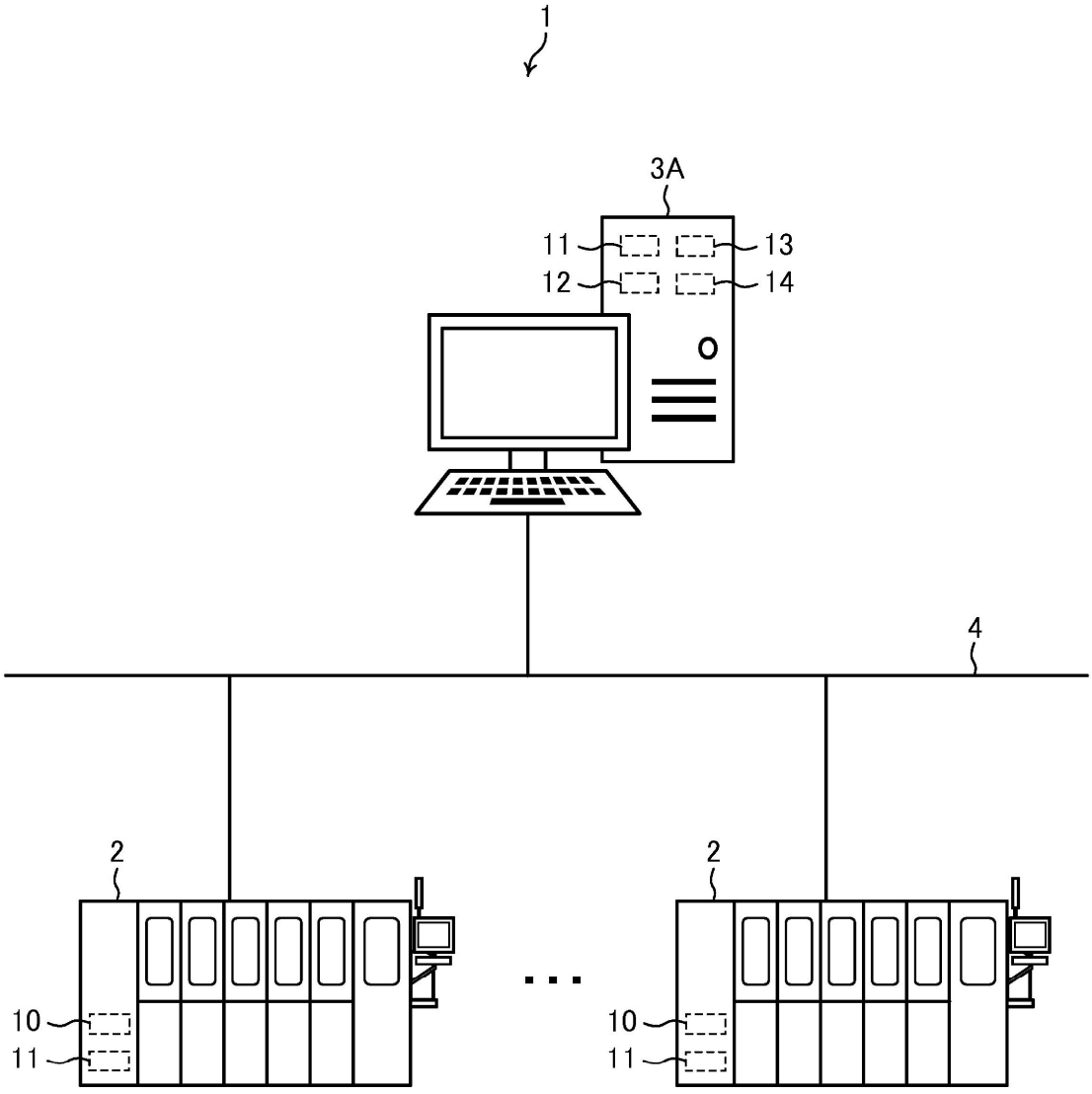


FIG. 1

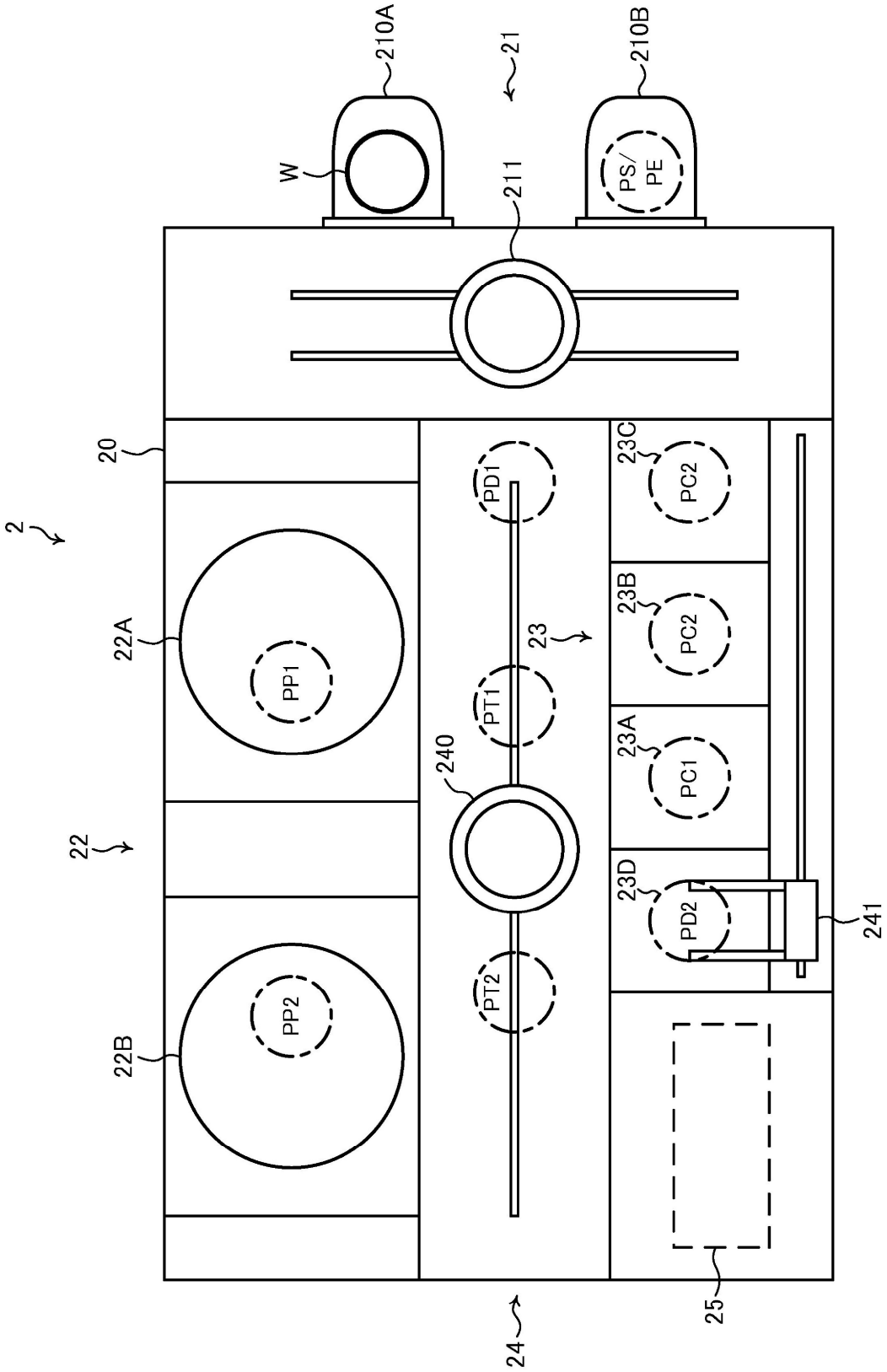

2
20
22
22A
22B
PP1
PP2
W
210A
21
210B
211
PS/
PE
PD1
PT1
PT2
23
240
23C
PC2
23B
PC2
23A
PC1
23D
PD2
241
24
25

FIG. 2

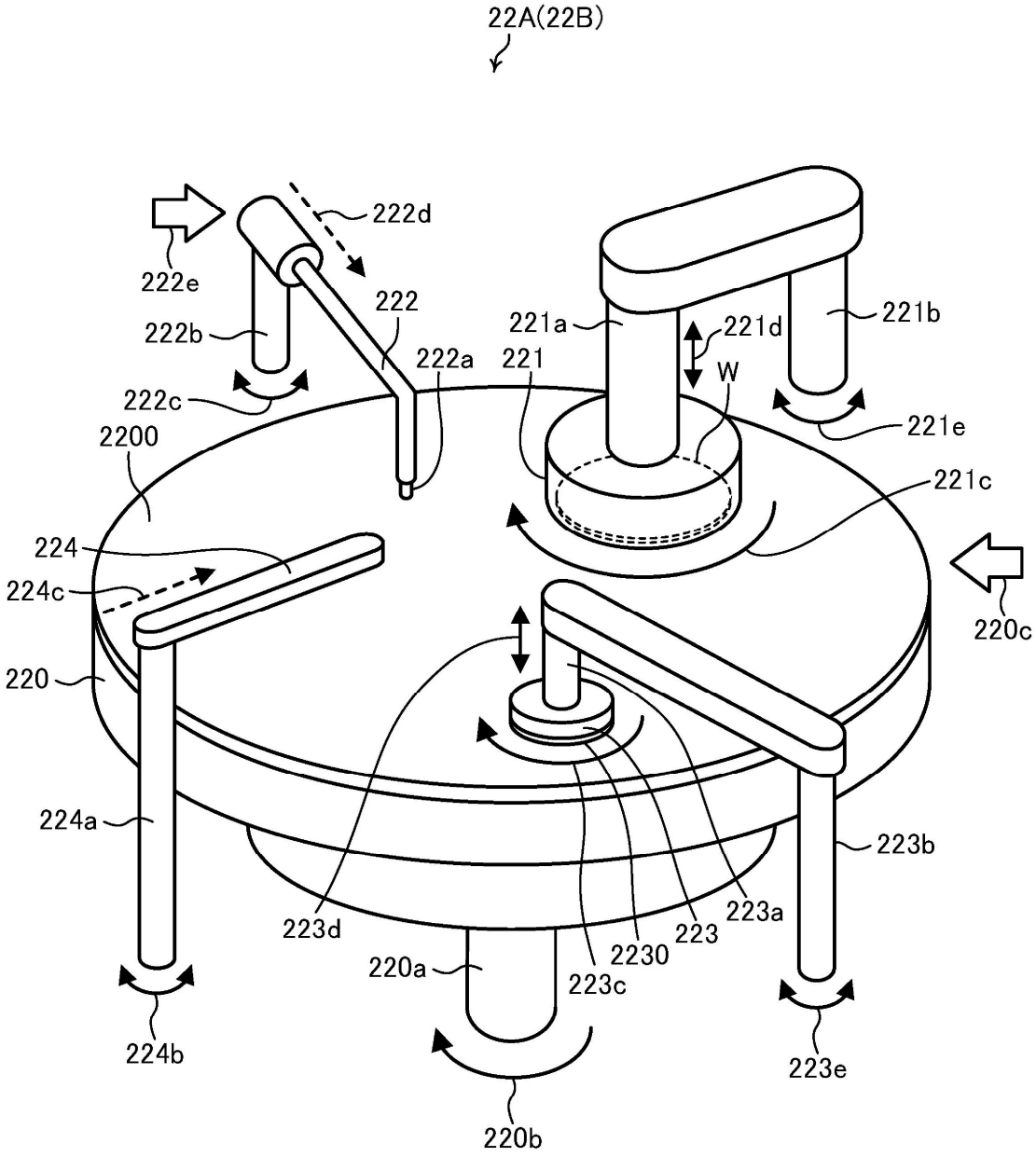

22A(22B)
222d
222e
222
222b
222a
221
221a
221d
W
221b
222c
221e
2200
221c
224
224c
220c
220
224a
223b
223d
223a
223
2230
220a
223c
224b
223e
220b

