

If the separate-excitation current is constant, traction characteristics are quite different.

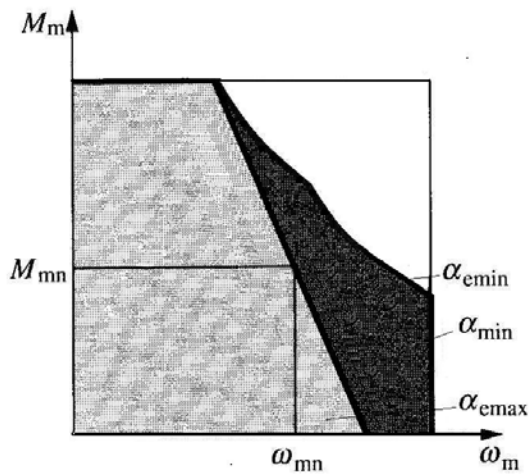


Fig. 4.143A Characteristics in traction with field weakening.: separate excitation.

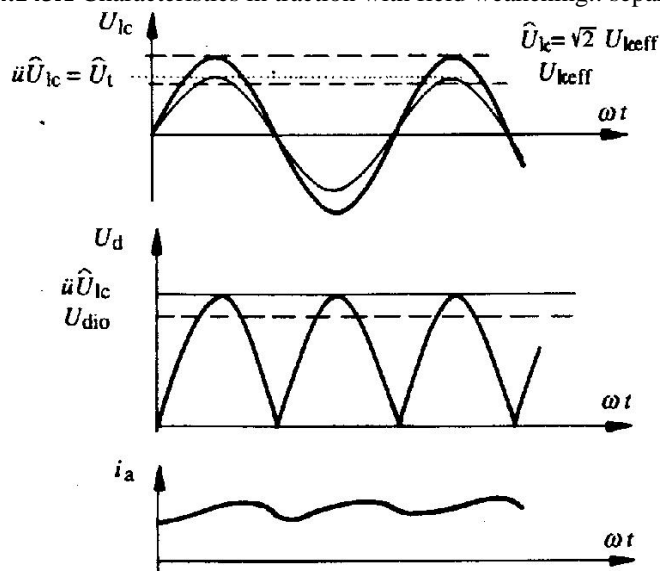


Fig. 4.113 DC-motor with diode rectifier: motor current and voltages.

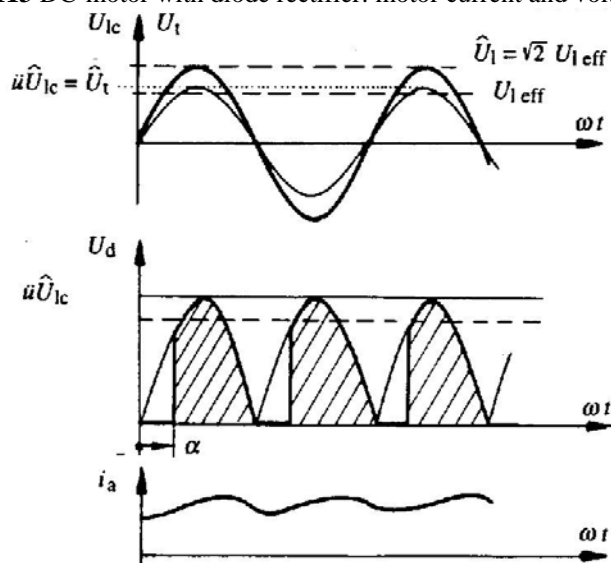


Fig. 4.123 DC-motor with controlled rectifier: motor current and voltages.

