

(19)  
(12)(KR)  
(A)(51) 。 Int. Cl. <sup>7</sup>  
H01L 21/8242(11)  
(43)2002 - 0031283  
2002 05 01(21) 10 - 2001 - 0053697  
(22) 2001 09 01(30) JP - P - 2000 - 0032 2000 10 23 (JP)  
2117(71) 가 가  
가 가  
가 4 6(72) 1 5 1 가 가  
1 5 1 가 가

(74)

:

(54)

Ru

, DRAM

.

가  
(Ru(C<sub>2</sub>H<sub>5</sub>C<sub>5</sub>H<sub>4</sub>)<sub>2</sub>/O<sub>2</sub>)가 10%  
(a) 50%

.

.

Ru  
(b)

Ru 가

18b

, Ru , .



24 2 ,

25a 25b ,

26 .

< >

1 ... ( )

2 ...

3 ... p (p - type well)

4 ...

5 ...

6 ...

7 ...

8 ... n

9 ...

10 ...

11. 12 ...

13 ...

14 ...

15 ...

16 ...

17 ...

18 ...

19 ... (through - hole)

20 ...

21 ... (side - wall spacer)

22 ...

23 ...

24 ...

26 ...

27 ... ( )

29 ...

30a ... Ru

30b ...

30c ...

30d ... Ru

30 ...

32 ...

33 ...

33a ... Ru

33b ... W

34 ...

BL ...

C ...

Qs ... MISFET

WL ...

L ...

) , , ( ) Ru( .



, 300 .

2. MISFET , (a) MISFET , (b)  
 , (d) MISFET , (c) 가 (短  
 徑) 5 , (e) Ru , Ru , Ru 가  
 50% . , 250nm . Ru  
 , 가 . Ru , 5nm .

가 ,  
 ( 1)  
 , DRAM 1~ 17 .  
 , 1 p ( ) (1)  
 (2) , (2) 2 (2)  
 가 (L) (L) ,  
 MISFET(Qs) 2 .  
 (2) , (1) 300~400nm ,  
 (1) CVD(Chemical Vapor Deposition)  
 (4)( 600nm ) , (4) (Chemical Mechanical P  
 olishing;CMP) .

, (1) B( ) p (3) , p (3) HF( )  
 (1) p (3)( (L)) 6nm  
 (5) .

, 3 (5) (5) (6) (6) ,  
 (5) P( ) n ( 70nm ) , WN( ) TiN(  
 ) ( 5nm~10nm ) , W ( 100nm ) (7)(  
 150nm ) ,  
 (7) CVD , W (sputtering)  
 (6) (WL) . , (wet • hydrogen) ,  
 (6) n , .

, 4 (3) As( ) P( ) (6) p  
 (3) n (8)( , ) . MISFET(Qs)

(1) CVD (9)( 50nm) (10)( 600nm )  
 (10)  
 (10) (9) MISFET(Qs) n  
 (8)( , ) (11,12) (10)  
 가 , (9) 가  
 (11,12) (6)( ) (self align)

5 (11,12) (13)  
 (10) P n CVD (13)  
 n (11,12) n (11,12) ( )

(10) CVD (14)( 150nm )  
 ( ) (11) (14) (15)

(15) (16) (16) (14)  
 CVD W Ti TiN  
 (15)  
 (16 13) MISFET(Qs) n (8)( , )  
 (BL)

(14) (16) (BL) (BL)  
 (14) W ( 50nm ) TiN ( 10nm ) , TiN  
 CVD W ( ) ( )

6 (BL) CVD (17)( 300nm )  
 (13)가 (12) (19) (17)

(19) , (12) ( )  
 18) CVD (20) (19) (2  
 0) (20) ( )  
 (21) (20) (21)  
 (18) (17)

(20) (21) 7  
 (19) (22) (22) (18) P  
 n CVD (19) n (1  
 9) n ( )

