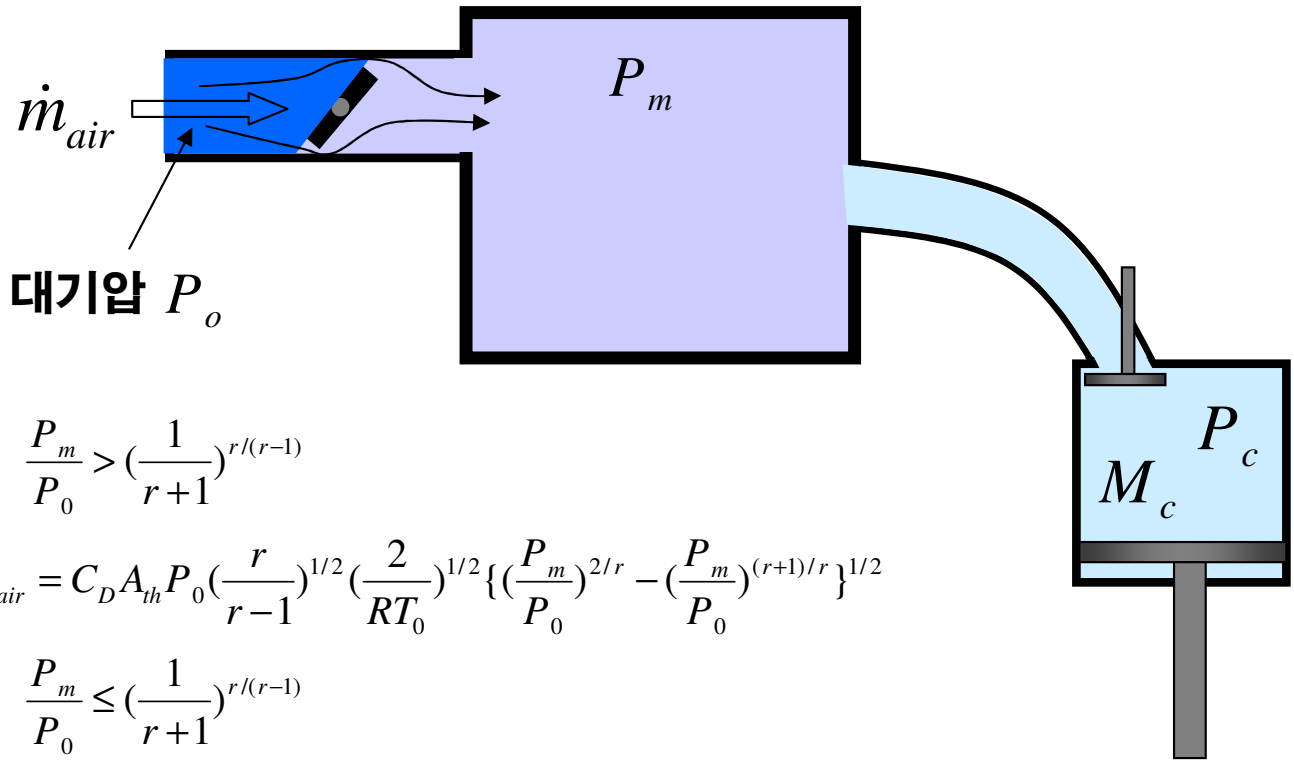
엔진 흡입 공기량 모델



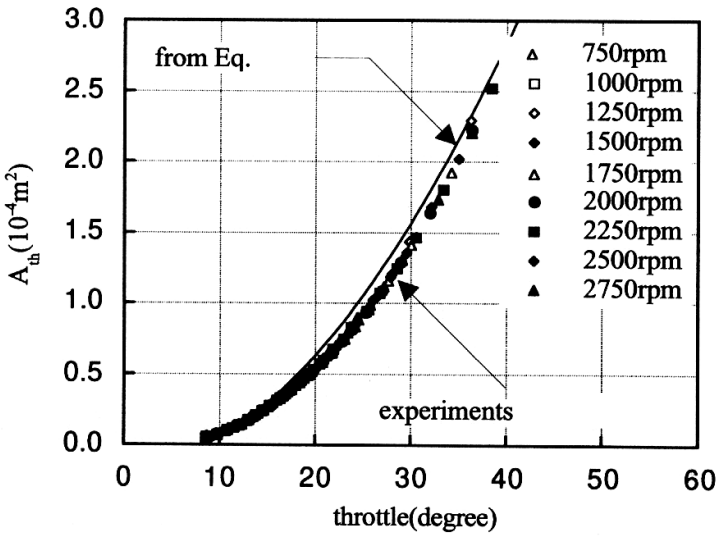
$$if \quad \frac{P_m}{P_0} > \left(\frac{1}{r+1}\right)^{r/(r-1)}$$

$$\dot{m}_{air} = C_D A_{th} P_0 \left(\frac{r}{r-1}\right)^{1/2} \left(\frac{2}{RT_0}\right)^{1/2} \left\{\left(\frac{P_m}{P_0}\right)^{2/r} - \left(\frac{P_m}{P_0}\right)^{(r+1)/r}\right\}^{1/2}$$

$$if \quad \frac{P_m}{P_0} \le \left(\frac{1}{r+1}\right)^{r/(r-1)}$$

$$\dot{m}_{air} = C_D A_{th} P_0 \left(\frac{2}{r+1}\right)^{(r+1)/2(r-1)} \left(\frac{2}{RT_0}\right)^{1/2}$$

초킹식
유량은 쓰로틀 면적에만 영향 받음.
단순히 스로틀 개도에 의해 유량이 결정



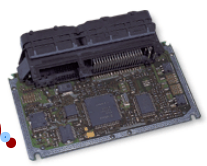
P_m과 P_c의 관계는?
M_c는 어떻게 계산?

P_m과 P_c는
왜냐하면
따라서 매니폴드 압력을 측정한다면 실린더에 흡입된 공기량은

$$P_m V_d = M_c R T_c \Rightarrow M_c = \frac{P_m V_d}{R T_c}$$

스로틀 급개폐와 같은
과도상태일 때에도 유효하다.

압력센서를 이용한 방식 유량 측정법
온도는? <- 유량 오차 원인



공기량 센서에 의한 유량 계산

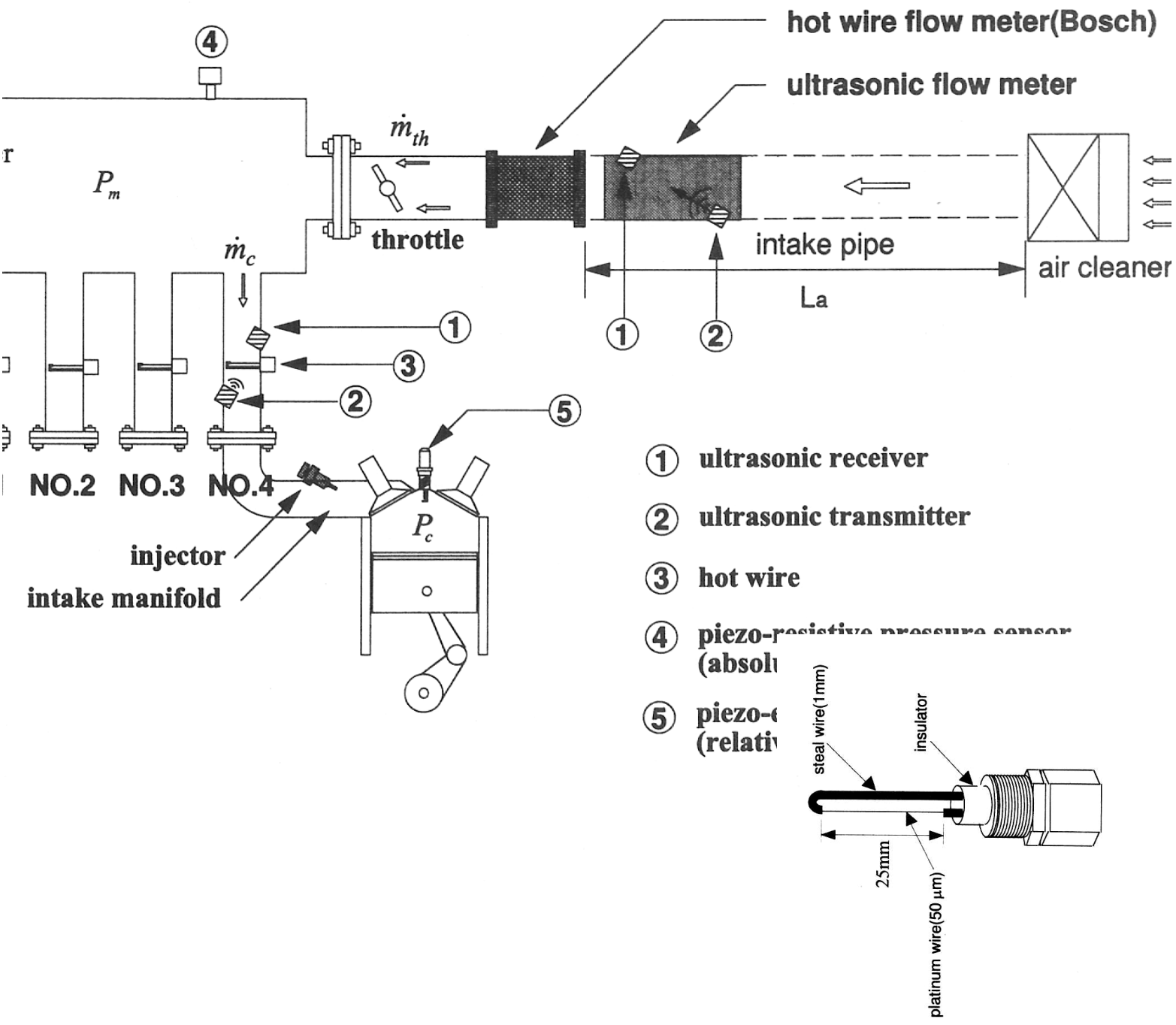
- 정상상태

  - 연속방정식
  - 스로틀을 통과하는 공기량 = 실린더로 흡입되는 공기량 (정상상태에서)

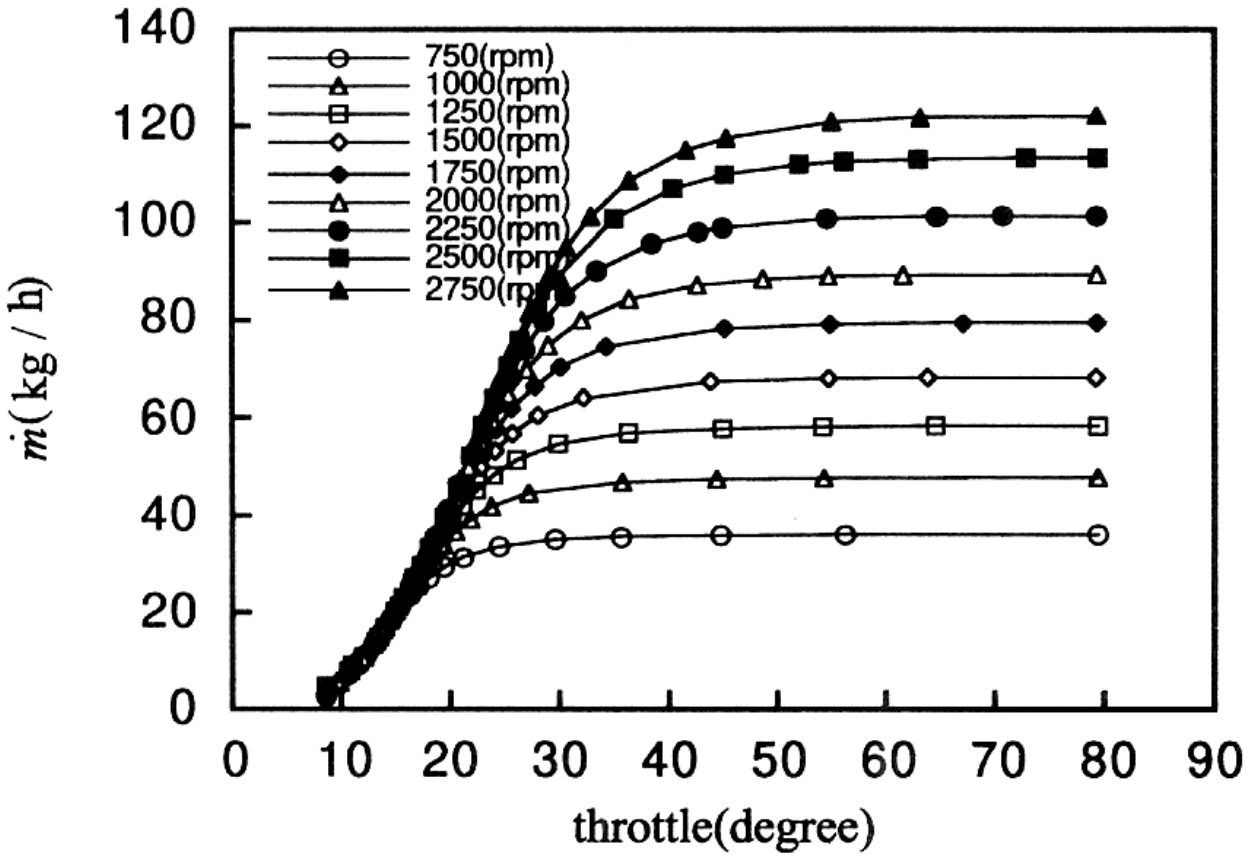
- 과도 상태 일 때는?

