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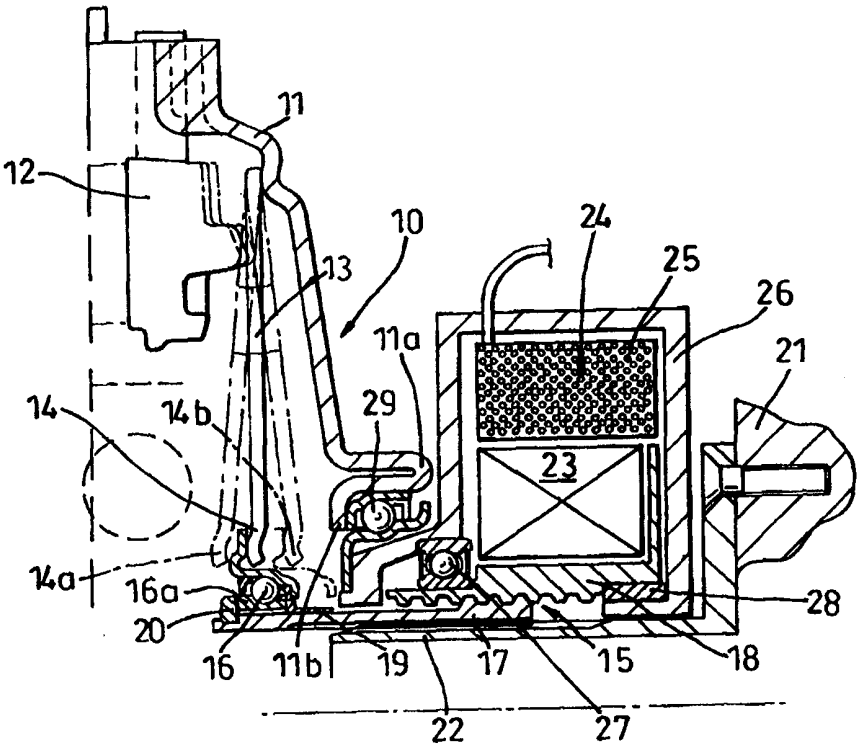
(54) Title: CLUTCH ASSEMBLY

(57) Abstract

A clutch assembly (10) comprises a clutch cover (11), a pressure plate (12) mounted on the cover, spring means (13) biasing the pressure plate away from the cover and lever means (14) for releasing the clutch. A rotary actuator (15) is mounted on the cover, the actuator (15) comprising a first component (17) and a second component (18) relative rotation of which varies the effective length of the actuator to move the lever means. An actuator means (24) may be provided for causing relative rotation of the first and second components. In one embodiment the rotary actuator (15) does not rotate with the cover (11) and the actuator means comprises an electric motor (24) which rotates the second component relative to the first component. In further embodiments (see figures 4,5 and 6) the rotary actuator (15) rotates with the cover (11) and the actuator means tends to brake rotation of the second component to cause relative rotation of the first and second components.



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CLUTCH ASSEMBLY

This invention relates to clutches and in particular to vehicle clutches for use in a vehicle drive line to connect a vehicle engine with an associated transmission.

There is a requirement from the vehicle manufacturers to provide a clutch assembly which comprises the clutch cover, pressure plate, clutch spring, release levers and the associated primary clutch actuator.

Thus according to the present invention there is provided a clutch assembly comprising:

- a clutch cover,
- a pressure plate mounted on the cover,
- spring means biasing the pressure plate away from the cover to engage the clutch,
- lever means for releasing the clutch, and
- a rotary actuator mounted on the cover, the actuator comprising first and second components relative rotation of which varies the effective length of the actuator to move the lever means.

The above assembly meets the requirements of the vehicle manufacturers since it includes the primary actuator mounted on the clutch cover.

In a preferred embodiment the first and second components of the rotary actuator are in screw-threaded engagement.

In an alternative embodiment the first and second components of the rotary actuator may have co-operating ramp surfaces. Such as, for example, a ball and ramp expander mechanism.

The assembly may further comprise an actuator means for causing relative rotation of the first and second components.

The first and second components may not rotate with the clutch cover and may be supported relative thereto via a support bearing, the first component acting on the lever means via a release bearing.

In such an arrangement, the actuator means may comprise an electric motor in which case an armature of the electric motor may be connected to the second component for rotation therewith and the electric motor may further comprise a winding which when energised causes the armature and hence the second component to rotate relative to the first component.

In such an arrangement the entire electric motor and the first and second components may be supported from the cover as an integral assembly. Alternatively, the winding of the motor may be supported from a housing of the clutch thus allowing installation of the winding on the housing as a separate operation from the mounting of the cover on an associated flywheel.

