17.11 EFFECT OF GROUNDING ON STABILITY

The line-to-ground fault is the most common fault and the magnitude of fault current depends upon the zero, positive and negative sequence impedances. Of these impedances, positive- and negative-sequence impedances are practically constant. The zero-sequence impedance depends upon the impedance of the grounding resistor or reactor, number of grounding points, the zero-sequence impedance of the lines and of the tower-footings. Normally a *L-G* fault is less severe as compared to other faults due to high value of zero-sequence impedance. The effect of a double line-to-ground fault approaches that of a line-to-line fault and a line-to-ground fault approaches no fault when zero-sequence impedance is appreciably large. Therefore, from stability point of view, the impedance grounding is better than solid grounding especially during ground faults. Either resistors or reactors are used to decrease the severity of ground faults. Reactors are more commonly used as they are cheaper than the equivalent values of resistors.

However, it is to be noted that at some locations resistors are more useful as compared to reactors from stability point of view. Consider the system of Fig. 17.22. In case of a *L-G* fault on the system, the output of the generator is reduced and hence the input to the motor is decreased. For the generator $P_s > P_e$, therefore, the generator accelerates and for the motor the mechanical output is more than the electrical input, hence the motor decelerates. If the fault is closer to the generator, the acceleration of generator is more; similarly if the fault is closer to the motor, the input to the motor is affected more and hence the motor deceleration is more. A resistor in the generator neutral will increase the output of the generator during *L-G* fault and hence the acceleration is reduced. The grounding resistor consumes power during a ground fault and thus exerts braking effect on the synchronous machine which is greater, the closer the fault is to the resistor and the closer the machine is to the fault. A grounding resistor located near a generator is, therefore, beneficial. However, a grounding resistor should neither be used near an actual or equivalent synchronous motor nor it should be used near a synchronous condenser, as such machines already are retarded by faults. In a two-machine system, it is, therefore, advisable to have resistance gounding at the sending end and reactance grounding at the receiving end. it is to be noted that during 3-phase faults neither resistance grounding, nor reactance grounding have any effect on power transfer and hence on the stability of the system.

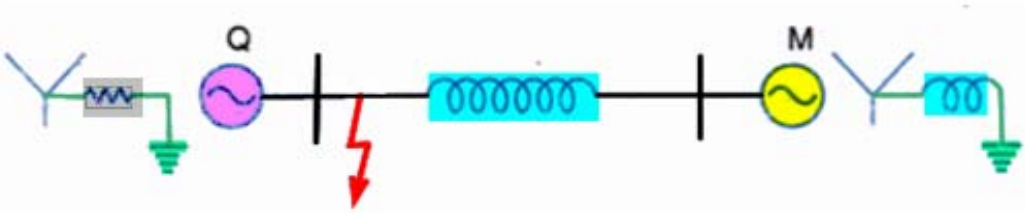

Fig. 17.22 Synchronous generator and a motor connected through a line—*L-G* fault.