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(12) # EUROPEAN PATENT APPLICATION

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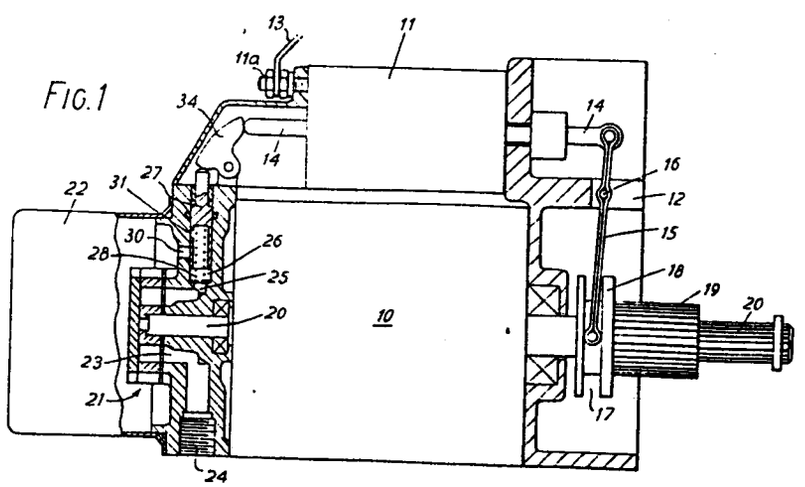
(54) **Pump drives.**

(57) A starter motor for an internal combustion engine is arranged to drive a pump, e.g. for engine coolant or supplying servo fluid but the load on the motor due to the pump is limited, reduced or removed when the motor is being used to start the engine. Alternatively, operation of the motor to drive the engine is prevented if the load on the motor due to the pump exceeds a predetermined value.

FIG.1



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PUMP DRIVES

This invention relates to pump drives and is more particularly concerned with pumps to be driven by internal combustion engines, for example, for motor vehicles.

In the present-day motor vehicles, the electric starter motor carries on its output shaft a pinion which is moved axially into mesh with the flywheel of the engine of the vehicle either prior to or substantially simultaneously with the commencement of rotation of the starter motor. When the engine starts, the pinion is automatically disengaged from the flywheel and the starter motor is stopped. The starter motor then remains idle until it is required again.

According to the present invention in one aspect, there is provided the combination with an electric starter motor for an internal combustion engine of a pump connected to be driven by the motor, and means for limiting, reducing or removing during operation of the motor to drive the engine, the load imposed on the motor by the pump, or for preventing operation of the motor to drive the engine if the load imposed on the motor by the pump exceeds a predetermined value.

The pump may for example be for supplying servo fluid for power steering apparatus or for circulating cooling water through the engine.

In general, all the power from the starter motor is required to start the engine, and said means may therefor operate to reduce the power absorbed by the pump or to disconnect the drive to the pump during the time in which the motor is connected to drive the engine.

In one arrangement according to the invention, said means operates to reduce said load during operation of the motor to drive the engine and

comprises a valve operable to cause fluid delivered by the pump to be passed to the inlet of the pump or other low pressure region thereby to by-pass the external circuit of the pump. Where a solenoid is provided for moving a pinion on the shaft of the motor into a position in mesh with a gearwheel on the main shaft of the engine, said valve may be operated by the solenoid. Alternatively the valve may be operated by a second solenoid electrically connected to the first solenoid or to the starter switch.

In another arrangement according to the invention, a device responsive to the delivery pressure of the pump is arranged to obstruct axial movement of a pinion or the output shaft of the motor into a position in driving engagement with the engine if the delivery pressure exceeds a predetermined value.

In an alternative arrangement according to the invention, said means operates to remove said load during operation of the motor to drive the engine, said motor being a reversible motor and being connected to drive the pump said means comprising a free wheel device, whereby when rotating in one direction the motor drives the engine but not the pump and, when rotating in the opposite direction drives the pump.

In another alternative arrangement according to the invention the motor is connected to drive the pump through a clutch, and means is provided for disengaging the clutch to remove the load of the pump from the motor when the starter motor is actuated to drive the engine.

