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DRAWINGS

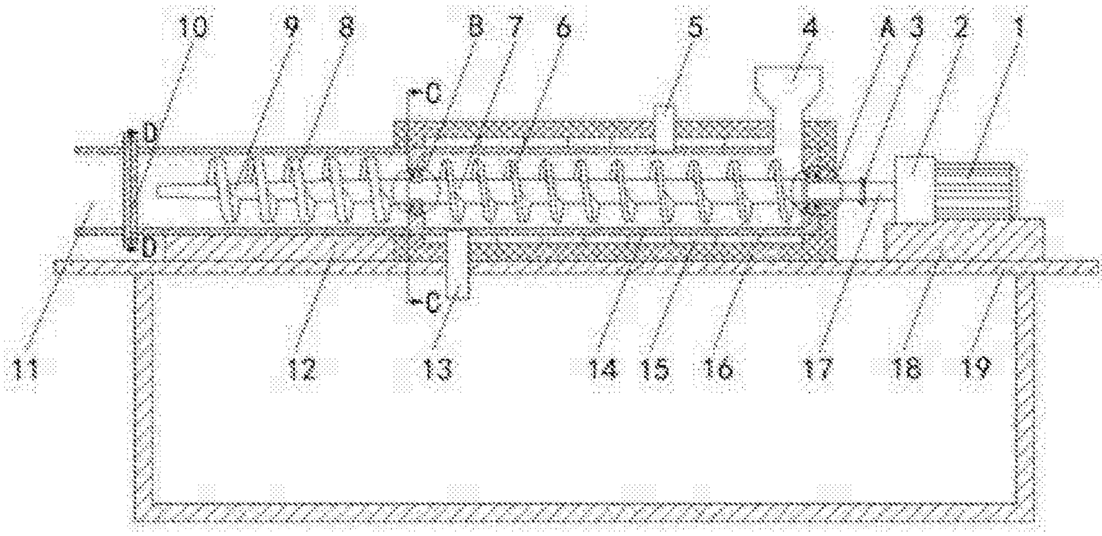

FIG. 1

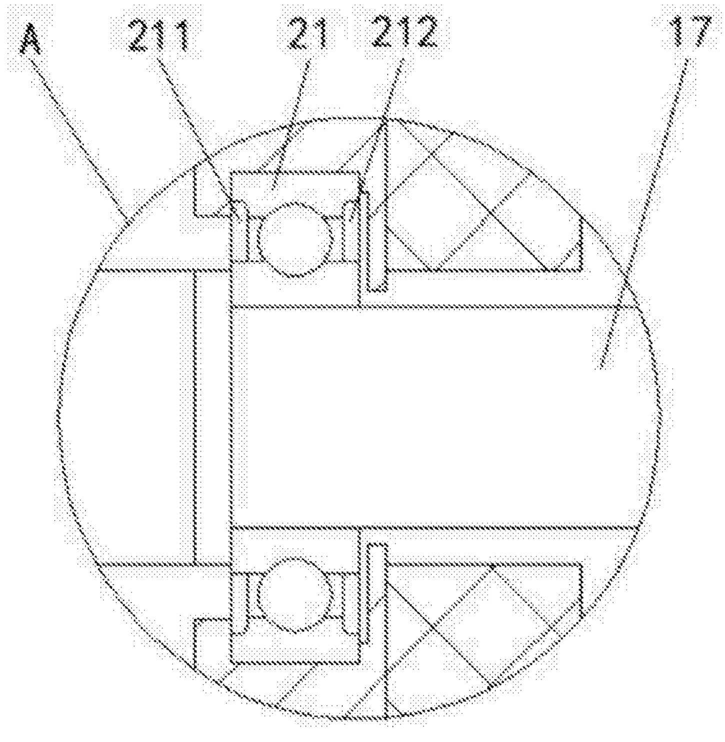

FIG. 2

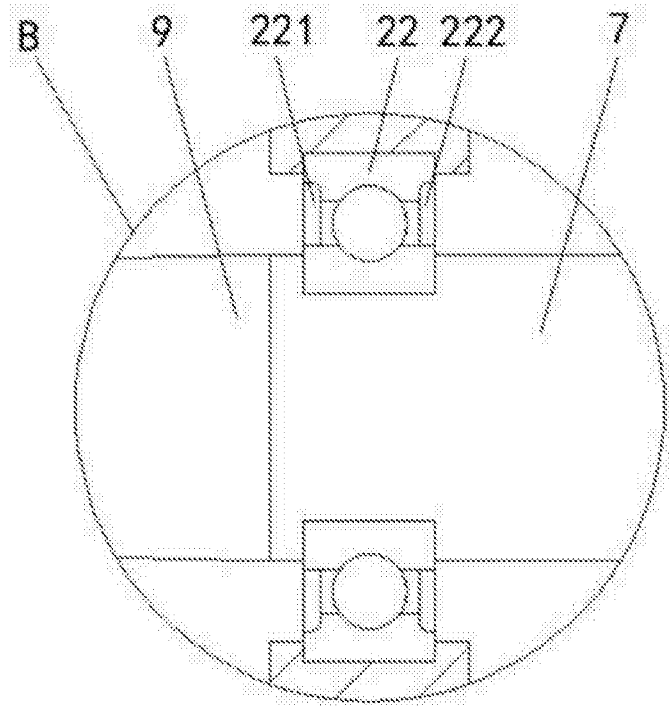

FIG. 3

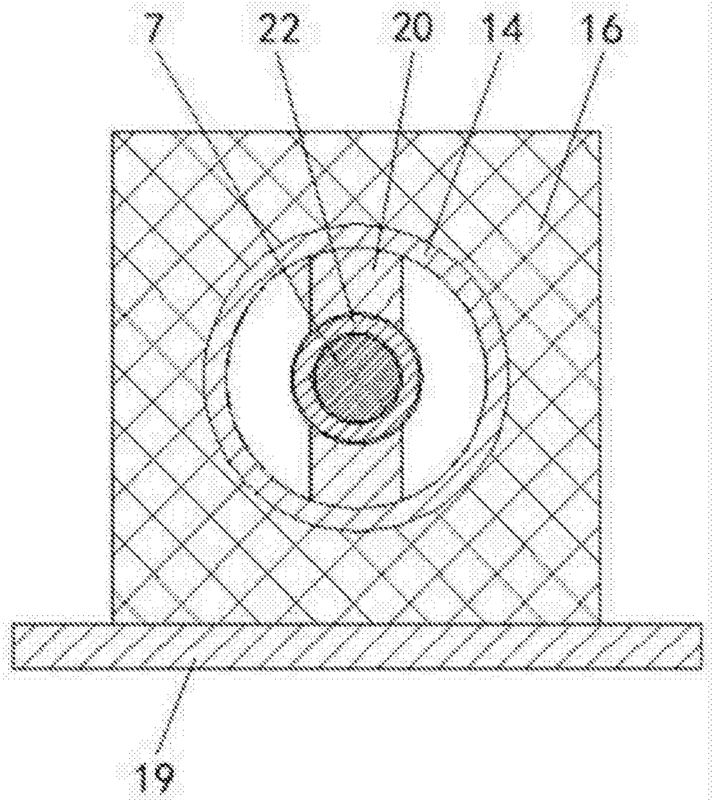

FIG.4

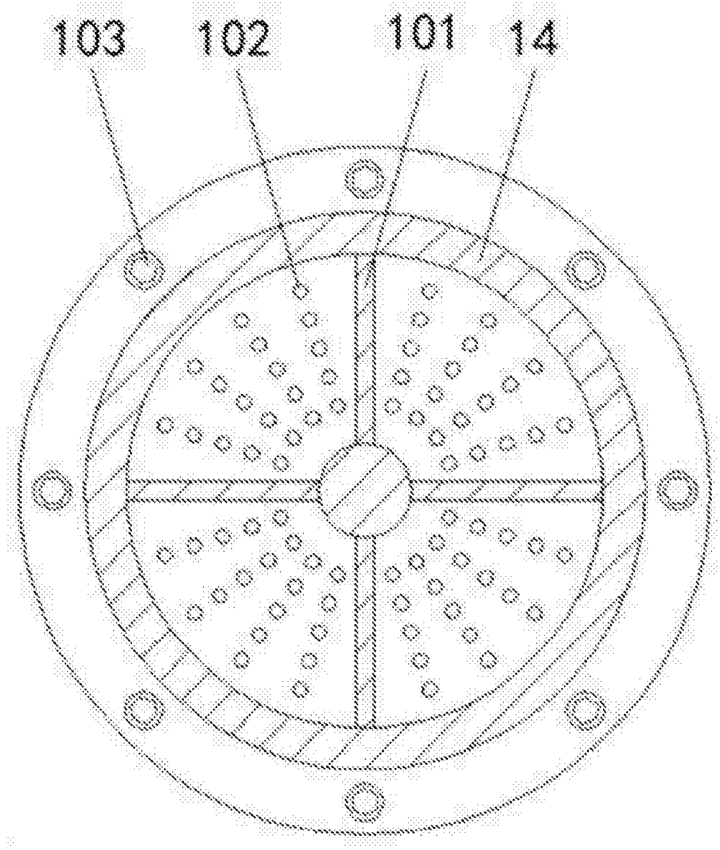

FIG. 5

INTEGRATED DEVICE FOR MANUFACTURING BIOCARBON THROUGH LOW-TEMPERATURE PYROLYSIS AND FORMATION OF ORGANIC SOLID WASTES

TECHNICAL FIELD

[0001] The present disclosure belongs to the field of low-temperature pyrolysis and extrusion forming, and particularly relates to an integrated device for manufacturing biocarbon through low-temperature pyrolysis and formation of organic solid wastes.

BACKGROUND ART

[0002] Drying and extrusion forming of organic wastes such as straw can effectively solve the problem of low bulk density that restricts large-scale utilization of the organic wastes. In addition, due to relatively loose structures of the organic wastes such as straw, volatile contained in the wastes is high and easy to precipitate, and thus combustion process of the organic wastes is extremely unstable. This problem has also been well solved through pulverizing, drying, extrusion forming of the organic wastes.

[0003] However, common organic waste molding devices on the market directly perform compression forming on the organic wastes. In fact, there are many kinds of organic wastes which have complex components, and in order to implement the extrusion forming of the organic wastes, complex preprocessing is often performed on the organic wastes, which