozzle, a tubular body and an ejector, said nozzle extending into the tubular body so as to form between the external surface of the nozzle and the internal surface of the upper part of the tubular body a first water chamber, a water supply conduit opening into said first water chamber, the lower extremity of the gas nozzle forming together with the internal wall of the tubular body an annular water nozzle, the space below the gas nozzle and the annular water nozzle in the tubular body forming a chamber for a hydraulic jump creating thereby a thorough mixture of water and gas, the lower part of said tubular body extending into the ejector, forming between its external surface and the internal surface of the ejector a second water chamber, a water supply conduit opening into said second water chamber, an annular nozzle formed between the lower extremity of the tubular body and the internal wall of the ejector, the ejector extending in its lower part into a diffuser, a vessel provided below said diffuser, the lower extremity of the diffuser extending into said vessel below the level of water therein.

2. Arrangement for sucking-off gases, constructed, arranged and adapted to operate substantially as herein described, with reference to and as shown in, the accompanying drawing.

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