

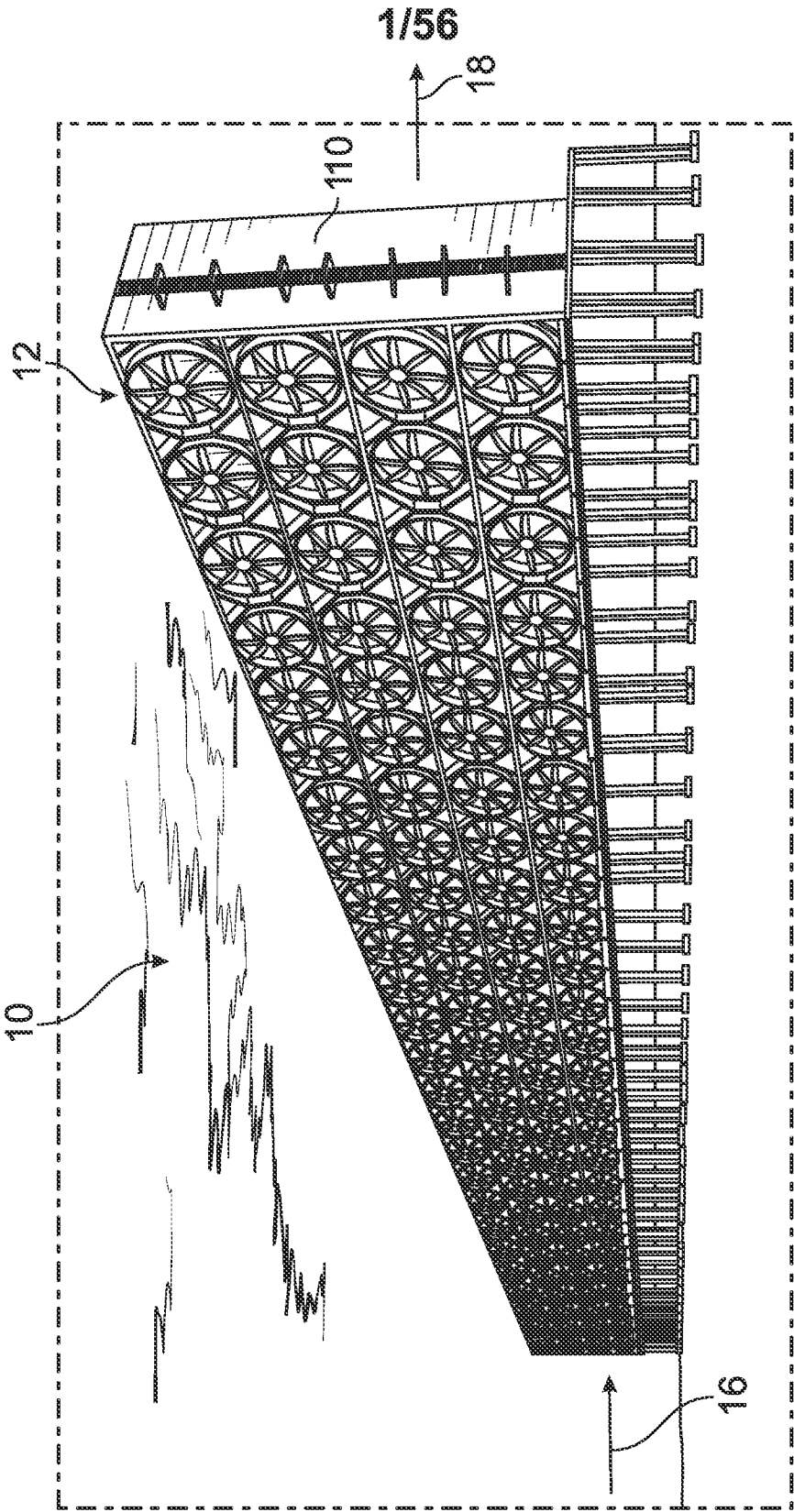


FIG. 1

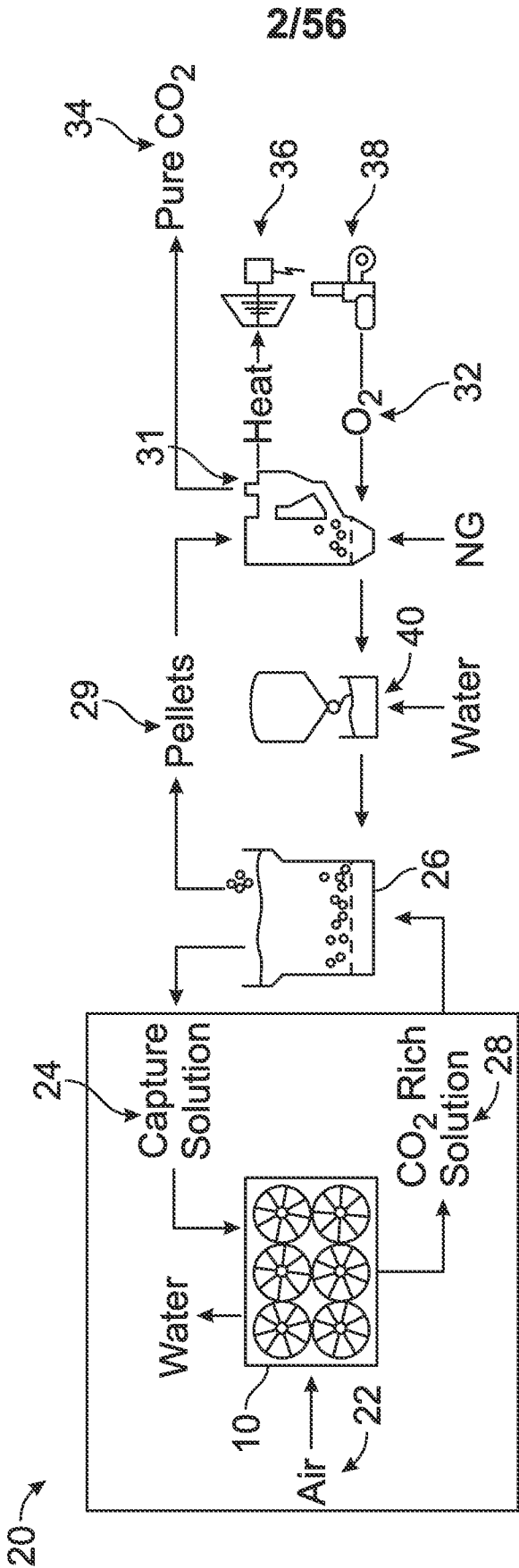
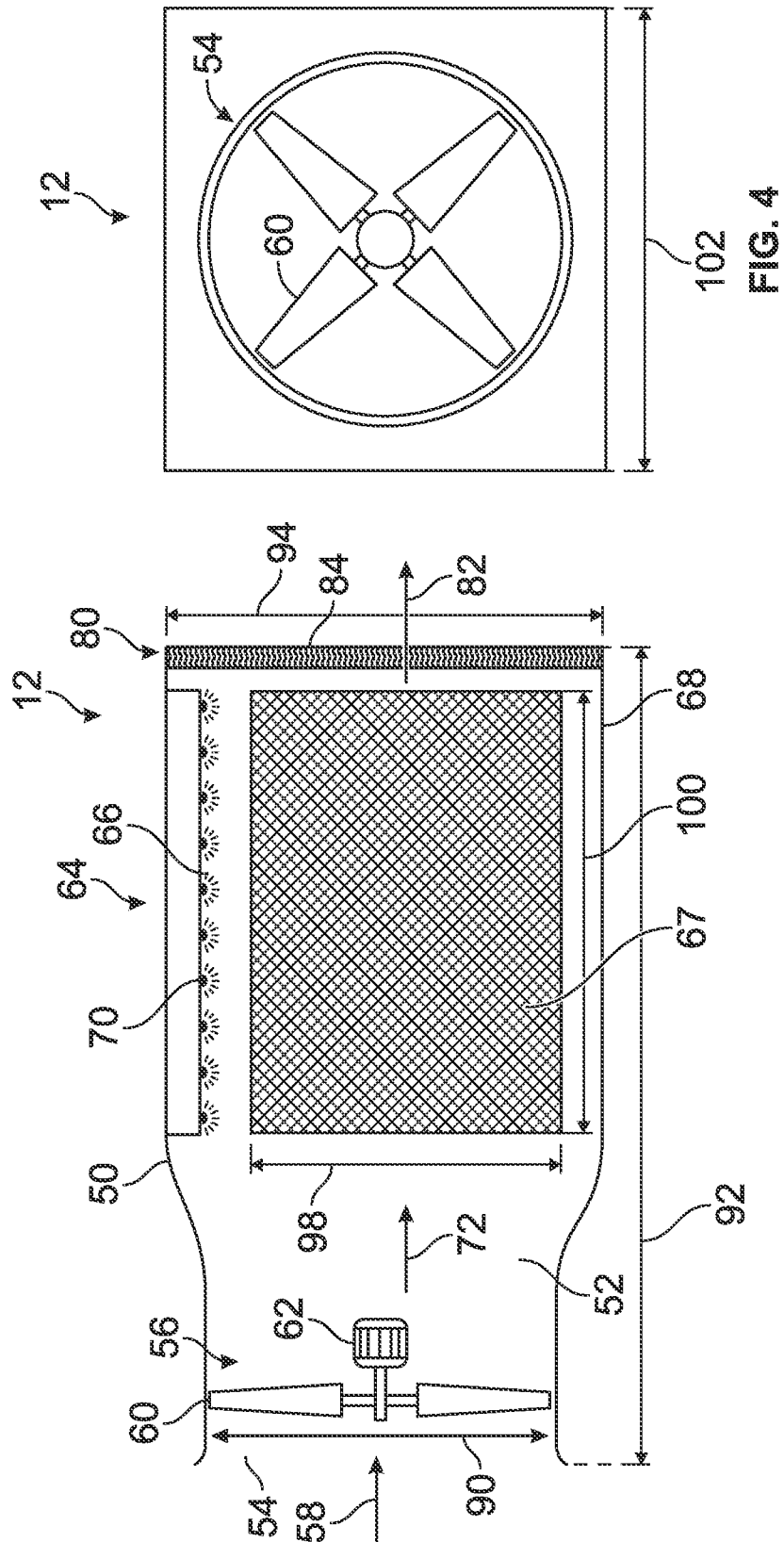
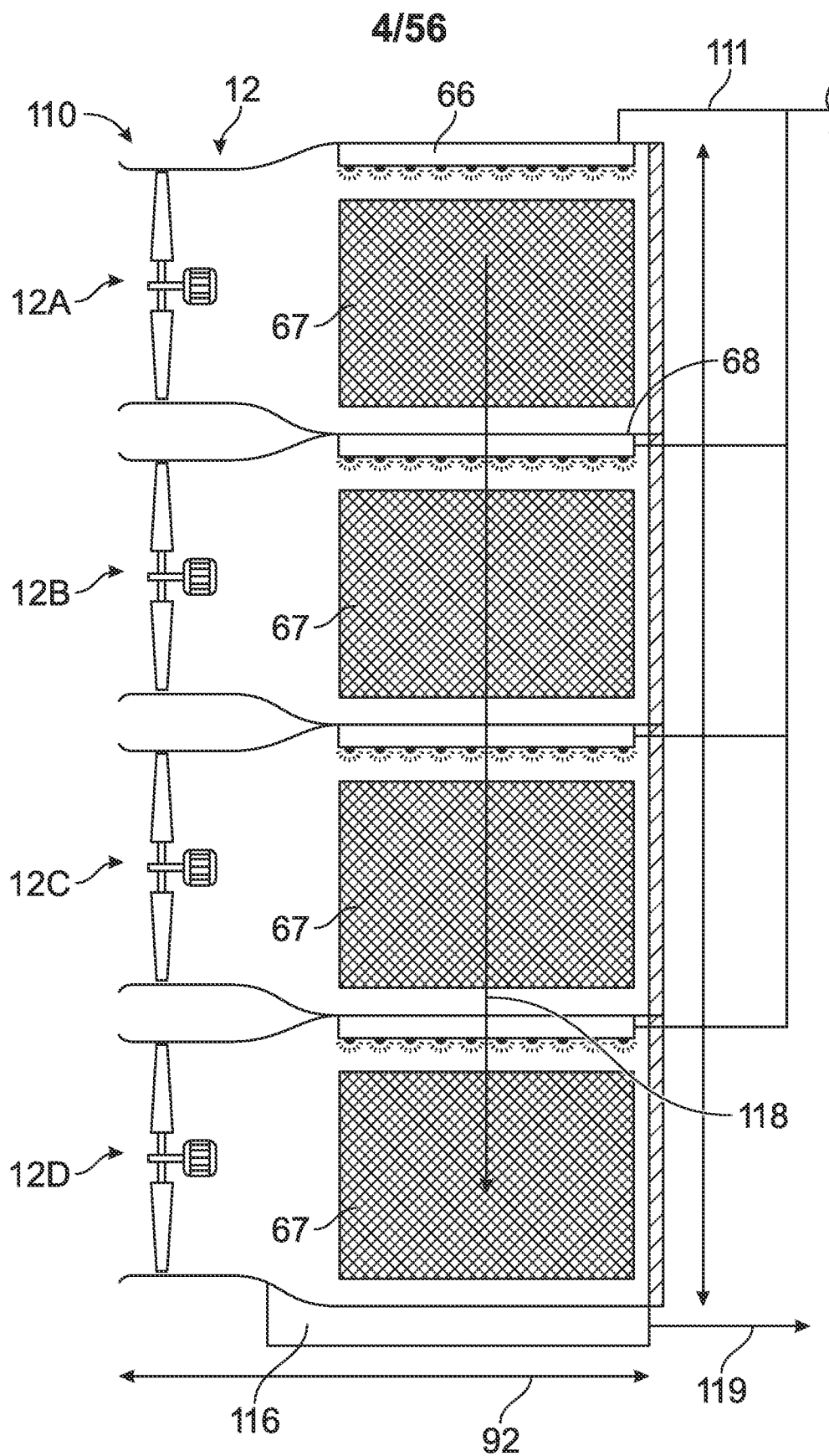


FIG. 2



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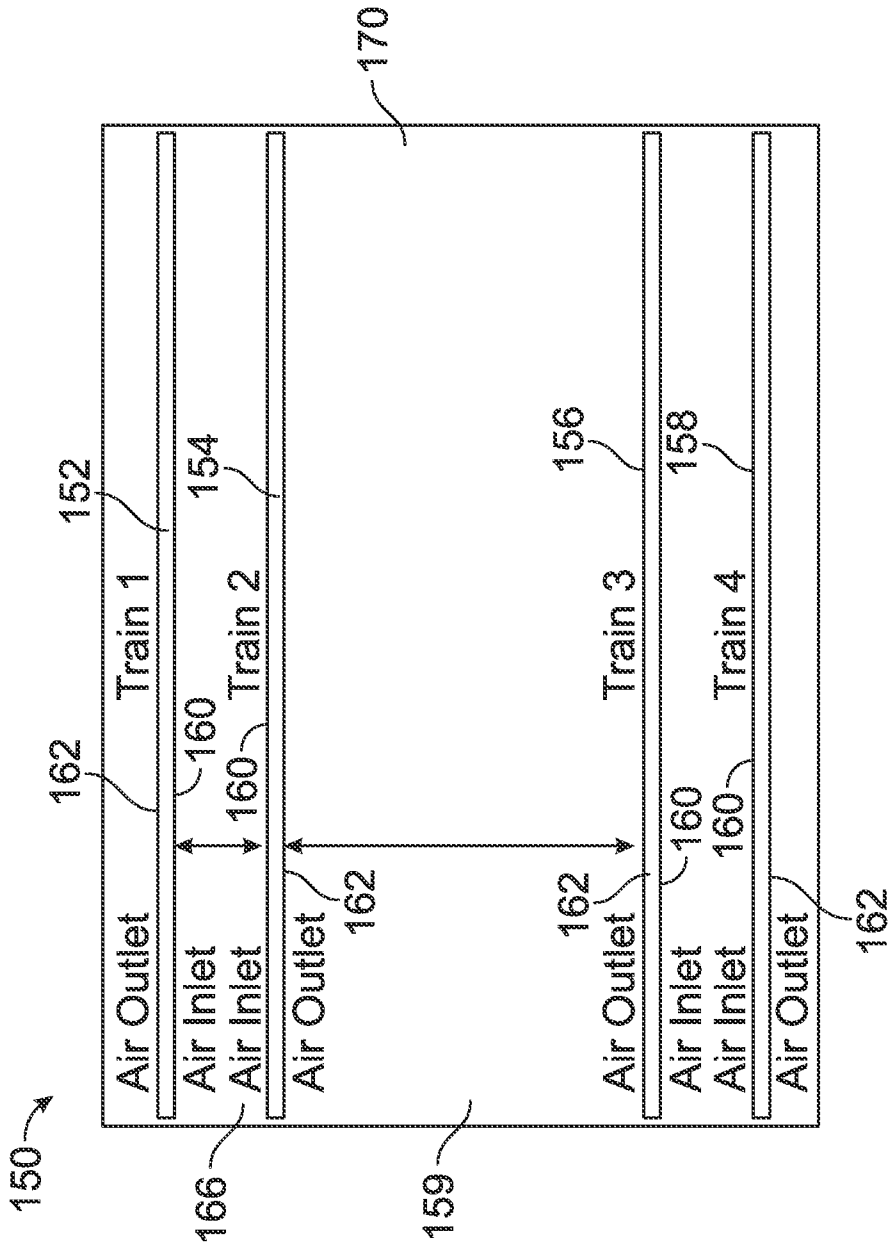


FIG. 6

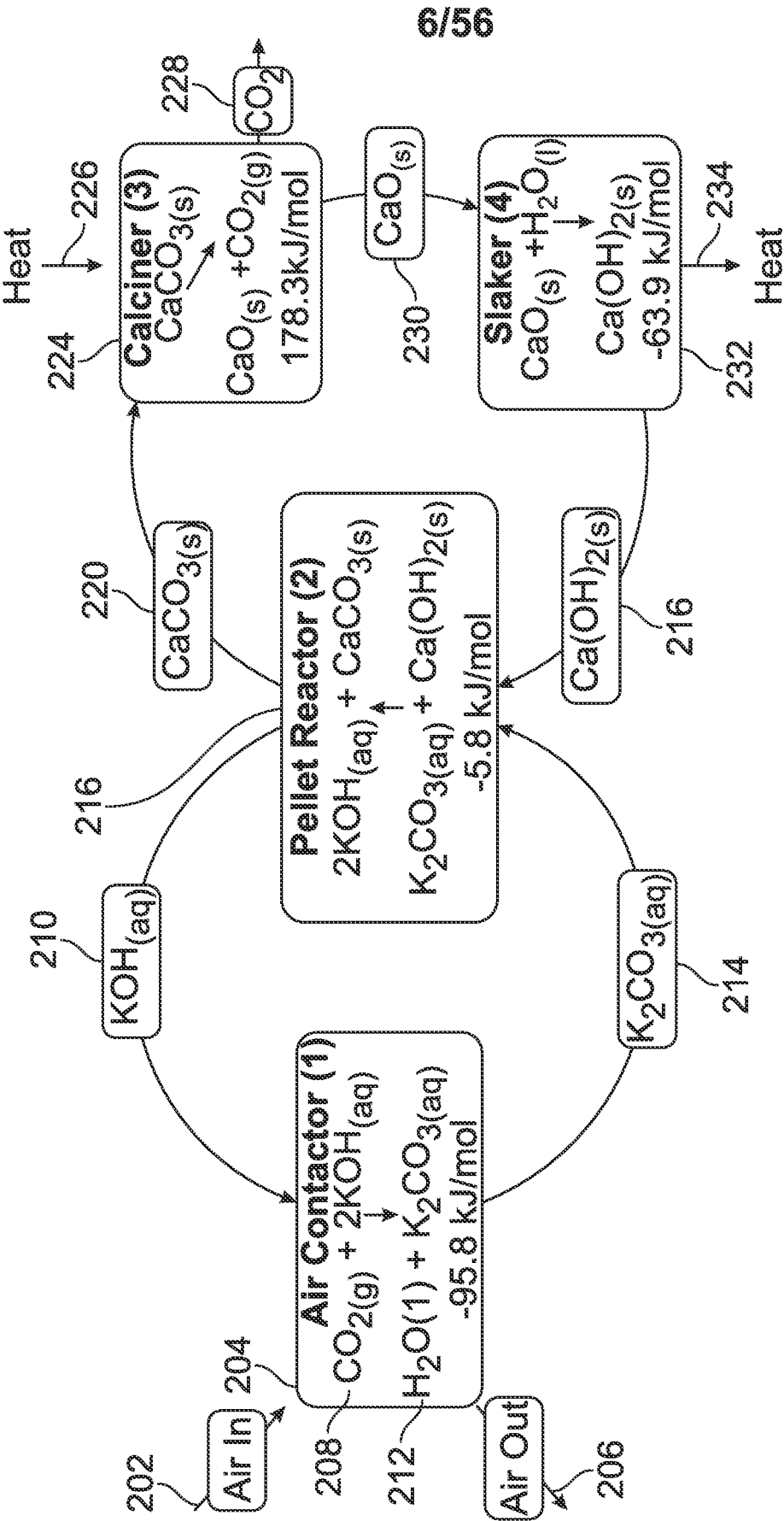


FIG. 7

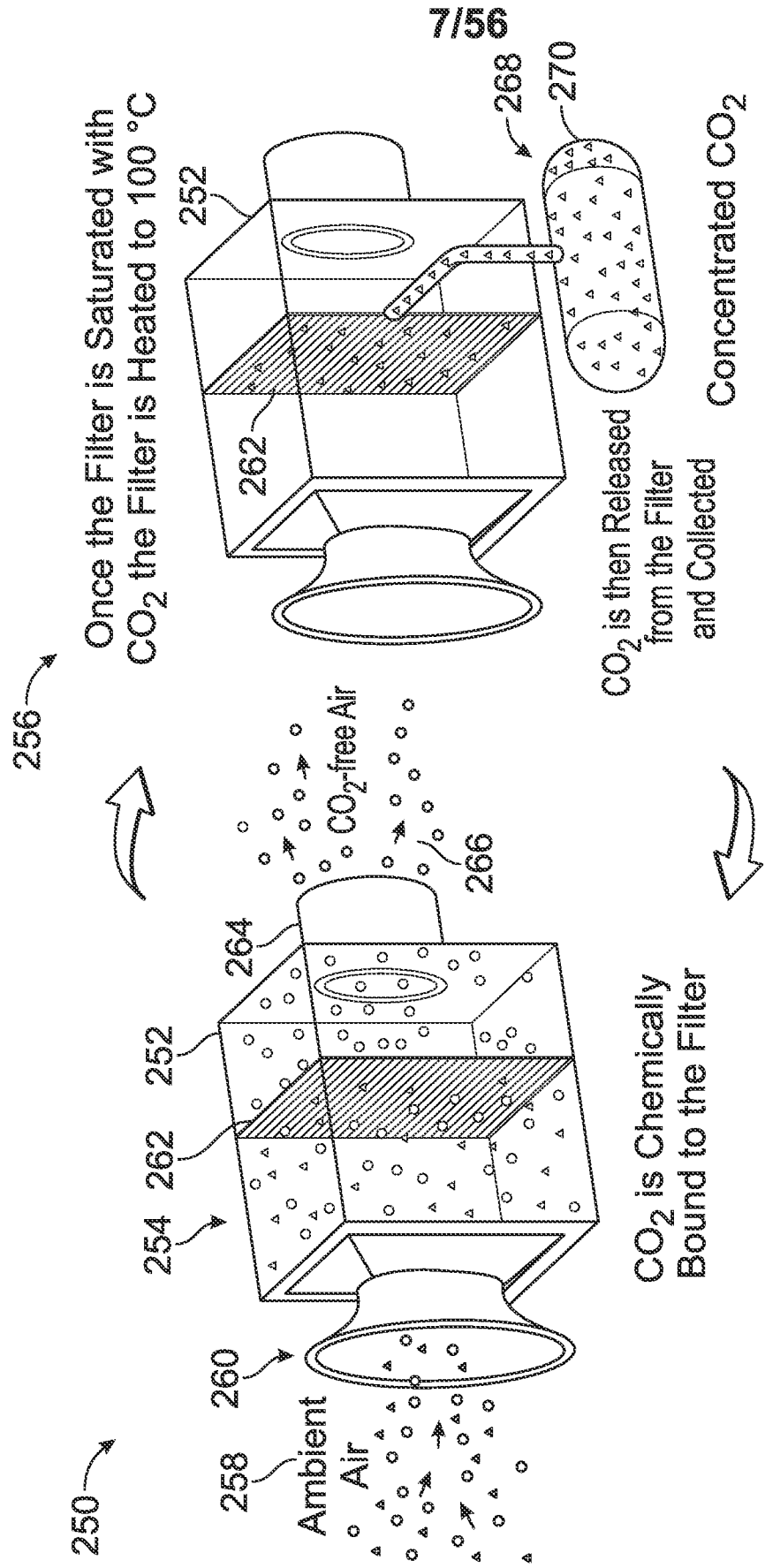
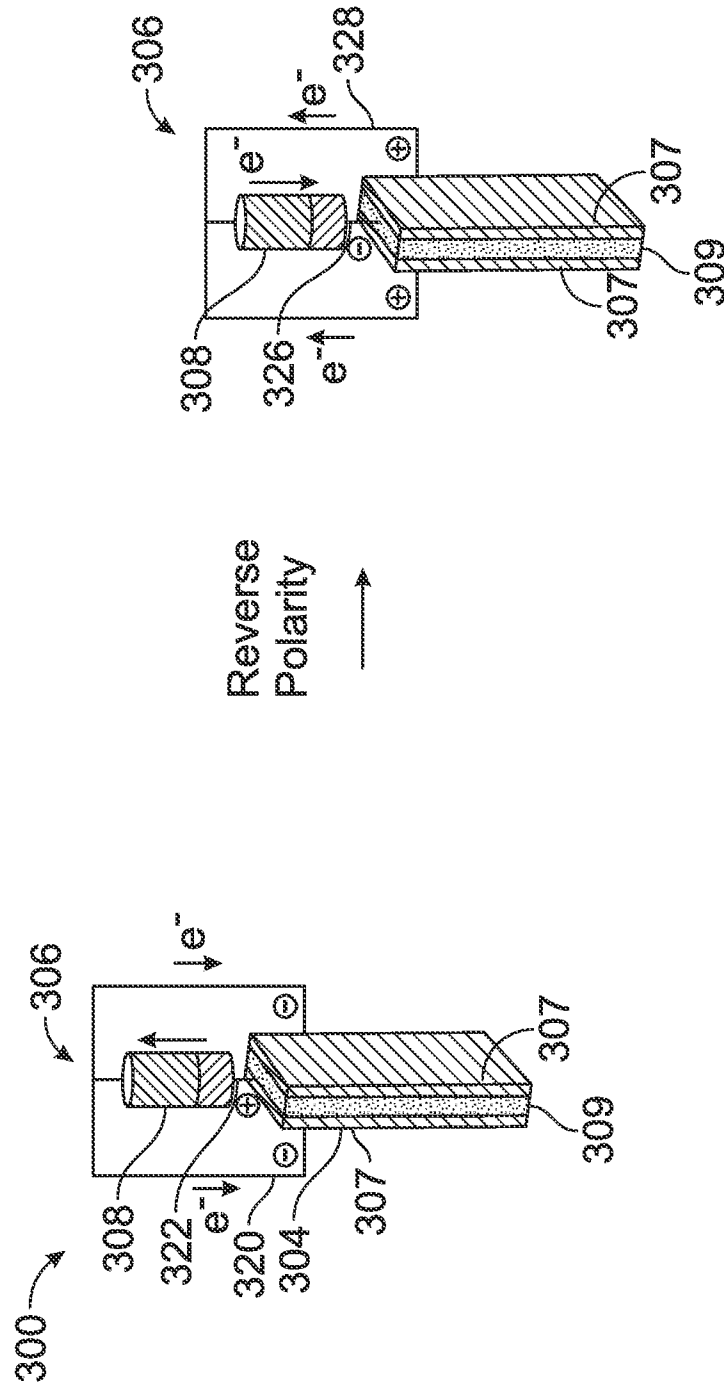


