BANSILAL RAMNATH AGARWAL CHARITABLE TRUST'S

VISHWAKARMA INSTITUTE OF TECHNOLOGY
PUNE-411037

(An Autonomous Institute Affiliated to University of Pune)

ENGINEERING DESIGN AND DEVELOPMENT (EDD)

on

TOPIC: - THE GREAT BUBBLE BARRIER

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BANSILAL RAMNATH AGARWAL CHARITABLE TRUST`S

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CERTIFICATE

This is to certify that the EDD project titled **"THE GREAT BUBBLE BARRIER"** has been completed by **Sohel Sayyed, Siddhant Mane, Sakshi Jadhav, Sanika Talathi, Pankaj Rangari** in the academic year 2019 – 2020, in partial fulfillment of S.Y. B. Tech. **in Chemical Engineering.**

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Pune	Pune
Place: Pune	**Date:** 22/05/2020

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The project would have been uphill task without their continuous direction and unwavering support.

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ABSTRACT

Great ecological benefit will be gained if effective barriers can be constructed to control the movement of invasive common carp. Carp feeding habits lead to an over-enrichment of nutrients in lakes that dramatically reduces water quality and ecosystem health. Reducing juvenile carp recruitment through the use of a barrier at the entrances to the interconnecting channels could prove useful in an integrated carp management plan for the entire watershed. Current barrier technologies are not well suited for these sites due to the shallow water and rapidly changing water level. This research focuses on the use of bubble curtain barriers, which has been relatively ignored in previous barrier studies, as a barrier technology that shows promise for this application. Bubble curtains generate distinct acoustic and hydrodynamic fields, and through proper manipulation could be used to deter juvenile carp migration.

An Air Bubble Barrier blockade is a new invention that can be used in a crap migration response as a blockade' or barrier to prevent oil from entering a area to be protected. The Air Bubble Barrier works by releasing a wall of air bubbles from below the water surface, usually from a Bubble Pipe system and anchored on the floor of a body of water floor, so that the rising air bubbles form a up-current which reverses or halts the surface current thereby preventing or slowing Surface pollutants such as oil from entering a area, CO2 while also making skimming or Suctioning easier and putting oxygen back into the water.

CHAPTER 1

INTRODUCTION

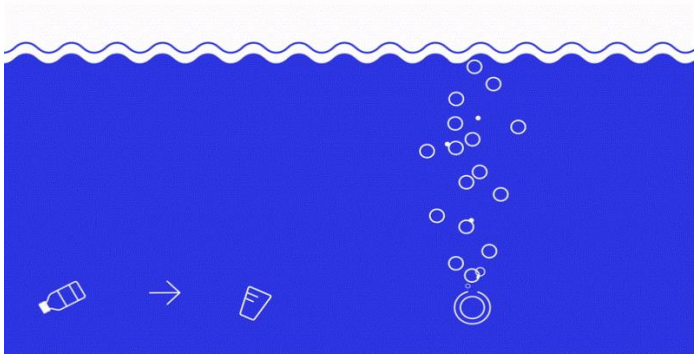
In recent years, air-bubble systems have been applied successfully as breakwaters and barriers against spreading of oil, salt water intrusion and ice formation. However, all attempts to correlate results from model tests and from field investigations have failed, because no analytical framework is at hand which suits both model and prototype. In a first attempt to close this gap, the vertical velocity field of the air-water mixture above an orifice has been measured and analyzed. The flow pattern produced by an air jet entering vertically into sideways unlimited water shows certain similarities to a submerged water jet which suggest a similar analytical treatment with proper consideration of the momentum flux increase with height due to the buoyancy of the air.

The Great Bubble Barrier intercepts plastics in rivers and raises awareness in order to prevent more plastic pollution. We aim for a total solution that can permanently decrease the amount of plastics entering our oceans. Our goal is to protect the global ecosystem from plastic pollution and to sustain and improve the quality of life on earth.

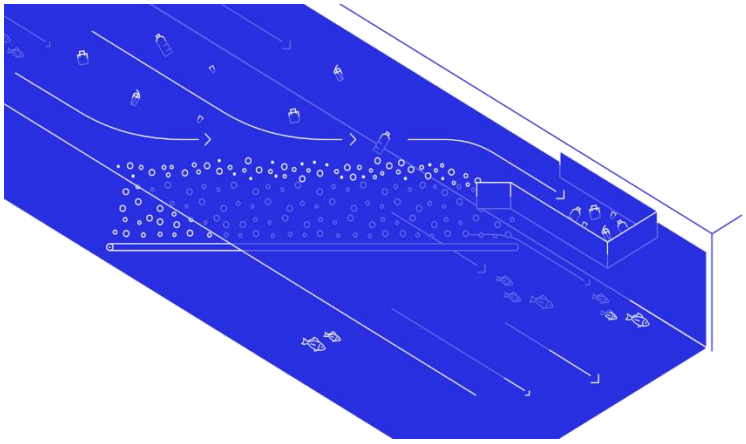
A smart solution to river pollution:

1. Cleaning rivers and canals with The Great Bubble Barrier
2. Research and monitor plastic pollution
3. Increase public awareness
4. Connect to a circular chain for the re-use of plastics

Plastic waste is being dumped in our waterways, where it brings great harm to the environment – including human beings. Aquatic animals get tangled in plastic, micro plastics pose a health risk from the smallest to the largest organisms and ships suffer damages. This increasing problem is recognized by different institutions worldwide, such as the United Nations, Ellen Mc Arthur Foundation and the World Health Organization. We have designed a solution that intercepts plastics in rivers and canals before it reaches the ocean.



We create a bubble screen by pumping air through a tube with holes in it, which is located on the bottom of the waterway. The Bubble Barrier creates an upwards thrust, which brings waste to the surface of the water. By placing it diagonally in the waterway, the Bubble Barrier uses the natural current to guide the plastic to the catchment system at the riverside. Both ships as fish can pass the Bubble Barrier, but plastic will be stopped.



Besides the capture of debris, the Bubble Barrier has other positive side effects. Oxygen levels within the water increase by a Bubble Barrier, which stimulates the ecosystem and stops the growth of toxic blue algae.

As bubble screens absorb sounds and waves, fish and shores experience less harm from the ship traffic.

