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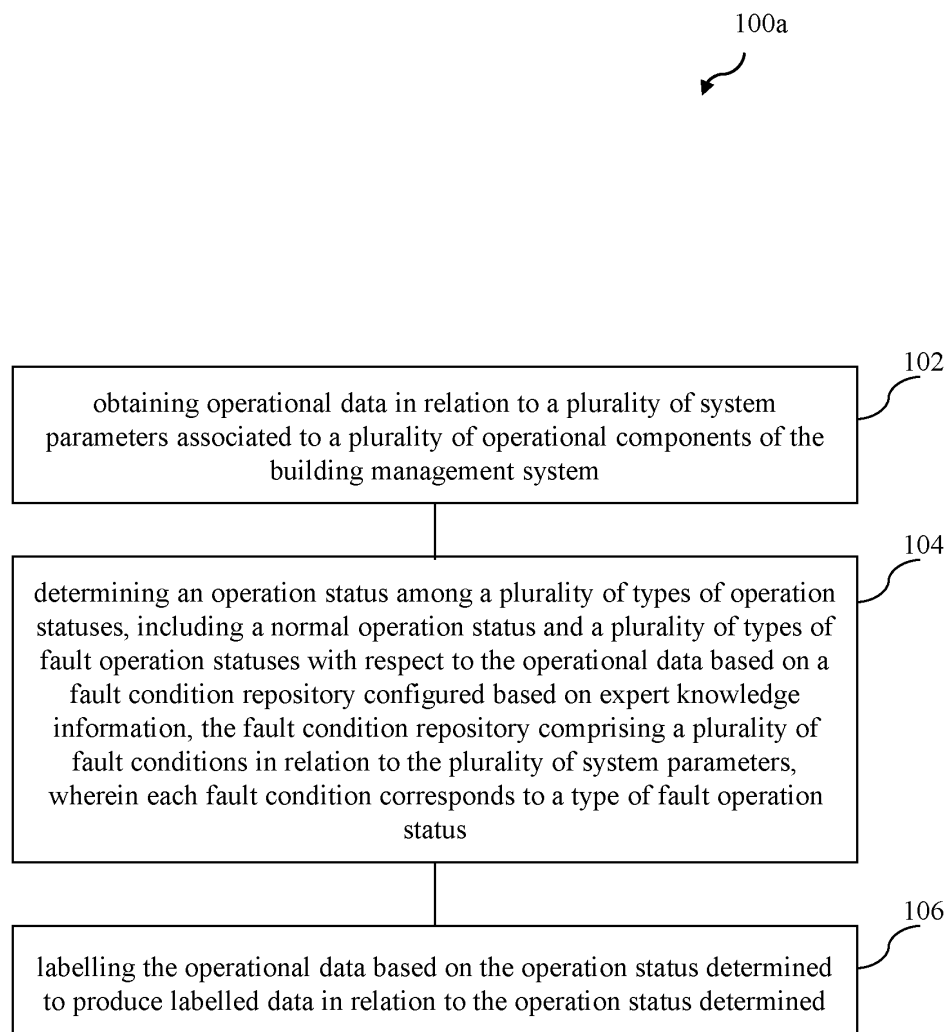


