

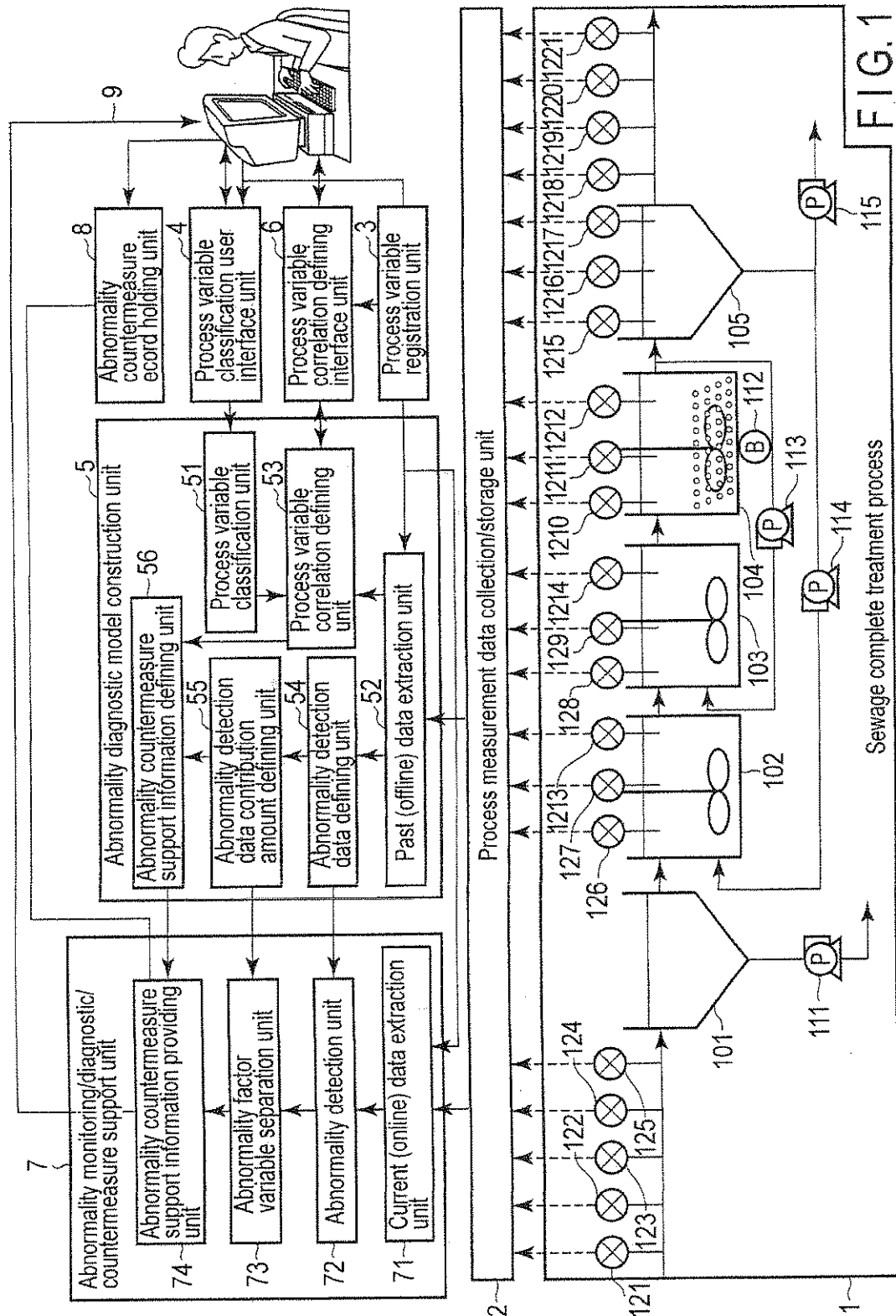


FIG. 1

Number	Variable name	Input variable	Output variable	Intermediate variable
[1]	Air supply amount	○		
[2]	Circulating flow rate	○		
[3]	Return flow rate	○		
[4]	Excess flow rate	○		
[5]	Rainfall			○
[6]	Sewage inflow amount			○
[7]	Influent TN			○
[8]	Influent TP			○
[9]	Influent UV			○
[10]	Anaerobic tank ORP			○
[11]	Anaerobic tank pH			○
[12]	Anoxic tank ORP			○
[13]	Anoxic tank pH			○
[14]	Aerobic PO4-P			○
[15]	Aerobic tank DO			○
[16]	Aerobic tank NH4-N			○
[17]	Aerobic tank MLSS			○
[18]	Reaction tank water temperature			○
[19]	Effluent TN		○	
[20]	Effluent TP		○	

