

Internal distribution code:

- (A) Publication in OJ
(B) To Chairmen and Members
(C) To Chairmen

D E C I S I O N
of 12 September 1996

Case Number: T 0889/95 - 3.2.1

Application Number: 90300193.1

Publication Number: 0378341

IPC: F16D 35/00

Language of the proceedings: EN

Title of invention:

Viscous fluid shear clutches and control valves therefor

Applicant:

KYSOR INDUSTRIAL CORPORATION

Opponent:

-

Headword:

-

Relevant legal provisions:

EPC Art. 56

Keyword:

"Inventive step (yes) "

Decisions cited:

-

Catchword:

-

Case Number: T 0889/95 - 3.2.1

D E C I S I O N
of the Technical Board of Appeal 3.2.1
of 12 September 1996

Appellant: KYSOR INDUSTRIAL CORPORATION
1 Madison Avenue
Cadillac
Michigan 49601 (US)

Representative: Newell, William Joseph
Wynne-Jones, Lainé & James
22 Rodney Road
Cheltenham
Gloucestershire GL50 1JJ (GB)

Decision under appeal: Decision of the Examining Division of the European Patent Office posted 2 June 1995 refusing European patent application No. 90 300 193.1 pursuant to Article 97(1) EPC.

Composition of the Board:

Chairman: F. J. Pröls
Members: P. Alting van Geusau
G. Davies

Summary of Facts and Submissions

I. European patent application No. 90 300 193.1 filed on 8 January 1990, claiming priority of 13 January 1989 and 11 April 1989 from earlier applications in Great Britain (GB 8900756 and GB 8908129) and published under the publication No. 0 378 341, was refused by a decision of the Examining Division dated 2 June 1995.

II. The ground for that decision was the non-compliance with the requirements of Article 56 EPC with regard to the combined teaching of the documents:

D1: EP-A-0 274 408 and

D2: EP-A-0 068 644

cited in the European search report.

More specifically, it was stated in the decision that D1 disclosed the precharacterising features of claim 1 under consideration and that the characterising features, which were in itself known from D2, were already hinted at in D1.

III. On 1 August 1995 a notice of appeal was lodged against this decision together with payment of the appeal fee. The statement of grounds of appeal was filed on 12 October 1995.

IV. In a communication dated 10 May 1996, the Board expressed doubt whether the subject-matter of claim 1 rejected by the Examining Division was inventive, in particular because the skilled person would not

appear to encounter any difficulties when incorporating a known mechanical speed control based on a centrifugal governor known from D2 instead of the hydraulic speed control of D1. As regards continuous modulation of the fan speed, attention was drawn to the document US-A-3 144 922 (D7) a further document cited in the European search report.

- V. Oral proceedings were held on 12 September 1996. At the oral proceedings the appellant filed new claims 1 to 15, with amended description pages 1 to 17 and figures 1 to 6. The appellant requested that the decision under appeal be set aside and that a patent be granted on the basis of these new application documents.

Claim 1 of the request reads as follows:

"1. A viscous fluid shear clutch comprising:
a rotary casing (14,15)
an inner clutch member (10) within the casing (14,15)
and spaced therefrom by a clearance gap,
a fluid reservoir (22) communicating with said
clearance gap,
pump means (25) arranged to pump fluid from the
clearance gap to the reservoir (22) in response to
relative rotation between the casing (14, 15) and the
inner clutch member (10),
valve means (32,34,36) arranged to control the flow
of fluid between the pump means (25) and the
clearance gap and including a movable control element
(36),
thermal sensor means including a remote sensor (66 et

sec) for sensing the temperature of a coolant fluid and a separate actuator (44) for applying to said movable control element (36) a temperature dependent force which acts upon said movable control element (36) and which is substantially invariant for a given temperature, and speed sensor means (40) for generating a speed dependent force which acts upon said movable control element (36), whereby an increase in the sensed temperature or a decrease in the sensed speed tends to cause the movable control member to be moved to adjust the valve means to increase the fluid in the clearance gap, characterised in that said speed sensor means including a mass means (40) pivotally mounted within the rotary casing (14, 15) for centrifugally generating a speed dependent force, and applying it to said control element (34), whereby said clutch provides substantially continuous modulation of the rotary speed of the casing in accordance with said sensed temperature."