In yet a further alternative arrangement the winding of the electric motor may rotate with the cover and may be fed by slip rings.

The first and second components may alternatively rotate with the clutch cover and be supported relative thereto by a support bearing, the first component acting on the lever means and the actuator means, when actuated, tending to brake the rotation of the second component to cause relative rotation between the first and second components to move the lever means.

Such an arrangement avoids the need for a clutch release bearing between the first component and the lever means.

In such an arrangement the actuator means may comprise an electric motor in which case an armature of the motor may be connected to the second component for rotation therewith, and the motor may further comprise a winding which when energised actuates the motor armature to brake the second component.

Alternatively the actuation means may comprise a brake member which frictionally engages a co-operating brake surface which rotates with the second component. The brake member may be electrically or hydraulically operated

Several embodiments of the present invention will now be described, by way of example only, with reference to the accompanying drawings in which:-

Figure 1 is a diagrammatic radial half section through a clutch assembly embodying the present invention actuated by a stationary electric motor winding;

Figure 2 shows an alternative motor actuated clutch assembly in which the motor winding rotates with the clutch cover;

Figure 3 shows a further alternative motor actuated clutch assembly in which the motor winding can be separately installed on the vehicle from the remainder of the assembly;

Figure 4 shows a further alternative clutch assembly in which the actuator rotates with the clutch cover and is activated by a stationary brake;

Figure 5 shows a modified form of the assembly of figure 4 with a conical brake area, and

Figure 6 shows a further form of motor actuated actuator where the motor applies a braking torque to the second component of the actuator.

Referring to figure 1 this shows a clutch assembly 10 having a clutch cover 11, a pressure

plate 12 supported from the cover and a diaphragm spring 13 which biases the pressure plate away from the cover towards a driven plate (not shown) which is clamped by the pressure plate against an associated engine flywheel (not shown) to which the cover 11 is secured in a conventional manner. The diaphragm spring 13 has a radially inner portion 14 in the form of conventional finger like levers which are axially displaced by an associated rotary actuator 15 via a release bearing 16.

The rotary actuator 15 comprises a first component 17 and a second component 18 which are in screw-threaded engagement. The first component 17 is connected with the radially inner race 16a of release bearing 16 via flange 19 and circlip 20 and is held against rotation relative to an associated clutch housing 21 by a splined support 22. The second component 18 is connected with an armature 23 of an electric motor 24, the electric motor also including a winding 25. The motor 24 is encased in a cover 26 from which the second component 18 of the actuator is supported for rotation via a ball bearing 27 and a plain bearing 28. The cover 26 is held stationary onto the associated clutch housing 21 either by a connection with the splined support 22 or otherwise. Splined support 22 can be formed integrally with cover 26 as shown in figure 3. The motor cover 26 is mounted on the clutch cover 11 via a support bearing 29 since the motor remains stationary when mounted in the vehicle whereas the cover 11 rotates with the associated vehicle flywheel.

The entire assembly comprising the cover 11, pressure plate 12, diaphragm spring 13, release bearing 16, rotary actuator 15, motor 24, cover 26 and support bearing 29 is provided as an integral unit to the motor vehicle manufacture together with the associated splined support 22. The assembly is mounted on the associated flywheel together with the associated driven plate and the splined support 22 is then introduced into the splines in the first component 17 when the clutch housing 21 is mounted onto the lower part of the engine.

The above described clutch assembly operates as follows. With the clutch fully engaged the diaphragm spring fingers 14 occupy the full line position shown in figure 1 and the motor 24 is not energised. To disengage the clutch the motor winding 25 is energised to cause the armature 23 to rotate the second component 18 in a manner which reduces the effective length

of the rotary actuator thus moving the diaphragm spring fingers to the right as viewed in figure 1.

As will be appreciated the level of clutch disengagement (and thus clutch slip) is determined by the amount of movement of fingers 14 to the right. Position 14b shows the fully disengaged clutch condition. The clutch is re-engaged by energising the winding 25 of the electric motor in the opposite sense to move the diaphragm fingers 14 to the left. The left hand dotted position 14a indicates the engaged position for a worn clutch.

It will be understood the first and second components 17 and 18 need not be in screw-threaded engagement but other means may be provided by which relative rotation of the components varies the effective length of the rotary actuator 15. For example the components may have co-operating ramp surfaces.

Furthermore, if desired, the components 17 and 18 of the rotary actuator 15 may not be in direct frictional contact but may have balls, grooved rollers or other friction reducing members acting between the screw threaded members. Such balls and rollers etc. may be also used in any of the other rotary actuator arrangements referred to below. Also, the so-called ball and ramp expander type of rotary actuator may be employed.