FIG. 2

■ Example 1 of correlation determination rule

```

For k=1:n
  For j=1:n
    If | S(k,j) | > Th
      SS(k,j)=Correlation is present
    Else
      SS(k,j)=Correlation is absent
    End
  End
End
End

```

FIG. 3

■ Example 2 of correlation determination rule

```

For k=1:n
  For j=1:n
    If | S(k,j) | > Th1
      SS(k,j)=Strong correlation
    Else if | S(k,j) | > Th2
      SS(k,j)=Weak correlation
    Else
      SS(k,j)=Correlation is absent
    End
  End
End
End

```

FIG. 4

■ Example 3 of correlation determination rule

```

For k=1:n
  For j=1:n
    If  $|P(k,j)| > 1/n$ 
      SS(k,j)=Correlation is present
    Else
      SS(k,j)=Correlation is absent
    End
  End
End
End

```

FIG. 5

■ Abnormality factor candidate classification rule

```

FU=[];
FZ=[];
FY=[];
For k=1:3
  If  $FX(k) \in U$ 
    FU=[FU FX(k)];
  ElseIf  $FX(k) \in X$ 
    FZ=[FZ FX(k)];
  ElseIf  $FX(k) \in Y$ 
    FY=[FY FX(k)];
  End
End
End

```

FIG. 7

	Input variable U				Intermediate variable Z										Output variable Y						
	Air supply amount	Circulating flow rate	Return flow rate	Excess flow rate	Rainfall	Sewage inflow amount	Influent TN	Influent TP	Influent UV	Anaerobic tank ORP	Anaerobic tank pH	Anoxic tank ORP	Anoxic tank pH	Aerobic tank PO4-P	Aerobic tank DO	Aerobic tank NH4-N	Aerobic tank MLSS	Reaction tank water temperature	Effluent TN	Effluent TP	
Input variable U	▨	×	×	×	○	○	○	○	○	×	×	×	×	○	○	○	×	×	×	○	○
	×	▨	×	▨	○	○	×	×	×	×	×	○	×	×	×	×	×	×	○	○	
	×	×	▨	▨	○	○	×	×	×	×	×	×	×	○	×	×	×	×	○	○	
	×	×	×	▨	×	○	×	×	×	×	×	×	×	○	×	×	×	×	○	○	
Intermediate variable Z	○	○	○	×	▨	○	×	○	○	×	○	○	○	×	×	×	×	○	○	○	
	○	○	○	×	▨	▨	×	○	○	×	○	○	○	×	×	×	×	○	○	○	
	○	○	○	×	○	×	▨	○	○	×	○	○	○	×	×	×	○	×	○	○	
	○	○	○	×	○	×	▨	○	○	×	○	○	○	×	×	×	○	×	○	○	
	○	○	○	×	○	×	▨	○	○	×	○	○	○	×	×	×	○	×	○	○	
	○	○	○	×	○	×	▨	○	○	×	○	○	○	×	×	×	○	×	○	○	
	○	○	○	×	○	×	▨	○	○	×	○	○	○	×	×	×	○	×	○	○	
	○	○	○	×	○	×	▨	○	○	×	○	○	○	×	×	×	○	×	○	○	
	○	○	○	×	○	×	▨	○	○	×	○	○	○	×	×	×	○	×	○	○	
	○	○	○	×	○	×	▨	○	○	×	○	○	○	×	×	×	○	×	○	○	
	○	○	○	×	○	×	▨	○	○	×	○	○	○	×	×	×	○	×	○	○	
	○	○	○	×	○	×	▨	○	○	×	○	○	○	×	×	×	○	×	○	○	
	○	○	○	×	○	×	▨	○	○	×	○	○	○	×	×	×	○	×	○	○	
	○	○	○	×	○	×	▨	○	○	×	○	○	○	×	×	×	○	×	○	○	
Output variable Y	○	○	○	×	○	○	○	○	○	×	○	○	○	×	×	×	○	○	○	▨	▨
	○	○	○	×	○	○	○	○	○	×	○	○	○	×	×	×	○	○	○	○	○
	○	○	○	×	○	○	○	○	○	×	○	○	○	×	×	×	○	○	○	○	○
	○	○	○	×	○	○	○	○	○	×	○	○	○	×	×	×	○	○	○	○	○

