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INTERNAL DOCUMENT

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ARRANGEMENT OF THE MAIN COMPUTATION NETWORK FOR THE SEA AROUND THE BRITISH ISLES

A part of the electronic model
for tides and storm surges

S. Ishiguro
1980

NATURAL ENVIRONMENT RESEARCH COUNCIL
INSTITUTE OF OCEANOGRAPHIC SCIENCES

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ARRANGEMENT OF THE MAIN COMPUTATION NETWORK FOR THE SEA AROUND THE BRITISH ISLES

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53 pages, 3 tables, 47 diagrams.

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CONTENTS

ABSTRACT

The construction of the 'Main Computation Cabinet' of the electronic model for tides and storm surges has been explained, which includes the grid-socket matrix boards, input-data patch boards, output-data multiplexers, and floating DC-power supply. Then, a model scheme for the sea around the British Isles has been described with the full data for its time-independent model parameters. The model has actually been assembled to this scheme.

1. INTRODUCTION

The outline of the electronic model for tides and storm surges has been described in a separate paper (Ref. 1). 'Grid cards' which are building blocks of the main computation network of the model have also been described in detail in the same paper. Peripheral instruments including the control cabinet of the model have been described in another paper (Ref. 5).

In the first half of this paper, the construction of the 'main computation cabinet', which contains the computation network and its directly related components, has been explained mainly for its user's aid. In the last half, an example of setting the network to the sea around the British Isles has been described with the full data, while the model can be set to any continental-shelf sea.

2. CONSTRUCTION OF THE MAIN COMPUTATION CABINET

Fig. 1 shows a general view of the computation cabinet. Fig. 2 shows the schematic diagram of the circuits contained in the cabinet, and Fig. 3 shows the locations of components in the cabinet.

The main computation cabinet (169 × 67 × 64 cm^3) consists of four identical vertical drawers, a rear panel with a cover and the base of the cabinet (67 × 105 cm^2) with four rollers. The mechanical details of the cabinet have been described in a separate paper (Ref. 6).

Other than the grid cards, the cabinet contains:-

Grid-card matrix boards	One board per drawer, 240 cards per board
Floating DC-power supply units	240 units per drawer
Patch board A for time-dependent input	60 sections per drawer, 4 terminals per section
Output multiplexer with impedance converters	240 sets per drawer, 3 channels per set
Inter-drawer connectors with patch board B	150 channels per drawer
Common power transformer	One

The above-mentioned components are electrically linked with external circuits or instruments by:-

Connector CN P	240V AC power line (3 lines)
Connectors CN21 to CN26	Time-dependent input for normal grids, from the input memory (300 lines)
Connector CN100	Time-dependent input for non-coastal boundary, from the input memory (50 lines)
Connector CN15	Output data to the output memory (6 lines); and the multiplexer control signals (4 lines), from the control cabinet

Although the cabinet can contain up to 990 grid cards, only 330 cards are connected at the moment. See the footnote on page 18 for the reason.

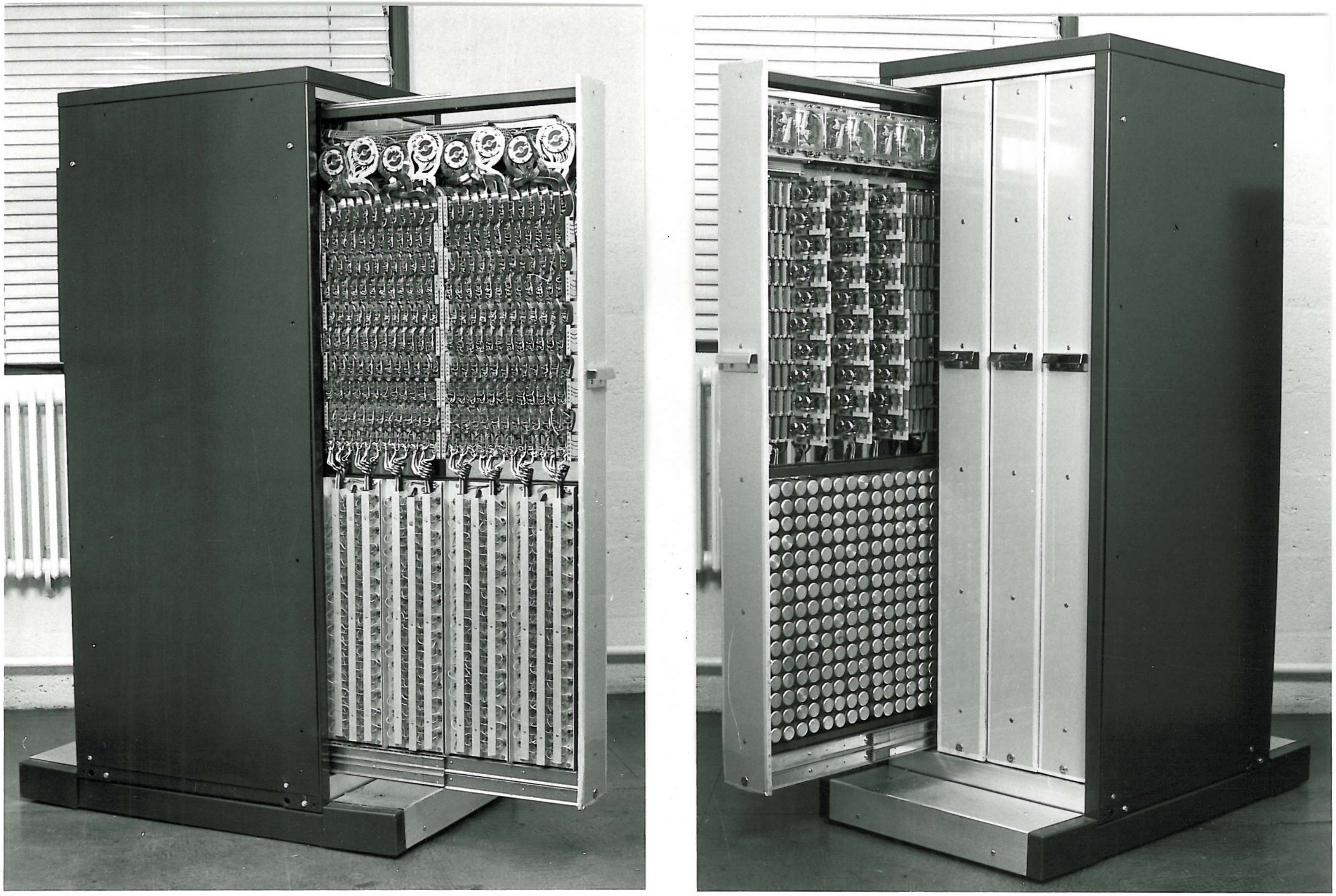


Fig. 1 Main computation cabinet.

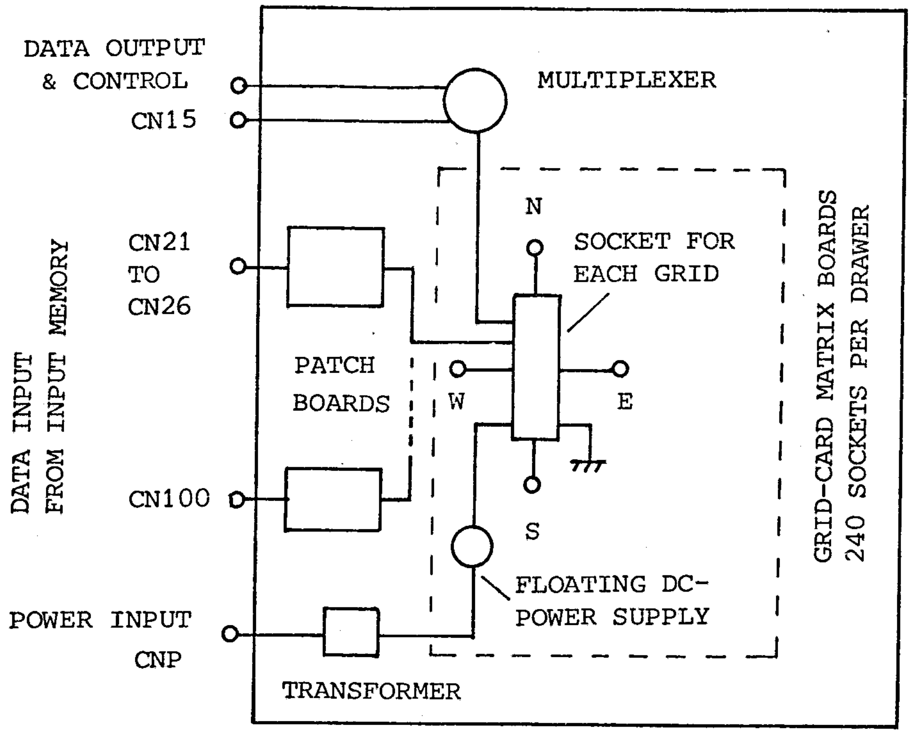


Fig. 2 Schematic diagram of the circuit in the main computation cabinet.

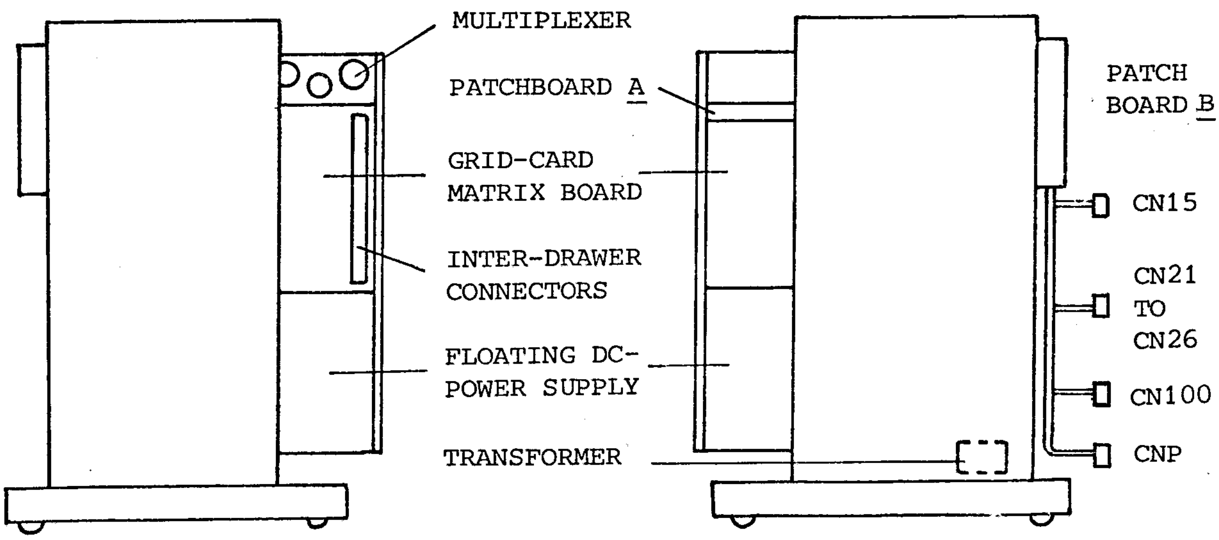


Fig. 3 Physical arrangement of components in the main computation cabinet.

2.1 Power supply

Fig. 4 shows the schematic diagram of the power supply system in the cabinet. The power supply unit for each grid card is operated from a 240V AC power line, but its DC output (10V) terminals are 'floating' from the common conductor (ground line) with a high degree of AC/DC isolation. The isolation is achieved by an isolation transformer specially designed for this purpose (Ref. 1). It is important that all the AC power-line conductors in the cabinet are electro-statically screened. For this reason, the power-supply unit rack is separated from the grid-card rack, as shown in Fig. 5. Fig. 6 shows the details of the screened wiring rack for the power supply units.

All the power supply units are electrically and physically identical, except for minor differences in their stray capacitances (see Appendix 2). Each power unit is physically fixed to the rack with a single screw, and electrically connected with 4 'micro' plugs: 2 to the AC power line sockets, and 2 others to the DC output line sockets. Each set of DC power-line sockets is permanently connected to a particular grid socket. They can be identified by a common number for a power supply unit and its grid socket (Fig. 5).

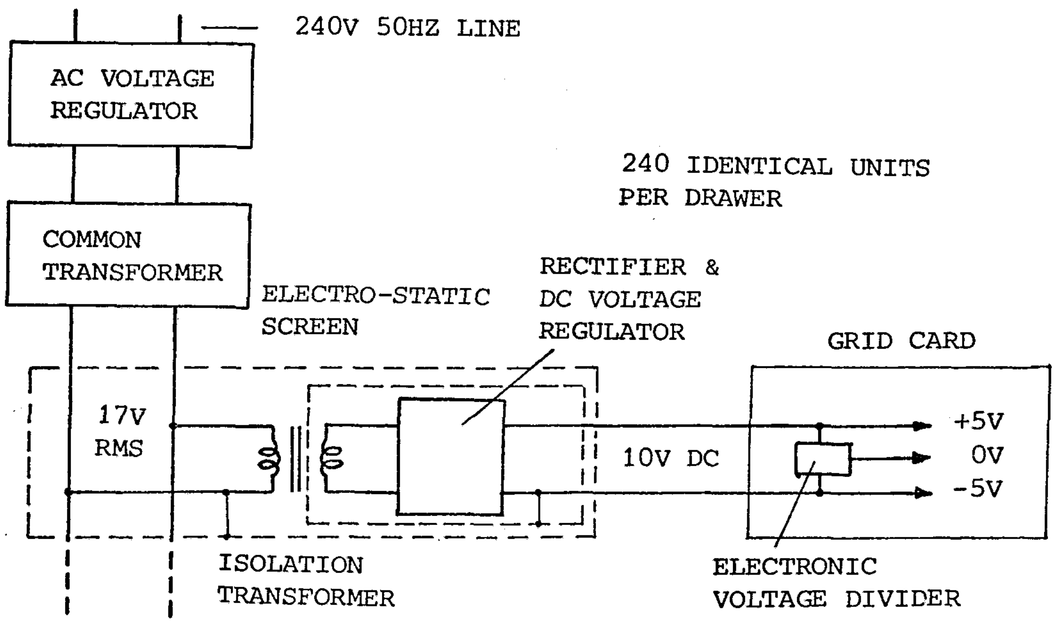
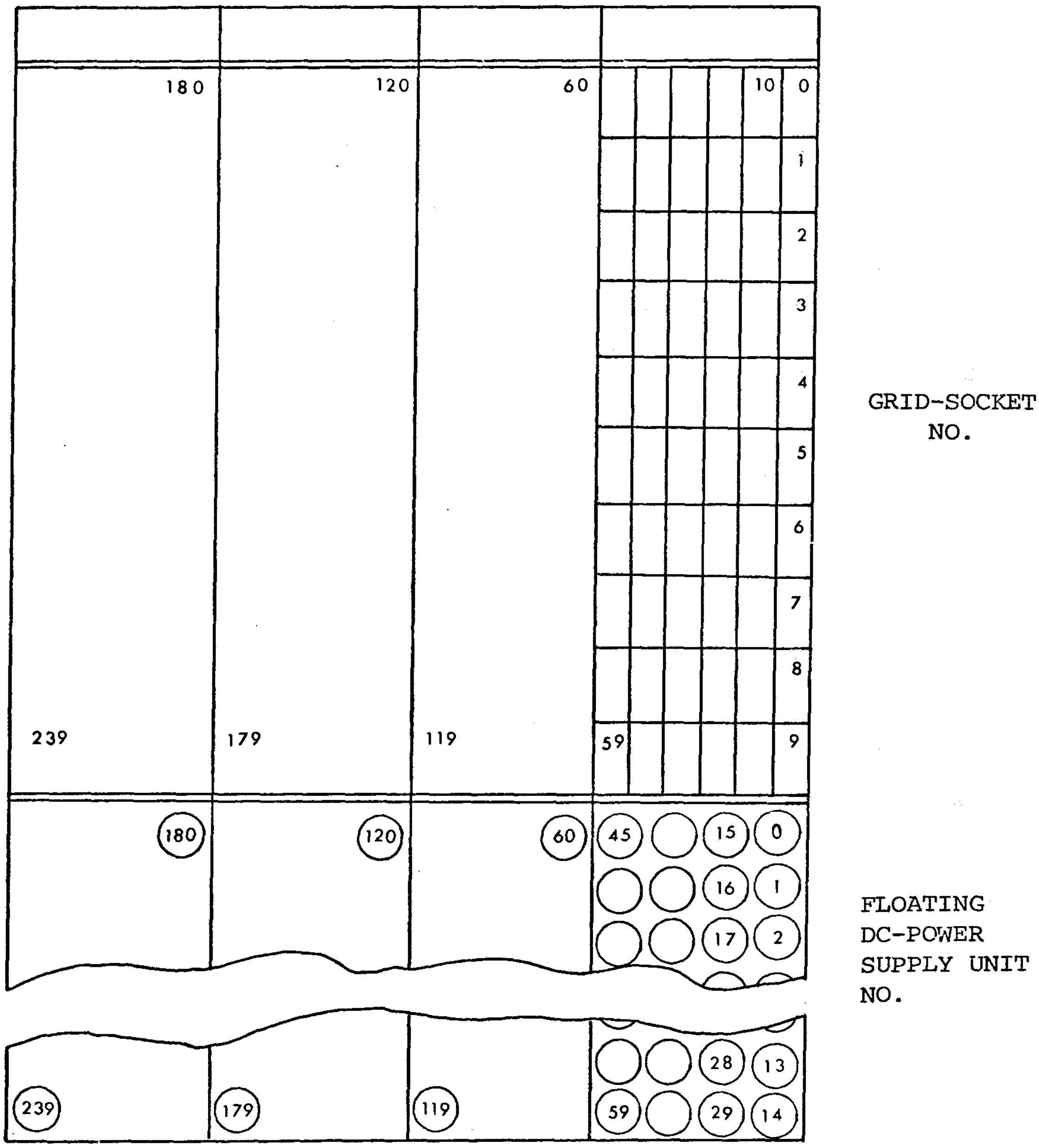


Fig. 4 Schematic diagram of the power supply system in the main computation cabinet.



<u>Fig. 5</u> Grid sockets and floating DC-power supply units in a drawer. A grid-socket is internally connected to the power supply unit which has the same number.

