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K. MAYBACH ET AL
POWER TRANSMITTING MECHANISM FOR MOTOR VEHICLES
Filed Sept. 16, 1939

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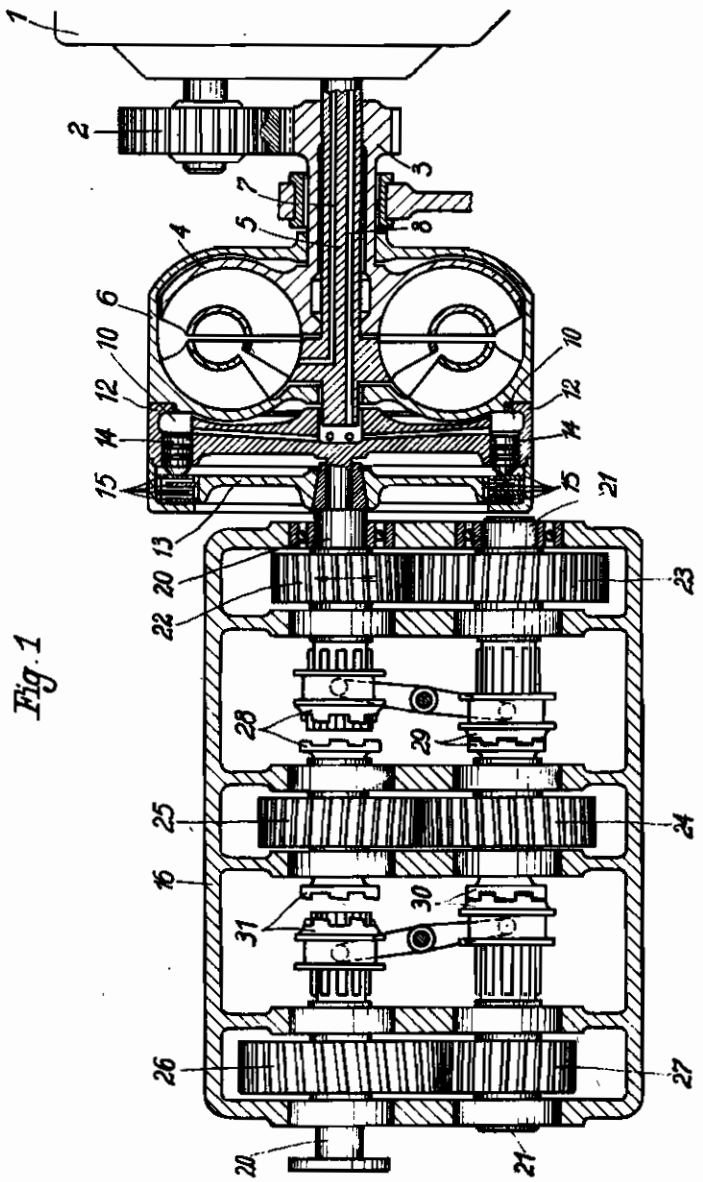

Fig. 1

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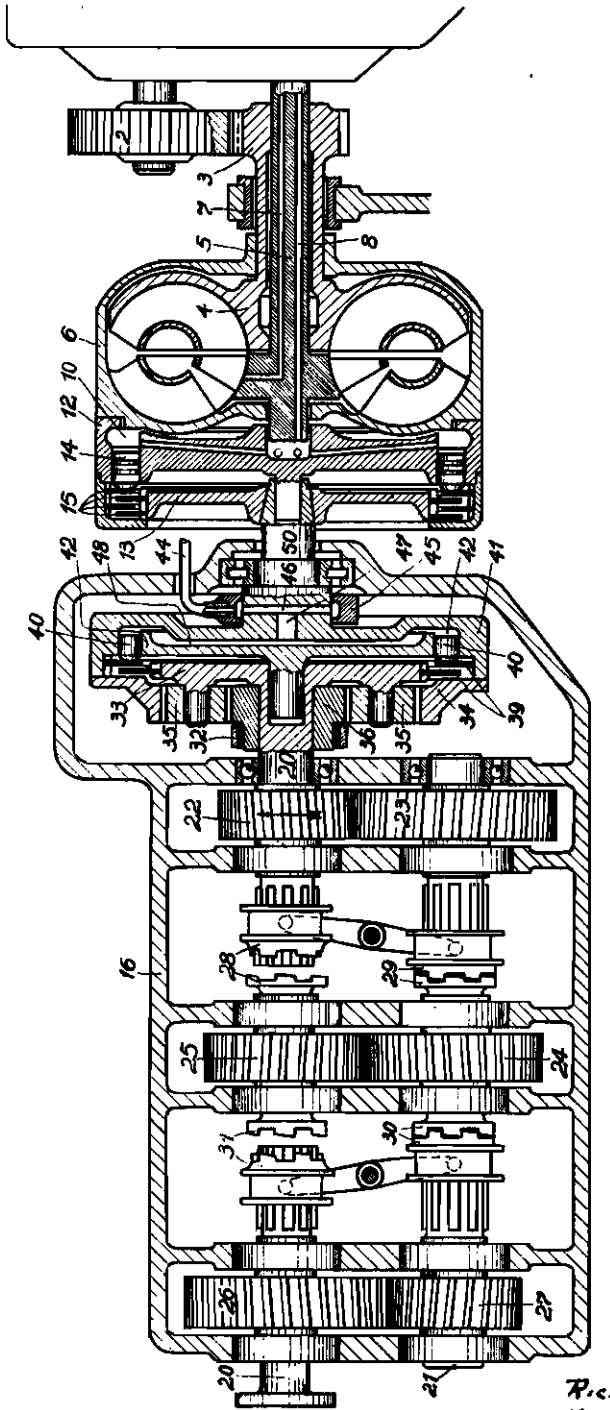

