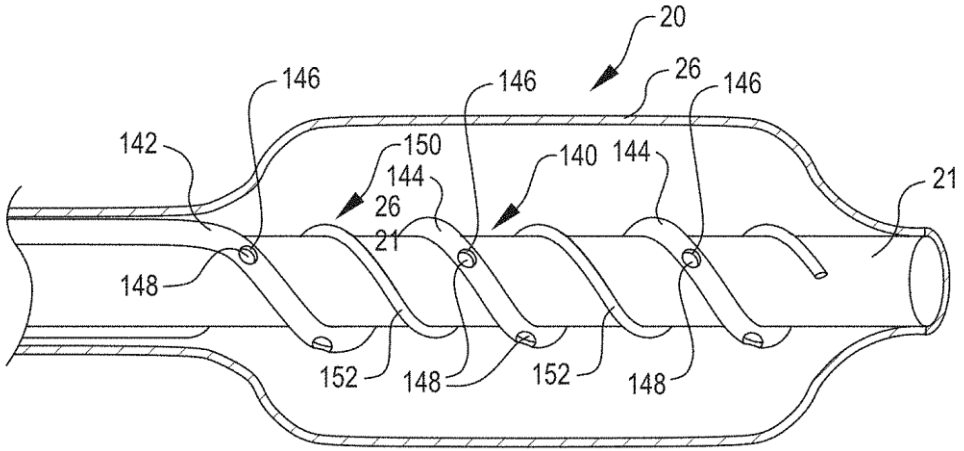
# Portfolio View

**3rd Quarter 2019**



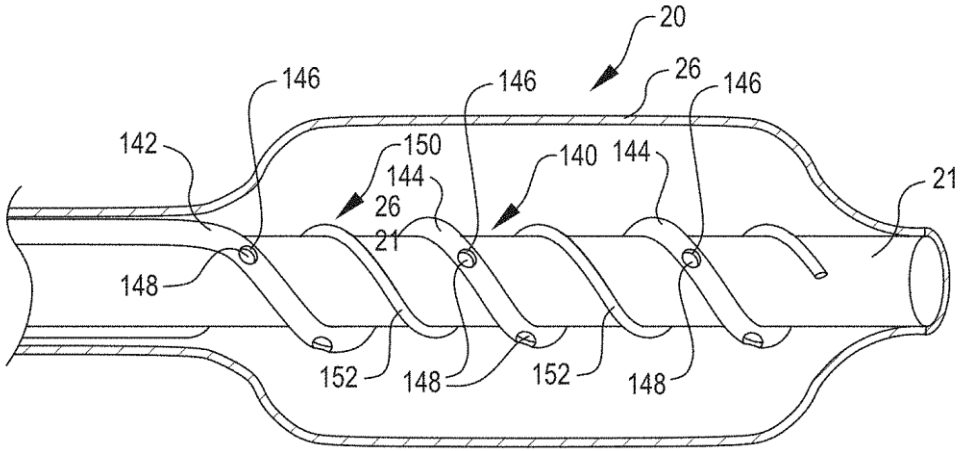

SHOCK WAVE BALLOON CATHETER WITH MULTIPLE SHOCK WAVE SOURCES

# SHOCK WAVE BALLOON CATHETER WITH MULTIPLE SHOCK WAVE SOURCES

PRODUCT NAME

FAMILY Summary…

- U.S. case summary - 3 US(9,993,292; 9,011,463; 9,642,673)
  - Estimated expiration date: 06/27/2032
- 3 AU; 1 BR; 1 CA; 2 CN; 1 EP; 2 JP; 1 WO
  - Earliest Foreign Expiration Dates: 06/27/2032
- 3 US Pending
  - Earliest Priority Date: 06/27/2012



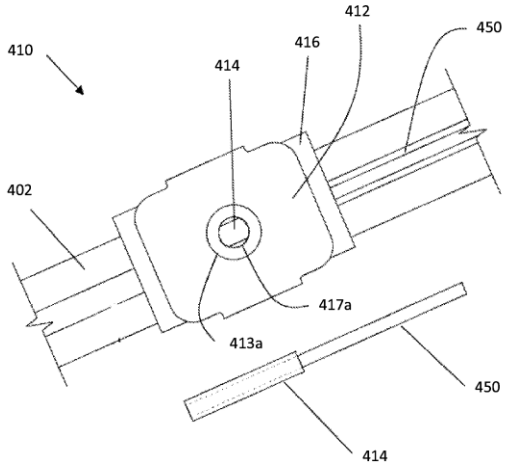

- Issued Claims Summary
  - A device for generating shock waves for treating a calcified lesion within a blood vessel or a calcified aortic valve comprising: an elongated support; a fluid fillable chamber mounted on the support; a first wire extending along the support and into the chamber; a second wire extending along the support into the chamber, with the proximal ends of the first and second wires being connectable to a high voltage source, and wherein a distal portion of the first wire is helically wound around the support, and wherein a distal portion of the second wire is helically wound around the support, interleaved with the helically wound first wire, the helical windings being located within the chamber, and wherein said first wire is coated with insulation and wherein at least one discrete region of the insulated coating is removed from the side of the first wire opposite to the support to expose said first wire to the fluid in the chamber, said exposed region being in the helically wound portion of said first wire spaced from the distal end thereof and wherein when a high voltage pulse is applied to the first and second wires, an electrical arc is initiated at said exposed region of said first wire allowing current to flow to second wire and generating a shock wave for treating the calcified lesion or valve.

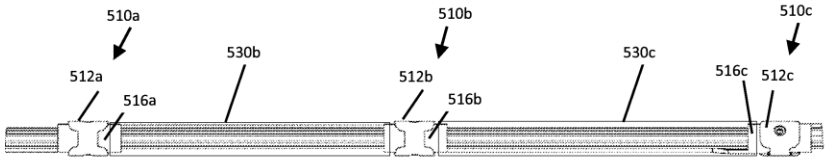
# ANGIOPLASTY BALLOON

PRODUCT NAME

FAMILY Summary…

- U.S. case summary - 1 US(9,867,629)
  - Estimated expiration date: 07/25/2036
- 1 WO
- 1 US Pending
  - Earliest Priority Date: 07/31/2013



