(12) STANDARD PATENT (11) Application No. **AU 2021311157 B2**
(19) AUSTRALIAN PATENT OFFICE

(54) Title
Crushing apparatus and method for purging crushed material

(51) International Patent Classification(s)
B02C 15/04 (2006.01) ***F23K 3/02*** (2006.01)
B02C 23/26 (2006.01)

(21) Application No: **2021311157** (22) Date of Filing: **2021.06.03**

(87) WIPO No: **WO22/018982**

(30) Priority Data

(31) Number	(32) Date	(33) Country
2020-123547	**2020.07.20**	**JP**

(43) Publication Date: **2022.01.27**
(44) Accepted Journal Date: **2023.12.14**

(71) Applicant(s)
IHI Corporation

(72) Inventor(s)
SUKO, Toshiyuki

(74) Agent / Attorney
Spruson & Ferguson, GPO Box 3898, Sydney, NSW, 2001, AU

(56) Related Art
JP S5949425 A
JP 2000130740 A

(12) 特許協力条約に基づいて公開された国際出願

(19) 世界知的所有権機関
国際事務局

(43) 国際公開日
2022年1月27日(27.01.2022)

WIPO | PCT

(10) 国際公開番号
WO 2022/018982 A1

(51) 国際特許分類:
B02C 15/04 (2006.01)　*F23K 3/02* (2006.01)
B02C 23/26 (2006.01)

(21) 国際出願番号：　PCT/JP2021/021280

(22) 国際出願日：　2021年6月3日(03.06.2021)

(25) 国際出願の言語：　日本語

(26) 国際公開の言語：　日本語

(30) 優先権データ：
特願 2020-123547　2020年7月20日(20.07.2020)　JP

(71) 出願人:株式会社ＩＨＩ(**IHI CORPORATION**) [JP/JP]; 〒1358710 東京都江東区豊洲三丁目１番１号 Tokyo (JP).

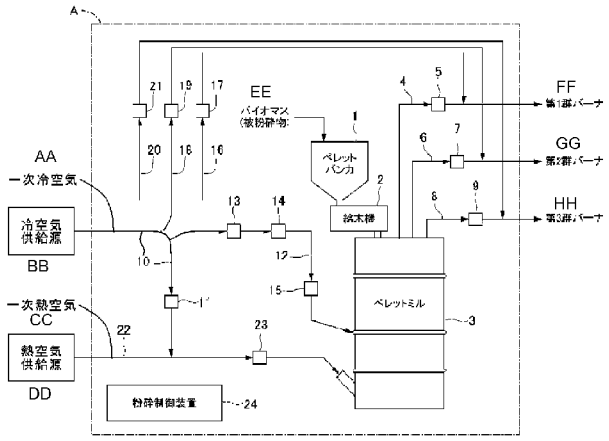
(72) 発明者:須古 敏行(**SUKO, Toshiyuki**); 〒1358710 東京都江東区豊洲三丁目１番１号 株式会社ＩＨＩ内 Tokyo (JP).

(74) 代理人:特許業務法人 青海特許事務所(**AOMI PATENT**); 〒1010052 東京都千代田区神田小川町１－８－８ Tokyo (JP).

(81) 指定国(表示のない限り、全ての種類の国内保護が可能): AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BN, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DJ, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IR, IS, IT, JO, JP, KE, KG, KH, KN, KP, KR, KW, KZ, LA, LC, LK, LR, LS, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ,

(54) **Title:** CRUSHING APPARATUS AND METHOD FOR PURGING CRUSHED MATERIAL

(54) 発明の名称： 粉砕装置及び粉砕物パージ方法



1 Pellet bunker
2 Water supply machine
3 Pellet mill
24 Crush control device
AA Primary cold air
BB Cold air supply source
CC Primary hot air
DD Hot air supply source
EE Biomass (material to be crushed)
FF First group burner
GG Second group burner
HH Third group burner

(57) **Abstract:** A crushing apparatus for supplying a crushed material crushed in the main body of the crushing apparatus to a supply destination through at least a discharge pipe, the crushing apparatus comprising a purging fluid supply part which is provided separately from the main body and supplies a predetermined purging fluid to the discharge pipe when the operation of the main body is stopped.

(57) 要約：本体で粉砕した粉砕物を少なくとも排出管を介して供給先に供給する粉砕装置であって、本体とは個別に設けられ、本体が作動停止した場合に排出管に所定のパージ用流体を供給するパージ流体供給部を備える。

WO 2022/018982 A1

［続葉有］

NA, NG, NI, NO, NZ, OM, PA, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SA, SC, SD, SE, SG, SK, SL, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, WS, ZA, ZM, ZW.

(84) 指定国(表示のない限り、全ての種類の広域保護が可能): ARIPO (BW, GH, GM, KE, LR, LS, MW, MZ, NA, RW, SD, SL, ST, SZ, TZ, UG, ZM, ZW), ユーラシア (AM, AZ, BY, KG, KZ, RU, TJ, TM), ヨーロッパ (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, KM, ML, MR, NE, SN, TD, TG).

添付公開書類:

一　国際調査報告（条約第21条(3)）

Description

Title of Invention: PULVERIZER AND METHOD FOR PURGING PULVERIZED MATERIAL

Technical Field

[0001] The present invention relates to a pulverizer and a method of purging a pulverized material. This application claims the benefit of priority to Japanese Patent Application No. 2020-123547 filed on July 20, 2020, and contents thereof are incorporated in this application.

Background Art

[0002] In Patent Literature 1 given below, there is disclosed a method of purging residual coal in a coal pulverizer for a boiler. According to this method, when the pulverizer is restarted after an emergency stop, an air blower that supplies drying air (air mixture of cold air and hot air) to the pulverizer is activated to discharge (purge) residual coal in the pulverizer and in a pulverized coal discharge pipe to a coal burner of a boiler where the residual coal is combusted. According to this method, a combustion of the residual coal in the coal burner can be detected with a flame sensor. Thus, quick restart of the pulverizer can be achieved.

Citation List

Patent Literature

2021311157 10 Nov 2023

[0003] Patent Literature 1: JP S63-57694 A

Summary of Invention

[0003a] It is an object of the present invention to substantially overcome or at least ameliorate one or more of the above disadvantages.

