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(54) **Electric motor driven hydraulic pump**

Elektrisch angetriebene Pumpe

Pompe à entraînement électrique

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Description

[0001] This invention relates to improvements in electric motor driven hydraulic pumps, for example of the type used in hydraulic suspension systems for vehicles.

[0002] Known electrical motor driven hydraulic pumps are controlled by electronic control units (ECUs) on printed circuit boards (pcbs) which are connected to the motor by some means. The space envelope of these is not optimised and the best cost cannot be achieved due to the need for providing a separate housing for the ECU or pcb.

[0003] US-A-6091 174 describes a pump having a casing extended to form a casing for electronics.

[0004] According to our invention we provide an electric motor driven pump as described in independent claim 1.

[0005] Due to the limitation of space in the area of the chamber, a lead-frame assembly may be implemented that retains and connects all the high power components, for example including a power-module of bare die FETs.

[0006] The low power electronics may be mounted on a pcb board which is mounted on and connected to the lead-frame.

[0007] The low power electronics may be mounted on a traditional FR4 pcb board which is mounted on and connected to the lead-frame.

[0008] Conveniently the lead-frame also includes a system connector moulded into it. The lead frame may also include mouldings adapted to guide the connectors of a stator assembly through the lead frame. The lead frame may also include mouldings adapted to guide the connectors of a stator assembly through the lead frame, for connection to the bare die FETs Conveniently the lead frame may include integrally moulded portions for housing components of a three hall effect sensor.

[0009] A support frame may be provided which together with a closure lid covers the electronics of the motor.

[0010] Our invention has the advantage of achieving optimum space and conserving costs. It is not necessary, in this construction, to provide a separate housing for the electronics.

[0011] A clamping means may be provided for releasably connecting the pump sub-assembly to the electronics sub-assembly.

[0012] The clamping means may secure the support frame to a cup shaped housing of the pump sub-assembly.

[0013] The pump/rotor sub-assembly may comprise a housing for a pump and a rotor assembly attached to the pump and sealed by a can within the pump housing. The pump sub-assembly may comprise a housing for a pump and a rotor assembly attached to the pump and sealed by a can within the pump housing. On assembly, the support frame may be introduced to the pump housing to place the stator around the rotor whereby the pump, the stator and the electronics are sealed by the pump housing, the support frame and the closure member.

[0014] With our invention the motor with the pump and the motor drive and control electronics is integrated into a single case, preferably a single cast housing.

[0015] Two embodiments of our invention are illustrated in the accompanying drawings in which:-

Figure 1 is an end elevation of an electrical motor driven hydraulic pump;

Figure 2 is a section on the line 2-2 of figure 1;

Figure 3 is a perspective view of the pump with part of the casing removed for clarity;

Figure 4 illustrates two sub-assemblies comprising the pump rotor assembly;

Figure 5 is an exploded view of part of Figure 4;

Figure 6 is an exploded view of a second embodiment; and

Figure 7 is a cut-away version of the pump illustrated in Figure 6.

[0016] The electric motor driven hydraulic pump illustrated in Figure 1-5 of the accompanying drawings comprises two sub-assemblies 1 and 2. A first of the two sub-assemblies is associated with a casting 3 of cup-shaped outline and the second with a support frame 4 which are clamped together at adjacent ends by a circumferentially extending clamping band 5. The casting 3 defines a housing for the rotor of an electric motor 6 and a pump impeller 7. As illustrated the impeller 7 is driven by a drive shaft 8 driven by the rotor 9 of the motor and which is enclosed within a stainless steel can 10 which the stator 11 surrounds. The can is preferably manufactured from a non-magnetic material preferably stainless steel.

[0017] The open end of the casting 3 is closed by the support frame 4 by the clamping action of the band 5 as described above. The support frame is of die cast construction and defines a mounting for a lead frame 12, the support frame 4 and the lead frame 12 include connecting paths from the motor to the electronics for controlling operation of motor 6. The lead frame provides a mounting for a circuit board 14 and also includes a connector 13. The lead frame 12 also includes a moulded bare die FET module indicated at 12' and integrally moulded portions 12" housing a hall effect sensor. The lead frame has additional mouldings 12"' each having an opening through which respective connectors 11' from the motor stator can pass to be joined with the FET leads. The lead frame and electronics are enclosed within an end cover 15.

[0018] The sub-assembly 1 is built by inserting a further assembly comprising the pump impeller 7 and associated components, the shaft 8, the rotor 9, the pump housing 16 and the can 10. The further assembly being located within the housing 3 and then being secured with a circlip. The completed sub-assembly 1 then forms a

stand alone sealed unit in which all the elements of the pump can be hydraulically tested prior to final assembly with the electronics.

