

1
 2 1 A
 3 1 B
 4a, 4b 1 TMR
 5a, 5b 2 TMR
 6
 7 TMR
 8 1
 9 2
 10 9 C
 11 2
 12 3
 13 12 D
 14 3
 15 4
 16 4
 17
 18
 19

< >
 11 : P ()
 12 :
 13 : MOSFET
 14 : N /
 15 :
 16a, 16b, 16c, 16d :
 17a, 17b, 17c, 17d :
 18 : Gnd()
 19a, 19b, 19c :
 20 : TMR
 21 :

(TMR : Tunneling Magneto Resistive)
 (MRAM : Magnetic Random Access Memory)
 (Tunneling Magneto Resistive : , TMR)
 MRAM(Magnetic Random Access Memory) MRAM ISSCC
 2000 Technical Digest p.128 「A 10ns Read and Write Non-Volatile Memory Array Using a Magnetic Tunnel
 Junction and FET Switch in each Cell」, Roy Scheuerlein et. al
 17 가 18 TMR
 18 (19) TMR (21)가 (19, 26) TMR (20) (21) (21)
 (13) TMR (20) 2 (13) (26)
 18 TMR (20) TMR (20) (17) (41) (41) ()
) (21) (43) (41) (43)
 (42) (41) 가
 (43) (43) (21)
 (19)

19 () (11) STI(Shallow Trench Isolation) (12) P
 (11) MOSFET(13)가 MOSFET(13) N /
 (14) , MOSFET(13) (26) ,
 (11) / (14) 1 (16a)가 (15) 1 (16a)
 1 (17a) 가 , (15) 2 4 (16b, 16c, 16d) 2
 4 (17b, 17c, 17d) , 1 (17a) Gnd() (18) 3 (17c
) (19a, 19b, 19c) , 4 (17d) TMR (20)가 , TMR
 (20) (21) .
 , TMR (20) '1', '0' (19) (21) , ((19)
 (21) (21) 가 , TMR (20) ,
 , (41) (43) , (42)
 (43) 가 , '1' (41)
 (42) 가 ,
 '0' , MRAM '1', '0'
 , TMR (20) (26) (21) , ((21)
 21) TMR (20) MOSFET(13) Gnd (18) 가 , TMR (20)
 가 '1', '0'
 , 가 가 , 19
 X가 0.1 μ m 가 ,
 (19b) (19b) 가
 (19a, 19c) , (19a, 19c)
 , 가 .
 1 , 1 , 1 , 1
 , 1 2 , 2 1
 1 , 2 1 1
 2 , 1 2 , 1 1
 , 2 2 , 1 2
 , TMR(Tunneling Magneto Resistive)
 MRAM(Magnetic Random Access Memory) . MRAM TMR
 / 가 .
 [1]
 1 , , ,
 1 1 . 2 1 A
 , 1 3 1 B .
 (21) (21) (19, 26) ,
 (21) (19) TMR (20)가 (33)가 , ((19)
 MOSFET: 23)가 , A MRAM , 2
 , 1 A () (11) STI(Shallow Trench Isolation) ,
 (12) , P (11) MOSFET(13)가 MOSFET(13)
 , N / (14) , MOSFET(13)