[0003b] According to an aspect of the present invention, there is provided a pulverizer for supplying a pulverized material obtained in a main body to a supply destination via a plurality of discharge pipes, the pulverizer comprising: a purging fluid supply unit provided independently of the main body and configured to supply a predetermined purging fluid to the plurality of discharge pipes; and a controller of the pulverizer, wherein each of the plurality of discharge pipes is provided with an outlet damper, the purging fluid supply unit includes: a plurality of purge pipes connected to the plurality of discharge pipes; and a plurality of purge dampers provided in the plurality of purge pipes, and the controller is configured to execute: closing all of the outlet dampers of the plurality of discharge pipes after the main body stops operating; and supplying the purging fluid from the plurality of purge pipes to the plurality of discharge pipes with adjusting flow rates of the purging fluid by the plurality of purge dampers without passing through the main body after all of the outlet dampers of the plurality of discharge pipes are closed.

[0003c] According to another aspect of the present invention, there is provided a method for purging a residual pulverized material from a plurality of discharge pipes supplying a pulverized material obtained in a main body to a supply destination, each of the plurality of discharge pipes being provided with an outlet damper, the plurality of discharge pipes being connected to a purging fluid supply unit provided independently of the main body and configured to supply a

202131157 10 Nov 2023

predetermined purging fluid to the plurality of discharge pipes, the purging fluid supply unit including a plurality of purge pipes connected to the plurality of discharge pipes and a plurality of purge dampers provided in the plurality of purge pipes, the method comprising: closing all of the outlet dampers of the plurality of discharge pipes after the main body stops operating; and supplying the purging fluid from the plurality of purge pipes to the plurality of discharge pipes with adjusting flow rates of the purging fluid by the plurality of purge dampers without passing through the main body after all of the outlet dampers of the plurality of discharge pipes are closed.

[0004] In the related art described above, the residual coal is combusted with the coal burner and the combustion is detected. In this manner, whether or not the purging of the residual coal has been completed can be notified. The notification allows quick restart. However, there is a problem that the residual coal cannot be sufficiently purged. Specifically, the drying air supplied from the air blower to the pulverizer not only flows to the coal burner via the pulverized coal discharge pipe, but also leaks into a route other than the pulverized coal discharge pipe via various pipes or the like connected to the pulverizer. Thus, in particular, the residual coal in the pulverized coal discharge pipe, which is located on a most downstream side in the route for flow of the drying air, cannot be sufficiently purged.

[0005] In view of the above-mentioned circumstances, the present invention has an object to provide a pulverizer and a method of purging a pulverized material, allowing a residual pulverized material to be more reliably purged.

[0006] According to one aspect of the present invention, a pulverizer for supplying a pulverized material obtained in a main body to a supply destination via at least one discharge pipe includes: a purging fluid supply unit provided

202131157 10 Nov 2023

independently of the main body and configured to supply a predetermined purging fluid to the at least one discharge pipe when the main body stops operating.

[0007] The purging fluid may be primary cold air to be supplied to the main body.

[0008] The purging fluid supply unit may be configured to extract the primary cold air from a cold air supply pipe for supplying the primary cold air to the main body and to supply the extracted primary cold air to the at least one discharge pipe.

[0009] A sealing air supply pipe for extracting sealing air for protection of a rotary portion in the main body may be connected to the cold air supply pipe, and the purging fluid supply unit may extract the primary cold air from the cold air supply pipe at a position upstream of the sealing air supply pipe.

[0010] The at least one discharge pipe may include a plurality of discharge pipes, and the purging fluid supply unit may be configured to supply the purging fluid to the plurality of discharge pipes at a flow rate adjusted for each.

[0011] The main body may be configured to pulverize wood-based biomass to generate wood powder as the pulverized material.

[0012] According to another aspect of the present invention, a method for purging a residual pulverized material from a discharge pipe supplying a pulverized material obtained in a main body to a supply destination includes supplying a predetermined purging fluid from a purging fluid supply unit provided independently of the main body to the discharge pipe when the main body stops operating.

[0013] According to one aspect of the present invention, it

2021311157 10 Nov 2023

is possible to provide the pulverizer and the method of purging a pulverized material, allowing the residual pulverized material to be more reliably purged.

Brief Description of Drawings

[0014] FIG. 1 is a system configuration diagram for illustrating an overall configuration of a pulverizer A according to one embodiment of the present invention.

FIG. 2 is a flowchart for illustrating a purging operation of the pulverizer A according to one embodiment of the present invention.

Description of Embodiment

[0015] Hereinafter, a pulverizer A and a method of purging a pulverized material according to one embodiment of the present invention are described with reference to the drawings. The pulverizer A according to the present

embodiment uses wood-based biomass as a material to be pulverized, and the pulverizer A pulverizes the wood-based biomass to generate wood powder as a pulverized material. The pulverizer A supplies the wood powder (pulverized material) to a supply destination such as a boiler.

[0016] As is well known, the wood-based biomass is surplus wood such as timber from forest-thinning, and is mainly obtained in the forestry business industry. The wood-based biomass is, for example, processed into pellets at a location where the wood-based biomass is generated, and is conveyed by predetermined transportation means to a location of pulverization where the pulverizer A is installed. Hereinafter, the wood-based biomass (material to be pulverized) is simply referred to as "biomass (material to be pulverized)".

[0017] The pulverizer A comprises, as illustrated in FIG. 1, a pellet bunker 1, a wood feeder 2, a pellet mill 3, a first discharge pipe 4, a first outlet damper 5, a second discharge pipe 6, a second outlet damper 7, a third discharge pipe 8, a third outlet damper 9, a cold air supply pipe 10, a cold air damper 11, a sealing air supply pipe 12, a sealing air damper 13, an isolation damper 14, a check valve 15, a first purge pipe 16, a first purge damper 17, a second purge pipe 18, a second purge damper 19, a third purge pipe 20, a third purge damper 21, a hot air supply pipe 22, a primary air damper 23, and a pulverization controller 24.

[0018] The pellet bunker 1 is a hopper having a

predetermined capacity and receiving biomass supplied from an outside. The pellet bunker 1 temporarily stores the biomass loaded from above, and supplies the stored biomass to the wood feeder 2 from a bottom. The pellet bunker 1 functions as a buffer that temporarily stores a predetermined volume of biomass.

[0019] The wood feeder 2 is a biomass feeding apparatus that weighs the biomass supplied from the pellet bunker 1 and feeds the biomass to the pellet mill 3. For example, the wood feeder 2 measures the weight of the biomass supplied from the pellet bunker 1, and feeds a given weight of biomass to the pellet mill 3 in each unit time.

[0020] Specifically, the wood feeder 2 controls a supply amount of biomass to the pellet mill 3 not in volume (m^3/h) of biomass per unit time but in weight (kg/h) per unit time. The wood feeder 2 is an apparatus to be controlled by the pulverization controller 24, and its operation (supply amount) is controlled by the pulverization controller 24.

