

Fig 4

Description

[0001] The present invention relates to a driving device for driving a rail vehicle, comprising a drive unit acting on a straight and rigid drive axle which in a synchronised manner drives two driving wheels which are included in a wheel pair and which are rotatable about a common rotational axis, the drive axle extending between the two driving wheels and being non-rotatably connected to each of the driving wheels, and each of the driving wheels being rotatably mounted, by means of a support shaft, relative to a supporting chassis of the rail vehicle.

Background Art

[0002] Driving devices of the type described above are well known in the fields of rail vehicles, for instance locomotives. In such cases the drive unit is usually an angular gear which is mounted on the drive or wheel axle and which is driven by, for instance, a diesel engine or an electric motor optionally via a gearbox and a propeller shaft which extends in the longitudinal direction of the vehicle.

[0003] There are several drawbacks of such a driving device for a rail vehicle. Among other things, the wheel axle has the double function of transmitting the torque from the drive unit to the wheels and supporting the weight of the locomotive by the wheel axle being rotatably mounted in the supporting chassis of the locomotive. Consequently, the wheel axle must have great dimensions to resist the stress, above all because it is desirable to make the locomotive as heavy as possible since the weight determines the amount of load to be pulled by the locomotive, by the frictional force that can be transmitted between the driving wheels and the rail being proportional to the weight. Due to a heavily dimensioned wheel axle, also the angular gear must be heavily dimensioned. As a result, it is generally not possible to use standard components in the angular gear, which must as a rule be specially manufactured, thus causing high cost and a long time of delivery.

[0004] The heavily dimensioned angular gear also occupies a large space in the area between the wheels, which makes it difficult to place also the rotatable bearing of the wheel axle in the chassis of the rail vehicle in the area between the wheels. As a rule, such rail vehicles are therefore mounted in bearings in the chassis on the outside of the wheels, which requires an increased width of the vehicle and still greater dimensions of the wheel axle owing to the increased bending moment. When using rail vehicles for mining and construction of tunnels, it is often favourable if the vehicle can be made as narrow as possible, since this may cause great savings due to a reduced tunnel cross-section. Also a smaller height of the rail vehicle may be favourable in the construction of tunnels, which however is inconvenient in rail vehicles of the type described above since angular gears and propeller shafts occupy a large part of the space between

the wheels and between the pairs of wheels, thus making it difficult, for instance, to provide low-level arrangement of the diesel engine, gearbox and other machinery.

[0005] In rail vehicles, both wheels on one and the same wheel axle should be driven at the same speed for the vehicle to be centred on the rails and for the wear on wheel flanges and rails to be minimised. It is therefore favourable if the wheel axle is rigid, that is the two wheels in a pair of wheels are mechanically interconnected and non-rotatable relative to each other. If the two wheels included in a pair of wheels are driven by separate motors, for instance by hydraulically operated wheel motors, this actually solves the problem with bulky drive units in the area between the wheels, but then the wheel motors should be synchronised, which as a rule is both complicated and costly. In addition there will be extra costs for double drive units for each wheel axle.

[0006] US 5,345,878 discloses a rail vehicle, which is driven by hydraulic motors, which are arranged at one end of each driven, rigid wheel axle. With such a driving device, the space between the driving wheels is left free, but the width of the rail vehicle will be very great, which may be disadvantageous in many cases, for instance in the construction of a tunnel. A further drawback is that the motors will be mounted in an unprotected position, exposed to weather and mechanical influences.

[0007] US 4,721,430 discloses a vehicle for transporting heavy goods by rail. The driving device of the vehicle is arranged directly on the driven wheel axle, more specifically by a hydraulic motor driving the wheel axle via a gearbox, a transmission and an angular gear. In this way, the driving device will be well collected in the area around the wheel axle but will nevertheless take up a relatively large space. By the weight of the rail vehicle being supported by the wheel axle, the angular gear must in fact be heavily dimensioned, which requires a large space and, as a rule, special manufacture and the ensuing high costs and long times of delivery.