Figure 2 shows a modified form of electric motor actuated clutch assembly in which components of a similar function to those referred to in relation to figure 1 have been similarly numbered. In the figure 2 arrangement the main difference is that the motor cover 30 is secured directly to clutch cover 11 and rotates with the clutch cover. The winding 25 of the motor rotates with cover 30 and is fed with current via slip rings 31 in a conventional manner.

As is apparent from figure 2 the main support bearing 29 can be eliminated and the rotary actuator is supported from the cover simply by bearings 27 and 28.

The arrangement shown in figure 2 operates in a similar fashion to that of figure 1 with movement of the diaphragm fingers 14 being again initiated by feeding the winding 25 with

current in the appropriate direction to either lengthen or shorten the effective length of the rotary actuator 15 via the armature 23 which rotates with the second actuator component 18.

Figure 3 shows an arrangement similar to that shown in figure 1 with the exception that the main support bearing 29 directly supports the rotary actuator 15 thus eliminating bearing 27 (and associated bearing 28) and the motor cover 26 terminates at location 32 allowing the armature 23 and associated rotary actuator 15 to be withdrawn from within the motor cover 26 by movement to the left as shown by arrow X in figure 3. Also in figure 3 the splined support 22 is formed integrally with the motor cover 26. The assembly shown in figure 3 may be supplied to the motor manufacturer as a single component or the cover, pressure plate, diaphragm spring, release bearing 16, rotary actuator 15, and motor armature 23 may be supplied as one component and the motor winding 25 and cover 26 may be supplied as a separate component which is separately mountable on the associated clutch housing.

In the clutch assemblies described in relation to figures 1 to 3 the rotary actuators 15 are all basically held stationary relative to the associated clutch housing and do not rotate with the clutch cover being connected thereto via a clutch release bearing. Figures 4 to 6 below show alternative arrangements in which the rotary actuators rotate with the associated clutch covers thus avoiding the necessity for clutch release bearings.

Referring to figure 4, for example, the rotary actuator 15 is supported from the cover 11 via a support bearing 29 but rotates with the cover. The second component 18 of the rotary actuator has a flange 18a formed thereon having a braking surface 33 which is engaged by an annular brake member 34 supported on a component 35 which is non rotatably secured to the associated clutch housing. In the arrangement shown in figure 4 the brake member 34 is displaced axially to the left to engage brake surface 33 by an annular piston 36 which slides in an annular bore 37 and is displaced by pressurisation of an annular chamber 38 via a hydraulic fluid inlet 39.

As an alternative to hydraulic actuation, brake member 34 may be displaced axially by an electric motor acting either linearly or via a further screw-thread actuator.

As will be appreciated, to disengage the associated clutch the second component 18 which normally rotates with the clutch cover 11 is braked relative to the stationary clutch housing by operation of brake member 34 to reduce the effective length of rotary actuator 15 thus moving the diaphragm clutch fingers 14 to the right as viewed in figure 4. When the clutch is fully disengaged slippage takes place between the braking surface 33 and the brake member 3, the arrangement being such that sufficient torque is generated to hold the clutch in the disengaged condition. The clutch is re-engaged when the braking effect is released due to the spring effect of the diaphragm spring 13 which tends to increase the effective length of the rotary actuator 15. If desired a torsion spring (not shown) may be connected between components 17 and 18, this spring being wound up when the brake member 34 is applied and releasing its torsional loading when the brake member 34 is released to assist the diaphragm spring 13 to move the first component 17 to the left.

The entire clutch assembly may be supplied to the vehicle actuator as a single unit with the support 35 and associated brake member 34 being separately connectable to the associated clutch housing whilst the cover and associated rotary actuator 15 are connected to the associated flywheel. It will be appreciated that in this arrangement there is no support of the actuator 15 other than via bearing 29 directly onto cover 11.

Figure 5 shows a modified version of the arrangement shown in figure 4 in which the braking surface 33 is of a conical form as is the co-operating brake member 34. This allows a greater area of contact thus tending to make the unit more efficient. Again this arrangement may be operated either hydraulically of electrically as described above in relation to figure 4.

Although not shown in the drawings, the arrangements shown in figures 4 and 5 can be adapted for use with other forms of brake member 34. For example, a radially outwardly facing braking surface could be provided, either on the flange 18a or directly on the second component 18 and the brake member could take the form of a brake band surrounding the braking surface. The diameter of the brake band being variable so that the band can be brought into contact with the braking surface. Alternatively, the brake member can comprise one or

more brake shoes which can be brought into contact with, for example, a radially inwardly facing braking surface on the flange 18a.

Figure 6 shows a motor actuator arrangement very similar to that shown in figure 3 with the exception that the rotary actuator 15 now rotates with the clutch cover 11 and the non-rotatable motor winding 25 acts to brake the rotation of the second component 18 via the armature 23 to disengage the clutch. Clutch re-engagement is again achieved by the diaphragm spring 13 with or without an assisting torsion spring as in figure 4. Again in this arrangement the armature 23 can be withdrawn to the left as shown by arrow X thus facilitating installation of the assembly in the associated vehicle.

