MANAGEMENT OF DYNAMO-ELECTRIC MACHINERY. PART 1; INSTRUCTION PAPER

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MANAGEMENT OF DYNAMO-ELECTRIC MACHINERY

PART I

INSTRUCTION PAPER

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MANAGEMENT OF DYNAMO-ELECTRIC MACHINERY.

The object of this instruction paper is to set forth the most important features which must be considered in the actual handling and operation of electric generators and motors. The principles and general construction of direct-current (D. C.) and alternating-current (A. C.) generators and motors, are treated elsewhere.

The subject may be divided into three parts as follows:

A. The Selection, Erection, Connection, and Operation.
B. The Inspection and Testing.
C. The Troubles or "Diseases" and Remedies.

SELECTION OF A MACHINE.

The voltage, capacity, and type of machine are dependent upon the system to which it is to be connected, and the purpose for which it is to be utilized, but there are certain general features which should be considered in every case.

Construction. This should be of the most solid character and guaranteed first-class in every respect, including materials and workmanship.

Finish. A good finish is desirable, since it is likely to cause the attendant to take greater care of the equipment.

Simplicity. The machine should be as simple as possible in all its parts; peculiar or complicated features should be avoided, unless absolutely essential for the operation of the system.

Attention. The amount of attention required by the machine should be small. The number of screws or nuts should be reduced to a minimum, and they ought always to be provided with some locking device to prevent them from becoming loose. The brushes should be capable of being easily adjusted and self-feeding, so that they may "follow" or make up for any trifling eccentricity of the commutator. The bearings should be self-oiling, and in the smaller sizes self-aligning.

Handling. An eye-bolt or other means by which the machine can be easily lifted and moved is desirable. It ought to be possible to take out the armature conveniently by removing one of the

bearings, or the tops of the field magnet, frame and bearings, or by moving the halves sideways if the frame is split vertically. The armature and field windings should be so designed and mounted that their removal for repairs is an easy matter.

Interchangeability. The machine selected should preferably be one of a regular and standard type, so that extra parts can be obtained without needless delay.

Regulation. Some form of regulating device should be provided by means of which the E. M. F. or current of a generator, or the speed, and in some cases the direction of rotation of a motor, can be readily and accurately controlled.

Form. The machine should be symmetrical, well-proportioned, compact and solid in form. The large and heavy portions should be placed as low as possible, to give greater stability.

Weight. It is a mistake to select a very light machine when it is for stationary use, since weight increases its strength, stability, and durability.

Capacity. This should be ample for the work to be done; in fact it is advisable to allow a margin for increase. The machine should be provided with the maker's name-plate, specifying the rated current, voltage, speed and capacity. The manufacturer should also guarantee the following: That the machine does not heat up in any part of its windings, to more than 50° C, after a run of six hours' duration, under rated load conditions;* also that it is able to carry a 25 per cent overload for two hours, and momentary overloads of 50 per cent, without excessive heating or sparking.

Cost. It is usually an error to select a generator or motor simply because it is cheap, since both the materials and workmanship required for the construction of a high-grade electrical machine are costly.

MECHANICAL CONDITIONS.

Location. The place chosen for the machine should be *dry, free from dust or grit, light, and well ventilated.* It must also be arranged so that there is room enough for the removal of the armature without shifting or turning the machine.

Foundations. It is of great importance to have the machine

*NOTE. By resistance measurements.

firmly placed upon a good and solid foundation; otherwise, no matter how well constructed and managed, the vibrations occurring on a poor foundation will produce sparking at the brushes, and its accompanying troubles.

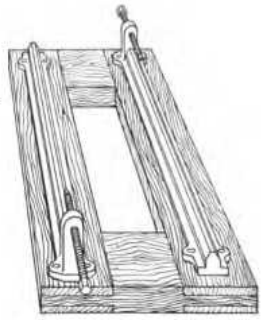

Fig. 1.

