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(54) **Titre : DISPOSITIF DESTINE A L'AMENEE DOSEE DES MATIERES PREMIERES A LA CUVE D'ELECTROLYSE D'ALUMINIUM**
(54) **Title: A DEVICE FOR THE DOSED FEEDING OF RAW MATERIALS TO THE ALUMINIUM REDUCTION CELL**

(57) **Abrégé/Abstract:**
The invention relates to devices for feeding raw materials (alumina, aluminium fluoride, and crushed bath) to the aluminum reduction cell. The device comprises a dosing hopper, a dosing chamber with a rod and a pneumatic cylinder. In the upper part of the rod, there is a valve that is rigidly fixed. At one end of the rod, there is a closing element consisting of a cone valve, piston and cone cover. In the upper part of the dosing chamber, above the bottom of the hopper, there are charging ports. They are located along the perimeter. The upper level of the charging ports is above the raised position of the valve, so the valve can agitate raw materials when the rod is being raised. The distance from the bottom of the cone valve of the closing element to the lower edge of the dosing chamber is not less than the distance from the lower surface of the valve to the lower level of the charging ports. The cone cover, which is part of the lower closing element, is rigidly fixed on the rod. When the rod goes up, the cone valve and piston provide for alignment of the cover of the lower closing element fixed on the rod. Dosed bulk material is loaded into the dosing chamber only when the discharge aperture of the feeder is closed by the lower closing element. Unloading of the dosing chamber is performed only when the upper valve is closed. Such a design provides for a stable dose of raw materials fed to the cell. 1 independent claim, 2 figures.

Abstract

A Device for the Dosed Feeding of Raw Materials to the Aluminium Reduction Cell

The invention relates to devices for feeding raw materials (alumina, aluminium fluoride, and crushed bath) to the aluminum reduction cell. The device comprises a dosing hopper, a dosing chamber with a rod and a pneumatic cylinder. In the upper part of the rod, there is a valve that is rigidly fixed. At one end of the rod, there is a closing element consisting of a cone valve, piston and cone cover. In the upper part of the dosing chamber, above the bottom of the hopper, there are charging ports. They are located along the perimeter. The upper level of the charging ports is above the raised position of the valve, so the valve can agitate raw materials when the rod is being raised. The distance from the bottom of the cone valve of the closing element to the lower edge of the dosing chamber is not less than the distance from the lower surface of the valve to the lower level of the charging ports. The cone cover, which is part of the lower closing element, is rigidly fixed on the rod. When the rod goes up, the cone valve and piston provide for alignment of the cover of the lower closing element fixed on the rod. Dosed bulk material is loaded into the dosing chamber only when the discharge aperture of the feeder is closed by the lower closing element. Unloading of the dosing chamber is performed only when the upper valve is closed. Such a design provides for a stable dose of raw materials fed to the cell. 1 independent claim, 2 figures.

A Device for the Dosed Feeding of Raw Materials to the Aluminium Reduction Cell

The invention relates to non-ferrous metallurgy. In particular, it relates to the electrolytic reduction of aluminium. More specifically, it relates to devices for feeding raw materials to the cell and can be used for feeding alumina, aluminium fluoride, and crushed bath to the reduction cell.

What is known is a device for feeding raw materials to the aluminum reduction cell (U.S. Patent 4,437,964, 1984, C25C 3/14) which includes a vertically installed pneumatic cylinder, a dosing hopper, and a protective casing separating the mechanisms of the feeder from bulk material. The volumetric feeder consists of a dosing chamber, a rod which is actuated by the pneumatic cylinder, and two closing elements in the form of cone valves rigidly fixed on the rod; the vertex of the cone of the upper valve is directed downwards, and the vertex of the cone of the lower valve is directed upwards. The dosing chamber is placed under an aperture in the lower part of the protective casing of the feeder, in which the rod of the pneumatic cylinder is located. The dosing chamber is fixed to the protective casing of the feeder by means of a plurality of fins, with a wide space between them. When the rod is in the raised position, the upper valve is open to be accessed with bulk material, and the lower valve closes the bottom of the dosing chamber. Due to gravitational forces, the dosed material penetrates between the fins and fills the dosing chamber. When the rod is lowered down, both cone valves are also lowered down, and, as a result, the upper valve closes the upper part of the dosing chamber and the lower valve moves downwards from the lower edge of the chamber allowing a dose of material to be fed, by distributing chute, to a hole in the bath crust made by breaker.