greatly improves utilization cost of the organic wastes. In addition, direct extrusion forming cannot achieve selective utilization of components in the organic wastes, which greatly reduces the utilization efficiency of the organic wastes, and also makes the final formed solid fuel unable to adapt to some low-pollution combustion scenarios.

SUMMARY

[0004] In view of the defects of the prior art, the present disclosure provides an integrated device for manufacturing biocarbon through low-temperature pyrolysis and formation of organic solid wastes, which solves the problems raised in the above background art.

[0005] The present disclosure provides following technical solutions.

[0006] An integrated device for manufacturing biocarbon through low-temperature pyrolysis and formation of organic solid wastes, includes a drive motor, a reducer, a coupling, a feed inlet, a water vapor outlet, first helical blades, an equal-diameter rotating shaft, second helical blades, a variable-diameter rotating shaft, a flange, a discharge outlet, a cylinder base, a pyrolysis product outlet, a metal cylinder, a temperature-adjustable heating element, a heat preservation box, a drive shaft, a motor base, a table, a bearing seat, a first deep groove ball bearing, and a second deep groove ball bearing. A side where the drive motor is located is assumed as a right side, and a side where the discharge outlet is located is assumed as a left side, the drive motor is fixedly installed on the motor base, and the motor base is fixedly installed on the table.