VI. In support of its request, the appellant relied essentially on the following submissions:

The arrangement defined in claim 1 provided a viscous coupling with a variable degree of coupling so that the rotary speed of the casing driven by the inner clutch member was modulated in accordance with a sensed temperature in smooth and continuous manner. In a previous attempt to provide speed and temperature modulation which was based on a temperature dependent pressure force and a speed pressure force derived from a scoop pump, such as

disclosed in D1, a sudden "kick" or discontinuity near full coupling was encountered. The discontinuity compromised control stability and led to under- or over- cooling.

In the arrangement known from D2, the air temperature was sensed by a bimetallic strip and its displacement force interacted with a centrifugally loaded spring valve. Such an arrangement did not give continuous modulation either, mainly due to the fact that the force applied to the bi-metallic strip was not constant for a given temperature and, moreover, interacted with the spring valve member at the same time being used as support for the centrifugal governor weight. A combination of the arrangements disclosed in D1 and D2 was not suggested and anyhow did not lead to the claimed subject-matter.

The arrangement in accordance with D7 did not modulate the clutch on the basis of the speed and temperature but rather in this arrangement the centrifugal governor overrode the response of the thermally responsive member at high output speeds.

Therefore, since none of the relevant documents of the prior art disclosed or hinted at the combination of features of claim 1, the skilled person could not arrive at its subject-matter without the exercise of an inventive activity.

Reasons for the Decision

1. The appeal is admissible.

2. *Amendments*

2.1 Present claim 1 is essentially a combination of the originally filed claims 1 and 2 and includes the further features that:

- (a) the temperature dependent force is substantially invariant for a given temperature,
- (b) the mass means is pivotally mounted within the rotary casing for centrifugally generating the speed dependent force and applying it to the control element and
- (c) the clutch provides substantially continuous modulation of the rotary speed of the casing in accordance with the sensed temperature.

Feature (a) follows from the functioning of the thermo pressure valve arrangement controlling a hydraulic pressure signal and modulating the pressure substantially linearly with the sensed temperature (see in particular page 15, lines 18 to 20 of the originally filed description).

Feature (b) follows from Figures 1 and 4 and the original description on page 9, lines 8 to 16.

Feature (c) is supported by the original description on page 10, last paragraph.

- 2.2 Claim 1 is now the only independent claim and therefore the objections of non-unity of the subject-matter of further independent claims filed initially are overcome.
- 2.3 The dependent claims 2 to 13 are based on the subject-matter of the originally filed claims 3 to 6, 8 and 9. The subject-matter of present claim 14 is supported by the statements in the last paragraph on page 17 of the originally filed description. The teaching of claim 15 is supported by original claim 10 in connection with page 15, last paragraph and page 16 of the description as originally filed.
- 2.4 In conclusion, since the subject-matter of all the claims is supported by the originally-filed application documents no objections arise in respect of the requirements of Article 123(2) EPC.
- 2.5 The amendments to the description concern essentially an adaptation to the now-claimed subject-matter and a discussion of the prior art as required by Rule 27 EPC. These amendments give no rise to objections under the EPC either.

3. *Novelty*

- 3.1 Novelty of the subject-matter of claim 1 can be concluded for the reason that none of the documents cited in the European search report discloses a viscous fluid shear clutch with a combined speed and temperature control in which the speed dependent force is centrifugally generated with a mass that is

pivotaly mounted within the rotary casing and the temperature dependent force is generated to be substantially invariant for a given temperature whereby both the speed dependent force and temperature dependent force are applied to a movable control element for controlling the flow of fluid between the pump means and the clearance gap of the clutch to provide substantially continuous modulation of the rotary speed of the clutch in accordance with the sensed temperature.

In this respect the most relevant documents D1 and D2 cited in the European search report show a combined speed and temperature control based on a hydraulic speed sensing or bi-metal temperature sensing means, respectively.

4. *Inventive step*

- 4.1 The closest prior art is represented by D1, a patent document of the same inventor as the present application, and which prior art is acknowledged in the precharacterising part of present claim 1.

In the embodiment disclosed in relation to Figure 7 of this prior art document, modulation of a viscous fluid shear clutch is performed and based on hydraulic control signals representing the motor vehicle engine temperature and engine speed.

However, this known automatic thermal and speed control of the viscous fluid clutch proved unable to give a sufficient modulation across substantially the

whole operating temperature range. In accordance with the statements of the present inventor, this prior art device in particular showed a discontinuity (a "kick") when approaching the maximum fan speed and too much hysteresis when varying the engine speed.

