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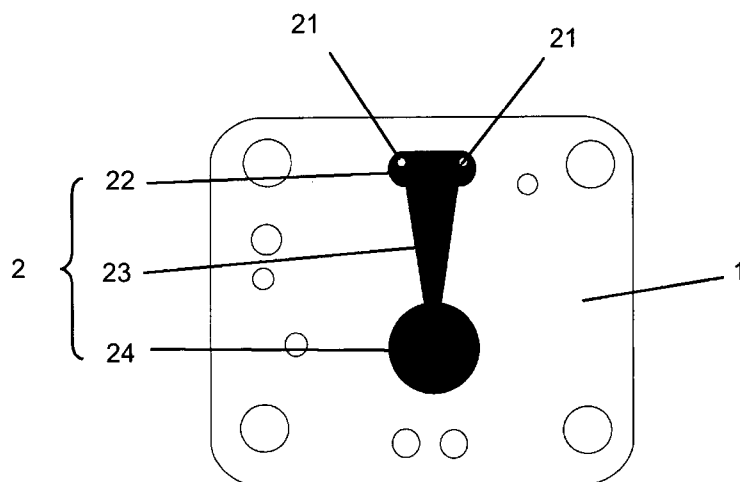
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(54) Title: VALVE SYSTEM FOR HIGH FREQUENCY COMPRESSORS



(PRIOR ART)
FIG. 1

(57) Abstract: Valve system for reciprocating compressors that operate at high frequency, especially at values greater than 200 Hz, comprises: a cylinder joint (3); a suction plate (4) containing at least one suction valve (42) with circular end (43) pertaining to the suction plate (4); a plate (5) comprising at least one suction hole (51) and at least one discharge hole (52); at least one discharge valve (6) comprising a blade with at least an orthogonal extension (63) having a circular end (64); and at least one discharge stop (7) cooperating with the discharge valve (6), the stop (7) comprising a lower profile part provided with at least one counterbore (72) limiting the movement of the end (64) of the discharge valve (6).

"VALVE SYSTEM FOR HIGH FREQUENCY COMPRESSORS".

Field of the Invention

The present invention relates to a valve system for compressors, more specifically for reciprocating compressors that operate at high frequency - especially at values greater than 200 Hz.

Background of the Invention

As is known in the art, compressors are devices that, in general, increase the pressure of a gas by reducing its volume by applying a mechanical force that, in case of reciprocating compressors, is usually accomplished by a piston within a cylinder. In order to carry out the control of gas flow, such devices use the vane - type valves, which open and close according to pressure differential between the cylinder and the suction or discharge chamber of the equipment.

However, it happens that the known compressors are typically operate at frequencies ranging from around 50 to 60 Hertz and the valves of the current state of the art are typically geometrically and dimensionally designed to operate at this frequency range, and it is not known valves suitable for operating at very high frequencies.

The valve systems in documents US 2001/0017162 and BR PI9202785 are examples of the current state of the art, since they have suction and discharge valves having very similar geometries, which are defined by substantially elongated vanes that are fixed to the respective plates by a single fastening region - what makes those parts to be extremely vulnerable to damage and any disruption because of the increase in the intensity of the working forces inherent in high frequency operations.

Document US 7390176 also describes a suction valve having an elongated shape - more specifically having a "Y" geometry -which provides support on the end of the valve on the base plate, which is a construction which could further cause more wear of both parts in the high frequency operations, in addition to incurring the already mentioned problems concerning stress resistances. An analogous construction is also provided in document CN 201202617 that, besides not mentioning the possibility of being uses at high frequency operation conditions, also provides that the end of the valves remain supported on the base plate.

It is noticed, therefore, that the present state of the art lacks a valve system specifically designed for the use in compressors that operate at high frequencies, which provides geometric, structural and dimensional solutions suitable to resist to working stresses under those conditions.

Objects of the Invention

Therefore, it is one of the objectives of the present invention to provide a valve system specifically designed for the use with compressors operating at high frequency, which

can be used, including in compressors whose frequencies exceed the value of 200 Hz.

Another among the objects of the present invention is to disclose a valve system for high frequency compressors that has geometric and dimensional characteristics capable of resisting to the stresses in such operation conditions.

