



-

.

(1)

. 1950

가

가

가

가

2

가 가 , 1950

W. C. Moog Jr.

가

가

. 1970

가 ,

가

가

1) (band width) 30Hz  
( 50Hz )

(on-off)

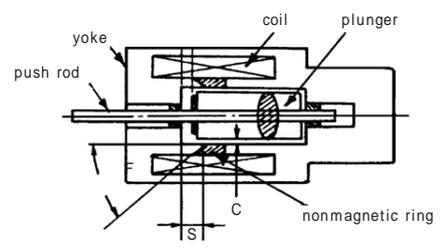
2) 가  
(over-lap)

(dead zone)가  
3) 가

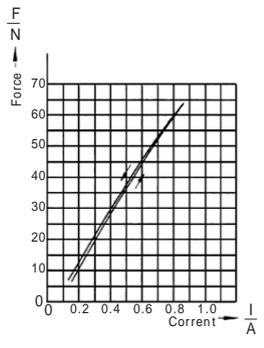
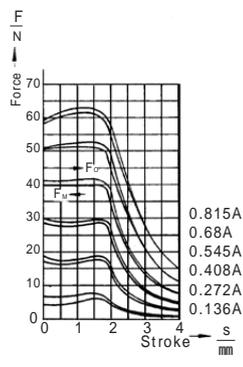
.<sup>1)</sup>

(2) 가 .  
 . 가 1 (on-off)  
 가  
 (nonmagnetic ring)

( ) 가  
 (S)



1.



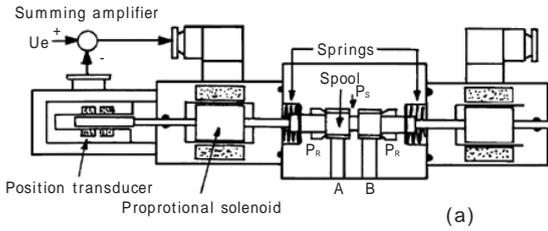
2.

PWM(pulse width modulation)  
 (dither signal) PWM  
 (carrier wave, 50 200Hz)

(3) 3 1 (single stage) ( )

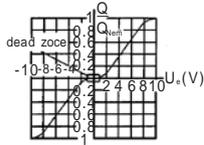
(A, B) 가

가



(LVDT)  
(pilot stage)

가



(b)

3. 1 (single stage)

( )

가

(LVDT)

(4)

, 2

5

4 2 (two stage)

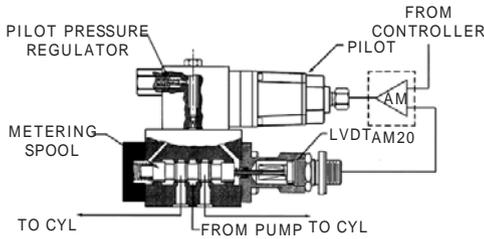
( )

1 2

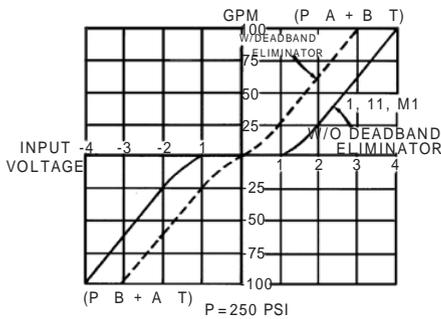
/min

가 가

( )

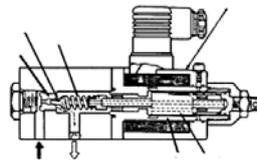


6

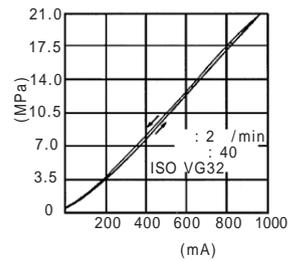


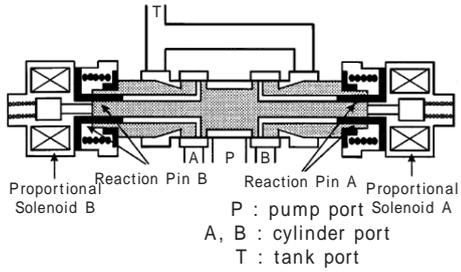
4. 2 (two stage)

( ) (Parker社)

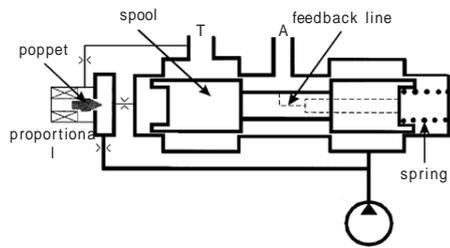


5.





6.



