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(54) LABORATORY EQUIPMENT FOR BIOCHAR PRODUCTION FROM VEGETABLE REMAINS

(57) The laboratory equipment for biochar production from vegetable remains is composed of a mobile support (100) on which are mounted two load cells (104) and two slewing bearings (105) supporting a casing (200) of octagonal shape having a lower cover (205) supporting an electrical resistance (208) for the ignition of solid fuel by means of an air diffuser with holes (209) and a fan (210), and a hinged upper cover. To burn the entire amount of material, the equipment is fitted with a draft fan (308). The control of the temperature and pressure in the enclosure is done with a thermostat (402), a thermocouple (312), a pressure sensor (314), which provides the information to an electronic system with programmable controller (400). The equipment is used to test the technology under laboratory conditions, on different types of vegetable remains, and uses a number of parameters that can be controlled, adjusted and monitored.

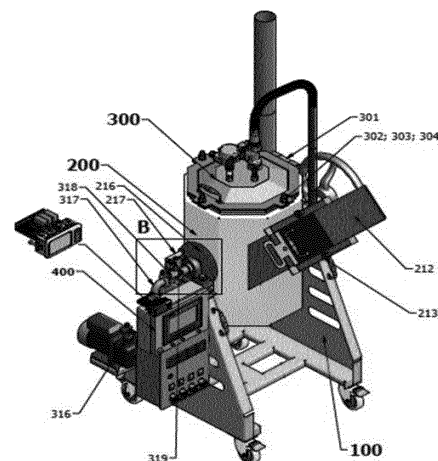
**Position A for operation**

Fig.1

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Description

[0001] The invention presents equipment for laboratory that will produce biochar and synthesis gas from vegetable remains, the equipment being fitted with temperature and pressure control sensors that provide the information for a programmable controller that ensures the operation of the system.

[0002] In the present state of the art, patent US 2013264831A1 is known, which relates to a gasifier with controlled biochar removal mechanism including a biochar and electric power generator that receives material and outputs variable amounts of electrical energy and chat, including a pyrolysis module, a reaction module and a char removal mechanism arranged between the pyrolysis module and the reaction module, an engine module including an engine and an alternator, configured to convert the gaseous fuel produced by the reaction module into electric power and to provide waste heat to the pyrolysis module and a flare configured to burn tar gas and provide waste heat to the pyrolysis module.

[0003] The disadvantages of this system are the following: the feeding system is complex and consists of three augers for transporting raw material, it has a low degree of sealing and the biochar production process does not occur in an environment with low input or in the absence of oxygen; unloading the biochar from the retort into a container is done by means of an auger conveyor and it is necessary that the equipment is not used for a period of time until the biochar has completely cooled.

[0004] Patent US 2014250784A1 is also known, which relates to a type of updraft gasifier that uses the heat from the gas rising from the combustion process to reduce, pyrolyze and dry the material for biochar production.

[0005] The disadvantages of this system are the following: low degree of sealing against the atmosphere during the pyrolysis process; unloading the biochar from the retort into a container is done using a tray and the biochar comes into contact with the atmosphere during the cooling process.

[0006] Patent CN 102936505A (B) is also known, which relates to biochar charring furnace for a laboratory with a technical solution that includes a feeding tank, a heating steel pipe, a resistance wire, a temperature sensor, a casing and a cover and is characterized in that the feeding tank is a hollow steel barrel structure with an open upper end and a closed bottom and the heating steel pipe has an open upper end and a closed lower end. The heating layer is a winding heating resistance wire with insulating porcelain beads.

[0007] The disadvantages of this system are the following: high consumption of electricity, because this system is with indirect heating of the enclosure until the temperature necessary to ignite the entire amount of material in the retort is reached; the long time required to ignite the material but also to cool the biochar in order to manually unload it from the equipment.

[0008] Patent US 2021222071A1 is also known, which

relates to a pyrolysis system and enhanced pyrolysis gas production where dry biosolids were pyrolyzed with the introduction of biochar as a downstream catalyst. The hot pyrolysis vapours exited the main pyrolysis reactor, passed through the hot catalyst, and were then separated by condensation. The biochar was obtained in the main reactor and the bio-oil was collected in the condensers.

[0009] The disadvantages of this system are the following: complex and expensive construction for the intended purpose; long time for the production of the biochar batch because a long time is required for cooling and unloading the obtained product.

[0010] Patent US 20080014132A1 is also known, which relates to a biomass gasifier. The invention presents a wall structure defining a gasification chamber that has a biomass inlet at an upper end thereof and a char outlet at a lower end, a generally U-shaped char tube which has two vertical limbs, the first limb is positioned to receive char from the gasification chamber and the second limb terminates upwardly at a level above the char outlet of the gasification chamber and is connected to a blower, for inducing a flow of gas through the gasification chamber.

