

Mercedes-Benz



# Dual-mode buses O 305/O 305 G:

From Daimler-Benz's development work



# Dual-mode buses O 305/O 305 G

## The flexible propulsion concept

Environmental pollution and dwindling energy resources call for improved propulsion systems.

The solution to this problem lies in the development of different alternative propulsion concepts. An important step towards putting such projects into practice is the O 305/O 305 G dual-mode bus system.

There are three prototype models incorporating the possibilities which result from the combination of different supply systems.

### Dual-mode bus O 305

Propulsion energy supplied by overhead wires or by batteries on board the bus.

### Dual-mode buses O 305 and O 305 G

Propulsion energy supplied by overhead wires or a conventional diesel engine. The basic idea of the dual-mode bus system is to reduce the disadvantages of the conventional trolley buses and of the conventional diesel-powered buses to a minimum, and to make full use of the advantages of both systems.

This means, first of all, that the bus should no longer be restricted to stretches equipped with overhead wires. Under certain conditions, for example in the event of road works, or where routes are altered, the bus can travel independent of the overhead wire network. In wide-spread suburban areas, buses will not need overhead wires, either. Secondly, the relatively expensive overhead wire network can be restricted to main roads where non-pollutant regular service is wanted. Costs can be kept relatively low by using many vehicles on these routes. It is possible to do without points and cross-connections in the overhead wire network, and this looks better and lowers costs.

### Dual-mode bus O 305 – overhead wires plus batteries

With this combination, operation is totally free of pollutant emission.

The propulsion energy can be taken from the overhead wires, with the trolley arms being automatically controlled from the driver's seat.

Where there are no overhead wires, the energy to drive the O 305 hybrid bus is supplied by shielded lead acid batteries fitted underneath the vehicle floor (rated voltage 360 V, capacity 230 Ah, total weight 3,000 kg).

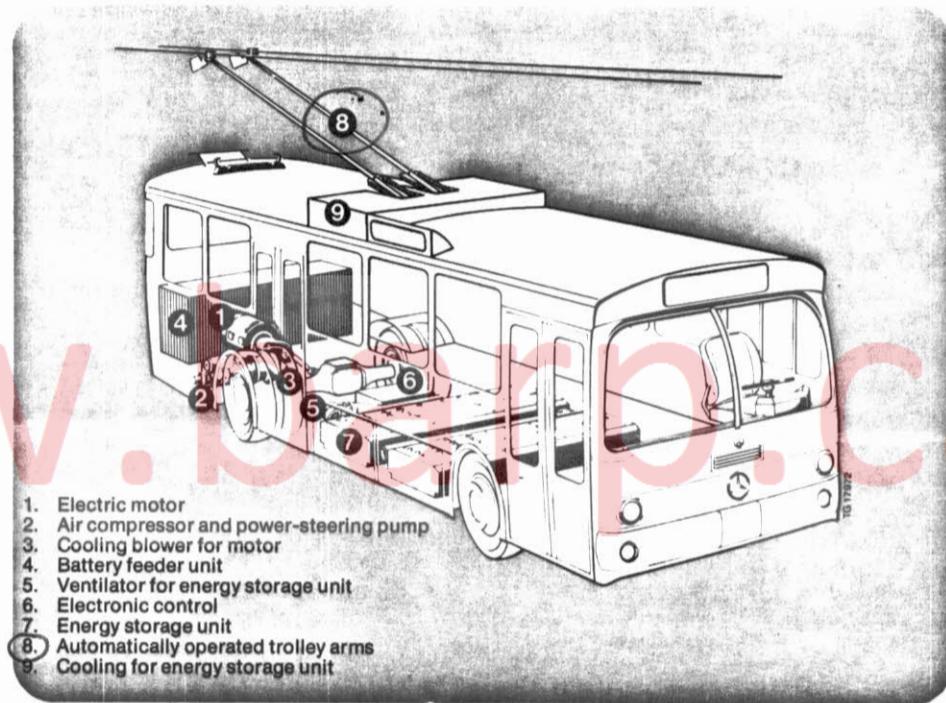
The electric propulsion motor (a sepa-

tely excited DC shunt motor) has a continuous output of 90 kW and an intermittent output capacity of 180 kW. It accelerates the bus in the same way as a conventional diesel engine does. The motor can be controlled smoothly, without energy being lost (chopper control, thyristor technology). Two auxiliary units (360 V) drive the air compressor, the power-steering pump, the 24 V generator and the cooling blower of the motor.

Overall weight: 18,800 kg  
Maximum capacity: 88 passengers.

charging and propulsion.

