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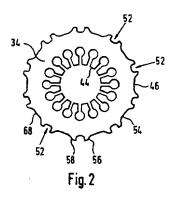
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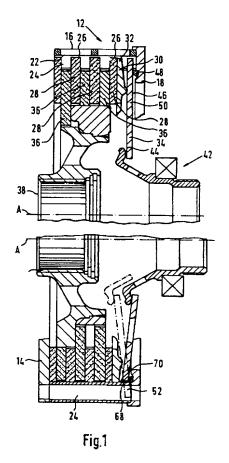
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(54) Abstract Title

Diaphragm spring securement.

(57) A multi disc clutch comprises a housing 12 with a toothed ring 16 between a flywheel 14 and a cover 18. The housing encloses a stack of discs 28, 38 with outer discs 28 secured to rotate with the housing and inner discs secured to rotate with the hub 38. A diaphragm spring 34 presses on a pressure plate 30 to compress the discs to couple the hub and housing. The toothed ring 16 has on its inner circumferential surface a plurality of circumferentially distributed teeth 24 which engage corresponding teeth on the outer discs. The diaphragm spring 34 is provided with recesses 52 in its outer circumferential region for engaging the teeth of the toothed ring to radially and circumferentially locate the spring in the housing. The recesses may be tapered (Fig. 3) and a transition between tapered (60,62) and circular (64,66) portions bears on the teeth.





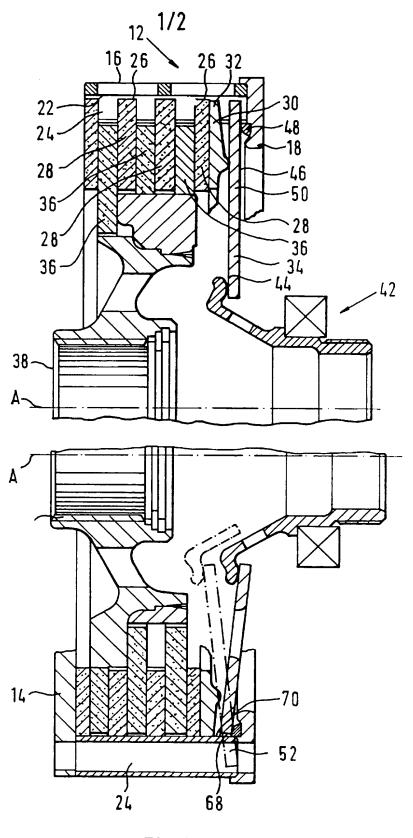
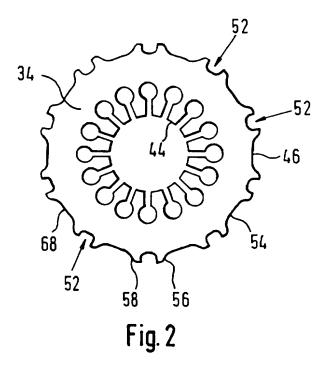
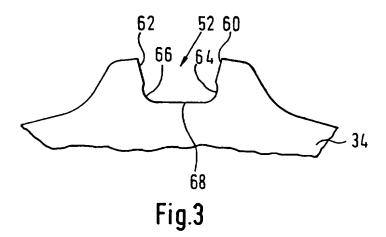


Fig.1





Multi-disc clutch

The present invention relates to a multi-disc clutch.

A multi-disc clutch is known from DE 195 45 972 A1. This clutch is composed of a housing with a toothed ring and a cover connected to the toothed ring enclosing a stack of inner and outer discs compressed together with the aid of a pressure plate and a diaphragm spring. On an inner circumferential surface of the toothed ring there is a plurality of disc engaging teeth distributed in a circumferential direction and the outer discs have outer toothing engaging with the disc engaging teeth on the toothed ring. The inner discs are coupled to a clutch hub. In this multi-disc clutch which is of the pushed type, the diaphragm spring is held in a radially central region on the cover of the housing of the multi-disc clutch by a plurality of spacer bolts and with the interpositioning of wire rings or the like, and thus movement in circumferential direction and in a radial direction with respect to the housing is prevented. A problem in this construction is that the spacer bolts penetrate the diaphragm spring precisely at the point which is considered the stress-critical point with respect to the pressing force produced by the diaphragm spring, so that if to accommodate the spacer bolts relatively large openings have to be made in the diaphragm spring, the force characteristics of the diaphragm spring can be adversely affected.

Furthermore, it is known that in a drawn clutch, in which the diaphragm spring is supported in the radially outer region thereof on the housing cover, to provide rotational locking for the diaphragm spring on the pressure plate using either locking pins or so-called "fingers" in the housing cover. Securing the diaphragm spring with locking pins and securing with fingers formed on the housing requires relatively little space but results in vibrational frictional wear at the contact points of the individual components.

