Innovation, Sciences et Développement économique Canada
Office de la Propriété Intellectuelle du Canada

Innovation, Science and Economic Development Canada
Canadian Intellectual Property Office

CA 2942466 C 2022/09/27

(11)(21) 2 942 466

(12) BREVET CANADIEN
CANADIAN PATENT

(13) C

(86) Date de dépôt PCT/PCT Filing Date: 2014/03/31
(87) Date publication PCT/PCT Publication Date: 2015/10/08
(45) Date de délivrance/Issue Date: 2022/09/27
(85) Entrée phase nationale/National Entry: 2016/09/12
(86) N° demande PCT/PCT Application No.: PL 2014/000031
(87) N° publication PCT/PCT Publication No.: 2015/152741

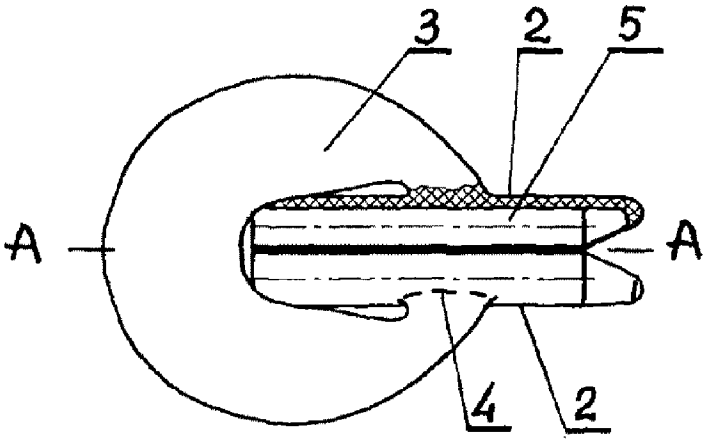
(51) Cl.Int./Int.Cl. *A61B 17/12* (2006.01),
A61B 17/128 (2006.01)

(72) Inventeurs/Inventors:
ROGOWSKI, JAN, PL;
BRZEZINSKI, MACIEJ, PL;
DABROWSKI, LESZEK, PL

(73) Propriétaire/Owner:
JITMED SP. Z.O.O., PL

(74) Agent: SMART & BIGGAR LLP

(54) Titre : DISPOSITIF D'OCCLUSION DE L'APPENDICE AURICULAIRE GAUCHE
(54) Title: LEFT ATRIAL APPENDAGE OCCLUSION DEVICE



(57) Abrégé/Abstract:
A left atrial appendage closure device comprises two clamping jaws (2) fixed to a bow (3) comprising a flange with a cut slot, where each of the edges of the slot is connected with the clamping jaw (2). The jaws (2) contain internal channels (5). In a section perpendicular to the symmetry axes of the internal channels (5), a line (a) connecting the symmetry axes of the internal channels (5) is distant from an imaginary line (b) connecting the centres of sections of the bow (3) arms by a distance (14). The bow (3) has in the central part of its periphery a larger section (6) than a section (7) in the places where the bow (3) arms are connected with the jaws (2). The jaw (2) wall (9) from the adjacent jaw (2) side is the thinnest, whereas the wall (9) from the side of fixing the clamping jaw (2) to the bow (3) is the thickest.

(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
8 October 2015 (08.10.2015)

WIPO | PCT

(10) International Publication Number
WO 2015/152741 A1

(51) International Patent Classification:
A61B 17/12 (2006.01) *A61B 17/128* (2006.01)

(21) International Application Number:
PCT/PL2014/000031

(22) International Filing Date:
31 March 2014 (31.03.2014)

(25) Filing Language: English

(26) Publication Language: English

(71) Applicant: **JITMED SP. Z.O.O.** [PL/PL]; Ul. Sportowa 8, PL-81-300 Gdynia (PL).

(72) Inventors: **ROGOWSKI, Jan**; Ul. Zofii Nałkowskiej 22, PL-83-110 Tczew (PL). **BRZEZIŃSKI, Maciej**; Ul. Węsierska 53, PL-80-178 Gdańsk (PL). **DĄBROWSKI, Leszek**; Ul. Łódzka 42 B 3, PL-80-180 Gdańsk (PL).

(74) Agent: **CZABAJSKI, Jacek**; TRASET Rzecznicy Patentowi, Czabajska, Szczepaniak Sp. p., ul. Piecewska 27, PL-80-288 Gdańsk (PL).

(81) Designated States *(unless otherwise indicated, for every kind of national protection available)*: AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BN, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IR, IS, JP, KE, KG, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LT, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PA, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SA, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

(84) Designated States *(unless otherwise indicated, for every kind of regional protection available)*: ARIPO (BW, GH, GM, KE, LR, LS, MW, MZ, NA, RW, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, RU, TJ, TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, KM, ML, MR, NE, SN, TD, TG).

