

FULLY AUTOMATIC POWDER MIXING MACHINE

FIELD OF TECHNOLOGY

[0001] The invention relates to the technical field of laser cladding , in particular to a fully automatic powder mixing machine.

BACKGROUND

[0002] Laser cladding technology is an advanced surface modification technology. The powder composition plays a vital role in the performance and surface quality of the laser cladding layer . Adding rare earth oxide powder, lubricating phase powder, hard phase powder, cast aluminum alloy powder, etc. to alloy powder are common powder adding methods .

[0003] Currently, powder doping in production is often done manually, with the process typically consisting of crushing , weighing, and mixing. Because powders tend to clump and agglomerate when left alone, crushing is necessary before mixing. Insufficient crushing not only increases the difficulty of weighing but also seriously affects the uniformity of the mixed powder. The weighing process often requires repeated additions and subtractions, and multiple measurements to improve accuracy.

SUMMARY

[0004] The object of the present invention is to provide a fully automatic powder mixing machine to solve the problems raised in the above background technology.

[0005] To achieve the above object, the present invention provides the following technical solutions:

[0006] A fully automatic powder mixing machine includes a frame, a powder pushing mechanism , a powder collecting mechanism, a detection and control mechanism, and at least two metering devices, wherein the metering devices include a pressing mechanism, a powder box, and a lifting mechanism fixedly arranged on the frame from top to bottom ;

[0007] The powder box is used to contain powder;

[0008] The pressing mechanism can be extended and retracted vertically, and its bottom lifting end has a blocking state for blocking the top discharge port of the powder box and an idle state suspended above the top discharge port of the powder box;

[0009] The lifting mechanism can be extended and retracted vertically, and its top lifting end extends into the interior of the powder box and is slidably and sealingly connected to the inner surface of the powder box;

[0010] The powder pushing mechanism is fixedly arranged horizontally on one side of the top discharge port of the powder box, and is used to push the powder ejected from the powder box by the lifting mechanism into the powder collecting mechanism;

[0011] The detection control mechanism includes a PLC controller, and a pressure sensor and an electromagnetic sensor electrically connected to the PLC controller; the pressure sensor is installed on the lifting mechanism; the electromagnetic sensor is set on the lifting mechanism and is used to detect the telescopic stroke of the lifting mechanism.

[0012] Preferably, the rack has a first layer, a second layer and a third layer arranged in sequence from bottom to top;

[0013] The powder pushing mechanism and the top of the powder box are both fixed on the second layer;

[0014] The pressing mechanism is fixed on the third layer;

[0015] The lifting mechanism and the powder collecting mechanism are both arranged on the first layer.

- [0016]** Preferably, the powder pushing mechanism includes a powder pushing seat, a powder pushing hydraulic cylinder , and a powder pushing scraper ;
- [0017]** The powder pushing hydraulic cylinder is fixedly mounted on the frame horizontally through the powder pushing seat ;
- [0018]** The powder pushing scraper is fixedly connected to the free end of the piston rod of the powder pushing hydraulic cylinder .
- [0019]** Preferably, the blade of the powder pushing scraper is in the shape of a right-angled trapezoid, and the inclined surface of the blade forms an inclination angle of 85° with the surface of the second layer.
- [0020]** Preferably, the pressing mechanism includes a pressing cylinder, a fixing seat and an aluminum sleeve;
- [0021]** The compression cylinder is fixedly mounted vertically on the frame, and the compression cylinder can be extended and retracted vertically downward;
- [0022]** The fixing seat is installed on the free end of the piston rod of the compression cylinder;
- [0023]** The aluminum sleeve is put on the outer side of the fixing seat .
- [0024]** Preferably, the lifting mechanism includes a lifting hydraulic cylinder and a lifting tray;
- [0025]** The lifting hydraulic cylinder is vertically installed on the frame;
- [0026]** The lifting tray is fixedly mounted on the free end of the piston rod of the lifting hydraulic cylinder, and the edge of the lifting tray is slidingly sealed with the inner surface of the powder box through a sealing ring;
- [0027]** The pressure sensor is installed at the small end outlet of the lifting hydraulic cylinder.
- [0028]** Preferably, the powder collecting mechanism includes a powder collecting box and a powder collecting funnel ;
- [0029]** The powder collecting funnel and powder collecting box are fixedly installed on the frame in an upper and lower position. The powder pushing mechanism is used to push the powder pushed out of the powder box by the lifting mechanism into the powder collecting funnel, and the powder rolls into the powder collecting box by its own gravity.

[0030] Preferably, the second layer is provided with first through holes and second through holes having the same number as the powder boxes ;

[0031] The top port of the powder collecting funnel is fixed in the first through hole;

[0032] The top discharge port of the powder box is fixed in the second through hole.

