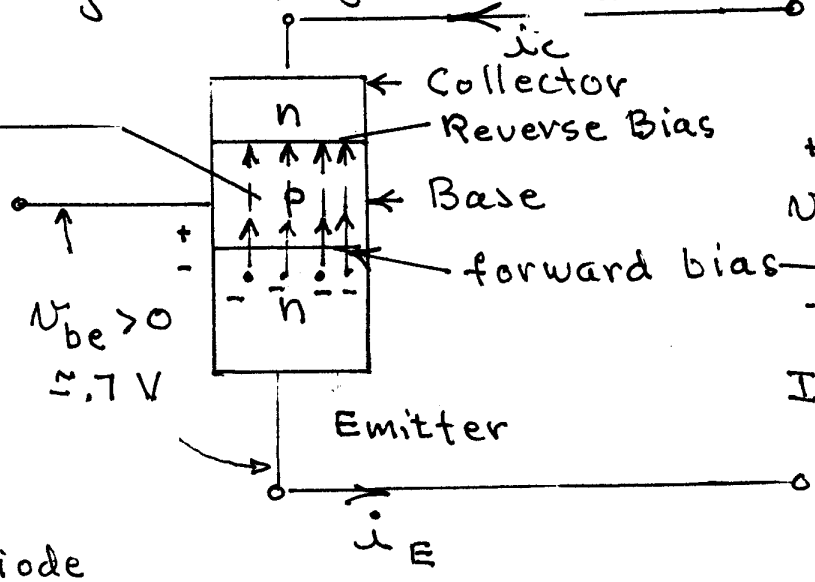
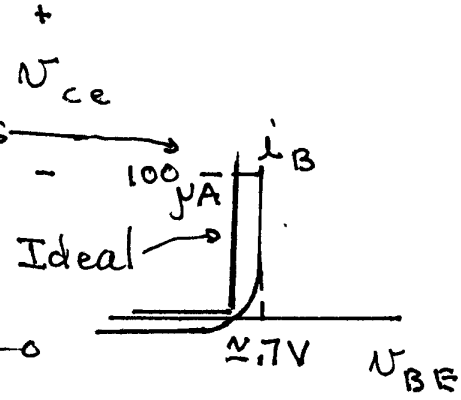
Basic Fig 13.3 page 619 The Bipolar



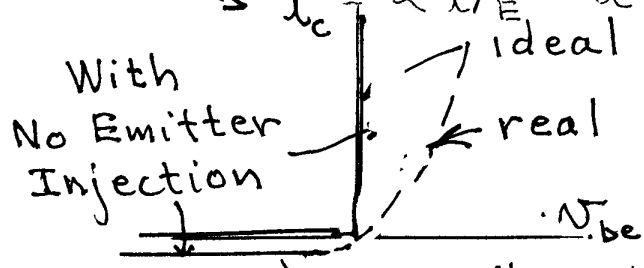
This is a Diffusion process

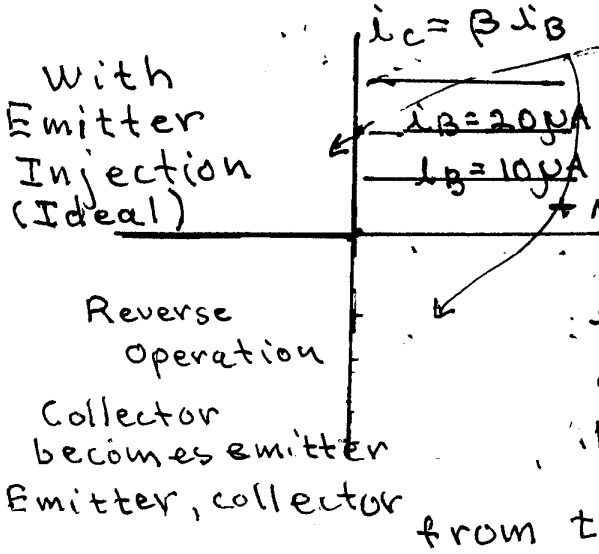
Most of the electrons reach the Collector Diode



collector Diode

$i_c = \alpha i_E$ $\alpha \simeq .99$

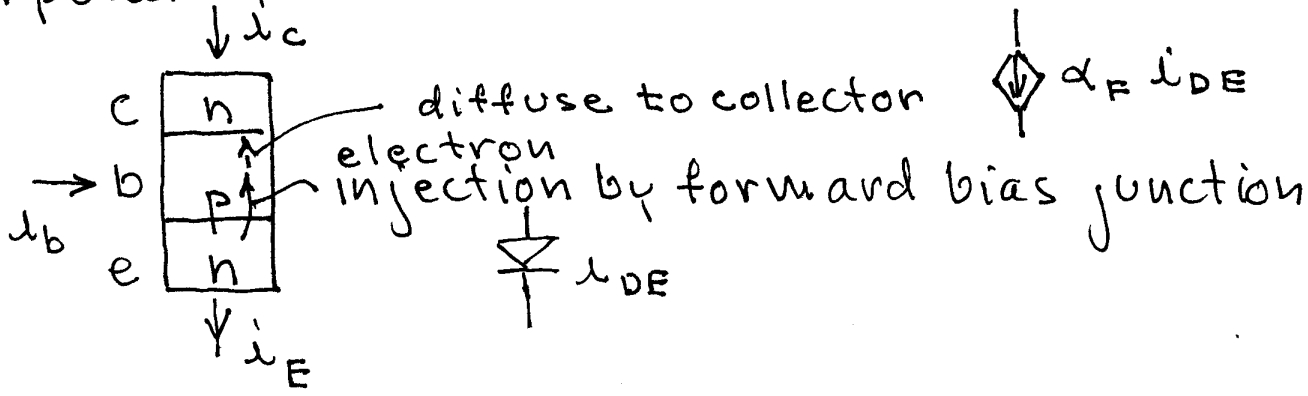




what happens here? collector-base becomes forward biased. Now we have the collector injecting electrons as well as the emitter. The base current Now becomes high from the extra carriers

The base current is the recombination current of the electrons on their way to the collector

Bipolar Ebers-Moll Model



In forward active mode collector is reversed bias (+ potential). Thus collector "attracts" electrons diffusing accross the base (when they reach the collector-base depletion region)

The $(1-\alpha_F) i_{DE}$ electrons combine with base holes supplied by i_b

Thus $i_C = \alpha_F i_E$

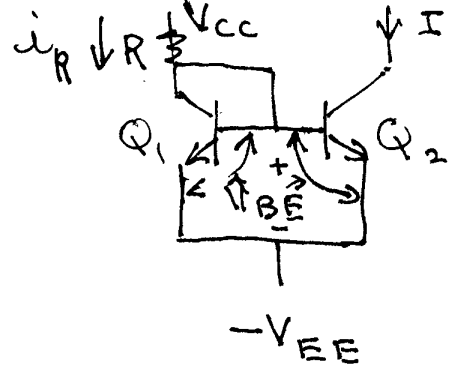
$$i_b = (1-\alpha_F) i_E$$

and thus also

$$i_C = \frac{\alpha_F}{(1-\alpha_F)} i_b = \beta i_b$$

Since $\alpha_F \simeq .9$ or greater β is large i_b is small.

Example: Current mirror



$$I_R = \frac{V_{CC} - (-V_{EE}) - V_{BE}}{R}$$

Since V_{BE}'s are same

I_C's are same

Thus $I = I_R$ ($I_B \simeq 0$)