Fig. 2

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POWER TRANSMITTING MECHANISM FOR MOTOR VEHICLES

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Application filed September 16, 1939

This invention relates to the transmission of power through a variable speed gear transmission between an internal combustion engine and the wheels of a motor vehicle. It is particularly concerned with the transmission of power in large and heavy vehicles such as rail cars, and is directed to a combination mechanism of practical size and adequate transmitting capacity which enables power from the vehicle engine to be transmitted without strain or jerks, and which enables shifting to different gear selections with facility and without strain on the operating parts.

Variable speed transmissions which are shifted manually are not suitable for large and heavy motor vehicles because of the considerable shifting force required and inability to judge the relative speed of the gear parts to be engaged and determine the proper time to complete engagement. Also, especially in rail cars, power operated gear shift transmissions adequate to transmit the high power involved in such cases are either too large, or if made sufficiently compact to be employed in the small space available are inadequate for the power of the internal combustion engine employed. A prolonged period is required for shifting from one gear selection to another, and the change in speed of the vehicle is relatively abrupt and manifested by undesirable jerks.

It has heretofore been attempted to overcome these difficulties through electrical power transmitting mechanism between the vehicle engine and wheels so that the torque of the engine might be transmitted and varied in a smooth and uniform manner. Such arrangement, however, has the disadvantage of high cost, great weight, and large space requirement per unit of output power. It has now been proposed to overcome the problem by effecting a drive from the vehicle engine to a variable speed gearing through a hydraulic torque converter.

In the latter combination the variable speed gearings heretofore employed in association with the hydraulic torque converter have been difficult to shift, and could be shifted only with prolonged interruption in the transmission of power from the engine to the vehicle wheels. Friction clutches if employed had to be too large in dimension. Synchronizing mechanism where employed permitted chattering and jars in the transmission parts during shifting. The wear on the parts was extremely heavy.

The mechanism of the present invention is designed to overcome the objections just referred to by providing a combination hydraulic torque converter and variable speed gearing giving a minimum of noise while running, permitting satisfactory shifting of the gears, and giving minimum wear and necessitating minimum size. The arrangement is such as to give a wide speed range for a relatively small number of gear selections.

According to the invention power is transmitted from the vehicle engine through a hydraulic torque converter to a variable speed gearing having constantly meshing gear pairs wherein jaw clutches are provided to effect a shift from one gear selection to another. Such clutches are so designed that upon being brought towards engagement they will come into positive engagement as the parts to be connected attain substantially the same speeds. The shafts of the gear trains are preferably divided into a plurality of sections.

Where it is desired to provide intermediate speed ratios and employ only a relatively small number of stages in the variable speed gearing, as for example, for towing, and to provide a speed ratio lower than the lowest ratio of the gear transmission, the invention contemplates the provision of a planetary gearing between the fluid coupling and the variable speed gearing.

Fig. 1 is a sectional elevation of a power transmitting mechanism according to the invention; and,

Fig. 2 is a similar view of a modified construction incorporating a device not shown in Fig. 1.