FIG. 1A

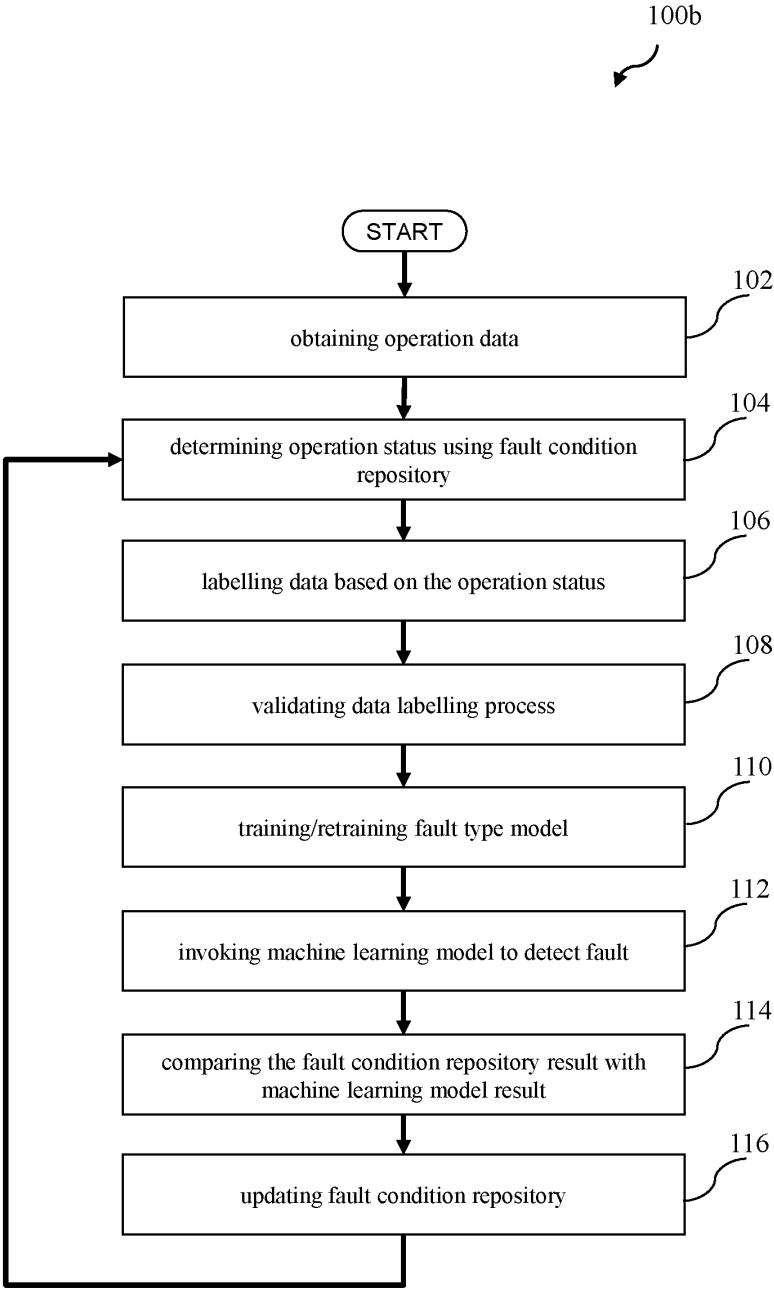


FIG. 1B

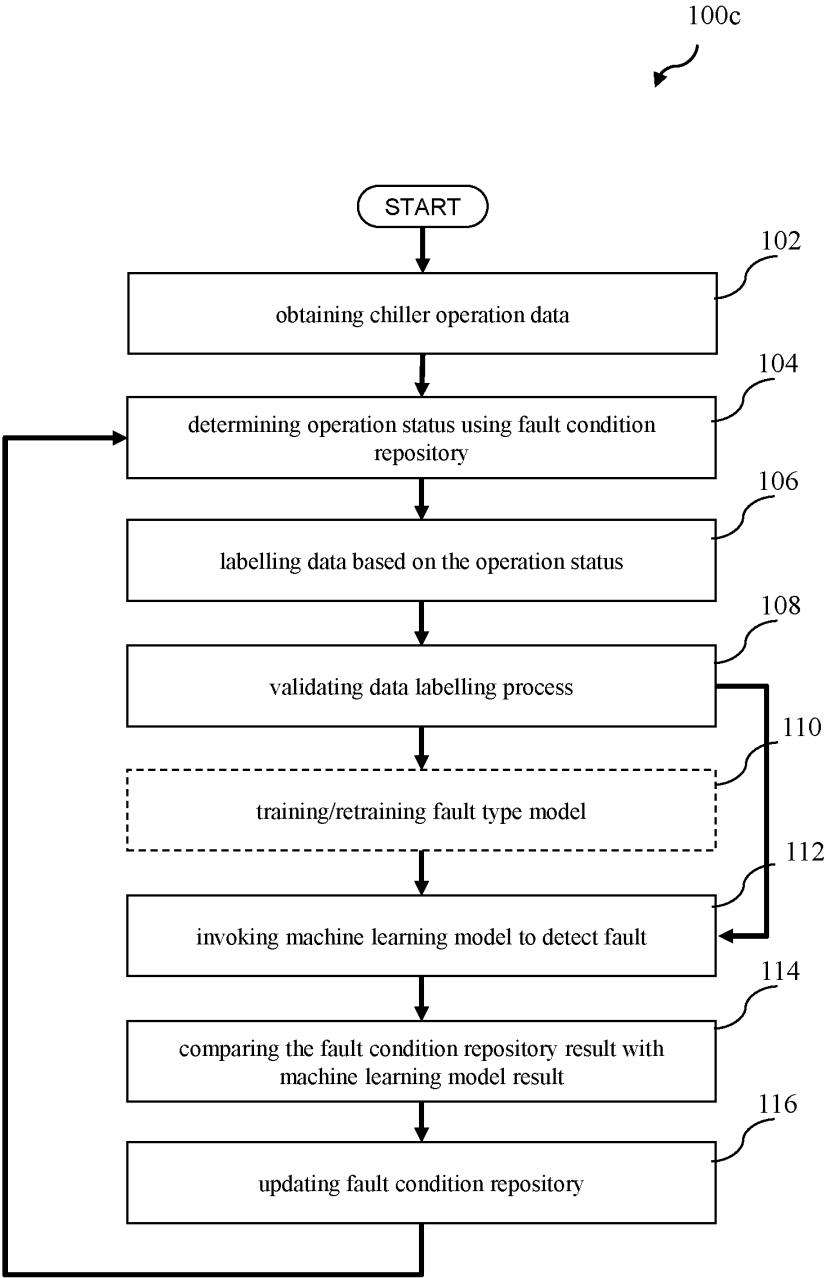


FIG. 1C

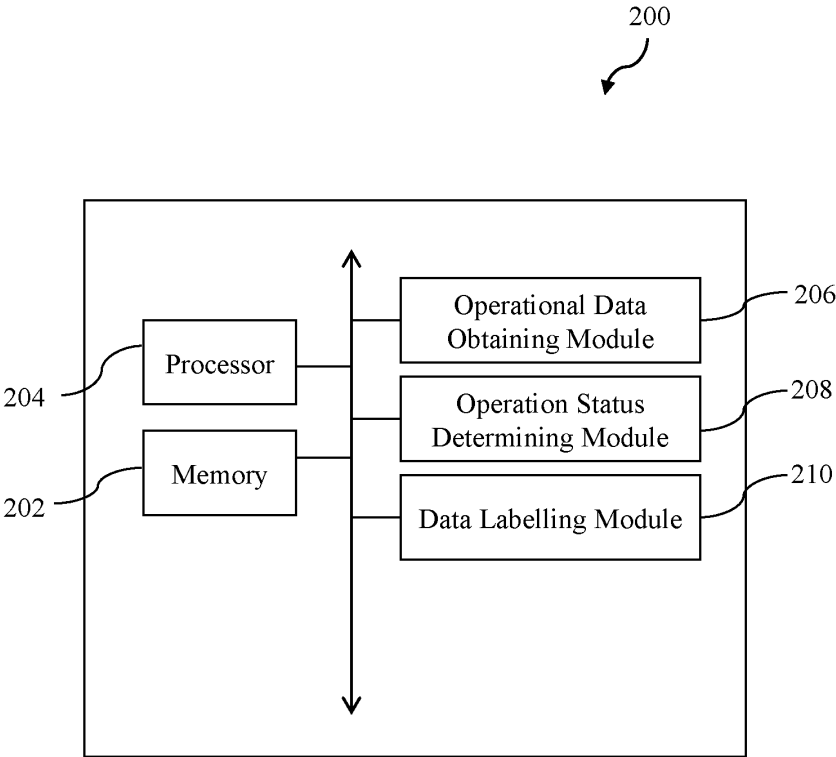


FIG. 2

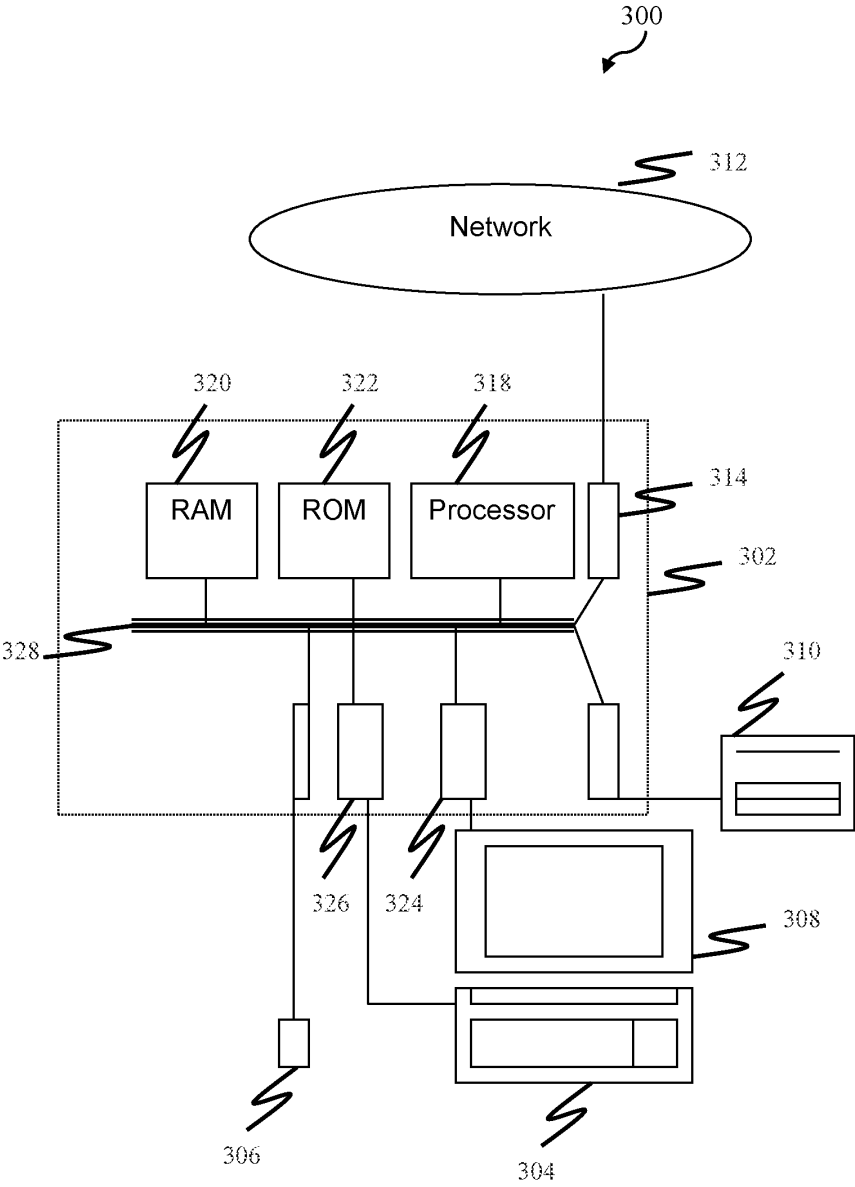


FIG. 3

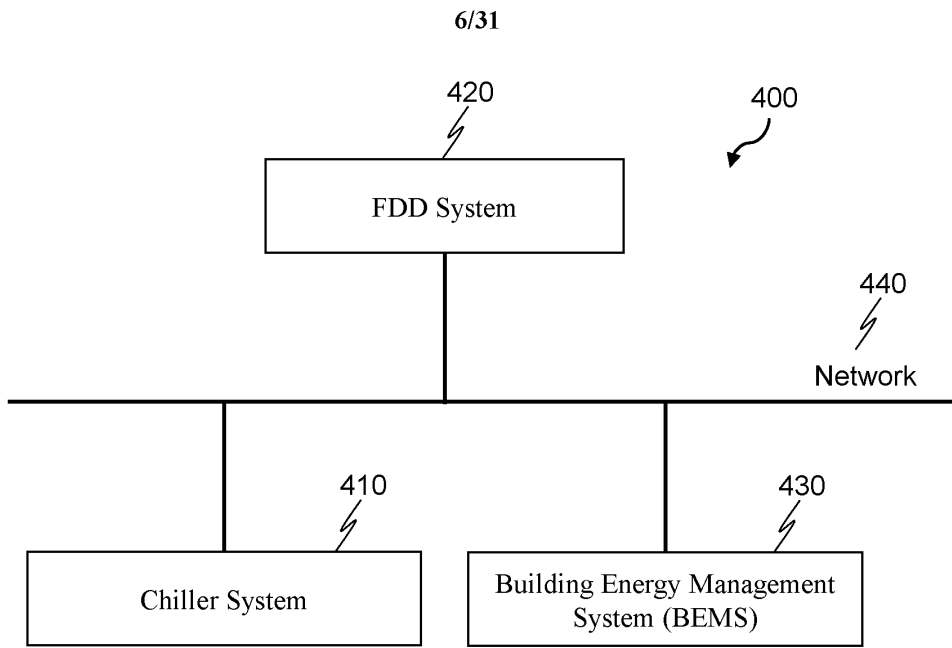


FIG. 4A