[0011] The disadvantage of the equipment is that the system for unloading the biochar from the auger retort - which forces the material up into a two-limb "U" shaped container - involves blocking it during operation and therefore stopping the work process and manual unclogging of the equipment.

[0012] Patent CN 215103026U is also known, which relates to a small mobile carbonization furnace for the production of biochar and fuel gas. The small carbonization furnace used to produce biochar and fuel gas comprises the furnace shell, a partition plate, a combustion chamber, a carbonization chamber, a waste gas treatment mechanism, a sealing mechanism, a cleaning mechanism, and a traction mechanism. The partition plate is fixedly installed in the furnace shell, the combustion chamber and the carbonization chamber are divided by the partition plate, the waste gas treatment mechanism comprises a waste gas treatment device, a first pipe, a cooler and a second pipe, the waste gas treatment device is arranged on one side of the furnace body, the first pipe is fixedly installed at the top of the furnace body, and the cooler is fixedly installed at the bottom of the furnace body.

[0013] The disadvantages of this equipment are as follows: the system presents the use of synthesis gas for heating the retort in which the material for the production of biochar is burned, but this synthesis gas is mixed with steam and smoke resulting from the technological process and therefore the combustion efficiency is very low; an additional amount of time is required to cool down the equipment and then unload the biochar.

[0014] Patent CN 218002214U is also known, which relates to a biochar carbonisation furnace under laboratory conditions.

[0015] The disadvantage of this system is that this carbonisation furnace has no cooling structure and depends only on free cooling in the atmosphere, which takes a long time and will lead to waste of heat. After carbonization is completed, due to the biochar in the furnace, the temperature is still high when it is directly opened, and it is easy to cause combustion when it comes into contact with oxygen, so it is necessary to cool the biochar.

[0016] Patent US 6790317 is also known, which relates to a carbonization process to produce biochar from sawdust or wood waste and which uses a small amount of material as tinder or fuel to ignite the material in the retort.

[0017] The disadvantages of this invention consist of the following: the long duration of time for the complete combustion of the raw material and then the unloading of the biochar; heavy working system involving physical effort when unloading; there isn't an active control of the working parameters during the technological process.

[0018] The **general disadvantages** of these inventions consist in the fact that they represent specific technical solutions for the purpose achieved and that are not suitable for small equipment, for the laboratory, but with a high degree of automation, which allows the adjustment of parameters to research the production of biochar from different vegetable remains recipes.

[0019] The technical problem that the invention solves consists in the design of laboratory equipment that allows the establishment of optimal values for the production of biochar from various vegetable remains recipes, equipment fitted with command and control elements that use a programmable controller for the automatic control of the system.

[0020] The equipment for biochar production from vegetable remains eliminates the disadvantages of the known solutions in that it consists of a mobile support provided with some swivel wheels for movement, the mobile support has two side walls on which are mounted two bearing housings that support an octagonal casing with the elements of actuation and control of important parameters for the production of biochar from vegetable remains. The octagonal casing is made of two octagonal tubs of stainless steel material class 316 (1.4401) which is the most suitable for polluted, industrial environments due to the fact that it has a higher corrosion resistance. The two octagonal enclosures are mounted concentrically and are insulated from each other with a very high temperature resistant ceramic fibre layer to eliminate heat loss from inside the equipment. The octagonal casing has two side bolts mounted in the two bearing housings on the support and will allow the equipment to be rotated from the vertical position to the inclined position at about 135° for unloading the material obtained by pyrolysis, the rotation of the equipment being done using a handwheel.

[0021] At the bottom of the casing there is an electrical resistance mounted for igniting the solid fuel. To ignite the

material, a fan or compressor can be used which sends the necessary air to a hole diffuser mounted near the electrical resistance. The air sent by this fan will hasten the ignition of the material in the vicinity of the electrical resistance. A double-walled, ceramic fibre-insulated metal top cover is mounted on the octagonal casing, the cover rotates by means of a hinge and is held in place by fixing screws. The cover will support a pressure relief valve, a high temperature thermocouple and a pressure sensor. Also in the cover is mounted a metal nipple that will allow coupling to a fan for high temperatures by means of a flexible metal hose. This fan can provide the draft necessary to ignite the entire amount of material, but it can also absorb the smoke together with the vapours produced at the beginning of the pyrolysis process and send them to the atmosphere.