Declarations under Rule 4.17:

— *of inventorship (Rule 4.17(iv))*

Published:

— *with international search report (Art. 21(3))*

WO 2015/152741 A1

(54) Title: LEFT ATRIAL APPENDAGE OCCLUSION DEVICE

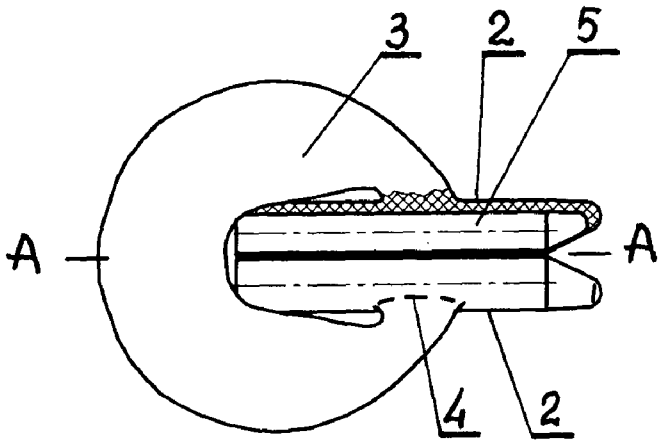


Fig. 2

(57) Abstract: A left atrial appendage closure device comprises two clamping jaws (2) fixed to a bow (3) comprising a flange with a cut slot, where each of the edges of the slot is connected with the clamping jaw (2). The jaws (2) contain internal channels (5). In a section perpendicular to the symmetry axes of the internal channels (5), a line (a) connecting the symmetry axes of the internal channels (5) is distant from an imaginary line (b) connecting the centres of sections of the bow (3) arms by a distance (14). The bow (3) has in the central part of its periphery a larger section (6) than a section (7) in the places where the bow (3) arms are connected with the jaws (2). The jaw (2) wall (9) from the adjacent jaw (2) side is the thinnest, whereas the wall (9) from the side of fixing the clamping jaw (2) to the bow (3) is the thickest.

Left atrial appendage occlusion device

The present invention relates to an occlusion device intended for medical use, for occluding the left atrial appendage, constituting an implant. The occlusion device can be used in medicine also for other purposes.

The left atrial appendage is a dead end in the blood flow through the heart, but during systole it is filled with blood. As compared to the right atrial appendage, it is longer, thinner and has more undulating surface. From the medical point of view, this organ does not have any significant role. In the case of atrial fibrillation, the left atrial appendage is insufficiently washed by blood, which results in the congestion of the blood. Congestion may cause activation of the coagulation system and formation of clot. Blood clots from the inside of the appendage can be released to the cardiovascular system and transferred to important life structures. Therefore, a frequent complication of atrial fibrillation is an ischemic stroke of the organ reached by blood clots, in the worst case, a cerebrovascular accident. Atrial fibrillation affects about 1% to 2% of the adult population and every tenth patient over 80. It increases the risk of stroke by five times, while every fifth stroke is associated with this cardiac arrhythmia. Ischemic strokes associated with atrial fibrillation are more often fatal, and patients who survive are often disabled and more often exposed to repeated episodes than patients after strokes caused by any other reason. As a consequence, the risk of death after a stroke due to atrial fibrillation is doubled, and the cost of treatment is 1.5 times higher.

Known solutions aimed at stopping the blood flow through the interior of the left atrial appendage can be divided into two groups. The first group of solutions aims at closing the blood supply from the inside. The second group of solutions aims at

closing the blood supply from the outside by occluding the appendage using an occlusion device from the outside, at the base of the appendage.

A known solution belonging to the first group of solutions is disclosed in European patent specification No. EP 1433437. This known solution proposes a number of solutions of a membrane for closing from the inside the ostium of the left atrial appendage to the inside of the appendage. The membrane secured inside the ostium prevents blood clots from escaping from the inside of the appendage to the inside of the left atrium. The membrane may be designed as permeable or impermeable with respect to blood flow, stopping blood clots. The membrane is configured to extend over the ostium of the left atrial appendage to the inside of the appendage; therefore, it has an outer periphery with a larger dimension than a dimension of the ostium of the interior of the appendage. Securing elements are designed so that the membrane has a central mandrel on which an element with self-expanding arms is inserted to the interior of the appendage, what makes it possible, in the next step, to occlude the ostium of the appendage between the membrane and the arms of the element located from the interior of the appendage, when they have been opened.

In another solution, known from US patent specification No. US 2005/0113861, a different solution is disclosed. According to this known solution, a device comprises a centre post and a sheet, stretched over a plurality of ribs, blocking the outflow of blood clots from an appendage. The sheet stretches over the ribs like a parachute, where from the interior of the appendage there is an open space left, whereas from the left atrium the flow of blood is closed by said sheet.

Another solution belonging to the first group of solutions, known from US patent specification No. US 2006/0247680, discloses a method and an implantable flange for occluding the blood orifice from the atrium to an appendage. The flange is secured in the lumen of the blood orifice to the appendage and contains a bigger plate from the atrium side with a resistance flange and a second plate secured to the flange on a cylindrical wall from the inside of the appendage. The flange, both plates and the cylindrical wall are semi-flexible. Both plates can be tightened to each other

using a screw mechanism causing the cylindrical wall to bulge sideward and the flange to be fixed in the orifice into the appendage.

Another solution belonging to the first group of solutions, known from the patent specification of international application No. WO 2012/003317, discloses another device for occluding the interior of the left atrial appendage. The occlusion device comprises a kind of an occluder in the form of a disc configured to prevent blood flow to the left atrial appendage. The occluder, according to this known solution, comprises a main flange, blocking blood supply to the appendage from the left ventricle and an auxiliary anchoring flange connected thereto via a flexible connector. The auxiliary flange inserted into the appendage opens up, preventing the whole from prolapsing into the atrium. Coils of the flexible connector are connected with the occluder disc, where the connector has a substantially constant cross-section and allows for variable length, variable orientation, as well as it being bent according to the appendage position. The anchoring flange is inserted as coiled into the atrium and it contains a shaped edge in the form of an umbrella, preventing prolapsing from the appendage.

