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(54) **TORQUE TRANSMITTING DEVICE**

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4,613,029	A *	9/1986	Beccaris	192/210
5,771,998	A *	6/1998	Olsen et al.	192/3.29
5,975,261	A *	11/1999	Woerner et al.	192/3.29
6,142,272	A *	11/2000	Meisner et al.	192/3.29
6,223,872	B1 *	5/2001	Heller et al.	192/3.29
2001/0015308	A1 *	8/2001	Heller et al.	192/3.29
2008/0202880	A1 *	8/2008	Kombowski	192/3.23

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 396 days.

This patent is subject to a terminal disclaimer.

FOREIGN PATENT DOCUMENTS

DE	199 20 542	11/1999
FR	2 867 540	9/2005

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See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

4,027,757 A * 6/1977 Radke et al. 464/64.1

* cited by examiner

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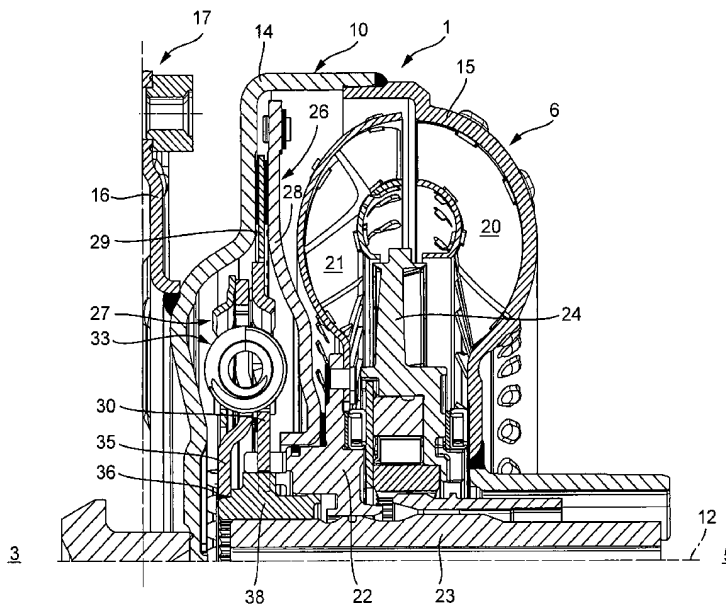
Assistant Examiner—Justin Holmes

