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(54) Clutch plate with a plastics hub

(57) A clutch plate (1) for a friction clutch has a plastics hub (5), the plastics hub being injection moulded in an injection moulding process around the radially innermost end region of the disc. By the use of a tough elastic heat resistant material for the hub and the use of a separate disc made of a different material the hub may be supported at least over an axial region by the disc. (figs 4 - 6) depict alternative similar disc/hub convections and (fig 7) depicts a modification in which the hub is injection moulded within a cylindrical disc extension.

Fig. 2
A-A

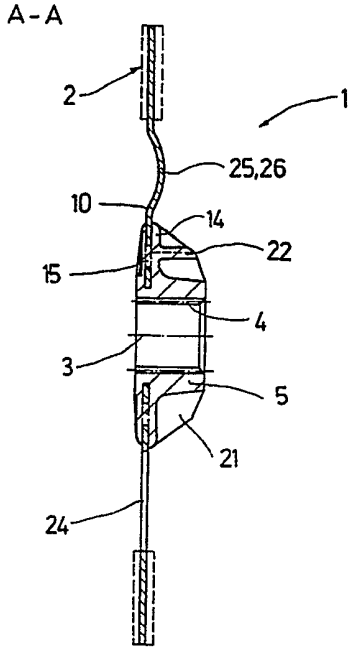

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Fig.1