In Fig. 1, 1 is the vehicle driving motor for example, an internal combustion engine. The driving part 4 of a fluid coupling, or hydraulic torque converter, is driven through the gears 2 and 3. 5 is the stationary axle of the directing vanes. 6 is the driven part of the torque converter. 7 is an axial bore which serves to supply operating fluid to the torque converter while the axial bore 8 supplies pressure fluid to the pressure chamber 10 of a friction clutch whose halves 12 and 13 are connected together by means of discs 15 which are pressed together by the pistons 14. The main shaft 20 which is broken at a number of places is located in the transmission housing 16 which likewise contains the broken counter shaft train 21. The constantly meshing three gear pairs 22 and 23, 24 and 25, 26 and 27, are shifted alternately by the overtaking jaw clutches 28—31 having teeth with inclined front faces.

The construction of Fig. 2 includes in addi-

tion to the mechanism of Fig. 1 a planetary gearing located in the front end of housing 16 and forming a driving connection between the torque converter and the gear transmission. In Fig. 2, 33 is a planet spider which is connected to the main shaft 20. 34 is an internal gear and 36 a sun gear; between the two there are meshed the planet gears 35. The discs 15 are arranged rotatively or movably on the one hand on the planet spider and on the other hand on the coupling element 41. Pistons 40 are mounted in pressure chambers 42. The line 44 opens into a stationary hollow ring 45 which surrounds the shaft 50 connected to the shaft of the torque converter. The bores 46 also open into this hollow space. 47 and 48 are further hollow spaces for the pressure fluid.

In shifting the friction clutch 12 and 15 is disengaged and the necessary shifts are rapidly effected in the transmission with overtaking jaw clutches in the manner usual with such transmissions.

In order to start in the lowest gear the jaw clutches 29 and 30 are brought into engaging position as shown in the drawings. The hydraulic torque converter is already filled with operating fluid through the channel 7. The pistons 14 under the action of pressure fluid from the bore 8 in the pressure chambers 10 compress the discs 15 together thus engaging the clutch. Since the vehicle is to start from a full stop the torque converter gives a great torque to the driven part corresponding to the R. P. M. of the driving motor and the large value of the ratio between R. P. M. of the driving and the driven portions of the converter. The low ratio corresponding to low gear in the transmission still further increases this torque. Under ordinary circumstances this suffices to overcome any resistance which is practically encountered in operation.

The planetary gear in the embodiment of Fig. 2 is for the purpose, when necessary, of providing still further intermediate gear ratios and particularly one lower than low gear with a corresponding range determined by the torque converter. If for example the planetary gear is to be engaged in low gear the pressure of the pressure liquid on the pistons 40 through the line 44 the hollow ring 45 and the bores 46, 47 and 48 is relieved resulting in a disengagement of the discs 39 on the other hand the band brake 32 locks the sun gear 36. As a result the internal gear 34 driven from the hydraulic torque converter rotates and the planet spider 33 transmits to the main shaft 20 of the transmission a further increased torque resulting from the double rotation of the planet gears 35 on the internal gear 34 and the sun gear 36.

If the next higher gear is to be engaged, in this case low gear, the gear reduction of the planetary gear is thrown out by releasing the brake 32 and introducing oil under pressure through the line 44. This reaches the hollow ring 45 and the chambers 47 and 48 and bores 42 and presses the pistons against the discs 39. As a result the planet spider 33, the internal gear 34 and the jaw clutch member 41 are connected together and the planetary gear is locked so that it now rotates as a unit at the R. P. M. of the shaft 50 and transfers this same R. P. M. to the main shaft 20 of the transmission.

As will appear from the above the mechanism illustrated results in an advantageous transmission of power with advantageous torque conversion in the smallest space and with a minimum of running and shifting noise. By using a transmission with shaft trains interrupted at a number of points the desired number of speed ratios is obtained with a minimum number of gears. Operation of the device is comparatively simple and the operating reliability is materially increased by reason of the fact that the circulating circuit of the hydraulic torque converter remains always filled. It is unnecessary to completely empty the pressure chamber of the friction clutch on declutching so that the reengagement of the clutch can be effected in minimum time.

The advantages of this power transmission are, according to a feature of the invention, furthermore increased by the provision of an auxiliary energy device for actuating the change stages and also the friction coupling. The action of the friction coupling may be controlled by the driver or by an automatic device depending upon speed or number of revolutions and which after release gives without further control by the driver and by an automatic arrangement which is provided, a positive sequence of the operating process in the change speed gear and of the disengaging and engaging process of the friction coupling. Such devices are shown and described, c. g., in the U. S. patent specifications applications Ser. Nos. 30,759; 30,760; 160,916; 172,020.

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