

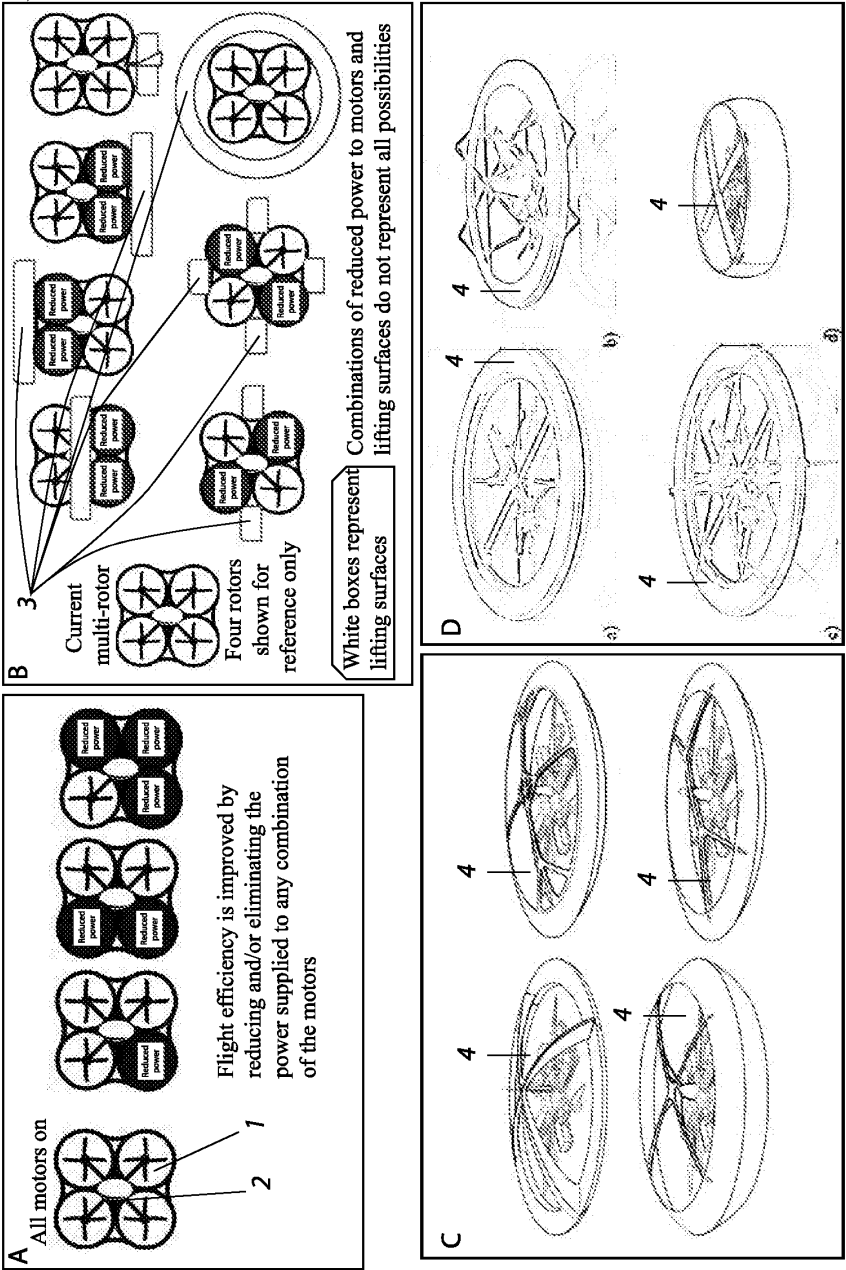
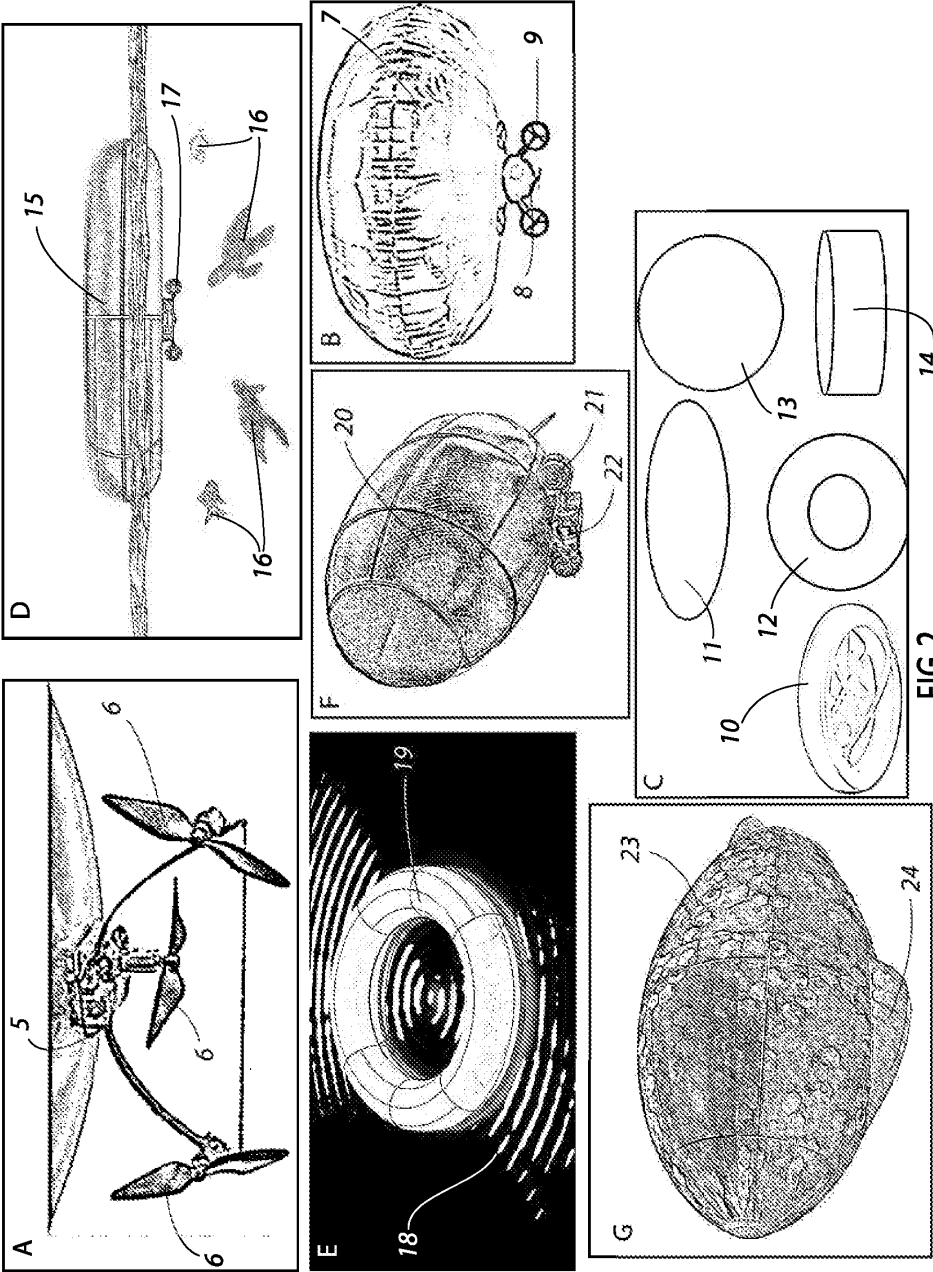
