M = 3, n = 2:

Original equation:

$$
\begin{aligned}
&+6f_{-1}^{2}f_{0}^{2}+4f_{-1}^{3}f_{1}+4f_{-2}f_{0}^{3}+24f_{-2}f_{-1}f_{0}f_{1}+12f_{-2}f_{-1}^{2}f_{2}\\
&\quad+6f_{-2}^{2}f_{1}^{2}+12f_{-2}^{2}f_{0}f_{2}+12f_{-2}^{2}f_{-1}f_{3}+12f_{-3}f_{0}^{2}f_{1}\\
&\quad+12f_{-3}f_{-1}f_{1}^{2}+24f_{-3}f_{-1}f_{0}f_{2}+12f_{-3}f_{-1}^{2}f_{3}\\
&\quad+24f_{-3}f_{-2}f_{1}f_{2}+24f_{-3}f_{-2}f_{0}f_{3}+6f_{-3}^{2}f_{2}^{2}+12f_{-3}^{2}f_{1}f_{3}=0
\end{aligned}
\tag{1}
$$

Simplified equation, where $f_{-j}=\overline{f_j}$:

$$
\begin{aligned}
&4f_{0}^{3}\overline{f_{2}}+12f_{0}^{2}f_{1}\overline{f_{3}}+6f_{0}^{2}\overline{f_{1}}^{2}+24f_{0}f_{1}\overline{f_{1}f_{2}}+24f_{0}f_{2}\overline{f_{1}f_{3}}+12f_{0}f_{2}\overline{f_{2}}^{2}\\
&\quad+24f_{0}f_{3}\overline{f_{2}f_{3}}+12f_{1}^{2}\overline{f_{1}f_{3}}+6f_{1}^{2}\overline{f_{2}}^{2}+24f_{1}f_{2}\overline{f_{2}f_{3}}+12f_{1}f_{3}\overline{f_{3}}^{2}\\
&\quad+4f_{1}\overline{f_{1}}^{3}+6f_{2}^{2}\overline{f_{3}}^{2}+12f_{2}\overline{f_{1}}^{2}\overline{f_{2}}+12f_{3}\overline{f_{1}}^{2}\overline{f_{3}}+12f_{3}\overline{f_{1}f_{2}}^{2}=0
\end{aligned}
\tag{2}
$$

All possible solutions:

$$\{f_1 : 0,\quad f_2 : 0\} \tag{3}$$

$$\{f_1 : 0,\quad f_2 : 0,\quad f_3 : 0\} \tag{4}$$