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(71) Applicant: **Canadian Fram Limited**
540 Park Avenue East P.O. Box 2014
Chatham Ontario N7M 5M7(CA)

(72) Inventor: **Dejong, Allen W.**
34 English Sideroad
Chatham Ontario N7M 4417(CA)

(74) Representative: **Brullé, Jean et al,**
Service Brevets Bendix 44, rue François 1er
F-75008 Paris(FR)

(54) **Engine crankshaft pulley clutch.**

(57) A vehicle engine (10) carries a number of belt-driven accessories which are driven through a belt (16) and a clutch and pulley assembly (14) carried on the engine crankshaft (12). The assembly (14) includes an electromagnetic coil (56) which responds to an electrical signal to couple the pulley (36) for rotation with the crankshaft (12) when a signal is transmitted to the coil (56) and to otherwise permit the crankshaft (12) to turn relative to the pulley (36). A throttle position switch (82) intercepts the signal to the coil (56) when the throttle mechanism of the vehicle is moved to a predetermined position when the vehicle is accelerated to thereby disconnect the pulley (36) from the crankshaft (12) during vehicle accelerations. The coil (56) is also wired through the vehicle ignition switch (86) so that the pulley (36) is also disconnected from the crankshaft (12) when the vehicle is started.

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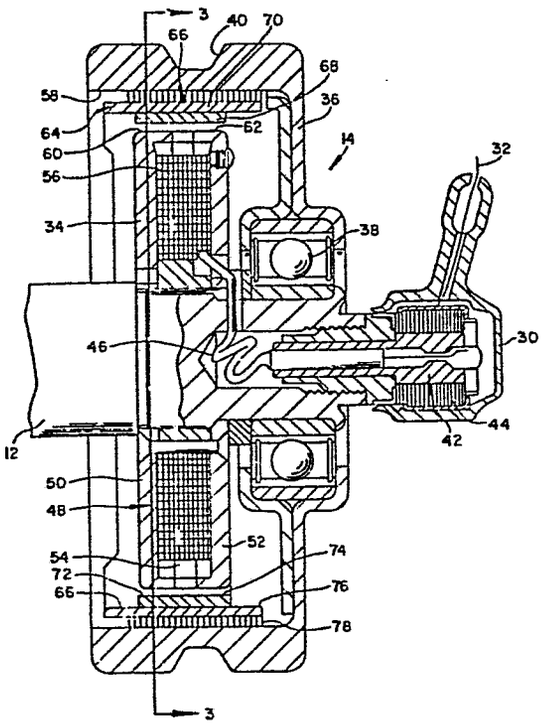
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FIG. 2

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ENGINE CRANKSHAFT PULLEY CLUTCH

This invention relates to an automobile in which the belt driven engine accessories are disconnected when the vehicle is cranked upon starting and when the vehicle is accelerated.

Because of fuel conservation considerations, vehicle engines have become progressively smaller and are expected to continue to do so in coming years. However, because of performance demands of vehicle opeators, power boost accessories (such as superchargers and turbochargers) are expected to be used with these smaller engines, since the smaller engines simply do not have the power to provide the necessary acceleration capabilities demanded by vehicle operators. Furthermore, small vehicle engines are made difficult to start because the necessary belt driven engine accessories, such as the alternator, power steering pump, air conditioning compressor, water pump, etc., represent a significant portion of the starting drag when the engine is started.

The present invention proposes that all of the belt driven engine accessories are disconnected when the vehicle engine is started or when the vehicle engine is accelerated, but are reconnected when the engine starts, when a vehicle acceleration is terminated, or after a predetermined time period has elapsed during a vehicle acceleration to prevent damage to the engine components during a long acceleration. In this way, the power robbing effects of the belt driven accessories are eliminated during an engine acceleration, thereby providing an increase in acceleration and power similar to that provided by supercharging or turbocharging, at a fraction of the cost. Furthermore, by disconnecting the engine belt driven accessories when the engine is started, a substantial reduction in starting drag is provided, thereby permitting use of smaller, and therefore lighter weight, batteries and less powerful starting motors. Accordingly, the device proposed by the present invention is associated with a motor vehicle having an engine, a starting motor for cranking the engine when the latter is started, a plurality of belt driven accessories driven by the engine which has a power output shaft, and drive belt means interconnecting the power output shaft with the accessories for providing a driving connection therebetween.