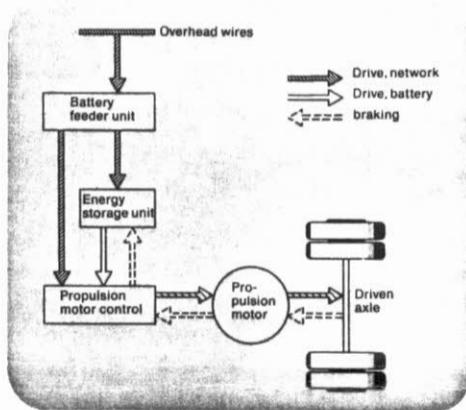
In alternate operation, in which the batteries should be used over not more than 10 kilometres, it is possible to run the bus for a whole day without changing batteries. During the night, the storage units are recharged from the mains via the battery feeder units. Hence it is possible to do without expensive quick-change stations.



### Flow of energy

The voltage of 600 V from the overhead wires is transformed by a battery feeder unit to the supply voltage of 360 V of the propulsion system, and supplied to the motor by means of electronic control. With the trolley arms connected to the overhead wires, the energy not needed for propulsion is used for recharging the battery. Braking energy is also fed into the storage unit after having been transformed. When the trolley arms are disconnected from the overhead wires, energy flows from the storage unit via the drive control unit to the motor.

To ensure an adequate service life of the batteries, there is a cooler for the energy stores, fitted on the roof, which reduces the heat produced during



# for public transport.

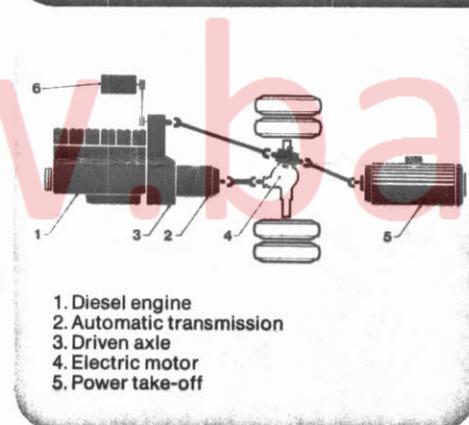
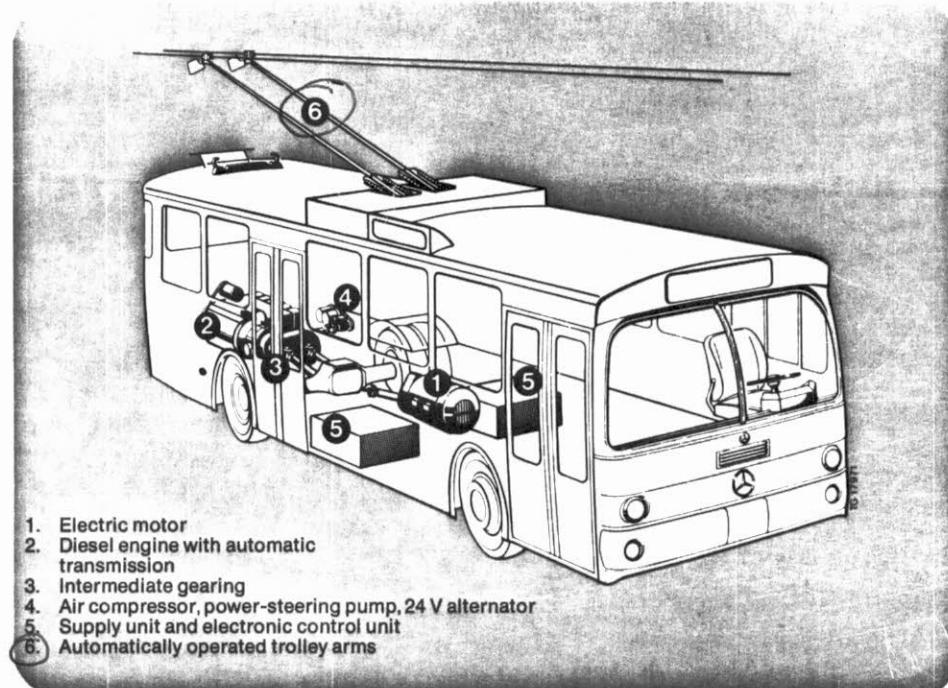
## Dual-mode bus O 305 – dual-mode bus O 305 G

