It is known that binding energies calculated from the Bethe-Salpeter equation in ladder approximation can be reasonably well accounted for by an energy-dependent interaction, at least for the lowest states. It is also known that none of these approaches gives results close to what is obtained by using the same interaction in the so-called instantaneous approximation, which is often employed in nonrelativistic calculations. However, a recently proposed effective interaction was shown to account for the main features of both the Bethe-Salpeter equation and the energy-dependent approach. In the present work, a detailed comparison of these different methods for calculating binding energies of a two-particle system is made. Some improvement, previously incorporated for the zero-mass boson case in the derivation of the effective interaction, is also employed for massive bosons. The constituent particles are taken to be distinguishable and spinless. Different masses of the exchanged boson (including a zero mass) as well as states with different angular momenta are considered and the contribution of the crossed two-boson-exchange diagram is discussed. With this respect, the role played by the charge of the exchanged boson is emphasized. It is shown that the main difference between the Bethe-Salpeter results and the instantaneous approximation ones are not due to relativity as often conjectured. 