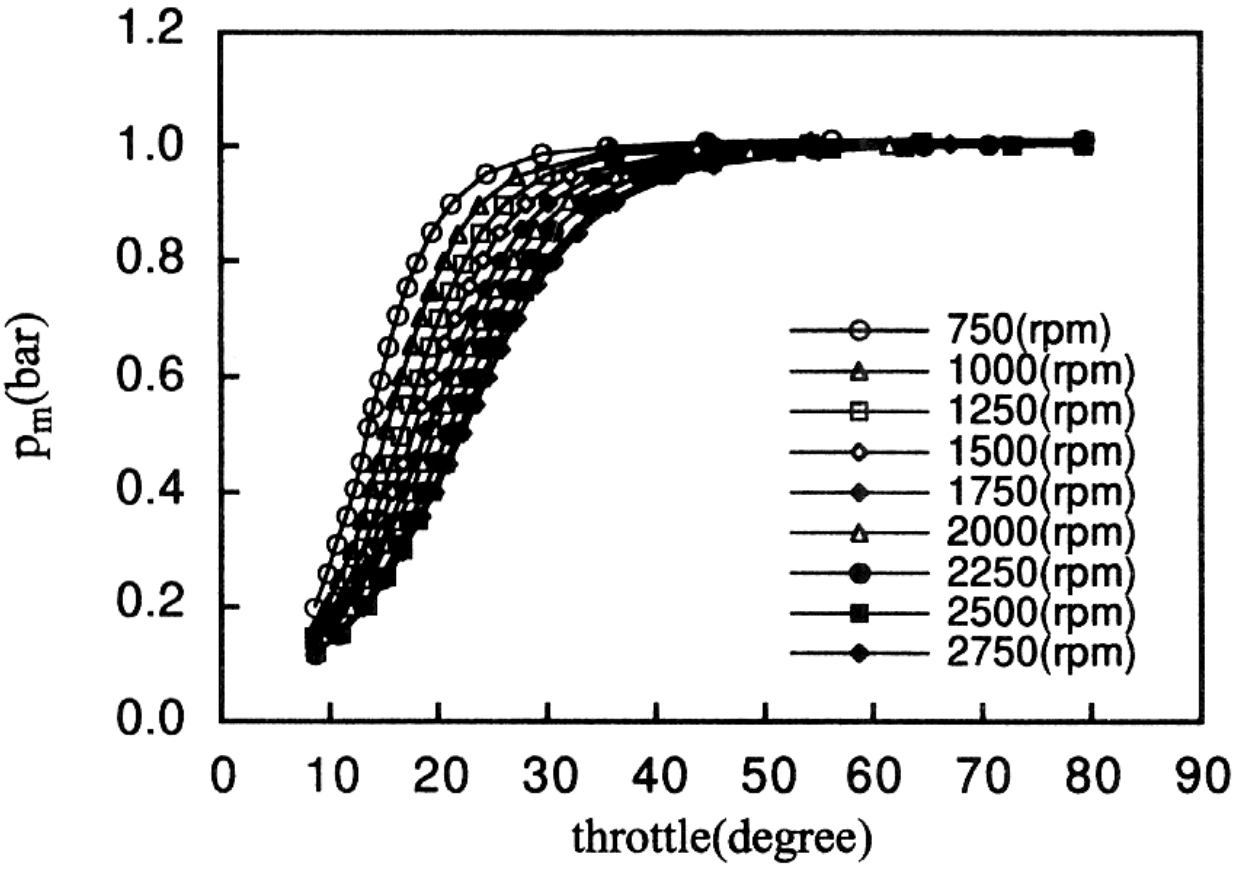
  매니폴드의 압력 변동에 필요한 공기량도 같이 검출되므로 별도의 계산이 필요하다.

