Smokeless burning equipment

Smokeless burning equipment capable of burning undried plant-origin materials as fuel, burning waste plastics, preventing generation of smoke and reducing ash. The smokeless burning equipment comprises: a material/air inlet located close to one end of an upper wall of a burning chamber; an inlet lid for opening and closing the material/air inlet; an air outlet located close to the other end of the upper wall; a burn-promoting plate dividing the burning chamber into a primary burning chamber and a secondary burning chamber and being downwardly extended from the upper ceiling wall; a communication path communicating the primary and secondary burning chambers and being formed under the lower end of the burn-promoting plate; through-holes being dispersedly formed in the burn-promoting plate; a dry wood inlet provided to the secondary burning chamber and located under the air outlet; and a guide tube for guiding dry a dry wood, the guide tube attached to the dry wood inlet.

FIG. 1
The present invention relates to a smokeless burning equipment, in which undried woods, waste plastics, etc. can be suitably burned or suitably used as fuel.

Generally, in case of burning waste woods, cardboard boxes, grasses, barks of trees, plastic pieces, etc. or using them as fuel, if temperature of a burning chamber of a stove or a furnace is low, e.g., about 400°C, imperfect burning occurs, grayish white or black smoke is generated, and a large amount of ash is produced. The problem of environmental destructions, which is caused by the smoke and the ash, etc., occurs.

To solve the problem, the inventor of the present invention invented a modified burning equipment, which is capable of burning burnable materials at high temperature and reducing smoke and ash (see Japanese Patent No. 3066066). The burning equipment comprises: a burning chamber having an upper ceiling wall whose half part is opened as an air inlet, from which air and burnable materials are introduced thereinto; an inlet lid for opening and closing the air inlet; an exhaust air outlet being provided to the upper wall or a side wall of the burning chamber and located on the other side with respect to the air inlet; an exhaust tube being connected to the exhaust air outlet; a burn-promoting plate for communicating the primary burning chamber, which the air inlet is communicated, and a secondary burning chamber, to which the exhaust air outlet is communicated, the burn-promoting plate being provided between the air inlet and the exhaust air outlet, and downwardly extended from the inner face of the upper ceiling wall of the burning chamber; a clearance for burning chamber, the clearance being formed between the lower end of the burn-promoting plate and an inner face of a bottom wall of the burning chamber; and a number of through-holes for communicating the primary burning chamber to the secondary burning chamber, the through-holes being dispersedly formed in the entire burn-promoting plate. Since the burn-promoting plate, in which a number of the through-holes are dispersedly formed, is downwardly extended from the upper ceiling wall and the clearance is formed between the lower end of the burn-promoting plate and the bottom wall, unique air streams are generated and the burn-promoting plate is red-heated so that the burning state reaches a static state in a short time from ignition, and the burnable materials can be burned at high temperature.

However, the above described burning equipment has following problems. Namely, in case of burning plant-origin burnable materials, e.g., cut branches, rejected woods, plant-origin wastes, if they are insufficiently dried, it is difficult to raise the temperature of the burning chamber to the high temperature in a short time from ignition. Further, if waste plastics are not burned at the high temperature, black smoke and toxic gasses are generated. Therefore, it is difficult to burn a large amount of waste plastics.

The present invention was conceived to solve the above described problems.

An object of the present invention is to provide a smokeless burning equipment, which is capable of burning plant-origin burnable materials, e.g., cut branches, rejected woods, as fuel, without drying them, suitably burning waste plastics, preventing generation of grayish white or black smoke and reducing ash and burned embers.

To achieve the object, the present invention has following structures.