[0022] At a time duration of 10-15 minutes after the material at the bottom of the enclosure is ignited, the electrical resistance for igniting the fuel is turned off. After about 30-40 minutes, depending on the raw material used and its moisture, the material is ignited throughout the mass, which is dried in the first stage, and to continue the technological process, it is necessary to hermetically close the air hole at the bottom of the of the casing and the electromagnetic valve connected with the flexible hose and which is mounted on the octagonal casing cover. Due to combustion in a hermetically insulated space, the oxygen content inside the enclosure drops from 21% to approximately 2%, the pressure in the enclosure will increase to 10 bars and the temperature achieved is 400-500°C, depending on the biomass used and the air intake. If necessary, the work cycle can be repeated by changing the working parameters: air pressure added to the combustion process and working temperature. During the pyrolysis process, a synthesis gas is obtained, which can be transported with the help of the high temperature fan connected to the upper cover of the enclosure. This gas can be cooled and separated from the liquid part and then stored in a gas cylinder, to be burned in a gas burner mounted on other pyrolysis equipment. The raw material is chopped to similar sizes, does not require prior drying and allows moisture of approx. 15-30%. The technological process takes about 40-60 minutes, depending on the moisture of the materials used in the production of biochar. After pyrolysis is complete, tilt the container of the octagonal casing using the handwheel, open the cover and tip the obtained material into a container, after which the cycle begins again.

[0023] Control of working parameters: the pressure and temperature inside the retort can be controlled with the help of an electronic command and control panel, which can be equipped with a programmable controller for automatic control and adjustment of working parameters.

[0024] The equipment for biochar production from vegetable remains has the following **advantages**:

- It does not require a biochar unloading system

(conveyor auger, trays, etc.) because the produced material can be unloaded by rotating the equipment with the help of a handwheel and tipped into an insulated container;

- The equipment has a single enclosure, it does not require a retort for heating and drying the material, the raw material is introduced into the reactor tank and the entire technological process takes place there;

- Reduced energy consumption for starting and running the production cycle;

- Automated production cycle, with programmable controller;

- Short working time;

- Thermal insulation with ceramic fibre and double jacket that ensures low energy consumption;

- The equipment is mobile, small in size and recommended for laboratory tests, with automatic adjustment of working parameters;

- It can use vegetable remains with a moisture content of 30-40%, compared to known solutions that can use vegetable residues with a maximum moisture content of 15%.

[0025] An embodiment of the invention is further shown in connection with Figs. 1-14, which represent:

- Fig.1 -Three-dimensional view of the equipment for biochar production from vegetable remains;
- Fig.2 -Lateral view of the equipment for biochar production from vegetable remains;
- Fig.3 -Three-dimensional view of the mobile support;
- Fig.4 -Detail A, consisting of the load cell and the slewing bearing;
- Fig.5 -Casing of the equipment for biochar production from vegetable remains;
- Fig.6 -Upper cover of the equipment for biochar production from vegetable remains;
- Fig.7 -Lower cover of the equipment for biochar production from vegetable remains;
- Fig.8 -Bottom view of the lower cover;
- Fig.9 -Detail B;
- Fig.10 -View of inclined equipment for biochar unloading;
- Fig.11 -Container for biochar unloading;
- Fig.12 -Detail C, consisting of the electronic control panel;

- Fig.13 -Rear view of equipment inclined for biochar unloading;

- Fig.14 -Biochar production equipment in position C for raw material supply

[0026] The laboratory equipment for biochar production from vegetable remains, according to the invention, is composed of a mobile support (100) which consists of a platform (101) equipped with four self-braking castor wheels (102) and two side walls (103) on which two load cells (104) and two slewing bearings (105) are mounted on the top plate of the load cells (104) with hexagon head screws (106).

[0027] A casing (200) is mounted on the mobile support (100) which has some spindles (201a) and (201b) that penetrate the slewing bearings (105). The casing (200) consists of two enclosures (202) and (203), of octagonal shape, mounted concentrically and which are insulated from each other with a layer of ceramic fibre (204). A double-walled, ceramic fibre-sealed cover (205) is integrally mounted to the bottom of the casing. Two nipples of different sizes (206 and 207) are mounted in the cover (205). An electrical resistance (208) is mounted in the nipple (206) for the ignition of solid fuel. An air diffuser with holes (209) is mounted in the nipple (207) which supplies the air necessary for igniting the combustible material and which is received from the fan (210).

[0028] An upper cover (300) is mounted on the casing (200) using hinges (301) and the cover can be tightened with some screws (302), washers (303) and nuts (304). The top cover is made of two walls (305 and 306) of temperature-resistant stainless steel sheet, these walls are insulated with ceramic fibre (307). To continue burning the material at maximum intensity for biochar production, a draft fan (308) is required. Transporting air from the fan (308) to the cover (300) is accomplished with a flexible metal hose (309), a quick coupler (310) and a nipple (311). To control the temperature on the cover (300) a thermocouple (312) is used to measure the temperature, which is mounted using a nipple (313).

