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(54) Liquid metal pump for chemical reactor heating circuit

(57) Body (8) of the pump for chemical reactor heating circuit is equipped with inflow chambers (3,3a) on both sides of the rotor (9), to which liquid metal is fed by means of at least two-way collector (2). Collector (2) sections are chosen to maintain quantitative balance of liquid metal fed into both inflow chambers (3,3a). Each arm of collector (2) is introduced into inflow chamber (3) and inflow chamber (3a) in favourably tangent way, causing whirl of metal stream according to sense of rotation of rotor (9).

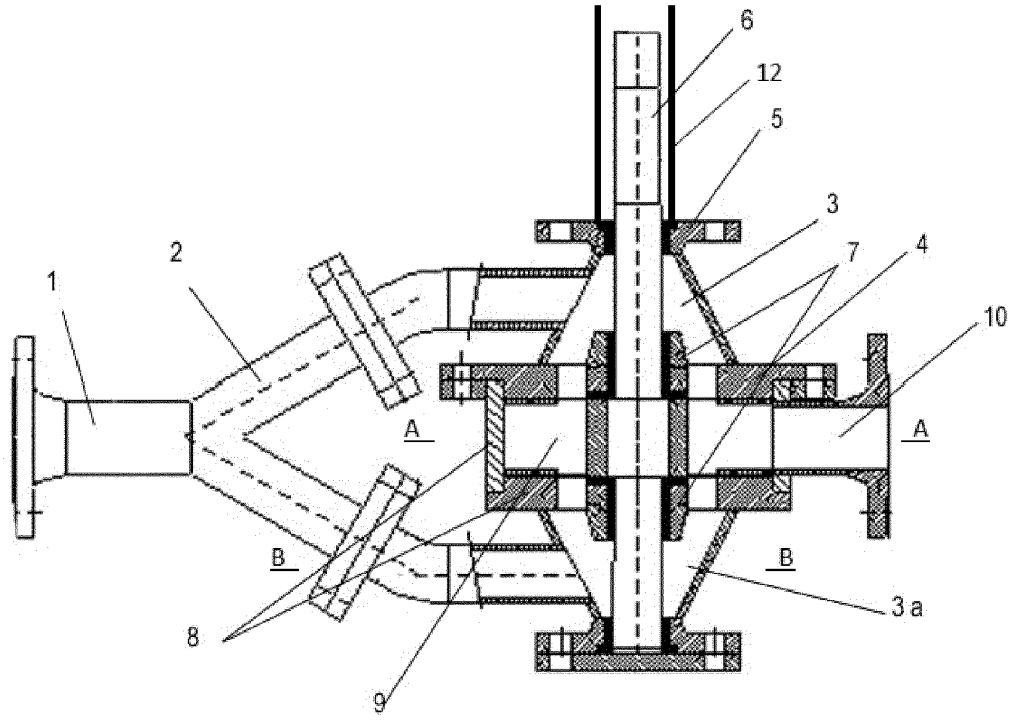

Fig. 1

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Description

[0001] The presently disclosed subject matter relates to rotor - type liquid metal pump for realization of chemical reactor heating circuit, for example for realization of continuous heat transport process within the process of plastic waste material depolymerisation for component recovery.

[0002] Pumps for liquid metal used as heating medium are up to now described in patent literature essentially exclusively as components of nuclear fast reactor cooling systems or processor cooling systems. There are however mostly of electromagnetic type and using a mechanical pump, as in patent specification JP2009243285 being an exception. Liquid metal mechanical pumps described in another patent specifications are designed as submersible and are used for periodical operation consisting of transferring of liquid metal between tanks or to moulds, as for example in invention specifications US2010196151, CN101363691, KR20090126368, CA2538556, MXPA05004332, US2001000465, W02004040143, utility pattern specifications CN201666260, CN202157970, CN201335021, CN2890429 or patent specifications US6439860, US6345964, JP4874243. Using of liquid metal for membrane heating of chemical reactor, as described in patent specification PL205686, requires continuous operating pump with high level of bearing shells protection which are submitted to very high temperature. Using of pumps as described in patents cited above is ineffective, as it was founded using such pumps of various design in industrial installations for depolymerisation of plastic waste material. Thrust bearings of such pumps, because of unbalanced forces acting on the rotor, were destructed at the latest after several days of operation.

[0003] On the basis of data obtained from tests carried out in industrial conditions a liquid metal pump was designed providing many weeks of continuous operation in chemical reactor heating system.

[0004] Body of the pump for chemical reactor heating system has inflow chambers from both sides of the rotor ensuring heating medium circulation. Liquid metal is fed to inflow chambers by means of at least two-way collector. Collector sections are chosen to maintain quantitative balance of liquid metal fed into both inflow chambers. Each collector arm is introduced into an inflow chamber in favourably tangent way, causing whirl of metal stream according to rotor sense of rotation. Pump body is provided with favourably top and bottom inflow chambers for liquid metal. One of those inflow chambers is provided with flange for fitting of pump shaft protective sheath of length greater than level of liquid metal in the tank, from which it is flowing into the pump and in this sheath a protective atmosphere is maintained between instantaneous level of liquid metal and the seal of rotor drive shaft.

