

COMPARISON BETWEEN THE DC MOTOR,  
ASYNCHRONOUS MOTOR, AND SYNCHRONOUS  
MOTOR, ON THE ONE HAND,

AND THE JAKELJ MAGNETIC MOTOR  
ON THE OTHER

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The Jakelj magnetic motor is an optimal combination of several conventional electric motors. The Jakelj motor preserves many of the positive features and advantages of conventional electric motors, while simultaneously eliminating many of the negative features and disadvantages of said motors.

The main essential advantages of the Jakelj motor are:

Linear, infinitely variable rpm in both clockwise and counterclockwise directions.  
Single-pole connection with ground connection.

The advantages of the Jakelj motor in comparison with conventional electric motors:

<u>The DC motor</u>	<u>The Jakelj magnetic motor</u>
Has commutator and brushes	Has no commutator and no brushes
The rotor has a winding	The rotor has no winding
The stator has the commutator winding and commutator coils.	The stator has no commutator winding and no commutator coils.
The stator has the compensating winding (cross field compensation).	The stator has no compensating winding (no cross field)
The motor has a starter with resistors .	The motor has no starter and no resistors
The motor has barrier resistors for regulating the rpm (high energy losses).	The motor has no barrier resistors for regulating the rpm (no energy losses)
The motor has shunts for exciter field attenuation .	The motor has no shunts. No exciter field attenuation process.
The windings have "heads", i.e. 50% of the copper is inactive.	The winding has no "head" so no inactive copper 50% copper savings
In the case of a flaw (interturn short circuit) the entire coil must be destroyed and rewound. Results in heavy losses and production delays .	In the event of an interturn short circuit, individual coils can be replaced, since all coils are individually accessible
During manufacture of the winding, the insulation and coils must be installed manually, the heads wrapped, and, due to centrifugal forces, a steel cover installed. Therefore, much manual work. Installing the insulation in the grooves, installing the winding and soldering to commutator segments	The entire winding is manufactured from concentric coils. The coils are wound in advance by automatic machine onto the coil body, coated with insulating lacquer, and dried. Therefore no manual work. The winding has no "heads". The coils thus fabricated are merely simply set onto the iron core or simply pulled off

Comparison (continued)

DC Motor

Jakelj Magnetic Motor

The turns of the winding are crossed in the "heads", and therefore very large interturn voltages prevail. Great danger exists of a breakthrough or interturn short circuit. Heavier insulation between turns due to the high interturn voltages

The turns of the winding (coils) are strict in sequence, and therefore minimal interturn voltages. Minimal risk of breakthrough or interturn shorting. Minimal insulation between turns. Winding in layers and connection in series.

The motor has several switches for switching resistors and winding parts on and off.

The motor has no such switch.

The motor has a switch for changing the direction of rotation of the motor to right or left

The motor has no such switch

When the direction of rotation is reversed the power supply must be interrupted. This results in a "current break", the energy inflow is interrupted. It has no stopping or holding moment

Rotation direction reversed contactlessly. Thus the current flow is not interrupted, nor the flow of energy. No "current break" but reverses without pausing.

The motor has a relatively strong stopping or holding moment. The motor can hold the full ballast and also hold for a long time without mechanical brakes

When locked up, stuck, or overloaded the motor winding burns through. Results in serious damage

When locked or overloaded, the winding of the motor does not burn through. There is no damage

The motor has a housing and a bearing shield

The motor has no housing and no bearing shield

The motor has a brush holder

The motor has no brush holder

Its manufacture, especially the centering of the rotor, is very complicated and demanding due to its construction with bearing shields

Its manufacture, especially the centering of the rotor, is very simple, because there are no bearing shields and no housing. The rotor is very precisely centered very simply with a spacing strip

Because of this exacting construction, a minimal air gap is impossible--the limit is about 0.5 mm

Due to its simple construction and centering procedure with the spacer strip between the stator and rotor, one can achieve a minimal air gap of 0.1 mm

Very large energy losses arise in the air gap due to the very high magnetic resistance (the air/iron ratio is 1:3000)

Minimal energy losses in the air gap. Therefore, the motor has higher efficiency.

