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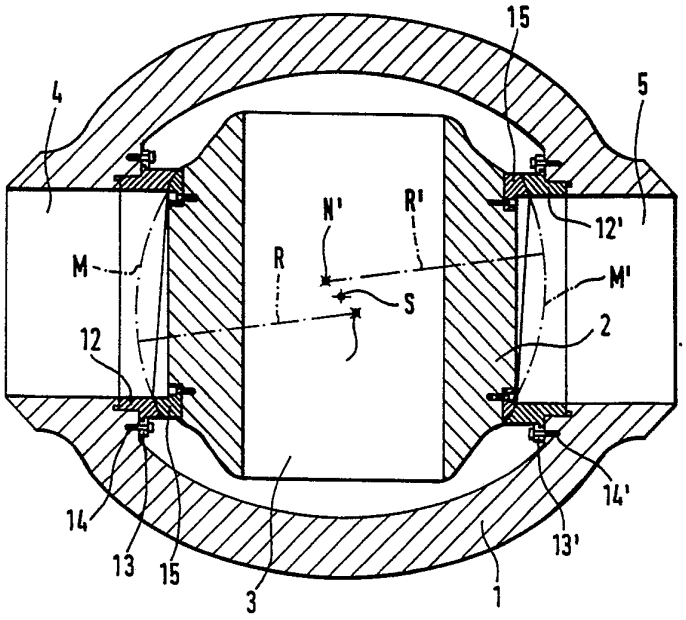
(54) Title: A BALL VALVE

(57) Abstract

A ball valve of the trunnion type comprises a valve housing (1) having, preferably, concentric oppositely directed inlet and outlet openings (4, 5), each provided with an internal seat (12, 12′), and a reversible ball-shaped valve body, the valve ball (2), which is formed with a passage in the form of a centrally through-going bore (3), adapted to be brought sustantially into alignment with said inlet and outlet (4, 5) in the open position of the valve, and wherein the valve ball (2) is adapted to close the passage through the valve housing in the closed position of the valve, while maintaining a sealed condition at the seats (12, 12′) of the valve housing. In order to provide a ball valve of this kind wherein the ball mechanically, without spring force and/or differential pressure, can be rotated into closed position, maintaining optimum sealing at both seats (12, 12′) of the valve housing, the valve ball (2) is provided with two diametrally opposite seals (15, 15′) which, in the closed position of the valve, simultaneously, are adapted to cooperate sealingly with one of the seats (12, 12′) of the valve housing (1) each; the sealing surfaces (17, 17′, 16, 16′) of the housing seats and the ball seals extending eccentrically with respect to the ball's rotation point constituted by the geometric centre thereof. Because of the eccentric design of the sealing surfaces of the seats/seals, the sealing action is optimalized with increasing mechanical tightening force and, in the open position of the valve, at each of the seats (12, 12′) of the valve housing, there being formed a slot having a rather large flow area into the interior of the valve housing, allowing efficient flushing of the internal components of the valve by means of a small partial flow of the fluid flowing through.



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A BALL VALVE

This invention relates generally to valves, and more particularly to a ball valve of the trunnion type, comprising a valve housing having an inlet and an (diagonally) opposite outlet, each provided with an internal seat, and a reversible ball-shaped valve body, the valve ball, formed with a through-going aperture in the form of a centrally through-going bore, adapted to be brought into alignment with said inlet and outlet in the open position of the valve, and wherein the ball is adapted to close the passage through the valve housing in the closed position of the valve while establishing sealing conditions at the seats of the valve housing.

In ball valves of conventional kind, the valve ball is assigned two diametrally opposite, external trunnions preventing the ball from moving. In this case, sealing conditions are established in that the one or the other seat of the housing urges against the ball, creating a seal caused through pressure difference across the ball.

In order to make a ball valve of the trunnion type to maintain a sealing condition, prior art embodiments presuppose a displacement of one or both seats of the valve housing towards the ball. This displacement is achieved by letting the line pressure urge the seat/seats towards the

ball. In order to let this happen, one is dependent on a piston area on the seats wherein the line pressure may exert a pressing force. Additionally, one has to depend on soft seals in order to maintain a positive pressure.

Deposits on seats and ball may cause i.a. sealing problems, the necessary relative movements being prevented or impeded. It is well known that e.g. hydrocarbons tend to form deposits hard to remove, in both pipe lines and in valves.

In conventional valves, one may not apply mechanical forces in order to make the valve to seal. As mentioned, such deposit problems are especially pronounced within the oil and petrochemical industries, both in refineries and oil installations offshore.

