The weak closure of $R$ is $V$, which is the set of all functions $v: \mathbb{R}^2 \to \mathbb{C}$ such that

$$v(x, y) = \sum_{i=1}^{K} c_i \phi_i(x) \phi_i(y)$$

with

$$\phi_i: \mathbb{R}^2 \to \mathbb{C}, \phi_i \in H^1(\mathbb{R}^2), \quad \phi_i, \phi_j > 0 \quad \forall i, j \in \mathbb{C}, \quad \sum_{i=1}^{K} c_i^2 = 1.$$