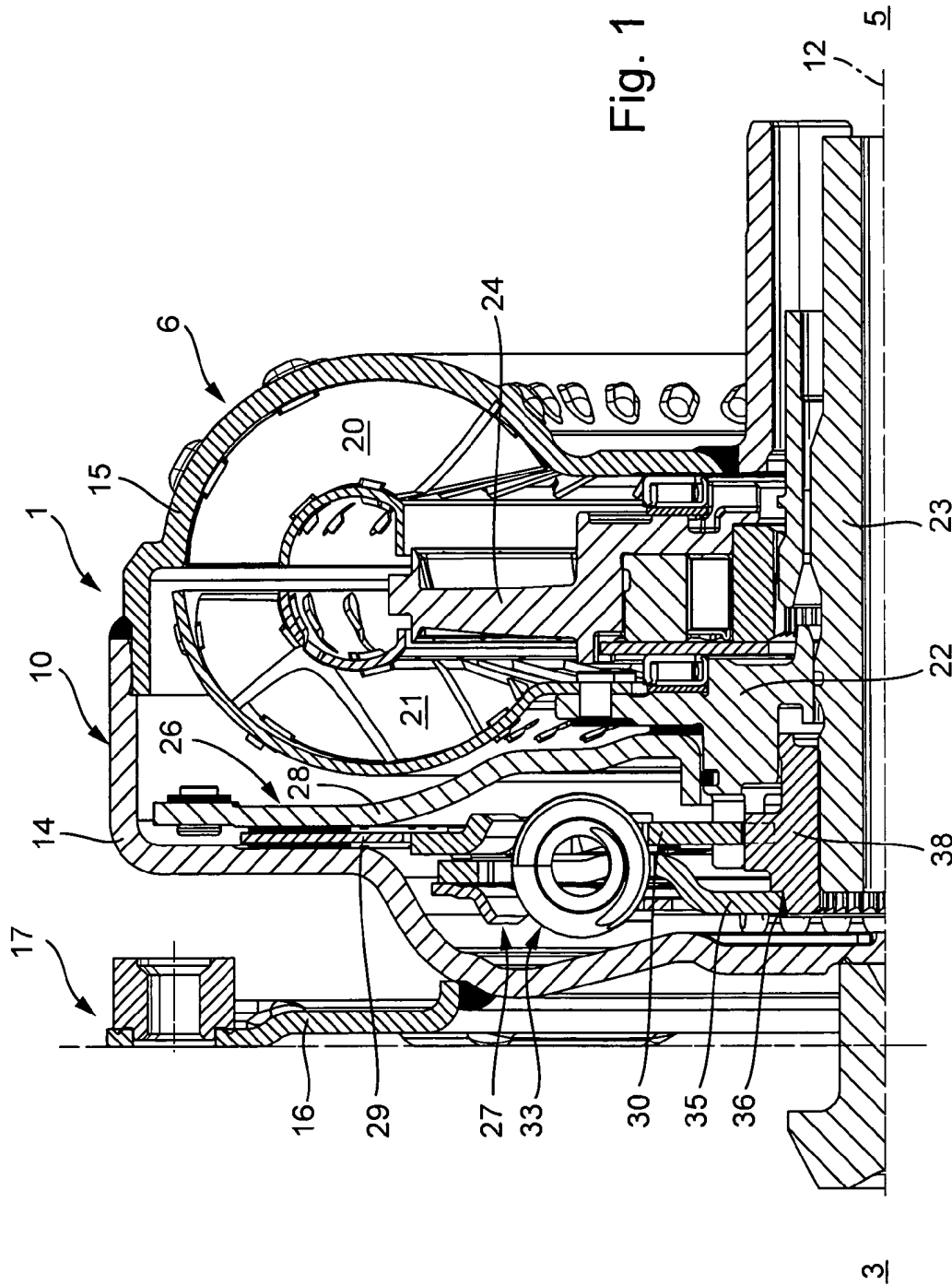
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(57) **ABSTRACT**

The invention relates to a torque transmitting device having a hub arranged in the drive train of a motor vehicle for transmitting torque between a drive unit and a transmission, in particular a turbine wheel hub of a turbine wheel of a torque converter which is coupled to a damper hub with a rotational vibration damper connected in between via a driving plate, in particular of a converter bridge coupling. The invention is operatively arranged such that the rotational vibration damper is equipped with a mechanical stop mechanism that is in effect as soon as a maximum design load on the rotational vibration damper has been exceeded.