7.

A

가 A

T

(5)

Uchida社  
URP-15W10

8

가

가 가

(pre-set)

(delay

, slow-up, slow-down  
PWM

A 가 가 가  
가 A

(PWM )

B

B

(Sol. A Sol. B)

Sol. A Sol. B

(delay)

가

A

(shock)

7

±

가 +

Sol. A , -

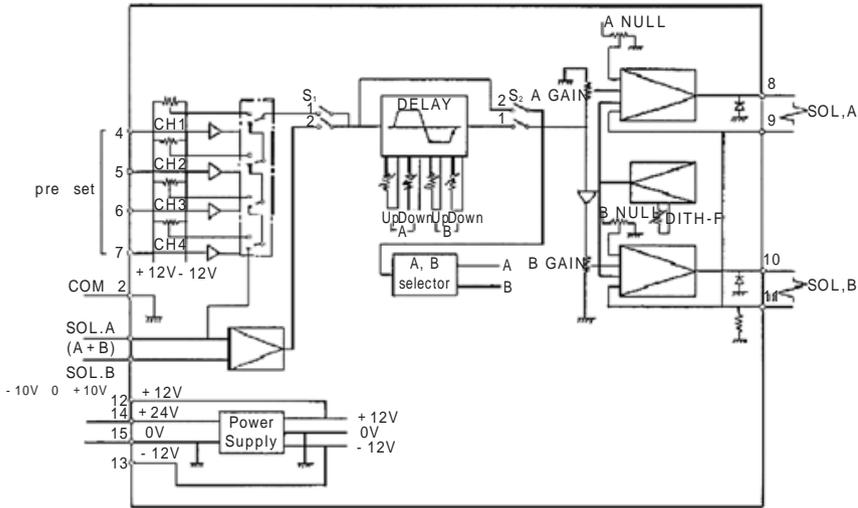
Sol. B

PWM(pulse width

가

modulation)

A  
가 가



8. (Uchida 社, URP-15W10)

(on-off)

( )

가 , (PWM

( )

가

가

(CW)

가 가 , Sol. A, Sol. B

2

3

(CW)

가 , Sol. A, Sol. B

(2)

(step)

(up)

(down)

(CCW)

(pulse width

modulation : PWM),

(pulse frequency modulation :

PFM),

(pulse number modulation

: PNM),

(pulse amplitude modulation : PAM), PNM

1 0

(pulse code modulation : PCM)

(1)

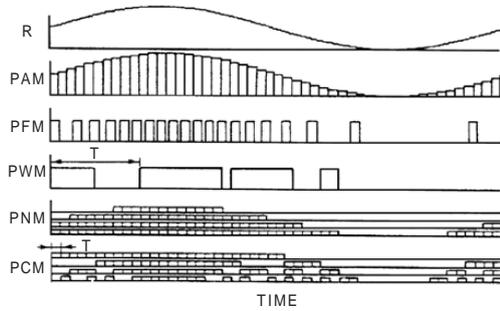
9

PWM

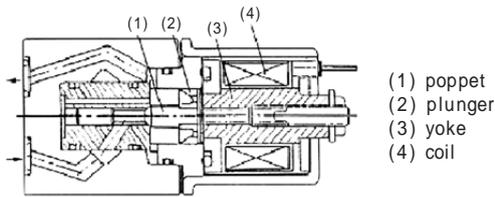
2 6ms

3

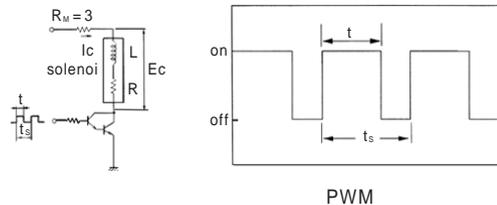
(3)



9.



10. 2



11.

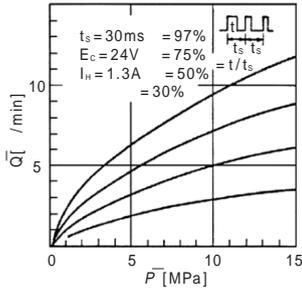
(PWM)

가  
 2 6ms  
 2 2 3  
 2  
 10 2  
 (4) 가  
 (2)가  
 P  
 T  
 11  
 (PWM) PWM 11  
 (b) (on) t  
 t\_s (duty ratio)  
 (%)

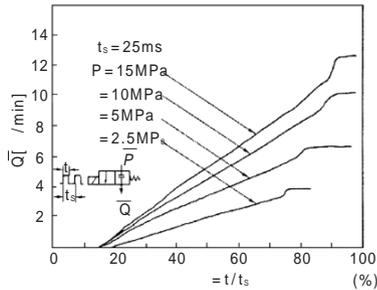
$$= \frac{t}{t_s} \times 100 \dots\dots\dots (1)$$