In U.S. Patent No. 2,999,574, a centrifugally responsive, mechanical clutch disconnects the engine accessories to prevent them from overspeeding or over-accelerating conditions. However, devices of this type are not anticipatory of accelerations but responsive to them, so that they cannot boost engine power. Instead of disconnecting the accessories at the beginning of an acceleration, they wait until an over-acceleration condition exists before disconnecting the accessories. Furthermore, the type of clutch shown in this patent does not disconnect the accessories when the engine is started. This invention avoids the drawbacks of the prior art, because the present invention proposes an electrically actuated clutch which is respnsive to vehicle engine throttle position. Accordingly, the present clutch disconnects the accessories during the lag time between the time the throttle is moved in a full accelerating position and the engine responds. In this way, the belt-driven accessories are disconnected before the engine and vehicle begin accelerating, removing the parasitic drag of the accessories and thereby boosting engine power. A control is also provided to provide an electrical signal disconnecting the clutch when the engine is cranked, thereby also removing the parasitic drag of the belt-driven engine accessories when the engine is started.

Accordingly, the present device is characterized in that an electrically actuated clutch is provided between the power output shaft of the engine and the drive belt means, and switch means for causing the electrically actuated clutch to disengage when the starter motor cranks the engine and when the engine is started, and also when the engine is accelerated.

The present invention has the advantage of disconnecting the belt-driven accessories when the vehicle throttle lever is moved to an accelerative position. Accordingly, the accessories are disconnected during the lag time between the time the vehicle throttle is moved into accelerated position and the engine responds, so that the parasitic drag of the belt-driven engine accessories is removed during the engine acceleration. Furthermore, starting of the engine is facilitated because the belt-driven accessories, which consume a substantial fraction of the total power of the starting motor when the engine is cranked, are

also disconnected when the engine is started. In this way, since the belt-driven accessories are disconnected during engine acceleration, an effect similar to providing a supercharger or turbocharger on the engine is achieved, but at a substantially lower cost. Furthermore, since a supercharger is a belt-driven engine accessory, use of the supercharger adds to the difficulty in starting the engine. The present invention facilitates engine starting. Also, a substantial weight reduction over a turbocharger or supercharger is provided by the present invention, since the supercharger and the turbocharger add weight to the vehicle engine, and any weight added by the clutch provided in the present invention is offset by reduction in the battery weight. Accordingly, a smaller engine may be used while obtaining performance similar to a larger engine, thereby providing substantial fuel savings.

Other features and advantages of the invention will appear with reference to the following description and the accompanying drawings, in which:

Figure 1 is a schematic illustration of the interconnection between the belt-driven accessories of a typical vehicle engine;

Figure 2 is a cross-sectional view taken substantially along lines 2-2 of Figure 1;

Figure 3 is a fragmentary cross-sectional view taken substantially along lines 3-3 of Figure 2; and

Figure 4 is a diagramatic illustration of the electrical interconnections used to control the electromechanical clutch illustrated in Figures 3 and 4.

Referring now to the drawings, Figure 1 illustrates schematically a typical vehicle engine generally indicated by the numeral 10. The engine 10 is typically a relatively small engine used on a relatively heavy vehicle such that a substantial percentage of the power output of the engine is necessary to accelerate the vehicle and the engine drag provided by the engine accessories represents a substantial proportion of the power available. Although the engine 10 is illustrated as a V-6 engine, the invention is perhaps even more applicable to smaller four-cylinder engines. The typical vehicle engine includes a crankshaft 12 which mounts a clutch and pulley assembly 14. A drive belt 16 interconnects the assembly 14 with a

pulley 18 driving the vehicle air pump; a pulley 20 which drives the vehicle air conditioning compressor; a pulley 22 which drives the vehicle alternator; a pulley 24 which drives the vehicle power steering pump, and a pulley 26 which drives the vehicle water pump and which also drives a shaft 28 to which the fan of the vehicle is secured. A slip ring assembly 30 and electrical lead 32 transmit an electrical signal actuating the clutch and pulley assembly 14.

