Funcoids as binary relations

A binary relation $\delta \in \mathscr{P}(\mathscr{P}A \times \mathscr{P}B)$ corresponds to a funcoid if and only if it complies to the formulas (for all suitable sets I, J, K):

$$\neg(\varnothing \,\delta\, I);\quad I \cup J \,\delta\, K \Leftrightarrow I \,\delta\, K \vee J \,\delta\, K;$$
$$\neg(I \,\delta\, \varnothing);\quad K \,\delta\, I \cup J \Leftrightarrow K \,\delta\, I \vee K \,\delta\, J.$$

The funcoid f and relation δ are related by the formulas:

$$\mathcal{X}\,[f]\,\mathcal{Y} \Leftrightarrow \forall X \in \mathcal{X}, Y \in \mathcal{Y}\colon X \,\delta\, Y;$$
$$X \,\delta\, Y \Leftrightarrow X\,[f]^*\,Y.$$