(22) Ru (30a, 30d) (30), (32)  
 W /Ru (33) (C)

(C) 8~ 17 (22)  
(C)

8 (22) (17) , CVD (18) 50nm  
(18) (24) (C)  
(24) ( )  
가 (24) (0.8 $\mu$ m) 가 (24) ,  
TEOS(tetraethylorthosilicate) 가 CVD , ,

(24) (26) (26)

9 (26) ( ) ,  
(26) (26) (24)  
(18) ( ) (27) ( ) (27)  
(19) (22)

(24) (26)  
10 nm (24) (27) , CVD (29) ( 10  
) Ta(OC<sub>2</sub>H<sub>5</sub>)<sub>5</sub> O<sub>2</sub> 가 400 ~450  
(29) (下地) (24) Ru (30)(30a,30d)

11 (29) (24)  
(27) (29) (27) (29) ,  
가 (27)

12 (24) (27) , Ru (30)( 5nm )  
CVD Ru , Ru  
, CVD Ru

, Ru (30a) . Ru (30a) , CVD ( )  
Ru(C<sub>2</sub>H<sub>5</sub>C<sub>5</sub>H<sub>4</sub>)<sub>2</sub> ) 5cm<sup>3</sup>/min, O<sub>2</sub> 50cm<sup>3</sup>/min, ( 0 , 1 (1.  
01324 × 10<sup>5</sup> Pa)) sccm ) N<sub>2</sub> 900sccm 290 , 665Pa  
Ru 가  
(a) (溝低部) 가 (b) (b/a(%)) 50% .

18a Ru CVD (Ru(C<sub>2</sub>H<sub>5</sub>C<sub>5</sub>H<sub>4</sub>)<sub>2</sub>/O<sub>2</sub>)  
가 (a) 18b 가 (b) (b/a(%)) Ru  
(Ru(C<sub>2</sub>H<sub>5</sub>C<sub>5</sub>H<sub>4</sub>)<sub>2</sub>/O<sub>2</sub>) , Ru(C<sub>2</sub>H<sub>5</sub>C<sub>5</sub>H<sub>4</sub>)<sub>2</sub>가 O<sub>2</sub>  
( ) 250nm, 1500nm( / =6) ,  
O<sub>2</sub> 50sccm .

18a, 가 5%, Ru, 가 5%, 가 10%, 50%, 가 20%, 100%.

(Ru(C<sub>2</sub>H<sub>5</sub>C<sub>5</sub>H<sub>4</sub>)<sub>2</sub>) (0.1mol/l) 5cm<sup>3</sup>/min, O<sub>2</sub> 50sccm N<sub>2</sub> 900sccm 0.0005mol/min, PV=nRT(P: (atm), V: (l), n: (mol), R: (0.082), T: (K)) 1 (1.01325 × 10<sup>5</sup> Pa), 273K 11cm<sup>3</sup>/min, 22% 100%.

18, O<sub>2</sub> 50sccm Ru(C<sub>2</sub>H<sub>5</sub>C<sub>5</sub>H<sub>4</sub>)<sub>2</sub> O<sub>2</sub>가, 10sccm O<sub>2</sub>가, 290, 300.

Ru, Ru(C<sub>2</sub>H<sub>5</sub>C<sub>5</sub>H<sub>4</sub>)<sub>2</sub>/O<sub>2</sub> 10%, Ru가 (a) 50%.

13, 600, 1, (22) Ru (30) (27) (30b)가, (27) (27), (27) (30b).

(NH<sub>3</sub>) 700 1 (30b) RuSiN 1nm RuSiN(30d) (22) Ru (30d) (22) Ru (30d) (22) RuSiN 0.5~1.0nm.

14, Ru (30a) RuSiN(30c), (Ru(C<sub>2</sub>H<sub>5</sub>C<sub>5</sub>H<sub>4</sub>)<sub>2</sub>) 5cm<sup>3</sup>/min, O<sub>2</sub> 50sccm N<sub>2</sub> 900sccm, 290, 665Pa, CVD 20nm Ru (30a).

