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D E C I S I O N
of 24 September 2001

Case Number: T 1155/00 - 3.2.3

Application Number: 96945614.4

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IPC: B05B 7/20

Language of the proceedings: EN

Title of invention:

Labyrinth gas feed apparatus and method for a detonation gun

Applicant:

Aerostar Coatings, S.L.

Opponent:

-

Headword:

-

Relevant legal provisions:

EPC Art. 56

Keyword:

"Inventive step (yes - after amendment)"

Decisions cited:

-

Catchword:

-



Case Number: T 1155/00 - 3.2.3

D E C I S I O N
of the Technical Board of Appeal 3.2.3
of 24 September 2001

Appellant:
(Applicant)

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Representative:

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Decision under appeal:

Decision of the Examining Division 2.3.07.085 of
the European Patent Office dated 11 August 2000
refusing European patent application
No. 96 945 614.4 pursuant to Article 97(1) EPC.

Composition of the Board:

Chairman: C. T. Wilson
Members: F. Brösamle
J.-P. Seitz

Summary of Facts and Submissions

I. With decision of 11 August 2000 the examining division refused European patent application No. 96 945 614.4 in the light of

(D2) GB-A-2 099 332 and

(D3) FR-A-2 274 365.

II. Against the above decision the applicant - appellant in the following - lodged an appeal on 10 October 2000 paying the fee and filing the statement of grounds of appeal on the same day together with new claims 1 to 8 (reference signs being introduced with letter of 21 February 2001, received on 28 February 2001).

III. The independent claims thereof read as follows:

"1. A gas detonation apparatus utilizing energy from a detonation wave front for applying powdered coatings in a downstream direction to a work piece, the gas detonation apparatus having a fuel and oxygen supply (16, 17), an ignition source (14), a means for supplying powder, and a barrel (13), the apparatus further comprising:

a combustion chamber (12) positioned upstream of the barrel (13) and communicating with the ignition source; and

in sidewalls of the combustion chamber (12) there is located at least one labyrinth (30) for communicating, through a mixing chamber (25), directly with the fuel and oxygen supplies (16, 17), the walls of the labyrinth (30) defining a tortuous gas path for the purpose of destroying detonation cells diffracted

from the detonation wave front."

"3. A gas detonation apparatus utilizing energy from a detonation wave front for applying powdered coatings in a downstream direction to a work piece, the gas detonation apparatus having a fuel and oxygen supply (16, 17), an ignition source (14), a means for delivering powder, and a barrel (13), the apparatus further comprising:

a combustion-chamber (12) positioned between the ignition source (14) and the barrel (13), and supplied, through a mixing chamber (25), directly with a combustible mixture of fuel and oxygen provided by the fuel and oxygen supplies (16, 17);

the combustion chamber (12) comprising at least two concentric cylinders in concentric contact with one another; and

the cylinders (70, 69, 26) having a plurality of apertures (72, 71, 28) in selective registry with one another and located in sidewalls (27) of the combustion chamber (12) for providing communication between the combustion chamber (12) and the fuel and oxygen supply (16, 17)."

"8. A method preventing backfire in a gas detonation apparatus utilizing energy from a detonation wave front, the detonation wave front having detonation cells for applying powdered coatings in a downstream direction to a work piece, the gas detonation apparatus having a fuel and oxygen supply (16, 17), an ignition source (14), a combustion chamber (12), a labyrinth (30) having walls which define a tortuous path within the walls of the combustion chamber (12) and communicating directly, through a mixing chamber (25), with the fuel and oxygen supply (16, 17), a means for

delivering powder, and a barrel (13), the method comprising:

producing a detonation wave front within the combustion chamber;

permitting a portion of the detonation wave front to enter the tortuous path; and

colliding the portion of the detonation wave front with the walls of the tortuous path and thereby destroying the detonation cells and preventing backfire into the fuel and oxygen supply (16, 17)."

IV. The appellant requested:

- (a) by implication to set aside the impugned decision and
- (b) to grant the patent on the basis of claims 1 to 8 filed with the statement of grounds of appeal and a revised description filed with letter of....