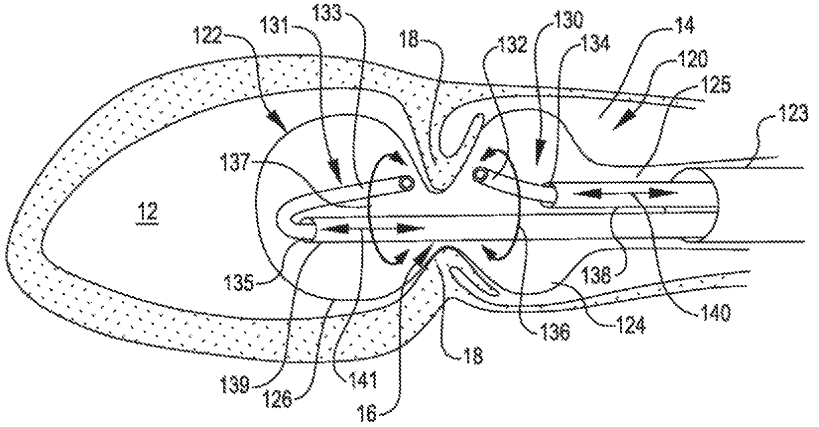

- Issued Claims Summary
  - A device for generating shock waves comprising: an elongate member having a diameter; a first electrode assembly at a first axial location on the elongate member and comprising a first inner sheath surrounded by a first outer sheath, with the diameter of the first outer sheath being larger than the diameter of the elongated member, and wherein the length of the first inner sheath is greater than the length of the first outer sheath such that the ends of the first inner sheath extend beyond the ends of the first outer sheath; a second electrode assembly at a second axial location on the elongate member and comprising a second inner sheath surrounded by a second outer sheath, with the diameter of the second outer sheath being substantially the same as the diameter of the first outer sheath, wherein the length of the second inner sheath is greater than the length of the second outer sheath such that the ends of the second inner sheath extend beyond the ends of the second outer sheath; and a tubular sleeve surrounding the elongate member and axially extending between the first and second outer sheaths and covering at least a portion of the first and second inner sheaths along the ends thereof that extend beyond the first and second outer sheaths, the tubular sleeve having an outer diameter substantially similar to the outer diameter of the first outer sheath, said tubular sleeve being radially shrinkable to create a substantially continuous outer diameter along the length of the elongate member.

# SHOCK WAVE VALVULOPLASTY DEVICE WITH MOVEABLE SHOCK WAVE GENERATOR

PRODUCT NAME

FAMILY Summary…

- U.S. case summary - 4 US(9,814,476; 8,57,4247; 8,709,075; 9,289,224)
  - Estimated expiration date: 11/08/2031
- 1 WO
- 5 US Pending
  - Earliest Priority Date: 11/08/2011



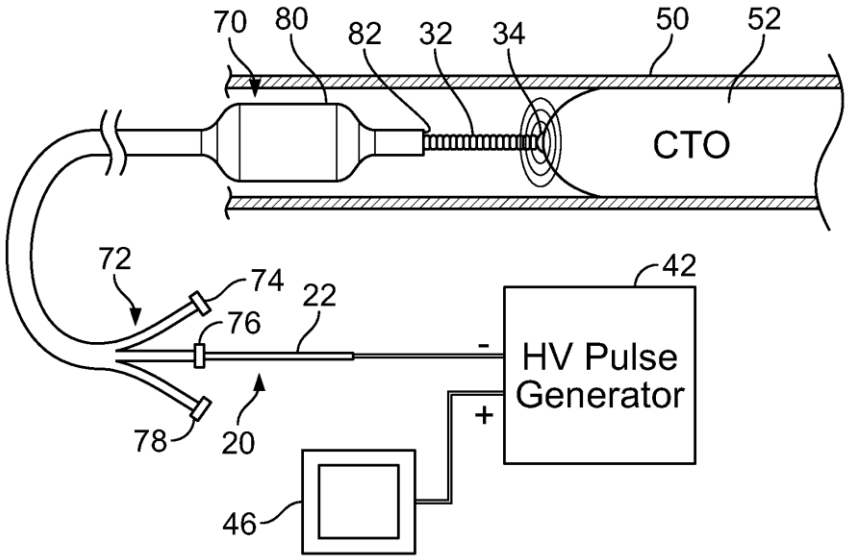

- Issued Claims Summary
  - A device for softening and/or breaking tissue calcifications comprising: an elongate tube; a balloon inflatable with a liquid having a longitudinal axis located at the distal end of the elongate tube; and a shock wave generator within the balloon, wherein the shock wave generator is arranged to produce a shock wave within the balloon to propagate through the liquid for impinging upon the calcified tissue, and wherein the shock wave generator is mounted on an elongate element that is slidably received within the balloon such that the shock wave generator is configured to move from a first location within the balloon to a second location within the balloon that is displaced along the longitudinal axis from the first location.

# SHOCK WAVE GUIDE WIRE

PRODUCT NAME

FAMILY Summary…

- U.S. case summary - 1 US(9,730,715)
  - Estimated expiration date: 07/19/2034
- 1 WO
- 2 US Pending
  - Earliest Priority Date: 05/08/2014



