

Publication in the Official Journal	Yes / No
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File Number: T 400/90 - 3.4.2
Application No.: 81 303 528.4
Publication No.: 0 045 646
Title of invention: Unitary electromagnetic flowmeter with sealed coils

Classification: G01F 1/58

D E C I S I O N
of 3 July 1991

Proprietor of the patent: Fischer & Porter Company

Opponent: 02 Danfoss A/S
03 Flowtec AG

Headword:

EPC Art. 87(1), 123(2), 56

Keyword: "right to priority (yes; prior document disclosing different invention)" - "additional subject-matter (no; feature unambiguously disclosed in application as filed)" - "inventive step (yes; after amendment)"

Headnote



Case Number : T 400/90 - 3.4.2

D E C I S I O N
of the Technical Board of Appeal 3.4.2
of 3 July 1991

Appellant :
(Proprietor of the patent)

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Decision under appeal :

Interlocutory decision of the Opposition Division
of the European Patent Office of 16 January 1990
posted on 23 April 1990 concerning maintenance of
European patent No. 0 045 646 in amended form.

Composition of the Board :

Chairman : C. Black
Members : M. Chomentowski
C.V. Payraudeau

Summary of Facts and Submissions

I. Appellant I is proprietor of European patent No. 0 045 646, which was granted on the basis of European patent application No. 81 303 528.4.

II. Appellants II and III filed an opposition against the European patent, in particular on the grounds that the subject-matter of the patent extended beyond the content of the application as filed, that the patent did not disclose the invention in a manner sufficiently clear and complete for it to be carried out by a person skilled in the art and that the subject-matter of the claims of the patent lacked novelty or an inventive step, respectively, having regard inter alia to the disclosure of

D13 = GB-A-2 059 066,

D4 = US-A-4 181 018,

D10 = US-A-3 824 856 and

D12 = GB-A-1 424 875,

whereby it was argued that, since the patent in dispute disclosed the same invention as the patent application

DA = US-A-075 037

of the same applicant which had been filed more than one year before the date of filing at the EPO, the patent in suit was not entitled to the priority claimed and D13 was therefore a prepublished prior art document.

III. The Opposition division decided to maintain the patent in amended form according to auxiliary request No. 2 of the proprietor.

IV. The appellants (proprietor and opponents) lodged appeals against this decision.

V. In the annex to the invitation to oral proceedings, which had been auxiliarily requested by all the parties, the Board expressed the provisional opinion that the patent in suit could be maintained in the same amended form as in the attacked decision, with the further amendment consisting of the word "flangeless" being introduced before "cylindrical housing" in Claim 1, line 6.

VI. During the oral proceedings appellant I requested that the patent in suit be maintained in the said amended form and appellant II and III requested that the patent be revoked.

VII. Claim 1 reads as follows:

"1. An electromagnetic flowmeter unit interposable between the end flanges of the upstream and downstream pipes (24, 25) of a line conducting a fluid whose flow rate is to be metered the end flanges (24A, 25A) of the pipes having a predetermined diameter and a circle of bolt holes, the said unit comprising:

(A) a flangeless cylindrical housing (12u, 12l) formed of ferromagnetic metal having an external diameter which is smaller than that of the circle of bolt holes whereby when the unit is interposed between the end flanges (24A, 25A) of the pipes, the housing lies within the circle and the flanges (24A, 25A) are bridged by bolts (26) passing through the holes to encage the unit and subject it to a compressive force effecting a fluid seal, the housing having annular closure plates (22, 23);

(B) a non-magnetic metal spool (10) coaxially disposed within said housing (12u, 12l) and provided

with end flanges (10A, 10B) which cooperate with the annular closure plates (22, 23) of the housing to define with said housing (12u, 12l) an enclosed internal cavity, said spool having an inner insulating liner (11) and forming a fluid conduit having a predetermined diameter and a longitudinal flow axis which joins the upstream and downstream pipes, the inner periphery of each annular closure plate (22, 23) of the housing mating with the outer periphery of an end flange (10A, 10B) of the spool (10), said spool having a strength sufficient to withstand the pressure of fluid flowing in the conduit and said compressive force;