Referring now to Figure 2, the clutch mechanism which couples and uncouples the crankshaft 12 and pulley 14 is disclosed in detail. The clutch mechanism is substantially similar to the clutch mechanism illustrated in my prior U.S. Patent No. 4,239,095, owned by the assignee of the present invention. The clutch and pulley assembly 14 includes a driving member 34 which is mounted for rotation with the crankshaft 12, so that the driving member 34 is rotated by operation of the engine. The clutch and pulley assembly 14 also includes a pulley 36 mounted for rotation relative to crankshaft 12 by bearing 38. The pulley 36 has a conventional V-groove 40 which receives the belt 16. The slip ring assembly 30 is carried on the outer end of the crankshaft 12 and includes a member 42 which is fixed for rotation with the crankshaft 12 and a slip member 44 which is mounted so that the member 42 can rotate relative to the member 44. Connecting wires 32, 46 extend from the members 42 and 44 respectively, so that an electrical connection is provided between the connecting wires 32 and 46 by the members 42 and 44 of the slip ring assembly 30. The connecting wires 32 and 46 are connected as illustrated in Figure 4, which will be described in detail hereinafter.

The driving member 34 also carries a circumferentially extending bracket 48 which is made of magnetic material and which is mounted for rotation with the driving member 39. The bracket 48 includes a pair of axially spaced, circumferentially extending pole piece portions 50, 52 which circumscribe the driving member 34 and which cooperate with one another to define a cavity 54 therebetween. An electromagnetic coil 56 is disposed in the cavity 54, and comprises windings which are wrapped circumferentially around the driving member 34. The coil 56 is connected to the connecting wire 46, so that when an electrical signal is transmitted

through the connecting wire 46, electrical current will be transmitted to the coil 56 by the connecting wire 46, the slip ring 30, and the connecting wire 32.

The pulley 36 includes an axially projecting, circumferentially extending surface 58 which circumscribes the pole piece portions 50 and 52. Surface 58 of the pulley 36 cooperates with the outer circumferential edges 60, 62 of the pole piece portions 50 and 52 to define a gap 64 therebetween. A circumferentially extending band 66 is disposed in the gap 64. The band 66 includes an inner band member 68 and an outer band member generally indicated by the numeral 70. The inner band member 68 is made from magnetic material, as are the pole pieces 50, 52, so that a magnetic circuit is defined consisting of pole piece portions 50, 52, and the inner band member 68. The outer peripheral portions 72, 74 of the radially inner edge of the inner band member 68 are adapted to engage the outer circumferential edges 60, 62 of the pole piece portions 50, 52 when the clutch is engaged. Accordingly, it will be noted that the inner band member 68 bridges the cavity 54 in which the magnetic coil 56 is housed. The outer band member 70 includes a strip of resilient, nonmagnetic material 76 and a corresponding strip of a frictional material 78 which is bonded to the outer circumferential surface of the strip 76. The strip of frictional material 78 may be of any conventional type well-known to those skilled in the art. Assuming rotation of the crankshaft 12 in the direction indicated by the arrow "A", the trailing ends 80 of the inner and outer band members are joined together, but the opposite ends are free to move radially in the gap 50 into and out of driving engagement with the driving member 34.

Referring now to Figure 4, the magnetic coil 56 is illustrated schematically and is connected through leads 46, 32 and slip ring 30 to one terminal of a conventional throttle position switch 82. The throttle position switch is normally closed, but opens when the vehicle throttle lever is moved to a predetermined position when the vehicle is accelerated. A timer 84 is connected to the switch 82 to close the switch 82 a predetermined time period after it is opened, so that the water pump will not be disconnected for a sufficiently long time period

to cause engine damage. The switch 82 is connected in series with the vehicle ignition switch 86. Ignition switch 86 is movable between "start" and "run" positions. When the ignition switch is moved to the "start" position for engine cranking, the circuit between the battery 88 and the coil 56 is intercepted.

