(*v*) **Metallic bonding.** In the case of metals, the ionisation energy is low. They have vacant valency orbitals and have a few valency electrons as compared to the number of valency orbitals. Thus in the atoms of metals, the electrons in the outermost orbits are loosely bound and are called *free electrons* or *conduction electrons*. One or two such electrons can be detached from the parent atom due to the attraction of adjacent atomic cores. The remainder portion of atom, which is a positively charged sphere is called a *kernel*. The free electrons are mobile in nature and move from one kernel to another throughout the metal lattice. Thus the metal crystal may be pictured *as an arrangement of positive ions immersed in a sea of mobile electrons*. The motion of these electrons is such that they are simultaneously near to two or more kernels and bind them together. The bond thus formed between the metal atoms is known as **metallic bond** and is shown in Fig. 3.13. *Hence a metallic bond may be defined as a result of simultaneous attraction of an electron by two or more than two positive ions of the metal.* Thus a metallic bond is also electrostatic in nature though partially. Because of proximity of the ions (positive), each free electron is on an average close to one nucleus or another, than it would have

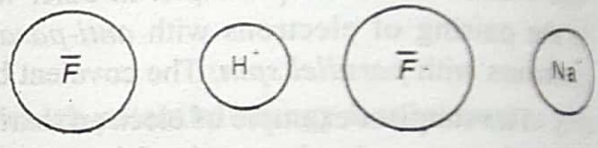

Fig. 3.12

been if it belonged to the isolated atom. This results in the decrease of potential energy of the electron forming the crystal. It is this decrease in the energy which is responsible for the metallic bond.

The covalent bond is of directional character because the electrons are localised in a way that fixes the positions of the atoms rigidly and these electrons tend to remain concentrated in the region between the two atoms. But in case of metallic bonds the electrons are spread uniformly throughout the crystal and do not exert directional influence.

The metallic bond is weaker than the covalent bond due to the fewer electrons bonding the nuclei. However, it becomes stronger for those metals in which the number of valence electrons is greater. Thus strength of metallic bond tends to increase as we move from left to right along a row in the periodic table.

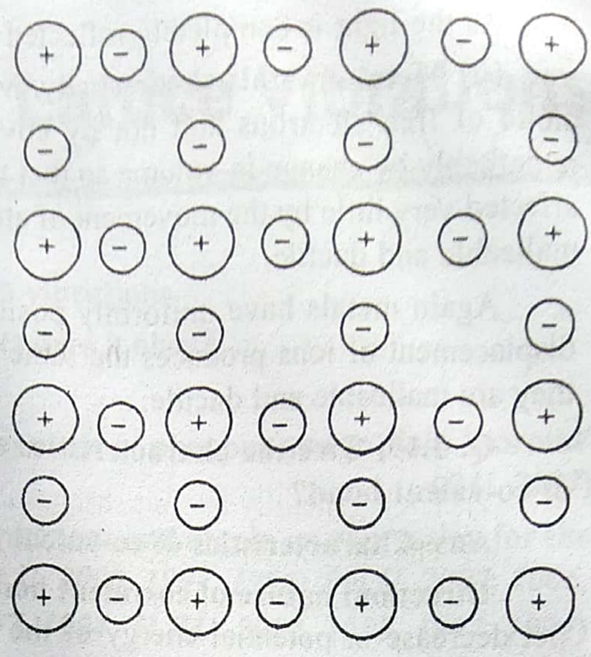

Fig. 3.13

Properties of metallic bonding: Following are the properties of metallic crystals formed by the metallic bonding:

(*i*) They are good conductors, as free electrons are accelerated under a potential difference.

(*ii*) Heat is produced in the metals when an electric current is passed. This is due to the collision of free electrons with atomic cores under the influence of current. The increase in the average K.E. of the cores results in heating.

(*iii*) The electrical resistance increases with the heating of metals, because the heating increases the probability of collisions between free electrons and atomic cores.

(*iv*) Metal crystals are of unlimited size due to the unsaturated nature of the bonds.

(*v*) As the metals have uniformly positive ions placed in uniform electron gas, the displacement of ions produces same environments. Hence metals can be deformed and they are malleable and ductile.

(*vi*) Metals have high tensile strength because of stronger attraction between positive ions and electrons.

(*vii*) They have high thermal and electrical conductivity because of the presence of free electrons.

(*viii*) The properties of an alloy formed by a mixture of metals do not depend upon the relative proportion of the metals because atoms interact through the medium of common electron gas.

(*ix*) The opacity and lustre of metals is also due to the presence of free electrons in bonding. These electrons first absorb energy from the electromagnetic radiations and then radiate the same producing lustrous appearance.

Examples. Some examples are Alkalie metals like *Na* and *K*.