Furthermore, from EP 0 627 051 B1 a clutch of the drawn type is also known, in which the diaphragm spring is secured into position on the housing in its radially outer region by a rocker bearing made of elastic material and surrounding the diaphragm spring. The provision of this rocker bearing results in an increased number of parts and thus a more difficult assembly process.

An object of the present invention is to provide a multi-disc clutch, in which the securing of the energy storing means in the clutch can be performed in a simple manner without reducing the force characteristics of the energy storing means.

According to the invention there is provided a multi-disc clutch, comprising: a rotatably driven housing composed of a toothed ring and a cover connected to the toothed ring, the toothed ring having on an inner circumferential surface a plurality of disc engaging teeth distributed in a circumferential direction, at least one outer disc, which with an outer toothing engages with the disc engaging teeth on the toothing ring, at least one inner disc, which is coupled for rotation with a clutch hub, a pressure plate for compressing the discs together to provide a driving connection between the housing and the hub via the discs, and an energy storing means supported on the housing and the pressure plate to bias the pressure plate to compress the outer and inner discs together, wherein the energy storing means has on an outer circumferential region an essentially radially outwards opening recess, in which one of the disc engaging teeth engages.

In this simple manner by means of the engagement of at least one disc engaging tooth in a recess especially assigned thereto the energy store is secured, in particular rotationally locked, in the housing, without any additional components being required.

It is preferable that the dimension of the recess in a circumferential direction corresponds essentially to the dimension of the disc engaging tooth in the circumferential direction.

The wear in the bearing region between the energy storing means and the disc engaging tooth can be kept very low, if a contour of the recess corresponds at least in parts to a cross sectional contour of the disc engaging tooth. Thus if as is preferred, the disc engaging teeth generally taper radially inwards it is preferable if the recess is widened radially outwards likewise.

A base region of the recess can bear directly on an inner surface of the disc engaging tooth or lies a small distance therefrom, so that an undesired movement of the energy storing means is prevented in the radial direction. A "small distance" is defined as a distance at which the radial locking function is fulfilled, and the pivotal

movement necessary for engaging and disengaging the clutch can be performed without hindrance.

In order to make the rotational coupling between the energy storing means and the housing stable, and in particular to suppress undesired radial movements of the energy storing means, it is proposed, that at least every second disc engaging tooth and more preferably every disc engaging tooth is assigned such a recess.

The construction described above is particularly advantageous in multi-disc clutches of the drawn type. If in such a construction it is ensured that the energy storing means is supported on the cover in a radial region close to at least one recess, then the rotational movement of the energy storing means made during engagement and disengagement is as low as possible in the region engaging in the disc engaging teeth in longitudinal direction of the disc engaging teeth. This means that the wear occurring in this region due to friction is very low.

The energy storing means can take the form of a diaphragm spring.

The present invention also relates to such a diaphragm spring, particularly for a multi-disc clutch, wherein the diaphragm spring is disc-like and on an outer circumferential region has at least one engaging tooth recess.

With a diaphragm spring constructed in accordance with the invention it is ensured that the components provided for securing can be designed to be integral with the diaphragm spring. It is further proposed that the diaphragm spring is formed by punching from a material blank and if necessary by subsequent shaping, hardening or the like.

It should be mentioned that the diaphragm spring according to the invention can have at least one of the energy storing-specific characteristics described above with reference to the multi-disc clutch according to the invention.

The invention may be understood more readily, and various other features of the invention may become apparent, from consideration of the following description.

An embodiment of the invention will now be described in detail, by way of example only and with reference to the accompanying drawings, wherein:

Figure 1 is a longitudinal cross section of a multi-disc clutch constructed in accordance with the invention;

Figure 2 is an axial view of a diaphragm spring used in the clutch shown in Figure 1; and

Figure 3 is an enlarged view of part of the diaphragm spring shown in Figure 2.

Figure 1 depicts a multi-disc clutch 10 which comprises a housing generally identified to by the reference numeral 12, formed by a flywheel 14, a toothed ring 16 and a cover 18. The flywheel 14 can be secured, for example, by a number of screws or bolts onto a drive shaft, for example a crankshaft of an internal combustion engine, so that the housing 12 is driven by the drive shaft to rotate about an axis of rotation A. The housing 12 encloses a stack of discs 28, 36 composed of outer discs 28 cooperating with inner discs 36 secured to a hub 38.

The toothed ring 16 has on an inner circumferential surface 22 a plurality of disc engaging teeth 24 distributed and spaced apart in the circumferential direction and extending in a longitudinal direction parallel to the axis A. Respective outer toothings 26 of the outer discs 28, four of which are shown in Figure 1, interengage between the disc engaging teeth 24. These outer discs 28 are thus connected for rotation with the housing 12, but can be moved in axial direction relative thereto.