[0033] Compared with the prior art, the present invention has the following beneficial effects:

[0034] The invention realizes the fully automatic powder mixing process of powder crushing, weighing and mixing by means of pneumatic, hydraulic and PLC electric control, thereby improving production efficiency and reducing the production cost of large-scale powder mixing.

[0035] This invention utilizes a PLC to calculate the signal from a pressure sensor installed at the outlet of the small end of the lifting hydraulic cylinder, enabling automatic weighing. The entire pneumatic and hydraulic system is controlled by the PLC, improving system accuracy.

[0036] The present invention can realize the compaction and flattening of the powder in the powder barrel and remove the air therein through the linkage of the lifting mechanism and the pressing mechanism, thereby improving the measurement accuracy.

[0037] This invention utilizes the linkage between the lifting and pushing mechanisms to apply shear force to the powder using a segmented powder pushing method, thereby crushing the powder and preventing powder agglomeration and clumping.

BRIEF DESCRIPTION OF THE DRAWINGS

[0038] FIG. 1 is a schematic diagram of the overall structure of the present invention;

[0039] FIG. 2 is a schematic diagram of the position structure of the first through hole and the second through hole of the present invention;

[0040] FIG. 3 is a rear view schematic diagram of the present invention;

[0041] FIG. 4 is a schematic diagram of the top view of the powder pushing mechanism of the present invention;

[0042] FIG. 5 is a side cross-sectional structural diagram of the powder pushing mechanism of the present invention;

[0043] FIG. 6 is a schematic structural diagram of the pressing mechanism and the lifting mechanism of the present invention;

[0044] FIG. 7 is a schematic front cross-sectional view of the pressing mechanism and the lifting mechanism of the present invention;

[0045] FIG. 8 is a schematic structural diagram of the lifting mechanism of the present invention.

[0046] In the figure: 1. Frame; 11. First layer; 12. Second layer; 121. First through hole; 122. Second through hole; 13. Third layer; 2. Powder pushing mechanism ; 21. Powder pushing seat ; 22. Powder pushing hydraulic cylinder ; 23. Powder pushing scraper ; 3. Pressing mechanism; 31. Pressing cylinder; 32. Fixed seat; 33. Aluminum sleeve; 4. Powder box; 5. Lifting mechanism; 51. Lifting hydraulic cylinder; 52. Lifting tray; 61. Powder collecting box; 62. Powder collecting funnel ; 71. PLC controller; 72. Pressure sensor; 73. Electromagnetic sensor.

DESCRIPTION OF THE EMBODIMENTS

[0047] The following will clearly and completely describe the technical solutions in the embodiments of the present invention in conjunction with the accompanying drawings. Obviously, the described embodiments are only part of the embodiments of the present invention, not all of the embodiments. Based on the embodiments of the present invention, all other embodiments obtained by ordinary technicians in this field without making creative efforts are within the scope of protection of the present invention.

[0048] Please refer to Figures 1 to 8. The present invention provides a technical solution:

[0049] A fully automatic powder mixing machine includes a frame 1, a powder pushing mechanism 2, a powder collecting mechanism, a detection and control mechanism, and at least two metering devices. In this embodiment, two metering devices are provided. The specific structure and working principle of these components are described in detail below.

[0050] As shown in the figure, the rack 1 has a first layer 11, a second layer 12 and a third layer 13 arranged in sequence from bottom to top, wherein the first layer 11 and the second layer 12 are rectangular plates of substantially equal size, while the third layer 13 is a rectangular plate smaller than the second layer 12, and the first layer 11 and the second layer 12, as well as the second layer 12 and the third layer 13 are fixedly connected by columns.

[0051] The detection and control mechanism includes a PLC controller 71, and a pressure sensor 72 and an electromagnetic sensor 73 electrically connected to the PLC controller 71, wherein the model of the PLC controller 71 can be DVP-16SN of Wuhan Shijia Weiye Kexun Electronic Technology Co., Ltd., the model of the pressure sensor 72 can be RS485 of Shandong Renke Measurement and Control Technology Co., Ltd., and the model of the electromagnetic sensor 73 can be HTD-200-6 of Deyang Dongfang Yili Mechanical and Electrical Equipment Co., Ltd.; through the selection and use of the above-mentioned electrical components, technical personnel in this field can install, test and use them well, or select other reasonable models of equipment according to actual usage to realize data collection, communication transmission and processing. The pressure sensor 72 is installed on the lifting mechanism 5; the electromagnetic sensor 73 is set on the lifting mechanism 5 and is used to detect the telescopic stroke of the lifting mechanism 5.