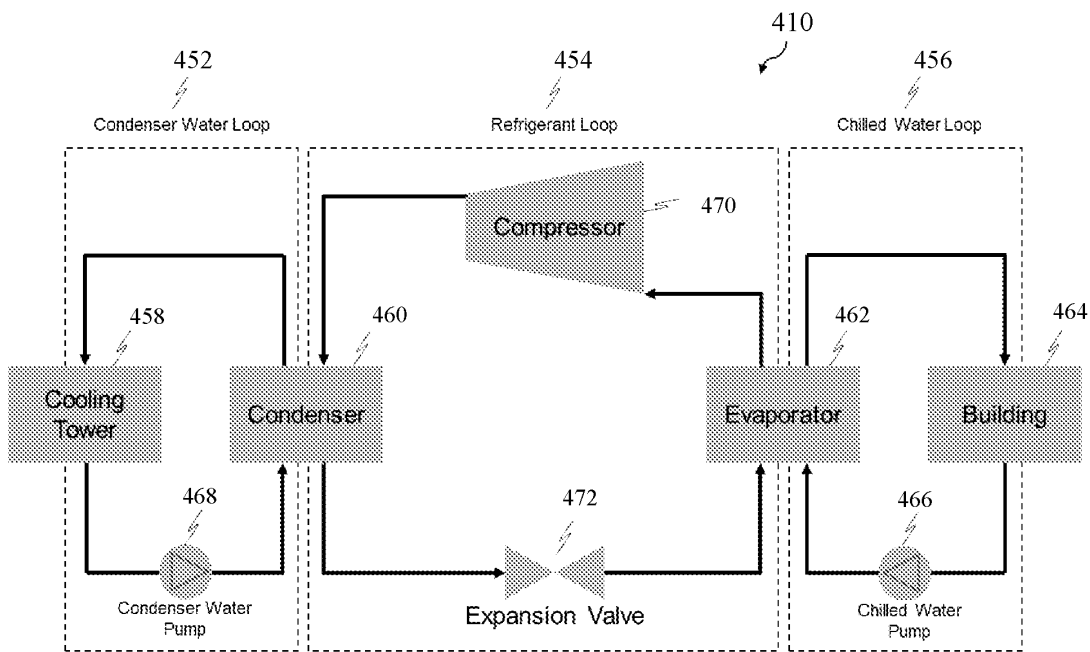


FIG. 4B

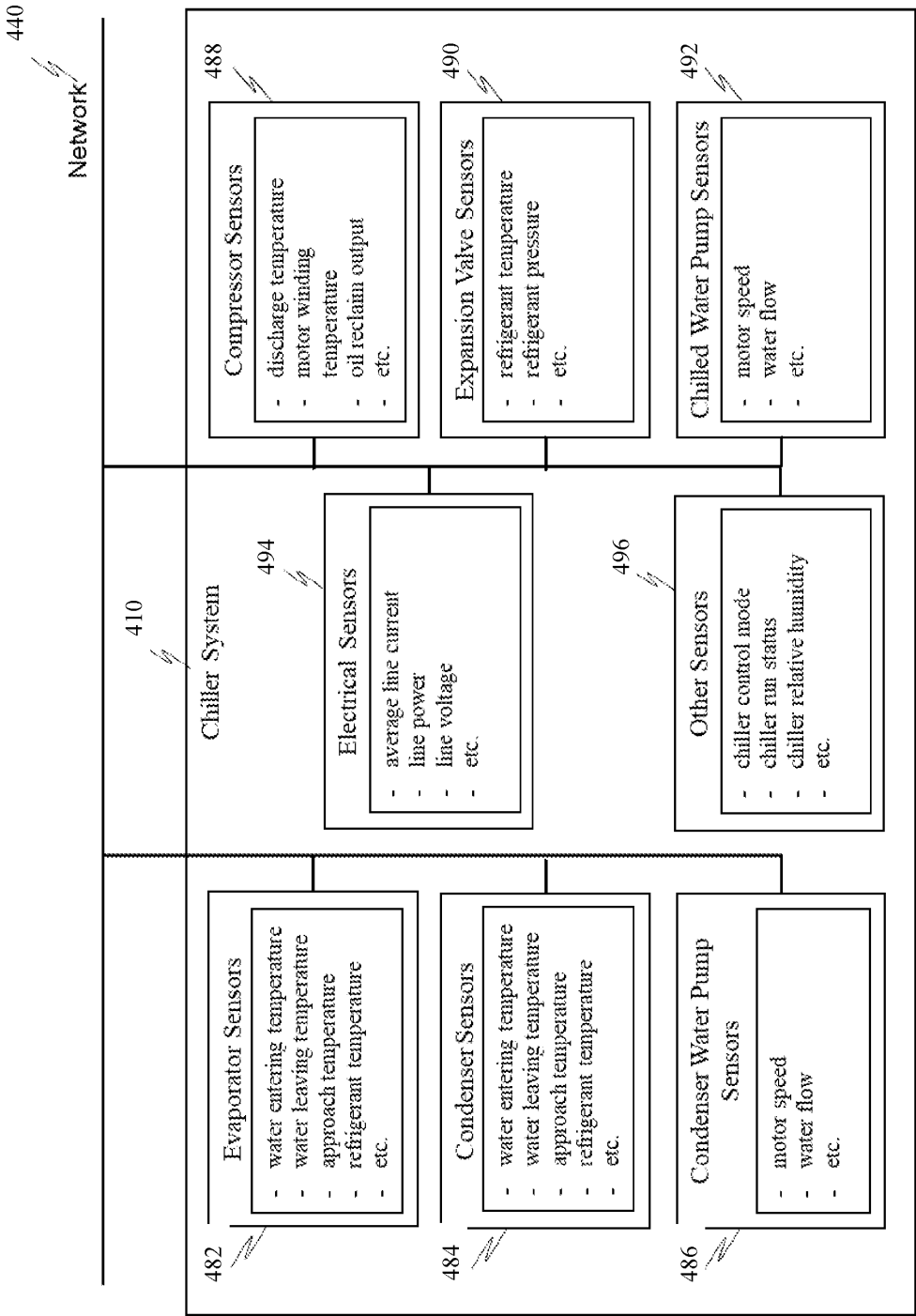


FIG. 4C

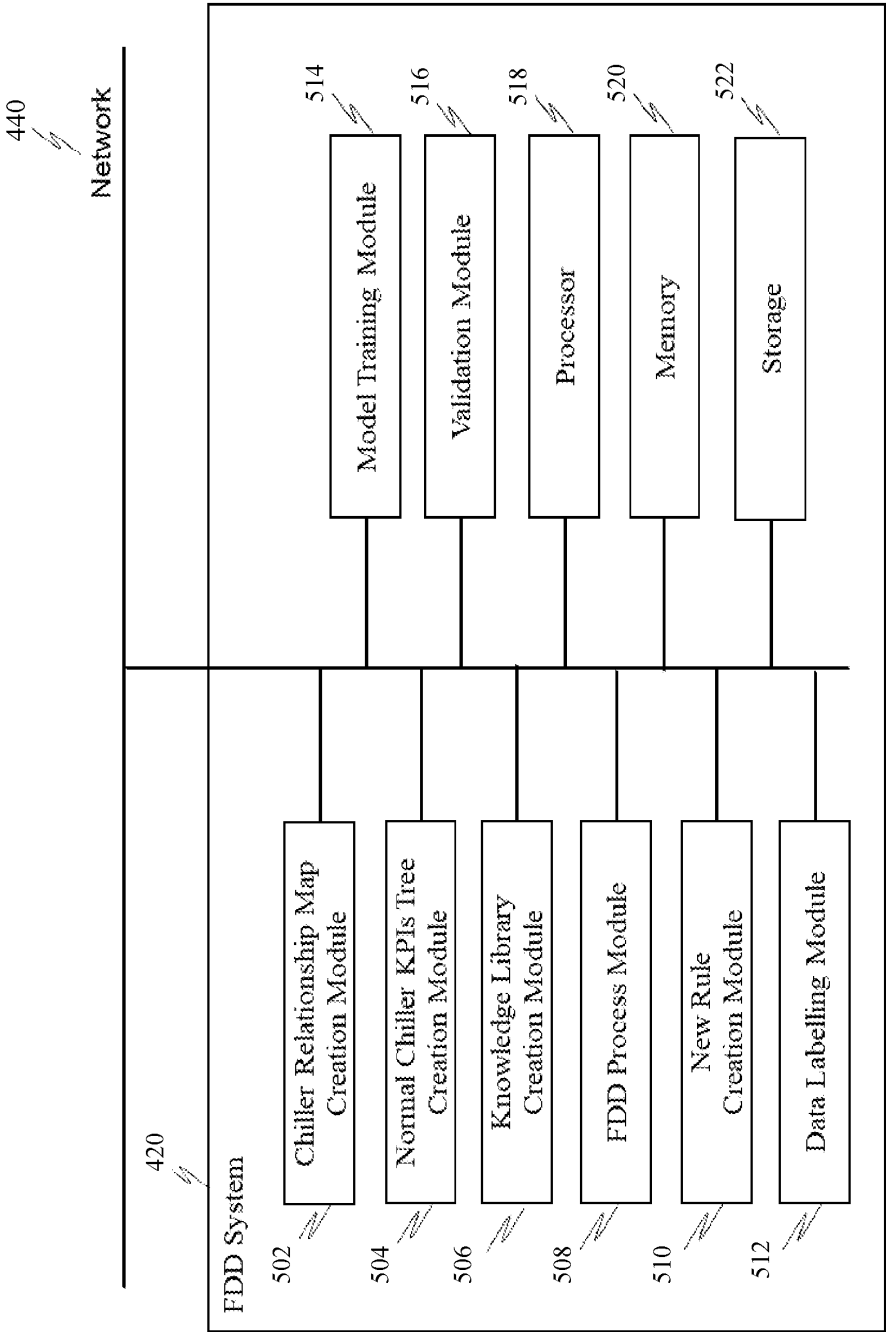


FIG. 5A

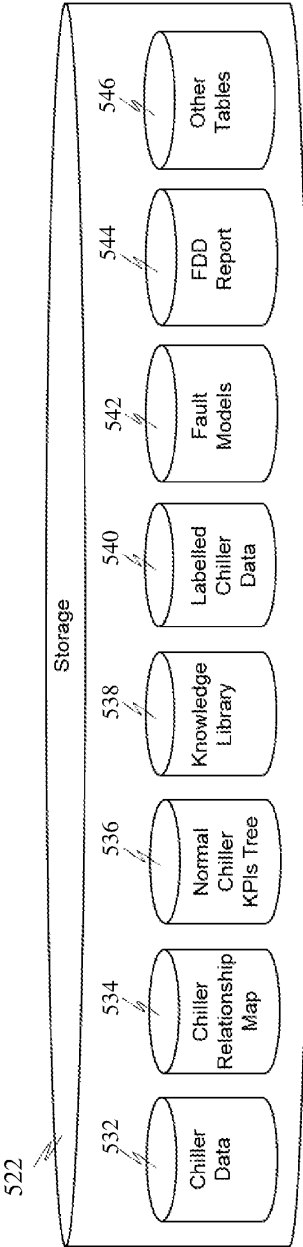


FIG. 5B

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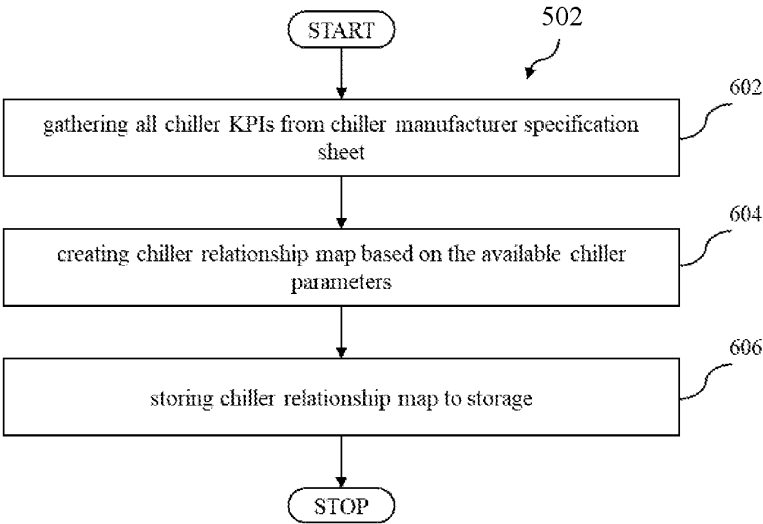


