

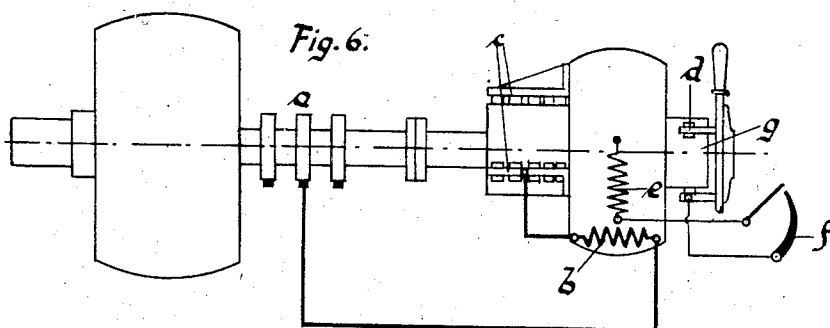
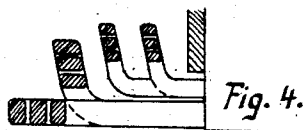
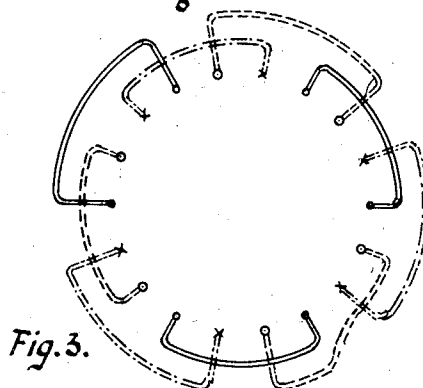
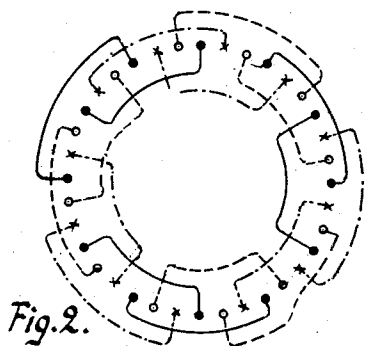
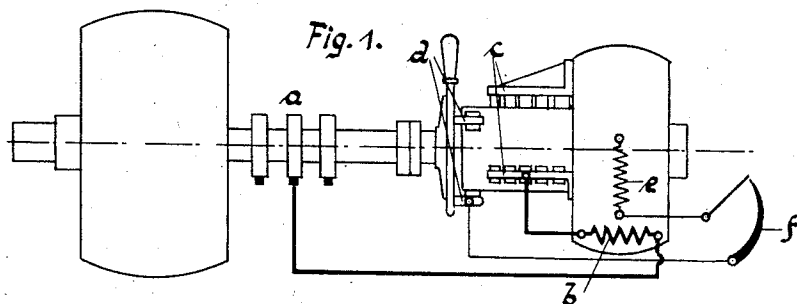
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APPARATUS FOR THE COMPENSATION OF ASYNCHRONOUS MACHINES
BY SHUNT COMMUTATOR MOTORS CONNECTED IN CASCADE

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UNITED STATES PATENT OFFICE.

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APPARATUS FOR THE COMPENSATION OF ASYNCHRONOUS MACHINES BY SHUNT COMMUTATOR MOTORS CONNECTED IN CASCADE.

Application filed July 21, 1925, Serial No. 45,122, and in Germany December 30, 1924.

It is old to effect the phase-compensation of the primary current of an asynchronous machine by means of a commutator-shunt machine connected in the secondary circuit.

5 Certain preliminary conditions are necessary to obtain a defined phase-compensation, as set forth for instance, in the German Patent No. 232282.

10 However, the practical experience has shown that the arithmetical predetermination of the required characteristic of compensation is difficult and uncertain, and that a subsequent correction is rarely ever possible. In the construction of the commutator-machine provided with a compensation-winding which is absolutely necessary for obtaining sparkless commutation, the angle between said compensation-winding and exciter-winding is also fixed (generally 20 90 degrees) and a change of said angle by means of shifting the brushes reduces the effect of the compensation-winding.

25 There is still another disadvantage consisting in the drop of voltage, caused by the variable brush-contact resistance, influencing the effect of the phase-compensation when the necessary commutator-voltage is extraordinarily low. The disadvantage last mentioned may be prevented in the manner described in the German Patent No. 232664 by supplying the exciter-winding across a special set of brushes, arranged in the construction according to said patent on the same axis as the main-brushes and adjustable relatively to the latter.

35 The object of the invention described hereinafter is to effect another improvement by arranging the set of exciter-brushes so as to be completely independent of the set of main-brushes, and separately adjustable relatively thereto.

The invention is diagrammatically illustrated in the accompanying drawings in which

45 Figure 1 is an elevation of the invention.

Fig. 2 shows the arrangement with a 3-phase six polar compensation and exciter winding with the main and exciter brushes arranged coaxially.

50 Fig. 3 illustrates a modification of the arrangement in Fig. 2.

Fig. 4 shows the arrangement of the end turns with the winding shown in Fig. 2.

Fig. 5 shows the arrangement of the end turns for the winding according to Fig. 3. 55

Fig. 6 illustrates a modification of the arrangement shown in Fig. 1.

