CLAIMS

1. A catheter for treating an occlusion in a body lumen, the catheter comprising:

an elongated tube comprising a guidewire lumen for receiving a guidewire, and wherein the catheter is configured to be advanced into the body lumen over the guidewire;

a flexible enclosure wrapped circumferentially around at least a portion of the elongated tube, the flexible enclosure being fillable with a conductive fluid;

a first electrode pair located inside the flexible enclosure and configured to generate shock waves, the first electrode pair having a first electrode and a second electrode spaced apart by a gap; and

a second electrode pair located inside the flexible enclosure and configured to generate shock waves, the second electrode pair having a first electrode and a second electrode spaced apart by a gap;

wherein the gap of the second electrode pair is circumferentially aligned with the gap of the first electrode pair relative to the elongated tube, and wherein a distance between the gap of the first electrode pair and the gap of the second electrode pair is between 1 mm and 4 mm such that, when a voltage is applied across the first electrode pair and the second electrode pair, shock waves generated at the first electrode pair and the second electrode pair constructively interfere to produce a combined shock wave.

2. The catheter of claim 1, wherein:

the first electrode pair comprises:

an insulation removed portion of a first insulated wire extending along an outer surface of the elongated tube; and

a first conductive sheath mounted circumferentially around the elongated tube; and

wherein the second electrode pair comprises:

an insulation removed portion of a second insulated wire extending along the outer surface of the elongated tube;

a second conductive sheath mounted circumferentially around the elongated tube;

wherein, when a voltage is applied across the first insulated wire and the second insulated wire, a current is configured to flow across the gap between the insulation removed portion of the first insulated wire and the first conductive sheath to generate a first shock wave, and

wherein the current is further configured to flow across the gap between the second conductive sheath and the insulation removed portion of the second wire to generate a second shock wave.

3. The catheter of claim 2, wherein the first conductive sheath comprises an arcuate cut-out formed on the side edge of the first conductive sheath, and wherein the current is configured to flow between the arcuate cut-out and the insulation removed portion of the first insulated wire.

4. The catheter of claim 2, wherein the first conductive sheath comprises a circular cut-out located between the opposed side edges of the first conductive sheath, and wherein the current is configured to flow between the circular cut-out and the insulation removed portion of the first insulated wire.

5. The catheter of claim 2, further comprising:

a third electrode pair located inside the flexible enclosure and configured to generate shock waves, the third electrode pair having a first electrode and a second electrode spaced apart by a gap; and

a fourth electrode pair located inside the flexible enclosure and configured to generate shock waves, the fourth electrode pair having a first electrode and a second electrode spaced apart by a gap;

wherein the gap of the fourth electrode pair is circumferentially aligned with the gap of the third electrode pair relative to the elongated tube, and wherein a distance between the gap of the third electrode pair and the gap of the fourth electrode pair is between 1 mm and 4 mm such that, when a voltage is delivered across the third electrode pair and the fourth electrode pair, shock waves generated at the third electrode pair and the fourth electrode pair interfere to produce a combined shock wave.

6. The catheter of claim 5, wherein:

the third electrode pair comprises:

the first conductive sheath; and

an insulation removed portion of a third insulated wire extending along an outer surface of the elongated tube; and

wherein the fourth electrode pair comprises:

the second conductive sheath;

a further insulation removed portion of the third insulated wire;

wherein, when a voltage is applied across the first insulated wire and the second insulated wire, a current is configured to flow across the gap between the first conductive sheath and the insulation removed portion of the third insulated wire to generate a third shock wave, and wherein the current is further configured to flow across the gap between the second conductive sheath and the further insulation removed portion of the third insulated wire to generate a fourth shock wave.

7. The catheter of claim 5, wherein the third electrode pair is circumferentially offset from the first electrode pair by approximately 180 degrees relative to the elongated tube.

8. The catheter of claim 2, wherein the outer surface of the elongated tube comprises grooves, and wherein the first insulated wire and the second insulated wire extend along grooves of the elongated tube.