11 Claims, 3 Drawing Sheets





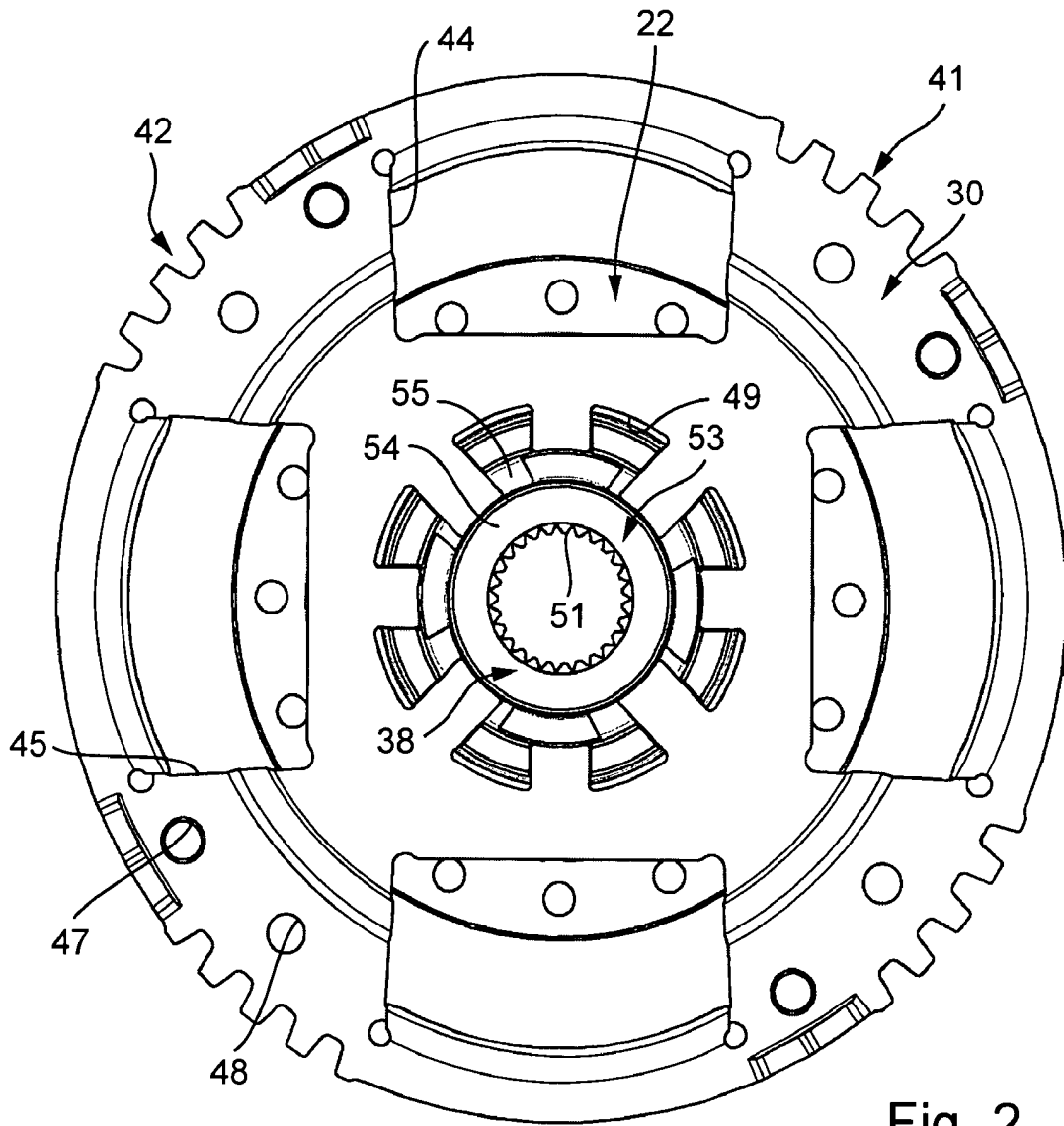


Fig. 2

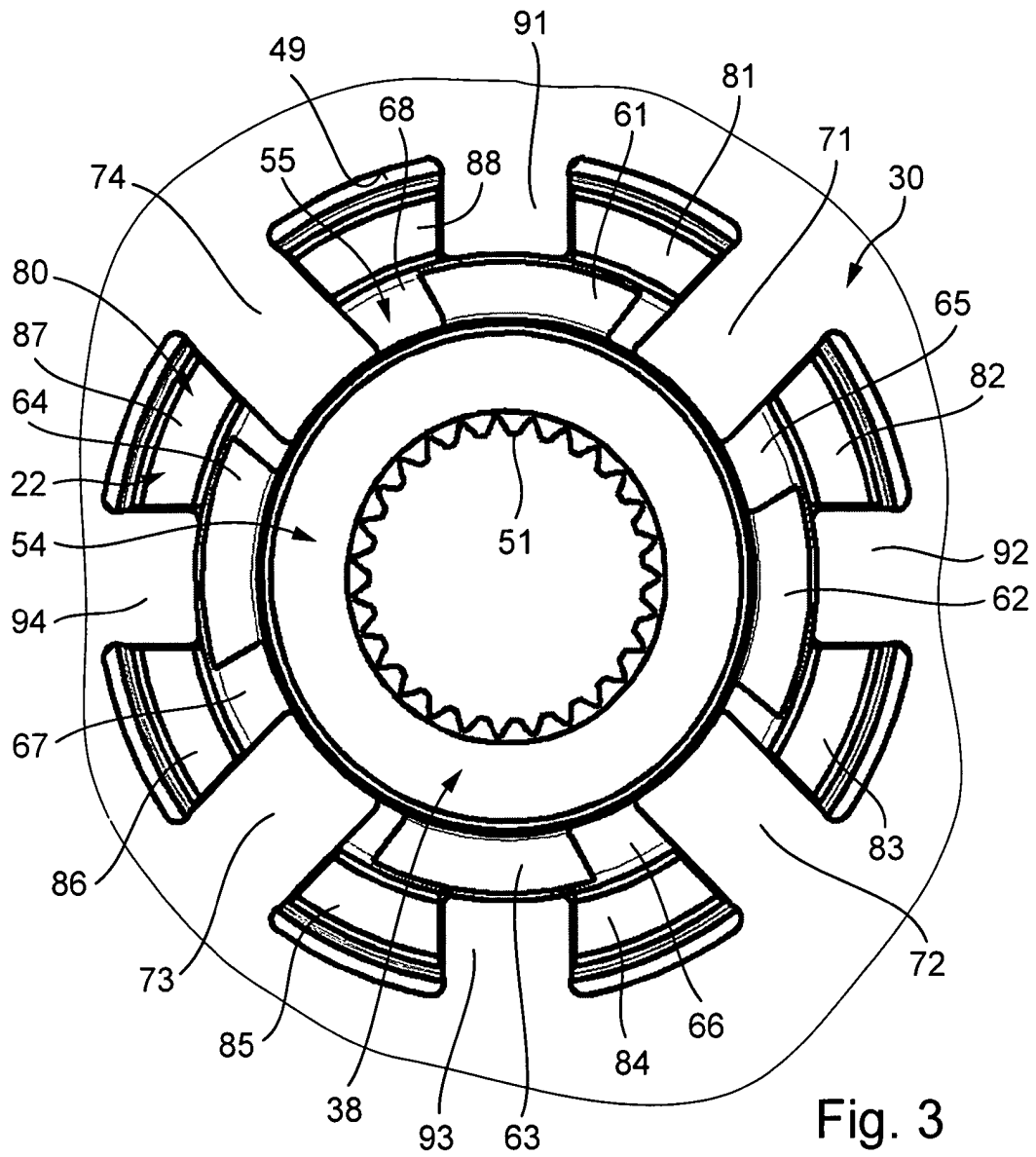


Fig. 3

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TORQUE TRANSMITTING DEVICE**CROSS REFERENCE TO RELATED APPLICATIONS**

This patent application claims priority of German Patent Application No. 10 2005 060 566.4, filed Dec. 17, 2005, which application is incorporated herein by reference.

BACKGROUND OF THE INVENTION

The invention relates to a torque transmitting device having a hub, in particular a turbine wheel hub of a turbine wheel of a torque converter, arranged in the drive train of a motor vehicle for transmitting torque between a drive unit and a transmission, the torque converter being connected to a damper hub with a torsional vibration damper connected in between via a driving plate, in particular a converter bridge coupling.

SUMMARY OF THE INVENTION

The invention broadly comprises a torque transmitting device having a hub, in particular a turbine wheel hub of a turbine wheel of a torque converter, arranged in the drive train of a motor vehicle for transmitting torque between a drive unit and a transmission, the torque converter being coupled to a damper hub with a torsional vibration damper connected in between via a driving plate of a converter bridge coupling in particular due to the fact that the torsional vibration damper is equipped with a mechanical stop mechanism that is effective as soon as a maximum design load on the torsional vibration damper is exceeded. This yields the advantage that it effectively prevents an overload of the torsional vibration damper. An overload can be defined as any load in excess of the design damper capacity. The protection of the mechanical stop mechanism relates to the force transmitting components of the damper, including the elastic elements that are in effect in the damper.

A preferred exemplary embodiment comprises a torque transmitting device having a stop mechanism comprising stop fingers that start from the driving plate and protrude into an interspace bordered in the circumferential direction by two stop limiting elements provided on the damper hub. The maximum angle of rotation between the driving plate and the damper hub can be adjusted based on the distances in the circumferential direction between the stop fingers and the respective stop limiting elements.

In another preferred exemplary embodiment of the torque transmitting device, the stop fingers extend radially inward from a central opening in the driving plate. This allows space to be saved in the axial direction.

In another preferred exemplary embodiment of the torque transmitting device, the stop limiting elements extend axially from the damper hub. The stop limiting elements are preferably in the form of arcs of a circle.