The drive motor is connected with the reducer, the drive shaft protrudes from a left end of the reducer, and the drive shaft is connected to the equal-diameter rotating shaft through the coupling. A surface of the equal-diameter rotating shaft is provided with the first helical blades, and a left end of the equal-diameter rotating shaft is connected with the variable-diameter rotating shaft, a surface of the variable-diameter rotating shaft is provided with the second helical blades. The variable-diameter rotating shaft and the equal-diameter rotating shaft are formed in one piece; a top of a right end of the metal cylinder is provided with the feed inlet. The water vapor outlet is provided at a top of the metal cylinder on a left side of the feed inlet, and the pyrolysis product outlet is provided at a bottom of the metal cylinder on a left side of the water vapor outlet. The pyrolysis product outlet passes through the temperature-adjustable heating element, and the heat preservation box and the table; a section of the metal cylinder from a right end of the metal cylinder to a boundary line between the equal-diameter rotating shaft and the variable-diameter rotating shaft is wrapped with the temperature-adjustable heating element which is surrounded by the heat preservation box. The heat preservation box is fixedly installed on the table; a section of the metal cylinder corresponding to the variable-diameter rotating shaft is fixedly installed on the cylinder base, the cylinder base is fixedly installed on the table; and a left end of the metal cylinder is provided with the flange.