[0008] US 4,095,530 discloses a driving device according to the preamble of claim 1. In this construction, there are a separate drive axle and a separate support shaft. The drive axle is tubular with an inner bore through which extends the support shaft. However, such a construction makes it necessary for the support shaft to be rotatably mounted relative to the chassis of the rail vehicle in the area outside the wheels, which results in the width of the rail vehicle being relatively great. Furthermore the drive axle must be made thick since it should accommodate the support shaft. This results in the further drawback that the connection of the drive unit to the drive axle must probably be specially manufactured, resulting in high costs and long times of delivery.

Brief Description of the Invention

[0009] The present invention aims at providing a driving device for rail vehicles, which eliminates problems and drawbacks of prior-art driving devices. More specif-

ically, the invention aims at a driving device, which saves space and cost by providing better possibilities of using commercially available standard components. At least this object is achieved by a driving device according to claim 1.

[0010] Thus, the invention is based on the knowledge that this object can be achieved by dividing the wheel axle into a separate drive axle, which only transmits the torque between the motor and the driving wheels, and two separate support shafts which rotatably support the wheels on the chassis. Moreover, the support shafts are located on the outside of the supporting chassis and are tubular with through bores, which are concentric with the rotational axis of the wheels and through which extend the respective ends of the drive axle.

[0011] Within the scope of this general concept, the invention can be accomplished in various ways. In an embodiment shown in the following description and in the drawings, two short support shafts are arranged for each pair of wheels, that is one for each wheel, which are non-rotatably connected to the chassis and on which the wheels are rotatably mounted. Moreover, the wheels are arranged on the outside of the supporting parts of the chassis for the purpose of minimising the width of the vehicle. For this reason, the support shafts must be tubular with a through bore through which extends the drive axle. In the embodiment illustrated, the drive motor is a hydraulic motor, more specifically a radial piston motor of the type having what is referred to as a hollow shaft, that is having a rotatable axle with a through bore in the axial direction. This makes it possible to use a drive axle which is made in one piece and extends undivided from one wheel, through the bore in the support shaft thereof, through the motor and through the bore in the support shaft of the other wheel, to the other wheel.

[0012] Letting a hydraulic motor thus directly drive a wheel axle is very favourable by thus omitting the costs and the need for space for gearbox and transmission. The maximum number of revolutions of a radial piston motor is, however, relatively small, which means that such a mode of operation is best suited for slow rail vehicles, such as shunting locomotives and locomotives for construction of tunnels or mining.

[0013] However, according to the invention also other types of motors can be used, such as other types of hydraulic motors, electric motors or diesel engines. The drive axle need not be made in one piece and extend through a hollow shaft in the motor, as in the embodiment illustrated, but can also be in two parts and connected to an output shaft on each side of the motor, for instance by a flanged screw joint.

[0014] It is also within the scope of the invention that the drive unit may comprise a gear of some kind, for instance an angular gear, which is connected to the drive axle and is driven by a motor which is placed just beside the drive axle. It is true that this requires extra cost and space for the gear, but since the gear and the drive axle only transmit torque between motor and driving wheel

and do not have a supporting function, it is as a rule possible to use relatively inexpensive, commercially available standard components of small dimensions. Also in such an embodiment, considerable advantages over prior-art technique are thus obtained. An embodiment with a gear may be of interest, for instance if the motor that is to be used has an output shaft at one end only, or if the motor is an electric motor or a diesel engine. In fact, such motors generally have so high numbers of revolution that it is desirable to gear down the number of revolutions to obtain sufficient traction and/or to reduce the speed.

[0015] An advantage shared by all the above-described embodiments is that they are very easy to service. The drive units can in fact easily be released from the drive axle and dismounted from the rail vehicle for service, repair or exchange while the rail vehicle is still on its wheels, and it can also be towed in this state. A rail vehicle of a conventional type must first be raised to allow driving wheel, wheel axle and drive unit to be dismounted.

[0016] A further important advantage of a driving device according to the invention is that the reduced need for space for drive unit and drive axle provides greater flexibility in the location of the power source, for instance a diesel engine driving a hydraulic pump. The compacter design in fact provides better possibilities of freely placing the power source in the area between two succeeding pairs of wheels. This gives the rail vehicle an advantageously low centre of gravity and allows a lower total height of the rail vehicle, which is advantageous above all in the construction of tunnels as mentioned above.