FIG. 6

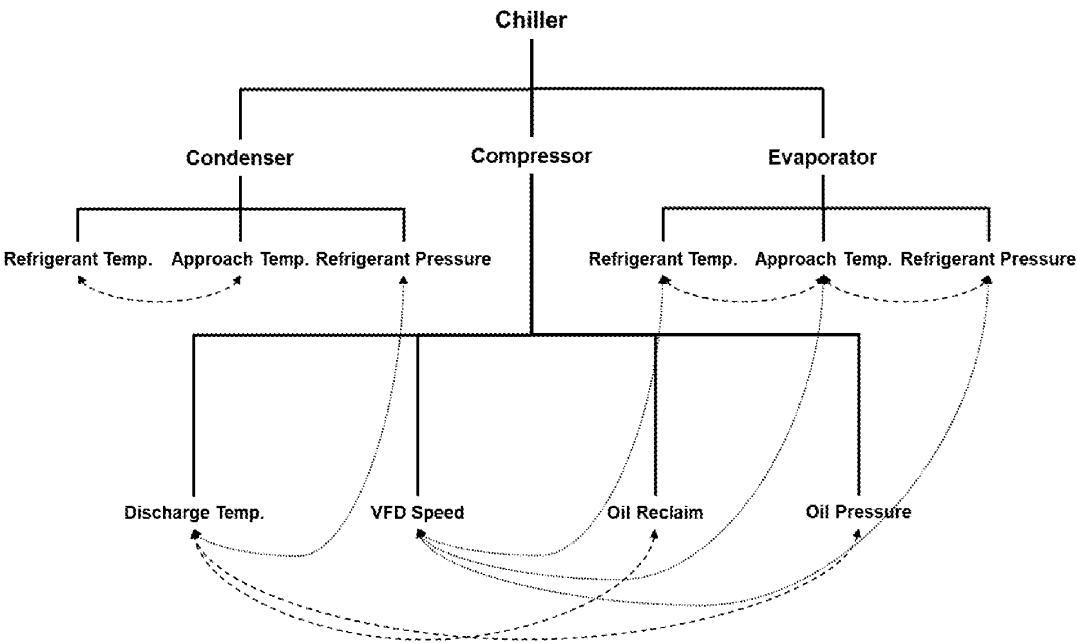


FIG. 7

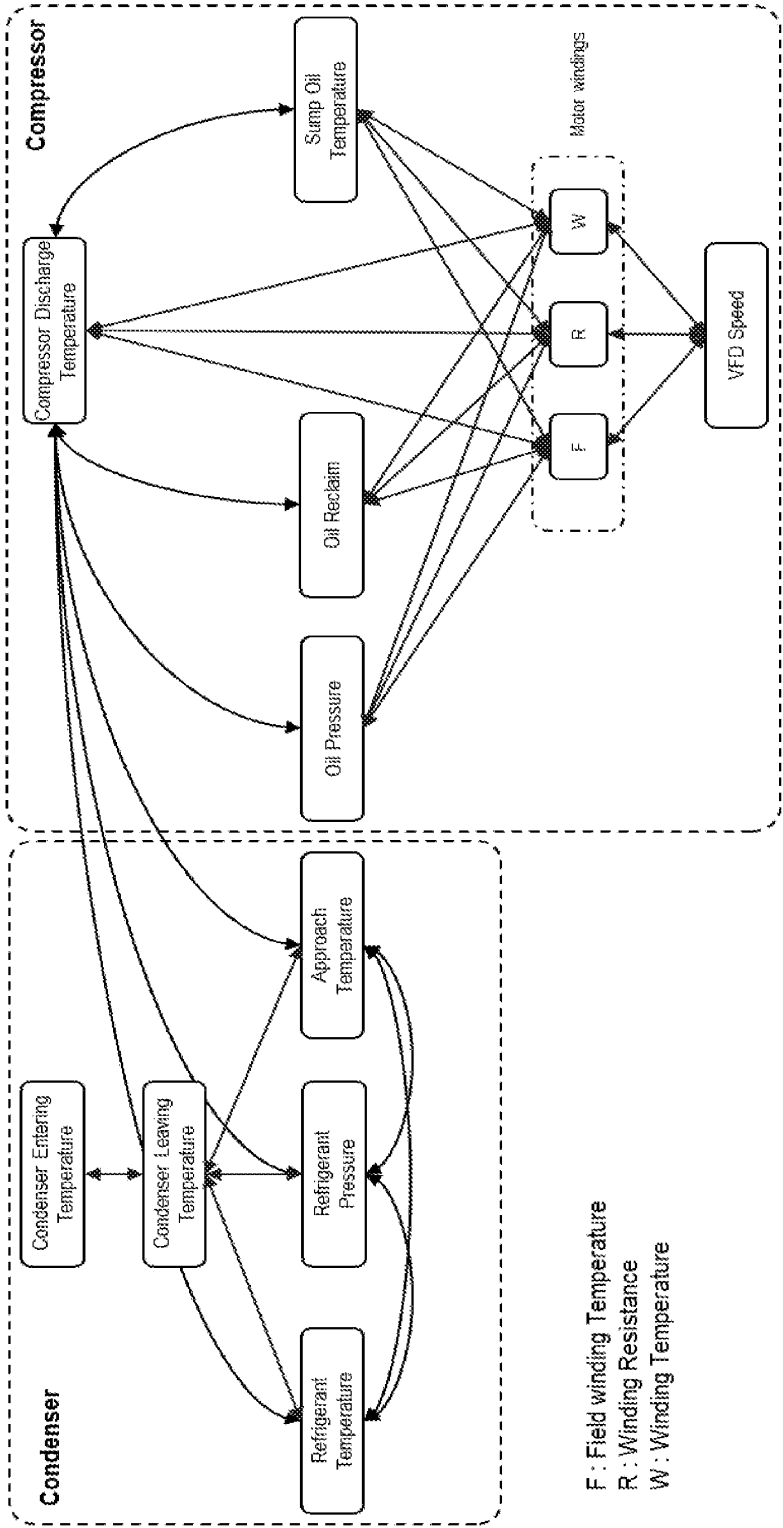


FIG. 8

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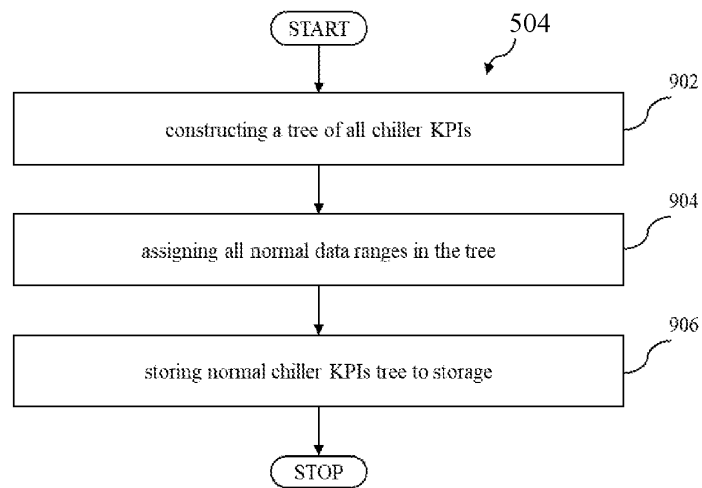


FIG. 9

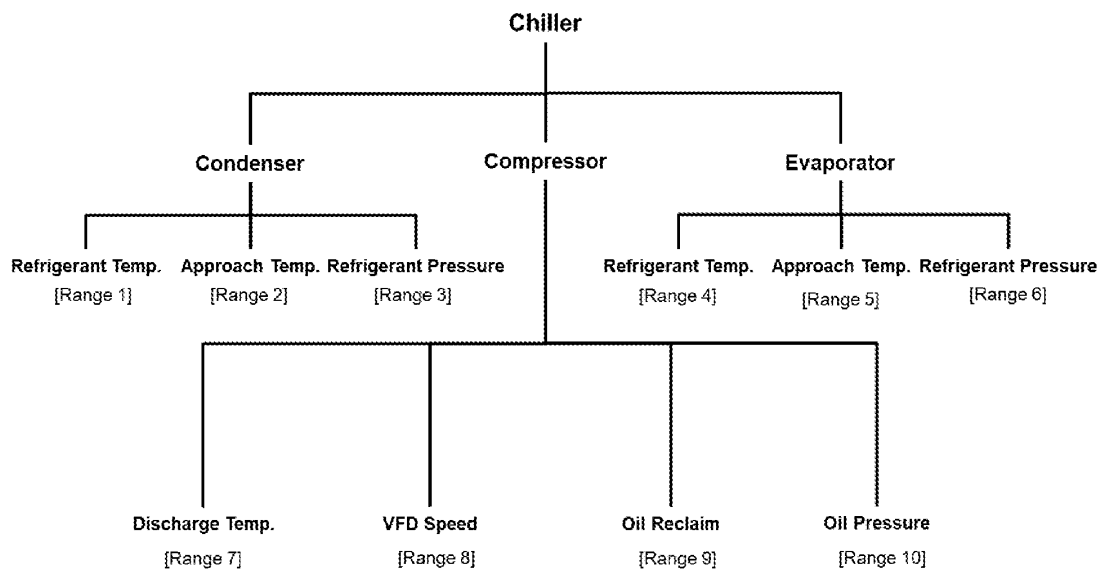


FIG. 10

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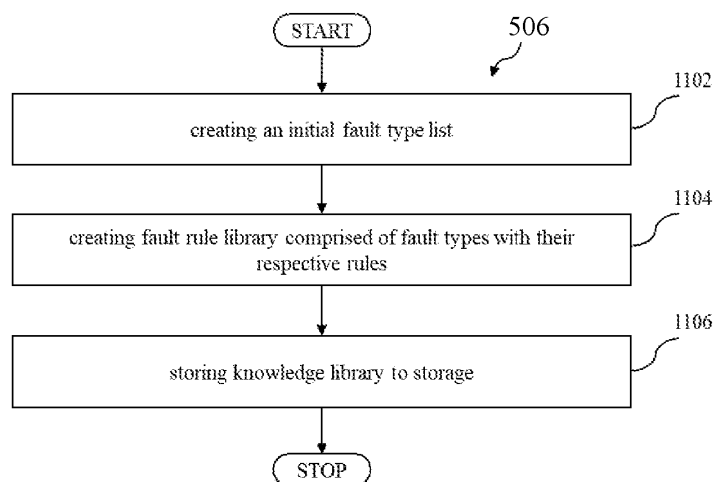


FIG. 11

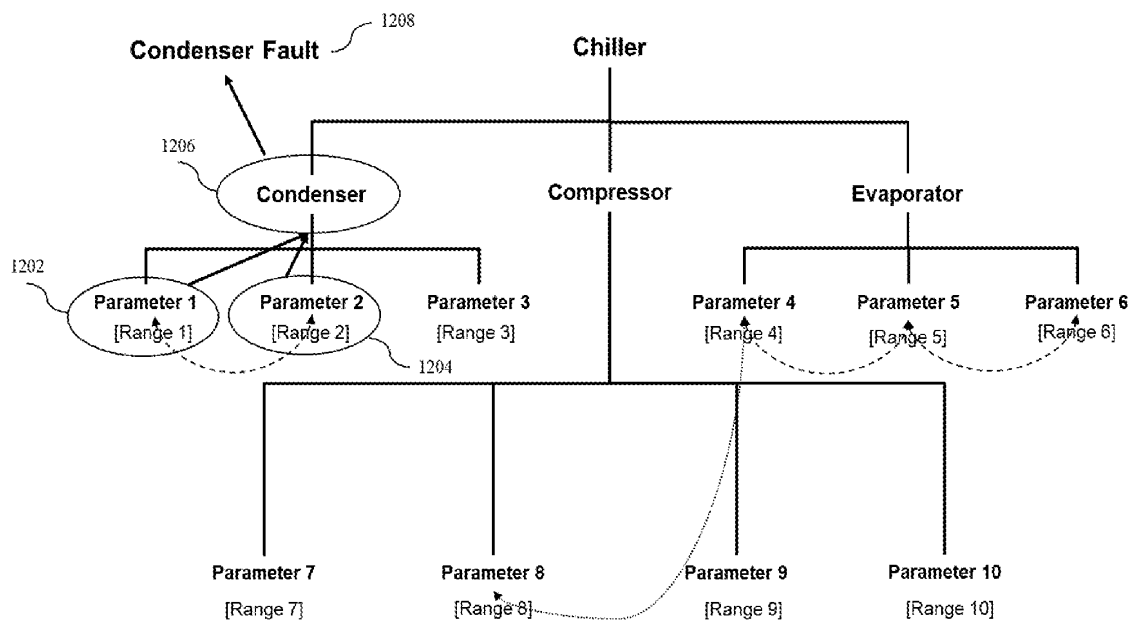


FIG. 12

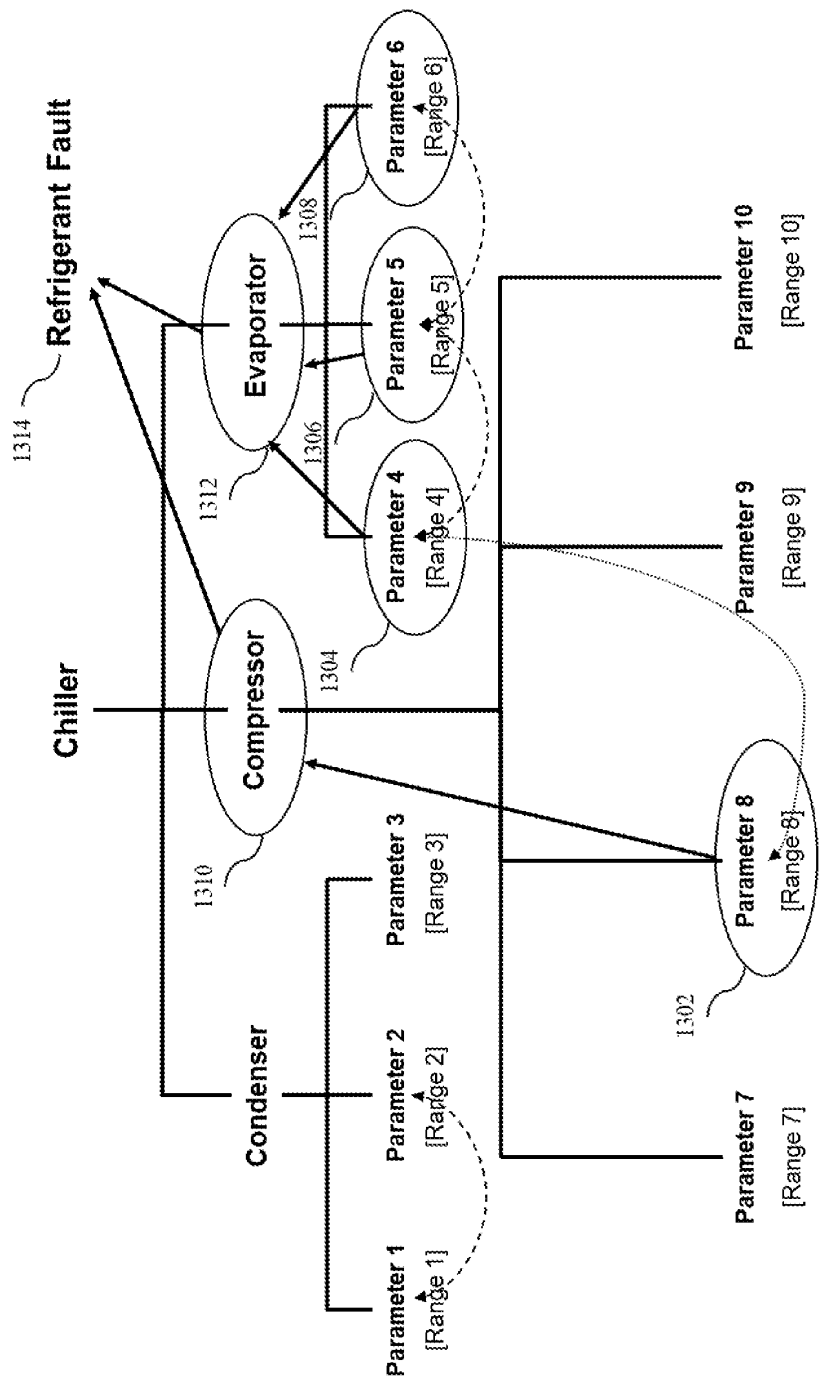


FIG. 13

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1402	1404	1406	1408	1410	1412
No	Fault ID	Fault Type	Description	Required Parameters	Parameter Normal Range
1	0001	Condenser Fouling	Accumulation of unwanted material on solid surfaces of condenser tubes	parameter 1	Range 1
				parameter 2	Range 2
2	0002	Degradation of Chiller Efficiency	Degradation of chiller efficiency across the range of cooling loads delivered.	parameter 1	Range 1
				parameter 5	Range 5
				parameter 6	Range 6
3	0003	Reduced Condenser Water Flow	Condenser water flow rate reduced by certain percentage	parameter 1	Range 1
				parameter 4	Range 4
				parameter 7	Range 7
				parameter 3	Range 3
				parameter 2	Range 2
...	...	...	...	...	...

