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NOTICE OF ENTITLEMENT

We COOPER INDUSTRIES, INC.

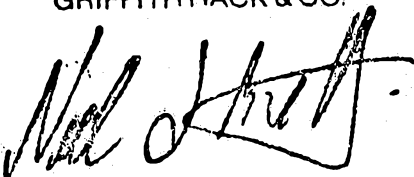
of P.O. BOX 4446
HOUSTON, TX 77210
U.S.A.

being the applicant in respect of an application for a patent for an invention entitled BALL VALVE (Application No. 29260/89), state the following:

1. The nominated person has, for the following reasons, gained entitlement from the actual inventor:
The nominated person is the assignee of the actual inventor.
2. The nominated person is the applicant of the application listed in the declaration under Article 8 of the PCT.
3. The basic application listed in the declaration under Article 8 of the PCT is the first application made in a Convention country in respect of the invention.

DATED this 16th day of June 1992

COOPER INDUSTRIES, INC.
GRIFFITH HACK & CO.



Patent Attorney for and
on behalf of the applicant(s)

(12) PATENT ABRIDGMENT (11) Document No. AU-B-29260/89
(19) AUSTRALIAN PATENT OFFICE (10) Acceptance No. 627442

- (54) Title
SPRING AND SEAT ASSEMBLY FOR BALL VALVES
- International Patent Classification(s)
(51)⁴ **F16K 005/06**
(51)⁵ **F16K 005/20**
- (21) Application No. : **29260/89** (22) Application Date : **16.12.88**
- (87) PCT Publication Number : **WO89/10506**
- (30) Priority Data
- | (31) Number | (32) Date | (33) Country |
|---------------|-----------------|------------------------------------|
| 187806 | 29.04.88 | US UNITED STATES OF AMERICA |
- (43) Publication Date : **24.11.89**
- (44) Publication Date of Accepted Application : **27.08.92**
- (71) Applicant(s)
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- (56) Prior Art Documents
AU 58307/86 F16K 5/20 5/06
US 3563265
AU 291490 59179/65 74.7 60.7
- (57) Claim

1. A ball valve having a valve body with inlet and outlet flow passages communicating with a valve chamber, a ball element mounted in said valve chamber for rotation between open and closed positions relative to the flow passages, a seal element mounted adjacent each flow passage with a sealing face in opposed sealing relation to the ball element,

a movable seat assembly located between said seal element and said valve body for maintaining said seal element in sealing relation to said ball element; and

a spring positioned between said movable seat assembly and said valve body adapted to urge said movable seat assembly and said seal element toward the ball element, said spring having a generally horseshoe shape.

