The invention relates to an electric drive for motor vehicles, comprising at least one wheel driving electric motor having a stator and a rotor, the rotor of said electric motor being connected to the vehicle wheel to be driven via a pinion/ring gear transmission accommodated at least substantially within the rim of the vehicle wheel.

Electric drives for motor vehicles have been known for a long time in a large variety of forms. However, concrete constructions and the use thereof in practical applications have remained relatively rare so far.

An electric drive of the above-indicated type is known from CH-A-238 772. In this known electric drive the axis of rotation of the wheel driving electric motor is rigidly coupled to the pinion of the pinion/ring gear transmission. The electric motor itself is formed in usual manner with an external stator and an inner rotor. For stable support of the rotor and the rotor shaft carrying the pinion on one end, a bearing is additionally provided on the side of the shaft facing away from the wheel to be driven. The entire arrangement virtually takes the entire half of the space between two wheels of one axle of the vehicle, so that both electric motors need virtually the entire space between the two wheels.

FR-A-469 666 discloses a connection between a drive shaft and a vehicle wheel to be driven, which makes use of a jointed shaft. The use of a jointed shaft is also known from US-A-3 347 333 for the drive between a wheel of a motor vehicle and an electric motor provided for the drive. The electric motor is formed in usual manner with an external stator and an internal rotor. The jointed shaft is to compensate relative motions between the wheel and the motor when the motor vehicle is in motion.

It is the object of the invention to indicate an electric drive for motor vehicles of the type indicated at the outset, which, while being of compact construction, enables a kind of torque transmission of the electric motor to the vehicle wheel which is relatively easy to realize in practical application.

This object is met by the features indicated in claim 1.

The invention reveals an approach for creating the torque necessary at the respective driving wheel for driving the motor vehicle, directly at the driving wheel with low expenditure. In order to have at all sufficient space available for the transmission stage accommodated at least substantially within the rim of the vehicle wheel, the brake drum or brake disk accommodated there in case of usual motor vehicles must be deleted there and must either be provided at a different location or - apart from the parking brake that must always be provided - must be replaced by designing the electric motor at the same time as a motor brake.

The electric drive preferably comprises one electric motor for each vehicle wheel to be driven, i.e. there are often two electric motors for the two wheels on the driving axle or, in case of a four-wheel drive, there are provided for electric motors for four vehicle wheels.

The invention can be realized for vehicle wheels with the dimensions usual in passenger cars for road traffic. In particular for larger vehicle wheels, such as the wheels of trucks, busses or the like, the invention is feasible wherein also the electric motor is accommodated within the rim of the vehicle wheel to be driven. In doing so, the rotor of the electric motor can be supported on a transmission stage component in particularly space saving manner.

In connection with the pinion/ring gear transmission stage, it must be emphasized that the pinion axis can be arranged a distance above the motor vehicle axle so that the electric motor has its axis of rotation arranged in a somewhat higher location while in other respects the torque connection to the vehicle wheel remains the same. This permits

the provision of an electric motor - also an electric motor of large diameter - without disadvantageous restrictions of the ground clearance of the motor vehicle.

When an electric motor is provided for each wheel to be driven, a differential can be dispensed with. The gear reduction usually provided in a differential at the same time can be displaced into the vehicle wheel.

The invention and further developments of the invention will be elucidated in more detail hereinafter by way of an embodiment. The sole figure shows a wheel driving electric motor and an associated vehicle wheel to be driven, each in a fragmentary sectional view.

The electric motor 2 shown on the left-hand side in the figure is a so-called external rotor motor. The electric motor 2 comprises a casing 4 open at a face side and in total of substantially pot-shaped configuration, which is attached to the motor vehicle at an appropriate location. Extending from the closed face side 6 is a hollow cylindrical connecting piece 8 in axial direction towards the motor interior. This connecting piece 8 carries on its outer circumference an in total hollow cylindrical stator 10 provided with coils, not shown. The rotor 12 of the electric motor 2 also is substantially pot-shaped and has an open face side. On the inside of the circumferential wall 14 of the rotor 12, there are disposed permanent magnets 16 of alternating polarity in circumferentially distributed manner. From the closed axial side 18 of rotor 12, an extension 20 extends in axial direction into the motor interior. This extension is cylindrical and supported in the connecting piece 8 by means of rolling bearings 22. Electric motors having this basic construction are known per se, so that the construction need not be described here in more detail.

The closed face side 18 of rotor 12 is recessed in its centre, and this is where the first joint 24 of a jointed shaft 26 is disposed, said joint being shown only schematically in the form of a circle. The second joint 28 of the jointed shaft 26, which is shown in equally schematic manner, is located at the end of a short shaft 32 disposed inside the wheel 30.

Wheel 30 consists in essence of a rim 34 that may be of conventional configuration, a tyre 36 and a cylindrical pot-shaped central part 38 open on one side towards the electric motor 2 and having largely the shape of a conventional brake drum. However, in this central part 38 an extension 40 projects centrally in the direction towards electric motor 2 and serves for supporting said central part 38 in the wheel carrier 42 provided with a corresponding pocket bore. Furthermore, the circumferential wall of the central part 38 is provided on its inner circumference with gear teeth 44.

These teeth 44 mesh with teeth on the outer end of pinion shaft 32, thereby constituting a pinion/ring gear transmission. Pinion shaft 32 is supported in an upwardly extending projection of the wheel carrier 42. The transmission mentioned thus, both axially and radially, is accommodated completely in the interior of the rim 34. The fast rotating jointed shaft 26 may be of thin structure and may have less strongly dimensioned joints 24, 28.

It is to be emphasized that the invention preferably makes use of electric motors operating in synchronism and/or equipped with permanent magnets and/or operating with electronic switching of the coils and having an external rotor.

A brake disc 68 or, analogously, a brake drum may be provided coaxially with respect to the rotor 12 and rigidly connected to the latter.

It is also possible to dispense with the inner joint 24 of jointed shaft 26 and to support the electric motor 2 instead in tiltingly movable manner, so that it follows the pivoting motions of the jointed shaft 26 during jounce and rebound of the motor vehicle.



Patent Claims

1. An electric drive for motor vehicles, comprising at least one wheel driving electric motor (2) having a stator (10) and a rotor (12), the rotor (12) of said electric motor (2) being connected to the vehicle wheel (30) to be driven via a pinion/ring gear transmission (32, 44) accommodated at least substantially within the rim (34) of the vehicle wheel (30), characterized in that the electric motor (2) is constructed as an external rotor motor whose rotor (12) has a face wall (18) facing the vehicle wheel (30) to be driven and is supported in the interior of the hollow stator (10) by means of a central extension (20); and in that the rotor (12) of the electric motor (2) is connected via a jointed shaft (26) to the pinion (32) of the pinion/ring gear transmission (32, 44).

2. An electric drive according to claim 1, characterized in that a separate electric motor (2) is provided for each vehicle wheel (30) to be driven, without a differential gear being interposed therebetween.