Since the media treated within said industries are very inflammable, satisfactorily operating valves are an absolute presupposition for a reliable operation.

Conventional ball valves can not be opened or closed during through-flow or at pressure difference across the valve. If one, nevertheless, tries to effect opening/closing during these circumstances, the result will be an entirely untenable "eatening-up" of the seal rings. At repeated attempts, the sealing path of the ball will also be damaged. There are, indeed, valves on the market wherein mechanical force may be supplied in order to achieve sealing. However, each of these valves has one seat only and, thus, being of no interest in the present case.

As previously mentioned, conventional ball valves of the trunnion type will be destroyed in case they should be opened while a pressure difference exists across the valve. Consequently, such valves are unsuitable as throttle valves. During opening, a small aperture will be created locally,

i.e. at one side only, and this will cause a large wearing when a large fluid volume tries to pass through the small aperture. Likewise, it is very difficuelt to effect maintenance on valves being under pressure, and lacking maintenance results inevitably in smaller or larger leakages. In this connection, there is a great need for a ball valve which will keep itself clean automatically. A ball valve structure wherein the seats of the housing and the seals on the ball easily may be detached and exchanged would, likewise, meet a desideratum felt for a long time.

Thus, a main object of the present invention is to provide a ball valve of the trunnion type wherein opposite seats may be brought to seal by exertion of mechanical forces, so that one is no longer dependent on line pressure and floating seats. Such a novel ball valve is to have one movable member only, namely the ball, the seals being securely attached and non-movable. In such a ball valve construction, opening and closing shall be effectable during full through-flow of fluid and/or at pressure difference across the valve. In an optimal embodiment, the ball valve according to the invention may advantageously be applied as a throttle valve.

In accordance with the invention, said object is achieved by forming the ball valve according to the features indicated in the characterizing part of the following claim 1.

Advantageous embodiments appear from the sub claims.

Through the eccentric course of all four sealing surfaces, cooperating in pairs, in relation to the centre of the valve ball, a particularly efficient sealing action is achieved, the sealing action being optimalized with increasing mechanical closing force. In the open condition of the valve - because of the sealing surface course of the valve house

seats in relation to the centre of the ball - only two diagonally opposite ball portions will be positioned adjacent to, but not entirely onto each separate seat portion, so that, at each valve housing seat, between the sealing surface thereof and the ball portion resting thereon, there being established a narrow circumferential slot extending along the entire seat periphery and, thus, exhibting a relatively large flow area (substantially larger than in known valves) for fluid into the interior of the valve housing. Within the valve housing, the flowing fluid will effect a very desirable flushing and cleaning function, causing an efficient washing, cleaning the ball with its seals and the internal valve housing walls and seats. Thus, in the open valve position, the fluid flow within the housing, through the flushing action thereof, counteracts deposits and buidling-up of various materrials such as sand, grease, solidified hydrocarbons, calcium, chalk, etc. Thus, in the ball valve according to the invention, an automatic cleaning process is carried into effect, representing a substantial technical progress. This flow of fluid through the valve in the open position thereof, will not influence the ball path disadvantageously towards closed position, as this will be located within the housing. The relatively large flow area established, in the open position of the valve, between the seats of the valve housing and the ball, causes a quite neglectable wearing of the valve parts. This enables the ball valve according to the invention to serve as a throttle valve. On the other hand, conventional ball valves of the type in question are unsuitable for such a task.

The seals on the ball and the seats in the valve housing, respectively, and including sealing surfaces, consist advantageously of metal. Metal/metal-seals are previously known per se.

A ball valve having metal seats and being formed with eccentric seat/sealing surfaces according to the invention, may be used in piping systems wherein the pressure of the flowing fluid substantially exceeds those pressure conditions whereunder ordinary ball valves can operate. At so high pressures, the ball of conventional ball valves of the klind in question will bend/flex where the material is thinnest, i.e. at diagonally opposite lateral portions. Through designing the ball with a large material thickness within both sealing rings, the ball of the valve according to the invention is not flexible in nearly the same degree when influenced by high pressures.

Thus, in the ball valve according to the invention, a positive sealing at two diagonally opposite sides of the valve ball is achieved, independent on spring force and/or pressure difference across the seats. In such a valve, low pressure sealing will be as good as high pressure sealing.