[0017] The expression straight drive axle, as used herein, relates to a drive axle which does not have to be cylindrical but which should at least be symmetrical with respect to the rotational axis to prevent vibrations in operation.

Brief Description of the Drawings

[0018] In the following description, an exemplary embodiment of the invention will be described with reference to the accompanying drawings, in which

- Fig. 1 is a side view of a mining locomotive;
- Fig. 2 is a front view of the locomotive in Fig. 1;
- Fig. 3 is a perspective view obliquely from above of a pair of driving wheels, comprising a driving device according to the present invention; and
- Fig. 4 is a longitudinal section, from the front, of the pair of driving wheels and the driving device in Fig. 3.

Detailed Description of an Embodiment of the Invention

[0019] In the following, the invention will be described by way of example with reference to what is referred to as a mining locomotive which is intended for mining or

construction of tunnels. The mining locomotive is illustrated in Figs 1 and 2 in a side view and a front view, respectively, and comprises a driver's cab 1, a motor compartment 2 and two pairs of driving wheels 3. 4 and 5 designate actuators for brakes and sanding units, respectively, to reduce the spinning of the driving wheels on the rails when starting and stopping. These components thus have nothing to do with the actual driving device which will now be described.

[0020] Reference is then made to Figs 3 and 4, which illustrate a pair of driving wheels with an associated driving device according to the present invention, on the one hand in a perspective view and, on the other, in a longitudinal section from the front. Each pair of driving wheels comprises two driving wheels 3' of a conventional type. Each of the driving wheels is rotatably mounted on a support shaft via a roller bearing 7. Each of the support shafts 6 is relatively short and tubular and, in an inner portion, non-rotatably mounted in a through hole in a supporting chassis part 8 of the rail vehicle. In this manner, the driving wheels 3' will be placed on the outside of the chassis of the rail vehicle, which makes it possible to form the rail vehicle with an advantageously small width.

[0021] An elongate drive axle 9 is passed through the holes or bores formed by the support shafts 6, and the drive axle has such a length that it extends from the outside of one driving wheel to the outside of the other. A drive unit in the form of a hydraulic motor 10, in this case a radial piston motor, is arranged in the area between the supporting chassis parts 8 of the rail vehicle. More specifically, the hydraulic motor is formed with a hollow shaft through which the drive axle extends. The drive axle has a slightly smaller outer diameter than the inner diameter of the bore of the support shafts 6, preferably about 1-3 mm smaller. The drive axle is further non-rotatably connected to each of the driving wheels by a keyway joint 11 which on the one hand is screwed into the driving wheel and, on the other, locks the drive axle by keys and grooves. The drive axle will thus be centred coaxially with the rotational axis of the driving wheels and consequently rotates freely inside the support shafts 6 without contact with the inner circumference thereof during rotation of the driving wheels about the support shafts. The hydraulic motor 10 is also non-rotatably connected to the drive axle 9 by a clamp joint 12. The hydraulic motor is non-rotatably connected to the chassis of the rail vehicle via a torque arm 13 (Fig. 3). It should be understood that instead of keyway and clamp joints which non-rotatably lock the drive axle relative to the wheels and the motor, respectively, any other suitable joint can be used, such as a bolt joint or spline joint. The keyway joint 11 between the drive axle and the respective wheels has the advantage to allow a certain axial movement of the drive axle relative to the wheels, for instance due to a temperature-dependent change of the length of the drive axle. To prevent too large an axial movement of the drive axle, covers 14 are arranged in the hubs of the wheels.

[0022] In operation of the hydraulic motor 10, the driving wheels 3' will thus be synchronously driven by rotation of the drive axle 9 while the support shafts 6 are kept immovable relative to the chassis 8 and only support the weight of the rail vehicle via the driving wheels 3' and the roller bearings 7. Consequently the drive axle 9 will only transmit the torque between the hydraulic motor 10 and the driving wheels 3'. Due to this solution, the dimensions of the drive axle can be kept relatively small so as to fit standardised, commercially available drive units, such as the shown hydraulic motor 10. The inventive driving device makes it easy to perform service, repair or exchange of the hydraulic motor 10. To dismount the motor, it is only necessary to release the keyway joints 11 adjacent to the driving wheels 3' and the clamp joint 12 which connects the hollow shaft of the hydraulic motor to the drive axle 9. After that the drive axle 9 will be pressed out in either direction through the support shafts 6 and the hollow shaft of the hydraulic motor, after which the hydraulic motor can be dismounted from the rail vehicle while still standing on the driving wheels 3'.