The disadvantages of the above analogous solution are as follows:

1. When the rod is being moved from the raised position to the lowered position, the lower valve is already open for material dumping from the chamber, and the upper valve is still open. Therefore, it makes it possible to add new

portions of bulk material to the chamber. Different conditions (rod movement rate, dosed material moisture, etc.) can cause these additional portions of bulk material to be different. Thus, the dose of bulk material is not constant.

2. Due to the unfavorable environment and considerable loads on the rod, the rod may be deformed. Deformation of the rod, on which the valves are rigidly mounted, can sometimes lead to the deformation of the valves and end surfaces of the dosing chamber. As a result, it can cause material dumping even when the valves are closed.

The closest device – in terms of its technical essence and technical effect – to the claimed device is a device for the dosed feeding of raw materials to the aluminum reduction cell (RF Patent No. 2,315,823 C25C 3/14, 2008). The device has a dosing hopper, a dosing chamber with a rod and pneumatic cylinder. Lower and upper closing elements are rigidly fixed on the rod; the upper closing element is in the form of piston. The lower closing element is fixed at one end of the rod and is in the form of cone valve, to which the lower piston is connected. In the upper part of the dosing chamber, above the bottom of the hopper, charging ports are located. The charging ports are located along the perimeter and so that the upper piston is above the charging ports when the rod is in the raised position. The distance from the bottom of the cone valve to the lower edge of the dosing chamber is not less than the height of the charging ports. A cone cover is attached to the rod through the universal joint, which makes possible soft self-aligning at the lower edge of the dosing chamber. The cone cover is required to fix the rod in the raised position, to protect the lower piston from hot and corrosive gases coming from the surface of the bath and to prevent spillages of dosed material that penetrates through the gap between the lower piston and the inner surface of the dosing chamber. The device provides for a stable dose by means of a significant decrease in the dependence of the dose of bulk material on the physical characteristics of raw materials and the rod movement rate.

One of the disadvantages related to this device is a high cost of the feeder due to the complexity of manufacturing, and low reliability of the universal joint in the abrasive medium. Another disadvantage is that a certain amount of alumina can leak on the cone cover through the gap between the lower piston and the inner surface of the dosing chamber. Moreover, there is a potential for bulk material pelletization that can take place near the charging ports due to lack of material agitation. Both factors affect the accuracy of dosing.

The aim of the invention is to develop a device for the dosed feeding of raw materials to the reduction cell. The design of such a device, compared to the prior art, not only provides for a stable dose of bulk material, which is the case for the prior art, but it also operates more accurately and it is more reliable. Moreover, it costs and weighs less.

The above aim is achieved as follows: a device for the dosed feeding of raw materials to the reduction cell which includes a dosing hopper, a dosing chamber containing a rod with a pneumatic drive, which is rigidly fixed on the rod, an upper closing element in the upper part of the dosing chamber, a lower closing element fixed at one end of the rod and being in the form of cone valve with a cone cover, and charging ports located along the perimeter in the upper part of the dosing chamber above the bottom of the hopper. According to the proposed invention, the upper closing element is in the form of valve and is located on the rod so that the upper surface of the valve, when the rod is in its initial position, is lower than the upper level of the charging ports; in the lower closing element, the cone valve is connected to the cone cover through the piston, the distance between the bottom of the cone valve and the lower edge of the dosing chamber, when the rod is in the raised position, is not less than the distance from the lower surface of the upper closing element to the lower level of the charging ports.