FIG.6

■Example of abnormality countermeasure support message generation rule (template)

```

If FX contains FY
  For each k
    Message( 'There is a sign of abnormality in performance index FY(k).' )
    Find correlated variables of FY(k) and store them to CV
    If CV contains input variable(s) U
      If the input variable(s) U contains FU
        MU=contained FU
        Message( 'Abnormality in performance index FY(k) occurs due to MU
          at high probability. Please contemplate revising manipulated
          variable MU.' )
      End
      MU1=U-MU
      Message( 'Abnormality factor of performance index FY(k) may be MU1.
        Please check manipulated variable MU1 as a precaution.' )
    End
    If CV contains hidden variable(s) Z
      If the hidden variable(s) Z contains FZ
        MZ=contained FZ
        Message( 'Abnormality in performance index FY(k) occurs due to MZ
          at high probability. Please properly manage control value
          MZ.' )
      End
      MZ1=Z-MZ
      Message( 'Abnormality factor of performance index FY(k) may be MZ1.
        Please check control value MZ1 as a precaution.' )
    End
  End
End
If FX contains FU which are not correlated FY
  For each k
    Message( 'There is a sign of abnormality in manipulated variable FU(k).
      Please check FU(k).' )
    Find correlated variables of FU(k) and store them to CV
  