MOSFET(13) (26) (11) / (14)
) 가 (15) (16a)가 (15) (16a) (17a) (17a)
 가 (15) 2 4 (16b, 16c, 16d) 2 4 (17b, 17c, 17d)
 19c) , 1 (17a) Gnd() (18) 3 (17c) (19a, 19b ,
 , 1 B (17d) TMR (20)가 , TMR (20) (21)
 , 3 B (19a, 19b, 19c) 3 1 (16c), 2 (17b), 2 (16
 b), 1 (17a), 1 (16a)가 , 1 (16a) (11) (11)
 (23a, 23b) / (24) , (19a, 19b)
 (23a)가 (19b, 19c) (23b)가
) TMR (20) TMR (20) 2 , TMR (20) (
)(41), () (42), () (43) , TMR (20)
 1 2
 4a, 4b 1 TMR , 1 TMR (20)
 4a TMR (20) (101), (102), (103), (104)
 (41) , (41) (42) , (42)
 (105), (106) (43)
 가 , 4b TMR (20) (101), (102), (103), (104')
), (107), (104') (41) , (41)
 (42) , (42) (105'), (107), (105'), (106)
 (43)
 , 4b TMR (20) (41) (104'), (107), (104')
 3 , (43) (105'), (107), (105') 3
 , 4a TMR (20)
 5a, 5b 2 TMR , 2 TMR (2
 0)
 5a TMR (20) (101), (102), (103), (104)
 1 (51) , 1 (51) 1 (52) , 1
 (52) (43) , (43) 2 (53) , 2
 (53) (104), (103), (102), (106) 2
 (54)
 5b TMR (20) (101), (102), (103), (104)
 1 (51) , 1 (51) 1 (52) , 1
 (52) (43'), (107), (43') 3 (43) ,
 (43) 2 (53) , 2 (53) (104'), (10
 7), (104'), (103), (102), (106) 2 (54)
 , 5b TMR (20) (43) (43'), (107), (4
 3') 3 , 2 (54) (104'), (107), (104') 3
 , 5a TMR (20)
 2 TMR (20) , 1 TMR (20)
) 가 , MR(Magneto Resistive) ('1' '0'
 1 2 TMR (20)
 (41, 51, 54) (43) Fe, Co, Ni
 , CrO₂ , RXMnO₃ -y(R; , X; Ca, Ba, Sr) , NiMnSb, PtMnSb
 , Ag, Cu, Au, Al, Mg, Si,
 Bi, Ta, B, C, O, N, Pd, Pt, Zr, Ir, W, Mo, Nb 가
 (41) (103) Fe-Mn, Pt-Mn, Pt-Cr-Mn, Ni-Mn, Ir-Mn, NiO,
 Fe₂O₃
 (42, 52, 53) , Al₂O₃ , SiO₂ , MgO, AlN, Bi₂O₃ , MgF₂ , CaF₂ , SrTiO₂ , AlLaO
 3 가
 , 1
 6 , 6 , ((19),
 (21)) X 0.1μm×0.1μm

6 X
X가 , 가

7 TMR ,

'1', '0'

X 0.1 μ m (19), (21)

'1' P 가 (19) ,
100e (19) 5MA/cm² (21) , 20 250e (21) 10MA/cm² 가 (19) ,
(6). , P '1'

'0' Q 가 (19) ,
100e (19) 5MA/cm² (21) , 20 300e (21) 10MA/cm² 가 (19) ,
(6). , Q , '0'

1 (19b) (25) (31) (23a, 23b) (30) TMR (19b) (25) (23a, 23b) (19a, 19c) (20) 7 P Q (21b) (33) (31) (25)

(19b) (25) (32) (19a, 19c) (25a, 25b) (32)가 (19a, 19b) (32) (19a, 19b) (32a, 32b) (32a, 32b)

가 TMR (20) MOSFET(13) (21) TMR (20),
(16a, 16b, 16c, 16d), (17a, 17b, 17c, 17d) / (14) 가 '1', '0'

가 TMR (20) (23) (25)

1 (19b) (19a, 19c) (25a, 25b) (32a, 32b)

8 (21) (23) 1, 8
(19) (21) (23)

[2]

2

9 2 9 A 10 9 C 1

2 (21) (19) TMR (20)가 (19, 26) (61)가
(19) (33)가

9 C C 2 (16c), 2 (17b), 2 (16b),
10 (17a), 1 (16a)가 (19a, 19b) 3 (16a) (11) (61)가
PN (61) (19a, 19b) (61)가

9 (19b) (21b) (30) TMR (20) 7 P Q (21b)