[0019] The sub-assembly 2 is assembled by mounting the board 14 carrying the electronics on the lead frame 12 and then locating the connector 13 of the lead frame through the opening 4' in the support frame 4. Once mounted in this position the bare die FET module is exposed on the side of the lead frame adjacent the support member 4 such as to abut the spigot 4" on the support member 4. A thermal compound may be applied between the abutting surfaces.

[0020] The stator connectors 11' are inserted through respective openings in the support frame 4 and the lead frame 12 to be joined with the FET leads in known manner. The support frame 4 is configured to support the stator 11 in its final position on sub-assembly 2.

[0021] The final part of sub-assembly 2 is to mount the cover 15 in place by way of a snap fit connection with the edge of the lead frame 12. The completed sub-assembly 2 then forms a stand alone unit in which the electronics and stator can be tested prior to final assembly with the pump assembly.

[0022] As the sub-assemblies 1 and 2 are brought together, the stator 11 of assembly 2 is assembled such as to surround the can 10 of assembly 1. Finally, the assembly is completed by securing the clamping band 5 in position to clamp mating faces of the casting 3 and the lead frame 2 into engagement. In this final position, it is notable that the bare die FET module on the lead frame 12 is in contact with the support frame 4 as described above, which serves to help dissipate heat.

[0023] The construction described above has the advantage that each of the two sub-assemblies 1 and 2 can be manufactured separately, and tested individually. Each of the two sub-assemblies 1 and 2 can be manufactured at different locations and then both supplied to the customer for final assembly, for example on a vehicle during production. The two sub-assemblies can simply be assembled together and then clamped with mating faces in engagement as described above.

[0024] In the modified construction illustrated in Figures 6 and 7 the position of the circuit board 14 and the mounting lead frame 12 are the same as for the embodiments Figure 1-5, but a separate FET module 17 is used.

[0025] It will be appreciated that whilst the sub-assembly 1 can be fully tested for hydraulic integrity in order to test the rotor 9 a slave stator locked to a suitable power source may be employed.

[0026] In an alternative embodiment (not shown) the stator could be part of sub-assembly 1 and the electronics alone would be a separate sub-assembly.

Claims

1. An electric motor driven hydraulic pump in which the casing of the motor is extended to include a chamber in which the electronics can be housed, the casing being constructed appropriately to be split in order to define a pump rotor sub-assembly (1) and an electronics sub-assembly (2) which can be tested separately and then joined together by use of simple interconnections, the electronics sub-assembly (2) comprises a support frame (4), a lead frame (12) carrying power components (12), a printed circuit board carrying electronic components (14), and a closure member **characterised in that** the electronic sub-assembly (2) includes the motor stator windings which are supported by the support frame and connected to the lead frame.

2. A pump according to claim 1 in which the lead-frame assembly (12) retains and connects all the high power components.

3. A pump according to claim 2 in which the high power components comprise a power-module of bare die FETs(12').

4. A pump according to claim 2 or claim 3 in which the low power electronics are mounted on the pcb board which is mounted on and connected to the lead-frame (12).

5. A pump according to any one of claims 2 to 4 in which the lead-frame (12) includes a single connector (13) moulded into it.

6. A pump according to any one of claims 2 to 5 in which the lead-frame (12) includes mouldings adapted to guide the connectors (11') of a stator assembly (11) through the lead-frame (12).

7. A pump according to any one of claims 2 to 6 in which the lead-frame (12) also includes integrally moulded portions for housing components of a three hall effect sensor.

8. A pump according to any previous claim in which a support frame (4) is provided which, together with a closure lid, covers the electronics of the motor.

9. A pump according to any preceding claim in which a clamping means (5) is provided for releasably connecting the pump sub-assembly (1) to the electronics sub-assembly (2).

10. A pump according to claim 10 when dependant on claim 8 in which the clamping means (5) secures the support frame (4) to a cup-shaped housing (3) of the pump sub-assembly (1).

11. A pump according to any one of claims 1 to 10 in which the pump sub-assembly (1) comprises a housing (3) for a pump, and a rotor assembly (9) attached

to the pump and sealed by a can within the pump housing (3).

12. A pump according to claim 10 or 11 in which the support frame is adapted to be, on assembly of the pump, introduced to the pump housing (1) to place the stator (11) around the rotor whereby the pump, the stator (11) and the electronics are sealed by the pump housing, the support frame (4) and the closure member.