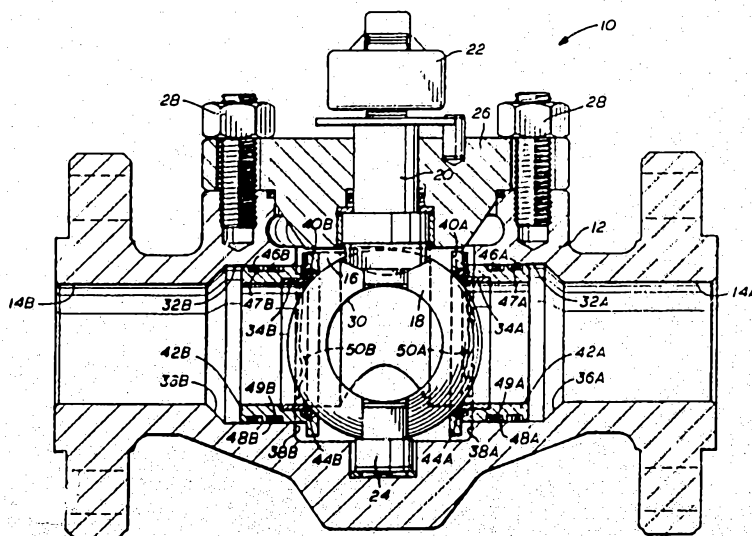
PCT

International Bureau

INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

<p>(51) International Patent Classification⁴ : F16K 5/06</p>	<p>A1</p>	<p>(11) International Publication Number: WO 89/10506 (43) International Publication Date: 2 November 1989 (02.11.89)</p>
<p>(21) International Application Number: PCT/US88/04513 (22) International Filing Date: 16 December 1988 (16.12.88) (30) Priority data: 187,806 29 April 1988 (29.04.88) US (71) Applicant: COOPER INDUSTRIES, INC. [US/US]; P.O. Box 4446, Houston, TX 77210 (US). (72) Inventor: STONE, Ralph, Scott ; 2010 Village Park, Missouri City, TX 77489 (US). (74) Agent: SCOTT, Eddie, E.; Cooper Industries, Inc., P.O. Box 4446, Houston, TX 77210 (US). (81) Designated States: AU, BR, FR (European patent), GB (European patent), JP, NL (European patent), NO.</p>		<p>Published <i>With international search report.</i></p> <p style="font-size: 2em; text-align: center;">627442</p>

(54) Title: SPRING AND SEAT ASSEMBLY FOR BALL VALVES



(57) Abstract

A spring for a top entry ball valve includes a generally "u" shaped spring body (50A) with an open end. The ball valve includes a valve body (12) with inlet and outlet flow passages communicating with a valve chamber. A ball element (18) is mounted in the valve chamber for rotation between open and closed positions relative to the flow passages. A seal element (40A, 40B) is mounted adjacent each flow passage with a sealing face in opposed sealing relation to the ball element. A movable seat assembly is located between the seal element and the valve body for maintaining the seal element in sealing relation to the ball element. The spring is located between the movable seat assembly and the valve body and is adapted to urge the movable seat assembly and the seal element toward the ball element.

BALL VALVES

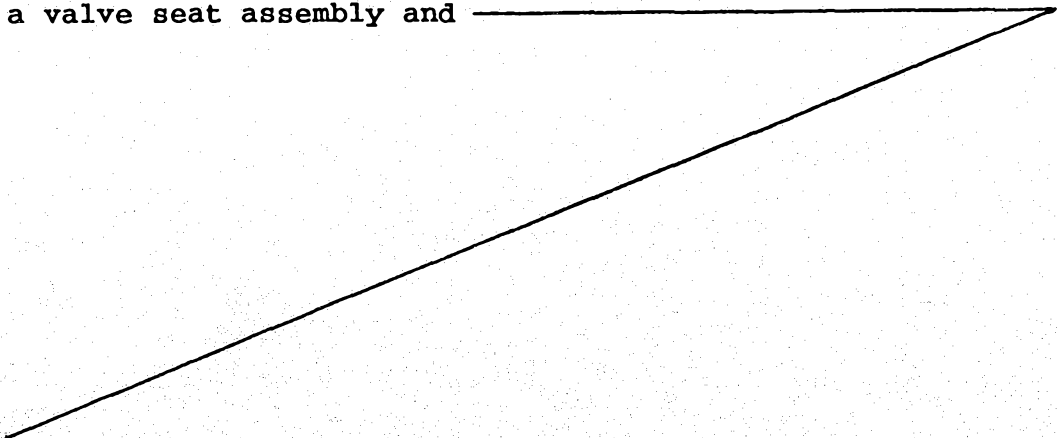
BACKGROUND OF THE INVENTION

Field of the Invention

5 The present invention relates in general to ball valves and for controlling fluid flow. The present invention is particularly adapted for valves used in the oil and gas industry.

10 Background

A ball valve of the type used in the oil and gas industry includes a ball valve element with an internal flow passage. The internal flow passage is aligned with inlet and outlet passages in the "open" position and placed out
15 of alignment with the inlet and outlet passages in the "closed" position. Sealing members contact the ball valve element to provide a fluid tight seal between the inlet/outlet passages and the ball valve element. A seat assembly system is provided for maintaining the sealing
20 membes in an energized condition. Heretofore, various types of spring and seat assemblies have been utilized to urge the sealing members into sealing engagement with the associated ball valve member. As shown in U.S. Patent No. 4,266,566 to Gary W. Karal and Charles C. Partridge dated
25 12 May 1981, continuous wave springs are illustrated urging a valve seat assembly and _____



In U.S. Patent No. 4,477,055 to Charles C. Partridge dated October 16, 1984, a ball valve structure is shown having a valve seat assembly positioned in annular seat pockets located in a flow passage on opposed sides of a ball valve member. Each valve seat assembly is mounted for limited longitudinal movement toward and away from the adjacent ball valve member and spring means are placed within the seat pockets behind the valve seat assemblies to urge the assemblies toward and into intimate contact with the ball valve member. The valve seat assembly includes inner and outer annular concentric seat rings with a resilient sealing ring secured therebetween. The inner annular seat ring has a flared end which fits inside the outer seat ring and energizes or deforms the sealing ring held therebetween, thereby, securely retaining the sealing ring between the seat rings and preventing the introduction of line pressure behind the sealing ring to possibly extrude the sealing ring from its position within the seat rings.