5 It is also an object of the present invention to disclose the dimensional characteristics more suitable for a valve system for the use in compressors operating at high frequencies.

Summary of the Invention

The present invention achieves the above mentioned objects through a valve
10 system for high frequency compressors, of the type comprised of plates, suction valves and discharge valves for operation in cylinders of compressors which are fastened with the aid of rivets, pins, and said system comprises a cylinder joint; a suction plate cooperating with the cylinder joint, the suction plate comprising a substantially circular body provided with a central hollow portion which generates at least one suction valve having a circular end; a
15 plate cooperating with the suction plate, such a plate comprising at least one suction hole and at least one discharge hole; at least one discharge valve cooperating with the plate, the discharge valve comprising a blade containing at least one orthogonal extension having circular ends; and at least one discharge stop cooperating with the discharge valve, the stop comprising a lower profile part provided with at least one counterbore limiting the movement
20 of the ends of the discharge valve.

Said invention comprises, therefore, means for allowing such a valve system to be used in compressors that operate at high frequencies, even those above 200 Hz.

In a preferred embodiment of the present invention, the suction plate has substantially circular geometry and suction valves embedded in its body along crimping lines,
25 so that the plate and the suction valves form a single body.

Further in the preferred embodiment of the present invention, such suction valves have length of between 5.0 and 5.5 millimeters.

Furthermore, preferably the suction plate, the suction valves and the discharge valve have a thickness ranging from 0.05 to 0.11 millimeters - preferably 0.0762 millimeters.

30 It is further noticed that, in a preferred embodiment of the invention, the discharge valve also has a total length of between 5.5 and 6.0 millimeters.

Brief Description of the Drawings

Figures show:

Figure 1 - shows a front view of a valve plate and suction valve used in the present
35 state of the art;

Figure 2 - shows an exploded perspective view of the compressor valve system built in accordance with a preferred embodiment of the present invention;

Figure 3.1 - shows a rear view of the suction valve assembly of system of the present invention;

Figure 3.2 - shows a side view of the object shown in Figure 3.1;

Figure 3.3 - shows a front view of the object shown in Figure 3.1;

5 Figure 4 - shows an enlarged detail of the suction valves illustrated in Figure 3.1;

Figure 5.1 - shows a front view of the discharge valve assembly of system that is object of the present invention;

Figure 5.2 - shows a side view of the object shown in Figure 5.1;

Figure 5.3 - shows a rear view of the object shown in Figure 5.1;

10 Figure 6 - shows an enlarged detail of the discharge valve of the system of the present invention, which appears in the effective hatched region of the discharge valve;

Figure 7 - shows a side view of the discharge valve stop of valve system that is the object of the present invention; and

Figure 8 - shows a top view of the discharge stop illustrated in Figure 7.

15 Detailed Description of the Invention

The attached Figure 1 illustrates an exemplary suction plate 1 of the current state of the art, which has substantially quadrangular geometry on which it is attached by means of independent fastening elements 21, an elongated shape - vane - type suction valve 2. It should be noted that, in general, such valves have a fastening area 22, an elongated intermediate region 23, and, finally, the element 24 that effectively is disposed on the suction hole (not shown) of plate 1.

20 It is worth clarifying that, in general, the suction and discharge valves usually used in compressors that operate at frequencies between 20 Hz and 75 have thicknesses between 0.152 and 0.254 millimeters and a total length ranging between 10 and 30 mm, which results in parts that have a certain natural vibration frequency, consequently, leading to restrictions on the frequency wherewith they can be appropriately used.

25 The valve system proposed in the present invention is CHARACTERIZED by drawing the contour of the suction and discharge valves as shown in Figure 2, which shows an exploded perspective view of the system with its constituent parts taken separately, namely: cylinder joint 3, suction plate 4, valve plate 5, exhaust valve 6, discharge stop 7, rivet 8 and pins 9.

30 The suction plate 4 - also illustrated in Figures 3.1 to 4 - displays substantially circular geometry and cutting lines or a hollow central portion 41 which results in two small suction valves 42 having circular ends 43, the latter effectively constituting the closing elements of the suction holes 51 of plate 5.