CHAPTER 2

LITERATURE SURVEY

1. BACKGROUND AND THEORY:

The pattern of vertical velocities induced by an orifice discharging air into water can be represented by Gaussian distribution curves with a linear spread in the vertical except for the regions near the orifice and close to the free surface. An analytical treatment considering the momentum-flux increase due to the buoyancy of the air together with experimental information about the spread of the velocity profiles and the mean rising speed of the air bubble stream, which has been obtained from velocity and density measurements over a wide range of conditions, leads to a complete description of the flow field. The ratio of the water volume flux to the air discharge rate, which has been proposed as an efficiency criterion, is now at hand as a function of depth and air supply for both single orifices and rows. The experimental evidence supports the analysis well and suggests that extrapolation to larger water depths and air supplies should be permissible, which would allow approximate predictions of the volume flux for any air-bubble system.

2. THE BENEFITS OF THE BUBBLE BARRIER:

- Makes smart use of the natural current of a river
- Guides plastic to the side of rivers and canals.
- Stops plastic on its way to the ocean
- Is based on existing technology
- Is an innovative concept
- Increases the oxygen within the water

- Does not need changes in infrastructure or policies
- Is easy scalable

With these features, our system meets the most important conditions: it has little effect on fish migration, shipping and the overall natural functioning of the delta.
The Bubble Barrier can be placed in various rivers and canals.
Our goal is to place Bubble Barriers in urban and industrial areas, which are known to have a high rate of plastic litter.

3. A SMART SOLUTION TO PLASTIC POLLUTION:

The Bubble Barrier can reduce the amount of plastic pollution in rivers and can help raising awareness in order to prevent further plastic pollution. We believe plastic debris should be eliminated from our environment. That is why we have four goals:

1. Clean up plastic pollution in rivers and canals with our Bubble Barriers to prevent it from flowing towards the ocean.
2. Investigate and monitor plastic pollution in rivers to collect data about plastic debris and the source.
3. Increase public awareness about plastic pollution in order to prevent plastic waste and litter.
4. Build towards a circular plastic chain to create a shift from a linear to a circular economy in which plastics never become waste.

The Great Bubble Barrier offers solutions for different problems. The Great Bubble Barrier catches more plastic than current solutions in flowing water because we can reach plastic (> 1mm) in the total width and depth of a river. A Bubble Barrier can be placed both in big rivers as in small canals.

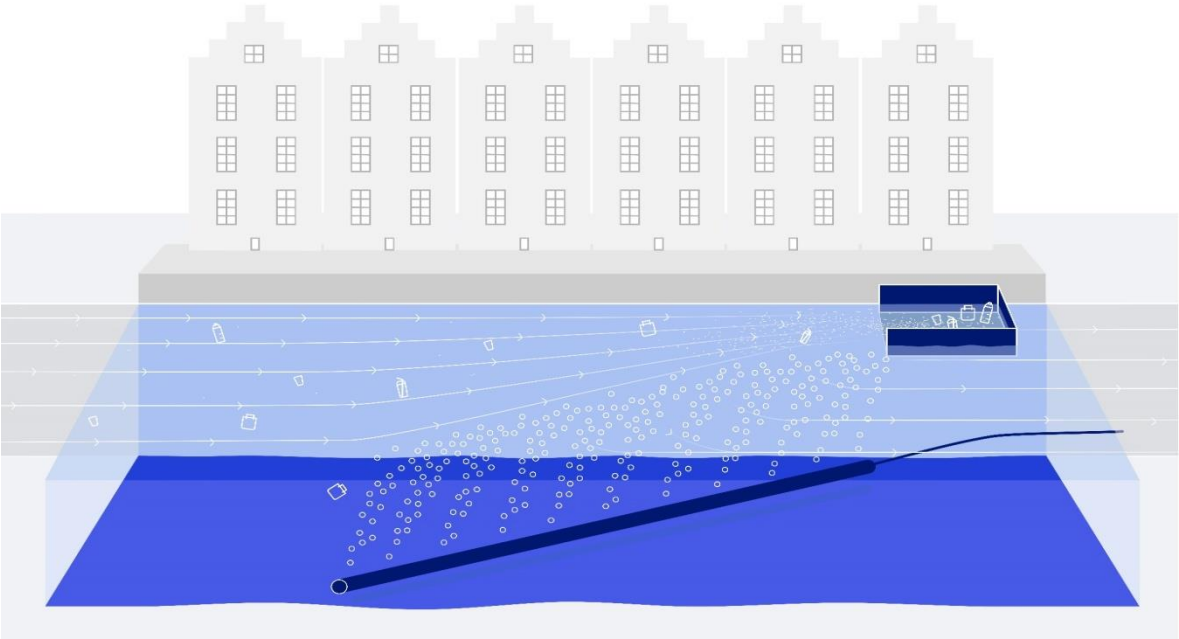
4. PRACTICAL EXPERIMENTATION:

PLACE: THE WESTERDOK, AMSTERDAM

The Bubble Barrier in the Western dock is strategically placed to be able to stop as much of the outflow of plastic from Amsterdam's city centre as possible. The Bubble Barrier complements the garbage boats of Water net and also catches plastic in the weekends and evenings, 24 hours a day, 7 days a week.

The Bubble Barrier does not only collect plastic on the surface, but also under the water surface. The rising bubbles of the Bubble Barrier create an upwards current which brings the plastic to the surface of the water. Due to the diagonal placement in the waterway, the Bubble Barrier uses the natural flow to guide the plastic to the collection system at the river side.

Bird view Bubble Barrier Amsterdam:



The Amsterdam aquatic life is not being blocked by the bubbles, in fact: the oxygen level in the water increases thanks to the bubbles. This stimulates the

ecosystem and prevents harmful algae blooms. Because bubble screens absorb sounds and waves, fish and shorelines experience less damage from ship traffic. Moreover, unlike many other plastic capture technologies, the Bubble Barrier does not interfere with the passage of ships or wildlife.

With the Bubble Barrier in Westerdok, the Amstel, Gooi and Vecht Water Management Board is looking for a solution that captures floating plastic and smaller plastic waste up to 1 millimeter.

With the current collection methods in Amsterdam, only plastic which remains inside the city is removed and only pieces which are larger than 2cm. It will also be monitored how much and what kind of plastic is removed from the water with the Bubble Barrier. In addition, the Bubble Barrier can be used for further research purposes.

