[0001] WHAT IS CLAIMED IS:

1. A method for separating oil droplets from water in a mixture thereof, comprising:

flowing said mixture through a first length of pipe having a first exit orifice;

generating first acoustic standing waves inside of the first length of pipe effective for producing acoustic radiation forces having first pressure nodes such that said oil droplets concentrate and coalesce at the first pressure nodes, and wherein the acoustic waves have a first frequency;

flowing the mixture having the concentrated and coalesced oil droplets passing through the first exit orifice through a second length of pipe having a second exit orifice, the second length of pipe being formed into a planar configuration having a radius of curvature and an axis, such that the coalesced oil droplets move to greater distances from the axis as a result of centrifugal forces; and

separating the coalesced oil droplets from the water passing through the second exit orifice.

2. The method of claim 1, wherein said step of separating the coalesced oil droplets from the water, comprises flowing the mixture having concentrated and coalesced oil droplets passing through the exit of the second length of pipe through a third length of pipe disposed vertically and having an upper exit orifice and a lower exit orifice, whereby the concentrated and coalesced oil droplets separate from the water as a result of the buoyancy of the coalesced oil droplets and pass through the upper exit orifice, and the water passes through the lower exit orifice thereof.

3. The method of claim 1, further comprising the step of:

generating second acoustic standing waves inside of the second length of pipe effective for producing acoustic radiation forces having second pressure nodes such that said oil droplets concentrate and coalesce at the second pressure nodes, and wherein the second acoustic waves have a second frequency.

4. The method of claim 3, wherein the first frequency and the second frequency are between 500 kHz and 3 MHz.

5. The method of claim 3, wherein the first frequency is greater than the second frequency.

6. The method of claim 1, wherein the second length of pipe is formed into a helical configuration having a radius of curvature and an axis, wherein the axis is vertical.

7. The method of claim 3, wherein the first length of pipe is oblate in cross section.

8. A method for separating oil droplets from water in a mixture thereof, comprising:

flowing said mixture through a first length of pipe having a first exit;

generating first acoustic standing waves inside of the first length of pipe effective for producing acoustic radiation forces having first pressure nodes such that said oil droplets concentrate and coalesce at the first pressure nodes, and wherein the acoustic waves have a first frequency;

flowing the mixture having concentrated and coalesced oil droplets passing through the first exit through a second length of pipe having a second diameter and a second exit, the second length of pipe being formed into a planar circular configuration having a radius of curvature and an axis, such that the coalesced oil droplets move to greater distances from the axis as a result of centrifugal forces; and

flowing the mixture having concentrated and coalesced oil droplets passing through the second exit orifice through a third length of pipe disposed vertically and having an upper exit orifice and a lower exit orifice, whereby the concentrated and coalesced oil droplets separate from the water as a result of the buoyancy of the coalesced oil droplets and pass through the upper exit orifice of the third length of pipe, and the water passes through the lower exit orifice thereof.

9. The method of claim 8, further comprising the steps of:

generating second acoustic standing waves inside of the second length of pipe effective for producing acoustic radiation forces having second pressure nodes such that said oil droplets concentrate and coalesce at the second pressure nodes, and wherein the second acoustic waves have a second frequency.

10. The method of claim 8, wherein the first frequency and the second frequency are between 500 kHz and 3 MHz.

11. The method of claim 10, wherein the first frequency is greater than the second frequency.

12. The method of claim 8, wherein the second length of pipe is formed into a helical configuration having a radius of curvature and an axis, wherein the axis is vertical.

13. The method of claim 9, wherein the first length of pipe is oblate in cross section.

14. An apparatus for separating oil droplets from water in a mixture thereof, comprising:

a first length of pipe through which said mixture is caused to flow, said first length of pipe having an outer surface, an inner volume, and a first exit orifice;

at least one first acoustic transducer in acoustic contact with the outer surface of said first length of pipe, for generating first acoustic standing waves in the inner volume of said first length of pipe effective for producing acoustic radiation forces having first pressure nodes such that said oil droplets concentrate and coalesce at the first pressure nodes, and wherein the acoustic waves have a first frequency;

a first waveform generator for powering said at least one first acoustic transducer; and

a second length of pipe for receiving the concentrated and coalesced oil droplets flowing through the first exit orifice of said first length of pipe, having a second exit orifice, said second length of pipe being formed into a planar configuration having a radius of curvature and an axis, such that the coalesced oil droplets move to greater distances from the axis as a result of centrifugal forces.

