Let $\sigma$, $\theta$ be commuting involutions of the connected reductive algebraic group $G$ where $\sigma$, $\theta$ and $G$ are defined over a (usually algebraically closed) field $k$, $k \neq 2$. We have fixed point groups $H := G^\sigma$ and $K := G^\theta$ and an action $(H \times K) \times G \to G$, where $((h, k), g) \mapsto h g k^{-1}$, $h \in H$, $k \in K$, $g \in G$. Let $G/((H \times K)$ denote $O(G)^{H \times K}$ (the categorical quotient).

Let $A$ be maximal among subtori $B$ of $G$ such that $\theta(s) = \sigma(s) = s^{-1}$ for all $s \in B$. There is the associated Weyl group $W := W_{H \times K}(A)$. We show:

1) The inclusion $A \to G$ induces an isomorphism $A/W \to G/((H \times K)$. In particular, the closed $(H \times K)$-orbits are precisely those which intersect $A$.

2) The fibers of $G \to G/((H \times K)$ are the same as those occurring in certain associated symmetric varieties. In particular, the fibers consist of finitely many orbits.

We investigate the structure of $W$ and its relation to other naturally occurring Weyl groups. We also consider the case where $k = R$. 
