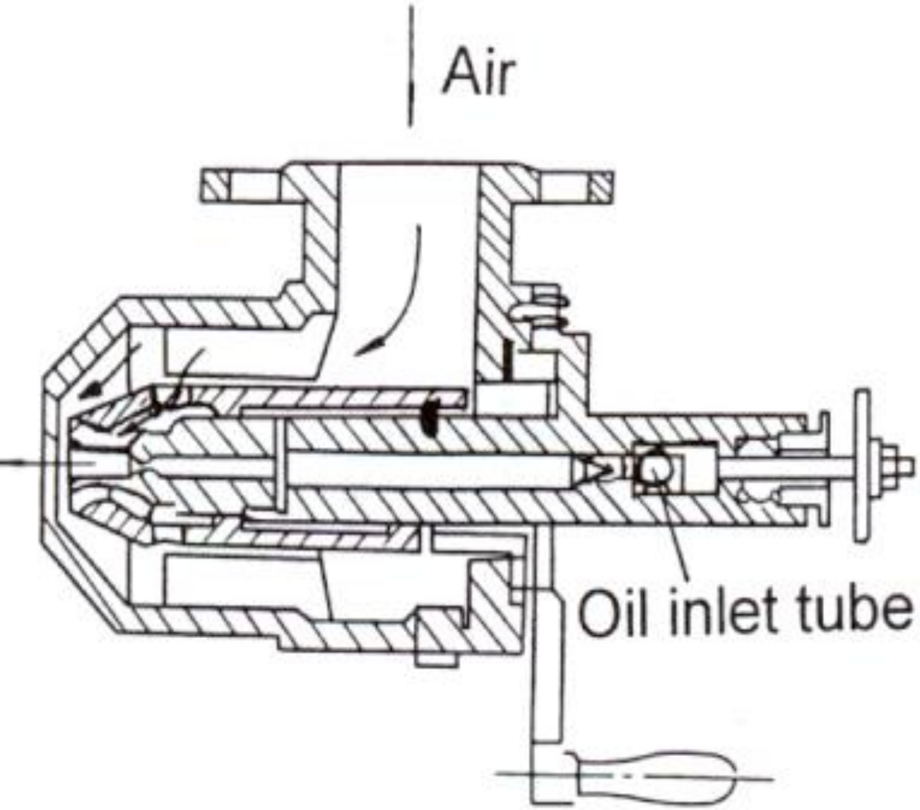
OIL BURNER -II

UNIT - 14

A typical oil burner



AIR REGISTRAR:

Here air enters from an air tube and exit through annulus aperture.

OIL GUN:
Oil enters through oil tube and is atomized while passing through a nozzle at its end.

FLAME SENSOR

Typical design finds the sizes of oil & air tubes and oil nozzles for a given output