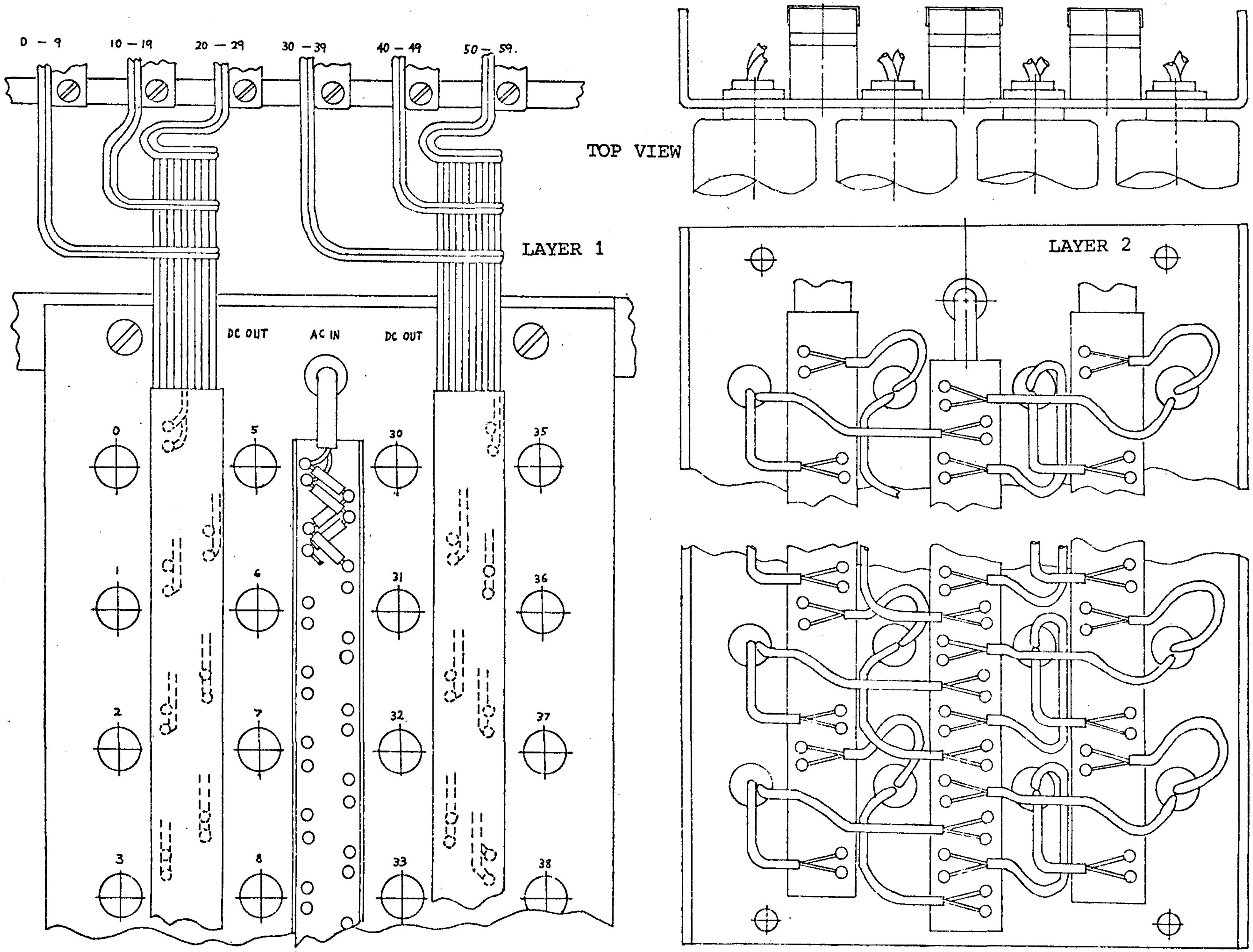


Fig. 6 Physical arrangement of the screened wiring-rack of the power supply within a drawer. 1/4 of the drawer is shown.

2.2 Inter-grid connections

'Grid sockets' are physically fixed in the top half of the rack in each drawer of the cabinet, forming a 10 × 24 matrix. Each grid socket is used for holding a grid card physically, and for connecting electric circuits with 16 terminals (including 2 unused terminals). 10 of these terminals used are permanently connected within the rack: 2 for the DC power supply lines; one for the ground line; 4 for the input-data line; and 3 for the output-data lines. The remaining 4 terminals, N, E, W, S, are left for programming the network.

The 4 terminals of each grid socket should be connected according to a model scheme, so that the whole grid forms a two-dimensional net-work, e.g. see Fig. 17. Fig. 7 shows the 4 terminals of a grid socket, and its typical connections to the adjacent sockets. This example shows a case where the 4 adjacent grid sockets are physically adjacent to the socket in question. Although such a case is easy to imagine, it is not always possible to actually arrange. A socket in a physically remote position in the drawer (or another drawer) can be used as an adjacent grid socket by using a long connection wire.

Standard wires with micro plugs for connecting the grid sockets vertically (N-S direction) or horizontally (E-W direction) are colour coded as shown in Fig. 7.

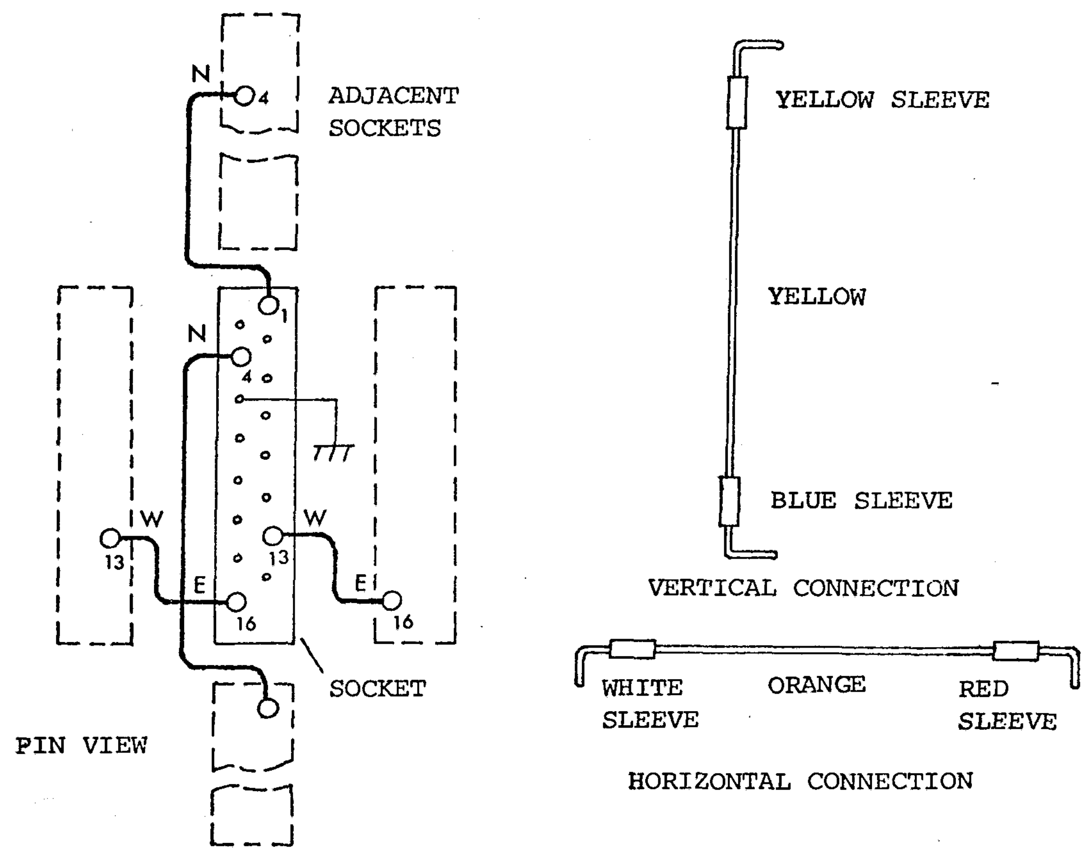


Fig. 7 Inter-grid connections and colour-coded wires.

2.3 Time-dependent variable input

Time-dependent variable input represents, for example, the atmospheric pressure or wind on the sea surface; while the time-independent variable input represents, for example, the water depth or latitude of a certain part of the sea. The former is fed into each grid card from the Input Memory (Ref. 2) through a pair of opto-electronic couplers (N and E components), while the latter is stored in the grid.

Generally the size of a 'sea grid' (a grid representing a quantized section of the hydrodynamic system of the sea) is smaller than that of a 'meteorological grid'. This is mainly due to the scales of the two systems limited by their boundaries, and the numbers of grids available for the systems. An example, described in chapter 3, employs 50 km square grids for the sea, and 100 km square grids for the meteorological system, i.e. 1-to-4 ratio in their area.

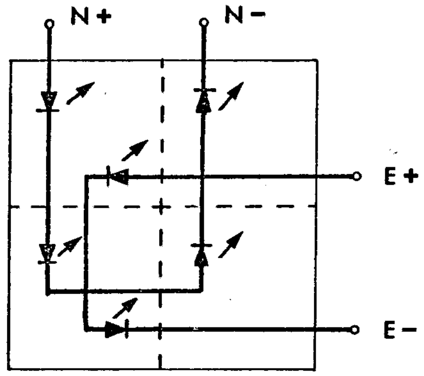


Fig. 8 Typical connections for driving LEDs in opto-electronic couplers. This example shows a group of four grids.

Fig. 8 shows the typical connections of LEDs in the opto-electronic circuits of 4 adjacent sea grids (or one meteorological grid). Note, the opto-electronic output from the LEDs is proportional to their currents (not voltages), and each set of LEDs should be connected in series.

The currents for each set of grid cards (typically 4 cards) are generated by the 2 channels of the input memory which has many independent channels. In order to obtain versatile combinations in the input memory channels and grid sockets, 'patch board A' has been prepared between the memory and sockets (the top part of each drawer; see Fig. 2).

Fig. 9 shows the details of patch board A and the grid socket matrix board in the same drawer. Each section of the patch baord consists of 4 sockets, N−, N+, E−, E+, and each section has a serial number. These 4 sockets are permanently connected to the grid card which has the same number as the patch board section. When a grid card is connected to a grid card socket, the opto-electronic input terminals of the grid card are automatically connected to the 4 sockets of the patch board section, as shown in Fig. 10 (the left side diagram).

Each output channel of the input memory has a set of two plugs which ends near patch board A, as shown in Fig. 10 (top-left diagram), so that this is directly connected to appropriate terminals of the patch board, according to the programme of the model. Jump wires which have the same type of plugs as the former have also been prepared (bottom-left diagram in Fig. 10) for necessary connections as shown in Fig. 8.

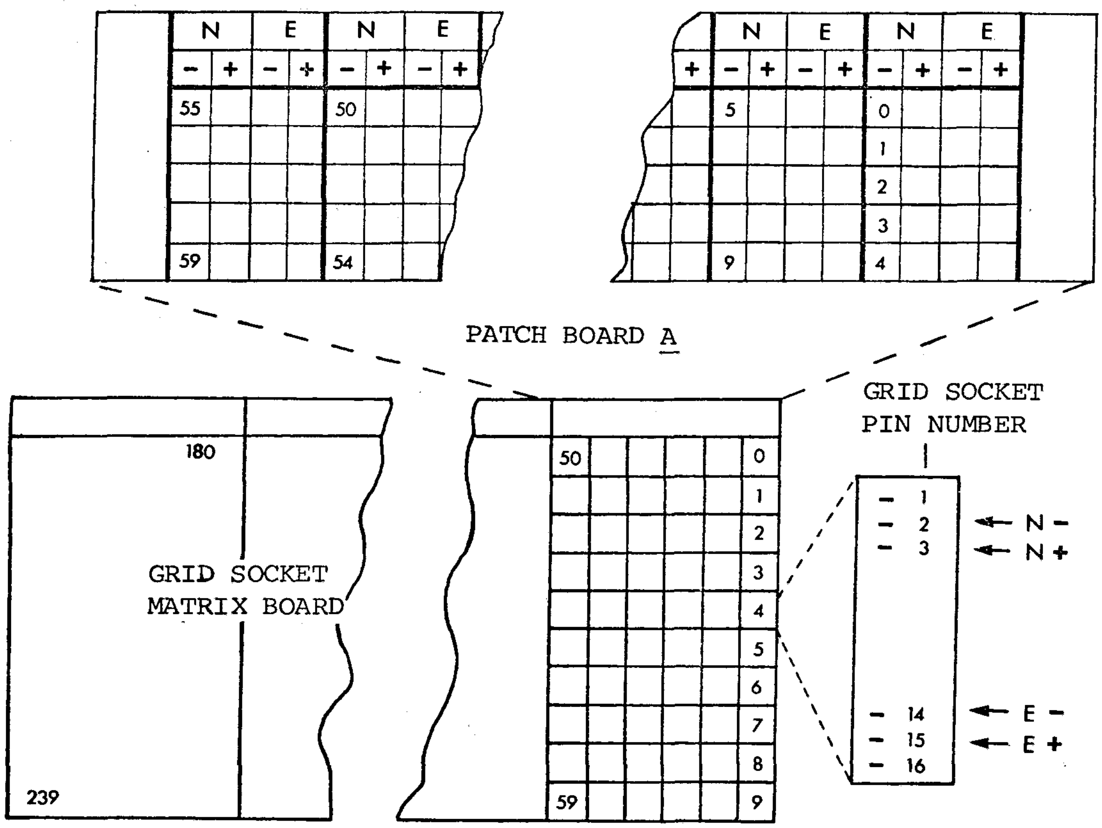


Fig. 9 Identifications of channel no. and polarities of a grid-card terminal, patch board sockets and wires.

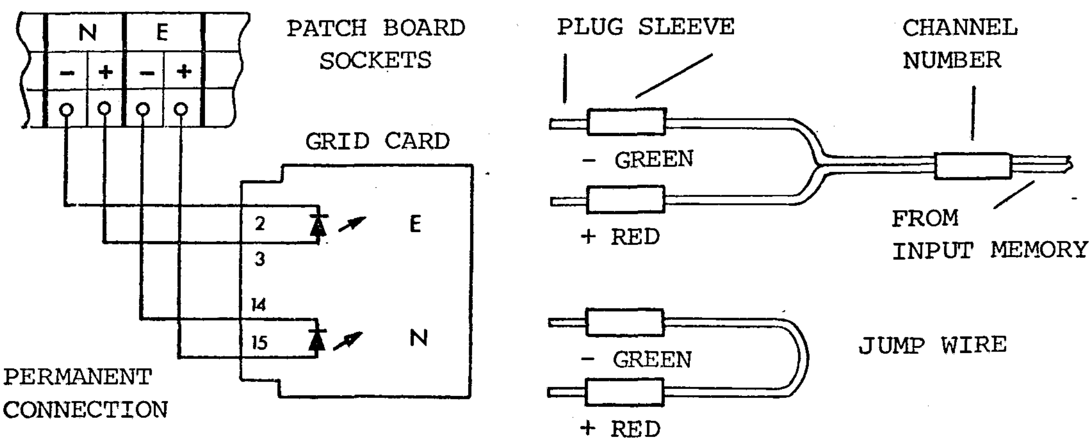


Fig. 10 Relationship between grid socket no. and terminal no. on patch board A.

2.4 Non-coastal boundary

A boundary of a model representing other than a coastal line of the sea should have the following characteristics:-

a Waves which are going through the boundary are not reflected by it, and

b waves which are coming through the boundary are artificially generated at the boundary. Ideally, waves reflected beyond the boundary should also be generated in the same way.

The model grids for the boundary have been designed to simulate these conditions, i.e.

a' The model boundary is terminated with a grid whose dynamic impedance is equal to the dynamic impedance of the modelled area seen through the boundary, and

b' simulated external waves are fed from the input memory through the model boundary.

The waves in b' are again simulated by the input memory. However, an interface circuit (a different type from the opto-electronic coupling used for general grids) is used between each channel of the input memory and a boundary grid. Fig. 11 shows a circuit, using such an interface, which satisfies the requirements in a' and b'. Fig. 12 shows the actual circuit board on which 24 channels of interface circuit are assembled.

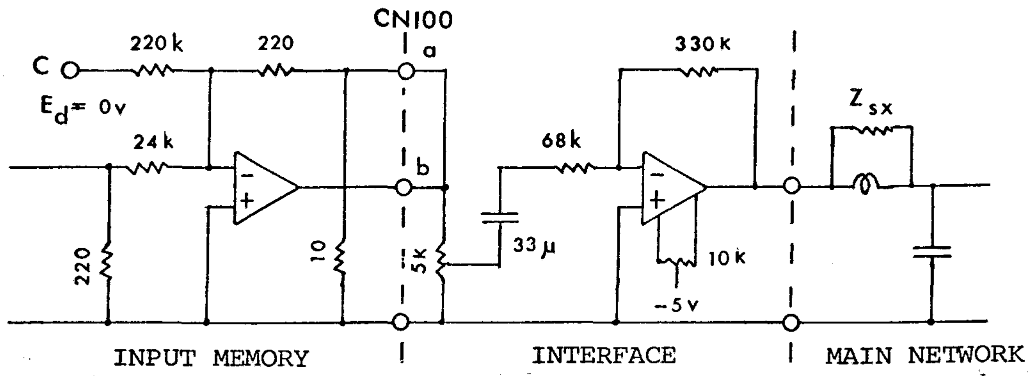


Fig. 11 Circuit diagram of a non-coastal boundary grid.

In order to adjust a terminating impedance (Z_{SC} in Fig. 11), 40 independent potentiometers ($10 \times 10 \times 5$ mm^3 each) have been assembled on a single circuit board, 'board Z'. This can be used for a boundary with external waves or without external waves (the interface circuit is replaced simply by a short circuit).

Fig. 13 shows a typical arrangement of the circuits from the input memory to the 'inter-drawer connector' (see Section 2.5) in each drawer, for a non-coastal boundary.