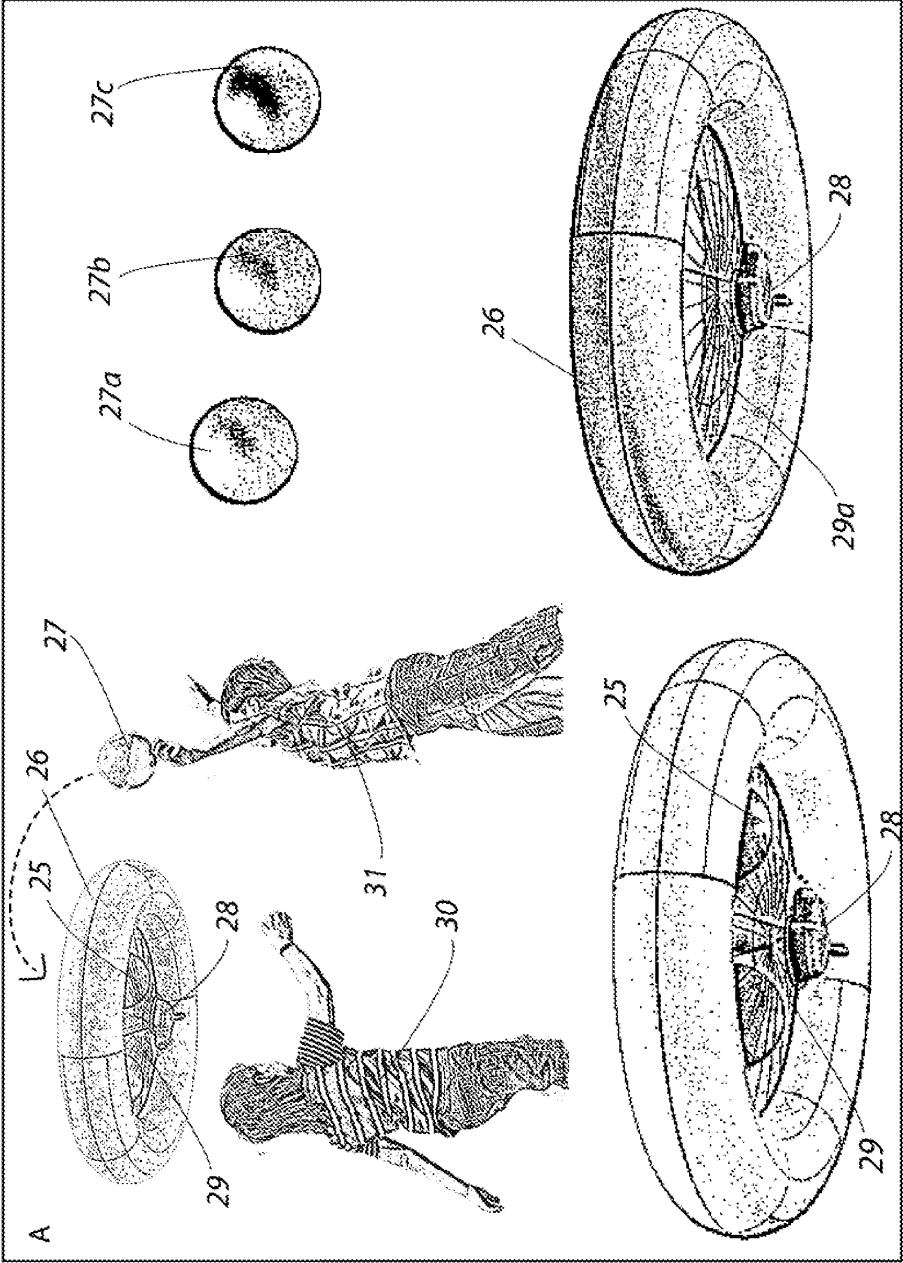
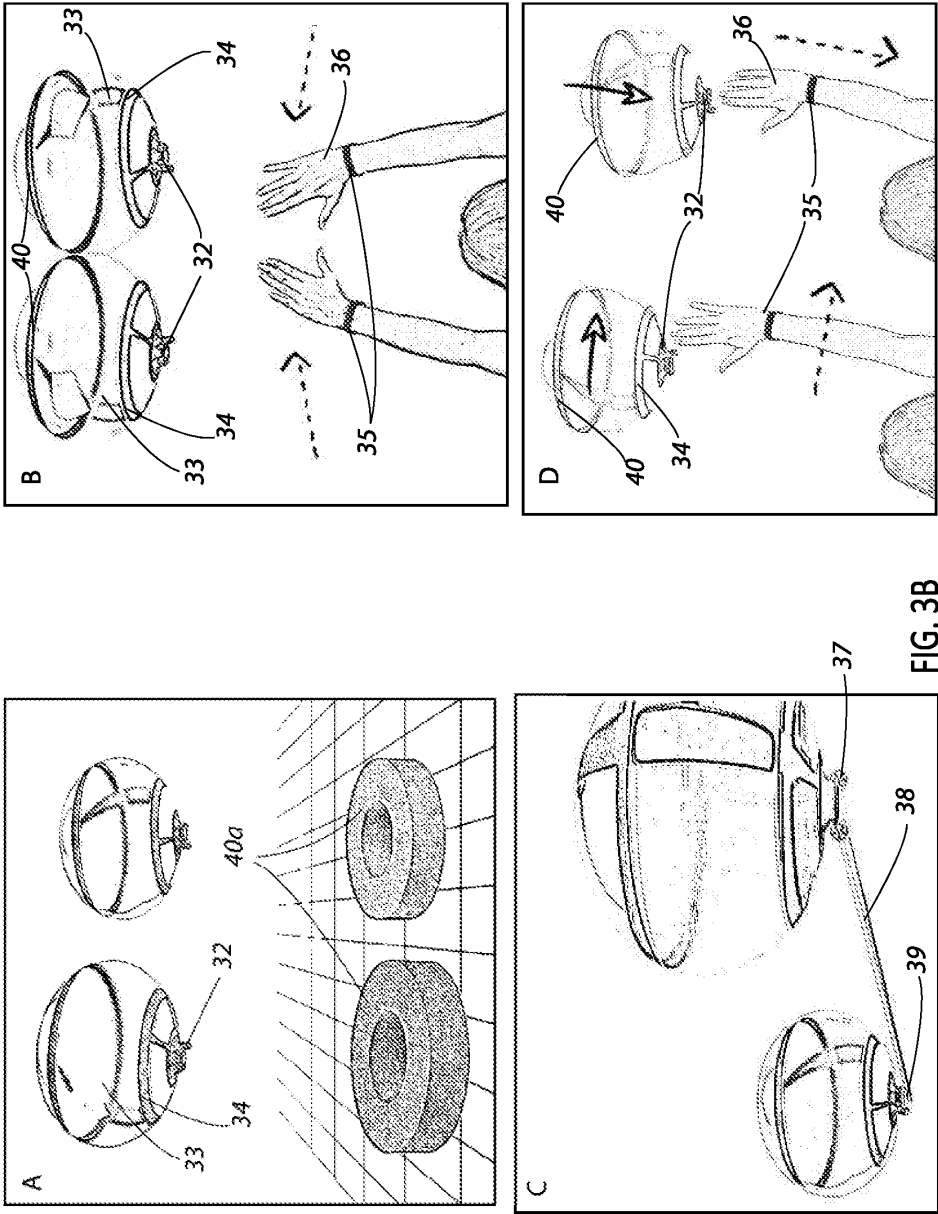