[0007] Further, in order to optimize the above technical solution, the first deep groove ball bearing is fixed on the right end of the metal cylinder, two sides of the first deep groove ball bearing are provided with metal dust covers respectively; a right end of the equal-diameter rotating shaft is fixed to an inner ring of the first deep groove ball bearing; the second deep groove ball bearing is fixed on the bearing seat, and the bearing seat is welded to an inner wall of the metal cylinder at a connection between the equal-diameter rotating shaft and the variable-diameter rotating shaft; two sides of the second deep groove ball bearing are provided with metal dust covers respectively; a clamping slot which is used to fix rotating shafts is provided at the connection between the equal-diameter rotating shaft and the variable-diameter rotating shaft.

[0008] Further, pitches of the first helical blades are gradually increased by 1 mm for every turn of helical blades, from a right end to a left end of the equal-diameter rotating shaft.

[0009] Further, a diameter of the variable-diameter rotating shaft is gradually reduced by 1 mm for every 5 cm from a right end to a left end of the variable-diameter rotating shaft, and the diameter of the variable-diameter rotating shaft is no longer reduced along a length direction of the variable-diameter rotating shaft after being reduced to 2 cm.

[0010] Further, a thickness of each second helical blade is 2 mm greater than that of each first helical blade.

[0011] Further, an end of the water vapor outlet near the metal cylinder is provided with a screen.

[0012] Further, an end of the pyrolysis product outlet near the metal cylinder is provided with a screen.

[0013] Further, a left plate surface of the flange is welded with a molding die, and circular forming holes are formed on a circular surface of the molding die, support plates are welded on a left side of the forming die, and the left plate surface and a right plate surface of the flange are fastened by hexagonal bolts.

[0014] The beneficial effects of the present disclosure are provided as follows.

[0015] 1. The heating temperature of the heating element can be adjusted according to different types of organic wastes, so as to achieve the purpose of forming after low-temperature pyrolysis; the integrated device of the present disclosure can be used widely, regardless of types of organic wastes.

[0016] 2. Pyrolysis products in three different states of gas, liquid and solid can be utilized respectively, which enriches the utilization scenarios of the products and greatly improves the utilization efficiency.

[0017] 3. Solid forming fuels of two different shapes i.e. cylindrical pellets or cylindrical fuel rods, can be obtained by installing or dismantling the left plate surface of the flange.

[0018] 4. The pitches of the first helical blades arranged on the surface of the equal-diameter rotating shaft of the present disclosure gradually decreases from the left end to the right end of the equal-diameter rotating shaft, which realizes the preliminary compression of the organic wastes during the pyrolysis and transportation of the organic wastes, thereby effectively improving the forming efficiency.

[0019] 5. The second helical blades disposed on the surface of the variable-diameter rotating shaft of the present disclosure is thickened to ensure that the second helical blades can withstand the high forming pressure from the solid forming fuel near the discharge outlet.

BRIEF DESCRIPTION OF THE DRAWINGS

[0020] FIG. 1 is a schematic structural diagram of an integrated device for manufacturing biocarbon through low-temperature pyrolysis and formation of organic solid wastes according to the present disclosure;

[0021] FIG. 2 is an enlarged schematic structural diagram of a portion A in FIG. 1;

[0022] FIG. 3 is an enlarged schematic structural diagram of a portion B in FIG. 1;

[0023] FIG. 4 is a schematic structural diagram of FIG. 1 along a direction of line C-C.

[0024] FIG. 5 is a schematic structural diagram of a left plate surface of a flange in Fig.1 along a direction of line D-D.

[0025] Reference numerals: 1 drive motor; 2 reducer; 3 coupling; 4 feed inlet; 5. vapor outlet; 6 first helical blade; 7 equal-diameter rotating shaft; 8 second helical blade; 9 variable-diameter rotating shaft; 10 flange; 11 discharge outlet; 12 cylinder base; 13 pyrolysis product outlet; 14 metal cylinder; 15 temperature-adjustable heating element; 16 heat preservation box; 17 drive shaft; 18 motor base; 19 table; 20 bearing seat; 21 first deep groove ball bearing; 211 first metal dust cover of first deep groove ball bearing; 212 second metal dust cover of first deep groove ball bearing; 22 second deep groove ball bearing; 221 first metal dust cover of second deep groove ball bearing; 222 second metal dust cover of second deep groove ball bearing.