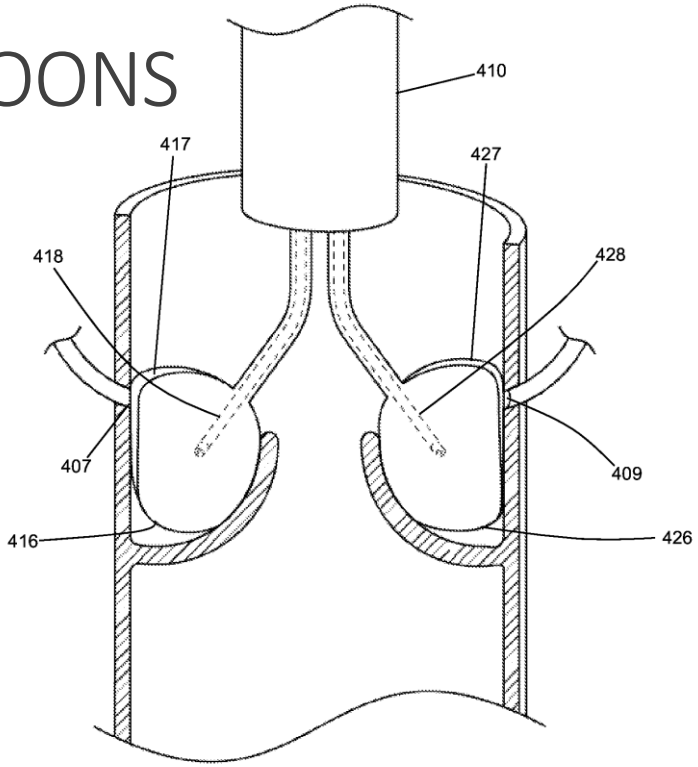

- Issued Claims Summary
  - A method for use in guiding an elongated catheter through an artery or vein of a mammalian body having a stenosis and/or an occlusion therein, the method comprising: providing an elongated guide wire having a longitudinal dimension, a proximal end and a distal end and an insulator overlying the elongated guide wire, the insulator configured to expose the distal end of the elongated guide wire to form a monopolar electrode; inserting the elongated catheter into an artery or vein to a point adjacent the stenosis and/or the occlusion; passing the guide wire through the catheter so that the distal end of the guide wire passes out through the distal end of the catheter directly into the vessel and adjacent the stenosis and/or the occlusion; and applying at least one high voltage pulse to the elongated guide wire, said voltage pulse being between about 300 and 3000 volts and between 0.1 to 2.0 microseconds in duration to cause at least one electrical arc at the electrode that in turn forms at least one steam bubble and a shock wave to break the stenosis and/or open the occlusion.
  - A method for opening a vascular occlusion comprising: advancing a shock wave guide wire within the vasculature to contact the vascular occlusion, wherein the shock wave guide wire comprises an elongated conductor with a conductive distal tip defining a monopolar electrode and an insulator overlying the elongate conductor without covering the conductive distal tip; advancing an angioplasty balloon catheter over the shock wave guide wire to the vascular occlusion; applying at least one high voltage pulse to the guide wire, said voltage pulse being between about 300 and 3000 volts and between 0.1to 2.0 microseconds in duration to cause at least one electrical arc at the electrode that in turn forms at least one steam bubble and a shock wave to create one or more openings in the occlusion; and advancing the angioplasty balloon catheter into the one or more openings to perform an angioplasty procedure.
  - A method for opening a vascular occlusion comprising: advancing a shock wave guide wire within the vasculature to contact the vascular occlusion, wherein the shock wave guide wire comprises an elongated conductor with a conductive distal tip defining a monopolar electrode and an insulator overlying the elongate conductor without covering the conductive distal tip; and generating one or more shock waves using the guide wire to create one or more openings in the occlusion wherein each shock wave is generated by applying a high voltage pulse to the guide wire, said voltage pulse being between about 300 and 3000 volts and between 0.1 to 2.0 microseconds in duration to create an electrical arc at the electrode that in turn forms at least one steam bubble and a shock wave.

# SHOCKWAVE VALVULOPLASTY WITH MULTIPLE BALLOONS

PRODUCT NAME

FAMILY Summary…

- U.S. case summary - 1 US(9,554,815)
  - Estimated expiration date: 05/21/2034
- 3 AU; 1 CA; 2 CN; 1 EP; 1 JP; 1 WO
  - Earliest Foreign Expiration Dates: 08/08/2033
- 2 US Pending
  - Earliest Priority Date: 08/08/2012



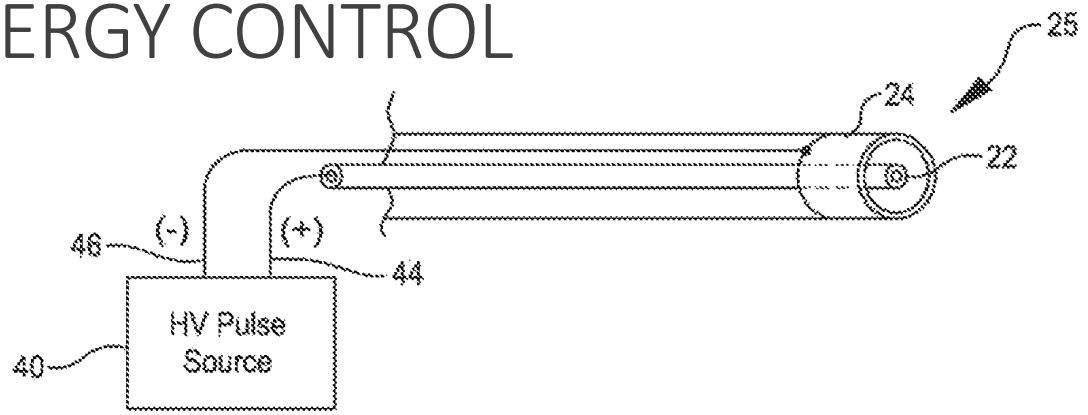

- Issued Claims Summary
  - A method for applying shock waves to an aortic valve having a first cusp and a second cusp each having a free edge comprising: intro the shock wave device comprising a first elongate body, a first balloon sealably enclosing a portion of the first elongate body, a first s enclosed within the first balloon, a second elongate body, a second balloon sealably enclosing a portion of the second elongate body elongate body and enclosed within the second balloon, wherein the first and second balloons are independently inflatable with a liqu vasculature to the aortic valve; inflating the first balloon with a liquid, wherein inflating the first balloon causes the first balloon to be aligned within a concave portion of the first cusp facing the aorta; inflating the second balloon with a liquid, wherein inflating the second balloon causes the second balloon to be aligned within a concave portion of the second cusp facing the aorta and wherein the first and second balloons do not extend beyond the free edges of the first and second cusps respectively to permit blood to flow through the aortic valve; and activating the first shock wave source to apply a shock wave to the first cusp.
  - A method for applying shock waves to an aortic valve having a first cusp and a second cusp comprising: introducing a shock wave device into a patient's vasculature, the shock wave device comprising a first elongate body, a first balloon sealably enclosing a portion of the first elongate body, a first shock wave source coupled to the first elongate body and enclosed within the first balloon, a second elongate body, a second balloon sealably enclosing a portion of the second elongate body, and a second shock wave source coupled to the second elongate body and enclosed within the second balloon, wherein the first and second balloons are independently inflatable with a liquid; advancing the shock wave device within the vasculature to the aortic valve; inflating the first balloon with a liquid, wherein inflating the first balloon causes the first balloon to be aligned within a concave portion of the first cusp facing the aorta; inflating the second balloon with a liquid, wherein inflating the second balloon causes the second balloon to be aligned within a concave portion of the second cusp facing the aorta; thereafter, deflating the second balloon to permit increased blood flow through the aortic valve; thereafter activating the first shock wave source to apply a shock wave to the first cusp; after activating the first shock wave source, reinflating the second balloon with a liquid and deflating the first balloon; and thereafter activating the second shock wave source to apply a shock wave to the second cusp.

# SHOCKWAVE CATHETER SYSTEM WITH ENERGY CONTROL

PRODUCT NAME

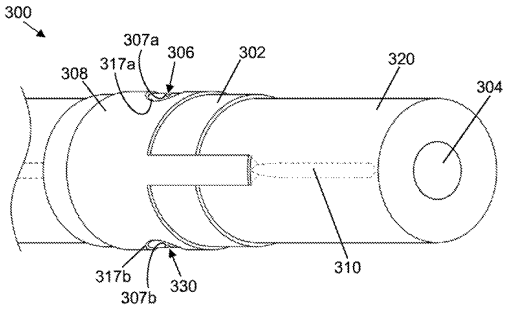
FAMILY Summary…

- U.S. case summary - 4 US(9,522,012; 8,728,091; 9,005,216; 9,333,000)
  - Estimated expiration date: 07/27/2033
- 2 AU; 1 CA; 3 CN; 1 EP; 2 JP; 1 WO
  - Earliest Foreign Expiration Dates: 09/13/2032
- 6 US Pending
  - Earliest Priority Date: 09/13/2012




- Issued Claims Summary
  - A system comprising: a catheter including an elongated carrier, a balloon about the carrier in sealed relation thereto, the balloon being arranged to receive a fluid therein that inflates the balloon, and first and second electrodes within the balloon arranged to carry a voltage there-across including an initial high electrical voltage at an initial low current, the initial high electrical voltage causing an electrical arc to form within the balloon, the electrical arc causing a gas bubble within the liquid, a high current to flow through the first and second electrodes, a decrease in the initial high electrical voltage, and a mechanical shock wave within the balloon; and a power source that provides the first and second electrodes with a drive voltage pulse that creates the initial high electrical voltage at the initial current and that terminates the drive voltage pulse in response to the decrease in the initial high electrical voltage.
  - A system comprising: a catheter including an elongated carrier, the carrier having a guide wire lumen, a balloon having an inner surface about the carrier in sealed relation thereto, a channel arranged to receive a fluid that inflates the balloon, and first and second electrodes, within the balloon between the carrier and the inner surface of the balloon, the first and second electrodes within the balloon being arranged to carry a voltage there-across including an initial high electrical voltage at an initial low current, the initial high electrical voltage causing an electrical arc to form within the balloon, the electrical arc causing a gas bubble within the liquid, a high current to flow through the first and second electrodes, a decrease in the initial high electrical voltage, and a mechanical shock wave within the balloon; and a power source that provides the first and second electrodes with a drive voltage pulse that creates the initial high electrical voltage at the initial current and that terminates the drive voltage pulse in response to the decrease in the initial high electrical voltage..