FIG. 1







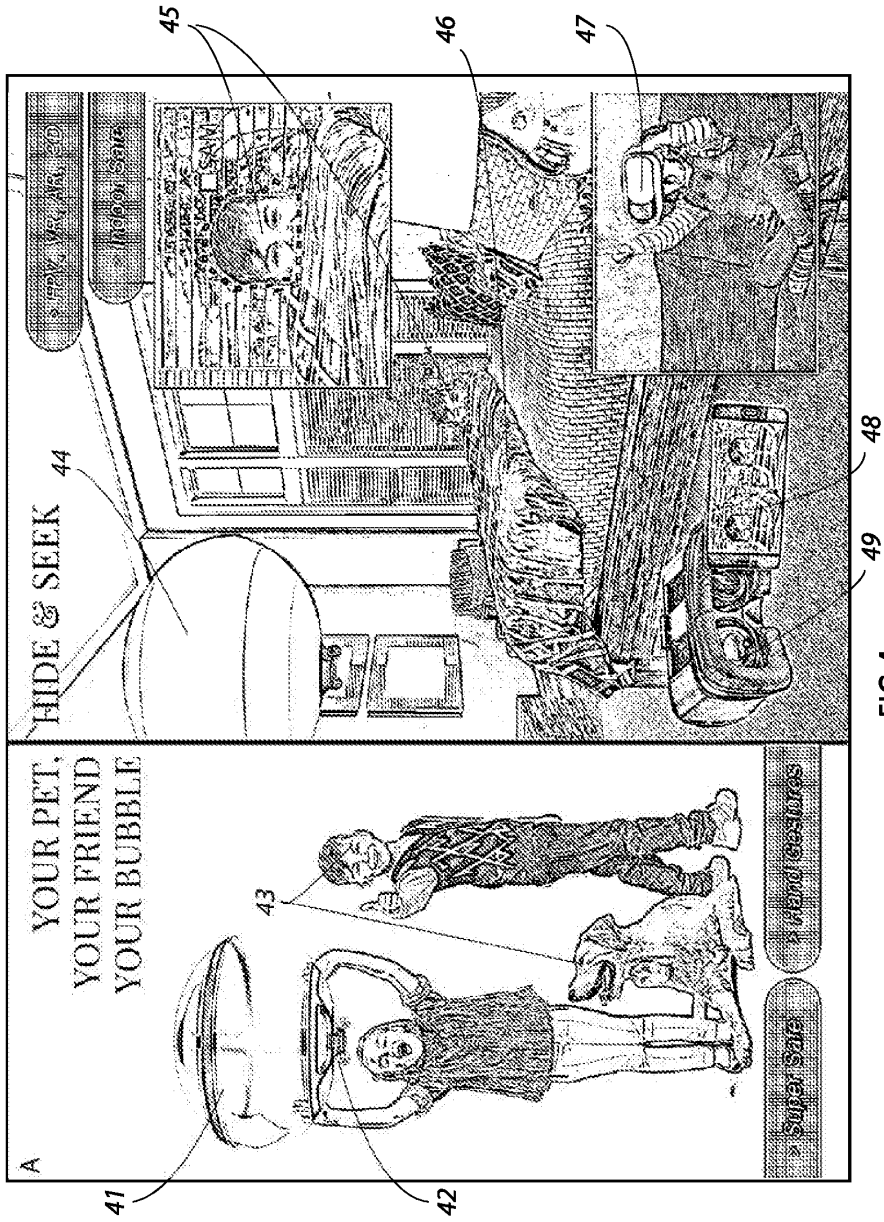
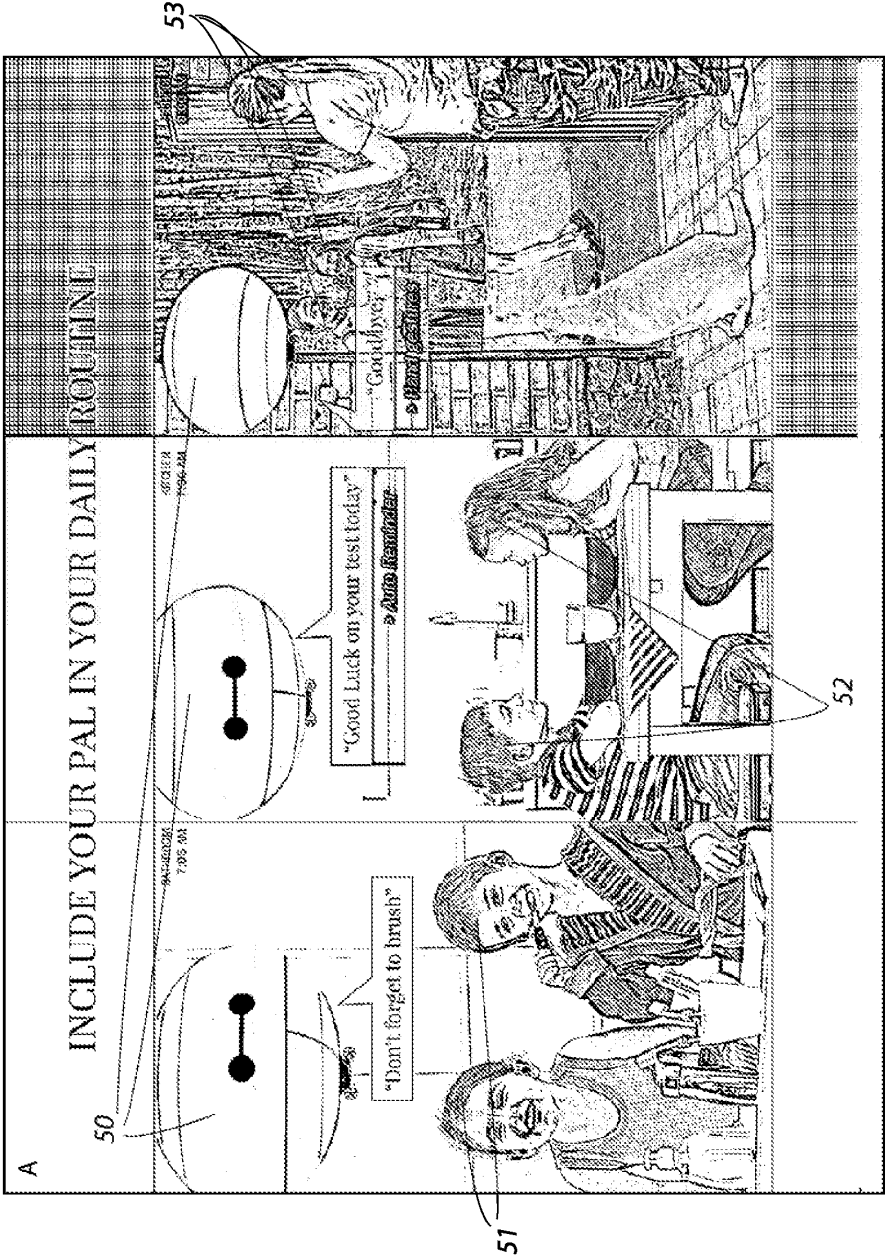