35 It is important to stress that the suction components of the present invention consist of a single part in which the valves are embedded to the suction plate 4, and the crimping

lines 44 confer to the part high resistance against disruption possibly arising from the movement of the valve circular ends 43 when operating at high frequencies -noticing that in the current state of the art discloses lengths of about 10 to 30 millimeters, while the overall length of valve 42 (including end 43) totalizes about 5.35 millimeters.

5 It is worth clarifying that the crimping line 44 is defined by the cylinder joint 3 which is located between the suction plate 4 and the compressor cylinder (not shown) and, therefore, the supporting region of the suction valve 42 - corresponding to the suction plate 4 - is defined between the cylinder joint 3 and the valve plate 5.

10 Furthermore, the thickness of the suction plate 4 is about 0.0762 mm (as in the current state of the art this value ranges from 0.152 to 0.254 millimeters), and due to the reduced thickness, the rigidity that is a characteristic of the part remains within limits within which the pumping efficiency is increased.

15 For the assembly, the suction plate 4 is positioned between the valve plate 5 and the cylinder joint 3, these three elements being fastened to the compressor cylinder (not shown) by means of suitable fastening elements to be positioned into the distal holes 10. It should be noted that the cylinder joint 3 has a central span portion 31 to enable the movement of the suction valves 42 with circular ends 43 of the suction plate 4.

20 In turn, the discharge valve 6 of the system object of the present invention - better illustrated in Figures 5.1 to 6 - is comprised of an integral blade having a thickness of about 0.0762 millimeters, defined by a convex rod 61, from whose ends two angled lateral rods 62 extend, which extend in orthogonal extensions 63 with circular ends 64, which effectively constitute the elements that overlap with the discharge holes 52 of the valve plate 5.

25 The discharge valve assembly 6 on the valve plate 5 is made with the aid of a discharge stop 7 shown in Figures 7 and 8, which is defined by a thick part and, in this W - shaped representation, has on its distal rods, holes 71 for coupling the rivets 8 and pins 9, the lower profile thereof having a counterhole in its central portion 72 which acts effectively as limiting the opening of the circular ends 64 of the discharge valve 6.

30 It should be noted that the total length of the rod 63 plus the circular end 64 of the discharge valve 6 totalizes to 5.85 mm - therefore, also significantly lower than the usually known.

The presented system also differs from the conventional ones because it presents a number of suction and discharge valves and holes other than those normally observed in similar known systems, since it contains two suction inlets 51 and two discharge inlets 52 - when usually there is only one valve for each function.

35 Further, it is worth clarifying that the presented system, in addition to the possibility of being used with operating frequencies that are higher than the conventional ones - and even greater than 200 Hz - can also be used in cylinders having diameters ranging from 8 to

12 millimeters.

It should be noted that although having been shown preferred constructive forms of the present invention, it is understood that any omissions, substitutions and constructive alterations may be accomplished by a person skilled in the art, without departing from the spirit and scope of the required protection. It is also expressly stated that all combinations of elements that perform the same function in substantially the same way in order to achieve the same results are within the scope of the invention. Substitutions of elements of a described embodiment with others are also fully intended and encompassed.

It should however be understood that the description given above based on figures above relate just to one of possible embodiments for the system of the present invention, the actual scope of the object of the invention being defined in the appended claims.

CLAIMS

1. Valve system for high frequency compressors, of the type comprised of plates, suction valves and discharge valves for operating in compressor cylinders which are fastened with the aid of rivets (8) and pins (9), CHARACTERIZED in that said system
5 comprises:

a cylinder joint (3);

a suction plate (4) cooperating with the cylinder joint (3), the suction plate (4) comprising a substantially circular body provided with cutting lines or a central hollow portion (41) which generates at least one suction valve (42) having a circular end (43);

10 a valve plate (5) cooperating with the suction plate (4), such valve plate (5) comprising at least one suction hole (51) and at least one discharge hole (52);

at least one discharge valve (6) cooperating with a plate (5), the discharge valve (6) comprising a blade containing at least an orthogonal extension (63) having a circular end (64);