FIG. 14

1502	1504	1506	1508
			
No	Fault ID	Fault Type	Fault Rule
1	0001	Condenser Fouling	IF (Condenser Approach Temperature increase exceed normal range and Condenser Refrigerant Pressure increase exceed normal range)
2	0002	Degradation of Chiller Efficiency	IF (Chiller Efficiency increase exceed normal range and Compressor Power increase exceed normal range and Evaporator Delta Temperature decrease exceed normal range)
...		...	IF ...

FIG. 15

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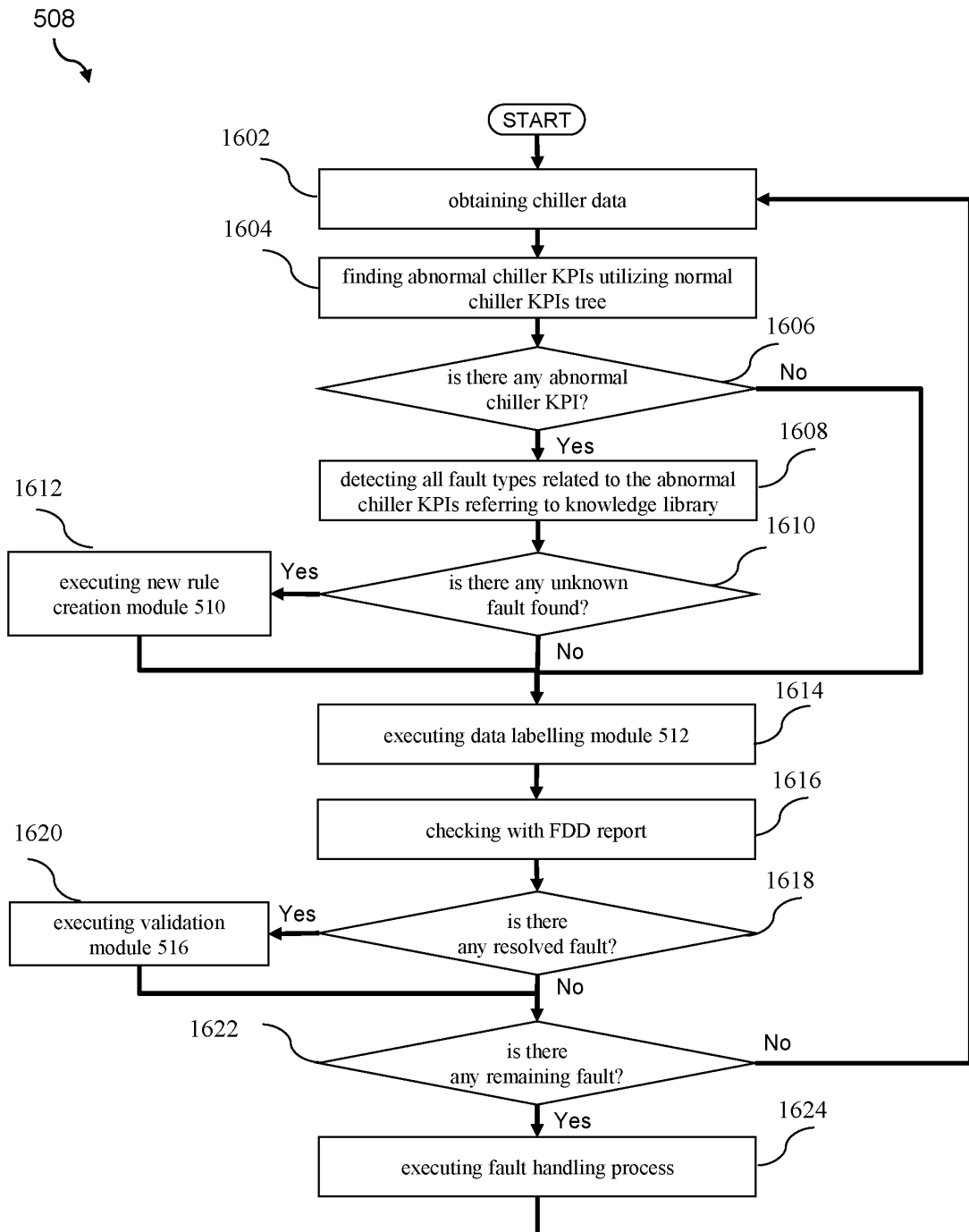


FIG. 16

1702	1704	1706	1708	1710	1712
timestamp	chiller_parameter_1	chiller_parameter_2	...	chiller_parameter_n-1	chiller_parameter_n
1	28/02/2019 5:15:40	20.79999924	19.79999924	473.2999878	484.2999878
...	...	...	...	...	...
361	28/02/2019 6:30:40	21	19.79999924	475.7999878	486.8999939
...	...	...	...	...	...
1227	28/02/2019 20:56:40	11.19999981	13.39999962	696.2000122	342.6000061
...	...	...	...	...	...

FIG. 17

1802	1804	1806	1808	1810	1812	1814	1816	1818
No	Fault ID	Fault Type	Version	First Occurrence Timestamp	Expected Resolving Period	Flag	Resolved Status	Resolved Timestamp
1	0001	Condenser Fouling	1.1	04-08-2020 16:00:00	3 days	Confirmed	YES	05-08-2020 16:00:00
2	0002	Degradation of Chiller Efficiency	1.0	31-07-2020 16:00:00	14 days	Potential	NO	-
3	0003	Reduced Condenser Water Flow	1.2	08-07-2020 16:00:00	7 days	Confirmed	NO	-
4	0001	Condenser Fouling	2.2	06-10-2020 16:00:00	3 days	Potential	NO	-
...	...	...	...	...	...	...	...	...

FIG. 18A

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No	Fault Type	Description	Occurrences	Last Occurrence Timestamp	Flag	Priority	Possible Causes	Abnormal Data Points	Table View	Graph View	Recommendations	Status
1	Condenser Fouling	Accumulation of unwanted material on solid surfaces of condenser tubes	4	05-08-2020 16:00:00	Confirmed	Medium	Deposit accumulation on condenser tubes, Dirt existence in condenser water	kW, TCA, PRC, TCO-TCI			chemical treatment on the condenser tube, mechanical removal of any deposit on the condenser tube, condenser water management	resolved
2	Degradation of Chiller Efficiency	Degradation of chiller efficiency across the range of cooling loads delivered.	2	31-07-2020 16:00:00	Confirmed	High	Decrease of oil in chiller compressor, Heat problem in chiller compressor	kW, kW/Ton, TEI-TEO			cleaning of evaporator tubes, maintenance service on chiller compressor	resolved
3	Reduced Condenser Water Flow	Condenser water flow rate reduced by certain percentage	1	10-07-2020 16:00:00	Potential	Medium	Defect on condenser water pump, Heat problem in condenser water pump	TCA			cleaning on condenser tubes	remain
...	...	...	...	...	...	...	...	...	...	...	...	...

FIG. 18B

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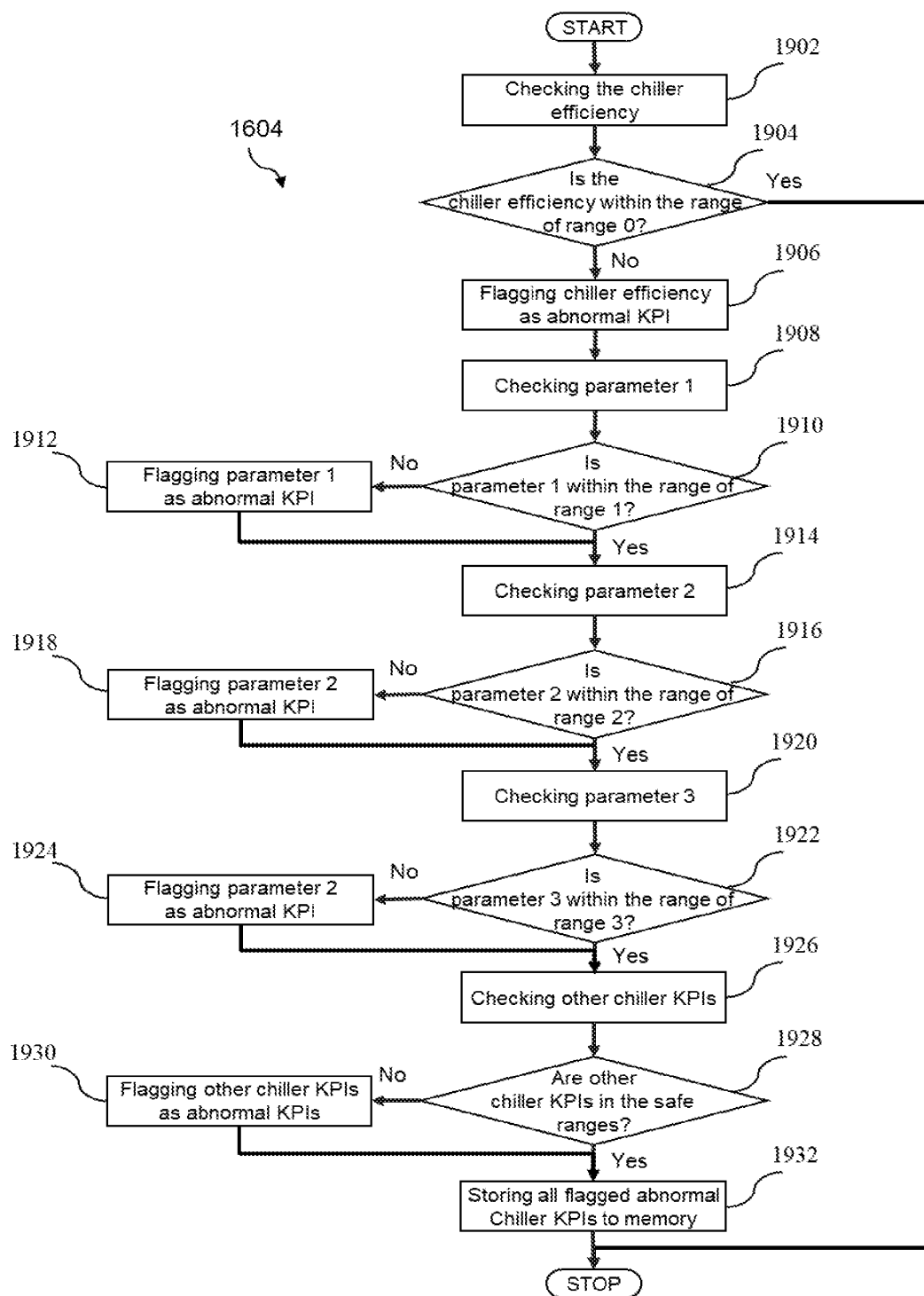