(25) , 가 , (19b) (25) (33) (31)
 (25) (25a, 25b)가 (61a, 61b) (25)가 , (19a, 19c)
) , (19b) (32a, 32b) (25) 가 (32) , (19a, 19c) (25a, 25b)
 (19a, 19b) , (32) , (19b) (19b) (32)가
 (32a, 32b)
 , TMR (20) 1 가 ,
 2 1 가
 , 11 , (21) (61) , 9, 11
 , (19) , (21) (61)
 [3 3] 1 ,
 12 3 , 13 12 D
 12 , B 1 가 , (19a, 19b)
 (23a)가 , (19b, 19c) (23b)가
 13 , D (21) (19a, 19b, 19c) TMR (20)가
 , TMR (20) PN (71)가
 3 1 가 , 3
 가 , (71) TMR (20) (71)
 , TMR (20) '1', '0' 가 ,
 3 , 1 가 (71) , 1 2
 , 14 , (21) (23) , 12, 14
 , (19) , (21) (23)
 [4 4] 2 , 3
 15 4 가 , 15 , C
 2 (19b, 19c) 가 , (19a, 19b) (61a)가 ,
 (21) (19) (61b)가 TMR (20)가 , D TMR (20) PN 가 ,
 4 , 2 가 , 4
 3 , 가 ,
 4 , 2 가 ,
 , (71) , 1 2
 , 16 , (21) (61) , 15, 16
 , (19) , (21) (61)
 , 4 , TMR 2 가 ,
 GMR(Giant Magneto Resistive) 가 , 가
 , 가
 , 가

1 , 2 3 GMR

13.

1 , 1 1 가

14.

2 , 2 2 가

15.

1 , 1 2

16.

2 , 1 2

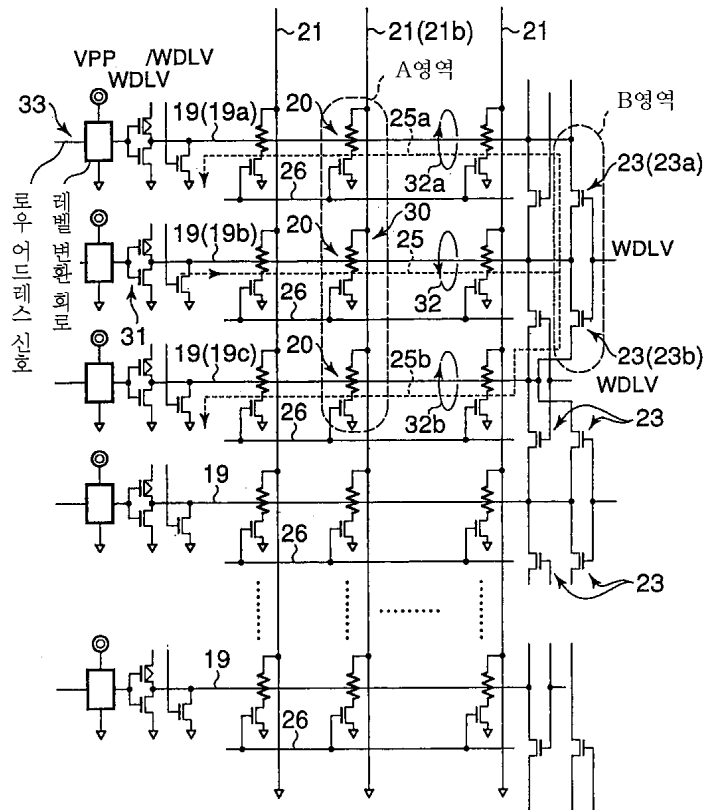
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1 , 1 2 3 , 2 2