```

A

A

FIG. 8

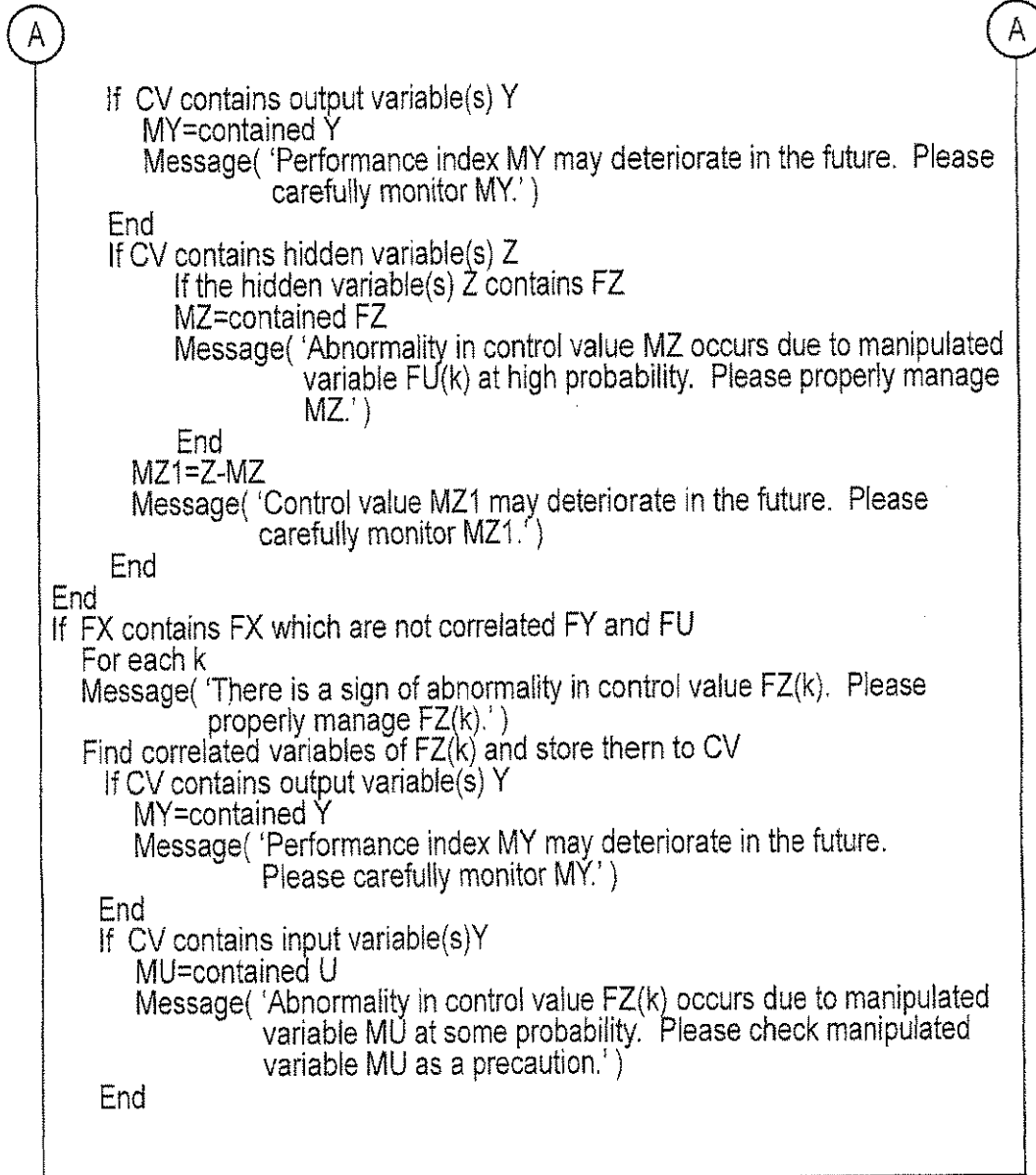


FIG. 9

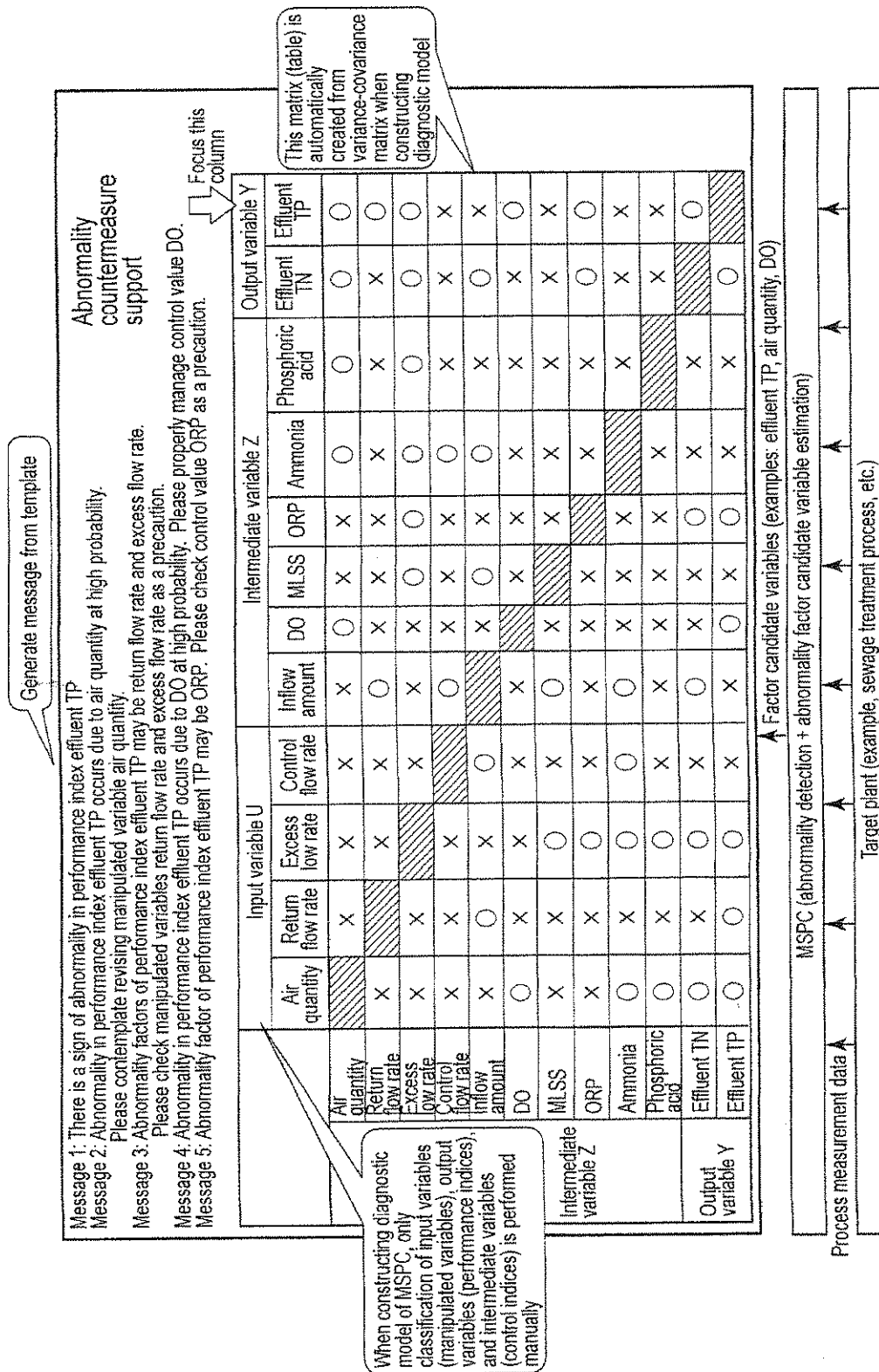


FIG. 10

■ Examples of countermeasure support message

Message 1: There is a sign of abnormality in performance index effluent TP

Message 2: Abnormality in performance index effluent TP occurs due to air quantity at high probability.

Please contemplate revising manipulated variable air quantity.

Message 3: Abnormality factors of performance index effluent TP may be return flow rate and excess flow rate.

Please check manipulated variables return flow rate and excess flow rate as a precaution.

Message 4: Abnormality in performance index effluent TP occurs due to DO at high probability. Please properly manage control value DO.

Message 5: Abnormality factor of performance index effluent TP may be ORP. Please check control value ORP as a precaution.