In the clutch assemblies described above in relation to figures 3 to 6, the support bearing 29 is arranged to be concentric with the first and second components of the rotary actuator. This arrangement is particularly advantageous as it reduces the overall axial extent of the assembly.

It is also apparent that in all the clutch assemblies described above, the actuator means for causing relative rotation of the first and second components (motor 24 or brake member 34 and braking surface 33) are arranged to be concentric with the first and second components 17 and 18. This arrangement also advantageously reduces the overall axial length of the clutch assemblies. In particular it should be noted that in the clutch assemblies described in relation to figures 3, 5 and 6 the actuation means are arranged to be concentric with both the first and second components and the support bearing 29 thus further reducing the axial length of the clutch assemblies. In the assemblies described in relation to figures 3 and 6 for example, the armature 23 of the motor 24 is provided at the end of the radial flange 18a with the support bearing 29 being arranged to lie axially within a recess 18b between the second component 18 and part of the armature 23. Similarly in the assembly described in relation to figure 5, the conical braking surface 33 is provided on a portion of radial flange 18a which is angled axially towards the cover 11 and the support bearing 29 is arranged to lie axially within the recess 18b between the second component and at least part of the conical breaking surface 33.

It will also be apparent that in all the embodiments described in which a support bearing 29 is

used to support the first and second components relative to the cover, the support bearing is mounted externally of the cover. This has the advantage of simplifying the procedure for assembling the rotary actuator to the cover compared to an arrangement in which the support bearing is arranged internally of the cover. In the embodiments described, the cover is provided with an axial projection 11a formed as a fold in the cover and a radially extending inner portion 11b for mounting of the support bearing. This construction has the advantage that the cover can be produced as a single component for example by means of a pressing process.

Although all the clutch assemblies described above use diaphragm springs it will be appreciated that, for example, coil springs may be used to clamp the pressure plate against the driven plate, these springs being released by separate clutch release levers. Also, pull type clutches are shown in which the actuator is shortened to release the clutch. Push type clutches may equally be used with elongation of the actuator to cause release.

The various assemblies described above may also include a flywheel to which the cover is secured and a driven plate located between the pressure plate and flywheel. The flywheel may be a conventional solid flywheel or a twin-mass flywheel in which the flywheel masses are capable of limited relative rotation against the action of a torsional damping means to damp drive-line vibrations.

Also, the assembly may include a flexplate for the connection of the flywheel (whether solid or twin-mass) to the associated engine crankshaft. The present assembly is particularly suitable for use with a flex plate [a flexible plate connected adjacent its outer periphery to the flywheel and in its central area to the crankshaft which flexes to cushion engine vibration etc.] since the mounting of the actuator on the cover results in the clutch release loads remaining self-contained within the cover assembly and not axially deflecting the flexplate which would cause loss of clutch release travel.

The present invention thus provides a vehicle clutch assembly in which the primary clutch actuator directly mounted on the clutch cover and which can be operated electrically or

hydraulically etc. This therefore meets the motor manufacturers requirements of a simple efficient and compact clutch assembly which is easy to install on the associated vehicle.

CLAIMS

1) A clutch assembly comprising:

- a clutch cover,

- a pressure plate mounted on the cover,

- spring means biasing the pressure plate away from the cover to engage the clutch,

- lever means for releasing the clutch, and

- a rotary actuator mounted on the cover, the actuator comprising first and second components relative rotation of which varies the effective length of the actuator to move the lever means.

2) An assembly according to claim 1 in which the first and second components of the rotary actuator are in screw-threaded engagement.

3) An assembly according to claim 1 in which the first and second components of the rotary actuator have co-operating ramp surfaces arranged such that relative rotation of the components varies the effective length of the actuator to move the lever means.

4) An assembly according to claim 2 or claim 3 in which the first and second components are in direct contact with each other.

5) An assembly according to claim 2 or claim 3 in which the first and second components have rollers, balls or rolling elements therebetween to reduce friction.

6) An assembly according to any one of claims 1 to 5 further comprising an actuator means for causing relative rotation of first and second components.

7) An assembly according to claim 6 in which the actuator is arranged to be concentric with the first and second components.

8) An assembly according to any one of claims 1 to 7 in which the first and second components do not rotate with the clutch cover and are supported relative thereto via a support bearing, the first component acting on the lever means via a release bearing.

9) An assembly according to claim 8 in which the second component is rotated relative to the first component by an actuator means in the form of an electric motor.