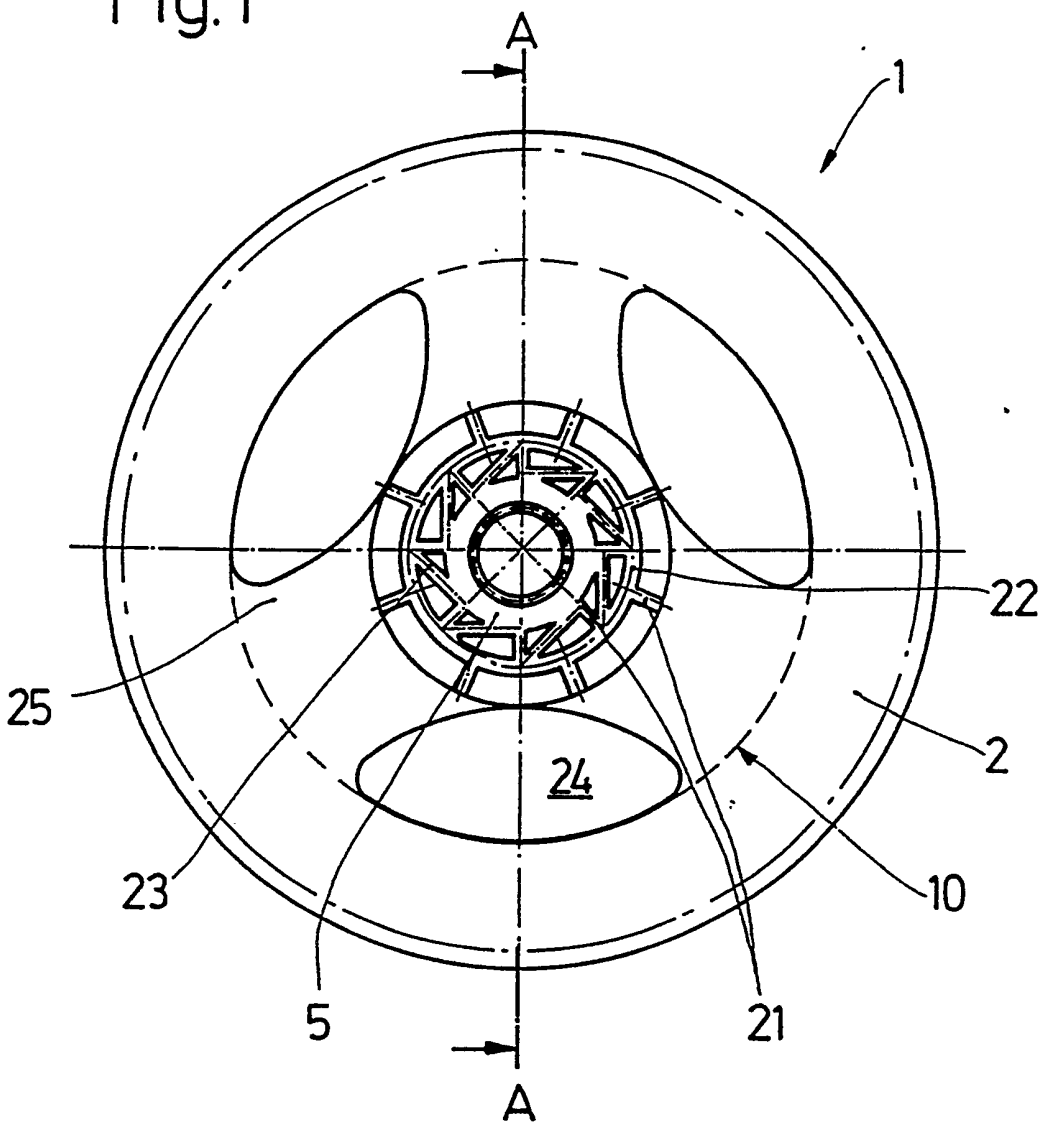


Fig. 2
A - A

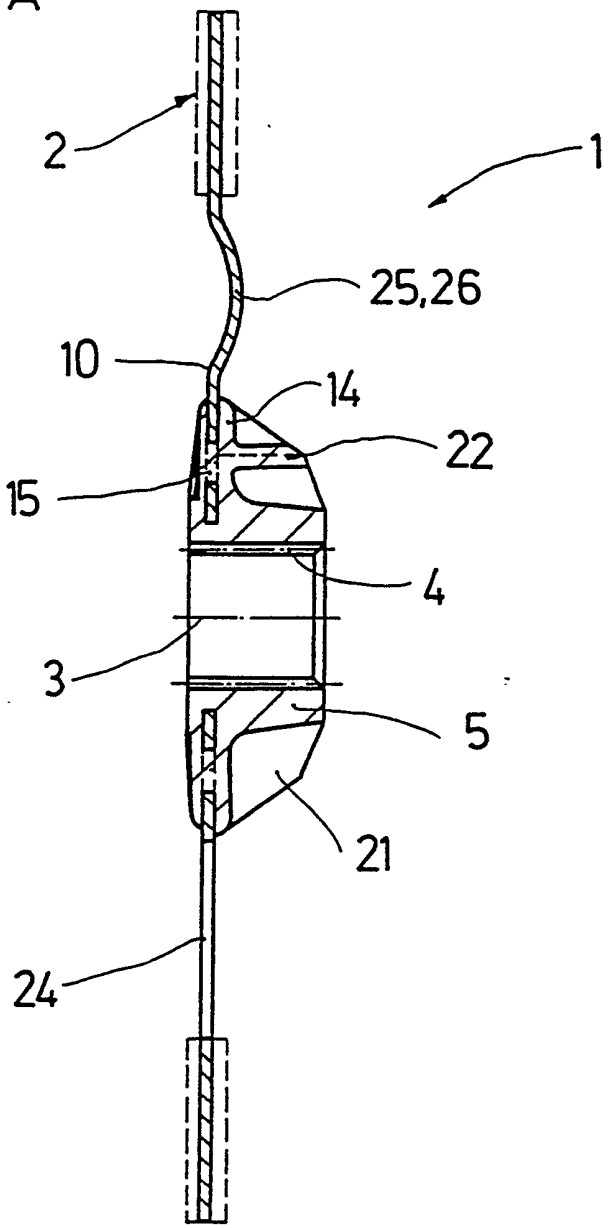


Fig. 3

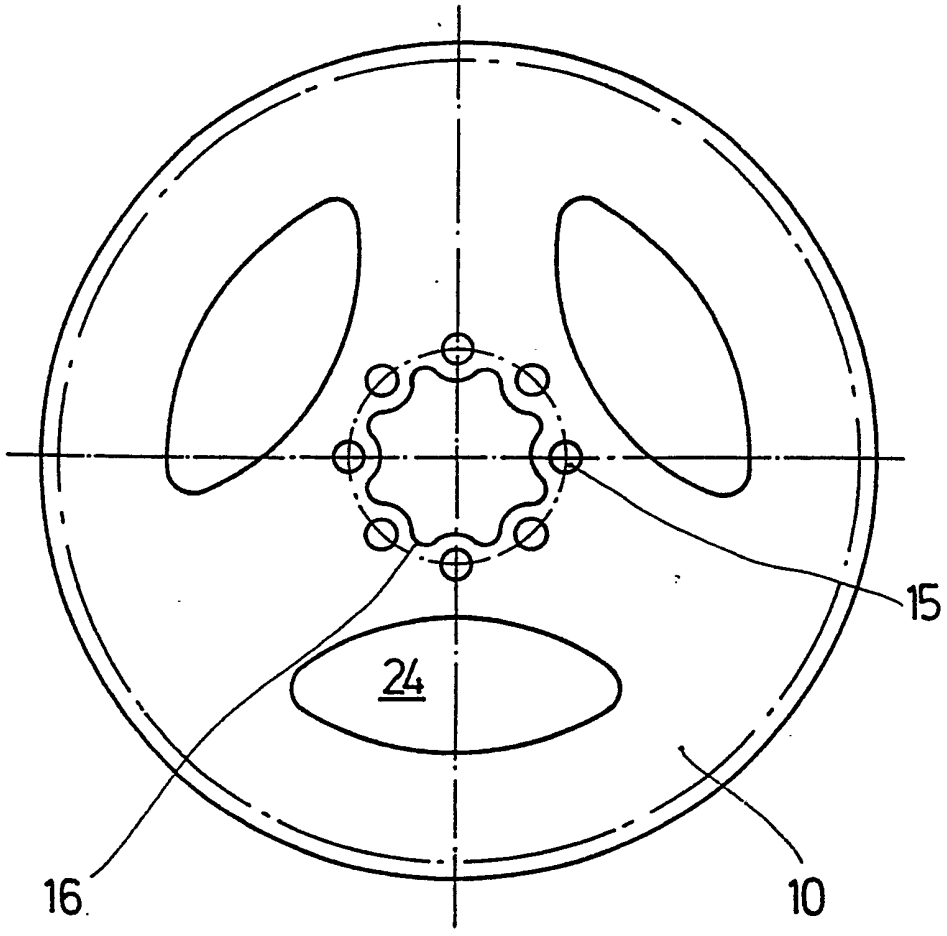


Fig. 4

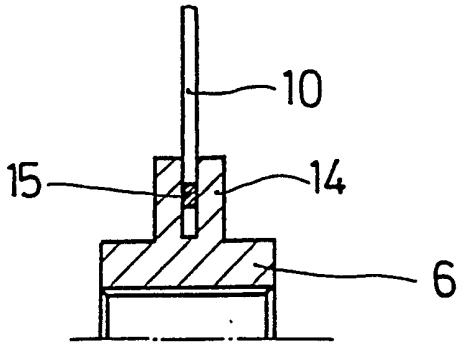


Fig. 5

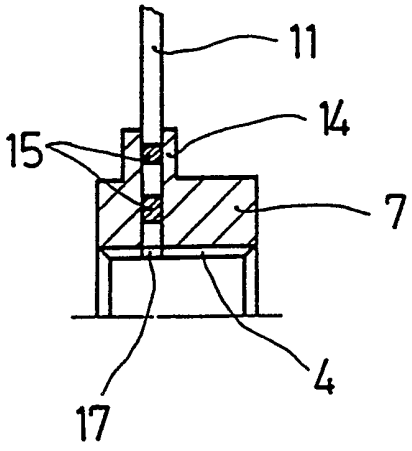


Fig. 6

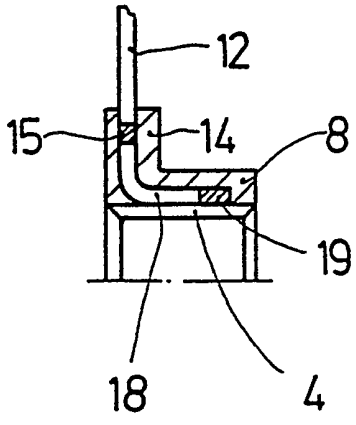
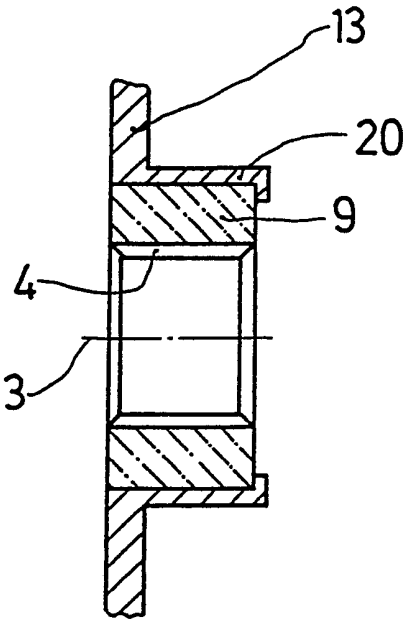


