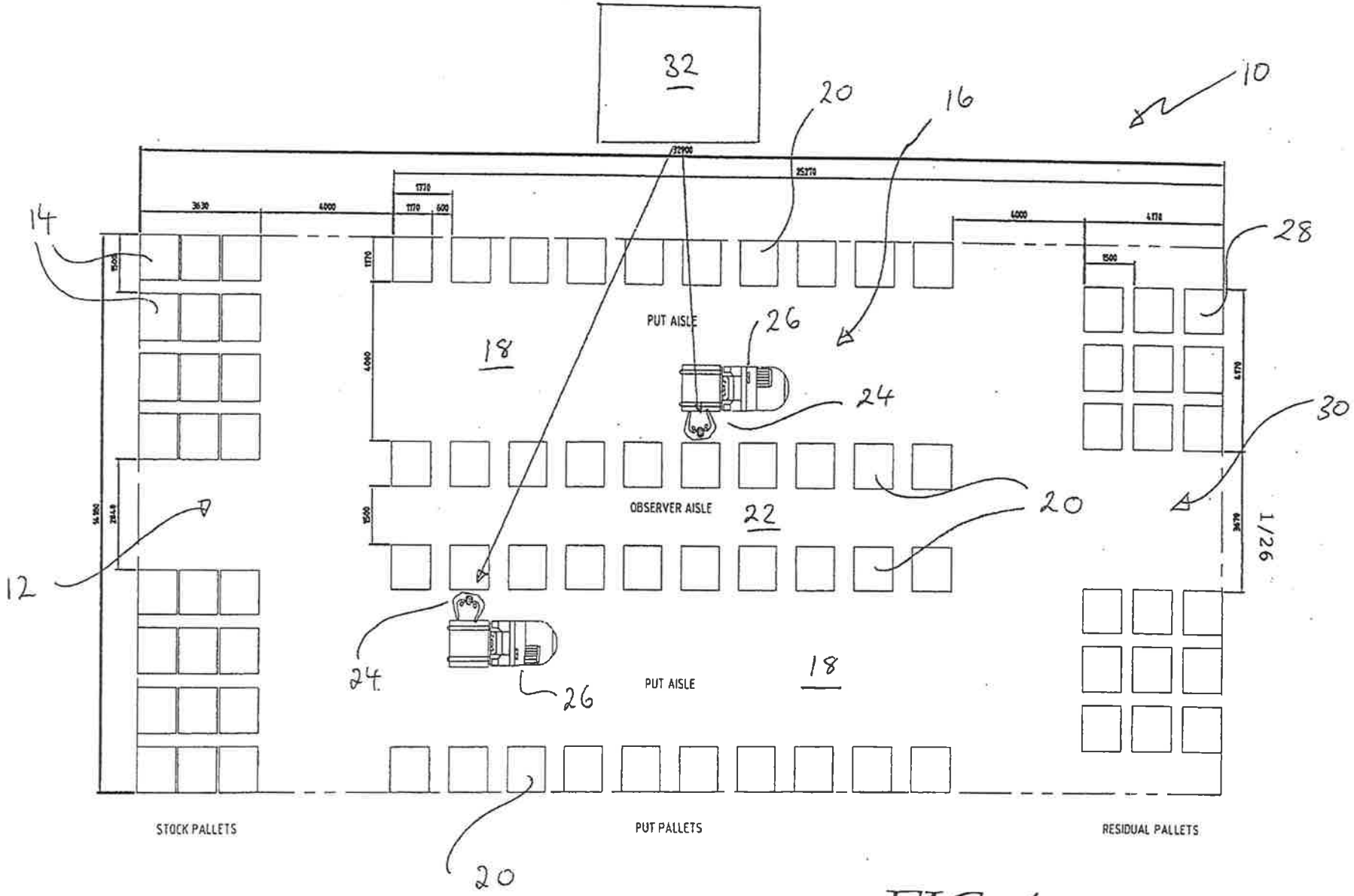

32
10
20
16
14
28
PUT AISLE
18
26
24
30
OBSERVER AISLE
22
20
12
24
26
PUT AISLE
18
1/26
20
STOCK PALLETS
PUT PALLETS
RESIDUAL PALLETS

FIG. 1

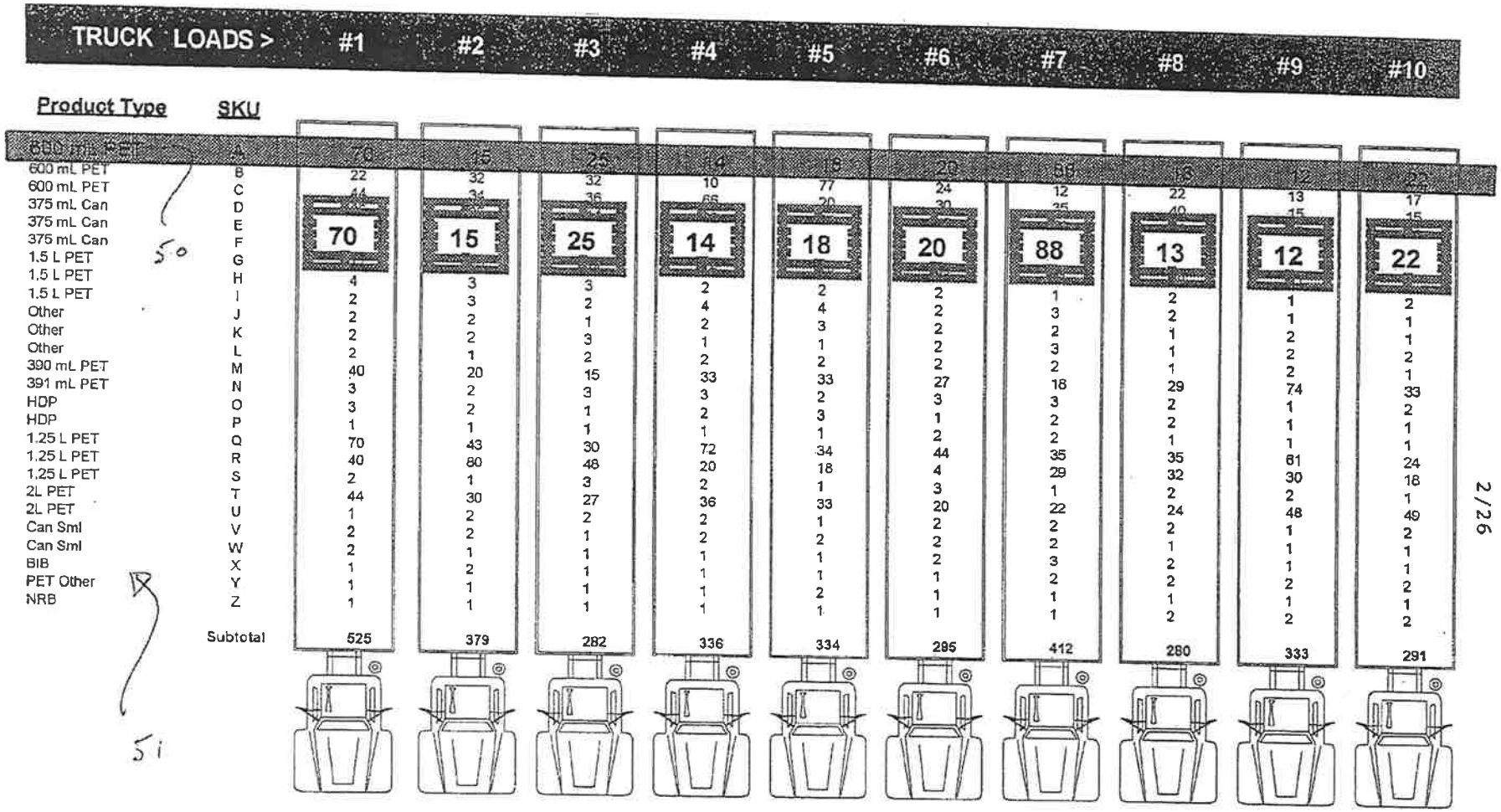

TRUCK LOADS >
#1
#2
#3
#4
#5
#6
#7
#8
#9
#10
Product Type
SKU
600 mL PET
600 mL PET
375 mL Can
375 mL Can
375 mL Can
1.5 L PET
1.5 L PET
1.5 L PET
Other
Other
Other
390 mL PET
391 mL PET
HDP
HDP
1.25 L PET
1.25 L PET
1.25 L PET
2L PET
2L PET
Can Sml
Can Sml
BIB
PET Other
NRB
Subtotal
70
15
25
14
18
20
88
13
12
22
525
379
282
336
334
285
412
280
333
291
50
51
2/26

FIG. 2

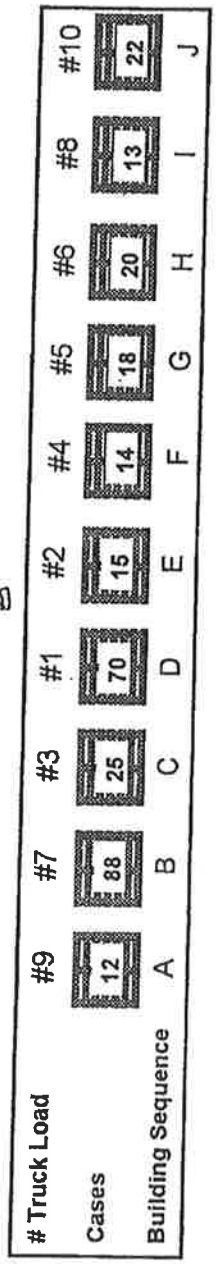

52
Truck Load
Cases
Building Sequence
#9
#7
#3
#1
#2
#4
#5
#6
#8
#10
12
88
25
70
15
14
18
20
13
22
A
B
C
D
E
F
G
H
I
J

FIG. 3

Current Method

Load #	Inventory Pallet	Ordered Cs	(-) Pick	Traditional Pick	Cases Handled
Load 1	100	70	70	0	30
Load 2	100	15	0	15	15
Load 3	100	25	0	25	25
Load 4	100	14	0	14	14
Load 5	100	18	0	18	18
Load 6	100	20	0	20	20
Load 7	100	88	88	0	12
Load 8	100	13	0	13	13
Load 9	100	12	0	12	12
Load 10	100	22	0	22	22
		297	158	139	181

Proposed Method

Load #	Inventory Pallet	Ordered Cs	(-) Pick	Traditional Pick	Cases Handled
Load 9	100	12	0	12	12
Load 7	88	88	88	0	0
Load 3	100	25	0	25	25
Load 1	75	70	70	0	5
Load 2	105	15	0	15	15
Load 4	90	14	0	14	14
Load 5	76	18	0	18	18
Load 6	58	20	0	20	20
Load 8	38	13	0	13	13
Load 10	25	22	22	0	3
		297	180	117	125