[0023] Figs 3 and 4 also illustrate resilient rubber shock absorbers 15 to support the superstructure of the rail vehicle on the chassis part 8, and protection plates 16 around the motor 10, which however are only exemplary solutions that can be modified and varied in many ways, according to need and convenience.

Claims

1. A driving device for driving a rail vehicle, comprising a drive unit (10) acting on a straight and rigid drive axle (9) which in a synchronised manner drives two driving wheels (3') which are included in a wheel pair and which are rotatable about a common rotational axis, the drive axle extending between the two driving wheels and being non-rotatably connected to each of the driving wheels, and each of the driving wheels (3') being rotatably mounted, by means of a support shaft (6), relative to a supporting chassis (8) of the rail vehicle,
characterised in that the support shafts (6) are located on the outside of the supporting chassis (8) and are tubular with through bores which are concentric with the rotational axis of the wheels and through which extend the respective ends of the drive axle (9).
2. A driving device as claimed in claim 1,
characterised in that the drive unit (10) acts on the drive axle (9) in the area between the driving wheels (3').
3. A driving device as claimed in claim 1 or 2,
characterised in that the drive unit (10) comprises two output shafts which are concentric with the drive axle (9).

4. A driving device as claimed in any one of the preceding claims, **characterised in that** the drive unit (10) comprises a hollow shaft and the drive axle (9) is formed in one piece. 5
5. A driving device as claimed in any one of the preceding claims, **characterised in that** the drive unit is a hydraulic motor (10). 10
6. A driving device as claimed in any one of the preceding claims, **characterised in that** the hydraulic motor is a radial piston motor (10). 15
7. A driving device as claimed in any one of the preceding claims, **characterised in that** the support shafts (6) are supported by a supporting chassis of the rail vehicle, the supporting chassis parts (8) being located in the area inside the driving wheels (3'). 20
8. A driving device as claimed in any one of the preceding claims, **characterised in that** the drive axle (9) extends through the support shafts (6) without being in contact with and supported by the same. 25

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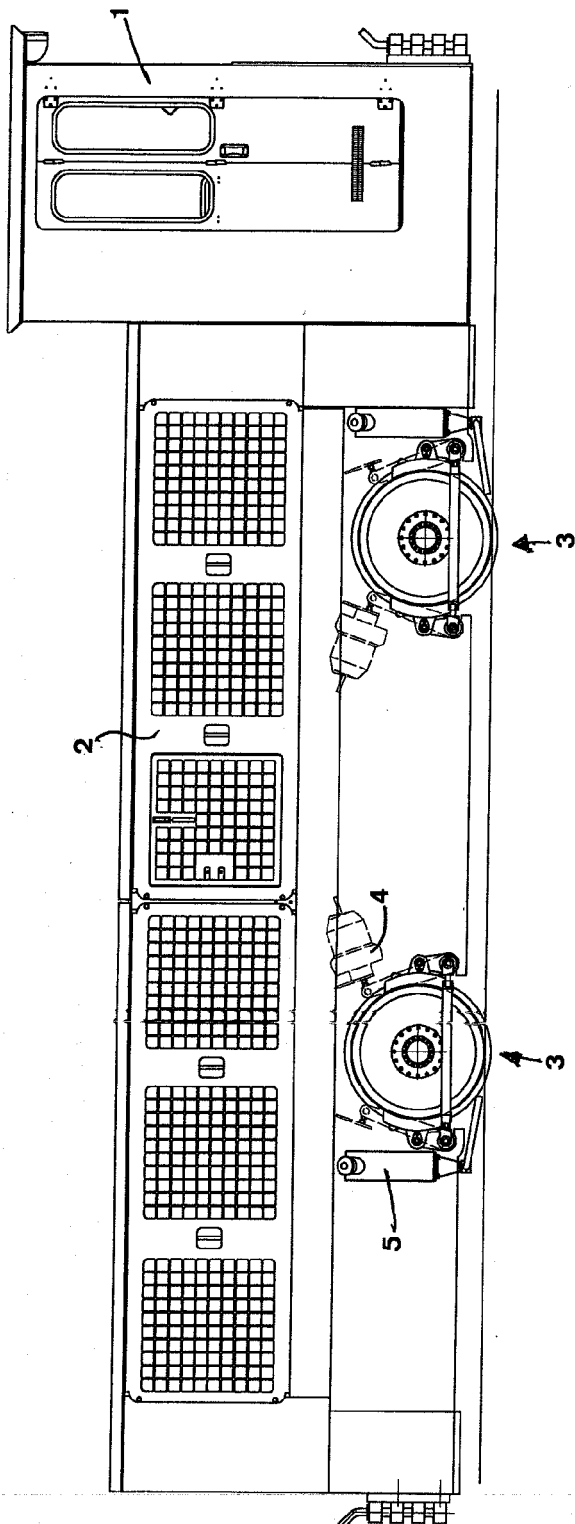