유량 측정 장치도

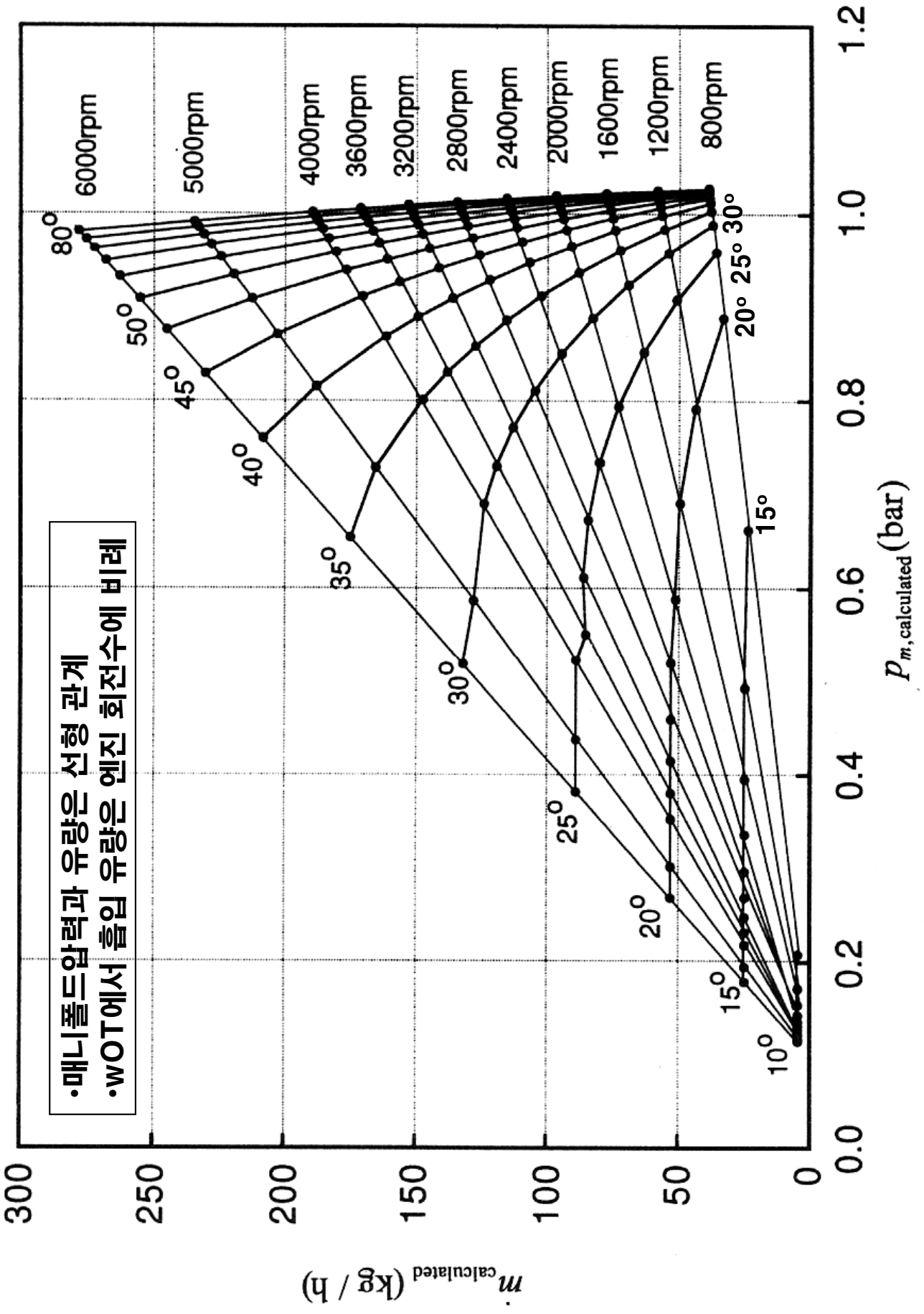


스로틀유량과 매니폴드압력

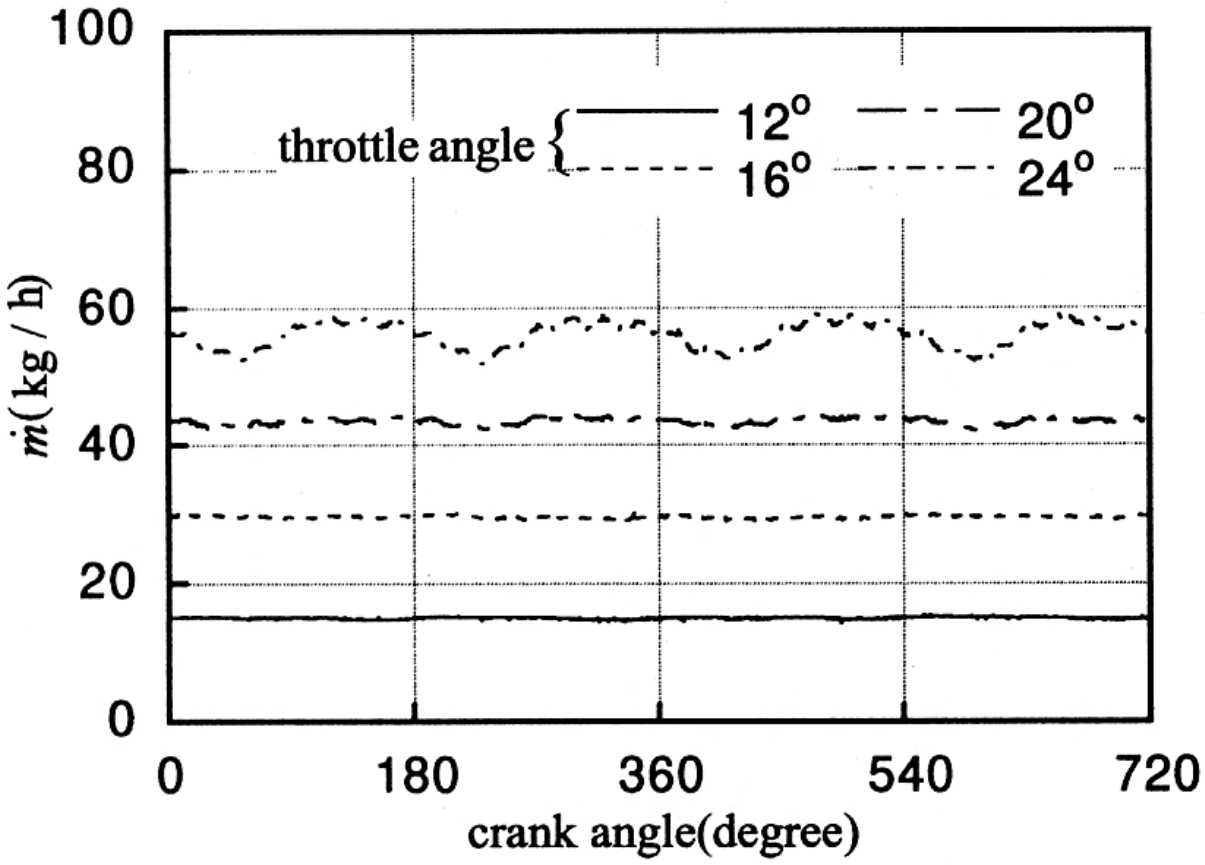


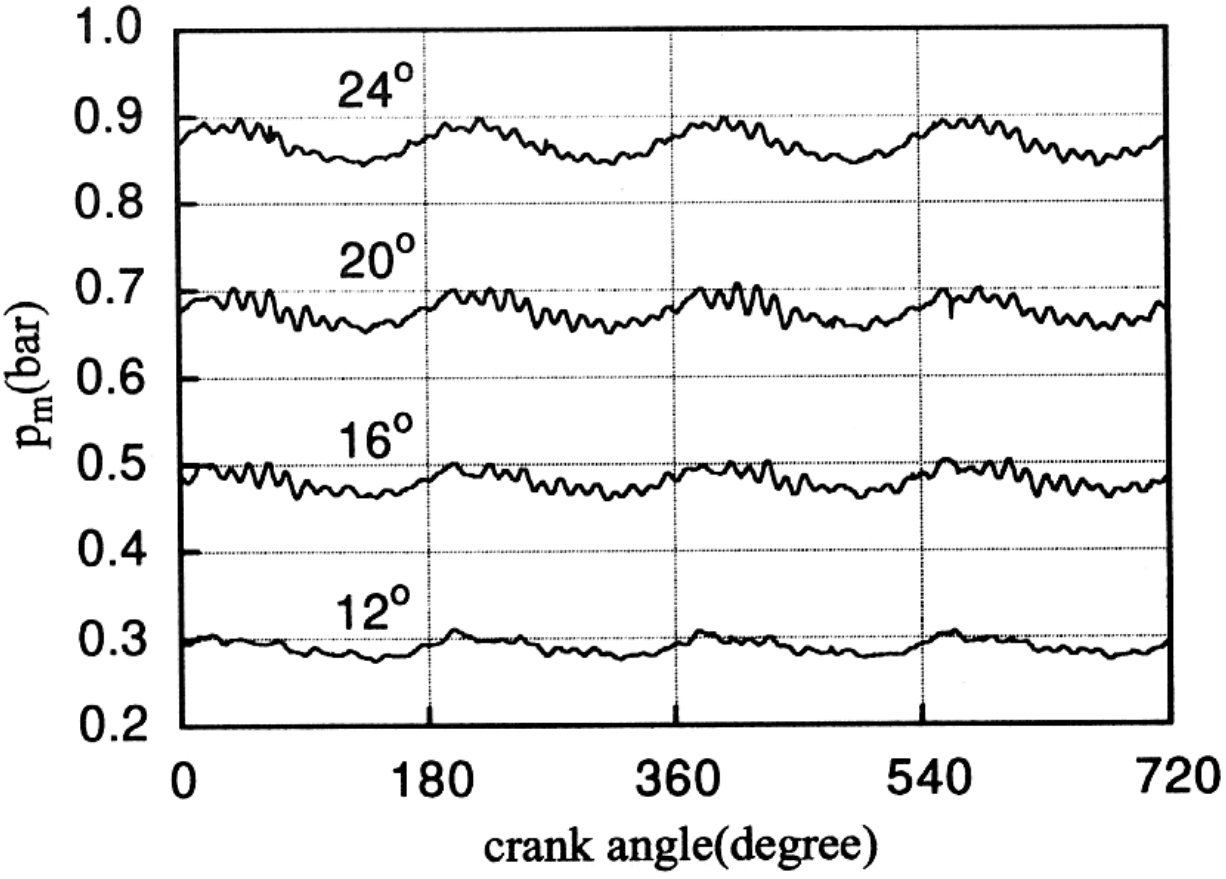


전체 유량 맵

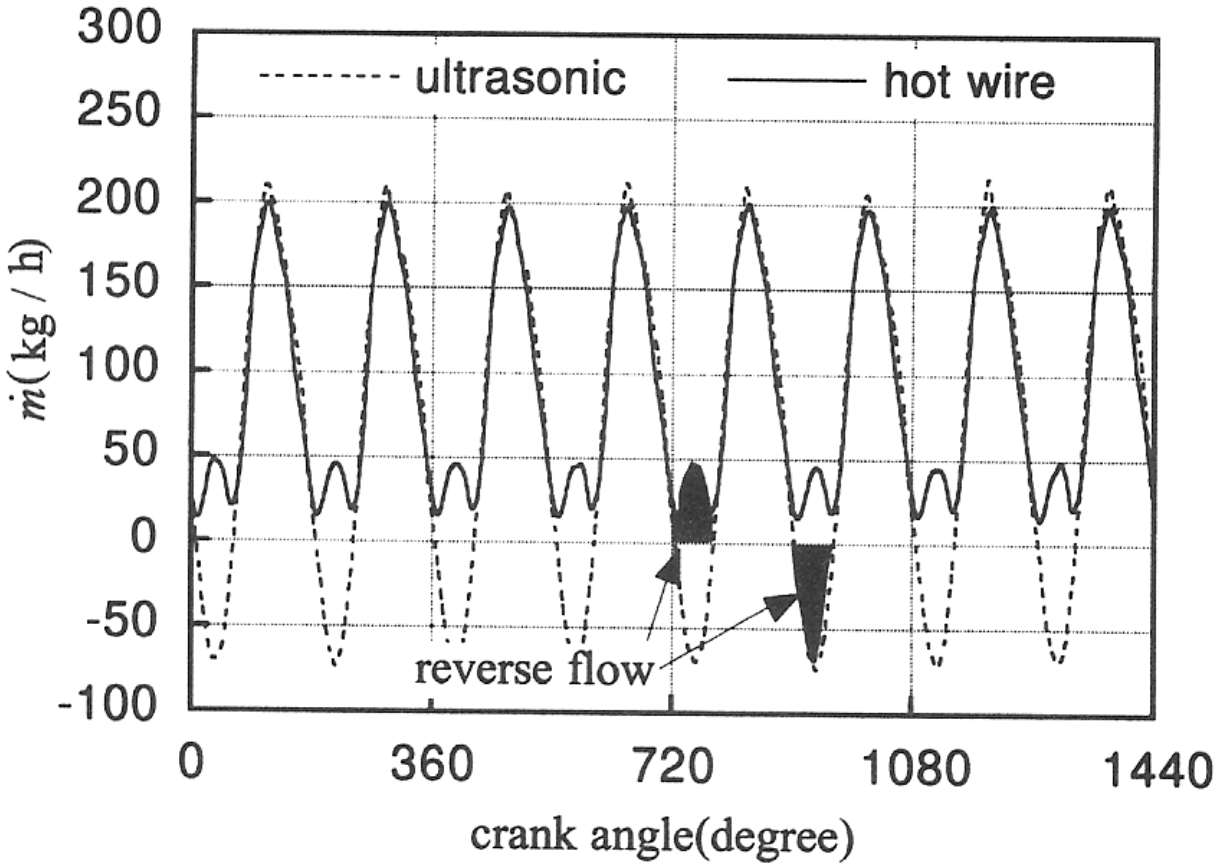


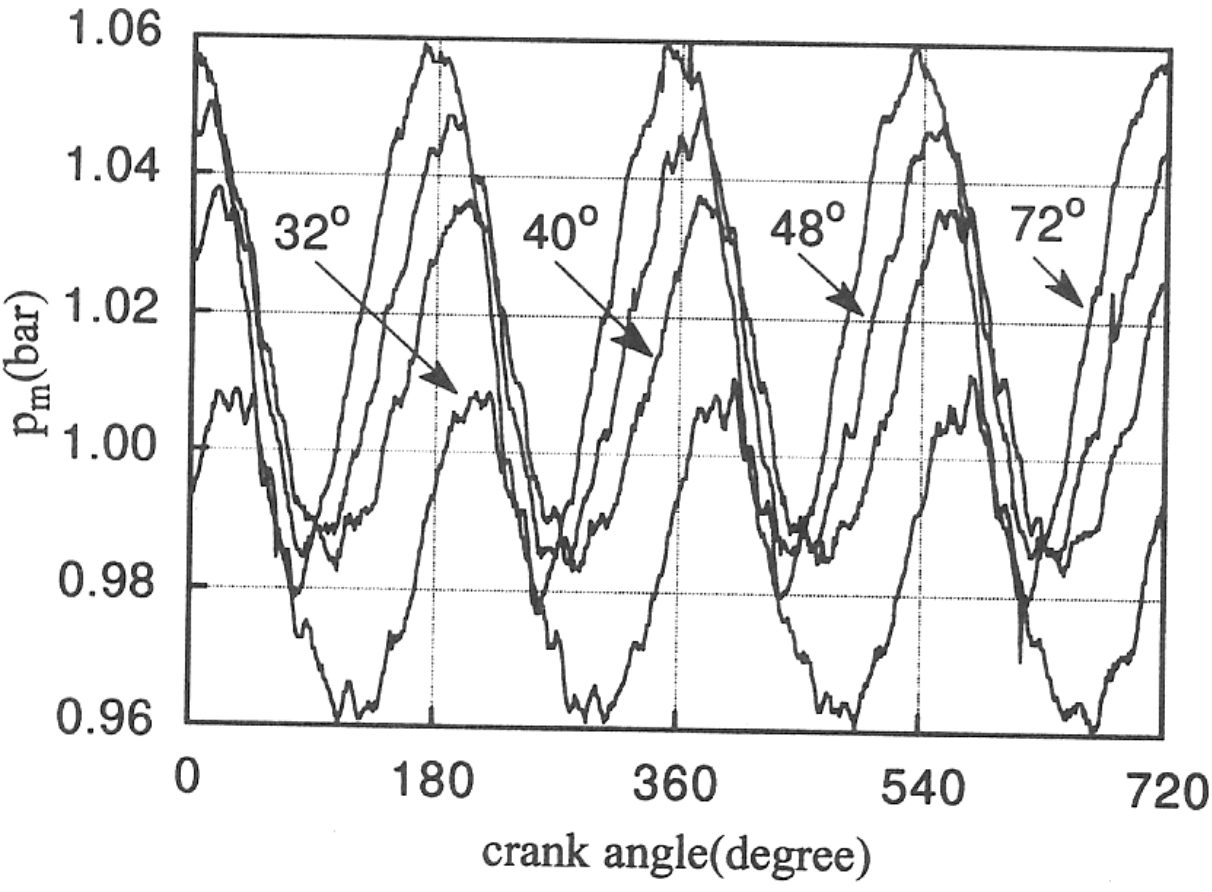
스로틀 상류의 유동 형태



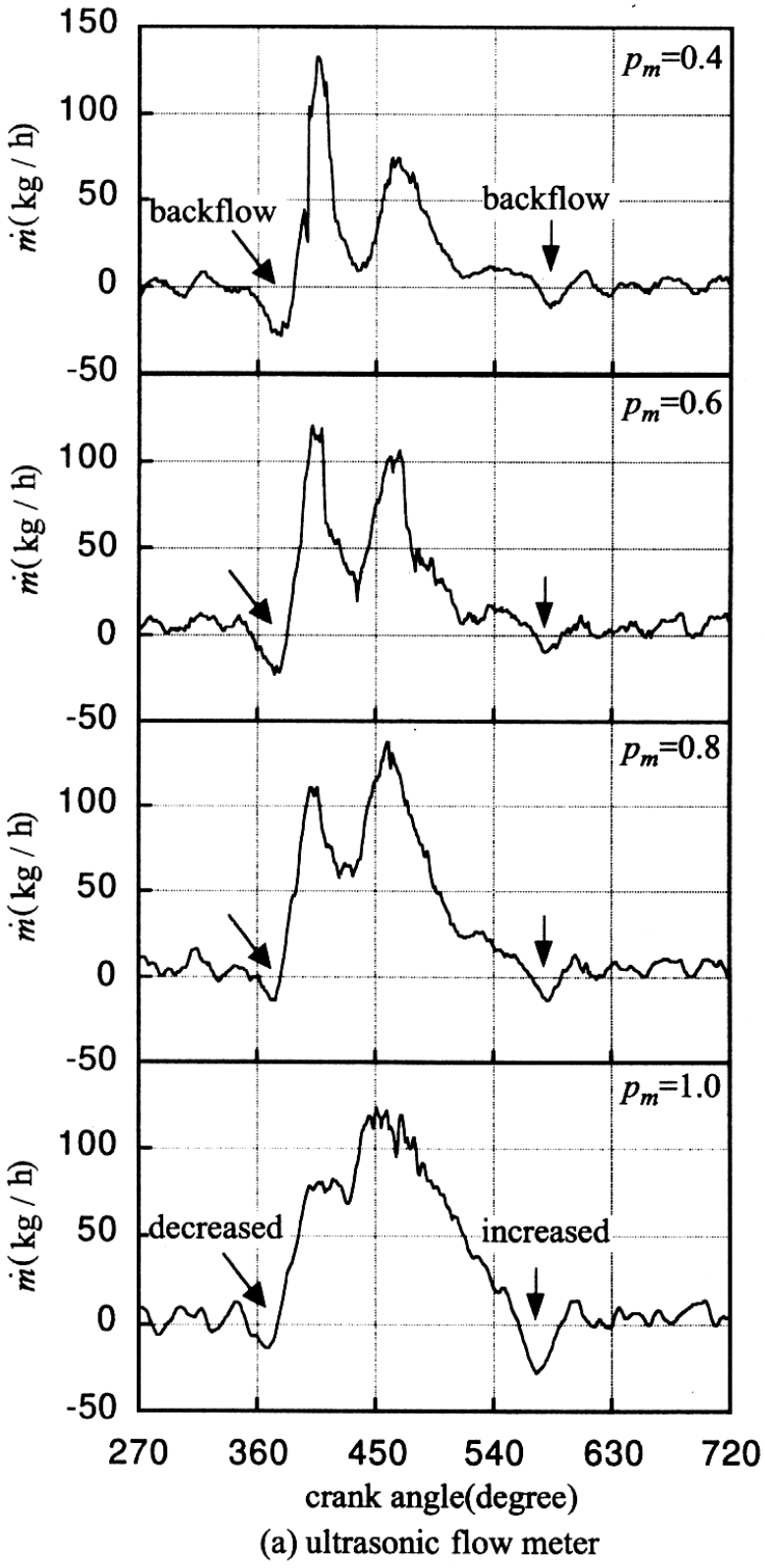


스로틀 상류의 유동 형태

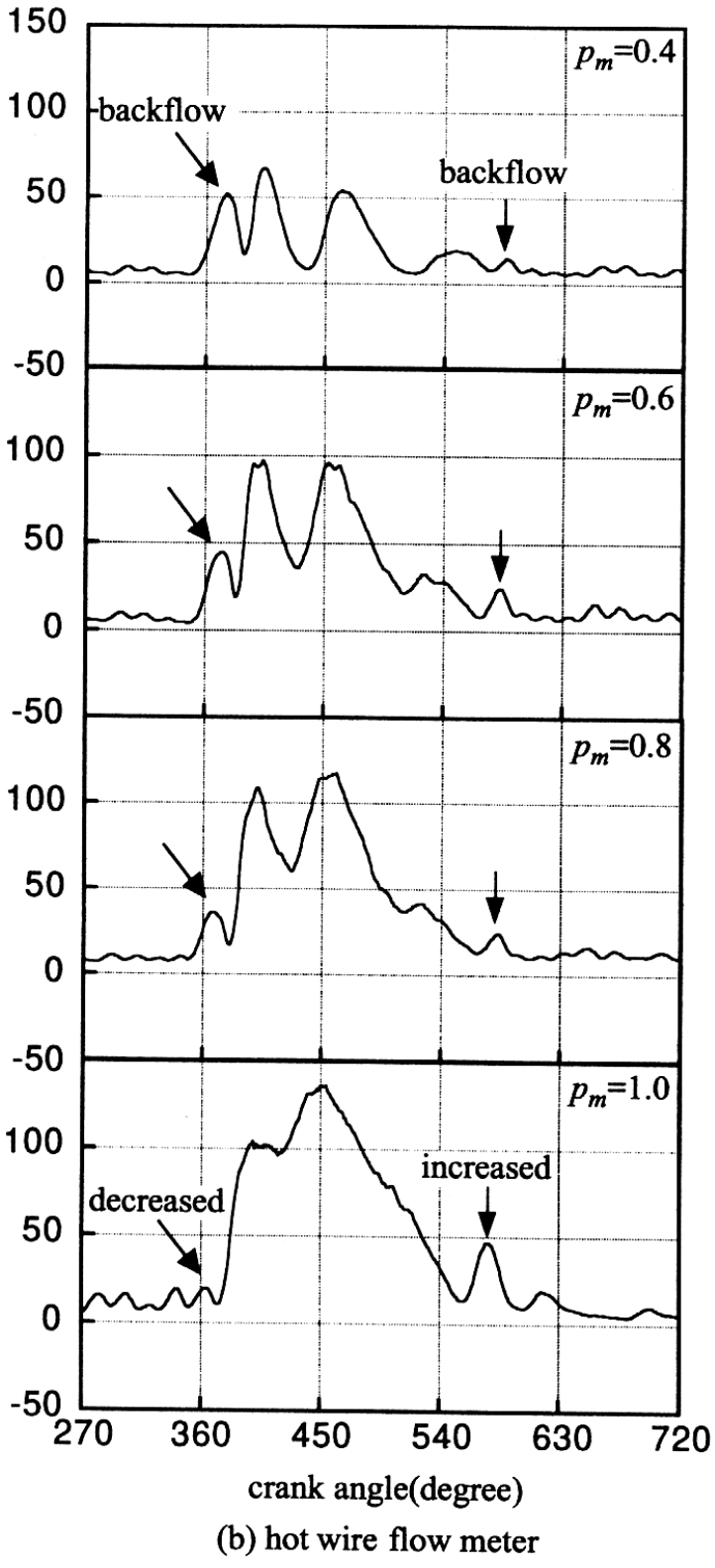




