The original `eqnarray*` would give this (we have to split it in separate lines):

$$A \quad = \quad B,$$
$$\sin x \quad = \quad \cos x,$$
$$\begin{pmatrix} 1 & 2 \\ 3 & 4 \end{pmatrix} = 0 \quad \left| \begin{array}{c} \Longleftrightarrow \\ \neq \end{array} \right| \quad \text{FALSE},$$
$$C \quad \Longleftrightarrow \quad D,$$
$$\text{foo} \quad = \quad \text{bar}.$$

Proof. `eqnarray*` works in the same way as `align*`, even in `proof`:

$$A = B, \qquad \sin x = \cos x,$$
$$\begin{pmatrix} 1 & 2 \\ 3 & 4 \end{pmatrix} = 0 \left| \begin{array}{c} \Longleftrightarrow \\ \neq \end{array} \right| \text{FALSE}, \qquad C \Longleftrightarrow D, \qquad \text{foo} = \text{bar}. \qquad \square$$

Proof. And the original `align*`:

$$A = B, \qquad \sin x = \cos x,$$
$$\begin{pmatrix} 1 & 2 \\ 3 & 4 \end{pmatrix} = 0 \left| \begin{array}{c} \Longleftrightarrow \\ \neq \end{array} \right| \text{FALSE}, \qquad C \Longleftrightarrow D, \qquad \text{foo} = \text{bar}. \qquad \square$$

Numbered variants — `eqnarray` first:

$$A = B, \qquad \sin x = \cos x, \tag{1}$$
$$\begin{pmatrix} 1 & 2 \\ 3 & 4 \end{pmatrix} = 0 \left| \begin{array}{c} \Longleftrightarrow \\ \neq \end{array} \right| \text{FALSE}, \qquad C \Longleftrightarrow D, \qquad \text{foo} = \text{bar}. \tag{2}$$

and `align` second:

$$A = B, \qquad \sin x = \cos x, \tag{3}$$
$$\begin{pmatrix} 1 & 2 \\ 3 & 4 \end{pmatrix} = 0 \left| \begin{array}{c} \Longleftrightarrow \\ \neq \end{array} \right| \text{FALSE}, \qquad C \Longleftrightarrow D, \qquad \text{foo} = \text{bar}. \tag{4}$$