Patentansprüche

1. Elektromotorgetriebene Hydraulikpumpe, bei der das Motorgehäuse verlängert ist, um eine Kammer einzuschließen, in der die Elektronik untergebracht werden kann, wobei das Gehäuse geeignet konstruiert ist, um geteilt zu werden, um eine Pumpen-Rotor-Unterbaugruppe (1) und eine Elektronik-Unterbaugruppe (2) zu bilden, die separat getestet und dann unter Verwendung einfacher Verbindungen miteinander verbunden werden können, wobei die Elektronik-Unterbaugruppe (2) ein Gestell (4), einen Leistungsbauelemente (12) tragenden Leitungsrahmen (12), eine elektronische Bauteile (14) tragende Leiterplatte und ein Verschlussbauteil aufweist, **dadurch gekennzeichnet, dass** die Elektronik-Unterbaugruppe (2) die Statorwicklungen des Motors enthält, die vom Gestell abgestützt und mit dem Leitungsrahmen verbunden sind.

2. Pumpe nach Anspruch 1, bei der die Leitungsrahmenbaugruppe (12) alle Leistungsbauelemente fixiert und verbindet.

3. Pumpe nach Anspruch 2, bei der die Leistungsbauelemente ein Leistungsmodul aus offenliegenden FET-Bausteinen (12') umfasst.

4. Pumpe nach Anspruch 2 oder Anspruch 3, bei der die Niederspannungselektronik auf der Leiterplatte montiert ist, die auf dem Leitungsrahmen (12) angebracht und mit ihm verbunden ist.

5. Pumpe nach einem der Ansprüche 2 bis 4, bei der der Leitungsrahmen (12) einen in ihn eingeformten einzelnen Steckverbinder (13) umfasst.

6. Pumpe nach einem der Ansprüche 2 bis 5, bei der der Leitungsrahmen (12) Formstücke aufweist, die Steckverbinder (11') einer Statoranordnung (11) durch den Leitungsrahmen (12) zu führen vermögen.

7. Pumpe nach einem der Ansprüche 2 bis 6, bei der der Leitungsrahmen (12) ferner integral geformte Teile für Gehäusebestandteile eines Dreier-Halleffektsensors umfasst.

8. Pumpe nach einem der vorhergehenden Ansprüche, bei dem ein Gestell (4) vorhanden ist, das zusammen mit einem Schließdeckel die Elektronik des Motors abdeckt.

9. Pumpe nach einem der vorhergehenden Ansprüche, bei der eine Klemmeinrichtung (5) zum lösbaren Verbinden der Pumpen-Unterbaugruppe (1) mit der Elektronik-Unterbaugruppe (2) vorhanden ist.

10. Pumpe nach Anspruch 10 in seiner Abhängigkeit vom Anspruch 8, bei der die Klemmeinrichtung (5) das Gestell (4) an einem becherförmigen Gehäuse (3) der Pumpen-Unterbaugruppe (1) befestigt.

11. Pumpe nach einem der Ansprüche 1 bis 10, bei der die Pumpen-Unterbaugruppe (1) ein Gehäuse (3) für eine Pumpe umfasst und eine Rotoranordnung (9), die an der Pumpe befestigt und durch eine Dose innerhalb des Pumpengehäuses (3) abgedichtet ist.

12. Pumpe nach Anspruch 10 oder 11, bei der das Gestell dazu eingerichtet ist, beim Zusammenbau der Pumpe in das Pumpengehäuse (1) eingeführt zu werden, um den Stator (11) um den Rotor zu platzieren, wodurch die Pumpe, der Stator (11) und die Elektronik durch das Pumpengehäuse, das Gestell (4) und das Verschlussbauteil abgedichtet sind.

Revendications

1. Pompe hydraulique entraînée par moteur électrique dans laquelle le boîtier du moteur est étendu pour inclure une chambre dans laquelle l'électronique peut être longée, le boîtier étant construit de manière appropriée pour être partagé afin de définir un sous-ensemble de rotor de pompe (1) et un sous-ensemble d'électronique (2) qui peuvent être testés séparément et ensuite assemblés à l'aide de simples interconnexions, le sous-ensemble d'électronique (2) comprenant un châssis de support (4), une grille de connexion (12) supportant les composants de puissance (12), une carte de circuit imprimé supportant les composants électroniques (14) et un élément de fermeture, **caractérisée en ce que** le sous-ensemble d'électronique (2) comprend des enroulements de stator de moteur qui sont supportés par le châssis de support et raccordés à la grille de connexion.

2. Pompe selon la revendication 1, dans laquelle l'ensemble de grille de connexion (12) retient et raccorde tous les composants de courant fort.

3. Pompe selon la revendication 2, dans laquelle les composants de courant fort comprennent un module

de puissance de transistors à effet de champ (12') nus.

4. Pompe selon la revendication 2 ou la revendication 3, dans laquelle l'électronique à faible courant est montée sur la carte PCB qui est montée sur et raccordée à à grille de connexion (12).