FIG. 8

FIG. 9

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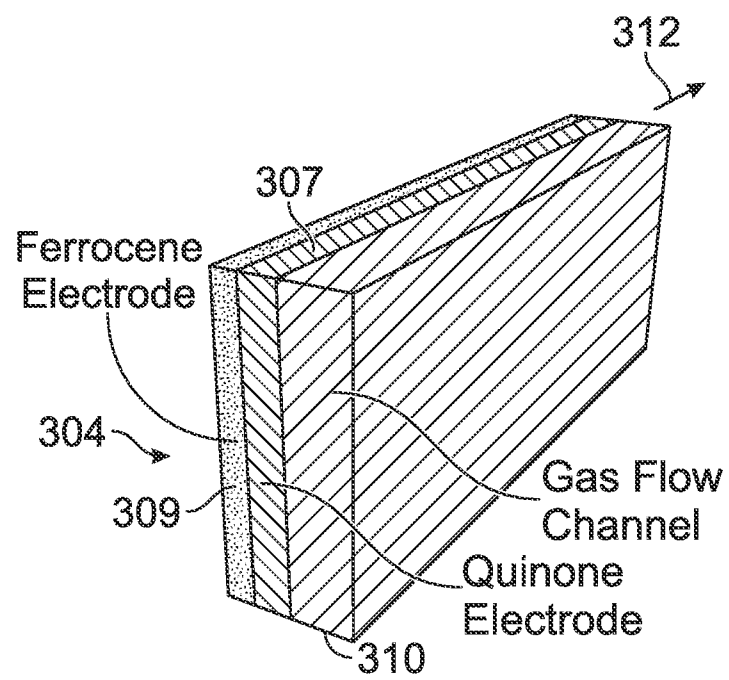
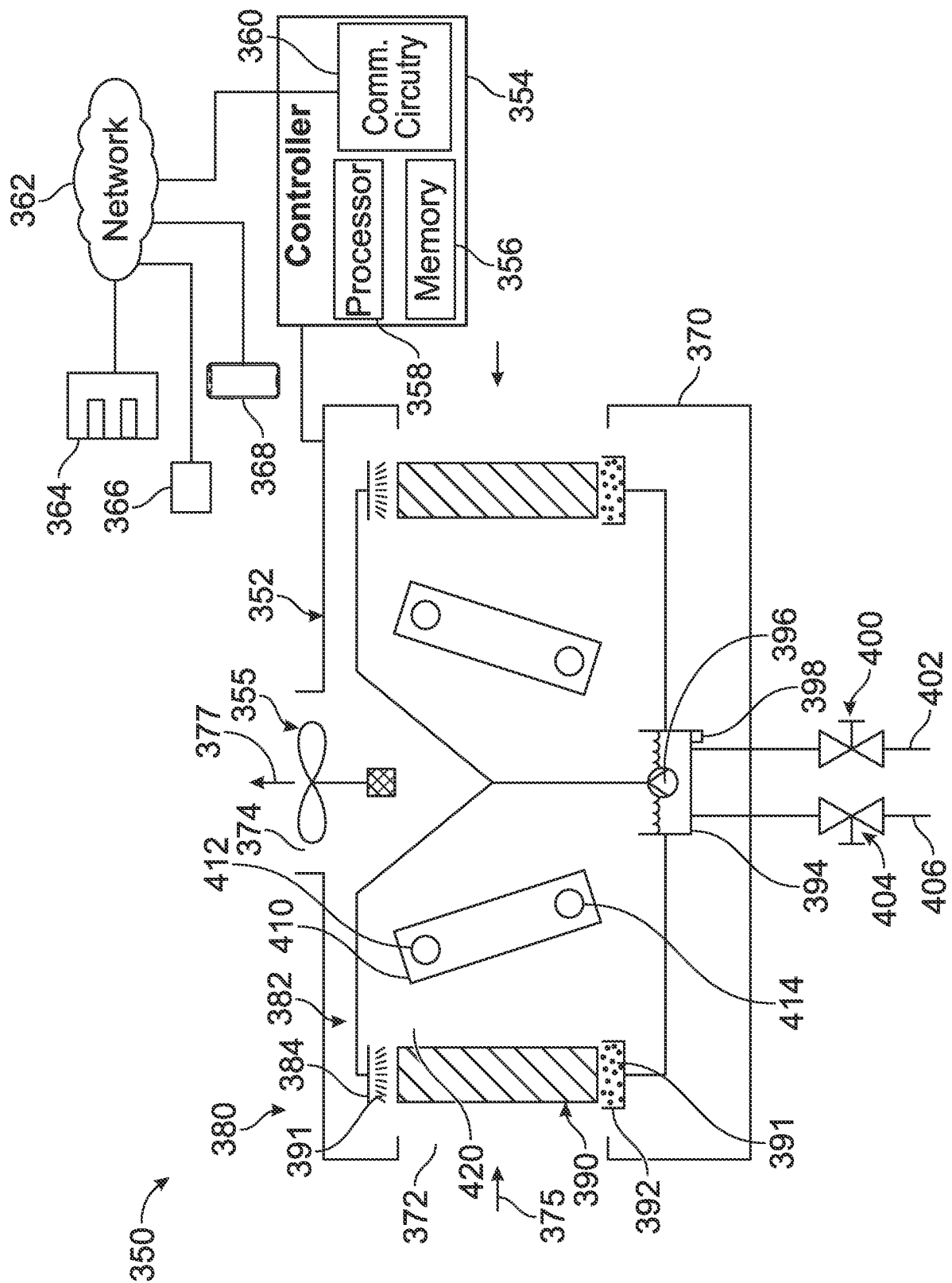


FIG. 12

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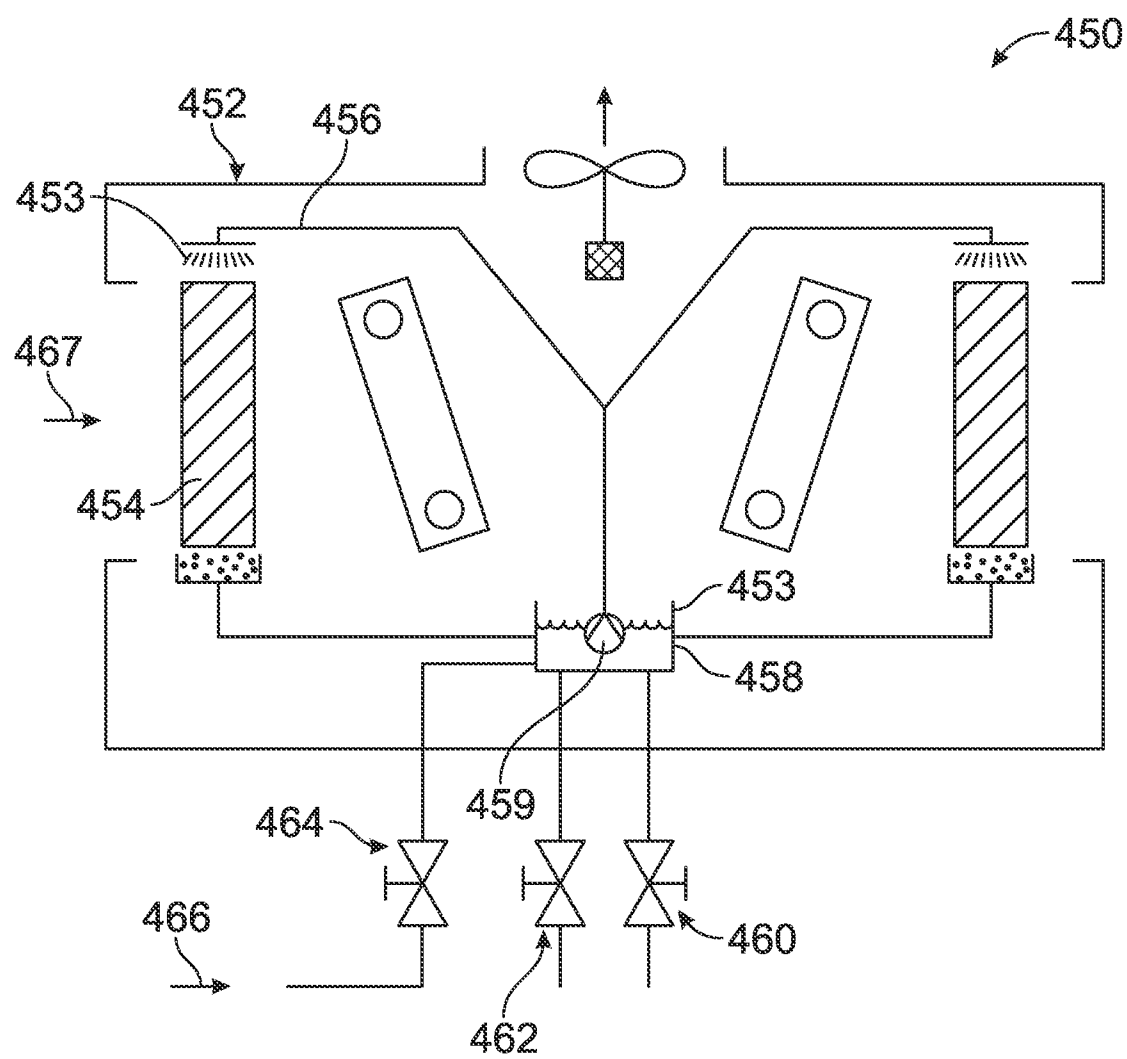


FIG. 14

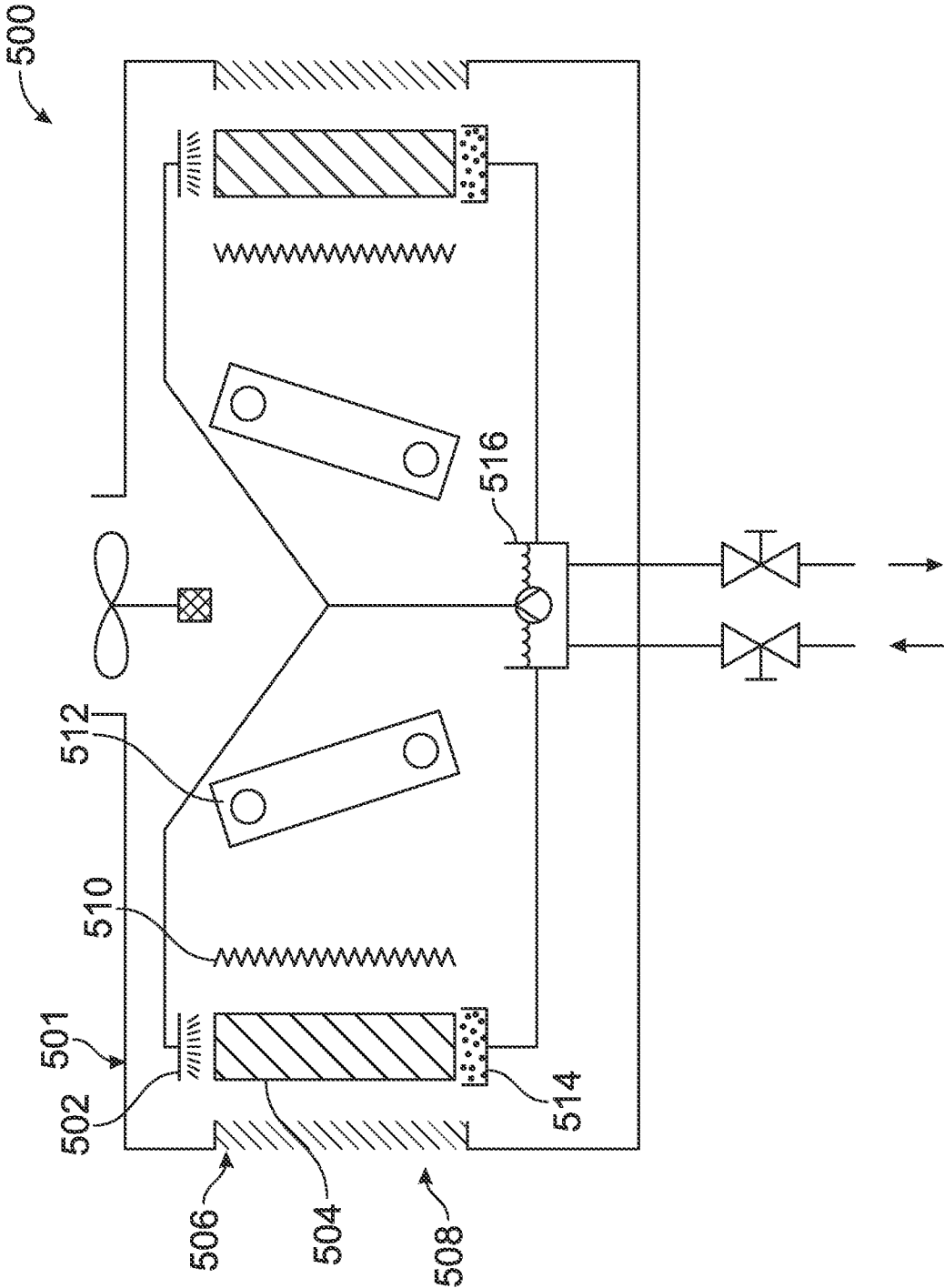


FIG. 15

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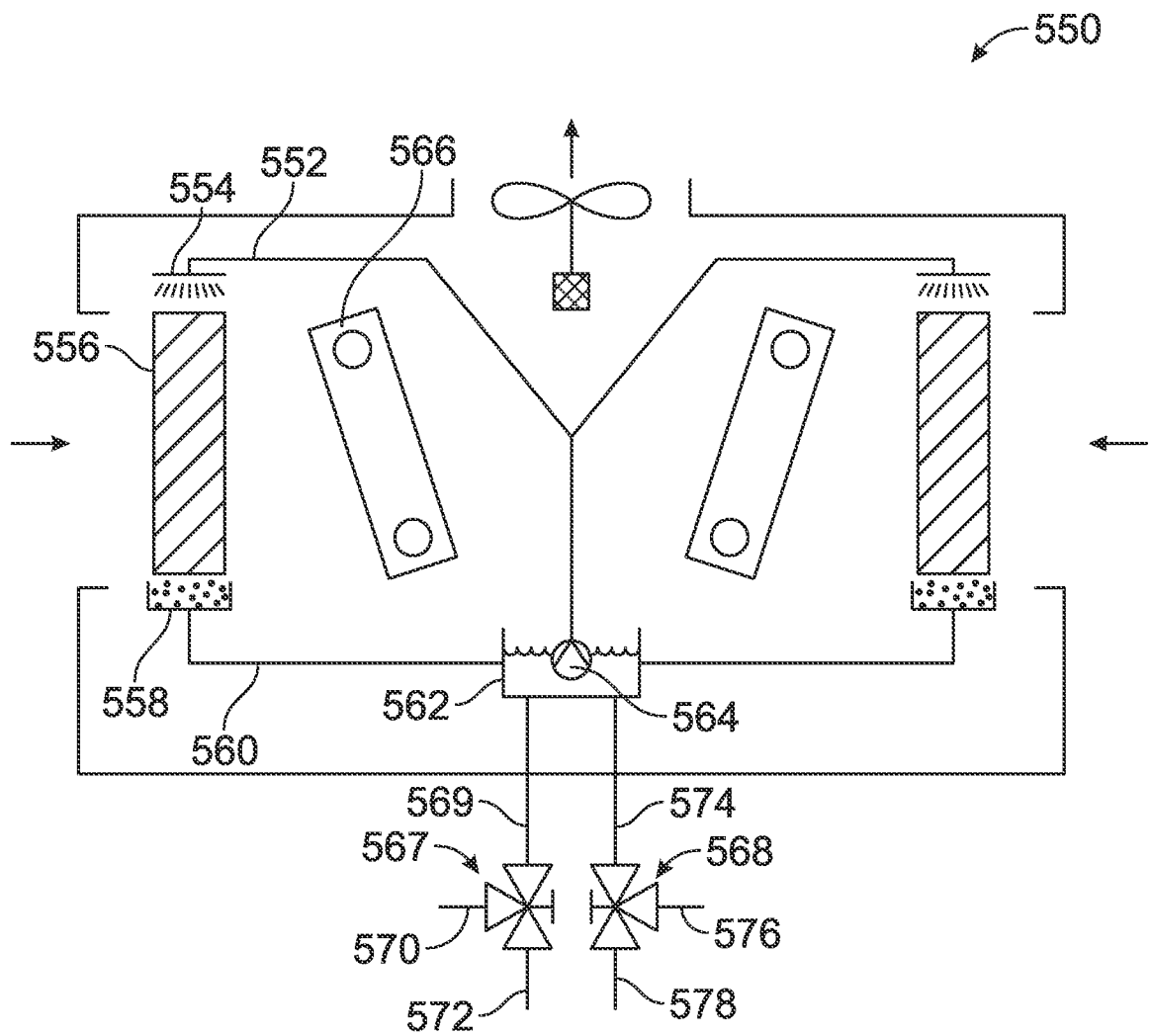


FIG. 16

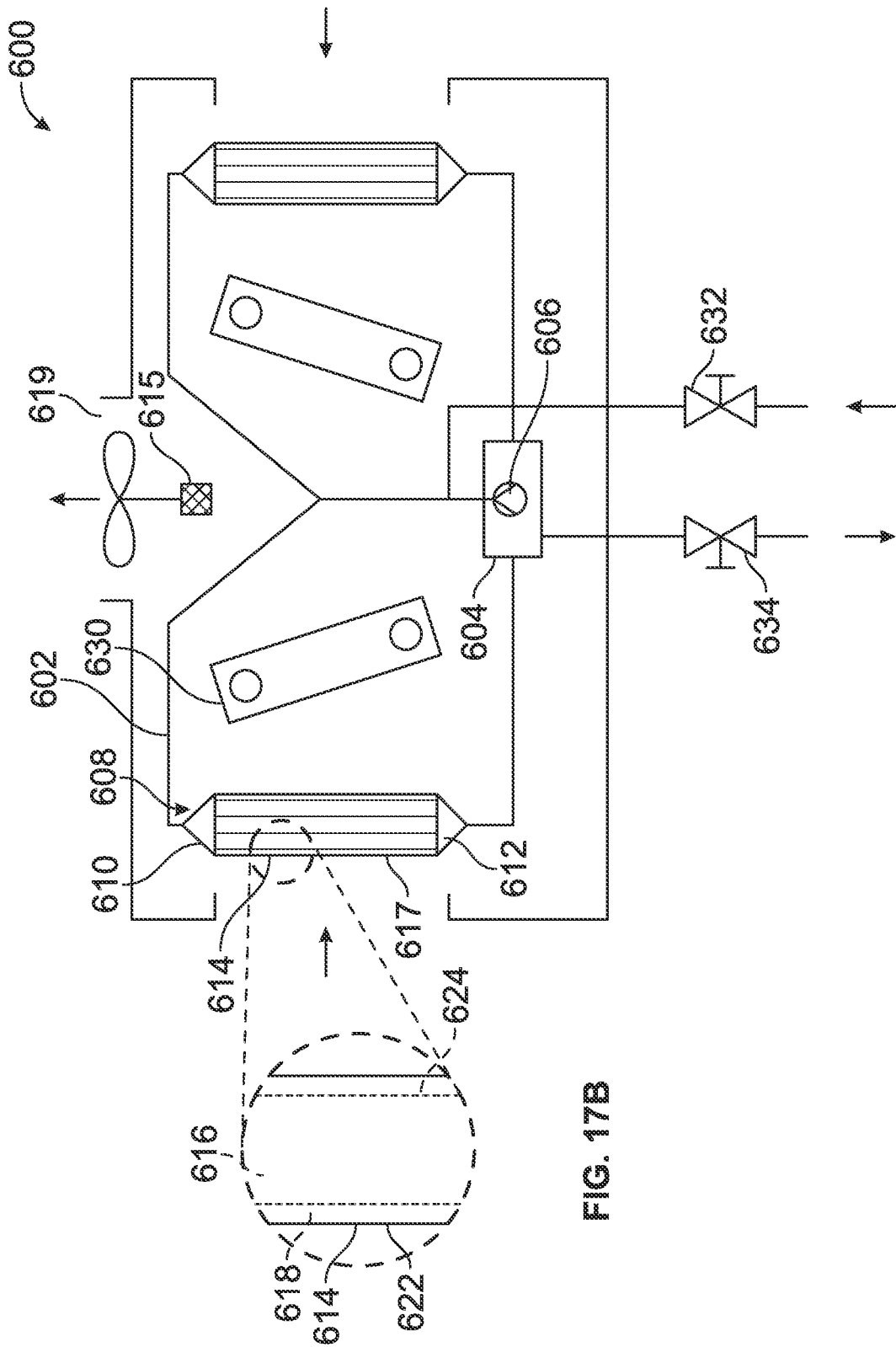
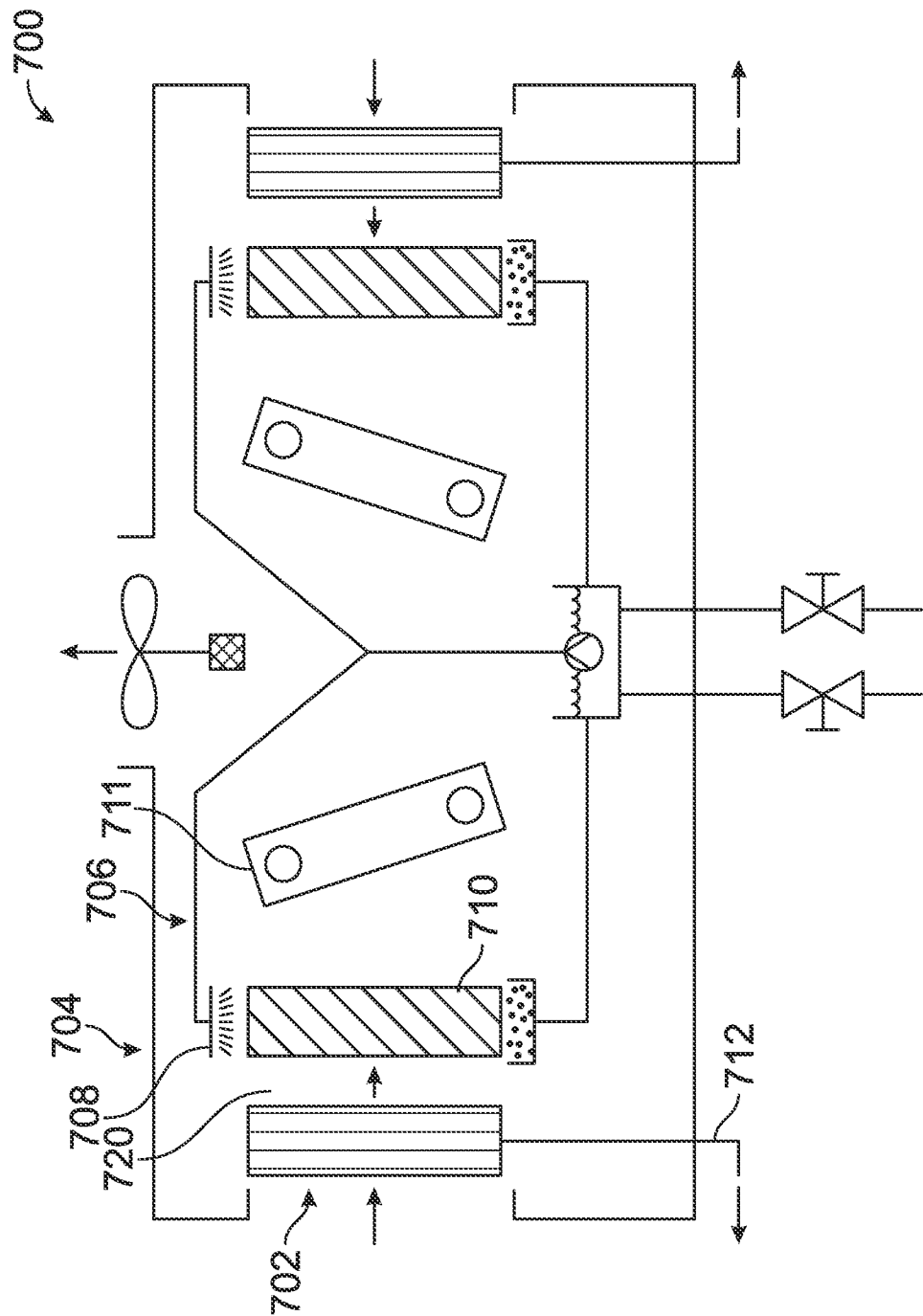