15. The apparatus of claim 14, further comprising a third length of pipe for receiving the concentrated and coalesced oil droplets flowing through the second exit orifice, disposed vertically and having an upper exit orifice and a lower exit orifice, whereby the concentrated and coalesced oil droplets separate from the water as a result of the buoyancy of the coalesced oil droplets and pass through the upper exit orifice of said third length of pipe, and the water passes through the lower exit orifice thereof.

16. The apparatus of claim 14,

wherein said second length of pipe has an outer surface and an inner volume for receiving the mixture having concentrated and coalesced oil droplets flowing through the first exit orifice; and

comprising at least one second acoustic transducer in acoustic contact with the outer surface of said second length of pipe, for generating second acoustic standing waves in the inner volume of said second length of pipe effective for producing acoustic radiation forces having second pressure nodes such that said oil droplets concentrate and coalesce at the second pressure nodes, and wherein the acoustic waves have a second frequency.

17. The apparatus of claim 16, wherein the first frequency and the second frequency are between 500 kHz and 3 MHz.

18. The apparatus of claim 16, wherein said at least one first acoustic transducer and said at least one second acoustic transducer comprise piezoelectric transducers.

19. The apparatus of claim 17, wherein the first frequency is greater than the second frequency.

20. The apparatus of claim 14, wherein said second length of pipe is formed into a helical configuration having a radius of curvature and an axis, wherein the axis is vertical.

21. The apparatus of claim 16, wherein said first length of pipe is oblate in cross section.

22. An apparatus for separating oil droplets from water in a mixture thereof, comprising:

a first length of pipe through which said mixture is caused to flow, said first length of pipe having an outer surface, an inner volume, and a first exit orifice;

at least one first acoustic transducer in acoustic contact with the outer surface of said first length of pipe, for generating first acoustic standing waves in the inner

volume of said first length of pipe effective for producing acoustic radiation forces having first pressure nodes such that said oil droplets concentrate and coalesce at the first pressure nodes, and wherein the acoustic waves have a first frequency;

a first waveform generator for powering said at least one first acoustic transducer;

a second length of pipe for receiving the concentrated and coalesced oil droplets flowing through the first exit orifice of said first length of pipe, having a second exit orifice, said second length of pipe being formed into a planar configuration having a radius of curvature and an axis, such that the coalesced oil droplets move to greater distances from the axis as a result of centrifugal forces; and

a third length of pipe for receiving the concentrated and coalesced oil droplets flowing through the second exit orifice, disposed vertically and having an upper exit orifice and a lower exit orifice, whereby the concentrated and coalesced oil droplets separate from the water as a result of the buoyancy of the coalesced oil droplets and pass through the upper exit orifice of said third length of pipe, and the water passes through the lower exit orifice thereof.

23. The apparatus of claim 22,

wherein said second length of pipe has an outer surface and an inner volume, for receiving the mixture having concentrated and coalesced oil droplets flowing through the first exit orifice; and

comprising at least one second acoustic transducer in acoustic contact with the outer surface of said second length of pipe, for generating second acoustic standing waves in the inner volume of said second length of pipe effective for producing acoustic radiation forces having second pressure nodes such that said oil droplets concentrate and coalesce at the second pressure nodes, and wherein the acoustic waves have a second frequency.

24. The apparatus of claim 23, wherein the first frequency and the second frequency are between 500 kHz and 3 MHz.

25. The apparatus of claim 23, wherein said at least one first acoustic transducer and said at least one second acoustic transducer comprise piezoelectric transducers.

26. The apparatus of claim 24, wherein the first frequency is greater than the second frequency.

27. The apparatus of claim 22, wherein said second length of pipe is formed into a helical configuration having a radius of curvature and an axis, wherein the axis is vertical.

28. The apparatus of claim 23, wherein said first length of pipe is oblate in cross section.