DETAILED DESCRIPTION OF THE EMBODIMENTS

[0026] The technical solutions in the embodiments of the present disclosure will be clearly and completely described below with reference to the accompanying drawings in the embodiments of the present disclosure. Obviously, the described embodiments are only a part of the embodiments of the present disclosure, rather than all the embodiments. Based on the embodiments of the present disclosure, all other embodiments obtained by those of ordinary skill in the art without paying creative efforts shall fall within the protection scope of the present disclosure.

[0027] As shown in Fig. 1, an integrated device for manufacturing biocarbon through low-temperature pyrolysis and formation of organic solid wastes, includes: a drive motor 1, a reducer 2, a coupling 3, a feed inlet 4, a water vapor outlet 5, first helical blades 6, an equal-diameter rotating shaft 7, second helical blades 8, a variable-diameter rotating shaft 9, a flange 10, a discharge outlet 11, a cylinder base 12, a pyrolysis product outlet 13, a metal cylinder 14, a temperature-adjustable heating element 15, a heat preservation box 16, a drive shaft 17, a motor base 18, a table 19, a bearing seat 20, a first deep groove ball bearing 21, and a second deep groove ball bearing 22. It is assumed that a side where the drive motor 1 is located is defined as a right side, and a side where the discharge outlet 11 is located is defined as a left side. The drive motor 1 is fixedly installed on the motor base 18, the motor base 18 is fixedly installed on the table 19, and the drive motor 1 is connected with the reducer 2. The drive shaft 17 protrudes from a left end of the reducer 2. The drive shaft 17 is connected with the equal-diameter rotating shaft 7 through the coupling 3. A surface of the equal-diameter rotating shaft 7 is provided with first helical blades 6, and a left end of the equal-diameter rotating shaft 7 is connected with the variable-diameter rotating shaft 9. A surface of the variable-diameter rotating shaft 9 is provided with the second helical blades 8, and the variable-diameter rotating shaft 9 and the equal-diameter rotating shaft 7 are formed in one piece. The feed inlet 4 is provided on a top of a right end of the metal cylinder 14, the water vapor outlet 5 is provided on the top of the metal cylinder 14 on the left side of the feed inlet 4, and the pyrolysis product outlet 13 is provided on a bottom of the metal cylinder 14 on the left side of the water vapor outlet 5, and the pyrolysis product outlet 13 runs through the temperature-adjustable heating element 15, the heat preservation box 16 and the table 19. A section of the metal cylinder 14 from its right end to a boundary line between the equal-diameter rotating shaft 7 and the variable-diameter rotating shaft 9, is wrapped with the temperature-adjustable heating element 15, and the heat preservation box 16 is provided around the temperature-adjustable heating element 15, and the heat preservation box 16 is fixedly installed on the table 19. A section of the metal cylinder 14 corresponding to the variable diameter rotating shaft 9 is fixedly installed on the cylinder base 12, and the cylinder base 12 is fixedly installed on the table 19; the left end of the metal cylinder 14 is installed with a flange 10.

[0028] As shown in Fig. 2, the first deep groove ball bearing 21 is fixed on a right end of the metal cylinder 14, and a left side of the first deep groove ball bearing 21 is provided with a first metal dust cover 211 of the first deep groove ball bearing, the second metal dust cover 212 of the first deep groove ball bearing is provided on the right side of the first metal dust cover 211 of the first deep groove ball bearing. A right end of the equal diameter rotating shaft 7 is fixed to an inner ring of the first deep groove ball bearing 21. The second deep groove ball bearing 22 is fixed on the bearing seat 20, and the bearing seat 20 is welded to an inner wall of the metal cylinder 14 at a position where the equal diameter rotating shaft 7 and the variable diameter rotating shaft 9 are connected. A left side of the second deep groove ball bearing 22 is provided with a first metal dust cover 221of the second deep groove ball bearing, and a second metal dust cover 222 of the second deep groove ball bearing is provided on the right side of the first metal dust cover 221 of the second deep groove ball bearing. A clamping slot is provided at a place where the equal-diameter rotating shaft 7 is connected with the variable-diameter rotating shaft 9. The clamping slot is used to fix the equal-diameter rotating shaft 7 and the variable-diameter rotating shaft 9.