It is also necessary, if the machine is belt-driven, to mount it upon rails or a sliding bed-plate provided with holding-down bolts and tightening screws for aligning and adjusting the belt while the machine is in operation. (See Fig. 1). The machinery foundations consist of a mass of stone, masonry, brickwork, or concrete, upon which the machinery is placed and usually held firmly in place by bolts passing entirely through the mass. These bolts are built into the foundations, the proper position for them being determined by a wooden template suspended above the foundation, as shown in Fig, 2. The bolts are preferably surrounded by iron

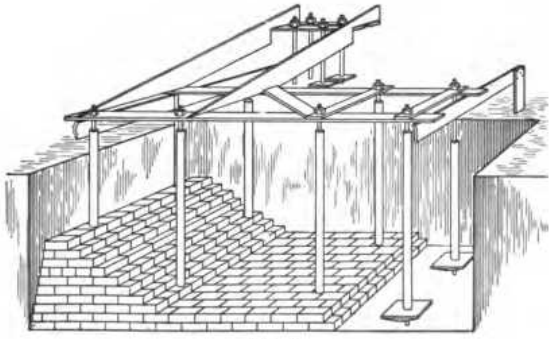

Fig. 2.

pipe that fixes them longitudinally but allows a little side play which may be necessary to enable them to enter the bed-plate

holes readily. The brickwork for machinery foundations should consist of hard burned bricks of first quality, *laid in good cement mortar*. Ordinary *lime mortar is entirely unfit* for the purpose, being likely to crumble away under the effect of the vibrations caused by the machinery. Brick or concrete foundations should be finished with a cap of bluestone or cement. This tends to hold the foundation together, and forms a level surface upon which to set the machinery. If the engine and generator are provided with a cast-iron sub-base, the capping may be dispensed with

Fixing the Machine. In fixing either direct-connected or belt-driven machines, first determine, with a long straight edge and spirit level, if the top of the foundation is level and true. If this is found to be the case, the holding-down bolts may be dropped into the holes in the foundation, if they are not already built in, and the machine carefully placed thereon, the ends of the bolts being passed through the holes in the bed-plate and secured by a few turns of the nuts. The machine should then, if belt-connected, be carefully aligned with the transmitting pulley or fly wheel. Particular attention should be paid to the alignment of the pulleys in order that the belt may run properly. If direct-connected, the dynamo bed-plate and armature shaft must be carefully aligned and adjusted with respect to the engine shaft, raising or lowering the bed-plates of the corresponding machines by means of thin cast-iron or other wedges; and the generator frame should also be adjusted to its proper height by means of thin strips of metal or fiber set between its supporting feet and the bed-plate. Having thus aligned and leveled the machine, it should next be grouted with thin cement. This is done by arranging a wall of mud or wooden battens around the bed-plates of the machines, and running in thin cement until the holding-down bolt holes are filled, and the cement has risen to the level of the under side of the bed-plate. When the cement has set, the wall may be removed and the nuts on the holding-down bolts drawn up. This firmly fixes the machine upon its foundation.

Mechanical Connections. Various means are employed to connect the engine or other prime mover with the generator, or the motor with the apparatus to be driven. The most important are as follows:

Direct Connection.
Belting.
Rope Driving.
Toothed Gearing.

Other apparatus, such as shafting, clutches, hangers and pulleys, are used in connection with the above means.

Direct Connection. This is the simplest, and for that reason the most desirable, means of connection, provided it can be carried out without involving sacrifices that offset its advantages. This

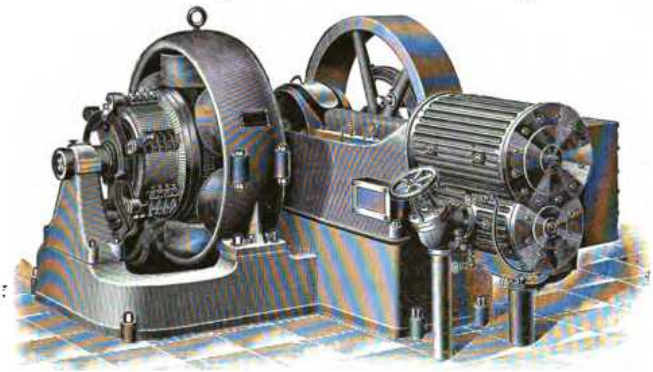

Fig. 3.

method, also called direct coupling or direct driving, compels the engine and generator to run at the same speed, which gives rise to some difficulty, as the most desirable speeds of the two machines do not usually agree. The natural speed of a generator is high, while that of an engine is low; hence to obtain the same voltage from a direct-connected generator, more inductors are necessary, or the flux cut must be increased. Accordingly, the armature and frame of the direct-connected generator must be larger, thus making it a more expensive machine than the belt-driven.

The direct connection of an engine and generator is accomplished in several ways; the simplest of which consists in mounting the armature of the generator directly on one end of the shaft of the engine. This may be accomplished in any one of several