V. His arguments essentially can be summarised as follows:

- (D2) includes valves which open to fill the combustion chamber and close in each firing cycle before firing with the spark-plug so that the firing frequencies are limited;
- contrary to (D2) the claimed subject-matter is based on valves which open once only during the entire operating period and it is the labyrinth which acts to prevent backfiring and not an additional safety device "3" and a duct "15" outside the detonation gun as in (D2);
- (D2), moreover, uses an inert gas to prevent

backfiring so that again the firing frequencies are limited to less than 10 Hz compared with 100 Hz in the claimed detonation gun;

- (D3) is based again on valves and on an inert gas acting as a barrier to prevent backfiring;
- contrary to the findings of the examining division the holes "11" are a flame distributor or multiplier since the explosion takes place inside the chamber "10" whereby the holes "11" serve for the explosion flame to pass to the chamber "1'" and do not prevent backfiring because the explosion takes place behind the holes;
- the safety device in (D3) is again arranged outside the detonation gun and its safety duct "7" and its non-return valve "8" are different from the claimed labyrinth defining a tortuous path for destroying detonation cells;
- according to both documents (D2) and (D3) gasses are fed discontinuously resulting in low firing frequencies; since in the claimed invention no inert gas is used between two combustible gas volumes feeding is not discontinued until the entire part coating process is over; with the assistance of the claimed labyrinth the continuous feed is changed into a cyclic feed inside the combustion chamber allowing firing frequencies in excess of 100 Hz.

Reasons for the Decision

1. The appeal is admissible.

2. *Amendments (Article 123(2) EPC)*

2.1 Claim 1 contains all features of originally filed claim 1 plus features directly derivable from originally filed Figures 1 to 3B and their corresponding description, namely a labyrinth in the sidewalls of the combustion chamber.

The features of claim 2 are derivable from originally filed claim 2 and from originally filed page 6, lines 20 to 24.

2.2 Claim 3 is based on the features of originally filed claim 3 and Figure 1, namely the supply of fuel, and oxygen directly to a mixing chamber and to a combustion chamber. Claims 4 to 7 correspond to originally filed claims 4 to 7.

2.3 Claim 8 contains all features of originally filed claim 8 plus the feature of a labyrinth provided in the walls of the combustion chamber again derivable from originally filed Figures 1 to 3B and their corresponding description.

2.4 Summarising, claims 1 to 8 are not open to an objection under Article 123(2) EPC.

3. *Clarity (Article 84 EPC)*

By rewording the independent claims 1 and 3 the appellant has overcome the objections raised in the impugned decision in this respect, since it is now clear **where** and **how** the "labyrinth" is provided for

even if in claim 3 the word "labyrinth" is not used.

4. *Novelty*

4.1 (D2) and (D3) do not disclose a "labyrinth" or a "tortuous gas path" arranged in the sidewalls of the combustion chamber within the meaning of claims 1, 3 and 8 since they rely on other types of safety installations, namely on a **separate** installation comprising a lattice "14", a diaphragm "16" of porous refractory material and a coil "15" downstream thereof according to (D2), see Figure 1 and page 1, line 127 to page 2, line 4, or rely on a security tube "7" in wound form and a non-return valve "8" again arranged outside the detonation gun according to (D3), see Figure 1 and page 6, lines 6 to 10.

4.2 Novelty not being disputed in the impugned decision or by the board it is not necessary to deal with this issue in more detail.

5. *Prior art*

5.1 The relevant prior art in form of (D2) and (D3) is based on valves which after opening to fill the combustion chamber with a mixture of fuel and oxygen are closed **in each firing cycle** before firing is started with the spark-plug. The valves under discussion according to (D2) have the reference signs "9 to 12" in its Figures 1, 2 and 5, 6 and according to (D3) have the reference signs "23 to 25" according to Figure 1 of (D3); it has to be added that by these valves an inert gas for purging purposes can be switched on/off either to prevent backfiring or to separate combustible gas volumes of subsequent cycles.

Switching the above valves limits the firing frequencies to less than 10 Hz as set out by the appellant.