A pressure plate 30 is also connected for rotation with the housing 12 by means of a corresponding outer toothing 32 and can likewise be displaced in axial direction. An energy storing means, here in the form of a diaphragm spring 34, operates between the pressure plate 30 and the cover 18. The diaphragm spring 34 presses the pressure plate 30 against the adjacent outer disc 28, so that the outer discs 28 together with the inner discs 36 arranged between the outer discs 28 are compressed in the direction of the flywheel 14. By means of this pressing force a torque transmission connection is formed between the outer discs 28 connected for rotation with the housing 12 and the inner discs 36 connected for rotation with the hub 38. The inner discs 36 have inner toothing which engage with a corresponding outer toothing of the hub 38. The hub 38 also has an inner toothing 40, with which

the latter can be locked into rotational engagement with a clutch output shaft, in general a transmission input shaft.

It is evident in Figure 1, that the illustrated disc clutch 10 is a clutch of the drawn type, in which a clutch release generally referred to by the number 42 acts on a radially inner region 44 of the diaphragm spring 34, and moves the latter away from the flywheel 14 to perform clutch release operations as shown in the lower half of Figure 1. The top half of the illustration shows the engaged position of the diaphragm spring 34 and the multi-disc clutch 10. In its radially outer region 46 the diaphragm spring 34 is supported by a bearing ring 48 on the cover 18. In its radial central region 50 the diaphragm spring 34 presses against the pressure plate 42.

As shown in particular in Figures 2 and 3, the diaphragm spring 34 in its radially outer region 46 has a plurality of recesses 52 distributed and spaced apart in the circumferential direction and opening radially outwards. These recesses 52 correspond respectively with the disc engaging teeth 24 of the toothed ring 16 so that in the assembled state of the multi-disc clutch 10 a disc engaging tooth 24 fits into each recess 52. The arrangement is preferably such that one recess 52 is assigned to each disc engaging tooth 24. It is shown that the recesses 52 are delimited by projections 56, 58 projecting radially outwards from an outer circumferential surface 54 of the diaphragm spring 34. This shaping particularly in the radially outer region 46 of the diaphragm spring 34 contributes significantly to the inertia moment and material and weight can be saved.

The inner region 44 of the spring 34 is provided with key-hole shaped openings to produce spring tongues for interacting with the release mechanism 42.

The contour of one of the recesses 52 is shown more clearly in Figure 3. It can be seen that the side flanks 60, 62 of the recess 52 widen radially outwards. These flanks 60, 62 merge with almost circular sections 64, 66 into the recess base 68. The contouring of the recesses 52 can be such that the sides 60, 62 with their incline are adjusted essentially to the radially inwards tapering shape of the disc engaging teeth 24, so that a precise fit of the diaphragm spring 34 on the disc engaging teeth 24 is obtained and a correspondingly precise securing in both the circumferential and radial directions is obtained. By having rounded sections 66, 64 running into the recess base 68 the occurrence of stress concentration in corners or

the like is avoided. Furthermore, as shown in Figure 1, the base 68 is kept close to the adjacent surface 70 of the disc engaging tooth 24, so that in the same manner a very precise securing in the radial direction is obtained. The arrangement can be such that the base 68 bears on the surface 70 so that the entire diaphragm spring 34 is held in the housing 12 under slight tension. However, between the base 68 and the surface 70 a small intermediate space can be formed so that despite providing sufficiently effective radial securing the diaphragm spring 34 can move radially in this region relative to the respective multi-disc engaging tooth 24.

It is possible that the contouring of the diaphragm spring 34 is such that the disc engaging teeth 24 come into contact with the diaphragm spring 34 only in the regions, that correspond to the bend-shaped transitions from the flanks 60, 62 to the circular sections 64, 66. The bearing surface can then be reduced.

It is of considerable importance that in the present invention the relative displacement occurring on the rotational movement of the diaphragm spring 34 in the region of the recesses 52 relative to the disc engaging teeth 24 is very small, as the diaphragm spring 34 is supported by the bearing ring 48 on the cover 18 in the radial region of the recesses 52, i.e. immediately radially inside the recesses 52. The relative movements occurring during the clutch engagement and disengagement procedures are therefore very small, which leads to a correspondingly low amount of frictional wear in this region.

It can be seen that in the multi-disc clutch 10 no additional components are provided for securing the diaphragm spring 34 against movement in the circumferential direction and against movement in the radial direction. This function is fulfilled by the already present disc engaging teeth 24 in association with the recesses 52 in the diaphragm spring 34. As the diaphragm spring 34 is generally produced in a punching operation, the recesses 52 and the projections 58, 56 delimiting the recesses 52 can be made on the diaphragm spring 34 at the same time during the punching operation, so that no additional steps are necessary to create the locking functions for the diaphragm spring 34 into the multi-disc clutch 10.

