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INDUCTION MOTOR

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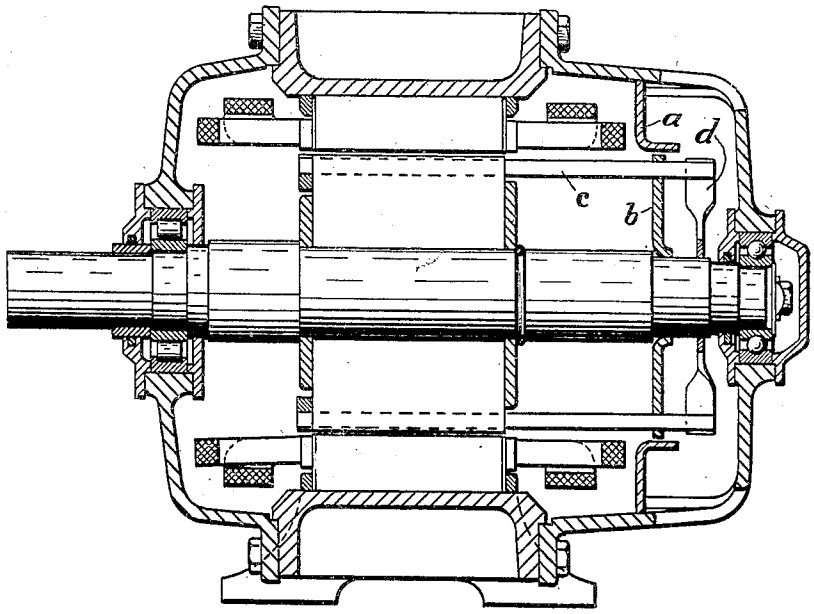

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UNITED STATES PATENT OFFICE

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INDUCTION MOTOR

Application filed January 13, 1931, Serial No. 508,420, and in Germany January 24, 1930.

If an induction motor with a short-circuited rotor has to be started or reversed in rapid succession, as is known, a large amount of energy is converted into heat in the rotor winding, and this heats the winding. This is particularly the case when the motor has to work at starting against great resistances, or when it has to accelerate masses having a large moment of inertia. The heating of the rotor winding may, under some circumstances, be so considerable that the safety of the operation is endangered. In designing motors for such work, therefore, it is usually necessary to employ special means for removing this waste heat from the rotor.

The removal of the heat, however, is associated with special difficulties when the internal parts of the machine are to be protected against injurious external influences, such as dust, vapours and the like, by totally, or almost totally enclosing the rotor in a casing.

The object of the present invention is to eliminate these difficulties. The invention is based upon the fact that the greatest amount of heat in the rotor winding is developed where the product of the square of the current density and the specific resistance has its maximum value. Now it is possible, by suitably dimensioning the current paths, or the various parts thereof, to locate the main seat of the generation of heat at any desired part of the rotor winding.

The invention utilizes this possibility by locating a portion of the rotor winding, so far as it projects out of the active iron, outside the casing, and, by suitably selecting the material of the winding or the cross-section of the conductor thereof, or both, provides for the greater part of the heat generated to be produced in the part of the winding located outside the casing.

This invention is particularly easy to apply to drives of the kind mentioned above, primarily because in these a curve of torque (torque as a function of speed of revolution) is frequently desired, in which the maximum torque occurs at or near zero speed. In order to attain this, as is known, the rotor winding must be given a higher resistance than is usual in the construction of ordinary motors.

The characteristic here indicated, namely that the torque of the motor decreases with increasing speed, is particularly valuable when the mass to be set in motion is not to be brought right up to full synchronous speed, but has to move very frequently a short distance forwards or backwards in accordance with working conditions. Such conditions occur, for example, in driving rolls provided with individual driving means, located in front of shears by which the rolled material is to be cut up into short pieces. In order to obviate losses of time the rolls must here set the material in motion very rapidly. They must therefore develop large torques, they must not attain a very high speed, in order that the material may be brought to a standstill in the correct ultimate position in front of the shears without too great a braking torque having to be exerted.

It is also possible to construct the direct driving motor according to the invention with a comparatively small number of poles, where otherwise a motor driving through transmission gear or else a motor with a very large number of poles would have to be employed, with its known disadvantages.

The invention is illustrated by way of example in the accompanying drawing in which the figure is a central, longitudinal section through a motor embodying the improvements.

The stator may be constructed, for example, as an ordinary three-phase motor stator. On one side the motor is totally enclosed in a known manner. On the other side the casing consists of two walls, one of which, *a*, is secured to the stator and is therefore stationary, while the other, *b*, is secured to the rotor and therefore revolves with it.

Between the two there is only a narrow gap. The bars *c* of the rotor winding extend to the outside through the closure wall *b*. The connecting of the bars with one another is effected, not by the ordinary short-circuiting ring, but by lugs *d*, which, as regards material and cross-section, are so constructed that in them, at starting, the greater part of the heat generated in the rotor is produced.

In order to remove the heat in a satisfactory manner the lugs may be given such a cross-sectional shape that the heat discharging area is as great as possible. Furthermore, the lugs may be so constructed that all of them, or else only a part of them, act as a fan. The removal of the heat may, however, also be promoted by providing a separate fan, which blows a current of air against the external parts of the winding, or else cold air from some external source may be supplied.

The winding of the rotor need not of course be a simple squirrel-cage winding as illustrated in the drawing, but may be constructed as a multi-squirrel-cage winding for instance, or as a phase winding.

What we claim is:

1. An induction motor comprising a casing, stator and rotor structures within said casing, the rotor structure including a shaft and a winding and the winding including conductor bars, means providing a wall at least in part mounted on and rotatable with the rotor shaft and cooperating with the casing to substantially completely enclose the stator and rotor structures, said wall having openings of substantially the same sectional size and shape as the conductor bars and through which the conductor bars extend whereby foreign matter is prevented from finding access to the casing, and means at the outside of said wall connecting said conductor bars together and effective to have produced herein the major portion of the heat generated in the rotor winding.

2. An induction motor comprising a casing, stator and rotor structures within said casing, the rotor structure including a shaft and a winding and the winding including conductor bars, a wall element extending inwardly from the casing, a wall element carried by the shaft and cooperating with said first mentioned wall element and the casing to substantially completely enclose the stator and rotor structures, the wall element carried by the shaft having openings of substantially the same sectional size and shape as the conductor bars and through which the conductor bars extends whereby foreign matter is prevented from finding access to the casing, and means at the outside of said shaft carried wall element connecting said conductor bars together and effective to have produced therein the major portion of the heat generated in the rotor winding.

3. An induction motor as set forth in claim 1 in which the means at the outside of the wall connecting the conductor bars of the stator comprises a disk having pairs of lugs between which the conductor bars are received, said lugs being disposed to constitute an air circulating fan.

In testimony whereof we affix our signatures.

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