10) An assembly according to claim 9 in which an armature of the electric motor is connected to the second component for rotation therewith, the electric motor further comprising a winding which when energised causes the armature and hence the second component to rotate relative to the first component.

11) An assembly according to claim 10 in which the entire electric motor and first and second components are supported from the cover as an integral assembly.

12) An assembly according to claim 10 in which the winding of the motor is supported from a housing of the clutch.

13) An assembly according to claim 10 in which the winding of the electric motor rotates with the cover and is fed by slip rings.

14) An assembly according to claim 6 or claim 7 in which the first and second components rotate with the clutch cover and are supported relative thereto by a support bearing, the first component acting on the lever means and the actuator means when actuated tending to brake the rotation of the second component to cause relative rotation

between the first and second components to move the lever means.

15) An assembly according to claim 14 in which the actuator means comprises an electric motor.

16) An assembly according to claim 15 in which an armature of the electric motor is connected to the second component for rotation therewith, and the electric motor further comprises a winding which when energised actuates the motor armature to brake the second component.

17) An assembly according to claim 14 in which the actuator means comprises a brake member which frictionally engages a co-operating braking surface which rotates with the second component.

18) An assembly according to claim 17 in which the brake member and co-operating braking surface engage on a conical area of contact concentric with the rotation axis of the clutch assembly.

19) An assembly according to claim 17 in which the brake member is a brake band.

20) An assembly according to claim 17 in which the brake member comprises at least one brake shoe.

21) An assembly according to any one of claims 17 to 20 in which the braking member is hydraulically or electrically operated.

22) An assembly according to any one of claims 8 to 21 in which the support bearing is mounted externally of the cover.

23) An assembly according to claim 22 in which the cover has an axially extending flange against which the support bearing is mounted.

24) An assembly according to claim 23 in which the axially extending flange comprises a fold produced in the cover.

25) An assembly according to any one of claims 8-24 when dependent on claim 6 in which the support bearing is arranged to lie generally in radial alignment with the rotary actuator and/or the actuator means to reduce the axial length of the assembly.

26) An assembly according to claim 25 in which the support bearing is recessed between the rotary actuator and the actuator means.

27) An assembly according to claim 25 or claim 26 in which the support bearing is recessed between the second component and an element of the actuator means which is connected to the second component.

28) An assembly according to any one of claims 1 to 27 in which the lever means is moved towards the cover to release the clutch.

29) An assembly according to any one of claims 1 to 27 in which the lever means is moved away from the cover to release the clutch.

30) An assembly according to any one of claims 1 to 27 including a flywheel and driven plate.

31) An assembly according to claim 30 also including a flexplate for connection of the flywheel with an associated engine crankshaft.

32) An assembly according to claim 30 or 31 in which the flywheel is a twin-mass flywheel.

33) A clutch assembly constructed and arranged as hereinbefore described with reference to and as shown in any one of figures 1 to 6 of the accompanying drawings.

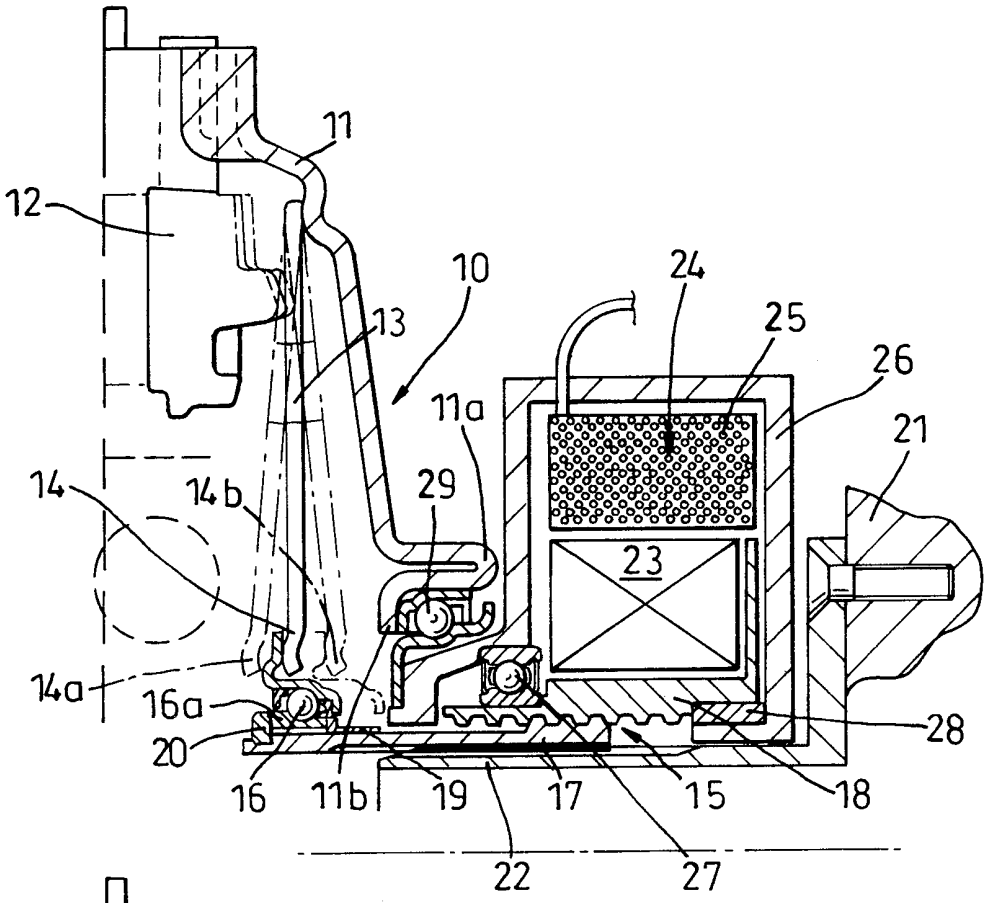
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Fig. 1