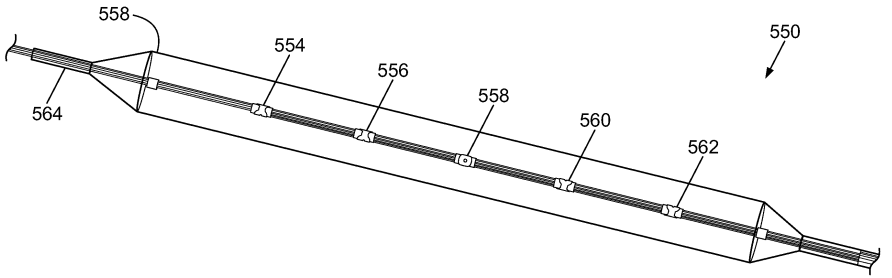
# LOW PROFILE ELECTRODES FOR AN ANGIOPLASTY SHOCK WAVE CATHETER




PRODUCT NAME

FAMILY Summary…

- U.S. case summary - 3 US(9,433,428; 8,747,416; 8,888,788)
  - Estimated expiration date: 03/24/2033
- 2 AU; 1 CA; 1 CN; 2 EP; 3 JP; 1 WO
  - Earliest Foreign Expiration Dates: 12/07/2017
- 4 US Pending
  - Earliest Priority Date: 08/06/2012



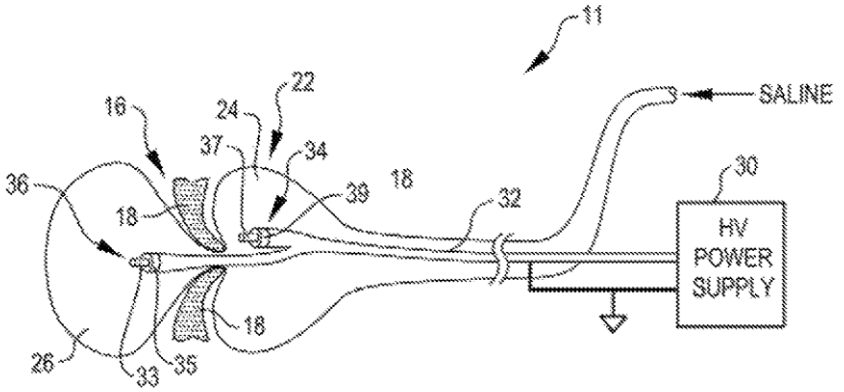

- Issued Claims Summary
  - A device for generating shock waves for cracking calcified lesions comprising: an axially extending elongate member; a balloon surrounding a portion of the elongate member, said balloon being fillable with a conductive fluid: a first wire extending along a length of the elongate member, said wire being insulated and having a non-insulated portion defining a first inner electrode; a second wire extending along the length of the elongate member said second wire being insulated and having a first non-insulated portion defining a second inner electrode, said second inner electrode being located at a position circumferentially offset from the first inner electrode, said second wire having a second non-insulated portion defining a third inner electrode axially spaced from the first inner electrode along the length of the elongate member; a first conductive sheath having first and second apertures formed therein, said sheath being mounted on the elongate member so that the first aperture thereof is aligned with the first inner electrode and the second aperture thereof is aligned with the second inner electrode; a third wire extending along a length of the elongate member, said wire being insulated and having a non-insulating portion defining a fourth inner electrode, said fourth inner electrode being located at a position circumferentially offset from the third inner electrode and substantially at the same axial location as the third inner electrode; and a second conductive sheath having first and second apertures formed therein, said second conductive sheath being mounted on the elongate member so that the first aperture thereof is aligned with the third inner electrode and the second aperture thereof is aligned with the fourth inner electrode and arranged such that when said balloon is filled with a conductive fluid and a voltage is applied to the first and third wires, shockwaves will be generated near each of the first, second, third and fourth inner electrodes with a series connection being defined as the current travels along a path extending from the first inner electrode to the first conductive sheath and from the first conductive sheath to the second inner electrode and from the second inner electrode to the third inner electrode, and from the third inner electrode to the second conductive sheath and from the second conductive sheath to the fourth inner electrode.

# SHOCKWAVE VALVULOPLASTY CATHETER SYSTEM

PRODUCT NAME

FAMILY Summary…

- U.S. case summary - 3 US(9,421,025; 9,044,618; 9,044,619)
  - Estimated expiration date: 11/04/2029
- 2 AU; 2 CA; 2 CN; 3 EP; 6 JP; 2 WO
  - Earliest Foreign Expiration Dates: 11/04/2029
- 4 US Pending
  - Earliest Priority Date: 11/05/2008