2 PWM 가  
 $\bar{p} = \frac{1}{T} \int_0^T p dt$   
 $\bar{Q} = C_d A \sqrt{2p}$   
 12  
 13  
 가

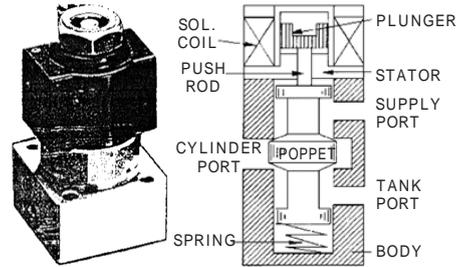
$$\bar{Q} = C_d A \sqrt{2p} \dots\dots\dots (2)$$



12.2  $\bar{p}$  -  $\bar{Q}$  ( ) = ( )



13.2  $\bar{Q}$  ( ) =  $\bar{p}$  ( )



14.3

가 (cylinder port)

( =0 ) ( =1 )  
가

(2)  $\bar{Q}$  ( ,  $\bar{p} =$  ),  
 $\bar{p}$  1 PWM

가

$$\left. \frac{Q(s)}{p(s)} \right|_{\bar{p}=\text{const}} = \frac{k_q}{1+T_q(s)} \left. \frac{p(s)}{Q(s)} \right|_{Q=\text{const}} = \frac{K_p}{1+T_p(s)}$$

(3)  $k_q, k_p, T_q, T_p$

가 (3)  $Q$  -  $p$

가

3

3

14 3

가

가

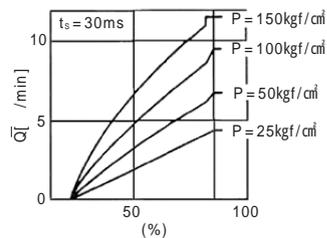
(1) 3  $Q_i$

$$\bar{Q}_i = C_d A \sqrt{2(p_s - \bar{p})} - (1 - C_d) C_d A \sqrt{2\bar{p}} \dots (4)$$

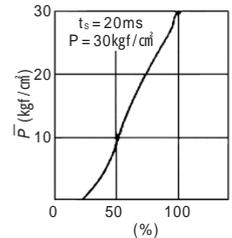
3 14

(4)  $Q = 0$

$\bar{p}$



15.3



16.3

$$\bar{p} = \frac{p_s}{2 + (1 - )^2} (Q = 0) \dots\dots\dots (5)$$

(4)

가 가

PWM

D/A

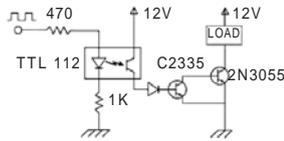
3

16

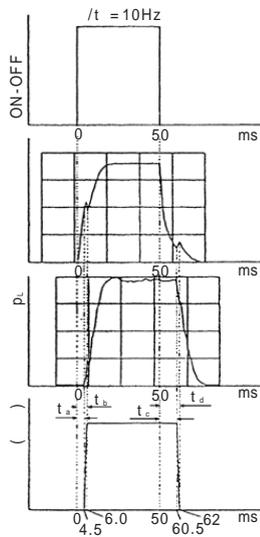
가

17

5V 12V

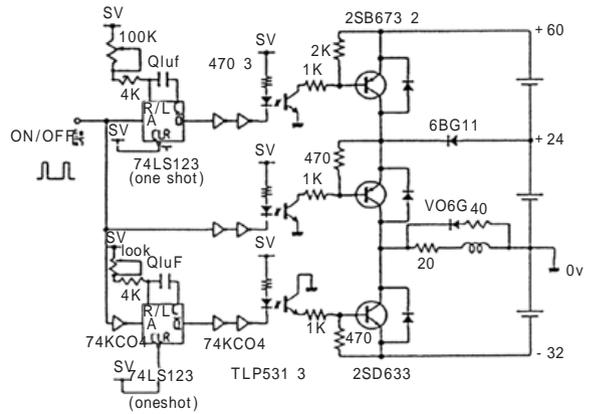


17.

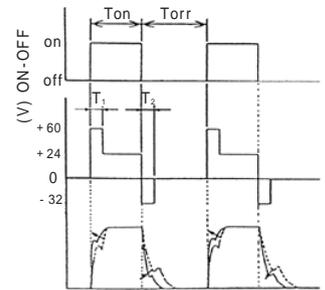


18.

18



19. 3



20.

3

19

19

20

가

1) < >

BK21

, 2001, p.2-1 2-34

2) 田中裕久, "油中壓のデジタル制御と應用", 近代圖書, 1987, p.74

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