FIG. 17A

FIG. 17B



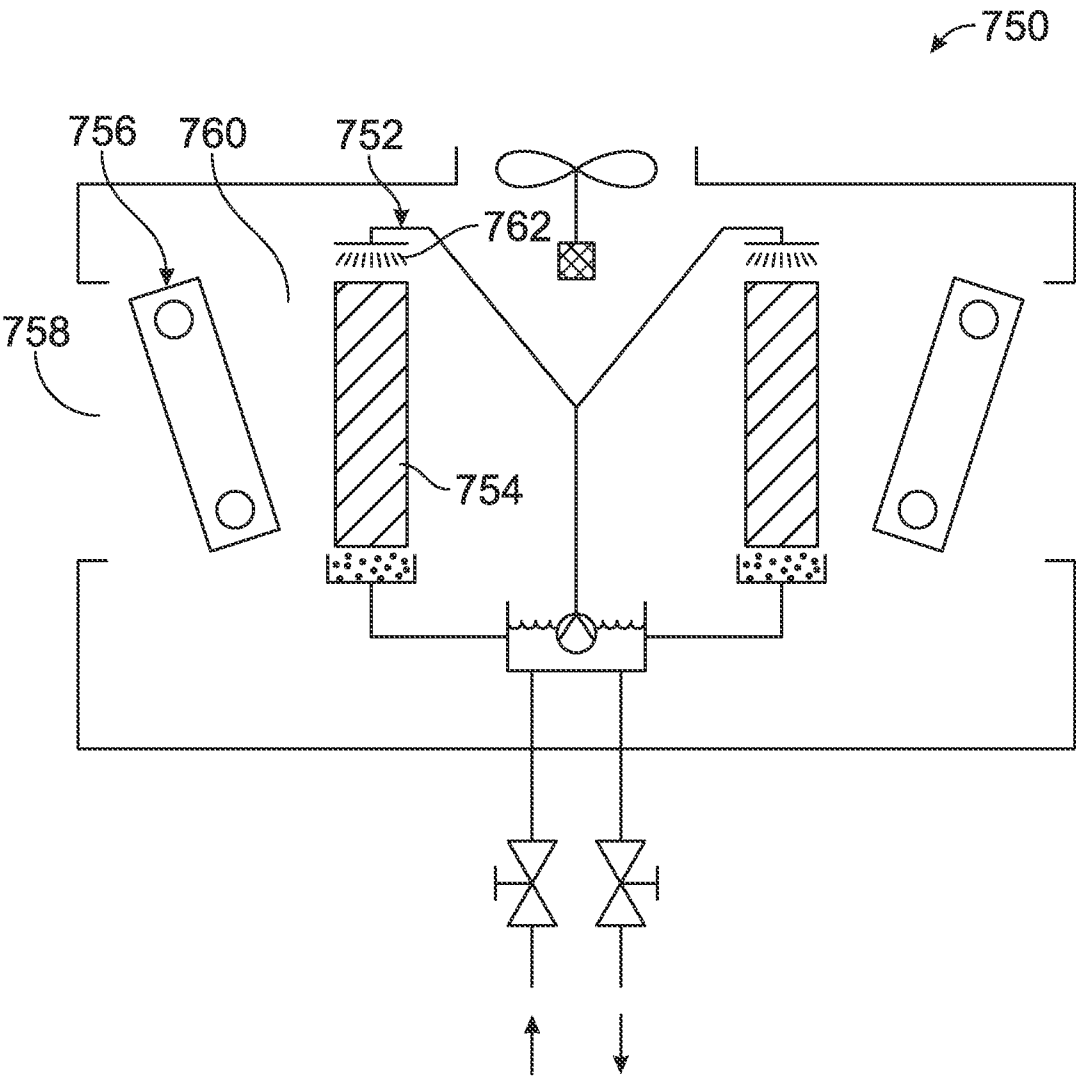


FIG. 19

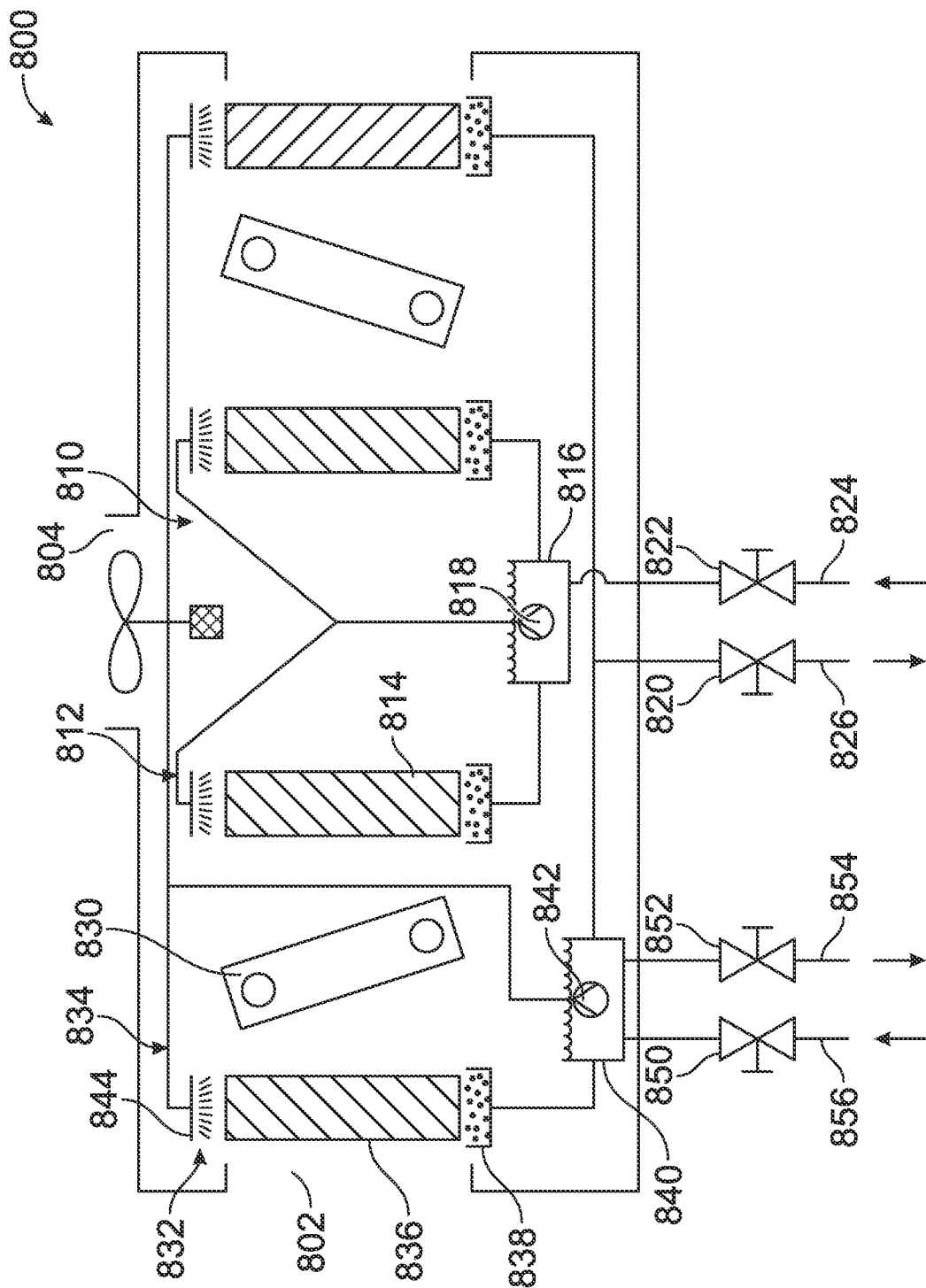


FIG. 20

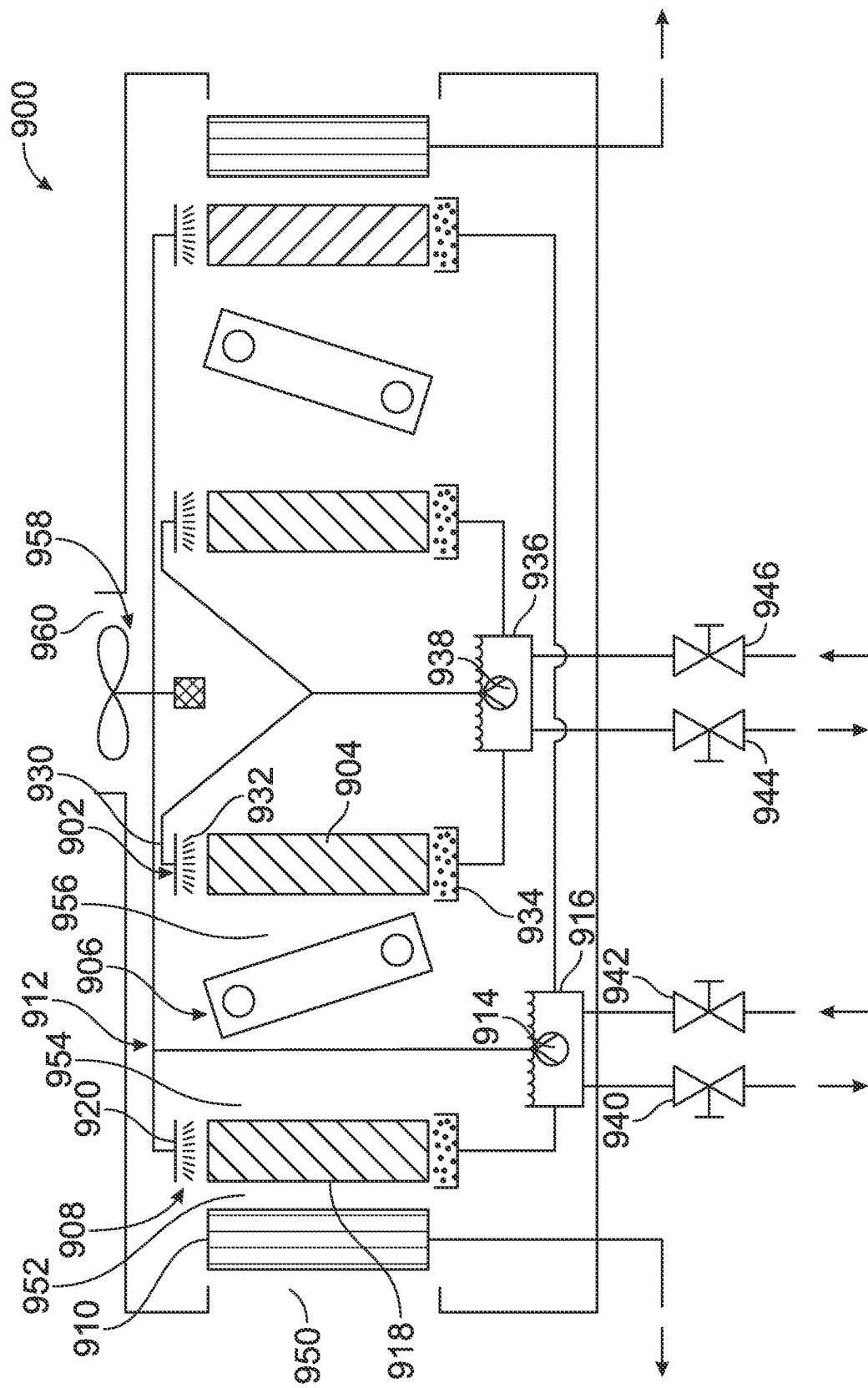


FIG. 21

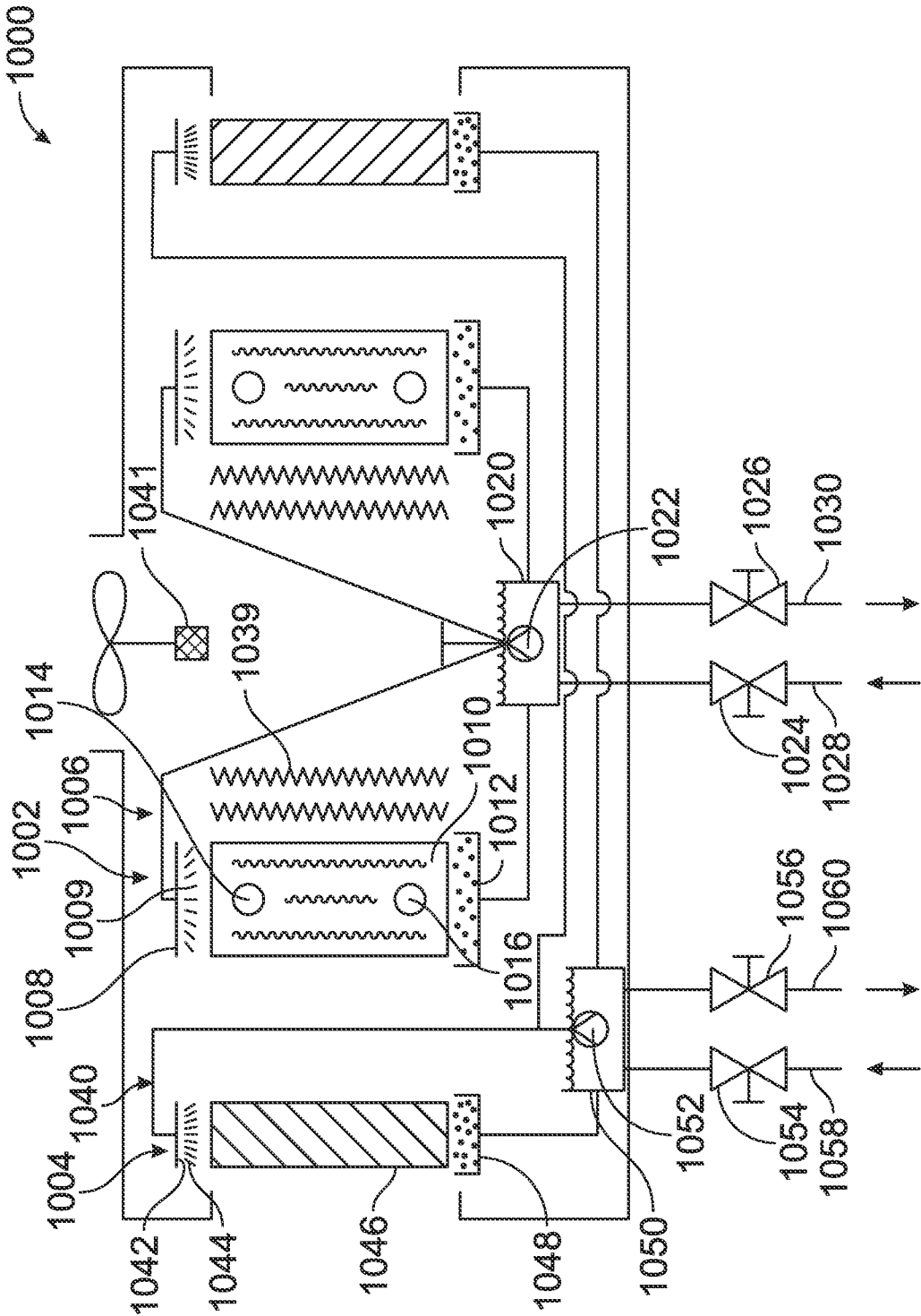


FIG. 22

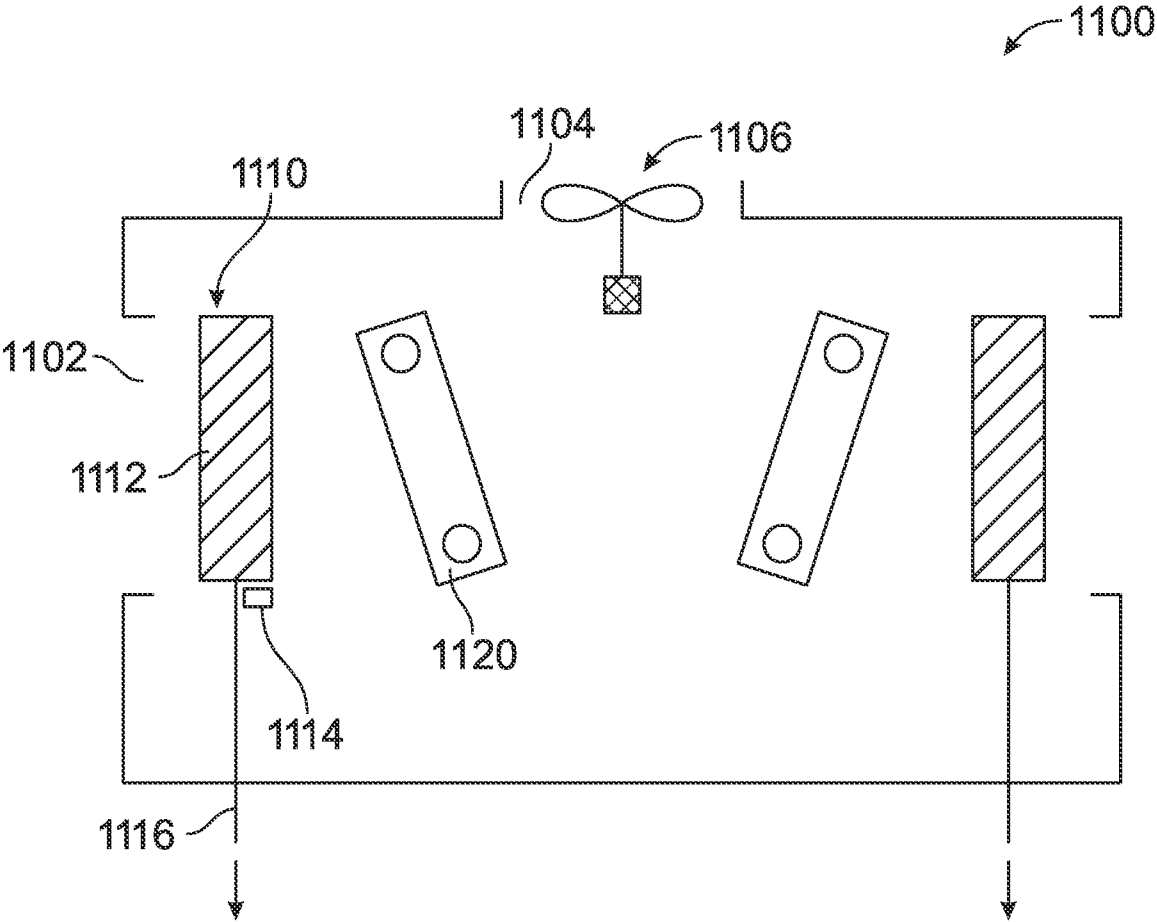


FIG. 23

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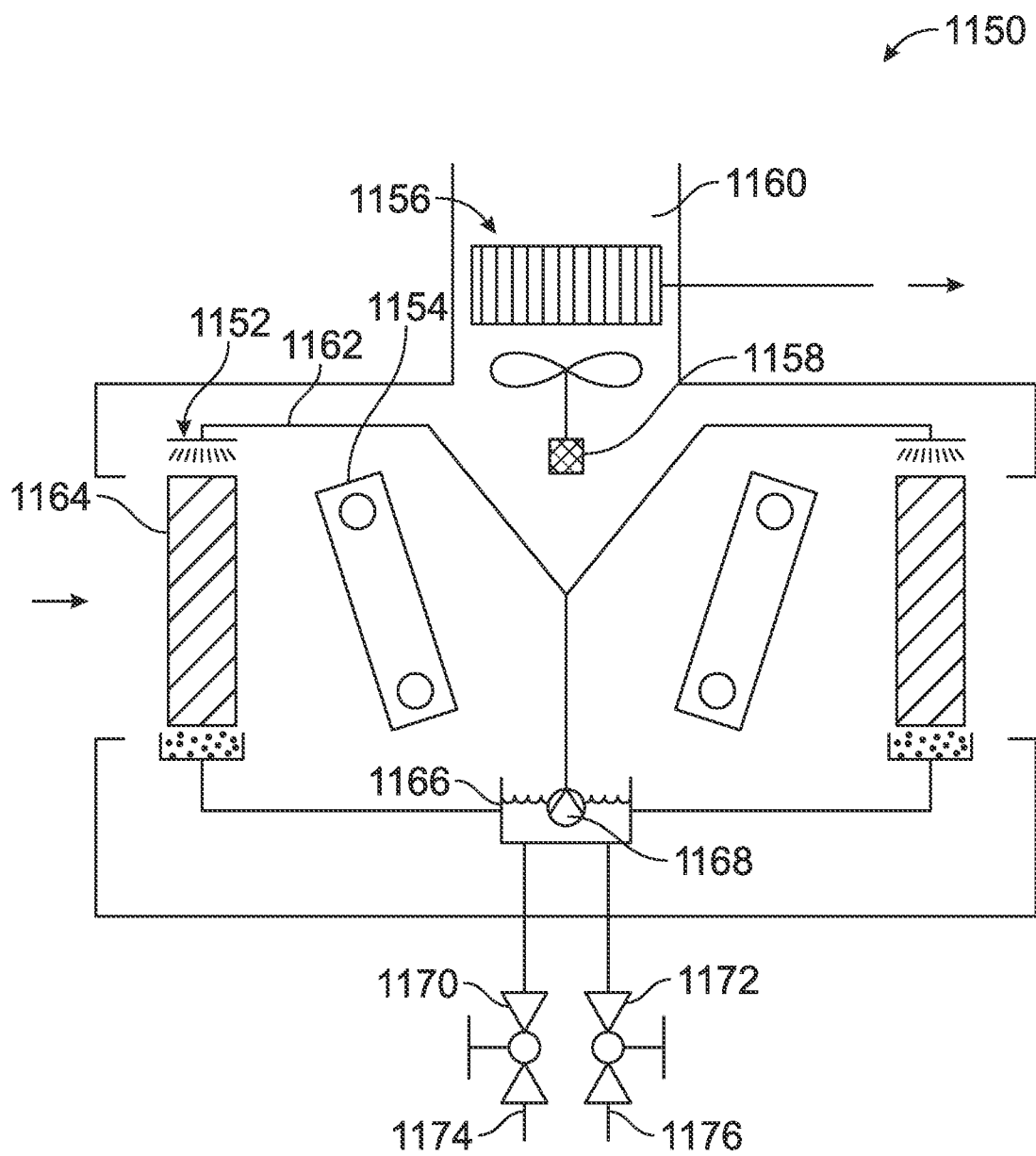


FIG. 24

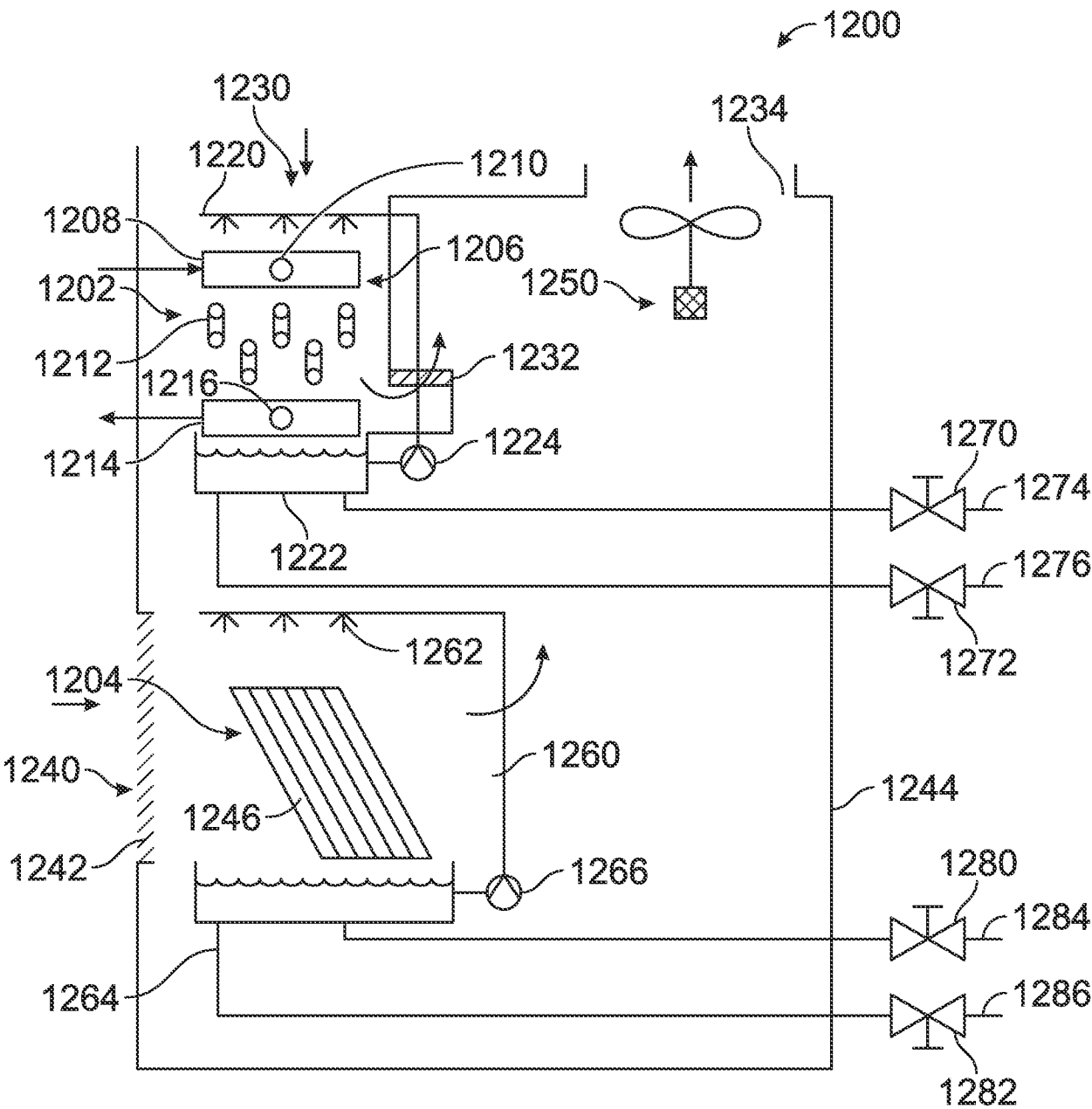


FIG. 25

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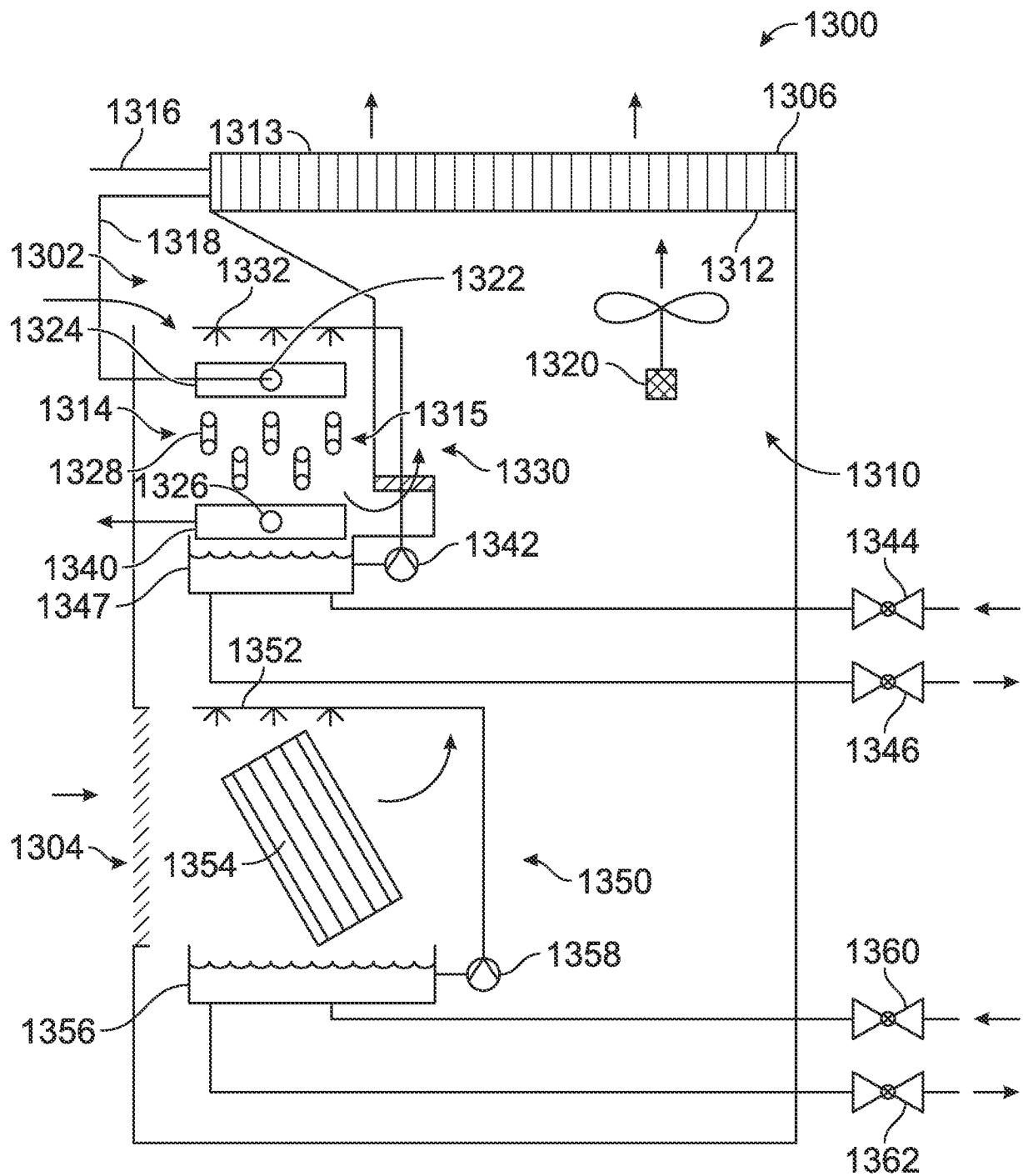