FIG. 19

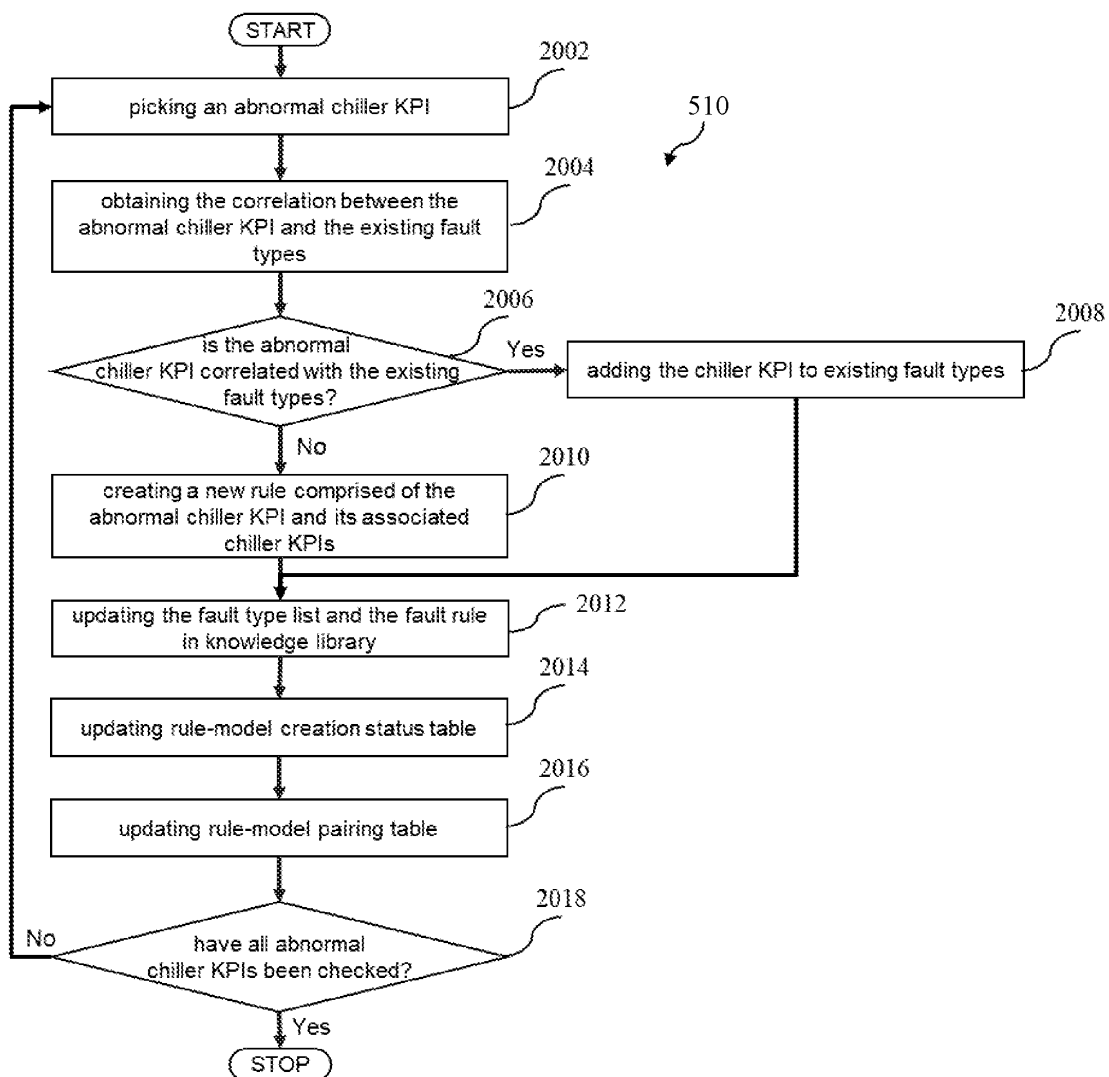


FIG. 20

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2102	2104	2106	2108	2110
No	Fault ID	Fault Type	Rule Creation Status	Model Creation Status
1	0001	Condenser Fouling	Update Existing	Under Retraining
2	0012	Refrigerant Overcharge	New	Under Training
3	0013	Refrigerant Undercharge	New	Completed
4	0014	Excess Oil	New	Under Data Labelling
...	...	...	...	...

FIG. 21

2202	2204	2206	2208	2210	2212	2214
No	Fault ID	Fault Type	Rule Version	Model Version	Version	Last Updated Timestamp
1	0001	Condenser Fouling	2	2	2.2	05-10-2020 16:00:00
2	0002	Degradation of Chiller Efficiency	1	0	1.0	30-07-2020 16:00:00
3	0003	Reduced Condenser Water Flow	1	2	1.2	07-07-2020 16:00:00
...	...	...	...	...	...	...

