Methods of voltage control and schemes for excitation systems:

The reliability of an exciter system is essential and all modern machines have their own exciters, to avoid the serious consequence of a failure of a common supply. Direct coupled exciters are preferred, but their ouput is limited to about 350 kW, at a shaft speed of 3000 rpm; however geared drive may be used. Gear drives are not favoured for the large output.

In large synchronous machines, the field winding is always on the rotor as discussed earlier. We will discuss various schemes for supplying d.c excitation to the field winding of large synchronous machine briefly.

I. One excitation scheme is illustrated in fig (a). the pilot exciter and the main exciter are driven by the synchronous machine main shaft. The pilot exciter, which is a small dc shunt generator, feeds the field winding of the main exciter, which is a separately excited d.c. generator. The main exciter feeds the field winding of the synchronous machine, through slip ring and brushes. The regulator keeps the alternator terminal voltage constant.
The conditions under which exciters work are not ideal for d.c. machines. The speed is rather high for turbo alternators and is somewhat low for the water-wheel machines. The voltage range is also exceptionally wide, so the machines are large for their rating. Main and pilot exciters are employed. Vertical machines carry the exciters at the top of the main shaft. If the main exciter is arranged commutator up , the pilot above it with commutator down, and the rotor sliprings between, the whole assembly can be conveniently enclosed with all the brushgear in one place for inspection, and an overall reduction of height.

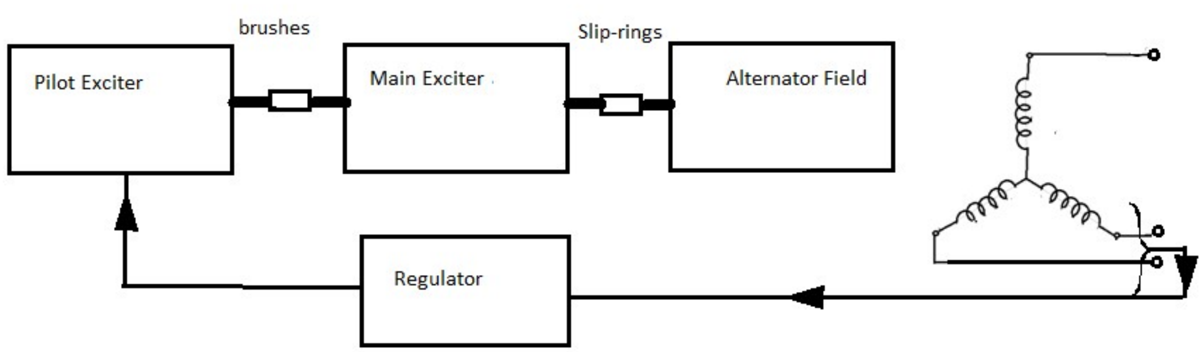

Fig. (a) : Scheme of Exciting the Main Alternator Field with Pilot Exciter

II. The excitation scheme shown in fig. (b) consists of main a.c. exciter and stationary solid state rectifier. The a.c. exciter which is coupled with the alternator has rotating field and stationary armature. The armature output from the main exciter has high frequency (400 Hz). The output is fed to stationary rectifier. After rectification, the d.c. power is fed to the main alternator field, through slip-rings and brushes. The regulator keeps the alternator terminal voltage constant.

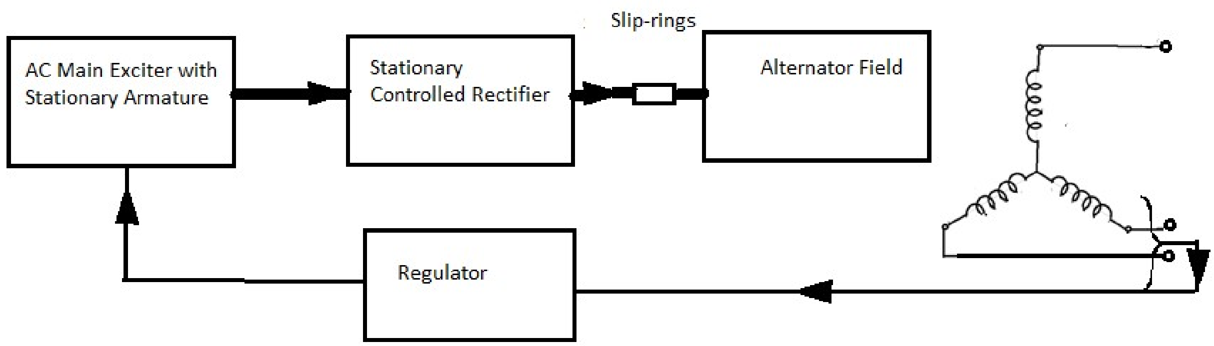

Fig. (b) : Scheme of Exciting the Main Alternator Field with AC Main Exciter

III. A third scheme of supplying d.c. power to the rotating field winding is illustrated in fig (c). the A.C. exciter coupled to the alternator, has stationary field and rotating 3-phase armature. The 3-phase power of the A.C. exciter is fed along the main shaft, to the rotating rectifiers mounted on the same shaft. The output from the rectifier is given to the main alternator field along the main shaft without any slip-rings and brushes. In other words, the power flows through the wires mounted on the main shaft, from the A.C. exciter, from the A.C. exciter to the rectifier and from the rectifier to the main alternator field. Since there is no sliding contacts and brushes, this arrangement of exciting the synchronous machine is called *'brushless excitation system'*. The regulator keeps the alternator terminal voltage constant.

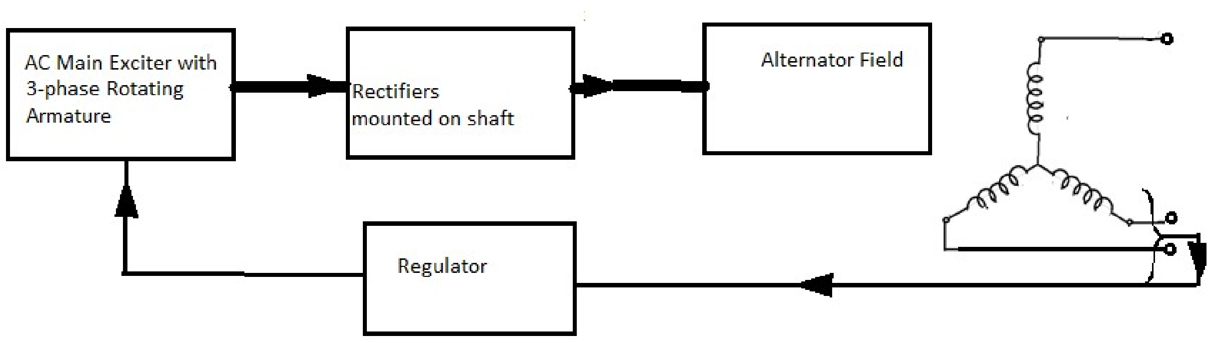

Fig. (c) : Brushless Excitation System for a Synchrnous Machine

For large (> 500 MW) turbo-generator excitation system, the direct current required by the rotating field winding increases considerably (up to 10 kA or more). In such cases the brush gear design becomes more complicated and the reliability of the turbo-generator operation decreases. So, the brushless system is preferred.