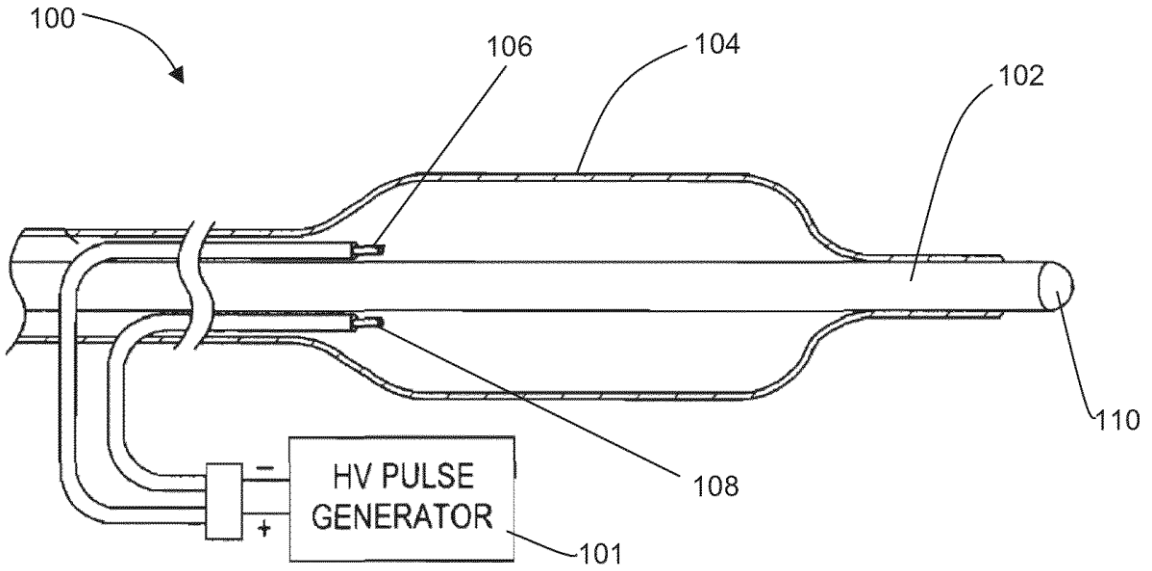

- Issued Claims Summary
  - An intravascular valvuloplasty system for breaking calcium deposits on the leaflets of an aortic valve, each leaflet connected to a wall and having a concave region, comprising: an elongate body; a balloon being inflatable with a liquid via an inflation lumen provided in the elongate body, wherein the inflated balloon has a portion shaped to fit within the concave region of a leaflet and between the leaflet and the wall; and a shock wave generator for generating shock waves that propagate through the liquid for impinging upon the leaflets and breaking calcium deposits on the leaflets.
  - An intravascular valvuloplasty method for breaking calcium deposits on the leaflets of an aortic valve, each leaflet connected to the wall of the aorta and having a concave region, comprising: advancing an elongated tube into the region of the aortic valve, said tube including a fluid lumen, said elongated tube including a balloon on the distal end thereof, said balloon carrying a shock wave generator located between the tube and the inner surface of the balloon; inflating the balloon with a liquid delivered through the fluid lumen in a manner so that a portion of the balloon fits within the concave region of a leaflet between the leaflet and the wall; and energizing the shock wave generator to produce a shock wave within the balloon that propagates through the liquid for impinging upon the valve leaflet in order to break calcium deposits on the leaflet.
  - An intravascular valvuloplasty method for breaking calcium deposits on an aortic valve having leaflets, comprising: advancing an elongated tube into the region of the aortic valve, said tube including at least one fluid lumen, said elongated tube carrying two balloon chambers near the distal end thereof; inflating the balloon chambers with a liquid delivered through the at least one fluid lumen, with one balloon chamber being positioned on one side of the valve and the other balloon chamber being positioned on the other side of the valve, each of said balloon chambers having a shock wave generator located therein; and energizing both of the shock wave generators in both balloon chambers so that the shock waves generated thereby impinge on both sides of the leaflets in order to break calcium deposits on the leaflets.

# SHOCKWAVE NERVE THERAPY SYSTEM AND METHOD

PRODUCT NAME

FAMILY Summary…

- U.S. case summary - 1 US(9,237,984)
  - Estimated expiration date: 02/13/2034
- 1 US Pending
  - Earliest Priority Date: 08/10/2012




- Issued Claims Summary
  - A method for nerve therapy comprising: advancing a shock wave device within a renal artery, wherein the shock wave device comprises an elongate body having a guide wire lumen, and a shock wave generator coupled to the elongate body; and initiating a shock wave from the shock wave generator at a first location in the renal artery adjacent to a renal plexus to impinge upon a wall of the renal artery to at least partially block activation of a renal plexus and wherein the shock wave device further comprises a balloon sealably enclosing a portion of the elongate body, and wherein the shock wave generator is located within the balloon, and wherein the method further comprises inflating the balloon with a liquid before initiating a shock wave from the shock wave generator.
  - A method for nerve therapy comprising: advancing a shock wave device within a carotid sinus, wherein the shock wave device comprises an elongate body having a guide wire lumen, and first and second shock wave generators coupled to the elongate body wherein the first shock wave generator is at a first location and the second shock wave generator is at a second location; and initiating shock waves at substantially the same time from both the first and second shock wave generators at said first and second locations in the carotid sinus to impinge upon and activate baroreceptors located in the carotid sinus.

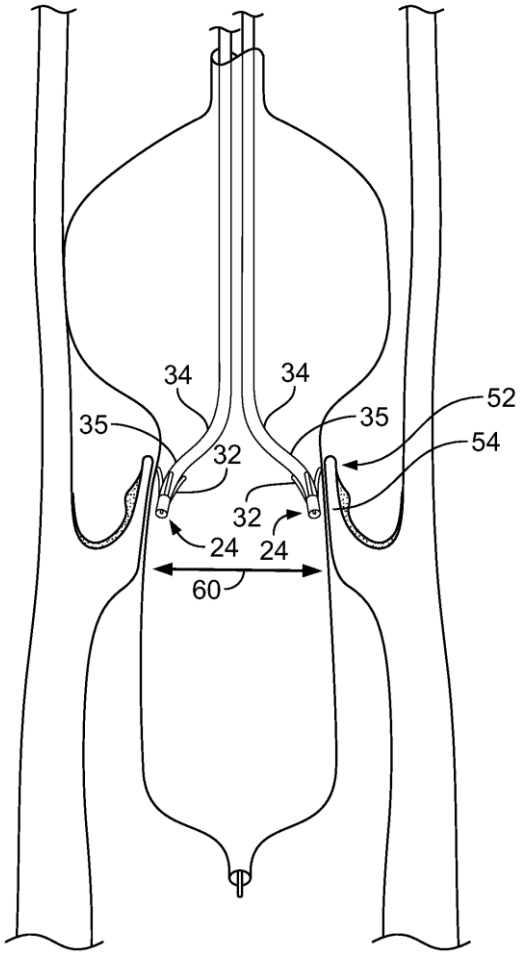
# SHOCKWAVE CATHETER

PRODUCT NAME

FAMILY Summary…

- U.S. case summary - 1 US(9,220,521 )
  - Estimated expiration date: 06/28/2034
- 1 CA; 1 CN; 2 EP; 2 JP; 1 WO
  - Earliest Foreign Expiration Dates: 04/24/2018
- 1 US Pending
  - Earliest Priority Date: 08/06/2012

- Issued Claims Summary
  - A catheter comprising: an elongated body; an inflatable balloon carried by the elongated body, the balloon having an inner surface and an outer surface; at least one shock wave source within the inflatable balloon wherein the shock wave source is biased towards the inner surface of the balloon when the balloon is inflated; and a follower arrangement, said follower arrangement including a stand-off that maintains the at least one shock wave source a substantially fixed distance from the inner surface of the balloon when the balloon is inflated.
  - A method comprising: providing a catheter including an elongated body, an inflatable balloon carried by the elongated body, the balloon having an inner surface and an outer surface, and at least one shock wave source within the inflatable balloon; inserting the catheter into a vein or artery of a patient and placing the balloon adjacent to an anatomical structure to be treated; inflating the balloon with a liquid; biasing the shock wave source towards the inner surface of the balloon; causing the shock wave source to provide shock waves within the balloon that propagate through the liquid to treat the anatomical structure; maintaining the at least one shock wave source a substantially fixed distance from the inner surface of the balloon while the shock waves are provided by the at least one shock wave source.
  - A catheter comprising: an elongated body; an inflatable balloon carried by the elongated body, the balloon having an inner surface and an outer surface; an elongated lead carrying at least one shock wave source located within the inflatable balloon, wherein the lead is biased towards the inner surface of the balloon when the balloon is inflated; and a stand-off attached to the lead and configured to space the shock wave source away from the inner surface of the balloon when the balloon is inflated.