Fig. 7



CLUTCH PLATE WITH A PLASTICS HUB

The invention relates to a clutch plate for a friction clutch comprising a hub having an internal shape for a torque-transmitting mounting on a gearbox spindle and is made from plastics, a disc which is arranged concentrically with the hub and secured to it, and friction pads or linings which transmit the applied torque through the disc to the hub.

A clutch plate of the kind set forth is known for example from German ALS 22 56 682. In this known clutch plate the hub and the disc are made in one piece of plastics and are intended, by virtue of the characteristics of the material, to provide at least part of the damping action.

A clutch plate in accordance with the state of the art gives rise to problems from a number of areas. For one thing a hub made of plastics must not have too much damping action as otherwise it will heat up too much in service and be destroyed. Another point is that for example with the use of torsion springs the surface loading in this region is generally too high for plastics material.

Accordingly it is the aim of the present invention to provide a clutch plate having a plastics hub which can meet the requirements and can be produced economically.

According to the present invention, a clutch plate for a friction clutch which comprises a hub having an internal profile for torque transmitting application to a gearbox shaft and manufactured from plastics material, a disc which is arranged concentrically on

the hub and connected in a torque-transmitting manner to it, and friction linings which transmit the applied torque through the disc to the hub, is provided in which, the hub is manufactured from a tough elastic heat-resistant plastics material, the plate is manufactured as a separate component and from a different material and the hub supports it radially outwards over at least a partial axial region.

By the use of a tough elastic heat-resistant plastics material for the hub and by the use of a separate disc made of a different material the possibility of supporting the hub at least over an axial partial region by the disc radially outwards is provided. In this way it is ensured that when torque loadings arise the hub cannot shift beyond the flanks of the teeth as a result of forces directed outwards or in an inclined outward direction.

According to a further feature of the invention it is of advantage for the hub to be manufactured as an injection moulding and the disc is bonded to the hub in its radially inner region by the injection-moulding process. In this way economical manufacture is possible in that the disc is cast into the hub in the injection moulding process and rigidly bonded to it.

It is furthermore proposed that the hub body of the hub should be made of substantially annular cylindrical form with a radially projecting flange portion, the disc extending from the radially outermost portion at least into the flange portion and having material injected onto both faces of it. Such a construction allows secure bonding between the hub and the disc over interconnecting regions of large surface area.

In such an arrangement, according to the invention, the disc can be provided with openings in that region which is covered by the injection moulding, so that the plastics material of the hub can enter through these openings and produce a homogeneous bonding to the disc from both sides. Moreover it is also possible to make the inner profile of the disc circumferentially irregular so that in this way as well a certain degree of mechanical connection is provided.

An embodiment capable of particularly high loading is envisaged in that the disc is extended in its radially inner region as far as the shape of the internal splines on the hub. In the disc the same splines are provided corresponding to those in the hub. In this way the disc can engage directly on the splines of the gearbox spindle and relieve the remaining regions of the hub of the torque.

In a further advantageous embodiment it is envisaged that the hub is provided in that region around which the injection-moulding takes place with an axial substantially annular cylindrical projection or extension. This annular extension likewise constrains the plastics hub against radial outward movement in order to ensure reliable functioning of the splines in relation to the gearbox spindle. In such an arrangement the end of the projection extending away from the disc can be made circumferentially irregular in order to achieve at this point a toothed effect in relation to the plastics material of the hub. Where a disc is used with an axially extending substantially annular projection it is also possible for this projection not to be embedded in the injection-moulded material of the hub but simply to be covered from the inside only. This likewise signifies stabilisation of

the body of the hub radially outwards without the disc having to be covered in injection moulded material from both sides in the region of its annular projection. Such an embodiment is regarded as free from problems from the manufacturing point of view.