[0005] Pump according to the present invention is characterized by a much lower failure frequency comparing to pumps used previously for liquid metal in the metallurgical industry. Balanced feeding of the pump significantly extends the lifetime of bearing shells, and also lifetime of the pump operated in chemical reactor heating system.

[0006] Example of embodiment of the present subject matter is depicted in Figures 1 to 3, where vertical section of the pump is depicted in Fig. 1, section of the pump in the rotor plane is depicted in Fig. 2 and top view in horizontal section is depicted in Fig. 3.

[0007] The pump is provided with connecting pipe 1 passing into two-way collector 2 for liquid metal inflow from the kettle, two inflow chambers, located over 3 and under 3a pump body, feeding liquid metal from both sides of the rotor 9. Each of both parts of inflow collector 2 is connected to generatrix of chambers 3 and 3a in favourably tangent direction, in the way causing whirl of metal stream according to rotor sense of rotation. In other words, liquid metal is introduced in a way bypassing rotor axle. In pump body cover 4 and in bottom of rotor chamber 8 inflow openings 11 are provided, through which liquid metal can inflow in axial direction from both sides, along pump shaft 6, among rotor blades. Material of cover 4 and pump body 8 existing between openings 11 holds in a position bearing shell seats 7 of rotor shaft. Material of bearing shells does not contain copper because of most of metals used for heat transport wash out copper from bearing shells causing their erosion and fast wear. Outflow pipe 10 of pumped metal is led tangentially to the body of rotor chamber. Protective sheath 12 of rotor shaft is fitted to the flange 5. Height of protective sheath 12 is greater than level of liquid metal in the kettle, from which it is flowing into the pump. Protective atmosphere is maintained between metal level in this sheath and shaft seal.

[0008] Before starting the pump levels of the metal in the protective sheath 12 and in the kettle are equal. In the moment of turning the pump on the level in the protective sheath starts lowering until such a difference of levels will appear which ensures metal inflow to the pump in the amount compensating delivery of the pump. In other words those level difference generates pressure enabling overcoming of pipe resistance of connection between the kettle and the pump at given rate of delivery of the pump.

Claims

1. Liquid metal pump for chemical reactor heating circuit equipped with rotor to provide circulation of heating medium, **characterized in that** the body of the pump (8) has inflow chambers (3,3 a) on both sides of the rotor (9), to which with at least two-way manifold (2) liquid metal is provided.

2. Pump according to claim 1, **characterized in that** sections of the collector (2) are chosen to maintain quantitative balance of liquid metal fed into both inflow chambers (3,3a).

3. Pump according to claim 2, **characterized in that** each arm of collector (2) is introduced to inflow chamber (3) and inflow chamber (3a) in favourably tangent way, causing whirl of metal stream according to sense of rotation of rotor (9).

4. Pump according to claim 1, **characterized in that** pump body (8) is provided with top (3) and bottom (3a) liquid metal inflow chamber.

5. Pump according to claim 1, **characterized in that** inflow chamber (3) is equipped with flange (5) for fitting of protective sheath (12) of pump shaft (6) of length greater than the level of liquid metal in the tank, from which it inflows to the pump, ant that in this sheath a protective atmosphere is maintained between instantaneous level of liquid metal and the seal of rotor drive shaft.