Ru (30d), Ru (30a) 가, Ru(C<sub>2</sub>H<sub>5</sub>C<sub>5</sub>H<sub>4</sub>)<sub>2</sub>/O<sub>2</sub> 10%, Ru가 (a) 50%.

Ru가 (30a,30d), Ru(C<sub>2</sub>H<sub>5</sub>C<sub>5</sub>H<sub>4</sub>)<sub>2</sub>/O<sub>2</sub> 10%, (a) 50%, Ru (5nm), Ru가 Ru.

Ru (30d) ( ) (27) ( ) Ru (30a,30d) (27) ( ) Ru (30a,30d).

(24) Ru (30a,30d) (30) . , (27)  
( 15).

, 16 (30) (27) (24)  
(32) . (32) CVD , 15nm .  
(32) 700 , 2 ,  
550 , 1 .

, 17 (32) CVD Ru (33a)( 70nm ) (33) (33) ,  
(32) W (33) (33) 100nm )  
. W (32)) W 가 ( ) T  
iN .

, Ru (30a,30d) (30), (32)  
W (33b)/Ru (33a) (33) (C)가 ,  
MISFET(Qs) (C) DRAM  
. 19 , 7 , 19  
A - A .

, (C) (34) .  
, 2 Al , Al (passivation)  
, .

, Ru , (對)  
, .

( 2)

1 , (27) , (22) (RuS  
iN)(30c) , (27) ,

20 (22) (C) . , (22)  
1~ 7 1 .

(22) (23) . (23) , , (22)  
(18) , (22) TiN (23) (22)  
. TiN (17) TiN ( )  
, (22) , , (17) P n CVD  
(19) n , (19) n

( ) , (19) n ( ) , .

50nm , 21 , (22) (17) , CVD (18) (18) (24) (C) (24) ( ) . 가 (24) (0.8 $\mu$ m ) 가 . (24) , TEOS(tetraethylorthosilicate) 가 CVD , , (24) (26) . , (26) 가 . (26) , (26) ( ) , (26) (24) (18) (23) , ( ) (27) . ( ) (27) (22) . (24) (26) (27) , CVD (29) ( , 10 22 nm ) . (29) , Ta(OC<sub>2</sub>H<sub>5</sub>)<sub>5</sub> O<sub>2</sub> 가 400 ~450 Ru (30) , (29) . (27) , 23 , (29) , (24) (27) (29) , (27) 가 , (27) . , 24 , (24) (27) , Ru (30a) ( 20nm ) CVD Ru , CVD Ru . , Ru (30a) . Ru (30a) , CVD (Ru(C<sub>2</sub>H<sub>5</sub>C<sub>5</sub>H<sub>4</sub>)<sub>2</sub>) 5cm<sup>3</sup>/min, O<sub>2</sub> 50sccm N<sub>2</sub> 900sccm , 290 , 665Pa Ru (a) (27) Ru (b) (b/a) 50% . , 16, 17 1 . , 가 가 . , .

, Ru 가 , Ru 10%  
(a) 50% .  
,  
, DRAM .

(57)

1.

- (a) MISFET ,  
(b) MISFET , ,  
(c) ,  
(d) ,  
(e) , Ru 5% Ru Ru ,  
(f) Ru ,  
(g)  
가 .

2.

1 ,  
Ru , 300  
.

3.

- (a) MISFET ,  
(b) MISFET , ,  
(c) ,  
(d) , 가 (短徑)  
5 ,  
(e) Ru , Ru Ru 가 50%  
.

4.