15 at least one discharge stop (7) cooperating with the discharge valve (6), the stop (7) comprising a lower profile part provided with at least one counterbore (72) limiting the movement of the end (64) of the discharge valve (6); and

means for allowing such a valve system to be used in compressors that operate at high frequencies, even those greater than 200 Hz

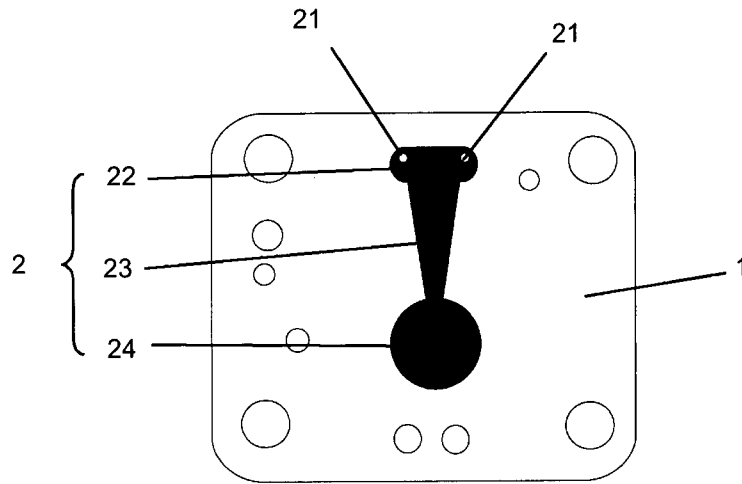
20 2. Valve system according to claim 1, CHARACTERIZED in that the suction plate (4) has a substantially circular geometry and cutting lines (41) that define the geometry of the suction valve (42).

3. Valve system according to claims 1 and 2, CHARACTERIZED in that the suction valves (42) have a total length of between 5.0 and 5.5 millimeters.

25 4. Valve system according to claim 1, CHARACTERIZED in that the suction plate (4), the suction valve (42) and the discharge valve (6) have a thickness of between 0.05 and 0.11 millimeters.

5. Valve system according to claim 4, CHARACTERIZED in that the suction plate (4), the suction valve (42) and the discharge valve (6) have a thickness of 0.0762 millimeters.

30 6. Valve system according to claims 1, 4 and 5, CHARACTERIZED in that the discharge valve (42) has a total length of between 5.5 and 6.0 millimeters.