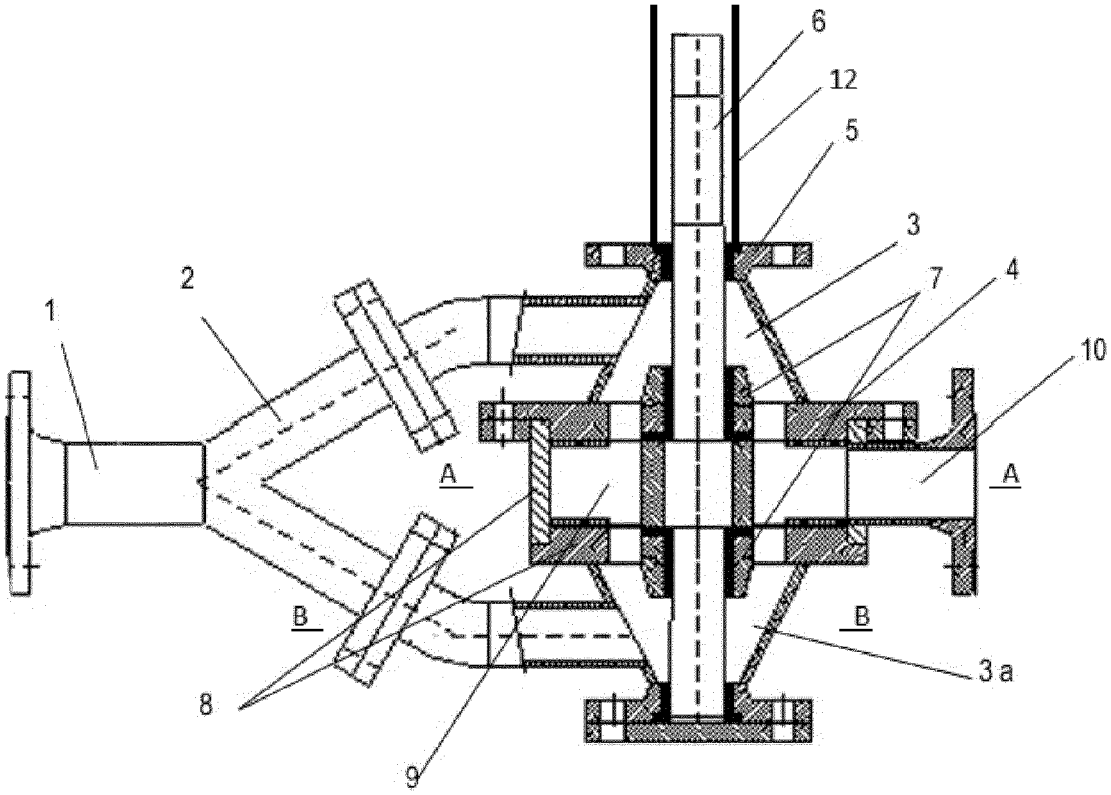

Fig. 1

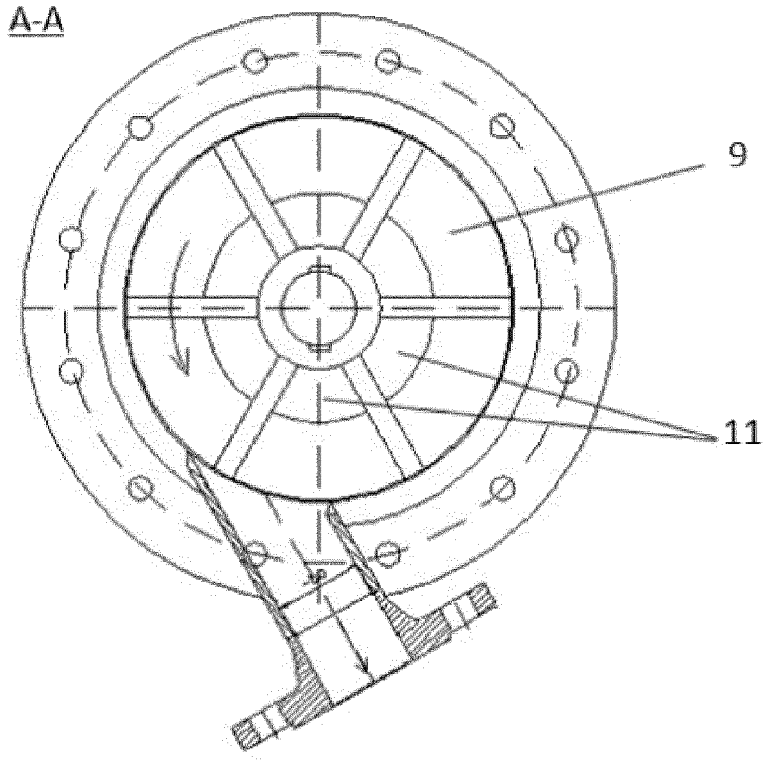

Fig. 2

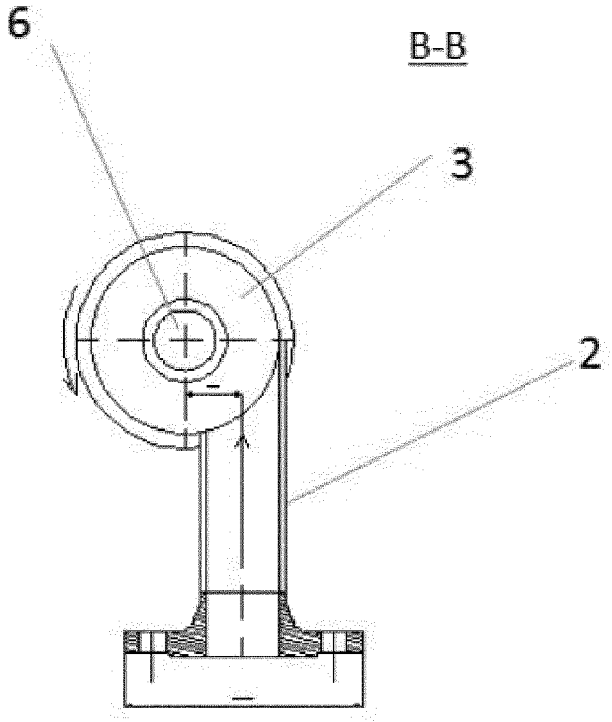

Fig. 3

REFERENCES CITED IN THE DESCRIPTION

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