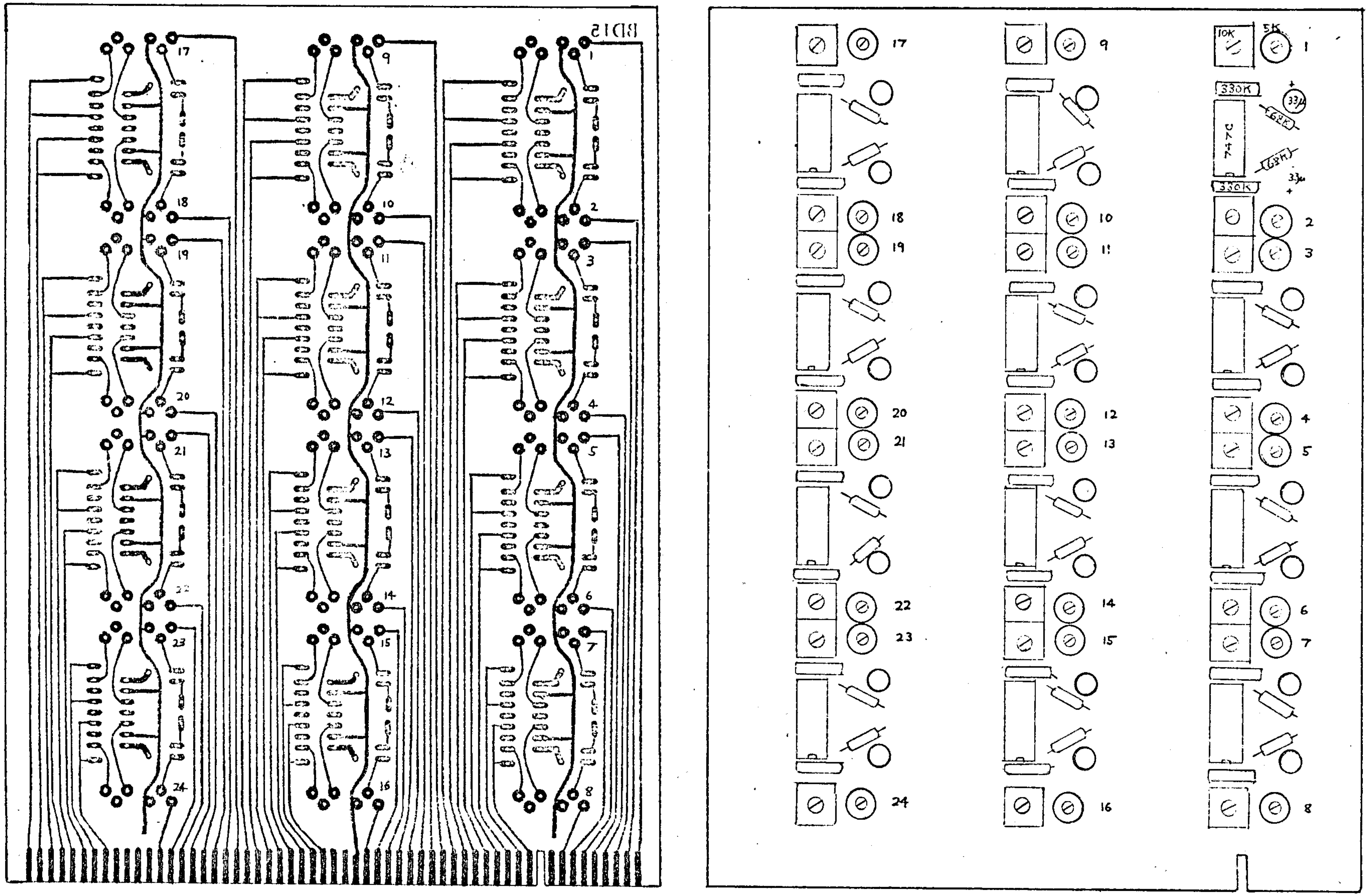


Fig. 12 Details of boundary grid circuit board, BD-AS.

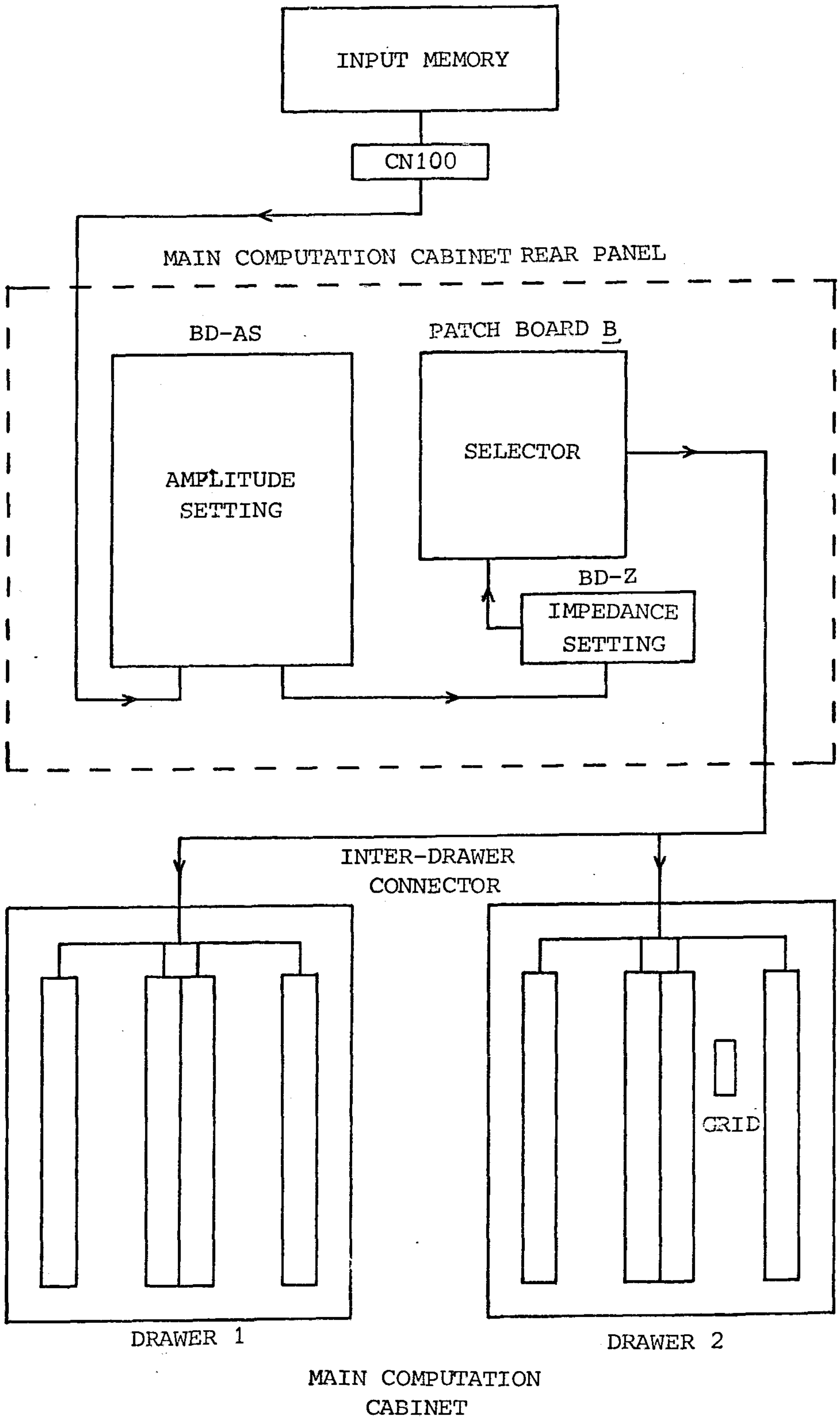


Fig. 13 Schematic diagram from the input memory to boundary grids.

2.5 Output circuits

Each grid card has three sets of output-data terminals:

X component (N-S component of water current)

Y component (E-W component of water current)

Z component (the water level)

The terminals for the first two sets of output are electrically 'floating' from the ground line, and their voltages are taken out through two differential amplifiers, so that the voltages can be referred to the ground line. One of the last set of terminals is grounded at the first place.

The output from all the grid cards are finally fed into the 'Output Memory' (Ref. 3) through a multiplexer.

Fig. 14 shows the scheme of the multiplexer* which includes above-mentioned differential amplifiers (which also work as impedance converters). 5 lines from each grid socket are connected to terminals X, X', Y, Y', Z of a 'grid selector' (No. 1 in the example shown in Fig. 14), which covers up to 30 grid sockets. The output of this selector (again 5 lines) is connected to one 'position' of the 'section selector', through impedance converters. The section selector has 30 positions (only 12 positions are used at the moment), i.e. all the selectors can cover up to 900 grid cards (or 2700 sets of output). The 5 lines of the final selector are connected to the output memory. Fig. 15 shows the details of the impedance converter board. The driving circuit for the multiplexer has been described in a separate paper (Ref. 4).

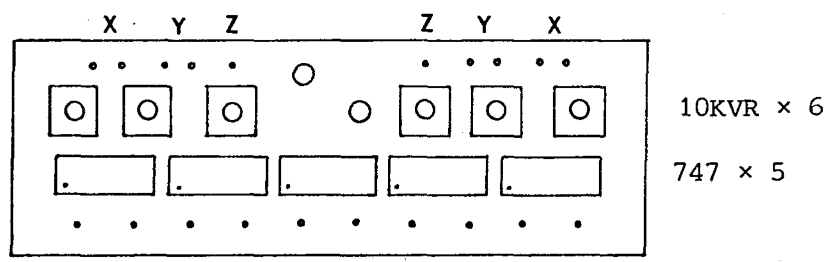


Fig. 15 Impedance-converter board.

2.6 Inter-drawer connections

In order to facilitate any connections between different drawers, 'inter-drawer connection terminals' have been prepared as shown in Fig. 16. Each wire of this connection has one terminal near the edge of a drawer, and the other terminal in patch board B, which is on the rear panel of the cabinet. Each drawer has 150 inter-drawer terminals.

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*The design of this multiplexer was carried out in 1972. Although electronic analogue-multiplexers were available at that time, their price was more than ten times that for magneto-mechanical multiplexers. This was the main reason why the latter was employed for this scheme.

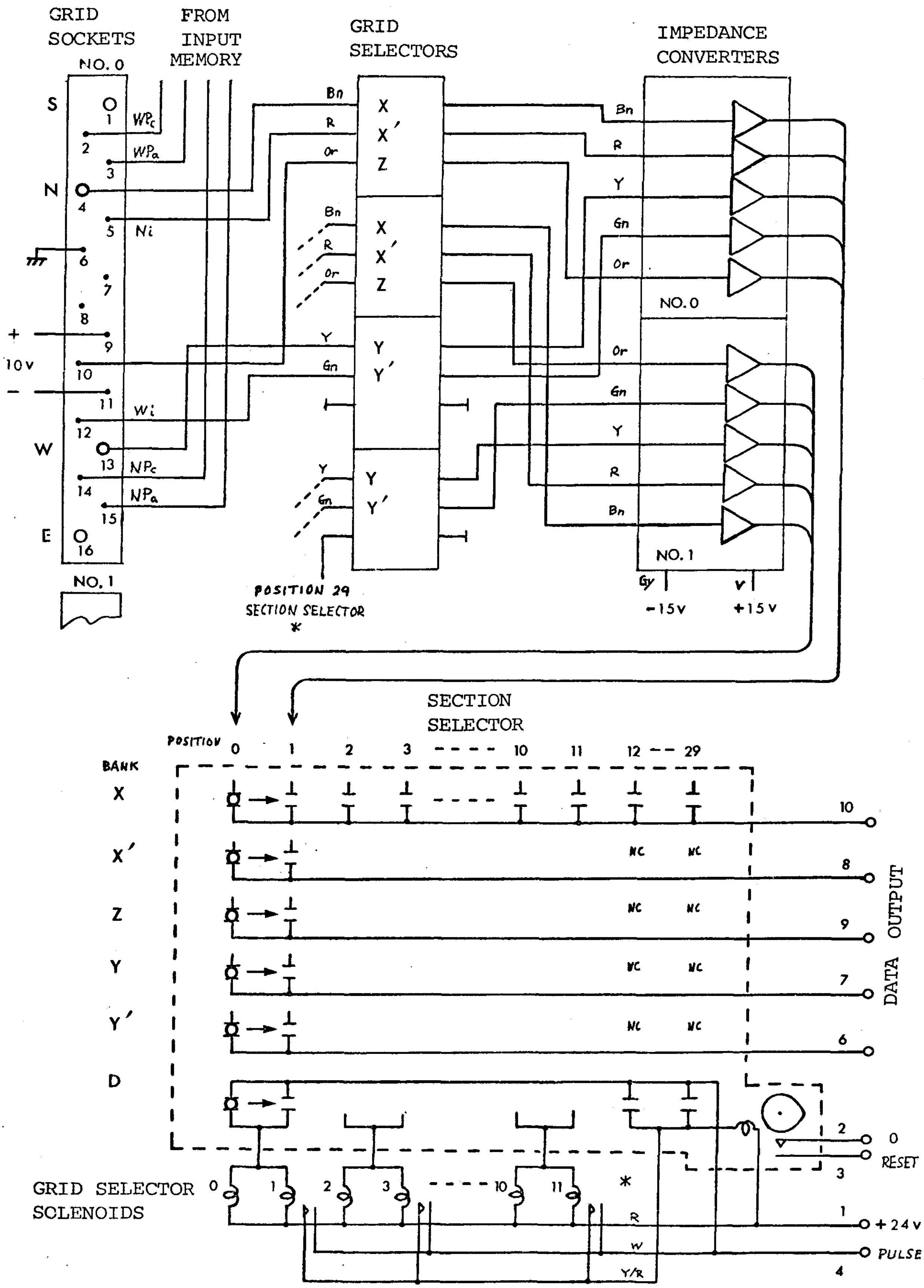

Fig. 14 Multiplexer, from each grid to connector CN5.

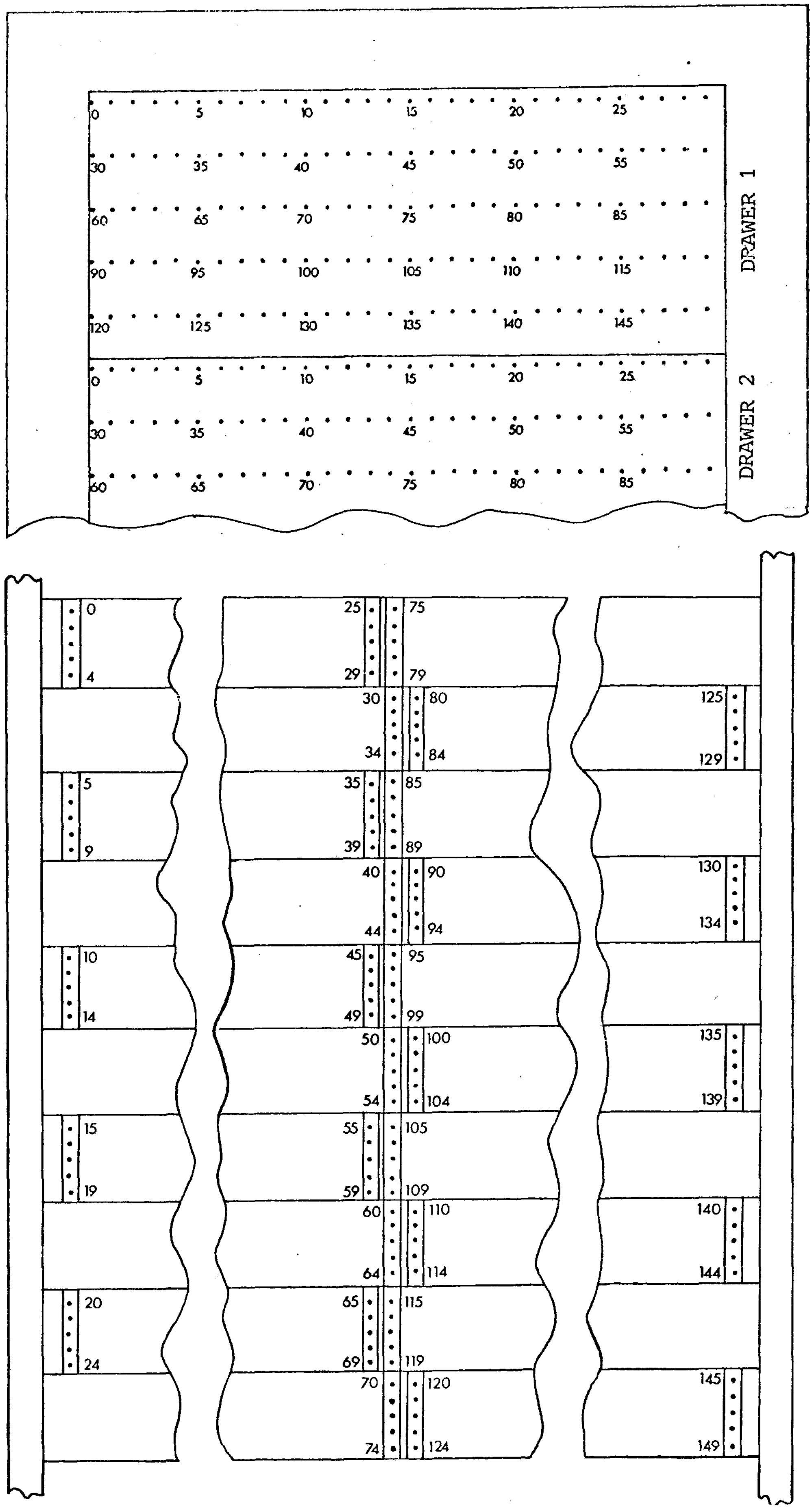

Fig. 16 Inter-drawer connection terminals in a drawer (bottom: scale 1/4 approx.), and patch board B (top: full scale).

3. GRID ARRANGEMENT FOR THE SEA AROUND THE BRITISH ISLES

An example of setting the model to the sea around the British Isles is described in this chapter, while the model can be set to any continental shelf sea.

Fig. 17 shows the grid scheme which requires 330 units* of 50 km × 50 km square grids. This scheme has been designed to match the 100 km × 100 km square grids of a meteorological model (a standard grid scheme designed by the Meteorological Office). Therefore, one meteorological grid corresponds to 4 sea grids in this scheme.

3.1 Grid parameters

The method of designing the grids, including the formula, has been described in a separate paper (Ref. 1). The model parameters are shown in Fig. 18 (18 diagrams on pages 20 to 37) by dividing the model into 6 areas. The following symbols and rules are used:-

	Boundary of model areas (electrically no boundary)
	Coastal boundary
	Boundary to an open sea (or non-coastal boundary)
Ω_e	In ohms, shown by the figure in the centre of each box.
R	In ohms, shown by the figure along the edge of each box. The value for r = 0.24 cm/s.
L	In mH, the value for a grid is shown by the figure in the centre of each box; and the average value for the grid and its adjacent grid is shown by the figure along the edge of each box.
F	In mV, the value for each grid is shown by the figure in the centre of each box; and the average value for the grid and its adjacent grid is shown by the figure along the edge of each box.

Table 1 (page 38) shows data for the non-coastal boundary termination.

Each grid card can be calibrated to the data given in this paper by using the grid-card calibrator (Ref. 3).

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*This number is limited by an artificial reason: a particular committee who did not appreciate the details of the scheme in 1973 ordered the cessation of the manufacture of the grids, after 330 units had been made.