In U.S. Patent No. 4,175,577 to Gary W. ~~Kara~~^{Kara} and Charles C. Partridge dated November 27, 1979, a means and method for in-line removal of seat rings in ball valves is shown. A ball valve structure has a removable upper cover plate to permit the ball to be removed from the valve body. A separate cam tool (after removal of the cover plate) is positioned within the bore of the ball which has been



partially rotated from the full open position, and upon a return rotation of the ball with the cam tool therein to a full open position an adjacent spring urged seat ring is cammed away from the ball to a retracted position. A seat ring retainer is then acutated to hold the seat ring in the retracted position. The cam tool is then utilized in a similar manner to cam the other opposite seat ring in the retracted position. The ball may then be removed with the seat rings for replacement or repair as desired. The seat rings and seals thereon may be removed and replaced in such manner without removal of the valve from the flowline in which the valve is positioned.

OBJECT AND STATEMENT OF THE INVENTION

The present invention attempts to overcome one or more of the problems of the prior art.

According to the present invention there is provided a ball valve having a valve body with inlet and outlet flow passages communicating with a valve chamber, a ball element mounted in said valve chamber for rotation between open and closed positions relative to the flow passages; a seal element mounted adjacent each flow passage with a sealing face in opposed sealing relation to the ball element, a movable seat assembly located between said seal element and said valve body for maintaining said seal element in sealing relation to said ball element; and a spring positioned between said movable seat assembly and said valve body adapted to urge said movable seat assembly and said seal element toward the ball element, said spring having a generally horseshoe shape.

In one embodiment the spring is of a generally horseshoe shaped configuration with an open end. When the spring is



moved into its operative position, it causes the spring to be in an biasing relation to the seat assembly, the seal ring, the ball valve element and the valve body surface. The spring is easily replaced in so-called top entry ball valves. The upper cover plate is removed. The spring is removed. The old seal is removed and a new seal installed.

In one embodiment the seal ring can be removed and replaced while the valve is in place in a flowline. The spring is easily reinstalled once the new seal ring is located in position.

BRIEF DESCRIPTION OF THE DRAWINGS

In order that the invention can be more clearly ascertained an example of an embodiment will now be described with reference to the accompanying drawings wherein:-

Figure 1 is a sectional view of a preferred ball valve of the top entry type having movable seat assemblies. The valve is shown in the closed position.

Figure 2 is a sectional view of the ball valve of the top entry type shown in Figure 1. The valve is shown in the open position.

Figure 3 is an isometric view of a spring shown removed from the valve illustrated in Figures 1 and 2.

Figure 4 is a front view of the spring shown in Figure 3.

Figure 5 is a side view of the spring shown in Figures 3 and 4.

Figure 6 is an enlarged view of the seal area of Figure 2.



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DETAILED DESCRIPTION OF ~~THE INVENTION~~ PREFERRED EMBODIMENT

Referring now to the drawings and to Figures 1 and 2 in particular, a top entry ball valve is shown and generally designated by the reference numeral 10. The valve 10 includes a valve body 12 having flow passages 14A and 14B. A valve chamber 16 is located between flow passages 14A and 14B. A ball valve element 18 is mounted in the valve chamber for movement between the closed position shown in Figure 1 and the open position shown in Figure 2. A stem 20 secured to ball valve element 18 has a handle 22 which may be gripped for moving ball valve element 18 between the open and closed positions relative to flow passages 14A and 14B. A lower trunnion 24 is mounted on the lower portion of ball valve element 18. An upper cover plate 26 is removably connected to valve body 12 by studs 28. Ball valve element 18 includes a flow passage 30 therethrough which is adapted to be aligned with flow passages 14A and 14B when the ball valve element 18 is moved to the open position shown in Figure 2.