FIG.4



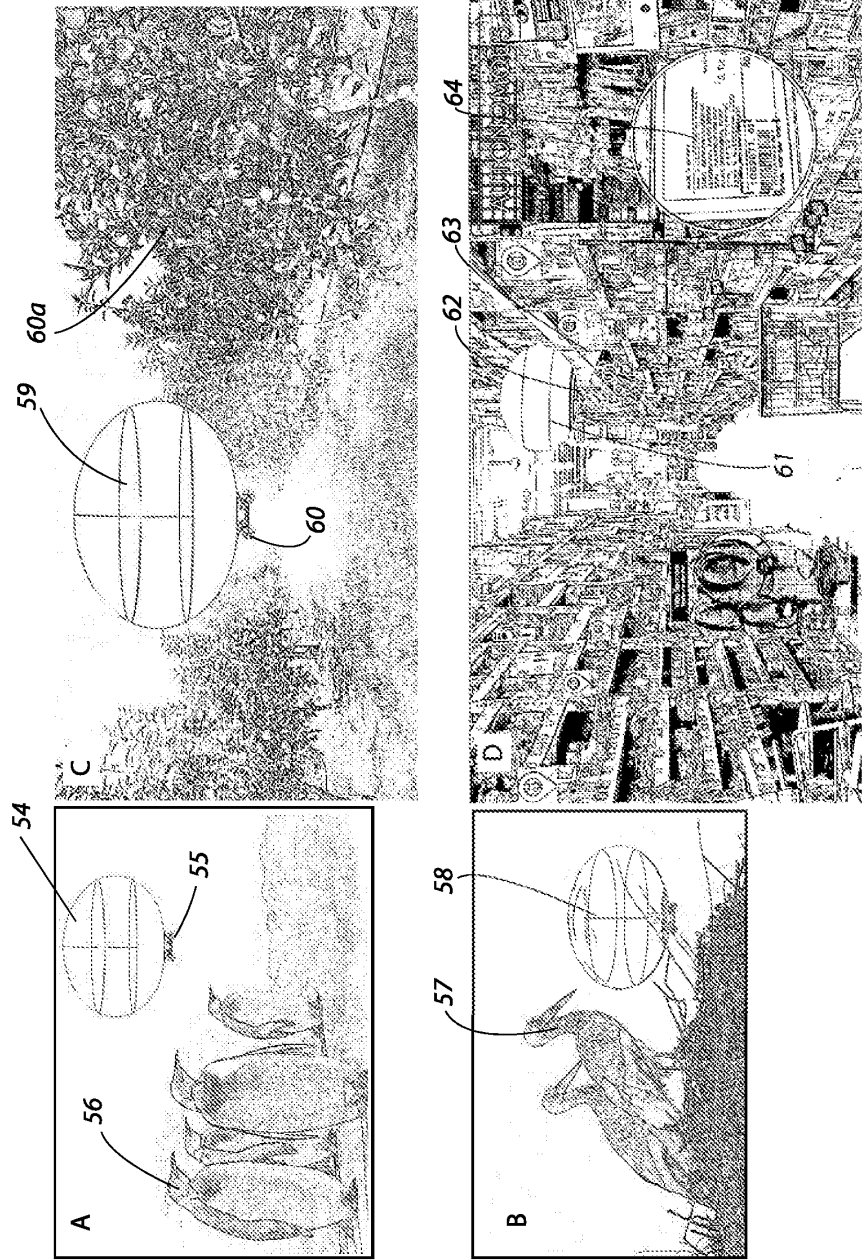


FIG.6

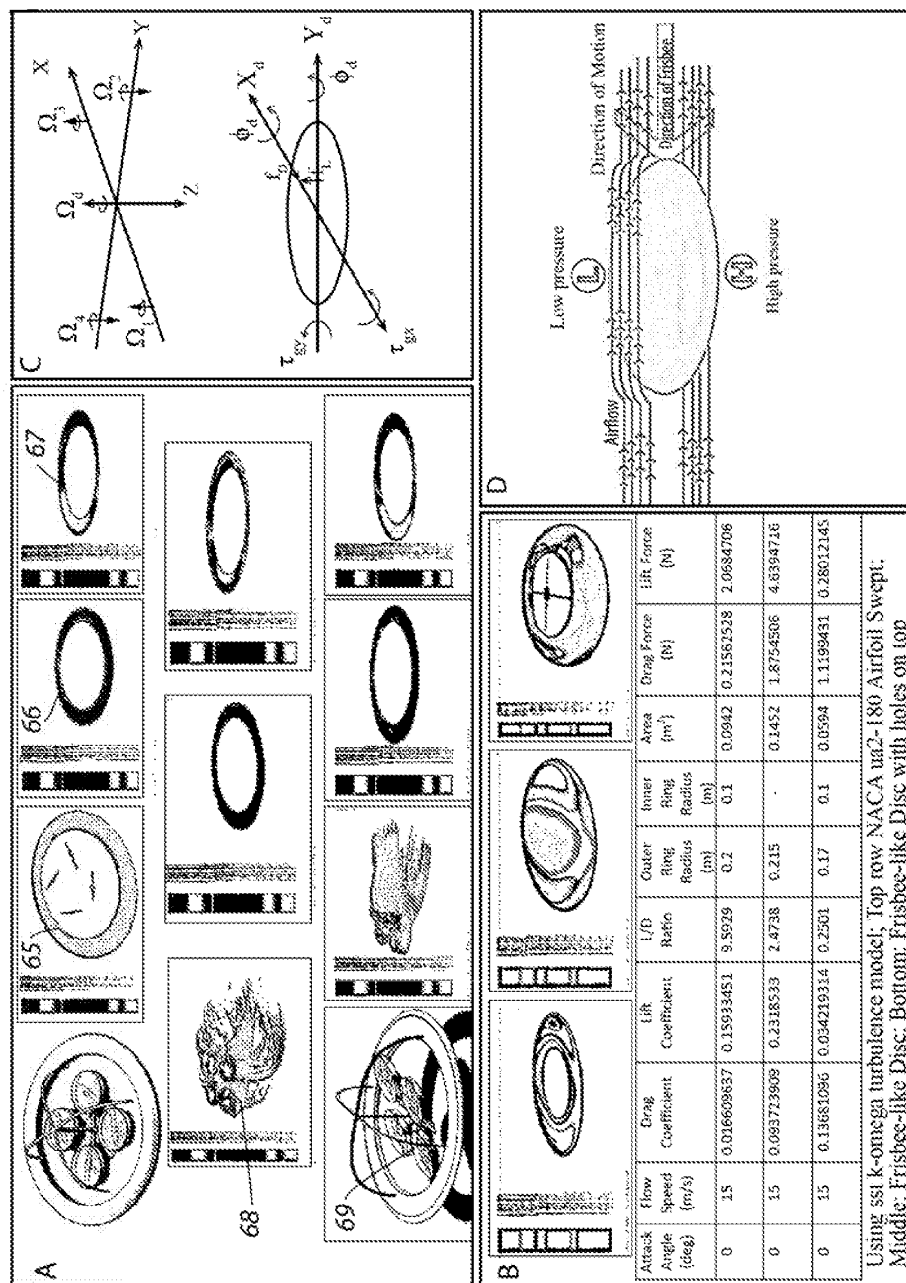
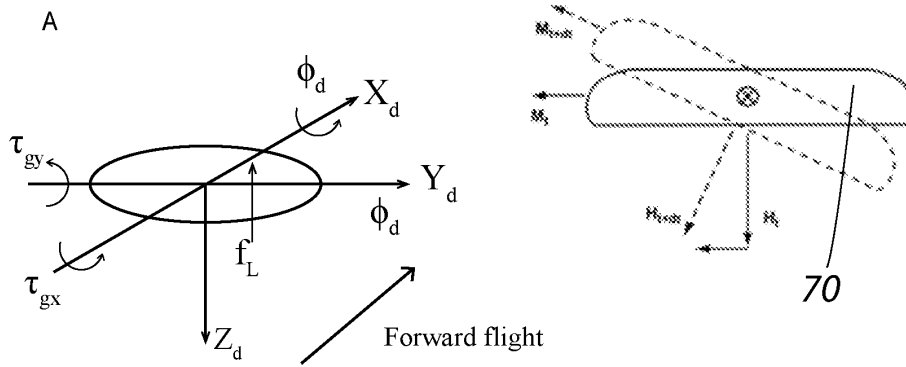


FIG. 7A



$$\left. \begin{aligned} \tau_{gx} &= I_d \theta'_d \Omega_d \\ \tau_{gy} &= -I_d \phi'_d \Omega_d \end{aligned} \right\} \text{Gyroscopic torque}$$

$$\tau_a = f_L \times d \quad \text{--- Aerodynamic torque}$$

Movement balance ground Y axis $f_L \times d = I_d \times \phi_d \times \Omega_d$

assuming disc has a 30% rolling motion ($\phi_d = 30\text{deg/s} = 0.5236 \text{ rad/s}$)

$$\Omega_d = \frac{f_L \times d}{I_d \times \phi_d} = \frac{1\text{N} \times 0.15\text{m}}{0.0016\text{kgm}^2 \times 0.5236\text{rad/s}} = 179 \text{ rad/s} = 1710 \text{ rpm}$$

The disc accelerates from static to 200 rad/s in 10 sec, then the angular acceleration is $\alpha = 200/10 = 20 \text{ rad/s}^2$