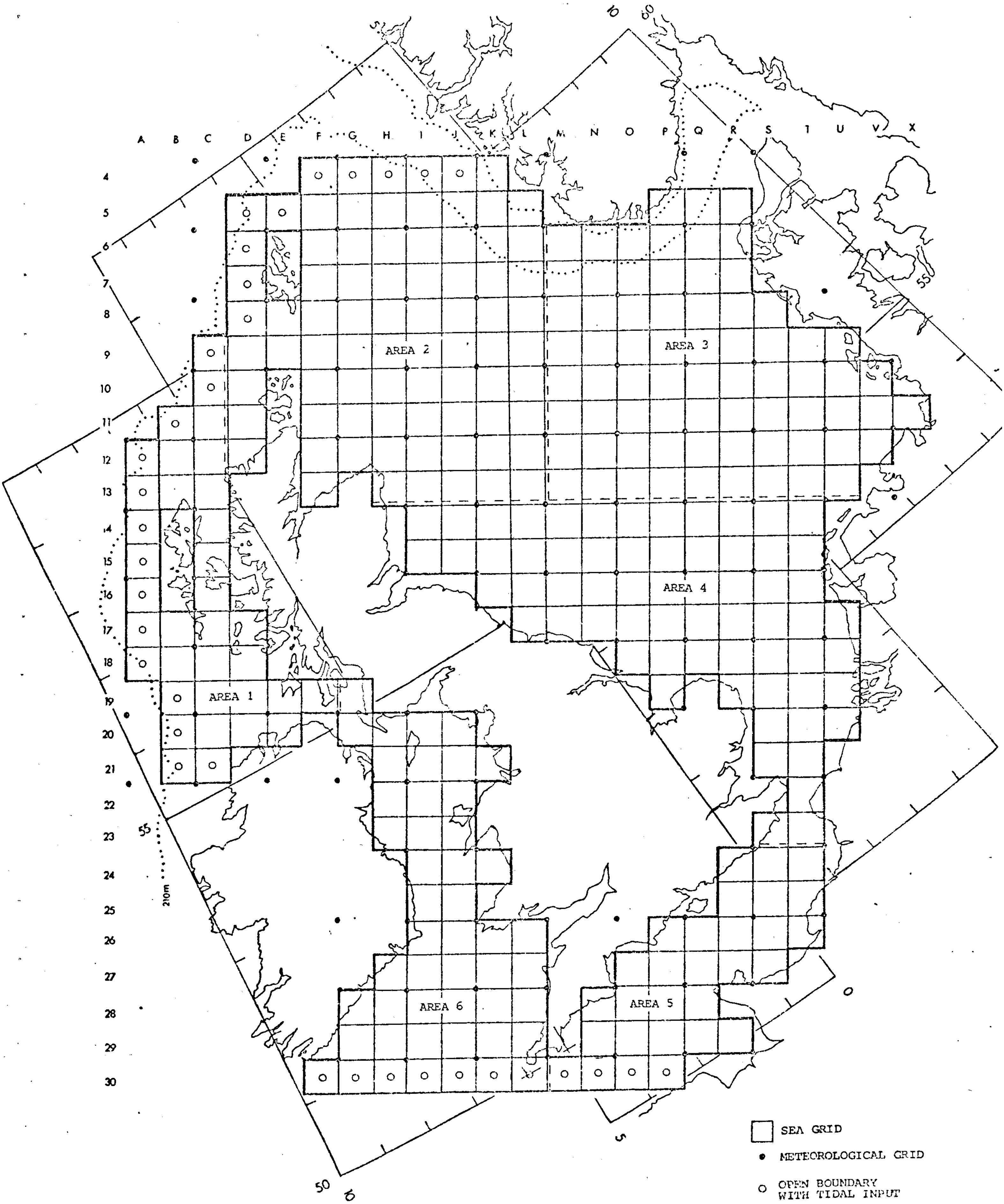


Fig. 17 Grid scheme of a model of the sea around the British Isles.

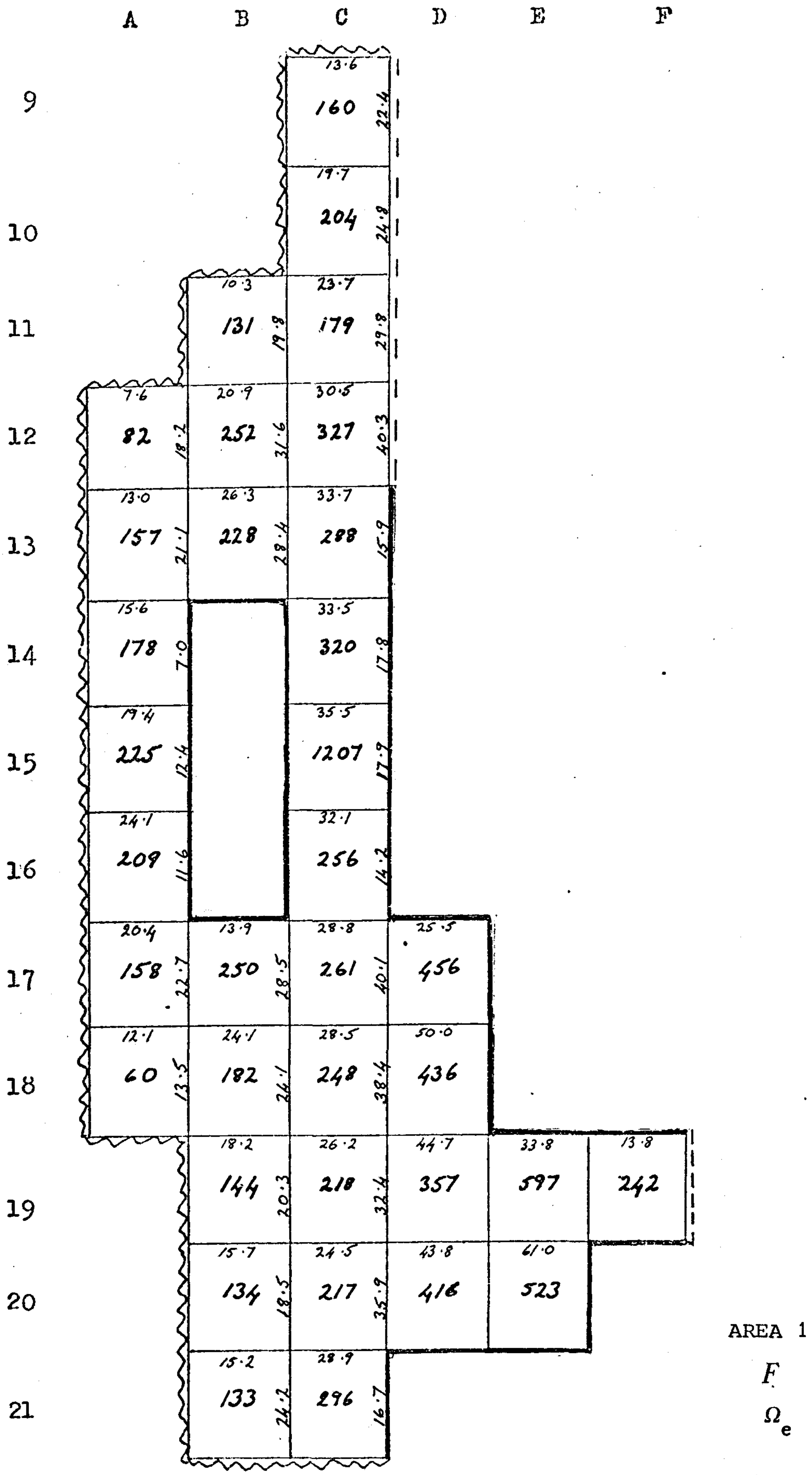
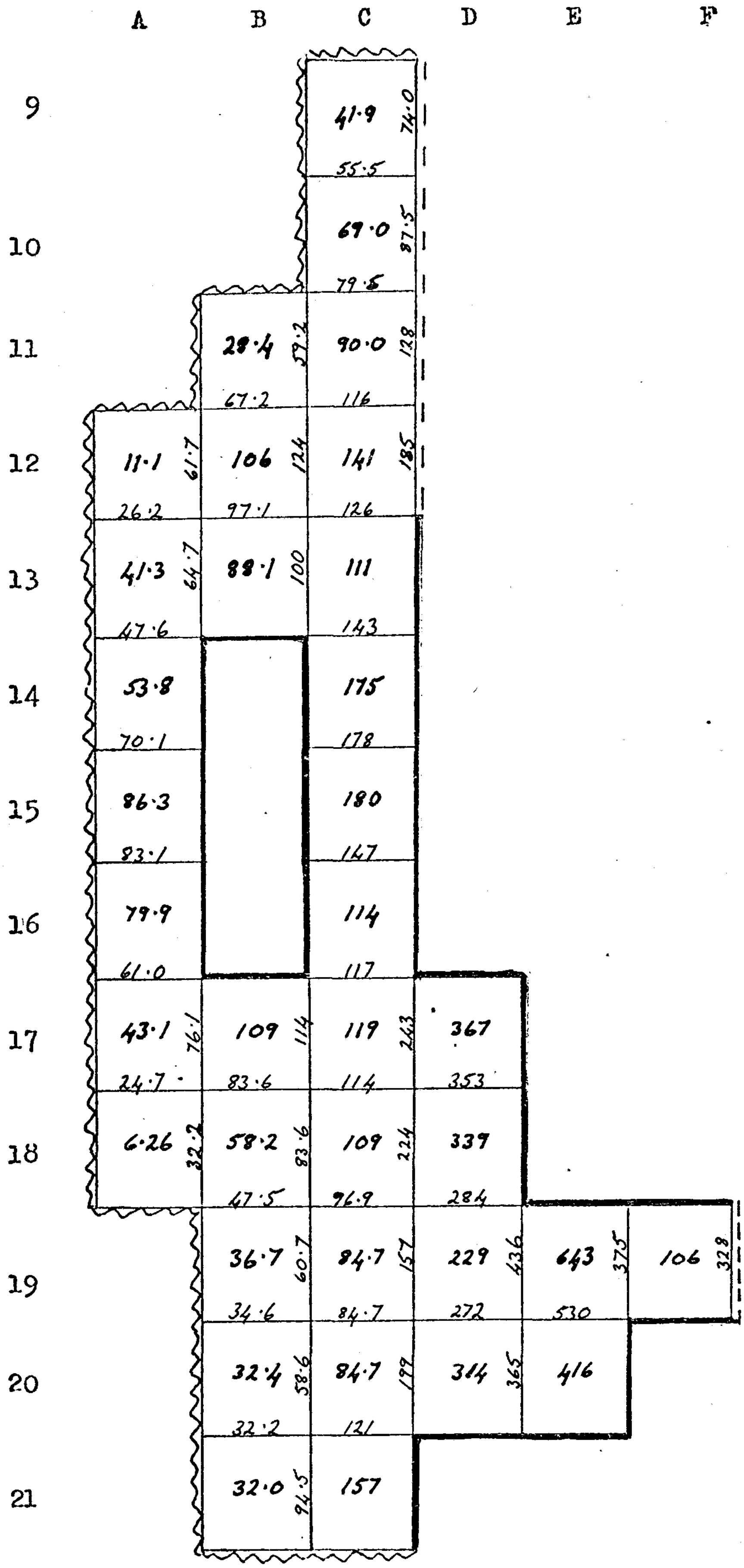
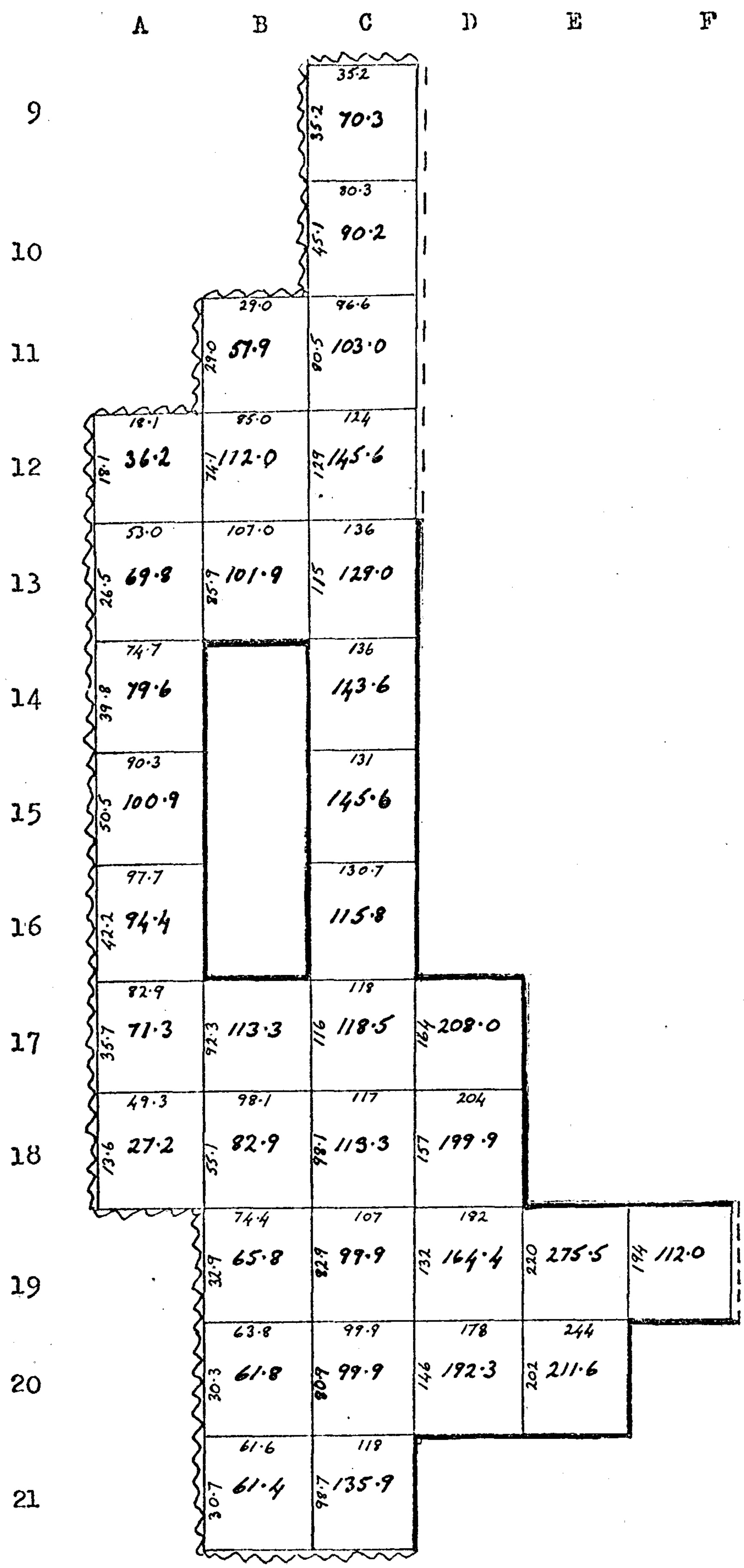


Fig. 18 (18 diagrams on pages 20 to 37). Model parameters.


A B C D E F
9 41·9 74·0 55·5
10 69·0 87·5 79·5
11 28·4 57·2 67·2 90·0 128 116
12 11·1 61·7 26·2 106 124 97·1 141 185 126
13 41·3 64·7 47·6 88·1 100 111 143
14 53·8 70·1 175 178
15 86·3 83·1 180 147
16 79·9 61·0 114 117
17 43·1 76·1 24·7 109 114 83·6 119 243 114 367 353
18 6·26 32·2 58·2 83·6 47·5 109 224 96·9 339 284
19 36·7 60·7 34·6 84·7 157 84·7 229 436 272 643 375 530 106 328
20 32·4 58·6 32·2 84·7 199 121 314 365 416
21 32·0 94·5 157

AREA 1

R


A
B
C
D
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9
10
11
12
13
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16
17
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20
21
35·2
35·2
70·3
80·3
45·1
90·2
29·0
29·0
57·9
96·6
90·5
103·0
18·1
18·1
36·2
85·0
74·1
112·0
124
129
145·6
53·0
26·5
69·8
107·0
85·9
101·9
136
115
129·0
74·7
39·8
79·6
136
143·6
90·3
50·5
100·9
131
145·6
97·7
42·2
94·4
130·7
115·8
82·9
35·7
71·3
92·3
113·3
118
116
118·5
164
208·0
49·3
13·6
27·2
98·1
55·1
82·9
117
98·1
113·3
204
157
199·9
74·4
32·9
65·8
107
82·9
99·9
192
132
164·4
220
275·5
194
112·0
63·8
30·3
61·8
99·9
80·9
99·9
178
146
192·3
244
202
211·6
61·6
30·7
61·4
118
98·7
135·9

AREA 1

L

	D	E	F	G	H	I	J	K
3			9·4 / 116 / 11·9	9·5 / 105 / 10·0	8·8 / 100 / 8·9	4·4 / 81 / 9·1	4·8 / 88 / 4·9	
4			14·3 / 152 / 17·3	14·8 / 171 / 17·9	15·1 / 199 / 16·3	9·9 / 103 / 10·2	9·4 / 85 / 9·9	5·3 / 97 / 5·3
5	11·4 / 102 / 13·9	15·4 / 158 / 17·1	16·7 / 161 / 17·9	18·4 / 173 / 20·1	21·6 / 202 / 20·5	15·2 / 178 / 15·7	10·7 / 112 / 11·1	10·3 / 93 / 10·5
6	14·3 / 166 / 9·9		17·4 / 163 / 17·8	18·3 / 167 / 19·4	21·2 / 191 / 20·9	20·1 / 194 / 19·0	14·5 / 155 / 13·9	10·5 / 100 / 10·5
7	19·0 / 189 / 10·2		18·6 / 183 / 19·3	18·4 / 172 / 19·0	20·1 / 180 / 20·1	20·9 / 190 / 20·7	18·8 / 189 / 20·3	15·3 / 182 / 17·8
8	21·2 / 205 / 26·5	15·5 / 286 / 26·2	20·6 / 197 / 20·7	18·9 / 174 / 18·7	19·0 / 170 / 19·0	20·1 / 179 / 21·9	22·4 / 220 / 26·9	24·8 / 270 / 31·6
9	24·8 / 254 / 29·3	30·0 / 268 / 26·2	22·3 / 213 / 21·7	20·0 / 185 / 19·9	19·0 / 179 / 17·9	17·9 / 148 / 18·8	22·7 / 194 / 26·2	30·4 / 280 / 33·3
10	27·5 / 253 / 13·8		25·5 / 254 / 25·1	21·3 / 204 / 21·3	19·9 / 185 / 19·0	17·0 / 161 / 20·0	21·4 / 194 / 24·6	29·4 / 251 / 28·8
11	30·9 / 314 / 27·2		31·8 / 326 / 30·5	33·8 / 230 / 24·7	22·2 / 218 / 23·4	20·2 / 206 / 25·6	24·9 / 257 / 28·4	28·1 / 256 / 28·0
12	37·3 / 368 / 20·2		40·6 / 413 / 40·6	30·5 / 324 / 33·1	27·3 / 275 / 31·1	27·2 / 285 / 32·1	30·5 / 292 / 30·8	28·8 / 261 / 27·7
13			50·0 / 472 / 27·2		32·4 / 308 / 35·0	33·7 / 321 / 33·7	32·1 / 283 / 30·4	27·1 / 260 / 28·3