Further objects, advantages and features of the ball valve according to the invention will appear from the following specification of an example of a preferred embodiment, reference being made to the accompanying diagrammatical drawings, wherein:

Figure 1 shows the ball valve, in an axial section, in the closed position;

Figure 2 corresponds to Figure 1 and shows the ball valve in the open position;

Figure 3 is a section at right angles to the axial section of Figure 1, and shows further details of the valve structure.

In the drawings, reference numeral 1 denotes the housing of

a ball valve; 2 indicating generally the ball-shaped valve body, the valve ball, which, as known per se, is formed with a central passage in the form of a through-going circular-cylindrical bore 3.

The valve housing 1 is formed with diagonally opposite openings 4 and 5 in the form of circular-cylindrical bores having the same cross-sectional area as the passage 3 of the ball 2. In use, the ball valve is coupled into a pipe line carrying flowing fluid in liquid or gaseous form, and one housing opening, e.g. 4, may then act as the inlet, the other housing opening 5 acting as the outlet, provided a direction of flow from left to right according to Figures 1 and 2, or vice versa.

Reference is now made to Figure 3 showing the constructive building-up of the ball valve, and wherein the reference numeral 6 denotes the trunnion 2 of the ball, 7 indicating a lining. Diagonally opposite the trunnion 6, the valve stem 8 is arranged. In a cavity of a sealing ring or sleeve 9 surrounding the stem 8, a thrust bearing (ball bearing) 10 is placed. The reference numeral 11 denotes the valve lid.

In the closed position of the ball valve, Figures 1 and 3, the passage 3 of the ball extends at right angles to the axis of the inlet and the outlet 4,5, breaking the fluid communication therebetween, the passage 3, in the open position of the valve according to Figure 2, being brought into alignment with the inlet and the outlet 4,5, thus establishing an unimpeded passage through the valve; this representing the main principle of most known ball valves.

In the closed position of the valve, optimum sealing between the ball and the valve housing openings 4,5 should be established. For that purpose, the valve housing 1 internally is provided with annular seats 12 and 12'

extending around the inner mouth portion of each opening 4,5. For attachment of the housing seats 12,12', the valve housing 1 is, at each opening thereof, formed with a graded flange-like portion to which the respective seat is fixed by means of an attachment rim 13,13' and screws 14,14' . The particular design of the sealing surfaces of this housing seats 12,12' will be discussed later on in the specification.

In accordance with the invention, the valve ball 2, at two diagonally opposite sides, is provided with seals 15,15', the sealing surfaces thereof being denoted 16 and 16', respectively, in Figure 2, in which the corresponding sealing surfaces of the housing seats are indicated at 17 and 17', respectively.

According to the invention, all sealing surfaces 17,17',16, 16' of the seats 12,12'/the seals 15,15' follow a circular-annular course eccentric with regard to the geometric centre S of the ball 2 in an axial plane, Figures 1 and 2.

More particularly, cooperating sealing surfaces 16 and 17 extend along a circle M, the radius thereof being denoted R and the centre N being spaced from the geometric centre S of the ball 2. Similarily, the cooperating sealing surfaces 16' and 17' extend along a circle M' having a radius indicated at R', and the centre N' thereof being spaced correspondingly from the centre S of the ball 2, and situated diagonally vis-a-vis the centre N in relation to the centre S. These conditions which are characteristic of the present invention, apply for the constructive design of the sealing surfaces 16,16',17,17' only, and the centres N and N' do, of course, not form any pivot point; the actual pivot point being represented by the geometric centre S of the ball only.

According to the shown embodiment, when the ball valve is occupying its open position, Figure 2, only two diagonally opposite ball portions 18,18' will be positioned close to the housing seats, thereby exposing slots 19 and 19' between the remaining mouth portion of the housing seats 12,12' and the adjacent ball portions (around the passage 3), so that the flowing fluid is allowed to flow into and around the interior of the valve housing and, thus, flush and wash the internal components of the valve. These exposed slots 19,19' at the inlet and the outlet, respectively 4 and 5, exhibit a relatively large flow area laterally of the flow, and this condition assists i.a. to reduce possible wearing of the valve components.

When the valve ball 2 by means of the stem 8 is rotated about 90 degrees to the closed position, Figures 1 and 3, the sealing surfaces on the housing and ball, cooperating in pairs and being eccentric in relation to the rotational point S of the ball 2, will cause a clamping action, resulting in a very efficient sealing which, owing to the eccentricity, will be optimalized with increasing (mechanical) tightening force; (the harder tightening, the better sealing). The two design-centres N,N' will give an advantageous "scissors effect" when the valve closes, the rotation of the ball from the open towards the closed position giving rise to a sealing mechanical application of forces between seats/seals cooperating in pairs. Additionally, this condition will support the ball member, as it is clamped from both sides.

