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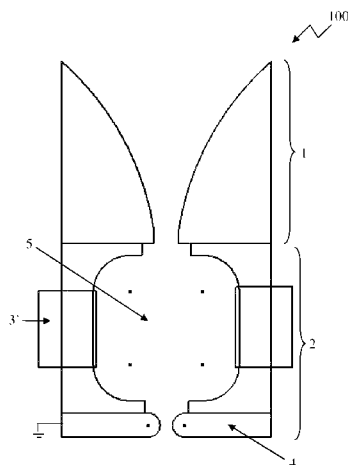
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(54) **Title:** AN ELECTROSTATIC INTERMINGLING DEVICE AND A PROCESS FOR INTERMINGLING FILAMENTS

Figure 1



(57) **Abstract:** The present disclosure relates to an electrostatic intermingling device and a process for intermingling filaments. The filaments are intermingled to produce a yarn. The electrostatic intermingling device comprises a funnel, an expansion tube, a plurality of slits, a plurality of electrodes, and an electrically grounded disc. The plurality of slits are configured on the periphery of the expansion tube to receive a plurality of electrodes. The funnel is adapted to statically charge the filaments passing therethrough. The polarity of the plurality of electrodes is selectively altered to modify the spatial configuration of the statically charged filaments, so as to intermingle the statically charged filaments and obtain intermingled charged filaments. The electrically grounded disc is adapted to receive and neutralize the intermingled charged filaments. The electrostatic intermingling device and the process of the present disclosure are economical.

AN ELECTROSTATIC INTERMINGLING DEVICE AND A PROCESS FOR INTERMINGLING FILAMENTS

FIELD

The present disclosure relates to the field of textile engineering. Particularly, the present disclosure relates to an electrostatic intermingling device and a process for intermingling filaments.

BACKGROUND

5 During the melt spinning of polymer filaments, a melt-spinnable polymer is melted and is extruded through a plurality of fine nozzle orifices configured on a spinneret plate, thereby producing a number of melt strands or fine filaments, which are then solidified by cooling in an air stream, and are wound on bobbins at a winding section. These fine filaments do not possess the necessary cohesive force because of the parallel arrangement of the fine
10 filaments. Moreover, the parallel arrangement of the fine filaments creates difficulties during winding, unwinding, and fabric forming processes.

Hence, in order to overcome the afore-stated problems, the fine filaments are intermingled during spinning. Particularly, the intermingling of the fine filaments increases the cohesive force between the fine filaments by changing the spatial arrangement of the fine filaments,
15 thereby forming a single bundle of yarns.

A conventional intermingling nozzle is a block of metal in which two holes or channels are drilled to meet at right angles. A first channel of the block facilitates the passage of the polymer filaments therethrough and a second channel of the block which meets the first channel at right angle facilitates the passage of air therethrough. The perpendicular injection
20 of the air facilitates in intermingling of the polymer filaments. Moreover, it is necessary to inject pressurized air through the second channel for intermingling the polymer filaments, thereby increasing the operating cost of the entire process.

There is, therefore, felt a need for an alternative for intermingling the polymer filaments and obviate the above mentioned drawback.

25

OBJECTS

Some of the objects of the present disclosure, which at least one embodiment herein satisfies, are as follows.

5 It is an object of the present disclosure to ameliorate one or more problems of the prior art or to at least provide a useful alternative.

An object of the present disclosure is to provide a device for intermingling polymer filaments.

Another object of the present disclosure is to provide a process for intermingling polymer filaments.

10 Yet another object of the present disclosure is to provide a device and a process for intermingling polymer that are economical.

Other objects and advantages of the present disclosure will be more apparent from the following description, which is not intended to limit the scope of the present disclosure.

SUMMARY

15 The present disclosure relates to an electrostatic intermingling device for intermingling filaments. The electrostatic intermingling device comprises a funnel, an expansion tube, a plurality of slits, a plurality of electrodes, and an electrically grounded disc.

The funnel can be adapted to statically charge the filaments passing therethrough.

20 The funnel can be made of at least one material, selected from the triboelectric series, having a positive charge.

The funnel can be a glass funnel.

The expansion tube can be adapted to receive and allow the passage of the statically charged filaments therethrough.