In another aspect the invention provides the combination with an electric starter motor for an internal combustion engine of a pump connected to be driven by the motor, and means for preventing operation of the motor to drive the pump when the motor drives the engine or for preventing operation of the motor to

drive the engine is the load on the motor due to the pump exceeds a predetermined load.

Some embodiments of the invention will now be described by way of example with reference to the accompanying diagrammatic drawings in which:-

Figures 1 to 4 respectively illustrate four embodiments of the invention.

In the drawings corresponding components are indicated by like reference numerals.

Referring to Figure 1, an electric starter motor 10 for the internal combustion engine of a motor vehicle is shown. A solenoid 11 is mounted on a bracket 12 secured to the casing of motor 10 and has an input terminal 11a to which is connected a conductor 13 for current for operating the solenoid under the control of a starter switch (not shown). The actuating rod 14 of the solenoid is pivotally connected at one end to a lever 15 which is mounted on a pivot pin 16 carried by the bracket 12. The opposite end of lever 15 is engaged in an annular groove 17 in the enlarged diameter end portion 18 of a starter pinion 19. The pinion is engaged on splines on the shaft 20 of the starter motor.

The opposite end of shaft 20 has secured to it the rotor of the rotary pump which in this instance operates to supply servo fluid under pressure to power steering apparatus (not shown) of a motor vehicle.

Fluid is drawn into the pump from a reservoir 22 surrounding the pump and is delivered to an annular space 23 communicating with the outlet 24 of the pump for delivery to the power steering apparatus. A port 25 leads from the annular space 23 to a cylinder 26 in which a plunger 27 is slidably mounted. The end portion of the plunger nearer the port is in the form of a hollow sleeve and a compression spring 28 seated about the port 25 extends into the hollow sleeve

portion and presses against the solid upper portion of the plunger. An aperture 30 in the wall of the cylinder is blanked off by the sleeve portion when the actuator rod of the solenoid is in its position corresponding to the inoperative position of the starter pinion, but a port 31 in the sleeve portion can be brought into register with the aperture 30, when the plunger is depressed against the force of spring 28. The upper end of the plunger is in engagement with the adjacent end of the actuation rod 14 through a rocking lever 34. In the inoperative position of the starter pinion as illustrated, the pump is driven by the starter motor and pressure fluid is fed to the pump outlet, but when the actuator rod moves to the left to engage the starter pinion 19 with a gearwheel (not shown) on the main shaft of the engine, the rocking lever 34 moves to depress the plunger 27 to bring the port 31 into register with the aperture 30. Pressure fluid delivered to the annular space 23 is thus directed from the cylinder 26 to the reservoir 22, so that the load placed on the starter motor by the pump is greatly reduced, and substantially the full power of the starter motor is available to drive the engine to start it.

Figure 2 shows an alternative arrangement in which the valve arrangement of Figure 1 is replaced by a stop which projects into the path of rectilinear movement of the starter pinion along the splines into its operative position. The stop comprises a piston element 40 which is slidably mounted in a cylinder 41 formed in a housing element 42 secured to the bracket 12. A pipe 43 communicating with the outlet of the pump leads to the cylinder 40, so that if the pump delivery pressure exceeds a predetermined low value the pressure acting on the piston element moves it against the force of a return spring 43 into a stop position in which a

forward end part 44 of the piston projects from the housing into engagement in the annular groove 17. Thus if for example the driver of the vehicle is pressing against the steering wheel, tending to turn the wheel, when he operates the resultant pressure in the external circuit of the pump will actuate the plunger preventing the starter pinion from moving into its operative position.

Figure 3 shows another alternative arrangement in which a free wheel mechanism 50 is connected between the ends of the starter motor shaft and the pump. The motor is reversible and the free wheel mechanism is arranged so that in one direction of rotation of the motor the splined shaft 20 is driven but not the pump, and in the other direction of rotation of the motor, the pump is driven. Thus when the starter switch is operated to start the engine, the motor is rotated in said one direction so that the load of the pump is removed from the motor shaft and substantially the full power of the motor is available to rotate the engine.