5. Pompe selon l'une quelconque des revendications 2 à 4, dans laquelle la grille de connexion (12) comprend un seul connecteur (13) moulé dans cette dernière.

6. Pompe selon l'une quelconque des revendications 2 à 5, dans laquelle la grille de connexion (12) comprend des moulages adaptés pour guider les connecteurs (11') de l'ensemble de stator (11) à travers la grille de connexion (12).

7. Pompe selon l'une quelconque des revendications 2 à 6, dans laquelle la grille de connexion (12) comprend également des parties moulées de manière solitaire pour loger les composants d'un capteur à trois effets hall.

8. Pompe selon l'une quelconque des revendications précédentes, dans laquelle on prévoit un châssis de support (4) qui, conjointement à un couvercle de fermeture, recouvre l'électronique du moteur.

9. Pompe selon l'une quelconque des revendications précédentes, dans laquelle on prévoit des moyens de serrage (5) pour raccorder de manière amovible le sous-ensemble de pompe (1) au sous-ensemble d'électronique (2).

10. Pompe selon la revendication 10, lorsqu'elle dépend de la revendication 8, dans laquelle les moyens de serrage (5) fixent le châssis de support (4) sur un boîtier (3) en forme de coupelle du sous-ensemble de pompe (1).

11. Pompe selon l'une quelconque des revendications 1 à 10, dans laquelle le sous-ensemble de pompe (1) comprend un boîtier (3) pour une pompe, et un ensemble de rotor (9) fixé sur la pompe et étanche grâce à une boîtier métallique à l'intérieur du boîtier de pompe (3).

12. Pompe selon la revendication 10 ou 11, dans laquelle le châssis de support est adapté, sur l'ensemble de la pompe, pour être introduit dans le boîtier de pompe (1) afin de placer le stator (11) autour du rotor moyennant quoi, la pompe, le stator (11) et l'électronique sont hermétiquement enfermés par le boîtier de pompe, le châssis de support (4) et l'élément de fermeture.