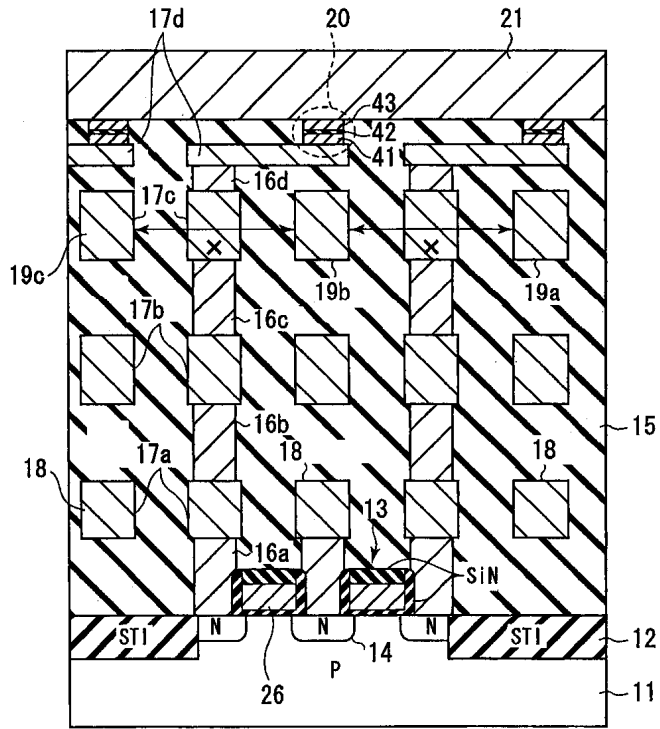
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3 4 1 , 2 2 , 2 3 2 , 1 5 , 1 1 2 6 2 , 1 1 1