FIG. 26

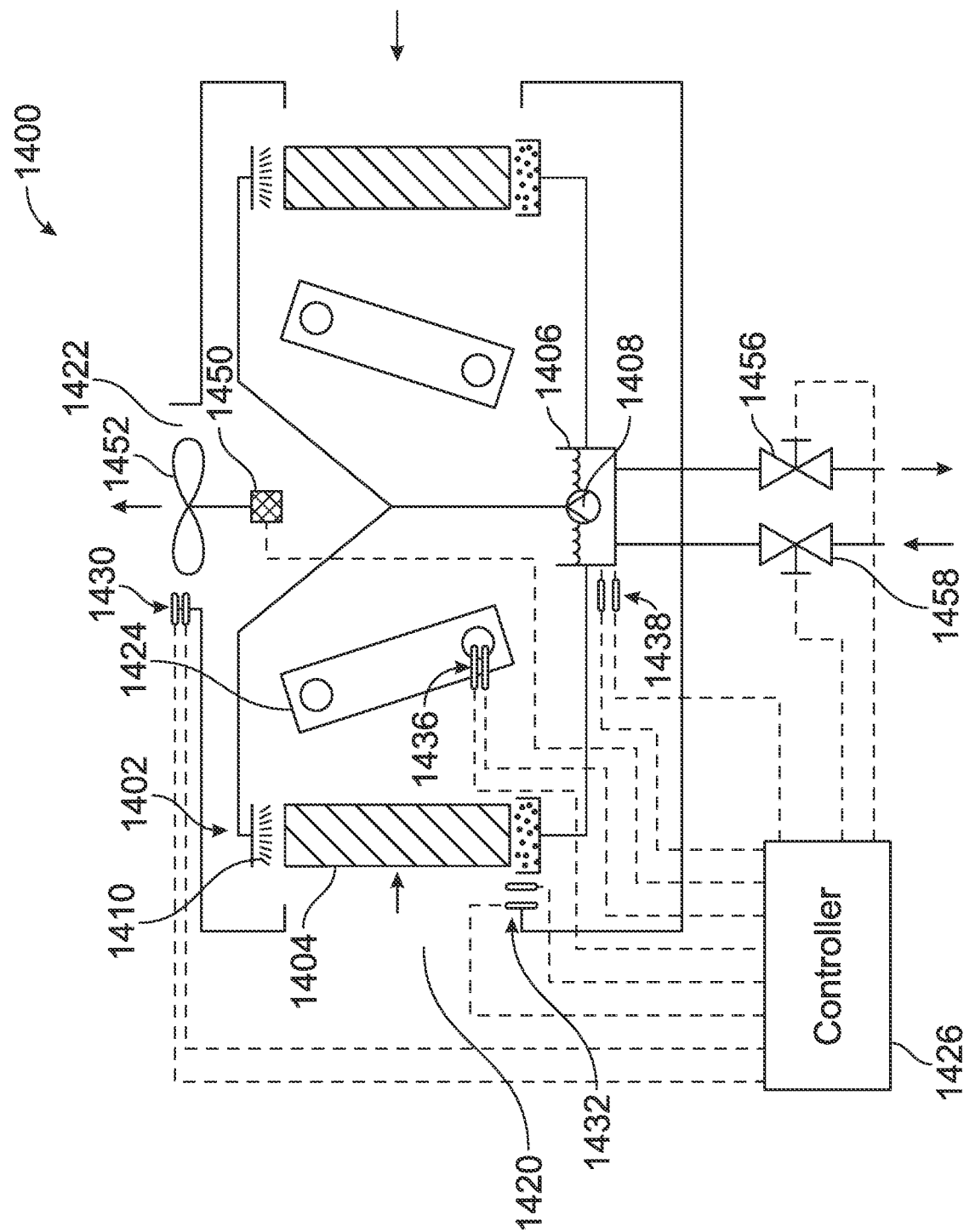
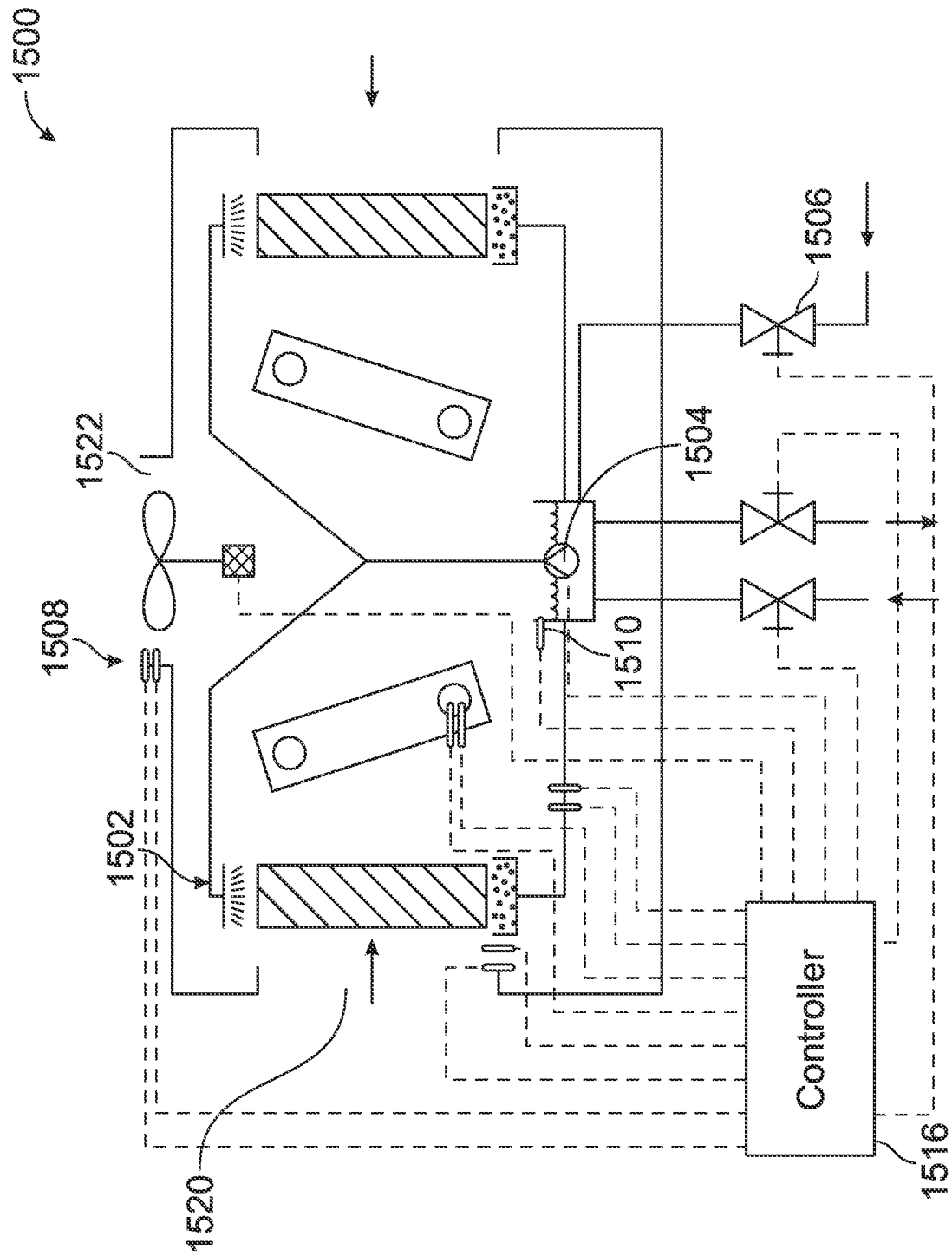
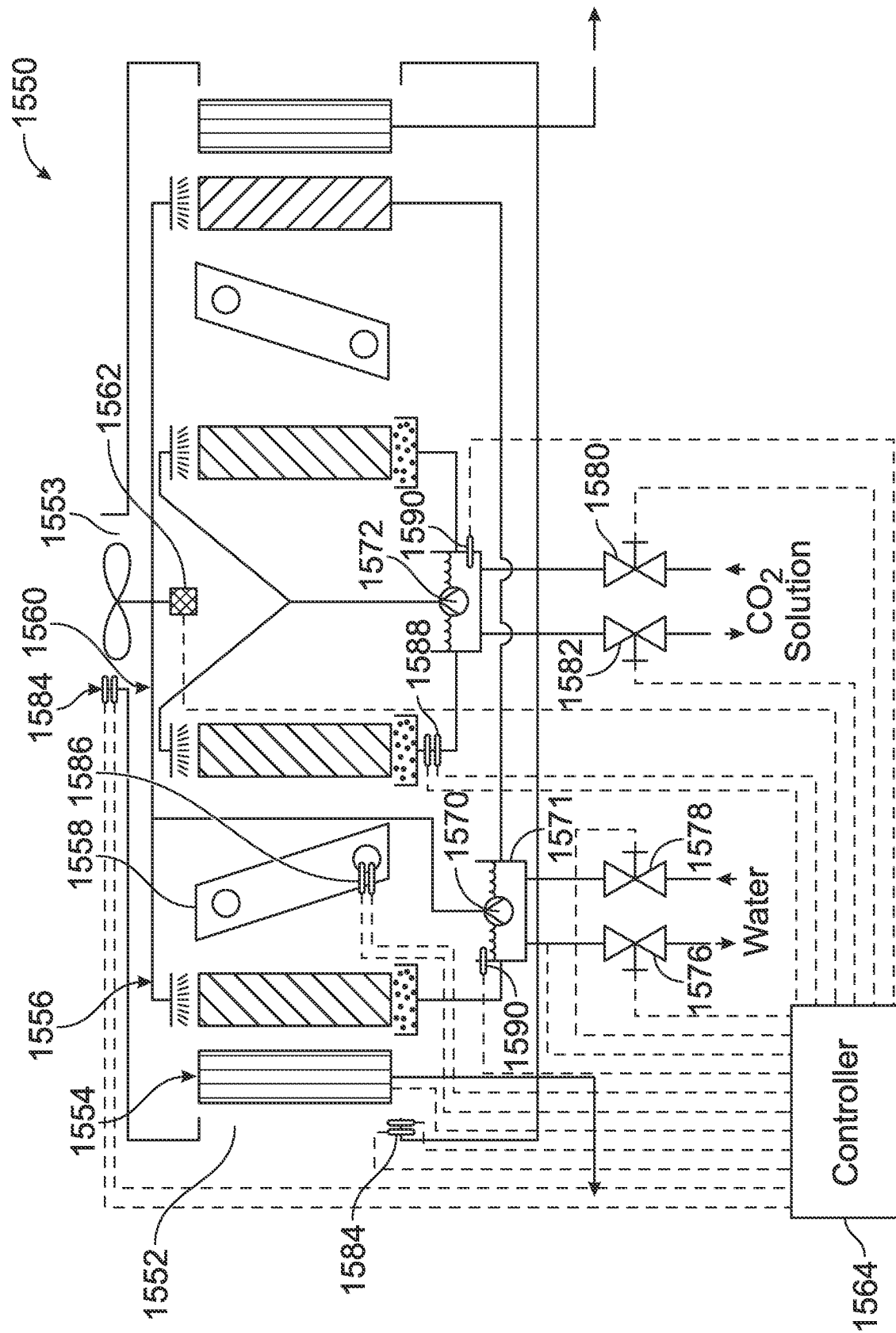


FIG. 27

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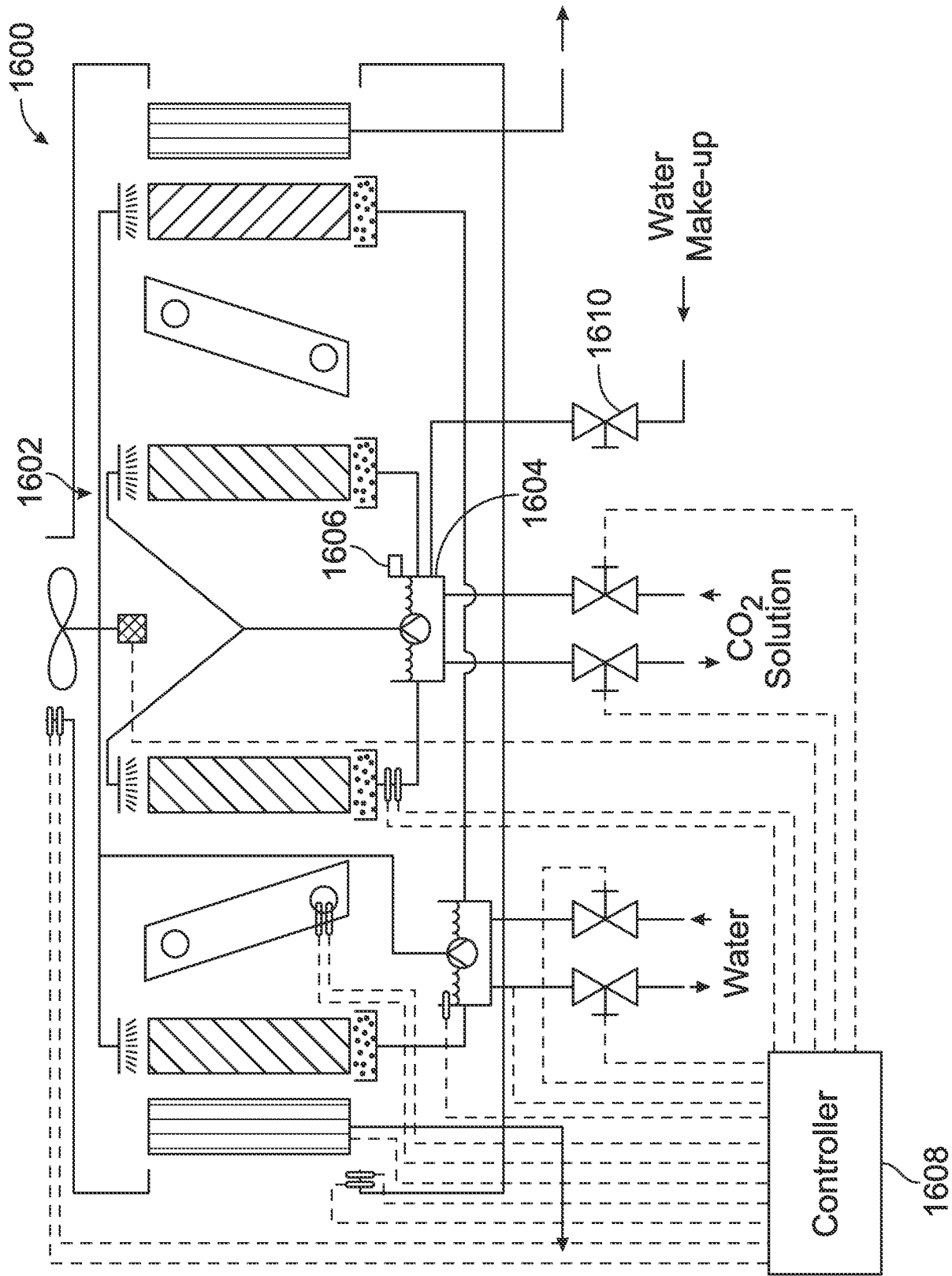
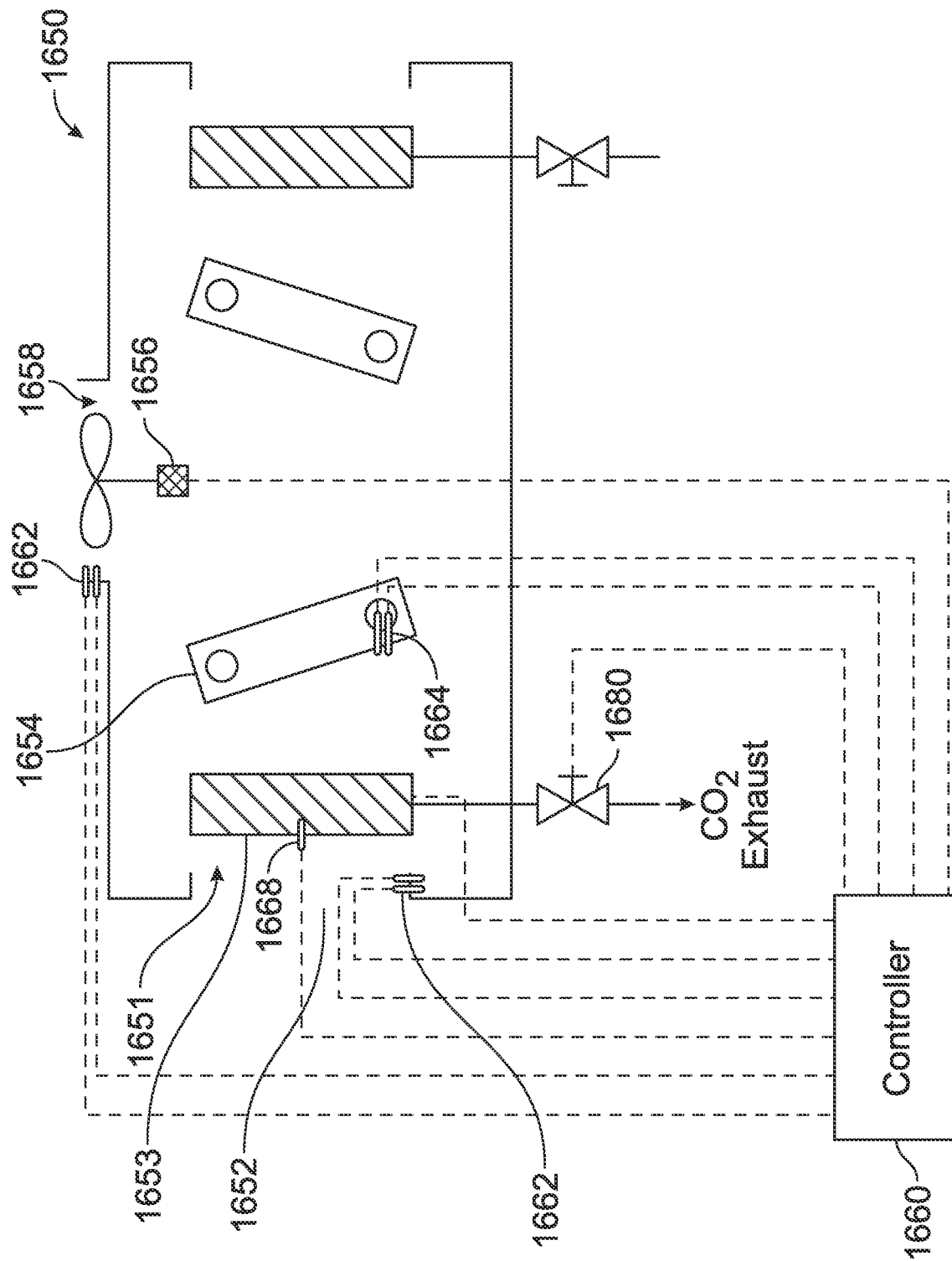


FIG. 30

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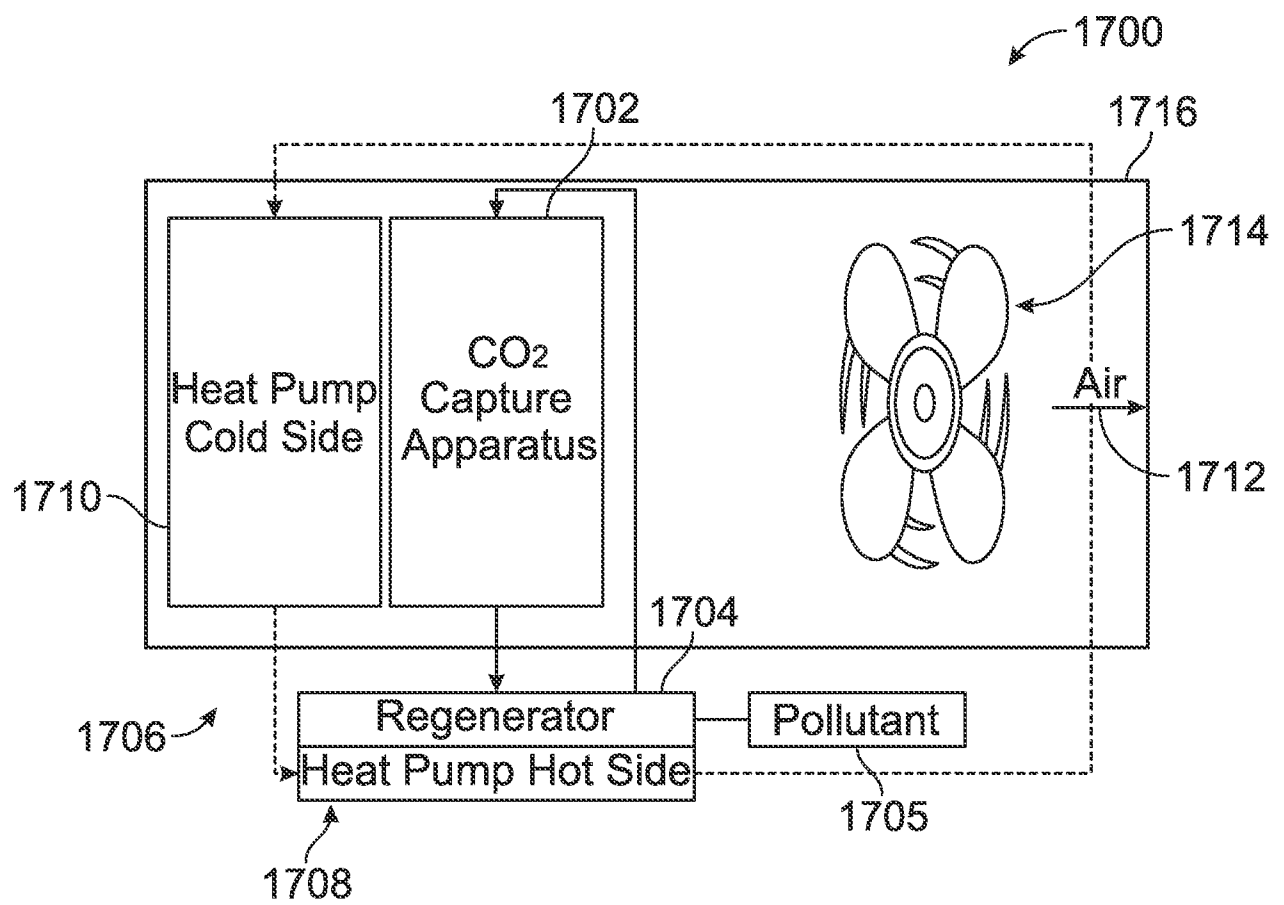