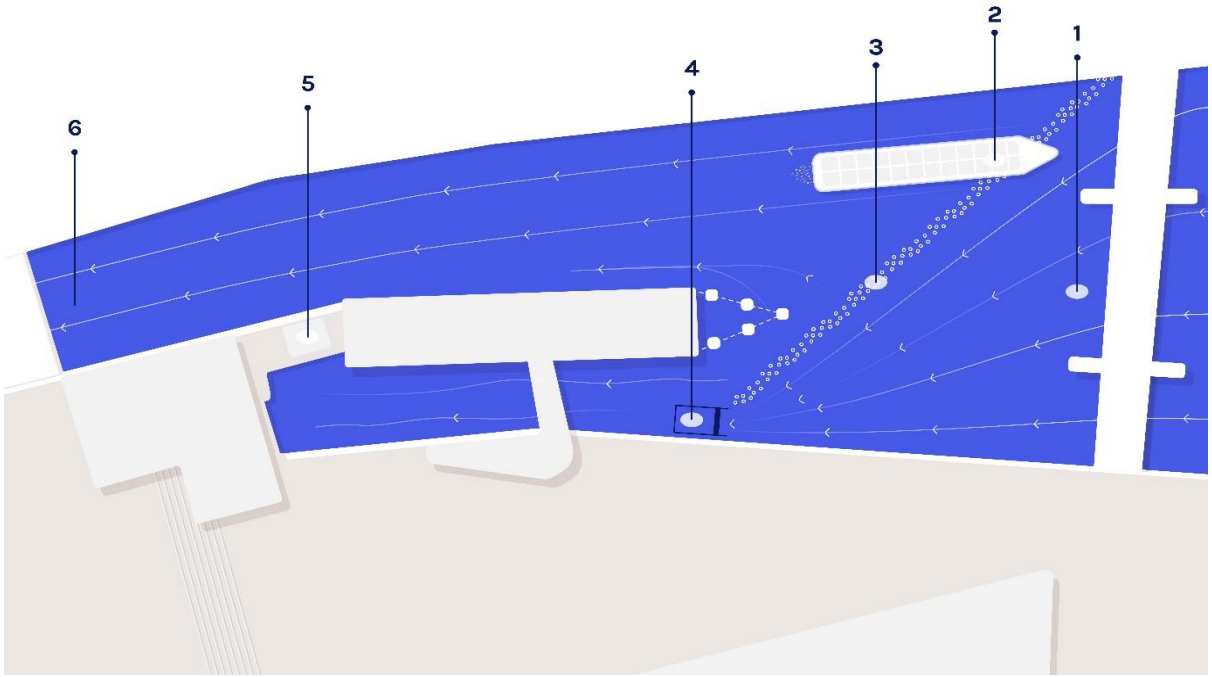


Fig. Setup Bubble Barrier in Westerdok

CHAPTER 3

DESIGN SPECIFICATION

1. BUBBLE PHYSICAL CHARACTERISTICS:

Understanding the formation of a single bubble through an orifice is vital to developing diffusers that can create well defined and predictable physical fields. Bubble formation is driven by two main components, buoyancy and surface tension. The buoyancy force acts to drive the bubble towards the surface, while the surface tension acts to keep the bubble attached around the orifice. As the bubble size increases, the buoyancy force overcomes the surface tension and the bubble detaches from the surface. Bubble formation creates pressure waves (sound) throughout the liquid and accounts for most of the sound generated by a bubble curtain. As the bubbles rise, they coalesce (merge to form larger bubbles). The thickness of the bubble curtain also increases as the bubbles rise.

These characteristics were utilized to design two diffuser types; fine-bubble and coarse-bubble. 17 When a bubble is disturbed by a pressure wave, it causes the bubble wall to pulsate or oscillate at a resonant frequency. Theoretical relationships have been developed to predict the resonant frequency and amplitude of the pressure wave created by an oscillating bubble. Understanding the small scale characteristics of bubbles may provide insight to interpreting the sound signal generated by a bubble barrier, and potentially improve the barrier design. The resonant angular frequency, natural frequency of bubble wall oscillations, of a singular bubble is provided by Minneart's frequency:

$$\omega_0 = \frac{1}{Ro}\sqrt{\frac{3kP\infty}{\rho f}}$$

Where

Ro = Bubble Radius

κ = Polytropic Index, For Air 1.402

p_∞ = Pressure in the Fluid

ρf = Density Of The Fluid

2. ANALYSIS OF AIR BUBBLE STREAM:

Consider an air jet discharging vertically upward at depth h below the water surface through a nozzle of diameter d_o at a mass discharge rate Q_o, pressure p_o and density $\rho_a{}^o$. If $\forall_o$ is defined to be the volume flux corresponding to Q_o at atmospheric pressure, then the momentum flux is given by:

$$M_o = (\rho_a{}^{atm} \forall_o)^2 / \rho_a{}^o A_o$$

Or in terms of a theoretical (loss-free) exit velocity U_0 and a discharge coefficient C_D by,

$$M_o = C_D\, U_0 \rho_a{}^{atm} \forall_o$$

Where, Subscript "o" refers to conditions at the orifice

M = Momentum Flux

d_o = Orifice Diameter (Slot Width)

C_D = Discharge Coefficient

$\forall_o$ = Volume Flux

$\rho_a{}^{atm}$ = Density Of Water (Air At Atmospheric Pressure)

U_0 = Theoretical Exit Velocity

V_b = Mean Rising Speed of Air Bubble Stream

The continuous air stream discharging through the orifice quickly expands according to the sudden pressure drop across the nozzle and breaks up into bubbles of discrete size. The bubble size distribution depends solely upon the discharge rate and varies neither with the fluid properties nor with the orifice diameter for all practical cases.