Figure 4 illustrated another alternative arrangement in which a clutch 50 is disposed between the motor shaft and the pump shaft. The clutch is actuated by a stirrup link 51 connected between the rocking lever 34 and twin operating levers 52 of the clutch. The clutch is disengaged when actuating rod 14 moves to slide the starter pinion 19 into its operating position, and is engaged when the starter pinion is moved back to its inoperative position.

In the arrangements of Figures 3 and 4, the pump may constitute the circulating pump for the engine coolant, or may be an auxiliary coolant pump which is operates only when the engine is switched off and which runs for a predetermined interval of time to prevent the coolant from boiling in the engine block.

CLAIMS

1. The combination with an electric starter motor for an internal combustion engine of a pump connected to be driven by the motor, and means for limiting, reducing or removing during operation of the motor to drive the engine, the load imposed on the motor by the pump, or for preventing operation of the motor to drive the engine if the load imposed on the motor by the pump exceeds a predetermined value.

2. The combination claimed in claim 1, wherein said means operates to reduce said load during operation of the motor to drive the engine and comprises a valve operable to cause fluid delivered by the pump to be passed to the inlet of the pump or other low pressure region thereby to by-pass the external circuit of the pump.

3. The combination claimed in claim 2, further comprising a solenoid for moving a pinion on the shaft of the motor into a position in mesh with a gearwheel on the main shaft of the engine, wherein said valve is connected to be operated by the solenoid.

4. The combination claimed inc laim 1, wherein a device responsive to the delivery pressure of the pump is arranged to obstruct axial movement of a pinion or the output shaft of the motor into a position in driving engagement with the engine if the delivery pressure exceeds a predetermined value.

5. The combination claimed in claim 1, wherein said means operates to remove said load during operation of the motor to drive the engine, said motor being a reversible motor and being connected to drive the pump said means comprising a free wheel device, whereby when rotating in one direction the motor drives the engine but not the pump and, when rotating in the opposite direction drives the pump.

6. The combination claimed in claim 1, wherein the

motor is connected to drive the pump through a clutch, and means is provided for disengaging the clutch to remove the load of the pump from the motor when the starter motor is actuated to drive the engine.

7. The combination with an electric starter motor for an internal combustion engine of a pump connected to be driven by the motor, and means for preventing operation of the motor to drive the pump when the motor drives the engine or for preventing operation of the motor to drive the engine is the load on the motor due to the pump exceeds a predetermined load.