FIG 1

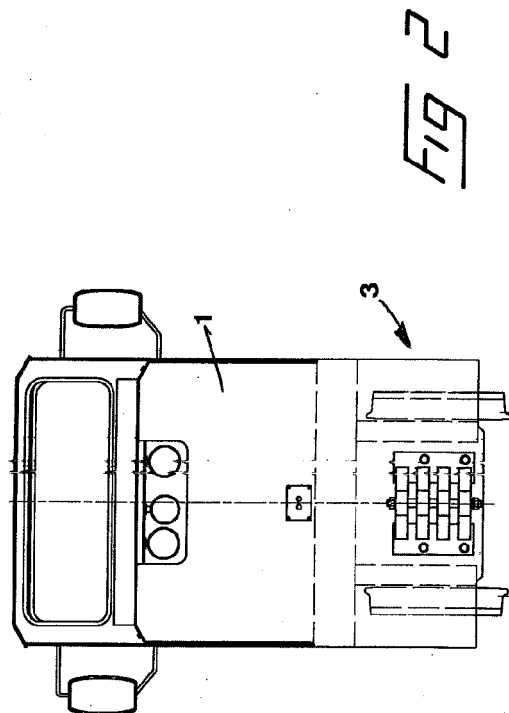


FIG 2

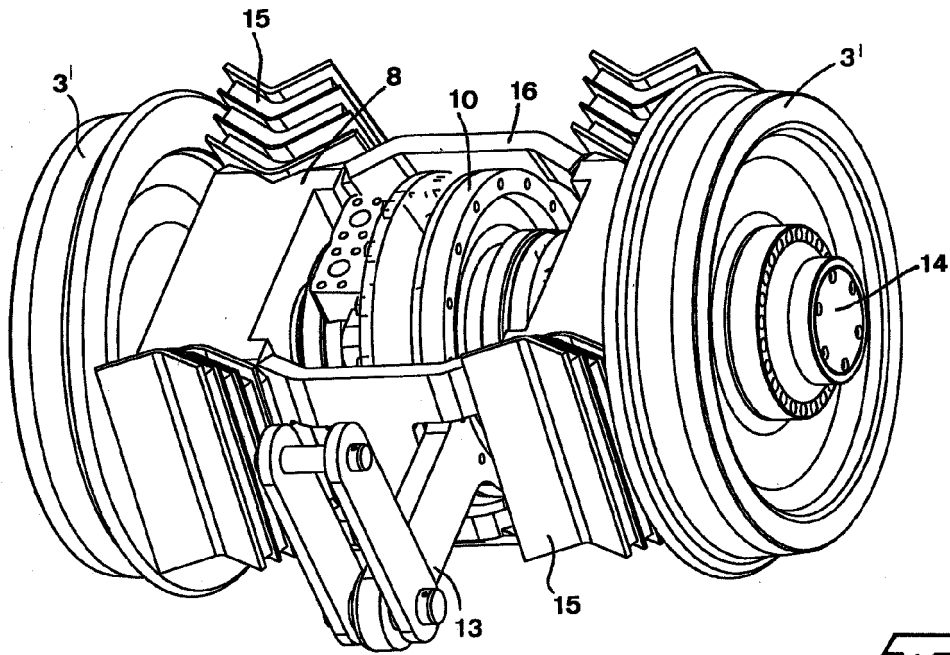


Fig 3

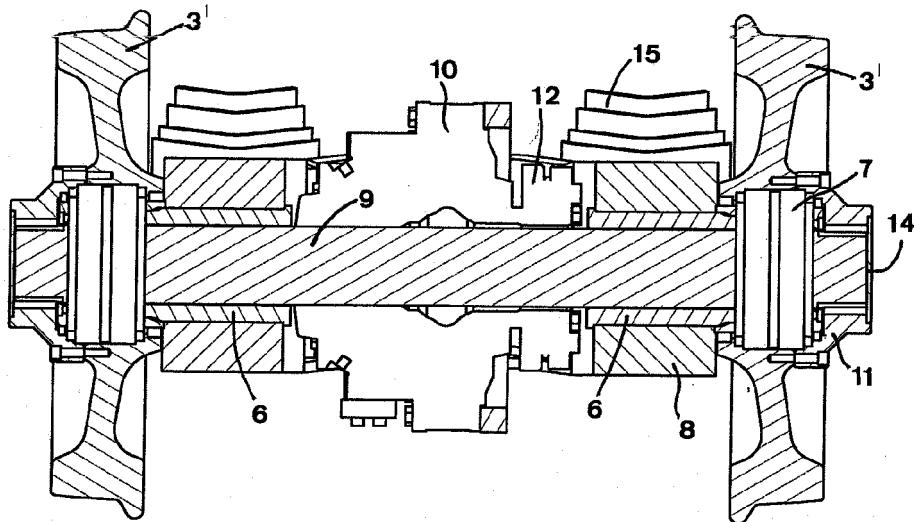


Fig 4



European Patent
Office

EUROPEAN SEARCH REPORT

Application Number
EP 06 11 6130

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
A	DE 564 510 C (WAGGON FABRIK A G) 19 November 1932 (1932-11-19) * figures 1,2 *	1,2,4,7	INV. B61C9/44 B61C9/14 B61C9/50 B61F3/04
A	DE 566 698 C (WAGGON FABRIK A G) 19 December 1932 (1932-12-19) * figure 3 *	1,2,7	
A	EP 0 046 135 A2 (SIEMENS AG [DE]) 17 February 1982 (1982-02-17) * the whole document *	1,2,4,7	
A	US 3 626 862 A (KORN GERHARD ET AL) 14 December 1971 (1971-12-14) * figure 2 *	3,4	
A	GB 213 245 A (LENTZ PATENTS LTD) 24 April 1924 (1924-04-24) * figures 1,2 *	5	
A	GB 628 681 A (CROMPTON PARKINSON LTD) 2 September 1949 (1949-09-02) * figure 1 *	1	TECHNICAL FIELDS SEARCHED (IPC)
			B61C B61F
The present search report has been drawn up for all claims			
Place of search Munich		Date of completion of the search 5 December 2006	Examiner Lorandi, Lorenzo
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document		T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document	

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**ANNEX TO THE EUROPEAN SEARCH REPORT
ON EUROPEAN PATENT APPLICATION NO.**

EP 06 11 6130

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.
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05-12-2006

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
DE 564510 C	19-11-1932	DE 567123 C	03-01-1933
DE 566698 C	19-12-1932	NONE	
EP 0046135 A2	17-02-1982	CA 1170910 A1	17-07-1984
		DE 3030594 A1	18-02-1982
		JP 57060961 A	13-04-1982
		US 4461218 A	24-07-1984
US 3626862 A	14-12-1971	CH 494662 A	15-08-1970
		DE 6750770 U	16-01-1969
		FR 2013063 A5	27-03-1970
		GB 1224107 A	03-03-1971
GB 213245 A	24-04-1924	NONE	
GB 628681 A	02-09-1949	NONE	

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- US 5345878 A [0006]
- US 4721430 A [0007]
- US 4095530 A [0008]