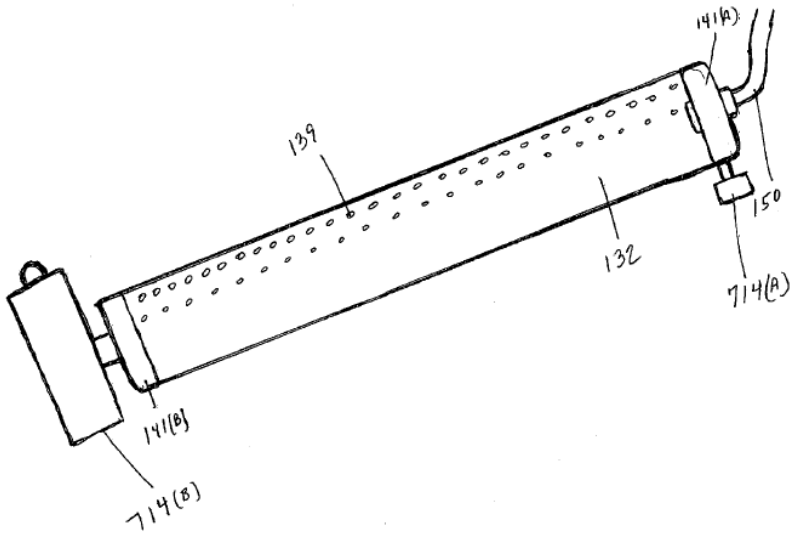
The speed of rise of the bubble stream rapidly approaches some terminal mean velocity V_b the bubble stream rises with a mean velocity V_b determined by the bubble size distribution and concentration, which are both functions of the discharge rate $\cancel{V}_o$ only. Therefore, V_b should be a unique function of $\cancel{V}_o$ independent of the local orifice conditions.

Extensive measurements on single bubbles so far have shown no evidence that the speed of rise vanes considerably with the depth of submergence, although the change in bubble volume with depth or pressure would suggest so. But, except for very small bubbles, the speed of rise changes only gradually with the bubble diameter, which in turn changes only with the third root of the bubble volume or the local pressure. It is therefore considered a satisfactory approximation to assume the average rate of rise V_b of the bubble stream to be independent of height.

3. DESCRIPTION OF AIR-BUBBLE BARRIER:

The Air Bubble Barrier is a blockade technique to be used in situations similar to that where traditional booms are applied. The Air Bubble Barrier is environmentally friendly oil response measure used primarily for blocking oil from entering area of water Such as the entrance to a Bay. Though the Air Bubble Barriers can be used by themselves, they should often be used alongside Barge

Barriers 180 and or traditional booms 777 so to back-up the protection layers, creating a more redundant barrier system.

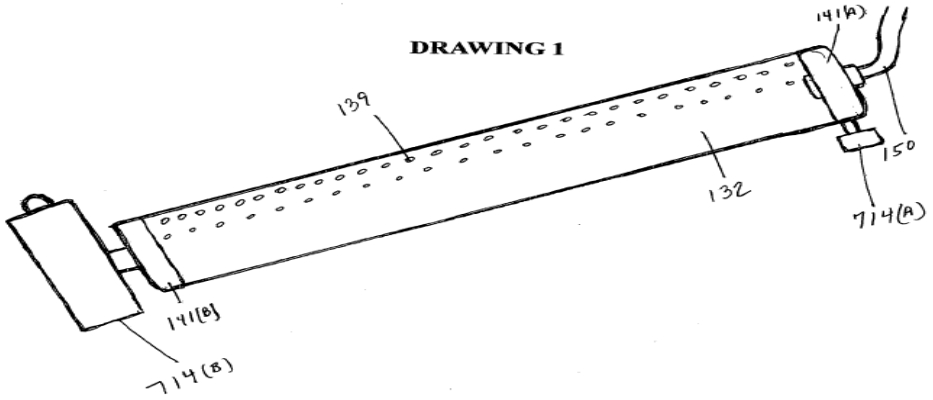


The Air Bubble Barrier system works by releasing a wall of Air Bubbles 133, from a (normally) one or more Air Bubble Pipes 132 or from any design of a air bubble units 137, from underneath the water line and or most often anchored on the floor of the body of water, so that the air bubbles 133 rising from below the surface to the surface creates up-current of water. The up-current forms a wall to any incoming lighter than water fluid Such as oil floating on the water surface. This up-current works to prevent the oil slick from entering the area the Bubble Barrier is protecting.

The protection level is only so strong, and it can be over whelmed by harsh wind and wave conditions. However, when used alongside other oil spill response devices, measures, or techniques, even if the oil gets above the air bubble wall, the air bubbles still act to assist the Suctioning or skimming efforts by keeping the oil at the top of the water instead of allowing it to saturate below the water surface.

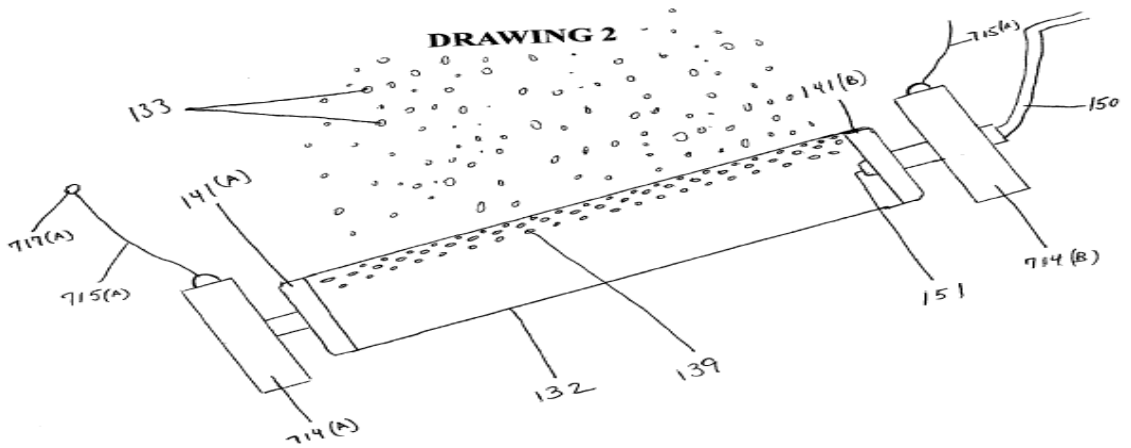
Adding air bubbles 133 to the water in areas where an oil slick 101 is an issue can also help to add more oxygen to the water to combat oxygen depletion caused by the oil. This can literally save the Surrounding environment from complete annihilation.