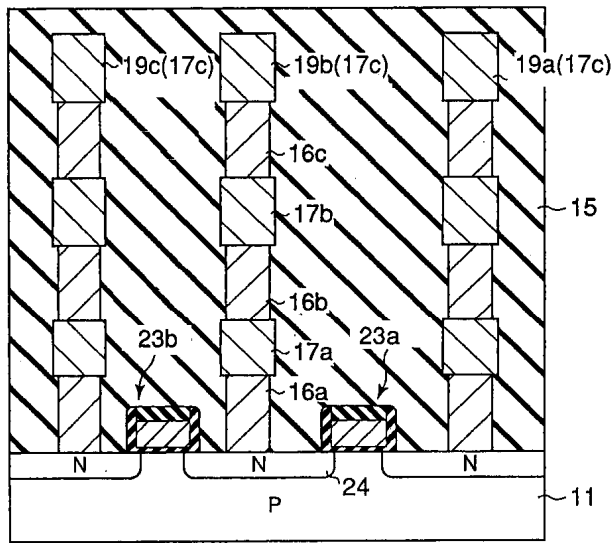
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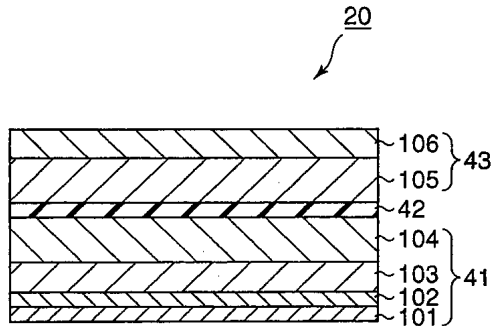
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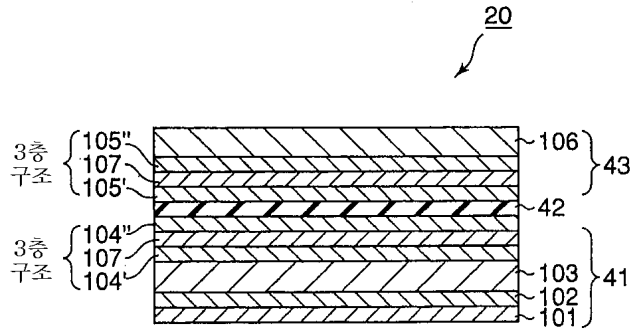
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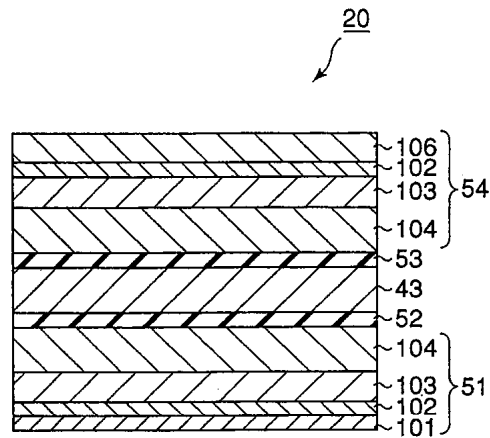