The hub body of the hub can be provided with substantially radially extending reinforcing webs extending towards the flange portion for stiffening purposes. Such stiffening webs are easily provided in the injection-moulding tool. They serve likewise for radially stiffening the hub body. On corresponding torque loading the entire region of the hub body does not need to be supported radially outwards but it can be sufficient over a smaller region which is limited substantially to the axial extent of the disc. So that the surface loading in the region of the splines on the hub can be kept lower, it is then necessary for additional stiffening webs to be arranged outside this radially supported region to prevent outward displacement of the material. The distribution of the surface loading can be such that in the region of the radial restriction greater surface loadings arise than in the regions which are axially displaced therefrom. The distribution, however, is desired as in this way as the edge loadings which often arise in steel hubs through excessive torsional stiffness are avoided. The axial displaceability of the hub on the gearbox spindle is also favoured by this, whereby the relief characteristics are improved.

It is further proposed that the radially extending stiffening webs should be interrupted approximately in the middle by a web extending circumferentially concentrically with the axis of rotation. This web takes care of additional stiffening of the hub.

Simultaneously the material in this region has a lower temperature and thereby a higher E modulus than the material in the region of the hub, where the heating arises through the fretting action. The interruption of the outwardly extending stiffening webs has the advantage that it is easier to injection-mould the hub. At the same time an improved radially symmetrical construction is achieved, and thereby a more uniform loading of the grooves between the splines.

In accordance with the invention it is of advantage if inclined webs are arranged between the hub body and the concentric web, starting from the hub body and extending roughly tangentially as far as the concentric web. These webs are of particular advantage for torsional stiffening. For improved manufacture from the injection moulding point of view they are arranged in one direction, but in principle they could also be arranged to be in different directions. The fan-like stiffening takes care of the fact that the individual webs are substantially more highly loaded as they are now not subjected to bending but to tension and compression like a space frame. In this way the stiffness is substantially increased as the stress arises throughout the material and for a given wall thickness substantially smaller deflections arise.

A construction in which each inclined web extends radially - starting from the body of the hub - approximately in the region of the foot of a radially extending stiffening web up to approximately the region of the head of the circumferentially following radially extending stiffening web and in fact to the transition region joining it to the concentric web brings with it the advantage of achieving the highest possible stiffness of the hub using the minimum amount of

material. At the same time the cycle time during manufacture is reduced by the reduction in wall thickness, so that the component can be produced substantially more cheaply than a homogeneous body. Moreover, it is to be regarded as an advantage that with this construction also more expensive materials can be introduced, capable of withstanding high temperatures. In this way the consumption of material can be still further reduced.

The arrangement of the disc approximately in an axial end region of the hub has the advantage that the shape can be more easily established for injection moulding since as a consequence of the prevention of expansion in the region of the body of the hub another correction in the tool must be arranged other than in the opposite part of the hub body. With the disc arranged centrally the correction can be more difficult to carry out than with a disc arranged at one end. Moreover the surface loading in the section can be distributed more uniformly along the axial extent as on the application of torque the spindle or shaft undergoes a certain amount of twist and this angle of twist should lie if possible in the same order of magnitude as in the hub. This can be better adjusted with such an offset arrangement of the disc.

In such an arrangement the hub is preferably produced from polyamide or polyether ketone with about 30% glass fibre content by weight. Such a material can be still easily handled in the injection moulding process and has the necessary strength for the field of use described.

In order to keep the weight and accordingly the moment of inertia of the clutch plate as small as

possible it is proposed that the disc should be provided in the radial region between the hub and the friction pads or linings with a number of circumferentially distributed openings.

In such an arrangement the circumferentially distributed arms arising between the openings are provided over their radial extent with axially directed bulges so that the clutch plate is made to be elastic in its radial direction, in order for example to be able to counteract any offset of axes between the crankshaft and the gearbox input shaft.

As a material for the disc there is preferably proposed a fibre composition material which contains for example at least 50% by weight of fibre content. A thermosetting plastics material, phenolic resin or epoxy resin has been found suitable as the matrix. Bearing in mind the temperatures which arise, glass fibres are the most suitable reinforcing fibres. In this connection a multi-layer construction is envisaged, the individual layers being preferably directed 0 and plus and minus 60° in relation to one another.

It is however, also possible to employ a disc made of steel, which can be employed with particular advantage in conjunction with torsional vibration dampers. It is economical in material and in manufacture, but somewhat less favourable when it comes to moment of inertia.