Burner Needs PA, SA and atomizing (root) air

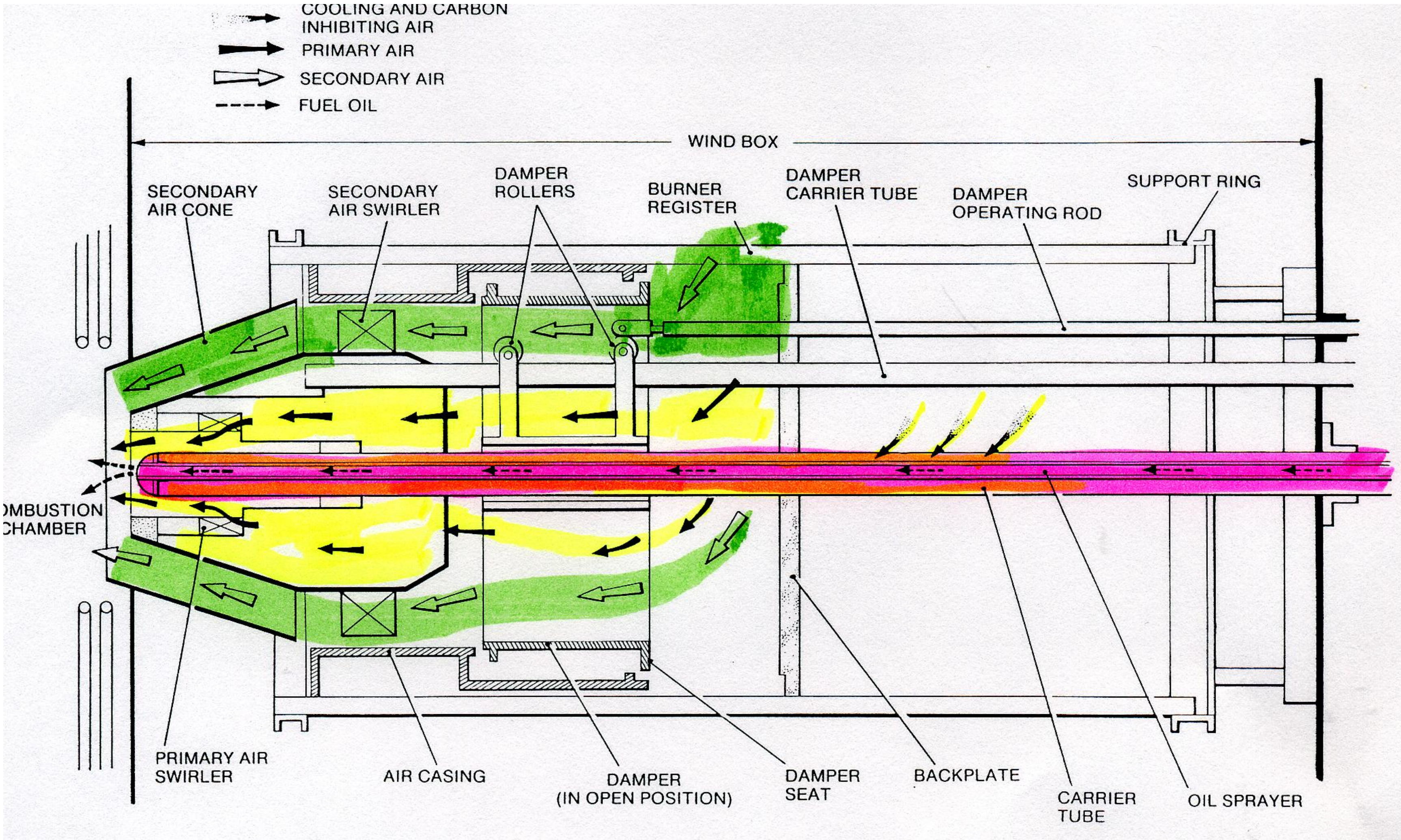


FIG. 1.35 Burner fuel and air flows

DESIGN METHOD (Oil nozzle)

- 1. The diameter D_{oil} of the tube through which the oil pass

$$D_{oil} = \left[\frac{4G}{3600\pi\rho W} \right]^{0.5} \mathrm{m} = 18.8\sqrt{\frac{\mathrm{G}}{\rho \mathrm{W}}}, \mathrm{mm}$$

where *G* – oil flow in kg/hr, *W* is permissible oil velocity in tube (m/s).