[0021] The pellet mill 3 is a pulverizer that pulverizes the biomass supplied from the wood feeder 2. The pellet mill 3 includes a pulverizing mechanism that pressurizes and pulverizes a predetermined supply amount of biomass successively supplied from the wood feeder 2, and generates wood powder as a pulverized material.

[0022] The pellet mill 3 is, for example, a vertical mill. The pellet mill 3 includes a rotary table and a pulverizing roller as the pulverizing mechanism. The rotary

table rotates in a horizonal plane. The biomass is sandwiched between the rotary table and the pulverizing roller, and pressed therebetween. Further, the pellet mill 3 is an apparatus to be controlled by the pulverization controller 24, and an overall operation of the pellet mill 3 is controlled by the pulverization controller 24.

[0023] When the pellet mill 3 is a vertical mill as described above, the biomass (material to be pulverized) is pulverized into wood powder (pulverized material) on the rotary table. The wood powder has a particle diameter smaller than that of the biomass, and thus is lighter than the biomass. Further, an upward flow of air is generated in the pellet mill 3. The upward flow acts on the wood powder to blow the wood powder upward from the rotary table.

[0024] Further, when the pellet mill 3 is a vertical mill, a classifier is included in an upper part of the pellet mill 3. The classifier classifies the wood powder carried with the upward flow and entering the classifier from a bottom. The classifier allows only wood powder having a particle diameter smaller than a predetermined standard particle diameter to pass therethrough toward an outside of the pellet mill 3, and causes wood powder having a particle diameter larger than the standard particle diameter to fall down and return onto the rotary table. The wood powder that has been returned to the rotary table is pulverized again by the pulverizing mechanism into powder having a smaller dimeter, and is carried with the upward flow to enter the

classifier.

[0025] As described above, the pellet mill 3 discharges, from its upper part, wood powder having a particle diameter smaller than the standard particle diameter to the outside. Wood powder having a particle diameter smaller than the standard particle diameter, specifically, a deliverable from the pellet mill 3, is supplied to the supply destination through three discharge pipes, i.e., the first discharge pipe 4, the second discharge pipe 6, and the third discharge pipe 8.

[0026] A discharge mechanism is included in the upper part of the pellet mill 3. The discharge mechanism divides the wood powder having a particle diameter smaller than the standard particle diameter and supplied from the classifier into three parts substantially equal to each other. The discharge mechanism distributes a substantially equal amount (discharge amount) of wood powder to each of the three discharge pipes (first discharge pipe 4, second discharge pipe 6, and third discharge pipe 8). The three discharge pipes (first discharge pipe 4, second discharge pipe 6, and third discharge pipe 8) are arranged, for example, on an upper surface of the pellet mill 3 at substantially equal intervals.

[0027] The pellet bunker 1, the wood feeder 2, and the pellet mill 3 mentioned above form a main body of the pulverizer A. Specifically, the pellet bunker 1, the wood feeder 2, and the pellet mill 3 work as a mechanism unit that

pulverizes biomass (material to be pulverized) and that is a main function of the pulverizer A, and also work as a mechanism unit producing wood powder (pulverized material) that is a deliverable obtained from the pulverizer A.

[0028] Each of the first discharge pipe 4, the second discharge pipe 6, and the third discharge pipe 8 in the present embodiment corresponds to a discharge pipe (also referred to as "pulverized material discharge pipe" in this disclosure) according to the present invention. Among the first discharge pipe 4, the second discharge pipe 6, and the third discharge pipe 8, the first discharge pipe 4 includes one end connected to the upper surface of the pellet mill 3 and the other end connected to fuel burners at the supply destination.

[0029] The first discharge pipe 4 communicates with an internal space of the pellet mill 3, and supplies a predetermined amount of wood powder supplied from the discharge mechanism to the fuel burner. The first discharge pipe 4 functions as, for the pellet mill 3, a discharge pipe that discharges wood powder, and functions as, for the fuel burners, a supply pipe that supplies wood powder.

[0030] The first outlet damper 5 is provided in a middle of the first discharge pipe 4, and is a flow rate adjustment device that adjusts a passing flow rate of wood powder, i.e., a supply amount of wood powder to the fuel burners. The first outlet damper 5 is, for example, a butterfly valve, and changes a passage area for wood powder (opening degree) to

adjust the supply amount of wood powder. The first outlet damper 5 is a device to be controlled by the pulverization controller 24, and has a passage area (opening degree) set by the pulverization controller 24.

[0031] The second discharge pipe 6 includes one end connected to the upper surface of the pellet mill 3 and the other end connected to the fuel burners at the supply destination. The second discharge pipe 6 communicates with the internal space of the pellet mill 3, and supplies a predetermined amount of wood powder supplied from the discharge mechanism to the fuel burner. The second discharge pipe 6 functions as, for the pellet mill 3, a discharge pipe that discharges wood powder, and functions as, for the fuel burners, a supply pipe that supplies wood powder.

[0032] The second outlet damper 7 is provided in a middle of the second discharge pipe 6, and is a flow rate adjustment device that adjusts a passing flow rate of wood powder, i.e., a supply amount of wood powder to the fuel burners. The second outlet damper 7 is, for example, a butterfly valve, and changes a passage area for wood powder (opening degree) to adjust the supply amount of wood powder. The second outlet damper 7 is a device to be controlled by the pulverization controller 24, and has a passage area (opening degree) set by the pulverization controller 24.

[0033] The third discharge pipe 8 includes one end connected to the upper surface of the pellet mill 3 and the other end connected to the fuel burners at the supply

destination. The third discharge pipe 8 communicates with the internal space of the pellet mill 3, and supplies a predetermined amount of wood powder supplied from the discharge mechanism to the fuel burner. The third discharge pipe 8 functions as, for the pellet mill 3, a discharge pipe that discharges wood powder, and functions as, for the fuel burners, a supply pipe that supplies wood powder.

[0034] The third outlet damper 9 is provided in a middle of the third discharge pipe 8, and is a flow rate adjustment device that adjusts a passing flow rate of wood powder, i.e., a supply amount of wood powder to the fuel burners. The third outlet damper 9 is, for example, a butterfly valve, and changes a passage area for wood powder (opening degree) to adjust the supply amount of wood powder. The third outlet damper 9 described is a device to be controlled by the pulverization controller 24, and has a passage area (opening degree) set by the pulverization controller 24.

[0035] A plurality of fuel burners are provided at the supply destination such as a boiler. Further, the plurality of combustion burners is divided into several groups. Each of the groups includes, for example, a plurality of combustion burners. For example, three groups are provided, and the above-mentioned three discharge pipes (first discharge pipe 4, second discharge pipe 6, and third discharge pipe 8) are provided so as to correspond to each of the groups, respectively.