3 ,

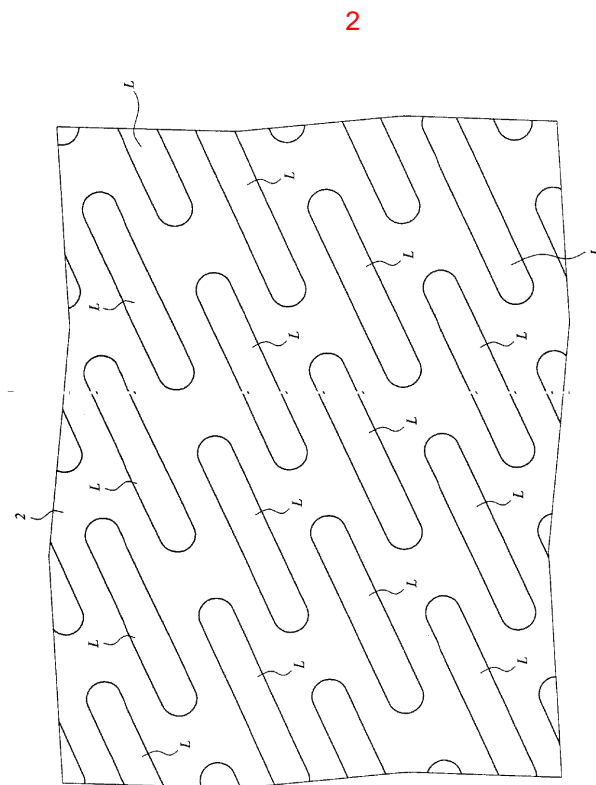
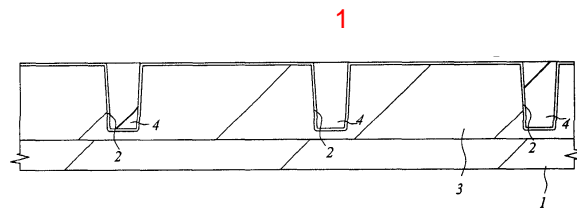
Ru

5.