[0029] Due to the fact that the material used for the production of biochar can have a maximum humidity of 40%, in the first stage of the technological process when the material is ignited in the vicinity of the electrical resistance, the material gradually dries and a large amount of water vapours are released in the enclosure. To control the pressure inside the combustion chamber a pressure sensor (314) is used which is mounted with a nipple (315) on the cover (300).

[0030] The reduction of the working pressure in the enclosure can be achieved with a vacuum pump (316) which is connected by means of a flexible metal hose (317), a solenoid valve (318), a rotary coupling (319) to a spindle (202a) which has drilled an inner hole that communicates with the inside of the casing (200). For protection against high steam pressure, a pressure relief valve (320) is mounted on the cover (300).

[0031] The fan (308) can provide transport of the smoke and vapours produced during the combustion of the material.

[0032] After the material is completely ignited and the temperature inside the enclosure reaches 250°C, it is necessary to hermetically close the enclosure for biochar production. Hermetic closure can be achieved with the solenoid valve (311) mounted on the upper cover (300); the solenoid valve (318) mounted on the rotation spindle (201a) and the solenoid valve (211) which is mounted on the casing lower cover (200).

[0033] During biochar production, synthesis gas is also obtained which can be released with the vacuum pump (316) and directed with a 3-way distributor to a cyclone separator and a gas cylinder, components that are not shown in the drawings. Syngas can be used as a heating agent in a gas burner for other equipment used for biochar production.

[0034] The casing (200) has a discharge mouth (213) which is provided at the top with a frame (213) for fixing a container (212) with some screws, not positioned. The container (212) has a prismatic guide (214) into which a separator plate (215) fits. A disk with two conical holes (216) is mounted together with the spindle (201a) and a counter (217) is mounted on the wall (103) of the mobile support (100) which will position the casing (200) in position (A), for feeding and biochar production - and in position (B), for unloading the biochar after the end of the technological flow. To unload the biochar, rotate the casing (200) using the handwheel (218) in position (B), remove the separator plate (215) so that the biochar reaches the container (212), then install the separator plate (215) in the prismatic guide (214) and remove the container (212).

[0035] In this way, the biochar at high temperature does not come into contact with the atmosphere and the production of ash during the cooling of the biochar is reduced.

[0036] For programming the working parameters: temperature, pressure, control of the electrical resistance for material ignition, regulation of the draft fan, the vacuum pump, the equipment is provided with an electronic panel with programmable controller (401) of PLC type.

[0037] The measurement, recording and regulation of temperature and pressure is done with a thermostat (402) which is used for the simultaneous control of the two control-thermocouple devices (312) and the pressure sensor (314) and then the recording of the measured parameters is done on the programmable controller (401). The connection and control of the electromechanical components is done with the electrical panel (403). For the manual control of the electromechanical actuation components and control of the working parameters, can be used only the electrical panel (403) and the thermostat (402).

[0038] It is necessary that for all the components for measuring the parameters and regulating the combustion be specified the very exact technical characteristics

which are necessary to create a software that will be used on the programmable controller (401). The monitoring of these parameters determines the establishment of optimal values for obtaining, in laboratory conditions, a quality biochar, from different types of plant remains.

[0039] The research results on this laboratory equipment can be used in the design and use of industrial equipment for biochar production.

[0040] The basic subsystems of the equipment are the following and present the description of the elements of novelty / inventiveness compared to the state of the art in this field, as follows:

1). The mobile support (100) is a metal structure with two slewing bearings (105), which allows the loading of the raw material and the unloading of the biochar from the casing (200) retort without the need for other transfer elements: transport auger, etc. The mobile support (100) has an ergonomic structure and supports the components that coordinate the combustion of the raw material for biochar production, namely the vacuum pump (316), the fan (308) but also the electronic control panel (400).

2). The casing (200) consists of two enclosures (202) and (203) of octagonal section, insulated from each other with ceramic fibre (204), and supporting a fixed cover (205) and a hinged cover (300) on which are mounted the material ignition elements for biochar production (208) and (209) and are connected to the two fans: one for ignition (210) and the other fan (308) to ensure the draft necessary to ignite the entire amount of raw material. This casing contains a spindle (201a), with a central hole, through which the absorption of the air from the inside is carried out before the production of biochar, namely after the complete ignition of the raw material, and the second spindle (201b), mounted collinear with the first spindle, allows casing rotation using a handwheel (218). The casing (200) is connected to the discharge mouth (213) into which the biochar obtained in a hot state is unloaded, without waiting for it to cool down together with the equipment. Due to the use of a separator plate (215), the unloaded biochar does not come into contact with oxygen from the atmosphere until complete cooling.