Located at the juncture of the flow passages 14A and 14B and the valve chamber 16 are a pair of enlarged bore portions. The enlarged bore portions comprise straight bore sections 32A and 32B. The surface between the straight bore sections 32A and 32B and flow passages 14A and 14B define tapered shoulders or abutments 36A and 36B.

The surfaces between valve chamber 16 and straight bores 32A and 32B define shoulders or abutment surfaces 38A and 38B



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which face valve chamber 16. A pair of seal rings 40A and 40B are mounted in sealing engagement with the ball element 18 to provide a fluid tight seal and also allow movement of the ball element 18.

5 Moveable seat assemblies are located within valve chamber 16 and straight bore sections 34A and 34B for floating longitudinal movement relative to ball valve element 18. The seat assemblies comprise seat outer rings 42A and 42B and seat inner rings 34A and 34B. Seal rings 40A and 40B are
10 located within seal retaining grooves 44A and 44B on the inner surface of seat outer rings 42A and 42B. The seal rings 40A and 40B are maintained in sealing engagement with the ball valve member 18 by the seat inner rings 34A and 34B. Primary seal rings 46A and 46B are mounted in the grooves 47A
15 and 47B in the outer circumferential surface of seat outer rings 42A and 42B. Graphite filament rope secondary seal rings 48A and 48B are located within grooves 49A and 49B.

 The seat outer rings 42A and 42B have a cylindrical body and projecting annular flanges extending outwardly from the
20 cylindrical body. Mounted between the annular flanges of seat outer rings 42A and 42B and the surfaces 38A and 38B on the valve body are spring elements generally indicated by the numerals 50A and 50B. The spring elements 50A and 50B are located in the annular space formed between the flanges on
25 seat outer rings 42A and 42B and opposed surfaces 38A and 38B which face valve chamber 16. Engaging portions on the springs 50A and 50B maintain the springs in a biasing

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relation to the seat outer rings 42A and 42B, seat inner rings 34A and 34B, the seal rings 40A and 40B, the ball valve element 18 and the valve body 12.

5 The seat outer rings 42A and 42B have a pair of grooves 47A and 47B and 49A and 49B. Mounted within the grooves 47A and 47B are o-rings 46A and 46B which provide the primary fluid seal. Graphite filament seal rings 48A and 48B are mounted within the grooves 49A and 49B. The graphite filament seal rings 48A and 48B are formed by double wrapping
10 graphite filament rope sections around the seat outer rings 42A and 42B with their ends spliced. The graphite filament seal rings provide a secondary seal and allow the valve 10 to safely operate in high temperature operations. Should the o-rings 46A and 46B be destroyed by heat, the graphite seal
15 rings 48A and 48B will provide the necessary sealing function.

The springs 50A and 50B are readily replaceable in so-called top entry ball valves. The upper cover plate 26 is removed. The seal rings 40A and 40B can be removed from the
20 valve body and replaced while the valve is in place in a flowline. The springs 50A and 50B are re-installed once new seal rings are located in position.

Referring to Figures 3, 4 and 5, one of the springs 50A is shown removed from the valve 10. The spring 50A is of a
25 generally horseshoe shaped configuration with an open end. The spring includes a body section 52 and extending leg sections 55 and 56. The body portion 52 has a section that

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lies in a first plane. Engaging portions 53 and 54 located on the leg sections 55 and 56 are located outside of the plane of the body section.

5 Referring to Figure 1 through 5, the removal of worn seal rings and replacement with new seal rings will be described. The springs 50A and 50B of the configuration shown in Figures 3 - 5 can easily be removed from the valve. The cover plate 26 is removed. A screwdriver is used to pry the springs 50A and 50B away from the flanges on seat outer
10 rings 42A and 42B. The spring 50A and 50B are removed. When the springs 50A and 50B have been removed, the seat assemblies 42A and 42B are moved outward. The seal rings 40A and 40B are removed and can be replaced with new seals. The moveable seat assembly 42A is shown positioned adjacent the
15 surface 38A in Figure 2. New seal rings are inserted in place and in the springs 50A and 50B are replaced thereby moving the moveable seat assembly 42A and the new seal rings back into place.