Namely, the smokeless burning equipment of the present invention comprises:

- a burning chamber;
- a material/air inlet for supplying a burnable material and air into the burning chamber, the material/air inlet being located close to one end of an upper wall of the burning chamber;
- an inlet lid for opening and closing the material/air inlet; an exhaust air outlet for discharging air, the exhaust air outlet being located close to the other end of the upper wall of the burning chamber;
- a burn-promoting plate for dividing the burning chamber into a primary burning chamber and a secondary burning chamber, the burn-promoting plate being provided between the material/air inlet and the exhaust air outlet, located close to the exhaust air outlet and downwardly extended from the inner face of the upper ceiling wall of the burning chamber;
- a communication path for communicating the primary burning chamber to the secondary burning chamber, the communication path being formed between the lower end of the burn-promoting plate and an inner face of a bottom wall of the burning chamber;
- a plurality of through-holes for communicating the primary burning chamber to the secondary burning chamber, the through-holes being dispersedly formed in the burn-promoting plate;
- a dry wood inlet being provided to a wall of the secondary burning chamber and located under the exhaust air outlet; and
- a guide tube for guiding a dry wood, the guide tube being attached to the dry wood inlet.

Preferably, an air damper is provided to a lower part of the wall of the secondary burning chamber.

Preferably, the exhaust air outlet is located at a top part of the secondary burning chamber, a smoke-stack is near-vertically extended from the exhaust air outlet, and an axial line of the guide tube is inclined with respect to that of the smoke stack so as to cross or nearly cross the axial lines of the smoke stack and the guide tube at or near a center of an inner face of the bottom wall of the secondary burning chamber.

Further preferably, an ash outlet is provided to the lower part of the secondary burning chamber, an outlet lid for opening and closing the ash outlet is provided.
to the ash outlet, and the air damper is provided to the lid for opening and closing the ash outlet.

In case of burning a large amount of burnable materials, e.g., undried woods, waste plastics, firstly dry materials, e.g., cut branches, rejected woods, are put into the primary burning chamber, via the material/air inlet, to fill the primary burning chamber, and then a fat wood is put on the dry woods and ignited. At that time, the inlet lid of the material/air inlet is opened. The dry woods are burned, without generating smoke and producing ash, so that a large amount of embers are produced. The embers are extended on the entire bottom plate of the burning chamber, and then a dry wood is put into the guide tube. At that time, the burn-promoting plate has been heated by burning the dry materials, so that the secondary chamber has been heated at high temperature. Therefore, the dry wood is rapidly burned from the lower end thereof, and a high power of sucking air toward the exhaust air outlet can be maintained.

Next, the burnable materials, e.g., undried woods, waste plastics are put into the primary burning chamber one after the other to burn. At that time, the inlet lid of the material/air inlet is still opened. Though the undried woods and/or the waste plastics are put into the primary burning chamber, a static burning state is maintained. Few heated air streams, which are generated in the primary burning chamber, pass through the red-heated burn-promoting plate, but most of heated air streams go into the secondary burning chamber via the communication path under the burn-promoting plate. In the secondary burning chamber, the dry wood, which has been burned from the lower end, naturally falls along the guide tube, so that the lower end of the dry wood continuously stays at the same place. Therefore, the temperature of the secondary burning chamber can be suitably maintained at the high temperature. With this structure, a large amount of unburned gasses, unburned black carbides, etc., which are included in the heated streams generated by burning undried woods or waste plastics, can be perfectly burned in the secondary burning chamber, and then they are discharged from the exhaust air outlet. Therefore, no grayish white or black smoke is generated, and producing ash can be highly restrained.

By providing the air damper to the lower part of the secondary burning chamber, a required amount of the air can be easily supplied into the secondary burning chamber by using the air damper, so that generation of smoke can be suitably prevented.

In case that the exhaust air outlet is located as or at the top part of the secondary burning chamber, the smokestack is near-vertically extended from the exhaust air outlet and the axial line of the guide tube is inclined with respect to that of the smokestack, so as to cross or nearly cross the axial lines of the smokestack and the guide tube at or near the center of the inner face of the bottom wall of the secondary burning chamber, the dry wood naturally falls along the guide tube and the lower end of the dry wood can stay at the center of the bottom wall, to which the axial line of the smokestack corresponds, even if the lower end of the dry wood is burned. Therefore, the lower end of the dry wood can be continuously burned at the same place, so that the temperature of the secondary can be easily maintained at the suitable high temperature.