Disk torque: $\tau_d = I_d \times \alpha = 0.0016 \times 20 = 0.032 \text{ Nm}$, which will be balanced by one pair of the quadcopter props

FIG.7B

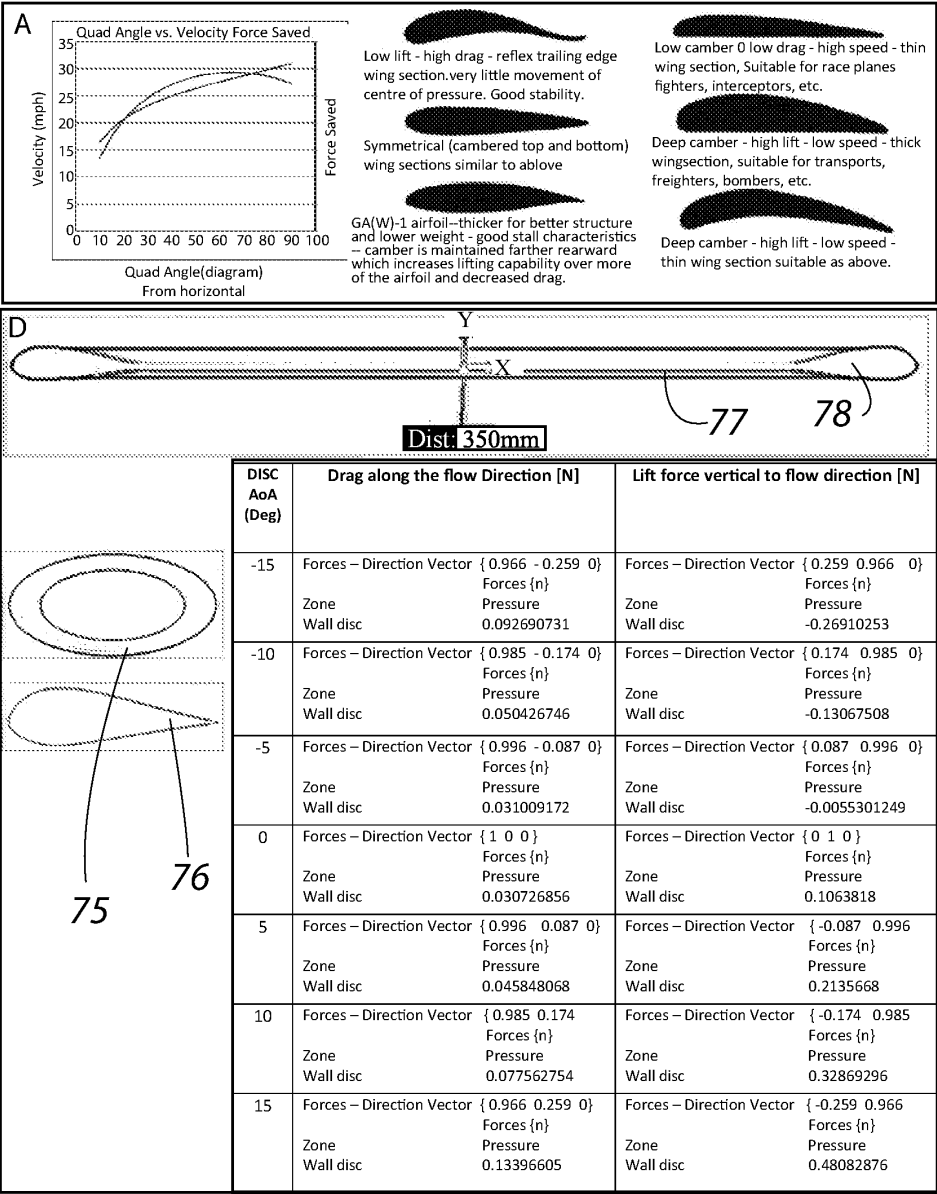


FIG.8

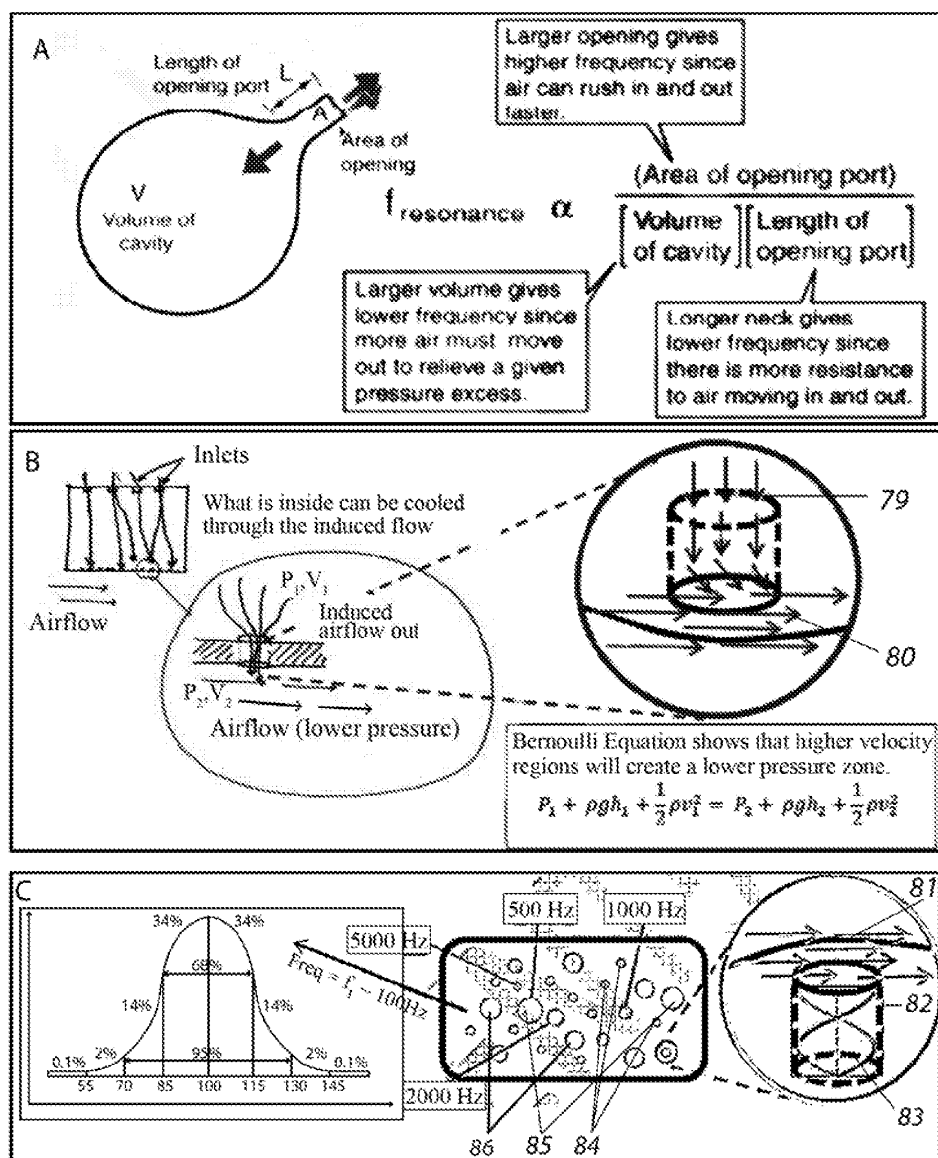


FIG.9A