(C) a pair of saddle-shaped electromagnet coils (15, 16) located in said cavity adjacent the inner surface of the housing and conforming to the curvature of the housing, the housing forming a return magnetic path for the coils, which coils are disposed at diametrically-opposed sides of said spool (10) to create a magnetic field whose lines of flux extend across the conduit, said coils (15, 16) lying on a coil axis (Y) which is normal to said flow axis Z; and

(D) a pair of electrodes mounted on said spool (10) within said cavity at diametrically-opposed positions (S1 S2) along an electrode axis (X) perpendicular both to the coil axis (Y) and to the flow axis (Z) whereby the fluid which flows through the conduit intersects said lines of flux to induce a signal in said electrodes which is a function of flow rate,

(E) the enclosed internal cavity being filled with a potting compound to seal said coils and said electrodes therein."

Claim 2 is a dependent claim.

VIII. Appellant I submitted the following arguments in support of his request.

Since the prior US application No. 75 035 (DA) discloses saddle-shaped coils only in relation to a commercialized device and not in relation to the related invention, the invention of the patent in suit differs from the invention of the prior application, which is thus not a first application for claiming priority. Therefore, the patent in suit claims rightly the priority of US patent application No. 174 609, and D13 is not a pre-published prior art document.

The flangeless housing, as generally understood in the relevant technique of flangeless flowmeters, is meant to be a housing wherein there is no flange projecting towards the exterior of the housing perpendicularly to the axis of the cylindrical housing; thus, bolts can bridge the end flanges of the pipes and encage the unit, whereby it is mainly the high-strength spool (10) which is submitted to the compressive force exerted by the bolts; the elements (22) and (23) which project towards the axis of the cylindrical housing, are mentioned as annular closure plates and are thus clearly distinguished from other elements which are mentioned as being flanges. Thus, this feature is unambiguously derivable from the whole application as filed. The flowmeter of Claim 1 is the result of a combination of features which interact to result in a device solving the problems of mechanical solidity and compactness of the magnetic components. Indeed, the isolated features are known but, when taking into account only the relevant prior art, i.e. the art of flangeless flowmeters, D4 and D12 do not provide the features of the claimed device. D10 does not pertain to this particular art and any combination of the features

of D10 with those of D4 and D12 would only be the result of an ex-post facto reasoning. Therefore, the subject-matter of Claim 1 in suit implies an inventive step.

IX. Appellants II and III submitted the following arguments in support of their requests.

It was contested that the US patent application No. 174 609, the priority of which has been claimed for the patent in suit, was a first application for claiming priority, since the prior US application No. 75 035 (DA) filed by the same applicant disclosed the same invention, comprising in particular saddle-shaped coils. Since the priority had not been validly claimed, D13 was a pre-published prior art document, and the subject-matter of Claim 1 lacked novelty. It was also argued that, in the application as filed, the cylindrical housing (12u, 121) was indeed not flangeless, as required by Claim 1, because said housing comprised at its ends the elements (22) and (23) which project towards the axis of the cylindrical housing and were thus "flanges" in the generally accepted meaning of the word; therefore, there was no basis in the application as filed for a flowmeter comprising a flangeless cylindrical housing.

It was further argued that all individual features of the claimed device were known per se. The combined structure of the flanges of the spool and of the annular closure plates of the housing and the specific mating of their respective peripheries claimed in Claim 1 did not provide any unexpected effect and could be derived in an obvious way from the structures of enclosed cavities disclosed in the prior art such as D4, D12 and D10. Therefore, the subject-matter of Claim 1 was not inventive.