FIG. 3

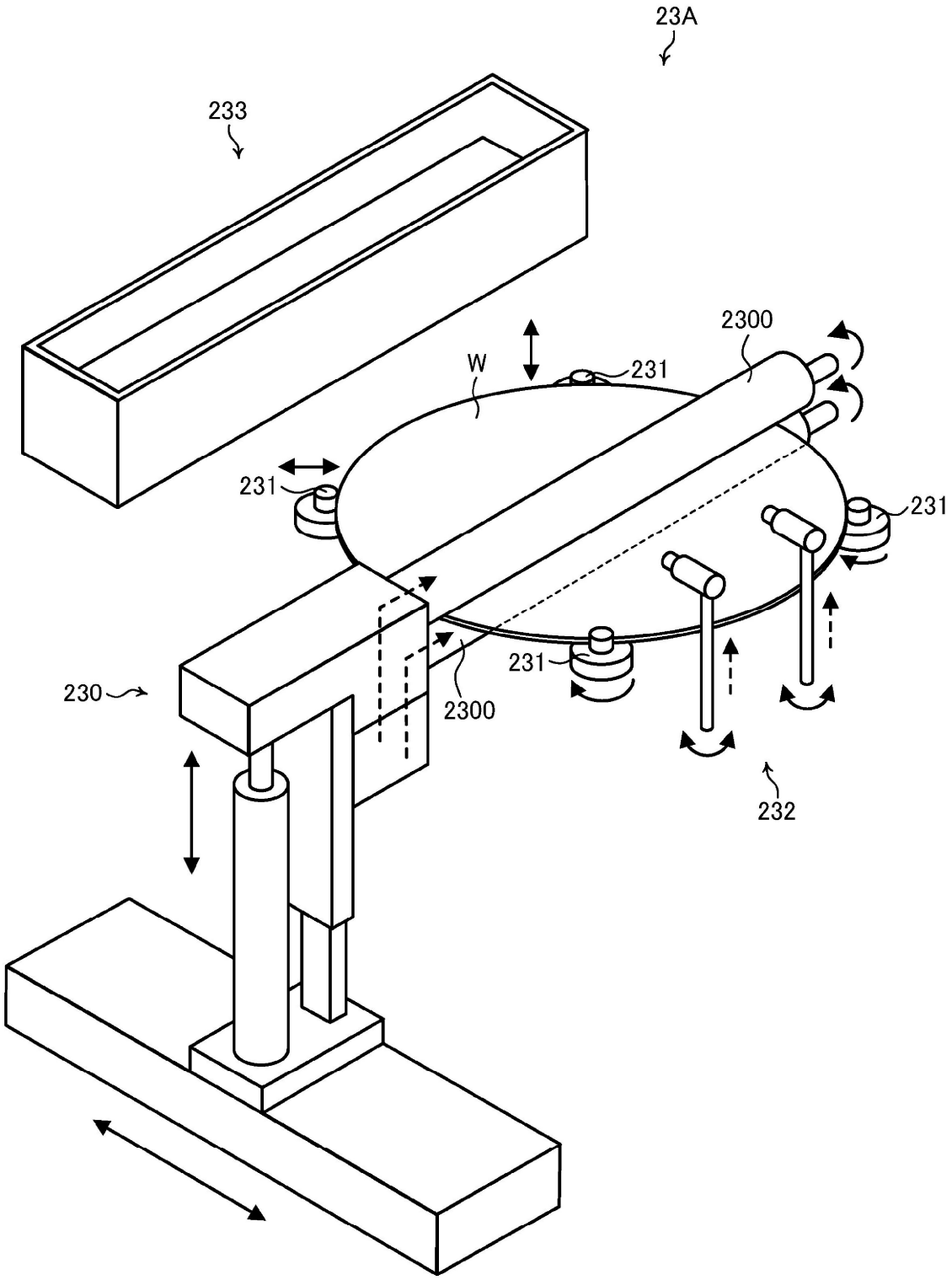


FIG. 4

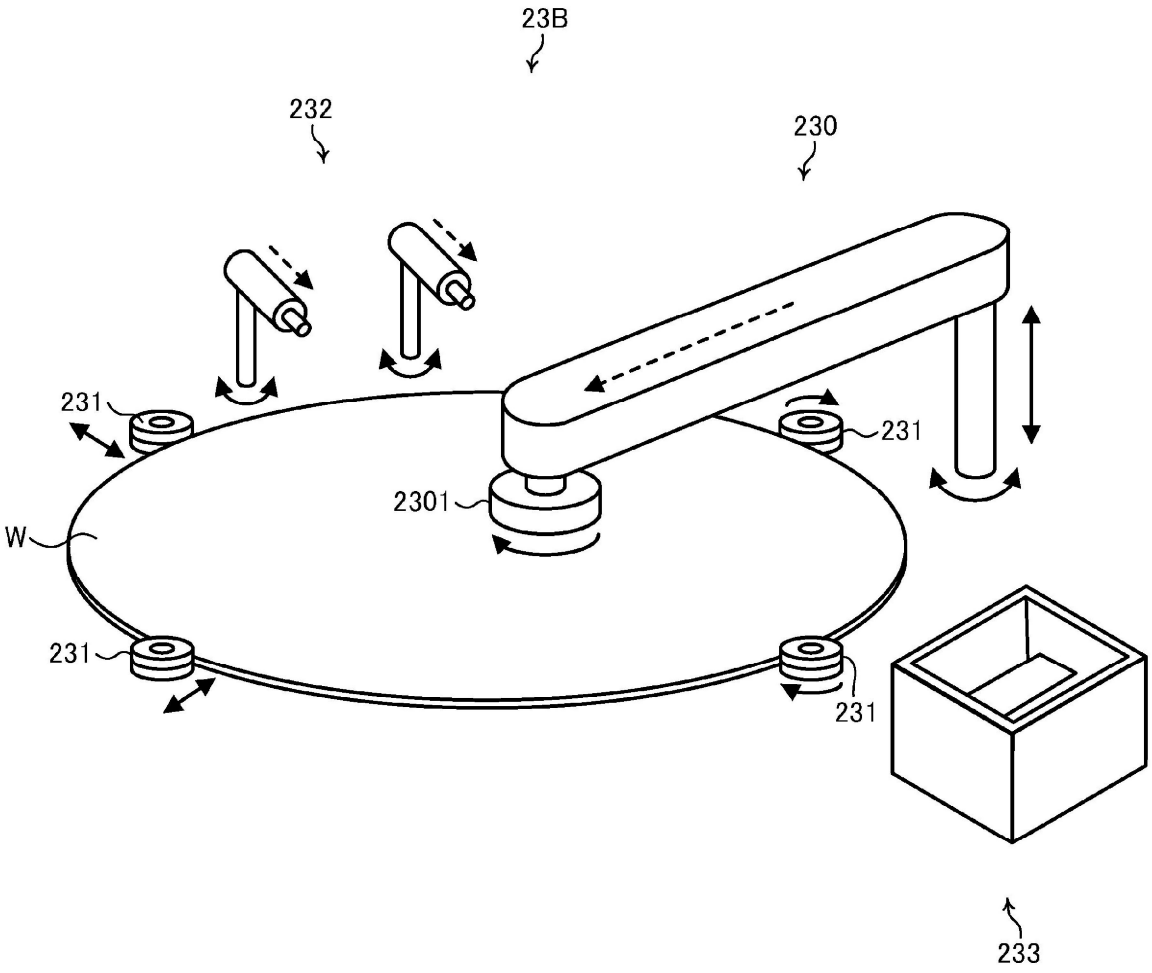


FIG. 5

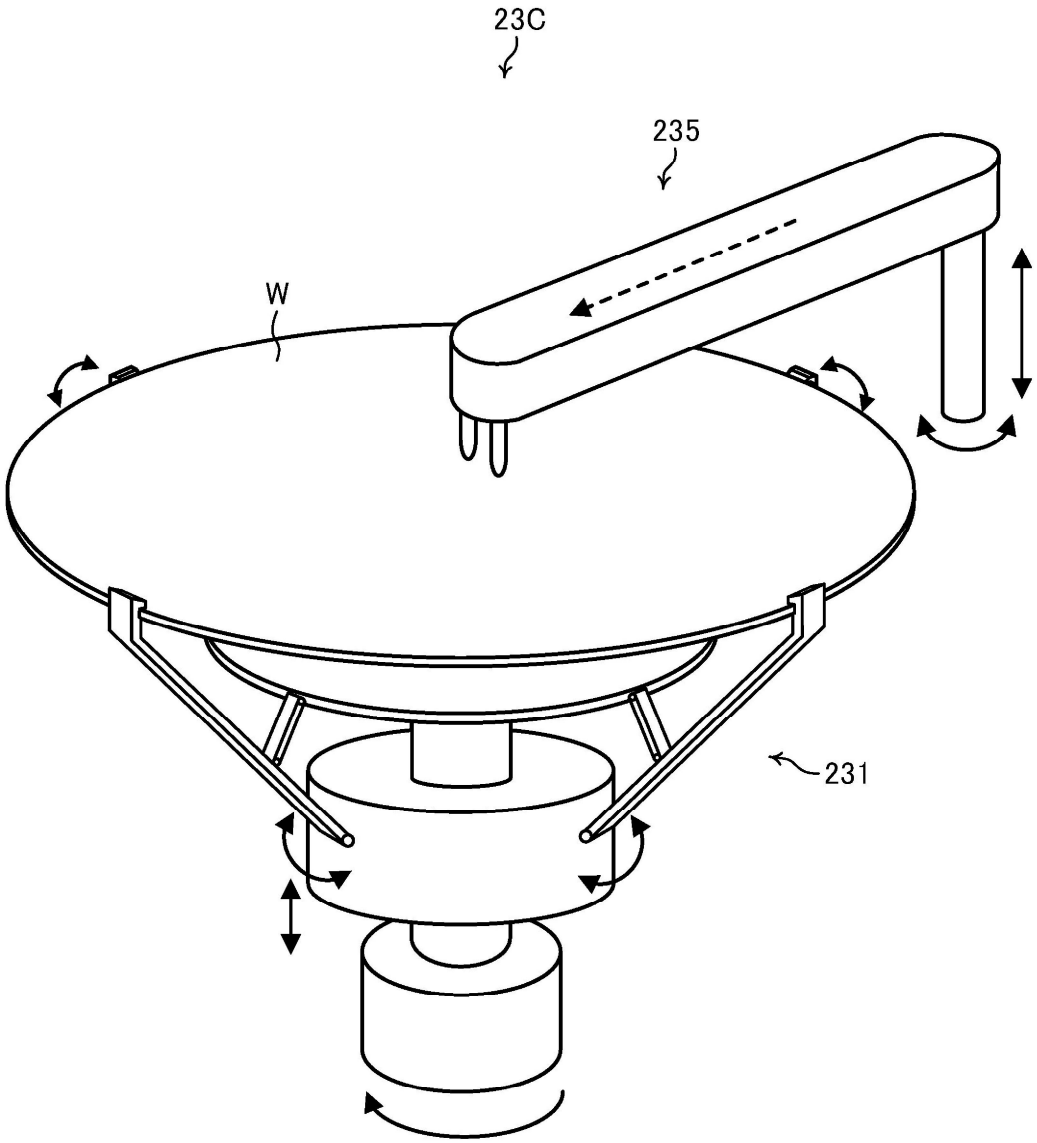


FIG. 6

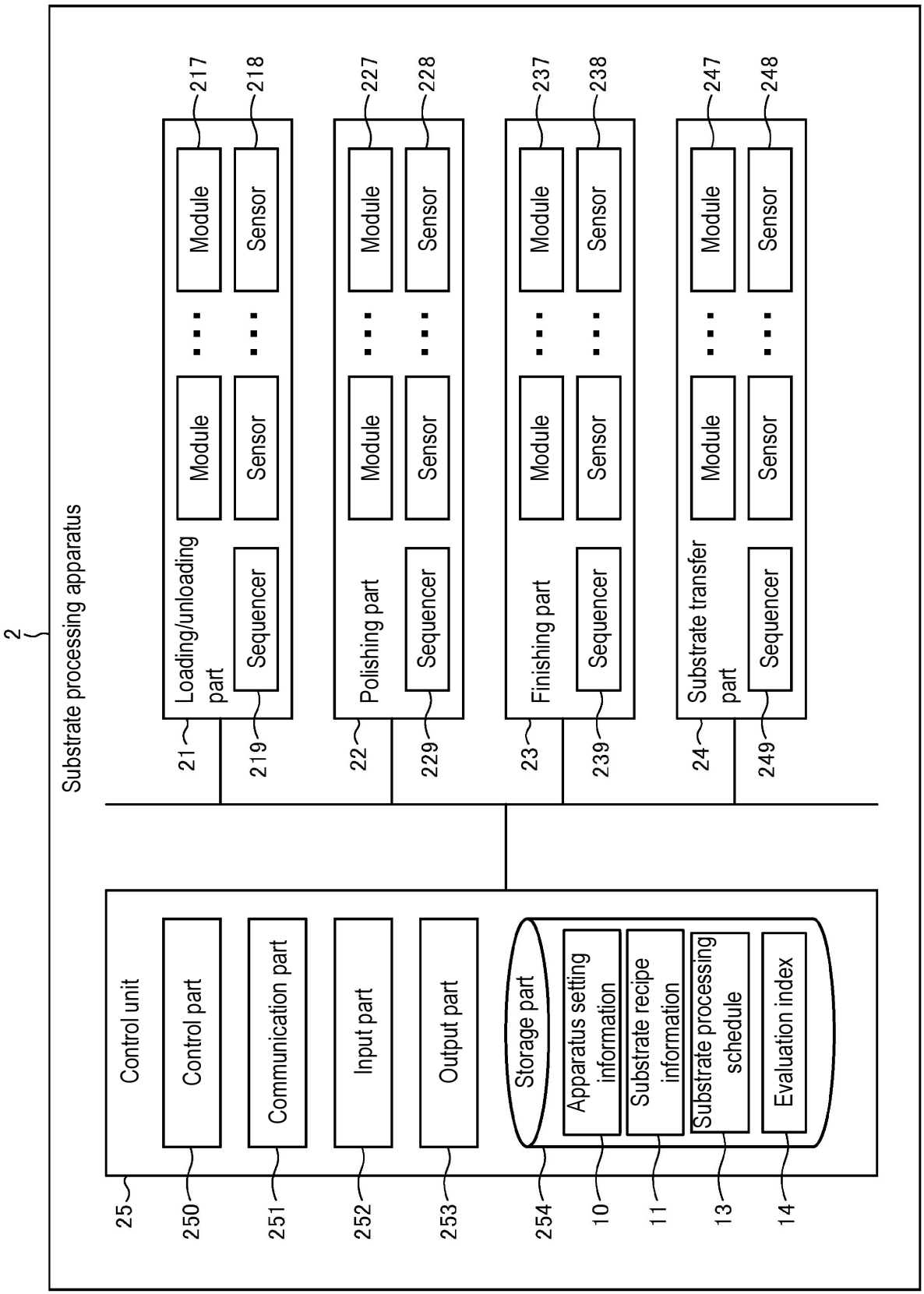

2
Substrate processing apparatus
Loading/unloading part
Module
Sensor
Sequencer
Polishing part
Module
Sensor
Sequencer
Finishing part
Module
Sensor
Sequencer
Substrate transfer part
Module
Sensor
Sequencer
21
217
218
219
22
227
228
229
23
237
238
239
24
247
248
249
Control unit
Control part
Communication part
Input part
Output part
Storage part
Apparatus setting information
Substrate recipe information
Substrate processing schedule
Evaluation index
25
250
251
252
253
254
10
11
13
14

FIG. 7

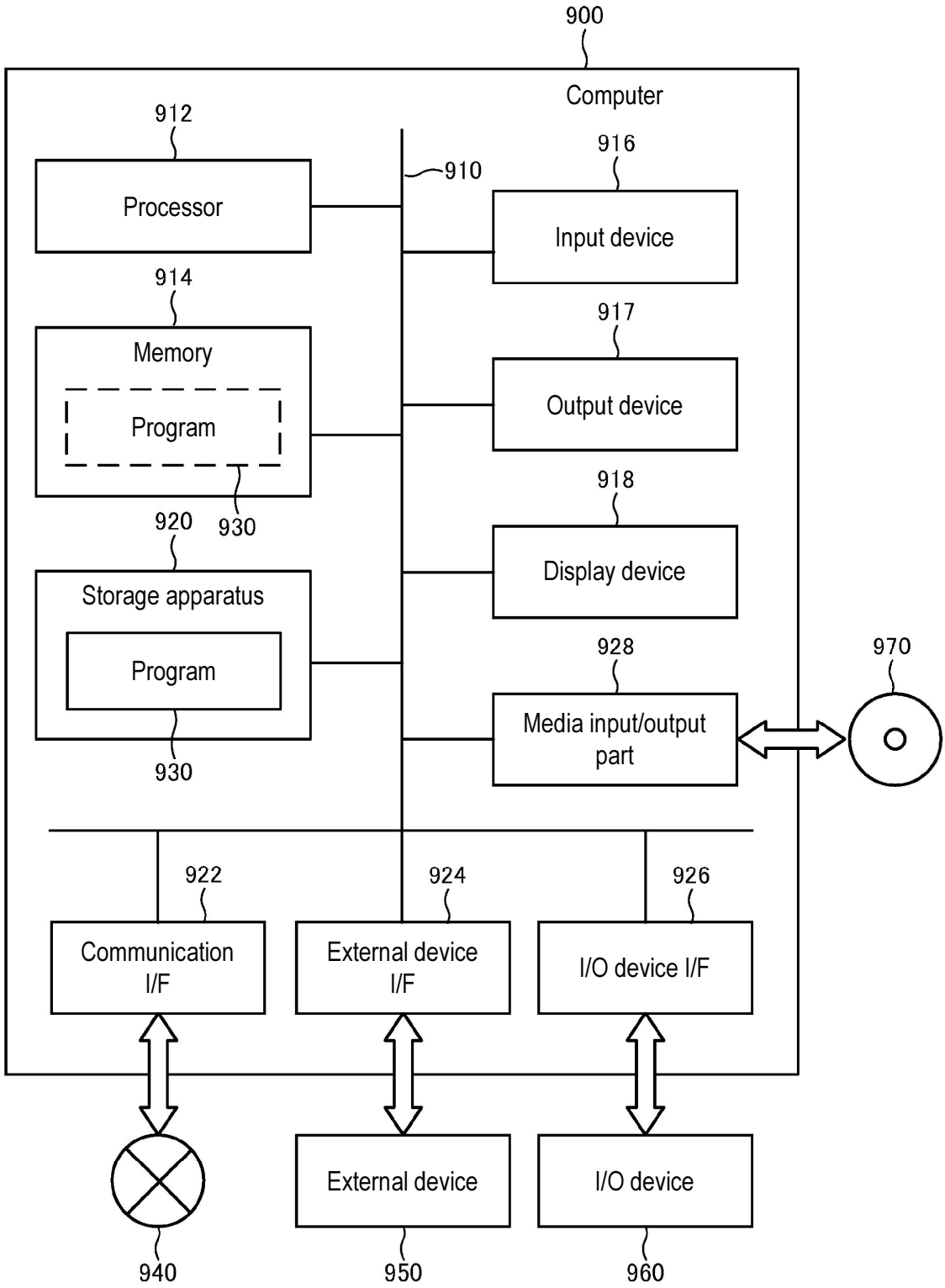

900
Computer
912
