This transforms the state $|s\rangle$ into a state very close (as in the original algorithm) to the state $\frac{1}{\sqrt{m}} \sum_{i=1}^{m} |w_i\rangle = |\tilde{w}\rangle$, as can be seen from the following argument. Look at the subspace spanned by $|\tilde{s}\rangle$ and $|\tilde{w}\rangle$.

$$= \frac{1}{\sqrt{N-m}} \sum_{\substack{x \neq w_i \\ \text{for some } i}} |x\rangle$$

$\cos\frac{\theta}{2} \mathbb{1} + i \sin\frac{\theta}{2} \sigma_y$

↑

This is preserved by U_s, $U_{\tilde{w}}$, and $U_s U_{\tilde{w}}$ is easily seen to be a rotation by $\theta \approx 4\sqrt{\frac{M}{N}}$ (actually $4\sqrt{M(N-M)}/M$) in this space.

Accordingly, after $\approx \frac{\pi}{4}\sqrt{\frac{N}{M}}$ iterations, the initial state $|s\rangle \approx |\tilde{s}\rangle$ is mapped into $|\tilde{w}\rangle$. Measurement of the state at this point will reveal one of the $|w_i\rangle$ such that $f(w_i) = 1$.