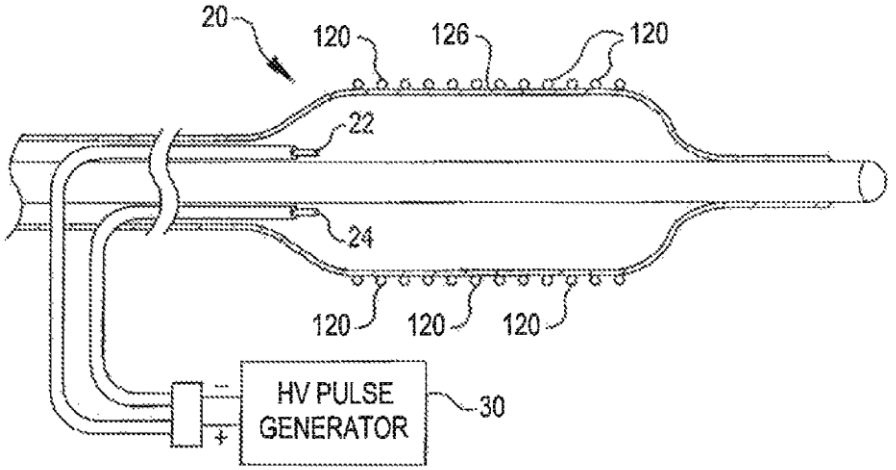


# DRUG DELIVERY SHOCKWAVE BALLOON CATHETER SYSTEM

PRODUCT NAME

FAMILY Summary…

- U.S. case summary - 1 US(9,180,280)
  - Estimated expiration date: 03/17/2032
- 1 US Pending
  - Earliest Priority Date: 11/04/2008



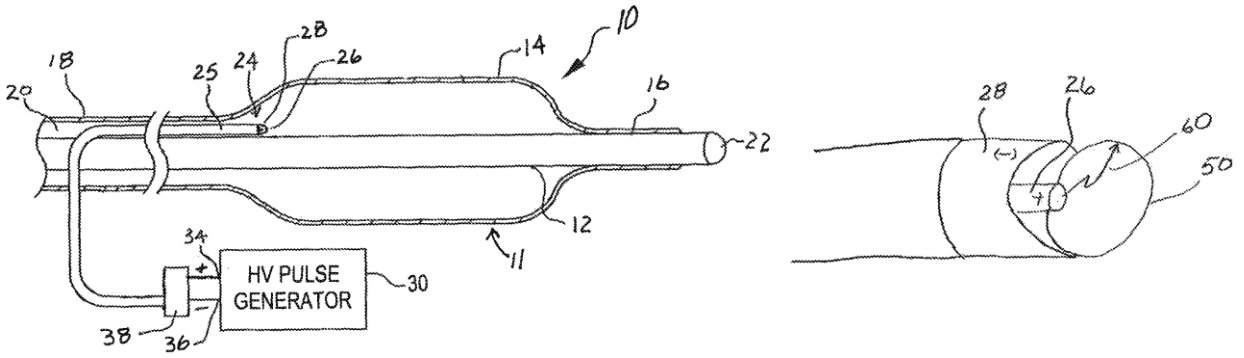

- Issued Claims Summary
  - A catheter comprising: an elongated carrier; a balloon carried by the elongated carrier in sealed relation thereto, the balloon having an outer surface and being arranged to receive fluid therein that inflates the balloon; a shock wave generator including a pair of electrodes located within the balloon, said pair of electrodes configured so that when a high voltage pulse is delivered thereto, a plasma arc is created which in turn creates a mechanical shock wave within the balloon; and a medicinal agent attached to the outer surface of the balloon, the medicinal agent being releasable from the outer surface of the balloon in response to the shock wave created within the balloon, wherein, the outer surface of the balloon remains sealed both during and after the creation of the shock wave and the release of the medicinal agent from the outer surface of the balloon.
  - A method comprising: providing a catheter comprising an elongated carrier, a balloon carried by the elongated carrier in sealed relation thereto, a shock wave generator within the balloon, a medicinal agent attached to an outer surface of the balloon, inserting the catheter into a blood vessel to be treated; inflating the balloon with a liquid; and supplying a high voltage pulse to a pair of electrodes located within the balloon to produce a plasma arc which in turn creates a mechanical shock wave within the balloon to release the medicinal agent from the outer surface of the balloon with the outer surface of the balloon remaining sealed both during and after the creation of the shock wave and the release of the medicinal agent from the outer surface of the balloon.

# SHOCK WAVE CATHETER SYSTEM WITH ARC PRECONDITIONING

PRODUCT NAME

FAMILY Summary…

- U.S. case summary - 1 US(9,138,249)
  - Estimated expiration date: 03/21/2034
- 2 AU; 1 CA; 2 CN; 2 EP; 2 JP; 1WO
  - Earliest Foreign Expiration Dates: 08/16/2033
- 1 US Pending
  - Earliest Priority Date: 08/17/2012



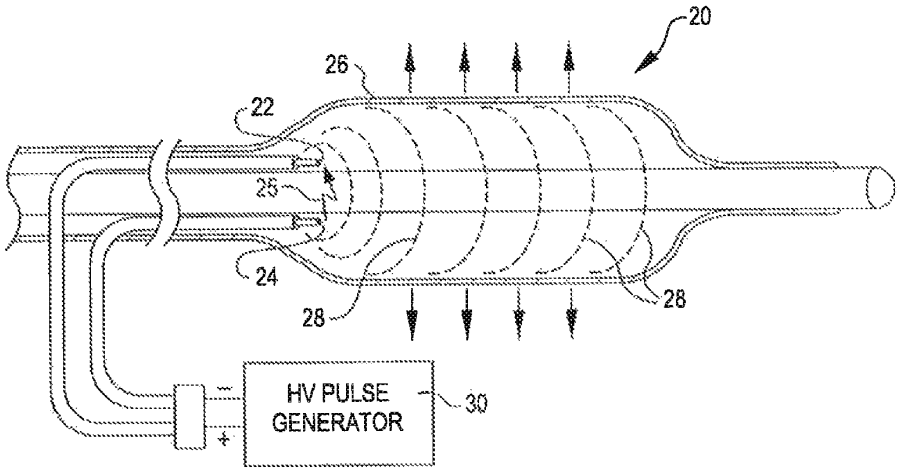

- Issued Claims Summary
  - A shock wave catheter system, comprising: a catheter having an elongated carrier, a balloon about the carrier in sealed relation thereto, the balloon being arranged to receive a fluid therein that inflates the balloon, and an arc generator including at least two electrodes within the balloon; and a power source that delivers a first electrical voltage across the at least two electrodes that grows a bubble at one of the at least two electrodes wherein the first voltage is insufficient to create an arc across the electrodes and then thereafter delivers a second electrical voltage across the at least two electrodes, with the second voltage being greater than the first voltage and sufficient to create an arc across the at least two electrodes and to rapidly expand the bubble to form a shock wave within the balloon.
  - A method of producing an electrohydraulic shock wave in a vessel to treat calcified lesions comprising the steps of: advancing a catheter into the vessel, said catheter having an elongated carrier and a balloon about the carrier in sealed relation thereto, and an arc generator including at least two electrodes within the balloon; inflating the balloon with fluid; applying a first voltage across the electrodes to grow a bubble within the fluid during a first time period wherein the first voltage is insufficient to create an arc across the electrodes; and thereafter, applying a second voltage across the electrodes to rapidly expand the bubble during a second time period with the second voltage being greater than the first voltage and sufficient to create an arc across the at least two electrodes, said rapidly expanding bubble forming a shock wave for treating the calcified lesion.