AREA 2

F

Ω_e

	D	E	F	G	H	I	J	K
3			9·11 / 15·3 / 23·1	21·4 / 16·2 / 34·2	10·9 / 10·8 / 37·6	10·7 / 11·7 / 14·1	12·7 / 12·4	
4			37·1 / 42·0 / 39·5	46·9 / 57·1 / 47·5	64·3 / 40·9 / 65·5	17·4 / 14·7 / 34·8	12·0 / 13·8 / 16·3	15·6 / 15·3
5	16·8 / 28·5 / 30·6	40·2 / 41·1	41·9 / 45·1 / 42·5	48·3 / 57·5 / 47·0	66·6 / 57·4 / 63·4	52·1 / 36·4 / 57·2	20·6 / 17·5 / 30·4	14·4 / 15·6 / 15·6
6	44·3 / 51·3		43·1 / 44·4 / 49·3	45·6 / 52·9 / 47·4	60·2 / 61·2 / 57·0	62·2 / 51·2 / 61·2	40·2 / 28·5 / 50·2	16·8 / 15·6 / 36·2
7	58·2 / 63·5		55·5 / 52·3 / 59·9	49·1 / 51·5 / 49·9	53·8 / 57·0 / 51·1	60·2 / 60·2 / 57·0	60·2 / 57·9 / 70·8	55·5 / 45·2 / 90·3
8	69·0 / 102 / 87·5	134 / 99·2 / 127	64·3 / 57·5 / 69·9	50·6 / 49·5 / 54·0	48·3 / 51·1 / 51·1	53·8 / 67·6 / 45·5	81·4 / 103 / 72·9	125 / 141 / 130
9	106 / 113 / 106	119 / 97·3	75·5 / 66·4 / 92·3	57·3 / 55·6 / 63·8	53·8 / 45·5 / 56·0	37·1 / 50·7 / 40·7	64·3 / 99·2 / 64·3	134 / 155 / 122
10	106 / 136		109 / 89·6 / 145	70·2 / 64·2 / 80·1	58·2 / 51·3 / 69·8	44·3 / 54·3 / 58·6	64·3 / 86·7 / 89·2	109 / 117 / 112
11	165 / 197		180 / 135 / 236	89·9 / 85·7 / 135	81·4 / 77·1 / 106	72·8 / 93·4 / 107	114 / 114 / 132	114 / 107 / 117
12	229		291 / 236 / 354	180 / 156	131 / 136 / 146	141 / 145 / 161	149 / 134 / 145	119 / 108 / 119
13			416		161 / 171	180 / 161 / 235	141 / 130 / 149	119 / 123 / 122

AREA 2

R

	D	E	F	G	H	I	J	K
3			25.1 / 25.1 / 50.2	22.9 / 48.0 / 45.7	18.0 / 40.8 / 35.9	17.8 / 35.7 / 35.5	19.4 / 37.2 / 38.8	
4			58.2 / 33.1 / 66.2	60.1 / 70.3 / 74.4	61.5 / 80.8 / 87.1	40.4 / 66.2 / 45.3	38.2 / 41.5 / 37.6	40.2 / 42.8
5	22.3 / 22.3 / 44.5	34.5 / 56.7 / 68.9	67.6 / 68.9 / 68.9	74.9 / 72.2 / 75.5	87.9 / 82.1 / 88.6	61.9 / 83.5 / 78.4	43.4 / 63.8 / 49.2	42.1 / 45.3 / 41.3
6	58.4 / 36.2 / 72.3		70.1 / 71.3	74.4 / 72.3 / 73.3	86.5 / 78.8 / 84.3	82.1 / 85.0 / 85.7	59.1 / 77.3 / 68.9	42.9 / 56.7 / 44.5
7	77.6 / 41.5 / 82.9		76.1 / 80.9	74.7 / 78.5 / 76.1	80.6 / 76.5 / 76.9	85.0 / 80.6 / 84.3	76.6 / 84.0 / 84.3	62.7 / 82.6 / 80.9
8	86.6 / 45.1 / 90.2	108 / 125.9	84.0 / 106 / 87.1	76.7 / 82.2 / 77.2	76.2 / 76.4 / 75.5	81.5 / 77.6 / 79.6	91.2 / 88.8 / 98.0	101 / 110 / 121.4
9	101 / 91.2 / 112.0	122 / 115 / 118.5	90.8 / 107 / 94.4	79.7 / 98.3 / 82.2	77.6 / 80.9 / 79.6	72.9 / 72.9 / 66.2	92.6 / 76.7 / 87.1	124 / 107 / 125.9
10	101 / 112.0		104 / 113.3	86.6 / 102 / 91.0	81.3 / 87.0 / 82.9	69.3 / 77.6 / 72.3	87.1 / 79.7 / 87.1	120 / 100 / 113.3
11	121 / 139.6		129 / 145.6	97.0 / 124 / 103.0	90.5 / 101 / 98.0	82.5 / 95.4 / 92.7	101 / 104 / 115.8	115 / 116 / 115.8
12	155 / 164.4		165 / 185.3	124 / 165 / 145.6	111 / 135 / 124.3	111 / 127 / 129.0	124 / 131 / 132.4	117 / 125 / 118.5
13			203 / 221.6		132 / 140	138 / 143 / 146	131 / 138 / 129	119 / 124 / 119

AREA 2

L

AREA 3

F

Ω_e

Each cell: upper figure / main figure / side figure (as written in the cell).

	L	M	N	O	P	Q	R	S	T	U	V	X
5	5.5 / 77 / 5.5				2.7 / 50 / 7.94	8.9 / 94 / 51.5	70.8 / 834 / 46.3					
6	10.5 / 93 / 9.61	4.5 / 92 / 9.12	4.5 / 92 / 9.56	5.0 / 90 / 10.7	8.4 / 103 / 21.5	21.0 / 285 / 85.3	116 / 1247 / 69.5					
7	12.9 / 143 / 14.9	11.6 / 128 / 16.3	13.8 / 168 / 19.4	15.2 / 184 / 27.3	22.8 / 304 / 50.0	48.7 / 591 / 48.1	118 / 860 / 48.1					
8	24.5 / 303 / 33.8	24.2 / 310 / 35.0	27.1 / 322 / 38.0	30.3 / 363 / 43.0	40.3 / 415 / 56.1	65.8 / 588 / 89.9	86.0 / 675 / 89.9	52.0 / 925 / 52.0				
9	34.5 / 319 / 37.4	36.7 / 352 / 40.4	38.7 / 375 / 42.8	42.1 / 395 / 48.0	49.2 / 465 / 54.5	61.3 / 506 / 77.5	69.2 / 555 / 77.5	98.3 / 819 / 119.8	74.0 / 1297 / 213	139 / 2440 / 139		
10	32.8 / 268 / 33.3	38.0 / 330 / 28.0	40.0 / 350 / 38.5	40.9 / 338 / 43.5	50.6 / 436 / 51.7	55.6 / 482 / 60.1	58.4 / 482 / 60.1	79.2 / 579 / 78.2	120 / 812 / 115.8	206 / 1214 / 382	318 / 5377 / 318	
11	28.7 / 247 / 30.4	35.1 / 299 / 34.5	37.4 / 314 / 28.0	39.1 / 359 / 49.9	54.3 / 528 / 61.0	58.4 / 552 / 61.0	56.8 / 524 / 61.0	64.2 / 548 / 65.1	80.1 / 591 / 74.1	120 / 702 / 97.3	370 / 986 / 370	318 / 5404 / 318
12	26.9 / 235 / 27.0	30.5 / 248 / 30.5	20.2 / 296 / 37.9	41.4 / 375 / 95.1	67.7 / 669 / 69.2	62.5 / 550 / 59.7	58.2 / 499 / 59.7	62.5 / 546 / 65.1	67.6 / 589 / 76.9	83.4 / 748 / 130.6	114 / 987 / 57.0	
13	26.9 / 244 / 28.7	28.8 / 264 / 32.5	34.3 / 314 / 47.4	51.0 / 525 / 72.9	81.0 / 758 / 71.5	59.7 / 418 / 52.9	52.9 / 428 / 54.3	61.0 / 518 / 65.5	69.5 / 619 / 40.4	68.2 / 1079 / 62.5		

AREA 3

R

	L	M	N	O	P	Q	R	S	T	U	V	X
5	16.8, –, 15.6				4.22, 9.71, 11.2	15.2, 612, 78.1	1208, –, 1963					
6	14.4, 13.1, 24.6	11.7, 11.7, 19.9	11.7, 12.9, 30.0	14.0, 16.1, 36.1	18.2, 79.6, 91.6	141, 1430, 376	2718, –, 2011					
7	34.8, 31.5, 95.9	28.1, 38.2, 94.6	48.3, 53.3, 114	58.2, 112, 144	165, 388, 234	610, 957, 610	1303, –, 1057					
8	157, 159, 166	161, 171, 206	180, 205, 213	229, 266, 250	302, 456, 342	610, 710, 533	810, 1170, 680	1529, –, 1369				
9	175, 195, 150	215, 230, 221	245, 258, 230	271, 327, 237	382, 269, 361	455, 503, 434	550, 879, 482	1208, 2324, 909	3440, 7170, 2324	10.9, –, 6809		
10	125, 158, 112	191, 203, 179	215, 209, 195	202, 271, 216	339, 378, 419	416, 259, 483	416, 513, 458	610, 909, 580	1208, 1963, 926	2718, 28709, 1817	55.0, –, 28410	
11	99.7, 133, 98.7	166, 171, 138	175, 202, 166	229, 364, 241	499, 525, 655	550, 525, 550	499, 525, 477	550, 597, 550	643, 780, 643	916, 1368, 982	1820, 28410, 1820	55.0
12	97.6, 102, 102	109, 133, 117	157, 205, 166	253, 532, 376	810, 680, 929	550, 503, 502	455, 503, 397	550, 597, 525	643, 845, 681	1047, 1434, 1625	1820	
13	106, 116, 119	125, 150, 150	175, 337, 223	499, 773, 773	1047, 751, 1175	454, 396, 788	338, 419, 396	499, 609, 524	719, 1461, 817	2202		

AREA 3

L

	L	M	N	O	P	Q	R	S	T	U	V	X
5	42.9 **44.5**				11.2 11.2 **22.3**	32.3 **42.3**	210 **378**					
6	42.9 42.9 **41.3**	41.3 **41.3**	41.0 **40.6**	43.5 **46.3**	34.3 46.3 **46.3**	85.7 87.7 **129**	472 348 **566**					
7	52.9 72.7 **64.5**	49.5 61.1 **57.6**	58.1 66.6 **75.5**	64.6 79.2 **82.9**	93.2 111 **140**	199 204 **268**	479 330 **392**					
8	100 129 **136**	96.8 136 **136**	111 141 **146**	123 155 **164**	164 176 **188**	268 228 **268**	351 289 **309**	367 **425**				
9	140 135 **144**	148 152 **159**	158 165 **170**	172 175 **179**	200 196 **212**	250 222 **232**	282 244 **255**	402 317 **378**	489 **600**	867 **1133**		
10	133 117 **121**	155 136 **150**	165 155 **159**	167 157 **155**	206 178 **200**	227 211 **222**	234 222 **222**	323 245 **268**	489 323 **378**	850 472 **566**	1558 **2549**	
11	117 114 **112**	143 124 **136**	155 140 **144**	160 154 **164**	222 204 **243**	239 249 **255**	233 249 **243**	262 249 **255**	327 266 **276**	448 303 **329**	1506 396 **463**	1506 **2549**
12	110 113 **107**	125 110 **113**	140 125 **136**	189 155 **173**	276 241 **309**	255 244 **255**	238 244 **232**	255 244 **255**	276 266 **276**	291 264 **252**	474 369 **485**	
13	110 116 **112**	117 117 **121**	140 133 **144**	208 194 **243**	331 298 **352**	244 292 **232**	222 215 **200**	249 222 **243**	284 267 **291**	431 400 **510**		

	I	J	K	L	M	N	O	P	Q	R	S	T	U
14	407 (40.6, 39.4)	297 (32.5, 31.6)	265 (29.5, 30.2)	270 (29.0, 32.9)	311 (32.5, 39.6)	287 (39.6, 65.1)	257 (63.9, 91.2)	842 (91.2, 92.8)	779 (73.1, 73.1)	494 (52.9, 59.7)	541 (61.0, 71.6)	691 (76.1, 52.0)	
15	530 (52.5, 49.9)	347 (36.8, 37.8)	312 (32.5, 35.2)	311 (32.9, 35.2)	310 (35.2, 41.2)	414 (45.6, 75.6)	911 (95.1, 98.3)	808 (96.2, 77.6)	543 (75.9, 64.2)	570 (61.3, 68.6)	610 (67.0, 87.7)	895 (92.4, 57.0)	
16			345 (37.2, 37.2)	310 (35.2, 35.2)	309 (35.2, 38.8)	370 (44.8, 52.5)	544 (93.3, 59.7)	493 (79.7, 64.1)	618 (67.0, 69.5)	582 (66.7, 81.9)	825 (83.8, 105)	973 (109, 122)	
17				298 (40.4, 45.5)	396 (40.4, 58.5)	410 (56.9, 67.0)	541 (62.5, 71.6)	696 (68.8, 92.4)	896 (87.7, 98.3)	794 (80.1, 89.4)	737 (91.2, 91.2)	818 (105, 109)	1248 (73.5, 73.5)
18							1078 (93.8, 146)	1434 (124, 153)	1190 (122, 122)	889 (98.3, 85.8)	575 (67.9, 85.8)	883 (100, 113)	959 (131, 57.0)
19								3567 (292, 209)		965 (109, 90.8)	784 (676, 77.9)	727 (95.1, 196)	1167 (127, 69.5)
20											1404 (80.1, 103)	954 (100, 57.0)	2321 (209, 139)
21											1398 (130, 140)	950 (114, 33.8)	
22												561 (90.8, 33.8)	
23											716 (43.1, 89.4)	765 (80.1, 46.3)	

AREA 4

F

Ω_e

	I	J	K	L	M	N	O	P	Q	R	S	T	U
14	166 / 185	133 / 161 / 136	120 / 129 / 121	118 / 123 / 124	133 / 134 / 144	162 / 162 / 179	297 / 266 / 352	372 / 372 / 392	298 / 378 / 364	216 / 298 / 232	249 / 244 / 255	310 / 292 / 329	
15	214 / 243	148 / 201 / 159	133 / 152 / 144	134 / 144 / 144	144 / 144 / 144	186 / 168 / 192	389 / 309 / 425	385 / 402 / 378	310 / 317 / 255	250 / 262 / 268	273 / 280 / 291	377 / 358 / 425	
16			152 / 195	144 / 152 / 144	144 / 144 / 144	183 / 189 / 173	340 / 214 / 255	305 / 244 / 232	273 / 262 / 291	272 / 234 / 276	342 / 334 / 392	444 / 428 / 463	
17				165 / 185	165 / 185 / 185	183 / 189 / 192	255 / 224 / 255	281 / 292 / 329	358 / 377 / 425	327 / 402 / 378	372 / 365 / 352	427 / 372 / 392	496 / 600
18							292 / 510	505 / 595 / 680	496 / 623 / 566	402 / 496 / 425	314 / 351 / 276	409 / 351 / 425	532 / 444 / 463
19								1190 / 1699		444 / 463	276 / 370 / 276	389 / 314 / 352	515 / 459 / 566
20											327 / 378	408 / 421 / 463	850 / 798 / 1133
21											529 / 680	463 / 572 / 463	
22												370 / 276	
23											176 / 176 / 352	327 / 365 / 378	

AREA 4

L

	I	J	K	L	M	N	O	P	Q	R	S	T	U
14	291, 224, 395	157, 141, 186	125, 128, 153	131, 153, 156	175, 223, 178	271, 659, 293	1047, 1175, 1288	1303, 1213, 1255	1123, 789, 836	455, 502, 532	550, 733, 634	916, —, 1223	
15	499, 357, —	215, 198, —	180, 180, 198	180, 180, 178	180, 247, 178	314, 912, 314	1529, 1368, 1039	1208, 879, 831	550, 580, 634	610, 664, 626	719, 1124, 1011	1530, —, 1675	
16			215, 195, —	175, 175, 175	175, 245, 175	314, 420, 289	550, 502, 550	455, 587, 715	719, 681, 1124	643, 973, 925	1303, 1081, 1175	1820, —, 1561	
17				175, 175, —	175, 214, —	253, 402, —	550, 764, 1376	979, 1254, 2446	1529, 1368, 2123	1208, 1127, 1368	1047, 1175, 845	1303, 2175, 1416	3047, —, 2433
18							2202, 3058, —	3914, 3316, 14187	2719, 2123, —	1529, 1086, 1674	643, 1086, 643	1529, 1674, 1288	1820, —, 2269
19								24460		1820, 1231, —	643, 1690, 925	1047, 1882, 1433	2718, —, 2794
20											1208, 1514, 2561	1820, 6345, 1820	10870
21											3914, 2867, —	1820, —, 1231	
22												643	
23											1047, 1128, 799	1208, —, 1963	

AREA 4

R

	N	O	P	Q	R	S	T
24					43·1 / 714 / 74·3	74·4 / 516 / 101	116 / 1141 / 69·5
25					74·4 / 515 / 60·3	60·3 / 478 / 75·4	115 / 758 / 46·8
26			27·2 / 449 / 53·2	26·1 / 429 / 47·9	53·2 / 360 / 55·8	62·9 / 553 / 90·8	103 / 926 / 57·0
27		28·4 / 468 / 49·5	48·4 / 348 / 41·4	46·2 / 330 / 53·4	55·8 / 551 / 80·1	80·1 / 753 / 40·1	
28	27·2 / 447 / 47·3	48·6 / 330 / 37·8	38·8 / 288 / 48·9	51·4 / 509 / 31·3			
29	44·8 / 288 / 33·4	36·0 / 254 / 32·5	34·3 / 271 / 41·2	55·8 / 397 / 103	78·0 / 1261 / 78·0		
30	31·8 / 231 / 28·1	29·7 / 225 / 32·8	35·6 / 306 / 27·8				

AREA 5

F

Ω_e

	N	O	P	Q	R	S	T
24					1047 / 797 / 799	550 / 1634 / 466	2718 / 1963
25					550 / 466 / 411	382 / 795 / 512	1208 / 1514
26			416 / 399 / 335	382 / 327 / 306	271 / 457 / 457	643 / 1232 / 926	1820
27		545 / 299 / 287	253 / 241 / 214	229 / 436 / 390	643 / 926	1208	
28	416 / 323 / 296	229 / 202 / 185	175 / 363 / 166	550 / 445			
29	175 / 158 / 145	141 / 149 / 125	157 / 249 / 170	339 / 1890	3440		
30	114 / 112	109 / 156	202				

AREA 5

R

	N	O	P	Q	R	S	T
24					176 176 352	304 304 255	472 410 566
25					304 128 255	246 246 237	472 308 378
26			111 111 222	106 217 212	217 196 179	256 228 276	420 370 463
27		126 126 232	198 203 173	188 169 164	228 220 276	327 327 378	
28	111 111 222	198 193 164	159 154 144	207 197 259			
29	183 72 144	147 137 129	140 133 136	225 168 200	319 419 637		
30	150 142 156	121 135 113	146 134 155				