[0029] The pitches of the first helical blades 6 are increased gradually by 1 mm for every turn of helical blades, from the right end to the left end of the equal-diameter rotating shaft 7.

[0030] A diameter of the variable-diameter rotating shaft 9 is gradually reduced by 1mm for every 5cm length of the variable-diameter rotating shaft 9, from the right end to the left end of the variable-diameter rotating shaft 9; when the diameter of the variable-diameter rotating shaft 9 is reduced to 2 cm, the diameter of the variable-diameter rotating shaft 9 is no longer reduced.

[0031] A thickness of the second helical blade 8 is thicker than that of the first helical blade 6 by 2 mm.

[0032] A screen is provided at an end of the vapor outlet 5 close to the metal cylinder 14.

[0033] A screen is provided at an end of the pyrolysis product outlet 13 close to the metal cylinder 14.

[0034] As shown in Fig. 5, a forming die is welded on the left plate surface of the flange 10; circular forming holes 102 are opened on a circular surface of the forming die, and support plates 101 are welded on a left side surface of the forming die. The left and right plate surfaces of the flange 10 are fastened by hexagonal bolts 103.

[0035] The working principle of the present disclosure is described as follows.

[0036] The raw material enters into the metal cylinder 14 through the feed inlet 4, and the temperature-adjustable heating element 15 heats the metal cylinder 14 according to the temperature required for low-temperature pyrolysis of the raw material. The heat preservation box 16 surrounds the temperature-adjustable heating element 15 for heat preservation. The drive motor 1 drives the drive shaft 17 to rotate through the reducer 2, and the drive shaft 17 is connected with the equal-diameter rotating shaft 7 through the coupling 3, and then drives the equal-diameter rotating shaft 7 and the variable-diameter rotating shaft 9 to rotate. In the metal cylinder 14 corresponding to the equal-diameter rotating shaft 7, the raw material is pushed by the first helical blades 6 to move towards the discharge outlet 11, and at the same time, is heated by the temperature-adjustable heating element 15 to increase temperature. The moisture in the raw material is evaporated and discharged from the vapor outlet 5. With further heating, the raw material begins to be pyrolyzed, and the gas and liquid products produced in the pyrolysis are discharged from the pyrolysis product outlet 13 for collection and utilization, while the solid products continue to, due to the obstruction of the screen, move further towards the discharge outlet 11, and the solid products are subject to preliminary compression through the first helical blades 6. When the raw material enter the metal cylinder 14 corresponding to the variable diameter rotating shaft 9, the low-temperature pyrolysis of the raw material has been completed thoroughly, and the metal cylinder 14 is no longer wrapped by the temperature-adjustable heating element 15 and the heat preservation box 16; the raw material undergone the low-temperature pyrolysis continues to move further towards the discharge outlet 11 under the push of the second helical blades 8, and are formed by the forming die at the flange 10, by using the residual temperature after the low-temperature pyrolysis. The formed solid fuel is extruded from the material forming port 102 and collected at the discharge outlet 11 for use.

[0037] It should be noted that the forming mold involved in the present disclosure is not limited to the cylindrical forming mold for particles.

[0038] The foregoing has shown and described the basic principles, main features and advantages of the present disclosure. Those skilled in the art should understand that the above-mentioned embodiments are only to illustrate the technical concept and characteristics of the present disclosure, and the purpose is to enable those who are familiar with the technology to understand the content of the present disclosure and implement it accordingly, and not to limit the protection scope of the present disclosure. All equivalent changes or modifications made according to the spirit of the present disclosure should be included within the protection scope of the present disclosure.

WHAT IS CLAIMED IS:

1. An integrated device for manufacturing biocarbon through low-temperature pyrolysis and formation of organic solid wastes, comprising a drive motor (1), a reducer (2), a coupling (3), a feed inlet (4), a water vapor outlet (5), first helical blades (6), an equal-diameter rotating shaft (7), second helical blades (8), a variable-diameter rotating shaft (9), a flange (10), a discharge outlet (11), a cylinder base (12), a pyrolysis product outlet (13), a metal cylinder (14), a temperature-adjustable heating element (15), a heat preservation box (16), a drive shaft (17), a motor base (18), a table (19), a bearing seat (20), a first deep groove ball bearing (21), and a second deep groove ball bearing (22), wherein a side where the drive motor (1) is located is assumed as a right side, and a side where the discharge outlet (11) is located is assumed as a left side, the drive motor (1) is fixedly installed on the motor base (18), the motor base (18) is fixedly installed on the table (19), the drive motor (1) is connected with the reducer (2), the drive shaft (17) protrudes from a left end of the reducer (2), and the drive shaft (17) is connected to the equal-diameter rotating shaft (7) through the coupling (3), a surface of the equal-diameter rotating shaft (7) is provided with the first helical blades (6), and a left end of the equal-diameter rotating shaft (7) is connected with the variable-diameter rotating shaft (9), a surface of the variable-diameter rotating shaft (9) is provided with the second helical blades (8), the variable-diameter rotating shaft (9) and the equal-diameter rotating shaft (7) are formed in one piece; a top of a right end of the metal cylinder (14) is provided with the feed inlet (4), the water vapor outlet (5) is provided at a top of the metal cylinder (14) on a left side of the feed inlet (4), and the pyrolysis product outlet (13) is provided at a bottom of the metal cylinder (14) on a left side of the water vapor outlet (5), the pyrolysis product outlet (13) passes through the temperature-adjustable heating element (15), the heat preservation box (16) and the table (19); a section of the metal cylinder (14) from a right end of the metal cylinder (14) to a boundary line between the equal-diameter rotating shaft (7) and the variable-diameter rotating shaft (9) is wrapped with the temperature-adjustable heating element (15) which is surrounded by the heat preservation box (16), the heat preservation box (16) is fixedly installed on the table (19); a section of the metal cylinder (14) corresponding to the variable-diameter rotating shaft (9) is fixedly installed on the cylinder base (12), the cylinder base (12) is fixedly installed on the table (19); a left end of the metal cylinder (14) is provided with the flange (10).

2. The integrated device according to claim 1, wherein the first deep groove ball bearing (21) is fixed on the right end of the metal cylinder (14), a left side of the first deep groove ball bearing (21) is provided with a first metal dust cover (211) of the first deep groove ball bearing, and a second metal dust cover (212) of the first deep groove ball bearing is arranged on a right side of the first metal dust cover (211) of the first deep groove ball bearing, a right end of the equal-diameter rotating shaft (7) is fixed to an inner ring of the first deep groove ball bearing (21); the second deep groove ball bearing (22) is fixed on the bearing seat (20), and the bearing seat (20) is welded to an inner wall of the metal cylinder (14) at a connection between the equal-diameter rotating shaft (7) and the variable-diameter rotating shaft (9); a left side of the second

deep groove ball bearing (22) is provided with a first metal dust cover (221) of the second deep groove ball bearing, and a second metal dust cover (222) of the second deep groove ball bearing is arranged on a right side of the first metal dust cover (221) of the second deep groove ball bearing; a clamping slot which is configured to fix the equal-diameter rotation shaft (7) and variable-diameter rotating shaft (9) is provided at the connection between the equal-diameter rotating shaft (7) and the variable-diameter rotating shaft (9).

3. The integrated device according to claim 1, wherein pitches of the first helical blades (6) are gradually increased by 1 mm for every turn of helical blades, from a right end to a left end of the equal-diameter rotating shaft (7).

4. The integrated device according to claim 1, wherein a diameter of the variable-diameter rotating shaft (9) is gradually reduced by 1 mm for every 5 cm from a right end to a left end of the variable-diameter rotating shaft (9), and the diameter of the variable-diameter rotating shaft (9) is no longer reduced along a length direction of the variable-diameter rotating shaft (9) after being reduced to 2 cm.

5. The integrated device according to claim 1, wherein a thickness of each second helical blade (8) is 2 mm greater than that of each first helical blade (6).

6. The integrated device according to claim 1, wherein an end of the water vapor outlet (5) near the metal cylinder (14) is provided with a screen.

7. The integrated device according to claim 1, wherein an end of the pyrolysis product outlet (13) near the metal cylinder (14) is provided with a screen.

8. The integrated device according to claim 1, wherein a left plate surface of the flange (10) is welded with a molding die, and circular forming holes (102) are formed on a circular surface of the molding die, a support plate (101) is welded on a left side of the forming die, and the left plate surface and a right plate surface of the flange (10) are fastened by hexagonal bolts (103).