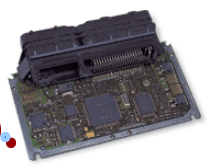
흡기밸브 상류의 유동



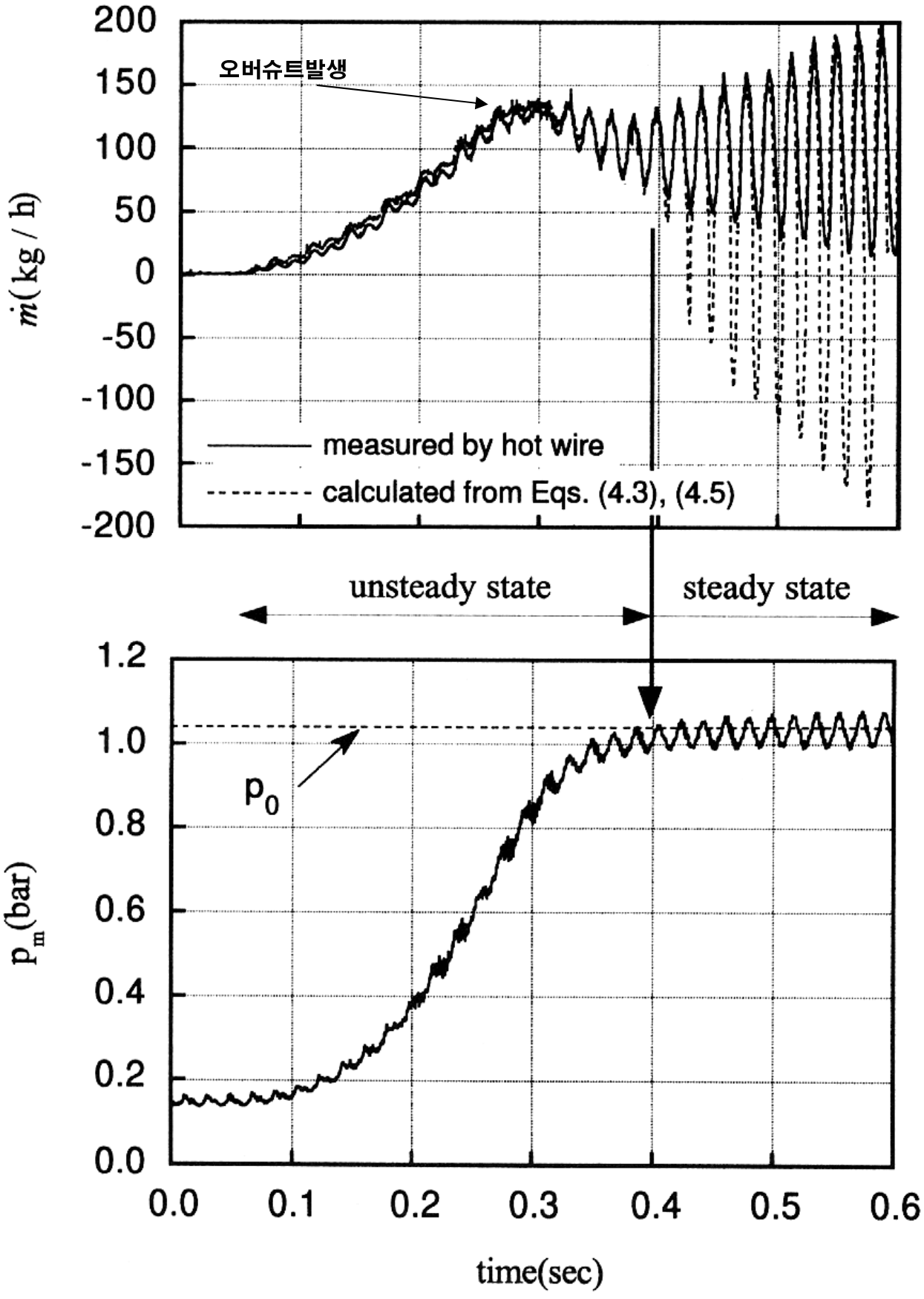
(a) ultrasonic flow meter



(b) hot wire flow meter



스로틀 급개도 때의 유동



공기량 센서

- 엔진으로 유입되는 공기량을 측정할 수 있는 장치
- 출력신호는 디지털 방식과 아날로그 방식
- 출력값은 공기량에 대해 선형적이거나 비선형적

• 베인 방식

• 칼만볼텍스 방식

- 와류를 카운트 하는 방법은

열선식 공기량 센서

- **열선식**
  - 공기 흐름의 중앙에 발열체를 두고 그 온도를 일정하게 유지

  - 클린 버닝(Clean Burning)