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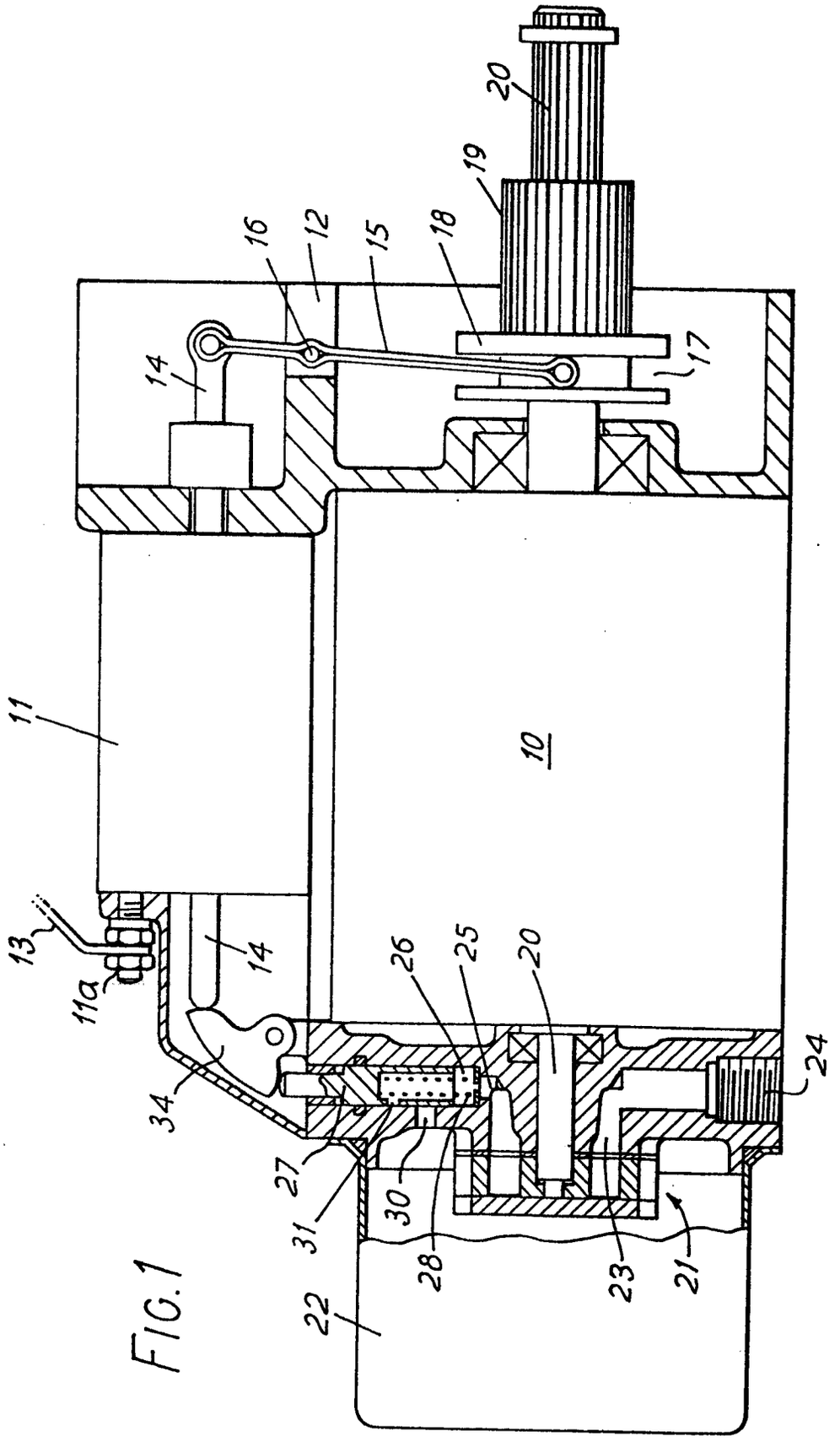