Processor
910
916
Input device
914
Memory
Program
917
Output device
920
930
Storage apparatus
Program
918
Display device
928
970
Media input/output part
930
922
924
926
Communication I/F
External device I/F
I/O device I/F
940
External device
I/O device
950
960

FIG. 8

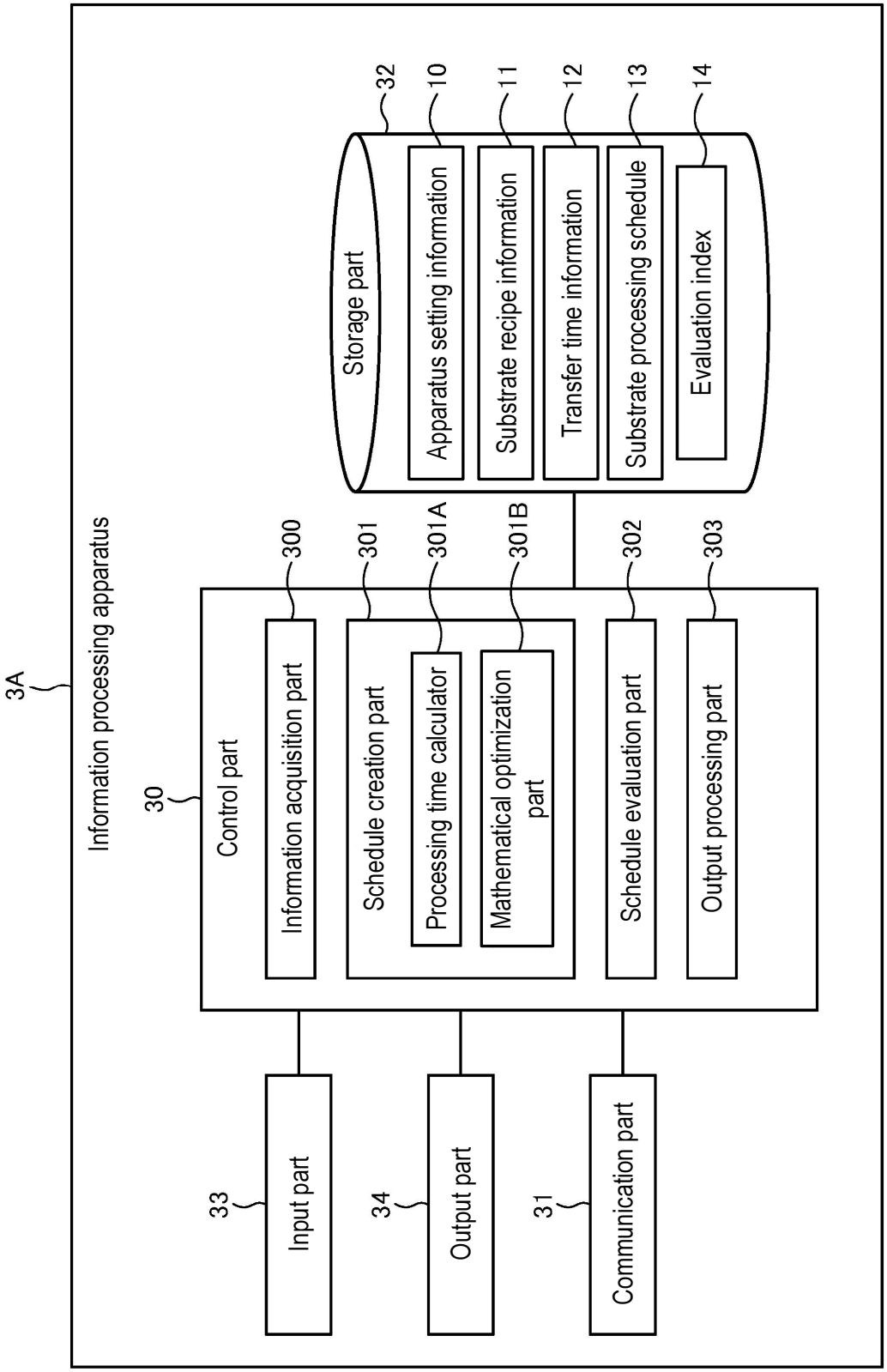

3A
Information processing apparatus
30
Control part
300
Information acquisition part
301
Schedule creation part
301A
Processing time calculator
301B
Mathematical optimization part
302
Schedule evaluation part
303
Output processing part
32
Storage part
10
Apparatus setting information
11
Substrate recipe information
12
Transfer time information
13
Substrate processing schedule
14
Evaluation index
33
Input part
34
Output part
31
Communication part