[0052] The metering device includes a pressing mechanism 3, a powder box 4 and a lifting mechanism 5 fixed on the frame 1 from top to bottom; the pressing mechanism 3 is fixed on the third layer 13; the powder pushing mechanism 2 and the top of the powder box 4 are both fixed on the second layer 12; the lifting mechanism 5 and the powder collecting mechanism are both arranged on the first layer 11.

[0053] The powder box 4 is used to contain powder; specifically, in some embodiments, the powder box 4 may be in the shape of a vertical cylinder, and may be made of stainless steel.

[0054] The clamping mechanism 3 can be extended and retracted vertically, and its bottom lifting end has a blocked state for blocking the top discharge port of the powder box 4 and an idle state for hanging above the top discharge port of the powder box 4 (the idle state is shown in the figure); specifically, the clamping mechanism 3 includes a clamping cylinder 31, a fixing seat 32 and an aluminum sleeve 33; the clamping cylinder 31 is vertically fixedly installed on the frame 1 (the third layer 13), and the clamping cylinder 31 can be extended and retracted vertically downward; the fixing seat 32 is installed on the free end of the piston rod of the clamping cylinder 31; the aluminum sleeve 33 is sleeved on the outside of the fixing seat 32, and the diameter of the aluminum sleeve 33 should be larger than the diameter of the top discharge port of the powder box 4; wherein, the free end of the piston rod of the clamping cylinder 31, the fixing seat 32 and the aluminum sleeve 33 together constitute the bottom lifting end of the clamping mechanism 3.

[0055] The lifting mechanism 5 can be extended and retracted vertically, and its top lifting end extends to the interior of the powder box 2 and is slidingly sealed with the inner surface of the powder box 2 ; specifically, the lifting mechanism 5 includes a lifting hydraulic cylinder 51 and a lifting tray 52, and the lifting tray 52 can be made of stainless steel; the lifting hydraulic cylinder 51 is vertically installed on the frame 1; the lifting tray 52 is fixedly installed on the free end of the piston rod of the lifting hydraulic cylinder 51, and the edge of the lifting tray 52 is slidingly sealed with the inner surface of the powder box 4 through a sealing ring (that is, the side surface of the lifting tray 52 is provided with an annular groove, and a sealing ring is embedded in the annular groove); wherein, the free end of the piston rod of the lifting hydraulic cylinder 51 and the lifting tray 52 together constitute the top lifting end of the lifting mechanism 5; the pressure sensor 72 is installed at the small end liquid outlet of the lifting hydraulic cylinder 51.

[0056] The powder pushing mechanism 2 is horizontally fixedly arranged on one side of the top discharge port of the powder box 4, and is used to push the powder pushed out of the powder box 4 by the lifting mechanism 5 into the powder collecting mechanism; specifically, the powder pushing mechanism 2 includes a powder pushing seat 21, a powder pushing hydraulic cylinder 22, and a powder pushing scraper 23; the powder pushing hydraulic cylinder 22 is horizontally fixedly installed on the frame 1 through the powder pushing seat 21 (that is, the powder pushing hydraulic cylinder 22 is horizontally fixedly installed on the upper surface of the second layer 12 through the powder pushing seat 21); the powder pushing scraper 23 is fixedly connected to the free end of the piston rod of the powder pushing hydraulic cylinder 22; the blade of the powder pushing scraper 23 is a right-angled trapezoid, and the inclined surface of the blade is at an inclination angle of 85° to the surface of the second layer. Furthermore, the side of the powder pushing seat 21 close to the powder pushing scraper 23 is a groove-shaped structure. When the powder pushing hydraulic cylinder 22 is in a retracted state, the powder pushing scraper 23 is located in the groove-shaped structure.

[0057] The powder collecting mechanism includes a powder collecting box 61 and a powder collecting funnel 62; the powder collecting funnel 62 and the powder collecting box 61 are fixedly installed on the frame 1 in an upper and lower position, and the powder pushing mechanism 2 is used to push the powder ejected from the powder box 4 by the lifting mechanism 5 into the powder collecting funnel 62, and the powder rolls into the powder collecting box 61 by its own gravity.

[0058] The second layer 12 is provided with first through holes 121 and second through holes 122 equal in number to the powder boxes 4 ; the top port of the powder collecting funnel 62 is fixed in the first through holes 121 ; the top discharge port of the powder box 4 is fixed in the second through holes 122 .

[0059] In some embodiments, three baffles parallel to each other and arranged side by side can be fixed on the upper surface of the second layer 12, and a powder channel is formed between every two adjacent baffles. The three baffles can form two powder channels, and the top discharge ports of the two powder boxes 4 are respectively connected to the two powder channels, and the powder scraper 23 pushes the powder in the powder channel.