As their design indicates, devices belonging to the first group of solutions need to be arranged in the ostium of the appendage only from the interior of the left atrium.

Solutions belonging to the second group are external occlusion devices placed at the base of an appendage, without surgical intervention to the inside of the heart. This is usually performed during a surgery by applicating an occlusion device on the appendage stalk, which excludes internal surface of the organ. This type of an occlusion device must meet stringent requirements. In addition to material requirements as to interaction with body fluids, the pressure force of arms must be constant and must be within strictly defined limits.

Too weak pressure of arms may not be able to stop blood flow to an appendage and blood outflow from an appendage. Limiting blood flow only by a partial occlusion of said flow may cause increased formation of blood clots, which may lead to an increased risk of a stroke.

However, too strong pressure of the occlusion device arms may cause necrosis. This means that the pressure force of arms must be within strictly defined limits.

A known solution belonging to the second group is disclosed in the patent specification of international application No. WO 2009/106907. This specification discloses a left atrial appendage closure device to be placed outside the appendage. Said device, according to this known solution, comprises an annular elastic band for medical applications, particularly made of medical silicone or a polymer containing medical silicone. First, the band is enlarged, and after positioning the enlarged band from the outside at the base of the appendage, the elastic band is released from enlarging surgical forceps. When released from the forceps, the band returns to its original size, tightening the base of the appendage causing the closure thereof. In another embodiment of the solution according to this known invention, the described device comprises an additional elastic element associated to the annular elastic band, for example a coil spring, or a mesh, made of biocompatible metal alloy.

Another solution, known from the patent specification of US application No. US 2004/0030335, discloses a device and method of use for occluding animal or human tissues. According to this known solution, a clamping ring is disposed on the left atrial appendage. In the first stage, a cover fixed at the end of an arm of a device supplying a gas medium is placed on the appendage from the outside. On the cover the clamping ring for clamping the appendage at the base is fixed. After placing the cover on the appendage, the clamping ring is slid off it and the cover is filled with air, which reduces the volume of the appendage, facilitates clamping of the clamping ring and facilitates removal of the cover from the appendage.

A further known solution from the second group is disclosed in US patent specification No. US 8,647,367. It discloses devices, systems and methods for occlusion of the left atrial appendage. According to this known solution, in the first stage a concentric tube of the device is inserted from the left atrium, wherein an outer jacket allows the inflation of a balloon sealing off blood flow to the appendage, whereas an inner tube is used to aspirate the interior of the appendage. After

After performing these steps, an outer closure device in the form of a loop is placed at the basis of the appendage.

A different known device belonging to the second group of solutions has been in use. It has the form of an elastic element made of titanium alloy wire with a shape memory, cooperating with a body composed of titanium tubes lined with polyurethane foam lining, wherein the whole is trimmed with polyester knitted fabric. The position of a frame of the device kept in a stretched position by means of threads is rearranged to perpendicular after putting the device through a cannula between ribs. Then, the device is placed on an appendage and the threads releasing a spring are cut off leading to the occlusion of the spring at the base of the appendage.

However, in most of the solutions belonging to the second group, where surgical intervention inside the heart is not required, it is necessary to lead the entire length of an appendage through the device and only then it is possible to place an occlusion device at the base of the appendage. The invention aims at developing a new design of an appendage occlusion device, belonging to the second group of solutions, but not requiring leading the whole appendage through the closure device before implantation.

Another known solution is disclosed in US patent specification No. US2008/0039879. This known solution discloses a number of embodiments of an occlusion device, including several variants of clips and springs occluded on an appendage.

According to one aspect a left atrial appendage occlusion device has at least two clamping jaws. Each of the clamping jaws has a tubular configuration with an internal channel. A common resilient and monolithic bow provides at least two arms connected to the at least two clamping jaws, and is configured to hold the clamping jaws close and next to each other. The bow has a flange with a cut slot having edges. Each of the edges of the cut slot is connected to a respective clamping jaw of the at least two clamping jaws.

According to a second aspect a left atrial appendage occlusion device has at least two clamping jaws. Each clamping jaw has an internal channel. A common resilient bow provides at least two arms connected to the at least two clamping jaws, and is configured to hold the

Date Reçue/Date Received 2021-10-20

clamping jaws close and next to each other. The bow has a flange with a cut slot having edges. Each of the edges of the cut slot is connected to a respective clamping jaw of the at least two clamping jaws. The internal channels of the clamping jaws are open from a side connected to the respective bow arm, and are closed on a side opposite to the respective bow arm. The side of the internal channel of a clamping jaw opposite to the respective bow has a closure having a conical shape. Tips of the conical shapes are divergent from each other.

According to a third aspect a left atrial appendage occlusion device has at least two clamping jaws, each having an internal channel. A common resilient bow provides at least two arms connected to the at least two clamping jaws, and is configured to hold the clamping jaws close and next to each other. The bow has a flange with a cut slot having edges. Each of the edges of the cut slot is connected to a respective clamping jaw of the at least two clamping jaws. The respective internal channels of the at least two clamping jaws each have an axis of symmetry. In a section of the bow arms perpendicular to the respective axis of symmetry, an imaginary line connecting the respective axes of symmetry is distant from an imaginary line connecting the respective center of the sections of the bow arms by a distance.