THE CLAIMS DEFINING THE INVENTION ARE AS FOLLOWS

1. A ball valve having a valve body with inlet and outlet flow passages communicating with a valve chamber, a ball element mounted in said valve chamber for rotation between open and closed positions relative to the flow passages, a seal element mounted adjacent each flow passage with a sealing face in opposed sealing relation to the ball element,

a movable seat assembly located between said seal element and said valve body for maintaining said seal element in sealing relation to said ball element; and

a spring positioned between said movable seat assembly and said valve body adapted to urge said movable seat assembly and said seal element toward the ball element, said spring having a generally horseshoe shape.

2. A ball valve as claimed in claim 1 including an upper cover plate removably secured to the valve body and permitting removal of the ball from the valve body when the cover plate is removed.

3. A ball valve as claimed in claim 2 wherein said movable seat assembly has an annular flange projecting from a cylindrical body and wherein said movable seat assembly includes a pair of external annular grooves with an o-ring located in one groove and a heat resistant seal located in the other groove.

4. A ball valve substantially as herein described with reference to the accompanying drawings.

DATED THIS 16TH DAY OF JUNE 1992
COOPER INDUSTRIES, INC.
By Their Patent Attorneys
GRIFFITH HACK & CO.
Fellows Institute of Patent
Attorneys of Australia.