(PRIOR ART)
FIG. 1

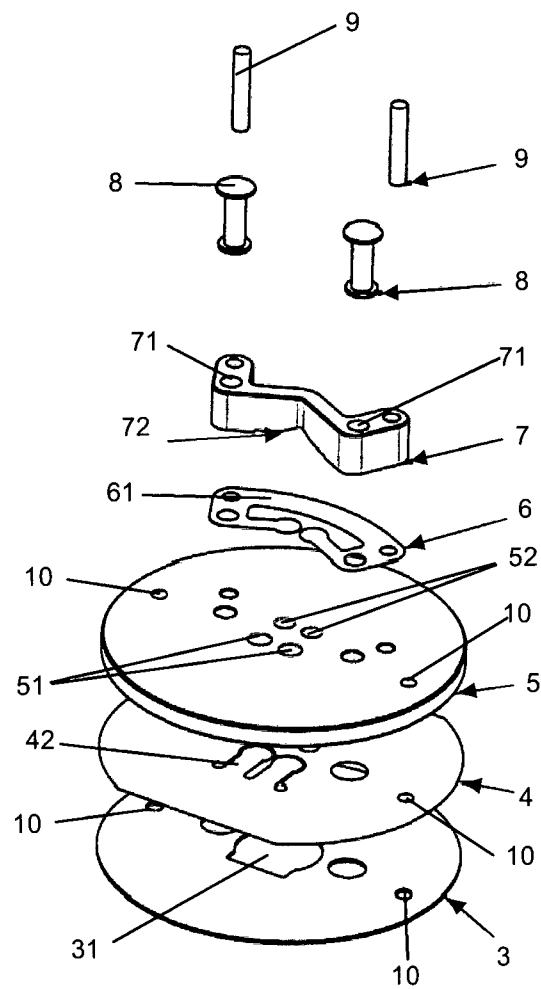


FIG. 2

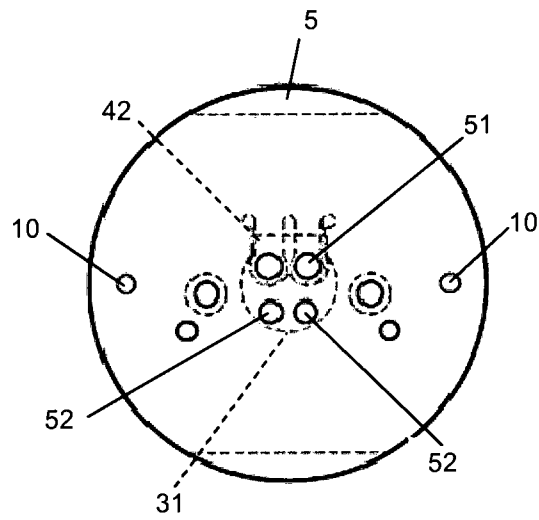


FIG. 3.1



FIG. 3.2

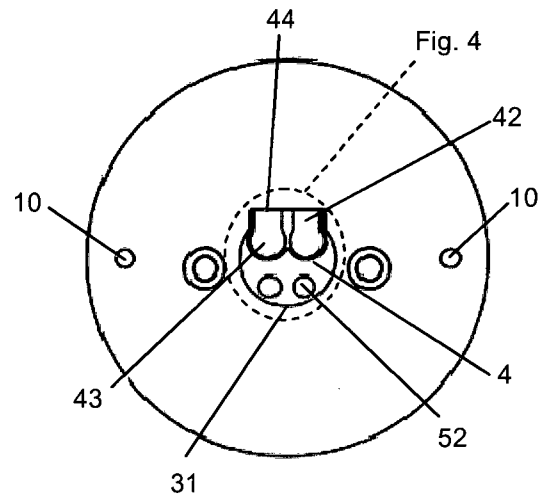


FIG. 3.3

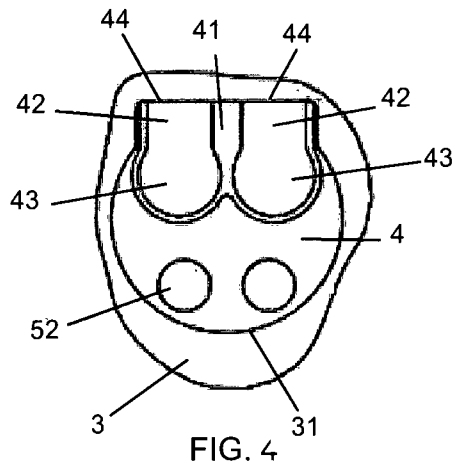


FIG. 4

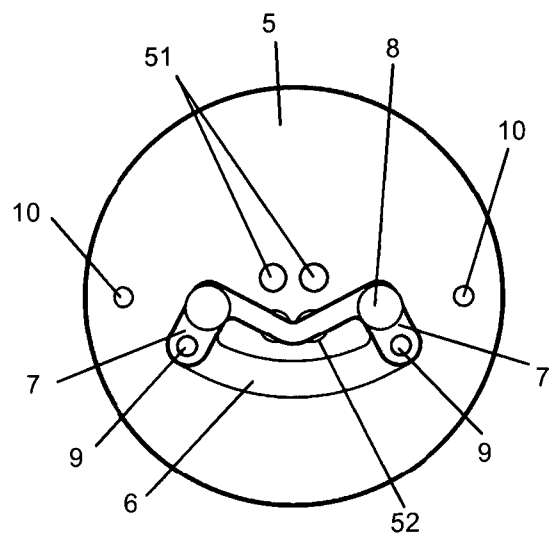


FIG. 5.1

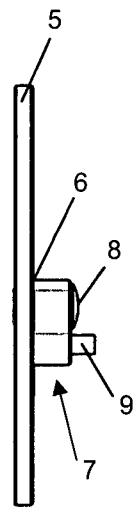


FIG. 5.2

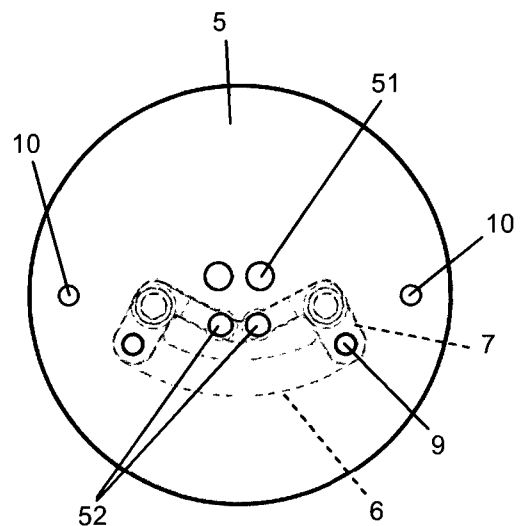


FIG. 5.3

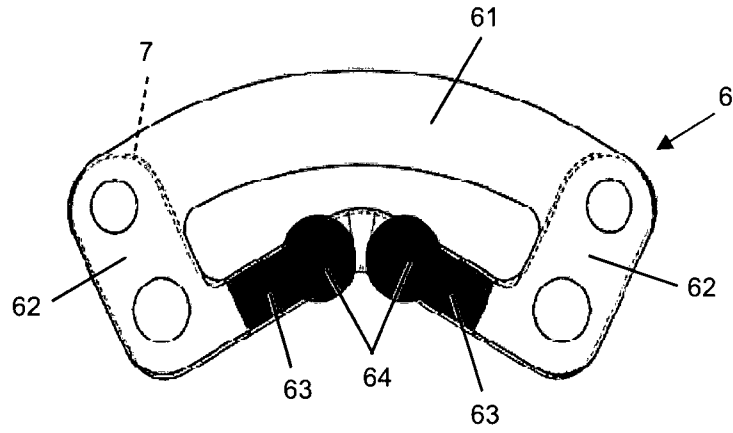


FIG. 6

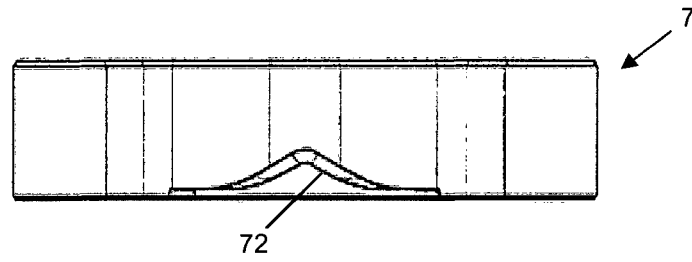


FIG. 7

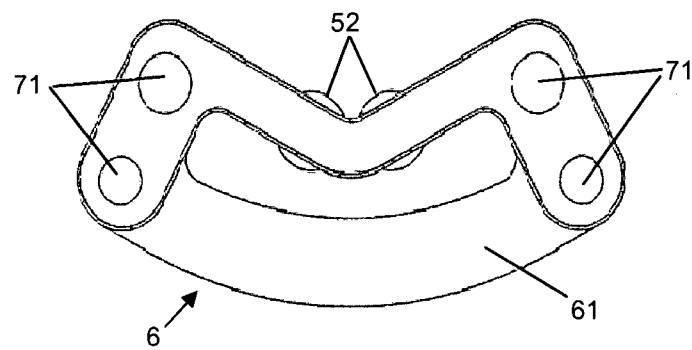


FIG. 8

INTERNATIONAL SEARCH REPORT

International application No

PCT/BR2012/000212

A. CLASSIFICATION OF SUBJECT MATTER
 INV. F04B39/10 F16K15/16
 ADD.

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)
 F04B F16K

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)

EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

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Y	US 2009/291007 A1 (YAMAOKA MASAKAZU [JP] ET AL) 26 November 2009 (2009-11-26) figures 4,5,10,11,16	1-6
Y	US 2001/017162 A1 (SEO SEUNG-DON [KR]) 30 August 2001 (2001-08-30) cited in the application figure 2	3,6
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Further documents are listed in the continuation of Box C.



See patent family annex.

* Special categories of cited documents :

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Date of the actual completion of the international search

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INTERNATIONAL SEARCH REPORT

International application No

PCT/BR2012/000212

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