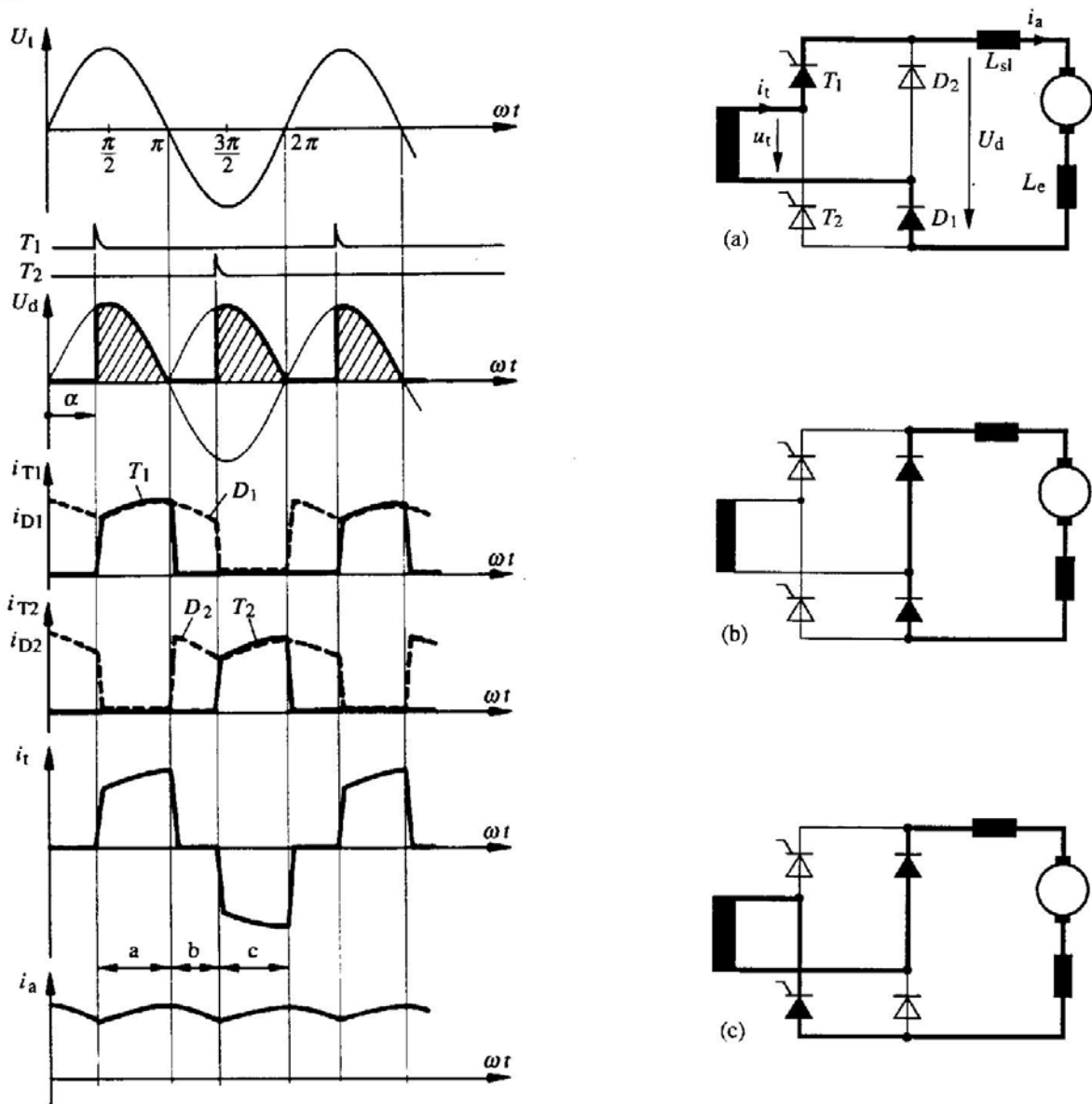


Fig. 4.126 DC-motor with controlled rectifier: currents and voltages.

It is clear to see the phase-shift between the voltage  $u_t$  at transformer secondary and the current  $i_t$  across this winding. This causes transit of reactive power in contact line and railway power supply network, with losses and temperature rises. More complex mountings (fig.4.140) were used to limit these problems, by reducing reactive power with a ratio of 4 for the same active power (fig. 4.141).

