Massive stars are powerful energetic sources shaping their surrounding interstellar medium, which is often swept up into a cold dense shell. If the shell fragments and forms a new generation of massive stars, the stars may form new shells, and this sequence repeats recursively leading to propagating star formation. Using three dimensional hydrodynamic simulations, we investigate fragmentation of the shell in order to estimate masses of stars formed in the shell. We develop a new numerical method to calculate the gravitational potential, which enables us to approximate a part of the shell with a plane–parallel layer. Our main results are as follows. Firstly, we compare our numerical calculations to several analytical theories for shell fragmentation, constrain the parameter space of their validity, and discuss the origin of their limitations. Secondly, we report a new qualitatively different mode of fragmentation - the coalescence driven collapse. While layers with low pressure confinement form monolithically collapsing fragments, layers with high pressure confinement firstly break into stable fragments, which subsequently coalesce. And thirdly, we study whether layers tend to self–organise and form regular patterns as was suggested in literature, and we find no evidence for this conjecture. Based on our simulations, we provide an analytic estimate for fragment properties, which in contrast to previous works, suggests that fragment masses are typically too low to form massive stars needed for self–propagating star formation.