FIG.1

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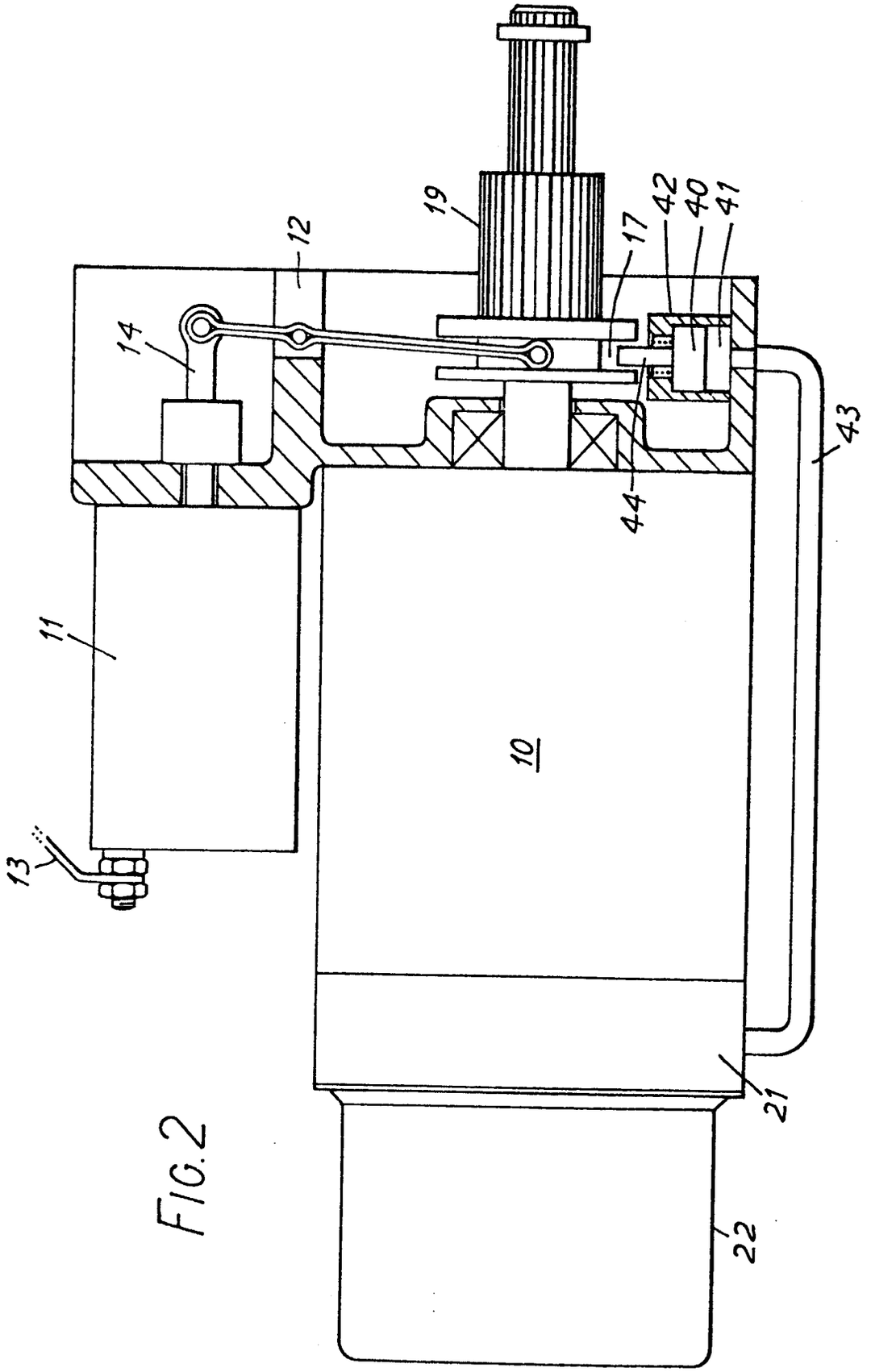