FIG. 9

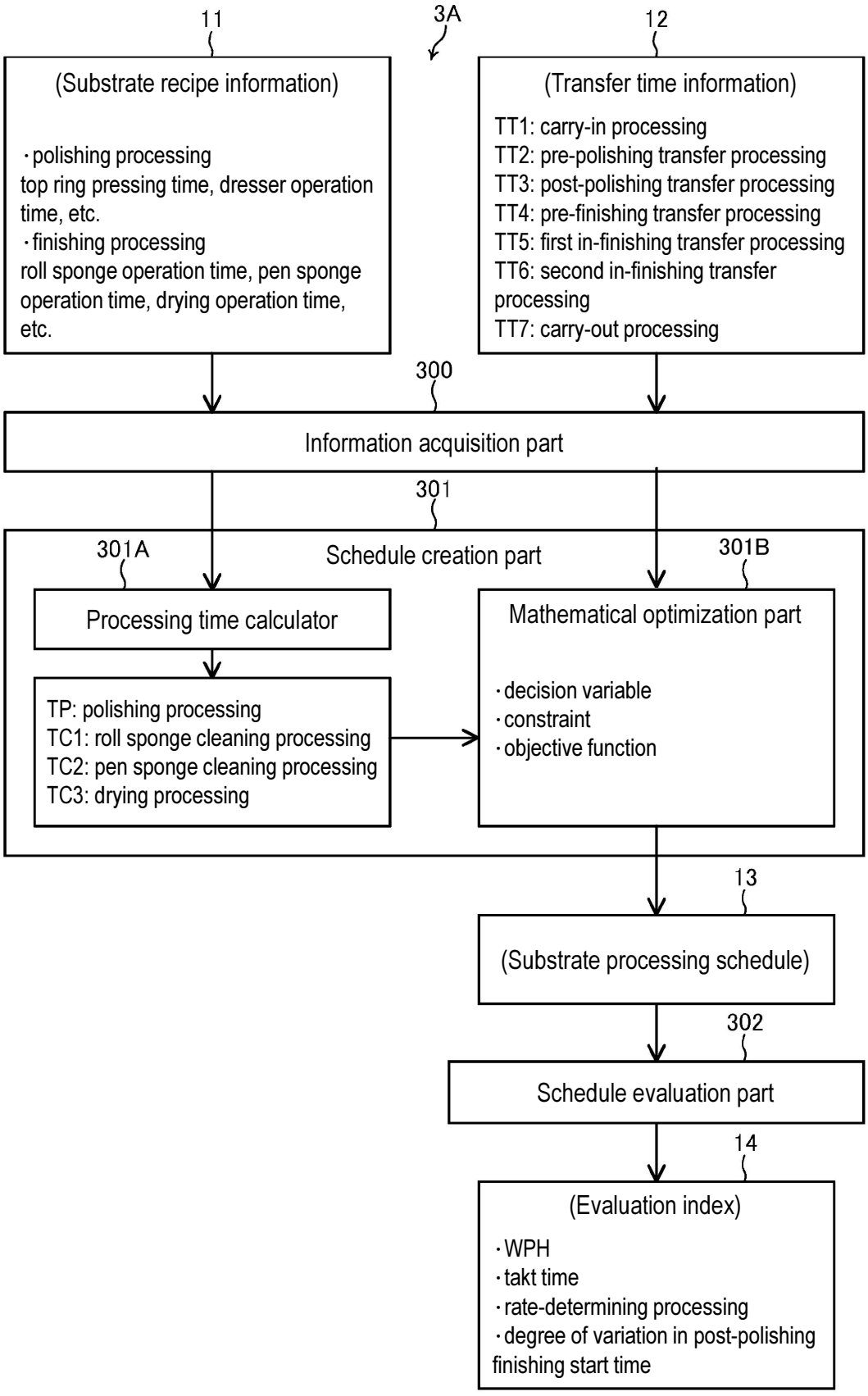
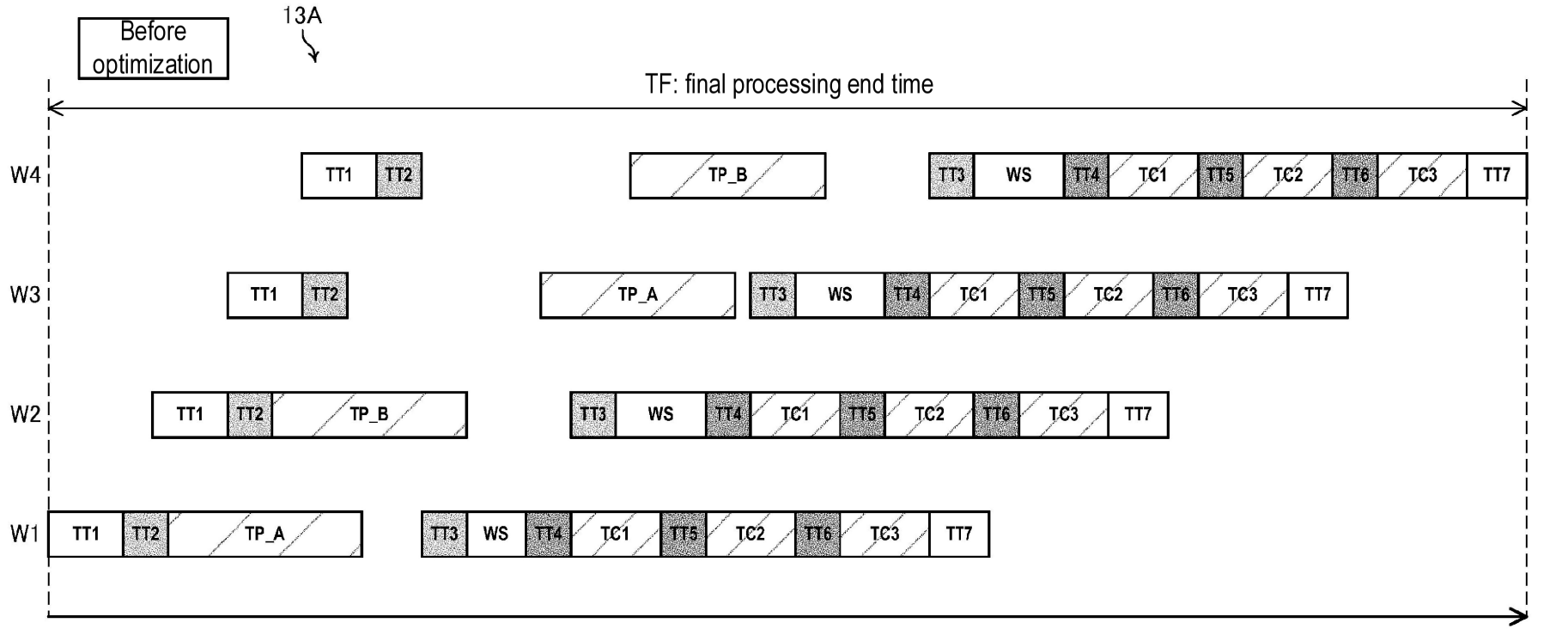

11
3A
12
(Substrate recipe information)
・polishing processing
top ring pressing time, dresser operation time, etc.
・finishing processing
roll sponge operation time, pen sponge operation time, drying operation time, etc.
(Transfer time information)
TT1: carry-in processing
TT2: pre-polishing transfer processing
TT3: post-polishing transfer processing
TT4: pre-finishing transfer processing
TT5: first in-finishing transfer processing
TT6: second in-finishing transfer processing
TT7: carry-out processing
300
Information acquisition part
301
Schedule creation part
301A
Processing time calculator
TP: polishing processing
TC1: roll sponge cleaning processing
TC2: pen sponge cleaning processing
TC3: drying processing
301B
Mathematical optimization part
・decision variable
・constraint
・objective function
13
(Substrate processing schedule)
302
Schedule evaluation part
14
(Evaluation index)
・WPH
・takt time
・rate-determining processing
・degree of variation in post-polishing finishing start time

FIG. 10



TT1: carry-in processing (carry-in/carry-out robot 211)
TT2: pre-polishing transfer processing (polishing processing transporter 240)
TP_A: polishing processing (first polishing unit 22A)
TP_B: polishing processing (second polishing unit 22B)
TT3: post-polishing transfer processing (polishing processing transporter 240)
WS: standby processing (wafer station 23D)
TT4: pre-finishing transfer processing (finishing processing transporter 241)
TC1: roll sponge cleaning processing (first finishing unit 23A)
TT5: first in-finishing transfer processing (finishing processing transporter 241)
TC2: pen sponge cleaning processing (second finishing unit 23B)
TT6: second in-finishing transfer processing (finishing processing transporter 241)
TC3: drying processing (third finishing unit 23C)
TT7: carry-out processing (carry-in/carry-out robot 211)

FIG. 11

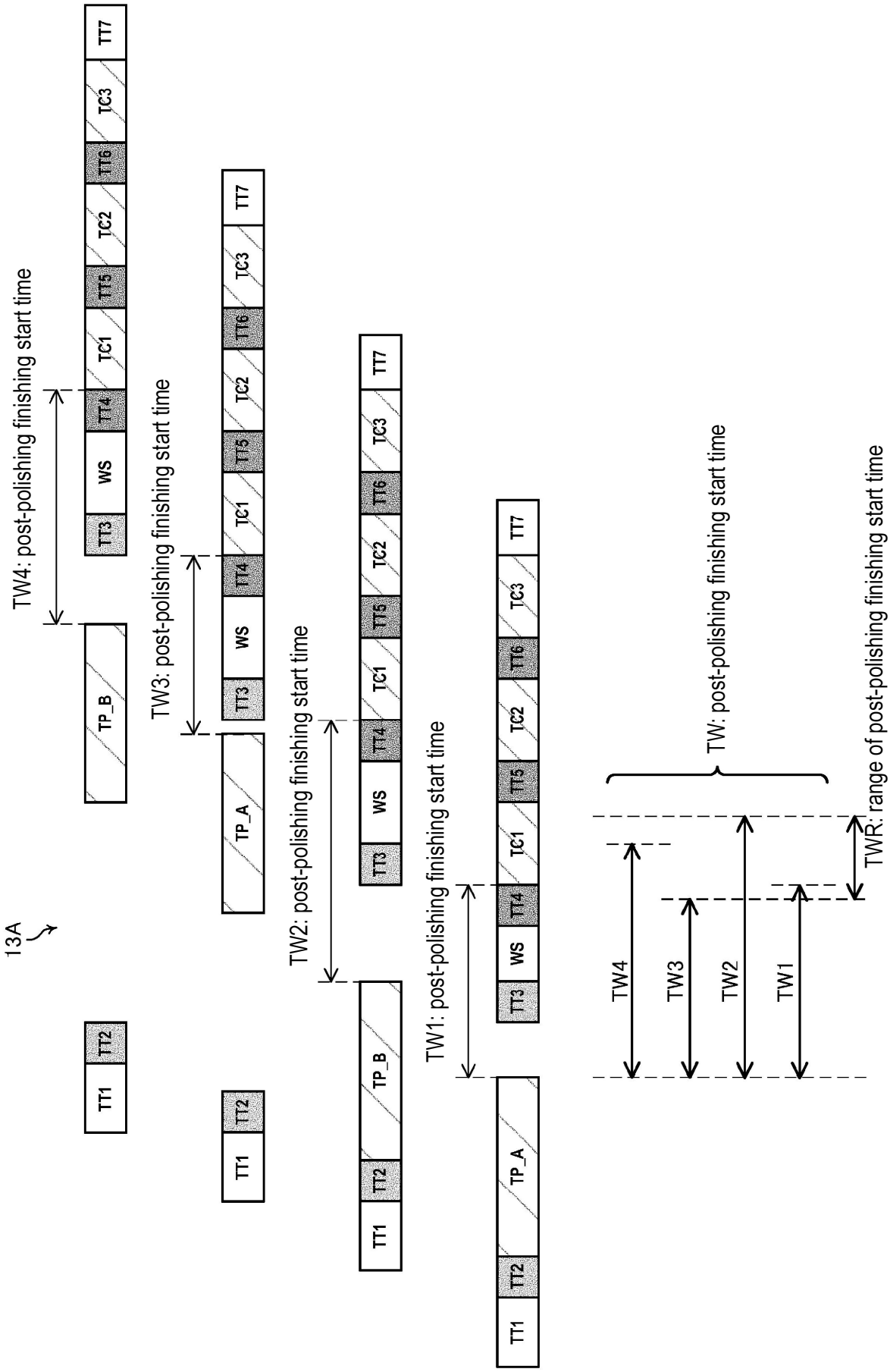
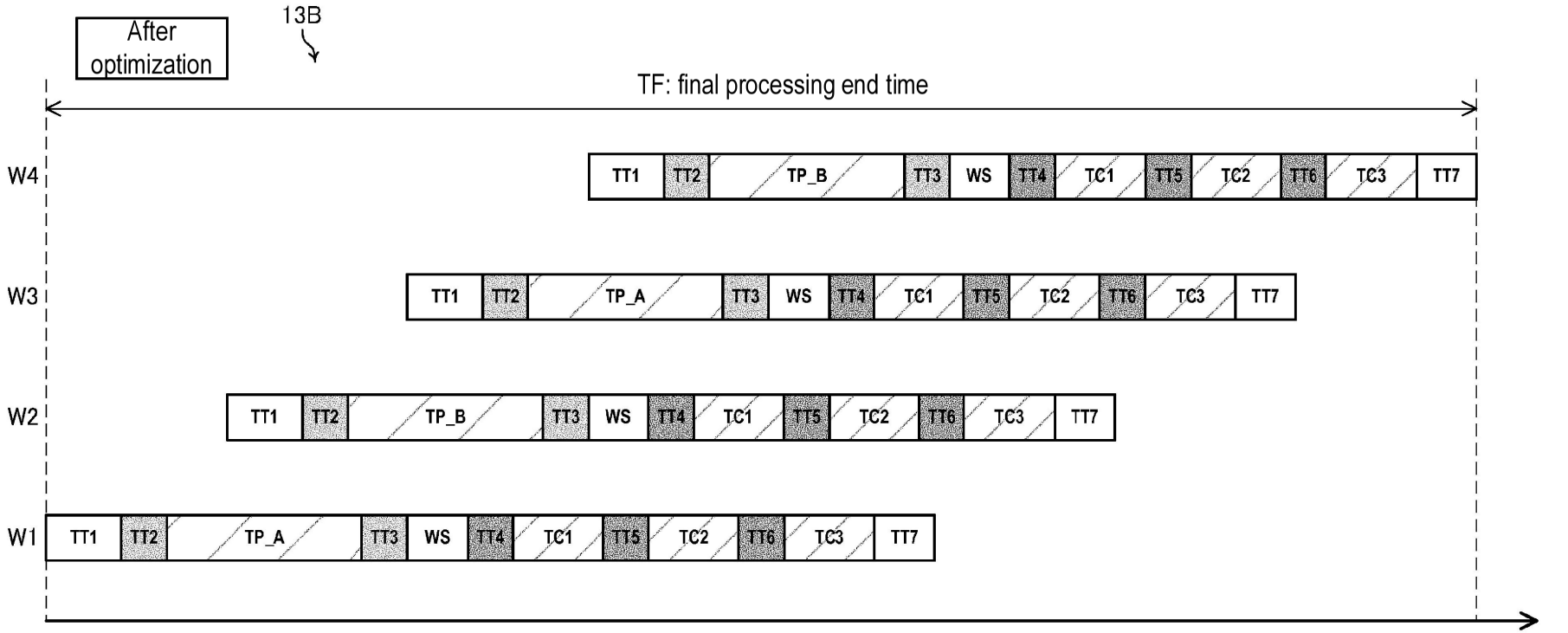