In case that the ash outlet is provided to the lower part of the secondary burning chamber, the outlet lid for opening and closing the ash outlet is provided to the ash outlet, and the air damper is provided to the outlet lid for opening and closing the ash outlet, ash deposited in the first burning chamber and the second burning chamber can be easily taken out or flattened, with a uniform thickness, for the next burning treatment.

Embodyments of the present invention will now be described by way of examples and with reference to the accompanying drawings, in which:

Fig. 1 is a right side view of a wheeled smokeless burning equipment of the present invention, wherein an inlet lid of a material/air inlet is opened;

Fig. 2 is a front view of the wheeled smokeless burning equipment, wherein the inlet lid of the material/air inlet is opened;

Fig. 3 is a rear view of the wheeled smokeless burning equipment, wherein an outlet lid of an ash outlet, which is equipped with an air damper, is closed;

Fig. 4 is a front view of a burn-promoting plate, which is provided in a burning chamber of the wheeled smokeless burning equipment; and

Fig. 5 is a plan view of the wheeled smokeless burning equipment, wherein a handle is operated.

Preferred embodiments of the present invention will now be described in detail with reference to Figs. 1-5 of the accompanying drawings.

Fig. 1 is a right side view of a wheeled smokeless burning equipment of the present invention, wherein an inlet lid of a material/air inlet is opened; Fig. 2 is a front view of the wheeled smokeless burning equipment, wherein the inlet lid of the material/air inlet is opened; Fig. 3 is a rear view of the wheeled smokeless burning equipment, wherein an outlet lid of an ash outlet, which is equipped with an air damper, is closed.

A main body section 2 of a wheeled smokeless burning equipment 1 is, for example, a steel cylindrical body, whose front end and rear end are closed. In the present embodiment, a length of the main body section 2 is 180 cm, and an inner diameter thereof is 63.7 cm. The main body section 2 is horizontally postured. A large semicircular material/air inlet 4, from which burnable materials and air can be supplied into the main body section 2, is formed in an upper part of a front wall 3. The mate-
An exhaust air outlet 7, to which a smokestack 8 is attached by a support tube, is formed at a rear end of a top part of a circular wall of the main body section 2. The smokestack 8 is approximately vertically extended from the exhaust air outlet 7. In the present embodiment, the smokestack 8 is a tubular configuration having a length of 100 cm and an inner diameter of 20 cm. A dry wood inlet 9 is formed in the rear end part of the main body section 2 and opened at a lower right position with respect to the exhaust air outlet 7. A circular guide tube 10, in which an upper lid 31 is attached to an upper end, is pierced through the dry wood inlet 9. A dry wood will be put into and guided by guide tube 10. An axial line B of the guide tube 10 is inclined, for example, about 30 degrees with respect to an axial line A of the smokestack 8. With this structure, the axial lines A and B of the smokestack 8 and the guide tube 10 are crossed or nearly crossed at or near a center of an inner face of a bottom part of a secondary burning chamber 19. Note that, in the present embodiment, a length of the guide tube 10 is 50 cm and is much shorter than that of the smokestack 8. An inner diameter of the dry wood inlet 9 is 10-13 cm and is much smaller than that of the exhaust air outlet 7.

A rectangular ash outlet 12 is formed in a lower part of a rear wall 11 of the main body section 2. An outlet lid 14, which is a single swing lid and equipped with an air damper 13, is attached to the ash outlet 12. A lid holder 15 is capable of holding a closing state of the outlet lid 14 where the outlet lid 14 closes the ash outlet 12.