3). The electronic control panel (400) recommended for this equipment, which is used in laboratory conditions for different types of plant residues and which uses the thermostat (402) for receiving and displaying the values measured by the thermocouple (312) for measuring the temperature but also from the sensor (314) used to measure the pressure inside the casing (200) during the combustion of plant remains for biochar production. This information is taken by the programmable controller (401) and, based on a software made for this purpose, it

will command the electrical control panel (403) which will operate the two fans: for combustion (210) and for draft (308), will control the start and stop of the electrical resistance (208) and the vacuum pump (316). This system performs the automatic control and adjustment of the working parameters to obtain a quality biochar under laboratory conditions and this information which is then listed will be useful in the development of an industrial equipment used for this purpose.

[0041] An embodiment of the invention is further shown in connection with Figs. 1-14, in which the main components and important materials have the following technical characteristics:

1. The load cells (104), used in the construction of the equipment, are of *single point* type and are made of aluminium, with improved insulation, which have a weighing capacity in the range of 30-750 kg, are generally used for commercial scales or small weighing platforms. The electrical signal is received by the electronic command and control panel.

2. The ceramic fibre (204) which is used for thermal insulation of the casing and covers of the equipment presented by the invention, has the following technical characteristics: it is made of aluminium oxide (45-50%) and silicon dioxide (48-53%), withstands up to 1260°C. The two octagonal enclosures (202) and (203) are made of stainless steel class 316 (1.4401) resistant to corrosion and high temperatures.

3. The electrical resistance (208), for igniting solid fuel, has the following technical characteristics: the energy load on the cartridge body is a maximum of 50 W/cm², the sheath of this product is made of stainless steel and at the end of the product there is a ceramic head for a better power cord protection. The current supply is made with copper-nickel monoconductor wires, which have external insulation made of silicone coated glass fibre.

4. The draft fan (210) is for blowing air and has the following technical characteristics: static pressure - maximum 360 Pa, air flow - maximum 255 m³/hour, maximum speed 2470 rpm, energy consumption - 67 W, capacitor 2 µF. Rotor - galvanized steel.

5. The draft fan (308) has the following working parameters: 230 V, 40 W, 2640 RPM.

6. The high temperature thermocouple (312) is with ceramic protection, with sheath, probe: K or S thermocouple, according to IEC 60584 standard, class 1, connection head: type B made of aluminium alloy coated with epoxy resins, cable outlet with cable

gland IP68 polyamide; refractory steel sleeve. Temperature of use: from -50°C to +1800°C.

7. The pressure sensor (314) has analog output, DC 0-10V type signal.

8. The vacuum pump (316) has two operating stages, 220 V power supply, with the following technical characteristics: flow rate 100 l/min.; vacuum depth - 15 microns; Hg column = 2 Pa; power 0.7 KW, threaded connection ¼ inch SAF; oil non-return solenoid valve: vacuum gauge (measures the depth of the vacuum).

9. The programmable controller (401), is a high-performance control system, executed according to the PLC + HMI concept, with an integrated colour touch screen. This system forms a single unit together with the inputs and outputs, respectively the attachable I/O modules.

10. The thermostat (402) is used for the simultaneous control of the two actuators-thermocouple (312) and the pressure sensor (314) and the recording of the measured parameters on the programmable controller (401). It is necessary for all measurement parameters and combustion control components to specify the very exact technical characteristics that are necessary to create a software that will be used on the programmable controller (401).

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[0042]

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Claims

1. **Equipment for biochar production from vegetable remains, characterized by the fact that**, in order to be able to produce biochar under laboratory conditions from different vegetable remains, is composed of a mobile support (100), which has two slewing bearings (105), supporting the spindles of a double-walled casing (200) and an electronic control panel (400) equipped with control elements and which uses a programmable controller (401) and performs the programming of the control elements in the electrical panel (403), the parameters are listed to a wireless printer and allow the subsequent analysis of each working sample depending on the raw material and the working parameters used on the laboratory equipment, the final information will be used in the sizing and regulation of industrial equipment for the production of biochar from vegetable remains, the equipment being configured to ensure the production of biochar in the absence of oxygen from the atmosphere, also achieving the transfer to a removable container (212), using the separator plate (215), of the product obtained immediately after the end of the process without coming into contact with the atmosphere, thus obtaining a quality product but also at a reduced time, without waiting for the biochar to cool down for unloading.
2. **Equipment for biochar production from vegetable remains**, according to claim 1, **characterized by the fact that**, the mobile support (100) consists of a platform (101) equipped with four self-braking castor wheels (102) and supports two side walls (103) on which two load cells (104) are mounted that perform measurements for raw material and the amount of biochar obtained, and on the upper part of the two load cells are mounted two slewing bearings (105) fastened with some hexagon head screws (106), the mobile support (100) having the role of supporting the basic components of the equipment and ensuring the transport at the place of use.
3. **Equipment for biochar production from vegetable remains**, according to claim 1, **characterized by the fact that**, the casing (200) consists of two enclosures (202) and (203), of octagonal shape, insulated from each other with ceramic fibre supporting a fixed cover (205) and a hinged cover (300) on which are mounted the material ignition elements for biochar production (208) and (209), the casing (200), at the two fans: one for ignition (210) and the other fan (308) to ensure the draft necessary to ignite the entire amount of raw material, having two lateral spindles for positioning in the slewing bearings (105): a spindle (201a) with a central hole, through which the absorption of air from the inside is carried out, before the production of biochar, namely after

