PCT/IB2008/003467

SHEET 1/17

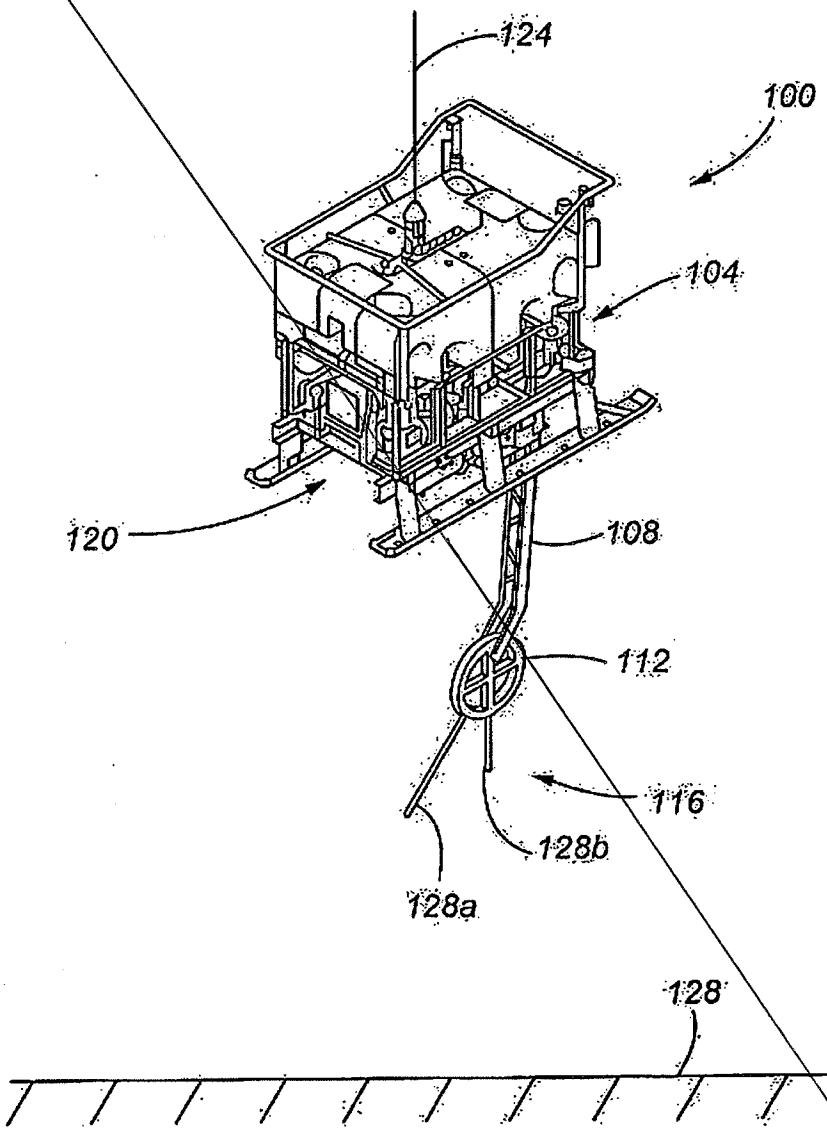


Fig. 1

PCT/IB2008/003467

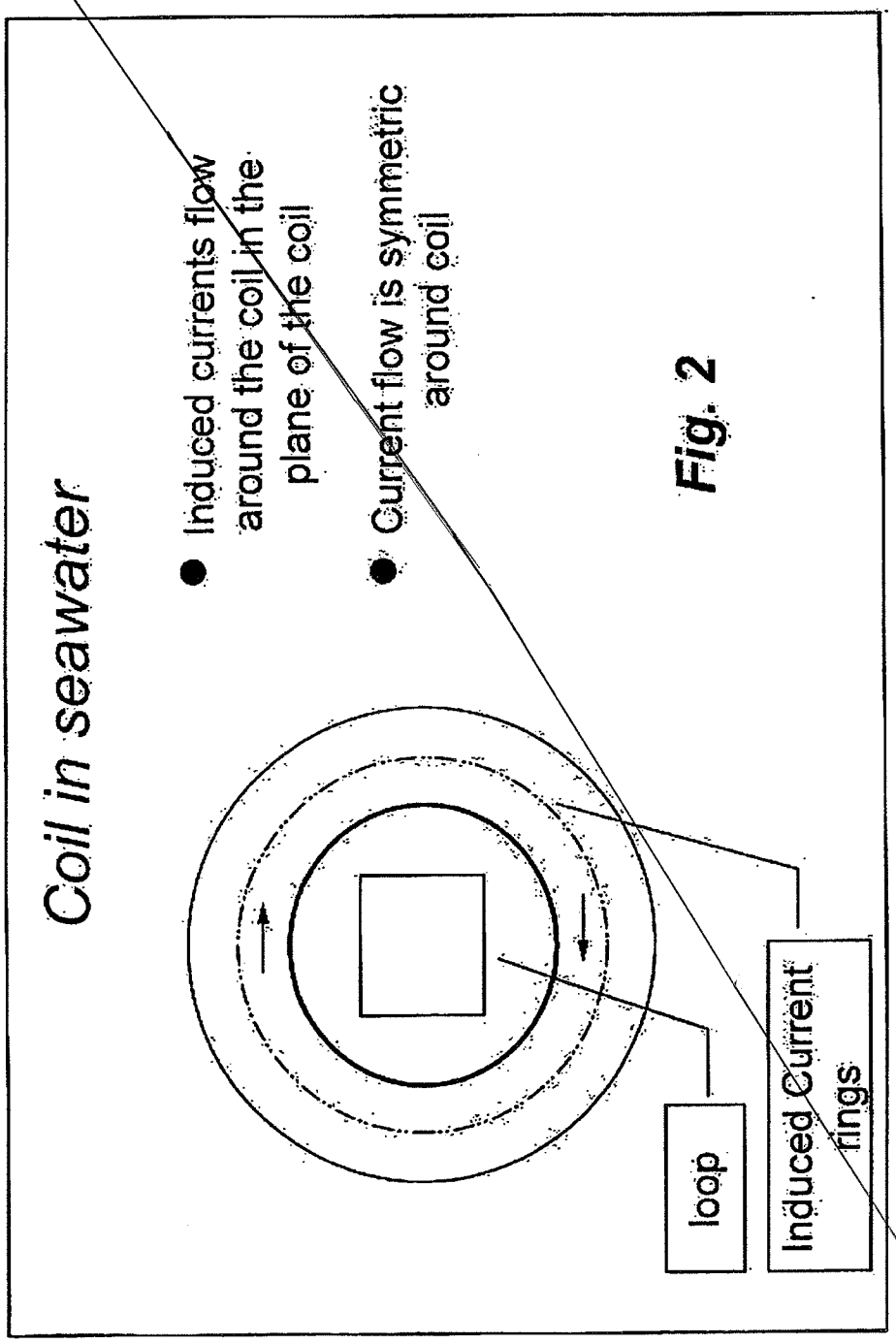


Fig. 2

PCT/IB2008/003467

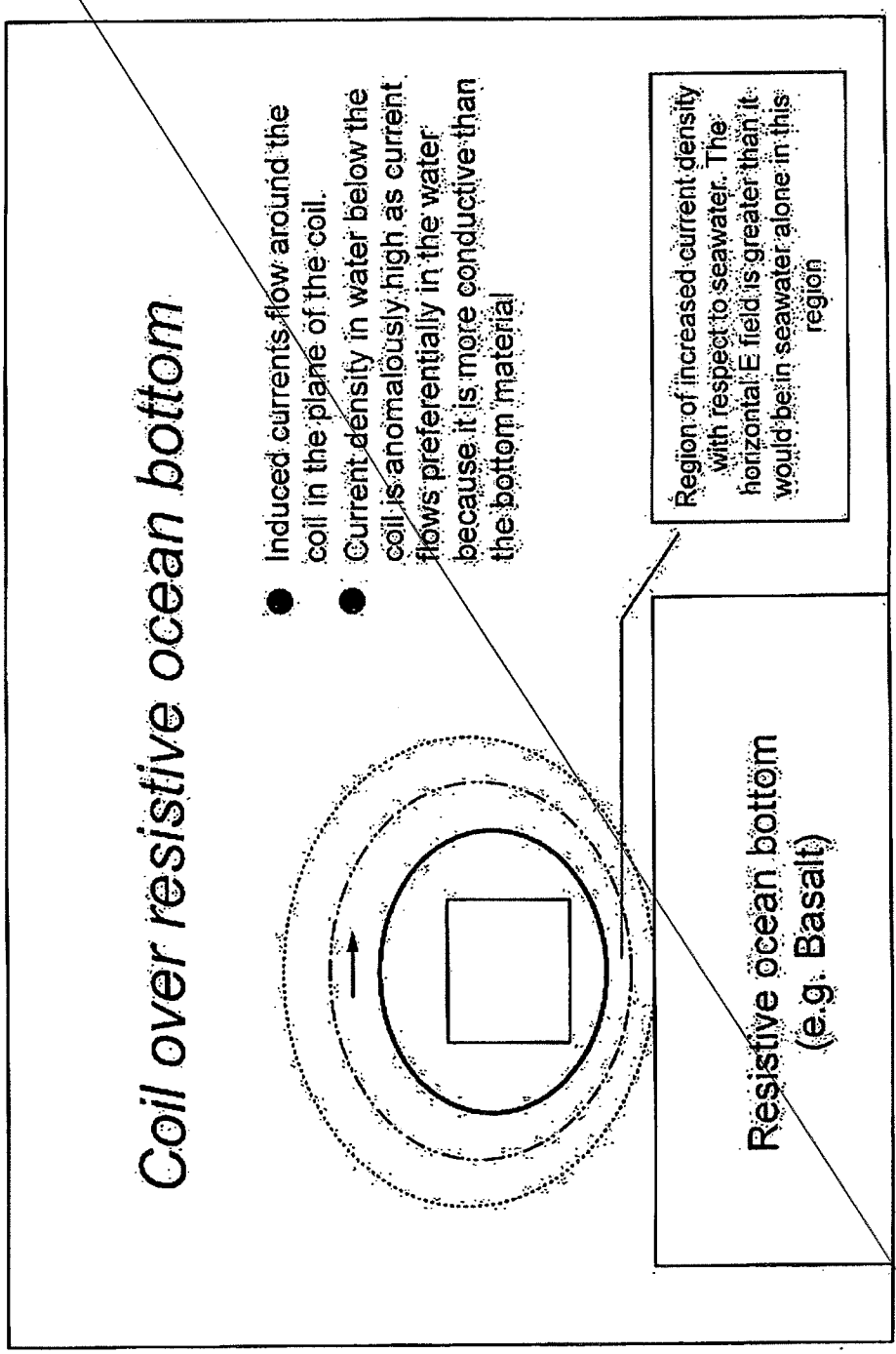


Fig. 3

PCT/IB2008/003467

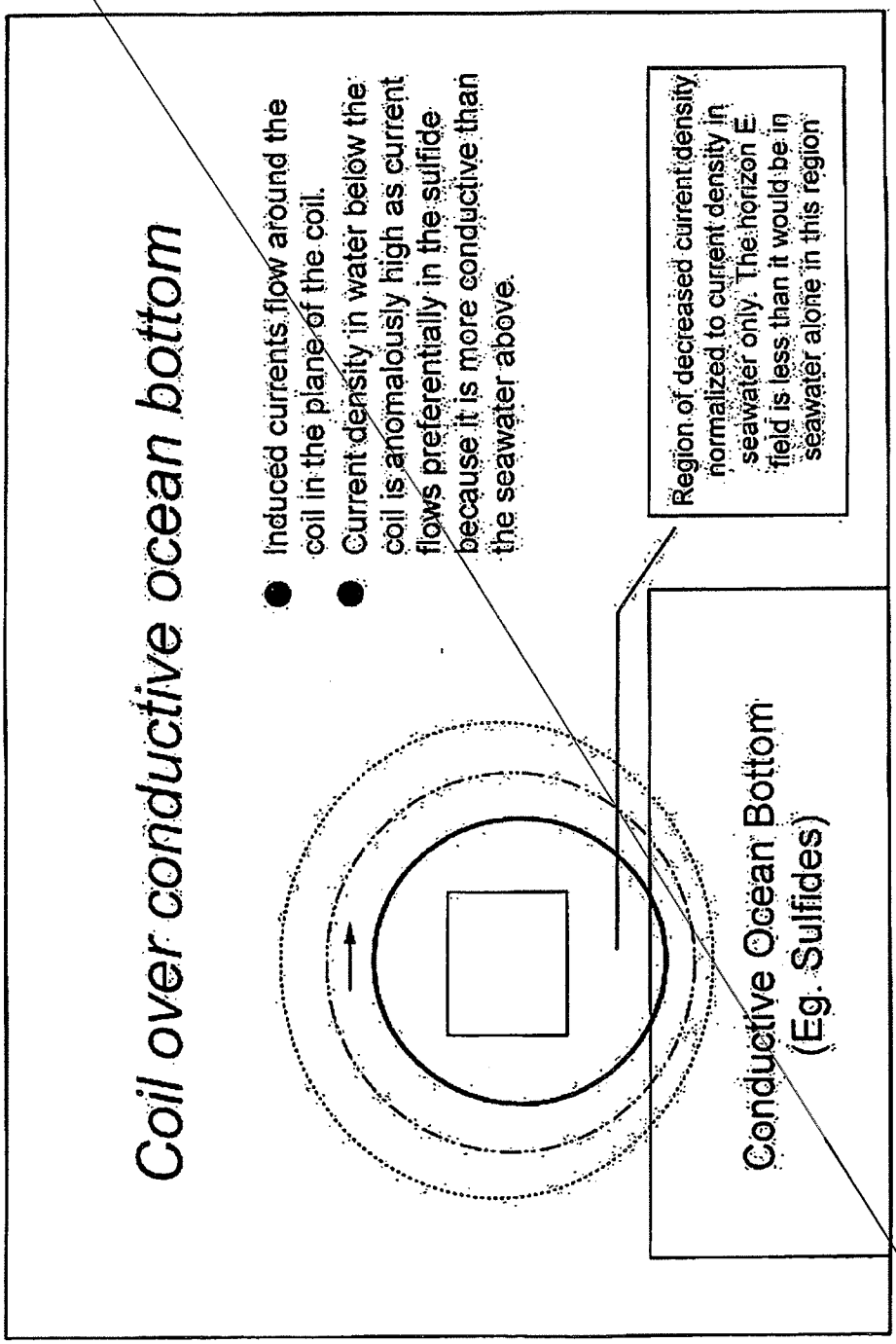


Fig. 4

PCT/IB2008/003467

SHEET 5/17

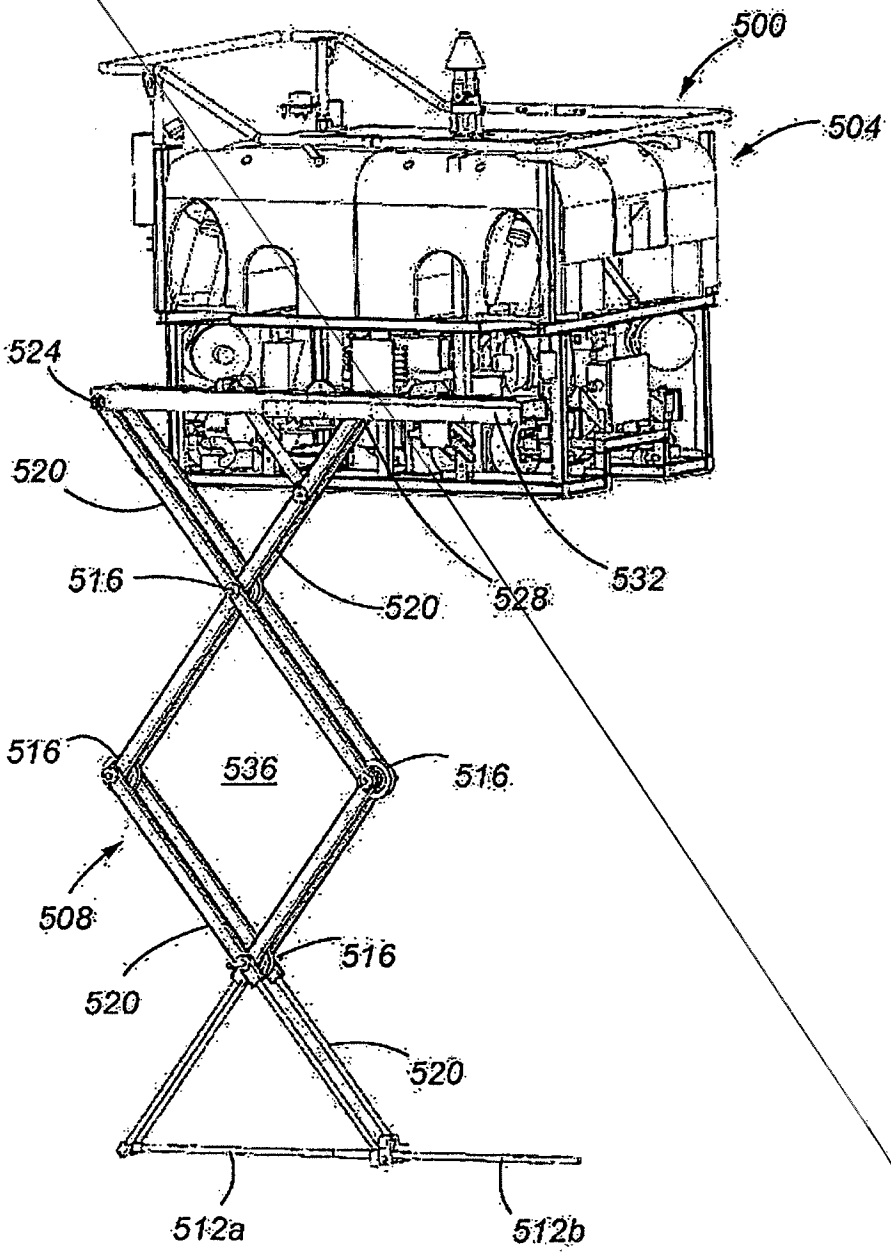


Fig. 5

PCT/IB2008/003467

