

The invention relates to an electric drive for motor vehicles.

Electric drives for motor vehicles have been known per se for a long period of time, however, without practical application thereof having reached a larger extent of distribution so far.

It is the object of the invention to make available a practicable compact configuration for electric drives for motor vehicles.

This object is met according to the subject matter of the invention by an electric drive for motor vehicles, having the following features:

- (a) at least one electric motor and at least one transmission are combined to form a constructional unit in which the rotor of the electric motor is supported in cantilever fashion by means of the supported input shaft of the transmission;
- (b) the electric motor has an external rotor and is designed for electronic commutation and/or in synchronous construction;

- (c) the constructional unit has a configuration with an angular space between the casing circumference of the electric motor and a portion of the transmission projecting therebeyond, with a motor vehicle wheel driving shaft being connected in this angular space to the output shaft of the transmission.

A drive constructional unit of an electric motor and a transmission, in which the rotor of the electric motor is supported in cantilever fashion by means of the supported input shaft of the transmission, is known from the document CH-A-405 485. However, this does not involve the drive of a motor vehicle.

Electric motors having an external rotor and being of synchronous construction are known from the document FR-A-2 176 010. Electronically commutated electric motors are known per se as well.

The document DE-A-1 430 322 discloses an electric drive for motor vehicles in which two electric motors are flangedly connected to a transmission having longer dimensions transversely of the axial direction and in which the drive is effected on two sides from the portion of the transmission projecting beyond the electric motors.

The constructional unit of electric motor and transmission provided in the electric drive for motor vehicles according to the invention is compact and advantageous in terms of installability and manufacturing expenditure. The driving shaft connection in the angular space is space-saving. The transmission may be of oval configuration. The construction of the electric motor with external rotor results in constructionally particularly favourable and compact

conditions. Electronically commutated electric motors and/or electric motors of synchronous construction are controllable particularly well, display little susceptibility to disturbances and can be designed with high torque density.

More specific developments of the invention are subject matter of the dependent patent claims.

It is preferred to combine a first electric motor with an associated first transmission and a second electric motor with an associated second transmission so as to form an overall constructional unit, in particular for the drive of the two wheels of a motor vehicle axle. This overall constructional unit can be mounted in the vehicle as a whole. This combination turns out to be particularly advantageous when the first and second transmissions are attached to each other.

The described possibility of combining two partial constructional units can also be advantageously used - as is preferred - for selectively mounting either the overall constructional unit or the spatially separate partial constructional units in the motor vehicle depending on the space requirements. When splitting the arrangement in two partial constructional units, the two transmissions are usually closed by means of a cover each.

The transmission is as a rule a step down gear system. In most cases single-stage transmissions are used. In principle all known transmission constructions are feasible, however, spur gear transmissions and inverted tooth type chain transmissions are often particularly advantageous in view of the space conditions in motor vehicles, as will be evidenced in more detail by the embodiments.

The constructional unit according to the invention, consisting of electric motor and transmission, has an advantageously long extension as measured transversely of the axes of electric motor rotor, input shaft and output shaft of the transmission, so that supporting points for torque support are created which are spaced apart by advantageously great distances.

The invention and developments of the invention will now be elucidated in more detail by way of an embodiment shown schematically in the drawing in which

Fig. 1 shows a sectional view of an overall constructional unit consisting of two electric motors and two transmissions.

The constructional unit 2 according to Fig. 1 is symmetrical with respect to the plane A-A, so that only one half needs to be described. Each partial constructional unit reveals an electric motor 4 and a transmission 6. Electric motor 4 is substantially cylindrical and has a clearly smaller axial thickness in comparison with the diameter. On the outside of constructional unit 2, the electric motor comprises a round baseplate 8 from which a hollow cylindrical projection 10 extends axially towards the motor interior. The stator poles 12, being as a whole substantially cylindrical, are attached to the outside circumference of the projection 10. The rotor 14 of electric motor 4 has substantially a cylindrical barrel-shaped configuration and engages with its circumferential wall around the stator poles 12 on the outside thereof. Permanent magnets 16 are attached annularly with alternating polarity to the inside of the circumferential wall. The face wall of the rotor

14 is located on the side of the electric motor 4 opposite to the baseplate 8 and is set back in a central portion into the interior space internally of stators 12. The rotor 14 is enclosed by a barrel-shaped casing 18 connected to baseplate 8.