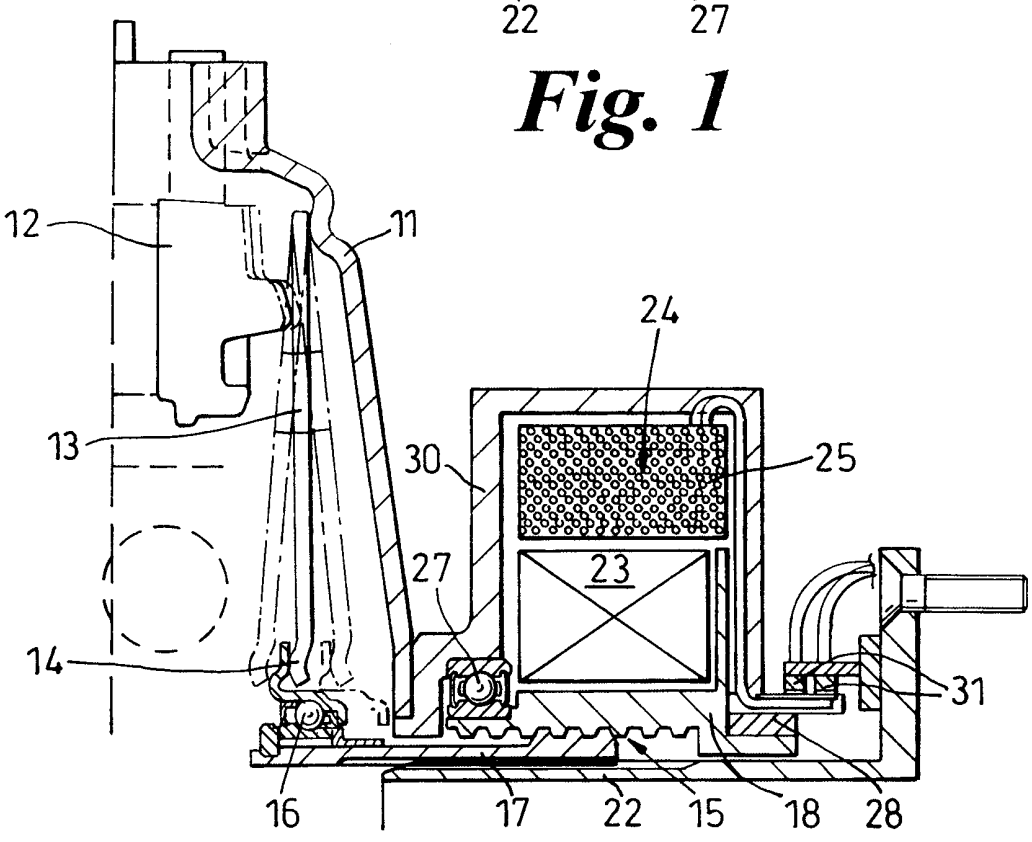
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Fig. 2