FIG. 22

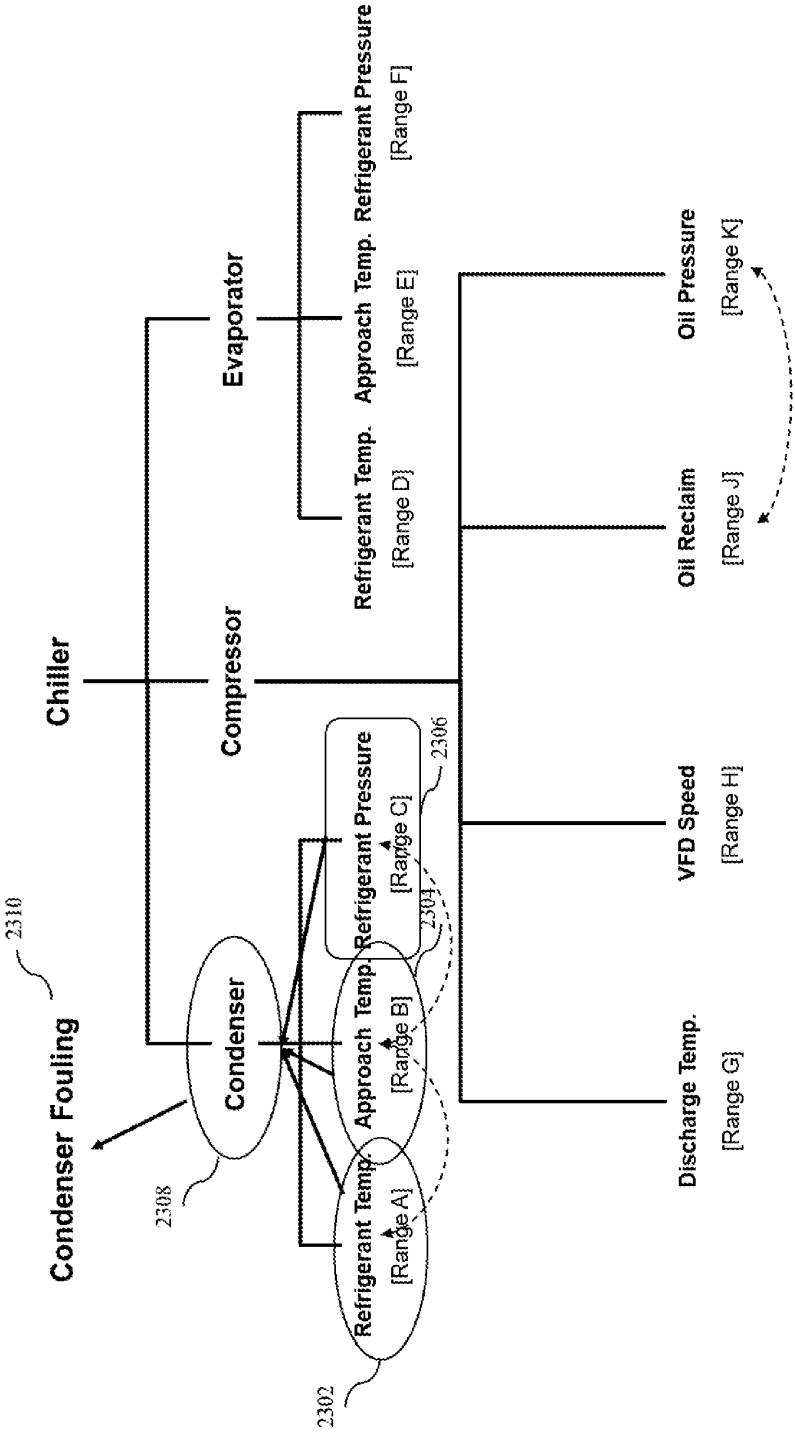


FIG. 23

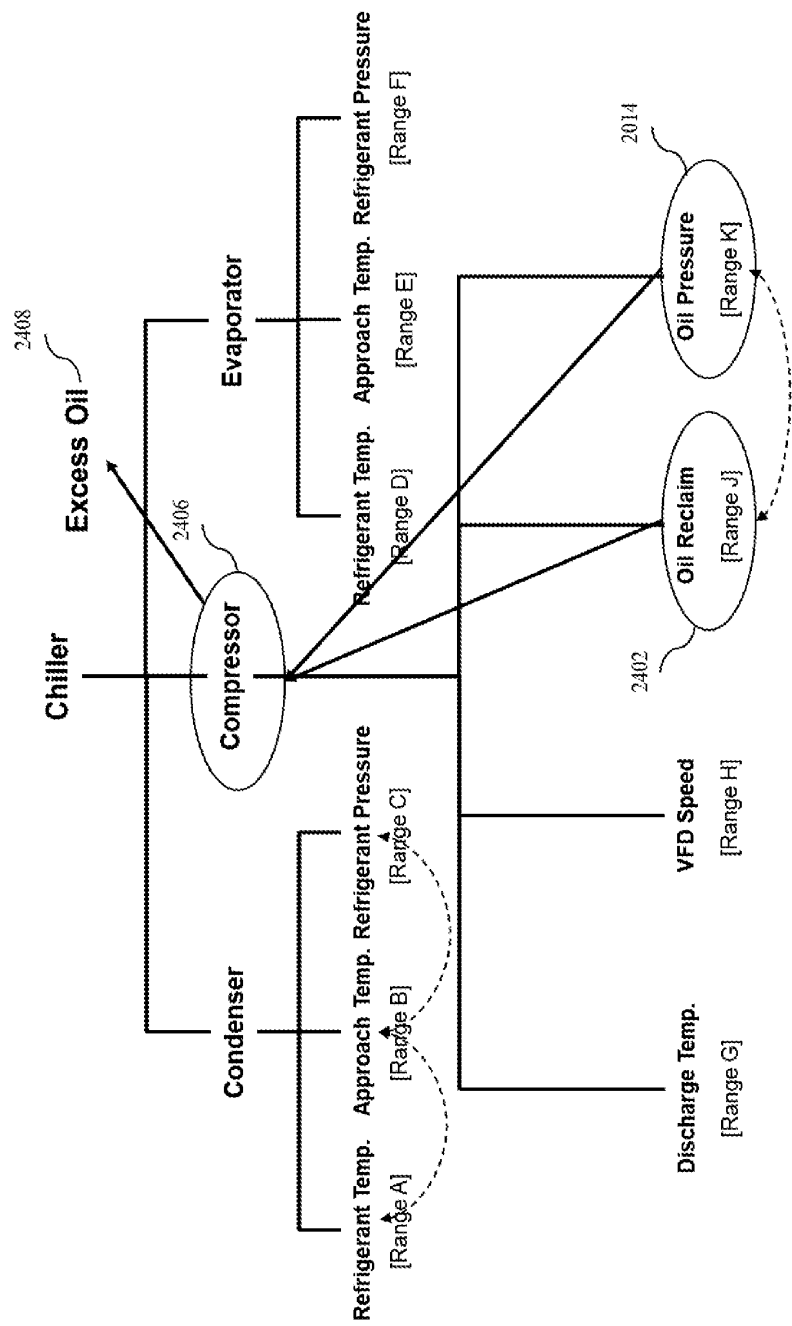


FIG. 24

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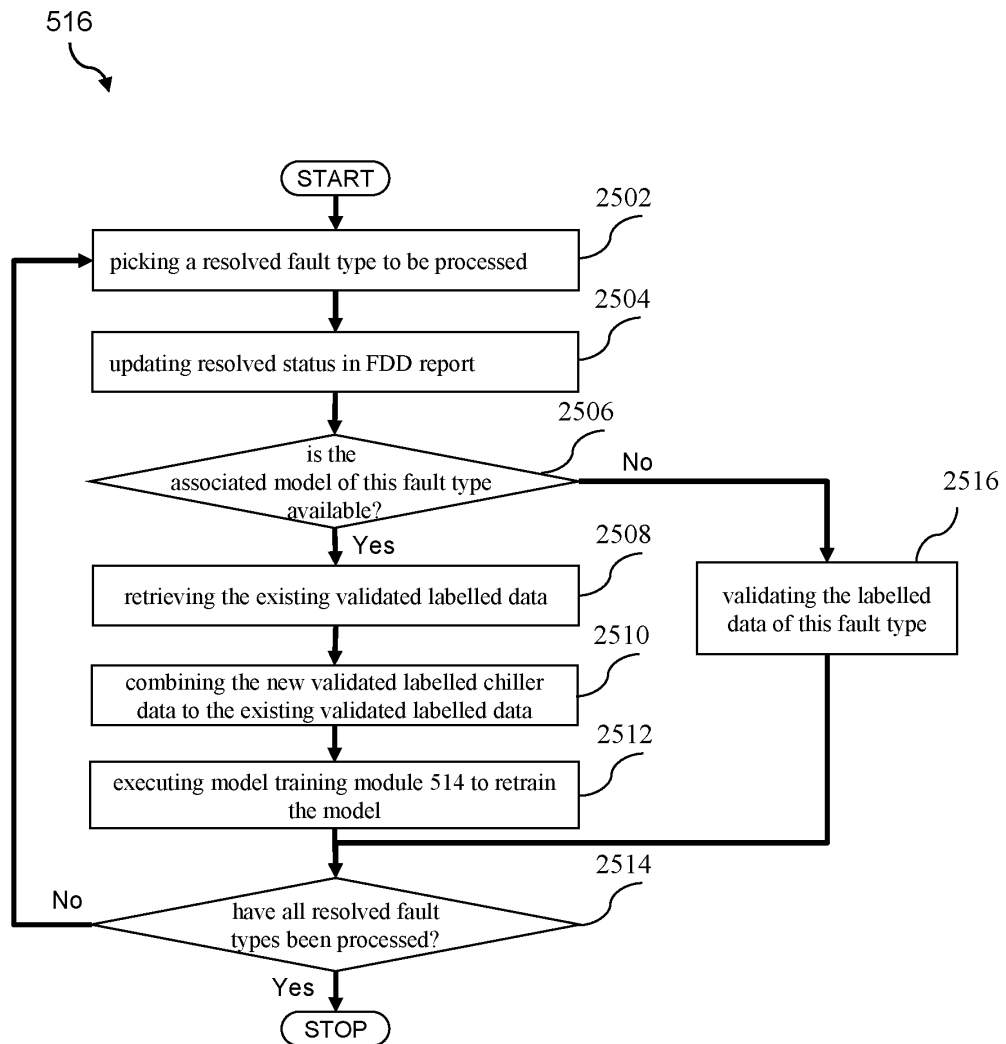


FIG. 25

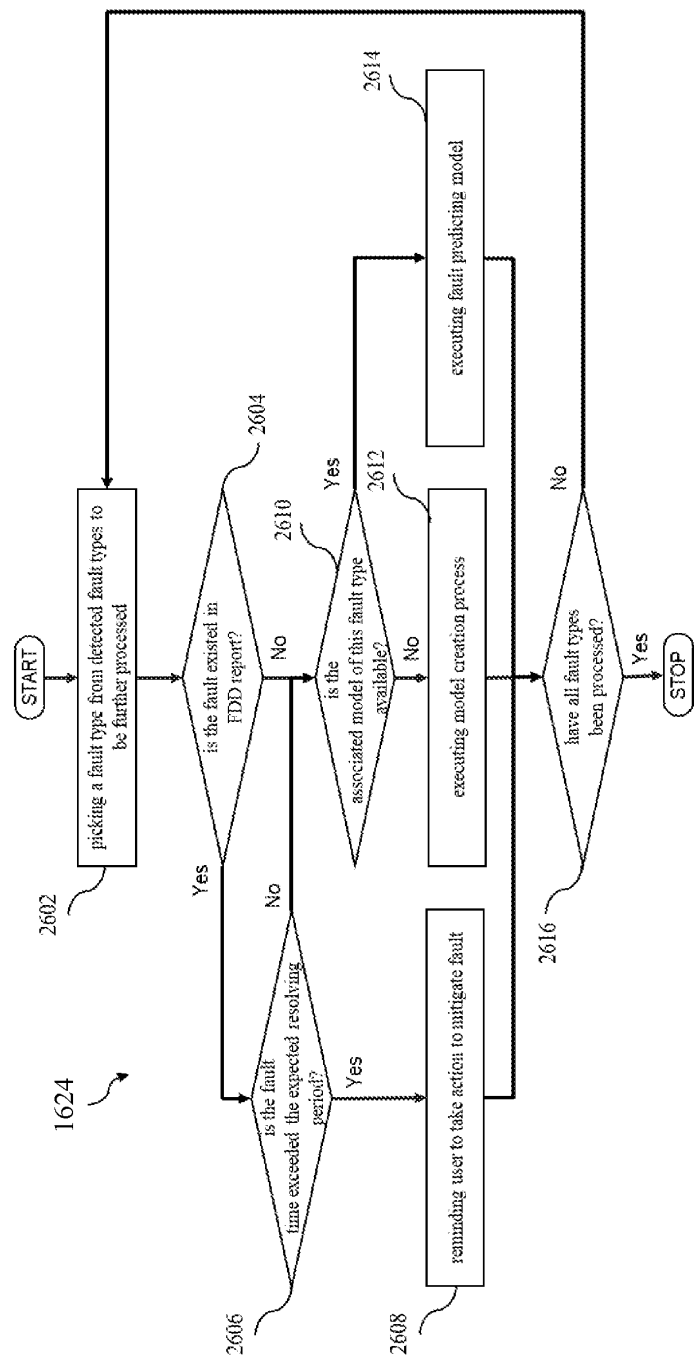


FIG. 26

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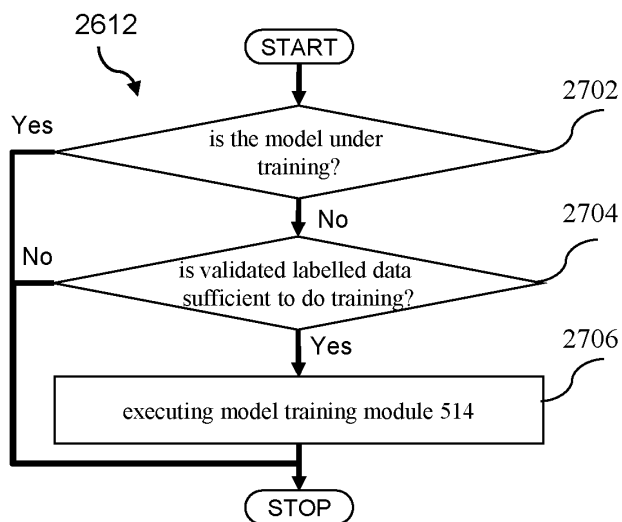


FIG. 27

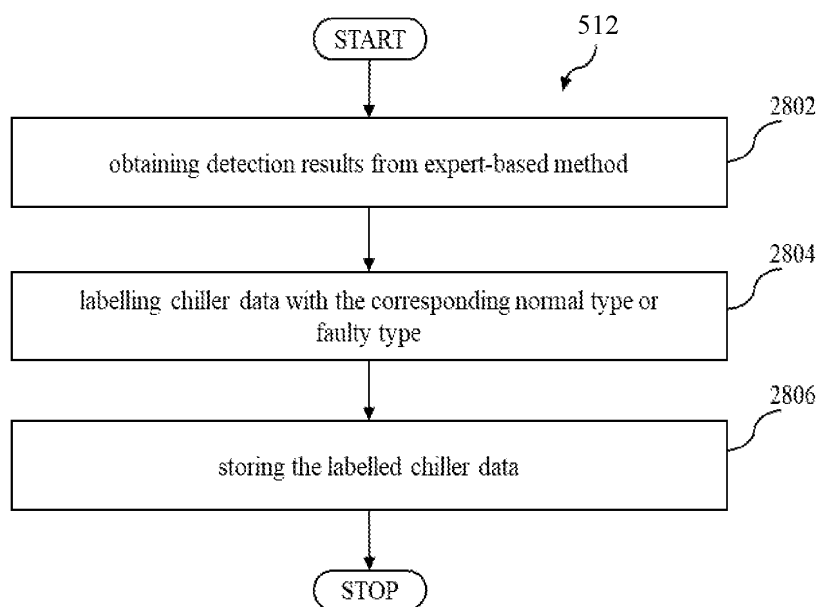


FIG. 28A

	timestamp	chiller_parameter_1	chiller_parameter_2	...	chiller_parameter_n-1	chiller_parameter_n	label	remarks	validation status
1	28/02/2019 5:15:40	20.79999924	19.79999924	...	473.2999878	484.2999878	0	normal	1
⋮	⋮	⋮	⋮	⋮	⋮	⋮			
361	28/02/2019 6:30:40	21	19.79999924	...	475.7999878	486.8999939	1	fault type 1	0
⋮	⋮	⋮	⋮	⋮	⋮	⋮			
1227	28/02/2019 20:56:40	11.19999981	13.39999962	...	696.2000122	342.6000061	2	fault type 2	0
...	...	...	...	...	...	...			