AREA 5

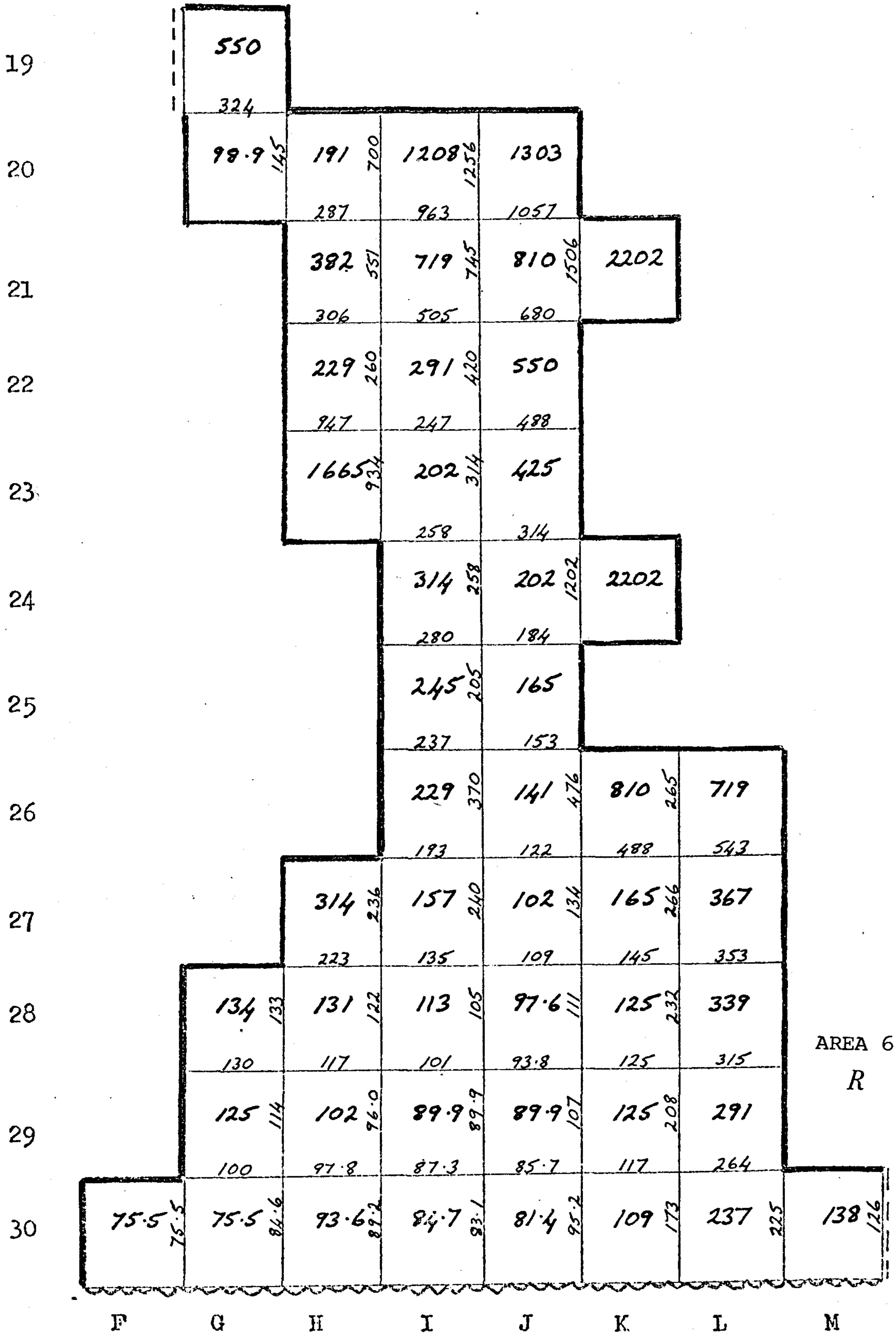
L

AREA 6

F

Ω_e

	F	G	H	I	J	K	L	M
19		31.3 / 550 / 31.3						
20		43.9 / 221 / 31.1	18.4 / 321 / 46.7	48.1 / 806 / 94.4	48.1 / 835 / 48.1			
21			44.5 / 452 / 61.8	82.0 / 618 / 73.6	86.0 / 653 / 100.4	62.5 / 268 / 62.5		
22			46.2 / 348 / 42.9	58.5 / 392 / 54.0	69.2 / 537 / 31.3			
23			51.4 / 268 / 50.2	41.7 / 325 / 47.4	59.7 / 607 / 28.4			
24				42.5 / 402 / 42.5	47.3 / 322 / 81.5	62.5 / 106 / 62.5		
25				44.4 / 354 / 38.0	36.1 / 290 / 18.1			
26				41.0 / 341 / 36.0	33.0 / 267 / 53.8	37.9 / 636 / 73.6	35.7 / 598 / 35.7	
27			47.2 / 397 / 40.3	36.8 / 280 / 29.6	28.8 / 255 / 23.3	48.2 / 286 / 35.8	61.2 / 425 / 25.5	
28		30.9 / 259 / 30.7	38.9 / 256 / 29.5	30.9 / 238 / 27.4	26.1 / 219 / 28.1	25.2 / 247 / 36.4	47.0 / 406 / 21.5	
29		30.4 / 249 / 28.4	28.7 / 224 / 26.1	26.9 / 210 / 25.3	25.8 / 209 / 27.6	27.8 / 246 / 37.7	44.3 / 275 / 22.8	
30		26.5 / 192	26.4 / 214 / 25.2	26.4 / 204 / 24.3	24.9 / 198 / 25.9	24.7 / 228 / 43.1	42.9 / 330 / 35.8	15.7 / 255 / 29.9


19
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98.9 145
191 700 287
1208 1256 963
1303 1057
382 551 306
719 745 505
810 1506 680
2202
229 260 947
291 420 247
550 488
1665 934
202 314 258
425 314
314 258 280
202 1202 184
2202
245 205 237
165 153
229 370 193
141 476 122
810 265 488
719 543
314 236 223
157 240 135
102 134 109
165 266 145
367 353
134 133 130
131 122 117
113 105 101
97.6 111 93.8
125 232 125
339 315
125 114 100
102 96.0 97.8
89.9 89.9 87.3
89.9 107 85.7
125 208 117
291 264
75.5 75.5
75.5 84.6
93.6 89.2
84.7 93.1
81.4 95.2
109 173
237 225
138 126
F
G
H
I
J
K
L
M

AREA 6

R

	F	G	H	I	J	K	L	M
19		184 254·8						
20		179 103·0	126 149·9	264 377·5	335 392·1			
21			179 212·4	335 252 291·3	351 300 308·9	409 509·7		
22			188 164·4	238 175 185·3	282 220 254·8			
23			210 254·8	170 205 154·5	243 194 231·7			
24				174 192·3	193 174 154·5	333 509·7		
25				181 169·9	148 155 139·6			
26				167 164·4	135 141 129	219 309	300 291	
27			192	150 164 136	120 123 110	224 124 138	252 173 208	
28		126	158 125 124	126 120 116	109 112 107	130 114 121	204 161 200	
29		124 121	117 116 110	110 107 103	105 103 103	121 112 121	193 153 185	
30	47·2 94·4	108 94·4 94·4	108 99·7 105	102 103 99·9	101 99·0 98·0	117 106 113	175 139 164	146 127

AREA 6

L

Table 1. Non-coastal boundary termination.

Channel No of Input Memory *	No. on BD-Z	Z_S (KΩ)	Drawer No.	Inter-drawer Con. No.	Socket No.	Grid No.	Wire colour
0	1	1.39	1	19	409	J4	Bn
1	2	1.53	1	20	309	I4	B
2	3	2.13	1	21	209	H4	Or
3	4	1.97	1	22	109	G4	Y
4	5	1.85	1	23	009	F4	Gn
5	6	1.86	1	24	609	E5	Be
6	7	1.89	1	80	232	D5	Bn
7	8	1.52	1	81	231	D6	R
8	9	1.93	1	82	230	D7	Or
9	10	2.07	1	83	171	D8	Y
10	11	2.17	1	84	160	C9	Gn
11	12	1.92	1	85	193	C10	Be
12	13	2.17	1	86	182	B11	V
13	14	1.73	1	87	181	A12	Gy
14	15	1.37	1	88	180	A13	W
15	16	1.90	1	100	165	A14	Bn
16	17	2.04	1	101	164	A15	R
17	18	2.28	2	20	249	A16	Gy
18	19	2.21	2	21	248	A17	Gy
19	20	1.92	2	22	247	A18	Gy
20	21	1.19	2	23	256	B19	Gy
21	22	1.19	2	10	255	B20	Gy
22	23	1.78	2	11	254	B21	Gy
23	24	2.64	2	12	264	C21	Gy
N.Ch.	25	2.41	2	15	296	F19	Gy
Skag.	20	4.43	1	70	128	R5	Or
"	27	1.48	1	71	118	Q5	Y
"	28	1.08	1	72	108	P5	Gn
E.Ch.	29	4.43	1	75	220	T23	Bn
"	30	4.27	1	76	210	S23	R

$$Z_s = \left(\frac{K_i}{K_e}\right)\frac{1}{\Delta L\sqrt{gh}}\sqrt{\frac{r}{h}\;\frac{T_e}{j2\pi K_t}+1} \doteqdot \frac{K_i}{K_e}\;\frac{1}{\Delta L\sqrt{gh}}$$

$Z_s = 2.30 \times 10^5 \times 1/\sqrt{h}$ for $Z_s = 3.60 \times 10^{13}\ cm^2 s^{-1} AV$

h in cm

* Boundary mode.

3.2 Arrangement of the grid cards

The diagram shown in Fig. 19a is the grid-card matrix board in Drawer 1 seen from the card side. Each socket is represented by a small square. Fig. 19b is the same as Fig. 19a except for Drawer 2 which is not fully used.

Each socket has a serial 'grid-socket number' as shown in Fig. 5. This number can be obtained in Fig. 19 by adding a number in its column to a number in its line.

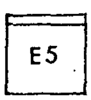
Each grid card has a 'grid-card number', F13 for example, which indicates the location of the grid in a geographical map (or a grid scheme) shown in Fig. 17.

The scheme of connecting a certain grid card to a certain grid socket is indicated in Fig. 19 by putting the grid-card number in the small square which corresponds to the grid socket. For example, Fig. 19a shows that grid card F13 should be connected to grid socket 000 (top-right corner of this diagram).

The following symbols and rules are also used for Fig. 19:-

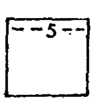
A normal grid which is connected to the 4 adjacent grids two-dimensionally.

A grid one of the edges of which (shown by a dotted line) is electrically connected to another grid (T13 in this example) in a remote position in a drawer.

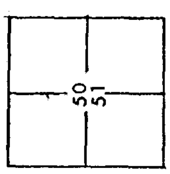


A grid on a coastal line of the sea. One of the edges facing the coast is indicated by a thick line.

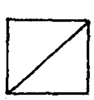
A grid on a boundary to an open sea (or a non-coastal boundary). One of the edges of the grid facing the open sea is indicated by a zig-zag line. This grid is terminated by a 'non-coastal boundary terminal' (page 38), and normally connected to the input memory in its 'boundary mode'. The channel numbers of the terminal and input memory are the same, and the number is indicated in small letters.



The same as above, but without the input memory. Often for an experimental termination.



The set of two numbers in the centre of a meteorological grid (or 4 sea grids) indicates the two channel numbers of the input memory which are connected to these sea grids.



Unused grid-socket.

Fig. 20 shows the arrangement of the inter-drawer connections for the grid scheme shown in Fig. 19.

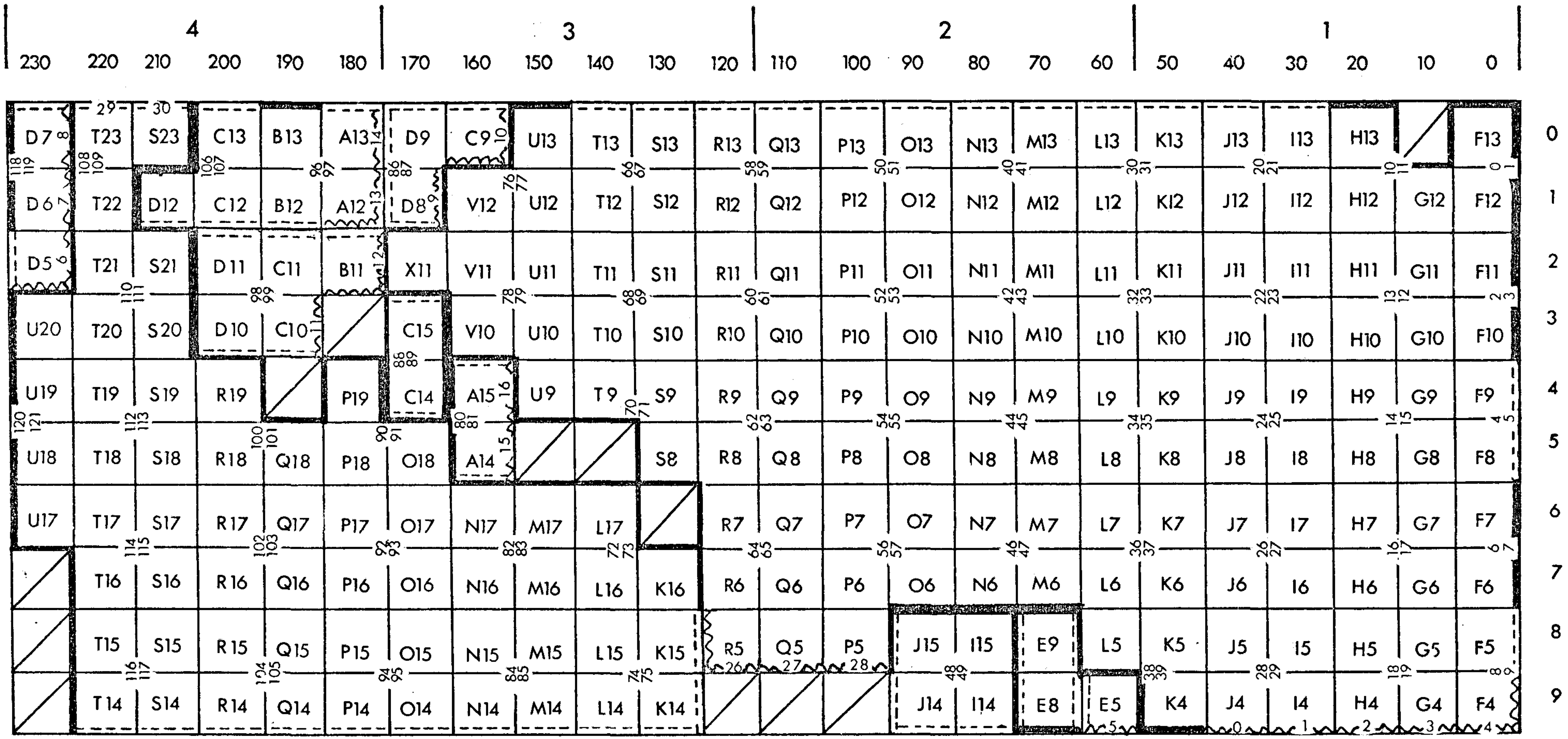
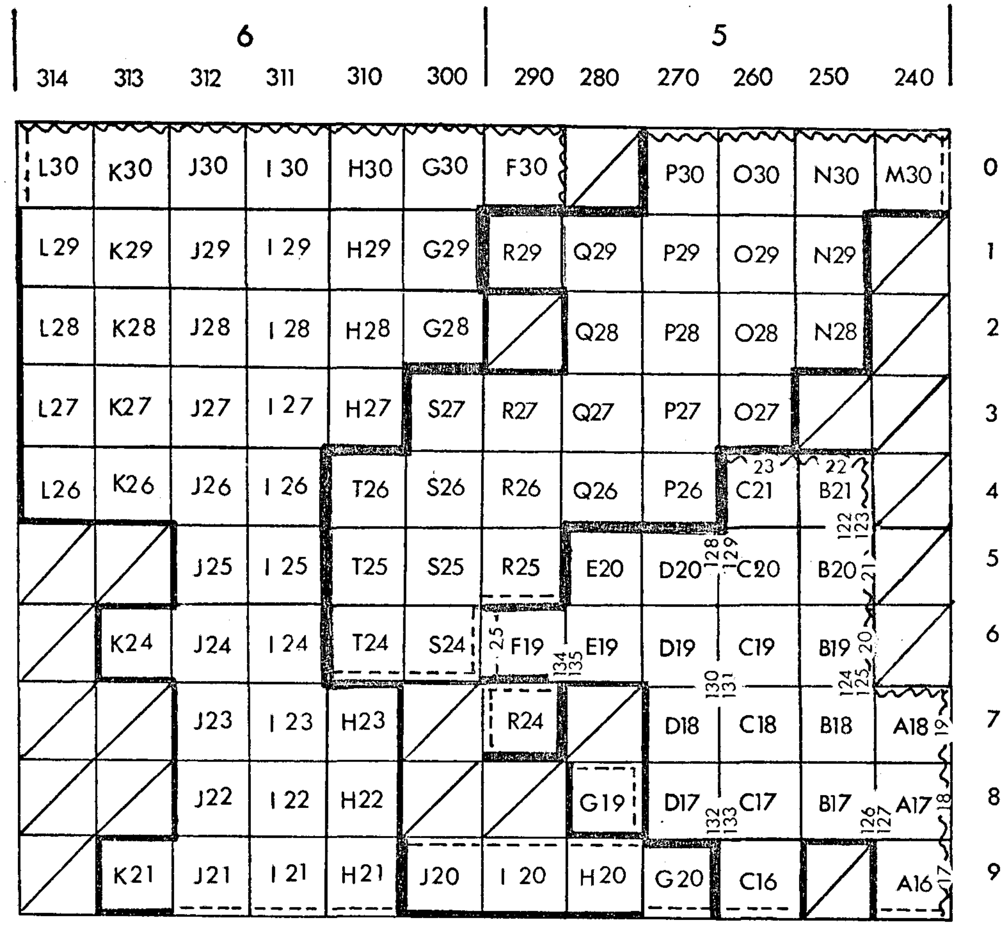


Fig. 19 Arrangement of grids on the socket matrix board for the scheme shown in Fig. 17 (continued to the next page).