FIG.2

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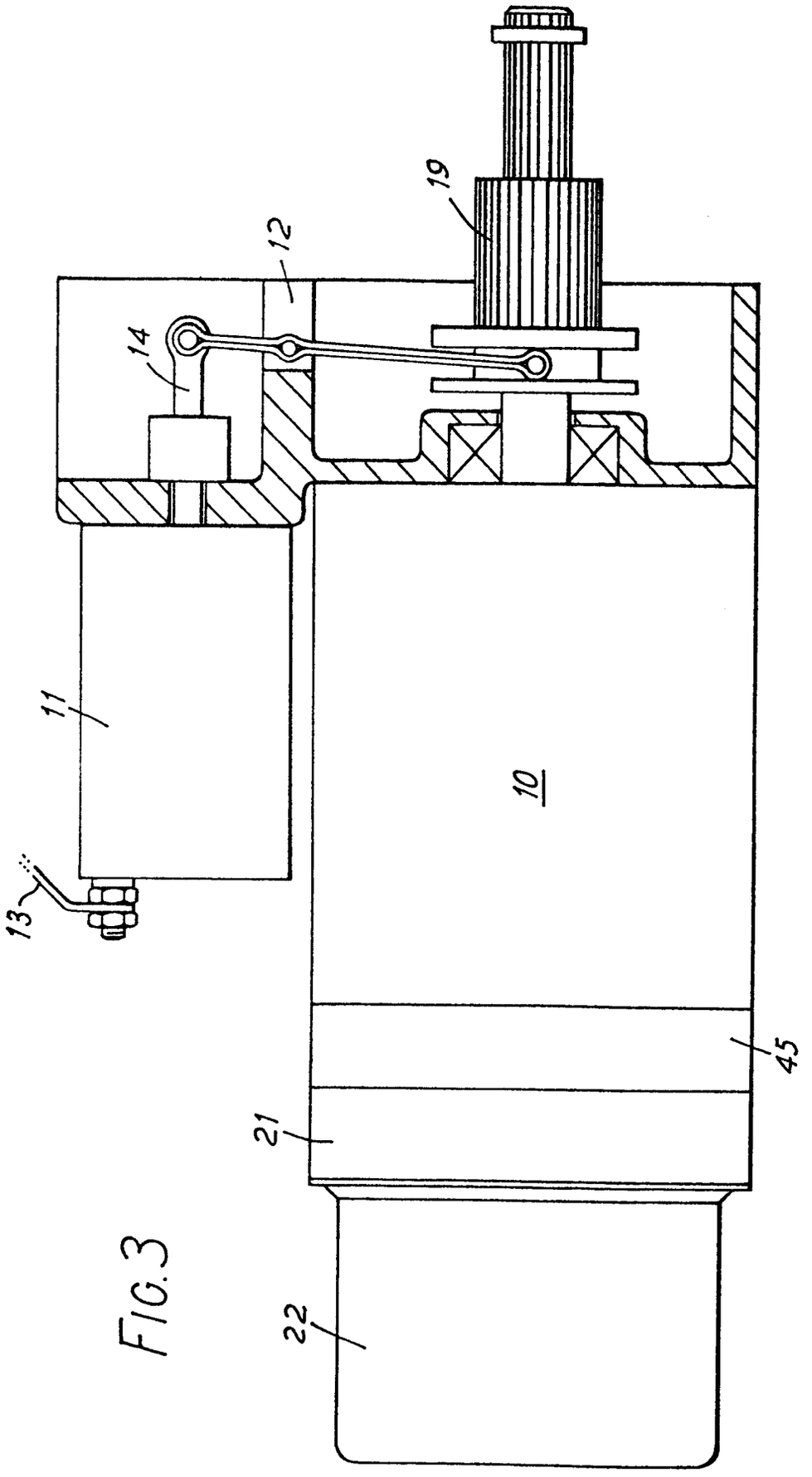