13A
TW4: post-polishing finishing start time
TW3: post-polishing finishing start time
TW2: post-polishing finishing start time
TW1: post-polishing finishing start time
TT1
TT2
TP_B
TP_A
TT3
WS
TT4
TC1
TT5
TC2
TT6
TC3
TT7
TW4
TW3
TW2
TW1
TW: post-polishing finishing start time
TWR: range of post-polishing finishing start time

FIG. 12



TT1: carry-in processing (carry-in/carry-out robot 211)
TT2: pre-polishing transfer processing (polishing processing transporter 240)
TP_A: polishing processing (first polishing unit 22A)
TP_B: polishing processing (second polishing unit 22B)
TT3: post-polishing transfer processing (polishing processing transporter 240)
WS: standby processing (wafer station 23D)
TT4: pre-finishing transfer processing (finishing processing transporter 241)
TC1: roll sponge cleaning processing (first finishing unit 23A)
TT5: first in-finishing transfer processing (finishing processing transporter 241)
TC2: pen sponge cleaning processing (second finishing unit 23B)
TT6: second in-finishing transfer processing (finishing processing transporter 241)
TC3: drying processing (third finishing unit 23C)
TT7: carry-out processing (carry-in/carry-out robot 211)

FIG. 13

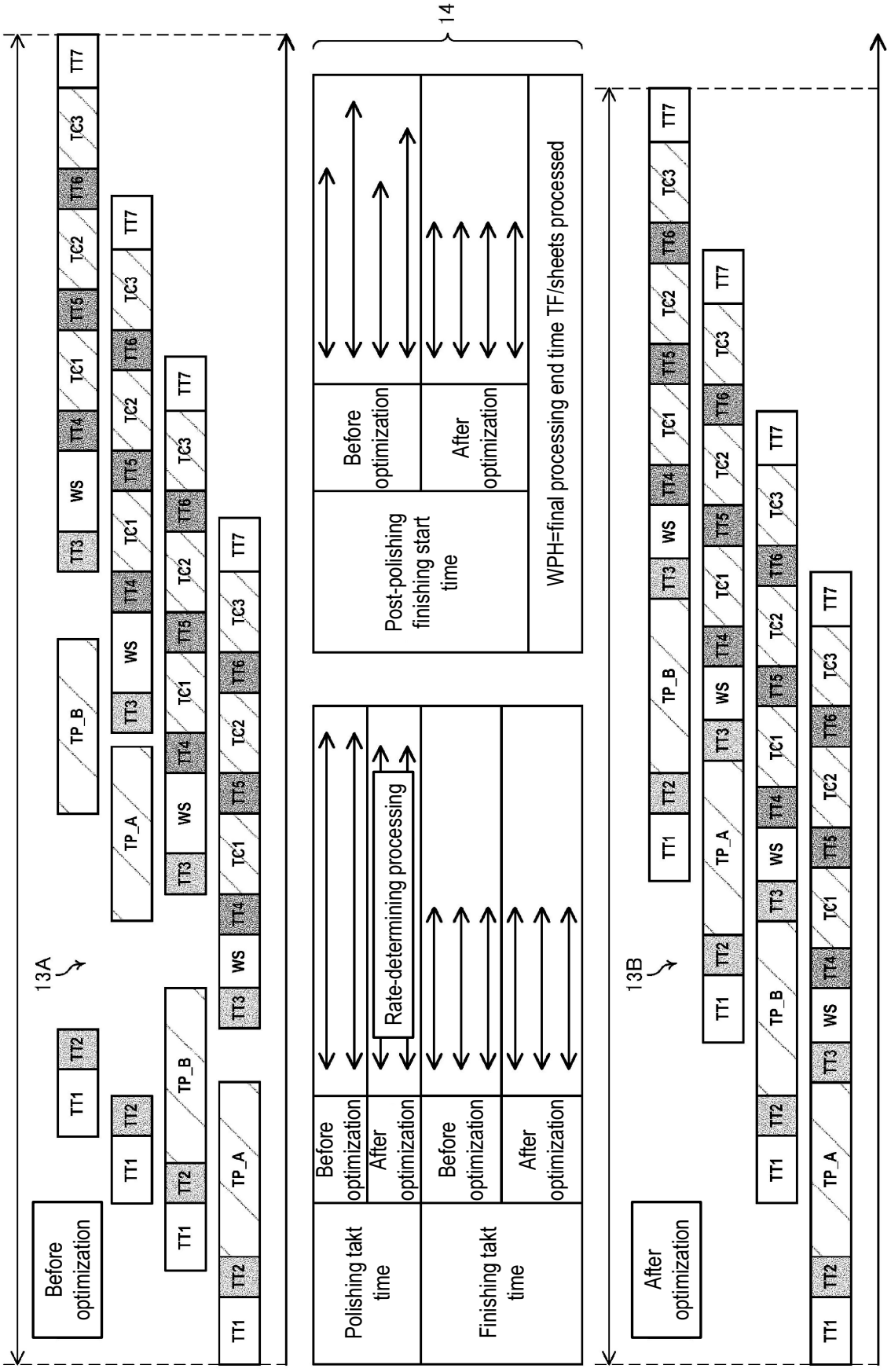

Before optimization
13A
TT1
TT2
TP_A
TP_B
TT3
WS
TT4
TC1
TT5
TC2
TT6
TC3
TT7
14
Polishing takt time
Finishing takt time
Before optimization
After optimization
Rate-determining processing
Post-polishing finishing start time
WPH=final processing end time TF/sheets processed
13B
After optimization

FIG. 14

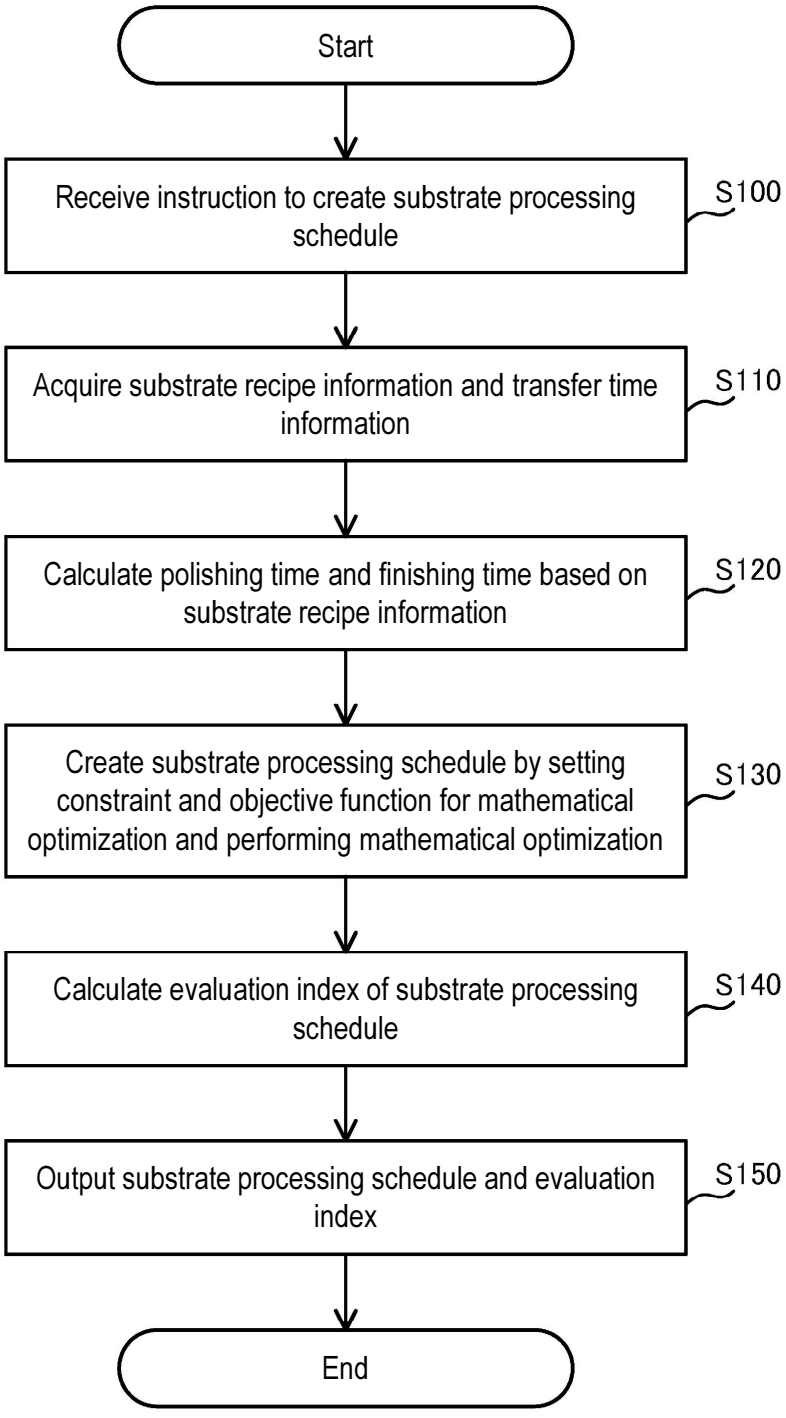

Start
Receive instruction to create substrate processing schedule
S100
Acquire substrate recipe information and transfer time information
S110
Calculate polishing time and finishing time based on substrate recipe information
S120
Create substrate processing schedule by setting constraint and objective function for mathematical optimization and performing mathematical optimization
S130
Calculate evaluation index of substrate processing schedule
S140
Output substrate processing schedule and evaluation index
S150
End