[0060] The working principle of this embodiment is described below using two kinds of powder as examples.

[0061] Before operation, the mass fractions of the two powders and the total mass M of the mixed powders are input into the PLC controller 71. The PLC controller 71 can then calculate the corresponding masses of the two required powders. It can also calculate the masses of the powders in the two powder boxes 4 using the formula, based on $F = P * S$, $m = F/g - M_2$ the pressure P of the small cavity of the lifting hydraulic cylinder 51: S is the pressurized annular area of the small cavity of the lifting hydraulic cylinder 51, F is the load force on the lifting hydraulic cylinder 51, g is the gravity constant, M_2 is the mass of the powder box 4, and m is the mass of the powder in the powder box 4.

[0062] During operation, the pressing cylinder 31 extends, the aluminum sleeve 33 seals the top discharge port of the powder box 4, and the lifting hydraulic cylinder 51 extends to compress the powder in the powder box 4, and discharges the air at the top of the powder box 4 through the gap between the aluminum sleeve 33 and the frame 1. The electromagnetic sensor 73 inside the lifting hydraulic cylinder 51 provides the telescopic length of the lifting hydraulic cylinder 51. When the pressure in the small chamber of the lifting hydraulic cylinder 51 rises to a threshold value, the lifting hydraulic cylinder 51 stops extending, and the PLC controller 71 calculates the volume of the powder in the two powder boxes 4 respectively by using the formula based on the telescopic length L of the lifting hydraulic cylinder 51, $V = L * S$ where V is the volume of the powder in the box and S is the bottom area $\rho = m/V$ of the powder barrel. The density of the two powders is then calculated by using the formula, where ρ is the density of the powder in the powder box 4. The formula is then used to $L_2 = M_2/\rho g$ calculate the length L_2 of the lifting hydraulic cylinder 51 required to obtain the required mass of the two powders, and then the pressing cylinder 31 retracts to an idle state.

[0063] The elongation length calculated by the PLC controller 71 is divided into 1mm segments. If it is less than 1mm, it is extended according to the remaining value until the actual elongation required by the lifting hydraulic cylinder 51 calculated by the PLC is reached. Then, for every 1mm rise of the lifting hydraulic cylinder 51, the powder in the corresponding powder box 4 is pushed out from its discharge port by 1mm (the mass of each 1mm of powder has been calculated by the PLC controller 71). After the powder in the powder box 4 is pushed out by 1mm, the lifting hydraulic cylinder 51 is temporarily closed, and the powder pushing hydraulic cylinder 22 is started so that the powder pushing hydraulic cylinder 22 pushes the powder pushing scraper 23 to move, so that the powder is scraped into the powder collecting funnel 62 by the powder pushing scraper 23, and then the powder enters the powder collection box 61. After the powder enters the powder collecting funnel 62, the PLC controller 71 controls the powder pushing hydraulic cylinder 22 to retract to its original position, and starts the lifting hydraulic cylinder 51 again, so that the powder in the powder box 4 is pushed out by 1mm, and then the lifting hydraulic cylinder 51 is temporarily closed again, and the powder pushing mechanism 2 is continued to be used to scrape the powder into the powder collecting funnel 62. This cycle is repeated until the powder is After the total height (or total mass) of the powder pushed out by the lifting hydraulic cylinder 51 in the powder box 4 is equal to the actual mass required for the powder, the PLC controller 71 controls to close the lifting hydraulic cylinder 51; further, taking two powder boxes 4 as an example, one of the powder boxes 4 and the powder pushing mechanism 2 and the lifting mechanism 5 corresponding to the powder box 4 are defined as the first group of powder taking components, and the other powder box 4 and the powder pushing mechanism 2 and the lifting mechanism 5 corresponding to the other powder box 4 are defined as the second group of powder taking components. During the entire powder taking process, the PLC controller 71 can drive the first group of powder taking components and the second group of powder taking components to take powder in an intermittent manner (the first group of powder taking components takes powder, followed by the second group of powder taking components, and then the first group of powder taking components takes powder, thus achieving intermittent powder taking).

The PLC controller 71 can also drive the first group of powder taking components and the second group of powder taking components to take powder synchronously; during the entire powder taking process, the blade of the powder pushing scraper 23 can cut and crush the 1mm powder pushed out to avoid powder agglomeration and agglomeration.

[0064] While embodiments of the present invention have been shown and described, it will be appreciated by those skilled in the art that various changes, modifications, substitutions, and variations may be made to these embodiments without departing from the principles and spirit of the invention, and that the scope of the invention is defined by the appended claims and their equivalents.