Reasons for the Decision

1. The appeal is admissible.

2. Priority right

2.1 The Board considers it preferable to examine this question first since the state of the art opposable to the patent in suit depends on the valid date of the corresponding application. It was contested that the US patent application No. 174 609, the priority of which has been claimed for the patent in suit, was a first application within the meaning of Article 87(1) EPC, since there existed a prior US application No. 75 035 (DA) filed by the same applicant and granted under No. 4 253 340 (DD) which disclosed the same invention. The patent proprietor (Appellant 1) has not contested that all the features of the flowmeter which is the subject-matter of the patent in suit were already disclosed in DA except for the saddle form of the coils. Appellant 1 has also not contested that the saddle form was well known and currently used in this field.

2.1.1 However, the question to be answered is not whether it would have been obvious for the person skilled in the art knowing DA to substitute saddle-shaped coils for the disclosed electromagnets, but whether the use of such coils would be unambiguously derivable from DA. The text locations of DA (see page 3, lines 15-23) mentioning saddle-shaped coils relate directly to a commercially available electromagnetic flowmeter, but not to the invention presented therein. The only passages of DA relating to electromagnets mention only that thin coils may be preformed and, although it is indicated (last line of the description) that these electromagnets may be coreless, however this does not give any information

regarding their specific shape. The person skilled in the art could thus only derive from this specification that the electromagnets may have any desired form.

2.2 Therefore, the Board is of the opinion that the invention which is the subject-matter of the priority document of the patent in suit and which relates to a flowmeter having necessarily saddle-shaped coils is different, due to this special shape, from the invention of DA and that consequently the corresponding US patent application No. 174 609 was a first application in the sense of Article 87(1) EPC the priority of which has been validly claimed.

3. Allowability of the amendments

3.1 Claim 1 in suit differs from Claim 1 as granted. The added features are based on the disclosure of the invention in the description and Claims 2, 4, 5, 6 and 7 of the patent as granted. It is to be noted that dependent Claims 2, 4, 5, 6 and 7 as granted are all only dependent on Claim 1; therefore, combinations of features of a plurality of said dependent Claims with the main claim could result in a combination of features of a plurality of independent flowmeters, which combination was not protected by the patent as granted. However, there is only one embodiment of the invention in the description and drawings as granted (see column 4, lines 11-13), which includes said particular features of the dependent claims in combination with the features of the main claim. Therefore, the features of said dependent Claims as granted do not correspond to alternatives but only to particular features of the only embodiment of flowmeter disclosed in the patent as granted and covered by Claim 1 as granted. Therefore, the Board is satisfied that Claim 1 does not extend the protection conferred by the patent (Art. 123(3) EPC).

3.2 Claim 1 specifies that the cylindrical housing (12u, 12l) is flangeless. It was argued that, in the application as filed, the cylindrical housing (12u, 12l) was indeed not flangeless because said housing comprises at its ends the elements (22) and (23) which project towards the axis of the cylindrical housing and are thus "flanges" in the generally accepted meaning of the word; therefore, there was no basis in the application as filed for a flowmeter comprising a flangeless cylindrical housing.

3.2.1 It is to be noted that, in the application as filed (see page 5, line 21 - page 6, line 34; Claim 1; Fig. 2, 3 and 7), flanges are mentioned in relation to the pipes (24, 25) and to the spool (10); in both cases, the end flanges (24A, 25A) and (10A, 10B), respectively, are flanges which are projecting in a direction perpendicular to the axis of the cylindrical housing towards the exterior of said housing; the cylindrical housing is specified in the application as filed as having end plates (22, 23) mating with the flanges (10A, 10B) of the spool (10) to create an annular inner chamber between the spool and the housing. Moreover, the application as filed (see page 1, lines 2-9; see also page 7, lines 17-30; page 9, line 30 - page 10, line 2; Fig. 1-3 and 7) specifies that the invention relates to a flangeless flowmeter having a cylindrical housing and whose components may be readily installed in a flow line between the flanged ends of downstream and upstream pipes (24) and (25), whereby said end flanges (24A, 25A) have bolt holes therein to accommodate a set of bolts (26) which bridge the flanges and engage the unit. This is in accordance with the generally accepted meaning of the term "flangeless meter" (see for instance D4, column 2, lines 52-55). Thus, the Board is of the opinion that the application as filed distinguishes in an unambiguous way the flanges which project outwards and the annular closure plates which project towards the axis of the cylindrical housing.