[0036] As illustrated in FIG. 1, the first discharge

pipe 4 supplies wood powder, as a fuel, to the plurality of fuel burners corresponding to a first group. The second discharge pipe 6 supplies wood powder, as a fuel, to the plurality of fuel burners corresponding to a second group. The third discharge pipe 8 supplies wood powder, as a fuel, to the plurality of fuel burners corresponding to a third group.

[0037] In other words, the first discharge pipe 4 is a first supply pipe that supplies wood powder, as a fuel, to the plurality of combustion burners included in the first group. The second discharge pipe 6 is a second supply pipe that supplies wood powder, as a fuel, to the plurality of combustion burners included in the second group. The third discharge pipe 8 is a third supply pipe that supplies wood powder, as a fuel, to the plurality of combustion burners included in the third group.

[0038] The cold air supply pipe 10 includes one end connected to an external cold air supply source and the other end connected to a middle part of the hot air supply pipe 22. More specifically, the other end of the cold air supply pipe 10 is connected to a position upstream of the primary air damper 23. The cold air supply pipe 10 supplies primary cold air received from the cold air supply source to the hot air supply pipe 22. The primary cold air has a temperature falling within substantially the same temperature range as that of outside air, and is mixed with primary hot air flowing through the hot air supply pipe 22. The primary cold

air corresponds to a purging fluid according to the present invention.

[0039] The cold air damper 11 is provided in a middle of the cold air supply pipe 10, and is a flow rate adjustment device that adjusts a passing flow rate of the primary cold air in the cold air supply pipe 10. The cold air damper 11 is, for example, a butterfly valve. A passage area for the primary cold air (opening degree) is changed so as to adjust a supply amount of primary cold air flowing into the hot air supply pipe 22. The cold air damper 11 is a device to be controlled by the pulverization controller 24, and has a passage area (opening degree) set by the pulverization controller 24.

[0040] The sealing air supply pipe 12 includes one end connected to a middle part of the cold air supply pipe 10 and the other end connected to the pellet mill 3. More specifically, the one end of the sealing air supply pipe 12 is connected to a position upstream of the cold air damper 11 in a direction of flow of the primary cold air. The sealing air supply pipe 12 supplies the primary cold air as sealing air for protection of various rotary portions of the pellet mill 3.

[0041] The sealing air damper 13 is provided in a middle of the sealing air supply pipe 12, and is a flow rate adjustment device that adjusts a passing flow rate of the primary cold air in the sealing air supply pipe 12. The sealing air damper 13 is, for example, a butterfly valve. A

passage area for the primary cold air (opening degree) is changed so as to adjust a supply amount of primary cold air flowing into the pellet mill 3. The sealing air damper 13 is a device to be controlled by the pulverization controller 24, and has a passage area (opening degree) set by the pulverization controller 24.

[0042] The isolation damper 14 is provided between the sealing air damper 13 and the check valve 15 on the sealing air supply pipe 12. The isolation damper 14 is an on-off valve, and blocks and permits flow of the primary cold air through the sealing air supply pipe 12. In other words, an opening degree of the isolation damper 14 is set in a binary manner, i.e., full closure or full opening. The isolation damper 14 blocks the flow of the primary cold air into the pellet mill 3 at the time of full closure, and permits the flow of the primary cold air into the pellet mill 3 at the time of full opening. The isolation damper 14 is a device to be controlled by the pulverization controller 24, and has an open or closed state set by the pulverization controller 24.

[0043] The check valve 15 prevents backflow of air. Specifically, the check valve 15 prevents air in the pellet mill 3 from flowing from the other end (pellet mill 3) of the sealing air supply pipe 12 toward the one end of the sealing air supply pipe 12. The check valve 15 prevents air in the pellet mill 3 from flowing into the sealing air supply pipe 12 due to an abnormally increased internal pressure of the pellet mill 3.

[0044] The first purge pipe 16 includes one end connected to the cold air supply pipe 10 and the other end connected to the first discharge pipe 4. More accurately, the one end of the first purge pipe 16 is connected to the cold air supply pipe 10 at a position upstream of the cold air damper 11. Further, the other end of the first purge pipe 16 is connected to the first discharge pipe 4 at a position downstream of the first outlet damper 5.

[0045] The first purge pipe 16 is a bypass pipe that allows the primary cold air to flow through the first discharge pipe 4. The first purge pipe 16 is provided specifically for the first discharge pipe 4. More specifically, when the main body of the pulverizer A, i.e., the pellet bunker 1, the wood feeder 2, and the pellet mill 3, is deactivated, the first purge pipe 16 supplies, in place of the pellet mill 3, the primary cold air to the first discharge pipe 4. The first purge pipe 16 purges (removes) residual wood powder (residual pulverized material) in the first discharge pipe 4 with the primary cold air.

[0046] The first purge damper 17 is provided in a middle of the first purge pipe 16, and is a flow rate adjustment device that adjusts a passing flow rate of the primary cold air in the first purge pipe 16. The first purge damper 17 is, for example, a butterfly valve, and changes a passage area for the primary cold air (opening degree) to adjust a supply amount of primary cold air flowing into the first discharge pipe 4. The first purge damper 17 is a device to

be controlled by the pulverization controller 24, and has a passage area (opening degree) set by the pulverization controller 24.

[0047] The second purge pipe 18 includes one end connected to the cold air supply pipe 10 and the other end connected to the second discharge pipe 6. More accurately, the one end of the second purge pipe 18 is connected to the cold air supply pipe 10 at a position upstream of the cold air damper 11. Further, the other end of the second purge pipe 18 is connected to the second discharge pipe 6 at a position downstream of the second outlet damper 7.

[0048] The second purge pipe 18 is a bypass pipe that allows the primary cold air to flow through the second discharge pipe 6. The second purge pipe 18 is provided specifically for the second discharge pipe 6. More specifically, when the main body of the pulverizer A, i.e., the pellet bunker 1, the wood feeder 2, and the pellet mill 3, is deactivated, the second purge pipe 18 supplies, in place of the pellet mill 3, the primary cold air to the second discharge pipe 6. The second purge pipe 18 purges (removes) residual wood powder (residual pulverized material) in the second discharge pipe 6 with the primary cold air.

[0049] The second purge damper 19 is provided in a middle of the second purge pipe 18, and is a flow rate adjustment device that adjusts a passing flow rate of the primary cold air in the second purge pipe 18. The second purge damper 19 is, for example, a butterfly valve, and

changes a passage area for the primary cold air (opening degree) to adjust a supply amount of primary cold air flowing into the second discharge pipe 6. The second purge damper 19 is a device to be controlled by the pulverization controller 24, and has a passage area (opening degree) set by the pulverization controller 24.