FIG. 11

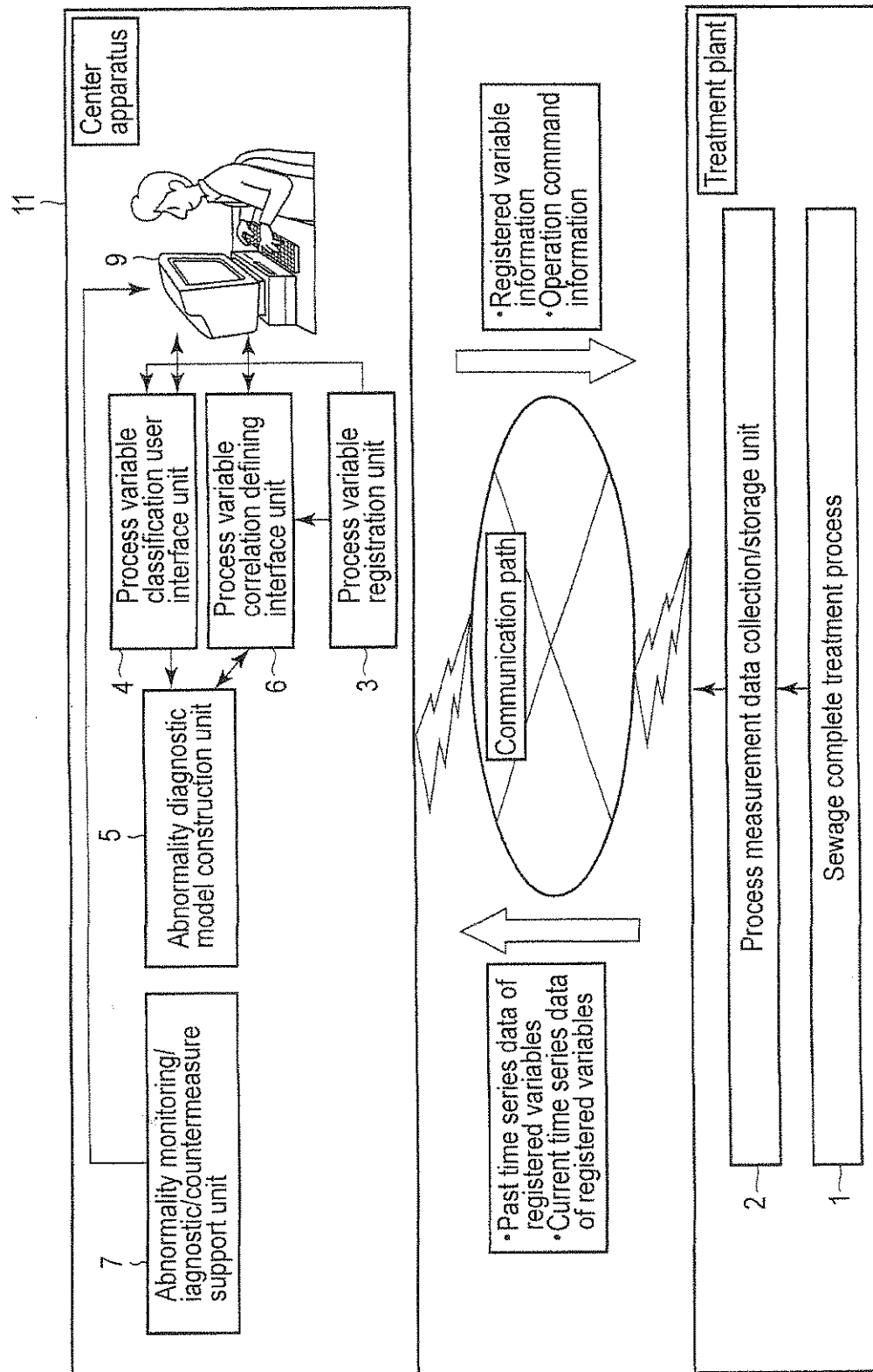


FIG. 12

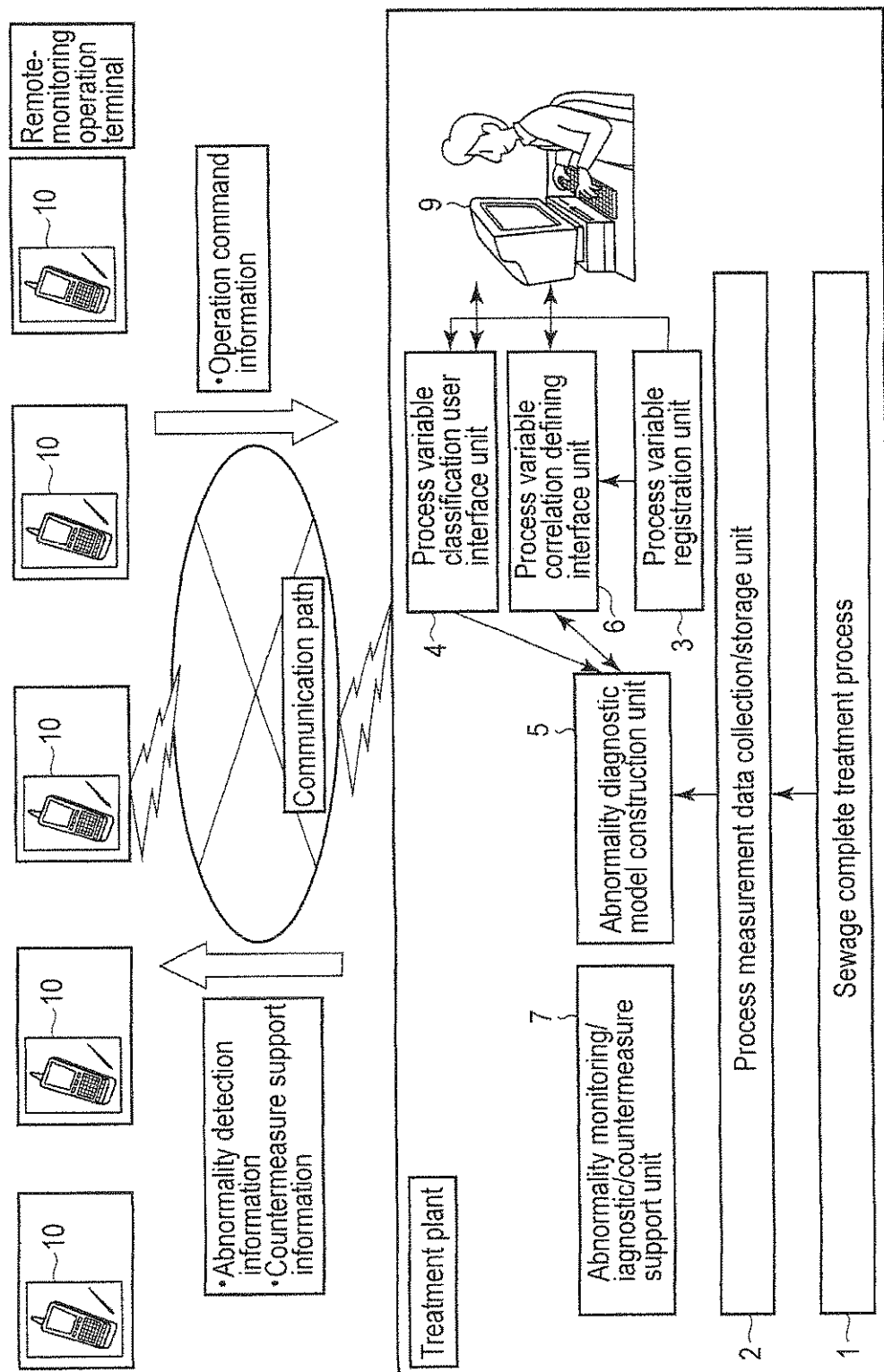