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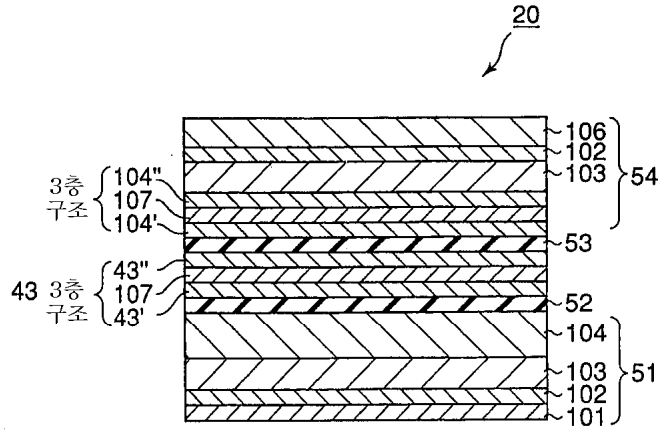
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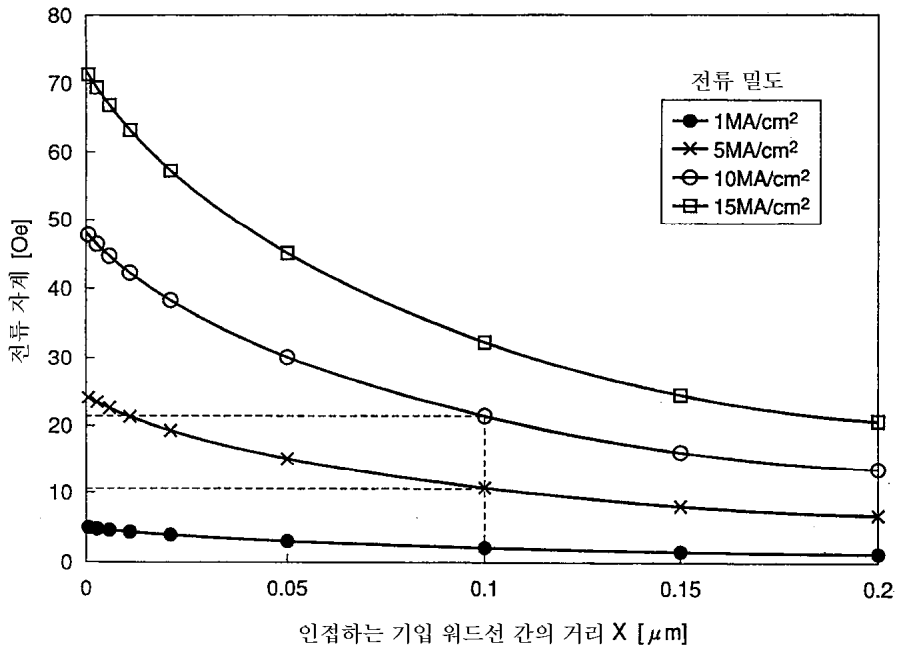
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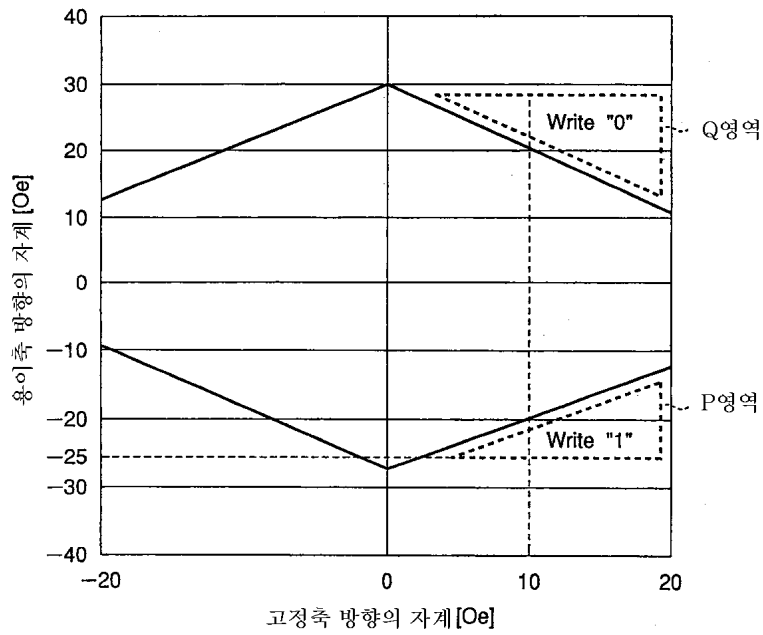