[0050] The third purge pipe 20 includes one end connected to the cold air supply pipe 10 and the other end connected to the third discharge pipe 8. More accurately, the one end of the third purge pipe 20 is connected to the cold air supply pipe 10 at a position upstream of the cold air damper 11. Further, the other end of the third purge pipe 20 is connected to the third discharge pipe 8 at a position downstream of the third outlet damper 9.

[0051] The third purge pipe 20 is a bypass pipe that allows the primary cold air to flow through the third discharge pipe 8. The third purge pipe 20 is provided specifically for the third discharge pipe 8. More specifically, when the main body of the pulverizer A, i.e., the pellet bunker 1, the wood feeder 2, and the pellet mill 3, is deactivated, the third purge pipe 20 supplies, in place of the pellet mill 3, the primary cold air to the third discharge pipe 8. The third purge pipe 20 purges (removes) residual wood powder (residual pulverized material) in the third discharge pipe 8 with the primary cold air.

[0052] The third purge damper 21 is provided in a middle of the third purge pipe 20, and is a flow rate adjustment

device that adjusts a passing flow rate of the primary cold air in the third purge pipe 20. The third purge damper 21 is, for example, a butterfly valve, and changes a passage area for the primary cold air (opening degree) to adjust a supply amount of primary cold air flowing into the third discharge pipe 8. The third purge damper 21 is a device to be controlled by the pulverization controller 24, and has a passage area (opening degree) set by the pulverization controller 24.

[0053] The first purge pipe 16, the first purge damper 17, the second purge pipe 18, the second purge damper 19, the third purge pipe 20, and the third purge damper 21 that have been mentioned above form a purging fluid supply unit according to the present invention. Specifically, the first purge pipe 16, the first purge damper 17, the second purge pipe 18, the second purge damper 19, the third purge pipe 20, and the third purge damper 21 are provided independently of the main body, and supply the primary cold air, as a predetermined purging fluid, to the discharge pipes (first discharge pipe 4, second discharge pipe 6, and third discharge pipe 8) when the main body stops operating.

[0054] The hot air supply pipe 22 includes one end connected to an external hot air supply source and the other end connected to the pellet mill 3. The hot air supply pipe 22 supplies the primary hot air received from the hot air supply source to the pellet mill 3. The primary hot air is generated by heating outside air, and therefore has a

temperature higher than a temperature of the primary cold air. Like the primary cold air, the primary hot air is supplied to the pellet mill 3 so as to generate the above-mentioned upward flow.

[0055] The primary air damper 23 is provided in a middle of the hot air supply pipe 22, specifically, at a position downstream of a connection position between the hot air supply pipe 22 and the other end of the cold air supply pipe 10. The primary air damper 23 is a flow rate adjustment device that adjusts a passing flow rate of an air mixture (primary air) of the primary cold air and the primary hot air, wherein the air mixture is generated at the position where the cold air supply pipe 10 and the hot air supply pipe 22 are connected to each other.

[0056] The primary air damper 23 is, for example, a butterfly valve, and a passage area for the primary air (opening degree) is changed so as to adjust a supply amount of primary air flowing into the pellet mill 3. The primary air damper 23 is a device to be controlled by the pulverization controller 24, and has a passage area (opening degree) set by the pulverization controller 24.

[0057] The pulverization controller 24 controls the above-mentioned devices and apparatus to be controlled so as to operate the pulverizer A as a whole. Although illustration is omitted in FIG. 1, the pulverization controller 24 is electrically connected, through control wires, to the wood feeder 2, the pellet mill 3, the first

outlet damper 5, the second outlet damper 7, the third outlet damper 9, the cold air damper 11, the sealing air damper 13, the isolation damper 14, the first purge damper 17, the second purge damper 19, the third purge damper 21, and the primary air damper 23 that are the devices and apparatus to be controlled.

[0058] The pulverization controller 24 detects operating states of the devices and apparatus to be controlled via the control wires, and outputs operation signals to the devices and apparatus to be controlled. Specifically, the pulverization controller 24 controls operations of the wood feeder 2 and the pellet mill 3 based on the operation signals, and appropriately sets opening degrees of the first outlet damper 5, the second outlet damper 7, the third outlet damper 9, the cold air damper 11, the sealing air damper 13, the isolation damper 14, the first purge damper 17, the second purge damper 19, the third purge damper 21, and the primary air damper 23.

[0059] Next, an operation of the pulverizer A according to the present embodiment is described in detail with reference to a flowchart of FIG. 2.

[0060] A normal operation of the pulverizer A is first described. The pulverization controller 24 outputs the operation signals to the devices and apparatus to be controlled (the wood feeder 2, the pellet mill 3, the first outlet damper 5, the second outlet damper 7, the third outlet damper 9, the cold air damper 11, the sealing air damper 13,

the isolation damper 14, the first purge damper 17, the second purge damper 19, the third purge damper 21, and the primary air damper 23) so as to successively pulverize the biomass (material to be pulverized) and successively supply the wood powder (pulverized material) as a deliverable to the supply destination.

[0061] When the pulverization controller 24 detects any abnormality about the pulverizer A, the pulverization controller 24 emergently stops the pulverizer A (Step S1). For example, when the pulverization controller 24 detects abnormality of the wood feeder 2, the pellet mill 3, the first outlet damper 5, the second outlet damper 7, the third outlet damper 9, the cold air damper 11, the sealing air damper 13, the isolation damper 14, the first purge damper 17, the second purge damper 19, the third purge damper 21, and the primary air damper 23 that are to be controlled, the pulverization controller 24 emergently stops the pulverizer A.

[0062] When the pulverizer A is emergently stopped, a manager who manages the operation of the pulverizer A specifies a cause of the emergency stop and takes a countermeasure against the cause. As a result, the pulverizer A returns to a state in which the normal operation can be performed. Then, after confirming that the abnormality of the pulverizer A is eliminated, the manager inputs a restart command to the pulverization controller 24. The restart command is input to the pulverization controller

24 through an operation panel provided to the pulverization controller 24.

[0063] After recognizing (being notified of) the input of the restart command described above (Step S2), the pulverization controller 24 first sets a fully closed state for each of the first outlet damper 5, the second outlet damper 7, and the third outlet damper 9 (Step S3). Specifically, the pulverization controller 24 completely interrupts communication between the pellet mill 3 and the first discharge pipe 4, the second discharge pipe 6, and the third discharge pipe 8 by setting a fully closed state for each of the first to third outlet dampers 5, 7, and 9.