The expansion tube can be detachably attached to an operative lower portion of the funnel.

The plurality of slits can be configured on the periphery of the expansion tube to receive the plurality of electrodes.

The polarity of the plurality of electrodes can be selectively altered to modify the spatial configuration of the statically charged filaments, thereby intermingling the statically charged
5 filaments to obtain intermingled charged filaments.

The electrically grounded disc can be adapted to receive and neutralize the intermingled charged filaments.

The electrically grounded disc can be detachably attached to the expansion tube.

An opening can be configured on the electrically grounded disc, so as to allow the passage of
10 the intermingled charged filaments therethrough.

Each of the plurality of electrodes can be electrically coupled to a high voltage generator.

The high voltage generator can be in data communication with a microcontroller.

The present disclosure also relates to a process for intermingling filaments, which is carried out in the steps described herein below.

15 In the first step, the filaments are allowed to pass through the funnel and rub against a wall of the funnel to obtain statically charged filaments.

In the second step, the statically charged filaments are allowed to pass through the expansion tube.

In the third step, the polarity of the plurality of electrodes received in the plurality of slits is
20 selectively altered so as to modify the spatial configuration of the statically charged filaments and intermingle the statically charged filaments to obtain intermingled charged filaments.

In the fourth step, the intermingled charged filaments are neutralized, by allowing the intermingled charged filaments to pass through the electrically grounded disc, to obtain neutralized intermingled filaments.

25

BRIEF DESCRIPTION OF THE ACCOMPANYING DRAWING

An electrostatic intermingling device and a process for intermingling filaments will now be described with the help of the accompanying drawing, in which:

Figure 1 illustrates a partial sectional view of an electrostatic intermingling device in accordance with the present disclosure;

Figure 2a illustrates a front view of the electrostatic intermingling device of **Figure 1**;

Figure 2b illustrates a half-cut view of the electrostatic intermingling device of **Figure 1**;

Figures 3a and **3b** illustrate an assembled view of the electrostatic intermingling device of **Figure 1**;

Figure 4 illustrates a schematic view of the electrostatic intermingling device of **Figure 1**; and

Figures 5a, 5b and **5c** illustrate a sectional view of statically charged filaments in the electrostatic intermingling device of **Figure 1**.

Table illustrates various components of the electrostatic intermingling device that are represented by the following reference numerals:

Components	Reference numeral
Electrostatic intermingling device	100
Funnel	1
Expansion tube	2
Plurality of slits	3
Plurality of electrodes	3'
Electrically grounded disc	4
Bulge	5
Opening	O
High voltage generator	V
Microcontroller	M

DETAILED DESCRIPTION

As described herein above, two holes or channels are drilled on a block of metal of a conventional intermingling nozzle such that the channels meet at right angles. A first channel

of the block facilitates the passage of the polymer filaments therethrough and a second channel of the block facilitates the passage of air therethrough. The injection of air in a direction perpendicular to the polymer filaments facilitates in intermingling of the polymer filaments. In order to intermingle the polymer filaments efficiently, it is necessary to inject
5 pressurized air through the second channel. However, increasing the pressure of air is a capital-intensive process, due to which the operating cost of the entire process for intermingling the polymer filaments is increased.

The present disclosure, therefore, envisages an electrostatic intermingling device and a process for intermingling filaments, so as to obviate the above mentioned drawback.

10 In accordance with one aspect of the present disclosure, the electrostatic intermingling device (100) is illustrated in figures 1, 2a, 2b, 3a, 3b, and 4. The electrostatic intermingling device (100) comprises a funnel (1), an expansion tube (2) that can be detachably attached to an operative lower portion of the funnel (1), a plurality of slits (3) that can be configured on the periphery of the expansion tube (2), a plurality of electrodes (3') that are received in the
15 plurality of slits (3), and an electrically grounded disc (4) that can be detachably attached to the expansion tube (2) and can have an opening (O) configured thereon.

The funnel (1) can be made of at least one material, selected from the triboelectric series, having a positive charge.

In accordance with one embodiment of the present disclosure, the funnel (1) can be a glass
20 funnel.

The plurality of electrodes (3') can be electrically coupled to a high voltage generator (V).