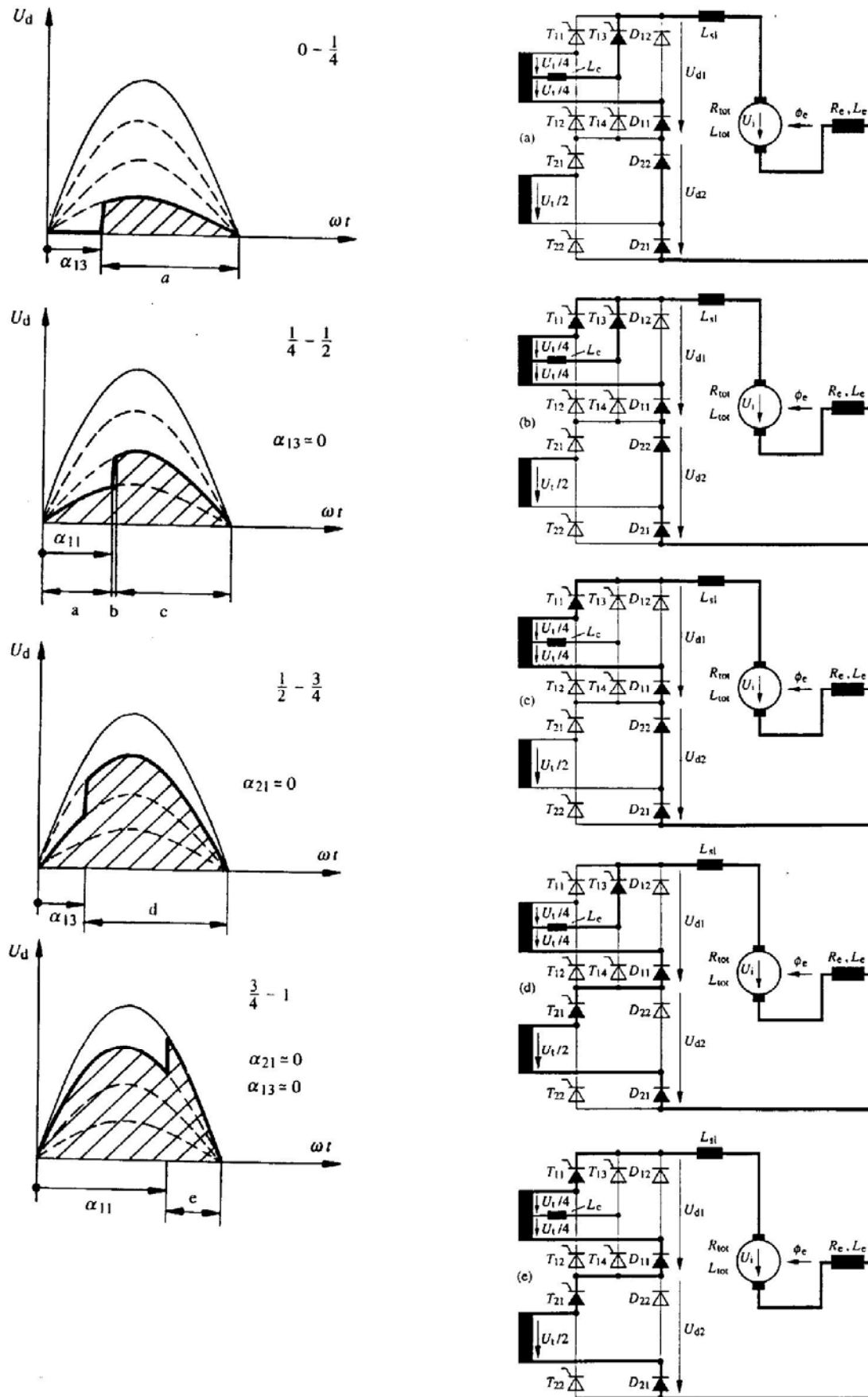


Fig. 4.141 DC-motor with "4-step" controlled rectifier : currents and voltages.