In a section perpendicular to the symmetry axes of the internal channels of the clamping jaws, a section of said jaws and a section of the bow arms is visible. In a preferred embodiment of the invention, in this section, an imaginary line connecting the symmetry axes of the internal channels of the clamping jaws is distant from an imaginary line connecting the centres of sections of the bow arms. The imaginary lines do not overlap.

The bow has the shape of a substantially flat or slightly curved flange. The bow according to the invention has in the central part of its periphery a larger section than in the places of connection with the clamping jaws. As a result, the bow strains resiliently when the clamping jaws open up, especially in the area of the jaws, not in the central part of the bow. The slot being created between the clamping jaws which are resiliently opened up is, owing to this design of the bow, of equal width over the entire length of the jaws. This means the same working pressure over the entire length of the jaws.

Date Reçue/Date Received 2021-10-20

As mentioned above, each clamping jaw contains an internal channel. The clamping jaw wall separates the internal channel from the outer surface of the clamping jaw. According to the invention, said wall of each of the clamping jaws, over the length corresponding to the length of the internal channel, is in its cross-section preferably irregular in thickness. If a clamping jaw is a tube, this means that the cylindrical outer surface of the tube and the cylindrical surface of the internal channel of the tube are not coaxial. The clamping jaw wall from the adjacent clamping jaw side, so in the working area of the clamping jaw, is the thinnest, whereas the wall of the same clamping jaw from the side of connection of the jaw with the bow arm is the thickest.

Date Reçue/Date Received 2021-10-20

In a preferred embodiment of the invention, the clamping jaws have straight symmetry axes, so they are straight in shape. However, a different shape of both jaws is not excluded in other embodiments, for example arcuate-shaped jaws.

The ends of the channels in the clamping jaws, from the bow side are open, and from the other side the ends of the channels in the clamping jaws contain closures.

Said closures of the internal channels in both clamping jaws, from the opposite side to the bow, in a preferred embodiment of the invention, have the shape of cones. The tops of both cones are preferably turned outwards from each other.

According to the invention it is proposed that two clamping jaws are connected by means of a resilient bow. The jaws from the side of the bow have internal channels open, and from the opposite side said channels comprise closures in the form of cones, where the tops of the cones are turned outwards. This makes it possible to insert two arms of a device to said internal channels of both jaws, from the side of the bow and open the jaws up using the device, enlarging a slot between the jaws. To the created slot, from the side of the conical closures of both jaws, it is easy to insert the base of the left atrial appendage and after releasing the device, clamp the jaws on the appendage, owing to the resilient qualities of the bow. The appendage closure is achieved with a single decided movement, without the need to intervene inside the left atrium and thread the whole appendage through the occlusion device loop, as provided for in a number of known solutions. The high speed of cut-off of the appendage interior from the blood flow, without it being deformed, reduces the risk of blood clots getting into the circulatory system compared to solutions where the appendage needs to be threaded.

Each of the clamping jaws has an internal channel non-coaxial in relation to the outer wall of the jaw. This is particularly visible when the clamping jaws have the form of tubes. The cylindrical outer surface of a tube has a different symmetry axis here than a cylindrical internal channel. Therefore, the thickness of the tube wall of which each jaw is made is not the same on the periphery. The jaw wall is the thinnest from the side of the other clamping jaw and the thickest from the side of connection with

the bow arm. Thus, the small wall thickness of each jaw from the side of the other clamping jaw, so from the side of contact with the left atrial appendage, additionally allows the correction of the pressure of both jaws on the appendage through the bending of the thin wall. Through the straining of the thin part of the wall under the mutual pressure of the jaw and the appendage, the width of contact increases and the highest value of pressure decreases, which is conducive to tissue viability in the area of contact. However, the thicker wall of both jaws from the side of connection with the bow arms prevents the straining of these parts of the surface of the clamping jaws under the pressure of the bow arms.

The bow can be a flat flange but in a preferred embodiment it is arched, thus it better adapts to the shape of the outer layer of the left atrium. The sectional dimension of the bow in a plane parallel to the surface of the left atrium is a few times bigger than the dimension in a direction perpendicular to the surface, which increases the contribution of twisting to the straining of the bow, and reduces bending. A big contribution of twisting makes it possible to preserve parallelism of the jaws when they open up and obtain equal distribution of pressure over the length of their contact with the appendage. In addition, in sections perpendicular to the axes of tubes, the axis passing through the centres of tubes is distant from the axis passing through the centres of the bow sections. This distance comprises the bow twisting arm. When the occlusion device is widened, so when the slot between the jaws is increased, the distance is increased, thus the occlusion device's stiffness is degressive and facilitates placing the occlusion device and reduces the influence of the appendage thickness on the clamping force.

Uniform pressure of both clamping jaws over the length of contact with the left atrial appendage makes it possible to achieve the effect of adhesion of the appendage walls, preventing unfavourable phenomena such as necrosis in the case of too strong pressure of the clamping jaws.

The object of the invention is shown in the embodiment in the accompanying drawings in which individual figures show:

Fig. 1 – the occlusion device in a side view.