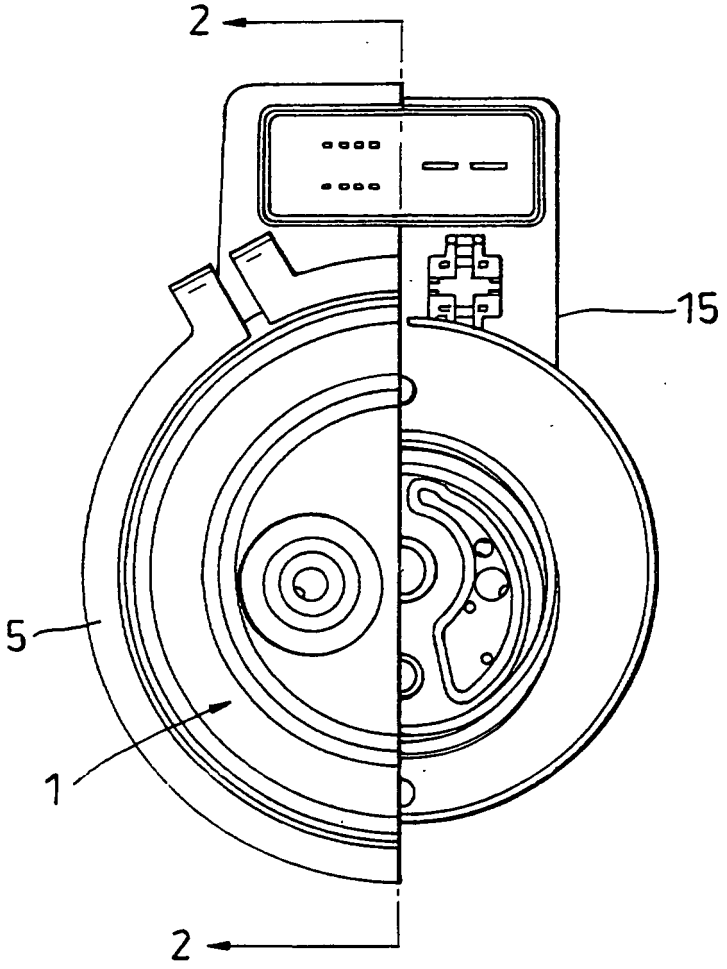

Fig. 1

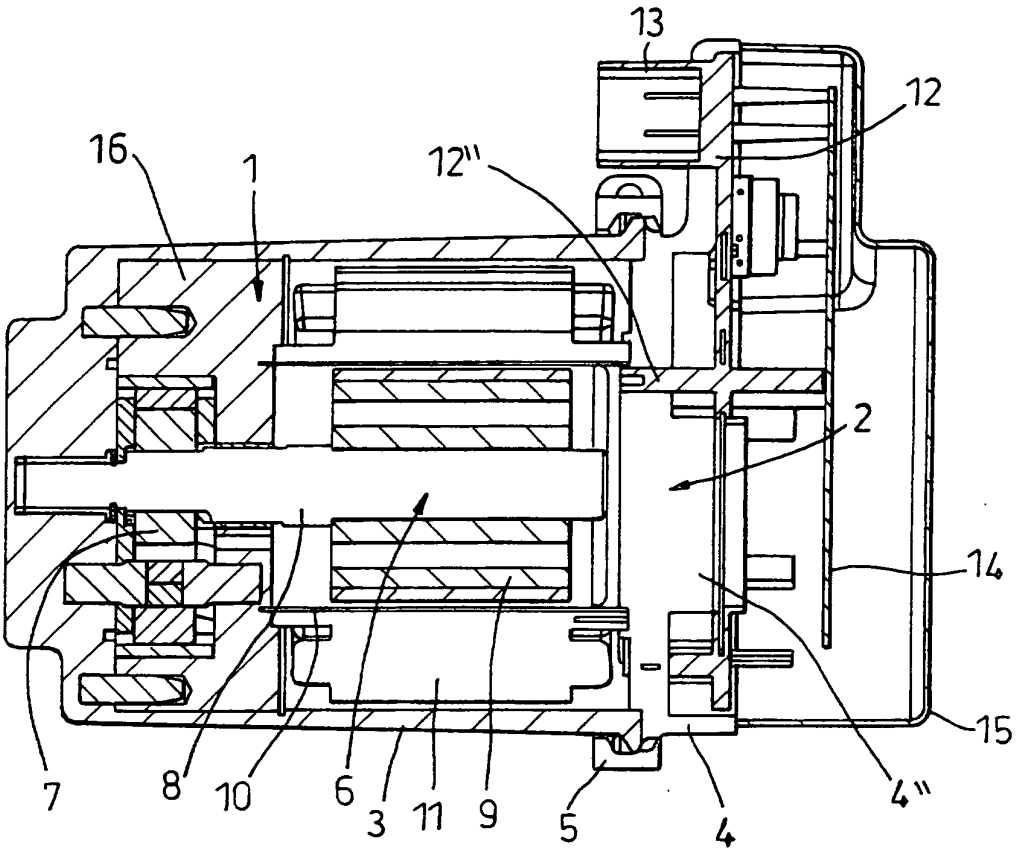

Fig. 2