Comparison (continued)

DC Motor

Because of the housing and the long active iron package, the motor has relatively poor conditions for cooling. Poor dissipation of heat to the environment

The motor has a cylindrical shape with a long shaft

The motor has "feet"

The rotor has a relatively small diameter and thus small moments [torques] because the "R" radius is small.

Because of its cylindrical shape the motor has a relatively small radius and thus at a given current consumption relatively low torque. Small "R" where electromotive forces occur

The motor has an unfavorable shape for propelling vehicles and an unfavorable gravitational position in the vehicle

When the rotor is to be removed, great difficulties arise due to the horizontal position of the motor. It must be pulled out horizontally; it is heavy; the bearing shield has to be removed

The shaft is susceptible to bending due to its great length

Commutation problems arise due to rotation voltage, transformation voltage, and difference voltage (circuit bias). Short circuits and transient currents occur.

The commutator requires expensive and complicated maintenance and care.

The active iron is relatively heavy, because the yokes are wide. 30% more active iron is needed

The magnetic flux circuit is relatively long. High magnetic resistance

Jakelj Magnetic Motor

The motor has relatively good conditions for cooling, since no housing is present and the active iron packages are quite short. Heat dissipated rapidly to environment

The motor has a disk shape with a short shaft

The motor has no "feet"---a flange motor.

The rotor has a large diameter. For the same current distribution and magnet strength, the torque of the motor is many times greater

Because of its disk shape the motor has a relatively large radius and thus at a given current consumption a relatively high torque. Large "R" where electromotive forces occur.

The motor has a favorable shape for vehicle propulsion and a good gravitational position in the vehicle. The motor is installed horizontally with the vertical shaft (axle) on the floor of the vehicle. In cars, under the seats.

Due to the vertical position of the rotor disassembly is simple. The rotor is lifted out vertically. No need to loosen a single screw. No bearing shields.

The shaft is short. No danger of bending (vertical position)

The commutation problem is solved without compromise. There are no rotation, transformation, or difference voltages; no short circuit currents and no transient currents. All short circuit current problems are solved without a residue. There is no commutator.

Since there is no commutator, there are also no problems.

The active iron is relatively light, because the yokes are narrow. The width of the yoke is equal to the width of the tooth

Magnetic flux circuit relatively short. Minimal magnetic resistance

ASYNCHRONOUS MOTOR (Continued)

Jakelj Magnetic Motor

A switch is necessary to reverse the direction of rotation.

No switch is needed.

A delta star switch or a starter with resistors is required.

No delta star switch and no starter with resistors is needed.

In the event of a flaw in only one coil (interturn short circuit), the entire winding has to be destroyed and rewound, resulting in serious damage and lost production.

In this motor, each coil can be replaced separately, since they are individually accessible. Therefore, no serious damage or lost production. The defective coils are replaced on the spot without the need of disassembling the motor.

Inductive transmission of energy from the stator to the rotor, resulting in heavy energy losses (air gap losses).

No inductive transmission of energy, therefore no losses.

THE UNDULATORY [MIXED] CURRENT MOTOR

THE JAKELJ MAGNETIC MOTOR

Power supply frequency is  $16\frac{2}{3}$  Herz. Requires a special power grid

Can be powered by conventional 50 Hz AC current or by DC current.

Commutation problems arise with undulatory [mixed] current with the transformer voltages between the segments. This results in a large number of poles and a minimal intersegment voltage

In this motor there are no such problems since there is no commutator.

The motor has a commutation winding, a commutation coil, and a compensation winding.

The Jakelj motor has no commutation winding, no commutation coil, and no compensation winding.

The motor has a commutator and brushes.

No commutator and no brushes.

The motor requires a switch to reverse rotation.

No such switch needed to reverse rotation. It has a contactless and uninterrupted rotation reversal.

Costly maintenance of commutator and switch is necessary.

No maintenance needed since these parts are not present.

Because of the commutator, the motor needs a transformer. On the standard gauge Austrian railroad 15,000 volts are stepped down to 500. The transformer is installed in the locomotive.

This motor needs no transformer since it has no commutator. It can be hooked up directly to 25,000 volts.

THE SYNCHRONOUS MOTOR

THE JAKELJ MAGNETIC MOTOR

The motor has no independent starting, no starting torque.

Independent starting with very high starting torque.

Fixed, synchronous rpm.

Linear infinitely variable rpm from 0 to 100%