The Air Bubble Barrier 160 is a relatively simple system. The Air Bubble Barrier 160 will be described by using simple Drawings along with simple descriptions associated with the Drawings. The concept is very simple; however, there can be many different designs. This utility covers all designs possible.



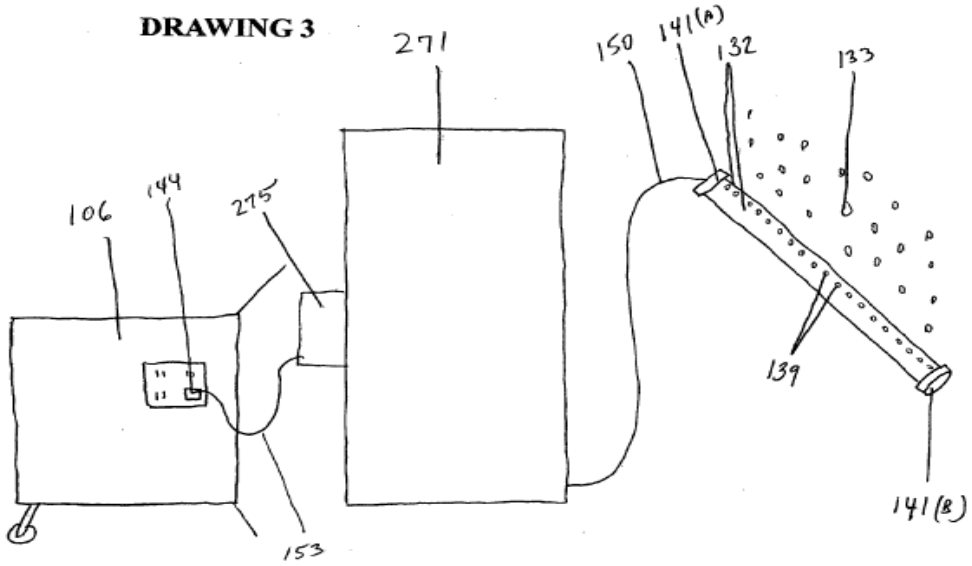
Drawing 1 is a explode drop close, out of the water, right side view of Air Bubble Pipe.

Drawing 1 shows an up close semi exploded view of one part of an Air Bubble Barrier System 160 called an Air Bubble Pipe 132. To make a Air Bubble Pipe 132, simple tiny holes 139 are drilled into and through one side of the pipes, (but alternative designs can use other materials such as rubber or plastic tubes, hoses, etc.) and lengthwise, from one side of the pipe to the other: On a single pipe system, such as in Drawing 1, both ends of the pipe are capped 141 (A) and 141 (B) so that the caps are air tight. A hose 150 is connected or inserted through one side of the pipe through the pipe cap. In Drawing 1 the hose 150 is connected at Cap 141 (A). The working from there is simple. Air is pumped through the hole 150 and into the pipe 132 where the air escapes through the holes 139 releasing air into the water forming air bubbles. The Air Bubble Pipe 132 is usually positioned on the floor of the body of water, and it is normally in front of or between other surface bathers, such as: Booms 777, Barge Barriers 180, etc. The Air Bubble Pipes 132 are usually set on the floor of a shallow water area, from one side to the other, covering the entrance to a Bay, Marsh, reef, etc. areas. The Air Bubble Pipes can be held in place using anchors at one or both ends of the pipes 132. Anchors 714 (A) and (B) are shown at each end of the pipe in Drawing 1. Anchors 714 (A) and (B) have loops added where strings 715 (A) and (B) are tied so to lower the Barrier System in place from a boat or vessel, etc.



Drawing 2 is an exploded or up close in the water view of the right side of Air Bubble Pipe shown working or with bubble coming out.

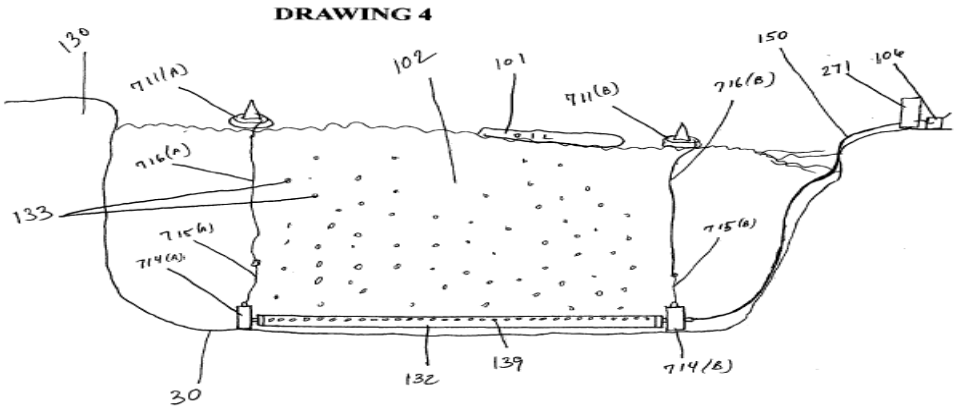
Drawing 2 shows a similar version to Drawing 1except in Drawing 2, it shows the released air as if it were released under water. The air released has formed Bubbles. A well placed wall of Bubbles 133 guarding the entrance to a Bay, Swamp, marsh, reef, etc. is all that is needed to form a bubble bather 133. Usually, there would be several layers of pipes under water, as well as a multitude of Bubbles 133 forming along several feet thick Air Bubble Barrier or blockade.



Drawing 3 is a compact, out of the water, view of an entire Air Bubble Barrier system showing one option or design for all the components needed to make it work.

Drawing 3 shows an example complete Air Bubble Barrier system 160. The Pipe Barrier 132 has already been discussed in previous Drawings. The hose attached to the pipes 150 that connect to the cap or Air Bubble Pipes also connects at the other end, in this Drawing, to an Air Compressor 271. The Air Compressor 271 is connected via Electric Cord153 at Plug Location 144 where it is powered by Electric Generator 106. Basically, the Generator 106 provides AC or DC, etc.