the complete ignition of the raw material, and the second spindle (201b), mounted in the opposite direction, collinear with the first spindle, allows the casing to be rotated by means of a handwheel (218), and also the casing (200) is connected to the container (212) in which is unloaded the biochar obtained in hot state, without waiting for it to cool down together with the equipment, provided with the discharge mouth coupled with a container having a separation plane that allows the biochar to be unloaded without coming into contact with the atmosphere.

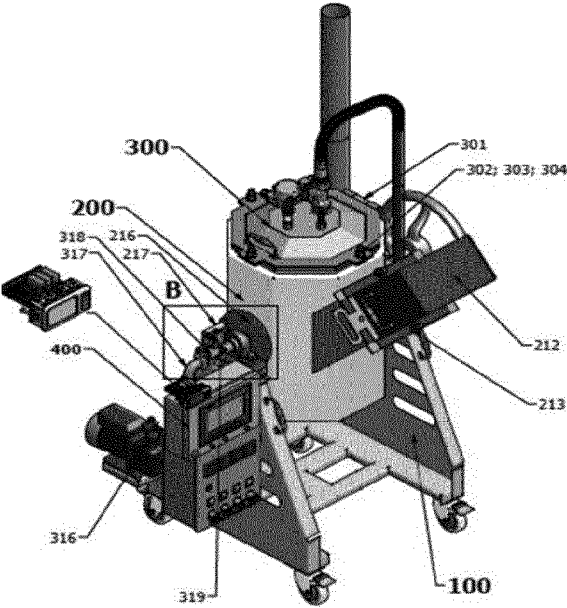
4. **Equipment for biochar production from vegetable remains**, according to claim 1, **characterized by the fact that**, the electronic control panel (400) recommended for this equipment which is used in laboratory conditions for different types of plant residues and which uses the thermostat (402) to receive and display the values measured by the thermocouple (312) for measuring the temperature also from the sensor (314) used to measure the pressure inside the casing (200) during the combustion of vegetable remains for the production of biochar, the information being taken by the programmable controller (401) and, based on a software made for this purpose, it will command the electrical control panel (403) which will operate the two fans: for ignition (210) and for draft (308), will command the start and stop of the electrical resistance (208) and will command the vacuum pump (316), thus monitoring the work process with sensors for measuring pressure, temperature, weight, the processing of this information with a programmable controller and the automatic control of the electromechanical components that actuate the equipment for the production of biochar from vegetable remains.
5. **Equipment for biochar production from vegetable remains**, according to claims 1 and 4, **characterized by the fact that**, the weight of the feed material and the amount of biochar obtained are measured with the load cells (104) and this information is transmitted to the programmable controller (401) so that, by intermediate measurement using this load cell system, can be determined the amount of water that evaporated following the drying process and therefore the humidity of the raw material used in each production cycle, so that the determination of the relative humidity of the raw material by weighing the material at loading and weighing the material after the drying operation of the raw material is done directly in equipment retort, without any additional apparatus.

Amended claims in accordance with Rule 137(2) EPC.