  - 유동의 방향을

- **핫필름식**

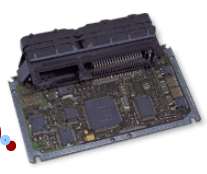
$$I^2 R_w = hA(T_w - T_f)$$

$$h = \frac{k}{d}(0.42\,\mathrm{Pr}^{0.2} + 0.57\,\mathrm{Pr}^{0.33}\,\mathrm{Re}^{0.5})$$

$$I^2 R_w = (A + B(\rho u)^{0.5})(T_w - T_f)$$

$$R_w = R_0(1 + \alpha_w T_w)$$

$$E = (c_0 + c_1(\rho u)^{0.5})^{0.5}$$

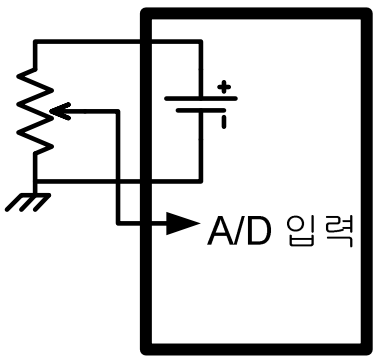


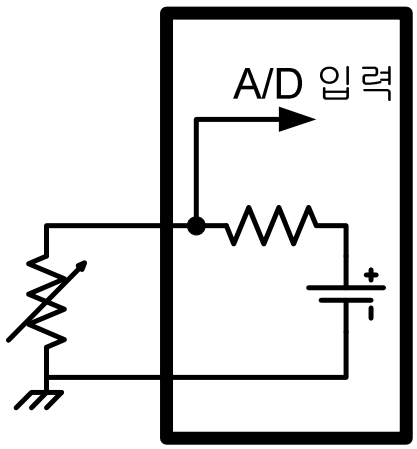
- **MAP(Manifold Absolute Pressure) 센서**

- **스로틀 포지션 센서**

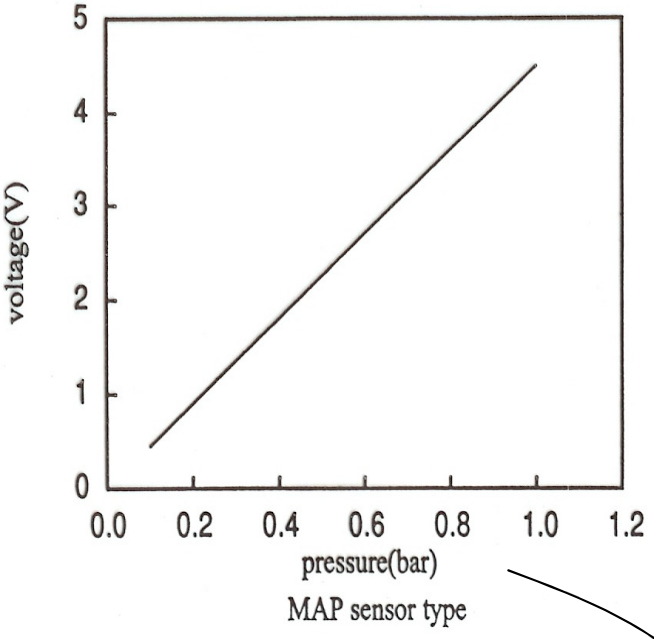
- **공기량 측정 보정 센서**
  - 대기압 센서
  - 공기온도센서
  - 냉각수온 센서