Ordered Cs	(-) Pick	Traditional Pick	Cases Handled
297	158	139	181
297	180	117	125
Advantage	12%	16%	31% Less

4/26

FIG. 4

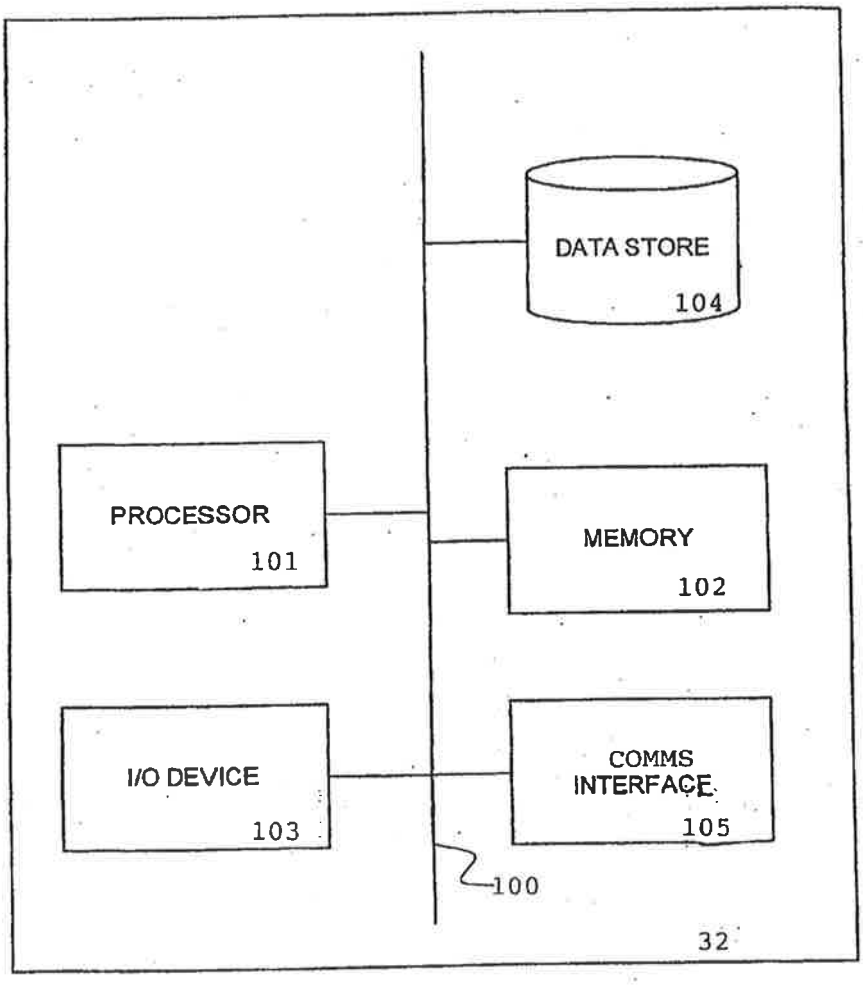

DATA STORE
104
PROCESSOR
101
MEMORY
102
I/O DEVICE
103
COMMS
INTERFACE
105
100
32

FIG. 5

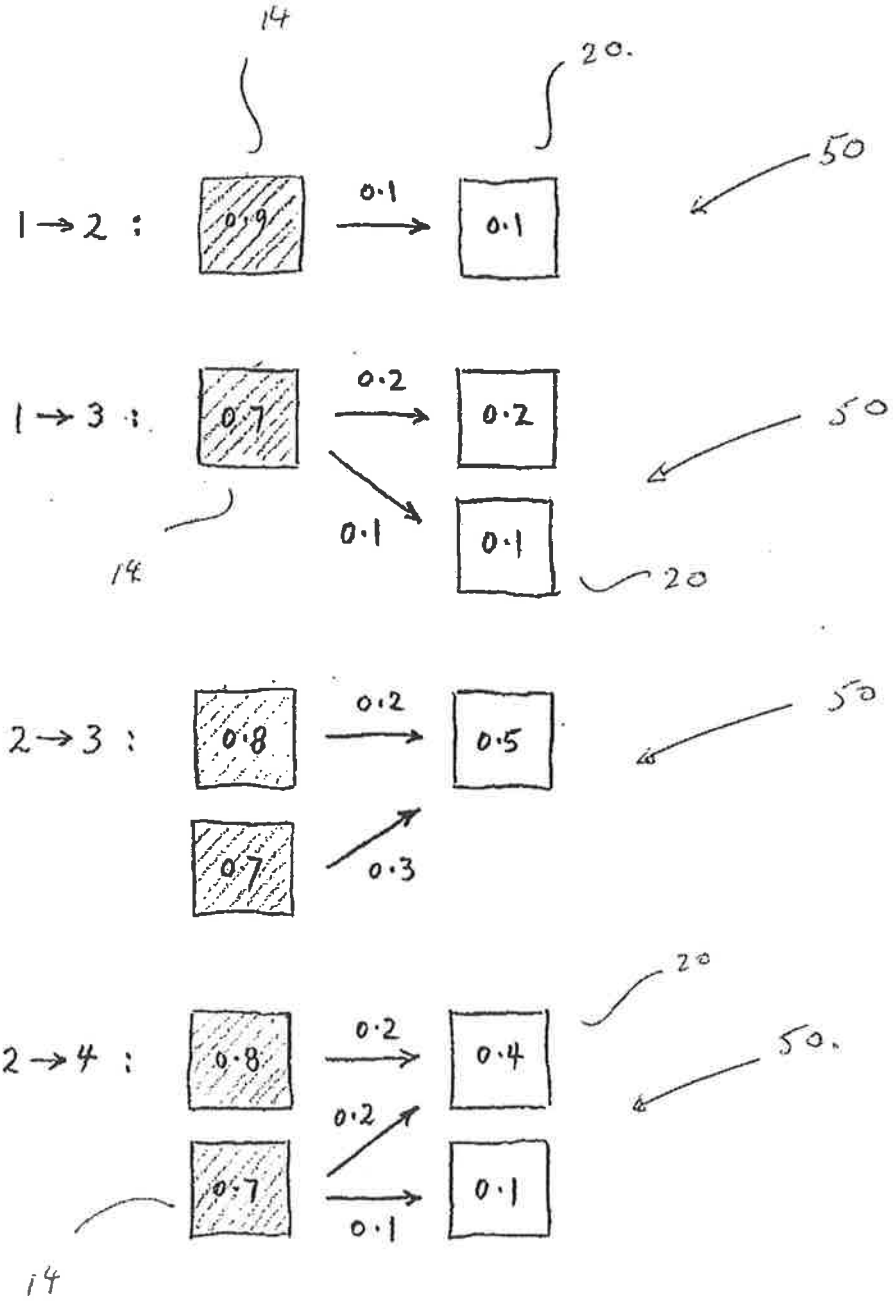

14
20
50
1→2 :
0.9
0.1
0.1
1→3 :
0.7
0.2
0.2
0.1
0.1
14
20
50
2→3 :
0.8
0.2
0.5
0.7
0.3
50
2→4 :
0.8
0.2
0.4
20
50
0.2
0.7
0.1
0.1
14

FIG. 6

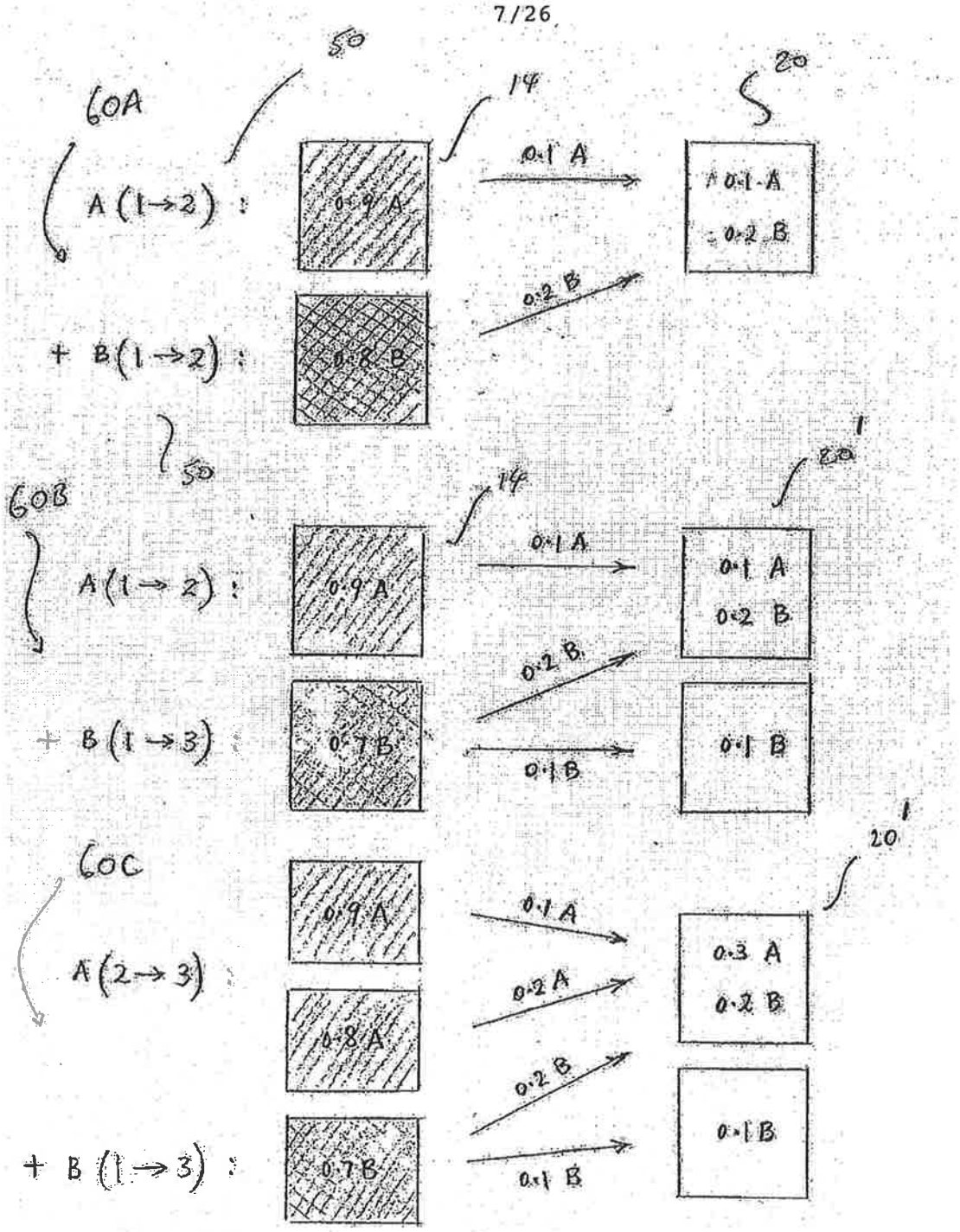

60A
A (1→2) :
0.9 A
0.1 A
0.1 A
0.2 B
+ B (1→2) :
0.8 B
0.2 B
50
14
20
60B
A (1→2) :
0.9 A
0.1 A
0.1 A
0.2 B
+ B (1→3) :
0.7 B
0.2 B
0.1 B
0.1 B
60C
A (2→3) :
0.9 A
0.8 A
0.1 A
0.2 A
0.3 A
0.2 B
+ B (1→3) :
0.7 B
0.2 B
0.1 B
0.1 B
1
1