In another preferred exemplary embodiment of the torque transmitting device, several stop fingers are distributed uniformly over the circumference of the driving plate. Preferably at least four stop fingers are uniformly distributed over the circumference of the driving plate.

In another preferred exemplary embodiment of the torque transmitting device, the stop fingers are arranged in the circumferential direction with one stop finger each between two coupling elements leading away from the hub. The coupling elements serve to connect the driving plate to the hub in a rotationally fixed manner. This achieves the result that any

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overload is directed from the hub directly into the damper hub via the stop fingers of the driving plate.

In another preferred exemplary embodiment of the torque transmitting device, the coupling elements extend axially away from the hub. The coupling elements are preferably in the form of arcs of a circle.

In another preferred exemplary embodiment of the torque transmitting device, one coupling finger extends radially inward from the driving plate between two stop fingers. The coupling fingers allow a good force distribution.

In another preferred exemplary embodiment of the torque transmitting device, the coupling fingers are arranged in the circumferential direction with one each between two coupling elements extending away from the hub. The coupling fingers are shorter than the stop fingers and do not extend into the inner spaces which are limited by two stop limiting elements provided on the damper hub in the circumferential direction.

In another preferred exemplary embodiment of the torque transmitting device, a damper hub flange is mounted on the damper hub. The two-part design with the damper hub and damper hub flange makes it possible for the two parts to adjust the maximum angle of rotation of the damper when establishing the connection of the damper hub flange to the damper hub. Thus, unlike previous approaches known in the past, it is possible to produce different damper characteristics, e.g., the torque via the angle of rotation, simply by varying the spring elements and without any further geometric change in the damper components.

In another preferred exemplary embodiment of the torque transmitting device, the damper hub flange is integrally bonded to the damper hub. The damper hub flange is preferably connected to the damper hub by a welded connection, in particular a laser-welded connection. The welded connection is preferably established only after adjusting the maximum angle of rotation of the damper.

The object of the invention is to create a torque transmitting device as recited in the claims that will have a longer lifetime than traditional torque transmitting devices.

BRIEF DESCRIPTION OF THE DRAWINGS

Additional advantages, features and details are derived from the following description in which an exemplary embodiment is described in detail with reference to the drawings, where:

FIG. 1 shows a torque transmitting device according to a first exemplary embodiment in a half-sectional view;

FIG. 2 shows a driving plate with a damper hub and a turbine wheel hub of the torque transmitting device from FIG. 1 as seen from above; and,

FIG. 3 shows an enlarged detail from FIG. 2.

DETAILED DESCRIPTION OF THE INVENTION

FIG. 1 shows a part of drive train 1 of a motor vehicle. Hydrodynamic torque converter 6 is arranged between transmission 5 and drive unit 3, in particular an internal combustion engine, with a crankshaft extending out of it. The crankshaft of internal combustion engine 3 is connected to housing 10 of torque converter 6 in a rotationally fixed manner via a drive plate, which is also referred to as a flex plate.

Housing 10 of torque converter 6 is rotatable about axis of rotation 12 and is equipped with housing wall 14 near the drive and housing wall 15 at a distance from the drive. Starter gear rim 17 is mounted on housing wall 14 near the drive with the help of connecting sheet metal part 16 extending radially

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outward. Housing wall **15** at a distance from the drive is combined into a modular unit with pump wheel **20** of hydrodynamic torque converter **6**.

Turbine wheel **21** which is mounted on turbine wheel hub **22** with the help of rivet connecting elements is arranged between pump wheel **20** and housing wall **14** near the drive.

Turbine wheel hub **22** is mounted to rotate in relation to input shaft **23** of transmission **5**. Stator **24** is arranged between turbine wheel **21** and pump wheel **20** in a known way. Converter bridge coupling **26** with rotational vibration damper **27** is arranged between turbine wheel **21** and housing wall **14** near the drive, again in a known way. Converter bridge coupling **26** comprises piston **28** mounted to be rotatable and axially displaceable radially to the outside on turbine wheel hub **22**. Piston **28** has on the outside, radially disposed, a friction surface facing internal combustion engine **3** and arranged opposite another friction surface which is provided on the side of housing wall **14** near the drive and facing away from internal combustion engine **3**. Friction plate **29** connected to driving plate **30** in a rotationally fixed mount is arranged between the two friction surfaces.