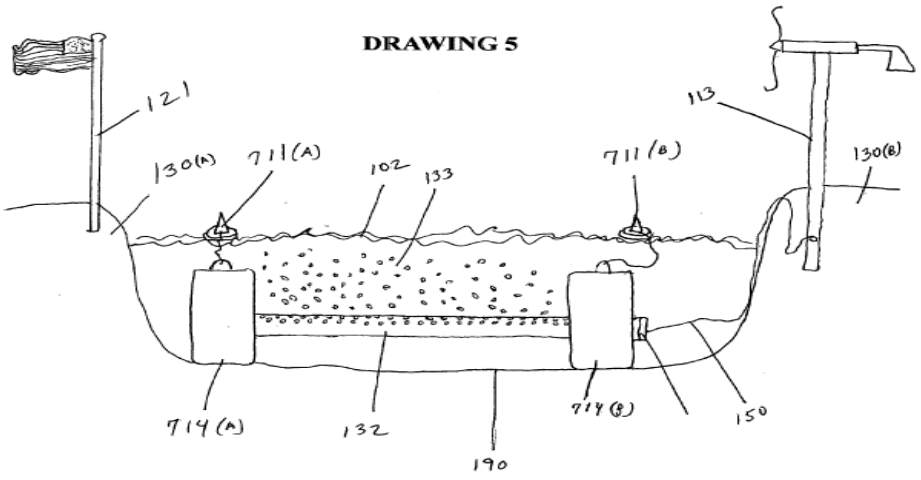
power to the Air Compressor motor 275 causing the Air Compressor 271 to start pumping and compressing air. The air is released through the hose 150 where it goes through cap 141 (A) and into the Bubble Pipe 132, where it fills the pipe due to the airtight cap 141 (B) not allowing the air to pass through the cap. The air inside the cap builds pressure, whereby the air escapes through holes 139. As the air escapes under water, the air forms Bubbles 133 which rise to the top of the water 102. A bunch of bubbles coming out of one or more pipes can form a barrier in the water from the floor of the water to the surface and at the surface.



Drawing 4 is a see through the water, side view of the waterline to the sea floor, showing the application of Air Bubble Barrier system working.

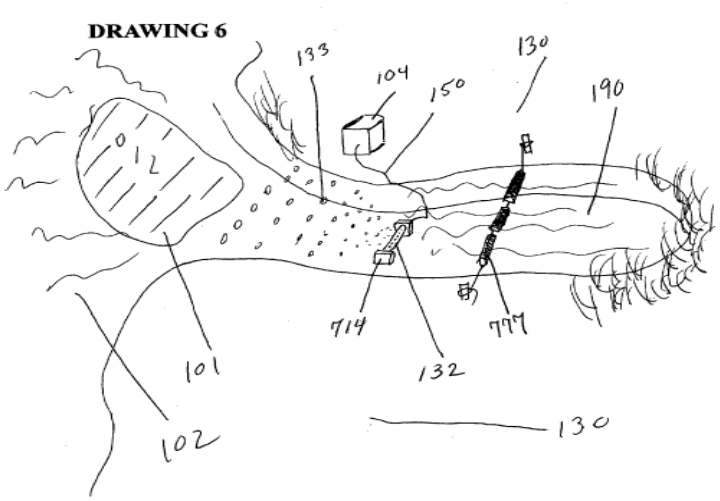
Drawing 4 shows a see-through the water line, to the bottom or floor of the body of water, side view, whereby a long Bubble Pipe 132 is positioned via anchors 714 (A) and (B) on the floor from one side to the other of the Bay entrance. The Buoys 711 (A) and 711 (B) have drop strings 716 (A) and (B) attached to the anchor strings 715 (A) and (B) so that the ends of the pipe locations are marked at the surface of the water. The use of the Buoys can be for ease of pick-up and or collection, and they can be to provide a visible surface mark where people can see from a distance showing the entrance of a bay or where a bubble barrier has been set, etc. In Drawing 4 the sides of the Bay are marked at 130, and at one side the power system is setting on the bank. The power systems would normally likely be sitting on a dock, anchored vessel, a barge wall or barrier, etc. In this case, there is a Generator 106 connected to a Air Compressor 271 where a hose 150 runs from the compressor to the end of the Bubble Pipe 132 and enters at position 714 (B) (where in this case the anchor 714 (B) contains a nozzle connector where the hose can attach): The air bubble barrier 133 is formed by the wall of bubbles released making their way to the surface of the water. Because of the density changes in air at water depths, air expands as it rises to the surface. This means that as the air bubbles 133 rises through the water, and they get closer to the top, the air bubble expands making it rise to the Surface with greater force. This makes air bubbles great for not only blocking the entrance of oil water on the water surface, it also makes bubbles have the ability to block many other contaminants below the water surface forcing them to the top of the water as well. Because the bubble force the incoming oil and contaminants to the top. So well, it makes suctioning the oil and other mess easier from off the sides of a barge barrier.

DRAWING 5



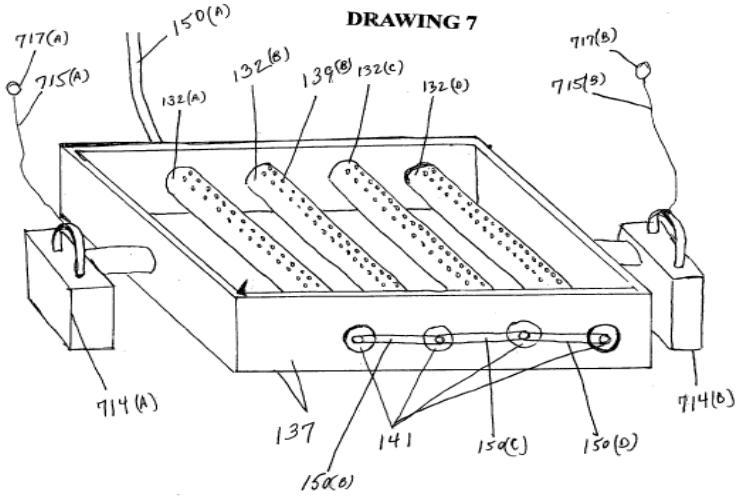
Drawing 5 is a see through the water, side view of the waterline to the sea floor, showing the application of an Air Bubble Barrier system working.

Drawing 5 shows the same view as Drawing 4, except the difference in this case is that the air is being supplied by a Windmill 113 aeration device. Windmills are often used in ponds to Supply oxygen; however, in this case it is used to supply air to a Bubble Pipe 132. Also in this Drawing, the Anchors 714 and Bubble Pipe system 132.