FIG. 7

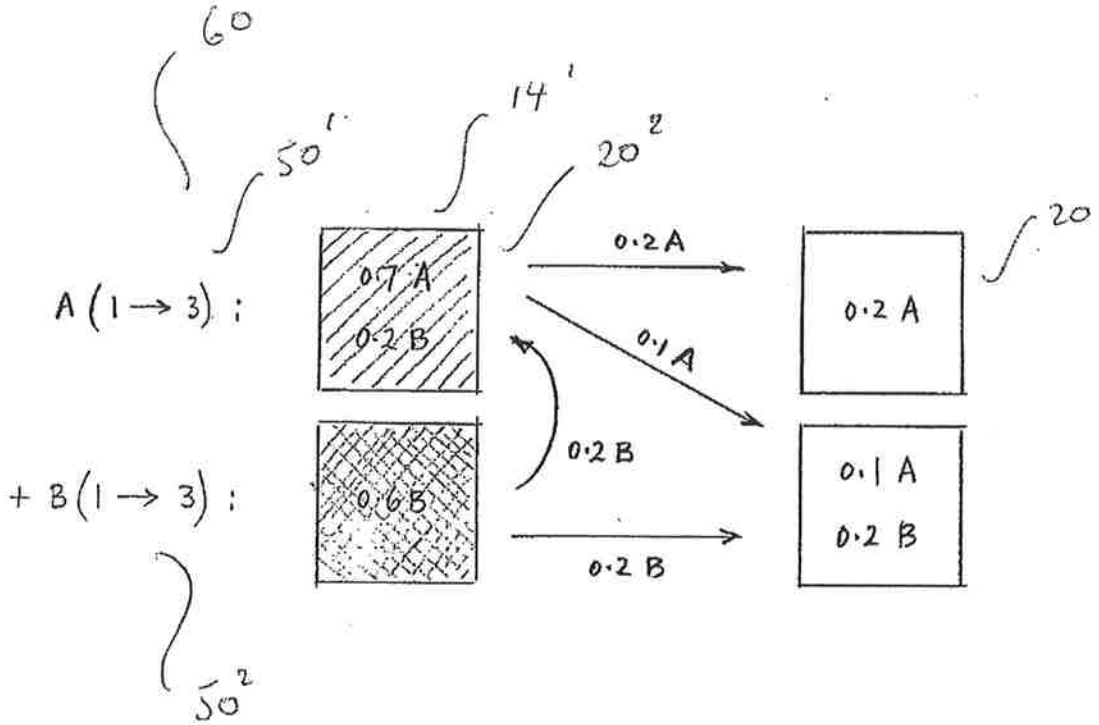

60
50¹
14¹
20²
20
A (1 → 3) :
0.7 A
0.2 B
0.2 A
0.1 A
0.2 A
0.2 B
+ B (1 → 3) :
0.6 B
0.1 A
0.2 B
0.2 B
50²

FIG. 8

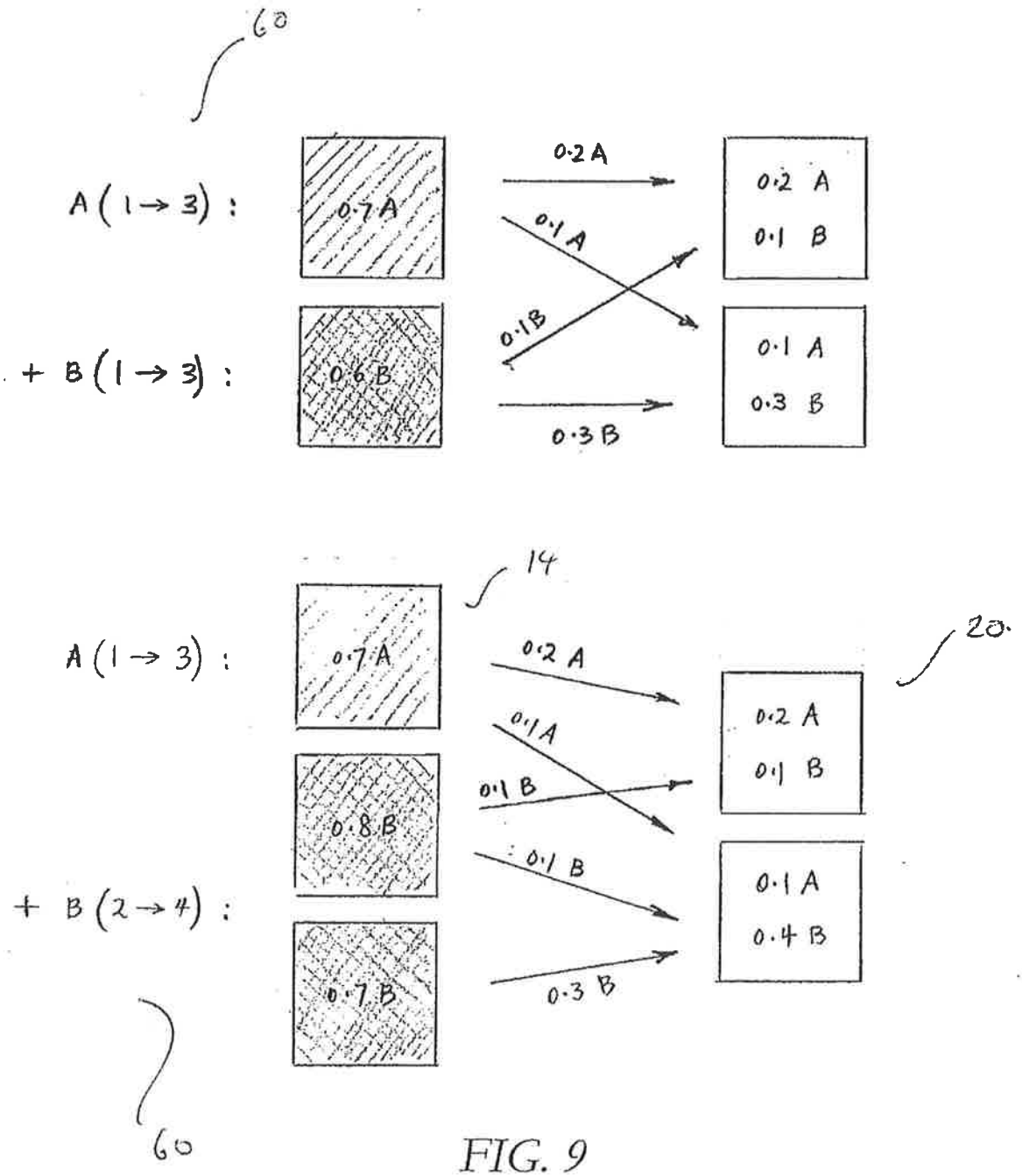

60
A (1 → 3) :
+ B (1 → 3) :
0.7 A
0.6 B
0.2 A
0.1 A
0.1 B
0.3 B
0.2 A
0.1 B
0.1 A
0.3 B
14
A (1 → 3) :
+ B (2 → 4) :
0.7 A
0.8 B
0.7 B
0.2 A
0.1 A
0.1 B
0.1 B
0.3 B
20
0.2 A
0.1 B
0.1 A
0.4 B
60