FIG. 32

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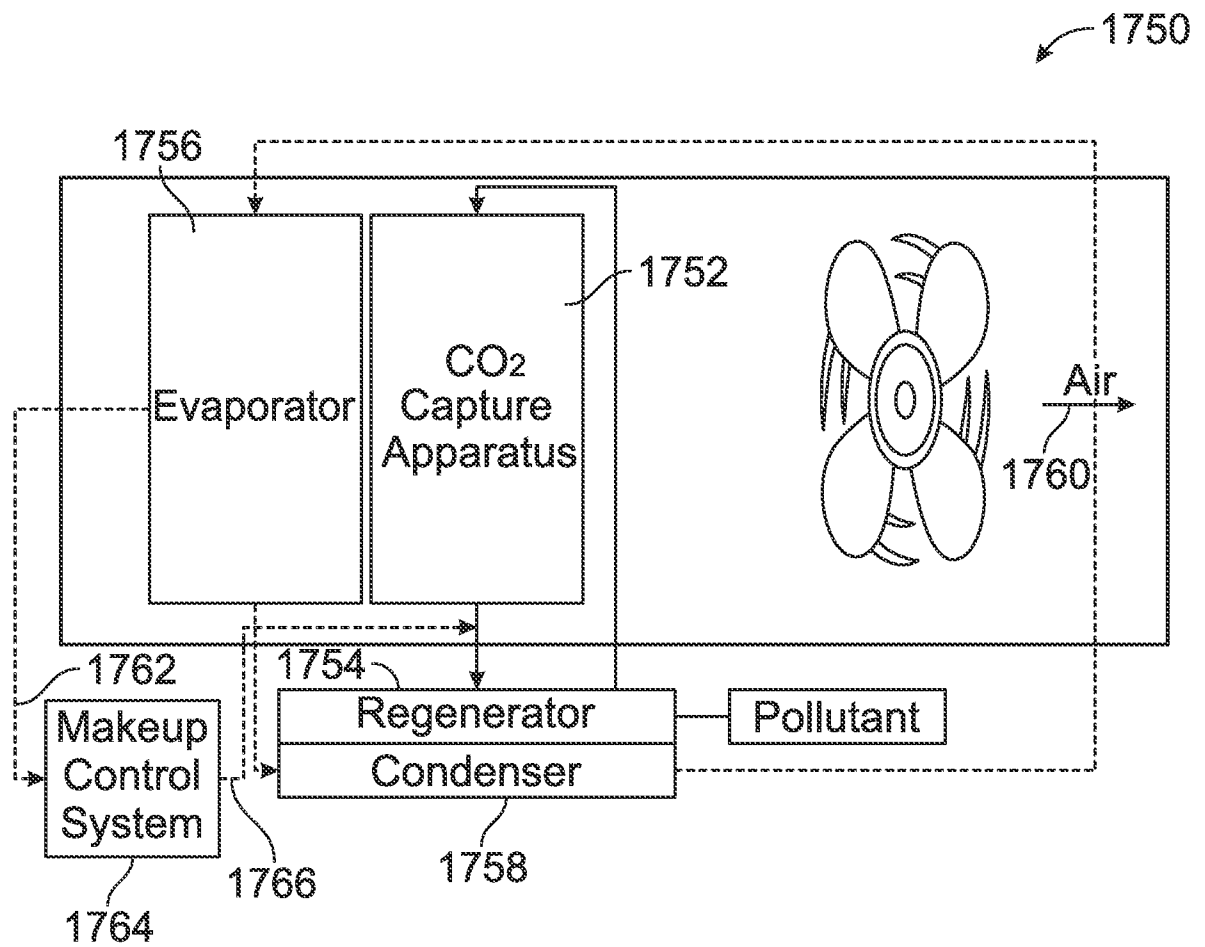


FIG. 33

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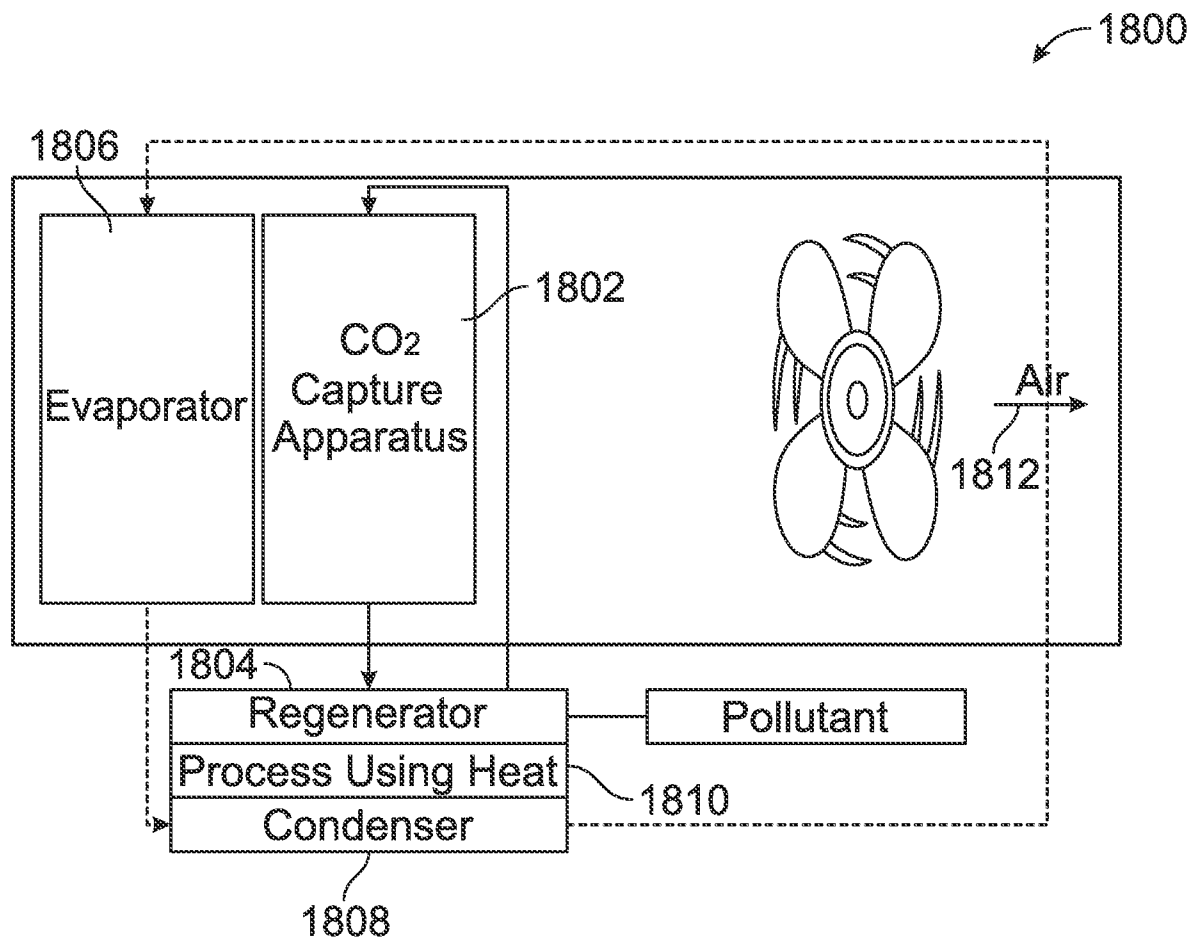


FIG. 34

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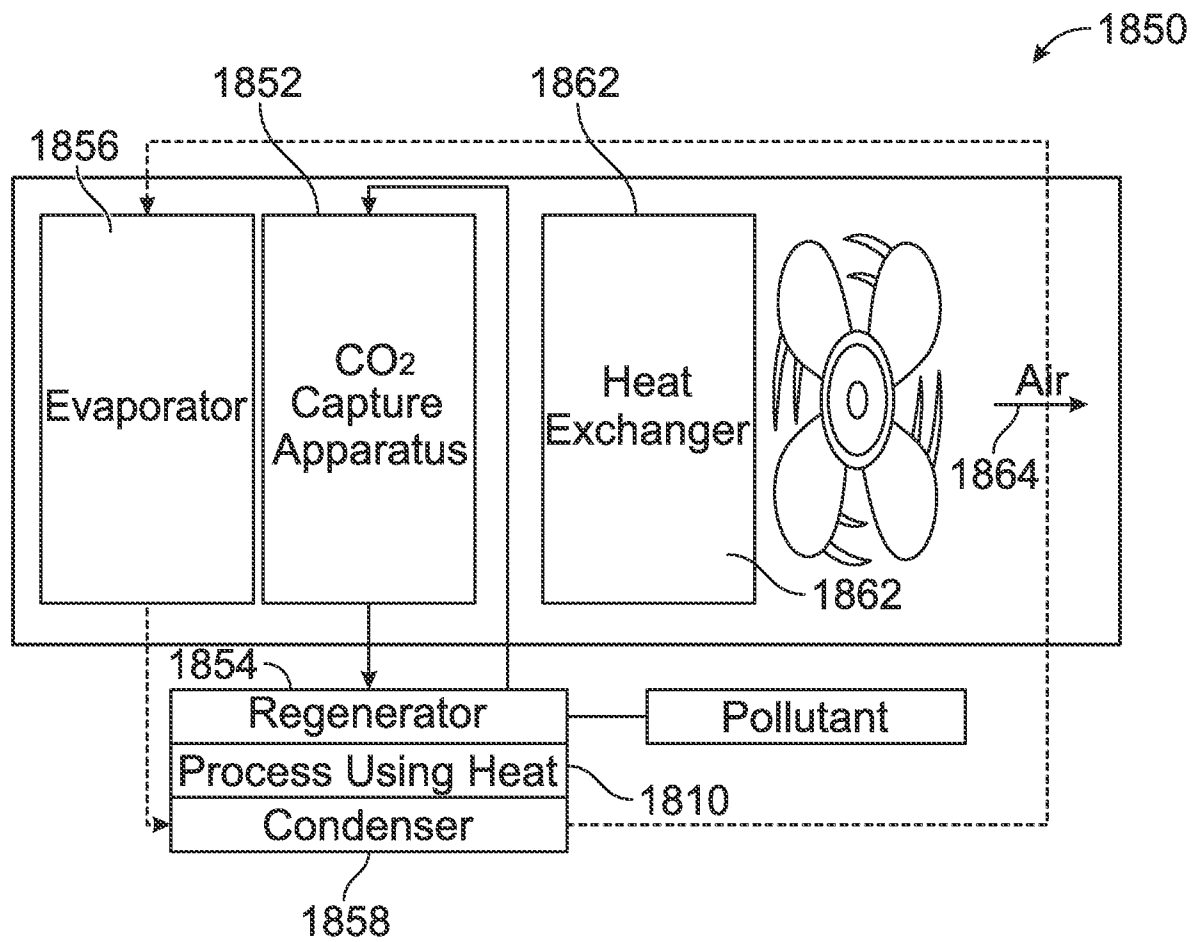


FIG. 35

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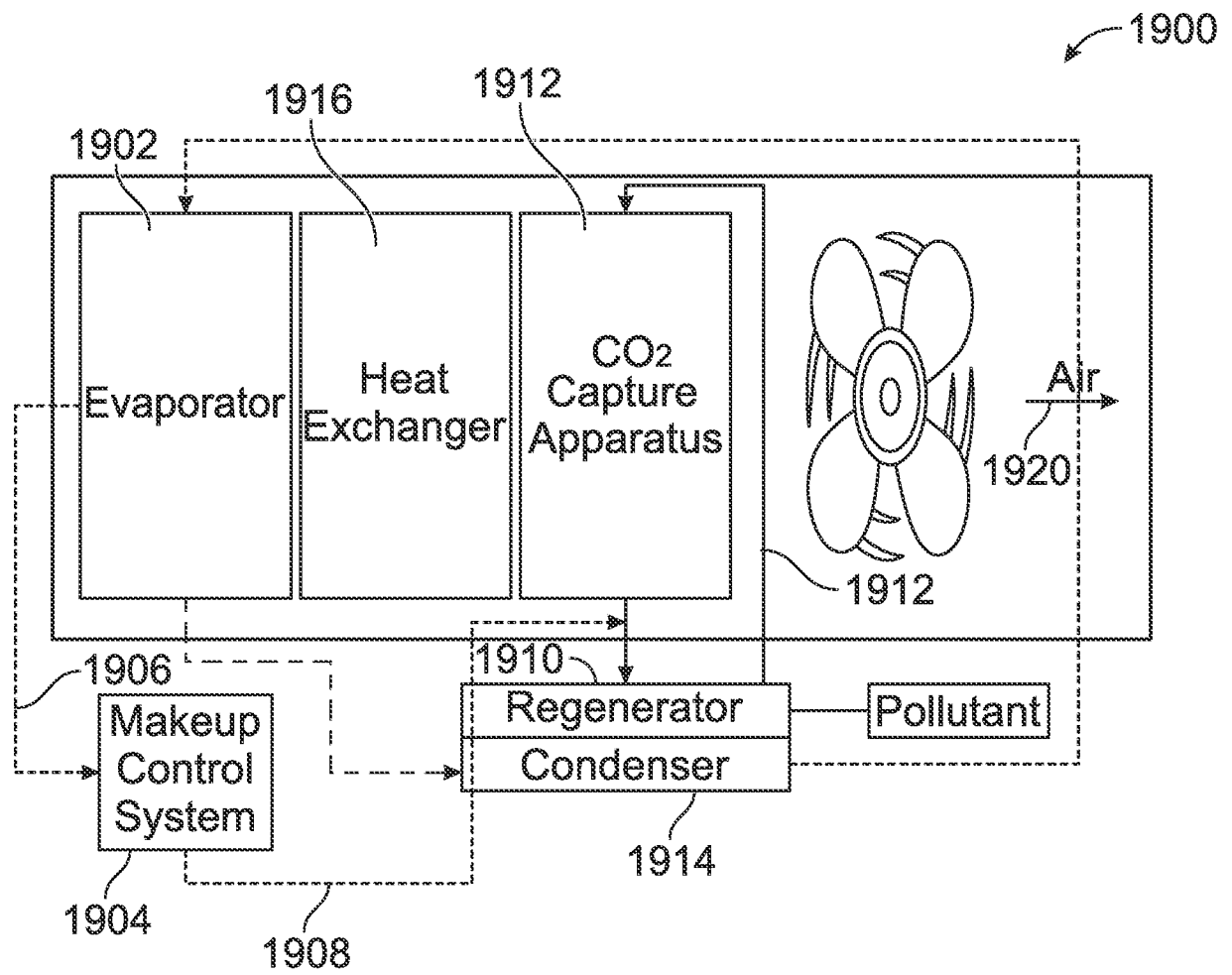


FIG. 36

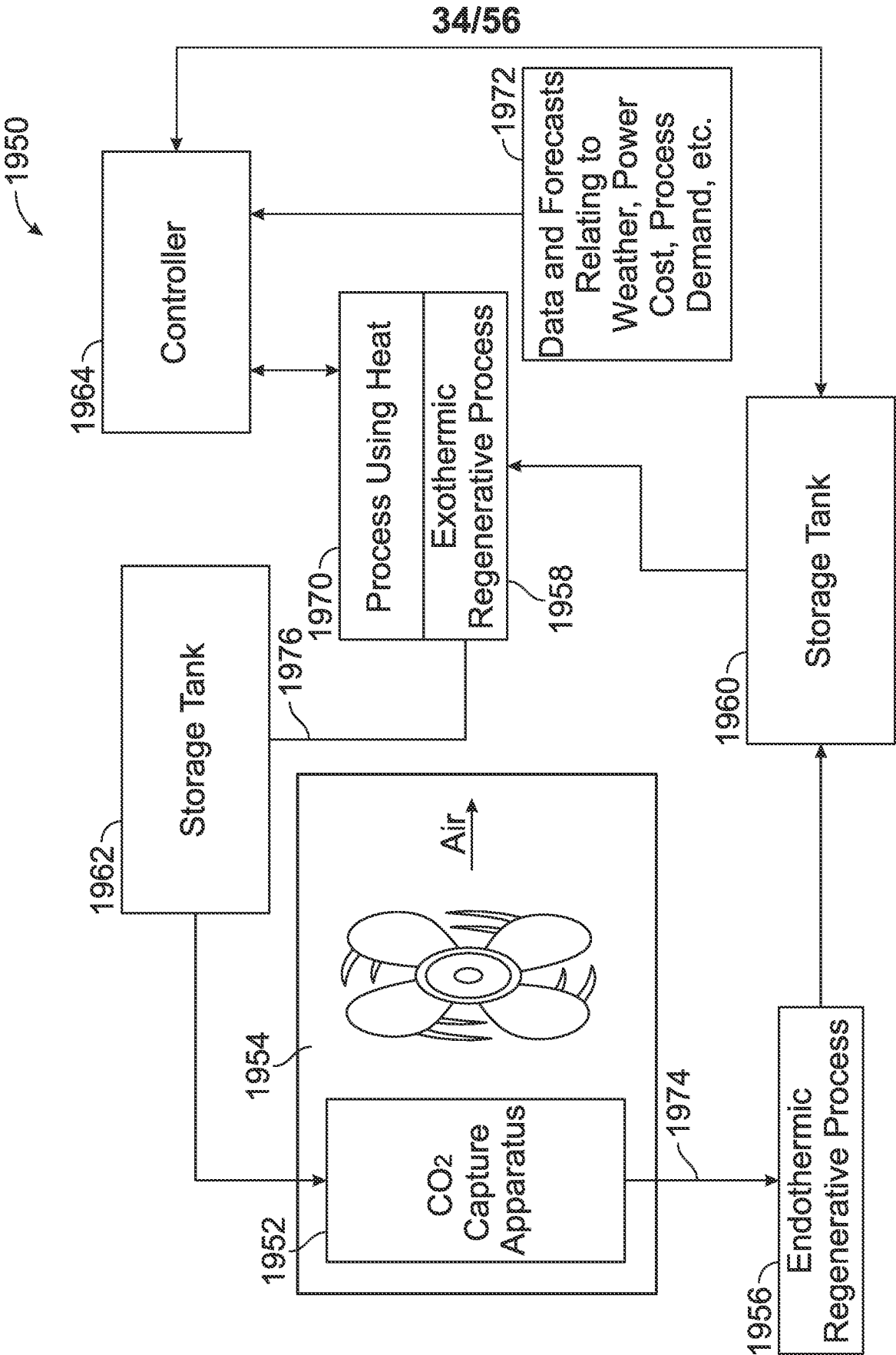


FIG. 37

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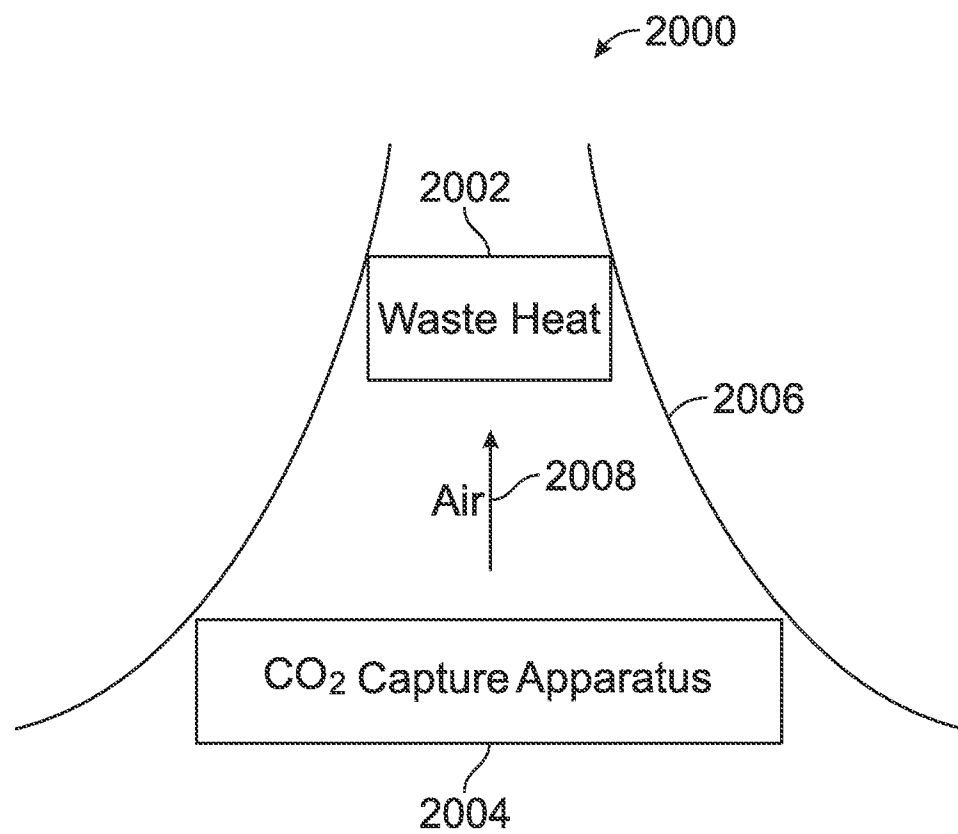


FIG. 38

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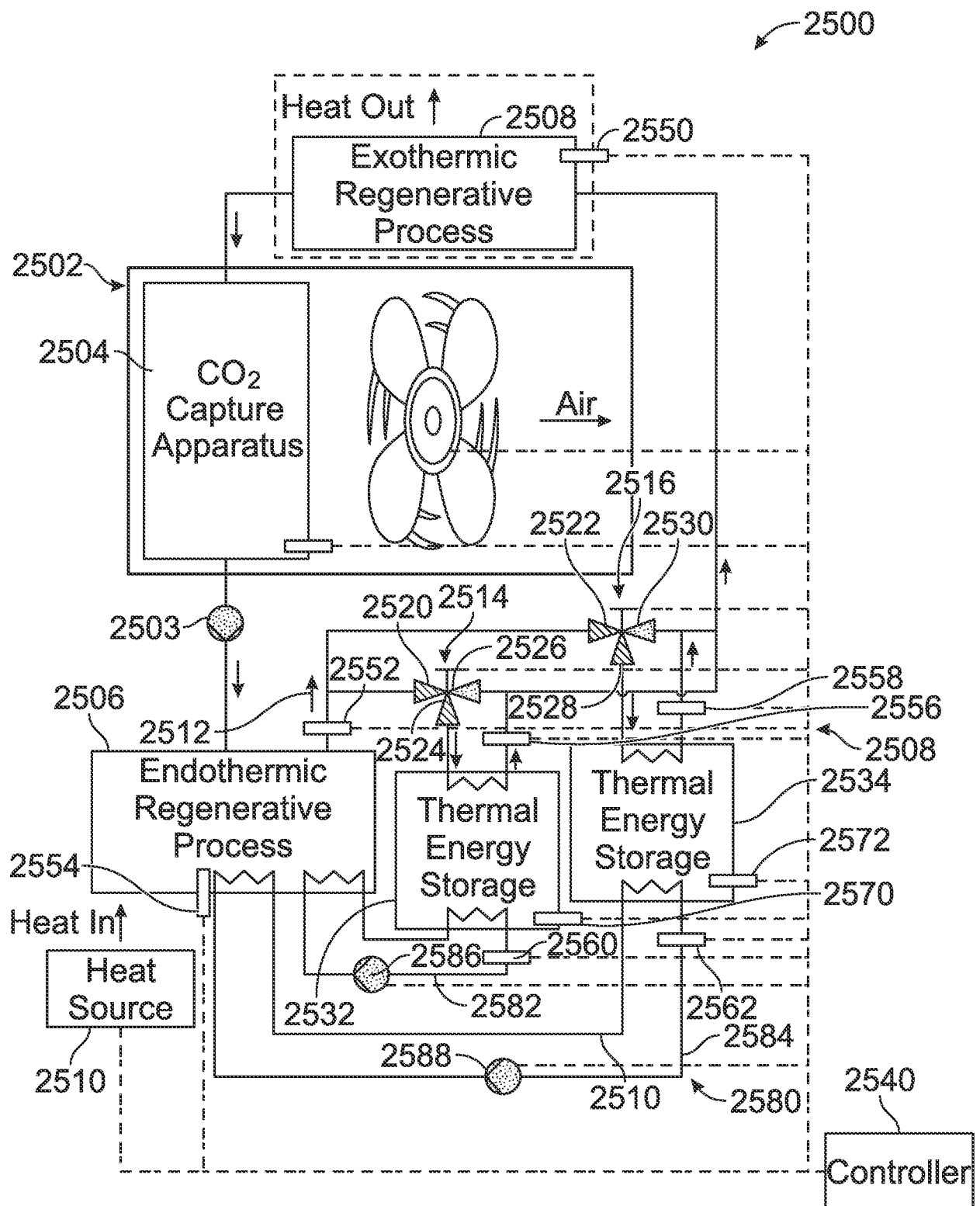


FIG. 39

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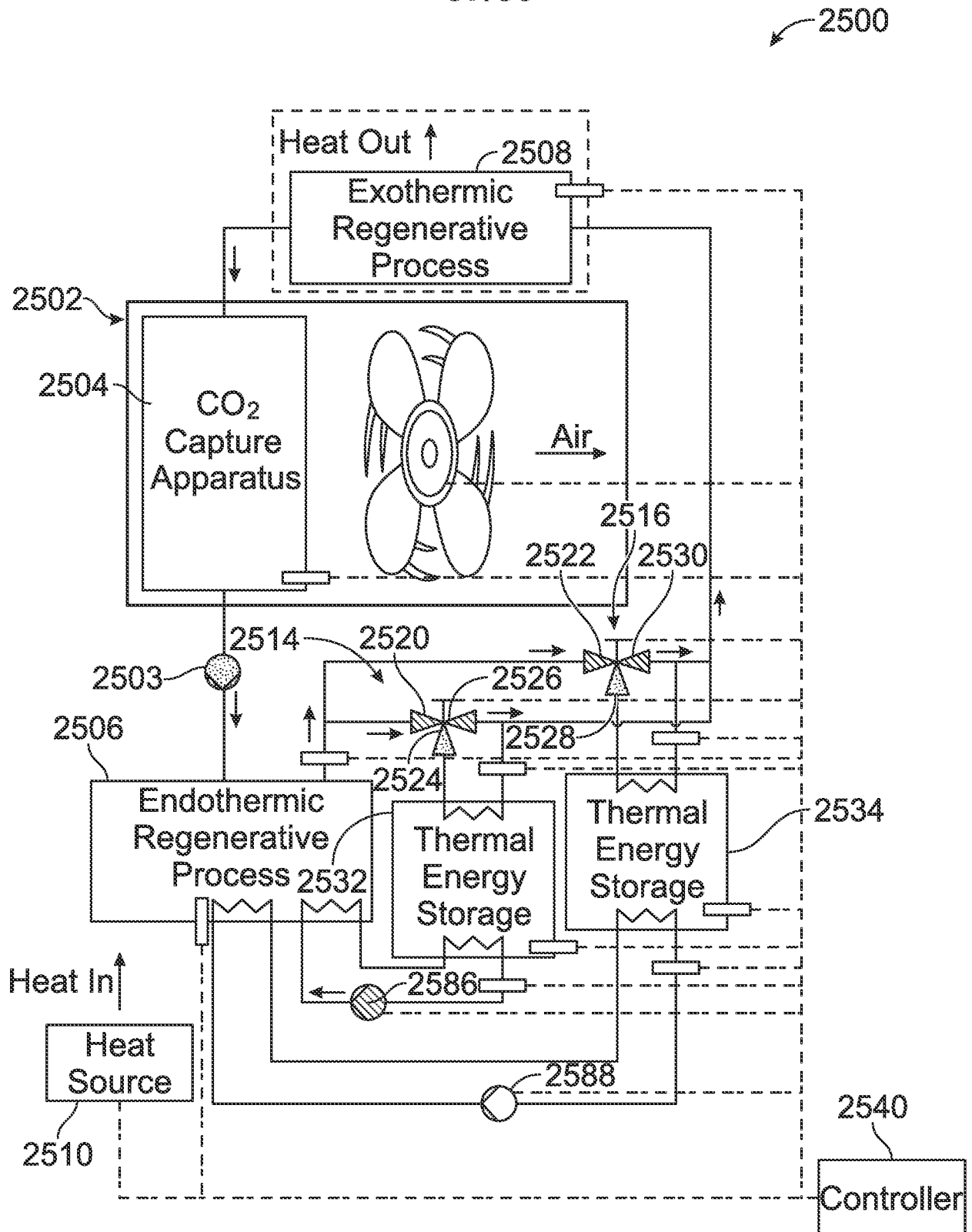