FIG. 15

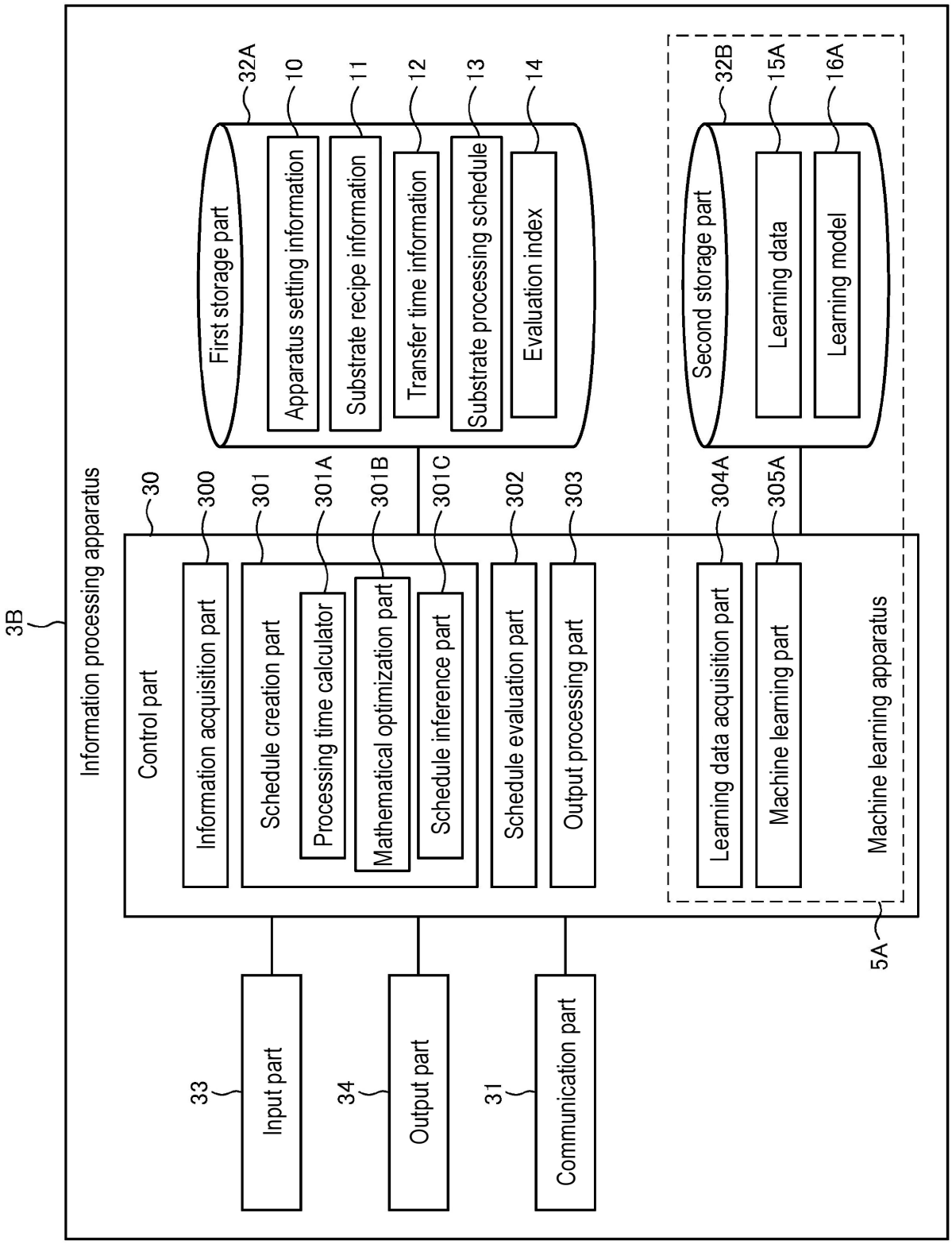

3B
Information processing apparatus
Control part
30
Information acquisition part
300
Schedule creation part
301
Processing time calculator
301A
Mathematical optimization part
301B
Schedule inference part
301C
Schedule evaluation part
302
Output processing part
303
First storage part
32A
Apparatus setting information
10
Substrate recipe information
11
Transfer time information
12
Substrate processing schedule
13
Evaluation index
14
Machine learning apparatus
5A
Learning data acquisition part
304A
Machine learning part
305A
Second storage part
32B
Learning data
15A
Learning model
16A
Input part
33
Output part
34
Communication part
31

FIG. 16

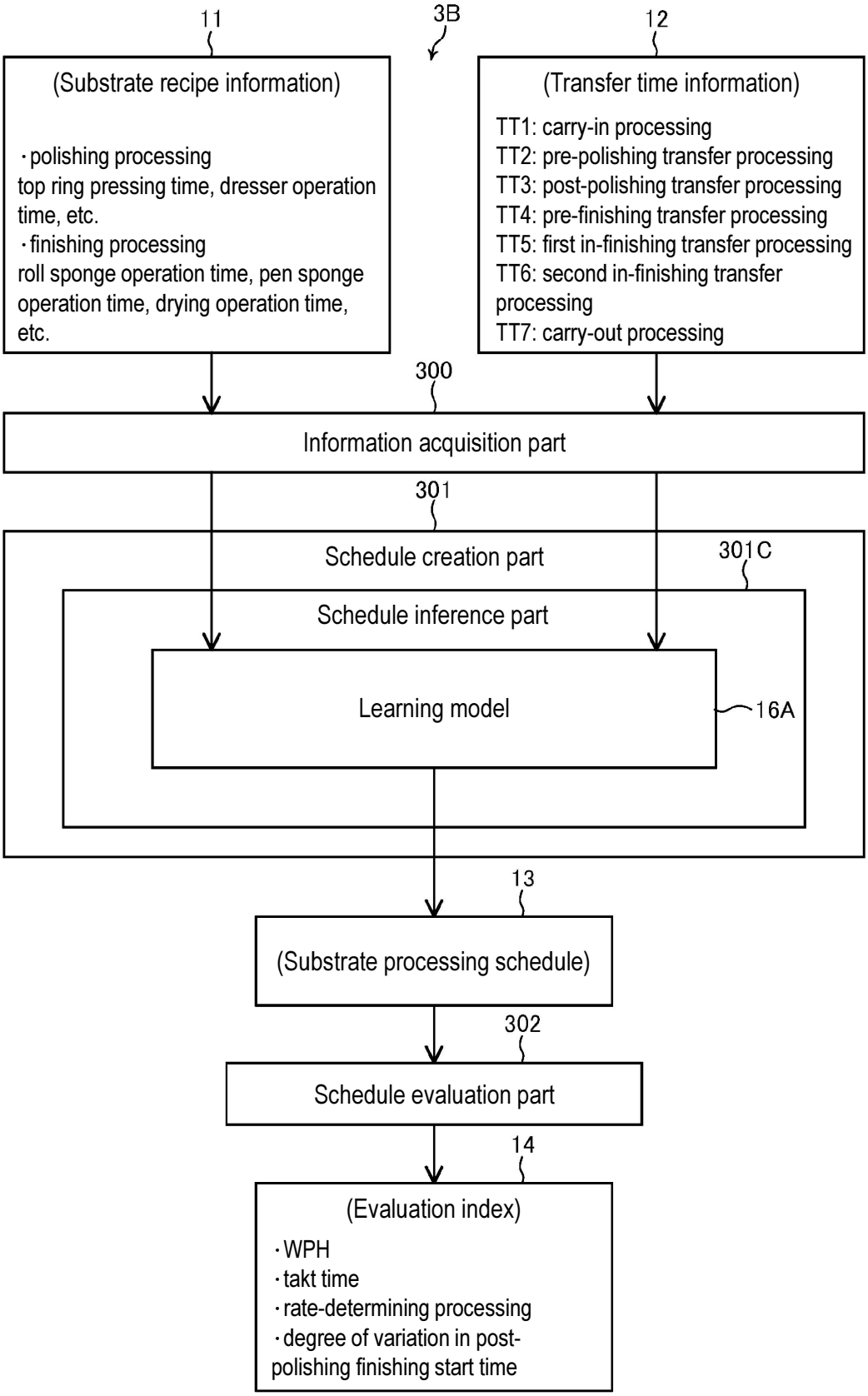

11
3B
12
(Substrate recipe information)
・polishing processing
top ring pressing time, dresser operation time, etc.
・finishing processing
roll sponge operation time, pen sponge operation time, drying operation time, etc.
(Transfer time information)
TT1: carry-in processing
TT2: pre-polishing transfer processing
TT3: post-polishing transfer processing
TT4: pre-finishing transfer processing
TT5: first in-finishing transfer processing
TT6: second in-finishing transfer processing
TT7: carry-out processing
300
Information acquisition part
301
Schedule creation part
301C
Schedule inference part
Learning model
16A
13
(Substrate processing schedule)
302
Schedule evaluation part
14
(Evaluation index)
・WPH
・takt time
・rate-determining processing
・degree of variation in post-polishing finishing start time

FIG. 17

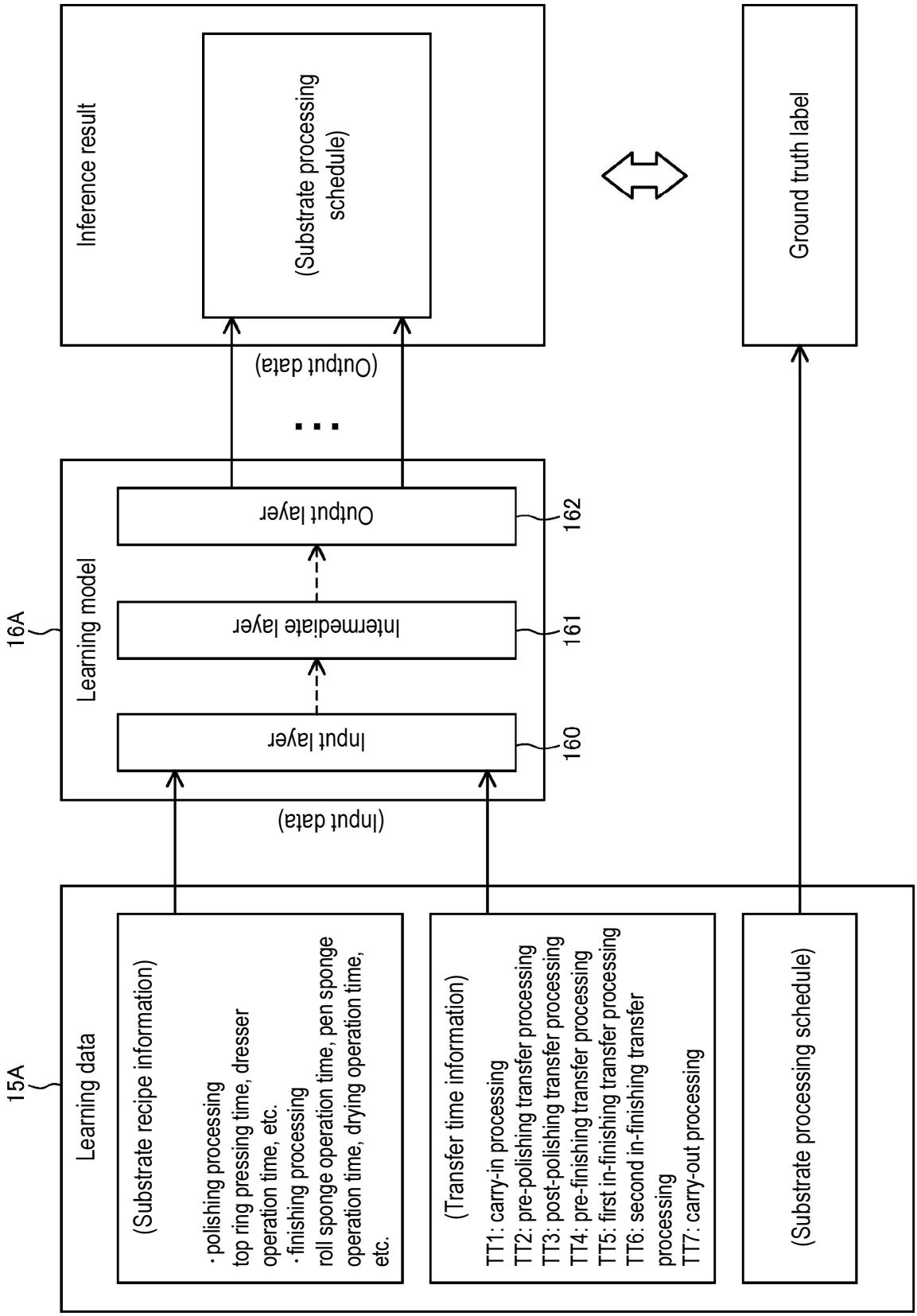

15A
Learning data
(Substrate recipe information)
・polishing processing
top ring pressing time, dresser operation time, etc.
・finishing processing
roll sponge operation time, pen sponge operation time, drying operation time, etc.
(Transfer time information)
TT1: carry-in processing
TT2: pre-polishing transfer processing
TT3: post-polishing transfer processing
TT4: pre-finishing transfer processing
TT5: first in-finishing transfer processing
TT6: second in-finishing transfer processing
TT7: carry-out processing
(Substrate processing schedule)
(Input data)
16A
Learning model
Input layer
160
Intermediate layer
161
Output layer
162
(Output data)
Inference result
(Substrate processing schedule)
Ground truth label