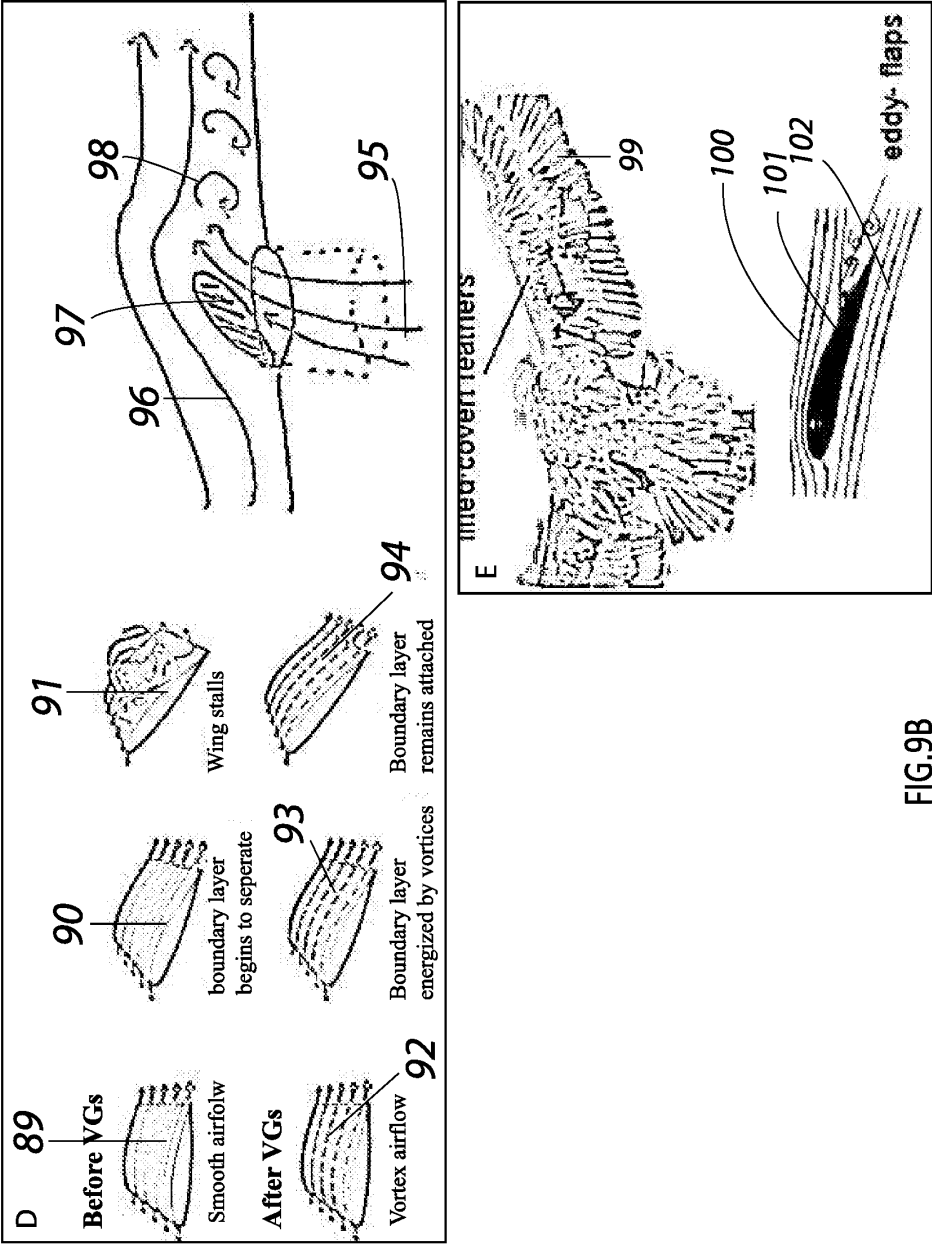


FIG.9B

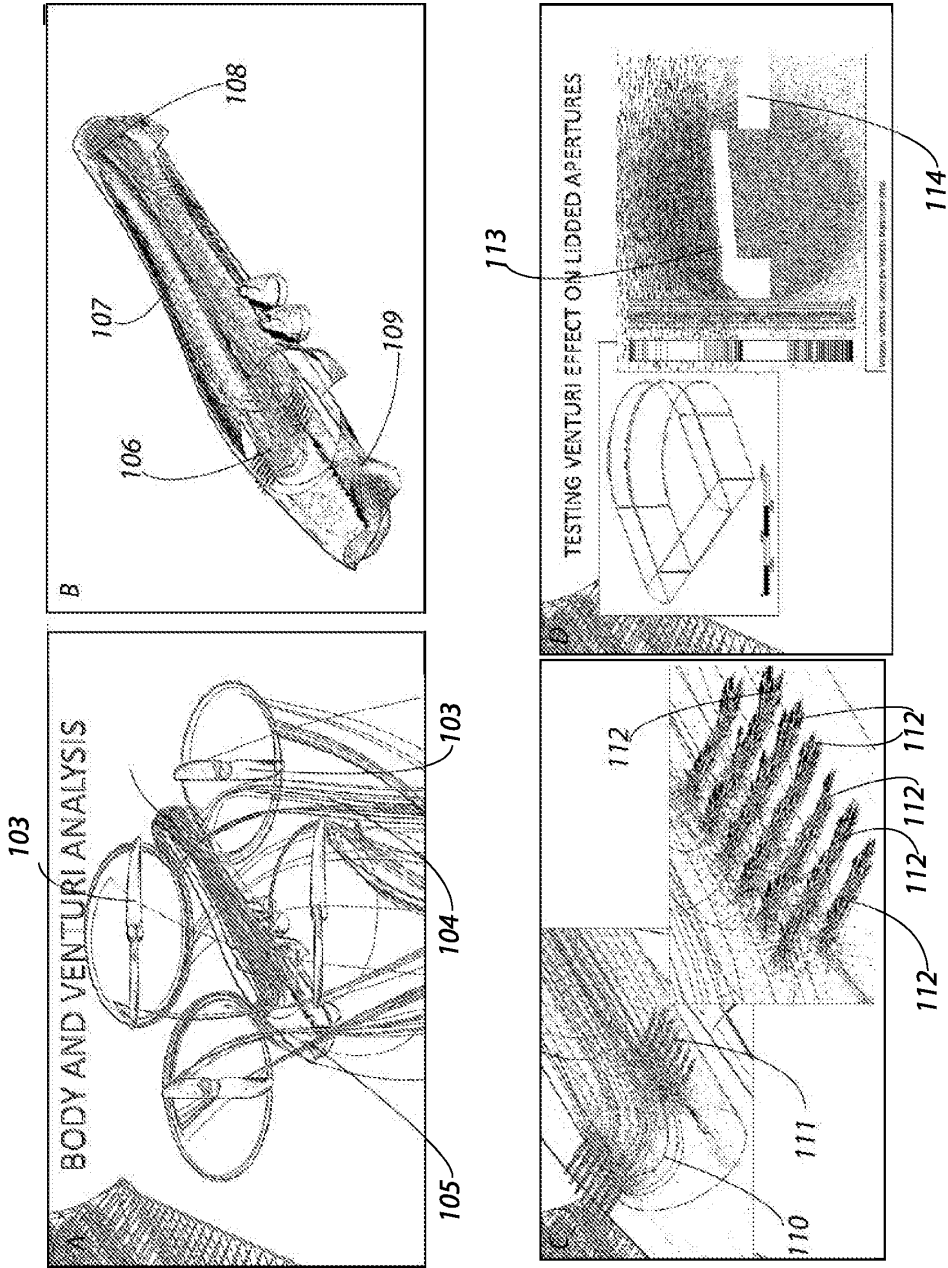


FIG. 10

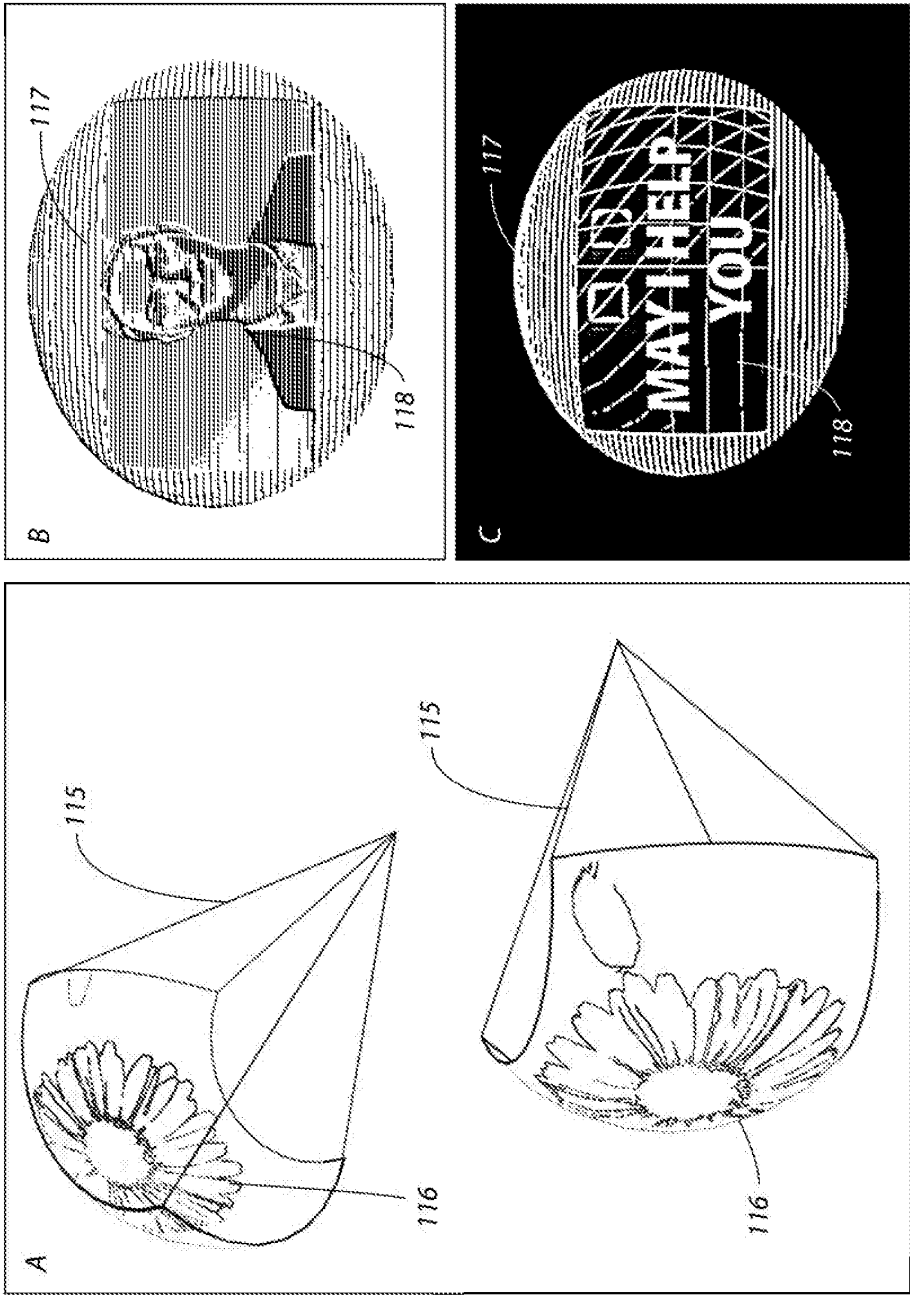


FIG. 11