Fig. 2 – the occlusion device according to Fig. 1 in a top view.

Fig. 3 – the occlusion device according to Fig. 1 in a view from the direction of the symmetry axes of the channels of the clamping jaws.

Fig. 4 – the occlusion device according to Fig. 2 with sections of the bow arms.

Fig. 5 – the occlusion device according to Fig. 2 in an A-A section.

Fig. 6 – the occlusion device with the jaws open when placed on the left atrial appendage.

Fig. 7 – a section of the occlusion device according to Fig. 9 on the appendage.

Fig. 8 – a section of the occlusion device according to Fig. 7 in an enlarged view.

Fig. 9 – a schematic view of the occlusion device in a working position.

As shown in the embodiment in the accompanying drawings, an occlusion device 1 comprises two clamping jaws 2 fixed to a common resilient element. The resilient element holds the jaws 2 close to each other. The occlusion device 1 is made as a monolithic product, of plastic material inert to the human body, for example of polyamide. The occlusion device can be made using different technologies, but in this embodiment the 3-D printing technology is used.

The resilient element comprises a bow 3 in the form of a flange with a cut slot. The slot is not shown in the accompanying drawings, because each of its edges 4 is connected with the clamping jaw 2. The edge 4 of the slot is schematically marked in Fig. 1 and Fig. 2.

Each of the clamping jaws 2 contains an internal channel 5. The clamping jaw 5 in this embodiment of the occlusion device according to the invention has the form of a tube. In other embodiments the clamping jaw 2 may have a different form, for example a flat with rounded edges, comprising said internal channel 5. In the position of rest, the clamping jaws 2 maintain a resilient position next to each other. This is shown in Fig. 2, Fig. 3 and Fig. 4. However, a slot is allowed between the clamping jaws 2 in the position of rest, but the slot cannot be wider than the total thickness of both put together walls of the left atrial appendage.

Fig. 5 shows the occlusion device according to the invention in an A-A section from Fig. 2.

The occlusion device according to the invention is shown in Fig. 7 and Fig. 8 in a section perpendicular to the symmetry axes of the internal channels 5 of the clamping jaws 2. The figures show a section of said jaws 2 and a section of the bow 3 arms.

The embodiment in Fig. 8 shows an enlarged view of a section of the occlusion device with a plane perpendicular to the symmetry axes of the channels 5 in the jaws 2. An imaginary line 12 connecting the symmetry axes of the internal channels 5 of the clamping jaws is shown. The imaginary line 12 is distant from an imaginary line 13 connecting the centres of sections of the bow 3 arms, in this section of the occlusion device 1 by a distance 14.

The bow 3 has the shape of a substantially flat or slightly curved flange. This is shown in Fig. 1, Fig. 2, Fig. 3, Fig. 4, Fig. 5 and Fig. 6. The bow 3 in this embodiment has in the central part of its periphery a larger section 6 than a section 7 near the places of connection with the clamping jaws 2. This is shown in detail in Fig. 4. The same figure also shows an intermediate section of the bow 3 arm between the sections 6, 7. With such changes of the sections a uniform durability of the bow is obtained, but also by reducing a dimension in the section 7, the bending stiffness of the fixing of the jaws to the bow is reduced. As a result, the fixing becomes a resilient joint, equalising pressure over the length of contact of the jaws and the appendage.

In this embodiment, each clamping jaw 2 has the form of a tube and contains the internal channel 5. In other embodiments of the occlusion device according to the invention the jaws 2 may have a different form, but also each of them preferably comprises said internal channel 5.

The clamping jaw 2 wall 9 separates the internal channel 5 from the outer surface of the jaw 2. In this embodiment of the occlusion device, said wall 9 of each of the clamping jaws 2, over the length corresponding to the length of the internal channel 5, is in its cross-section irregular in thickness. This is particularly clearly shown in Fig. 7 and Fig. 8, but also in Fig. 2, Fig. 3, Fig. 4 and Fig. 6. These figures show that the

outer surface and the surface of the internal channel 5 of the jaw 2 are not coaxial. The jaw 2 wall 9 from the adjacent jaw 2 side, so in the working area of the clamping jaws 2 is the thinnest, whereas the wall 9 of the same clamping jaw 2 from the side of connection of the jaw 2 with the bow 3 arm is the thickest. The result is a rigid connection of the bow 3 with the jaw 2 from one side of the jaw 2 periphery, and on the other side of the jaw 2 periphery, the wall 9 with some degree of flexibility. The flexible parts of the walls 9 of both jaws 2 face each other. This is shown in detail in Fig. 8.

In the embodiment shown in the accompanying drawings, the clamping jaws 2 comprise tubes and have straight symmetry axes, so they are straight in shape. However, a different shape of both jaws is not excluded in other embodiments, for example arcuate-shaped jaws. Both jaws 2 have substantially the same shape of the working part. However, in other embodiments they can have different shapes, for example complementary shapes of working surfaces.

Fig. 1, Fig. 2, Fig. 4 and Fig. 5 show that the ends of the channels 5 in the clamping jaws 2, from the bow 3 side are open, and from the other side the ends of the channels 5 in the clamping jaws 2 contain closures 10. Said closures 10 of the channels 5 of both clamping jaws 2, from the opposite side to the bow 3, in this embodiment, have the shape of cones. The tops of cones of both closures 10 are turned outwards from each other. This is clearly shown in Fig. 2 and Fig. 4. This turning of the tops of the closures 10 facilitates insertion of the left atrial appendage between the open jaws 2. In other embodiments of the occlusion device according to the invention, the closures 10 may have a different shape.