FIG. 18

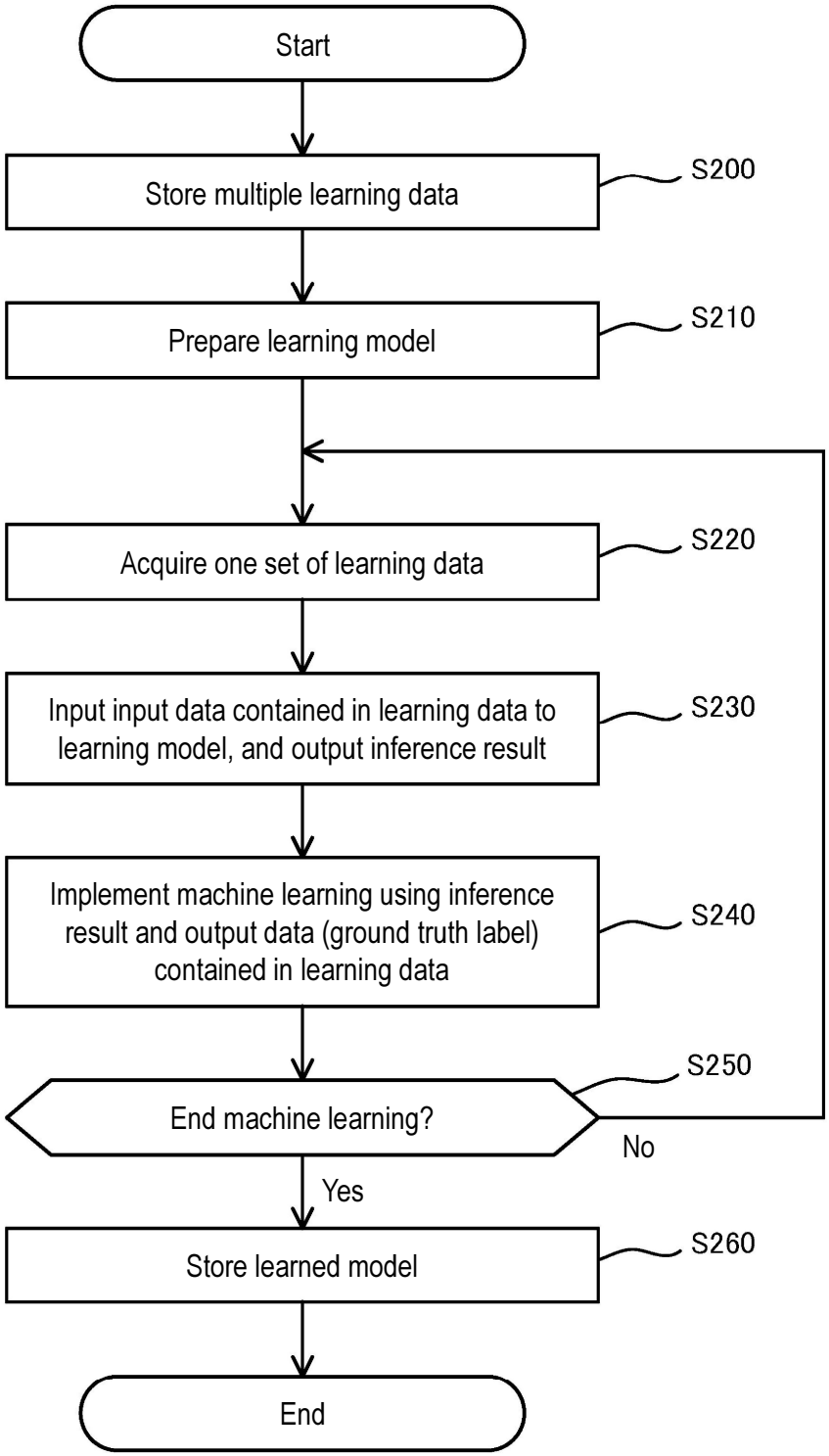

Start
Store multiple learning data
S200
Prepare learning model
S210
Acquire one set of learning data
S220
Input input data contained in learning data to learning model, and output inference result
S230
Implement machine learning using inference result and output data (ground truth label) contained in learning data
S240
End machine learning?
S250
No
Yes
Store learned model
S260
End

FIG. 19

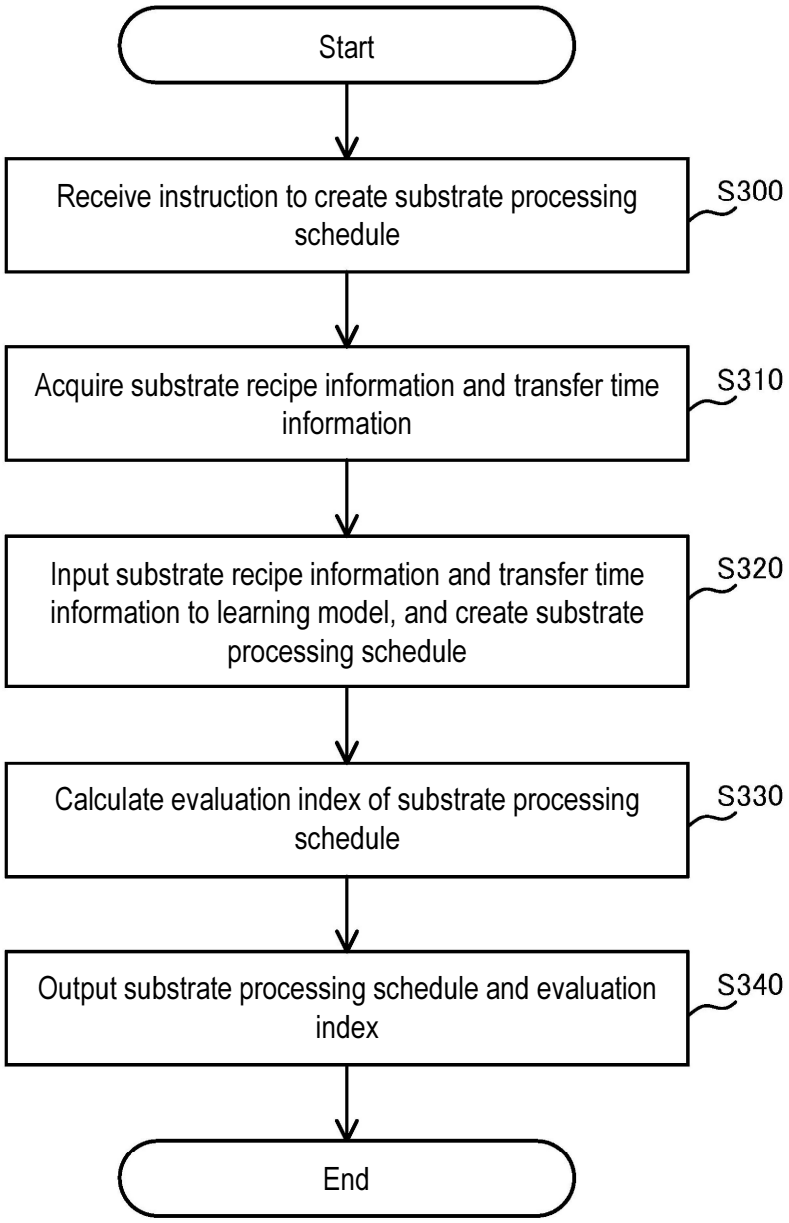

Start
Receive instruction to create substrate processing schedule
S300
Acquire substrate recipe information and transfer time information
S310
Input substrate recipe information and transfer time information to learning model, and create substrate processing schedule
S320
Calculate evaluation index of substrate processing schedule
S330
Output substrate processing schedule and evaluation index
S340
End

FIG. 20

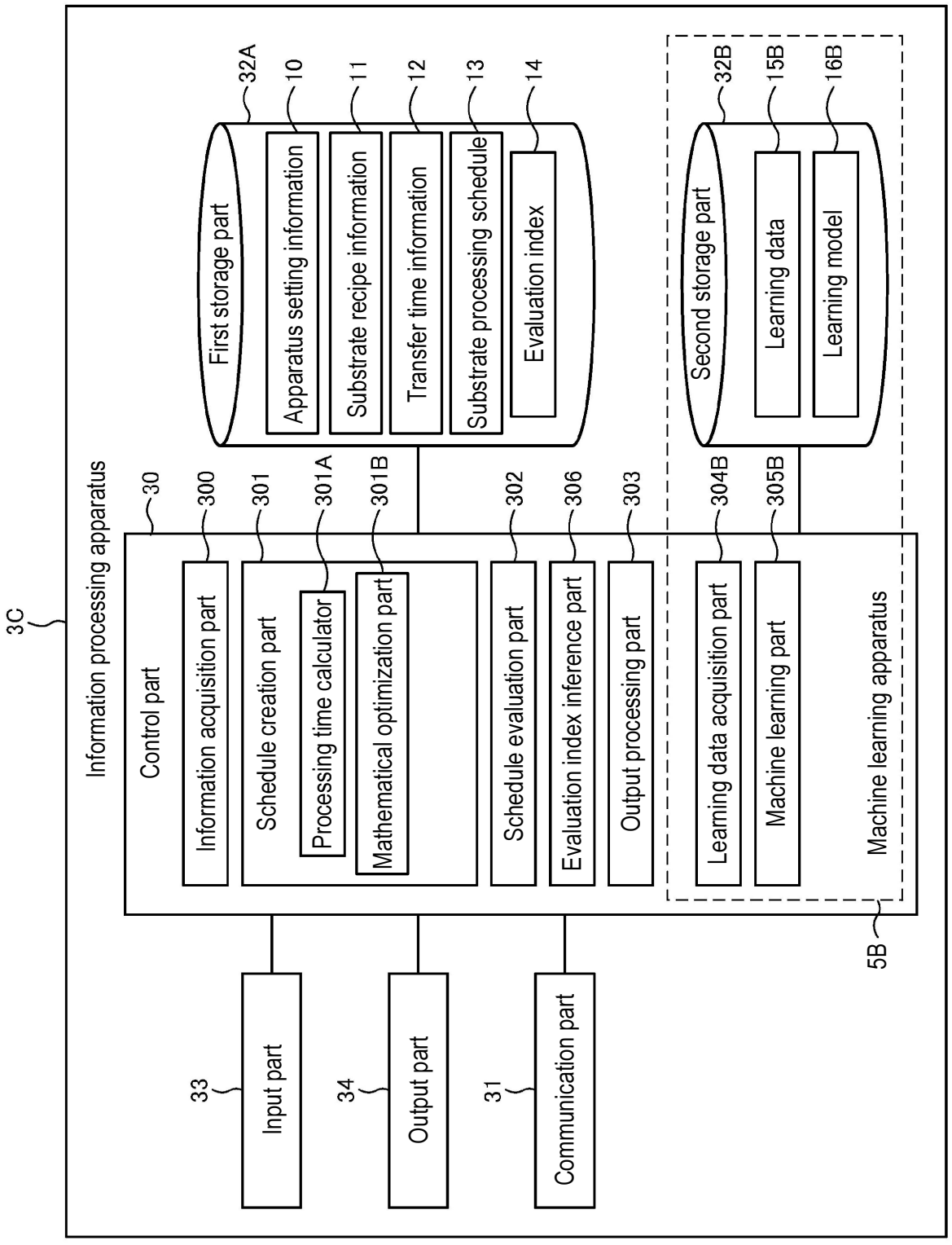

3C
Information processing apparatus
Control part
30
Information acquisition part
300
Schedule creation part
301
Processing time calculator
301A
Mathematical optimization part
301B
Schedule evaluation part
302
Evaluation index inference part
306
Output processing part
303
Learning data acquisition part
304B
Machine learning part
305B
Machine learning apparatus
5B
First storage part
32A
Apparatus setting information
10
Substrate recipe information
11
Transfer time information
12
Substrate processing schedule
13
Evaluation index
14
Second storage part
32B
Learning data
15B
Learning model
16B
Input part
33
Output part
34
Communication part
31