Drawing 6 is a see through the water to the sea or Bay floor overhead view of an Air Bubble Barrier as if working in an applicable situation blocking a Bay.

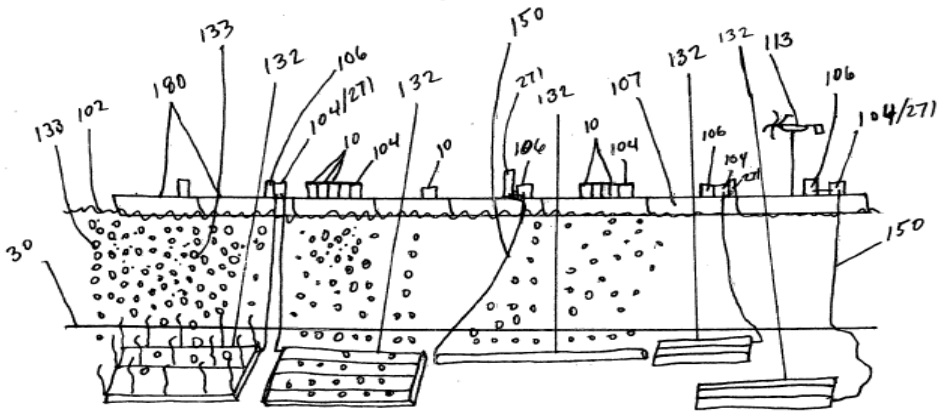
Drawing 6 shows a see through the water to the bottom or Bay floor, overhead view, of a Bay 190 entrance where a oil slick 101 is incoming from a main body of water102 (on the left), and the oil slick 101 is attempting to enter a Bay 190 blockaded by a Air Bubble Barrier system created by a all-in-one Vacuum/Pump Generator 104 system pumping air through a hose 150 to a anchored 714 Bubble Pipe 132: and it is being backed up with a Boom 777 system stretching from one side of the Bay to the other. The Drawing 6 attempts to show a wall of bubbles 133 from the Bay Floor, coming out of the Bubble Pipe 132 and rising to the water surface. The Drawing 6 is also meant to show an applicable use and possible location for use.



Drawing 7 is an up close view of an alternative design option of an Air Bubble Piping system using multiple pipes.

Drawing 7 shows a different or alternative design fora Pipe Barrier 132 system whereby multiple Bubble Pipes 132 (A), (B), (C), and (D) are all in a frame 137 which is anchored via anchors 714 (A) and (B). The hose 150 pumps air into Bubble Pipe 132 (A), where the hoses 150 (B), (C), and (D) attach each pipe at location 141 so that the air flowing into Pipe 132 (A) fills all the pipes. Each pipe has tiny holes drilled lengthwise along the tip, just as a single Bubble Pipe would. In this case, from one hose intake area, and from one Bubble Barrier system, a larger Bubble Barrier would form, thus creating a larger barrier. Of course the more pipes added, the more need for air Volume, unless the pipes are made in a Smaller diameter. This Drawing shows one of several options for design.

DRAWING 8

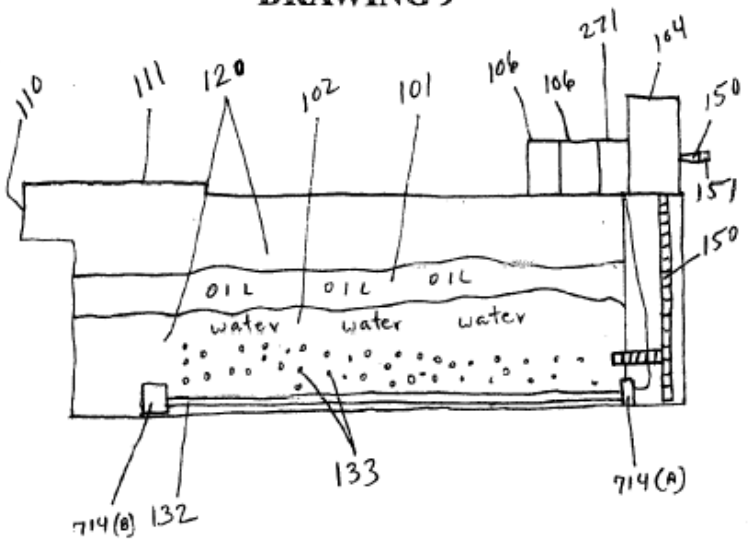


Drawing 8 shows a see through the water side view to the sea floor of a floating Barge Barrier system with multiple designs for the Air Bubble Barrier Pipe systems underneath releasing bubble for aiding in the blockade and working with the barge barrier.

Drawing 8 shows a see-through the water line side view, from the floor of the body of water to the surface of an air bubble barrier 160 providing a blockade alongside a Barge Barrier. This Drawing shows a very applicable use for the Bubble Barrier system. The Bubble Barrier is located underneath one side of a Barge Barrier, and the Bubbles would work to push all the incoming oil to the Surface so that skimmers and or the Suction equipment on the barge would be able to better or

more easily suction the oil from the water. More designs for the Bubble Frames and or other parts of the overall system are also visual.

DRAWING 9



Drawing 9 shows a see through Barge Skimmer, with an Air Bubble Barrier inside and helping with the oil from water separation process.

Drawing 9 shows another location for where the Bubble barrier system can be used in oil spill response. This Drawing shows a see-through view of a Barge Skimmer 107 where a Bubble Pipe 132 has been placed at the bottom of a Barge Skimmer collection tank 120. The collection tank 120 is filled with oil 101 and water 102 just suctioned or skimmed from the water during a skimming operation. Inside the tank 120, the air bubbles 133 released at the bottom of the tank acts to push the oil 101 and debris to the surface while the clean water 102 settles at the bottom. This is a water and oil separation technique that can be applied to the Barge Skimmers to make the skimming more efficient and effective. The drain to the pipe or hose 150 that is extended to the bottom of the barge skimmer collection tank 120, will

be opened at location 151. When opened, a vortex is created letting out a portion of the clean water, and the water will be cleaner due to the bubbles.