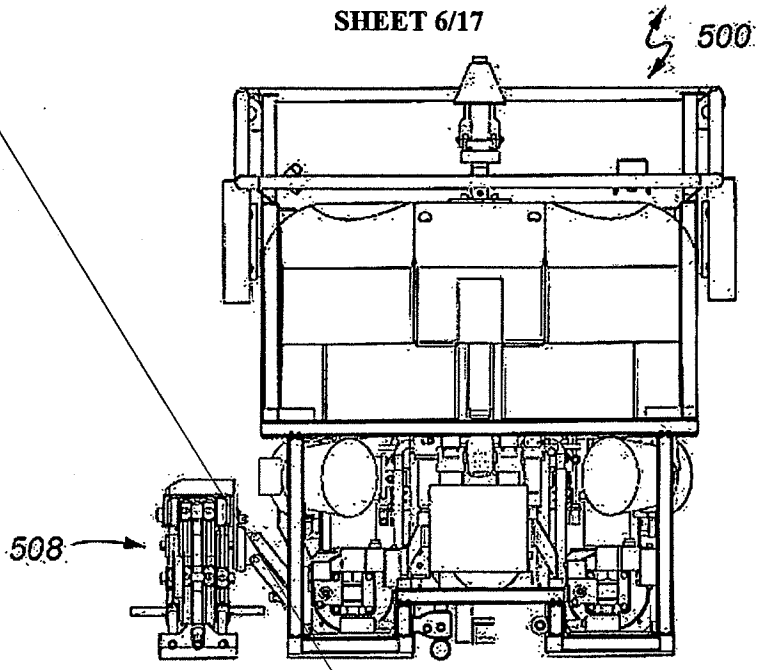


Fig. 6

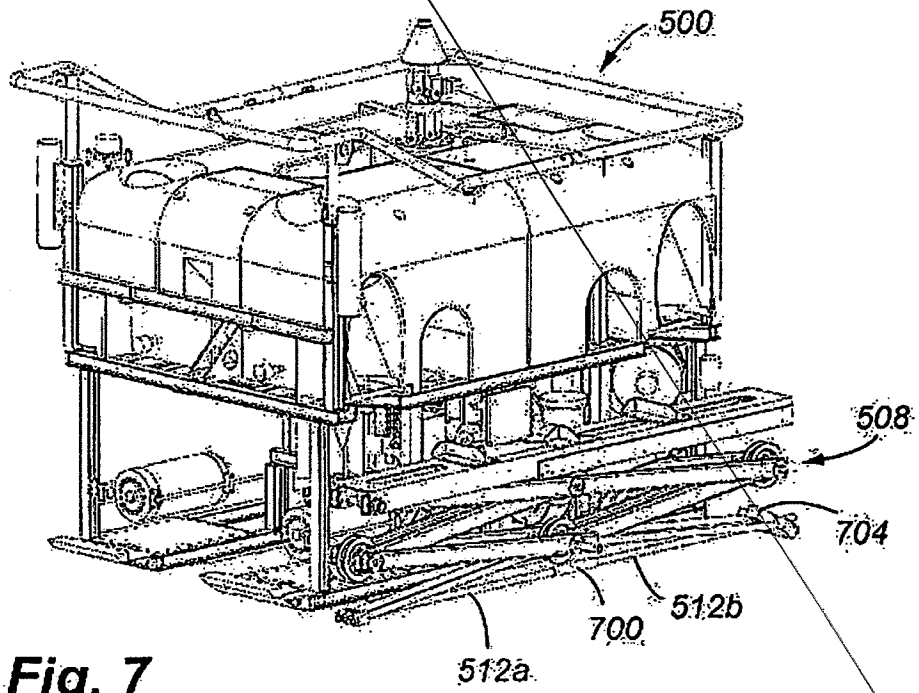


Fig. 7

PCT/IB2008/003467

SHEET 7/17

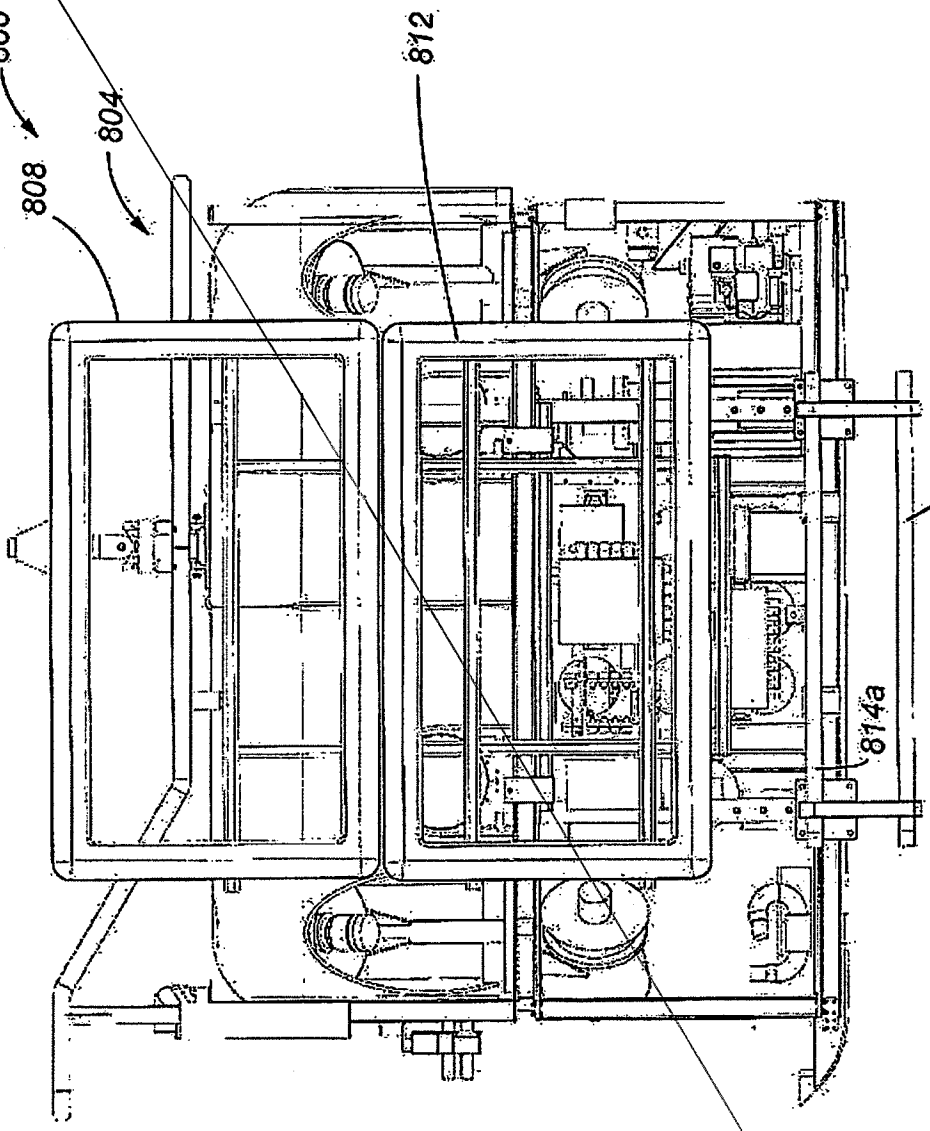


Fig. 8

PCT/IB2008/003467

SHEET 8/17

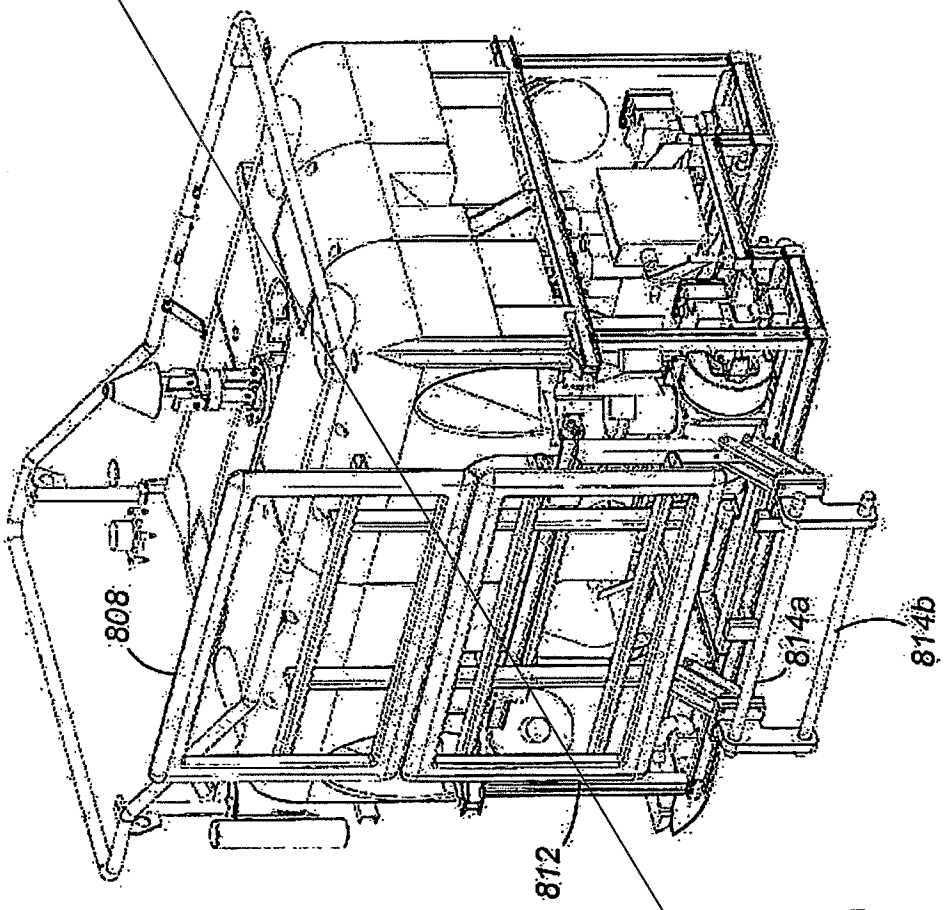


Fig.9

PCT/IB2008/003467

SHEET 9/17

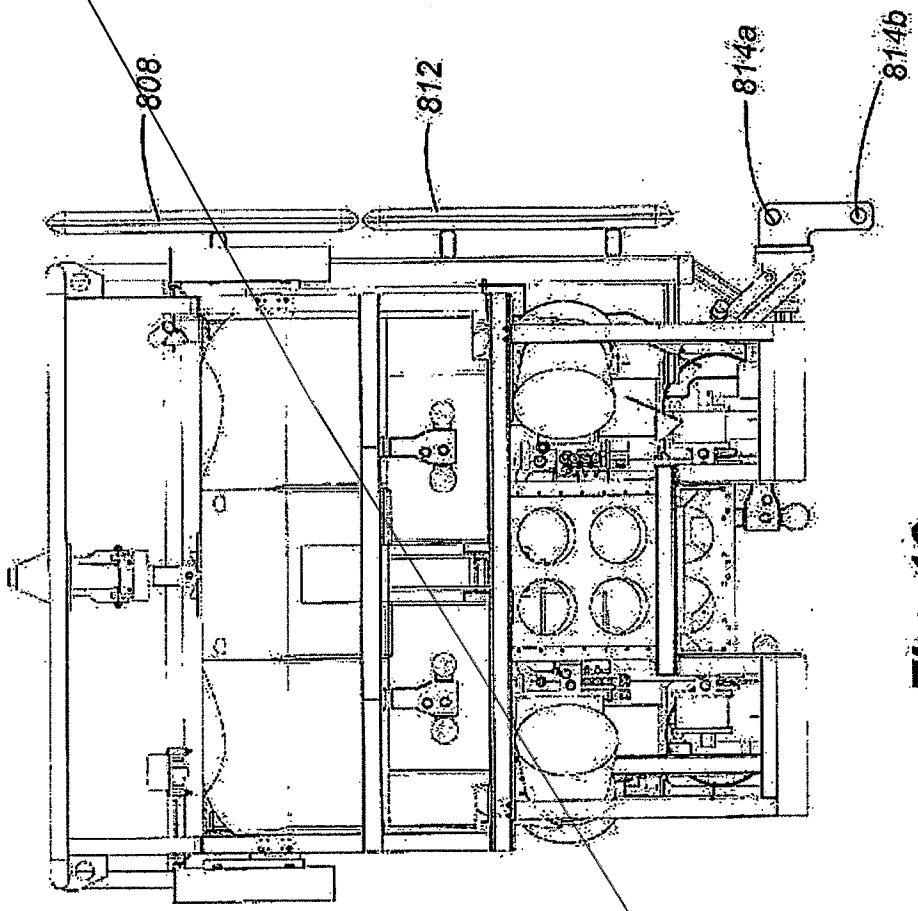


Fig. 10

PCT/IB2008/003467

SHEET 10/17

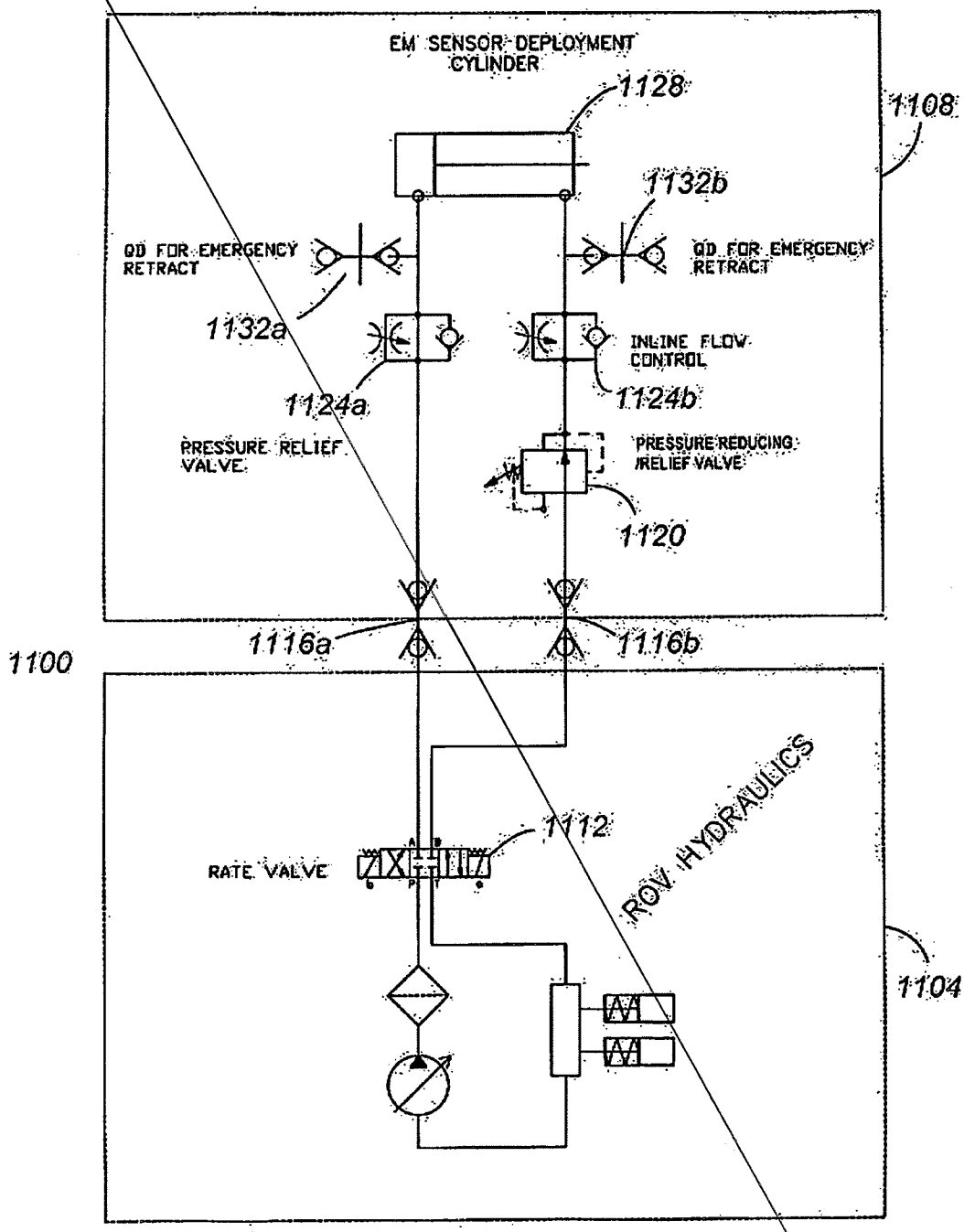