3.2.2 The Board is therefore satisfied that, in the context of the application as filed, the flowmeter comprises indeed a flangeless housing and that, accordingly, Claim 1 in dispute is correctly based on the application as filed (Art. 123(2) EPC).

4. Clarity

The Board is satisfied that, since the meaning of the term "flangeless housing" is considered as being unambiguous in the context of the patent for the reasons mentioned in paragraphs 3.3 to 3.3.3 above, Claim 1 in suit is clear in the sense of Article 84 EPC.

5. Novelty

5.1 It is to be noted that D13 has been published after the date of priority claimed by the patent in suit. Thus, since the Board is of the opinion that said priority has been validly claimed, D13 is not a pre-published document according to Article 54(2) EPC.

5.2 An electromagnetic flowmeter unit is known from D4 (see column 4, line 5 - column 5, line 42; Fig. 1, 1A, 1B and 10), which is interposable between the end flanges of the upstream and downstream pipes (27, 28) of a line conducting a fluid whose flow rate is to be metered the end flanges (27A, 28A) of the pipes having a predetermined diameter and a circle of bolt holes, the said unit comprising:

(A) a flangeless cylindrical housing (10) formed of ferromagnetic metal (cold rolled steel) having an external diameter which is smaller than that of the circle of bolt holes whereby when the unit is interposed between the end flanges (27A, 28A) of the pipes, the housing lies within the circle of bolt holes and the

flanges (27A, 28A) are bridged by bolts (26) passing through the holes to engage the unit and subject it to a compressive force for effecting a fluid seal;

(B) a non-magnetic spool (13) coaxially disposed within said housing (10) and provided with end flanges (13A, 13B) which cooperate with the housing to define with said housing (10) an internal cavity, said spool forming a fluid conduit having a predetermined diameter and a longitudinal flow axis which joins the upstream and downstream pipes, said spool having a strength sufficient to withstand the pressure of fluid flowing in the conduit and said compressive force;

(C) a pair of electromagnet coils (11, 12) located in said cavity adjacent the inner surface of the housing, the housing forming a return magnetic path for the coils, which coils are disposed at diametrically-opposed sides of said spool (10) to create a magnetic field whose lines of flux extend across the conduit, said coils (11, 12) lying on a coil axis which is normal to said flow axis; and

(D) a pair of electrodes (17, 18) mounted on said spool (13) within said cavity at diametrically-opposed positions along an electrode axis perpendicular both to the coil axis and to the flow axis whereby the fluid which flows through the conduit intersects said lines of flux to induce a signal in said electrodes which is a function of flow rate, (E) the internal cavity being filled with a potting compound to seal said coils and said electrodes therein.

5.2.1 However, in the device of D4

- the housing has no annular closure plates;
- the non-magnetic spool is not of metal;

- said spool has no inner insulating liner;
- the two end flanges (13A, 13B) of the spool do not define with said housing an enclosed internal cavity;
- the coils are not saddle-shaped electromagnet coils and are not mentioned as conforming to the curvature of the housing.