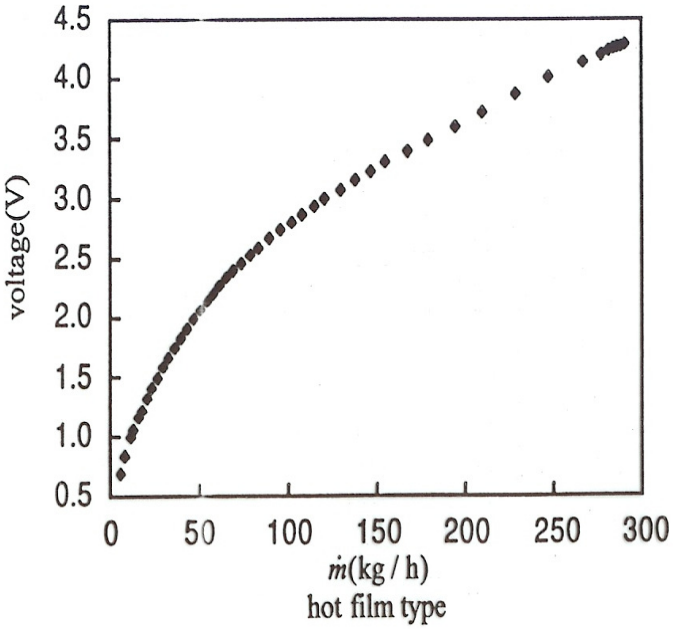
- **저항 변동 타입의 측정방법**



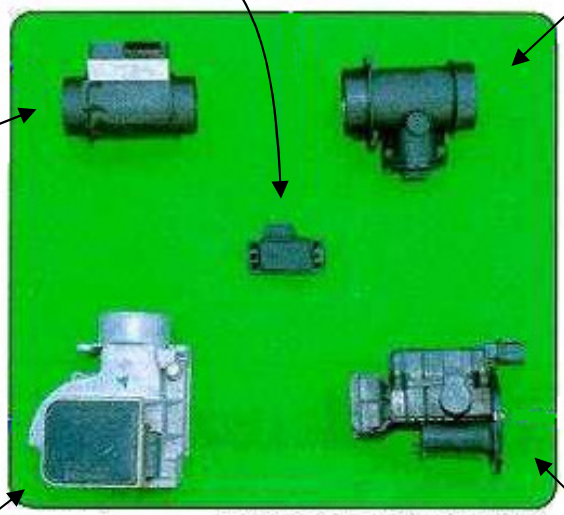


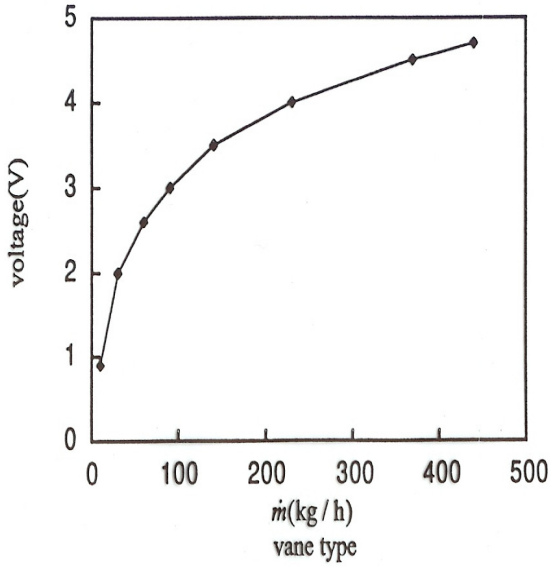
공기량 센서의 유량 특성

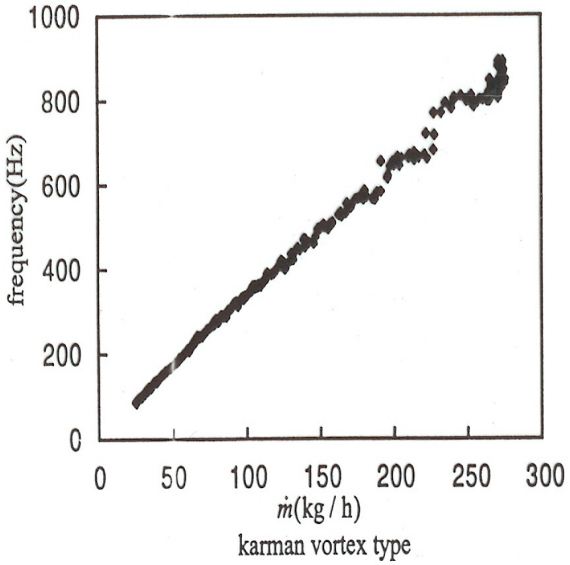


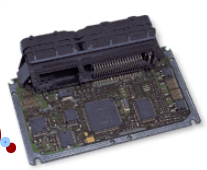


Hot Wire 방식

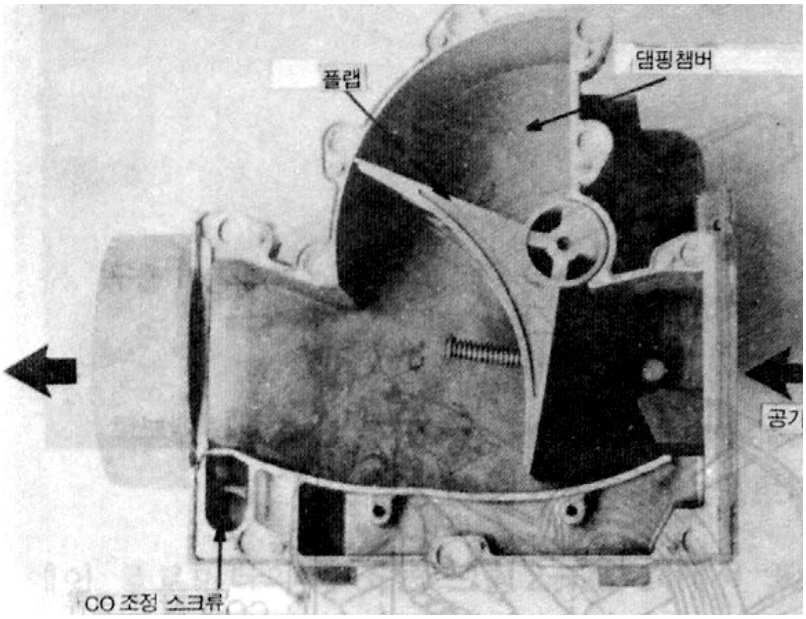


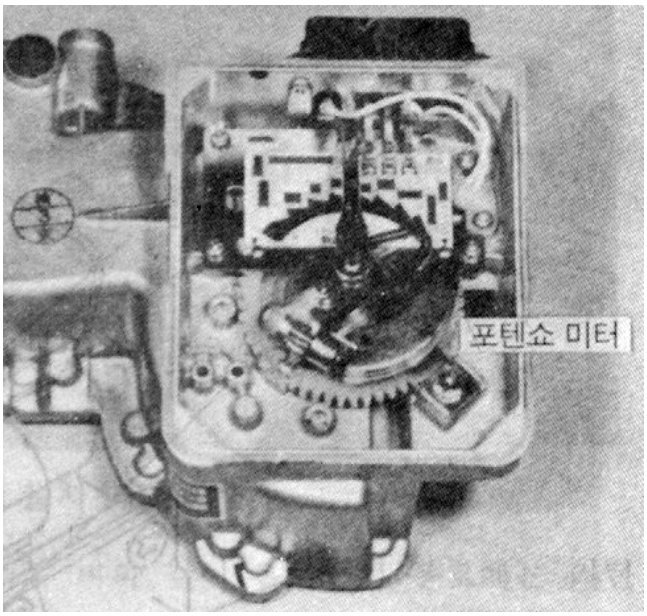


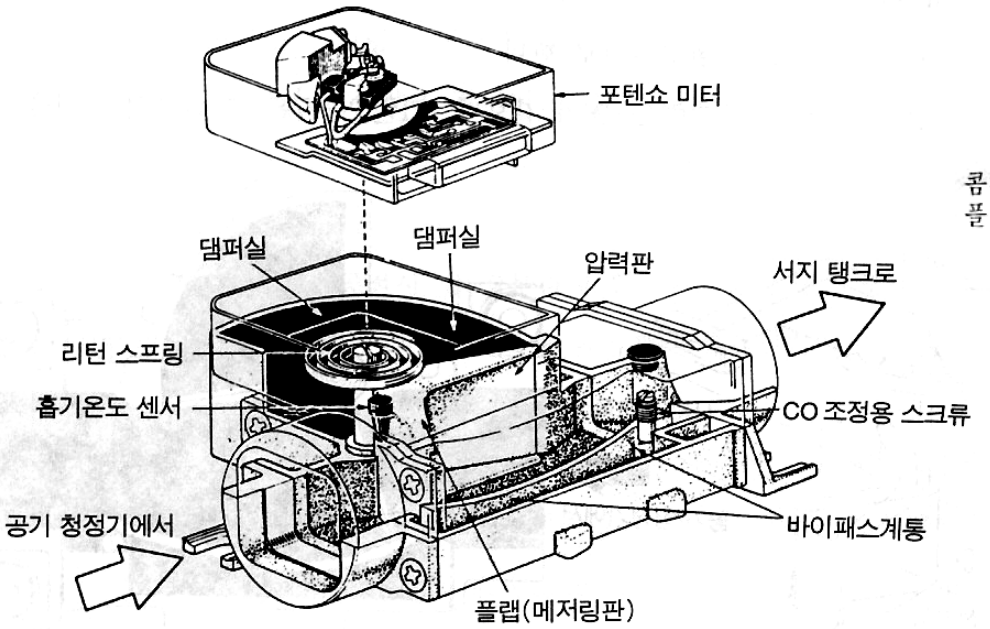


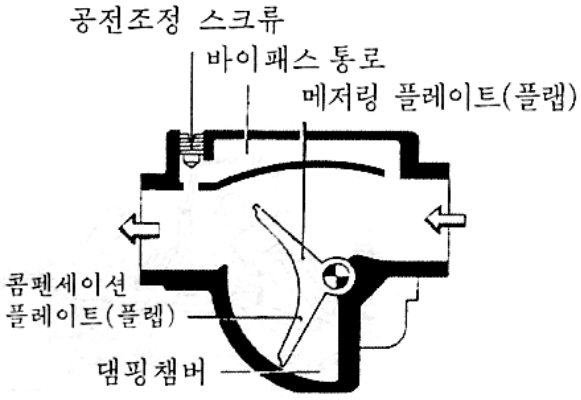


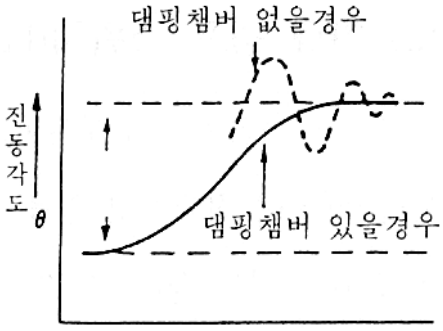
베인 타입 공기량 센서

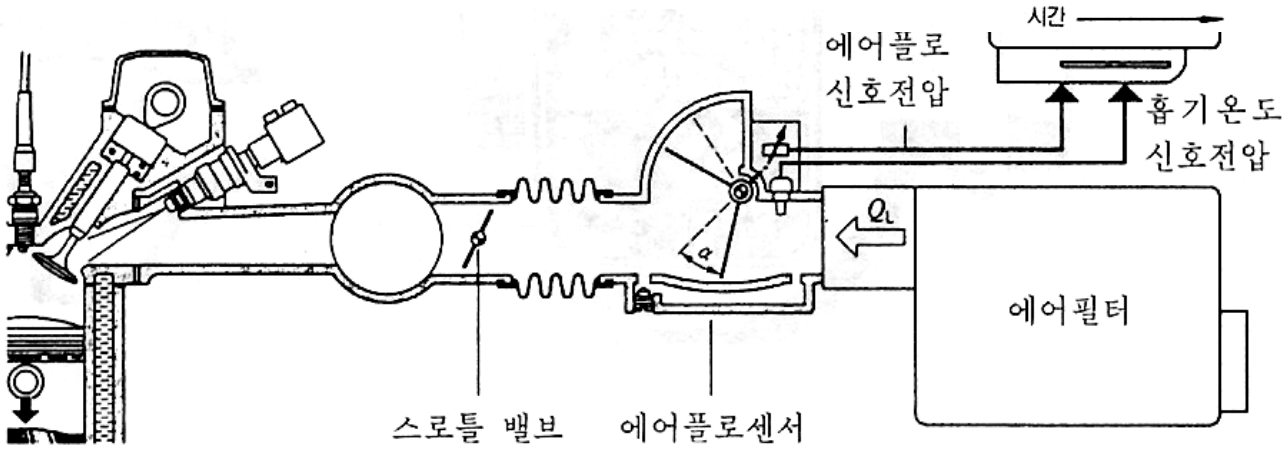




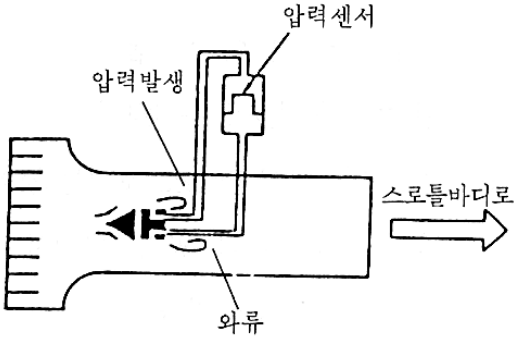


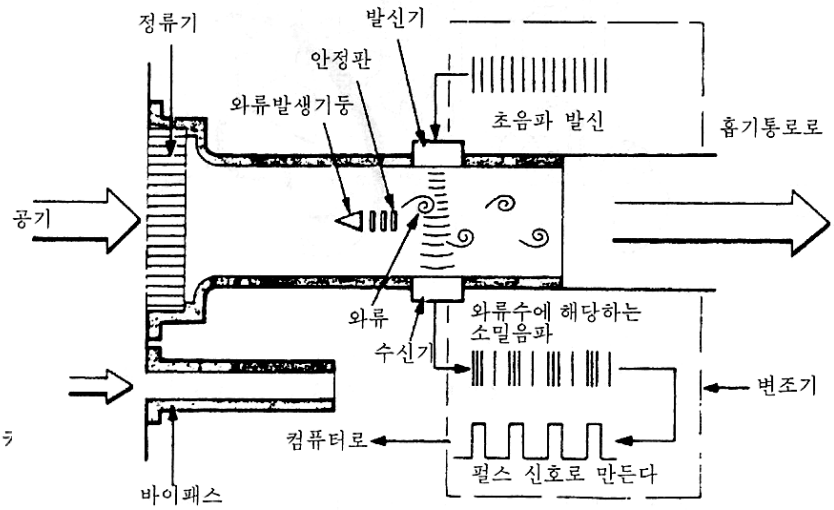


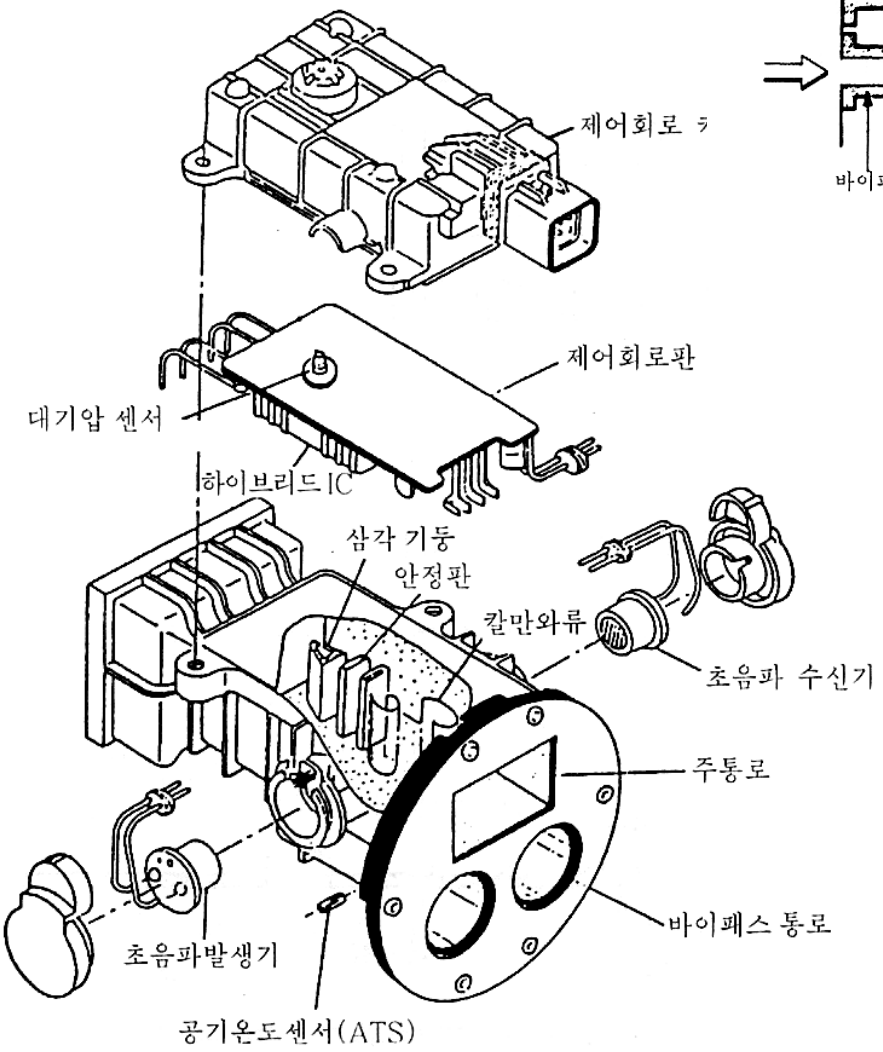


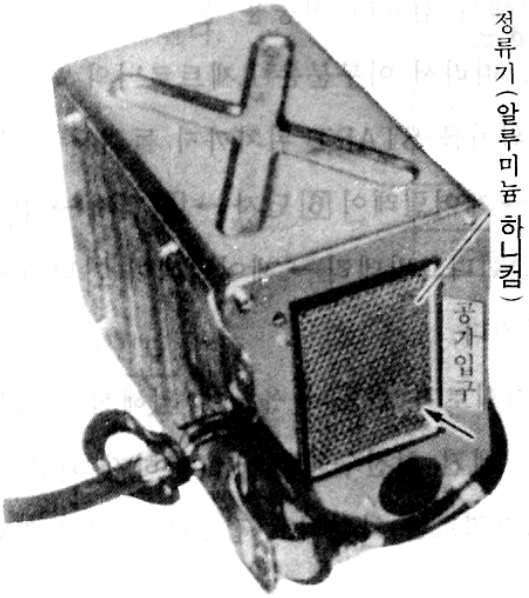


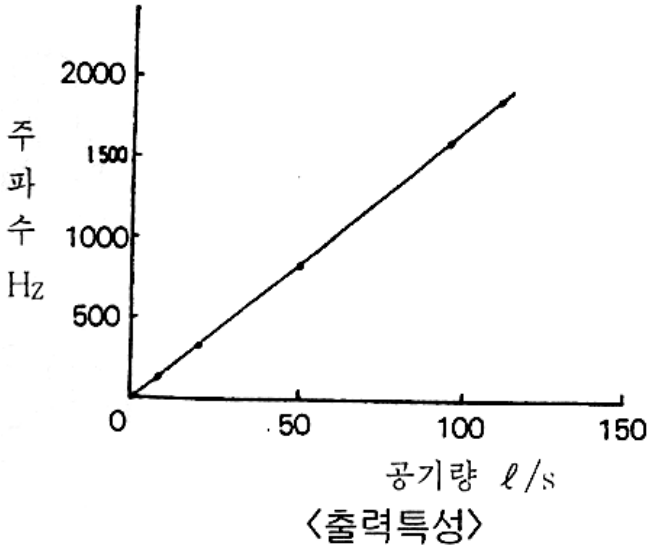
초음파 공기량 센서