FIG. 40

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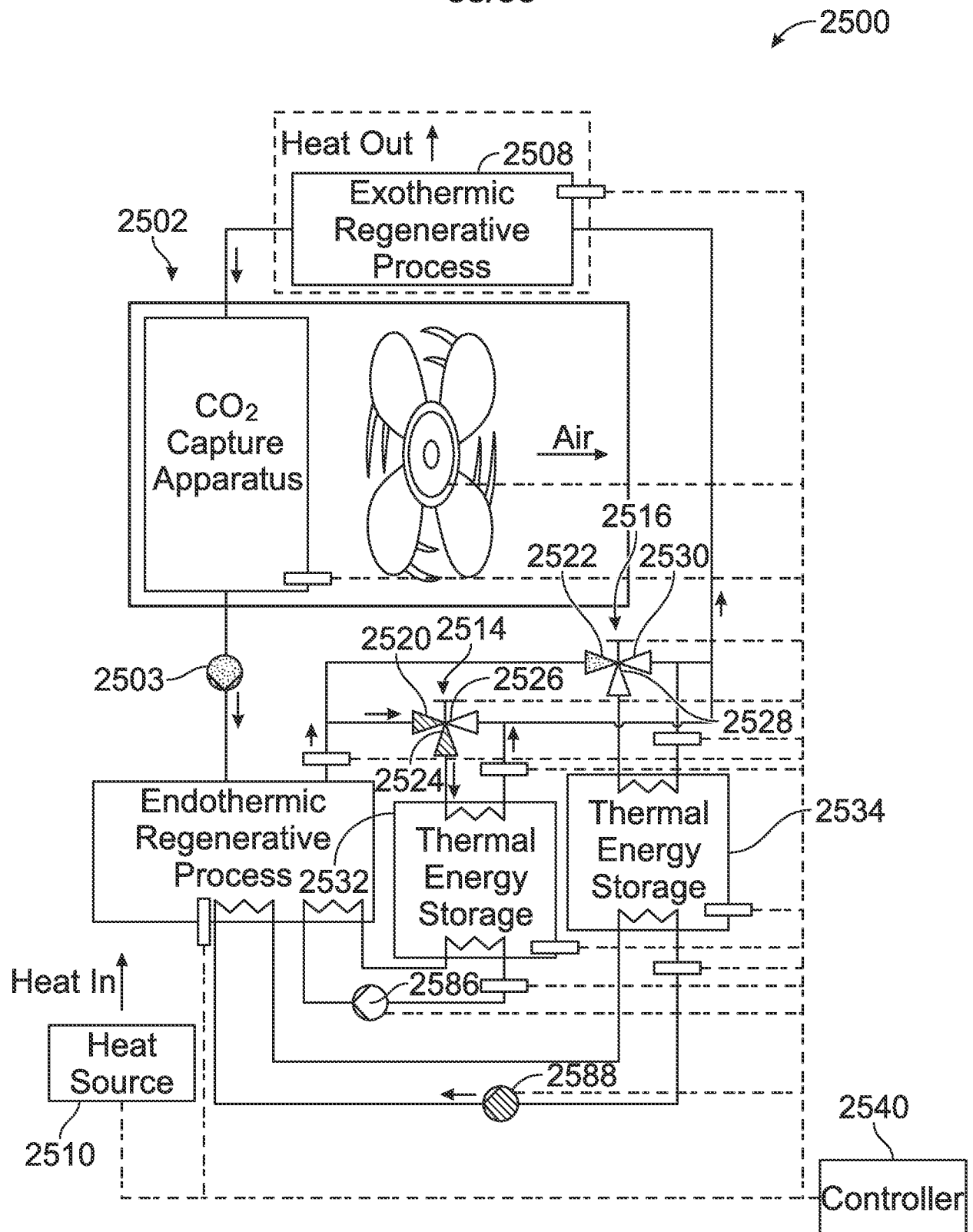


FIG. 41

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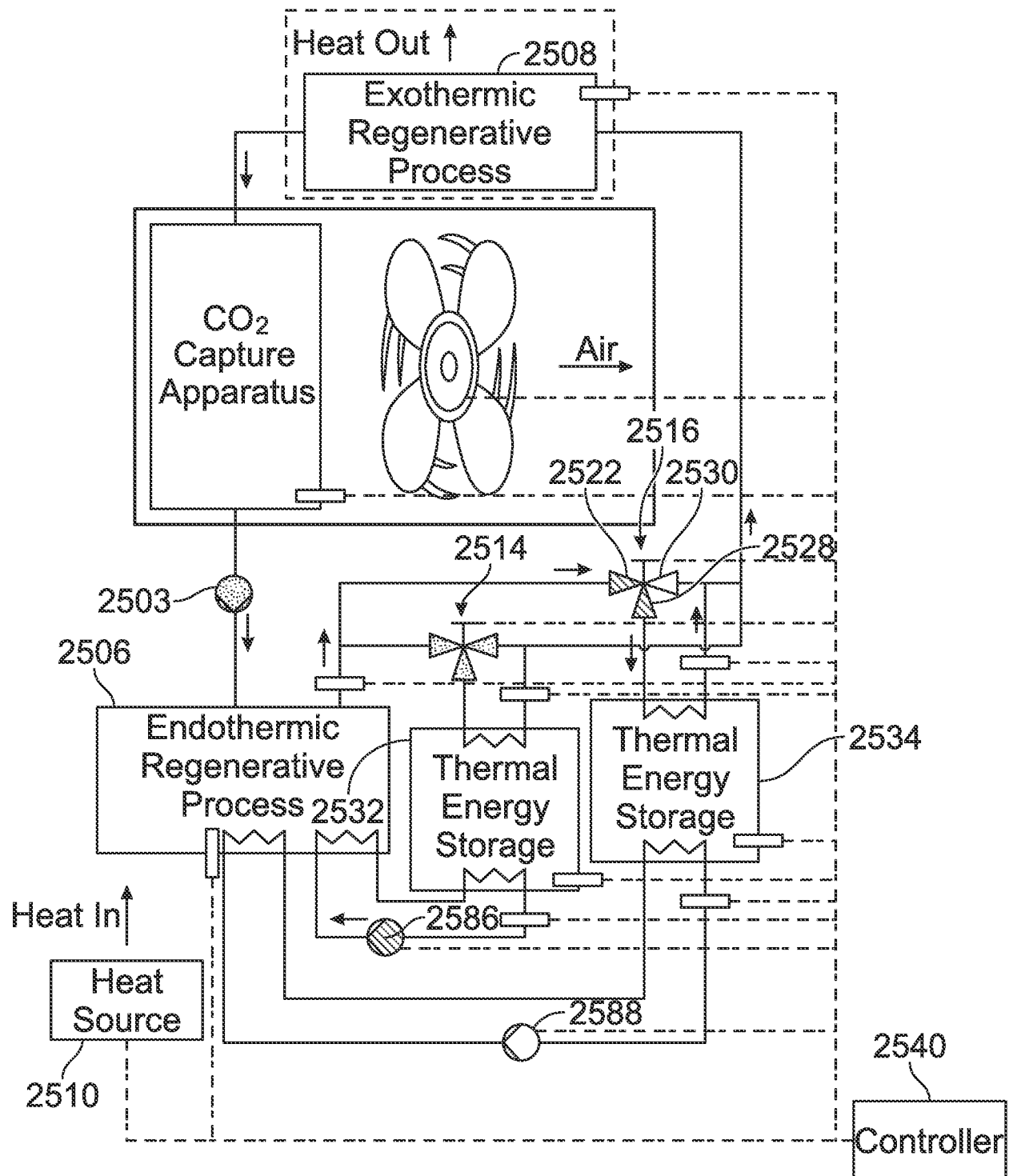


FIG. 42

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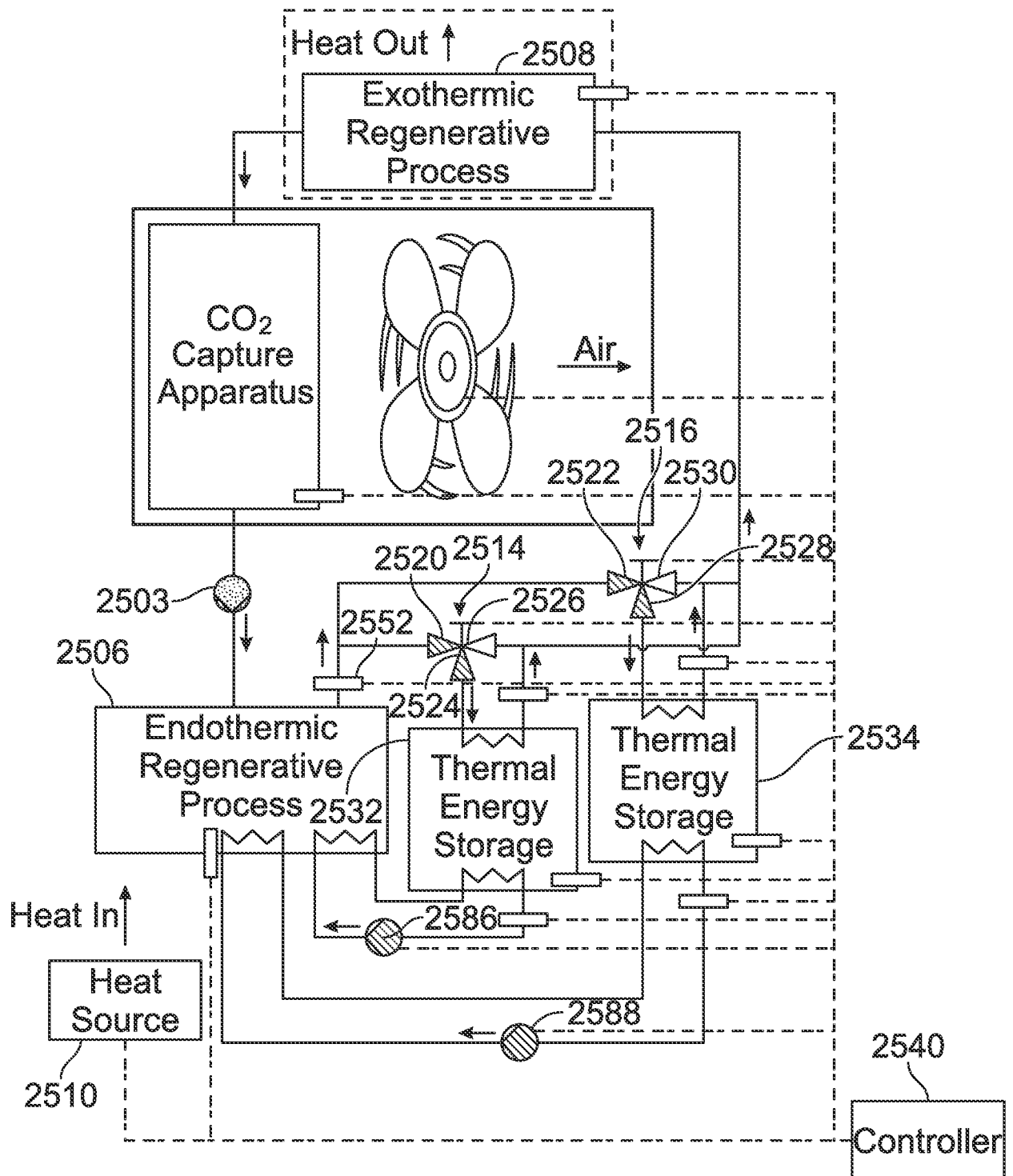


FIG. 43

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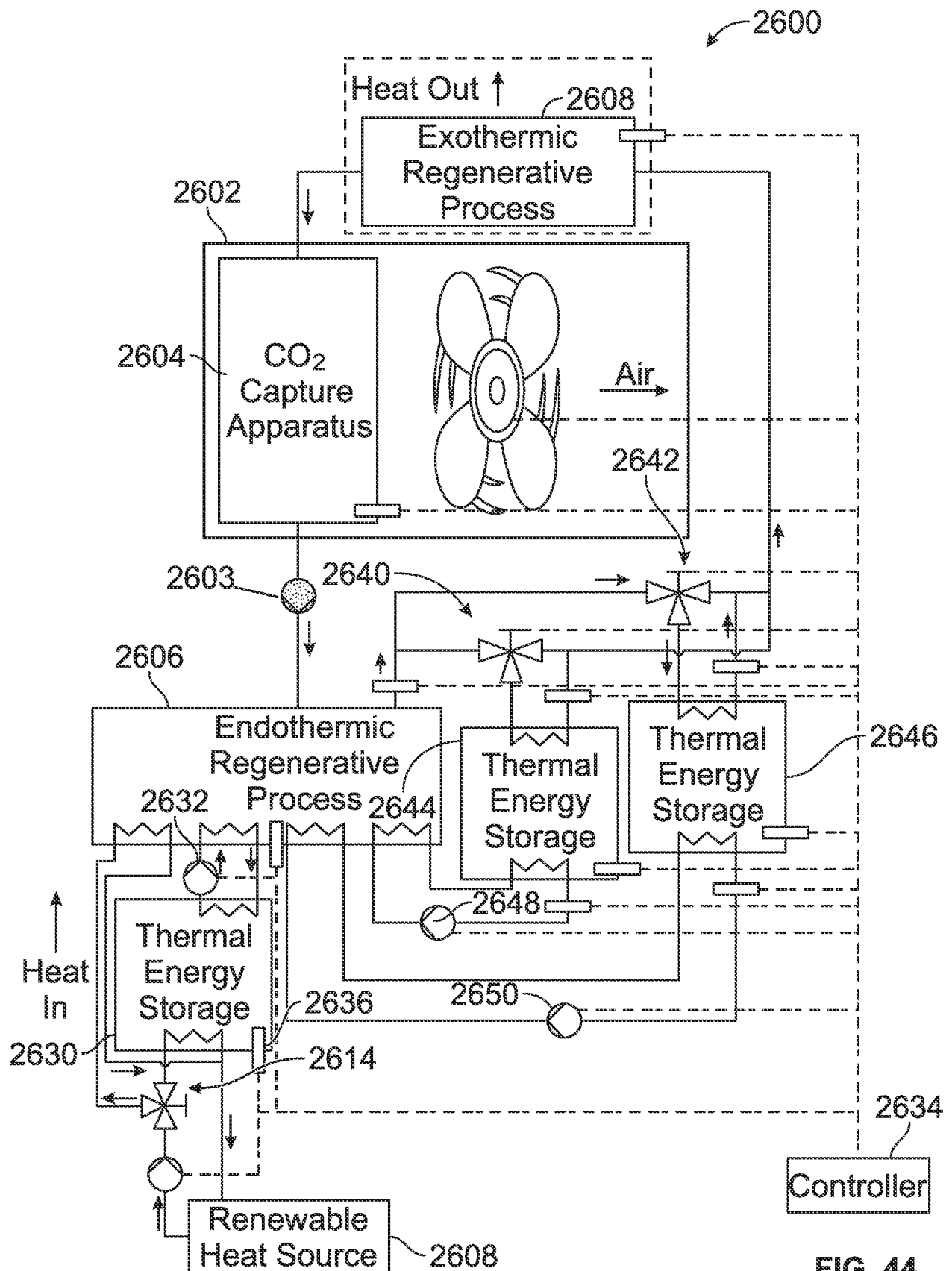
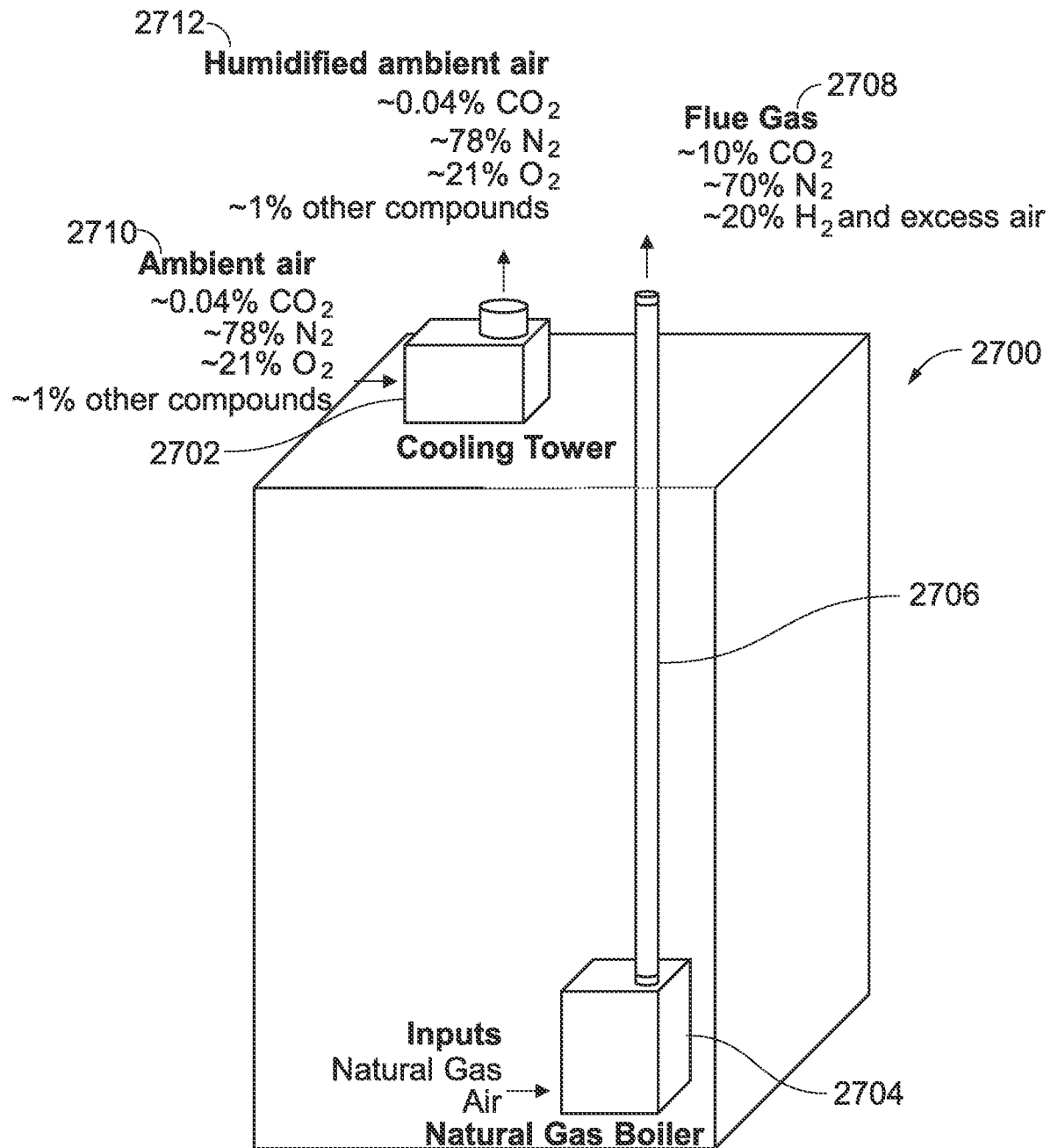


FIG. 44

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Existing building with cooling tower and natural gas boiler

FIG. 45

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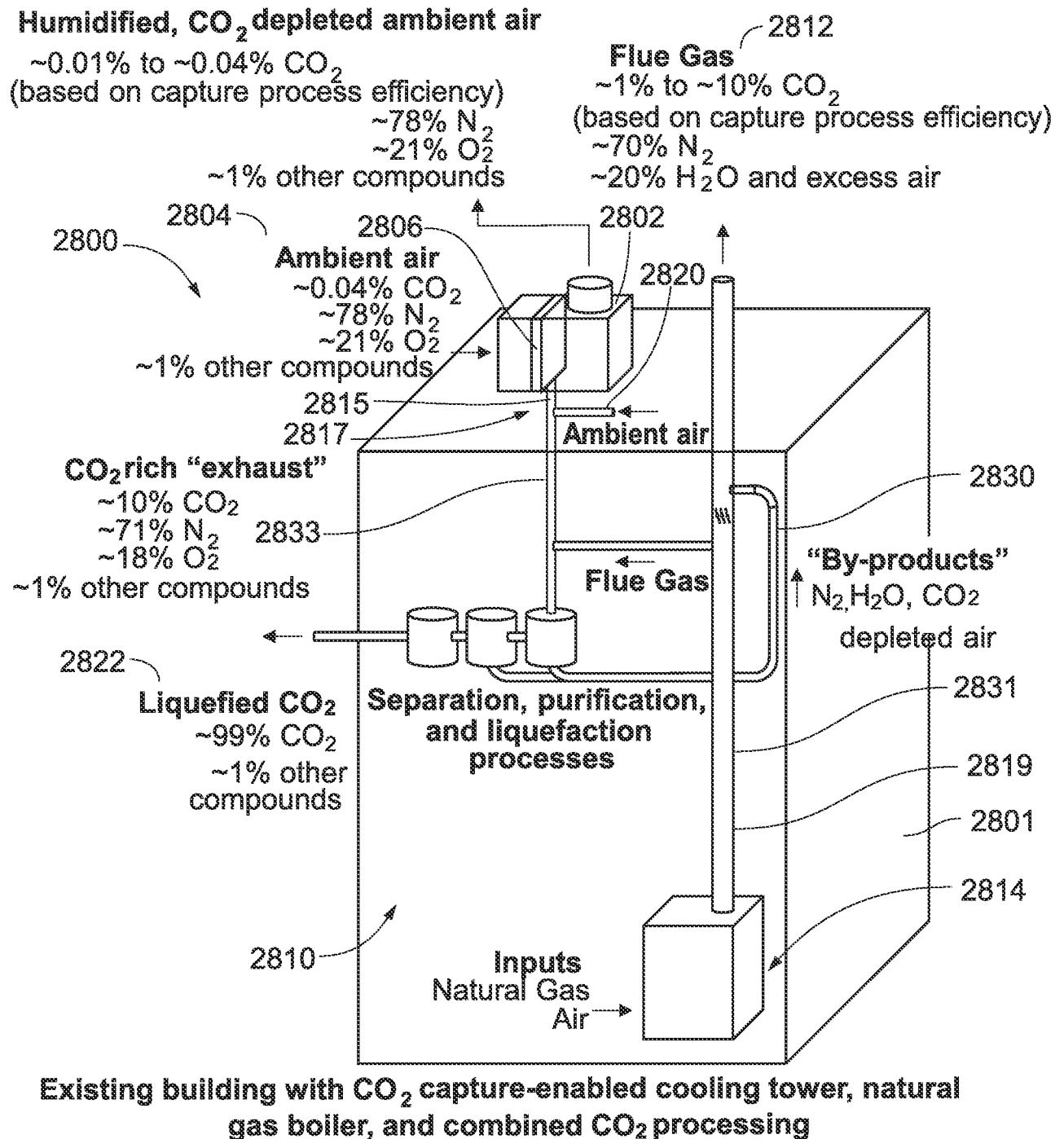