2. Bernoulli's equation relates the oil pressure P_0 with oil velocity in the nozzle, *U*.

So, the oil jet velocity, $U = \sqrt{\frac{2P_0}{\rho}}$

- $$G = 3600 C_v A_{oil} U\rho = 3600 C_v A_{oil}\sqrt{2\rho P_0}$$

where ρ is density of oil, and C_v is Flow coefficient. A_{oil} is nozzle area & P_0 is in Pascal

Orifice diameter

- Orifice diameter, D_e is related to others as:

$$A_{oil} = \frac{\pi}{4} D_e^2 = \frac{196G}{C_v \sqrt{2\rho P_{or}}} \, mm$$

- The diameter *De* is found as:

$$D_e = 1.13\sqrt{A_{oil}}$$

where *De* is in mm and A_{oil} in mm^2

Design methods (Air tube)

- 4. Diameter of air tube carrying air at W_a m/s
- $D_a = 18.8\,(G_a/[\rho_a\, W_a\,])^{0.5}$ (mm)
- 5. The exit section area A_a mm^2 of air nozzle

$$A_a = 196\frac{V_a}{C_{va}}\sqrt{\frac{\rho_a}{P_a}} = \frac{\pi}{4}d_{noz}^2$$

- 6. The approximate flame length, a function of air velocity and nozzle diameter, is given by
- $L = 2\left(42 + \frac{60}{V_{air}}\right)d_{noz}$ (m)

Empirical relations for size of droplets

Finer the drop better is the combustion

Xieu

$$d_m = \frac{K}{\rho W_{rel}^2}$$

Wang: $d_m = \dfrac{(200 \sim 300)}{P_a}$

Weinberg: $d_m = \dfrac{K}{\rho W_{rel}^2}$

$$d_m \sim (FN^3/\Delta P)^{0.143}$$

Where Flow number $FN = (G/\Delta P)^{0.5}$

AIR REGISTER

Air register stabilizes the flame and facilitates mixing between air and oil.

- Swirl type (air entering is split between the oil tube and an annular tube)
- Advection type (air enters through one common tube).
- In both cases some air may enter through the central oil tube.

SWIRL TYPE AIR REGISTER

Air enters through two separate concentric tubes for primary & secondary air.