The occlusion device 1 according to the invention is shown in a working position in Fig. 9. The clamping jaws 2 are clamped at the base of the left atrial appendage 11. The occlusion device 1 comprises an implanted implant which after some time results in the adhesion of the appendage 11 walls and the closure of its cavity. This makes it possible to occlude the connection of the left atrium with the internal cavity of the appendage 11 and thus eliminate the place of potential formation and accumulation of dangerous blood clots.

List of designations in the figures.

1. Occlusion device.
2. Clamping jaw.
3. Bow.
4. Edge of the bow slot.
5. Internal channel.
6. Section of the central part of the bow.
7. Section of the bow near the jaw 2.
8. Slot between the jaws.
9. Clamping jaw wall.
10. Internal channel closure.
11. Left atrial appendage.
12. Line connecting the symmetry axes of the channels 5.
13. Line connecting the centres of sections of the bow arms.
14. Distance of line 12 from line 13.

WHAT IS CLAIMED IS:

1. A left atrial appendage occlusion device comprising:

at least two clamping jaws, each of the clamping jaws having a tubular configuration with an internal channel;

a common resilient and monolithic bow providing at least two arms connected to the at least two clamping jaws, and being configured to hold the clamping jaws close and next to each other, the bow comprising a flange with a cut slot having edges,

wherein each of the edges of the cut slot is connected to a respective clamping jaw of the at least two clamping jaws.

2. The left atrial occlusion device according to claim **1**, wherein the respective internal channels of the at least two clamping jaws each have an axis of symmetry, and in a section of the bow arms perpendicular to the respective axis of symmetry, an imaginary line connecting the respective axes of symmetry, is distant from an imaginary line connecting the respective center of the sections of the bow arms by a distance.

3. The left atrial occlusion device according to claim **2**, wherein the bow has a periphery with a central part, the periphery having a larger section than a section where the bow arms are connected with the clamping jaws.

4. The left atrial occlusion device according to claim **1**, wherein each of the clamping jaws has a respective wall within the internal channel having, in cross-section, an irregular thickness, wherein the wall proximate to an adjacent clamping jaw side is the thinnest, and the wall from a side of the clamping jaw connected to the respective bow arm is the thickest.

5. The left atrial occlusion device according to claim **1**, wherein the internal channels of the clamping jaws have straight axis of symmetry.

6. A left atrial appendage occlusion device comprising:

at least two clamping jaws, each comprising an internal channel;

Date Reçue/Date Received 2021-10-20

a common resilient bow providing at least two arms connected to the at least two clamping jaws, and being configured to hold the clamping jaws close and next to each other, the bow comprising a flange with a cut slot having edges,

wherein each of the edges of the cut slot is connected to a respective clamping jaw of the at least two clamping jaws,

wherein the internal channels of the clamping jaws are open from a side connected to the respective bow arm, and are closed on a side opposite to the respective bow arm, and

wherein the side of the internal channel of a clamping jaw opposite to the respective bow has a closure having a conical shape, where tips of the conical shapes are divergent from each other.

7. A left atrial appendage occlusion device comprising:

at least two clamping jaws, each comprising an internal channel;

a common resilient bow providing at least two arms connected to the at least two clamping jaws, and being configured to hold the clamping jaws close and next to each other, the bow comprising a flange with a cut slot having edges,

wherein each of the edges of the cut slot is connected to a respective clamping jaw of the at least two clamping jaws, and

wherein the respective internal channels of the at least two clamping jaws each have an axis of symmetry, and, in a section of the bow arms perpendicular to the respective axis of symmetry, an imaginary line connecting the respective axes of symmetry is distant from an imaginary line connecting the respective center of the sections of the bow arms by a distance.

8. The left atrial occlusion device according to claim **7**, wherein the bow has in a central part of its periphery a larger section than a section wherein the bow arms are connected with the clamping jaws.