FIG. 9

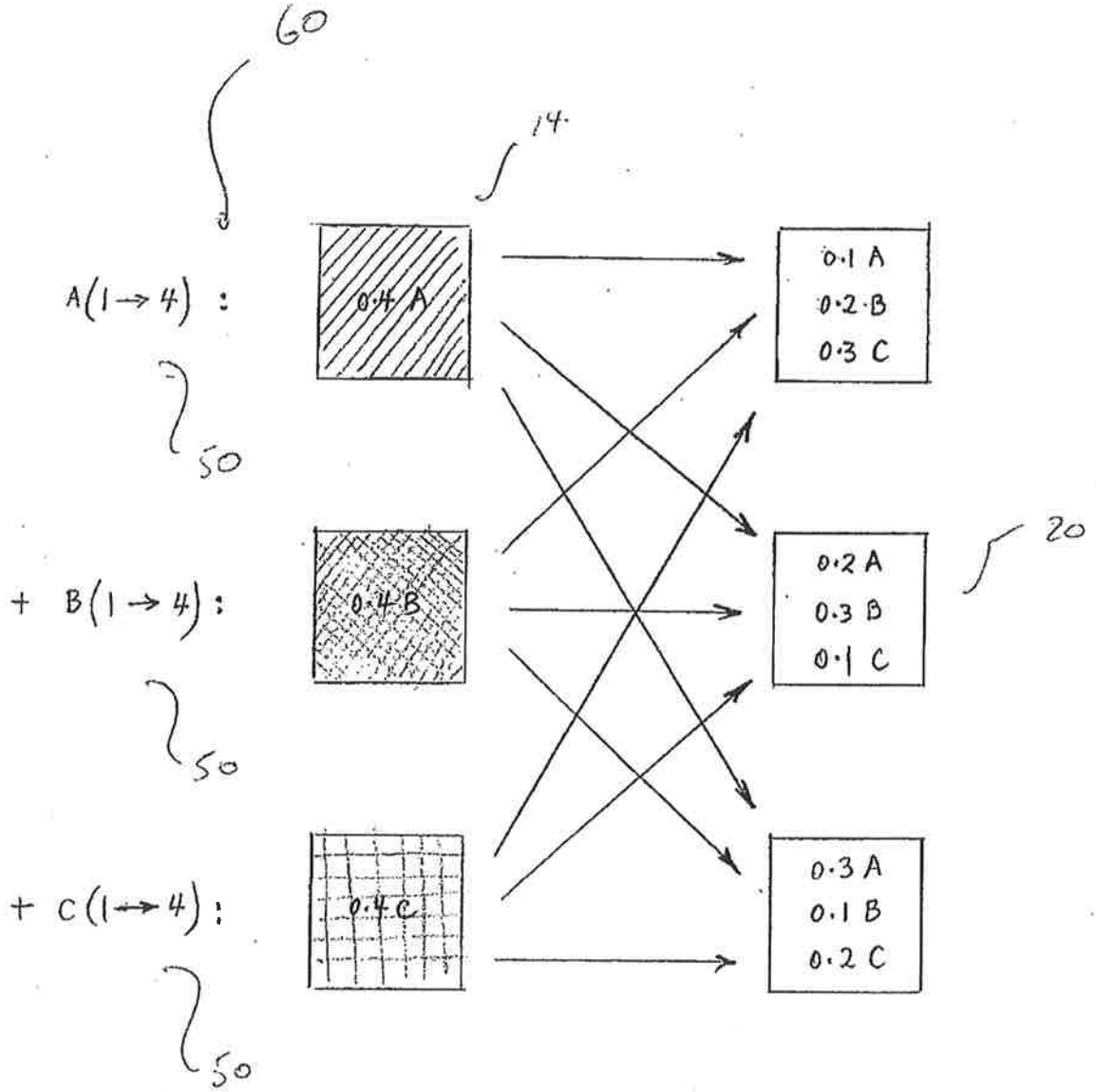

60
14
A(1→4) :
0.4 A
50
+ B(1→4) :
0.4 B
50
+ C(1→4) :
0.4 C
50
0.1 A
0.2 B
0.3 C
0.2 A
0.3 B
0.1 C
0.3 A
0.1 B
0.2 C
20

FIG. 10

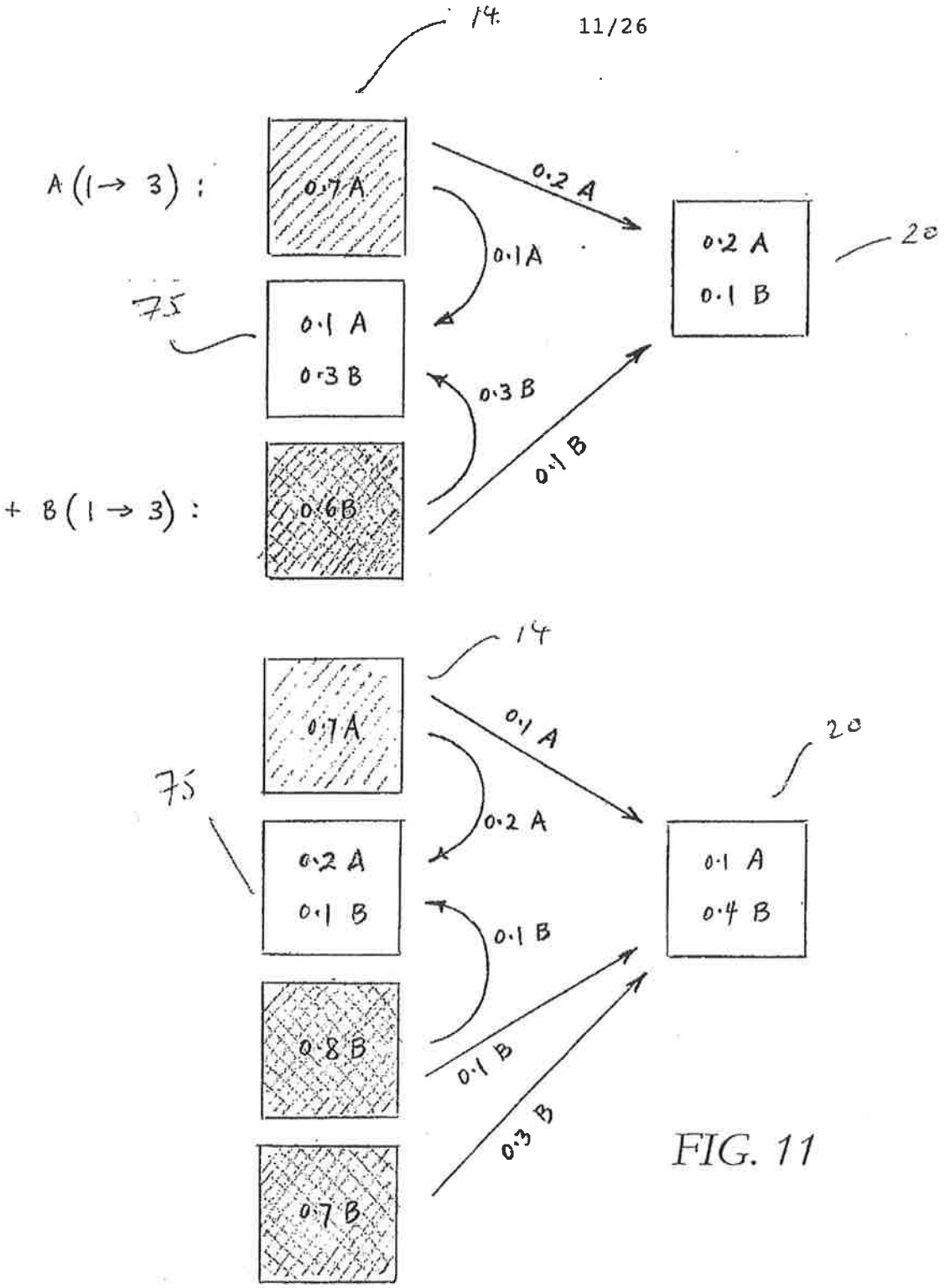

14
A (1 → 3) :
0.7 A
0.2 A
0.1 A
0.2 A
0.1 B
20
75
0.1 A
0.3 B
0.3 B
0.1 B
+ B (1 → 3) :
0.6 B
14
0.7 A
0.1 A
20
75
0.2 A
0.2 A
0.1 B
0.1 A
0.4 B
0.1 B
0.8 B
0.1 B
0.3 B
0.7 B