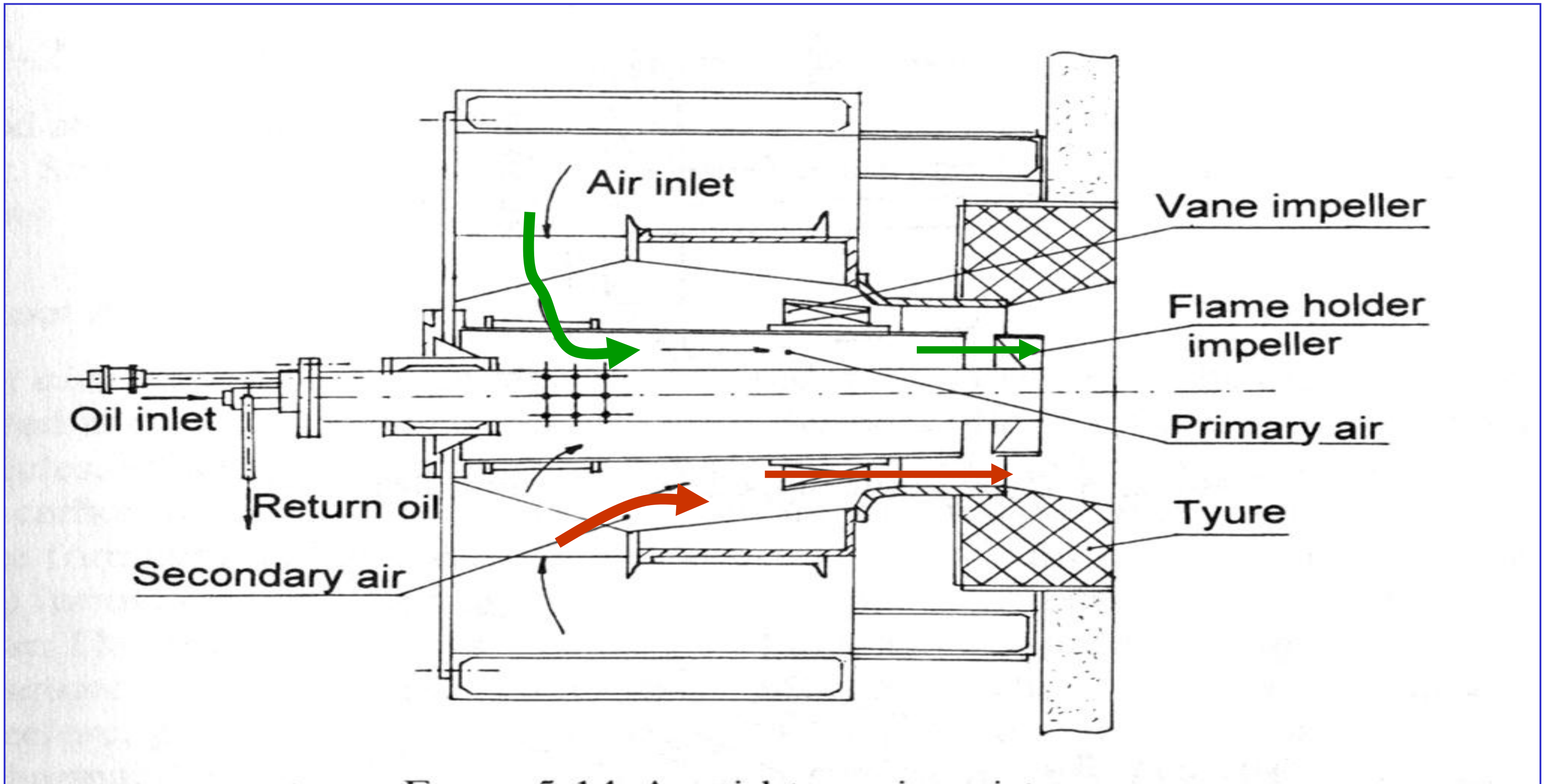
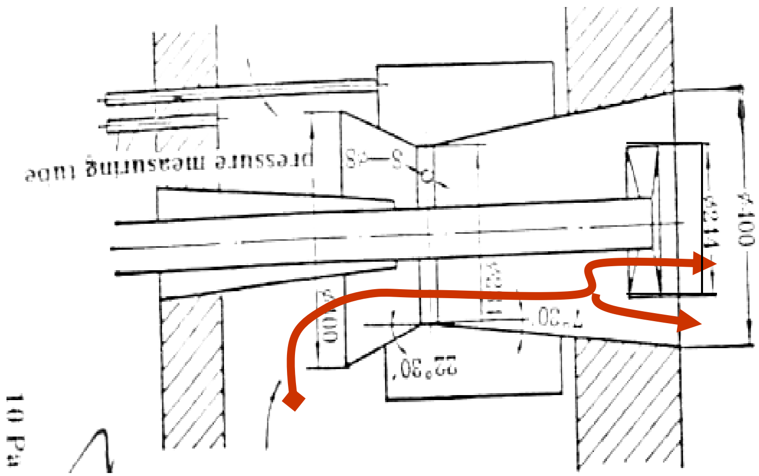