1. **Equipment for biochar production from vegeta-**

ble remains, comprising a mobile support (100) with the role of supporting the basic components of the equipment and ensuring the transport at the place of use, which has two slewing bearings (105), supporting the spindles of a casing (200) and an electronic control panel (400) equipped with control elements connected to a programmable controller (401), **characterised in that** the equipment is configured to produce biochar under laboratory conditions, in the absence of oxygen from the atmosphere, ensured by a special construction of the double-walled casing (200), and in an controlled configuration based on the monitoring the basic parameters that determines the establishment of optimal values for obtaining, in laboratory conditions, a quality biochar, from different types of plant remains, that comprises two load cells (104) mounted on the side walls (103) of a platform (101) equipped with four self-braking castor wheels (102), for measuring the weight of the feed material and the amount of biochar thus also determining the amount of water evaporated following the drying process and the humidity of the raw material used in each production cycle, a thermostat (402) used for the simultaneous control of the measured values from a thermocouple (312) for measuring and control of the temperature on a hinged cover (300), and from a sensor (314) for measuring the pressure inside the casing (200) during the combustion of vegetable residues for the production of biochar, and, based on a dedicated software, the process computer (401) operates two fans, namely an ignition fan (210) and a draft fan (308) that provides transport of the smoke and vapours produced during the combustion of the material, and respectively controls on the one side the start and stop of an electrical resistance (208) for the ignition of solid fuel so that an air diffuser with holes (209) is mounted in a nipple (207) for supplying the air necessary for igniting the combustible material received from the fan (210). and the control of a vacuum pump (316), that performs the reduction of the working pressure in the enclosure, being connected by means of a flexible metal hose (317), a solenoid valve (318), a rotary coupling (319) to a spindle (202a) which has drilled an inner hole that communicates with the inside of the casing (200) and for the protection against high steam pressure, a pressure relief valve (320) is mounted on the hinged cover (300), hermetic closure after the completely ignition of the material being achieved with a solenoid valve (311) mounted on the hinged cover (300), the solenoid valve (318) mounted on a rotation spindle (201a) and the solenoid valve (211) mounted on the casing lower cover (200), and finally the synthesis gas also obtained during biochar production can be released with a vacuum pump (316) and directed with a 3-way distributor to a cyclone separator and a gas cylinder.

2. **Equipment for biochar production from vegetable remains**, according to claim 1, **characterized by the fact that**, the casing (200) consists of two enclosures (202) and (203), of octagonal shape, concentrically mounted and insulated from each other with double-walled and sealed ceramic fibre (204), the casing (200) being rotated by means of a hand-wheel (218) in B position when unloading the biochar, the removal of a separator plate (215) mounted in the prismatic guide (214) enables the biochar to reach the container (212), and then the remounting of the separator plate (215) in the prismatic guide (214) and the removal of the container (212) containing the biochar obtained in hot state enables its cooling down without coming into contact with the atmosphere and thus reduces the production of ash during the cooling of the biochar.



Position A for operation

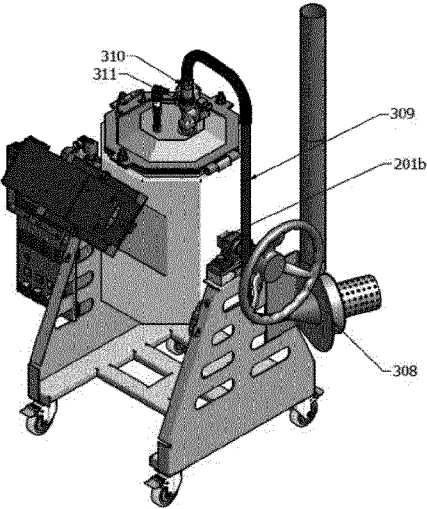


Fig.1

Fig.2

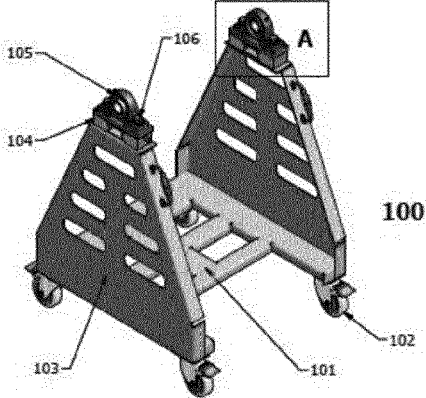
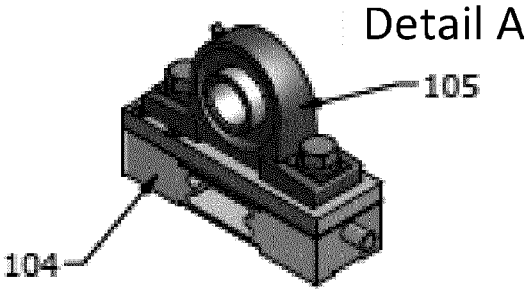