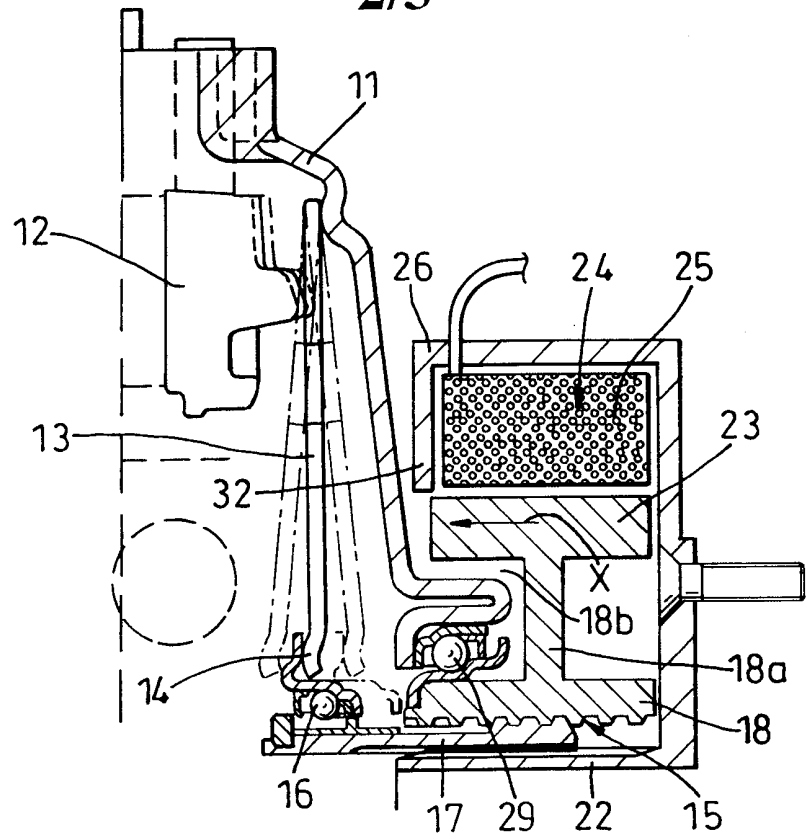
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Fig. 3

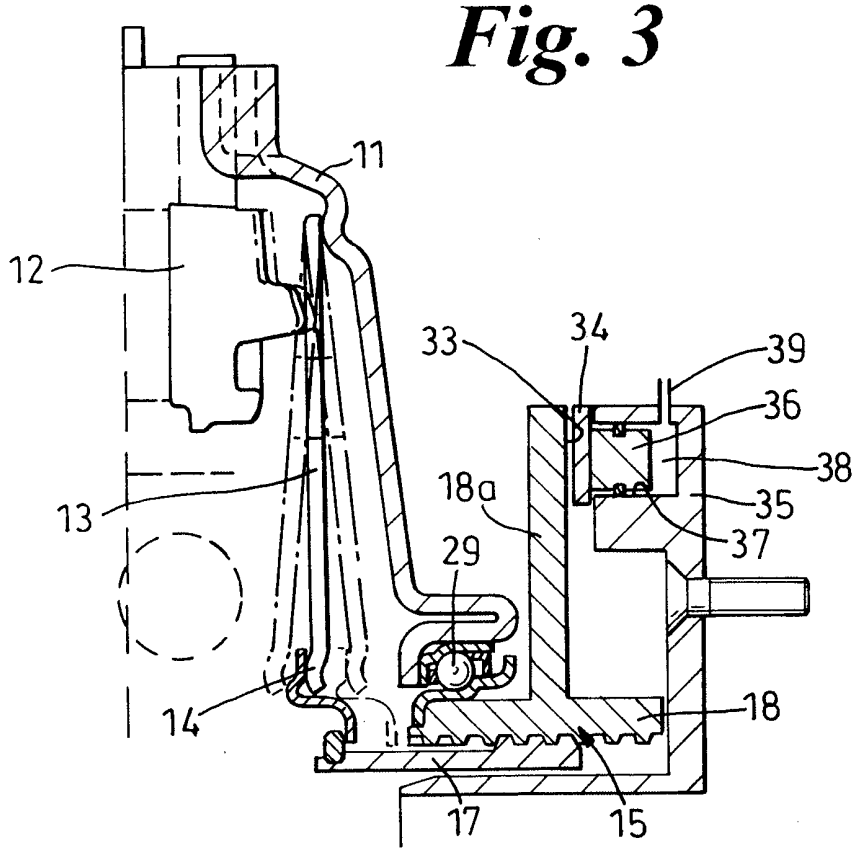
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Fig. 4