5.3 An electromagnetic flowmeter unit is also known from D12 (see page 1, line 76 - page 2, line 56; page 2, line 122 - page 3, line 22; Claims 1-4 and 7-9; Fig. 1-3 and 7); said flowmeter is interposable between the end flanges (45, 46) of the upstream and downstream pipes of a line conducting a fluid whose flow rate is to be metered the end flanges (45, 46) of the pipes having a predetermined diameter and a circle of bolt holes, the said unit comprising a flangeless cylindrical housing (10, 26) formed of metal and a flanged non-magnetic spool (9) coaxially disposed within said housing (10, 26) and provided with end flanges (12, 13) which cooperate with the housing to define with said housing an enclosed internal cavity.

- 5.3.1 However, in the device known from D12,
- the metal of the flangeless cylindrical housing is not mentioned as being ferromagnetic;
 - the housing has no annular closure plates;
 - the non-magnetic spool is a not a metal spool;
 - the saddle-shaped electromagnet coils located in said cavity are not adjacent the inner surface of the housing and conforming to the curvature of the housing, the housing forming a return magnetic path for the coils;
 - the enclosed internal cavity is not filled with a potting compound to seal said coils and said electrodes therein.

5.4 Except for documents technically equivalent to D4 and which are thus not considered as being more relevant, D4 and D12 are the only two prior art documents disclosing flangeless electromagnetic flowmeter units as defined in the patent in suit. Therefore, the other prior art documents are considered as even less relevant.

5.5 Therefore, the Board is of the opinion that the subject-matter of Claim 1 is novel in the sense of Article 54 EPC.

6. Inventive step

6.1 D12 does not disclose the feature that the housing is of a ferromagnetic metal and thus, the Board is of the opinion that it differs more from the subject-matter of Claim 1 in suit than does D4. Therefore, D4 is considered as the nearest prior art document.

6.2 The Board is of the opinion that, since in the device of Fig.1, 1A, 1B and 10 of D4,

- the housing has no annular closure plates,
- the non-magnetic spool is not of metal,
- the spool does not comprise end flanges which cooperate with the annular closure plates of the housing to define with said housing an enclosed internal cavity, and
- the inner periphery of each annular closure plate of the housing is not mating with the outer periphery of an end flange of the spool,

the mechanical solidity of the device, which is to be clamped between bolted elements, can be considered as a first problem (see column 6, lines 6-10 of the patent in suit).

6.2.1 Moreover, the Board is of the opinion that, since in the device of Fig. 1, 1A, 1B and 10 of D4,

- the coils are not saddle-shaped electromagnet coils, and
- said coils do not conform to the curvature of the housing,

said device has the further drawback that it necessitates voluminous electromagnets when used for flow conduits having large diameters, as mentioned in the patent in suit (see column 2, line 51 - column 3, line 35).

6.3 The Board is of the opinion that the device having the structure of Claim 1 solves both problems thanks to the materials and shapes of the elements forming the enclosed cavity which are mechanically solid and because of the shape and location of the saddle-shaped coils which allow the use of compact electromagnets which conform to the curvature of the housing.

6.4 The prior art discloses some of the distinguishing features mentioned in paragraphs 6.2 and 6.2.1 above, but only as isolated features of flowmeters.

6.4.1 For instance, D4 (see Fig. 1A-1B) discloses the use of flanges (13B, 13C) on the spool (13) which reach the housing (10) forming a closed structure on one side of the device; however, on the other side of the device, the flange (13A) does not reach the housing (10). Although Fig.3A of D4 (see also column 5, line 58 - column 6, line 14) discloses another embodiment wherein both sides of the device have spool flanges (29A, 29B) of the same size, said embodiment does not comprise any ferromagnetic metal housing. Moreover, even if one were to consider that the part (13C) on the first side of the device of Fig. 1 is an annular closure plate, said annular closure

plate would not be an annular closure plate in the sense of Claim 1 since it is not made of ferromagnetic metal whereas, when the claimed housing should be formed of ferromagnetic metal, then the claimed housing having annular closure plates should also be made of such a metal.