FIG. 11

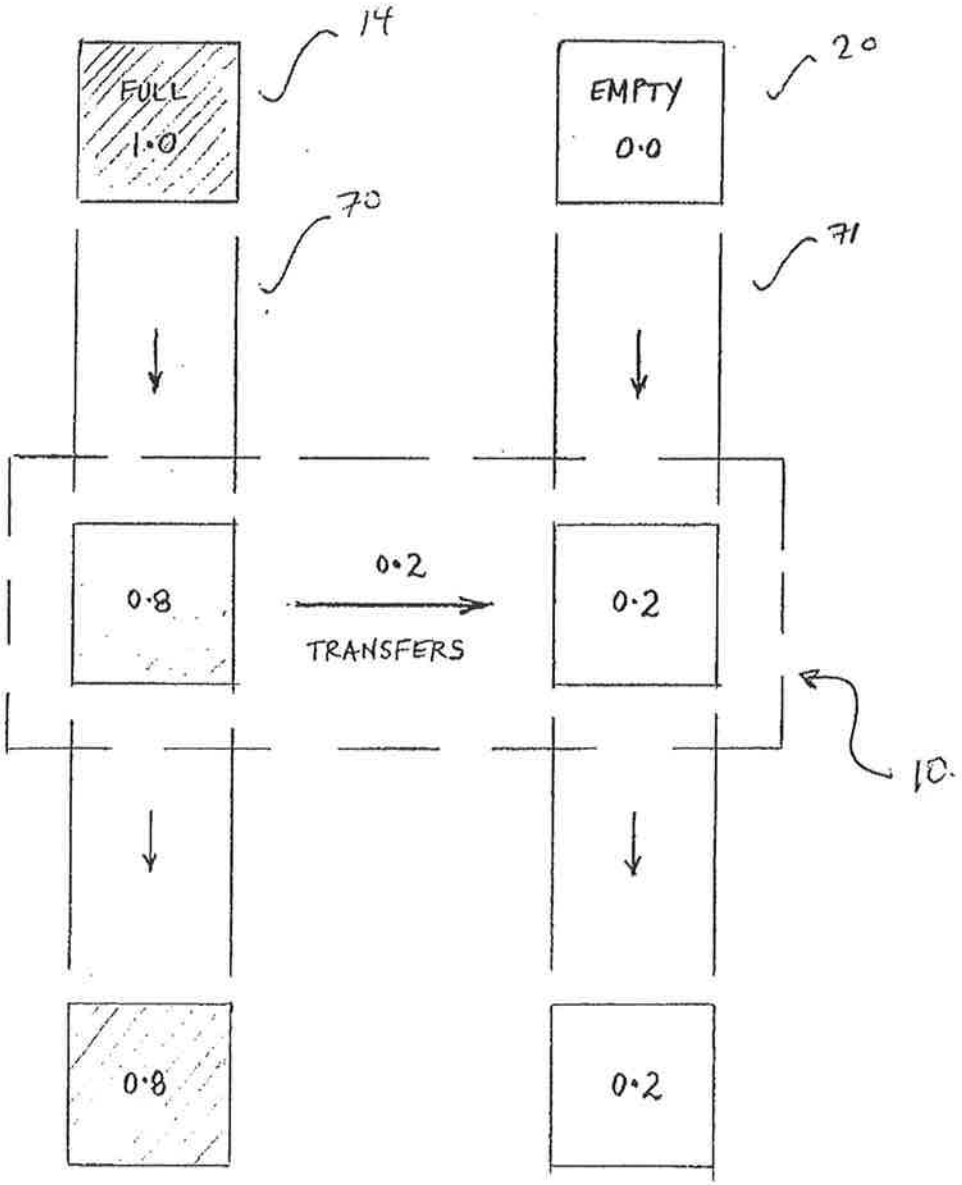


FIG. 12

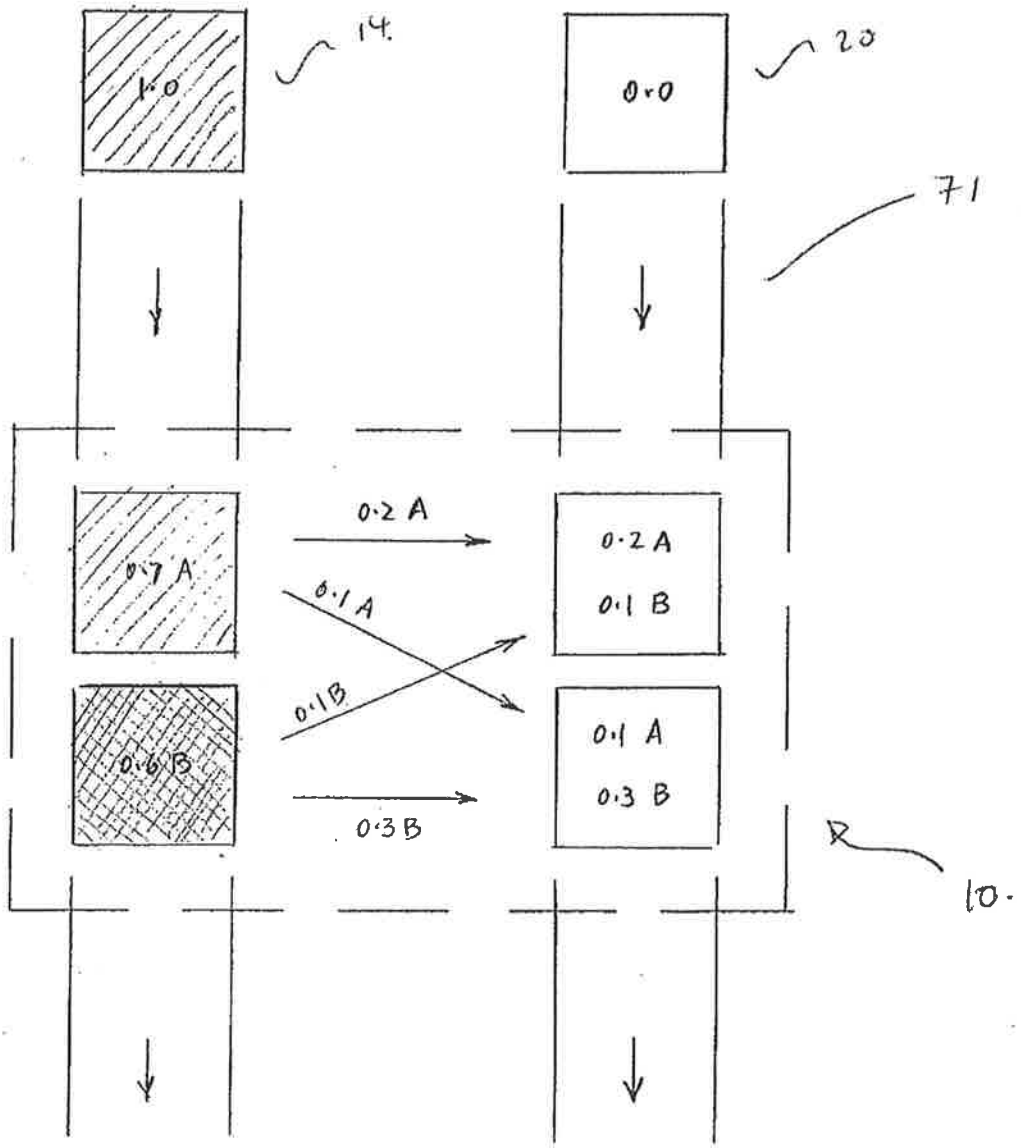


FIG. 13

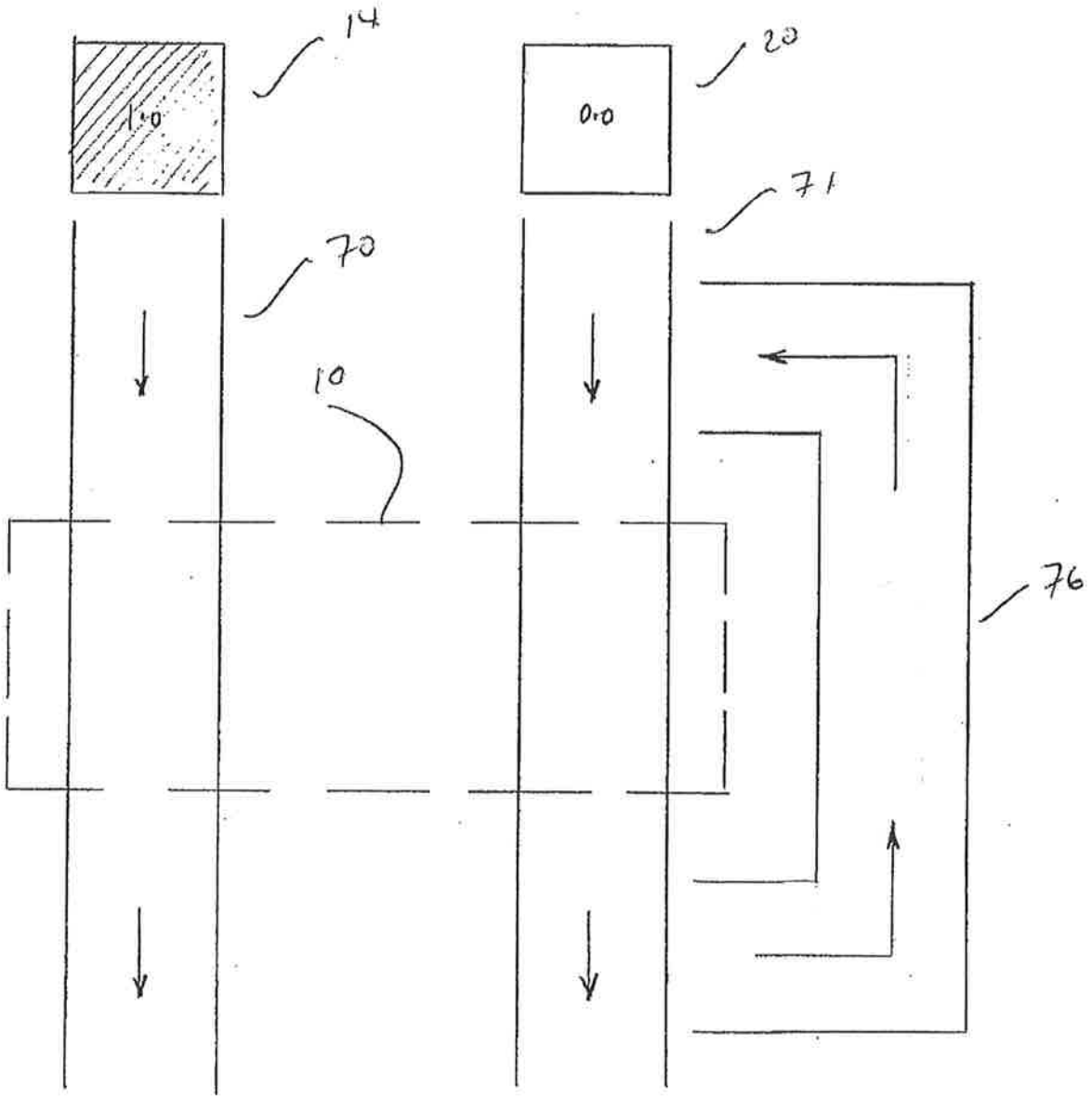


FIG. 14

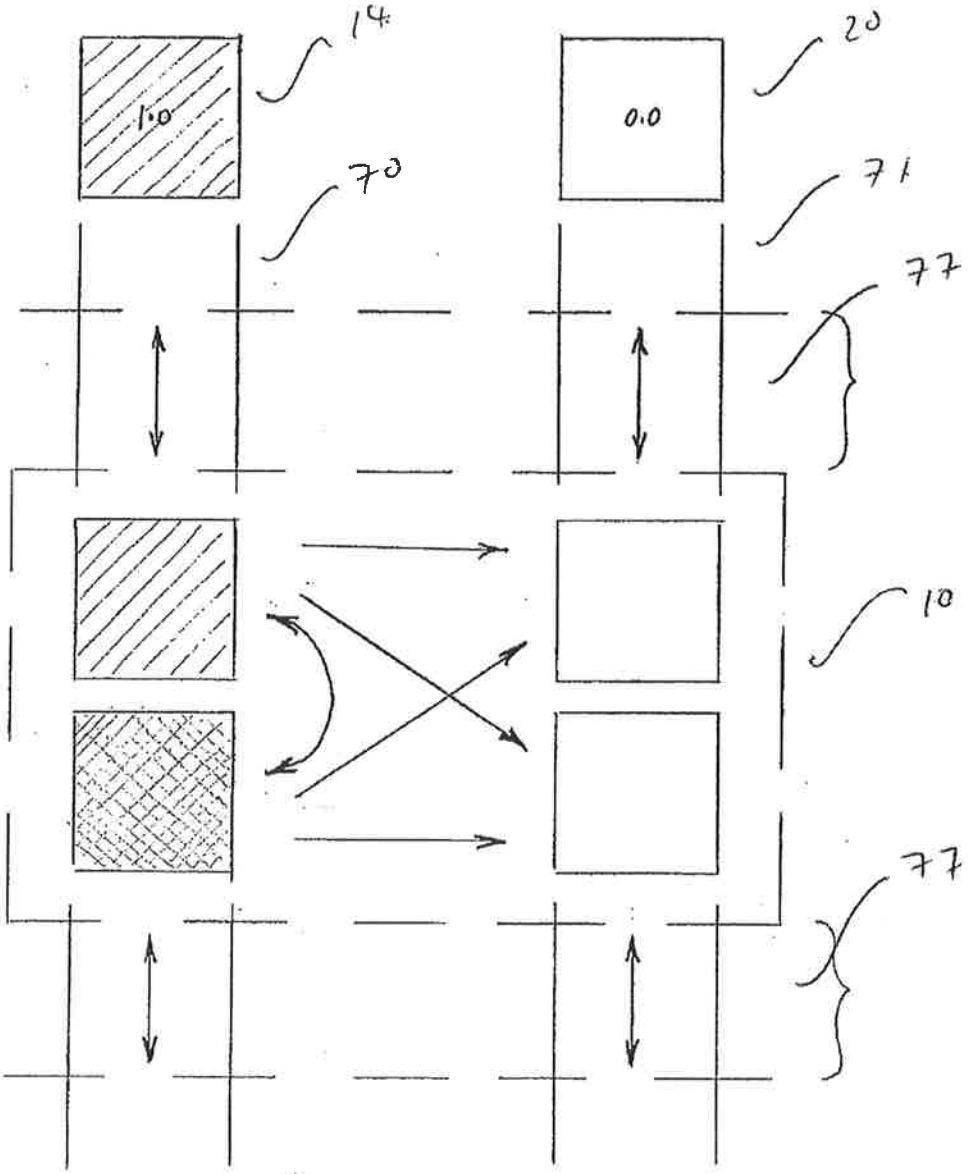


FIG. 15

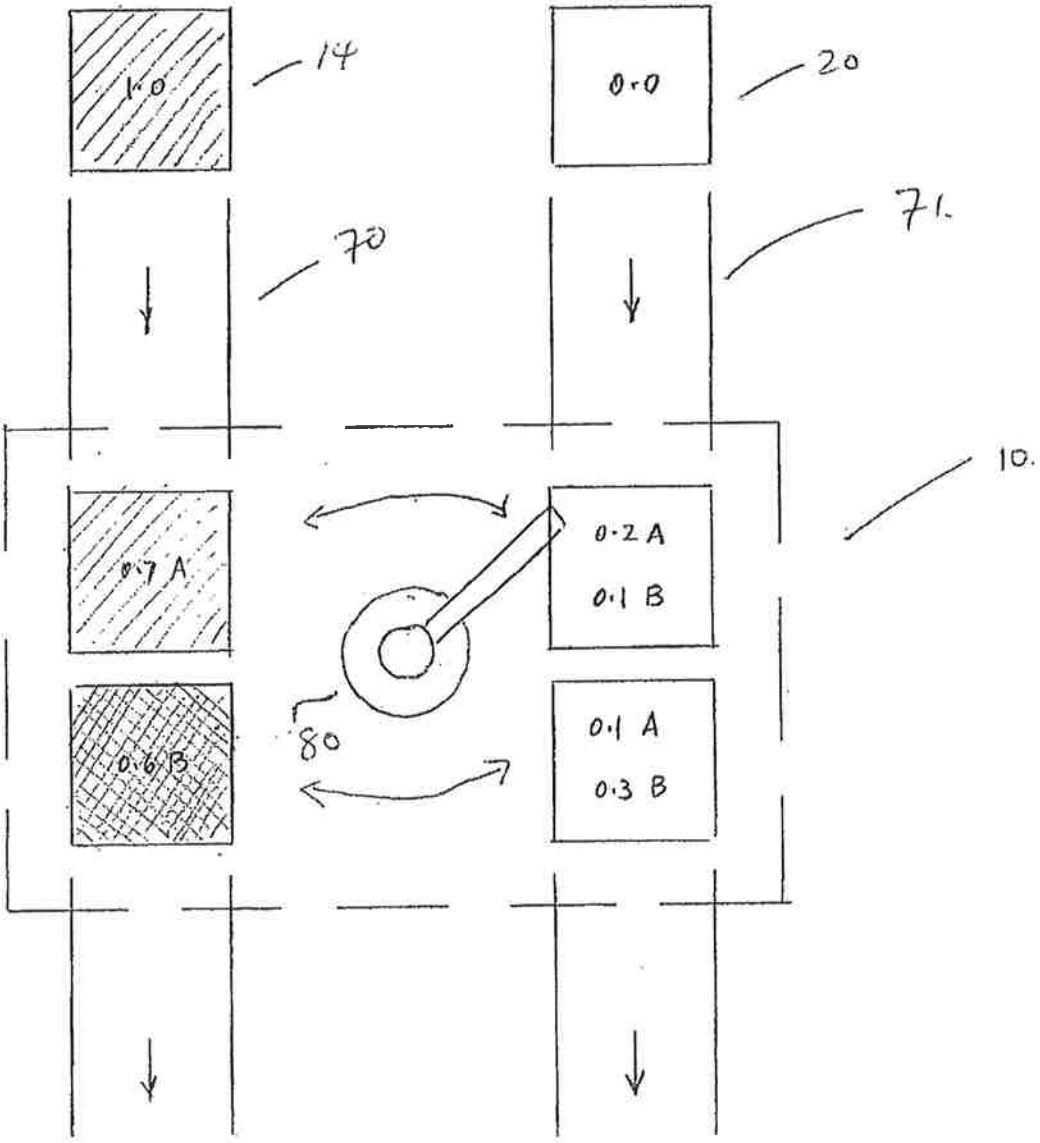


FIG. 16

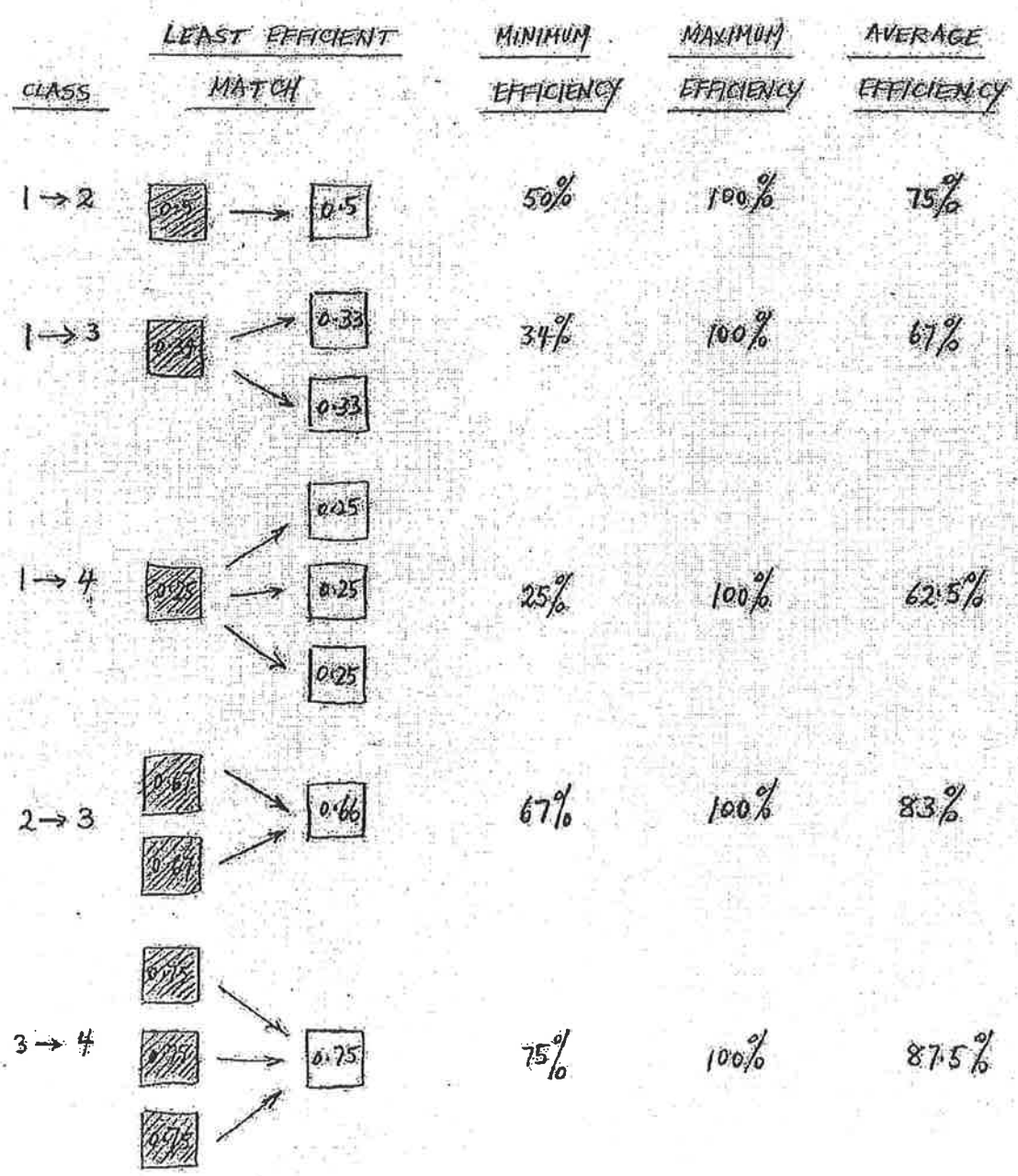
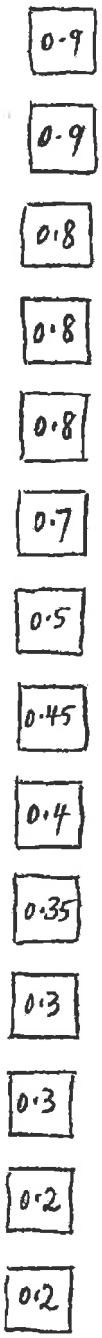

CLASS
LEAST EFFICIENT MATCH
