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CERTIFICATION

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the results of these proceedings.

I declare under penalty of perjury under the laws of the United States of America that the translation into ENGLISH is true and accurate of the attached document relating to:

WO 2009/067987

written in GERMAN.

NEWTYPE COMMUNICATIONS, INC.

Sworn to and subscribed before me
this 8th day of August, 2016

NOTARY PUBLIC

BRIAN G. BROWN
Notary Public, State of New York
No. 01BR6151227
Qualified in Suffolk County
Commission Expires August 14, 2018

Translator's notes re WO 2009/067987:

1. Claim 11:
   Translated with same word order as in German. The sentence is confusing because of the 2 occurrences of "mit" (= with). A similar sentence was not found in the description.

2. Claim 20:
   "is achieved" may be a misprint for "is disposed".

3. Claim 24:
   The subject "Bestandteile" (components) is plural and the verb "bildet" is singular.

Force-transmission device, especially for power transmission between a drive machine and a power take-off

The invention relates to a force-transmission device, especially for power transmission between a drive machine and a power take-off, comprising an input and an output and a damper arrangement disposed between input and output with at least two dampers that can be connected in series and a rotational-speed-adaptive vibration absorber.

Force-transmission devices in drive trains between a drive machine and a power take-off are known in the most diverse embodiments from the prior art. If an internal-combustion machine is used as the drive machine, a torsional motion superposed on the rotational motion develops on the crankshaft, with a frequency that varies with the rotational speed of the shaft. Vibration-absorbing arrangements are used for reduction. They comprise an additional mass, which is coupled via a spring system with the vibration system. The mode of action of the vibration absorber is based on the fact that, at a certain exciter frequency, the primary mass remains at rest while the additional mass executes a forced vibration. However, since the exciter frequency changes with the rotational speed of the drive machine, while the natural frequency of the vibration absorber remains constant, this vibration-absorbing effect takes place only at a certain rotational speed. Such an arrangement is already known, for example, from the publication DE 10236752 A1. Therein the drive machine is connected via at least one starting element, especially a clutch or a hydrodynamic rotational-speed/torque converter, with one or more gear-mechanism parts. This means that a spring-and-mass system capable of vibrations is not connected in series with the drive train but instead is disposed in parallel connection relative thereto, whereby the elasticity of the drive train is not impaired. This spring-and-mass system, capable of vibration, functions as a vibration absorber. According to a particularly advantageous embodiment in conjunction with the converter lockup clutch, this is associated therewith in order to prevent possible force surges during closing of the converter lockup clutch. According to one improvement, it is further provided to connect a torsion damper having two torsion-damping stages downstream from the starting element, in which case this is disposed in the force flow of the drive train. This means that the spring-and-mass system is disposed between the first torsion-damping stage and the second torsion-damping stage, whereby particularly good transmission behavior is supposed to be achieved. The spring-and-mass system may be provided with a variable natural frequency for use in a broader frequency band, which can be influenced by open-loop or closed-loop control.

Furthermore, a force-transmission device is already known from publication DE 19781582 T1, comprising a fluid clutch and a device for lockup thereof, wherein an arrangement of mechanisms is provided that functions to control the relative torsion between the input and output device of the power-transmission device.

In order to absorb the effect of excitation over a broad, preferably the entire rotational-speed range of a drive machine, rotational-speed-adaptive vibration absorbers capable of absorbing torsional vibrations over a larger rotational-speed range, ideally over the entire rotational-speed range of the drive machine, because the natural frequency is proportional to the rotational-speed, are provided in conformity with DE 19831160 A1 in drive trains. These operate according to the principle of a circular or centrifugal pendulum in the centrifugal-force field, which is already used in known manner in internal-combustion engines for absorption of crankshaft vibrations. Therein inertial masses are pendulum-mounted around an axis of rotation and are constrained to circle around it at the largest possible distance upon introduction of a torsional motion. The torsional vibrations lead to a relative pendulum motion of the inertial masses. In this context, different systems are known, in which the inertial masses move purely in translation relative to the torque-introduction axis on a circular movement path, or else, as in DE 19831160 A1, in which the movement path has a radius of curvature that varies at least partly with increasing deflection of the inertial mass from the middle position.

A starting unit, comprising a hydrodynamic rotational-speed/torque converter as well as a device for lockup of the power transmission via the hydrodynamic rotational-speed/torque converter is already known from publication DE 19926696 A1. This comprises at least one additional mass, the center of gravity of which is radially displaceable as a function of a relative position of the gear element, relative to an axis of rotation of the torque-transmission pathway.

From publication DE 102006028556 A1, a torque-transmitting device in the drive train of a motor vehicle for torque transmission between a drive machine and a power take-off is already known that comprises not only a connectable coupling device but also at least one torsional-vibration-damping device. A centrifugal-pendulum device, which has several pendulum masses linked movably relative to this by means of running rollers on the pendulum-mass support device, is associated with this.

Multiple dampers that in particular act in individual rotational-speed ranges and can be optimally matched thereto are frequently used in force-transmission units. However, without considerable special expense and partly also for reasons of overall space, it is also not possible to cover the entire rotational-speed range of a drive machine satisfactorily with these from the viewpoint of vibration damping.

The object of the invention is therefore to further develop a force-transmission device of the type mentioned in the introduction, especially a force-transmission device with a multiple damper arrangement, comprising at least two dampers connected in series as viewed in at least one force-flow direction, in order to reduce or completely cancel out rotational irregularities in the force-transmission device over the entire operating range of the drive machine.

The inventive solution is characterized by the features of claim 1. Advantageous configurations are described in the dependent claims.

A force-transmission device constructed according to the invention, especially for power transmission between a drive machine and a power take-off, comprising a damper arrangement with at least two dampers connectable in series and a rotational-speed-adaptive vibration absorber, is characterized in that the rotational-speed-adaptive vibration absorber is disposed between the dampers at least in one force-flow direction over the damper arrangement.

A rotational-speed-adaptive vibration absorber according to the invention will be understood as a device that does not transmit any torque but is suitable for absorbing excitations over a very broad range, preferably the entire rotational-speed range of a drive machine. The natural frequency of a rotational-speed-adaptive vibration absorber is proportional to the rotational speed, especially the rotational speed of the exciting machine.

The inventive solution permits reduction or prevention of the introduction of rotational irregularities into the drive train, especially in a force-flow direction that preferably is always used in the main working range. Furthermore, the entire damping system can be better adapted to the torsional vibrations to be absorbed without considerable additional modifications of the individual dampers.

The force-transmission device can be constructed in various ways. According to a particularly

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