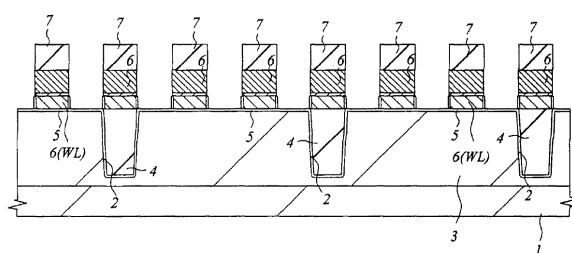
3 ,

Ru

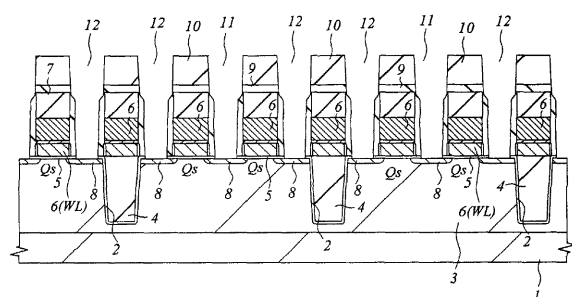
5nm



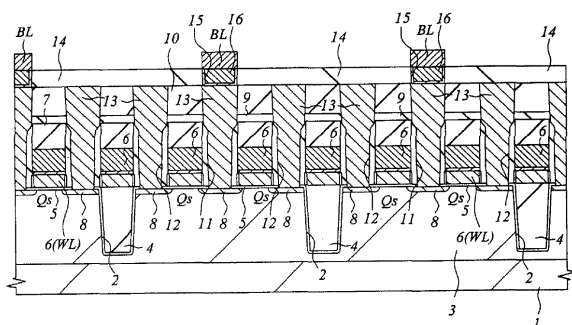
3



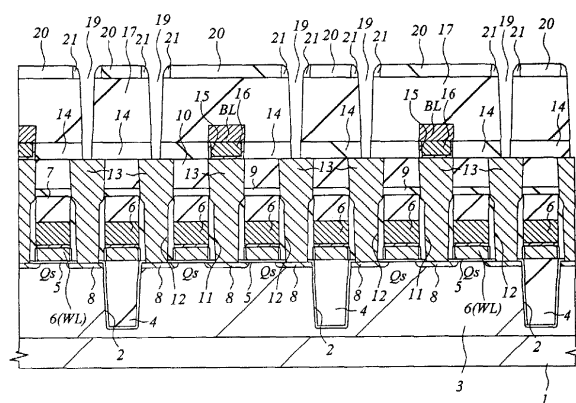
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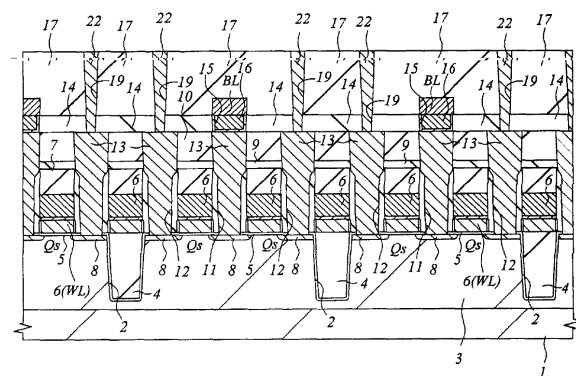
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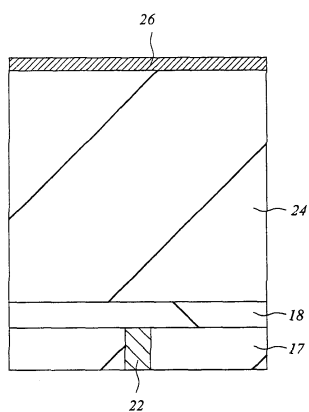
6