FIG. 21

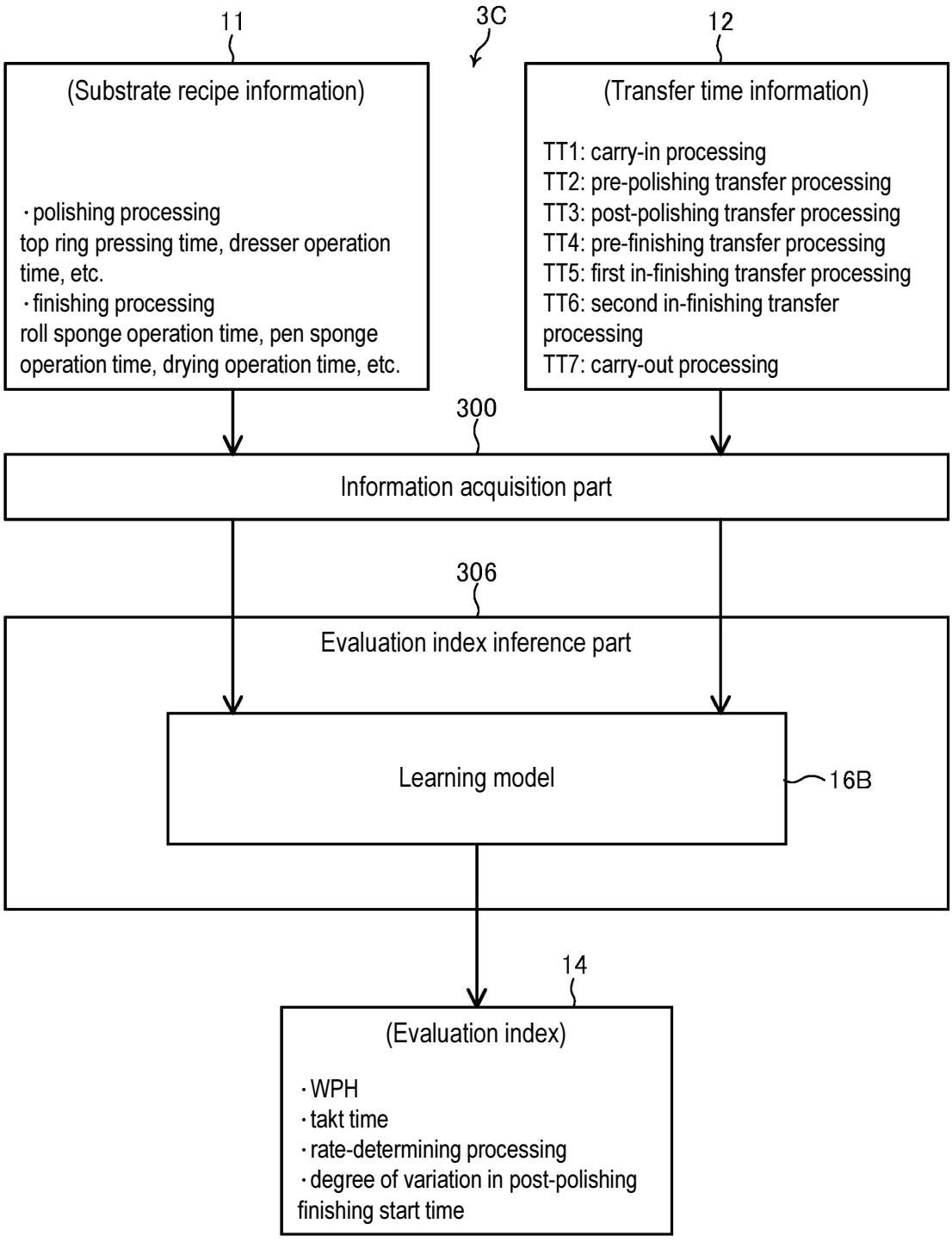

11
3C
12
(Substrate recipe information)
・polishing processing
top ring pressing time, dresser operation time, etc.
・finishing processing
roll sponge operation time, pen sponge operation time, drying operation time, etc.
(Transfer time information)
TT1: carry-in processing
TT2: pre-polishing transfer processing
TT3: post-polishing transfer processing
TT4: pre-finishing transfer processing
TT5: first in-finishing transfer processing
TT6: second in-finishing transfer processing
TT7: carry-out processing
300
Information acquisition part
306
Evaluation index inference part
Learning model
16B
14
(Evaluation index)
・WPH
・takt time
・rate-determining processing
・degree of variation in post-polishing finishing start time

FIG. 22

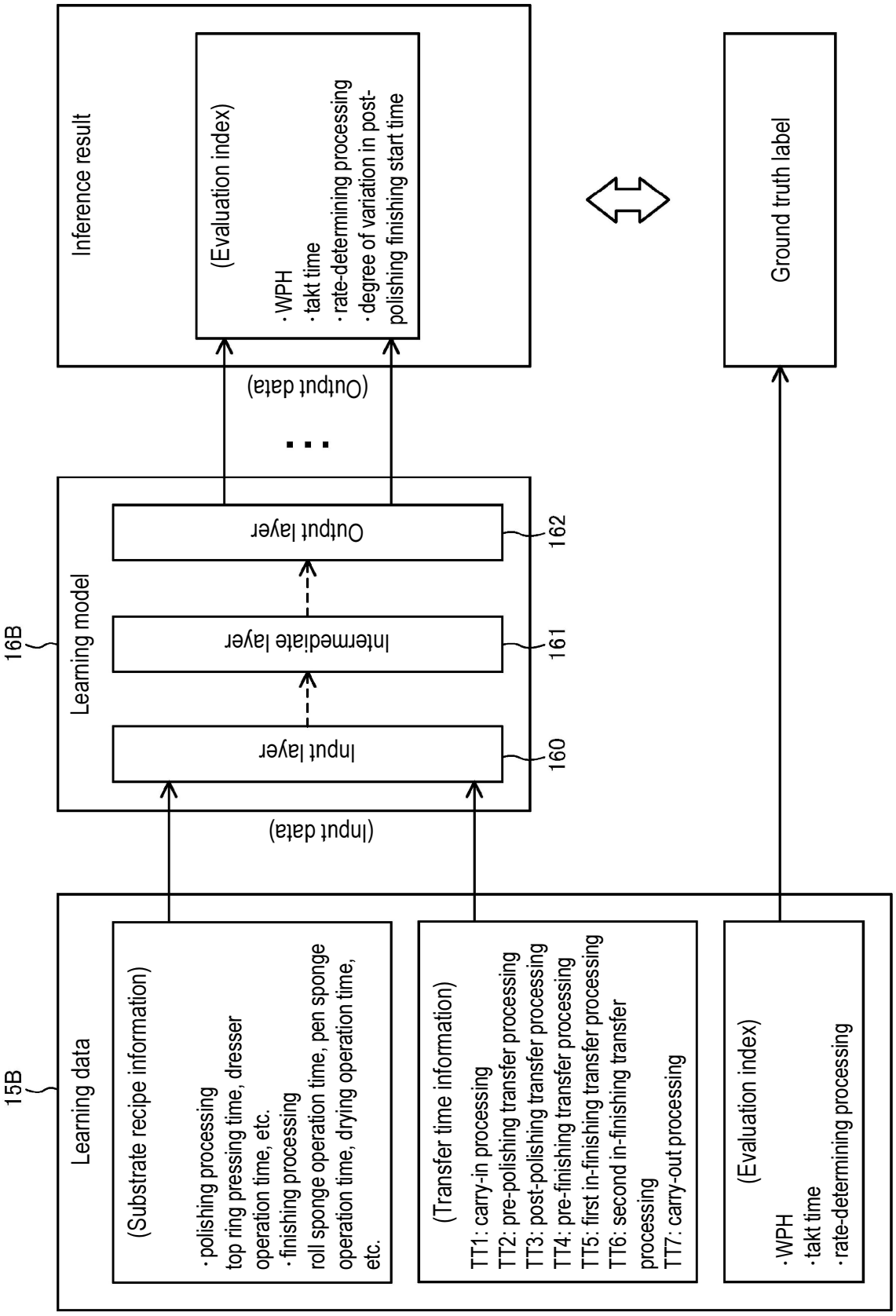

15B
Learning data
(Substrate recipe information)
・polishing processing
top ring pressing time, dresser
operation time, etc.
・finishing processing
roll sponge operation time, pen sponge
operation time, drying operation time,
etc.
(Transfer time information)
TT1: carry-in processing
TT2: pre-polishing transfer processing
TT3: post-polishing transfer processing
TT4: pre-finishing transfer processing
TT5: first in-finishing transfer processing
TT6: second in-finishing transfer
processing
TT7: carry-out processing
(Evaluation index)
・WPH
・takt time
・rate-determining processing
(Input data)
16B
Learning model
Input layer
160
Intermediate layer
161
Output layer
162
(Output data)
Inference result
(Evaluation index)
・WPH
・takt time
・rate-determining processing
・degree of variation in post-
polishing finishing start time
Ground truth label

FIG. 23

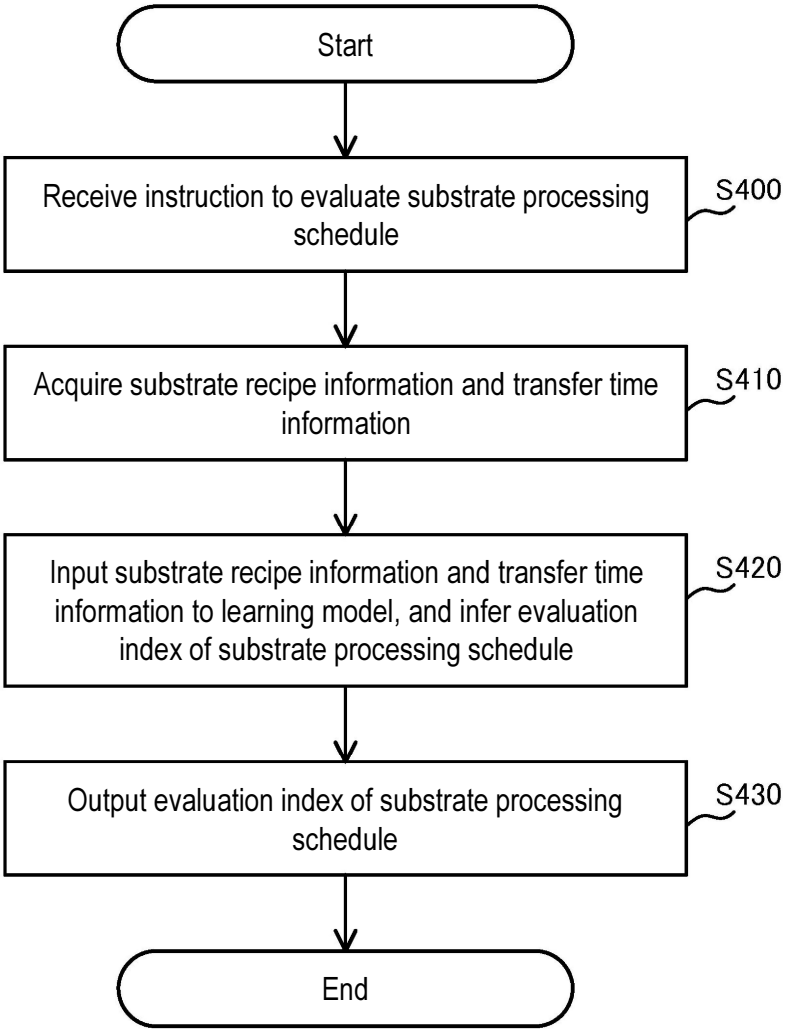

Start
Receive instruction to evaluate substrate processing schedule
S400
Acquire substrate recipe information and transfer time information
S410
Input substrate recipe information and transfer time information to learning model, and infer evaluation index of substrate processing schedule
S420
Output evaluation index of substrate processing schedule
S430
End

FIG. 24