6
5
314 313 312 311 310 300 290 280 270 260 250 240
0 1 2 3 4 5 6 7 8 9
L30 K30 J30 I 30 H30 G30 F30 P30 O30 N30 M30
L29 K29 J29 I 29 H29 G29 R29 Q29 P29 O29 N29
L28 K28 J28 I 28 H28 G28 Q28 P28 O28 N28
L27 K27 J27 I 27 H27 S27 R27 Q27 P27 O27
L26 K26 J26 I 26 T26 S26 R26 Q26 P26 C21 B21
J25 I 25 T25 S25 R25 E20 D20 C20 B20
K24 J24 I 24 T24 S24 F19 E19 D19 C19 B19
J23 I 23 H23 R24 D18 C18 B18 A18
J22 I 22 H22 G19 D17 C17 B17 A17
K21 J21 I 21 H21 J20 I 20 H20 G20 C16 A16
23 22 122 123 128 129 21 25 134 135 20 130 131 124 125 19 132 133 126 127 18 17

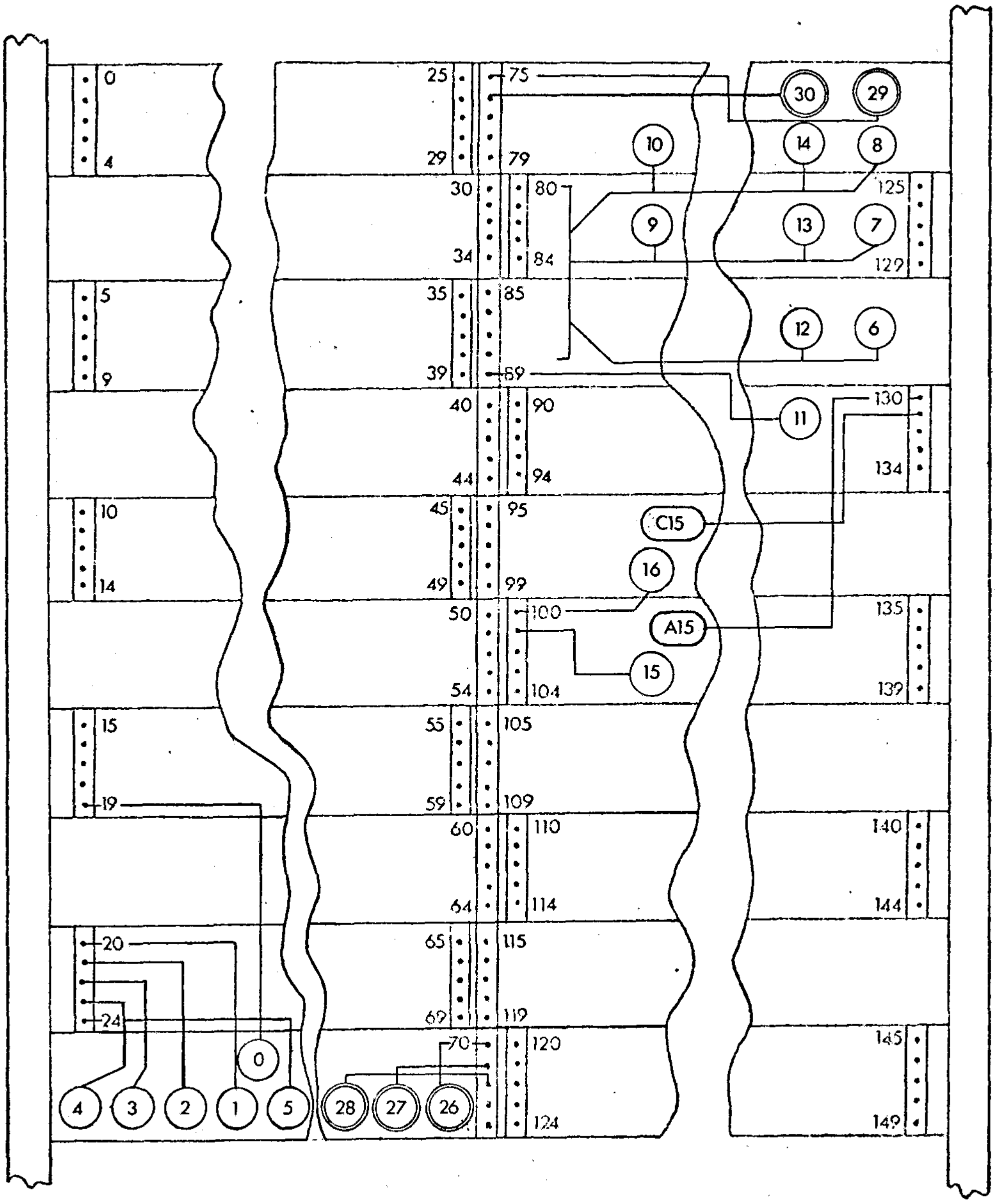


Fig. 20a Arrangement of the inter-drawer connection for the grid scheme shown in Fig. 17 (Drawer 1).

This diagram shows Drawer 1 seen from its grid-card pin side. Terminals 0 to 149 (vertically arranged in 4 lines along the edges of the drawer) are permanently connected to the patch board shown in Fig. 16.

(4) indicates, for example, channel 4 of the input memory.
(28) indicates, for example, channel 28 of the impedance setting board (Fig. 13).

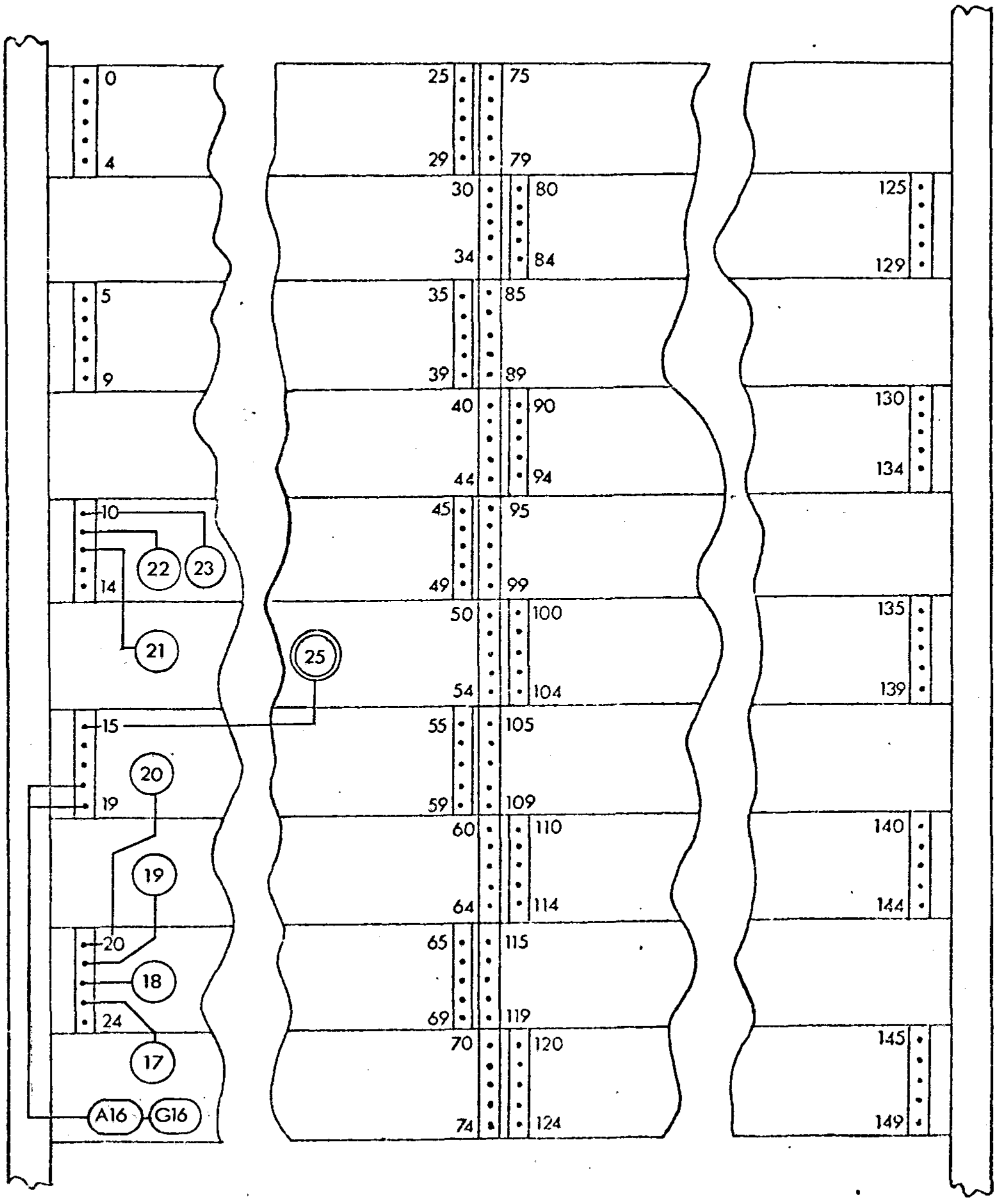


Fig. 20b Arrangement of the inter-drawer connection for the grid scheme shown in Fig. 17 (Drawer 2).

See the explanation on the previous page.

3.3 Arrangement of Patch Board A

Fig. 21 shows the physical arrangement of Patch Board A (see Fig. 9) for the scheme shown in Fig. 19. The following rules are applied:-

Each section of the patch board consists of four terminals representing N-, N+, E-, E+ (see Fig. 9). Each section has a serial number. This is the same as the grid socket number to which the patch board terminals are permanently connected.

A section number of the patch board is given in Fig. 21 by adding its Column Number (vertically written on the right side of the diagram) to Line Number (horizontally written on the top of the diagram).

Each terminal in a section can be identified by Fig. 9. Note, Fig. 21 has been made in the same way as Fig. 9.

A terminal to which the output of the input memory should be connected is indicated in Fig. 21 by the channel number of the input memory.

Two terminals, in the patch board, which should be connected directly are indicated in Fig. 21 by •——• generally. If two terminals, which should be connected, are not physically near in the diagrams, they are indicated, for example, by

▶ 79E+		▶ 4E+

An unused terminal is marked by X, if it has to be emphasised.

See Figs. 9 and 10 for other rules.

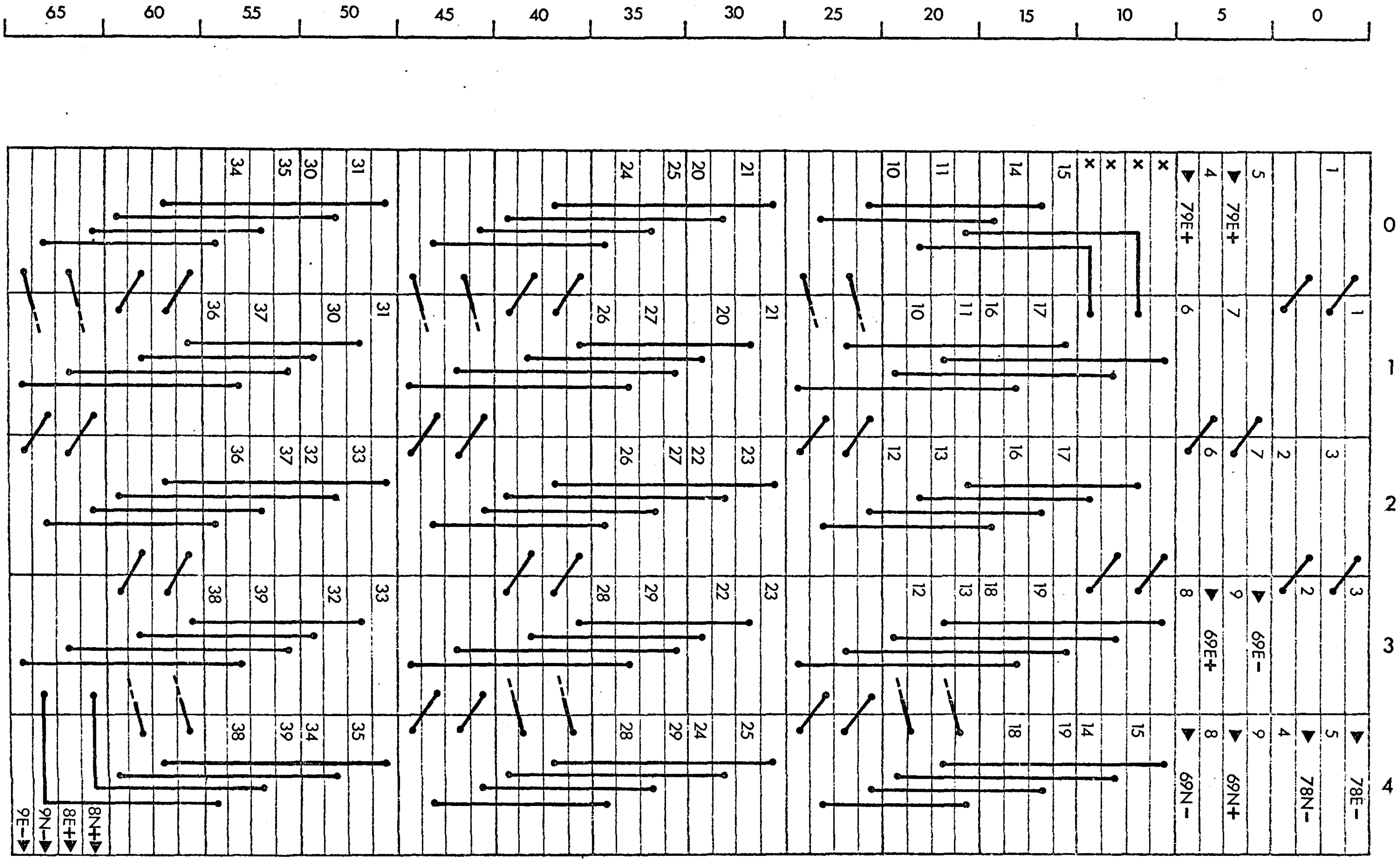
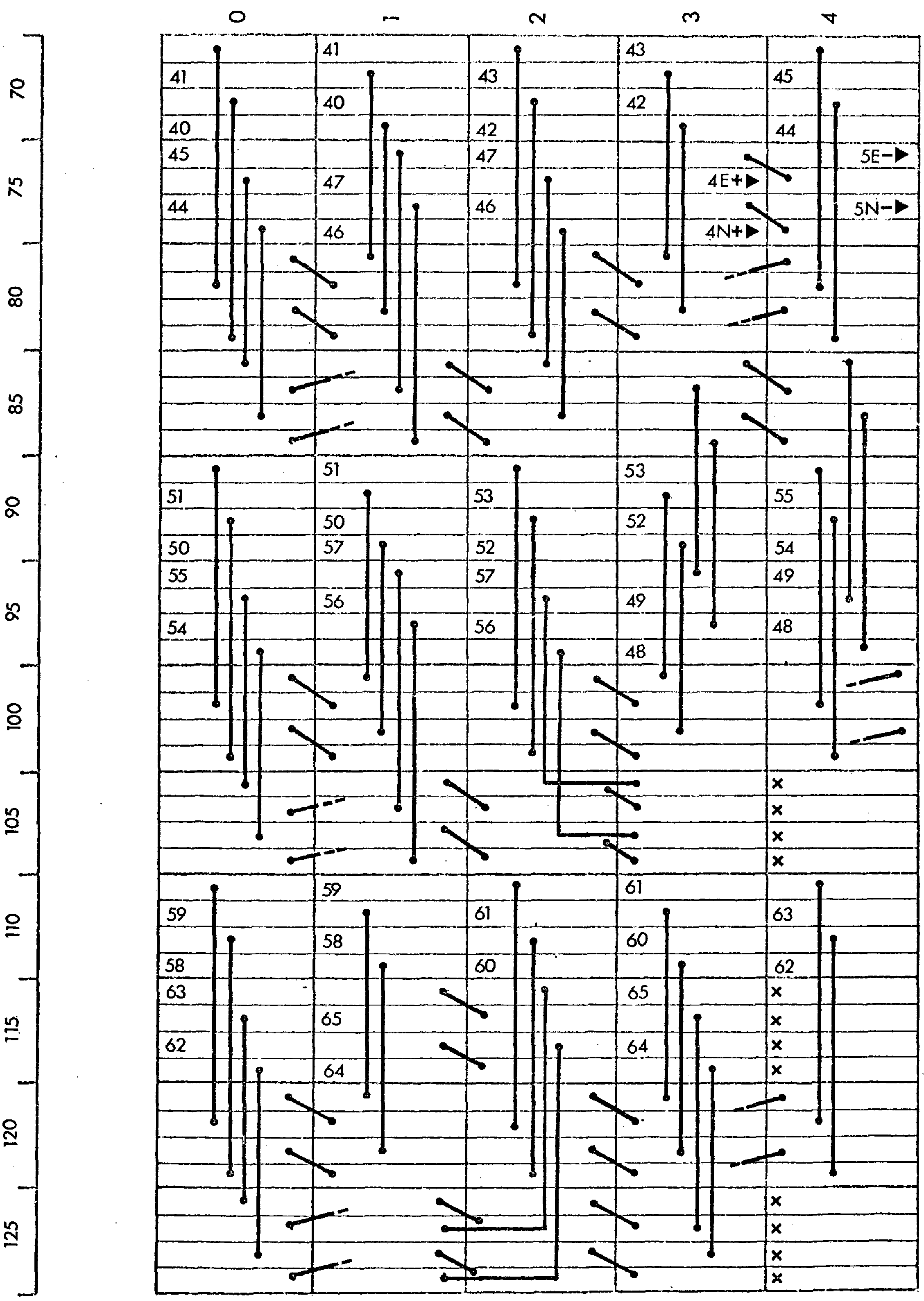
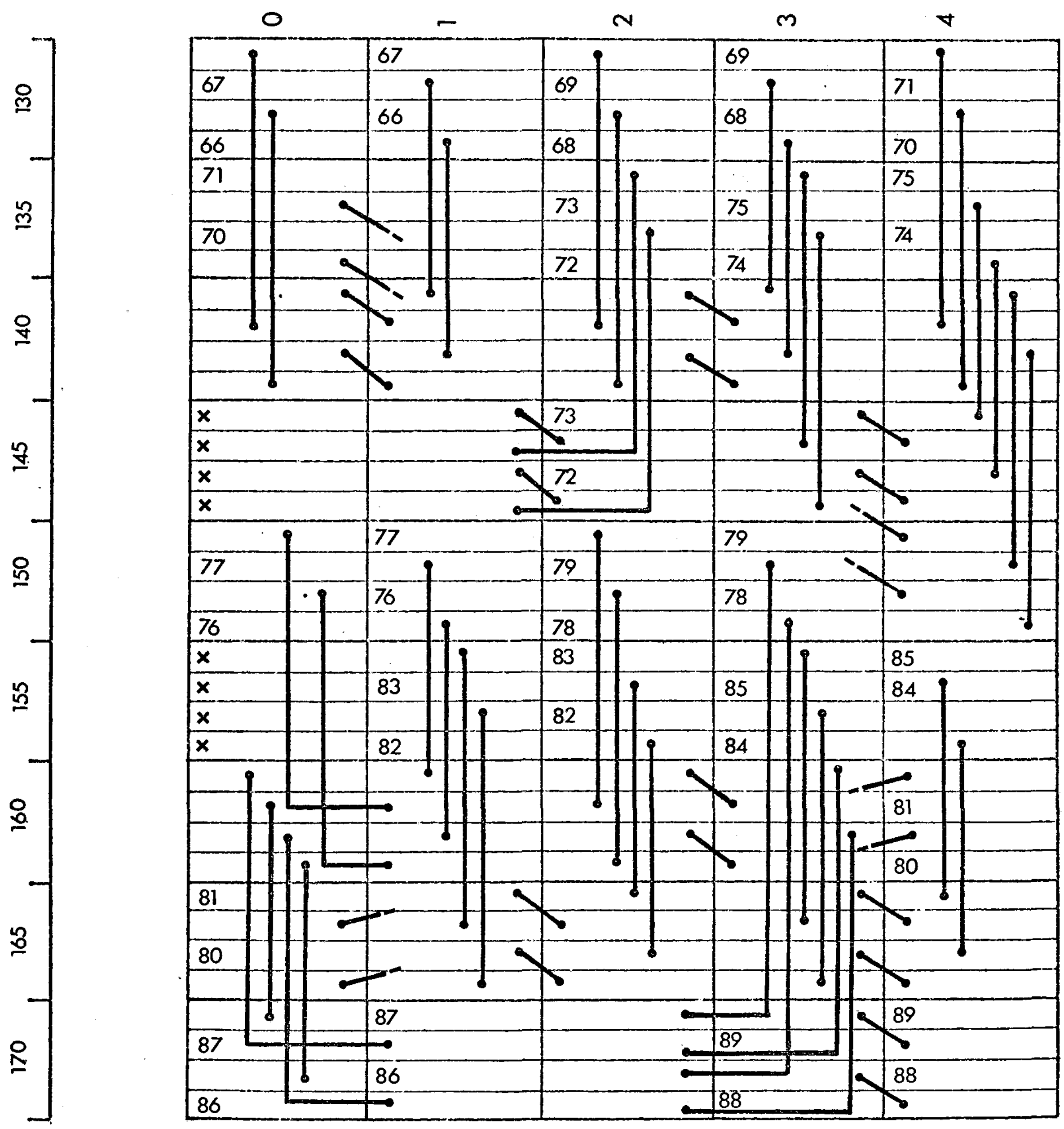


Fig. 21 (5 diagrams on pages 45 to 49). Physical arrangement of patch board B for the grid scheme shown in Fig. 17.