In addition to the previously mentioned advantages, it could be indicated that the present ball valve is designed such that one does not have to change the ball 2 in case the valve should start to leak from one reason or another. Both housing seats 12,12' and the ball seals 15,15' are designed such that they easily may be demounted and exchanged.

THis is, particularly, of great importance with large ball valves, wherein the ball-shaped valve body, the valve ball, may cost as much as Norw.Krs. 500,000.-

C l a i m s

1. A ball valve of the trunnion type, comprising a valve housing (1) having preferably concentric, oppositely directed inlet and outlet (4,5), each of which being provided with an internal seat (12,12'), and a reversible ball-shaped valve body, the valve ball (2), formed with a passage in the form of a centrally through-going bore (3), adapted to be brought substantially into alignment with said inlet and outlet (4,5) in the open position of the valve, and wherein the ball (2) is adapted to close the passage through the valve housing in the closed position of the valve, maintaining sealing at the seats (12,12') of the valve housing, c h a r a c t e r i z e d i n that the valve ball (2) is provided with two (diametrally) opposite seals (15,15') which, in the closed position of the valve, simultaneously, are adapted to cooperate with one of the seats (12,12') of the valve housing (1) each, and that the sealing surfaces (17,17' and 16,16', respectively) of the seats (12,12') and the seals (15,15'), respectively, follow an eccentric course with regard to their rotational point, corresponding to the geometric centre (S) of the ball (2).

2. A ball valve as set forth in Claim 1, c h a r a c t e r i z e d i n that one pair of cooperating sealing surfaces (e.g. 17,16), in an axial plane (Figures 1 and 2), extend along an arc of a circle (M), the centre (N) for the radius (R) thereof being spaced a relatively short distance from the geometric centre (S) of the ball (2), and that the other pair of cooperating sealing surfaces (17',16'), in the same axial plane, extend along an arc of a circle (M'), the centre (N') of the radius (R') thereof being similarily spaced from the geometric centre (S) of the ball (2), though located diametrally opposite the first-mentioned centre (N) with regard to the geometric

centre (S) of the ball.

3. A ball valve as set forth in Claim 1 or 2, wherein the seats and the seals, sealing surfaces included, consist of metal, c h a r a c t e r i z e d i n that the valve housing (1) as well as the ball (2) are formed for fastening of the associated seat rings and seal rings, respectively, (12,12' and 15,15'), by screws.

