$$(\text{Next}) \Leftrightarrow \sum_j \sum_i \left(\frac{\partial w^j}{\partial x^i} v^i - w^i \frac{\partial v^j}{\partial x^i} \right) \frac{\partial}{\partial x^j}.$$

$$\Leftrightarrow \sum_j \sum_i \left(\frac{\partial (\sum_k B'_{jk} x^k + w'_j)}{\partial x^i} \sum_\ell (B_{i\ell} x^\ell + w^i) \right.$$

$$\left. - \sum_k (B'_{ik} x^k + w'_i) \frac{\partial (\sum_\ell B_{j\ell} x^\ell + w^j)}{\partial x^i} \right) \frac{\partial}{\partial x^j} = 0$$

$$\Leftrightarrow \sum_j \sum_i \left(B'_{ji} \left(\sum_\ell B_{i\ell} x^\ell + w^i \right) - \left(\sum_k B'_{ik} x^k + w'_i \right) B_{ji} \right) \frac{\partial}{\partial x^j} = 0$$

$$\Leftrightarrow \sum_j \left(\sum_i \left(\sum_\ell B'_{ji} B_{i\ell} x^\ell + B'_{ji} w^i - \sum_k B'_{ik} B_{ji} - w'_i B_{ji} \right) \right) \frac{\partial}{\partial x^j} = 0$$

$$\Leftrightarrow \sum_j \left(\sum_\ell (B'B)_{j\ell} x^\ell - \sum_k (BB')_{jk} x^k \right) \frac{\partial}{\partial x^j} + B'w - Bw' = 0$$

$$\Leftrightarrow (B'B - BB')x + (B'w - Bw') = 0$$

$$\Leftrightarrow \quad B'B = BB' \qquad B'w = Bw'$$