The high voltage generator (V) can be in data communication with a microcontroller (M).

In accordance with an exemplary embodiment of the present disclosure, 6 to 18 slits can be configured on the periphery of the expansion tube (2).

25 In accordance with another aspect of the present disclosure, the process for intermingling the filaments in the electrostatic intermingling device (100) is described herein below.

In the first step, the filaments to be intermingled are allowed to pass through the funnel (1) and rub against a wall of the funnel (1) to obtain statically charged filaments. Particularly, the

filaments gain electrons while rubbing against the wall of the funnel (1) to become statically charged (negatively charged).

The material of the filaments can be made of a polyester.

In accordance with one embodiment of the present disclosure, the polyester can be
5 polyethylene terephthalate (PET).

In accordance with another embodiment of the present disclosure, nylon, polypropylene (PP), or any polymer that can attain electrostatic charge (positive or negative) upon rubbing against a wall of the funnel (1) can be used.

The static charge on the filaments can be controlled by varying the:

- 10
- length of the funnel (1); and
 - contact time of the filaments with the wall of the funnel (1).

In the second step, the statically charged filaments are allowed to pass through the expansion tube (2). The statically charged filaments carry the same charge; therefore, they tend to repel each other, thereby resulting in the separation of the statically charged filaments in the
15 expansion tube (2).

Further, the inner profile of the expansion tube (2) has a bulge (5) in such a way that, after the separation of the statically charged filaments, the statically charged filaments do not touch an inner surface of the expansion tube (2).

In the third step, the polarity of the plurality of electrodes (a to f) (as shown in figure 4)
20 received in the plurality of slits (3) is selectively altered by the high voltage generator (V) to modify the spatial configuration of the statically charged filaments, thereby intermingling the statically charged filaments to obtain intermingled charged filaments.

The polarity and its duration can be controlled electronically by a microprocessor or the microcontroller (M).

25 In accordance with the present disclosure, the modification in the spatial configuration of the statically charged filaments is illustrated with reference to figures 5a, 5b, and 5c.

The original spatial configuration of the statically charged filaments (l-r) before selectively changing the polarity is shown in figure 5a.

The electrodes are momentarily activated at a high voltage using the high voltage generator (V) such that the statically charged filaments (l and p) are influenced by the electric field of the plurality of electrodes (3'). Due to this, the statically charged filament (l) is repelled by the negative charge on the electrode and the statically charged filament (p) is attracted by the positive charge on the electrode, thereby altering the original spatial configuration of the statically charged filaments (l-r) (as shown in figure 5b).

Particularly, due to the influence of the electric field, the positions of the statically charged filaments (l and r) are swapped, thereby resulting in the intermingling of the statically charged filaments (l-r) to obtain intermingled charged filaments (as shown in figure 5c).

In the fourth step, the intermingled charged filaments are neutralized by allowing the intermingled charged filaments to pass through the opening (O) that is configured on the electrically grounded disc (4), so as to retain the modified spatial configuration of the intermingled charged filaments and obtain neutralized intermingled filaments.

The intermingling of the statically charged filaments to produce a yarn can be controlled by the:

- tension of the filaments entering the funnel (1);
- static charge on the filaments;
- number of electrodes (3');
- voltage applied across the electrodes (3');
- polarity of the electrodes (3'); and
- frequency of changing the polarity of electrodes (3').

The operating cost for intermingling the statically charged filaments using the electrostatic intermingling device and the process of the present disclosure to produce a yarn is comparatively less than the conventional process and conventional devices for intermingling the filaments.

TECHNICAL ADVANCES AND ECONOMICAL SIGNIFICANCE

The present disclosure described herein above has several technical advantages including, but not limited to, the realization of an electrostatic intermingling device and a process that:

- intermingles the filaments efficiently; and
- 5 • are economical.

The disclosure has been described with reference to the accompanying embodiments which do not limit the scope and ambit of the disclosure. The description provided is purely by way of example and illustration.

The embodiments herein and the various features and advantageous details thereof are
10 explained with reference to the non-limiting embodiments in the following description. Descriptions of well-known components and processing techniques are omitted so as to not unnecessarily obscure the embodiments herein.