MINIMUM EFFICIENCY
MAXIMUM EFFICIENCY
AVERAGE EFFICIENCY
1→2
0.5
0.5
50%
100%
75%
1→3
0.33
0.33
34%
100%
67%
1→4
0.25
0.25
0.25
25%
100%
62.5%
2→3
0.66
67%
100%
83%
3→4
0.75
75%
100%
87.5%

FIG. 17



NUMBER = 14

SUM = 7·6

FIG. 18

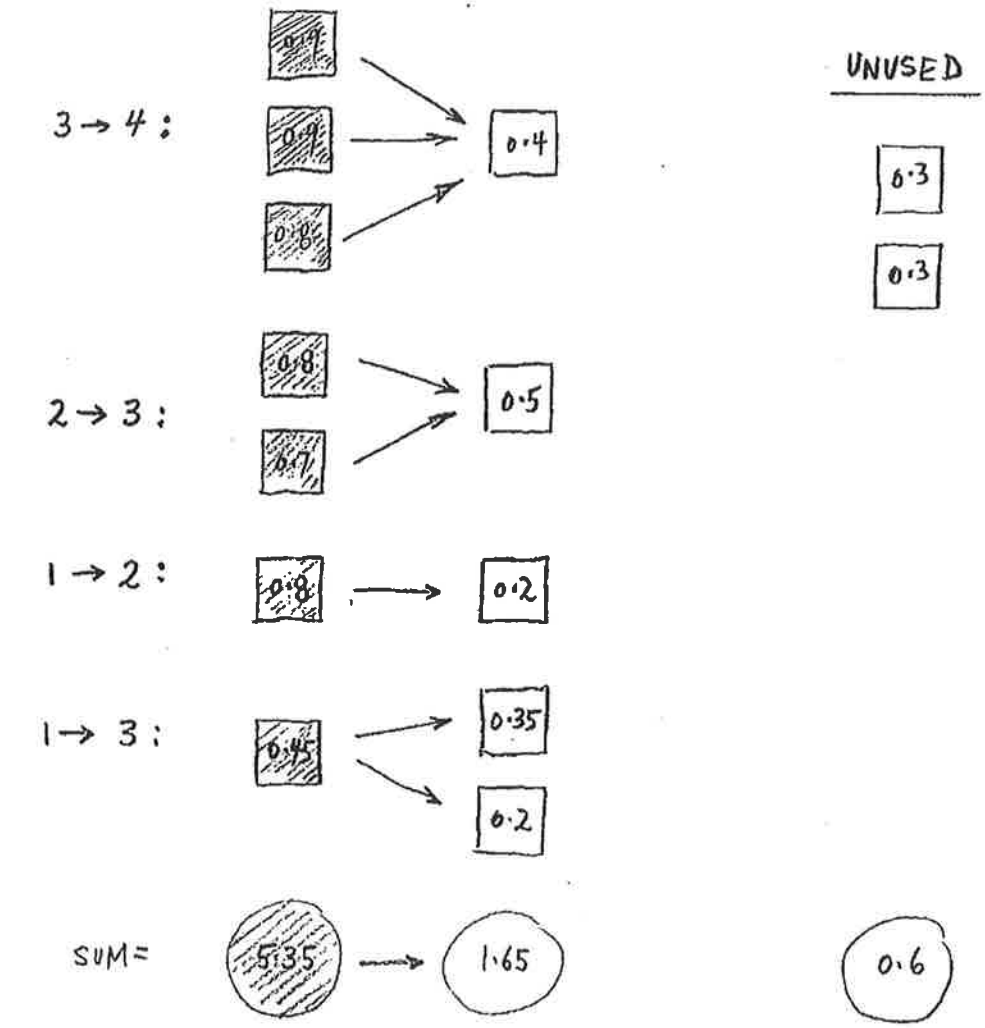

3 → 4 :
0.4
2 → 3 :
0.8
0.7
0.5
1 → 2 :
0.8
0.2
1 → 3 :
0.45
0.35
0.2
SUM =
5.35
1.65
UNUSED
0.3
0.3
0.6
EFFICIENCY = 76%