In operation, during normal engine operation, bott of the switches 82, 86 are closed to thereby connect the coil 56 with the voltage source or battery 88. Accordingly, the clutch is engaged during normal operation of the vehicle. When the vehicle is started, the ignition switch is moved to the "start" position, the circuit between the battery 88 and the coil 56 is disconnected, thereby causing the clutch to disengage, as will be more fully described hereinafter. Accordingly, the crankshaft 12 is free to rotate relative to the pulley 36, so that all of the aforementioned belt-driven engine accessories are disconnected from the crankshaft when the engine is started, to thereby eliminate the power drag of the accessories when the engine is cranked. Similarly, when the engine is to be accelerated in excess of the predetermined rate and the throttle lever is therefore moved into a predetermined position, the switch 82 is opened to thereby again permit the crankshaft 12 to rotate relative to the pulley 36 so that the belt-driven engine accessories are also disconnected during engine accelerations, to improve vehicle performance by eliminating the power drag of the belt-driven accessories. The timer 84 closes switch 82 after a predetermined time period even if the throttle lever remains in a position which would otherwise cause the switch 82 to remain open. Since the engine may be damaged if some of the accessories, such as the water pump, remain turned off for too long a time period, the timer 84 is necessary to make sure the switch 82 is closed after a relatively brief time period.

Referring now to Figures 2 and 3 of the drawing, the operation of the clutch mechanism itself will be described. The various components of the clutch and pulley assembly 14 are illustrated in Figures 2 and 3 in the position they assume when the clutch is disengaged. In this condition, the driving member 34, of course, will be rotated by the crankshaft 12 when the engine is operating, but the pulley will not be

driven thereby. When switches 82 and 84 are both closed to connect tne coil 56 with the battery 88, the coil is energized to create magnetic flux in the magnetic circuit defined by the pole piece portions 50, 52 and the inner band member 68 to cause the latter to move radially, viewing Figures 2 and 3, in a direction toward the pole pieces 50, 52. Consequently, the outer peripheral portions 72, 74 of the inner edge of the inner band member 68 will be brought into engagement with the outer circumferential edges 60, 62 of the pole piece portions 50, 52.

Forces exerted on the inner band member 68 due to engagement of the latter with the driving member 34 are transmitted to the outer band member 70 through the connection 80. Because of the resiliency of the strip, the frictional material 78 is loaded against tne surface 58 with a predetrermined force. Because of the transmission of the forces between the inner and outer band memberrs 68 and 76, a servo action well-known to those skilled in the art occurs in which a relatively small actuating force is multiplied many times by the wrapping effect of the band members. Accordingly, the force with which the strip 78 is loaded against the surface 58 is a function of this servo multiplied actuation force. Since the force required to initiate slippage between the strip of friction material 78 and the surface 58 is a function of the speed of rotation of the clutch, the resiliency of the outer band member 70 and the coefficient of friction between the friction material 78 and surface 58, slippage will occur between the frictional material 78 and the surface 58 upon engagement of the clutch if transmitted torque levels are greater than a predetermined maximum. Accordingly, slippage does not occur between the inner band member 68 and the pole pieces 50, 52, thereby avoiding the premature wear of these components which might be caused by slippage between them.

Claims:

1. A method of operating a motor vehicle having an engine (10), said engine having a power output shaft (12), a starting motor for cranking the engine when the latter is started, and at least one belt-driven accessory (11, 20, 22, 24, 26) driven by said engine through drive belt means (16) interconnecting said power output shaft with said accessory comprising the steps of disconnecting said at least one accessory from said power output shaft when the engine is cranked and reconnecting said accessory when the engine starts.

2. The method of Claim 1, wherein the power output shaft is the engine crankshaft having a pulley rotatably mounted thereon for connection with the belt means which drives a plurality of such accessories and an electrically actuated clutch for coupling and uncoupling the pulley with the crankshaft and wherein the step of disconnecting and reconnecting includes electrically connecting and disconnecting the clutch from a source of electrical energy.

3. The method of Claim 2, further comprising the steps of disconnecting said at least one accessory from the power output shaft when the vehicle is accelerated in excess of a predetermined rate, and reconnecting said accessories when the acceleration of the vehicle drops below the predetermined rate or a predetermined time period has elapsed after the accessories are disconnected, whichever occurs first.

4. The method of Claim 2, wherein said vehicle includes a throttle mechanism controlling fuel flow to the engine, further comprising the steps of disconnecting said at least one accessory from the power output shaft (12) when the throttle mechanism is moved to a predetermined position and reconnecting said at least one accessory with said power output shaft when the throttle mechanism is moved away from said predetermined position or a predetermined time period has elapsed after the accessories are disconnected, whichever occurs first.