The foregoing description of the specific embodiments so fully revealed the general nature of the embodiments herein that others can, by applying current knowledge, readily modify
15 and/or adapt for various applications such specific embodiments without departing from the generic concept, and, therefore, such adaptations and modifications should and are intended to be comprehended within the meaning and range of equivalents of the disclosed embodiments. It is to be understood that the phraseology or terminology employed herein is for the purpose of description and not of limitation. Therefore, while the embodiments herein
20 have been described in terms of preferred embodiments, those skilled in the art will recognize that the embodiments herein can be practiced with modification within the spirit and scope of the embodiments as described herein.

Claims:

1. An electrostatic intermingling device (100) for intermingling filaments, said electrostatic intermingling device (100) comprising:
 - a) a funnel (1) adapted to statically charge the filaments passing therethrough;
 - 5 b) an expansion tube (2) adapted to receive and allow the passage of said statically charged filaments therethrough, said expansion tube (2) is detachably attached to an operative lower portion of said funnel (1) and has a plurality of slits (3) configured on the periphery thereof to receive a plurality of electrodes (3'),

10 wherein, the polarity of said plurality of electrodes (3') is selectively altered to modify the spatial configuration of said statically charged filaments, thereby intermingling said statically charged filaments to obtain intermingled charged filaments; and
 - 15 c) an electrically grounded disc (4) adapted to receive and neutralize said intermingled charged filaments, said electrically grounded disc (4) is detachably attached to said expansion tube (2) and is having an opening (O) configured thereon, to allow the passage of said intermingled charged filaments therethrough.
2. The electrostatic intermingling device as claimed in claim 1, wherein each of said plurality of electrodes (3') is electrically coupled to a high voltage generator (V).
- 20 3. The electrostatic intermingling device as claimed in claim 2, wherein said high voltage generator is in data communication with a microcontroller (M).
4. The electrostatic intermingling device as claimed in claim 1, wherein said funnel (1) is made of at least one material, selected from the triboelectric series, having a positive charge.
- 25 5. The electrostatic intermingling device as claimed in claim 1 or claim 4, wherein said funnel (1) is a glass funnel.

6. A process for intermingling filaments in said electrostatic intermingling device as claimed in any of the preceding claims 1 to 5, said process comprising the following steps:

- 5 i. allowing said filaments to pass through said funnel (1) and rub against a wall of said funnel (1) to obtain statically charged filaments;
- ii. allowing said statically charged filaments to pass through said expansion tube (2);
- 10 iii. selectively altering the polarity of said plurality of electrodes (3') received in said plurality of slits (3) to modify the spatial configuration of said statically charged filaments, thereby intermingling said statically charged filaments to obtain intermingled charged filaments; and
- iv. neutralizing said intermingled charged filaments, by allowing said intermingled charged filaments to pass through said electrically grounded disc (4), to obtain neutralized intermingled filaments.

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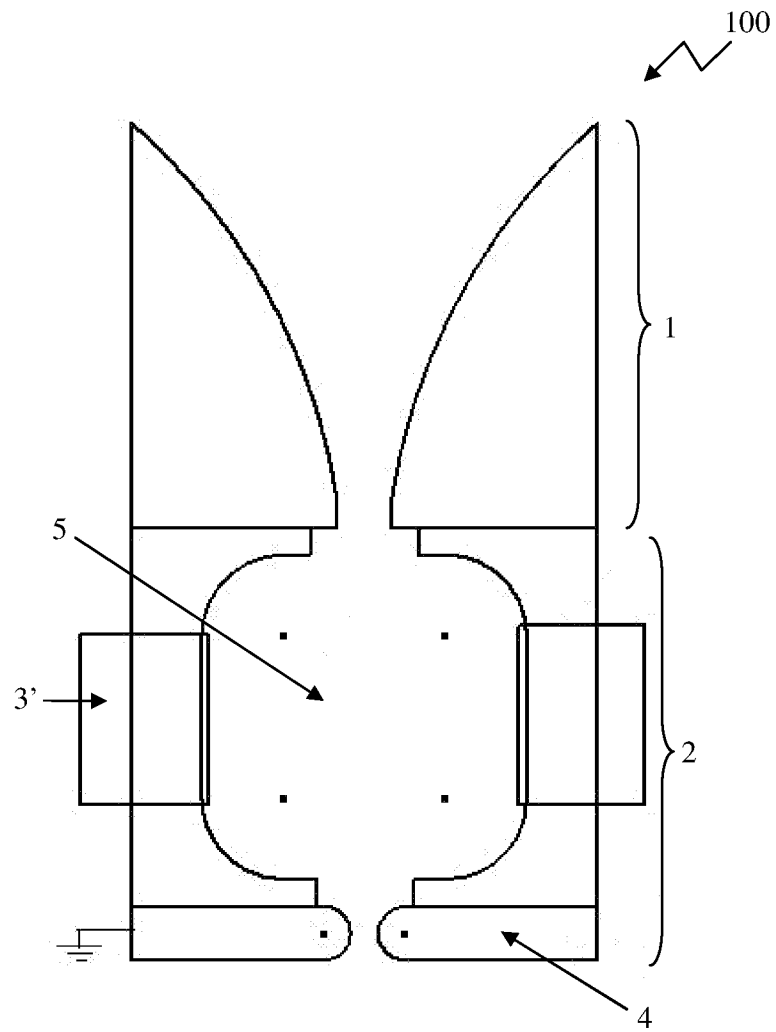