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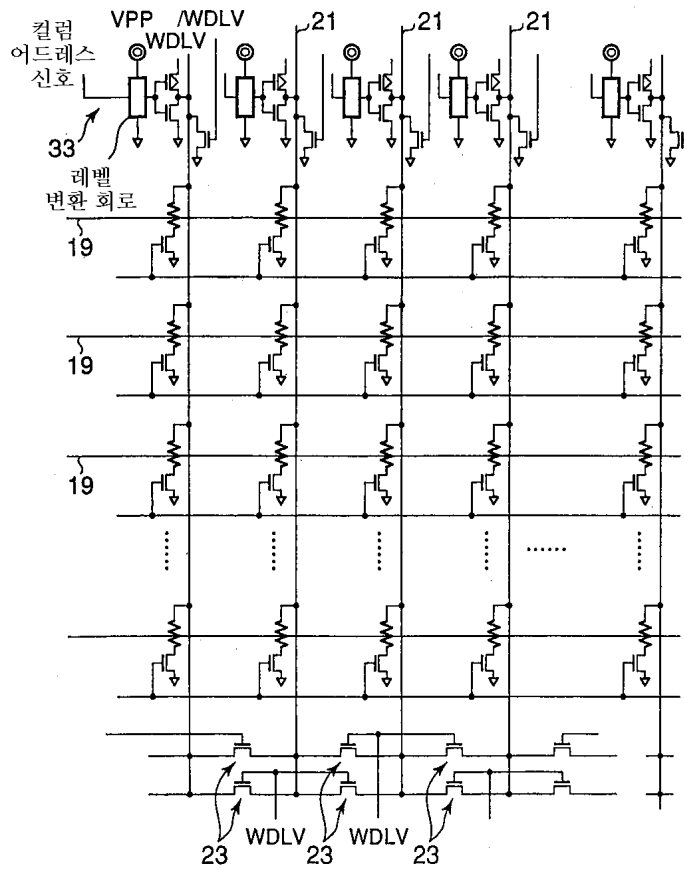
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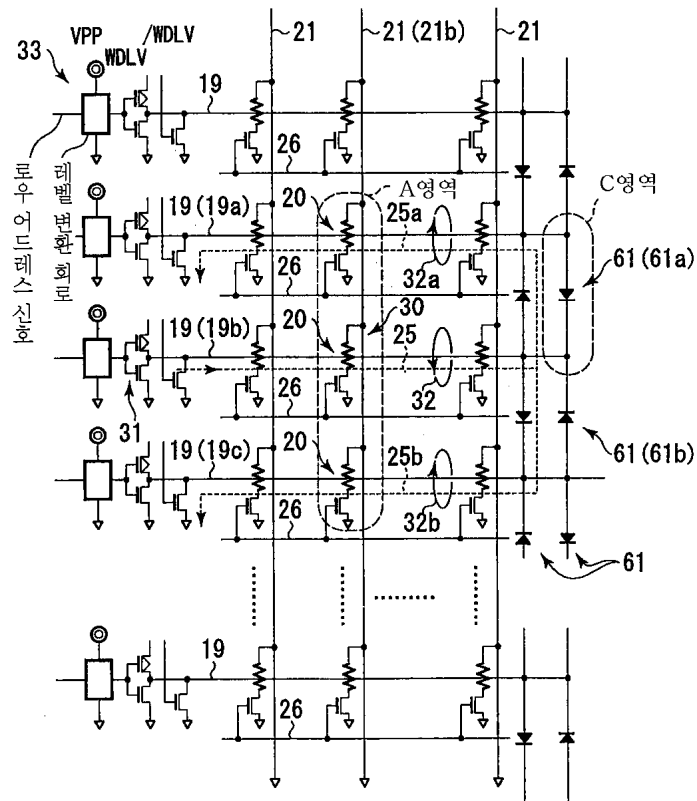
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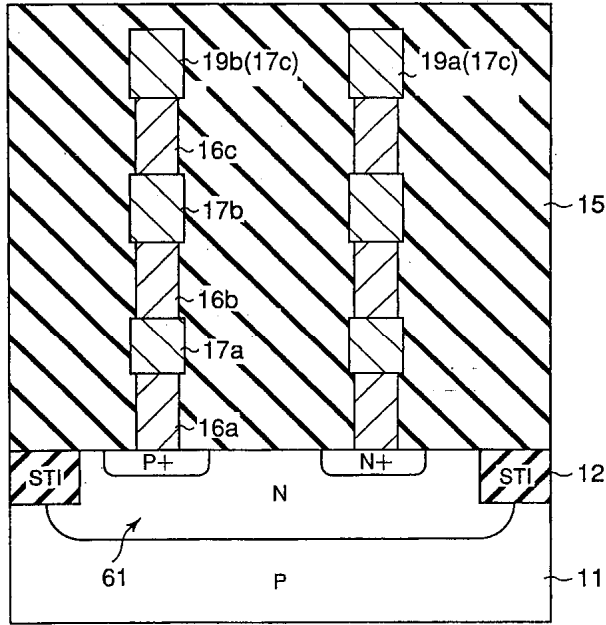
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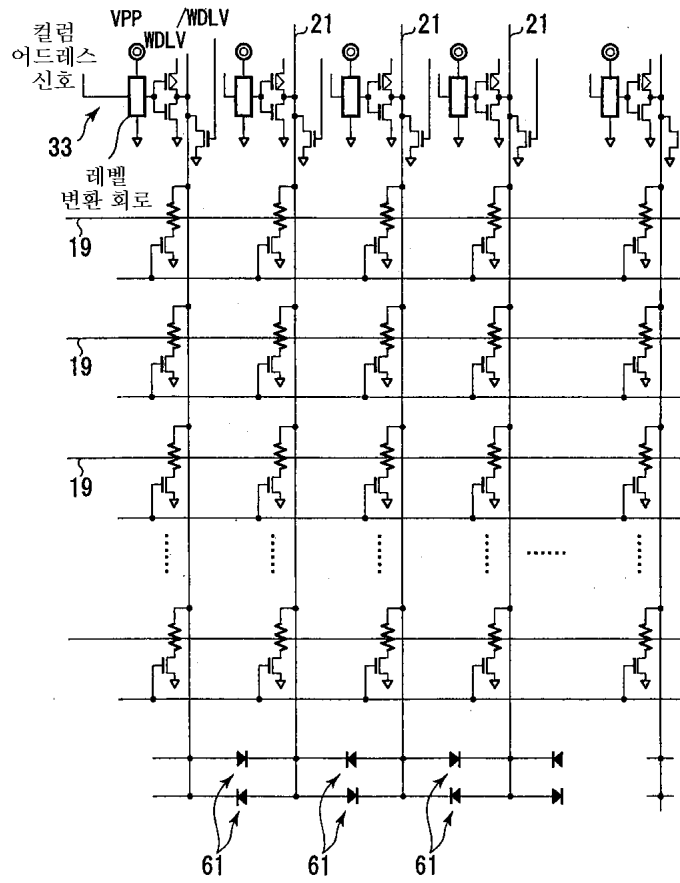