FIG.3

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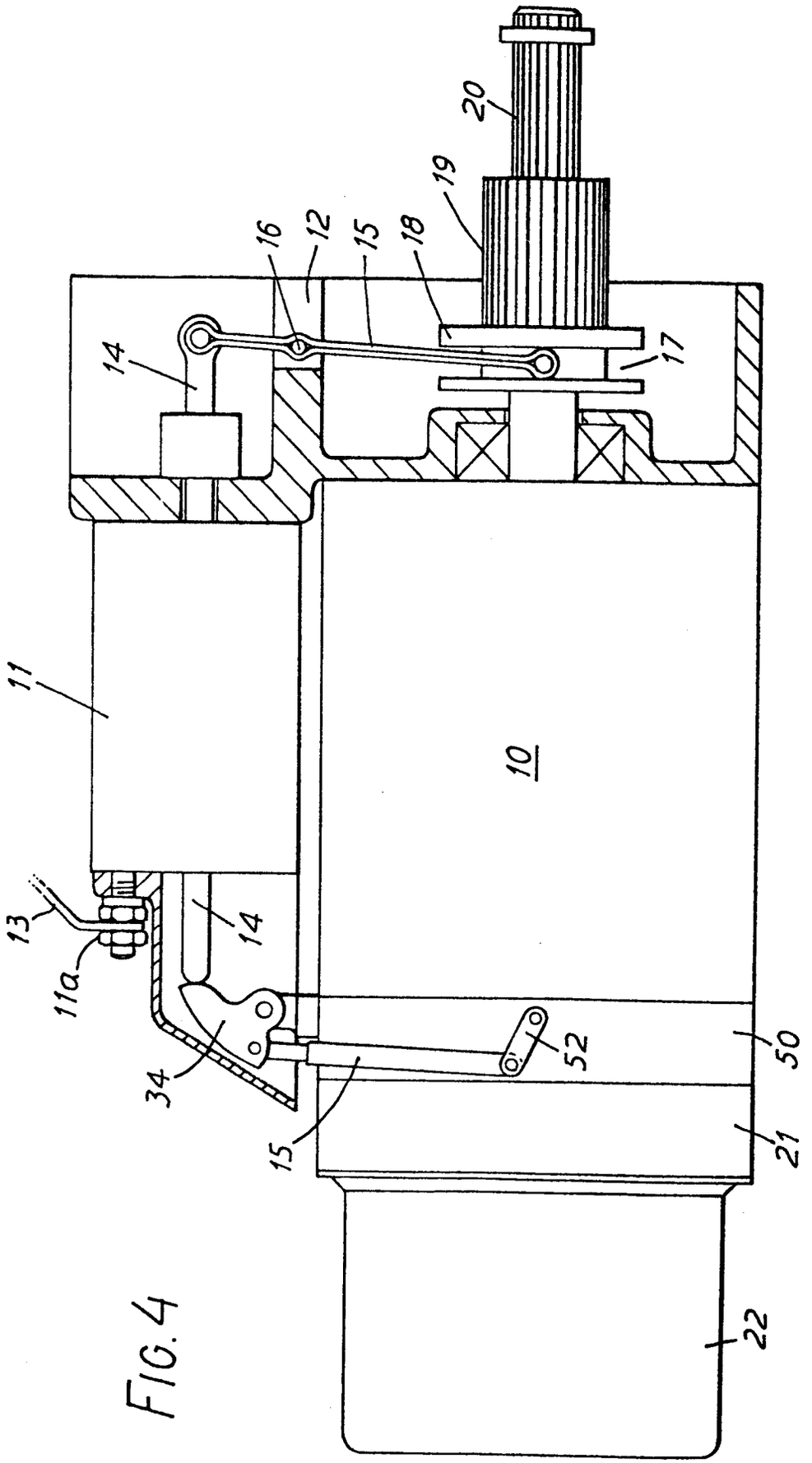

FIG. 4

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EUROPEAN SEARCH REPORT

Application number

EP 86 30 7278

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl 4)
X	GB-A-2 081 992 (NISSAN MOTOR CO.) * Page 1, line 109 - page 2, line 3; figure 1; page 2, lines 49-86; figure 2 *	1-3,6	F 02 N 11/00
X	EP-A-0 140 289 (MITSUBISHI DENKI K.K.) * Page 5, line 5 - page 6, line 24; figures 2,3 *	1,2	
A		3,7	
X	FR-A-2 443 588 (LUK LAMELLEN UND KUPPLUNGSBAU) * Page 2, line 29 - page 3, line 21; page 7, line 20 - page 8, line 14; figure 2; page 10, lines 1-5 *	1,2,4-7	
X	EP-A-0 109 216 (MITSUBISHI DENKI K.K.) * Page 5, line 22 - page 6, line 20; figure 2 *	1,5	
A		7	

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TECHNICAL FIELDS SEARCHED (Int. Cl 4)

F 02 N

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	26-11-1986	BIJN E.A.

CATEGORY OF CITED DOCUMENTS

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EUROPEAN SEARCH REPORT

Application number

EP 86 30 7278

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.4)
X	EP-A-0 109 246 (MITSUBISHI DENKI K.K.) * Page 6, line 16 - page 8, line 18; figure 2 *	1,6,7	
X	EP-A-0 115 643 (MITSUBISHI DENKI K.K.) * Page 7, lines 2-7; page 8, line 1 - page 9, line 18; figure 2 *	1,6,7	

TECHNICAL FIELDS SEARCHED (Int. Cl.4)

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	26-11-1986	BIJN E.A.

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