It is also evident that in the multi-disc clutch 10 with the diaphragm spring 34 the function of securing the diaphragm spring 34 is in the radially outer region, which with respect to the force characteristics of the diaphragm spring 34 is an uncritical

region. This means that by providing the recesses 52 and the projections 56, 58 the form of the diaphragm spring 34 in the critical region with respect to the force or the stress characteristics is not affected, so that by integrating the locking function there is no reduction of the spring force characteristics of the diaphragm spring.

1. A multi-disc clutch, comprising:

a rotatably driven housing (12) composed of a toothed ring (16) and a cover (18) connected to the toothed ring (16), the toothed ring (16) having on an inner circumferential surface (22) a plurality of disc engaging teeth (24) distributed in a circumferential direction,

at least one outer disc (28), which with an outer toothing (26) engages with the disc engaging teeth (24) on the toothing ring (16),

at least one inner disc (36), which is coupled for rotation with a clutch hub (38),

a pressure plate (30) for compressing the discs together to provide a driving connection between the housing (12) and the hub (38) via the discs,

and an energy storing means (34) supported on the housing (12) and the pressure plate (30) to bias the pressure plate (30) to compress the outer and inner discs (28, 36) together, wherein the energy storing means (34) has on an outer circumferential region (46) an essentially radially outwards opening recess (52), in which one of the disc engaging teeth (24) engages.

- A multi-disc clutch according to claim 1, wherein the dimension of the recess (52) in a circumferential direction corresponds to the dimension of the disc engaging tooth (24) in the circumferential direction.
- A multi-disc clutch according to claim 1 or 2, wherein the contour of the recess (52) corresponds at least in parts to a cross-sectional contour of the disc engaging tooth (24).
- 4. A multi-disc clutch according to any one of claims 1 to 3, wherein the recess (52) is widened radially outwards.
- 5. A multi-disc clutch according to any one of claims 1 to 4, wherein a base region (68) of the recess (52) bears against an associated surface (70) of the disc engaging tooth (24) or is a short distance therefrom.

- 6. A multi-disc clutch according to any one of claims 1 to 5, wherein the recess (52) is formed between two projections (56, 58) projecting radially outwards from an outer circumferential surface (54) of the energy storing means (34).
- 7. A multi-disc clutch according to any one of claims 1 to 6, wherein a number of recesses (32) are provided and at least every second and preferably each disc engaging tooth (24) is allocated to one of the recesses (52).
- 8. A multi-disc clutch according to any one of claims 1 to 7 and in the form of a drawn clutch whereby an inner radial region of the energy storing means (34) is displaced by a clutch release (42) away from the discs (28, 36) to effect clutch disengagement.
- 9. A multi-disc clutch according to any one of claims 1 to 8, wherein the energy storing means (34) is supported on the cover (18) in a radial region adjacent to at least one recess (52).
- 10. A multi-disc clutch according to any one of the preceding claims wherein the energy store is a diaphragm spring.
- 11. A multi-disc clutch substantially as described with reference to, and as illustrated in, the accompanying drawings.
- 12. In or for use in a multi-disc clutch according to any one of claims 1 to 11, a diaphragm spring (34) of disc-like form with an outer peripheral region (46) having at least one recess for receiving a tooth (24) of a toothed disc forming part of a housing of the clutch.
- 13. A diaphragm spring according to claim 12 and made by punching from a material blank and optionally by subsequent shaping, hardening or the like.
- 14. A diaphragm spring substantially as described with reference to and as illustrated in Figures 2 and 3 of the accompanying drawings.







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GB 9910678.3

Claims searched: 1-14

Examiner:

J. C. Barnes-Paddock

Date of search:

11 November 1999

Patents Act 1977 Search Report under Section 17

Databases searched:

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:

UK Cl (Ed.Q): F2C

Int Cl (Ed.6): F16D 13/52, 56, 58

Other: Online: WPI, EPODOC PAJ

Documents considered to be relevant:

Category	Identity of document and relevant passage		Relevant to claims
X	EP 0 812 998 A1	(DYNAX) See Figures 1B and 19 and para 6 of description. Multiplate clutch with main spring engaging inner housing teeth.	1-7,10,12
A	GB 2 307 958	(MANNESMANN SACHS) = DE 195 45 972 mentioned in spec. Multiplate clutch with pressure plate engaging inner housing teeth.	
Α	US 4 802 564	(VOITH) See Figures 1,3. Externally toothed belleville springs acting on plates.	
A	US 4 680 847	(ENFO) See Figures 1,2. Slotted diaphragm spring.	

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