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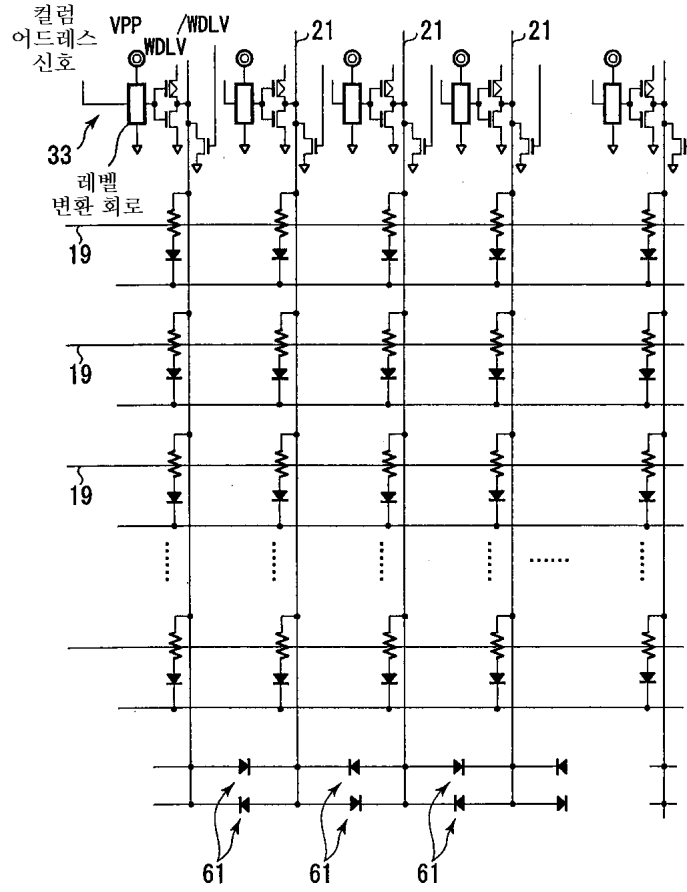
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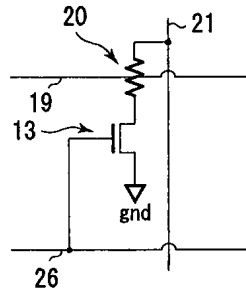
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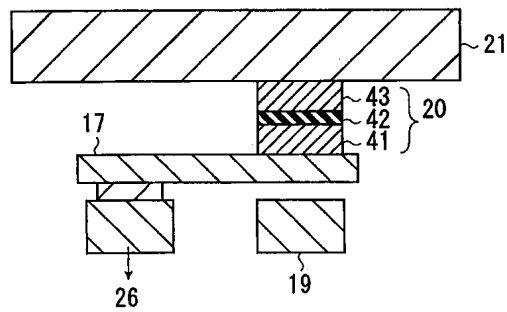
16



17



18



19