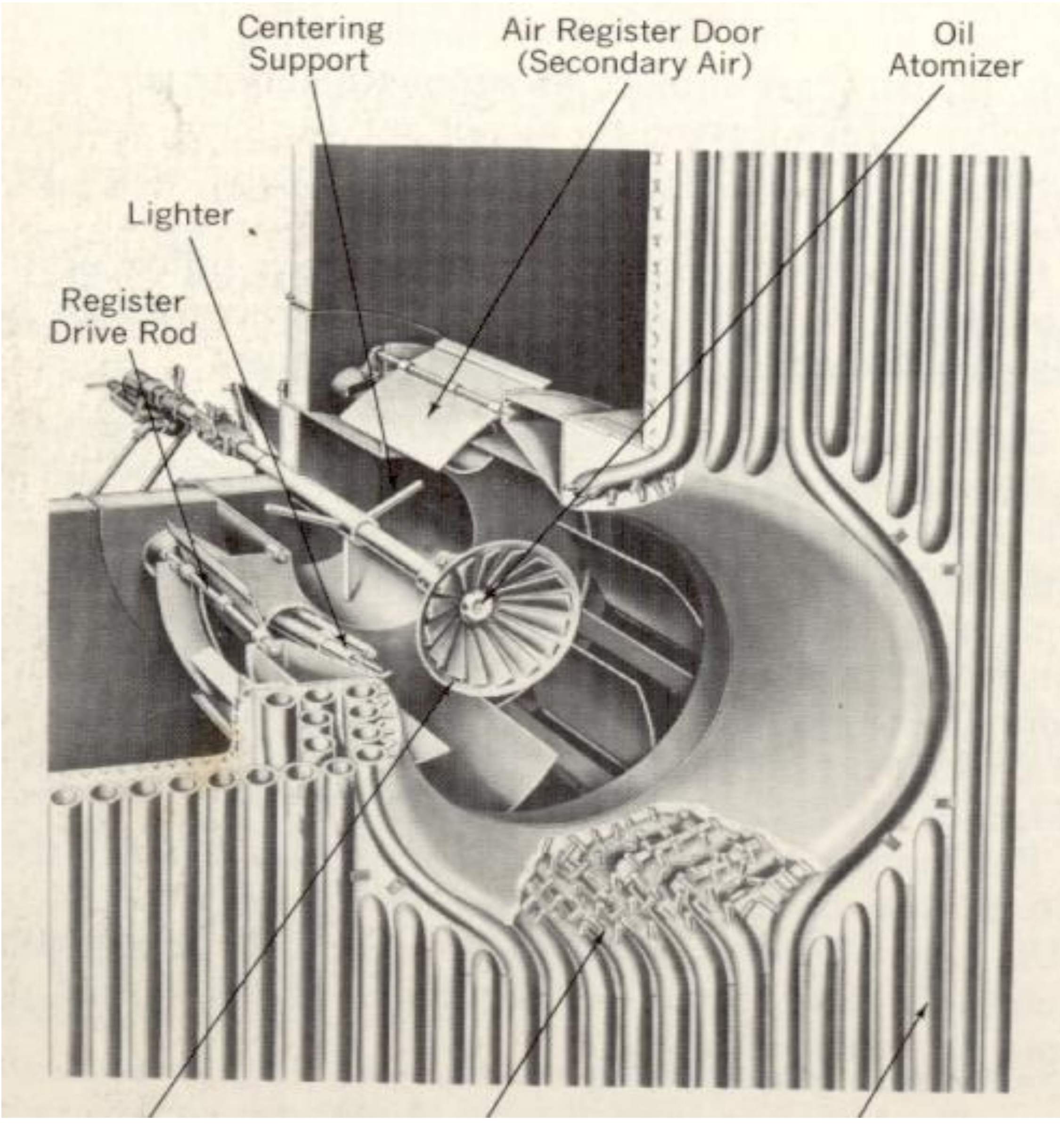
FIGURE 5-14. A swirl-type air register

Advection type register



- Here air enters through the annulus.
- One part of air pass through the flame holder & another around it
- There is no physical division between two air.

OIL BURNER WITH AIR REGISTER



Modern heating boilers using an oil burner use a Cadmium Cell sensor, usually located inside the oil burner tube, to "see" the presence of flame and to assure that the oil burner assembly stops pumping oil into the combustion chamber if flame ignition is unsuccessful.

FLAME SENSOR & CONTROL

Flame sensor

Cadmium cell

Flame scanner

Cadmium cell is a photo cell mounted near the rear of the oil burner tube, where it can "see" the flame. If the oil burner flame is absent the cell passes that information on its to relay switch which will, after a delay of 15-20 seconds, shut down the oil burner

CELL OPERATION

Oil Flame showing effect of secondary air