Date Reçue/Date Received 2021-10-20

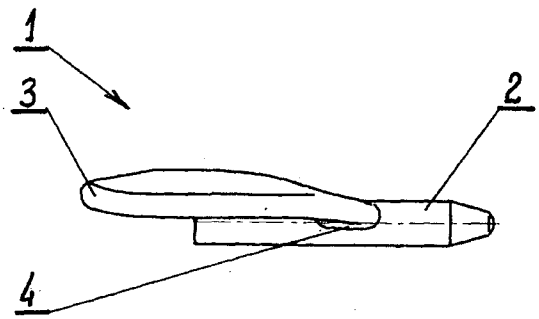


Fig. 1

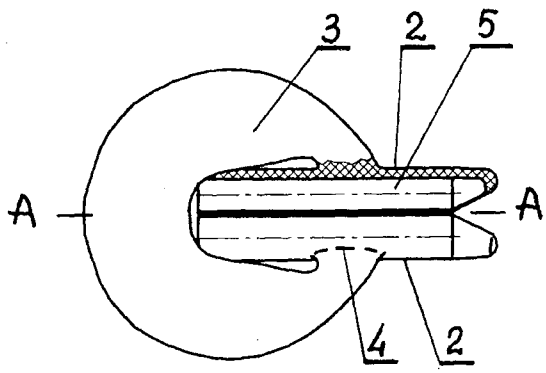


Fig. 2

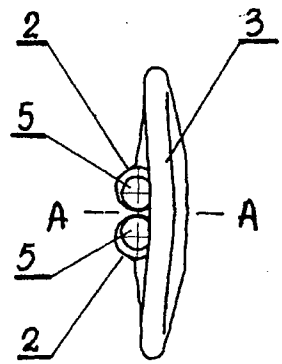


Fig. 3

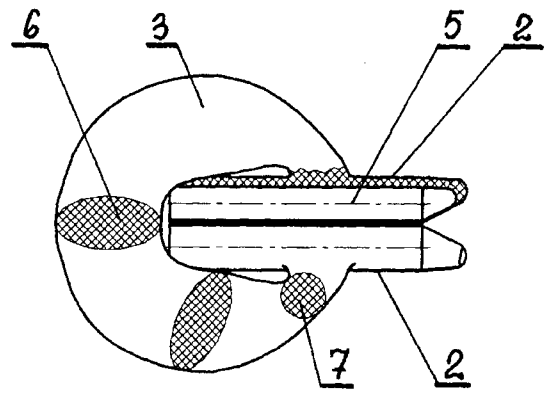


Fig. 4

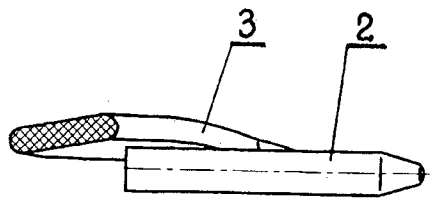