FIG. 46

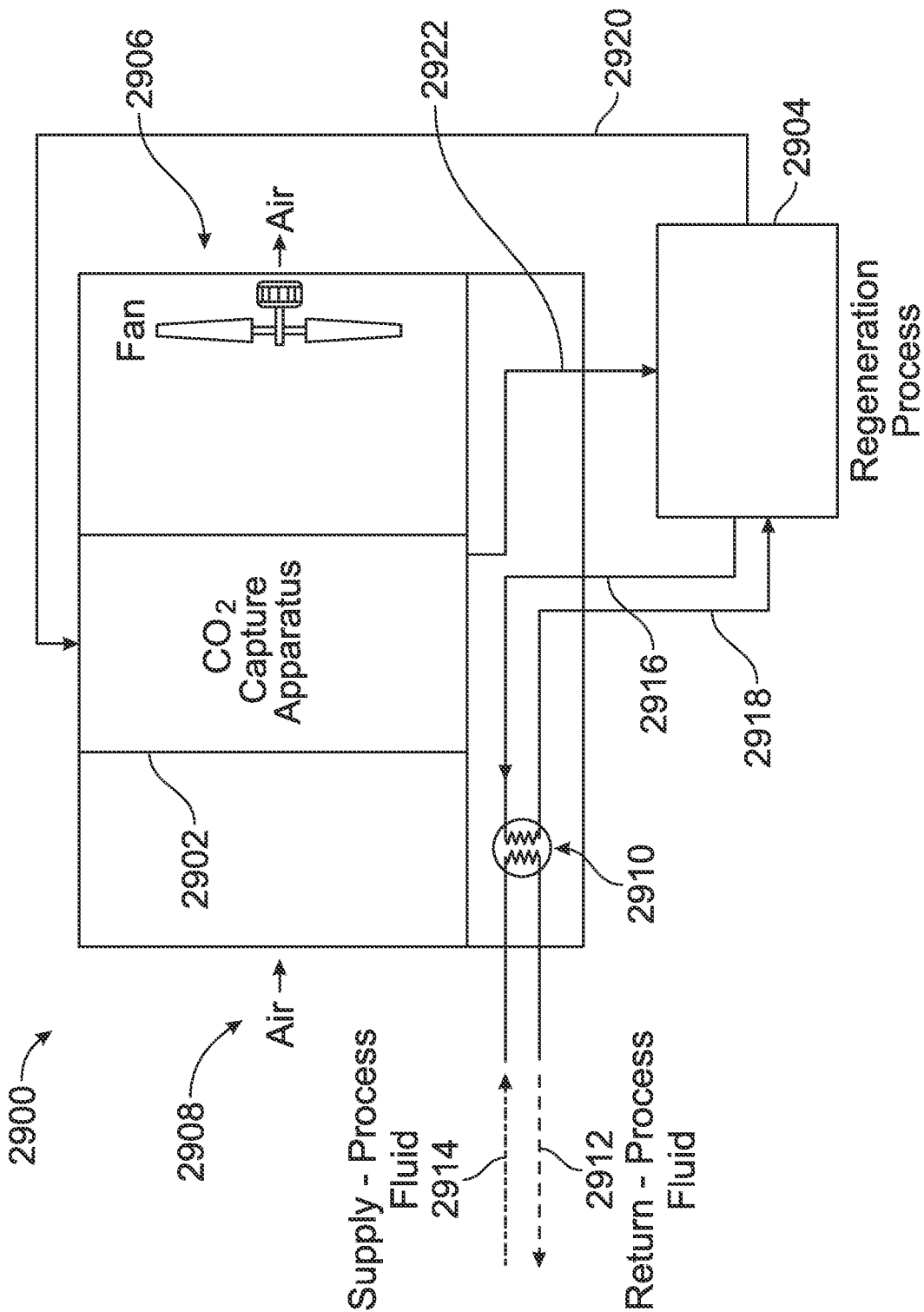


FIG. 47

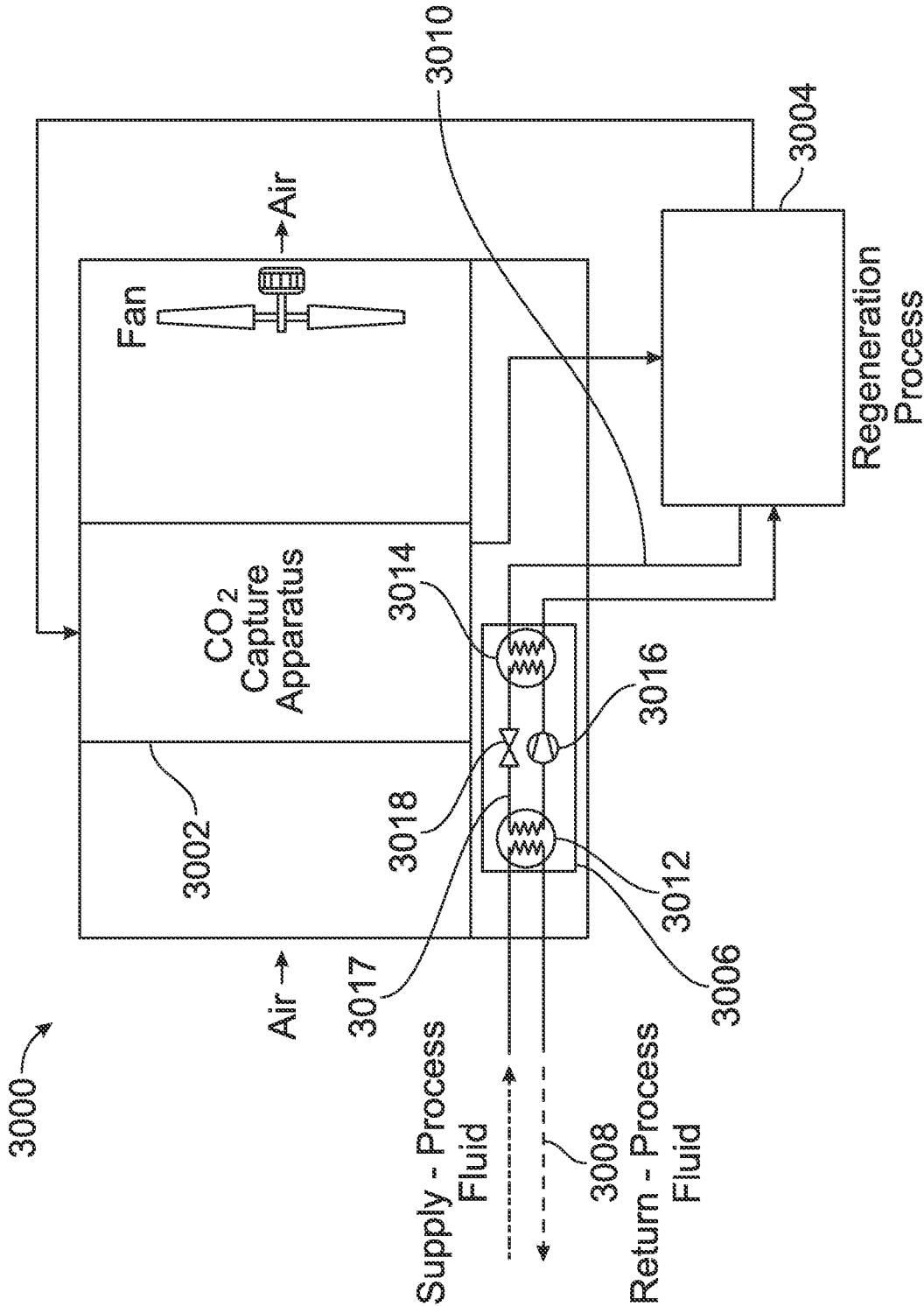


FIG. 48

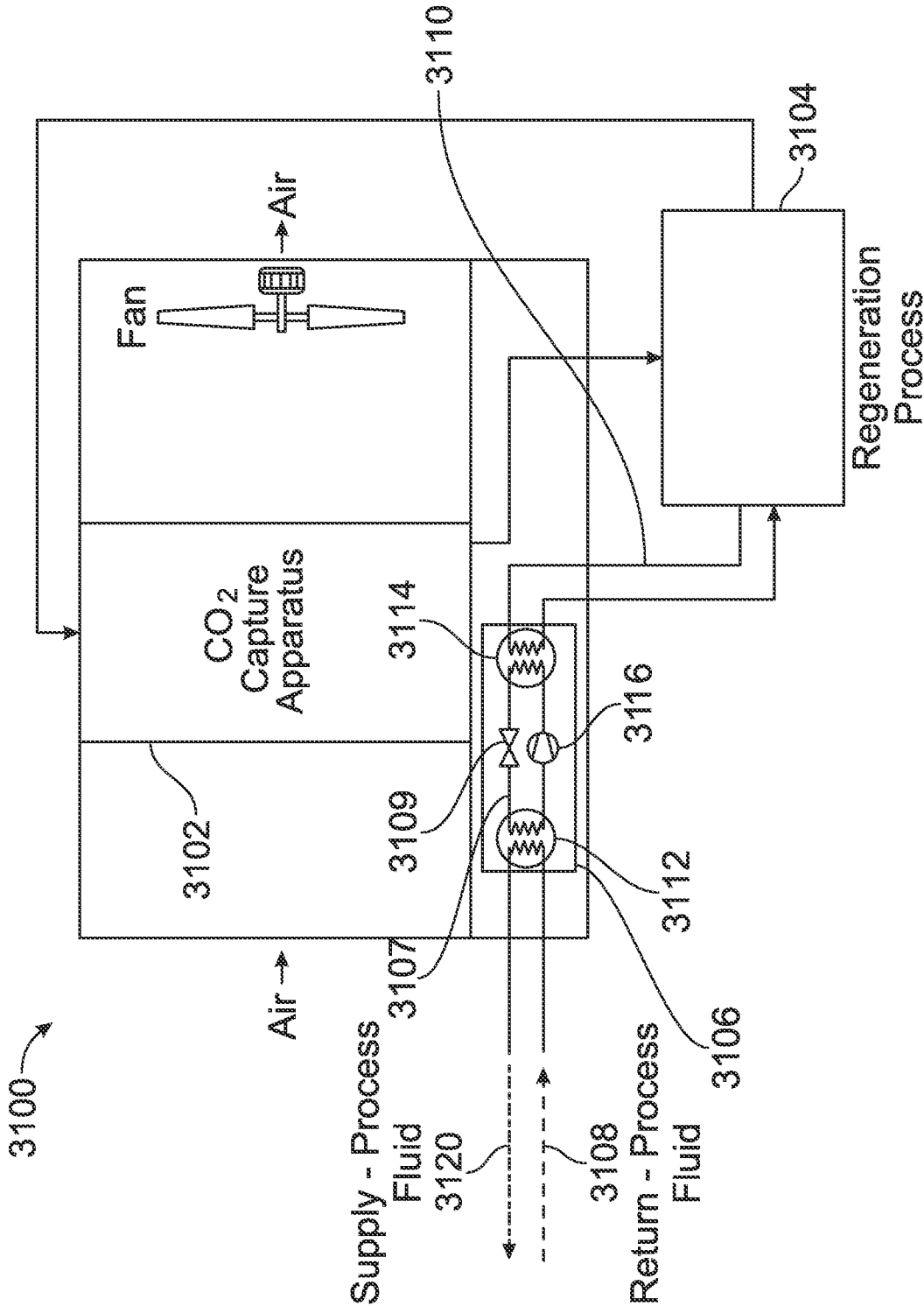


FIG. 49

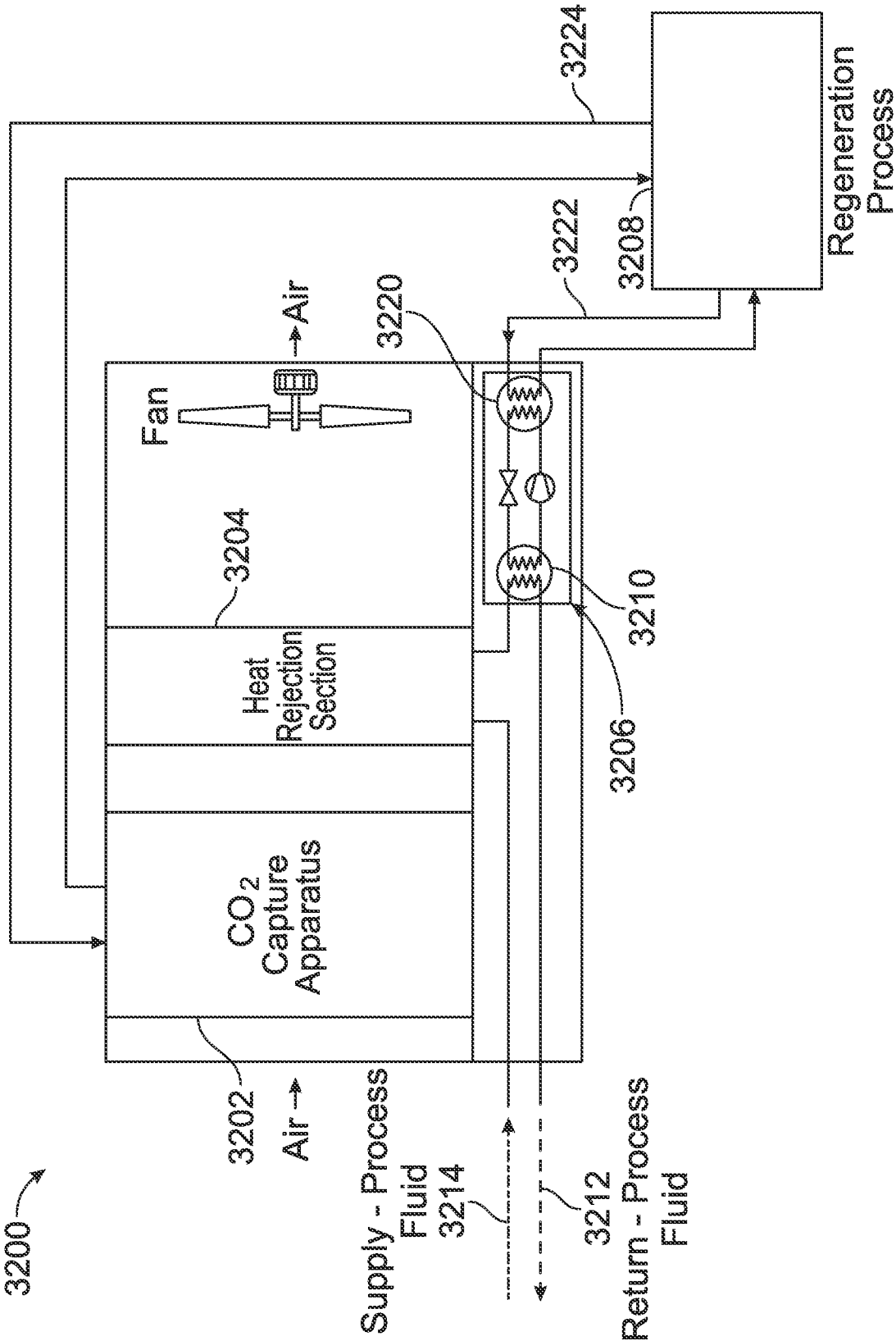


FIG. 50

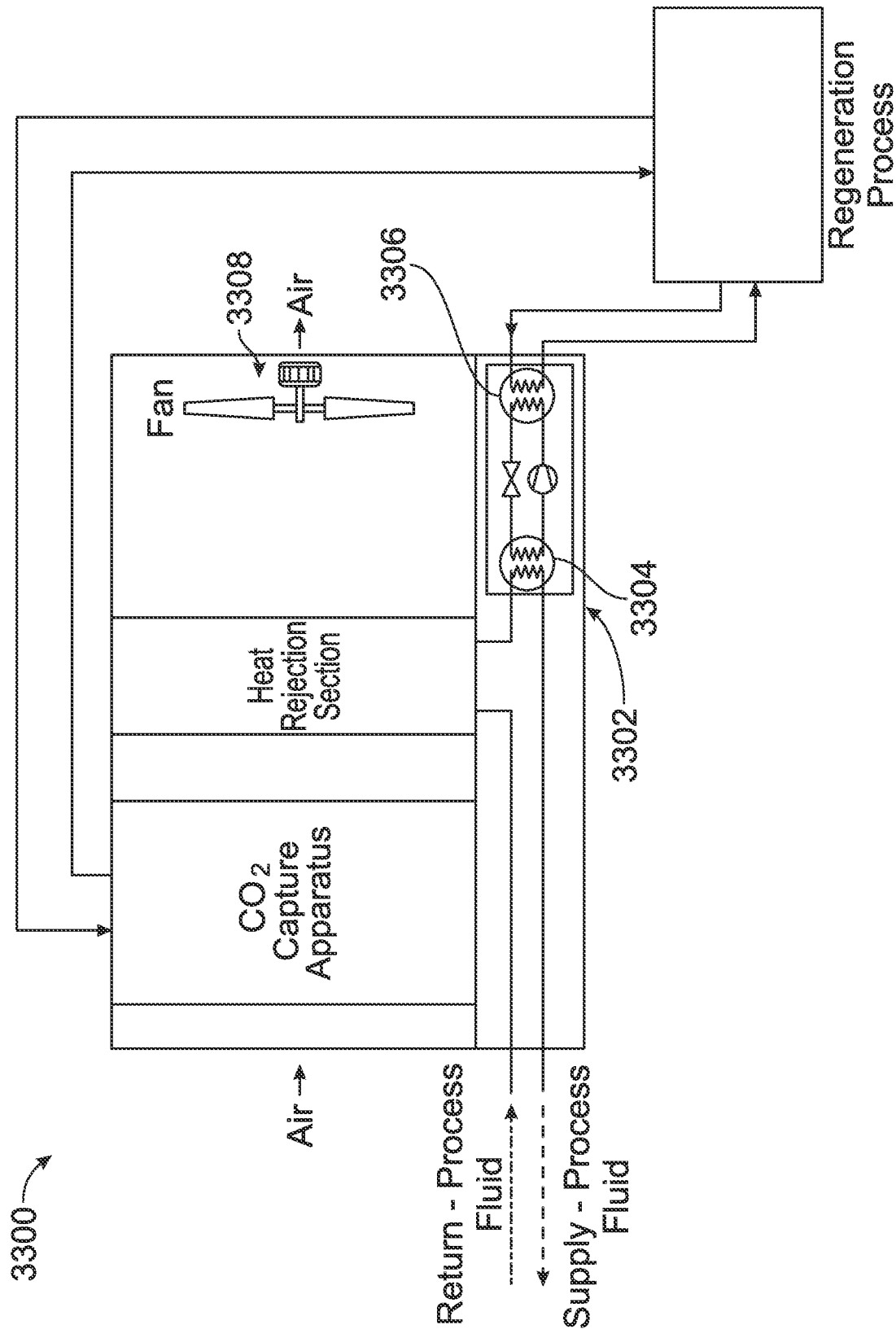


FIG. 51

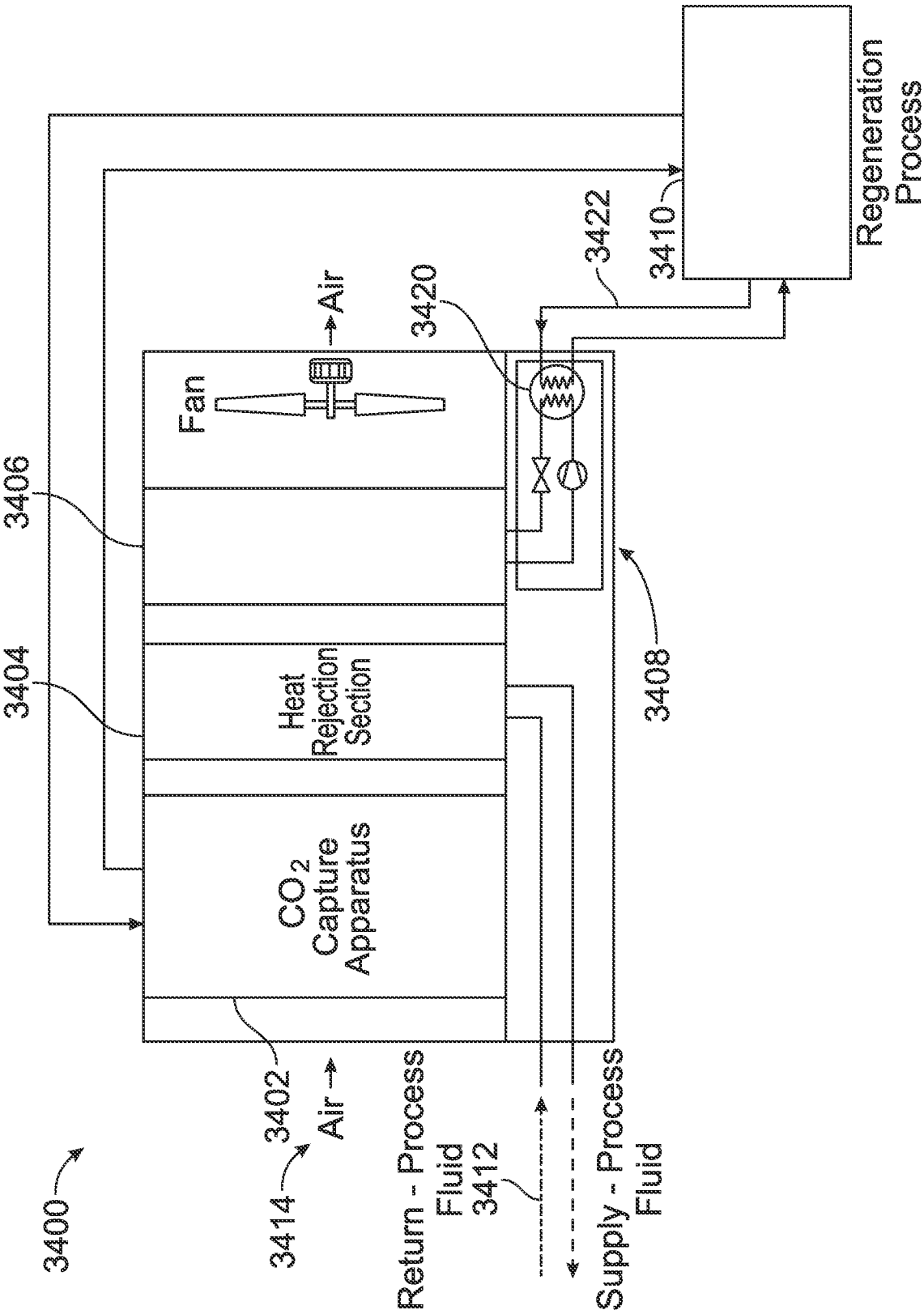


FIG. 52

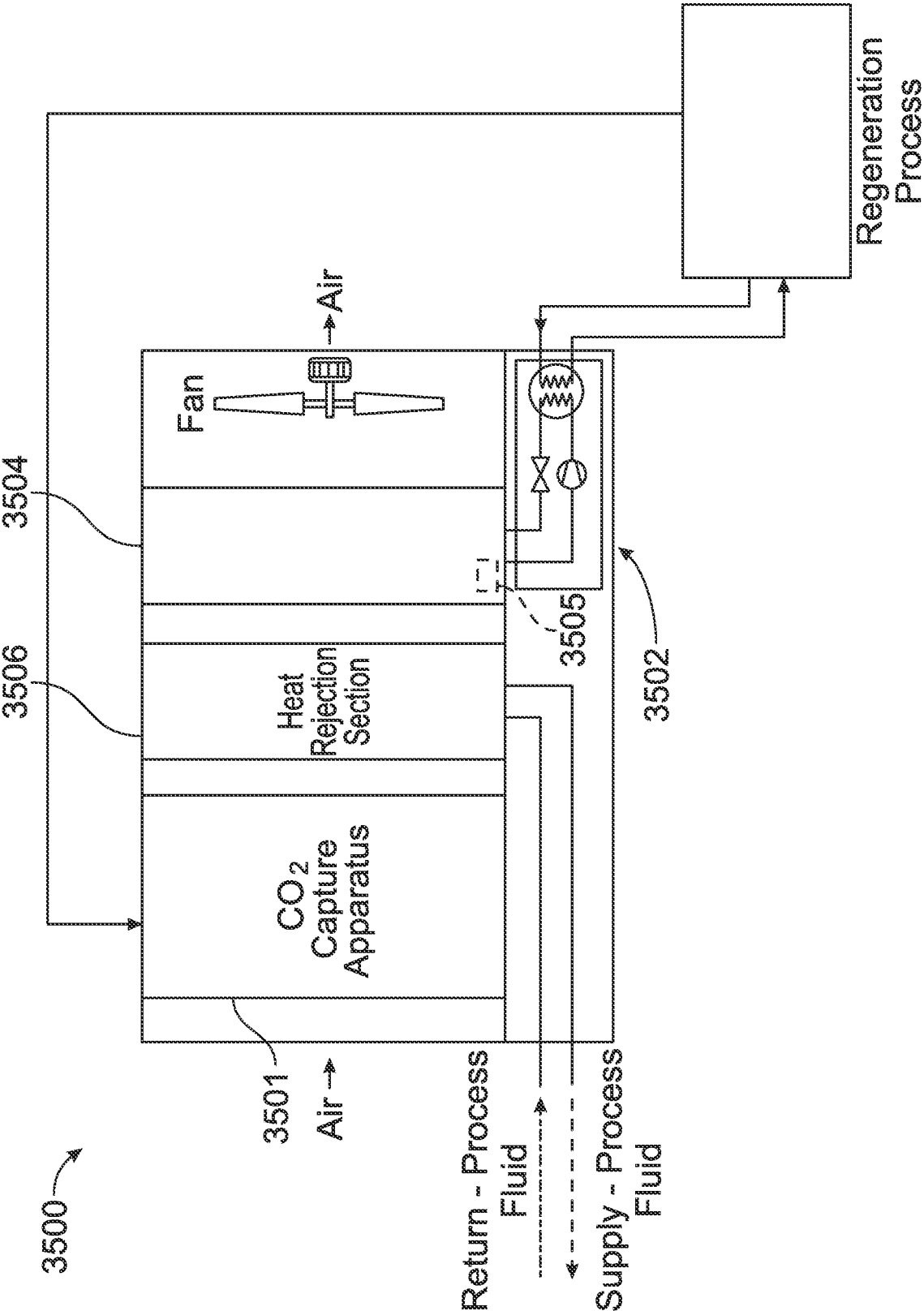


FIG. 53

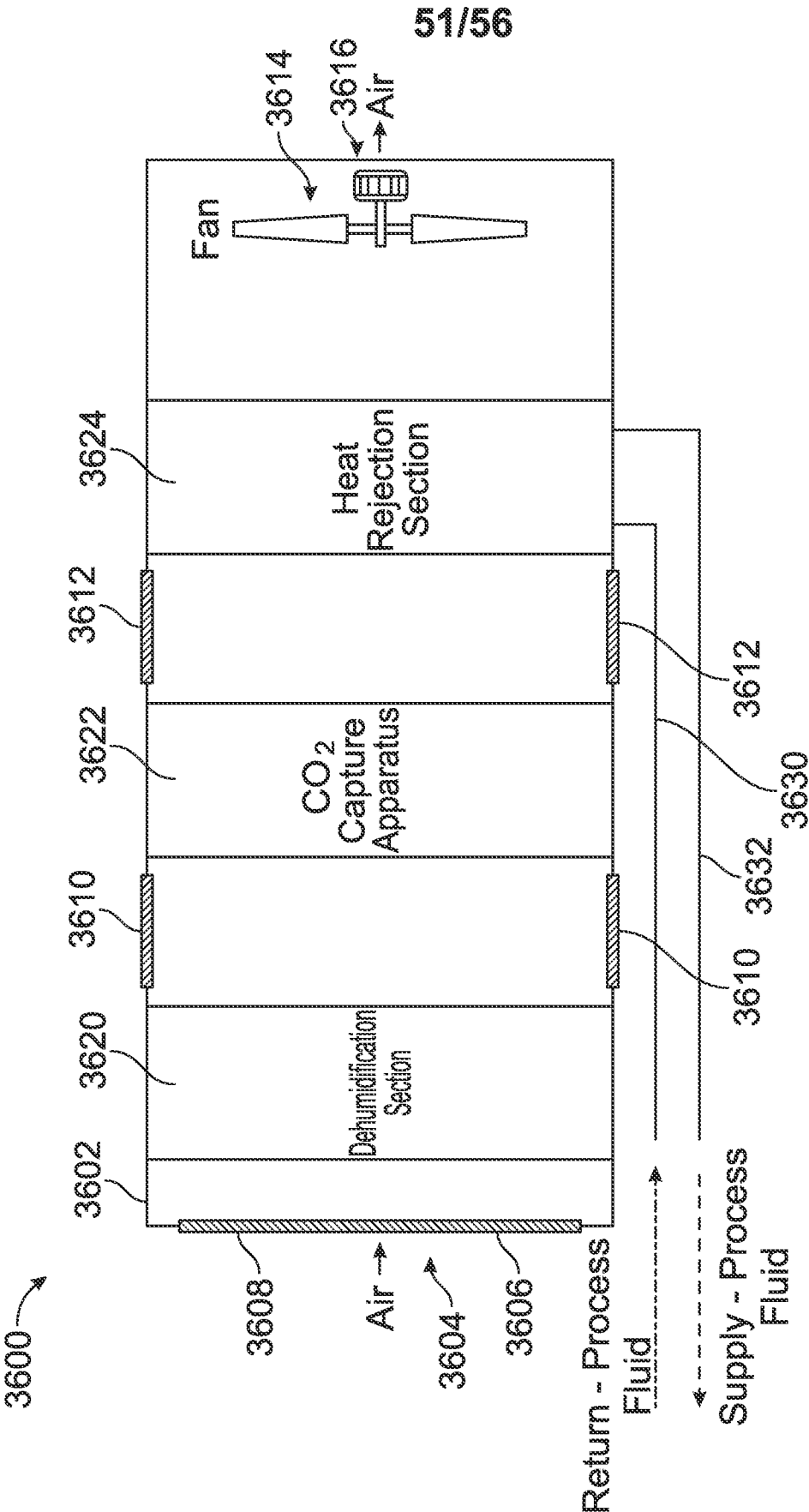


FIG. 54

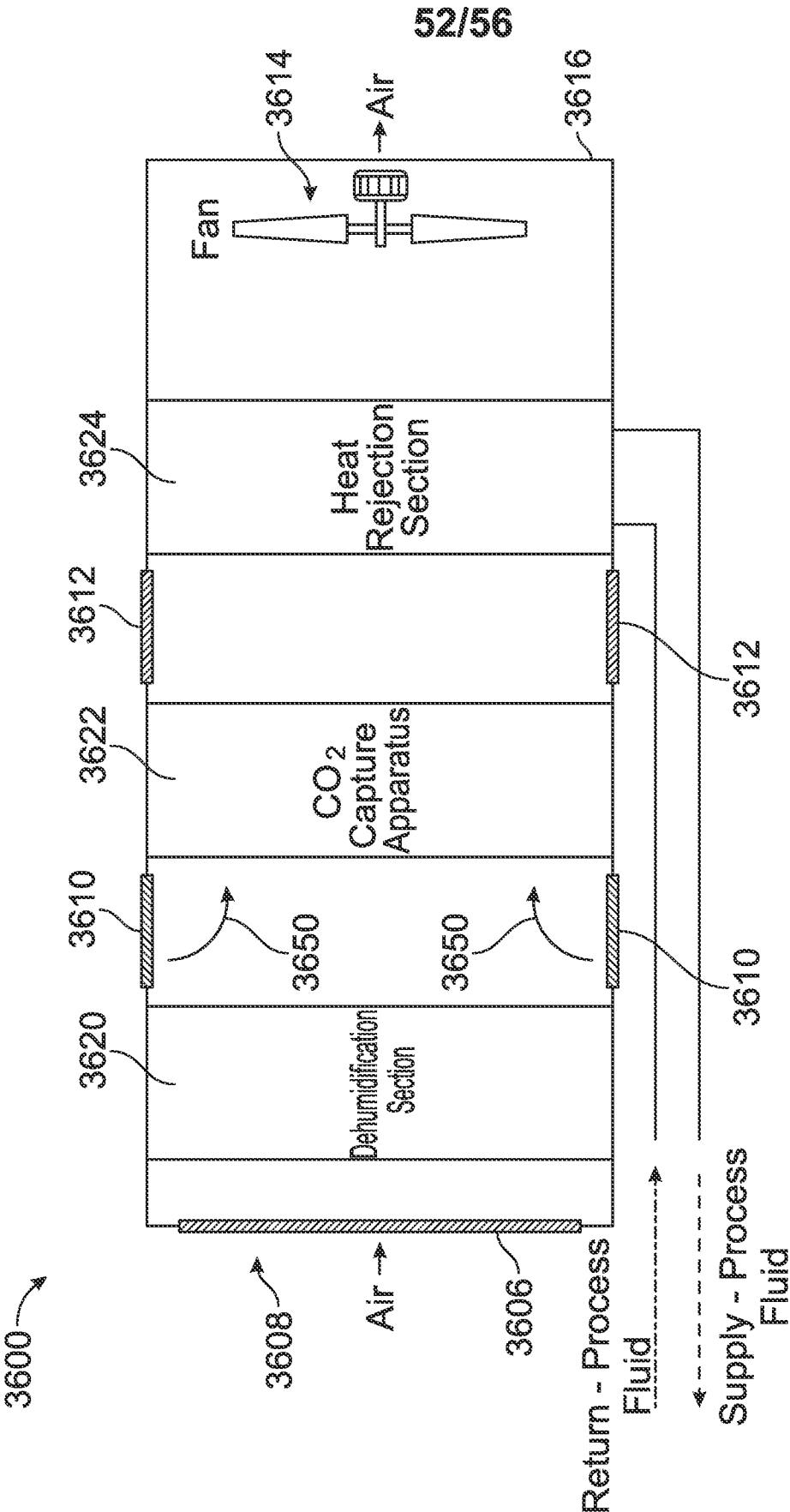


FIG. 55

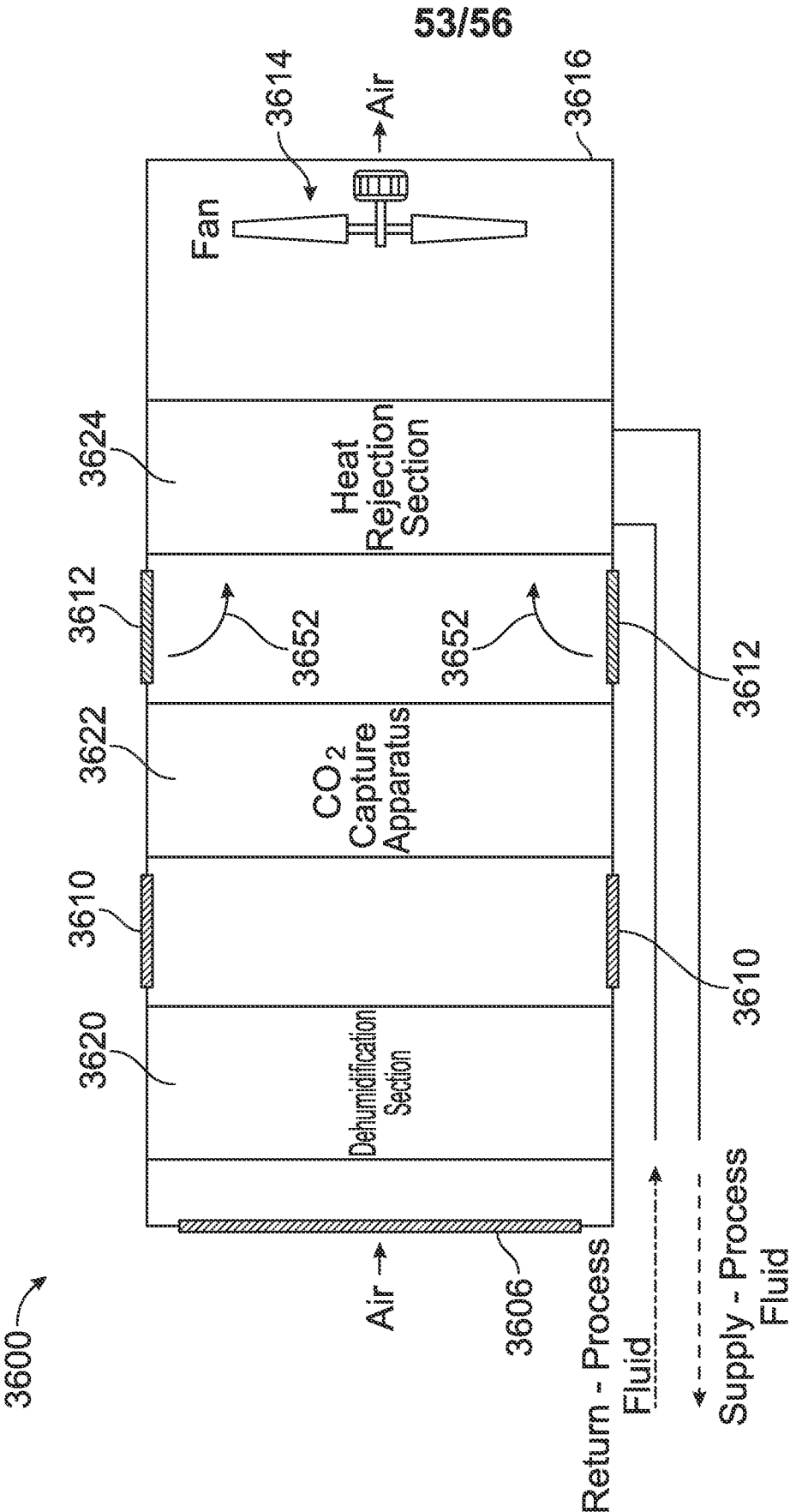


FIG. 56

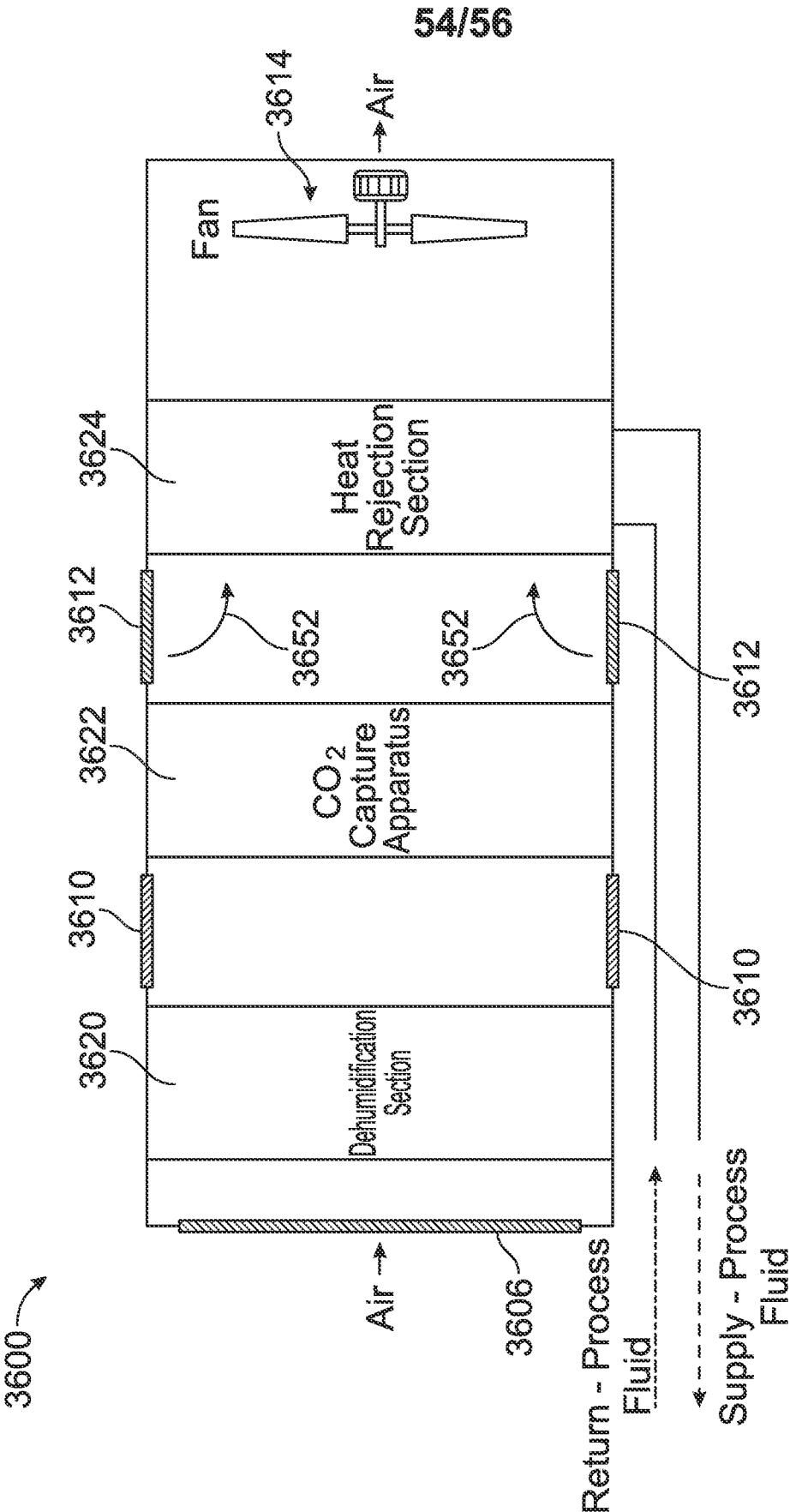


FIG. 57

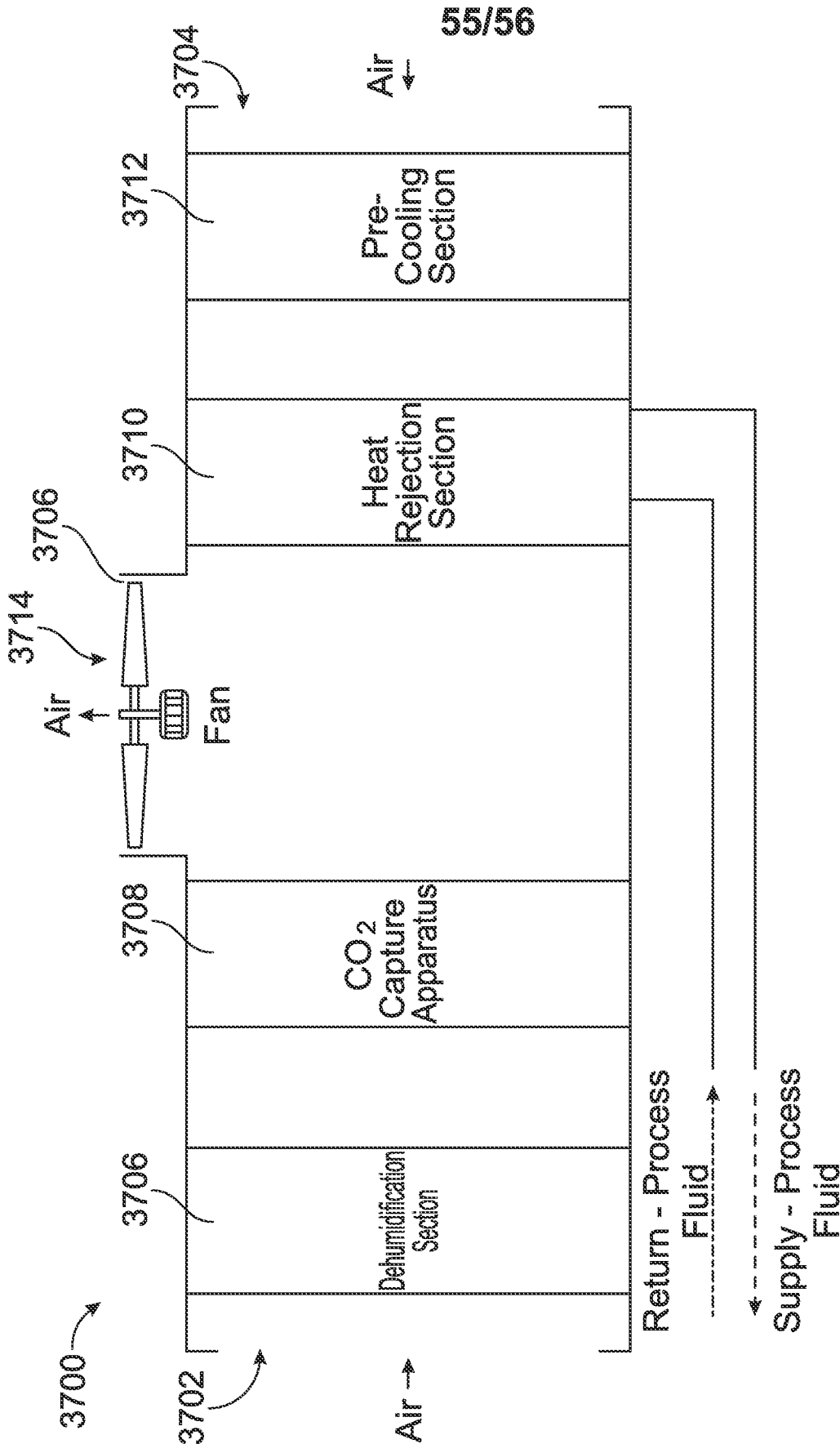
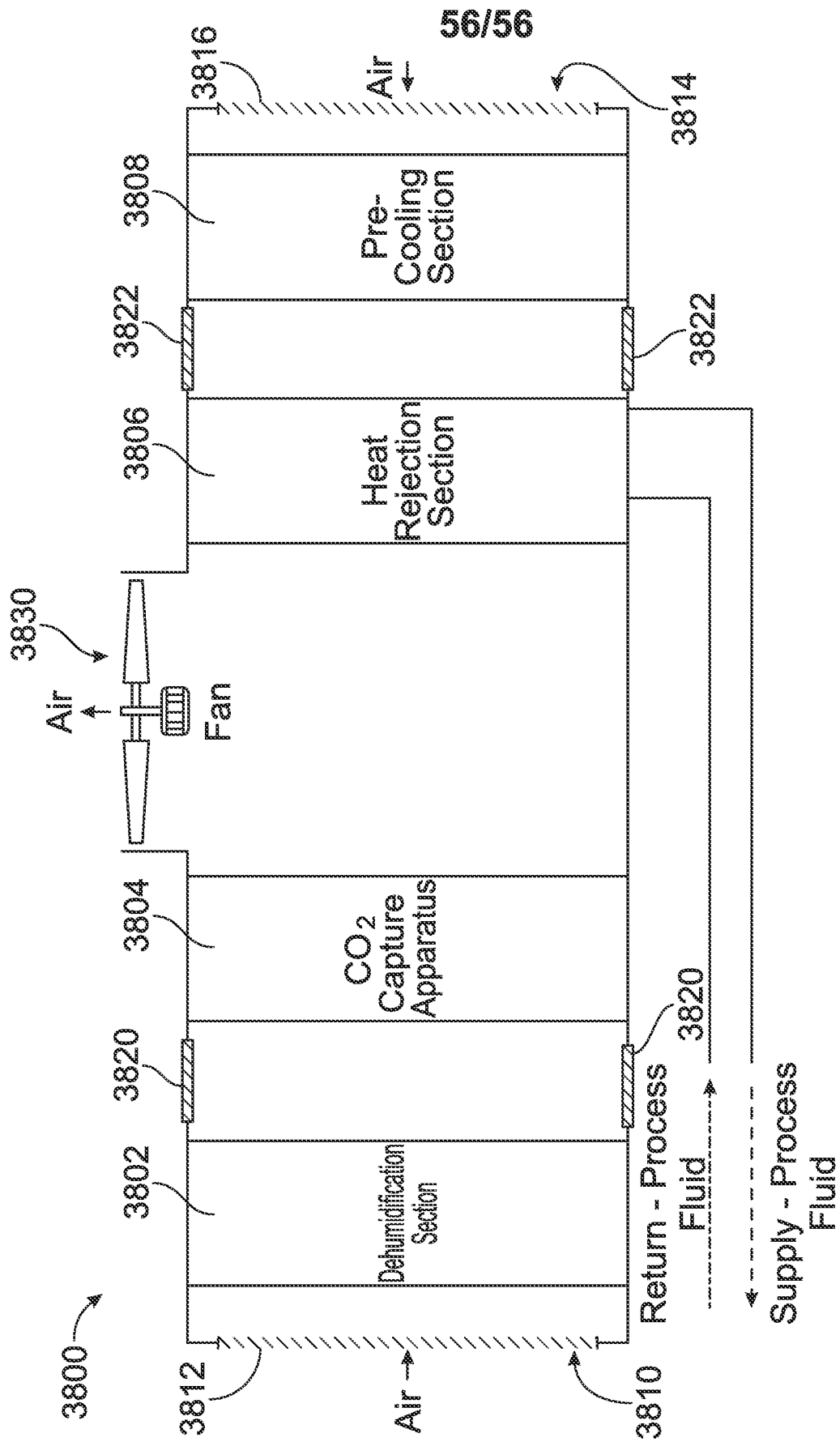


FIG. 58



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INTERNATIONAL SEARCH REPORT

International application No.

PCT/US 23/28602

A. CLASSIFICATION OF SUBJECT MATTER

IPC - INV. B01D 46/44, F28C 1/14 (2023.01)

ADD. B01D 46/00 (2023.01)

CPC - INV. B01D 46/44, B01D 47/024, B01D 53/025, B01D 46/0028, B01D 46/0036, B01D 53/1475, F28C 1/14

ADD. B01D 46/00, B01D 53/0423, B01D 53/0438, B01D 53/1425, B01D 2258/06

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

See Search History document

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

See Search History document

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

See Search History document

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X --- Y --- A	US 2020/0208887 A1 (Johnson Controls Technology Company) 02 July 2020 (02.07.2020), entire document, especially Fig 5-6; para [0031]; para [0047]-[0048]; para [0053]; para [0055]-[0056]; para [0058]-[0059]	1-4, 7, 11, 17-19, 22-23, 26-27 ----- 20-21, 28-29 ----- 5-6, 8-10, 12-16, 24-25
Y --- A	US 2022/0178619 A1 (Baltimore Aircoil Company, Inc.) 09 June 2022 (09.06.2022), entire document, especially Fig 4; para [0092]; para [0106]; para [0152]	20-21, 28-29 ----- 5-6, 8, 25
A	US 2020/0346165 A1 (8 Rivers Capital, LLC) 05 November 2020 (05.11.2020), entire document, especially Fig	10, 12-13, 14
A	US 2017/0082370 A1 (Frigel Firenze S.P.A.) 23 March 2017 (23.03.2017), entire document	1-29

☐ Further documents are listed in the continuation of Box C.☐ See patent family annex.

* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

"D" document cited by the applicant in the international application

"E" earlier application or patent but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

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"&" document member of the same patent family

Date of the actual completion of the international search

06 October 2023

Date of mailing of the international search report

JAN 26 2024

Name and mailing address of the ISA/US

Mail Stop PCT, Attn: ISA/US, Commissioner for Patents
P.O. Box 1450, Alexandria, Virginia 22313-1450

Facsimile No. 571-273-8300

Authorized officer

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INTERNATIONAL SEARCH REPORT

International application No.

PCT/US 23/28602

Box No. II Observations where certain claims were found unsearchable (Continuation of item 2 of first sheet)

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:

2. ☐ Claims Nos.:
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:

3. ☐ Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box No. III Observations where unity of invention is lacking (Continuation of item 3 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

See extra sheet

1. ☐ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.
2. ☐ As all searchable claims could be searched without effort justifying additional fees, this Authority did not invite payment of additional fees.
3. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:
4. ☒ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:
1-29

Remark on Protest

- ☐ The additional search fees were accompanied by the applicant's protest and, where applicable, the payment of a protest fee.
- ☐ The additional search fees were accompanied by the applicant's protest but the applicable protest fee was not paid within the time limit specified in the invitation.
- ☐ No protest accompanied the payment of additional search fees.

INTERNATIONAL SEARCH REPORT

International application No.

PCT/US 23/28602

-*- Continuation of Box No. III – Observations where unity of invention is lacking (Continuation of item 3 of first sheet) -*-

This application contains the following inventions or groups of inventions which are not so linked as to form a single general inventive concept under PCT Rule 13.1. In order for all inventions to be searched, the appropriate additional search fees must be paid.