[0064] Subsequently, the pulverization controller 24 sets a fully closed state for the cold air damper 11 provided to the cold air supply pipe 10 (Step S4). Specifically, the pulverization controller 24 interrupts a communicating state of the cold air supply pipe 10 at a position of the cold air damper 11. As a result, the primary cold air in the cold air supply pipe 10 is completely prevented from flowing into the hot air supply pipe 22 and flowing into the pellet mill 3 via the hot air supply pipe 22.

[0065] Further, the pulverization controller 24 sets a fully closed state for the isolation damper 14 provided in the middle of the sealing air supply pipe 12 (Step S5). Specifically, the pulverization controller 24 completely interrupts communication between the cold air supply pipe 10 and the pellet mill 3 through the sealing air supply pipe 12.

As a result, the primary cold air in the cold air supply pipe 10 is completely prevented from flowing into the pellet mill 3 via the sealing air supply pipe 12.

[0066] After a fully closed state is set for each of the first outlet damper 5, the second outlet damper 7, the third outlet damper 9, the cold air damper 11, and the isolation damper 14 as described above, the pulverization controller 24 sets a fully opened state for each of the first purge damper 17, the second purge damper 19, and the third purge damper 21 (Step S6). When a fully opened state is set for each of the first purge damper 17, the second purge damper 19, and the third purge damper 21, a full amount of the primary cold air flowed from the air supply source into the cold air supply pipe 10 flows into the first discharge pipe 4, the second discharge pipe 6, and the third discharge pipe 8.

[0067] Specifically, the primary cold air is successively supplied to the first discharge pipe 4 via the first purge pipe 16. The primary cold air is successively supplied to the second discharge pipe 6 via the second purge pipe 18. Furthermore, the primary cold air is successively supplied to the third discharge pipe 8 via the third purge pipe 20.

[0068] Then, the pulverization controller 24 measures an elapsed time period from start of the processing in Step S5, specifically, from the start of supply of the primary cold air to the first discharge pipe 4, the second discharge pipe 6, and the third discharge pipe 8, and then determines

whether or not the elapsed time period has exceeded a time threshold value T (Step S7). When a result of determination in Step S7 is "Yes", i.e., the elapsed time period has exceeded the time threshold value T, the pulverization controller 24 notifies the manager that purging from the first discharge pipe 4, the second discharge pipe 6, and the third discharge pipe 8 has been completed (Step S8).

[0069] According to the present embodiment, the primary cold air extracted from the cold air supply pipe 10 is supplied to the first discharge pipe 4, the second discharge pipe 6, and the third discharge pipe 8 via the first purge pipe 16, the second purge pipe 18, and the third purge pipe 20. Thus, when the pulverizer A emergently stops, residual wood powder (residual pulverized material) remaining in the first discharge pipe 4, the second discharge pipe 6, and the third discharge pipe 8 can more reliably be purged.

[0070] Specifically, when the primary cold air is supplied to the first discharge pipe 4, the second discharge pipe 6, and the third discharge pipe 8 via the pellet mill 3, the primary cold air cannot be supplied in a sufficient amount and at a sufficient pressure to the first discharge pipe 4, the second discharge pipe 6, and the third discharge pipe 8 due to, for example, leakage of the primary cold air from the pellet mill 3.

[0071] According to the present embodiment, however, the primary cold air is supplied to the first discharge pipe 4, the second discharge pipe 6, and the third discharge pipe 8

via the first purge pipe 16, the second purge pipe 18, and the third purge pipe 20 without passing through the pellet mill 3. Therefore, the primary cold air in a sufficient amount and at a sufficient pressure required to purge the residual wood powder (residual pulverized material) can be supplied.

[0072] Thus, according to the present embodiment, the residual wood powder (residual pulverized material) in the first discharge pipe 4, the second discharge pipe 6, and the third discharge pipe 8 can more reliably be purged than it can be in the related art. Further, according to the present embodiment, the residual wood powder (residual pulverized material) in the first discharge pipe 4, the second discharge pipe 6, and the third discharge pipe 8 can be purged within a shorter period of time than a time period required in the related art. Thus, the pulverizer A that has been emergently stopped can be restarted within a shorter period of time than a time period required in the related art.

[0073] Further, in the present embodiment, the primary cold air is used as a purging fluid to be supplied to the first discharge pipe 4, the second discharge pipe 6, and the third discharge pipe 8. The primary cold air has a temperature lower than a temperature of the primary hot air. Thus, ignition of the residual wood powder (residual pulverized material) which may occur when the purging fluid is supplied to the first discharge pipe 4, the second discharge pipe 6, and the third discharge pipe 8 can more

reliably be prevented.

[0074] Further, in the present embodiment, one end of each of the first purge pipe 16, the second purge pipe 18, and the third purge pipe 20 is connected to a part upstream of the sealing air supply pipe 12 through which the primary cold air (sealing air) flows for protecting the rotary portions in the pellet mill 3. Specifically, in the present embodiment, the primary cold air is extracted as a purging fluid from the cold air supply pipe 10 at a position upstream of the sealing air supply pipe 12, and is supplied to the first discharge pipe 4, the second discharge pipe 6, and the third discharge pipe 8.

[0075] According to the present embodiment described above, the primary cold air (purging fluid) can be supplied to the first discharge pipe 4, the second discharge pipe 6, and the third discharge pipe 8 independently from the supply of the primary cold air (sealing air) to the rotary portions in the pellet mill 3.

[0076] Further, in the present embodiment, the first purge damper 17, the second purge damper 19, and the third purge damper 21 are provided to the first purge pipe 16, the second purge pipe 18, and the third purge pipe 20, respectively. Specifically, in the present embodiment, the primary cold air (purging fluid) is supplied to the plurality of discharge pipes, i.e., the first discharge pipe 4, the second discharge pipe 6, and the third discharge pipe 8 at a flow rate adjusted for each.

[0077] According to such an embodiment, the flow rates of the primary cold air (purging fluid) supplied to the first discharge pipe 4, the second discharge pipe 6, and the third discharge pipe 8 can be individually adjusted. According to the present embodiment, for example, the flow rates of the primary cold air (purging fluid) can be appropriately set in accordance with the amounts of residual wood powder (residual pulverized material) in the first discharge pipe 4, the second discharge pipe 6, and the third discharge pipe 8, respectively.

[0078] The present invention is not limited to the embodiment described above. For example, the following modifications are conceivable.