FIG. 28B

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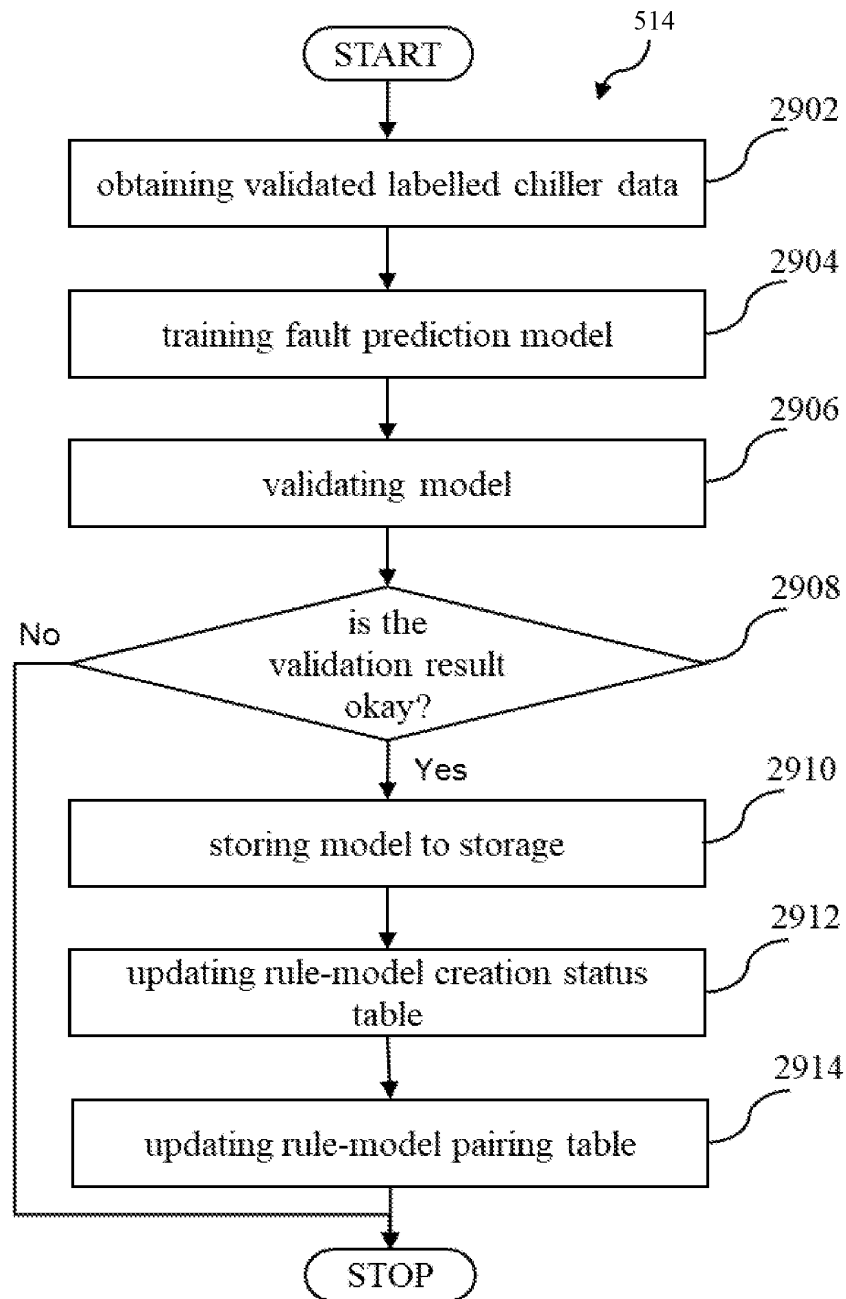


FIG. 29

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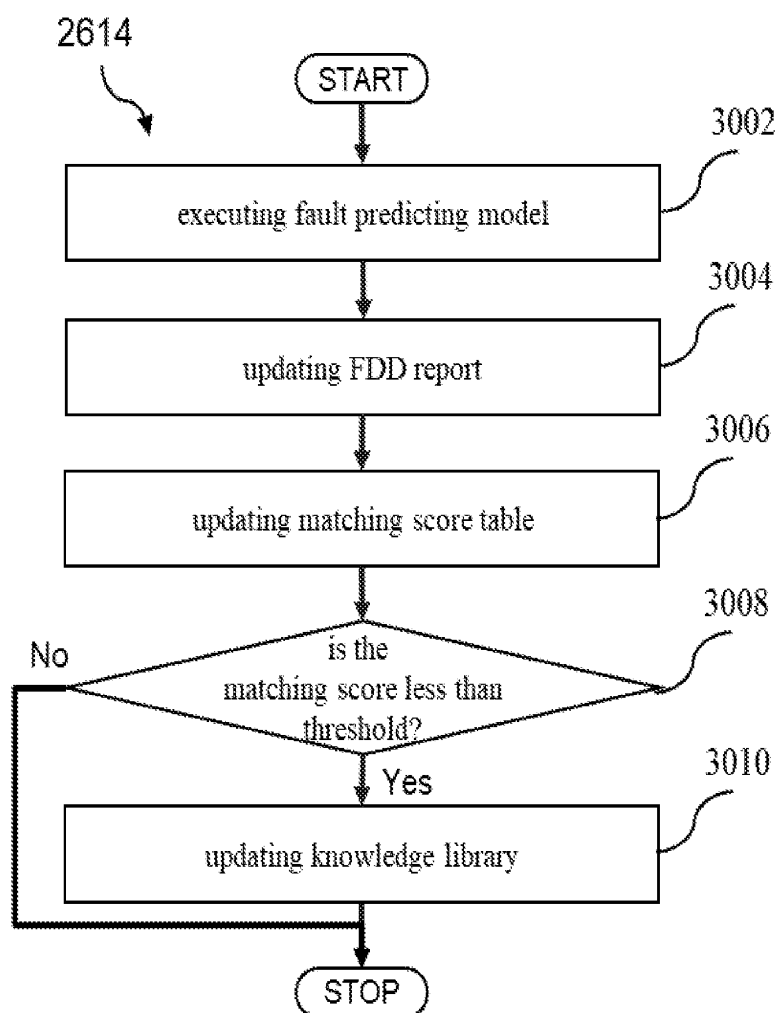


FIG. 30

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No	Fault ID	Fault Type	Matching Score
1	0001	Condenser Fouling	80%
2	0002	Degradation of Chiller Efficiency	100%
3	0003	Reduced Condenser Water Flow	100%
...		...	...

FIG. 31

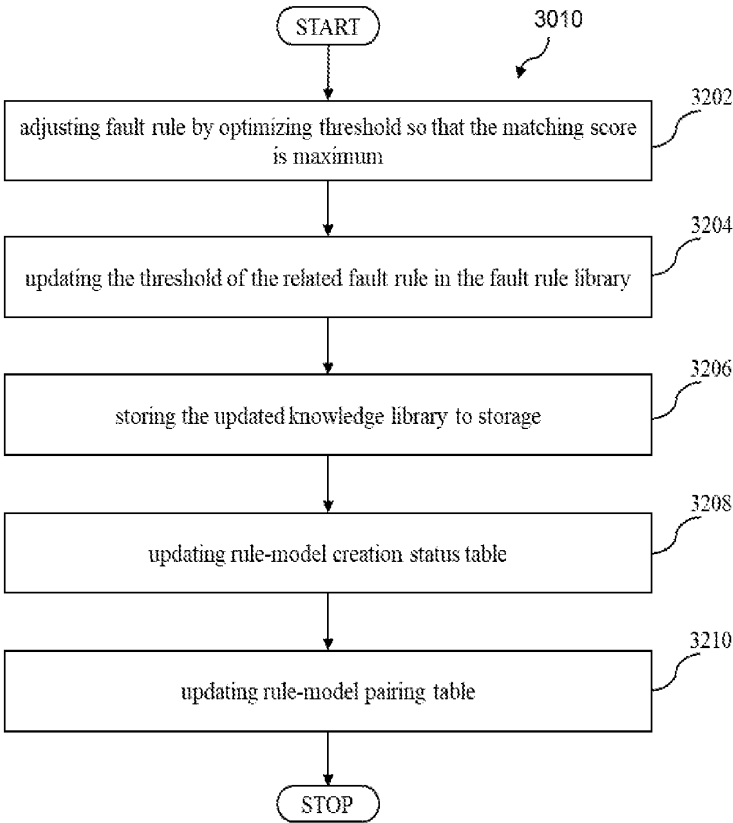


FIG. 32

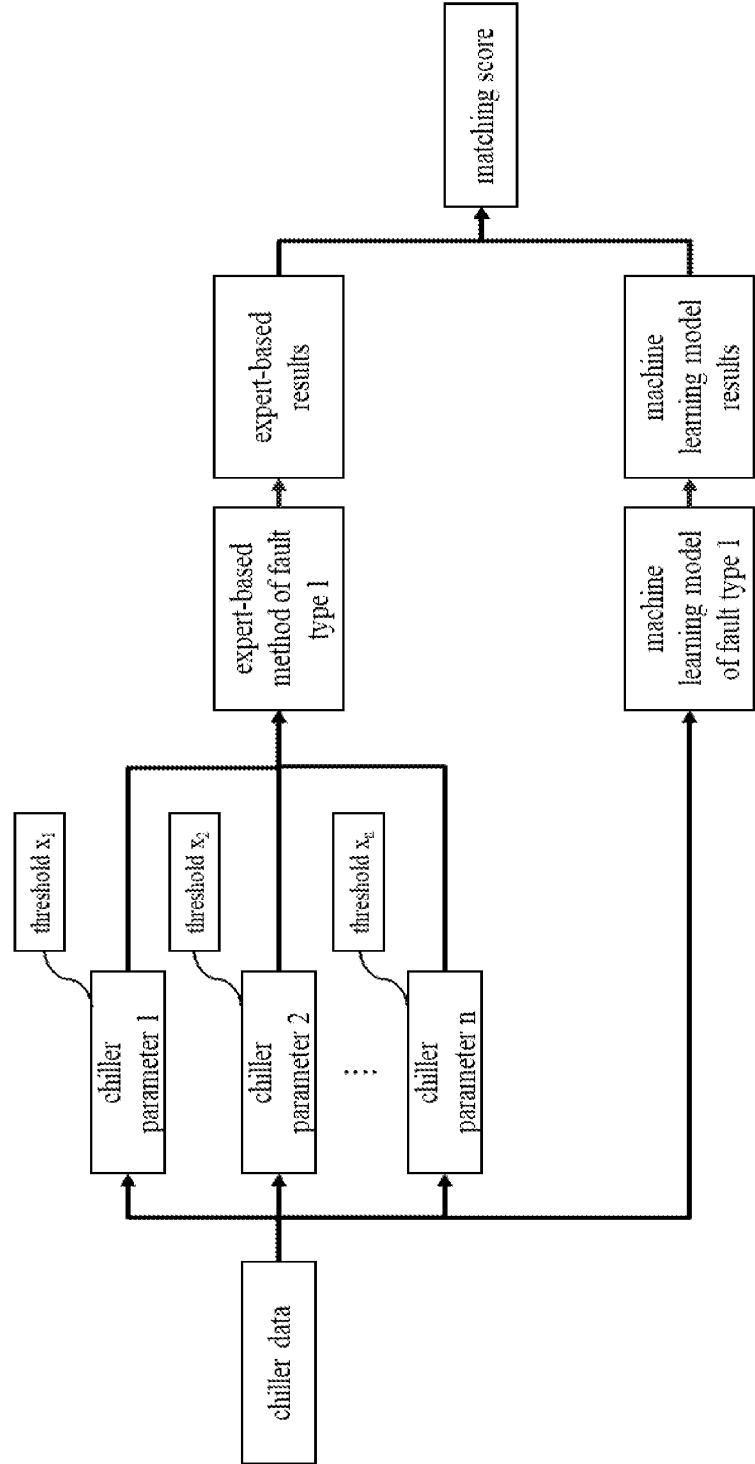


FIG. 33