FIG. 19

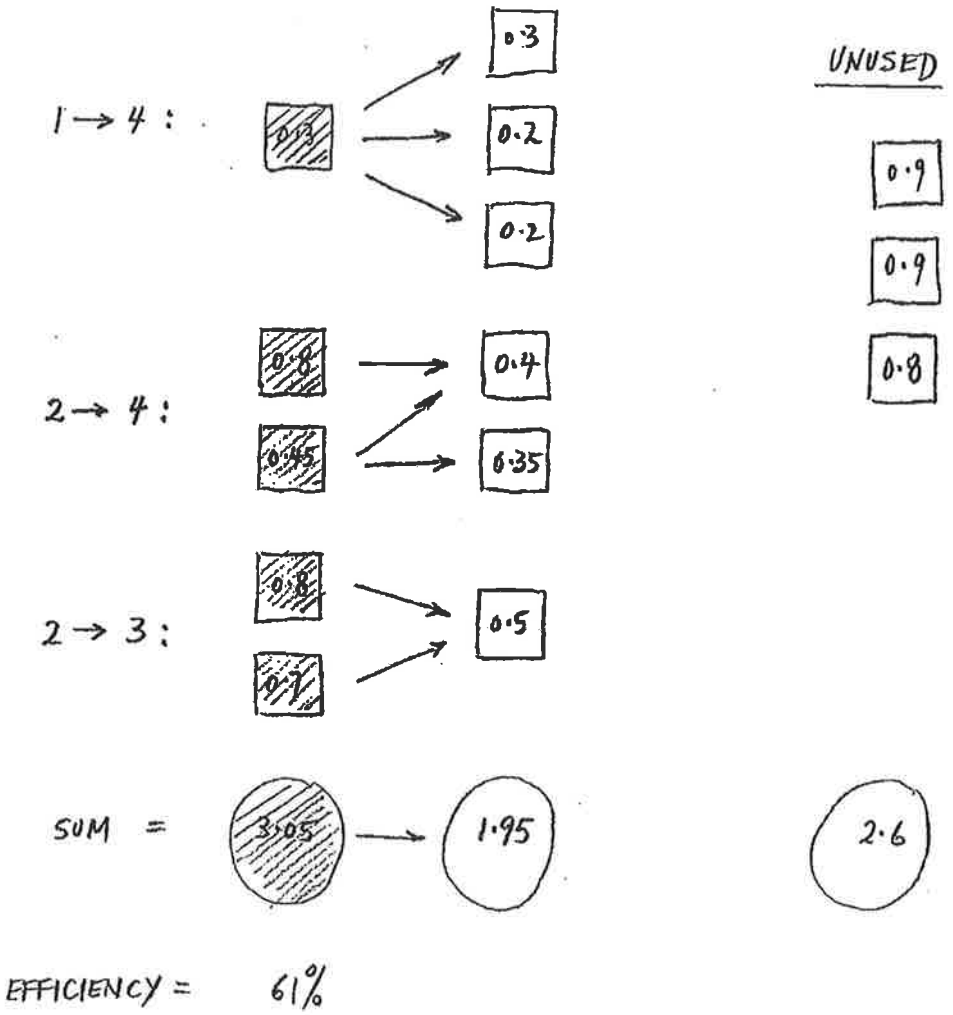

1 → 4 :
0.3
0.2
0.2
UNUSED
0.9
0.9
0.8
2 → 4 :
0.8
0.45
0.4
0.35
2 → 3 :
0.8
0.7
0.5
SUM =
3.05
1.95
2.6
EFFICIENCY = 61%