(1) In the above embodiment, the pulverizer A (biomass mill) uses the wood-based biomass as the material to be pulverized, and pulverizes the wood-based biomass to generate the wood powder as the pulverized material. However, the present invention is applicable to pulverization of various materials to be pulverized. The present invention is applicable at least to a pulverizer that uses coal as a material to be pulverized and generates pulverized coal as a pulverized material.

[0079] (2) In the above embodiment, the primary cold air is used as the purging fluid. However, the present invention is not limited thereto. For example, in place of the primary cold air, the primary hot air may be used as the purging fluid. As conditions in selection of the purging fluid, any

purging fluid having a flow rate and a pressure that allow the residual wood powder (residual pulverized material) in the first discharge pipe 4, the second discharge pipe 6, and the third discharge pipe 8 to be sufficiently purged may be used. It is preferred that a purging fluid have a temperature around an ambient temperature.

[0080] (3) In the above embodiment, the primary cold air (purging fluid) is supplied to the first discharge pipe 4, the second discharge pipe 6, and the third discharge pipe 8 by fully closing the first outlet damper 5, the second outlet damper 7, the third outlet damper 9, the cold air damper 11, and the isolation damper 14 at first, and then fully opening the first purge damper 17, the second purge damper 19, and the third purge damper 21. However, the present invention is not limited thereto.

[0081] For example, a flow rate required for the primary cold air (sealing air) is relatively small. Accordingly, the isolation damper 14 may be fully opened while the first outlet damper 5, the second outlet damper 7, the third outlet damper 9, and the cold air damper 11 are fully closed, and then the first purge damper 17, the second purge damper 19, and the third purge damper 21 may be fully opened.

[0082] (4) In the above embodiment, the first purge damper 17, the second purge damper 19, and the third purge damper 21 are provided to the first purge pipe 16, the second purge pipe 18, and the third purge pipe 20, respectively. However, the present invention is not limited thereto. For

example, the first purge damper 17, the second purge damper 19, and the third purge damper 21 may be replaced with a single purge damper including an inlet port connected to the cold air supply pipe 10 and a discharge port connected to one end of each of the first purge pipe 16, the second purge pipe 18, and the third purge pipe 20.

[0083] (5) In the above embodiment, the present invention is applied to the pulverizer A including the three discharge pipes (first discharge pipe 4, second discharge pipe 6, and third discharge pipe 8). However, the present invention is not limited thereto. Specifically, the present invention is also applicable to a pulverizer that includes one or a plurality of discharge pipes other than three discharge pipes.

[0084] (6) In the above embodiment, as illustrated in FIG. 2, the first outlet damper 5, the second outlet damper 7, and the third outlet damper 9 are fully closed at first (Step S3). Subsequently, the cold air damper 11 is fully closed (Step S4). Finally, the isolation damper 14 is fully closed (Step S5). However, the order of fully closing the dampers is not limited thereto, and the different order may be used.

[0085] (7) In the above embodiment, the primary cold air is extracted as a purging fluid from the cold air supply pipe 10 at a position upstream of the sealing air supply pipe 12, and is supplied to the first discharge pipe 4, the second discharge pipe 6, and the third discharge pipe 8. However,

the present invention is not limited thereto. The primary cold air (purging fluid) may be extracted at a position in the middle of the sealing air supply pipe 12 as needed so as to be supplied to the first discharge pipe 4, the second discharge pipe 6, and the third discharge pipe 8. For example, the primary cold air (purging fluid) may be extracted from the sealing air supply pipe 12 at a position between the sealing air damper 13 and the isolation damper 14.

Reference Signs List

[0086]

A	pulverizer
1	pellet bunker (main body)
2	wood feeder (main body)
3	pellet mill (main body)
4	first discharge pipe (discharge pipe)
5	first outlet damper
6	second discharge pipe (discharge pipe)
7	second outlet damper
8	third discharge pipe (discharge pipe)
9	third outlet damper
10	cold air supply pipe
11	cold air damper
12	sealing air supply pipe
13	sealing air damper
14	isolation damper
15	check valve

16 first purge pipe

17 first purge damper

18 second purge pipe

19 second purge damper

20 third purge pipe

21 third purge damper

22 hot air supply pipe

23 primary air damper

24 pulverization controller

2021311157 10 Nov 2023

CLAIMS:

[Claim 1] A pulverizer for supplying a pulverized material obtained in a main body to a supply destination via a plurality of discharge pipes, the pulverizer comprising:

a purging fluid supply unit provided independently of the main body and configured to supply a predetermined purging fluid to the plurality of discharge pipes; and

a controller of the pulverizer,

wherein each of the plurality of discharge pipes is provided with an outlet damper,

the purging fluid supply unit includes:

a plurality of purge pipes connected to the plurality of discharge pipes; and

a plurality of purge dampers provided in the plurality of purge pipes, and

the controller is configured to execute:

closing all of the outlet dampers of the plurality of discharge pipes after the main body stops operating; and

supplying the purging fluid from the plurality of purge pipes to the plurality of discharge pipes with adjusting flow rates of the purging fluid by the plurality of purge dampers without passing through the main body after all of the outlet dampers of the plurality of discharge pipes are closed.

[Claim 2] The pulverizer according to claim 1, wherein the purging fluid is primary cold air to be supplied to the main body.

2021311157 10 Nov 2023

[Claim 3] The pulverizer according to claim 2, wherein the plurality of purge pipes is configured to extract the primary cold air from a cold air supply pipe for supplying the primary cold air to the main body and to supply the extracted primary cold air to the plurality of discharge pipes.

[Claim 4] The pulverizer according to claim 3,

wherein a sealing air supply pipe for extracting sealing air for protection of a rotary portion in the main body is connected to the cold air supply pipe, and

wherein the plurality of purge pipes extracts the primary cold air from the cold air supply pipe at a position upstream of the sealing air supply pipe.

[Claim 5] The pulverizer according to any one of claims 1 to 4, wherein the main body is configured to pulverize wood-based biomass to generate wood powder as the pulverized material.

[Claim 6] A method for purging a residual pulverized material from a plurality of discharge pipes supplying a pulverized material obtained in a main body to a supply destination, each of the plurality of discharge pipes being provided with an outlet damper, the plurality of discharge pipes being connected to a purging fluid supply unit provided independently of the main body and configured to supply a predetermined purging fluid to the plurality of discharge pipes, the purging fluid supply unit including a plurality of purge pipes connected to the plurality of discharge pipes and a plurality of purge dampers

2021311157 10 Nov 2023

provided in the plurality of purge pipes, the method comprising:

closing all of the outlet dampers of the plurality of discharge pipes after the main body stops operating; and

supplying the purging fluid from the plurality of purge pipes to the plurality of discharge pipes with adjusting flow rates of the purging fluid by the plurality of purge dampers without passing through the main body after all of the outlet dampers of the plurality of discharge pipes are closed.