Group I: Claims 1-29, directed to an air contractor having a heat exchanger.

Group II: Claims 30-56 directed to an air contractor having a fluid regeneration apparatus.

The inventions listed as Groups I-II do not relate to a single general inventive concept under PCT Rule 13.1 because, under PCT Rule 13.2, they lack the same or corresponding special technical features for the following reasons:

SPECIAL TECHNICAL FEATURES

The invention of Group I includes the special technical feature of an air contractor having a heat exchanger operable to transfer heat between a process fluid and an airflow; an air pollutant capture system having an air pollutant capture medium with an affinity for the air pollutant to remove the air pollutant from the airflow;

a controller operatively connected to the fan assembly, heat exchanger, the controller having:
a process fluid cooling and air pollutant capture mode wherein the controller is configured to: control the fan assembly to facilitate the heat exchanger transferring heat between the process fluid and the airflow; and
a process fluid cooling mode wherein the controller is configured to:
control the fan assembly to facilitate the heat exchanger transferring heat between the process fluid and the airflow; and control the air pollutant capture system to remove less of the air pollutant from the air than when the controller is in the process fluid cooling and air pollutant capture mode, not required by the claims of Group II.

The invention of Group II includes the special technical feature of an air contractor having an air pollutant capture system having an air pollutant capture apparatus which transfers an air pollutant from an airflow and to a fluid; and has a fluid regeneration apparatus configured to utilize heat from a heat source to remove the air pollutant from the fluid; and a thermal energy storage operable to either receive heat from the fluid or provide heat to the fluid regeneration apparatus;

the air pollutant capture system having:
a regeneration and charging mode wherein the fluid regeneration apparatus receives heat from the heat source, the fluid regeneration apparatus removes the air pollutant from the fluid, and the thermal energy storage receives heat from the fluid; and
a regeneration and discharging mode wherein the fluid regeneration apparatus receives heat from the thermal energy storage and the fluid regeneration apparatus removes the air pollutant from the fluid; and
a controller configured to operate the air pollutant capture system in the regeneration and discharging mode in response to a determination of the air pollutant capture system in the regeneration and discharging mode satisfying an operating criterion, not required by the claims of Group I.

COMMON TECHNICAL FEATURES

Groups I-II share the common technical features of an air contractor having a means to produce an airflow, an air pollutant capture system configured to selectively remove an air pollutant from the airflow, and a controller operatively connected to the air pollutant capture system. However, this shared technical feature does not represent a contribution over prior art as being anticipated by US 2022/0193606 A1 to Carbon Engineering LTd, which discloses an air contractor having a means to produce an airflow (fan 212, Fig 2A), an air pollutant capture system configured to selectively remove an air pollutant from the airflow (packings 206 with capture fluid 214, Fig 2A; "CO₂ capture solution 214 can be distributed from top basins 204 (e.g., through pumping or gravity flow or both) over the packing 206...As the CO₂ capture solution 214 flows through and over the packing 206, CO₂-laden gas is circulated (e.g., by operating a fan 212) through the packing 206 to contact the CO₂ capture solution 214. A mixed fluid is formed by contacting the fluids and at least a portion of CO₂ within the CO₂-laden gas is absorbed by the CO₂ capture solution 214 to yield a CO₂-lean gas" para [00132]), and a controller operatively connected to the air pollutant capture system (controller 1000, Fig 10; para [0207]).

As the common technical features were known in the art, these cannot be considered special technical feature that would otherwise unify the groups.

Therefore, Groups I-II lack unity under PCT Rule 13 because they do not share a same or corresponding special technical feature.