Fig. 11

PCT/IB2008/003467

SHEET 11/17

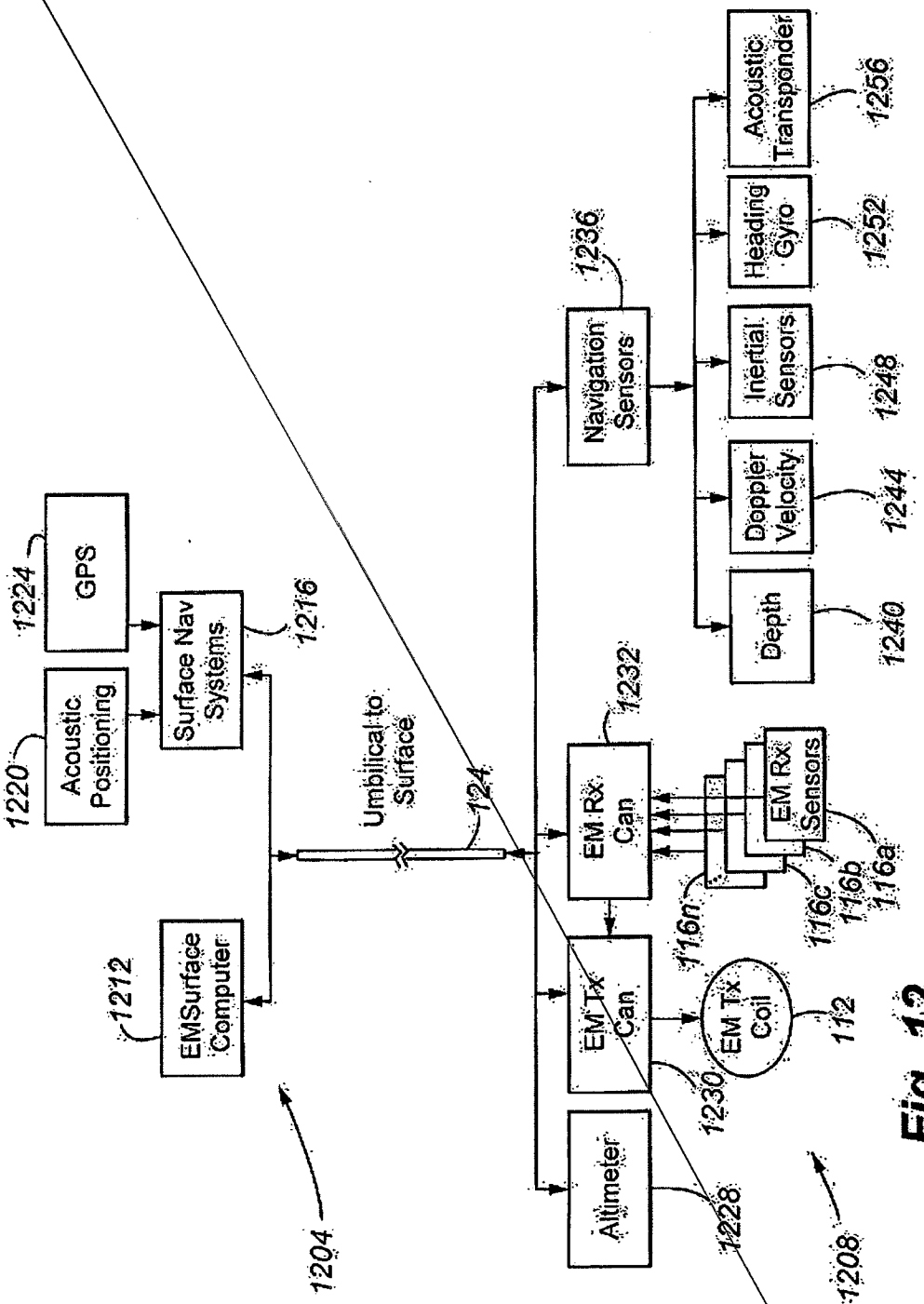


Fig. 12

PCT/IB2008/003467

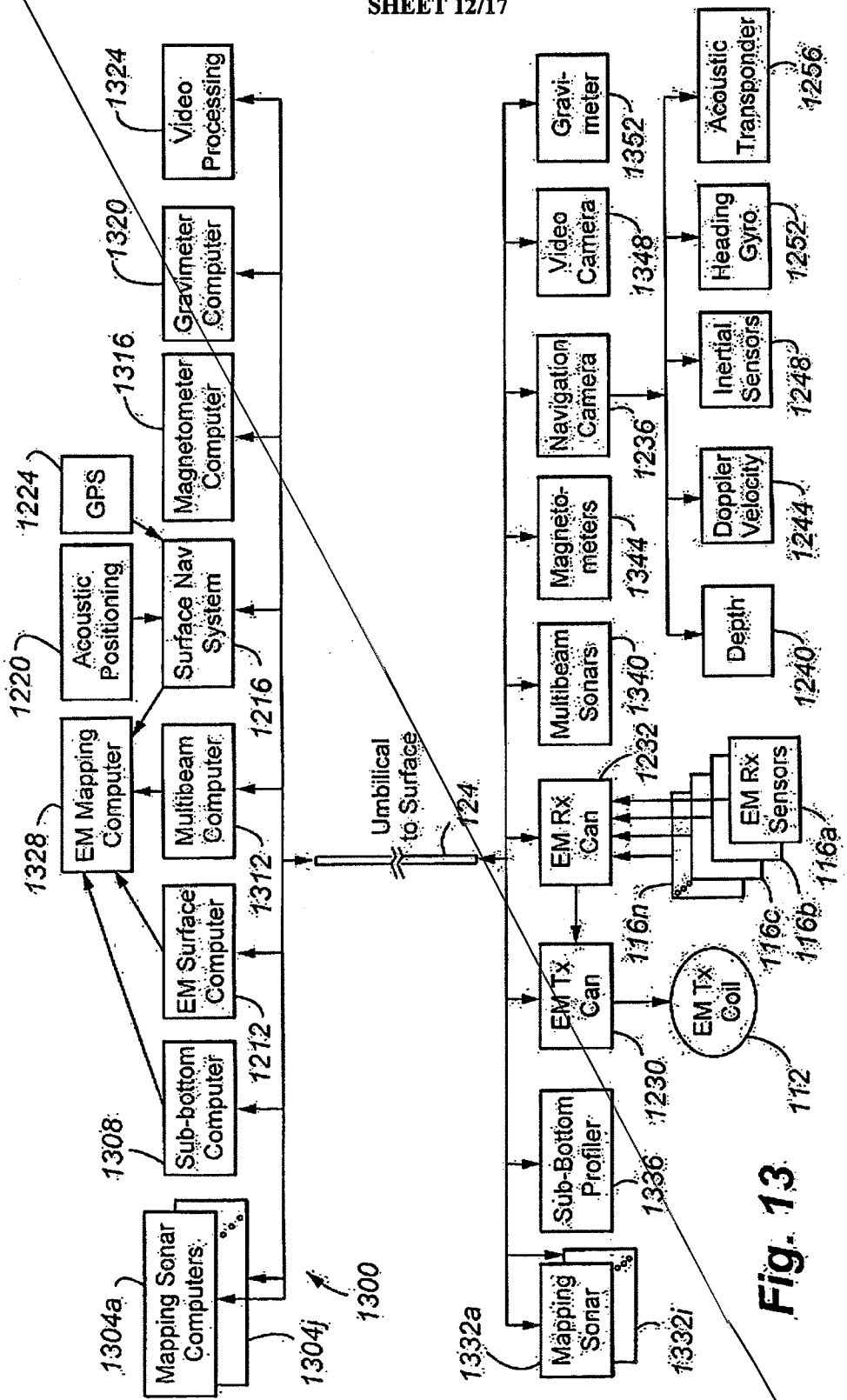


Fig. 13

PCT/IB2008/003467

SHEET 13/17

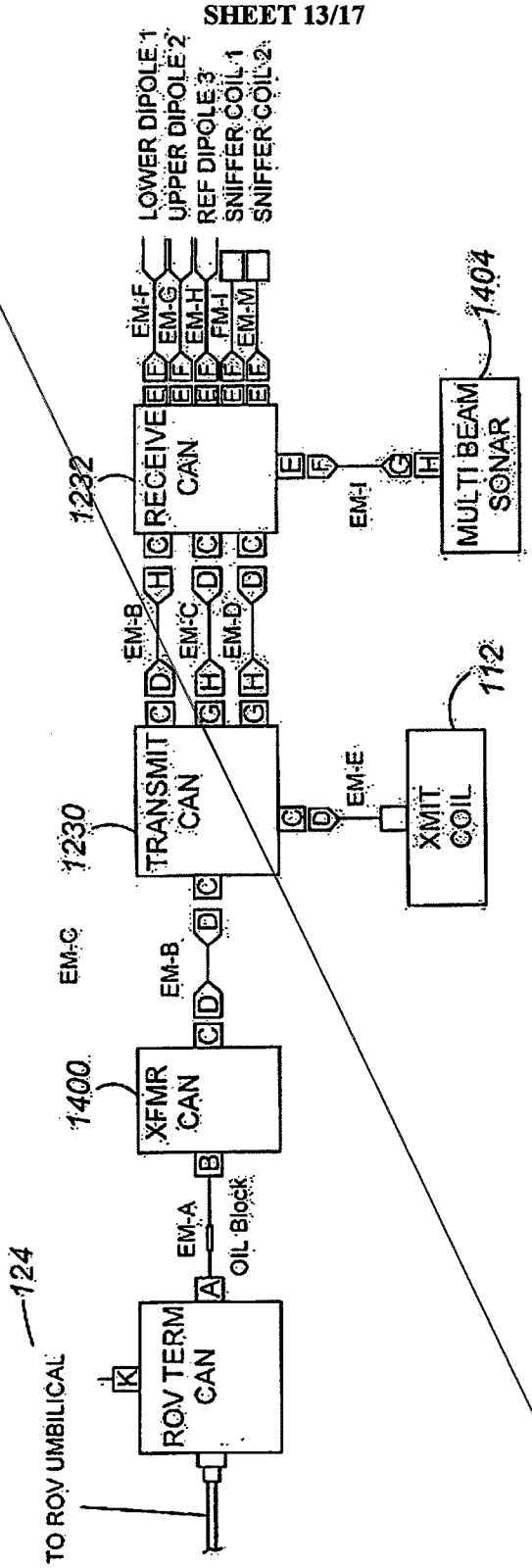


Fig. 14

PCT/IB2008/003467

SHEET 14/17

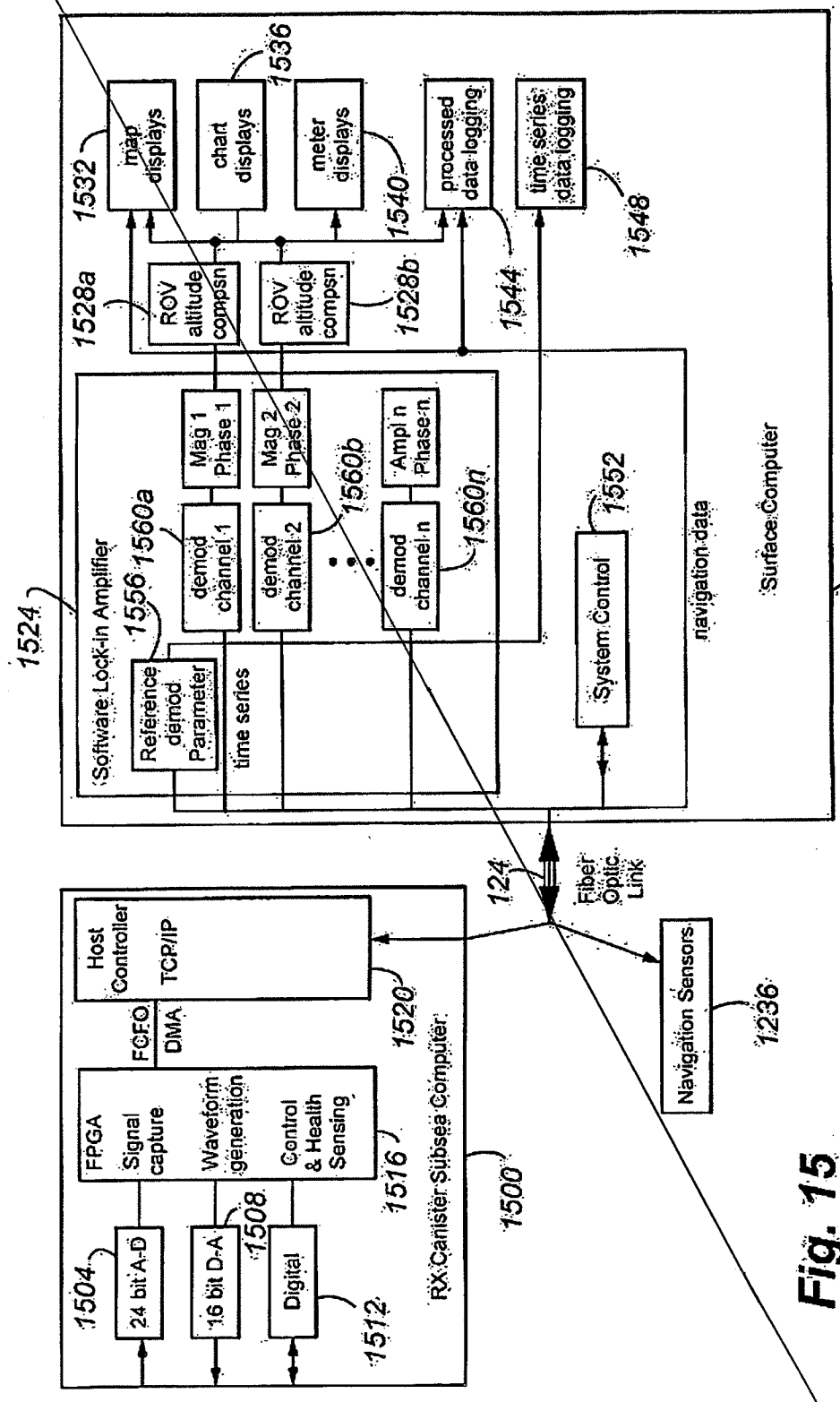


Fig. 15

PCT/IB2008/003467

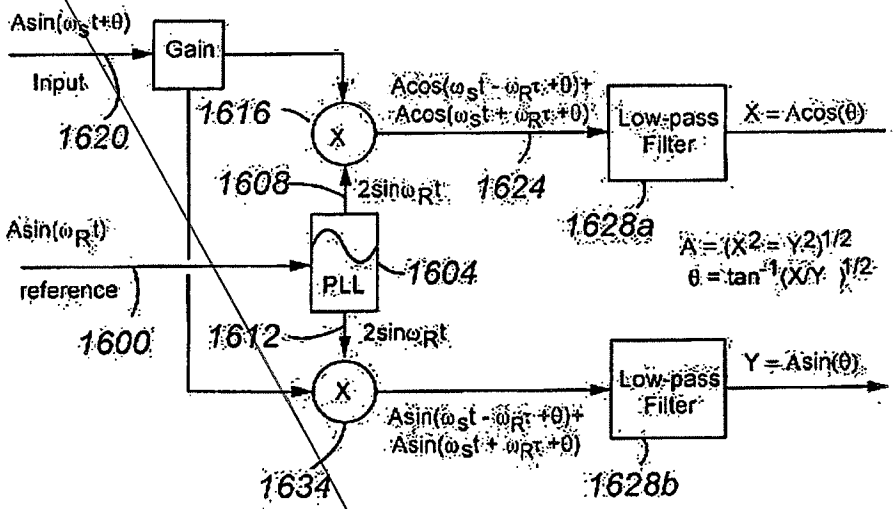