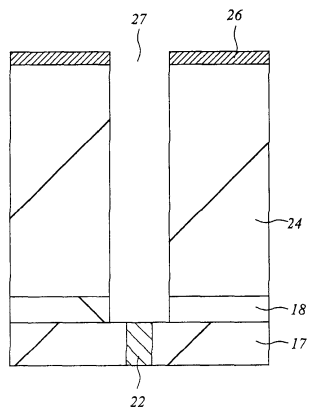
7



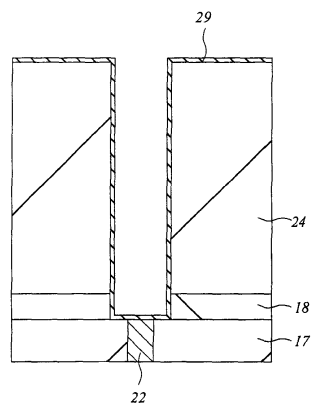
8



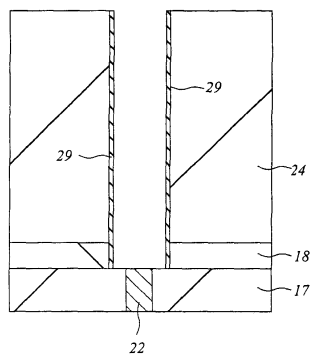
9



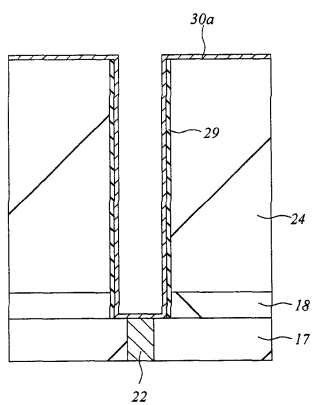
10



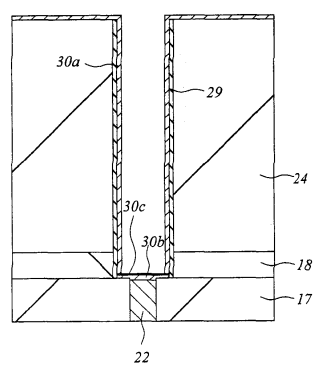
11



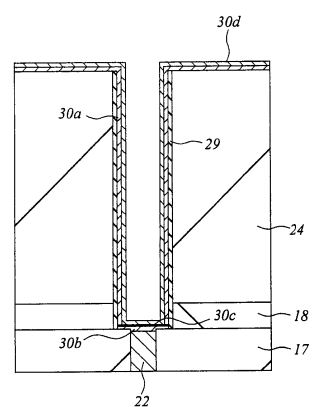
12



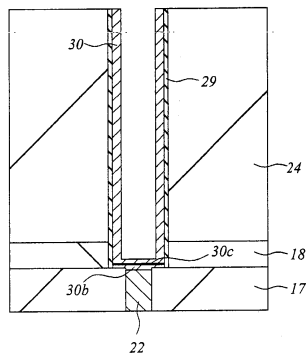
13



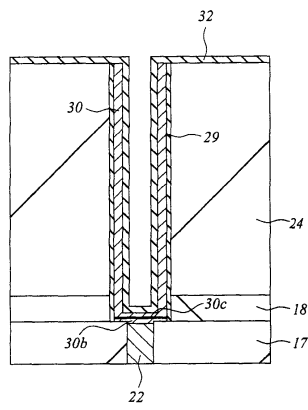
14



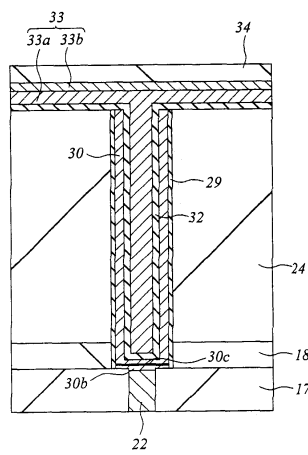
15



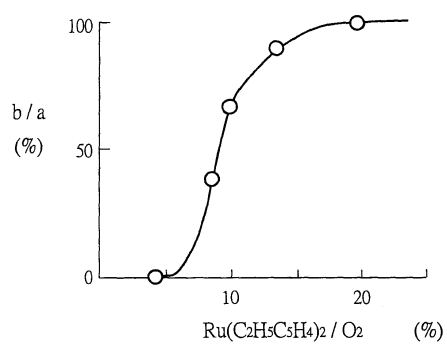
16



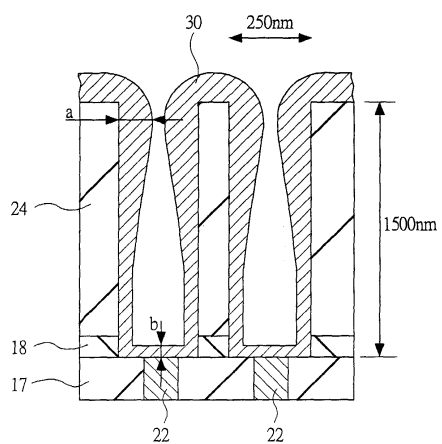