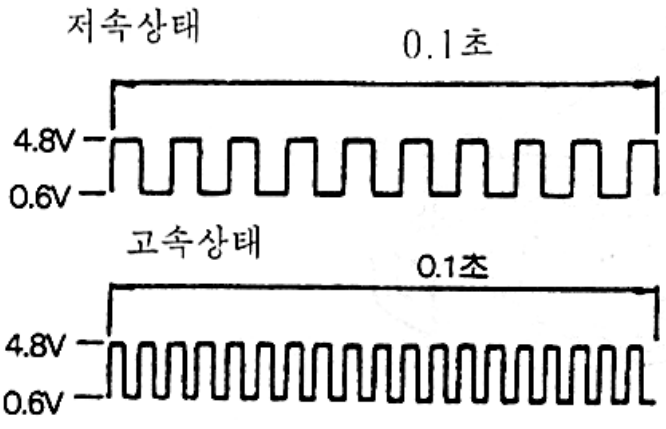




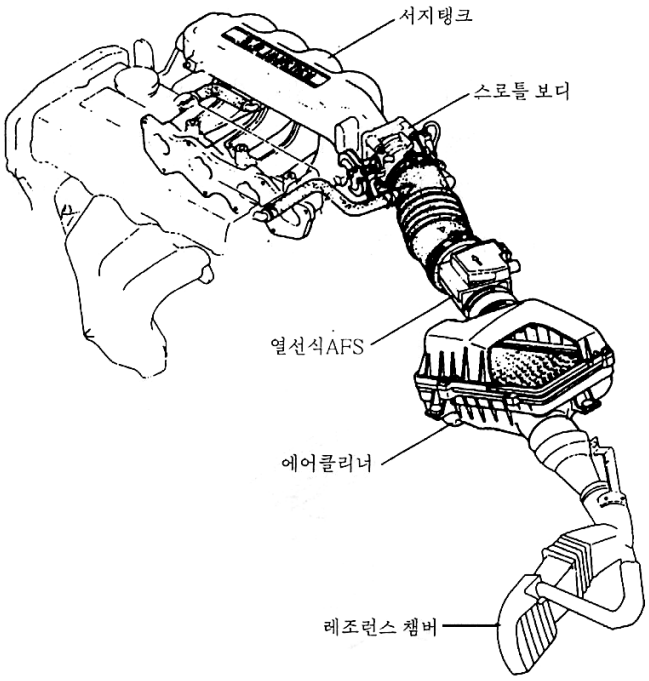


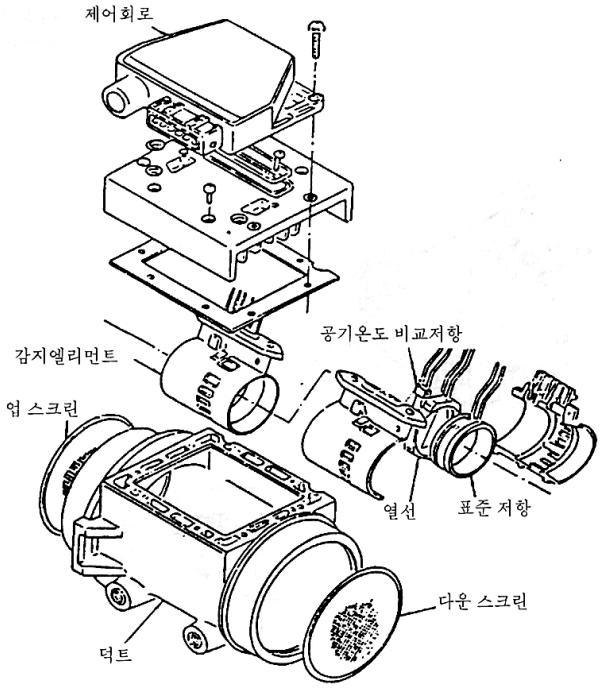


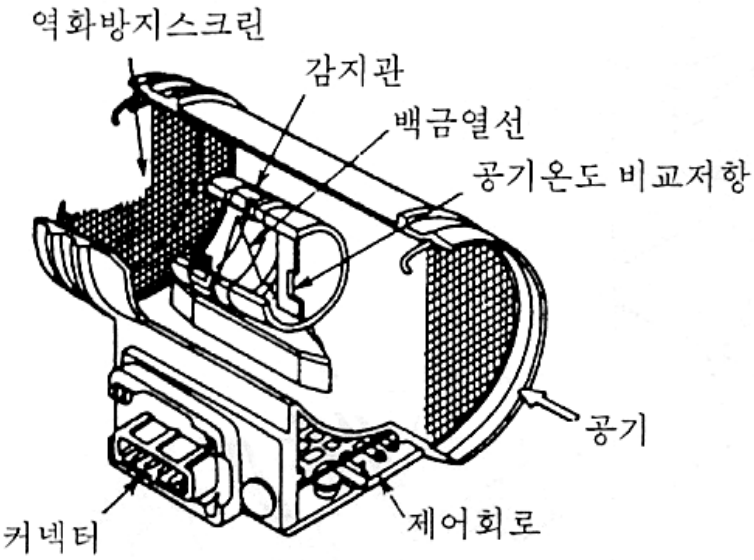
〈출력특성〉

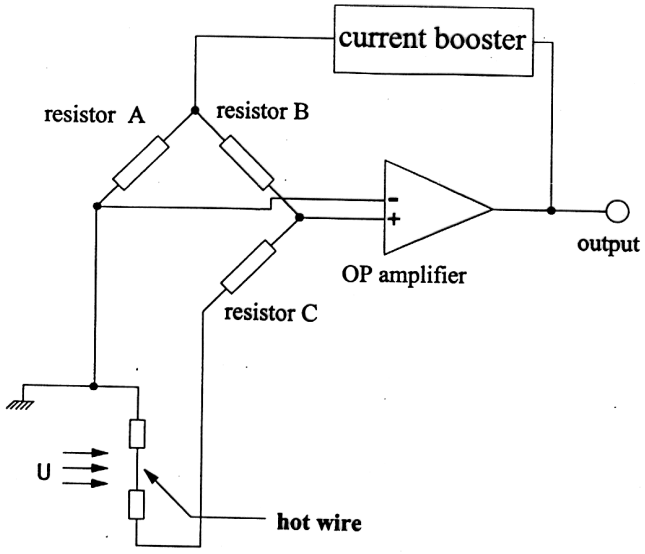


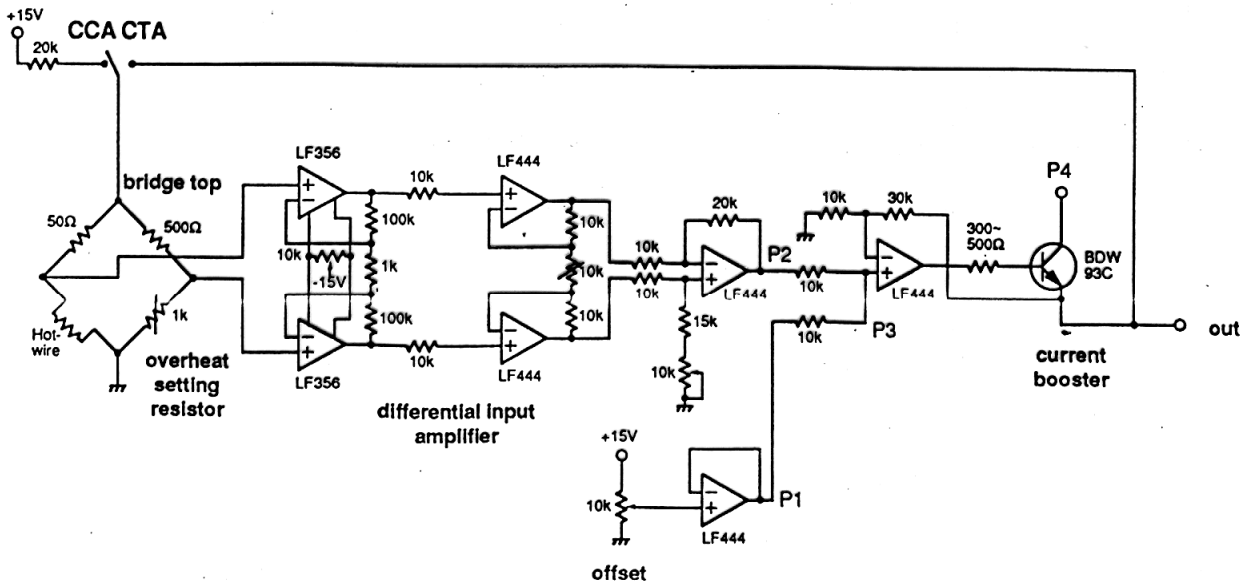
열선 & 핫필름식 유량 센서



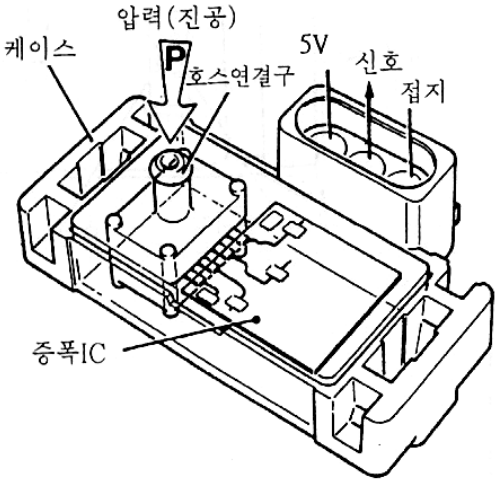


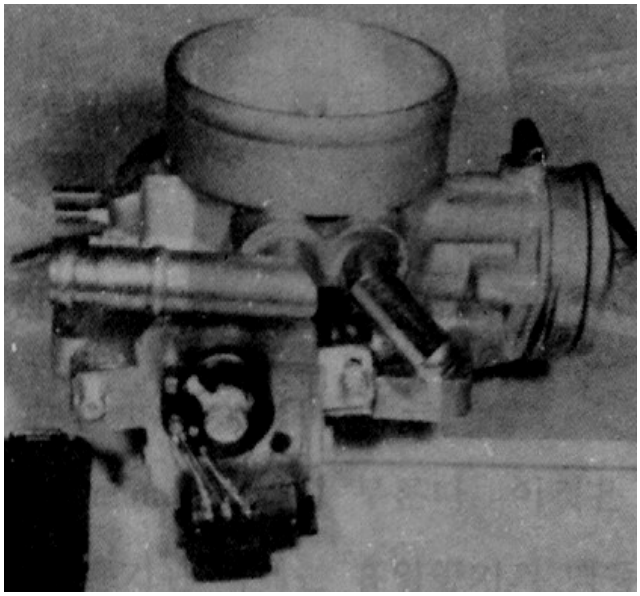


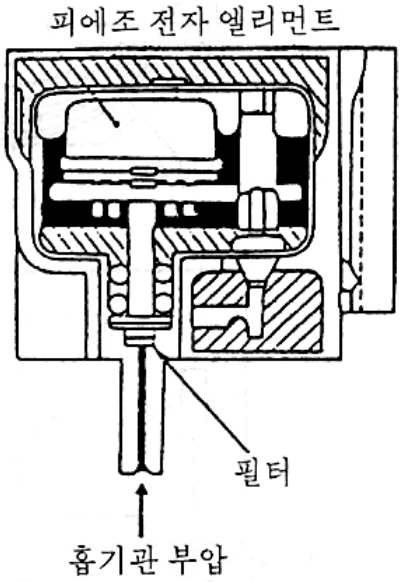


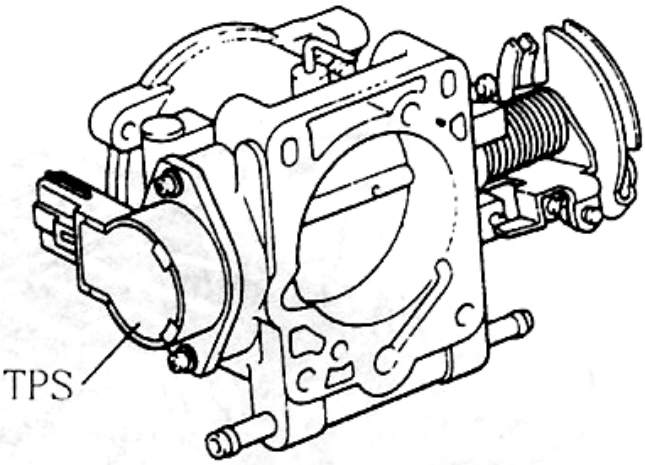


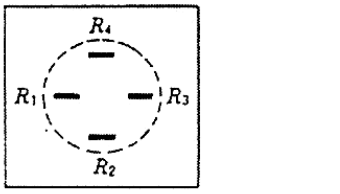
MAP & TPS

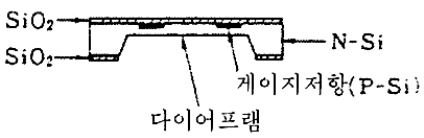


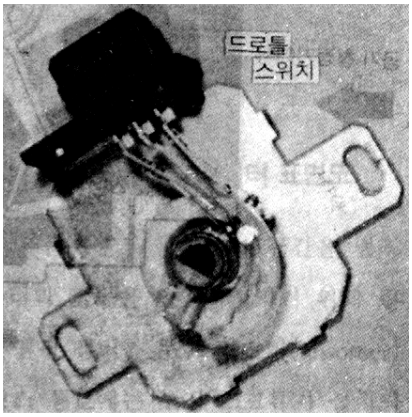


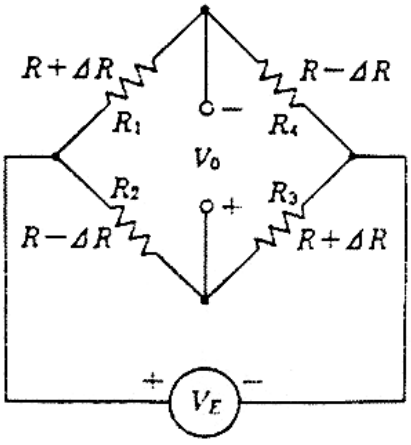


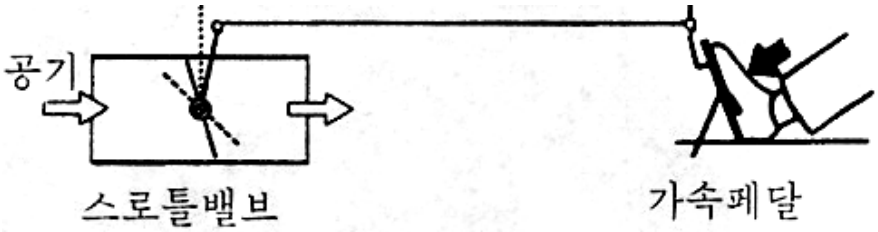






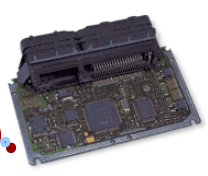




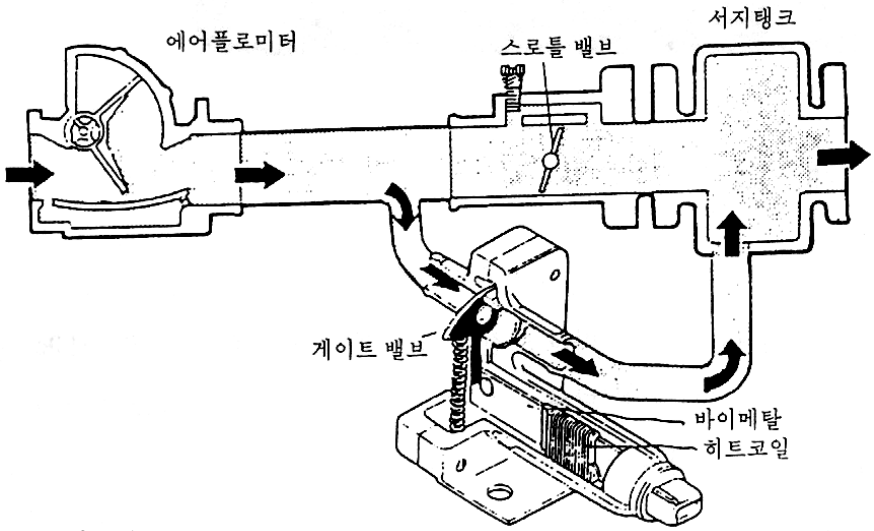