The invention will now be further in conjunction with a number of examples. In the drawings:

Figs. 1 and 2 show a front view and longitudinal section through a clutch plate;

Fig. 3 shows a front view of an individual disc;

Figs. 4 to 6 show different constructions for the disc within the hub; and

Fig. 7 shows a disc with an annular extension forming a radial outer limit for the hub.

The clutch plate 1 shown in Figs. 1 and 2 comprises a disc 10 made of composite fibre material. It is provided with a number of openings 24 distributed circumferentially and radially between the friction linings 2 and the hub 5. The circumferentially distributed arms 25 existing between the openings 24 can be provided with axially deflected bulges 26 in order to produce some radial elasticity.

The hub 5 of the clutch plate 1 defines an axis of rotation 3 and in use the hub has its internal splines 4 fitted onto corresponding splines on a gearbox input shaft, not shown, allowing it to be displaced axially but to transmit circumferentially the torque from the engine. The hub 5 itself is preferably manufactured from a polyamide or polyether ketone containing about 30% by weight of glass fibre and with its radially projecting flange portion 14 injection-moulded around the radially innermost region of the disc 10. To provide positive torque transmission in relation to the hub 5, the disc 10 has in the region around which the injection moulding takes place a number of circumferentially distributed openings 15, which are penetrated by the material of the hub 5 during the injection moulding process. In

order to save weight and to save material and at the same time to increase its strength the hub 5 is provided with substantially radially extending stiffening or reinforcing webs 21 which extend from the region of the hub which is furthest from the disc 10 to the flange portion 14. These stiffening webs 21 could, as illustrated, be interrupted radially by a concentrically extending web 22. In the present case the radially extending stiffening webs 21 are offset circumferentially radially outside the web 22 and radially inside the web 22. Radially inside the concentrically extending web 22 there are arranged additional inclined webs 23 which extend approximately tangentially in relation to the body of the hub 5 and terminate in the corner between the concentric web 22 and the radially extending webs 21. The fan-like stiffening shown in Figs. 1 and 2 ensures that the individual ribs can be loaded substantially more highly as they are now not loaded in bending but are loaded in tension and compression like a spaceframe. In this way the stiffness is significantly increased as the stress arises in the entire extent of the material and for a given wall thickness substantially smaller deflections arise.

Fig. 3 shows a front view of a disc 10 before its incorporation in a finished clutch plate. The disc 10 is provided in its radially innermost region with an irregular inside profile 16 in order to produce a mechanical interlock with the hub 5. A number of circumferentially distributed openings 15 are provided in addition in this region and during the injection process of the material for the hub 5 they are penetrated by this material. In this way an easily produced operationally secure transmission of torque can be achieved. Moreover the openings 24 are to be

seen arranged in the radial region between the friction linings 2 and the hub 5, and they could also have a different shape from that shown here.

Figs. 4 to 6 show different constructions of the individual hubs and the corresponding region of the disc. In Fig. 4 the disc 10 is made flat and is provided with the openings 15 already described. It is arranged symmetrically in relation to the axial extent of the hub 6 and is secured in the flange portion 14 by the action of injection-moulding.

Fig. 5 shows a disc 11 which is formed to extend radially as far as the splines 4 in the hub 7 and it likewise has internal splines 17 corresponding to the splines 4 and engaging the gearbox input shaft. In addition the disc 11 is provided with the openings 15 for penetration by the material of the hub during the injection moulding process. In this embodiment the torque can be transmitted directly from the disc 11 through the internal splines 17 to the splines on the gearbox input shaft.

Fig. 6 shows a disc 12 which is provided with a ring-shaped cylindrical extension 18 in the region around which the hub is injection moulded, this extension extending concentrically in relation to the splines 4. Furthermore, in this construction is to be seen the arrangement of the openings 15 as well as the arrangement of a set of teeth 19 at the end region of the annular extension 18 furthest from the disc 12, for improved torque connection in relation to the hub 8. This construction allows a high loading of the splines 4 as the annular extension 18 prevents any radial expansion of the plastics material.

A variant which is very easy to manufacture is illustrated in Fig. 7. The disc 13 is provided with an annular cylindrical extension 20 which forms the radial outer boundary of the hub. The annular extension 20 has the material of the disc 9 injection moulded into it from inside without any holes. In the present case the transmission of torque preferably takes place through an external profile of the annular extension 20 which is not concentric with respect to the axis of rotation 3. This external profile can for example be in the form of a polygonal cross-section. Also in this arrangement the radial expansion of the plastics material of the hub 9 at high torque loading is thereby prevented in that the annular extension 20 is arranged over the whole axial length of the hub 9.