0
1
2
3
4
70
75
80
85
90
95
100
105
110
115
120
125
5E-▶
5N-▶
4E+▶
4N+▶


0
1
2
3
4
130
135
140
145
150
155
160
165
170
67
66
71
70
77
76
81
80
87
86
67
66
77
76
83
82
87
86
69
68
73
72
79
78
83
82
73
72
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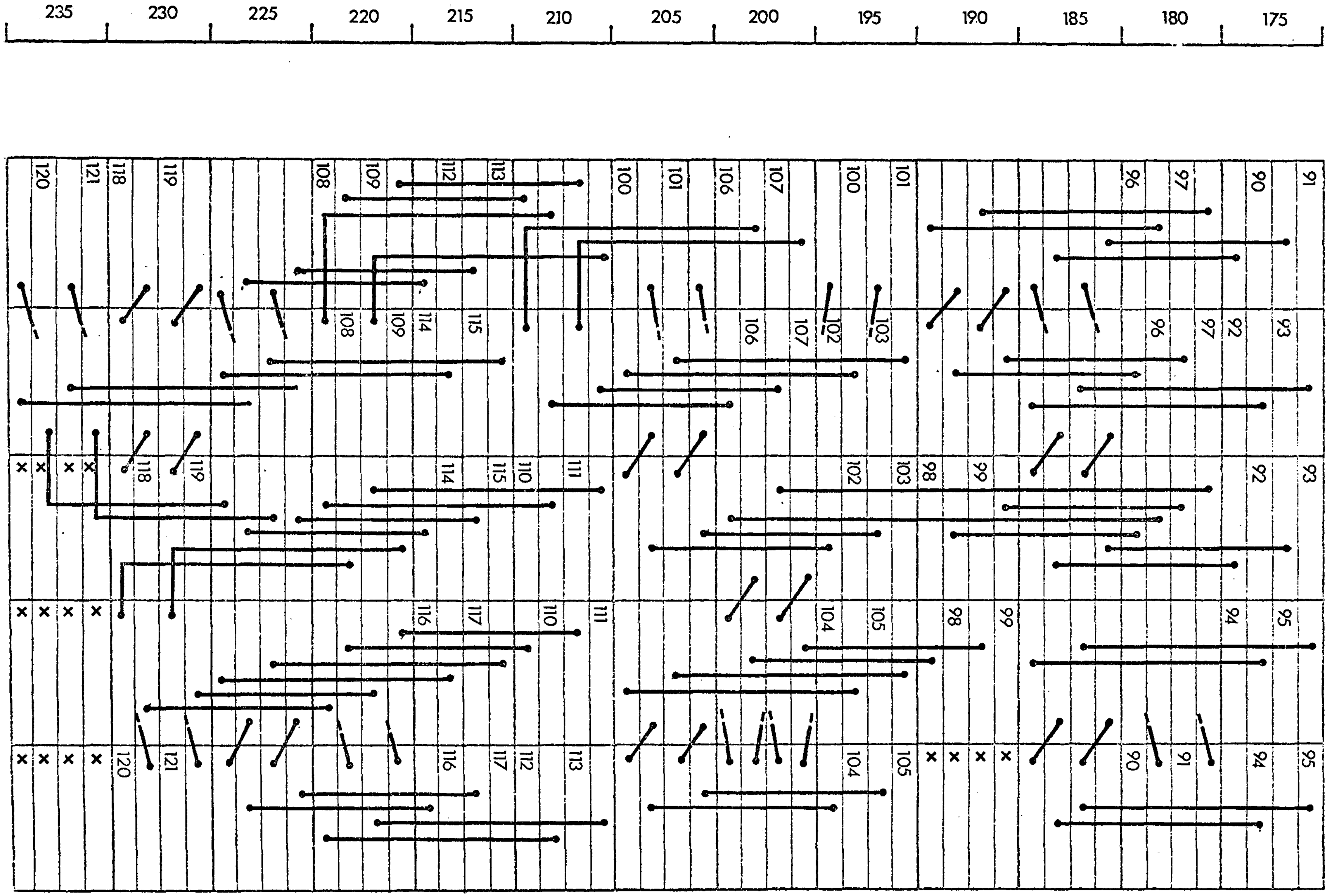
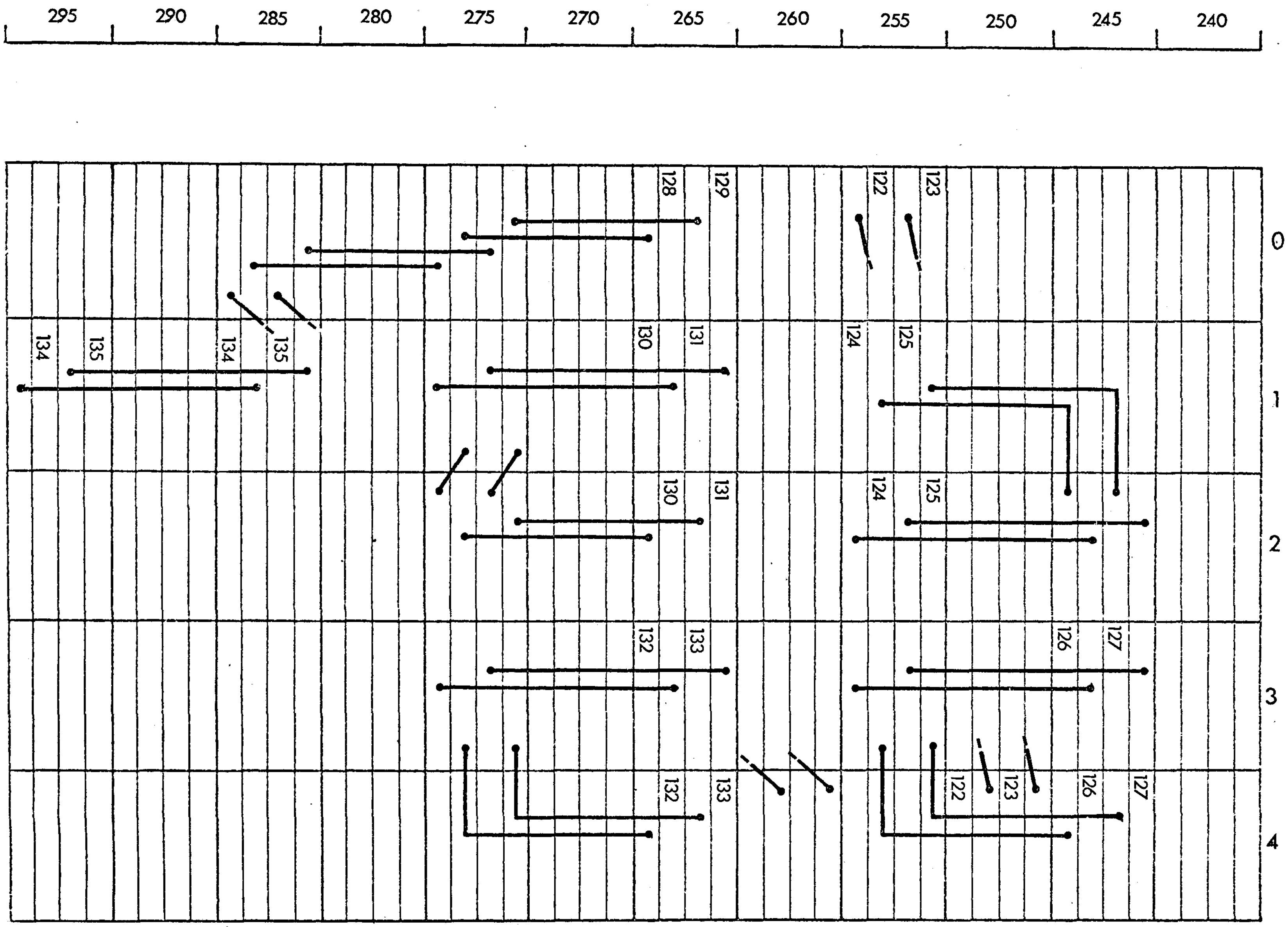
85
84
81
80
89
88


235 230 225 220 215 210 205 200 195 190 185 180 175
0
1
2
3
4


295
290
285
280
275
270
265
260
255
250
245
240
128
129
122
123
0
134
135
134
135
130
131
124
125
1
130
131
124
125
2
132
133
126
127
3
132
133
122
123
126
127
4

4. CONCLUSION

After the construction of the main computation network has been explained mainly for the user's aid, the scheme of a particular tide/surge model for the sea around the British Isles has been described with full data for its time-independent parameters.

ACKNOWLEDGEMENTS

This is a part of the project commissioned by the Ministry of Industry and Department of Energy. The author wishes to thank Miss Kathleen Reeves-Wilkin for her assistance in completing the patch board wiring, and drawing some diagrams in this paper.

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(1) S. Ishiguro (1973): Main Computation Network. IOS Internal Document 89, 46 pp.

(2) S. Ishiguro (1979): New Input Memory. IOS Internal Document 61, 74 pp.

(3) S. Ishiguro (1980): Grid-card Calibrator. IOS Internal Document 67, 20 pp.

(4) S. Ishiguro (1980): Output Memory. IOS Internal Document 85, 21 pp.

(5) S. Ishiguro (1980): Control Cabinet. IOS Internal Document 86, 56 pp.

(6) S. Ishiguro (1980): Mechanical designs of the Computation Cabinet. IOS Internal Document 92, 25 pp.

APPENDIX 1 GRID CONNECTION TEST PROCEDURE

Fig. A1 shows the connections of a channel from the input memory to a grid card, through connectors CN21 etc and the patch boards within the main computation cabinet.

When the connections for each section (corresponding to one connector, e.g. CN21) of the patch board has been completed, it is recommended that the circuit connections are checked as follows:-

(1) Connect all the grid cards involved to their sockets in the main computation cabinet.
(2) Disconnect connectors CN21 etc from the input memory.
(3) Measure the resistance between a pair of pins (No. n and No. n+1) by a resistance meter, with a constant polarity relationship (pin No. n for −, and pin No. n+1 for +), as shown in Fig. A2.
   (a) If the resistance meter indicates approximately 50 kΩ, the connection in the channel is correct.
   (b) If the meter indicates zero ohm, there is a short circuit.
   (c) If the meter indicates infinite resistance, reverse the polarity of the meter leads. Then, if the meter indicates approximately 50 kΩ, there is a reversed connection.
   (d) If the meter indicates an infinite resistance in the normal and reversed polarities, there is an open circuit.

An accidental open circuit can be traced on a resistance meter which is connected as shown in Fig. A3. Touch the circuit in question with the probe starting from one of the patch board pins, and continue through all the components. When a grid card is checked, Pin No. 2-3 (for N) or Pin No. 14-15 (for E) of each edge connector should be touched by the probe.

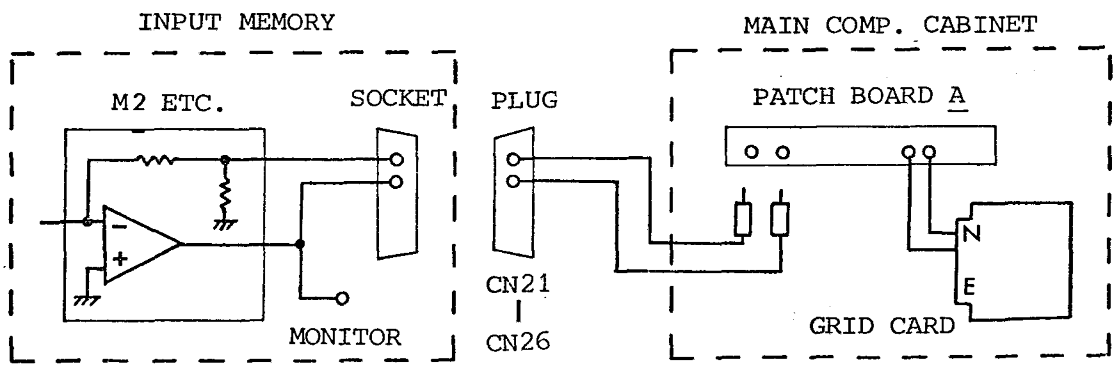

Fig. A1

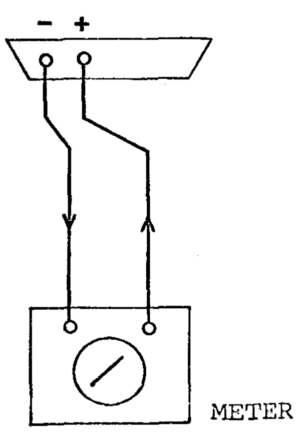

Fig. A2

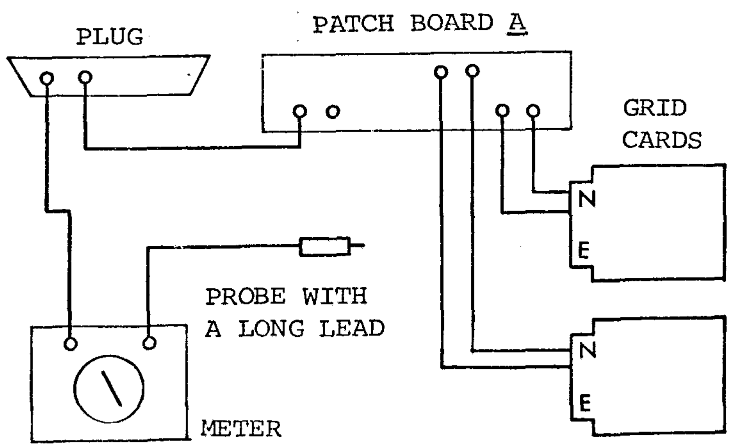

Fig. A3

APPENDIX 2 STRAY CAPACITANCE

The main computation network has been designed so that the errors due to its stray capacitance do not exceed ±1.5% of the full scale of the final output.

Actual stray capacitances within the 'floating part' of the network can be neglected compared with those of fixed components.

The stray capacitance between the floating part of the network and earth is relatively large. The main components involved in this capacitance are the floating DC-power supply units, selectors of the multiplexer, grid sockets and wires.

Table A1 shows the values of the fixed capacitors, stray capacitance of one grid, and their deviations.

Table 1 Values of the fixed capacitors and stray capacitance of one grid, and their deviations.

	Nominal (PF)	Deviation (PF)	Temperature effect (%) $0^{\circ}C$	$12^{\circ}C$	$20^{\circ}C$	$30^{\circ}C$
Fixed capacitors on grid card, C	15000 3300 680	±150 ± 33 ± 20	+0.2	0.0	-0.2	-0.3
Stray capacitance between grid centre and earth, C_s *	280	± 58				
Total	19260	±261				

$$19260 \pm 261 \text{ (PF)} = 19290 \begin{matrix} +231 \\ -291 \end{matrix} \text{ (PF)} = 19290 \text{ (PF)} \begin{matrix} +1.2 \\ -1.5 \end{matrix} (\%)$$

*The grid card is excluded. The multiplexer is included, but its wiper is not engaged with the grid. If it is engaged, the following value should be added:

Stray capacitance of the wiper alone C_w = 150 (PF) max. = 0.78 (%) of 19290 (PF)

In order to avoid the increase of the stray capacitance other than that of the wiper, an impedance converter (see Fig. 15) is inserted between each wiper and its external circuit. Consequently, the increase of the stray capacitance due to the external circuits remains within 1 PF, independent from them.

Table A2 shows the values of C_s against grid-socket numbers.

Table A2 Values of C_s against each grid number.

	0	10	20	30	40	50	60	70	80	90
0	228	255	272	223	253	268	227	254	255	236
1	264	278	292	258	294	322	270	274	299	282
2	274	287	308	270	307	323	267	284	311	284
3	275	289	321	266	306	330	277	317	313	285
4	269	299	323	287	305	337	286	306	317	281
5	281	292	302	252	288	317	259	286	316	250
6	253	291	328	266	280	319	272	291	316	247
7	252	311	308	271	272	326	280	302	298	266
8	266	302	313	276	299	326	293	302	310	260
9	243	271	291	254	259	286	245	267	292	249

	100	110	120	130	140	150	160	170	180	190
0	222	291	222	243	256	224	248	261	223	250
1	288	307	264	290	298	258	282	335	278	284
2	300	314	262	296	314	267	288	322	269	302
3	310	320	278	317	317	280	297	307	282	311
4	300	362	272	311	312	280	307	327	272	305
5	298	303	257	293	312	257	283	319	291	283
6	298	312	262	301	319	249	298	323	270	304
7	293	316	367	294	312	277	307	334	281	302
8	301	329	265	302	308	271	296	318	272	330
9	270	312	215	278	291	252	272	302	242	277

	200	210	220	230	240	250	260	270	280	290
0	270	224	245	270	226	255	234	220	260	279
1	320	253	306	320	254	288	302	241	284	311
2	317	265	304	336	271	294	235	270	299	326
3	322	271	317	342	280	310	320	273	318	330
4	308	282	319	340	274	298	314	273	309	333
5	308	272	291	308	241	376	298	272	287	318
6	292	268	318	323	271	275	318	264	288	327
7	309	259	313	338	273	318	324	276	281	333
8	326	259	305	336	282	302	321	251	305	310
9	286	252	259	304	255	275	297	248	263	264

	300	310	320
0	226	245	266
1	259	299	304
2	270	282	319
3	284	311	301
4	266	299	293
5	300	262	308
6	278	302	315
7	264	287	338
8	258	303	338
9	249	274	301

Grid Nos. 0 to 329

Capacitance in PF

Max	338
Min	222
Or	280 ± 58