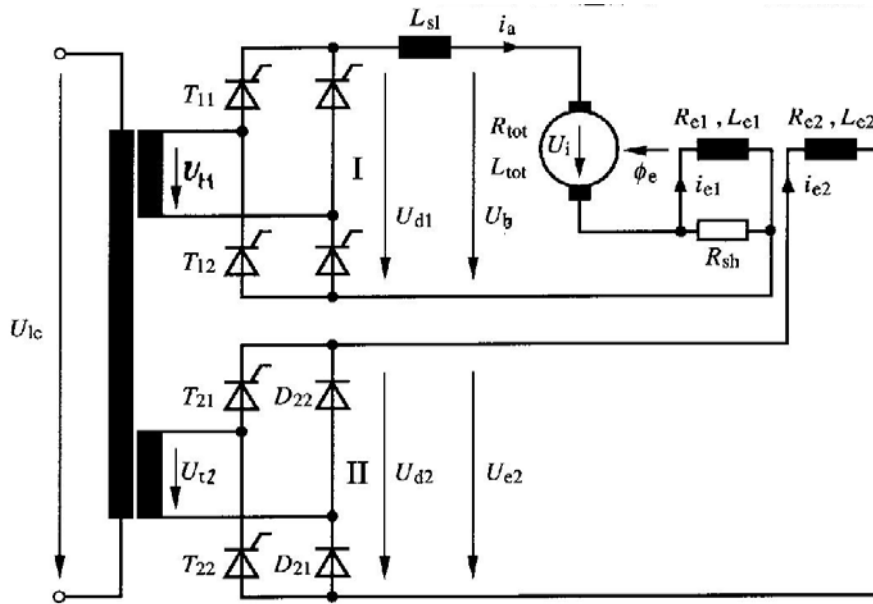


Fig. 4.148 DC-motor with controlled rectifier in compound excitation.

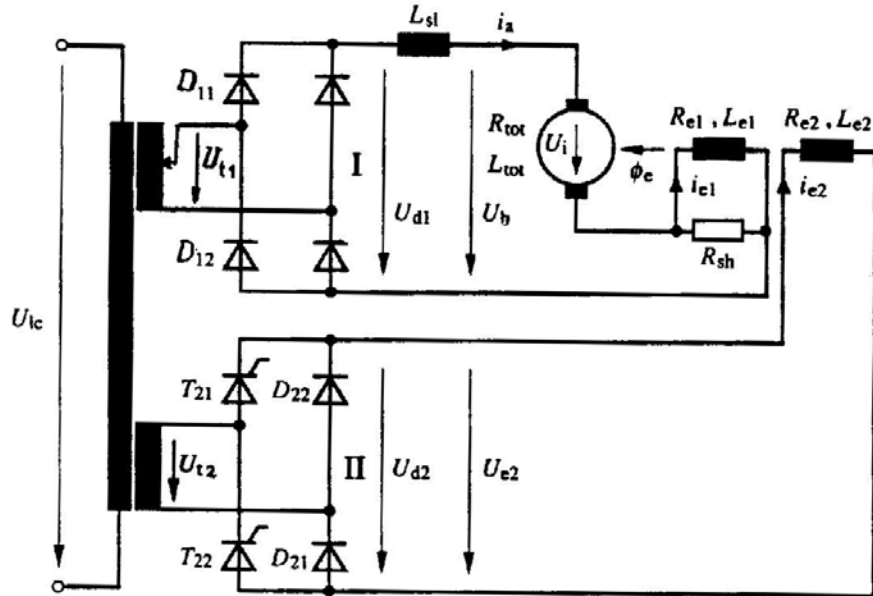


Fig. 4.148A DC-motor with controlled rectifier in compound excitation: hybrid control.

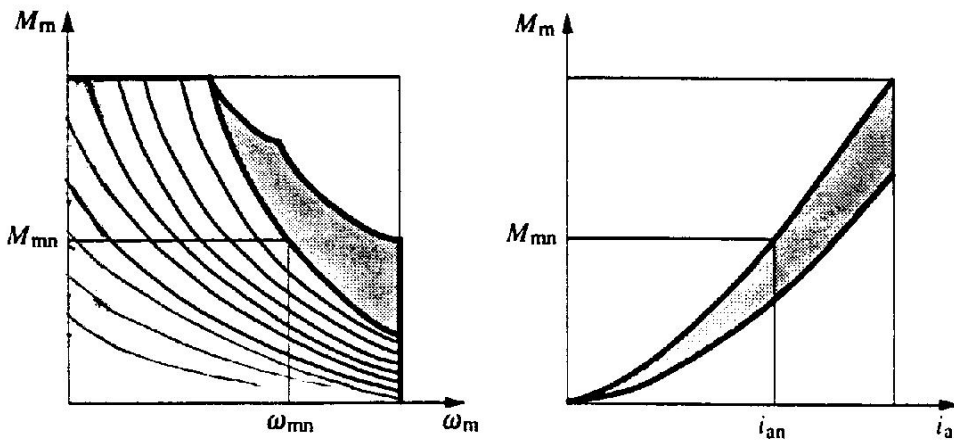


Fig. 4.148B DC-motor with compound excitation: hybrid control, characteristics.