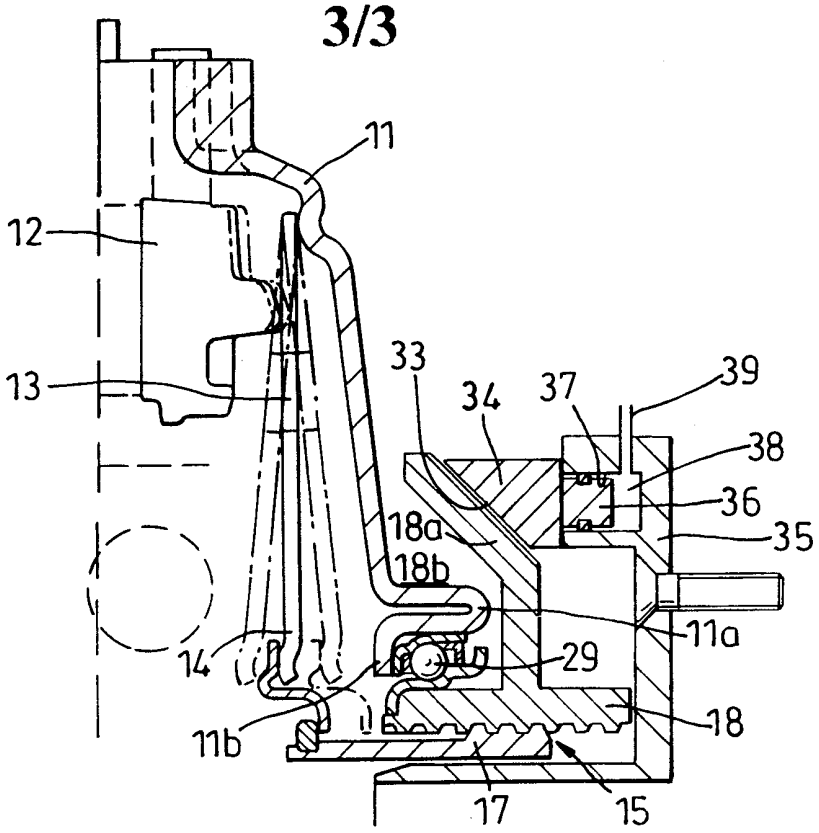
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Fig. 5

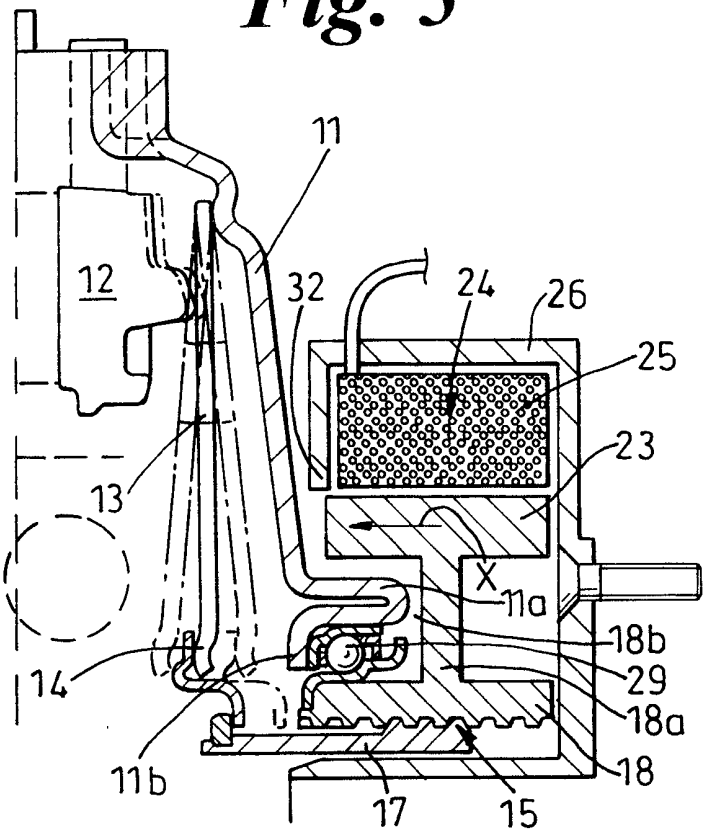
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Fig. 6

INTERNATIONAL SEARCH REPORT

International Application No
PCT/GB 99/01709

A. CLASSIFICATION OF SUBJECT MATTER
IPC 6 F16D25/02 F16D27/00

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 6 F16D

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 5 441 137 A (ORGANEK GREGORY J ET AL) 15 August 1995 (1995-08-15) column 6, line 24 - line 62; figure 1 ---	1-12,14, 17,18, 20,21,29
Y	US 4 936 428 A (LEIGH-MONSTEVENS KEITH V ET AL) 26 June 1990 (1990-06-26) the whole document ---	1-12,14, 17,18, 20,21,29
A	US 5 366 054 A (COOKE RICHARD D M ET AL) 22 November 1994 (1994-11-22) abstract ---	1,8,28, 30,31
A	DE 11 22 840 B (H KLAUE) 25 January 1962 (1962-01-25) column 2, line 34 - line 50; figure 1 ---	13

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[X] Further documents are listed in the continuation of box C.

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Date of the actual completion of the international search	Date of mailing of the international search report
10 September 1999	20/09/1999

Name and mailing address of the ISA	Authorized officer
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INTERNATIONAL SEARCH REPORT

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