The slip-rings *a* of an asynchronous motor are connected to the three terminals of the open compensation-winding *b* arranged in the stator of the commutator-machine. The other three terminals of the compensation-winding *b* are connected to the set of main brushes *c*. An independently adjustable set of brushes *d* is arranged on the commutator-machine and connected to the exciter-winding *e* of the stator. By means of a resistance *f*, or a choke-coil, inserted in the exciter-circuit, it is possible to make in a known manner, certain changes or adjustments of the excitation, and thereby of the compensation-characteristic. The commutator-machine can be driven independently or by the asynchronous-machine. In the latter case a mechanical connection is arranged between the two machines, either for direct coupling, or indirect coupling through the medium of any form of gearing. By the arrangement of an independent and separately adjustable set of exciter-brushes the following advantages are obtained: 80

Any suitable angle between the compensation-voltage and the exciter-voltage can be adjusted and, therefore, the compensation-characteristic can be changed in any desired manner within certain limits. Consequently, a precise predetermination is unnecessary and also it may be assured that the desired compensation will be obtained. The compensation can further be altered during working by shifting the brushes and, eventually, by switching a resistance or a choke-coil into the exciter-circuit. By the same measure a simultaneous regulation of the speed of the commutator machine is also made possible. 85

Heretofore, to obtain a maximum compensation, it was necessary to displace the exciter-winding at 90 electrical degrees relatively to the compensation winding. According to the present invention this displacement is unnecessary because that angle can be obtained with any suitable arrangement of the exciter-winding, because of the possible adjustment of the brushes. In many cases this arrangement provides a 100

technical advantage in regard to the winding, as will be more clearly explained in the following.

Fig. 2 represents diagrammatically the arrangement of a three-phase six-polar compensation- and exciter-winding, with the corresponding main- and exciter-brushes situated on the same shaft of the brush-rocker. In this case and in consequence of the displacement of the exciter-winding at 90 degrees relatively to the compensation-winding it is necessary to arrange the end turns of the windings in four planes which means a troublesome complication of the winding-operation, and results in a rather large protrusion of the end turns. If now the set of exciter-brushes, according to the present invention, is adjusted at about 90 electrical degrees relatively to the main brushes, both windings can be arranged coaxially, that is, they have the same axis, and can be simultaneously wound as shown in Fig. 3. Therefore, the winding-operation is materially simplified. The end turns can be arranged in two planes only, whereby their protrusion is approximately halved. Fig. 4 shows in longitudinal section the arrangement of the end turns for the diagram Fig. 2, and Fig. 5 that for the diagram Fig. 3.

In the arrangement according to the diagram of connection shown in Fig. 1, the voltage at the exciter-brushes depends on the voltage-drop in the rotor of the commutator-machine.

In case it is desirable to eliminate this dependency in order to obtain a special characteristic of the phase-compensation at different loads, according to the invention, a second winding connected to a second collector is arranged on the rotor, and preferably inserted in the slots of the main winding, said second winding only supplying the exciter-load of the commutator-machine. Fig. 6 shows an example of this arrangement. The connection of the main commutator and the compensation-winding remains the same. The exciter-brush set bears against the small auxiliary commutator *g*, while in the same manner, as shown in Fig. 1, a resistance or a choke-coil may be inserted in the exciter-circuit. The auxiliary exciter-winding can be constructed for producing an optimal voltage differing from, and independent of, that at the main-commutator. This modification is advantageous especially at small compensation-voltages for the reason that the exciter-winding can be constructed in a simpler

manner by the use of a higher exciter-voltage, and therefore the required regulating-resistance is cheaper, and the influence of the contact resistance is reduced.

I claim as my invention:

1. In an apparatus of the type described for the compensation of the phase displacement of an asynchronous machine, an asynchronous machine, a shunt commutator machine connected in cascade with the asynchronous machine for phase-compensating only, a compensating winding on the stator of the shunt commutator machine, an exciter winding in the stator of the shunt commutator machine, a set of main brushes in the circuit of the compensating winding, a set of exciter brushes in the circuit of the exciter winding, and means for shifting the sets of said brushes entirely independently of each other.

2. In an apparatus of the type described for the compensation of the phase displacement of an asynchronous machine, an asynchronous machine, a self-excited shunt commutator machine for phase-compensation only, a compensating winding in the stator of the commutator machine, an exciter winding in the stator of the commutator machine, a resistance device, a set of main brushes in the circuit of the compensating winding of the commutator machine, a set of exciter brushes in the circuit of the exciter winding of the commutator machine and the resistance device, and means for shifting the set of exciter brushes entirely independently of the set of main brushes.

3. In an apparatus of the type described for the compensation of the phase displacement of an asynchronous machine, an asynchronous machine, a self excited shunt commutator machine for phase-compensation only, a compensating winding in the stator of the commutator machine, an exciter winding in the stator of the commutator machine, a resistance device, a set of main brushes in the circuit of the compensating winding, a set of exciter brushes in the circuit of the exciter winding and the resistance device, means for directly connecting the self excited shunt commutator machine to the asynchronous machine, and devices for shifting the set of exciter brushes entirely independently of the set of main brushes.

In testimony, that I claim the foregoing as my invention, I have signed my name this 23rd day of June, 1925.

LUDWIG HARTWAGNER.