Fig. 16

PCT/IB2008/003467

SHEET 16/17

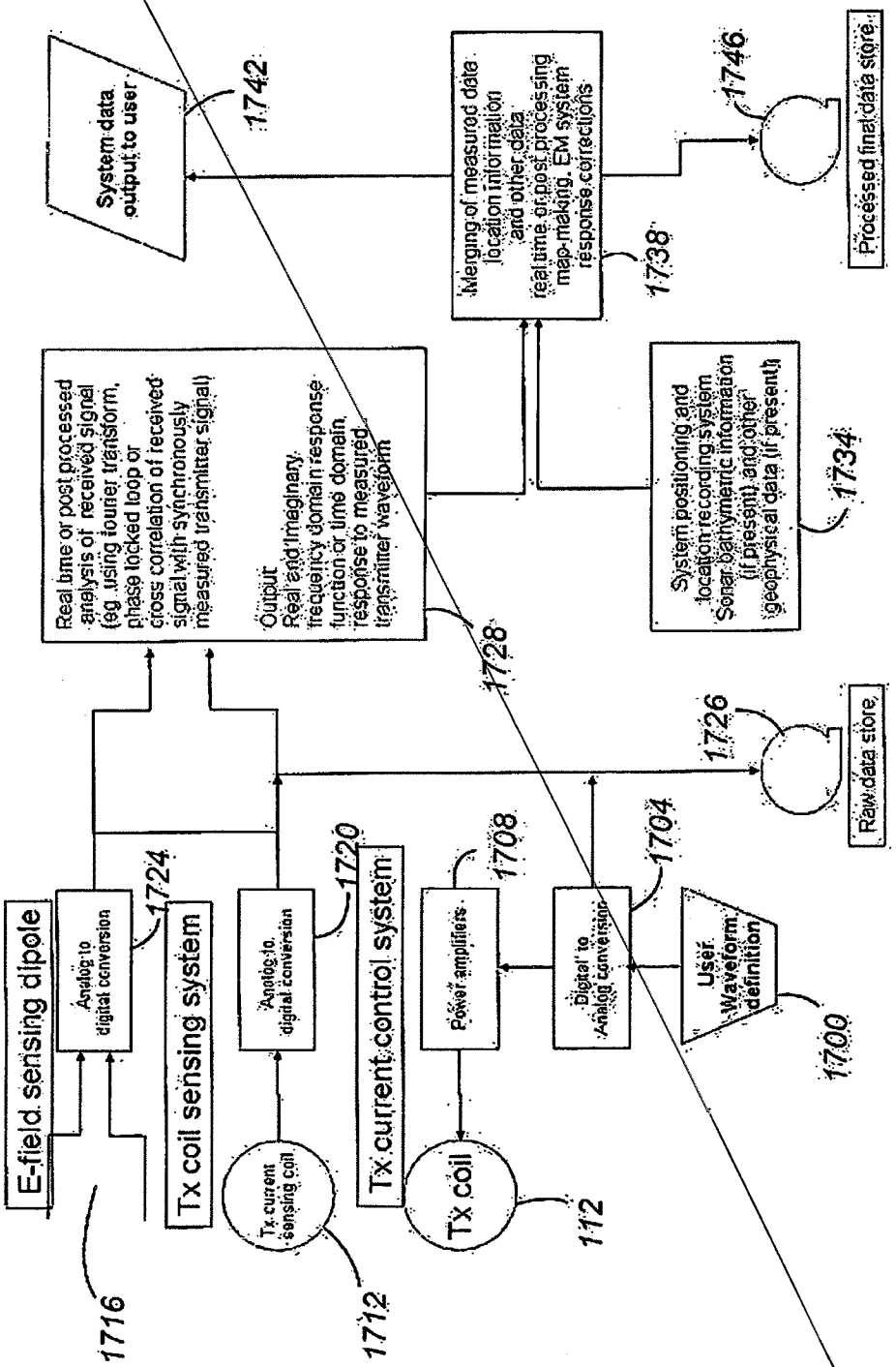


Fig. 17

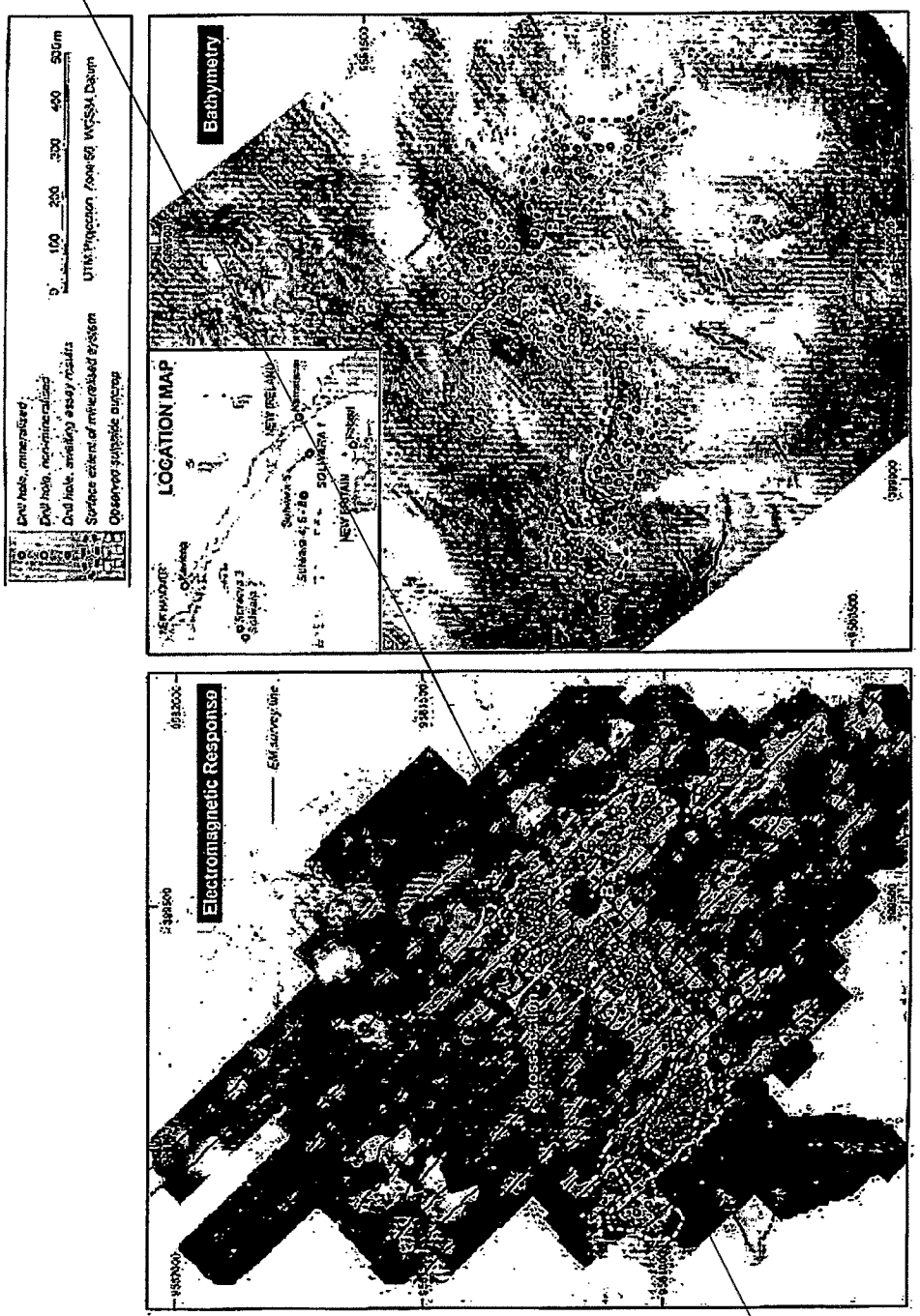

Electromagnetic Response
EM survey line
Bathymetry
LOCATION MAP
Drill hole, mineralised
Drill hole, non-mineralised
Drill hole, awaiting assay results
Surface extent of mineralised system
Observed outcrop
0 100 200 300 400 500m
UTM Projection Zone 50 WGS84 Datum