9. A catheter for treating an occlusion in a body lumen, the catheter comprising:

an elongated tube;

a flexible enclosure wrapped circumferentially around at least a portion of the elongated tube, the flexible enclosure being fillable with a conductive fluid;

a first electrode pair located inside the flexible enclosure and configured to generate shock waves, the first electrode pair having a first electrode and a second electrode spaced apart by a gap; and

a second electrode pair located inside the flexible enclosure and configured to generate shock waves, the second electrode pair having a first electrode and a second electrode spaced apart by a gap;

wherein the gap of the second electrode pair is circumferentially aligned with the gap of the first electrode pair relative to the elongated tube, and wherein a distance between the gap of

the first electrode pair and the gap of the second electrode pair is between 1 mm and 4 mm such that, when a voltage is applied across the first electrode pair and the second electrode pair, shock waves generated at the first electrode pair and the second electrode pair constructively interfere to produce a combined shock wave,

wherein the first electrode pair comprises:

an insulation removed portion of a first insulated wire extending along an outer surface of the elongated tube, and

a first conductive sheath mounted circumferentially around the elongated tube,

wherein the second electrode pair comprises:

an insulation removed portion of a second insulated wire extending along the outer surface of the elongated tube, and

a second conductive sheath mounted circumferentially around the elongated tube, and

wherein, when a voltage is applied across the first insulated wire and the second insulated wire, a current is configured to flow across the gap between the insulation removed portion of the first insulated wire and the first conductive sheath to generate a first shock wave, and wherein the current is further configured to flow across the gap between the second conductive sheath and the insulation removed portion of the second wire to generate a second shock wave.

10. The catheter of claim 9, wherein the first conductive sheath comprises an arcuate cut-out formed on the side edge of the first conductive sheath, and wherein the current is configured to flow between the arcuate cut-out and the insulation removed portion of the first insulated wire.

11. The catheter of claim 9, wherein the first conductive sheath comprises a circular cut-out located between the opposed side edges of the first conductive sheath, and wherein the current is configured to flow between the circular cut-out and the insulation removed portion of the first insulated wire.

12. The catheter of claim 9, further comprising:

a third electrode pair located inside the flexible enclosure and configured to generate shock waves, the third electrode pair having a first electrode and a second electrode spaced apart by a gap; and

a fourth electrode pair located inside the flexible enclosure and configured to generate shock waves, the fourth electrode pair having a first electrode and a second electrode spaced apart by a gap;

wherein the gap of the fourth electrode pair is circumferentially aligned with the gap of the third electrode pair relative to the elongated tube, and wherein a distance between the gap of the third electrode pair and the gap of the fourth electrode pair is between 1 mm and 4 mm such that, when a voltage is delivered across the third electrode pair and the fourth electrode pair, shock waves generated at the third electrode pair and the fourth electrode pair interfere to produce a combined shock wave.

13. The catheter of claim 12, wherein:

the third electrode pair comprises:

the first conductive sheath; and

an insulation removed portion of a third insulated wire extending along an outer surface of the elongated tube; and

wherein the fourth electrode pair comprises:

the second conductive sheath;

a further insulation removed portion of the third insulated wire;

wherein, when a voltage is applied across the first insulated wire and the second insulated wire, a current is configured to flow across the gap between the first conductive sheath and the insulation removed portion of the third insulated wire to generate a third shock wave, and wherein the current is further configured to flow across the gap between the second conductive sheath and the further insulation removed portion of the third insulated wire to generate a fourth shock wave.

14. The catheter of claim 12, wherein the third electrode pair is circumferentially offset from the first electrode pair by approximately 180 degrees relative to the elongated tube.

15. The catheter of claim 9, wherein the outer surface of the elongated tube comprises grooves, and wherein the first insulated wire and the second insulated wire extend along grooves of the elongated tube.

16. The catheter of claim 9, wherein the elongated tube comprises a guidewire lumen for receiving a guidewire, and wherein the catheter is configured to be advanced into the body lumen over the guidewire.