The first distinctive feature of this invention is the replacement of the upper piston, moving in the dosing chamber, by valve. As a result, it leads to a relative increase in the height of the charging ports. As opposed to the prior art,

the charging ports are located so that the upper level of the charging port is higher than the upper surface of the valve, and the valve is always under the layer of alumina. When the rod moves, the valve agitates alumina in the area of the charging ports. As a result, the number of alumina lumps, that have a potential to limit alumina loading to the dosing chamber through the charging ports, decreases. Moreover, the valve is considerably lighter and cheaper than the piston.

The other distinctive feature of the invention is the use of the cone valve, piston and the cone cover, rigidly fixed on the rod, as a lower closing element instead of the cone valve, universal joint and the cone cover. This design facilities and makes the device cheaper, and makes it more reliable. Furthermore, it prevents alumina accumulation between the cone valve and cover, which helps to have a more accurate dose of alumina.

The essence of the invention is clarified with the following figures:

Fig. 1 shows a device for the dosed feeding of raw materials to the aluminium reduction cell. Fig. 2a shows loading, the rod is in the raised (initial) position. Fig. 2b shows the rod in the medium position. Fig 2c shows unloading, the rod is in the lower position.

The device for dosing bulk materials includes dosing hopper 1, pneumatic cylinder 2 and dosing chamber 3. Lower part 4 of dosing chamber 3 is under charging ports 5, below the aperture in the bottom of hopper 1. The upper part of dosing chamber 3, including charging ports 5, is located in hopper 1. Inside the dosing chamber, there is rod 6 actuated by pneumatic cylinder 2. Valve 7 is mounted on rod 6. The upper surface of valve 7, when rod 6 is in the raised position, is lower than the upper level of charging port 5. Cone valve 8 and piston 9 connected to the cone valve, which are both fixed on the rod, function as a lower closing element. Cone cover 10 made of thermal resistant materials is connected to the lower end of rod 6 through piston 9.

Connection of cone cover 10 to rod 6 through cone valve 8 and piston 9 makes it possible for the cone cover to align relative to the axis of the dosing chamber and the chamfer of the lower edge of dosing chamber 4.

The device for the dosed feeding of raw materials functions as follows:

Dosed material constantly fills the space in the charging port 5 area of dosing chamber 3. In the initial position, rod 6 is in the raised position; valve 7 is lower than the upper level of charging ports 5. The discharge aperture in the lower part 4 of the dosing chamber is closed with cone cover 10; cone valve 8 with lower piston 9 are in the maximum possible raised position above the discharge aperture of the dosing chamber. The distance from the bottom of cone valve 8 (where this valve contacts lower piston 9) to the lower edge of the dosing chamber (Hc) of the feeder is not less than the height (Hb) between the lower level of the charging ports and the lower surface of the valve. Dosed material from hopper 1 fills lower part 4 of the dosing chamber through charging ports 5. For unloading dosing chamber 4, a control signal is transferred to pneumatic cylinder 2 which actuates rod 6 – with valve 7, cone valve 8 with piston 9 connected the cone valve and cone cover 10 – to move down. The channel under charging ports 5 which goes to lower part 4 of the dosing chamber is closed by valve 7, and bulk material is poured into a hole in the alumina-bath crust, through the discharge aperture in lower part 4 of the dosing chamber and, then, by gravity. The bottom of cone valve 8 with piston 9 connected to the cone valve passes the lower edge of the dosing chamber at the moment when the channel under charging ports 5 is fully closed by valve 7. There is no pass-through for bulk material from hopper 1, through dosing chamber 4 and through the discharge aperture, to the bath. The rod stroking length was determined by experiment: cone valve 8 had to provide for a full discharge of bulk material from the dosing chamber at the time of down movement of the rod with cone valve 8. After a discharge of bulk material from dosing chamber 4, rod 6 starts to go up to the raised position. The bottom of cone valve 8 reaches the discharge aperture of the dosing chamber before the channel for bulk material under charging ports 5

opens. Then, when rod 6 gets closer to its raised position, cone cover 10, aligned by cone valve 8 and piston 9, is accurately put on the chamfer of the lower edge of the dosing chamber, which prevents deformation of the cover itself and the surface of the feeder (which is in contact.) The cone cover is required to fix rod 6 in the raised position, protect piston 9 and the inner surface of dosing chamber 4 from hot aggressive gases coming from the surface of the bath, and, together with piston 9, prevent spillages of dosed material through the gap between cone valve 8 and the inner surface of dosing chamber 4.