# NON-CAVITATION SHOCKWAVE BALLOON CATHETER SYSTEM

PRODUCT NAME

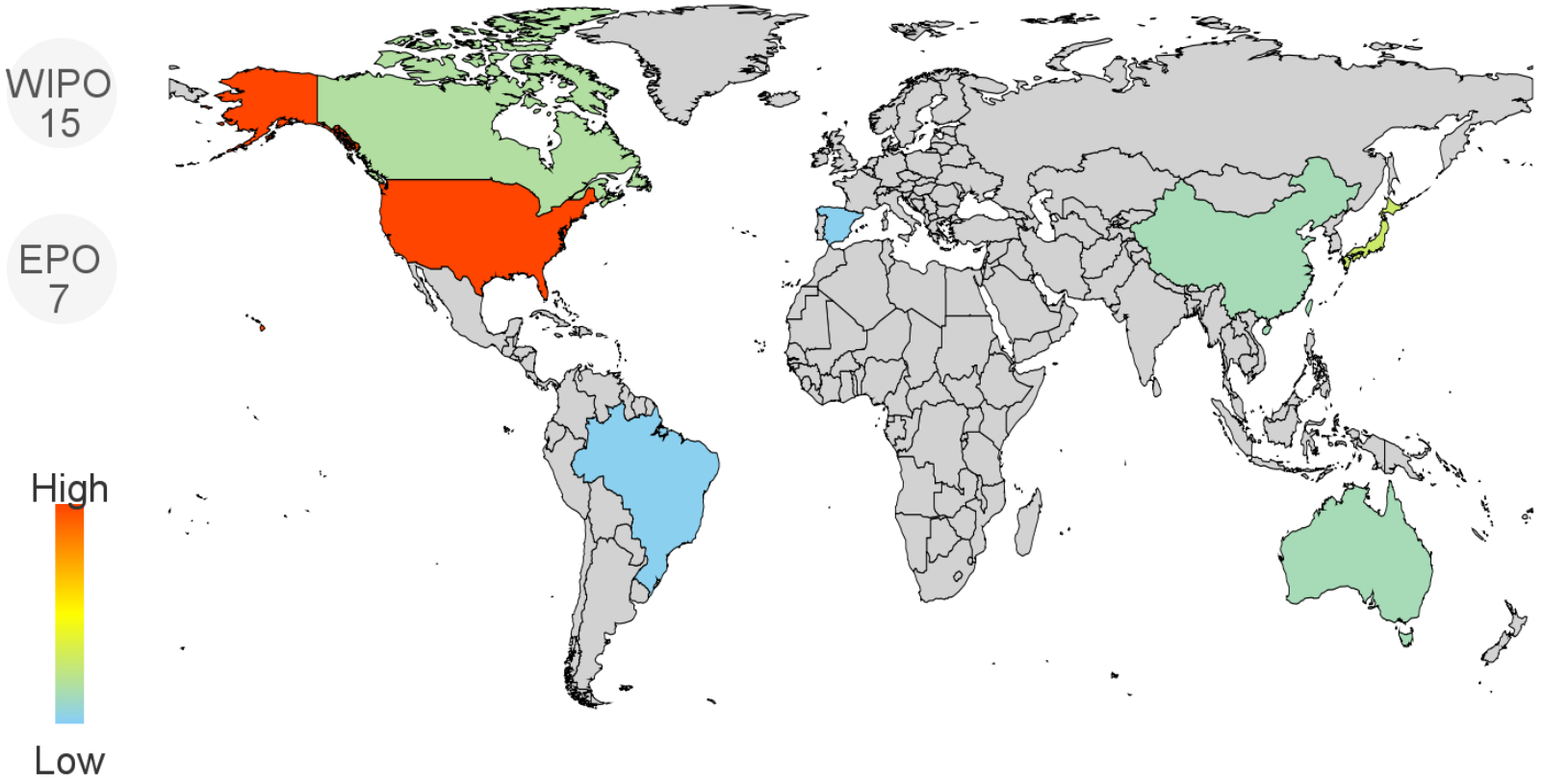
FAMILY Summary…

- U.S. case summary - 5 US(9,072,534; 8,956,371; 8,956,374; 9,011,462; 10,039,561)
  - Estimated expiration date: 09/27/2030
- 2 AU; 2 CA; 2 EP; 1 ES; 6 JP; 4 WO
  - Earliest Foreign Expiration Dates: 08/28/2017
- 6 US Pending
  - Earliest Priority Date: 06/13/2008