FIG. 20

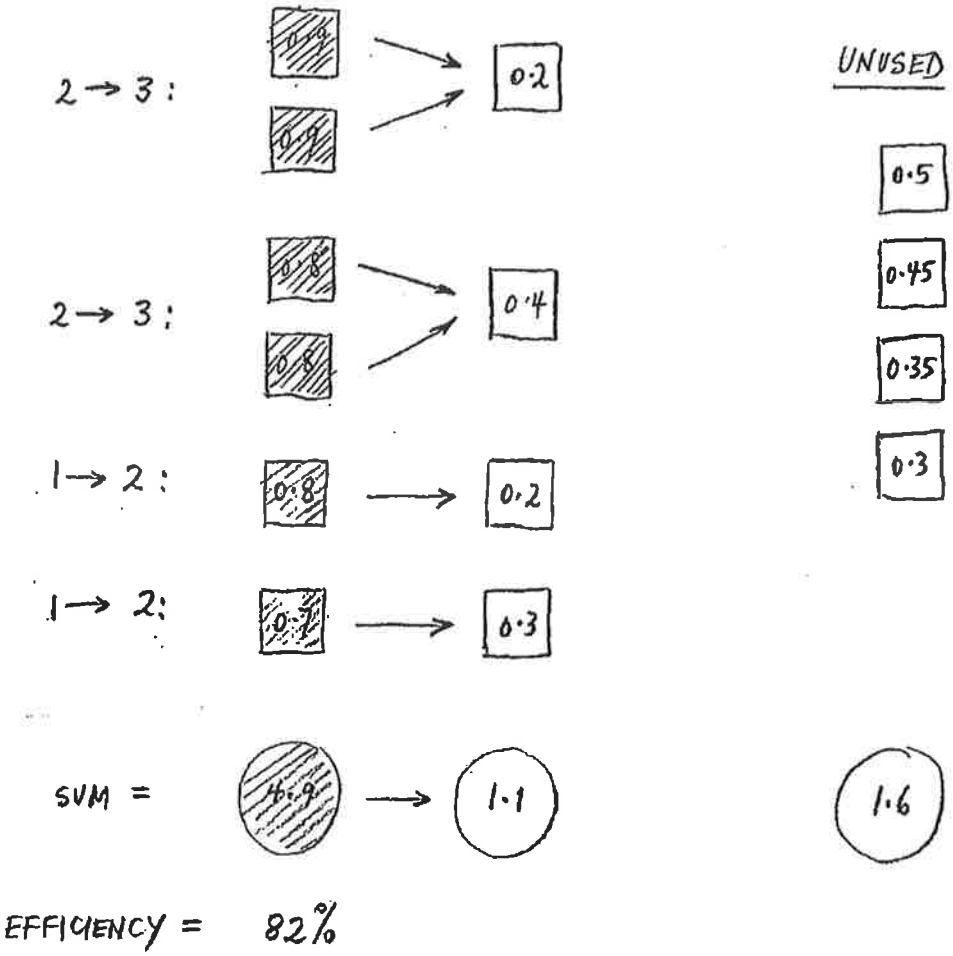

2 → 3 :
0.2
2 → 3 :
0.4
1 → 2 :
0.2
1 → 2 :
0.3
SVM =
1.1
UNUSED
0.5
0.45
0.35
0.3
1.6
EFFICIENCY = 82%

FIG. 21

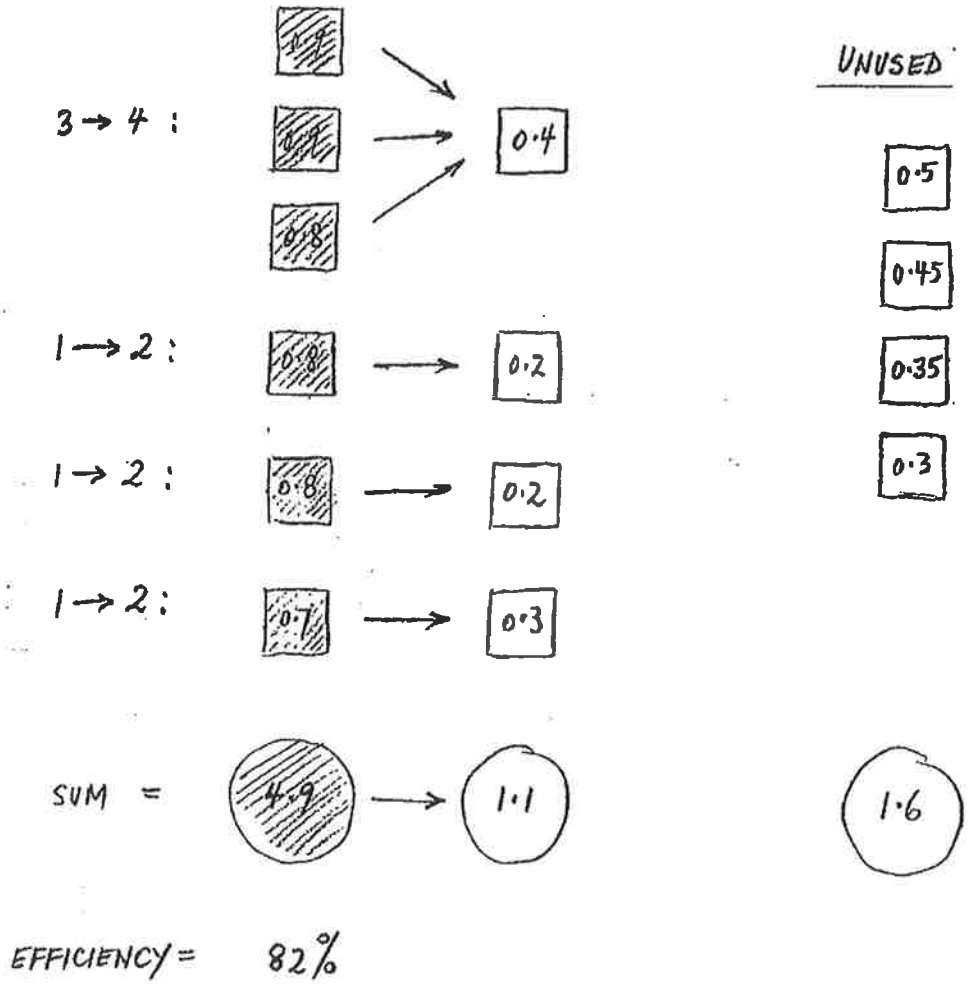

UNUSED
3 → 4 :
0.4
0.5
0.45
1 → 2 :
0.2
0.35
1 → 2 :
0.2
0.3
1 → 2 :
0.3
SUM =
4.9
1.1
1.6
EFFICIENCY = 82%

FIG. 22

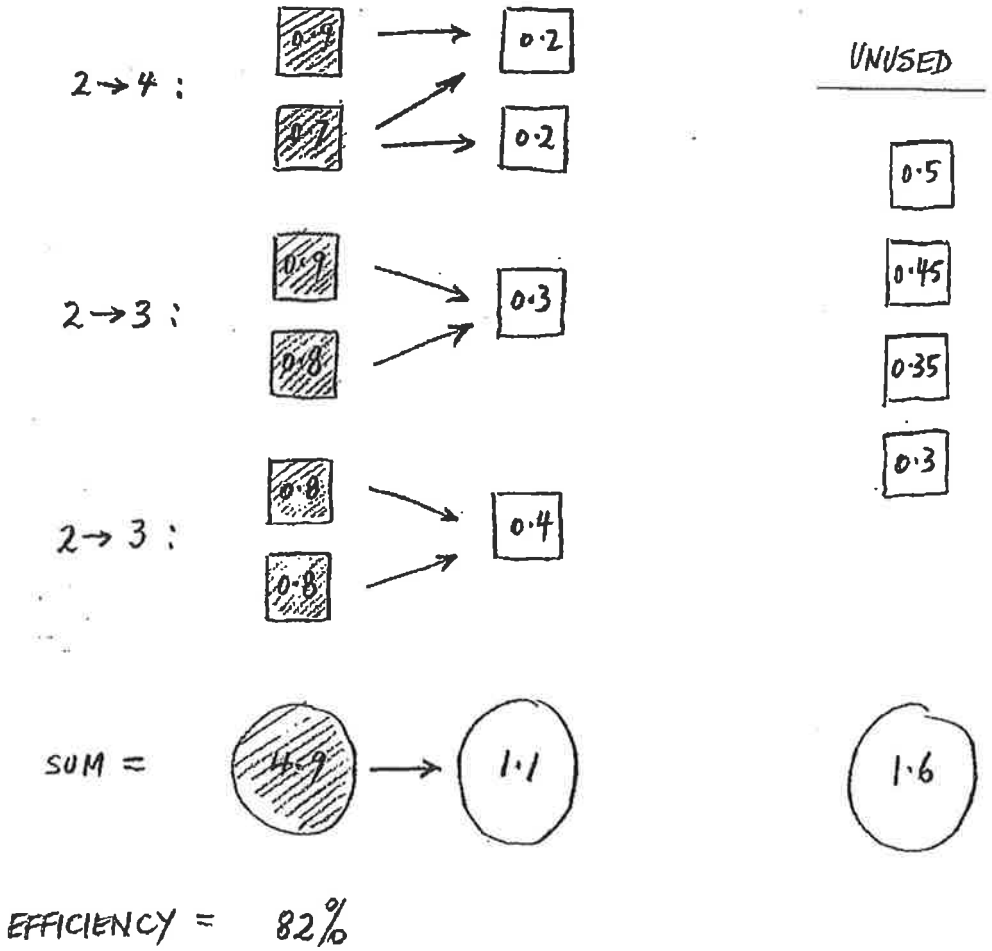

2→4 :
0·9
0·7
0·2
0·2
2→3 :
0·9
0·8
0·3
2→3 :
0·8
0·8
0·4
SUM =
4·9
1·1
UNUSED
0·5
0·45
0·35
0·3
1·6
EFFICIENCY = 82%

FIG. 23

ORDER LINES

PALLET ID	SKU ID	QUANTITY
1	A	0.01
1	B	0.10
1	C	0.01
1	D	0.12
1	E	0.02
1	F	0.02
2	B	0.07
2	E	0.32
3	B	0.07
3	D	0.02
4	D	0.36
4	E	0.50
4	F	0.14
5	B	0.13
5	F	0.16
6	D	0.38
6	E	0.04
6	F	0.04
7	B	0.22
8	D	0.26
8	E	0.10
8	F	0.20
9	B	0.82
10	A	0.01
11	B	0.18
11	D	0.26
11	E	0.06
11	F	0.06
12	D	0.04
12	E	0.02
12	F	0.02
13	B	0.27
13	D	0.02
14	C	0.93
15	E	0.18
15	F	0.14
16	D	0.72
16	F	0.16
17	A	0.01
17	C	0.01

FIG. 24

		Donor (Conv. 1)	Recipient (Conv. 2)	
Position	1	11	21	Pre-load
	2	12	22	
	3	13	23	Work area
	4	14	24	
	5	15	25	Complete
	6	16	26	

Functions

	Load	(	SKU_Pallet	,	To_Position	)		
	Index	(	Conveyor_Line	,	Postion	,	Num_Steps	)
	Transfer	(	From_Position	,	To_Position	,	Num_Cartons	)
	Remove	(	Destination_Pallet	,	From_Position	)		
»	Sequential processes							
	NULL	=	place holder					

Time

1	Load(A, 11)	»	Index(Donor, 11, 1)	»	Load(B, 11)
1	Load(Empty, 21)	»	Index(Recipient, 21, 1)	»	Load(Empty, 21)
2	Index(Donor, ALL, 2)				
2	Index(Recipient, ALL, 2)				
3	Load(C, 11)	»	Index(Donor, 11, 1)	»	Load(D, 11)
3	Load(Empty, 21)	»	Index(Recipient, 21, 1)	»	Load(Empty, 21)
3	Transfer(14, 24, 7)				
3	Transfer(13, 23, 2)				
4	Index(Donor, ALL, 1)				
4	Index(Recipient, ALL, 2)				
5	Load(E, 11)				
5	Load(Empty, 21)	»	Index(Recipient, 21, 1)	»	Load(Empty, 21)
5	Transfer(14, 24, 26)				
5	Transfer(13, 23, 13)				
5	NULL	»	Index(Donor, 15, 1)	»	Remove(1, 16)
5	Remove(2, 26)	»	Index(Recipient, 25, 1)	»	Remove(9, 26)

FIG. 25

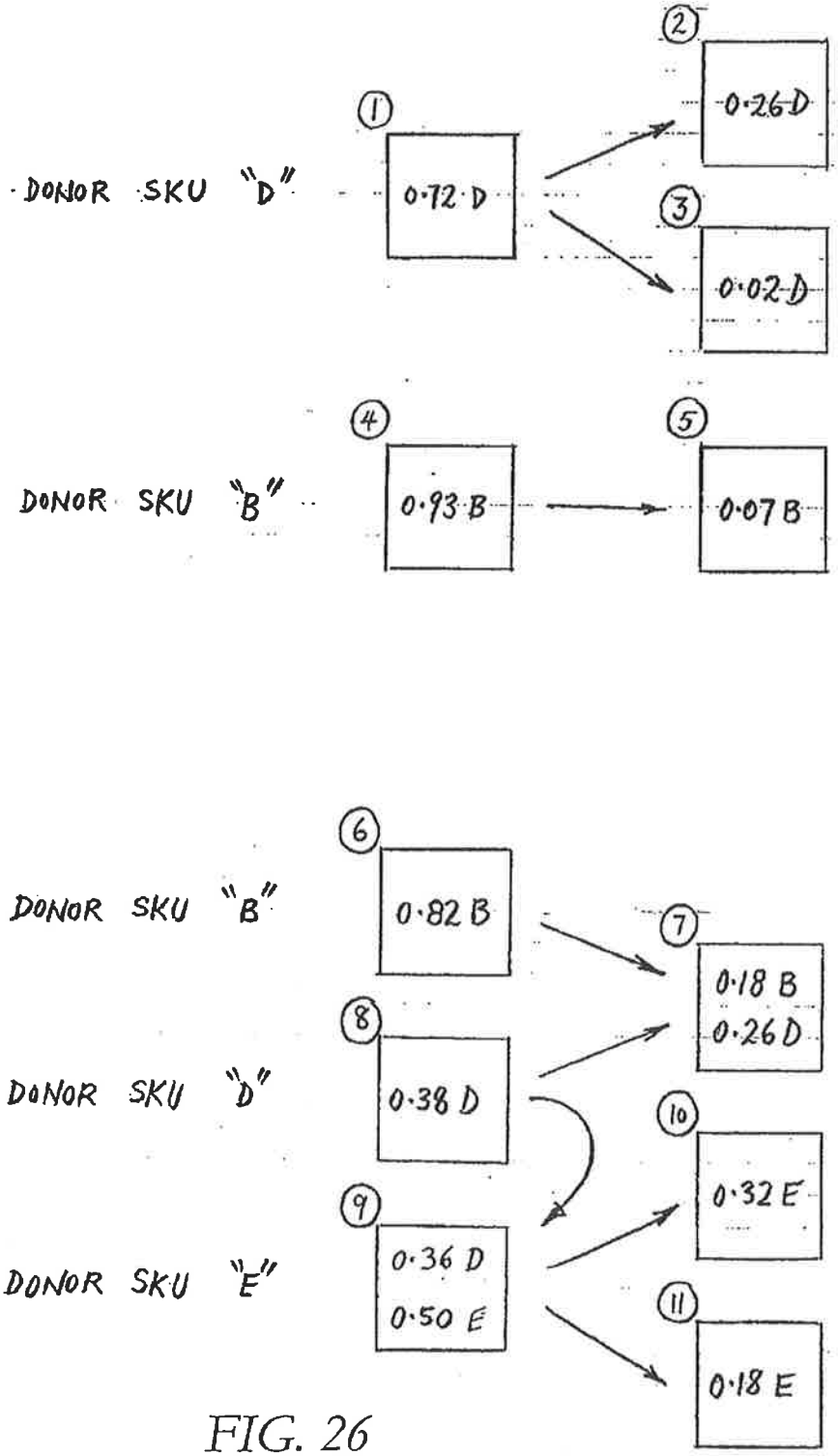

DONOR SKU "D"
1
0.72 D
2
0.26 D
3
0.02 D
DONOR SKU "B"
4
0.93 B
5
0.07 B
DONOR SKU "B"
6
0.82 B
7
0.18 B
0.26 D
DONOR SKU "D"
8
0.38 D
DONOR SKU "E"
9
0.36 D
0.50 E
10
0.32 E
11
0.18 E

FIG. 26