Driving plate **30** is connected to damper flange **35** of rotational vibration damper **27** with energy storage elements **33** connected in between, in particular bow springs. Damper flange **35** is integrally bonded to damper hub **38** with the help of welded connection **36**. Damper hub **38** is in turn connected to one end of input shaft **23** of transmission **5** in a rotationally fixed manner on the inside radially.

FIG. 2 shows turbine wheel hubs **22**, driving plate **30** and damper hub **38**, omitting the other parts in a view of drive unit **3** as seen from above, shown here in the assembled state. Driving plate **30** has essentially the shape of a circular ring plate. On the outside, disposed radially, driving plate **30** has several gear tooth areas **41**, **42**. Gear tooth areas **41**, **42** serve to connect driving plate **30** to the friction plate (**29** in FIG. 1) in a rotationally fixed but axially displaceable manner. In addition, driving plate **30** has four windows **44**, **45** that are distributed uniformly over the circumference and serve to hold the energy storage elements (**33** in FIG. 1) in a known manner. In addition, the driving plate has multiple through-holes **47**, **48** which serve to allow the passage or rivet-connecting elements, for example. On the inside, **25** disposed radially, driving plate **30** has central through-hole **49** which is also referred to as an opening.

Damper hub **38** is arranged concentrically with driving plate **30** and partially in central through-hole **49**. On the inside, disposed radially, damper hub **38** is equipped with internal gear teeth **51**. Internal gear teeth **51** are designed on the inside on essentially tubular damper hub body **53**, of which only ring surface **54** is visible in FIG. 2. Outside ring surface **54** radially and concentrically with it, damper hub **38** has another ring surface **55**. However, additional ring surface **55** is arranged with an offset in the axial direction to ring surface **54**. In the view shown here, additional ring surface **55** is offset into the plane of the paper with respect to ring surface **54**.

FIG. 3 shows the central section of driving plate **30** on turbine wheel hub **22** from FIG. 2 with damper hub **38** shown on an enlarged scale. Four stop limiting elements **61** through **64** extend axially from ring surface **55** of damper hub **38**. Four stop limiting elements **61** through **64** each have the shape of an arc of a circle and are uniformly distributed over the circumference of ring surface **55**. Essentially arc-shaped interspaces **65**, **66**, **67**, **68** are recessed between two stop limiting elements **61**, **62**; **62**, **63**; **63**, **64**; **64**, **61**. Stop fingers **71** through **74** protruding into each interspace **65** through **68** extend radially from central through-hole **49** of driving plate

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30. Stop fingers **71** through **74** are attached to driving plate **30** in one piece and are distributed uniformly over the circumference of through-hole **49**. Due to the distance in the circumferential direction between stop fingers **71** through **74** and respective stop limiting elements **61** through **64**, the size of the relative angle of rotation between driving plate **30** and damper hub **38** is defined.

Turbine wheel hub **22** has ring surface **80** on the outside, disposed radially and concentrically with ring surfaces **54**, **55** of damper hub **38**, eight coupling elements **81** through **88** extending axially away from the ring surface. Coupling elements **81** through **88** each are in the shape of arcs and are uniformly distributed over the circumference of ring surface **80**. Stop fingers **71** through **74** pass between each of coupling elements **81**, **82**, **83**, **84**, **85**, **86**, **87**, **88**. In addition, coupling fingers **91** through **94** are arranged between two coupling elements **88**, **81**, **82**, **83**, **84**, **85**, **86**, **87** and extend radially away from driving plate **30**. Coupling fingers **91** through **94** are arranged so that they are uniformly distributed over the circumference of central through-hole **49** of driving plate **30** in alternation with stop fingers **71** through **74**. However, coupling fingers **91** through **94** are designed to be shorter than stop fingers **71** through **74**. This achieves the result that coupling fingers **91** through **94** do not engage in damper hub **38** but instead are each in contact with one stop limiting element **61** through **64** on the outside, disposed radially. Coupling fingers **91** through **94** and stop fingers **71** through **74** also serve to center driving plate **30** on damper hub **38**.