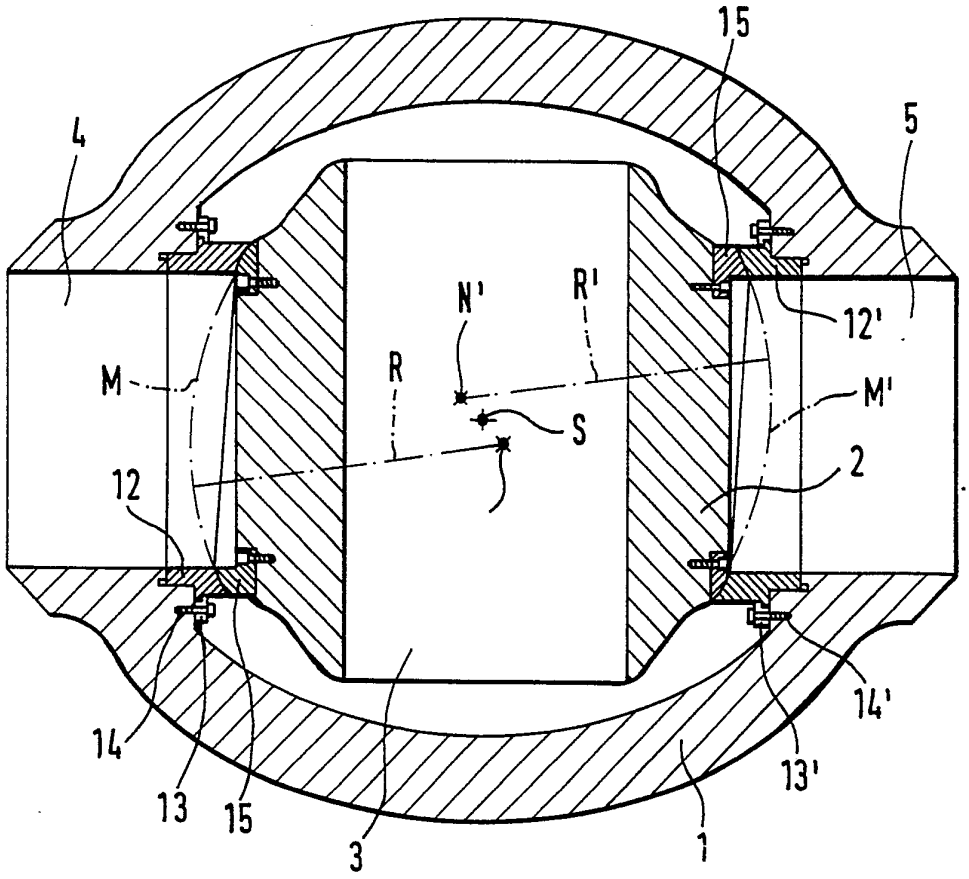

Fig. 1

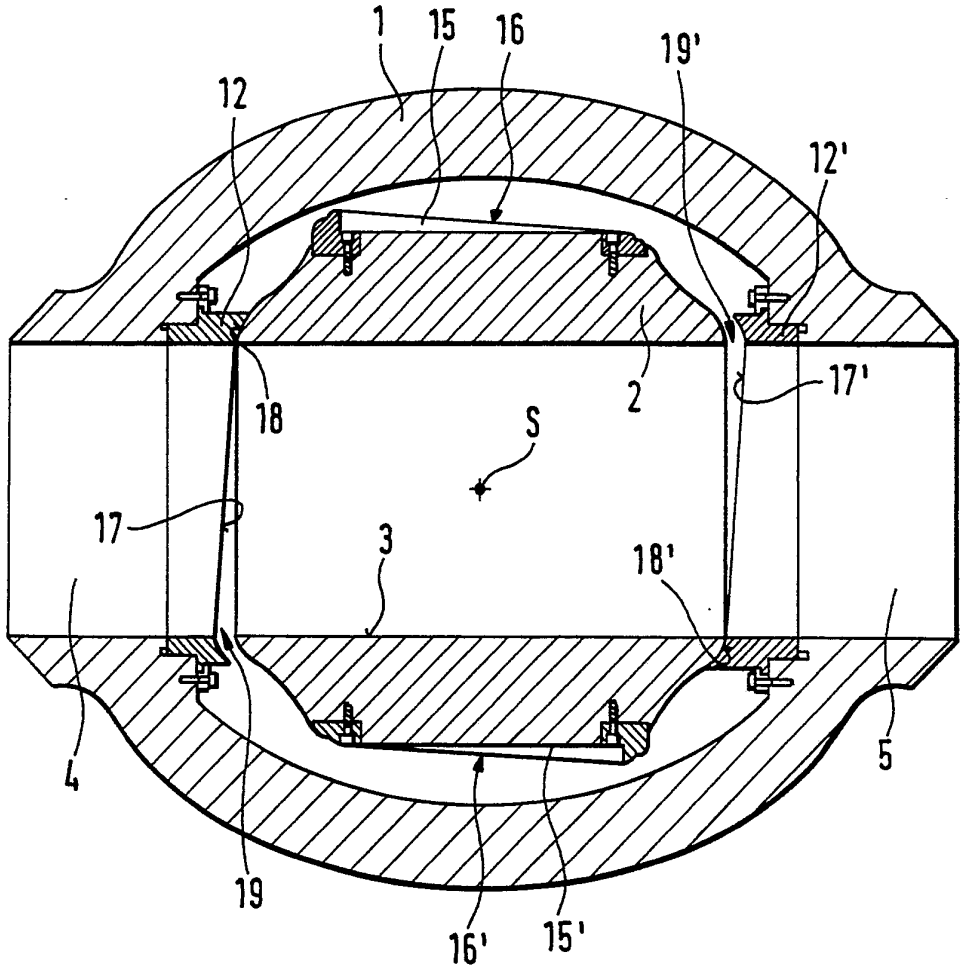

Fig. 2

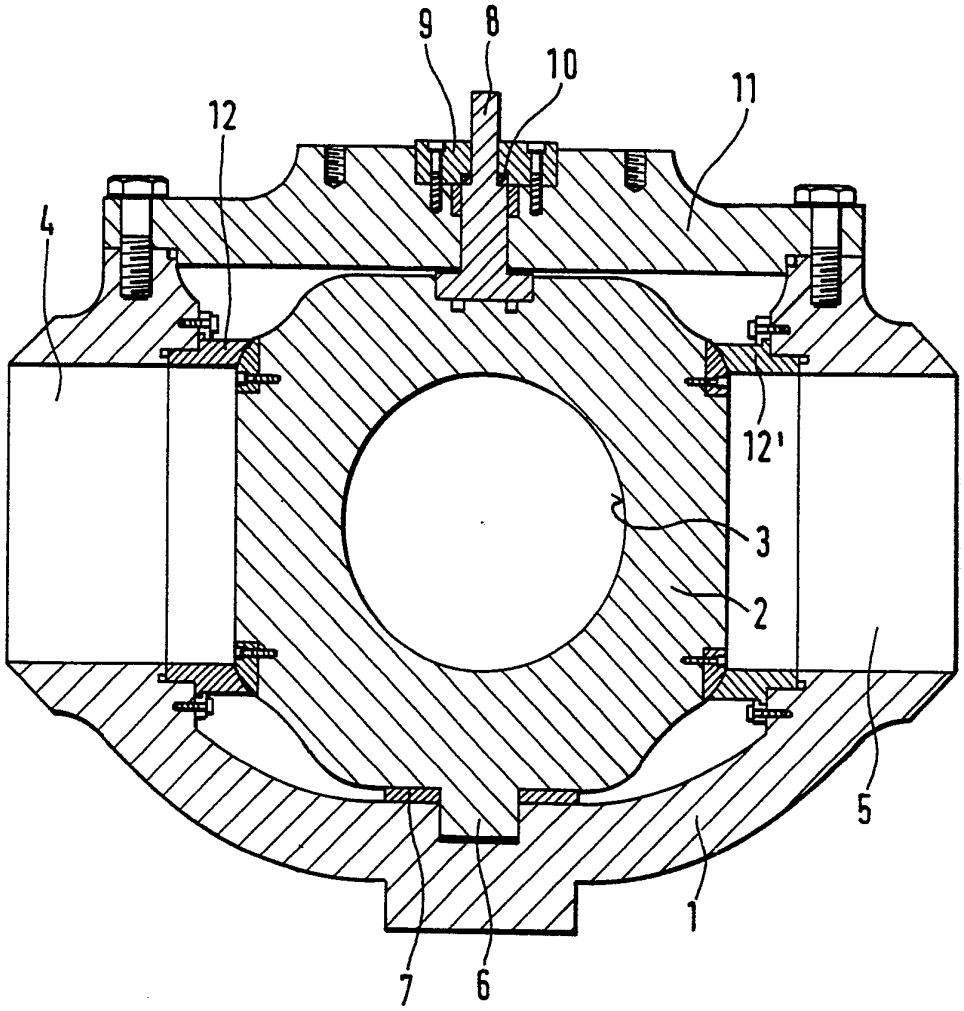

Fig. 3

INTERNATIONAL SEARCH REPORT

International Application No PCT/NO 91/00010

I. CLASSIFICATION OF SUBJECT MATTER (if several classification symbols apply, indicate all)[6]

According to International Patent Classification (IPC) or to both National Classification and IPC

IPC5: F 16 K 5/20

II. FIELDS SEARCHED

Minimum Documentation Searched[7]

Classification System	Classification Symbols
IPC5	F 16 K

Documentation Searched other than Minimum Documentation to the Extent that such Documents are Included in Fields Searched[8]

SE,DK,FI,NO classes as above

III. DOCUMENTS CONSIDERED TO BE RELEVANT[9]

Category *	Citation of Document,[11] with indication, where appropriate, of the relevant passages[12]	Relevant to Claim No.[13]
X	NO, B, 148608 (LEAR SIEGLER, INC.) 1 August 1983, see the whole document	1,2
Y	--	3
Y	EP, A2, 0216200 (NARDUZZI, FRANCO) 1 April 1987, see the whole document	3
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Y	US, A, 2663538 (R. BACCHI) 22 December 1953, see the whole document	3
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IV. CERTIFICATION

Date of the Actual Completion of the International Search	Date of Mailing of this International Search Report
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International Searching Authority	**Signature of Authorized Officer**
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ANNEX TO THE INTERNATIONAL SEARCH REPORT ON INTERNATIONAL PATENT APPLICATION NO. PCT/NO 91/00010

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Patent document cited in search report	Publication date	Patent family member(s)	Publication date
NO-B- 148608	83-08-01	NONE	
EP-A2- 0216200	87-04-01	US-A- 4667929	87-05-26
US-A- 2663538	53-12-22	NONE	
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		CA-A- 1073888	80-03-18
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