Fig. 18

Fig. 19

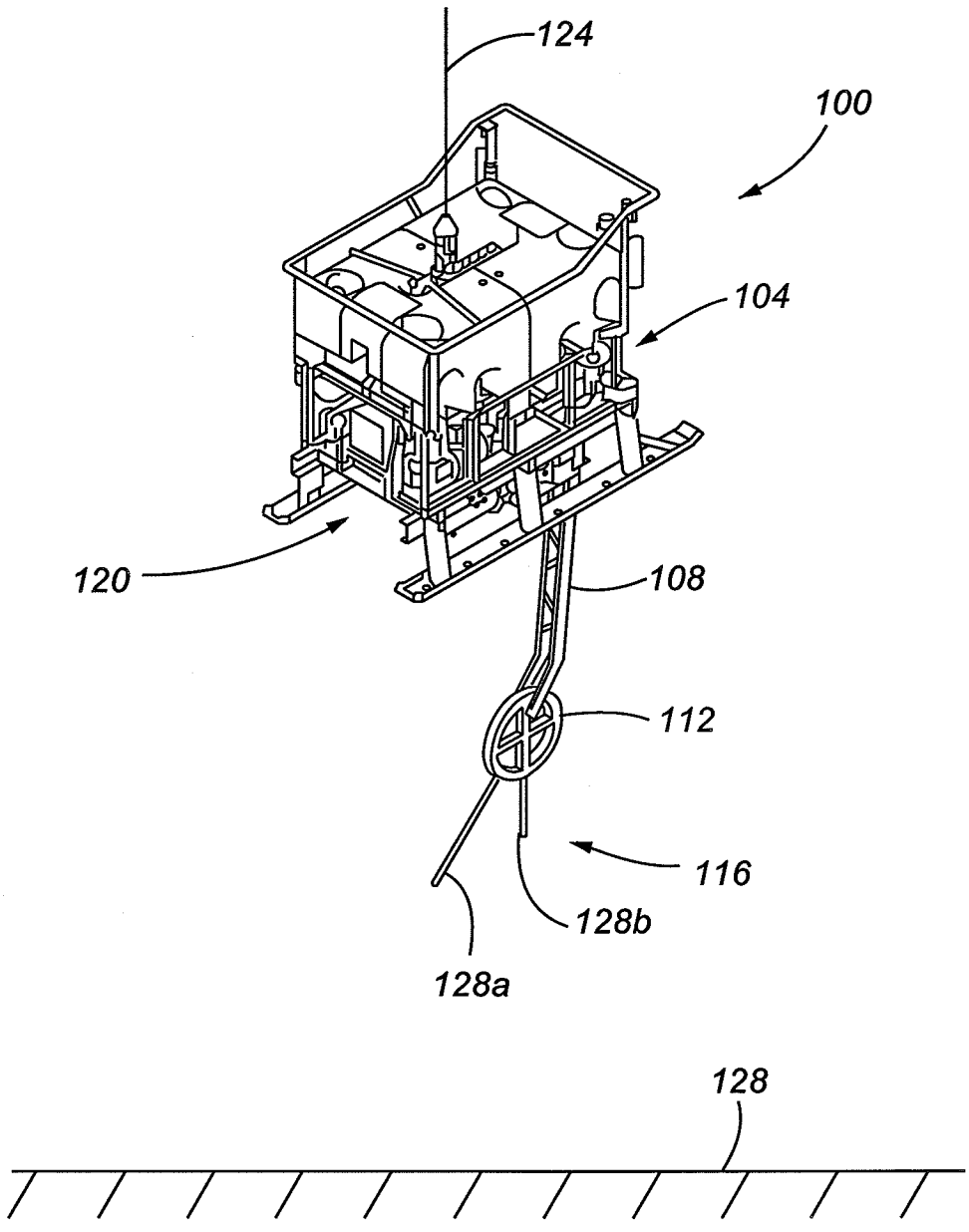


Fig. 1

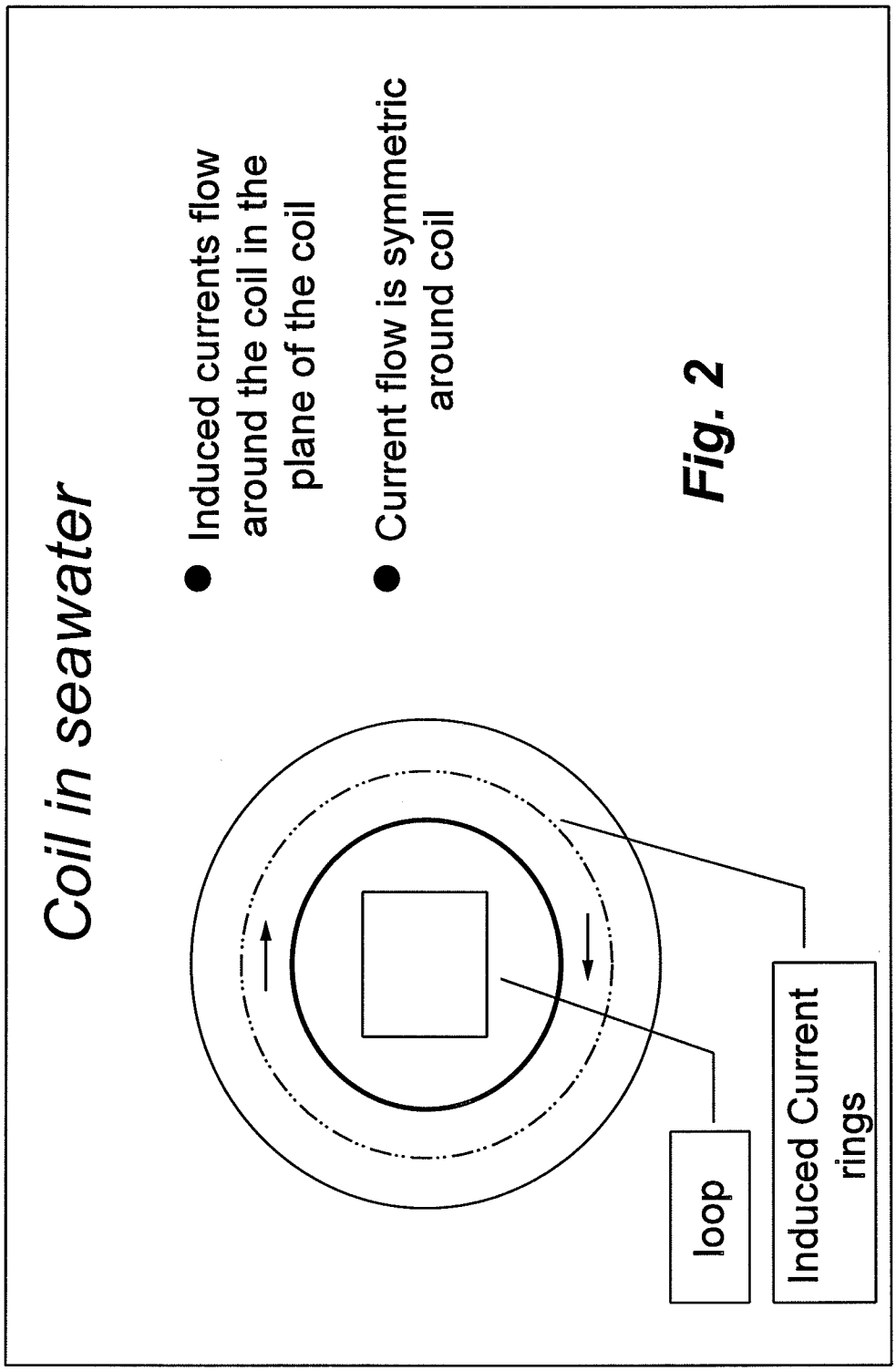

Coil in seawater
Induced currents flow around the coil in the plane of the coil
Current flow is symmetric around coil
loop
Induced Current rings

Fig. 2

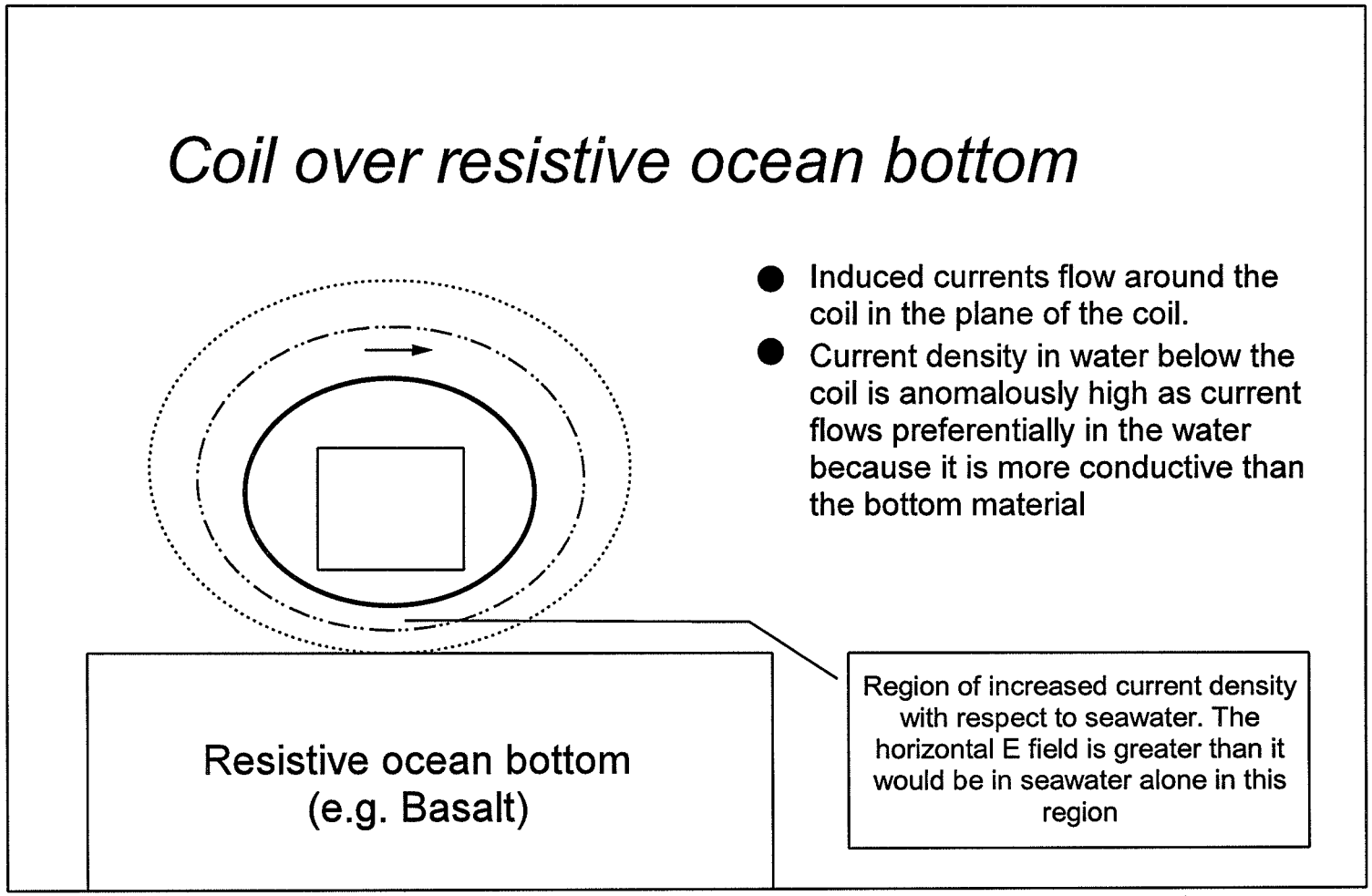

Coil over resistive ocean bottom
Induced currents flow around the coil in the plane of the coil.
Current density in water below the coil is anomalously high as current flows preferentially in the water because it is more conductive than the bottom material
Resistive ocean bottom
(e.g. Basalt)
Region of increased current density with respect to seawater. The horizontal E field is greater than it would be in seawater alone in this region

Fig. 3

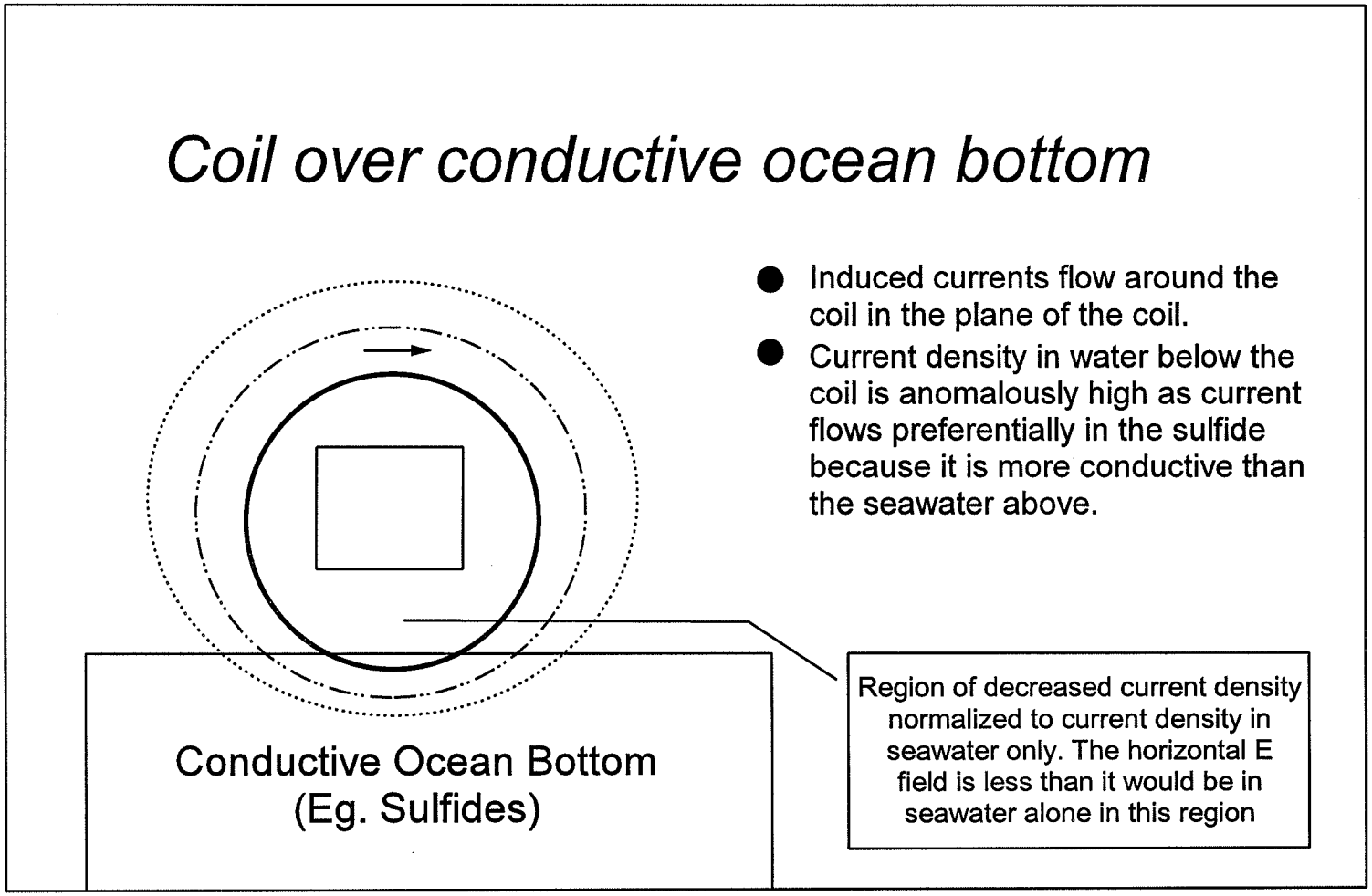

Coil over conductive ocean bottom
Induced currents flow around the coil in the plane of the coil.
Current density in water below the coil is anomalously high as current flows preferentially in the sulfide because it is more conductive than the seawater above.
Conductive Ocean Bottom
(Eg. Sulfides)
Region of decreased current density normalized to current density in seawater only. The horizontal E field is less than it would be in seawater alone in this region