A new method for responding to oil spills by creating a barrier or blockade in a body of water so to protect or keep oil from moving into a area, by,

(a.) setting a Bubble Pipe 132 or Bubble Barrier Structure 137 below the water surface, often anchored 714 at the floor or bottom of the body of water and,

(b.) connected to an Air Compressor 271 or other air producing and or pumping equipment, via a hose 150,

(c.) where the air pumped into the Bubble Pipe 132 filling the pipe with air, but the Bubble Piping having tiny holes drilled into and through the pipe lengthwise from one end to the other along the top of one or more sides of the pipe so that the air is released through tiny holes 139 in the Bubble Pipe(s),

(d.) which when the air is released under water, the air forms bubbles 133 in the water rising from the Bubble Pipe 132 or structure 137 to the water surface so that the rising air creates a barrier or wall of Air Bubbles 133,

(e.) where the rising air bubbles 133 creates an up-current in the water thus forming a reversed surface current,

(f) Where the reversed surface current then slows or stops incoming oil 101 or debris which may be floating on, at, or near the water,

(g.) which when used alongside or with other barriers provides an extra measure of protection from oil moving into the Surrounding environment,

(h.) the air bubbles 133 also acts to keep oil and debris at the top of the water for easier Suction, skimming, and or for use in water cleaning applications after the oil is skimmed and or contained,

(i.) the air bubbles 133 acts to put much needed oxygen back into the water in an area polluted by an oil spill.

A method of pushing oil and debris to the surface of the water to make skimming and or Suctioning easier while providing oxygen to the water during a oil spill,

(a.) by releasing a wall of air bubbles underneath the water,

(b.) thereby pushing everything in the water that the bubbles 133 can push upward to the surface,

(c.) while also releasing oxygen into the water combating the depleting effects of the oil.

A method of cleaning water inside the skimmers 107and or skimmer collection tanks 120, by,

(a.) using the Air Bubble Piping 132 or structures 137 to released air from the bottom of the tank to the surface,

(b.) forming a wall of air bubbles 133 inside the collection tank 120 so to push the oil and debris to the to surface of the water within the collection tanks 120,

(c.) so that the clean water 102 settles to the bottom of the collection tank 120 while the oil gets pushed to the top of the water 101,

(d.) thereby allowing the cleaner water 102 to be drained or pumped out at the bottom of the tank, while the purer oil101 can be pumped or suctioned out at the top,

(e.) a method of putting or Supplying oxygen to the collection tanks to keep sea life alive in case any fish, turtles, or other sea life may have been Suctioned during skimming or vacuum operations, so that when released they are healthier and have a better chance for surviving the oil skimming situation.

CHAPTER 4

CONCLUSION AND DISCUSSION

The main objective of this research was to develop a bubble barrier design that could be used to deter carp in small streams, as well as characterize the physical fields generated by the bubble barrier.

Following are physical parameters for bubble barrier:-

1. Bubble curtains generate distinct flow fields characterized by recirculation cells with an influence range of +/- 1-2 depths away from the diffuser in stagnant flow conditions.
2. A bubble curtain generates an acoustic field that has a peak SPL at 150 Hz (within the highest sensitivity range for carp) with a SPL magnitude between 90-130 dB. The acoustic signal is highly complex with significant frequency components within total carp hearing range.
3. The coarse-bubble diffusers generate stronger acoustic field than the fine-bubble diffuser; however, the fine-bubble diffuser generates a slightly stronger flow field than the coarse-bubble diffusers (17cm/s > 13cm/s).
4. The barrier trial result clearly demonstrates the accuracy and effectiveness of the RFID PIT tag detection system. The experimental configuration and testing protocol proved to be an effective method for the initial testing of the bubble barrier designs.

ADVANTAGES:

1. Plastic in water: Plastic in the water, which flows through the Amsterdam canals to the Bubble Barrier and is guided by the bubbles into the catchment

system.

2. Boats: Boats can sail through the Bubble Barrier without a problem.
3. Bubble Barrier: The Bubble Barrier is placed diagonally in the river, in a precisely calculated angle for the maximum capture of plastics.
4. Catchment system: The catchment system which retains the plastic until removal.
5. Compressor: Electric compressor which supplies the air for the Bubble Barrier (placed in an insulated container)
6. Result: Water without plastic waste flows via the river IJ into the North Sea.

DISADVANTAGES:

Every day a staggering amount of waste ends up in our water where it causes severe damage to marine and human life. Sea turtles and fish get entangled in plastic, ships are obstructed in their paths, and micro plastics form a health hazard for the smallest to the largest organisms. This problem is recognized more and more, by the general public, as well as businesses and governments.

We believe plastic waste can be caught before it reaches the oceans. Current solutions that stop waste in the rivers have two major drawbacks; they block ship traffic and/or hinder fish migration. We found an elegant solution that blocks waste in the river but also allows the passage of fish and ships: a barrier of bubbles.

The Bubble Barrier is created by pumping air through a tube with holes, which is placed on the bottom of the river. The rising bubbles result in an upwards current which brings the waste to the surface. At the surface, the water flow is directed sideways and the waste is being stopped from flowing downstream.

By placing two Bubble Barriers diagonally in the waterway, we block plastics from moving downstream and make clever use of the current of the river to direct the

waste to the banks. The waste accumulates on the side of the river where it can easily be collected with a catchment system. Fish can pass through the bubbles, underneath the Bubble Tubing or through the fish pass.

FUTURE SCOPE:-

The following is a collection of future work that would further development of bubble barrier technologies for common carp:

1. Quantify the effect of channel flow on the acoustic and hydrodynamic properties of a bubble curtain.
2. Perform more rigorous testing that includes, but not limited to, isolating either the hydrodynamic or acoustic fields of the barrier or sensory systems in the carp to identify the specific stimuli that causes the most significant change in carp behaviour.
3. Using the similar testing procedures and apparatus, compare the barriers designed in this research with current technologies available commercially to identify any advantage or disadvantages to either design.
4. Field test a barrier design with existing carp populations in a specific field site or using laboratory carp populations.

The bubble barrier design is considered a substantial promise as an effective carp barrier in shallow channels. The flexibility of the bubble curtain to adjust instantaneously with water depth and minimum decrease in field strength due to depth makes bubble curtains ideal for flashy streams. A 75% reduction in passages could provide a sizable decrease in the recruitment of juvenile carp from nursery lakes, consequently increasing the effectiveness of current carp management techniques in the main water bodies.

CHAPTER 5

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