- 6.4.2 Since D12 does not disclose a flowmeter wherein the cylindrical housing has annular closure plates, a combination of the teachings of D4 and D12 would not result in the device of present Claim 1.
- 6.4.3 D10 (see column 1, line 58 - column 2, line 16; column 2, line 32 - column 3, line 35; Fig. 1-3) discloses an electromagnetic flowmeter unit which is interposable between the end flanges (19) of the upstream and downstream pipes (20) of a line conducting a fluid whose flow rate is to be metered the end flanges (19) of the pipes having a predetermined diameter and a circle of bolt holes; however:
- the flowmeter cannot be considered as being a flangeless flowmeter or as comprising a flangeless housing in the sense of the patent in suit because the cylindrical casing (16) is welded to two mounting flanges (17, 18) which surround the ends of the flow tube (10);
 - the unit is not engaged by bridging bolts, but the mounting flanges (17, 18) of the case (16) are bolted to the complementary flanges (19, for instance) of the inlet and outlet pipes (20 for instance); and
 - the flow tube (10) is mentioned as being a thin wall element which does not need to have a strength sufficient to withstand the pressure of fluid flowing in the conduit since the high-pressure characteristics of the flowmeter are imparted by the thick-wall, high-strength cylindrical casing (16).

6.4.3.1 Since D10 is not concerned with a flangeless flowmeter, it includes specific corresponding structural features. For instance, the fluid-tightness of the flowmeter of D10 (see column 3, lines 2-9) results from the liner flange (15A) (which is a part of the liner (15) of the flow tube (10)) being pressed between the flange of the tube (20) and the mounting flange (17), a supplementary annular gasket (21) being also interposed and pressed therebetween; no pressure is exerted on the flow tube (10) to maintain it between the inlet and outlet pipes. Thus, in the opinion of the Board, D10 cannot be directly combined with D4 or D12 because D10 is not concerned with a flangeless flowmeter.

6.4.3.2 Appellants II and III have argued that the structure of the flowmeter claimed in Claim 1 was only an obvious combination of the different structural features known from the prior art and did not provide any surprising effect. However, since the housings and spools or the flow tubes disclosed in D4, D12 and D10 are made of different materials having respective different magnetic and/or mechanical properties, a selection of specific features in each of the known devices would be necessary to arrive at such a combined structure. The Board is of the opinion that, since no obvious reason which would incite the person skilled in the art to select and combine the features of the known devices in this way could be detected, such a combination would be the result of an ex-post facto reasoning. Moreover, even if, for any reason, the person skilled in the art could be incited to combine the teachings of D10 and D4 and/or D12, this would not result in the subject-matter of Claim 1 because none of these prior art documents discloses the specific feature of a flowmeter wherein the inner periphery of each annular closure plate of the cylindrical housing is mating with the outer periphery of an end flange of the spool for forming an enclosed internal cavity.

6.4.4 In the opinion of the Board, appellant I credibly argued that the flowmeter of Claim 1 is the result of a combination of features which interact to result in a device solving the problems of mechanical solidity and compactness of the magnetic components. Since this combination does not result in an obvious way from the prior art, the Board is of the opinion that the subject-matter of Claim 1 of the patent in suit implies an inventive step in the sense of Article 56 EPC.

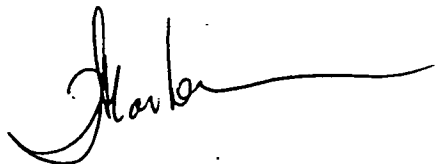
6.5 Thus, taking into consideration the amendments made by the proprietor of the patent, the patent and the invention to which it relates meet the requirements of the Convention and the patent as amended may be maintained (Art. 102(3) EPC).

Order

For these reasons, it is decided that:

1. The decision under appeal is set aside.
2. The case is remitted to the first instance with the order to maintain the patent in the form as maintained by the opposition division with the introduction of the word "flangeless" before "cylindrical housing" in Claim 1 (feature A).

The Registrar



P. Martorana



The Chairman



C. Black