17



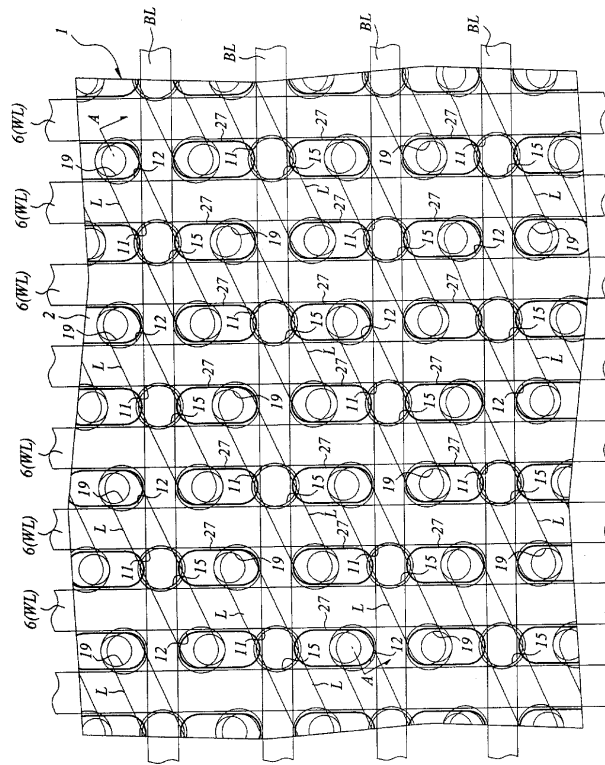
18a



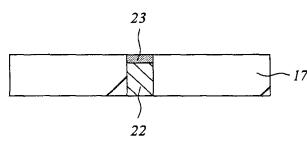
18b



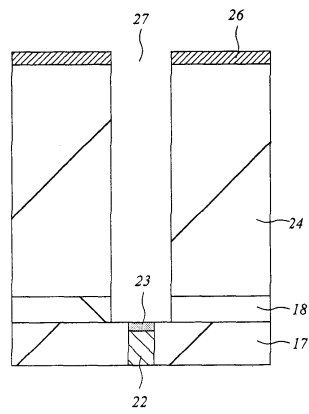
19



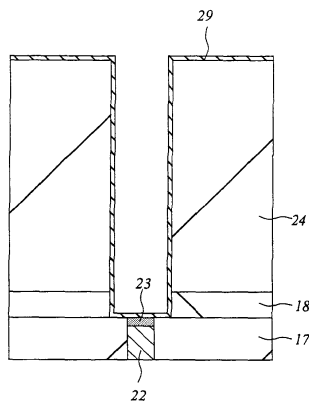
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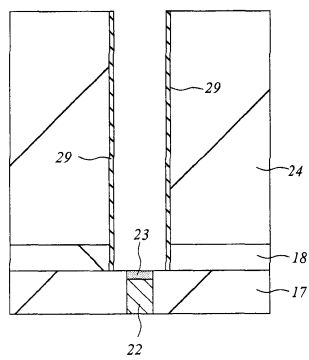
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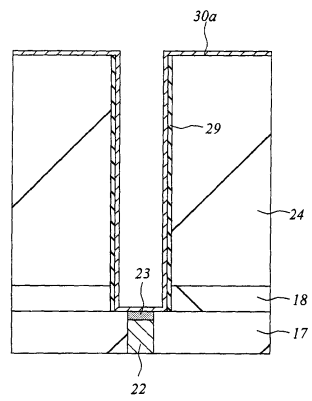
22



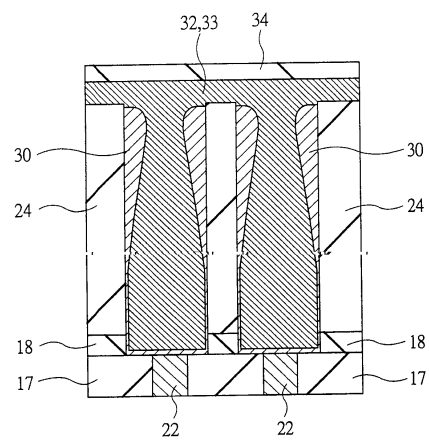
23



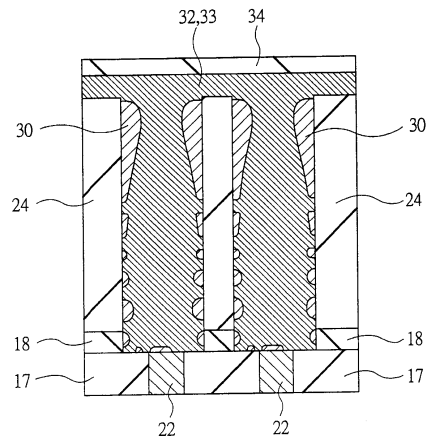
24



25a



25b



26