### Overhead wires plus diesel engine

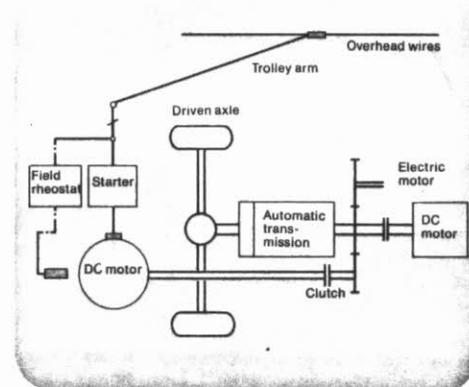
An alternative to purely electric propulsion is the system combining overhead wires with a diesel engine. On crowded, heavily polluted stretches, energy is derived from the overhead wires, while in not so densely populated and less polluted suburban areas, the bus is driven by a conventional diesel engine. The dual-mode bus is fitted with a mechanical propulsion unit, consisting of a diesel engine and an automatic gearbox transmitting the engine power to the drive axle. When the trolley arms are connected to the overhead wires, the diesel engine is switched off. The electric motor also acts on the drive axle via the automatic gearbox. For reasons of space, the electric motor has to be fitted in front of the drive axle, in the direction of travel. The prop shaft connecting the motor with the automatic gearbox via a transfer case is held by the axle housing. The transfer case also drives auxiliary units such as the compressor, the alternator and the power-steering pump.

### Flow of energy

The driver only has to actuate the selector switch to engage the diesel engine. The diesel engine's power is transmitted to the drive axle via clutch, transfer case and automatic gearbox. The clutch to the electric motor is then disengaged. When using electric drive, the diesel engine is switched off, and cannot be started by mistake. The clutch between diesel engine and transfer case is disengaged, and the clutch between electric motor and transfer case engaged. When the trolley arms have been automatically connected to the overhead wires, the control units are supplied with a line voltage of 600 V.



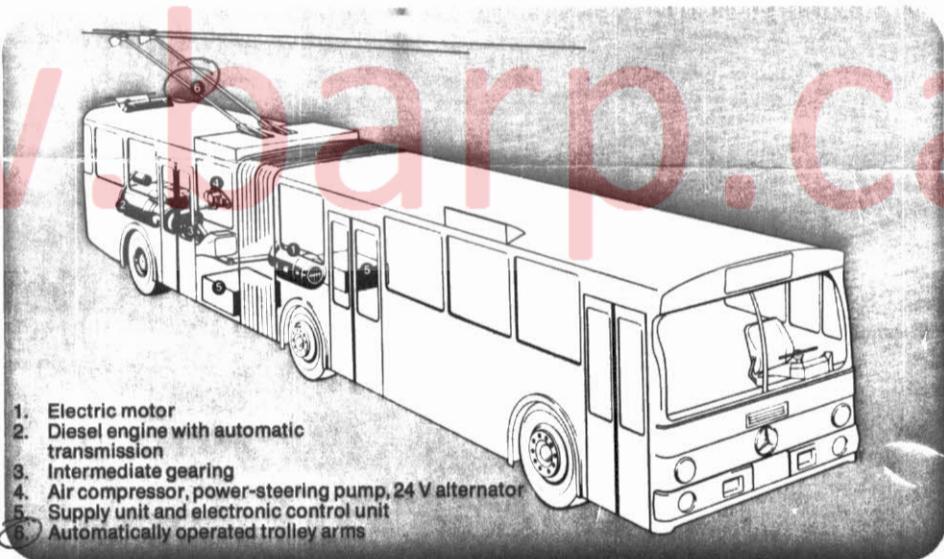
A resistive circuit is used to switch the electric motor to its nominal speed of 1,400/min which is made available to the automatic gearbox for the lower speed range. The motor is controlled solely in the shunt field. The DC regulating unit controls the speed up to 3,200/min for road speeds up to 60 kph. When braking, energy cannot be fed back, either into the overhead wires or into the battery. This is why a retarder is required.



# Articulated dual-mode bus O 305 G



The combination of overhead wires with a diesel engine is also used in the Mercedes-Benz O 305 G articulated bus. The propulsion and control elements as well as the automatic trolley arms on the rear bus section are identical with those of the solo bus. The diesel engine fitted in the rear of the bus can be encapsulated to reduce noise emission. Engine power is transmitted to the standard-production drive axle via the clutch, transfer case and automatic gearbox. The transfer case also drives auxiliary units such as compressor, alternator and power steering pump. The electric motor is also fitted in front of the rear axle. The control unit is located in protected compartments underneath the vehicle floor, and these compartments are accessible from outside through flaps.



This dual-mode bus system consists of proven components. Solo bus and articulated bus are assembled on the unit construction principle, using interchangeable components. The system is excellently suited to meet the demands of the eighties as regards environmental protection and flexibility. At the same time, the system makes allowances for the growing shortage of energy.

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