Following the axial side of the electric motor 4 opposite baseplate 8, there is provided the transmission 6. Transmission 6 has an in total "disc-like" configuration with two parallel confining walls transversely of the direction of extension of the shafts of the transmission. Confining wall 20 facing the electric motor is provided, at the passage sites of the transmission shafts, with one hollow cylindrical connecting piece 22 each, which extends outside of the transmission 6 for a shorter distance and inside the transmission for a longer distance. These connecting pieces 22 have supported therein an input shaft 24 and an output shaft 26 of the transmission. At each inner end, both the input shaft 24 and the output shaft 28 each carry a toothed wheel 28 and 30, respectively, with gear wheel 30 on output shaft 26 being of larger diameter. These may either be conventional meshing spur gears or, as shown, gear wheels constituting a transmission together with an inverted tooth type chain, non shown, that is placed around both gear wheels. The input shaft of the transmission 6 extends out of the transmission casing towards electric motor 4, and this is where the central recessed portion of rotor 14 is attached such that a cantilever support of the rotor 14 on the input shaft 24 of the transmission 6 results. In the overlapping portion between electric motor 4 and transmission 6, the casings of these two components coincide.

On the side of the transmission 6 directed away from electric motor 4, the casing 20 thereof is open. The

second partial constructional unit, which is designed in completely corresponding manner, is attached there by means of a flanged connection 44.

In the region where the transmission projects beyond the cylindrical casing 18 of the electric motor 4, there is formed an angular space in which an articulated shaft 32 leading to a motor vehicle wheel to be driven is connected to the output shaft 26 by means of a joint 34. This holds for both partial constructional units.

On the right hand side of motor casing 18 with respect to Fig. 1, there is provided a mounting eye 36. On the left hand side of the transmission casing 20 with respect to Fig. 1, there is also provided a mounting eye 38. Thus, two mounting eyes 36, 38 with optimum large spacing therebetween are formed. The overall constructional unit 2 thus has a total of four mounting eyes.

The constructional unit 2 as a whole is mounted in the vehicle such that the axes of rotor 14, input shaft 24 and output shaft 26 are disposed transversely of the running direction of the motor vehicle. Due to the fact that the two transmissions 6 need only little space in axial direction, two articulated shafts 32 result each having a great length, as is desired.

When the two transmissions 6 are separated at the flanged connection and the two then open transmission sides are closed by covers, it is also possible to mount each partial constructional unit in spatially separate manner in the motor vehicle. A typical example therefor is a motor vehicle with front drive in which the two partial constructional units are axially placed apart to such an extent that an inter-

nal combustion engine positioned in the front part of the motor vehicle can be accommodated therebetween. The internal combustion engine serves for driving a generator connected thereto, which produces the current necessary for driving the electric motors 4.

Furthermore, it must be stressed that the interior of the respective electric motor 4 is easily accessible, for instance for maintenance or repair work, by releasing the baseplate 8 which is located on the axial side opposite the associated transmission 6.



P a t e n t C l a i m s

1. An electric drive for motor vehicles, having the following features:

- a) at least one electric motor (4) and at least one transmission (6) are combined to form a constructional unit (2) in which the rotor (14) of the electric motor (4) is supported in cantilever fashion by means of the supported input shaft (24) of the transmission (6);
- b) the electric motor (4) has an external rotor (14) and is designed for electronic commutation and/or in synchronous construction;
- c) the constructional unit (2) has a configuration with an angular space between the casing circumference of the electric motor (4) and a portion of the transmission (6) projecting therebeyond, with a motor vehicle wheel driving shaft (32) being connected in this angular space to the output shaft (26) of the transmission (6).

2. An electric drive for motor vehicles according to claim 1,

characterized in that the motor vehicle wheel driving shaft (32) is an articulated shaft connected by means of a joint (34) to the output shaft (26) of the transmission (6).



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3. An electric drive for motor vehicles according to claim 1 or 2, characterized in that the transmission (6) has an in total disc-like configuration.

4. An electric drive for motor vehicles according to any one of claims 1 to 3, characterized in that the axial thickness of the electric motor (4) is smaller than the diameter thereof.

5. An electric drive for motor vehicles according to any one of claims 1 to 4, characterized in that the face wall of the rotor (14) of the electric motor (4) is set back in a central portion into the motor interior.

6. An electric drive for motor vehicles according to any one of claims 1 to 5, characterized in that the rotor (14) carries permanent magnets (16) on the inner circumference.

7. An electric drive for motor vehicles according to any one of claims 1 to 6, characterized in that a constructional unit (2) consisting of two transmissions (6) and two electric motors (4) is provided which is symmetrical to a central plane (A-A).