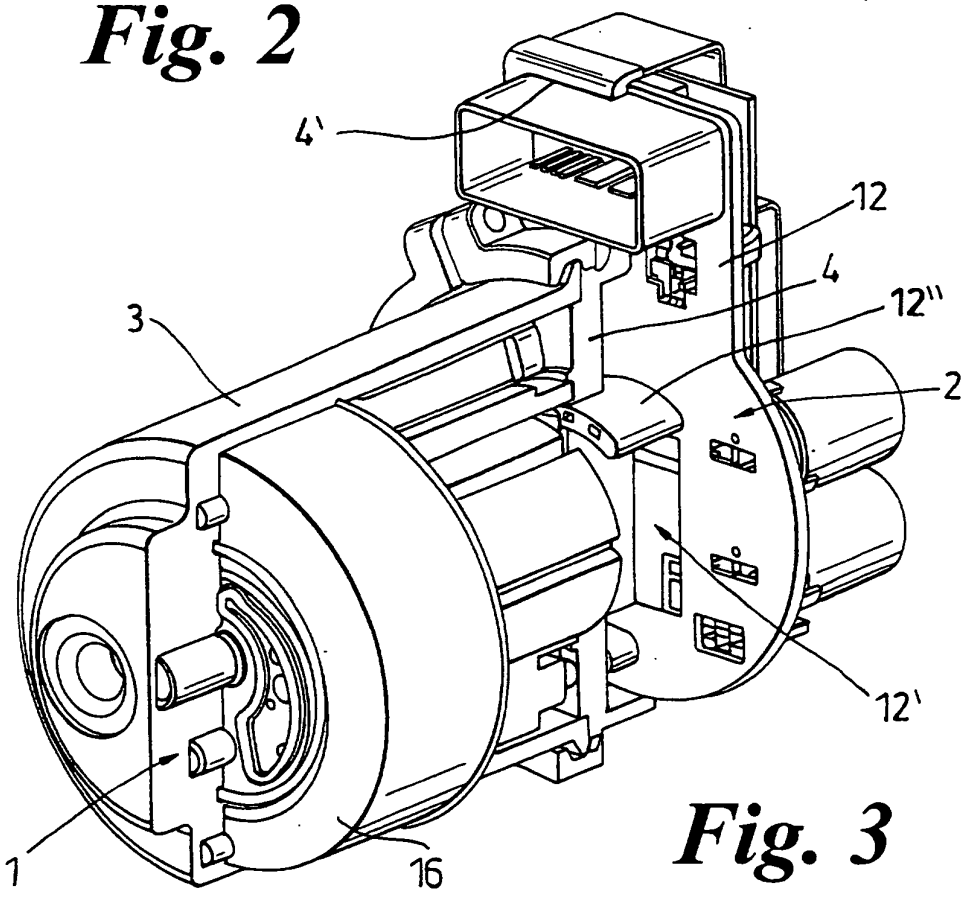

Fig. 3

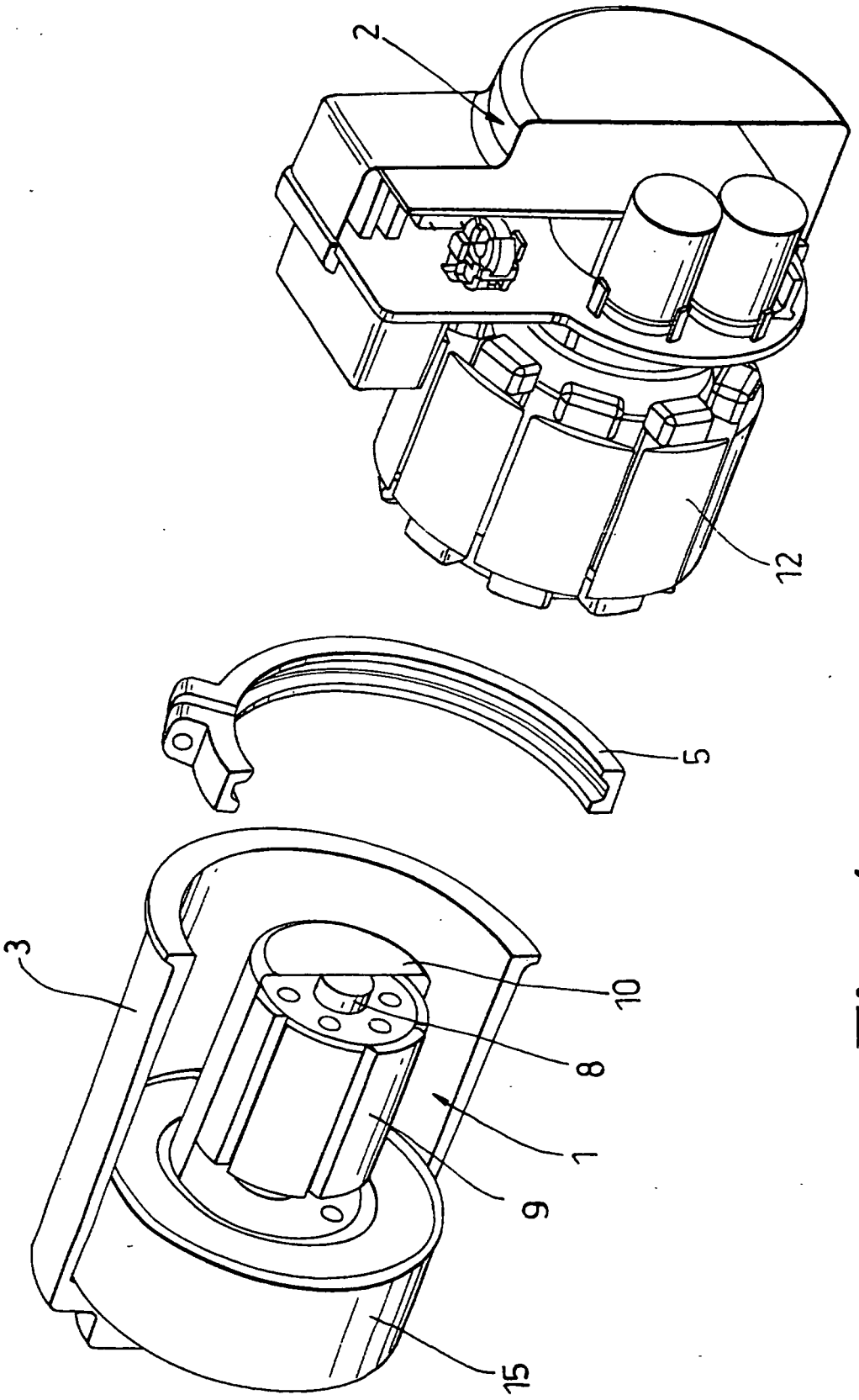

Fig. 4