5. The method of Claim 4, wherein the power output shaft (12) is the engine crankshaft, said crankshaft having a pulley (14) rotatably mounted on said crankshaft and an electrically actuated clutch (14) for coupling and uncoupling the pulley (14) with the crankshaft (12), further comprising the steps of uncoupling the pulley from the crankshaft when the engine is cranked and when the throttle mechanism is moved to the predetermined position and coupling the pulley with the crankshaft after the engine starts and when the throttle mechanism is moved away from the predetermined position or after the predetermined time period has elapsed.

6. In a motor vehicle having an engine (10), a starting motor for cranking the engine when the latter is started, at least one belt-driven accessory (10) driven by said engine, said engine having a power output shaft (12), and drive belt means (82, 86) interconnecting the power output shaft with the accessory for providing a driving connection therebetween, characterized in that an electrically actuated clutch (14) is provided between the power output shaft (12) and the drive belt means (16), and switch means (82, 86) for causing said electrically actuated clutch to disengage when said starter motor cranks the engine when the latter is started, said switch means causing said electrically actuated clutch (14) to be engaged in response to vehicle operational parameters after the engine starts.

7. The motor vehicle as claimed in Claim 6 wherein a plurality of accessories are driven by said belt means.

8. The motor vehicle as claimed in Claim 10, wherein said engine (10) includes a throttle mechanism for controlling fuel flow to the engine, and position responsive means (82) responsive to movement of the throttle mechanism to a predetermined position when the vehicle is accelerated, further characterized in that said electrically actuated clutch (14) is responsive to said position responsive means (12) to disengage said clutch to remove the driving connection between the accessory (18) and the power output shaft (12) after the engine has been cranked and when the throttle mechanism (82) is moved to said predetermined position and to reconnect the driving connection between the accessories and the power output shaft when the throttle mechanism is moved away from the predetermined position.

9. The motor vehicle as claimed in Claim 6, further characterized in that it includes timing means (84) actuated by movement of said throttle mechanism to said predetermined position for causing said clutch to reestablish the driving connection between the accessory (18) and the power output shaft (12) a predetermined time period after the clutch is disengaged.

10. The motor vehicle as claimed in Claim 8, further characterized in that said power output shaft (12) is the engine crankshaft, said crankshaft having a clutch and pulley assembly (14) mounted thereon to provide a connection between the crankshaft and the drive belt means (16), said clutch coupling and uncoupling the crankshaft and the pulley.

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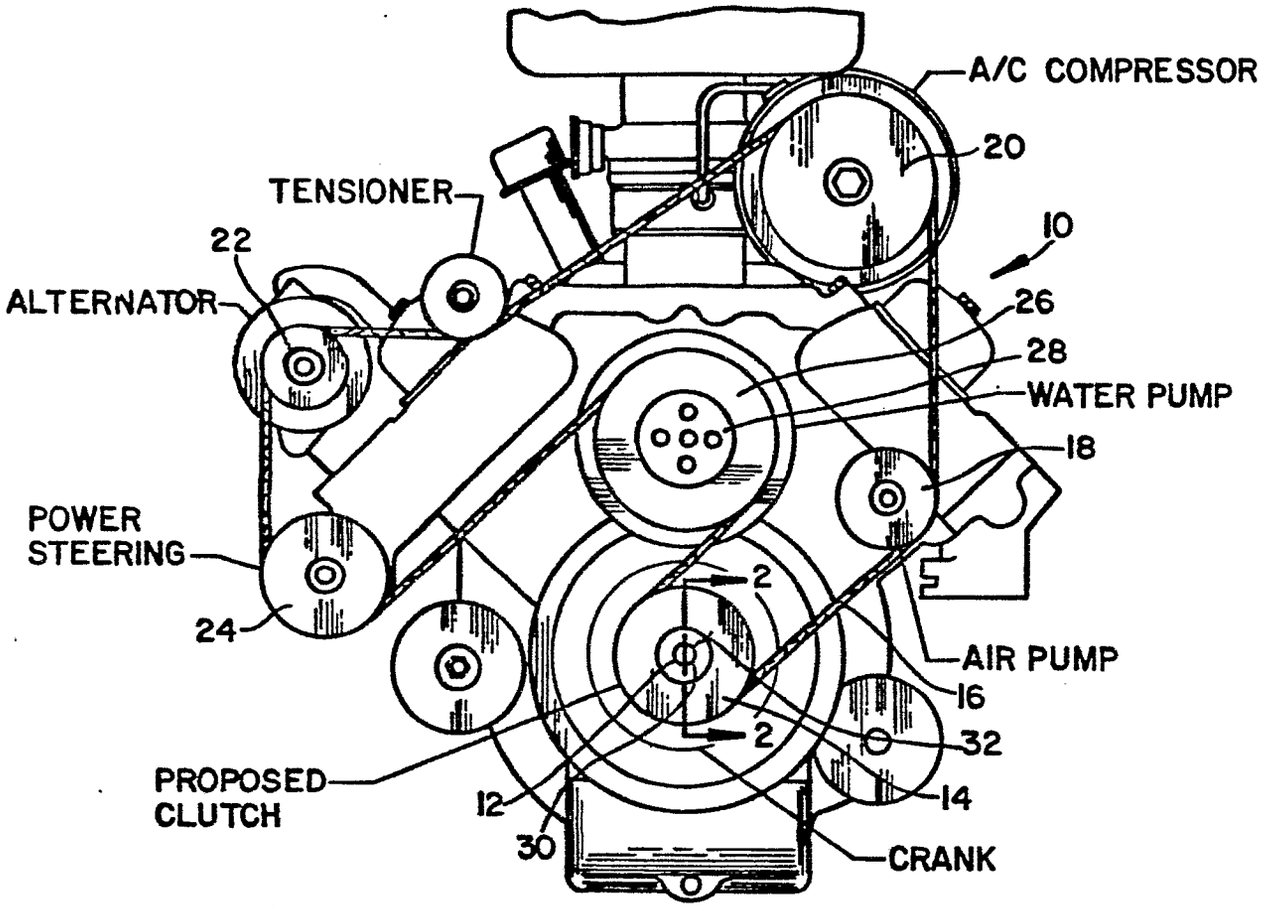