FIG. 13

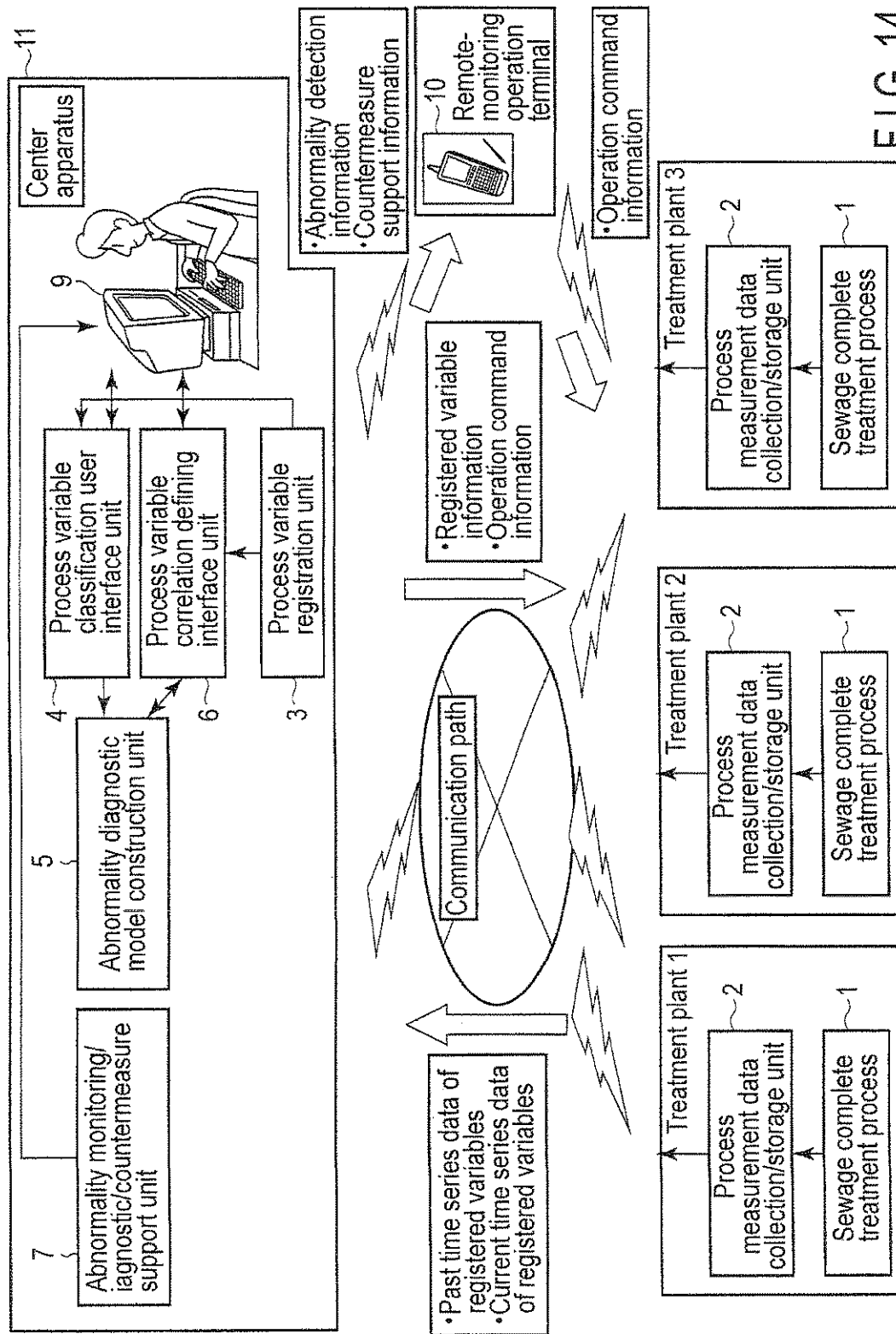


FIG. 14