Figure 1

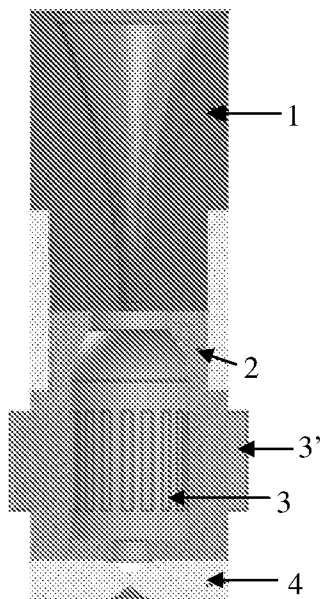


Figure 2a

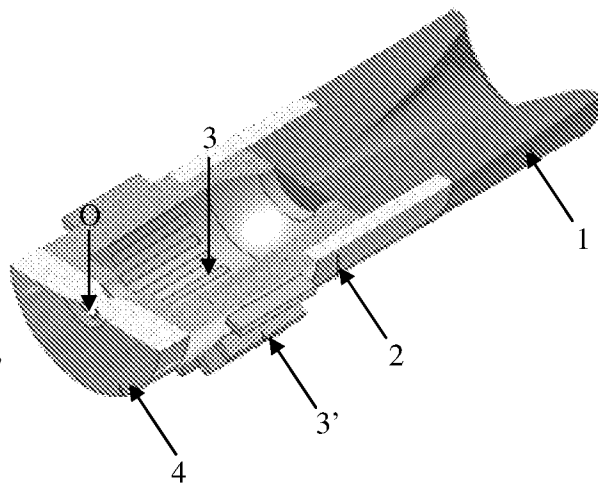


Figure 2b

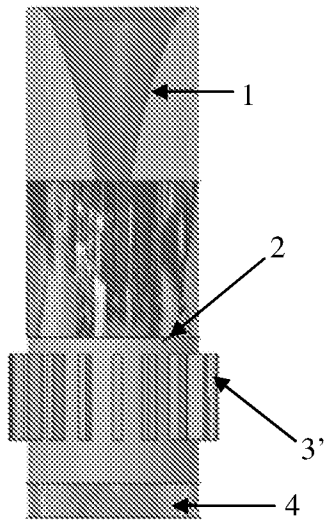


Figure 3a

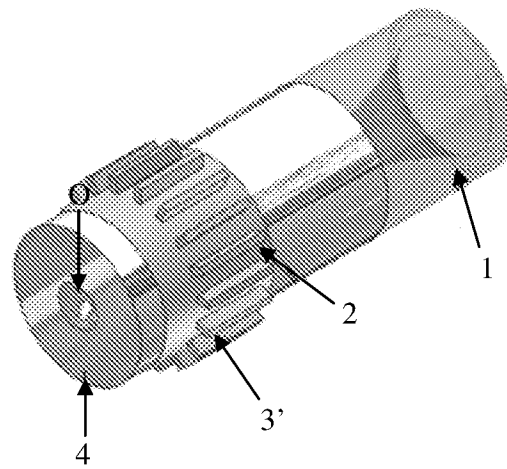


Figure 3b

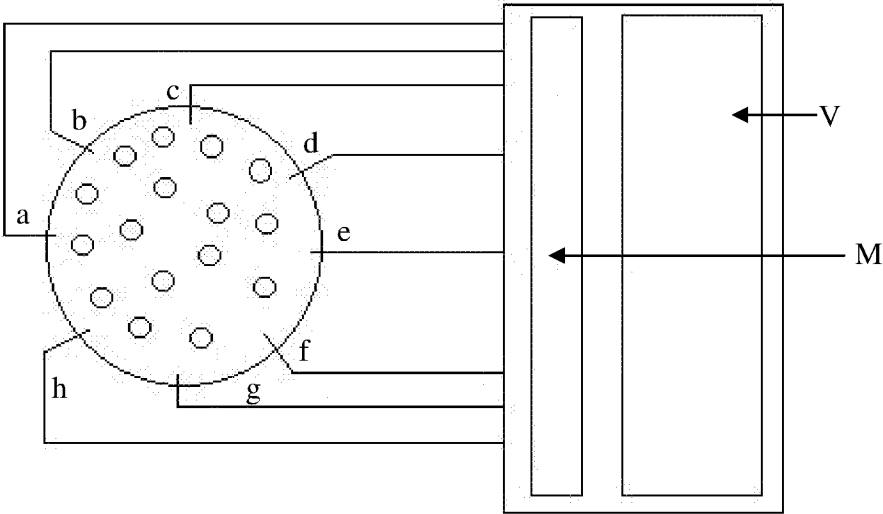


Figure 4

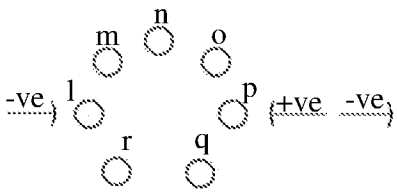


Figure 5a

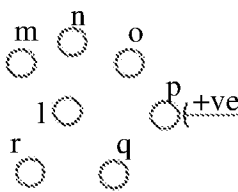


Figure 5b

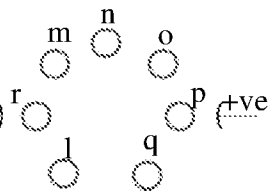


Figure 5c

INTERNATIONAL SEARCH REPORT

International application No.
PCT/IB2016/053430

A. CLASSIFICATION OF SUBJECT MATTER
D01D10/00, D01D5/22 Version=2016.01

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

D01D

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

Patseer, IPO Internal Database

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	GB1164921A (DUPONT CO) September 24, 1969. Abstract; claim 1 and 5-7.	1-6
Y	EP1887121 B1 (KIMBERLY-CLARK WORLDWIDE, INC.) October 20, 2010. Abstract; Para [0026]-[0036]; figure 1.	1-6
Y	DE602004009019D1 (KIMBERLY-CLARK WORLDWIDE, INC.) October 31, 2007. Abstract; Para [0028]-[0041]; Figure-2A.	1-6
Y	US4009508A (MONSANTO CO) March 01, 1977. Abstract; column 3-5, figure 2 and 5.	1-6
Y	US3319309A (DUPONT CO) May 16, 1967. Abstract; Figure-1.	1-6

☐ Further documents are listed in the continuation of Box C. ☒ See patent family annex.

* Special categories of cited documents:	"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
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Date of the actual completion of the international search
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INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/IB2016/053430

Citation	Pub.Date	Family	Pub.Date
GB 1164921 A	24-09-1969	DE 1669514 A1	18-03-1971
		NL 6707530 A	01-12-1967
EP 1887121 B1	20-10-2010	DE 602004029726 D1	02-12-2010
US 4009508 A	01-03-1977	JP 1031440 C	29-01-1981
		FR 2309655 B1	25-07-1980
		CA 1058691 A	17-07-1979
		DE 2618743 B2	13-06-1979
		US 40818856 A	28-03-1978
		GB 1503282 A	08-03-1978
		LU 74851 A1	08-02-1977