Fig. 4

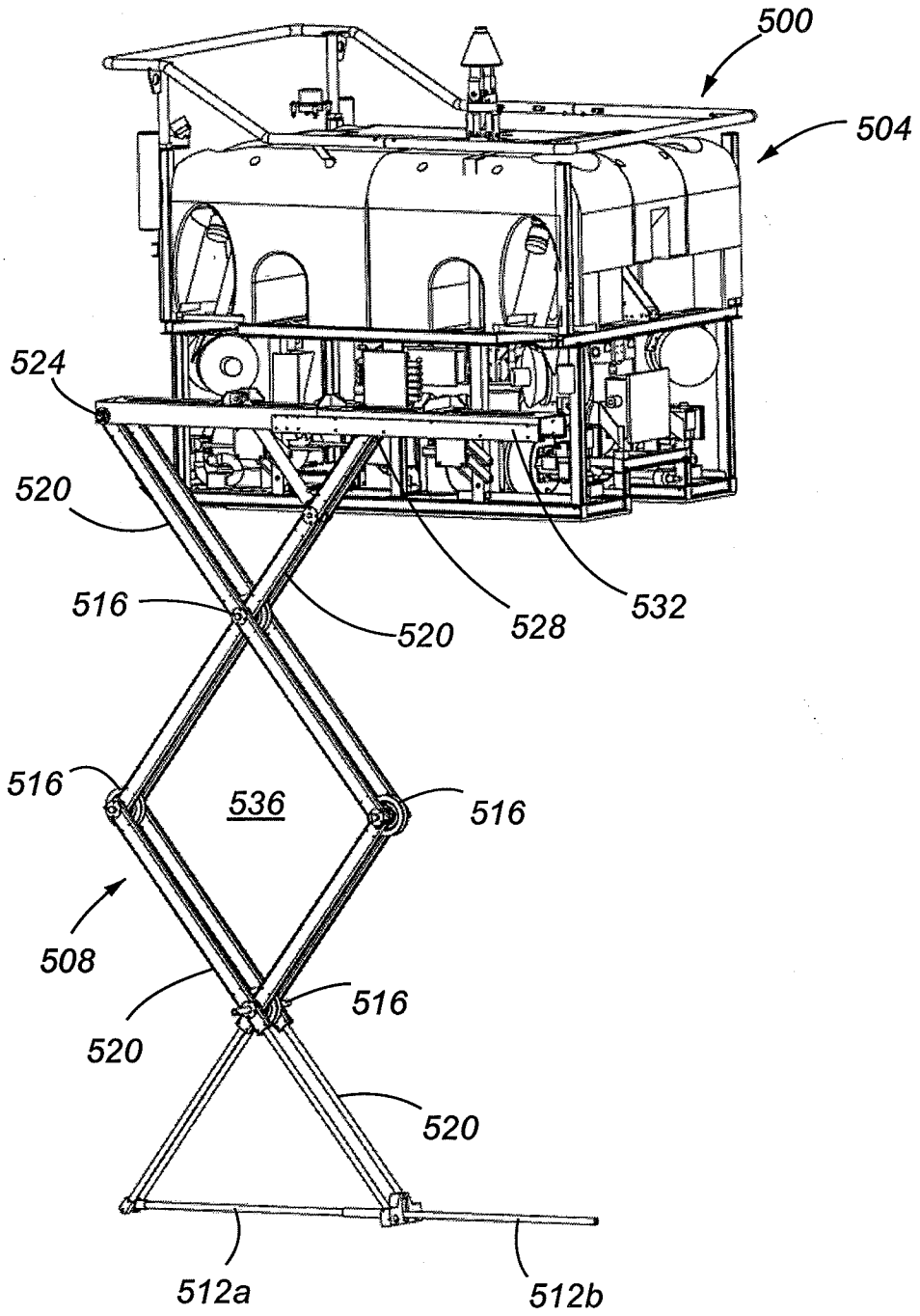

500
504
524
520
516
520
528
532
516
536
516
508
516
520
520
512a
512b

Fig. 5

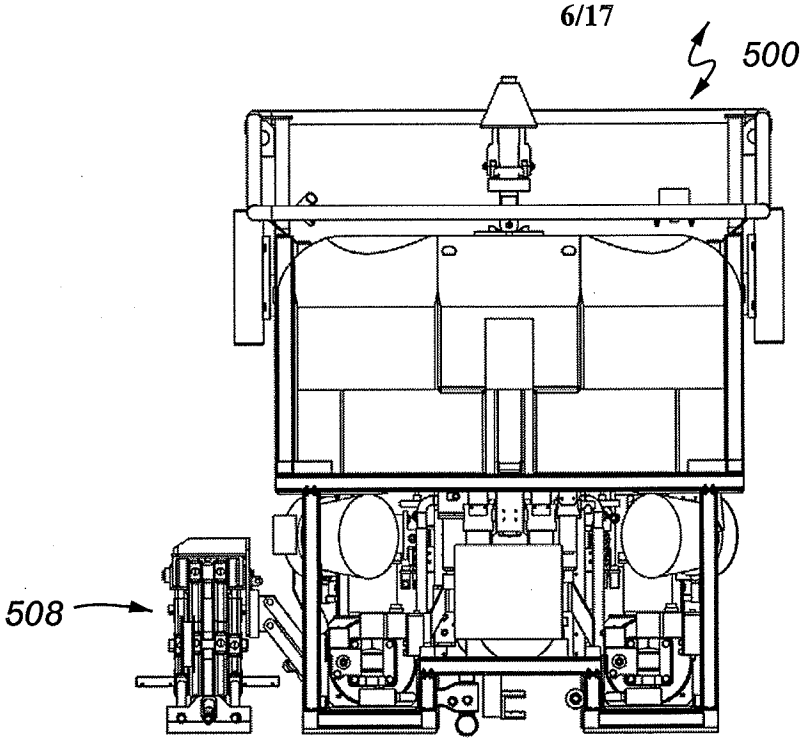


Fig. 6

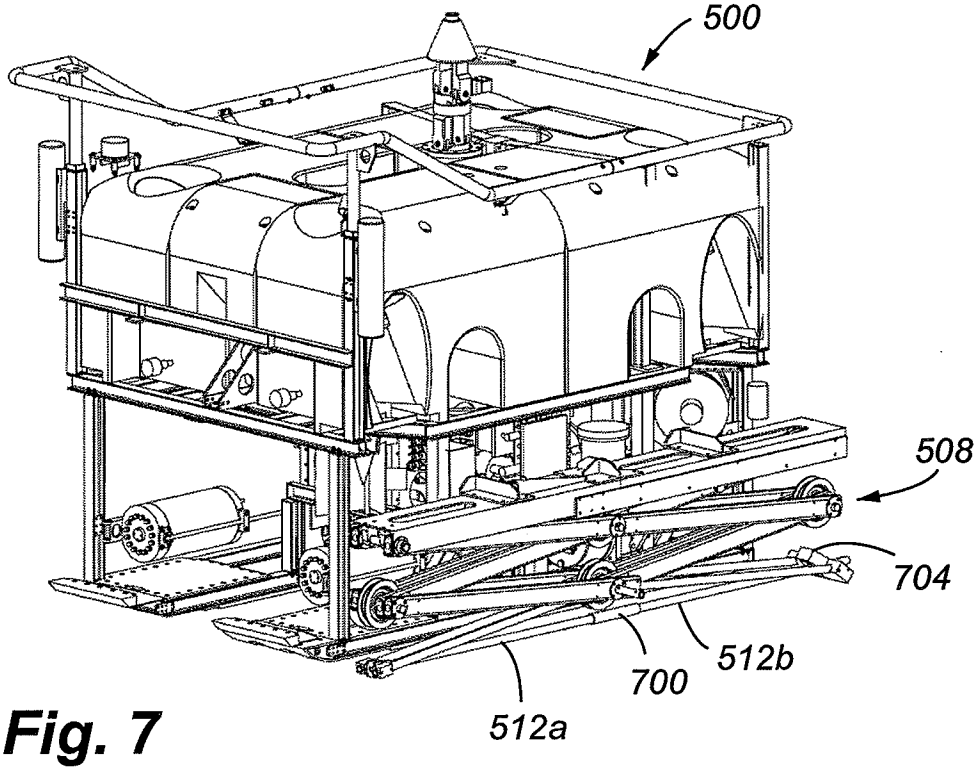


Fig. 7

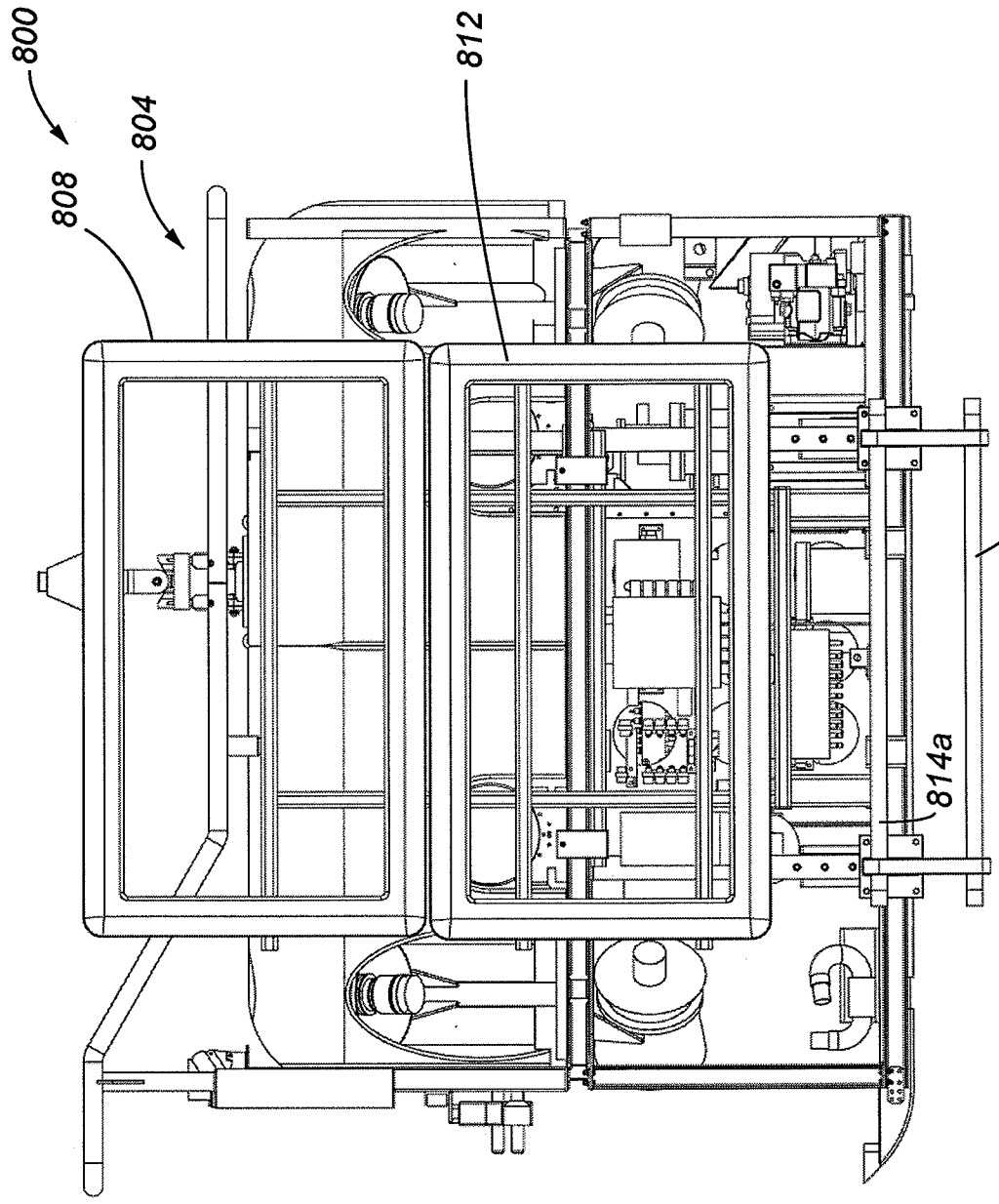


Fig. 8

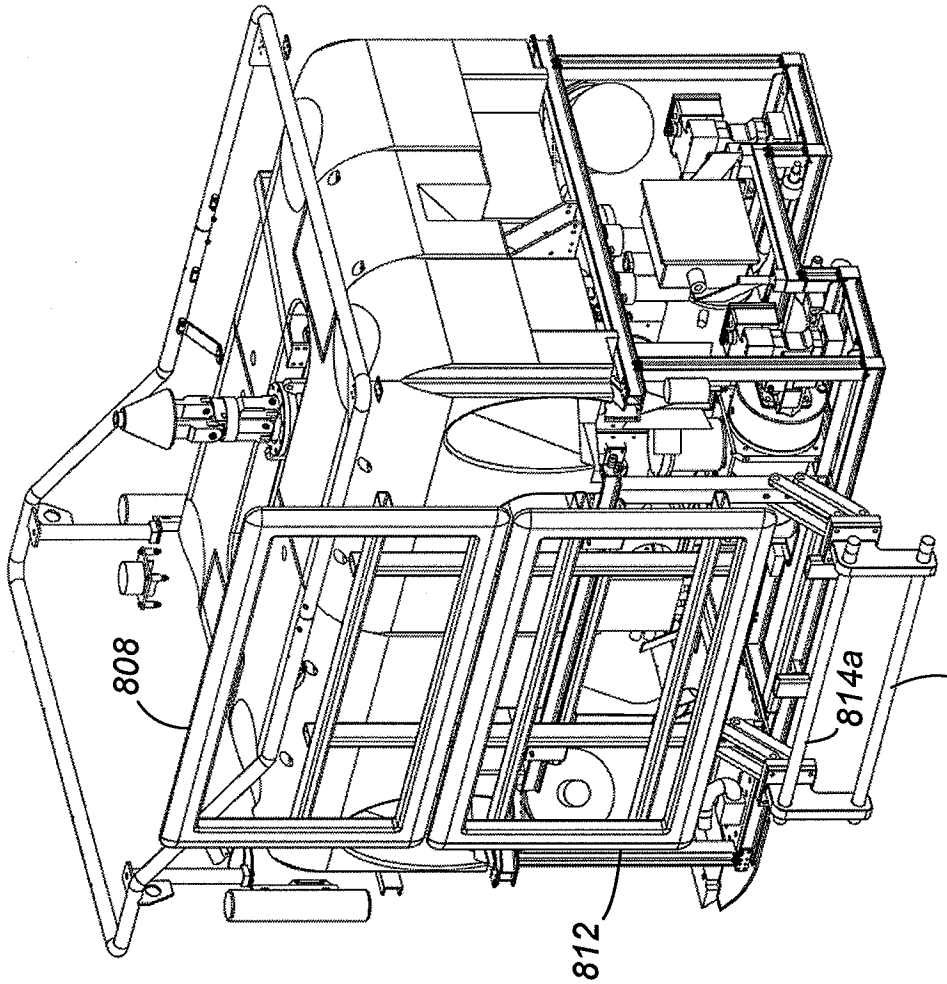


Fig.9

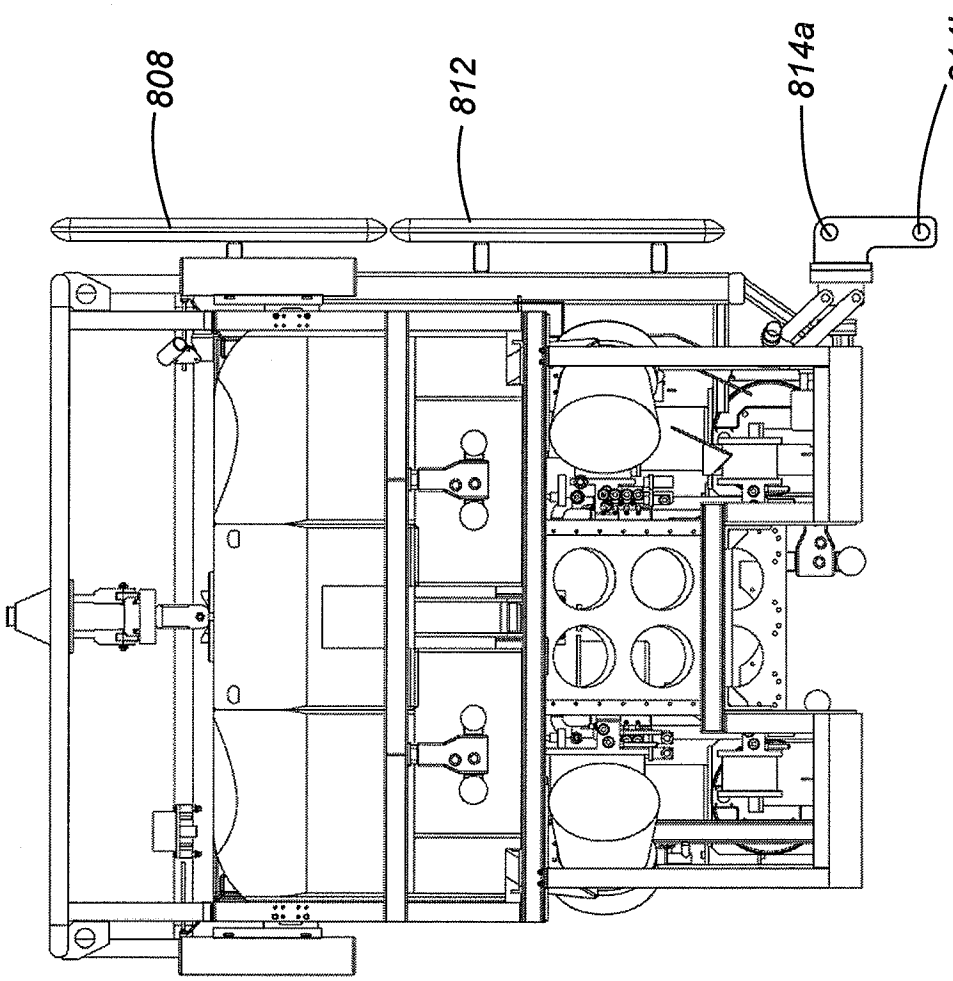


Fig. 10

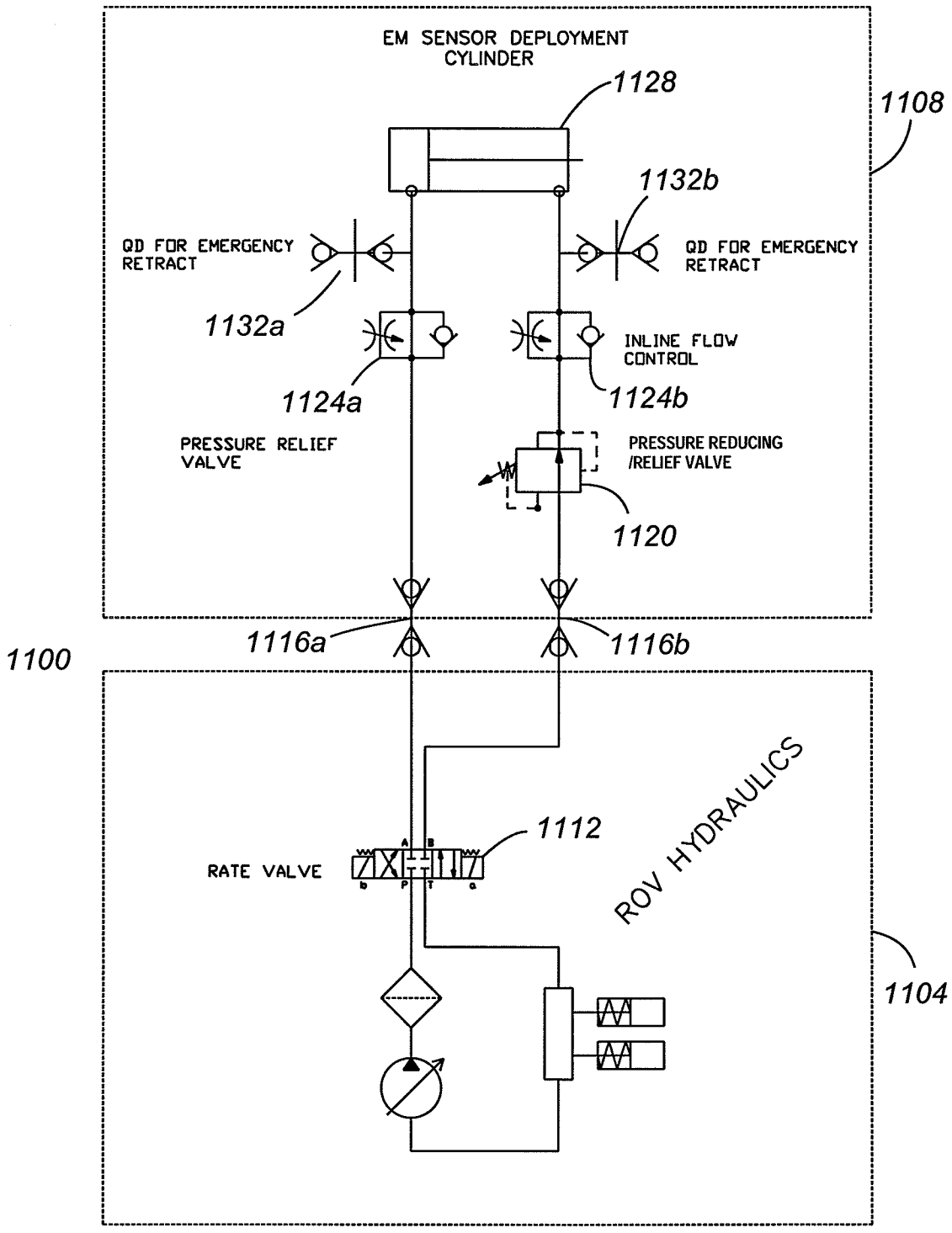

EM SENSOR DEPLOYMENT CYLINDER
1128
1108
1132b
QD FOR EMERGENCY RETRACT
QD FOR EMERGENCY RETRACT
1132a
INLINE FLOW CONTROL
1124a
1124b
PRESSURE RELIEF VALVE
PRESSURE REDUCING /RELIEF VALVE
1120
1116a
1116b
1100
1112
RATE VALVE
ROV HYDRAULICS
1104

Fig. 11

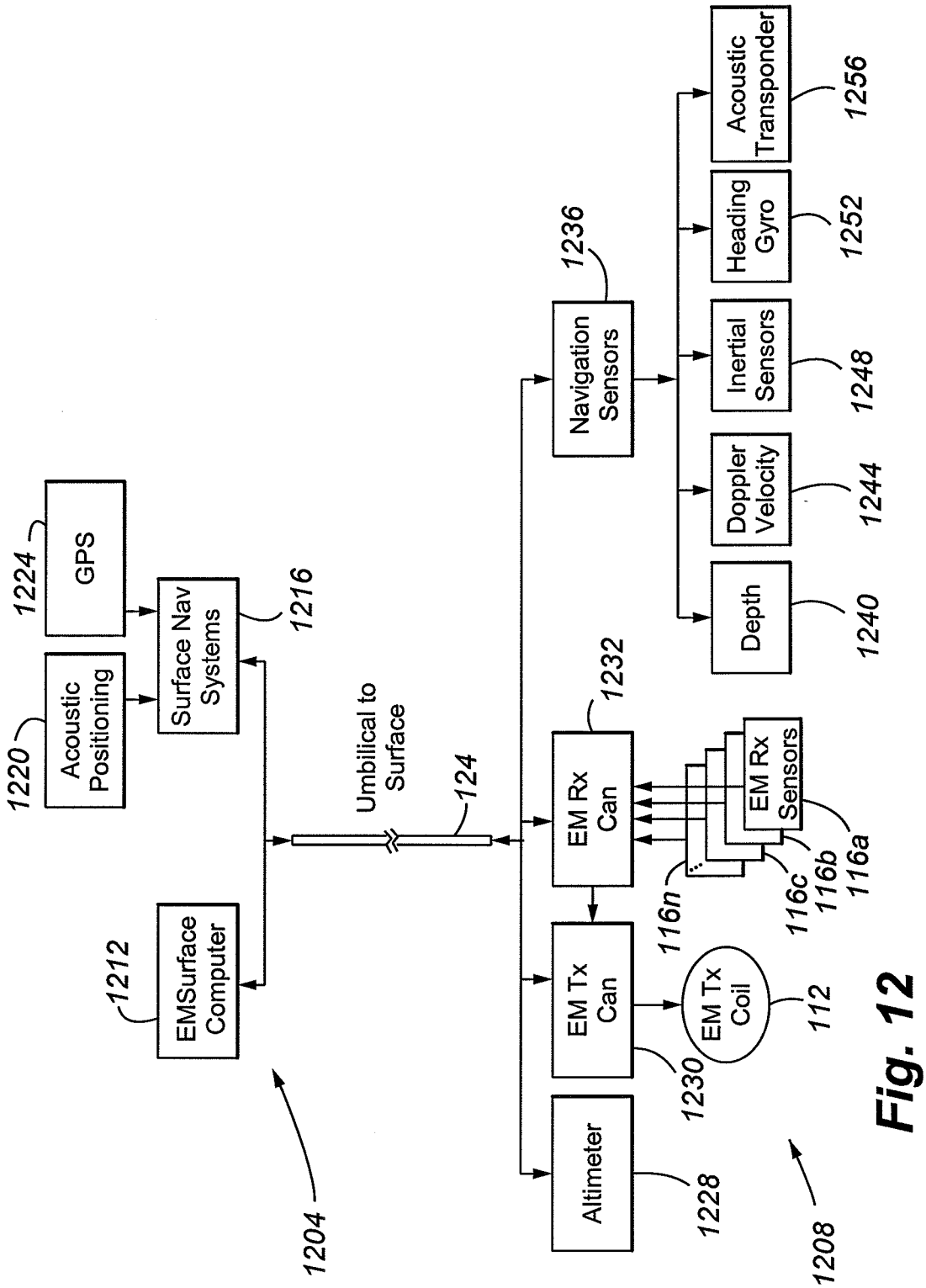

GPS
1224
Acoustic Positioning
1220
Surface Nav Systems
1216
EMSurface Computer
1212
1204
Umbilical to Surface
124
Navigation Sensors
1236
EM Rx Can
1232
EM Tx Can
1230
EM Tx Coil
112
Altimeter
1228
EM Rx Sensors
116a
116b
116c
116n
1208
Depth
1240
Doppler Velocity
1244
Inertial Sensors
1248
Heading Gyro
1252
Acoustic Transponder