4.2 It is therefore an object of the present application to improve the existing viscous shear clutch so that the above indicated drawbacks are eliminated (see page 1 of the application, last two paragraphs) and overall efficiency is ensured.

4.3 The above problem is solved by the features of present claim 1. In particular, by providing a speed sensor means including a mass pivotally mounted within the rotary casing for centrifugally generating a speed dependent force and applying it together with the temperature dependent force, which is substantially invariant for a given temperature, to the hydraulic valve means for controlling the flow of fluid between the pump means and the shear clutch clearance gap, a continuous modulation of the rotary speed of the casing in accordance with the sensed temperature and speed is achieved.

Furthermore, the balance of the temperature dependent force against a centrifugally generated speed dependent force provides reduced hysteresis when the sensed temperature falls, because the speed force varies as the square to the speed. Moreover, the fan speed versus coolant temperature characteristics can be predicted reasonably accurately because the temperature/force characteristic of the thermal

pressure valve and the speed/force characteristic of the speed sensor can be determined mathematically (see page 11, lines 1 to 11 of the description).

- 4.4 The use of a centrifugal governor for control of viscous fluid shear clutches is in itself known from EP-A-0 068 644 (D2) and US-A-3 144 922 (D7).

However, in both cases the centrifugal weight of the centrifugal governor is mounted on a spring member, which is not pivotally mounted within the rotary casing, and the temperature dependent force is applied to this spring member by a bimetal strip and, therefore, because of the interacting effects of the forces provided by the spring member and the bimetal strip, accurate modulation over the whole range of the fluid shear clutch speed control cannot be achieved.

These disclosures of the prior art documents do not lead the skilled person to the combination of features in accordance with the present claim 1 for the following reasons.

In D7 it is desired that an exponential relation between the fan speed or degree of coupling and air temperature occur only at a predetermined high input speed without disturbing the more linear fan speed-air temperature relationship at lower input speeds (see column 1, lines 58 to 63 and Figure 5) and thus in fact leads away from continuous modulation.

D2 indeed mentions modulation for achieving a stable change in fan speed as a function of cooling system requirements rather than an abrupt or rapid change (see D2 bottom of page 3) but essentially relies on the balancing of two spring forces in an arrangement whereby the temperature and centrifugal forces interact on the valve member, which itself is part of the spring mounting of the centrifugal weight. Such an arrangement leads to unwanted coupling of the control parameters so that an exact modulation of the clutch speed cannot be ensured over the whole working range of the fluid shear clutch.

- 4.5 It is to be noted that temperature sensing means providing a substantially invariant force for a given temperature are known from D1.

However, a replacement of the hydraulic speed sensing means by a centrifugal governor is not hinted at in this document either.

In particular, the arrangement disclosed in D1 relates to a further development of fluid shear clutch governor systems with improved speed sensing control and it is mentioned in D1 that speed governors based on a centrifugal speed governor will give slow and restricted response and may also cause undesirable speed fluctuations (see column 8, lines 56 to 59).

Although in view of the solution proposed in the present application clearly such statement cannot be considered valid for all centrifugal speed governor

systems, at least at the date of filing of the present application the skilled person, in the absence of information to the contrary, would be led to improve the existing hydraulic speed governor system of D1 in order to get better modulation rather than abandon the hydraulic speed governor and use a centrifugal speed governor for achieving this aim.

Furthermore, none of the centrifugal speed governor systems cited in the European search report shows a centrifugal speed governor including a mass which is pivotally mounted within the rotary casing. Also in this respect the skilled person would look in vain for a hint in the cited prior art both in regard to an expected improvement of the modulation by the use of a centrifugal governor or the use of a centrifugal governor mass which is pivotally mounted within the rotary casing.

4.6 In summary, in the Board's judgment, the proposed solution to the technical problem underlying the application in suit defined in the independent claim 1 is inventive and therefore this claim as well as its dependent claims 2 to 15 relating to particular embodiments of the invention in accordance with Rule 29(3) EPC can form the basis for grant of a patent.

5. The description and drawings are also in agreement with the requirements of the EPC and hence these documents are also suitable for grant of a patent.

Order

for these reasons it it decided that:

1. The decision under appeal is set aside.
2. The case is remitted to the first instance with the order to grant a patent with claims 1 to 15, description pages 1 to 17 and drawing pages 1/4 to 4/4 (Figures 1 to 6) as filed during the oral proceedings.

The Registrar:

The Chairman:

S. Fabiani

F. Pröls