An inner space 16 of the main body section 2 is fixed on a mounting frame 27, which is fixed to a center part of a wheel shaft 23 to which wheels 22 are rotatably attached; the rear part of the main body section 2 is fixed on a mounting frame 27, which is fixed at high temperature by burning catalytic function of the secondary burning chamber 19 can be maintained at high temperature by burning catalytic function of the secondary burning chamber 19. When the smokeless burning equipment 1 is moved there so as to burn the undried woods. Firstly, dry materials, e.g., cut branches, thinned woods, the undried woods are gathered in a corner of a farm field, and then the wheeled smokeless burning equipment 1 is moved there so as to burn the undried woods. At that time, the inlet lid 6 of the material/air inlet 4 is opened. Since the dry materials in the primary burning chamber 18 are burned from a top part to a bottom part, little smoke is generated even in the early stage of burning. The burn-promoting plate 17 is red-heated with progress of burning, so that temperature of the secondary burning chamber 19 can be maintained at high temperature by burning catalytic function of the burn-promoting plate 17. Further, heated air passes through the red-heated burn-promoting plate 17, so that enough amount of the heated air can be uniformly supplied into the flat secondary burning chamber 19 without lowering the temperature of the secondary burning chamber 19. Since the lower communication path 20, whose height is one third (1/3) of that of the burning chamber 16, is formed between the lower part of the burn-promoting plate 17 and the bottom part of the circular wall of the burning chamber 16, most of heated air streams generated in the primary burning chamber 18 go into the secondary burning chamber 19 via the communication path 20 under the burn-promoting plate 17 after the burning state reaches the static state. Therefore, the heated air streams can be perfectly burned in the
secondary burning chamber 19 and introduced toward the exhaust air outlet 7, so that the dry materials can be burned, without generating smoke and ashes, and a large amount of embers can be produced.

[0025] Next, the embers are extended on the entire bottom part of the circular wall of the burning chamber 16 by inserting a fire stick into the primary burning chamber 18 and the secondary burning chamber 19 from the material/air inlet 4 and the ash outlet 12. Next, the upper lid 31 is opened, a long dry wood (not shown) is put into the guide tube 10, and then the upper lid 31 is closed. A lower end of the long dry wood reaches the embers located at the center of the inner face of the bottom part of the secondary burning chamber 19. At that time, the long dry wood is inclined 30 degrees with respect to the axial line A of the smokestack 8, and the inclining posture of the long dry wood can be maintained by the guide tube 10. The burn-promoting plate 17 has been heated by burning the dry materials in the primary burning chamber 18, so that the secondary burning chamber 19 is maintained at the high temperature. Therefore, the long dry woods are rapidly burned from the lower end thereof, and a high power of sucking air toward the smokestack 8 can be maintained.

[0026] Next, undried woods (not shown) are put into the primary burning chamber 18, via the material/air inlet 4, one after the other to burn. When the undried woods are initially put into the primary burning chamber, the static burning state has been already maintained. Few heated air streams generated in the primary burning chamber 18 pass through the through-holes 21 of the red-heated burn-promoting plate 17, but the most of heated air streams go into the secondary burning chamber 19 via the communication path 20 under the burn-promoting plate 17. In the secondary burning chamber 19, the long dry wood is burned from the lower end and naturally falls along the guide tube 10, so that the lower end of the long dry wood can continuously stay at the center of the bottom part of the secondary burning chamber 19. Therefore, the temperature of the secondary burning chamber can be easily suitably maintained at the much high temperature by burning the long dry wood at the same place.

[0027] While burning the undried woods, the air damper 13 is manually operated, with observing color of exhaust air or smoke exhausted from the smokestack 8, so as to keep a smokeless state. The amount of air supplied to the secondary burning chamber 19 can be adjusted by the air damper 13, so that the exhausted air becomes blue or colorless and lambently rises. Namely, the exhaust air can be like heat haze. Further, a large amount of unburned gasses, unburned black carbides, etc., which are included in the heated streams generated by burning the undried woods, can be perfectly burned in the second burning chamber 19, and then the heated streams are discharged from the exhaust air outlet 7. Therefore, the blue or colorless air can be exhausted without generating grayish white or black smoke, leaving burned embers and producing ash can be highly restrained.