Fig. 5

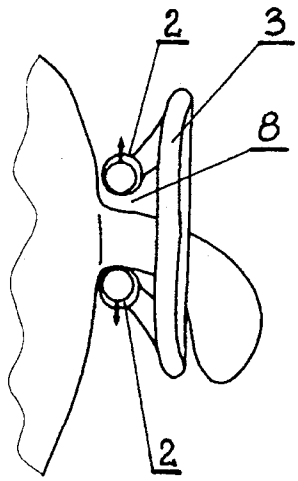


Fig. 6

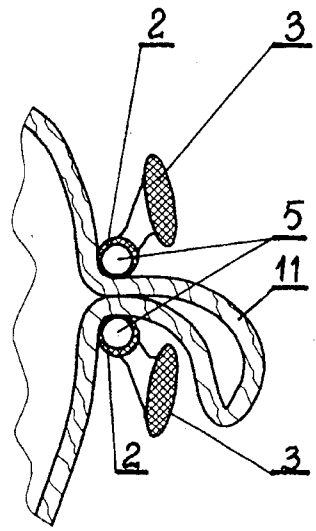


Fig. 7

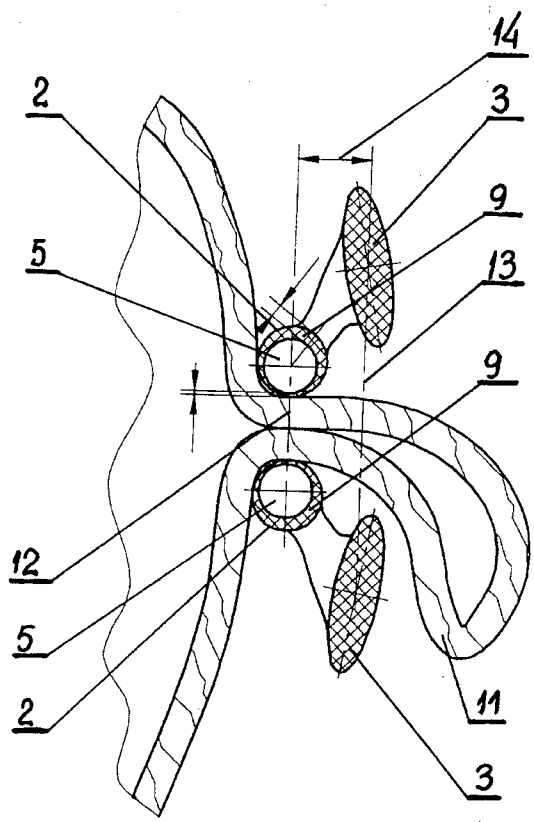


Fig. 8

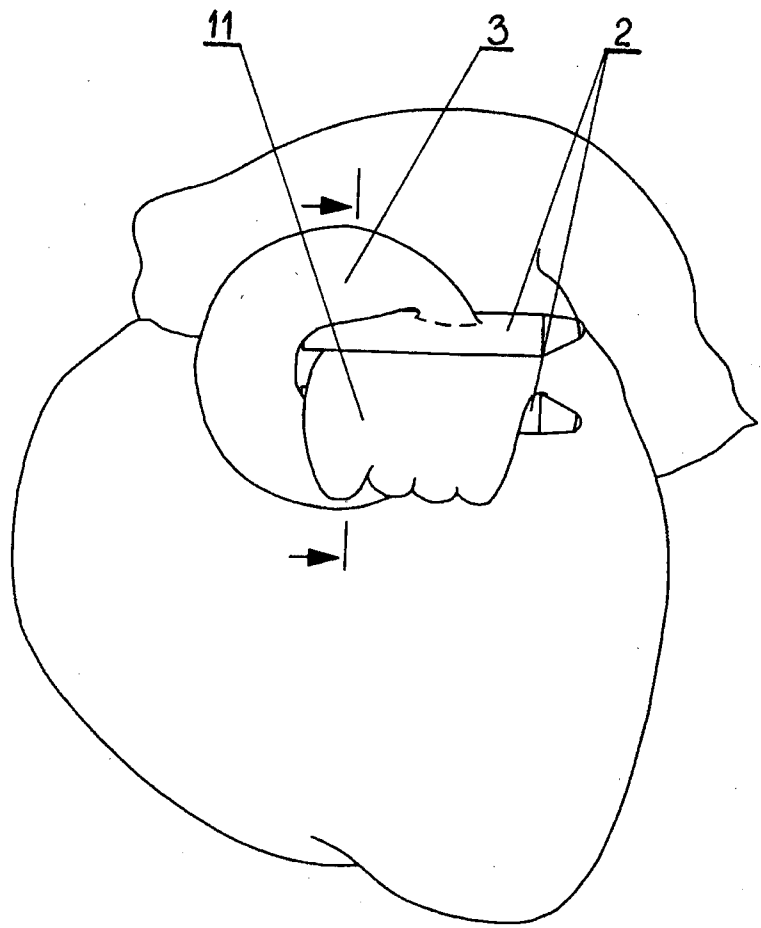
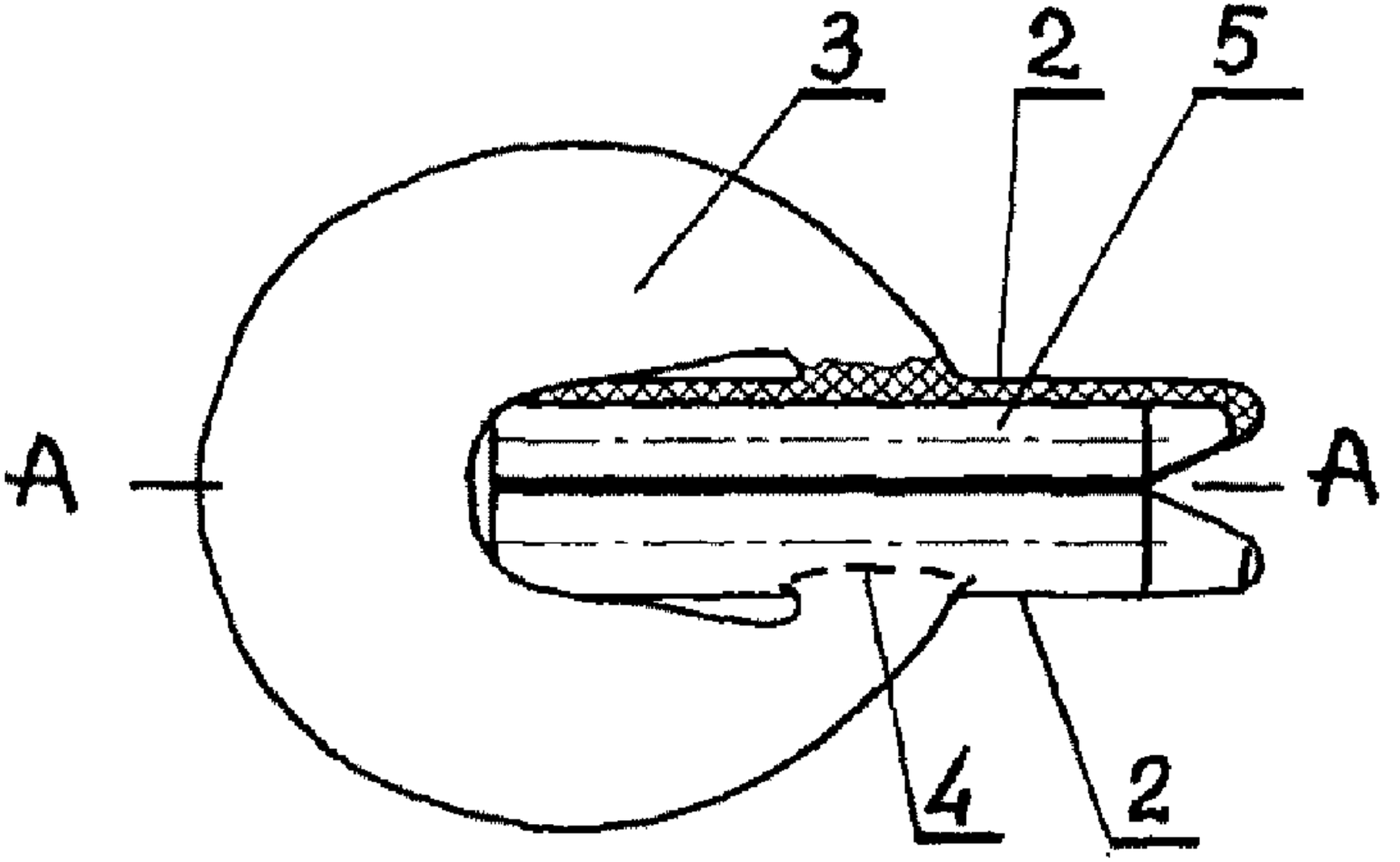


Fig. 9


3
2
5
A
A
4
2