x_i is given by

$$x_i = (-1)^{n+i} \begin{vmatrix} D_1a_1 & D_1a_2 & \cdots & D_1a_{n-1} \\ \multicolumn{4}{c}{\dotfill} \\ \widehat{D_ia_1} & \widehat{D_ia_2} & \cdots & \widehat{D_ia_{n-1}} \\ \multicolumn{4}{c}{\dotfill} \\ D_na_1 & D_na_2 & \cdots & D_na_{n-1} \end{vmatrix}.$$

If $\sum_{i=1}^n D_ix_i$ is 0, then G.J.I. results from identity (1.8). Thus it suffices to show that $\sum_{i=1}^n Dx_i = 0$. In fact,

$$\begin{aligned}
\sum_{i=1}^n D_ix_i &= \sum_{i=1}^n \sum_{j=1, j\neq i}^n (-1)^{n+i} \begin{vmatrix} D_1a_1 & D_1a_2 & \cdots & D_1a_{n-1} \\ \multicolumn{4}{c}{\dotfill} \\ \widehat{D_ia_1} & \widehat{D_ia_2} & \cdots & \widehat{D_ia_{n-1}} \\ \multicolumn{4}{c}{\dotfill} \\ D_iD_ja_1 & D_iD_ja_2 & \cdots & D_iD_ja_{n-1} \\ \multicolumn{4}{c}{\dotfill} \\ D_na_1 & D_na_2 & \cdots & D_na_{n-1} \end{vmatrix} \\
&= \sum_{1\le i<j\le n} (-1)^{n+i} \begin{vmatrix} D_1a_1 & D_1a_2 & \cdots & D_1a_{n-1} \\ \multicolumn{4}{c}{\dotfill} \\ \widehat{D_ia_1} & \widehat{D_ia_2} & \cdots & \widehat{D_ia_{n-1}} \\ \multicolumn{4}{c}{\dotfill} \\ D_iD_ja_1 & D_iD_ja_2 & \cdots & D_iD_ja_{n-1} \\ \multicolumn{4}{c}{\dotfill} \\ D_na_1 & D_na_2 & \cdots & D_na_{n-1} \end{vmatrix} \\
&\quad + \sum_{1\le i<j\le n} (-1)^{n+j} \begin{vmatrix} D_1a_1 & D_1a_2 & \cdots & D_1a_{n-1} \\ \multicolumn{4}{c}{\dotfill} \\ D_iD_ja_1 & D_iD_ja_2 & \cdots & D_iD_ja_{n-1} \\ \multicolumn{4}{c}{\dotfill} \\ \widehat{D_ja_1} & \widehat{D_ja_2} & \cdots & \widehat{D_ja_{n-1}} \\ \multicolumn{4}{c}{\dotfill} \\ D_na_1 & D_na_2 & \cdots & D_na_{n-1} \end{vmatrix}.
\end{aligned}$$

By moving the i-th row to the $(j-1)$-th row in the determinant in the second sum without changing the odering of the remaining rows, we get the following expression:

$$(-1)^{j-i-1} \begin{vmatrix} D_1a_1 & D_1a_2 & \cdots & D_1a_{n-1} \\ \multicolumn{4}{c}{\dotfill} \\ \widehat{D_ia_1} & \widehat{D_ia_2} & \cdots & \widehat{D_ia_{n-1}} \\ \multicolumn{4}{c}{\dotfill} \\ D_iD_ja_1 & D_iD_ja_2 & \cdots & D_iD_ja_{n-1} \\ \multicolumn{4}{c}{\dotfill} \\ D_na_1 & D_na_2 & \cdots & D_na_{n-1} \end{vmatrix}.$$