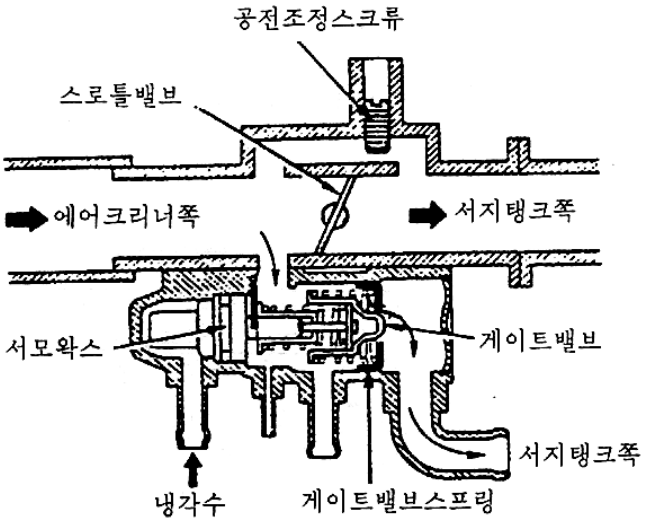
공회전 속도 제어 시스템

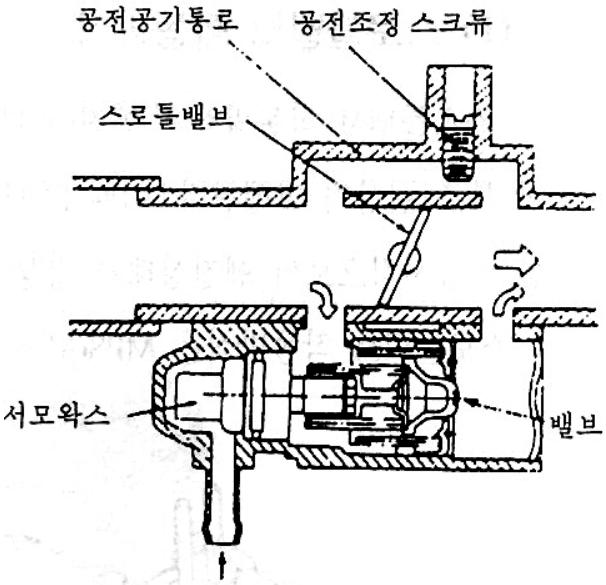
- **엔진의 아이들 상태(공회전 상태)**
  - 엔진의 토크가 엔진 자신의 마찰력과 평형을 이루고 있는 상태
  - 아이들 제어 시스템
- **작동기구**
  - 기계식
    - 오픈 루프 방식
    - 바이메탈식
    - 서모왁스식
  - 전자식
    - 스로틀벨브 작동식
    - 스텝모터방식
    - 에어 밸브 솔레노이드 방식

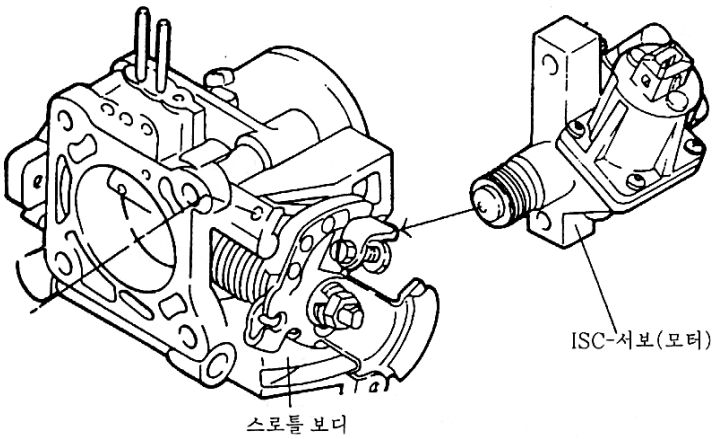


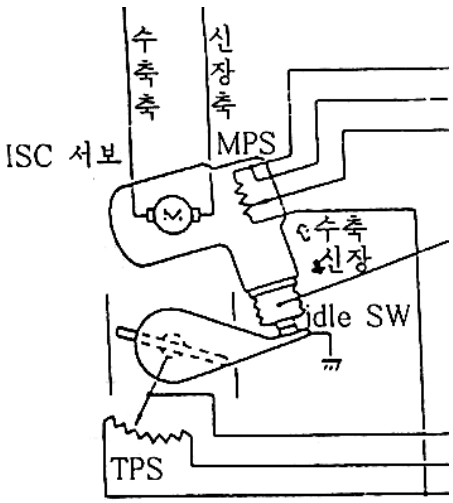
공회전 속도 제어 시스템

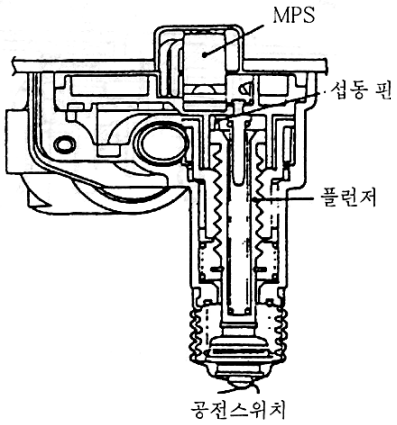


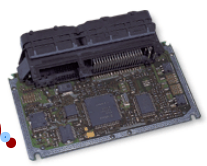


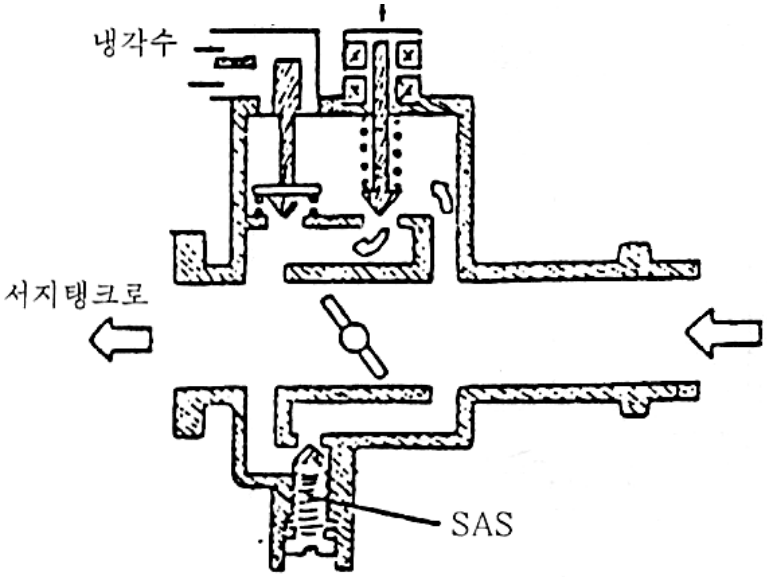


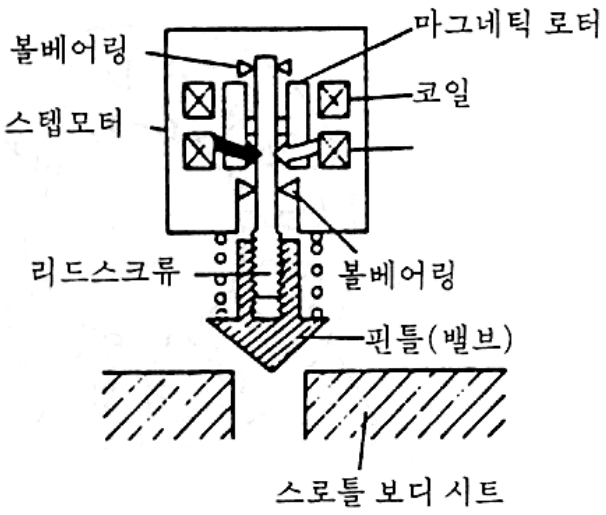












〈표〉 스텝모터의 특징

구 분	특 징
ISC-서보 스텝모터특징	피드백이 불필요하여 제어계가 단순하다. 컴퓨터로 제어가 매우쉽다. 회전 오차각이 누적되지 않는다. 정지시 큰 정지 토크를 갖는다. 브러쉬가 없어 신뢰성이 높다. 직류 모터보다 능률이 낮다. 출력당 무게가 크다. 특정 주파수에서 공진, 진동현상이 생긴다.