FIG. 1

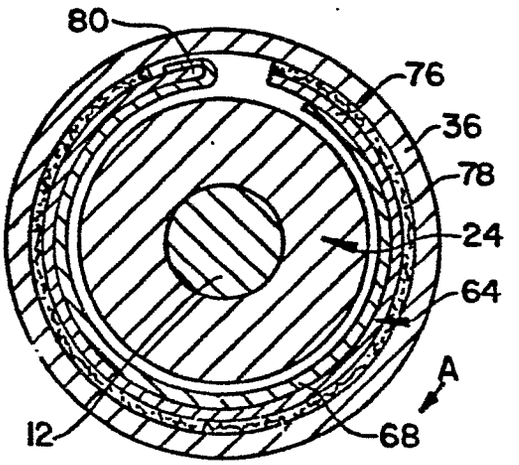

FIG. 3

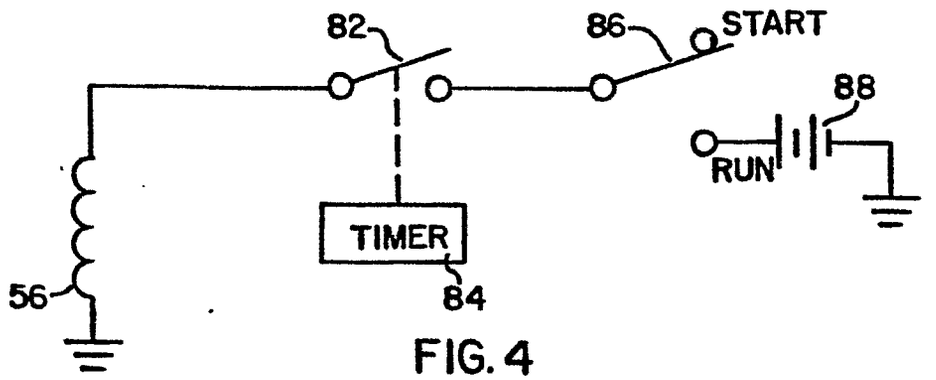

FIG. 4

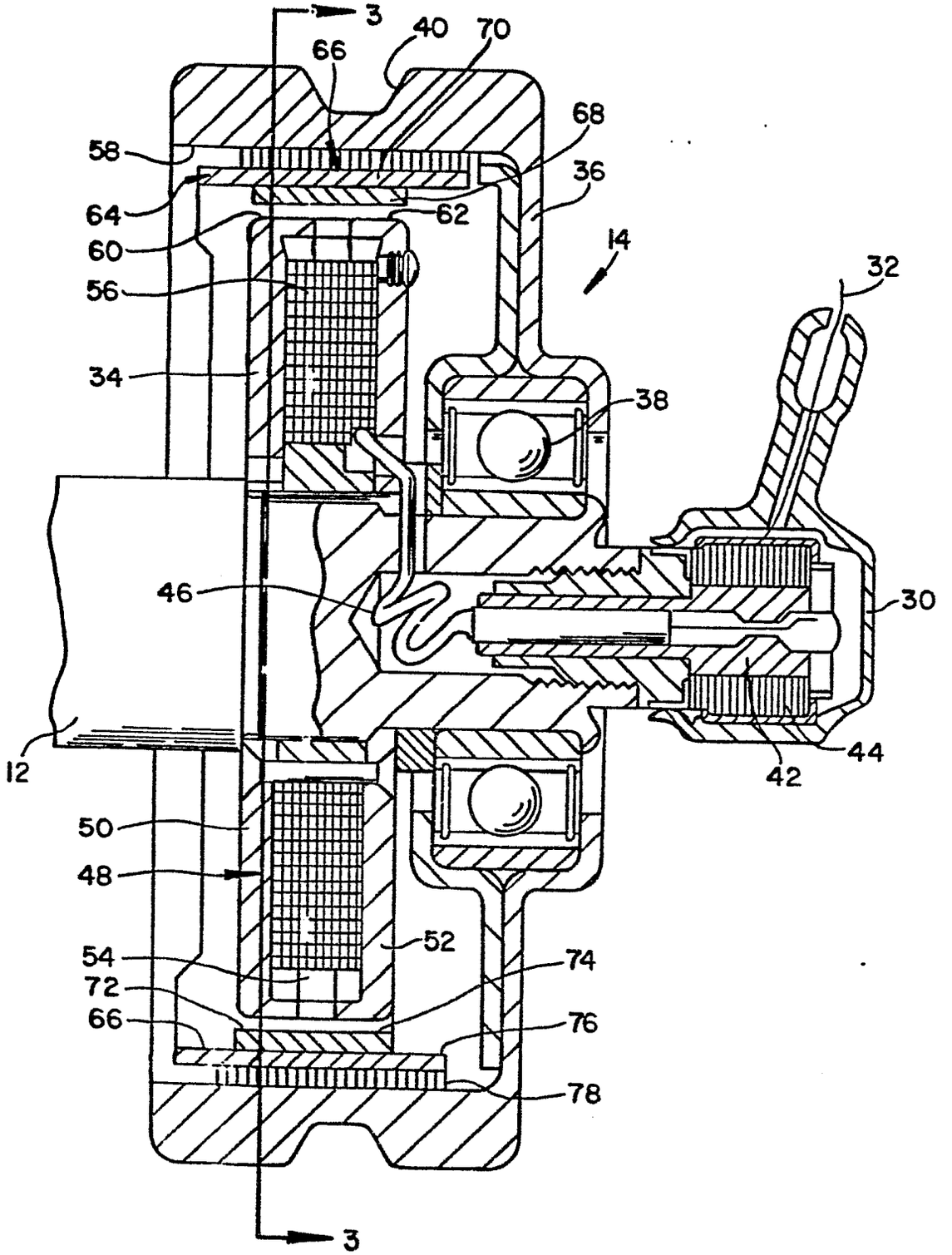
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FIG. 2

European Patent Office

EUROPEAN SEARCH REPORT

0136384
Application number

EP 83 40 1933

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 ³)
Y	FR-A-2 066 972 (DAIMLER-BENZ) * Page 2, line 30 - page 3, line 9; figures *	1,2,6, 10	F 02 N 17/08 F 02 B 67/06
A		5	

Y	GB-A-2 069 595 (BUTTERFIELD) * Page 2, lines 17-60, 102-109, figures 1-3 *	1,2,6, 7,10	
A	* Page 2, lines 61-86 *	3,5,8	

A	US-A-3 712 766 (JONES)		TECHNICAL FIELDS SEARCHED (Int. Cl. ³)
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The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	22-05-1984	BIJN E.A.

CATEGORY OF CITED DOCUMENTS

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