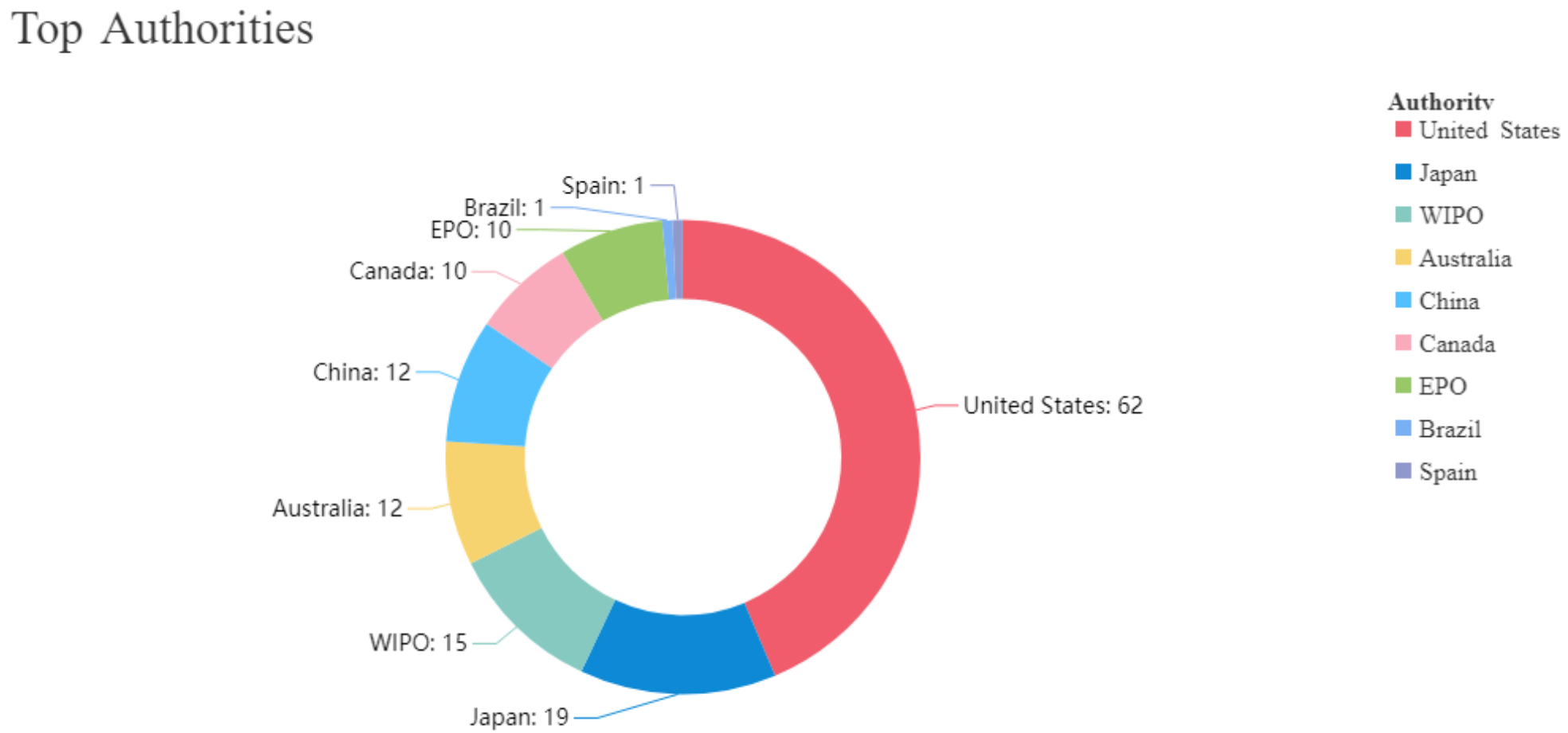

- Issued Claims Summary
  - An angioplasty catheter comprising: an elongated carrier; an angioplasty balloon about the carrier in sealed relation thereto, the balloon being arranged to receive a fluid therein that inflates the balloon wherein the balloon includes a central portion that extends longitudinally along the carrier, said central portion having a constant diameter; and a shock wave generator located within the balloon and aligned with the central portion thereof for generating a plasma arc within the balloon that in turn forms a rapidly expanding and collapsing bubble within the balloon and wherein the expansion of the bubble creates a first shock wave and the collapse of the bubble creates a second shock wave and wherein the bubble is non-spherical and wherein the plasma arc is limited to be shorter than two microseconds whereby the energy in the first shock wave is greater than the energy in the second shock wave.
  - A method comprising: providing a catheter including an elongated carrier, an angioplasty balloon about the carrier in sealed relation thereto, the balloon being arranged to receive a fluid therein that inflates the balloon wherein the balloon includes a central portion that extends longitudinally along the carrier, said central portion having a constant diameter; inserting the catheter into a body lumen of a patient adjacent a blockage or restriction of the body lumen; admitting fluid into the balloon; and generating a plasma arc within the balloon aligned with the central portion of the balloon, said plasma arc is limited to being shorter than two microseconds, said plasma are forming a rapidly expanding and collapsing bubble within the balloon and wherein the expansion of the bubble creates a first shock wave and the collapse of the bubble creates a second shock wave and wherein the bubble is non-spherical whereby the energy in the first shock wave is greater than the energy in the second shock wave.

# Geographic Territories



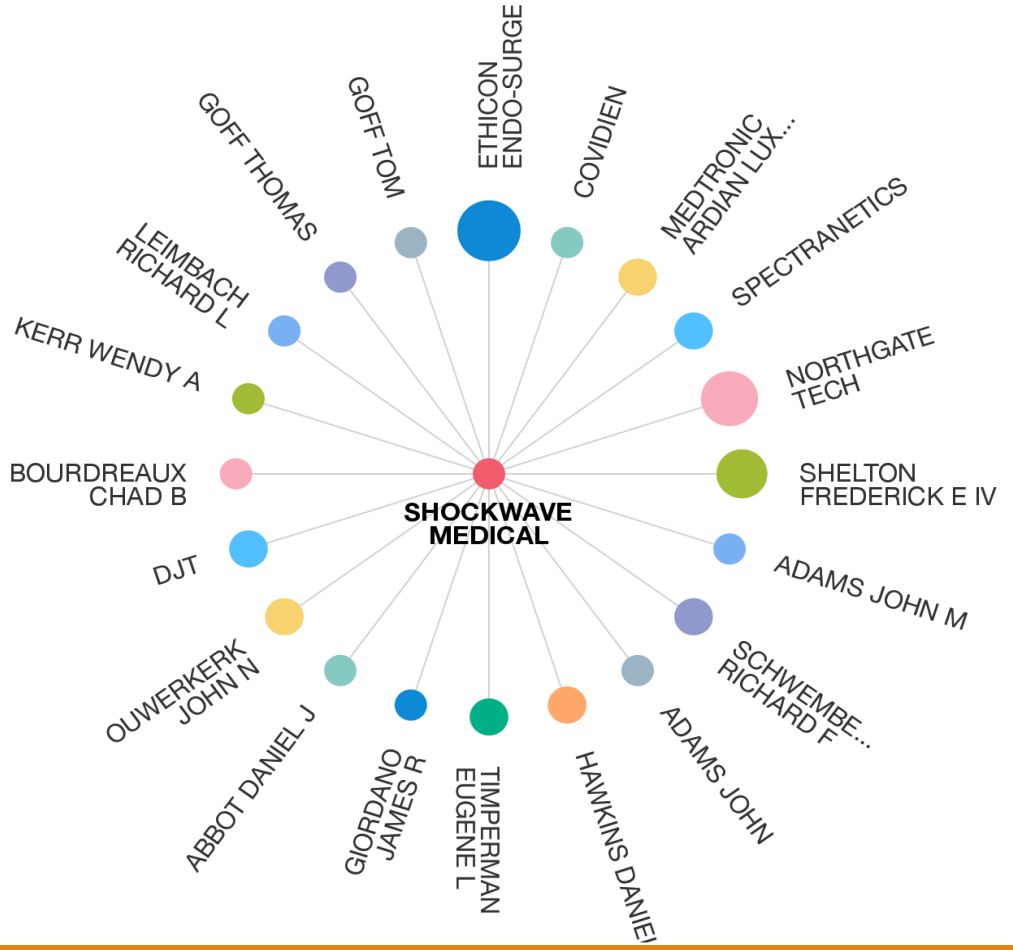
# Geographic Territory Map

The geographic breakdown shows the percentage breakdown of the patent portfolio coverage across different jurisdictions.



# Most Citing Companies

The chart shows the top 10 organizations citing the 10 most cited patents of the searched organization.



# Most Cited Patents

The graph shows the top 10 patents that have been cited most frequently by other patents