Fig.3



Detail A

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Fig.4

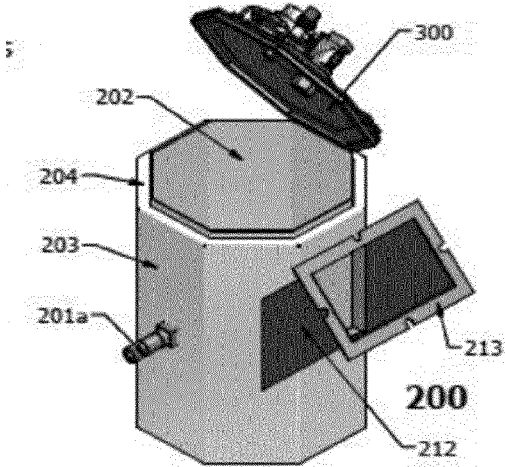


Fig.5

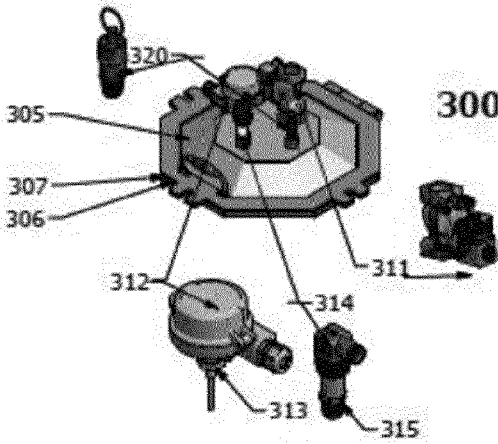


Fig.6

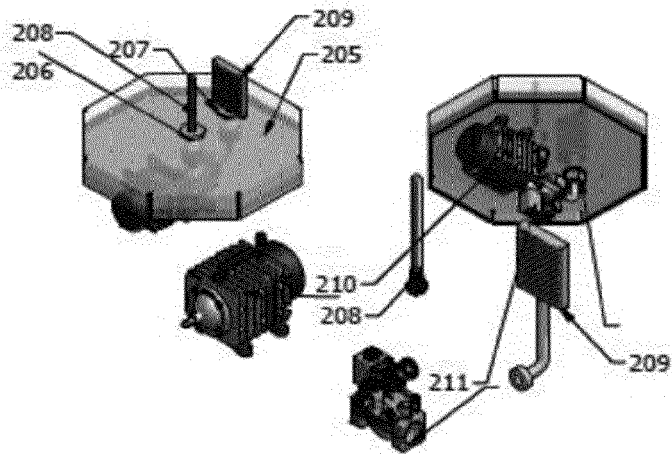


Fig.7

Fig.8

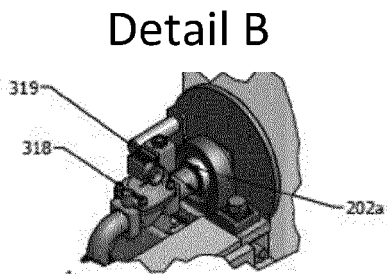


Fig.9

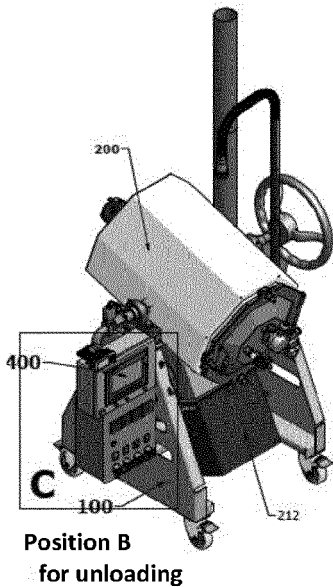


Fig.10

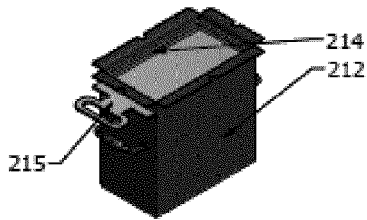


Fig.11

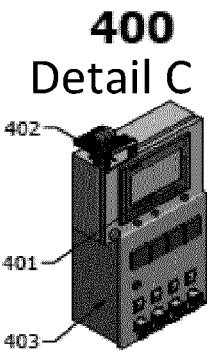


Fig.12

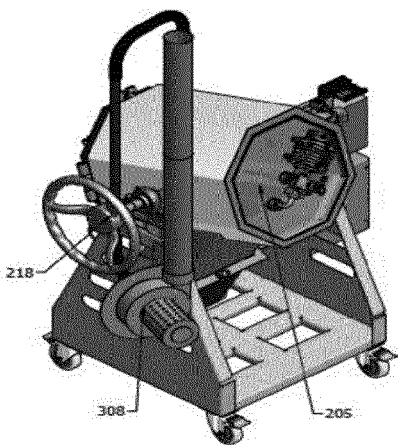


Fig.13

Position C for material supply

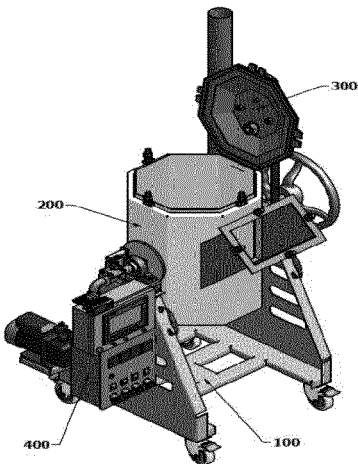


Fig.14



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