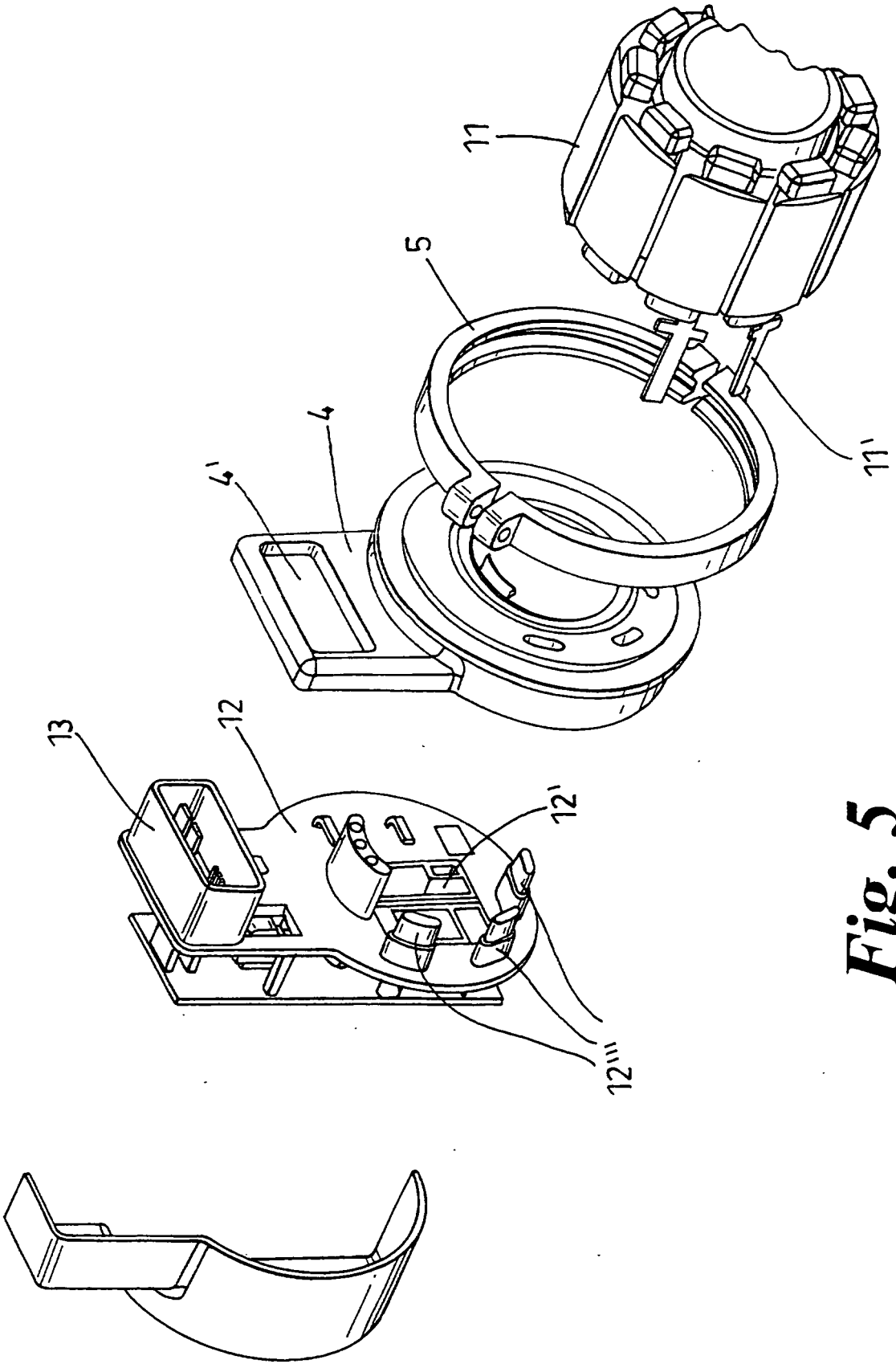

Fig. 5

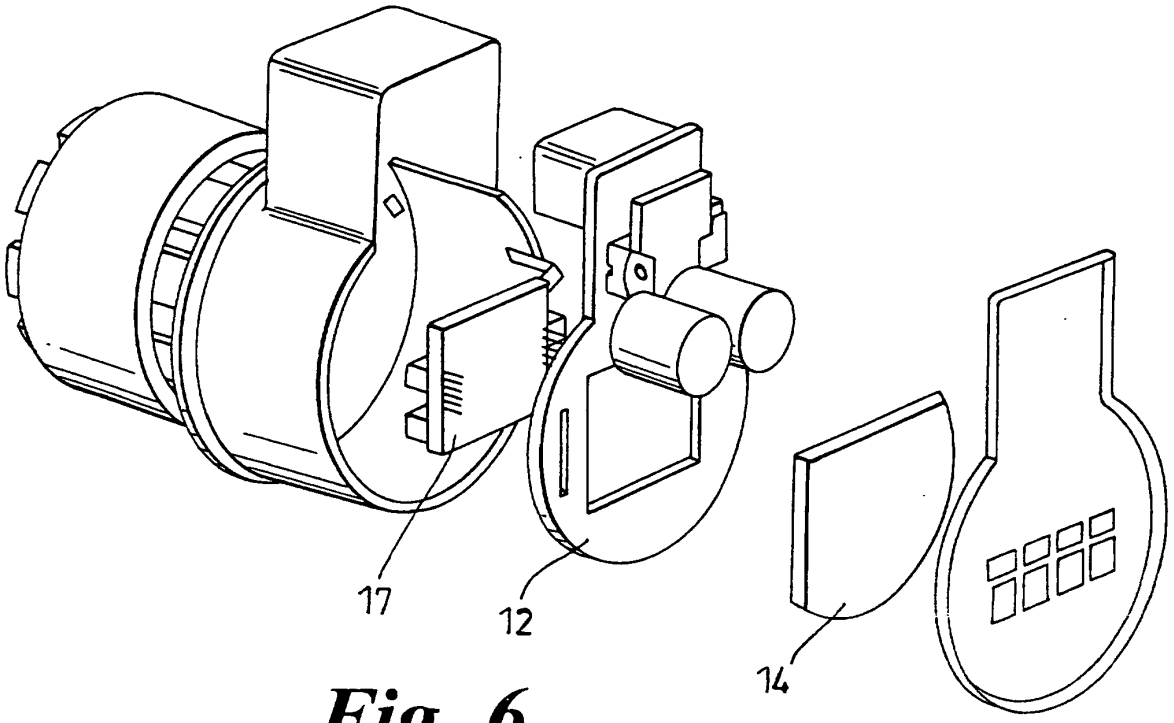

Fig. 6

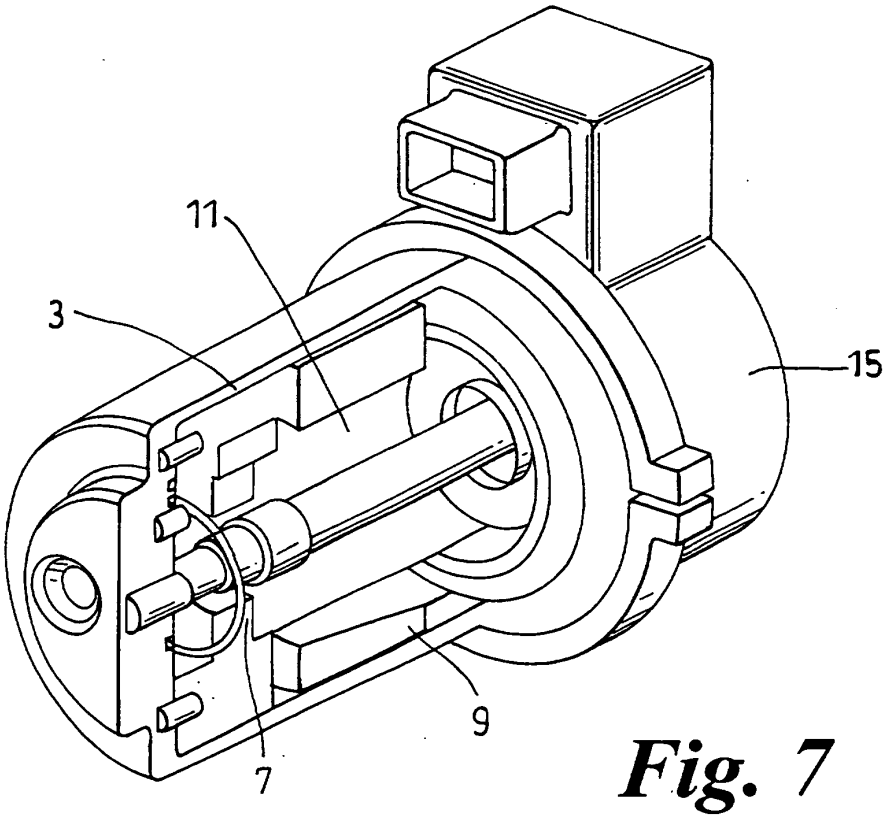

Fig. 7

REFERENCES CITED IN THE DESCRIPTION

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