IHI Corporation

Patent Attorneys for the Applicant/Nominated Person

SPRUSON & FERGUSON

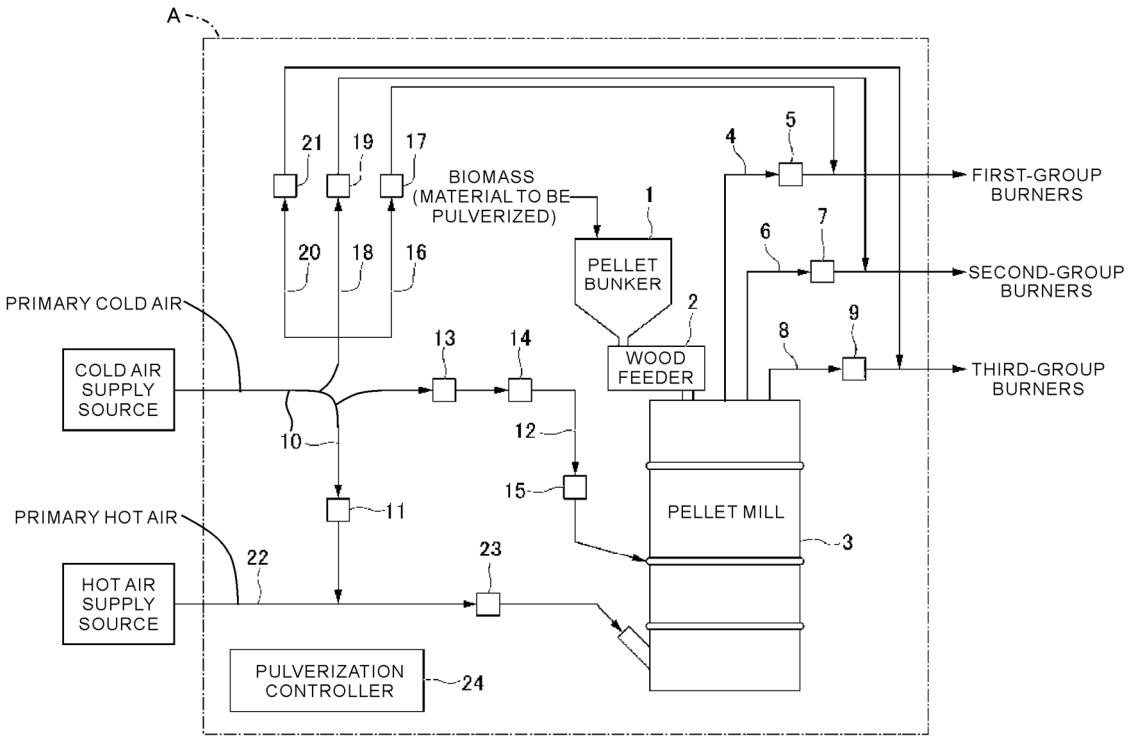

A
21
19
17
BIOMASS
(MATERIAL TO BE
PULVERIZED)
1
4
5
FIRST-GROUP
BURNERS
20
18
16
PELLET
BUNKER
6
7
SECOND-GROUP
BURNERS
PRIMARY COLD AIR
2
8
9
13
14
WOOD
FEEDER
COLD AIR
SUPPLY
SOURCE
THIRD-GROUP
BURNERS
10
12
15
PELLET MILL
11
3
PRIMARY HOT AIR
22
23
HOT AIR
SUPPLY
SOURCE
PULVERIZATION
CONTROLLER
24

FIG. 1

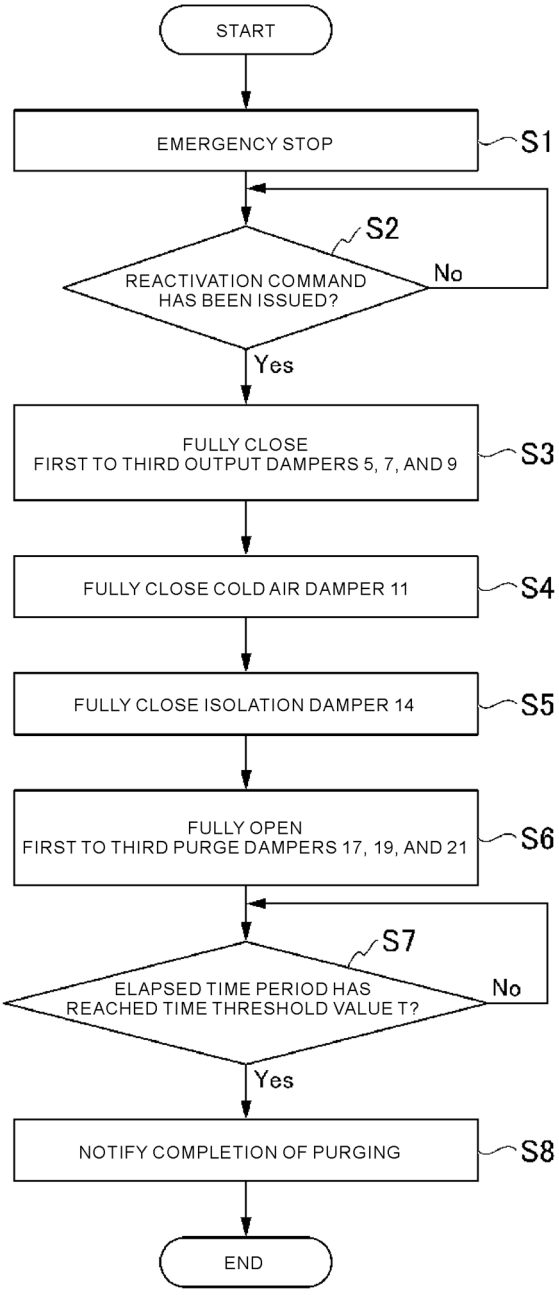

START
EMERGENCY STOP
S1
S2
REACTIVATION COMMAND HAS BEEN ISSUED?
No
Yes
FULLY CLOSE FIRST TO THIRD OUTPUT DAMPERS 5, 7, AND 9
S3
FULLY CLOSE COLD AIR DAMPER 11
S4
FULLY CLOSE ISOLATION DAMPER 14
S5
FULLY OPEN FIRST TO THIRD PURGE DAMPERS 17, 19, AND 21
S6
S7
ELAPSED TIME PERIOD HAS REACHED TIME THRESHOLD VALUE T?
No
Yes
NOTIFY COMPLETION OF PURGING
S8
END

FIG. 2