CLAIMS

1. A clutch plate for a friction clutch comprising a hub having an internal profile for torque transmitting application to a gearbox shaft and manufactured from plastics material, a disc which is arranged concentrically on the hub and connected in a torque-transmitting manner to it, and friction linings which transmit the applied torque through the disc to the hub, in which the hub is manufactured from a tough elastic heat-resistant plastics material, the plate is manufactured as a separate component and from a different material and the hub supports it radially outwards over at least a partial axial region.

2. A clutch plate according to claim 1, in which the hub is made as an injection-moulded component and the disc is bonded to the hub over its radially innermost region by the injection-moulding process.

3. A clutch plate according to claim 2, in which the body of the hub is made of substantially annular cylindrical form with a radially upstanding flange portion, the disc extending from radially outside into at least a flange portion and having material injection moulded around it from both sides.

4. A clutch plate according to claim 3, in which the disc is provided in its injection moulded region with openings and/or is formed at its inner periphery in a circumferentially irregular manner.

5. A clutch plate according to claim 4, in which the disc is provided in the region of its inner edge with internal splines corresponding to the internal splines on the hub.

6. A clutch plate according to claim 4, in which the disc is provided in its region around which injection takes place with an axial substantially annular cylindrical extension.

7. A clutch plate according to claim 6, in which the end of the extension furthest from the disc is formed with circumferentially irregularly teeth.

8. A clutch plate according to claim 2, in which in that the body of the hub is made of substantially annular cylindrical form and the disc has an axially extending substantially annular cylindrical extension and the latter has the hub body injection-moulded on it.

9. A clutch plate according to claim 4, in which substantially radially extending stiffenings webs are arranged between the body of the hub and the flange portion.

10. A clutch plate according to claim 9, in which the radially extending stiffening webs are interrupted substantially midway by a circumferentially extending web concentric with the axis of rotation.

11. A clutch plate according to claim 10, in which inclined webs are arranged between the body of the hub and the concentric web, extending approximately tangentially from the body of the hub as far as the concentric web.

12. A clutch plate according to claim 11, in which each inclined web extends radially - starting from the body of the hub - approximately in the region of the foot of a radially extending stiffening web up to approximately the region of the head of the

circumferentially following radially extending stiffening web and in fact to the transition region joining it to the concentric web.

13. A clutch plate according to any of claims 9 to 12, in which the disc is arranged substantially in one axial end region of the hub.

14. A clutch plate according to any of claims 1 to 13, in which the hub is made preferably of polyamide/polyether ketone with about 30% by weight of glass fibre.

15. A clutch plate according to any of claims 1 to 14, in which the disc is provided in the radial region between the hub and the friction linings with a number of circumferentially distributed openings.

16. A clutch plate according to claim 13, in which the circumferentially arranged arms resulting between the openings are provided over their radial extent with axially directed bulges.

17. A clutch plate according to either claim 15 or 16, in which the disc is preferably made of a fibre composition material.

18. A clutch plate substantially as described herein with reference to and as illustrated in Figs. 1 to 3 of the accompanying drawings.

19. A clutch plate substantially as described herein with reference to and as illustrated in Fig. 4 of the accompanying drawings.

20. A clutch plate substantially as described herein with reference to and as illustrated in Fig. 5 of the accompanying drawings.

21. A clutch plate substantially as described herein with reference to and as illustrated in Fig. 6 of the accompanying drawings.

22. A clutch plate substantially as described herein with reference to and as illustrated in Fig. 7 of the accompanying drawings.

Patents Act 1977 Examiner's report to the Comptroller under Section 17 (The Search report) -16-	Application number GB 9319240.9
Relevant Technical Fields (i) UK Cl (Ed.L) F2C (ii) Int Cl (Ed.5) F16D 13/64	Search Examiner A BURROWS Date of completion of Search 2 November 1993
Databases (see below) (i) UK Patent Office collections of GB, EP, WO and US patent specifications. (ii) ONLINE DATABASES: WPI	Documents considered relevant following a search in respect of Claims :- 1-22

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Category	Identity of document and relevant passages	Relevant to claim(s)
X	GB 1401186 (GKN) - whole document	1

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