Thus, the use of the proposed invention provides for a higher reliability of the device and a higher accuracy of dosing, which, in its turn, improves the process parameters of the cell.

Claims

1. A device for the dosed feeding of raw materials to the aluminium reduction cell from a dosing hopper, the device comprising a dosing chamber containing a rod with a pneumatic drive, connected to the rod for reciprocal movement of the rod in an axial direction between a raised position and a lowered position, an upper closing element in an upper part of the dosing chamber, a lower closing element secured to a lower end of the rod and being in the form of a cone valve with a cone cover, and charging ports located along a perimeter of the upper part of the dosing chamber above a bottom of the hopper wherein the upper closing element is in the form of a valve and is located on the rod so that an upper surface of the valve, when the rod is in its raised position, is lower than an upper level of the charging ports and in the lower closing element, a distance between a bottom of the cone valve and a lower edge of the dosing chamber is not less than a distance from a lower surface of the upper closing element to a lower level of the charging ports.

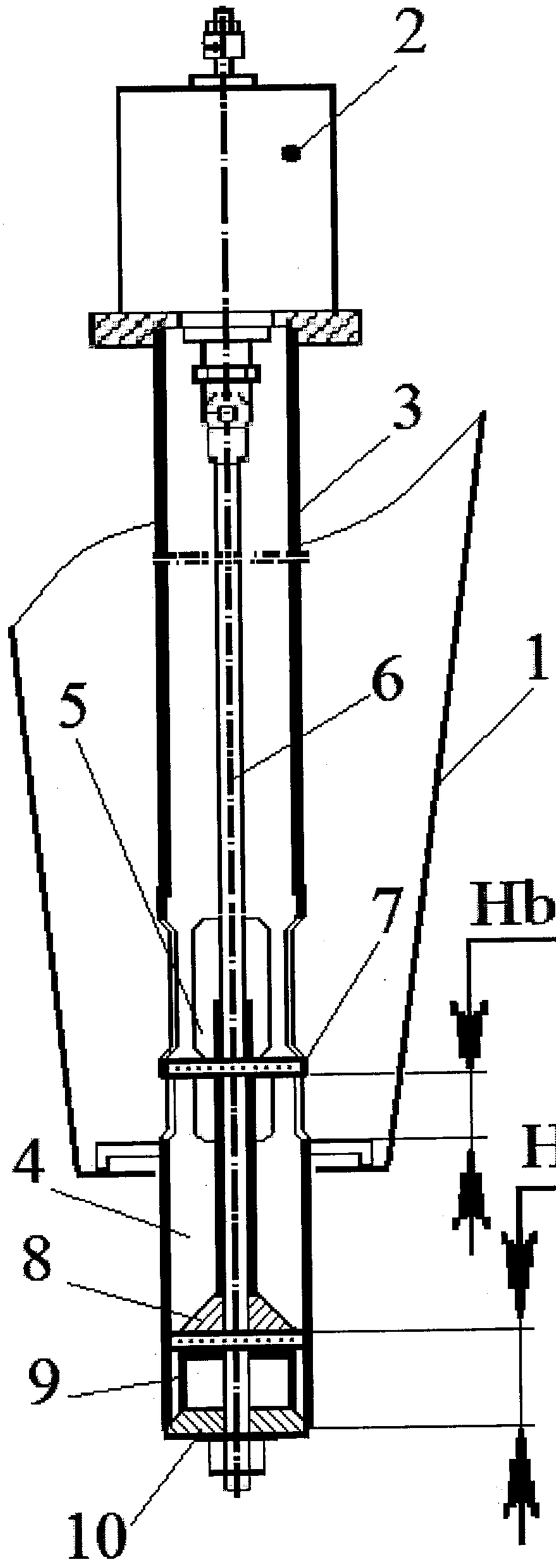

FIG. 1

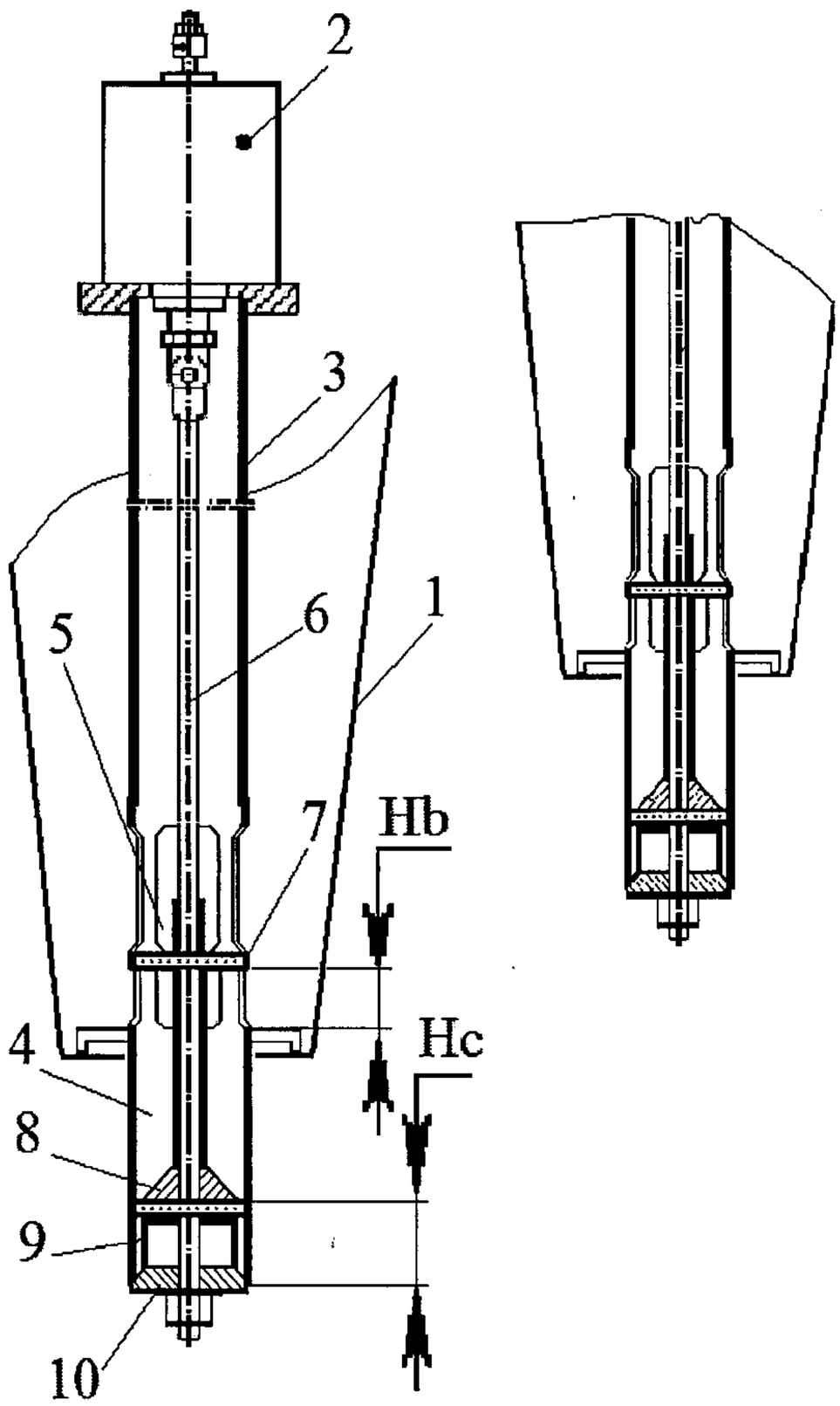

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FIG.2