1256

Fig. 12

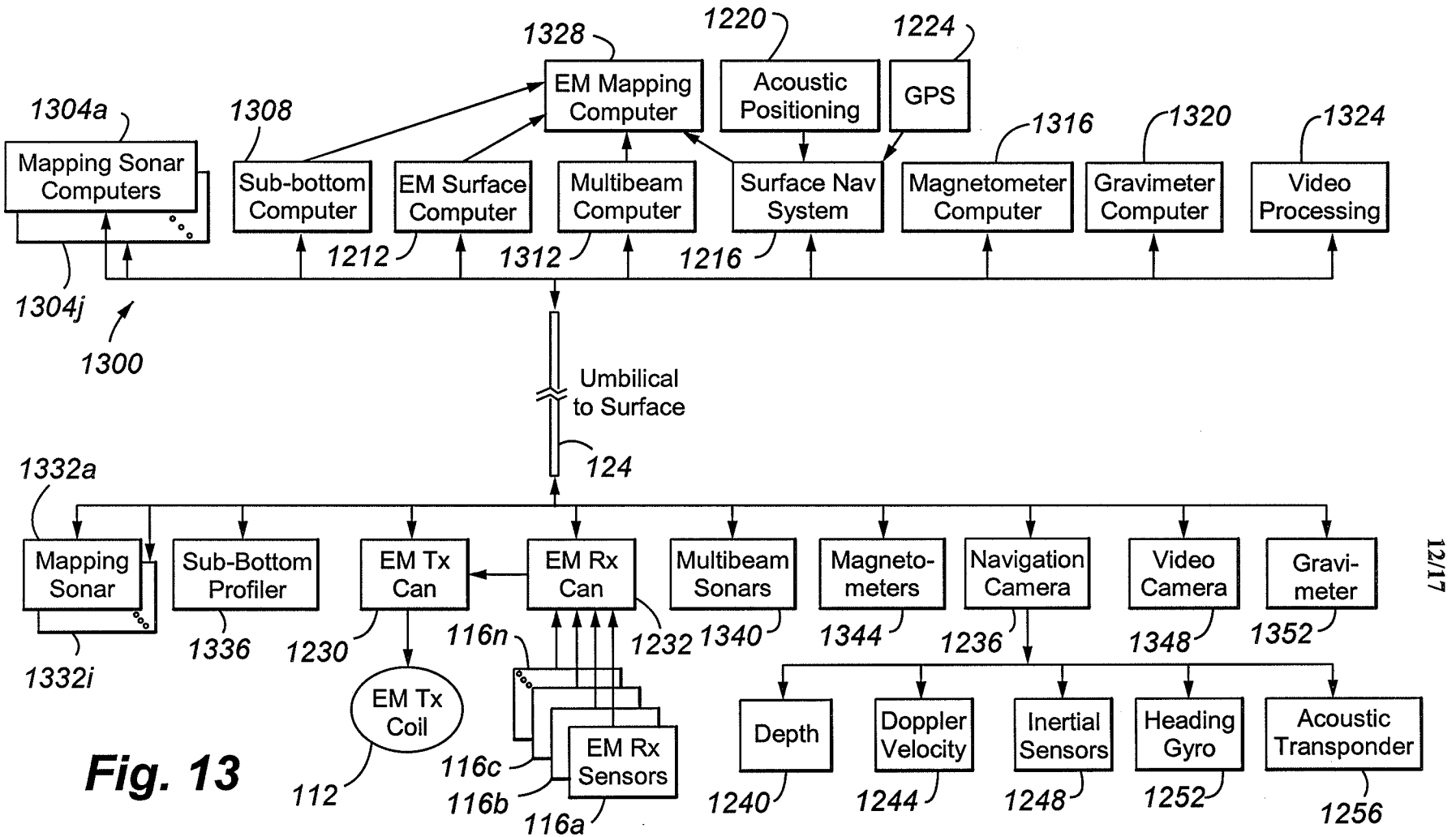

1328
1220
1224
EM Mapping Computer
Acoustic Positioning
GPS
1304a
1308
1316
1320
1324
Mapping Sonar Computers
Sub-bottom Computer
EM Surface Computer
Multibeam Computer
Surface Nav System
Magnetometer Computer
Gravimeter Computer
Video Processing
1212
1312
1216
1304j
1300
Umbilical to Surface
124
1332a
Mapping Sonar
Sub-Bottom Profiler
EM Tx Can
EM Rx Can
Multibeam Sonars
Magneto-meters
Navigation Camera
Video Camera
Gravi-meter
1332i
1336
1230
1232
1340
1344
1236
1348
1352
116n
EM Tx Coil
EM Rx Sensors
Depth
Doppler Velocity
Inertial Sensors
Heading Gyro
Acoustic Transponder
112
116c
116b
116a
1240
1244
1248
1252
1256

Fig. 13

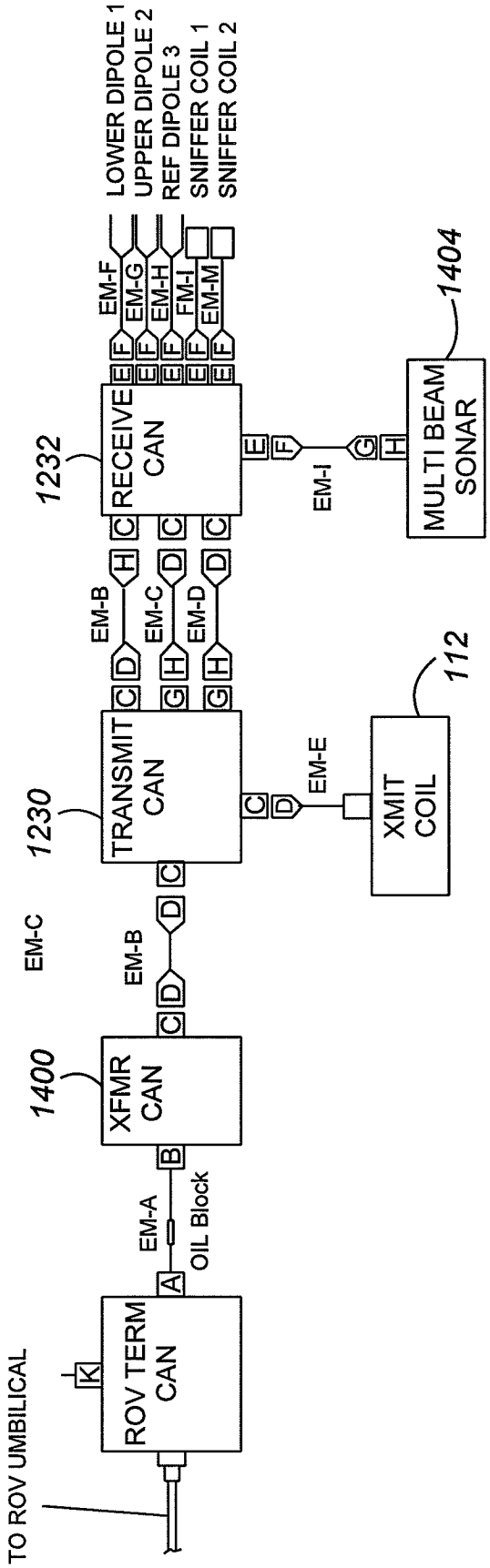

TO ROV UMBILICAL
124
ROV TERM CAN
K
A
EM-A
OIL Block
XFMR CAN
1400
B
C
D
EM-B
EM-C
TRANSMIT CAN
1230
C
D
EM-E
XMIT COIL
112
C
D
G
H
EM-B
EM-C
EM-D
RECEIVE CAN
1232
C
D
E
F
G
H
EM-I
MULTI BEAM SONAR
1404
E
F
EM-F
EM-G
EM-H
FM-I
EM-M
LOWER DIPOLE 1
UPPER DIPOLE 2
REF DIPOLE 3
SNIFFER COIL 1
SNIFFER COIL 2