[0028] After burning the undried woods, the outlet lid 14 is opened so as to remove extra ash, which has been stored in the primary burning chamber 18 and the secondary burning chamber 19, and then the ash left in the primary chamber 18 and the secondary chamber 19 is flattened, with a uniform thickness, e.g., 10 cm, for the next burning treatment. Therefore, the next burning treatment can be easily prepared. Note that, a minimum clearance under the burn-promoting plate 17 is 3 cm.

In the above described embodiment, the wheeled smokeless burning equipment 1 is used for burning undried woods. Further, the smokeless burning equipment 1 can be used as a wood stove capable of burning undried woods as fuel.

[0029] If waste plastics are not burned at high temperature, they are imperfectly burned, grayish white or black smoke is generated, and a large amount of ash is produced. However, the smokeless burning equipment 1 relating to the present invention is capable of suitably perfectly burning a large amount of waste plastics, at the high temperature, without generating grayish white or black smoke and producing a large amount of ash.

[0030] The invention may be embodied in other specific forms without departing from the essential characteristics thereof. The present embodiments are therefore to be considered in all respects as illustrative and not restrictive, the scope of the invention being indicated by the appended claims rather than by the foregoing description and all changes which come within the meaning and range of equivalency of the claims are therefore intended to be embraced therein.

Claims

1. A smokeless burning equipment (1), comprising:

a burning chamber (16);
a material/air inlet (4) for supplying a burnable material and air into the burning chamber (16), the material/air inlet (4) being located close to one end of an upper wall of the burning chamber (16);
an inlet lid (6) for opening and closing the material/air inlet (4);
an exhaust air outlet (7) for discharging air, the exhaust air outlet (7) being located close to the other end of the upper wall of the burning chamber (16);
a burn-promoting plate (17) dividing the burning chamber (16) into a primary burning chamber (18) and a secondary burning chamber (19), the burn-promoting plate (17) being provided between the material/air inlet (4) and the exhaust air outlet (7), located closed to the exhaust air outlet (7) and downwardly extended from the inner face of the upper ceiling wall of the burning.
chamber (16);
a communication path (20) for communicating
the primary burning chamber (18) to the second-
ary burning chamber (19), the communication
path (20) being formed between the lower end
of the burn-promoting plate (17) and an inner
face of a bottom wall of the burning chamber
(16);
a plurality of through-holes (21) for communicat-
ing the primary burning chamber (18) to the sec-
ondary burning chamber (19), the through-holes
(21) being dispersedly formed in the burn-pro-
moting plate (17);
a dry wood inlet (9) being provided to a wall of
the secondary burning chamber (19) and locat-
ed under the exhaust air outlet (7); and
a guide tube (10) for guiding a dry wood, the
guide tube (10) being attached to the dry wood
inlet (9).

2. The smokeless burning equipment according to
claim 1,
wherein an air damper (13) is provided to a lower
part of the wall of the secondary burning chamber
(19).

3. The smokeless burning equipment according to
claim 1 or 2,
wherein the exhaust air outlet (7) is located a top
part of the secondary burning chamber (19), a
smokestack (8) is near-vertically extended from
the exhaust air outlet (7), and an axial line (B) of the
guide tube (10) is inclined with respect to that (A) of
the smokestack (8) so as to cross or nearly cross
the axial lines of the smokestack (8) and the guide
tube (10) at or near a center of an inner face of the
bottom wall of the secondary burning chamber (19).

4. The smokeless burning equipment according to
claim 2 or 3,
wherein an ash outlet (12) is provided to the lower
part of the secondary burning chamber (19), an outlet
lid (14) for opening and closing the ash outlet (12) is
provided to the ash outlet (12), and the air damper
(13) is provided to the outlet lid (14) for opening and
closing the ash outlet (12).
REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

• JP 3066066 B [0003]