5.2 In (D2) and (D3) backfiring is in addition made impossible by **additional** safety installations each **arranged outside** the detonation gun, see (D2) and its safety installation "3" shown in Figure 1 thereof and already dealt with in above remark 4.1, or see Figure 1 of (D3) and its safety device "7,8" again dealt with in above remark 4.1.

5.3 For the following reasons the board is not in agreement with the interpretation of (D3) in the impugned decision:

Prima facie (D3) discloses holes "11,11" arranged in the walls of the combustion chamber. What is important in respect of the function of these holes "11,11" best shown in Figure 3 of (D3) is the place **where** the spark-plug is arranged, namely **upstream** of the holes and being in complete contrast to the subject-matter of claims 1, 3 and 8. The detonation gun of (D3) has the following function: in a mixing chamber "9" a mixture of fuel is created, fed to an annular pre-chamber "10'", in which the spark-plug "21" is arranged and ignites the combustible mixture of fuel and oxygen which escapes through the holes "11,11" radially inwardly to a combustion chamber "1'", see particularly page 7, lines 1 to 3, and page 9, lines 7 to 13, of (D3), in which the function of this arrangement of components is described *inter alia* with the words "de créer un allumage-flambeau" (to be translated as "to form an ignition torch"), namely that the detonation

spreads **downstream** into an inner chamber "1'" and barrel "20". With this arrangement the aspect of avoiding backfiring by a "labyrinth in the form of holes/of a tortuous path" is not envisaged and is technically not possible since in (D3) the holes are arranged downstream of the chamber in which the spark-plug ignites the combustible mixture **to protect the spark-plug** from the access of coating-powder, see page 9, lines 11 to 15 of (D3), making it clear that the flow of gasses is **downstream**.

6. *Problem to be solved*

Starting from the prior art (D2) or (D3) the object to be solved by the invention appears to be to overcome the restrictions of valves in combination with a detonation gun while maintaining the function of avoiding backfiring of the detonation gun in use.

7. *Solution and inventive step*

- 7.1 The above problem to be solved basically is achieved according to claims 1, 3 and 8 in that the safety installation is incorporated into the detonation gun and is arranged in the walls of the combustion-chamber either by a labyrinth (claims 1 and 8) or by a plurality of apertures in selective registry arranged in cylinder walls (claim 3) whereby these structural elements are arranged just upstream of the barrel "13", i.e. compared with the prior art in an extreme downstream position. Since valves switching between every detonation cycle are not used in the claimed invention backfiring is a real problem in a detonation apparatus according to claims 1, 3 and 8; this problem is, however solved by the "labyrinth/arrangement of

apertures" which prevent backfiring by destroying any detonation cells penetrating them - without any need of switching valves.

- 7.2 The cycle frequencies can therefore be raised in excess of 100 Hz compared to 10 Hz as in an installation according to a detonation gun using switching valves for **every** cycle.

It has to be added that the subject-matter of claims 1, 3 and 8 - in contrast to (D2/D3) - allows to **continuously** feed the combustion gasses since the detonation apparatus is not based on the use of an inert gas between two combustible gas volumes and since the claimed apparatus itself with the assistance of the claimed labyrinth/plurality of apertures in the right place converts the **continuous gas feed** into a **cyclic feed** inside the combustion chamber.

- 7.3 Summarising, claims 1, 3 and 8 define a gas detonation apparatus/method preventing backfiring in a gas detonation apparatus which is not rendered obvious by (D2/D3) taken singly or in combination since a completely different technical concept is followed not only for avoiding backfiring but also for the coating process as such by completely overcoming the restrictions in use of valves in combination with a coating process based on detonation gasses.

- 7.4 The subject-matter of claims 1, 3 and 8 meets therefore the requirements of Article 56 EPC so that these claims are allowable and can form the bases for grant of a patent.

- 7.5 Claims 2 and 4 to 7 refer to embodiments of the

independent claims 1 and 3 and are likewise allowable.

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 grant a patent on the basis of:

Claims: 1 to 8 submitted on 10 September 2001.

Description: pages 1 to 28 submitted on 10 September 2001.

Drawings: sheets 1/6 to 6/6 as originally filed.

The Registrar:

The Chairman:

A. Counillon

C. T. Wilson