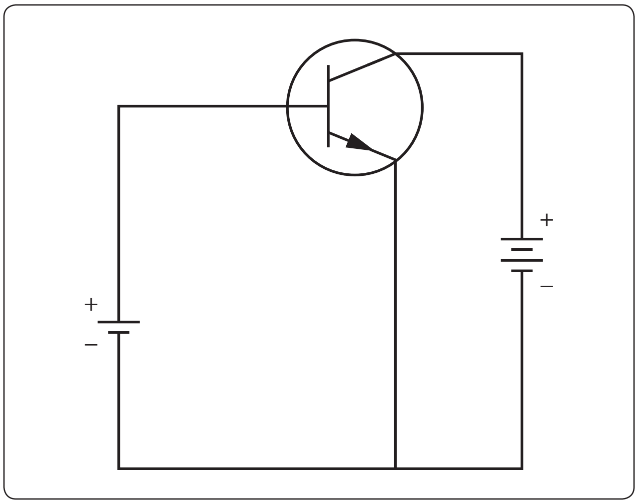

Figure 12-222. *NPN transistor.*

The second PN junction, which is the base-collector junction, is reverse biased. This prevents the majority carriers from crossing the junction, thus creating a high-resistance circuit. It is worth noting that there still is a small current passing through the reversed PN junction in the form of minority carriers—that is, electrons in the P-material and holes in the N-material. The minority carriers play a significant part in the operation of the NPN transistor.

Figure 12-223 illustrates the basic interaction of the NPN junction. There are two batteries in the circuit used to bias the NPN transistor. Vbb is considered the base voltage supply, rated in this illustration at 1 volt, and the battery voltage Vcc, rated at 6 volts, is called the collector voltage supply.

Current within the external circuit is simply the movement of free electrons originating at the negative terminal of the battery and flowing to the N-material. *[Figure 12-223]*

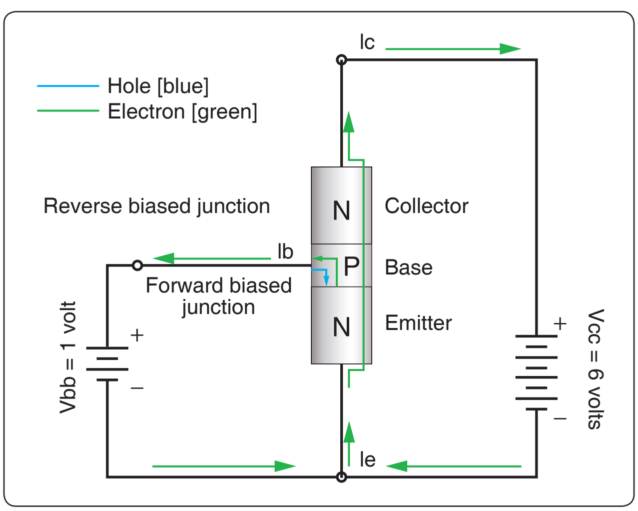

Figure 12-223. *NPN Junction.*

As the electrons enter the N-material, they become the majority carrier and move through the N-material to the emitter-base PN junction. This emitter-base junction is forward biased at about 0.65 to 0.7 volts positive with respect to the emitter and presents no resistance to the flow of electrons from the emitter into the base, which is composed of P-material. As these electrons move into the base, they drop into available holes. For every electron that drops into a hole, another electron exits the base by way of the base lead and becomes the base current or Ib. Of course, when one electron leaves the base, a new hole is formed. From the standpoint of the collector, these electrons that drop into holes are lost and of no use. To reduce this loss of electrons, the transistor is designed so that the base is very thin in relation to the emitter and collector, and the base is lightly doped.

Most of the electrons that move into the base fall under the influence of the reverse bias of the collector. While collector-base junction is reverse biased with respect to the majority carriers, it behaves as if it is forward biased to the electrons or minority carriers in this case. The electrons are accelerated through the collector-base junction and into the collector. The collector is comprised of the N-type material; therefore, the electrons once again become the majority carrier. Moving easily through the collector, the electrons return to the positive terminal of the collector supply battery Vcc, which is shown in *Figure 12-223* as Ic.

Because of the way this device operates to transfer current (and its internal resistances) from the original conduction path to another, its name is a combination of the words "transfer" and "resistor"—transistor.

PNP Transistor Operation

The PNP transistor generally works the same way as the NPN transistor. The primary difference is that the emitter, base, and collector materials are made of different material than the NPN. The majority and minority current carriers are the opposite in the PNP to that of the NPN. In the case of the PNP, the majority carriers are the holes instead of the electrons in the NPN transistor. To properly bias the PNP, the polarity of the bias network must be reversed.

Identification of Transistors

Figure 12-224 illustrates some of the more common transistor lead identifications. The methods of identifying leads vary due to a lack of a standard and require verification using manufacturer information to properly identify. However, a short description of the common methods is discussed below.

Figure 12-224D shows an oval-shaped transistor. The collector lead in this case is identified by the wide space between it and the lead for the base. The final lead at the