Fig. 14

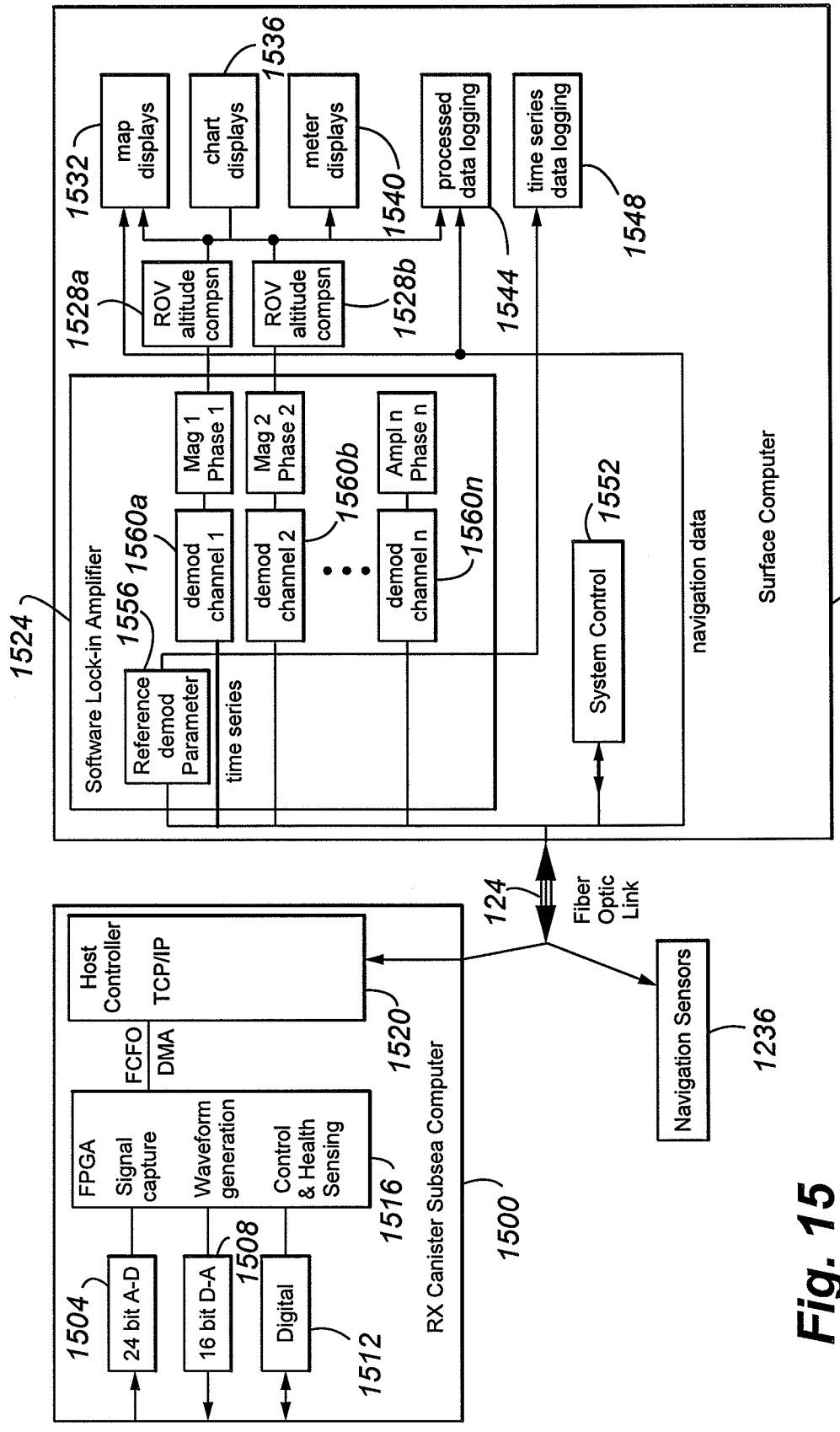

1212
Surface Computer
1524
Software Lock-in Amplifier
1556
Reference demod Parameter
time series
1560a
demod channel 1
Mag 1 Phase 1
1560b
demod channel 2
Mag 2 Phase 2
1560n
demod channel n
Ampl n Phase n
1528a
ROV altitude compsn
1528b
ROV altitude compsn
1532
map displays
1536
chart displays
1540
meter displays
1544
processed data logging
1548
time series data logging
1552
System Control
navigation data
124
Fiber Optic Link
1236
Navigation Sensors
1500
RX Canister Subsea Computer
1520
Host Controller
TCP/IP
FCFO
DMA
1516
FPGA
Signal capture
Waveform generation
Control & Health Sensing
1504
24 bit A-D
1508
16 bit D-A
1512
Digital

Fig. 15

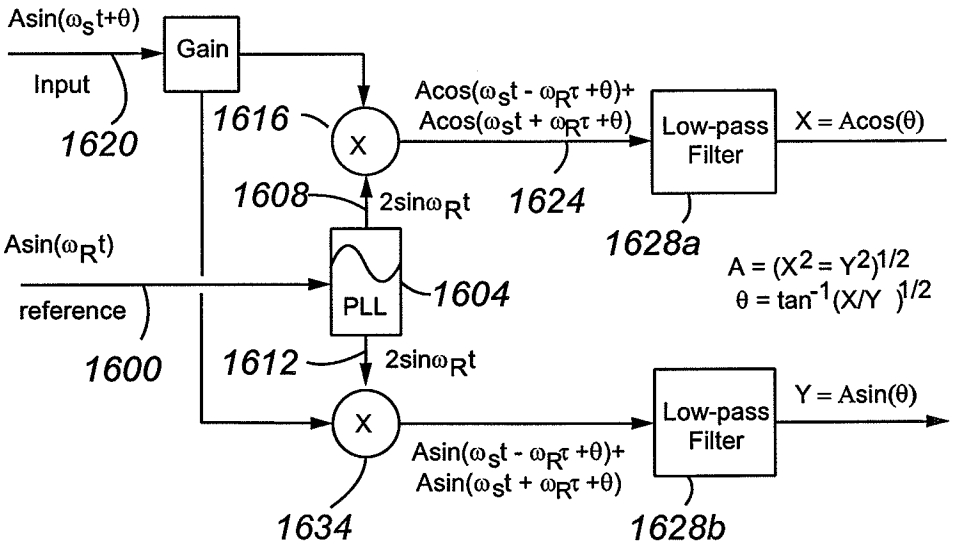

Asin(ωSt+θ)
Input
1620
Gain
1616
X
Acos(ωSt - ωRτ +θ)+
Acos(ωSt + ωRτ +θ)
1624
Low-pass Filter
X = Acos(θ)
1628a
1608
2sinωRt
Asin(ωRt)
reference
1600
PLL
1604
A = (X2 = Y2)1/2
θ = tan-1(X/Y)1/2
1612
2sinωRt
X
Asin(ωSt - ωRτ +θ)+
Asin(ωSt + ωRτ +θ)
1634
Low-pass Filter
Y = Asin(θ)
1628b

Fig. 16

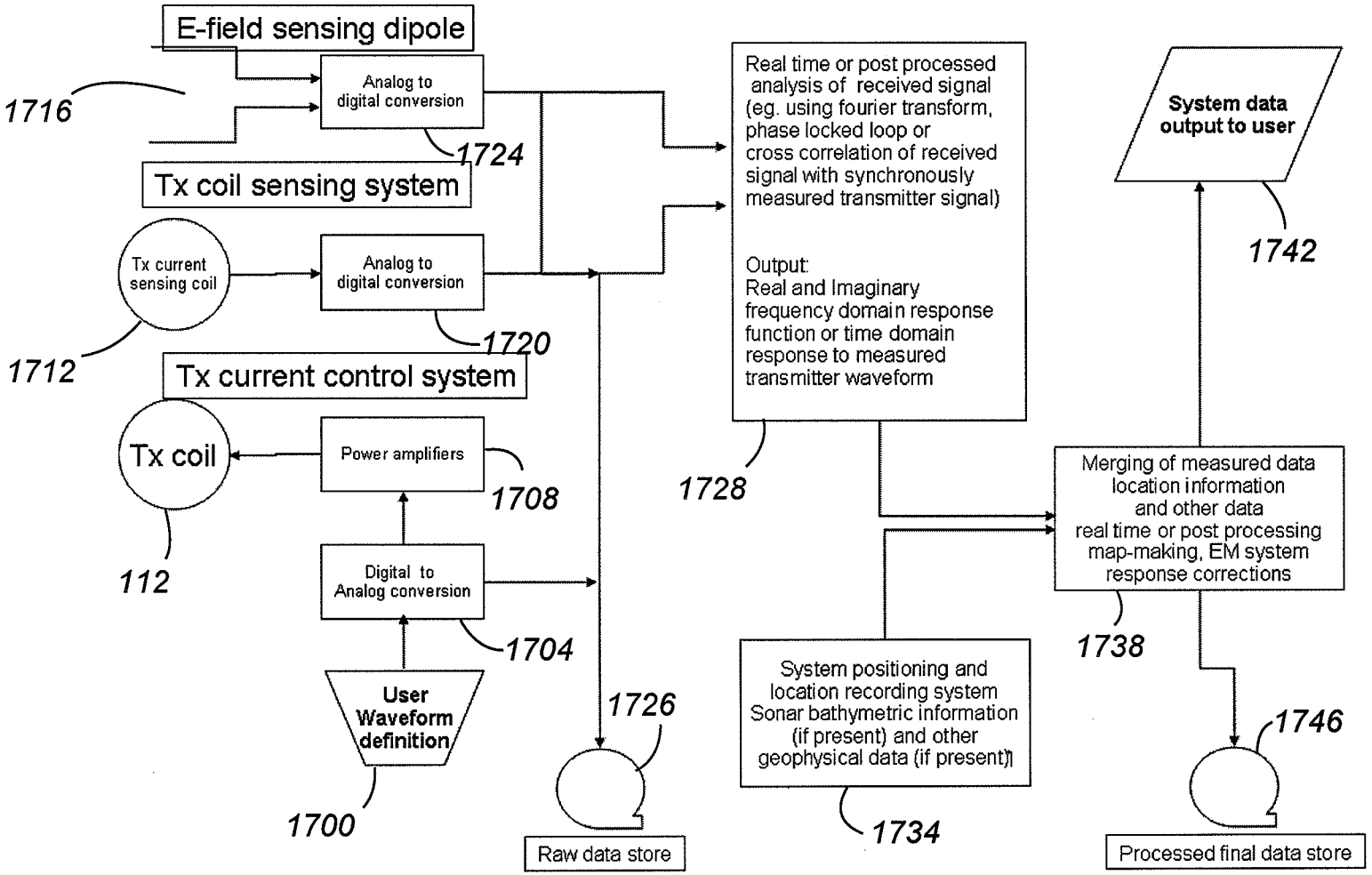

E-field sensing dipole
1716
Analog to digital conversion
1724
Tx coil sensing system
Tx current sensing coil
Analog to digital conversion
1720
1712
Tx current control system
Tx coil
Power amplifiers
1708
112
Digital to Analog conversion
1704
User Waveform definition
1700
1726
Raw data store
Real time or post processed analysis of received signal (eg. using fourier transform, phase locked loop or cross correlation of received signal with synchronously measured transmitter signal)
Output:
Real and Imaginary frequency domain response function or time domain response to measured transmitter waveform
1728
System positioning and location recording system Sonar bathymetric information (if present) and other geophysical data (if present)
1734
System data output to user
1742
Merging of measured data location information and other data real time or post processing map-making, EM system response corrections
1738
1746
Processed final data store

Fig. 17

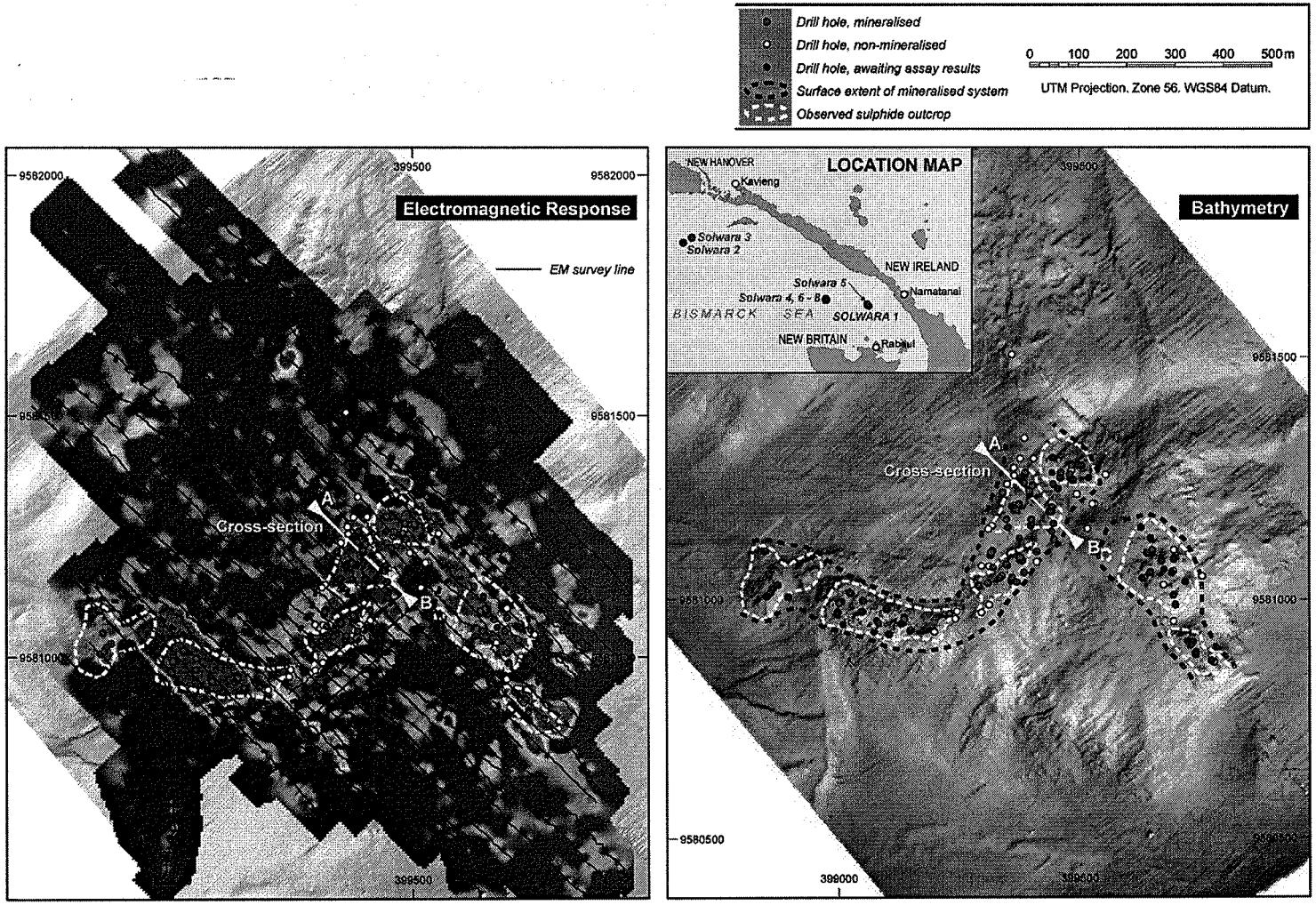

Drill hole, mineralised
Drill hole, non-mineralised
Drill hole, awaiting assay results
Surface extent of mineralised system
Observed sulphide outcrop
0 100 200 300 400 500m
UTM Projection, Zone 56, WGS84 Datum.
Electromagnetic Response
EM survey line
Cross-section
A
B
9582000
399500
9581500
9581000
LOCATION MAP
NEW HANOVER
Kavieng
Solwara 3
Solwara 2
NEW IRELAND
Solwara 5
Namatanai
Solwara 4, 6 - 8
SOLWARA 1
BISMARCK SEA
NEW BRITAIN
Rabaul
Bathymetry
9580500
399000

Fig. 18

Fig. 19