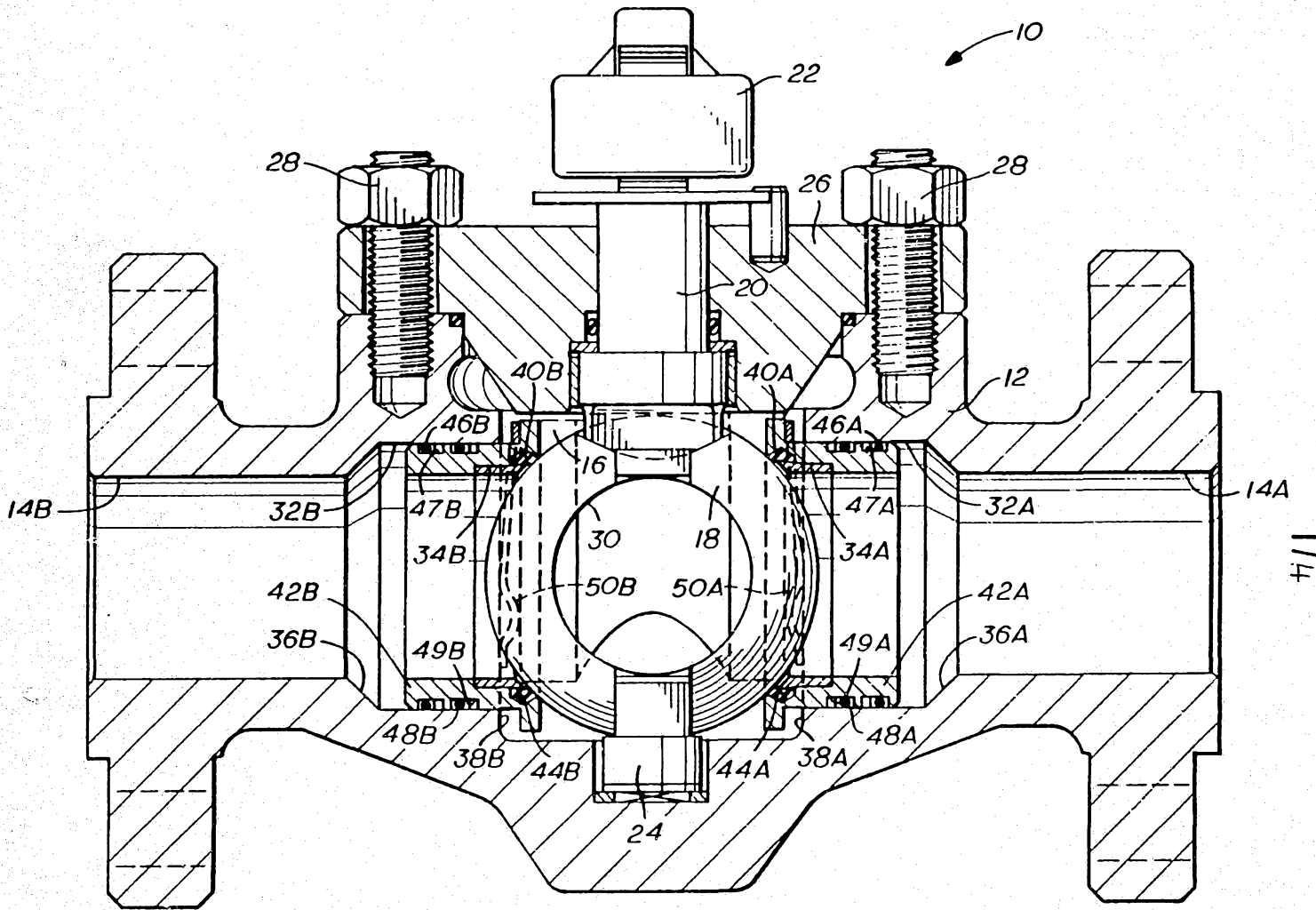


FIG. 1

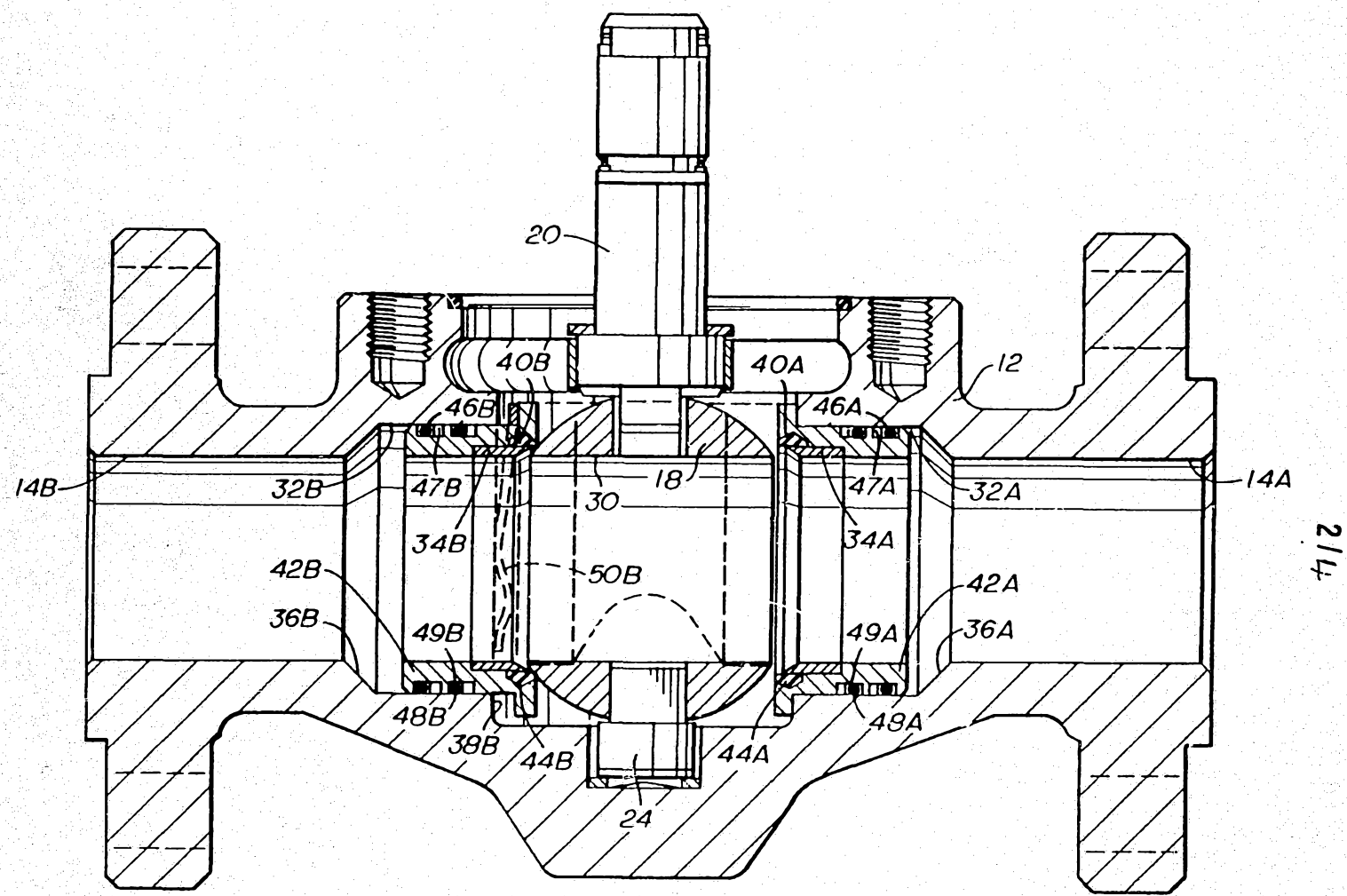


FIG. 2

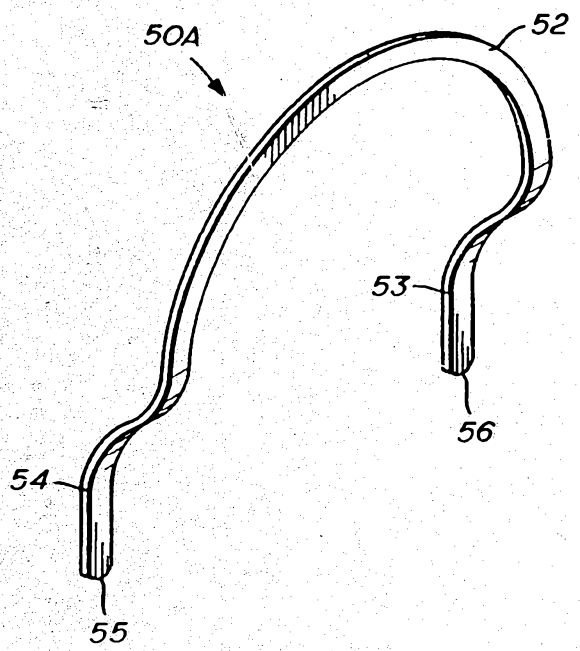


FIG. 3

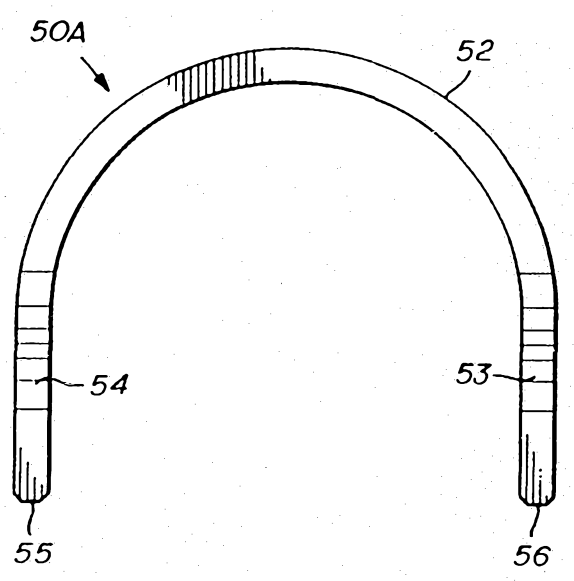


FIG. 4

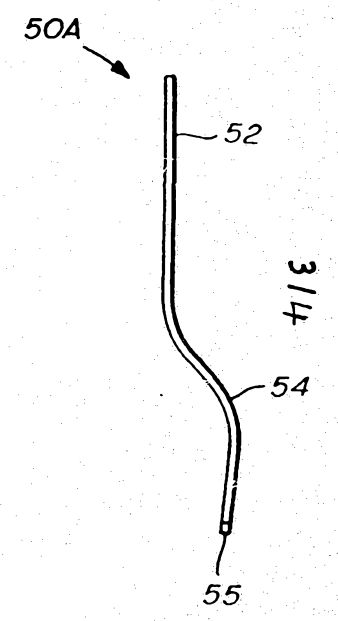
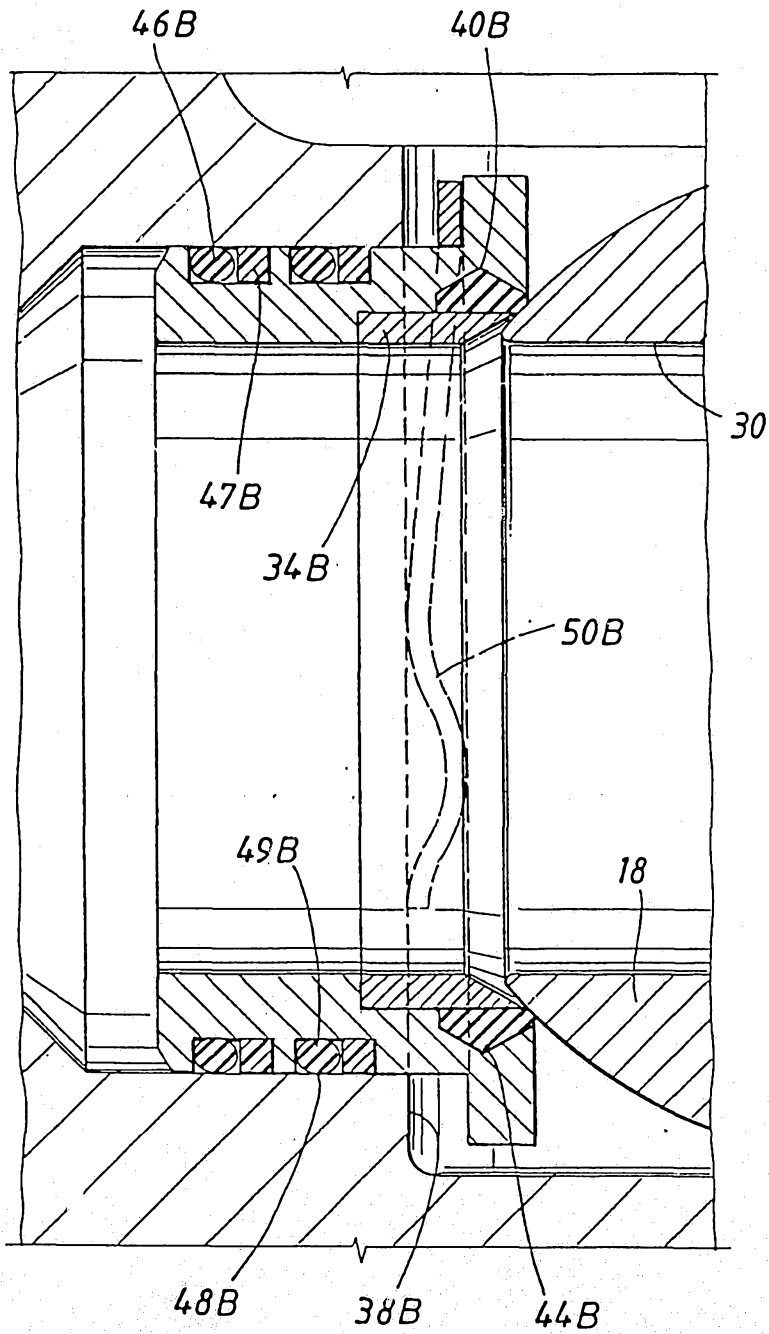


FIG. 5

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FIG. 6



SECRET

INTERNATIONAL SEARCH REPORT

International Application No. **PCT/US 88/04513**

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		
IPC (4): F16 K 5/06 U.S. CL. 251/174		
II. FIELDS SEARCHED		
Minimum Documentation Searched ⁷		
Classification System	Classification Symbols	
U.S.	251/174, 180, 315	
Documentation Searched other than Minimum Documentation to the Extent that such Documents are Included in the Fields Searched ⁸		
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
Y	US, A, 4,342,330 (WIEVEG ET AL) 03 August 1982. See Entire Document.	1,3,4,5
<p>[*] Special categories of cited documents: ¹⁰</p> <p>"A" document defining the general state of the art which is not considered to be of particular relevance</p> <p>"E" earlier document but published on or after the international filing date</p> <p>"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)</p> <p>"O" document referring to an oral disclosure, use, exhibition or other means</p> <p>"P" document published prior to the international filing date but later than the priority date claimed</p> <p>"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</p> <p>"X" document of particular relevance: the claimed invention cannot be considered novel or cannot be considered to involve an inventive step</p> <p>"Y" document of particular relevance: the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.</p> <p>"Δ" document member of the same patent family</p>		
IV. CERTIFICATION		
Date of the Actual Completion of the International Search	Date of Mailing of this International Search Report	
16 MARCH 1989	20 APR 1989	
International Searching Authority	Signature of Authorized Officer	
ISA/US	 JOHN C. FOX	