The mechanical stop may be used in two directions of rotation, as shown here. However, there is also the possibility of using the mechanical stop in only one direction of rotation. In this case, a load in the other direction of rotation is absorbed by another mechanical stop, e.g., inside the damper.

LIST OF REFERENCE NUMERALS

- 1 drive train
- 3 drive unit
- 5 transmission
- 6 torque converter
- 10 housing
- 12 axis of rotation
- 14 housing wall
- 15 housing wall
- 16 connecting sheet metal part
- 17 starter gear rim
- 20 pump wheel
- 21 turbine wheel
- 22 turbine wheel hub
- 23 input shaft
- 24 stator
- 26 converter bridge coupling
- 27 rotational vibration damper
- 28 piston
- 29 friction plate
- 30 driving plate
- 33 energy storage element
- 35 damper flange
- 36 welded connection
- 38 damper hub
- 41 gear tooth area
- 42 gear tooth area
- 44 window
- 45 window
- 47 through-hole
- 48 through-hole
- 39 through-hole

51 internal gear teeth
 53 damper hub body
 54 ring surface
 55 ring surface
 61 stop limiting element
 62 stop limiting element
 63 stop limiting element
 64 stop limiting element
 65 interspace
 66 interspace
 67 interspace
 68 interspace
 71 stop finger
 72 stop finger
 73 stop finger
 74 stop finger
 80 ring surface
 81 coupling element
 82 coupling element
 83 coupling element
 84 coupling element
 85 coupling element
 86 coupling element
 86 coupling element
 88 coupling element
 91 coupling finger
 92 coupling finger
 93 coupling finger
 94 coupling finger

What is claimed is:

1. A mechanical stop mechanism for a torque converter (6), comprising
 a hub (22) for a turbine wheel (21);
 a damper hub (38) connected to a rotational vibration damper (27), rotational vibration damper (27) connected to a converter bridge coupling (26); and,
 a damper including a plurality of springs, a flange rotationally fixed to the damper hub, and a driving plate (30), wherein the driving plate (30) is for receiving a torque load, wherein the torque load is transferable from the driving plate (30) to the flange via the springs, wherein the driving plate (30) is connected to converter bridge coupling (26), wherein as soon as a maximum design load of rotational vibration damper (27) has been

exceeded, relative rotation of hub (22), damper hub (38), and driving plate (30) causes drive plate (30) to directly engage hub (22) and to directly engage damper hub (38) to create a first torque path between driving plate (30) and hub (22) and a second torque path between driving plate (30) and damper hub (38).
 2. The mechanical stop mechanism recited in claim 1, further comprising a stop device, wherein the stop device has stop fingers (71-74) which emanate from driving plate (30), each protruding into an intermediate space (65-68) which is limited in the circumferential direction by two stop limiting elements (61-64) provided on the damper hub (38).
 3. The mechanical stop mechanism recited in claim 2, wherein the stop fingers (71-74) extend radially inward from the central opening (49) in the driving plate (30).
 4. The mechanical stop mechanism recited in claim 2, wherein the stop limiting elements (61-64) extend axially from the damper hub (38).
 5. The mechanical stop mechanism recited in claim 2, wherein multiple stop fingers (71-74) are distributed uniformly over the circumference of the driving plate (30).
 6. The mechanical stop mechanism recited in claim 2, wherein the stop fingers (71-74) are arranged between two coupling elements (81-88) in the circumferential direction, each extending outward from the hub (22).
 7. The mechanical stop mechanism recited in claim 6, wherein the coupling elements (81-88) extend axially away from the hub (22).
 8. The mechanical stop mechanism recited in claim 2, wherein a coupling finger (91-94) extends radially inward from the driving plate (30) between two stop fingers (71-74).
 9. The mechanical stop mechanism recited in claim 8, wherein the coupling fingers (91-94) are arranged between two coupling elements (81-88) in the circumferential direction, with the coupling elements extending outward from the hub (22).
 10. The mechanical stop mechanism recited in claim 1, wherein a damper hub flange (35) is mounted on the damper hub (38).
 11. The mechanical stop mechanism recited in claim 10, wherein the damper hub flange (35) is integrally bonded to the damper hub (38).

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