# FABRICATION OF AN AMPHIBIOUS CYCLE

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**ABSTRACT:** An Amphibious cycle is a human-powered vehicle capable of operation on both land and water. The design which has probably received the most coverage is Saidullah's Bicycle. The bike uses four rectangular air filled floats for buoyancy, and is propelled using two fan blades which have been attached to the spokes. Moraga's Cycle Amphibious uses a simple tricycle frame to support three floaters which provide both the floatation and thrust. The wings on the powered wheels propel the vehicle in a similar way to a paddle wheel Amphibious cycle. The bicycle is a self contained convertible structure so that it may be readily adapted to operation in either environment comprising conventional wheels and pedal, sprocket, chain drive system but also including front and rear pontoons which are adapted to pivot about the frame of the bicycle from a retracted above-wheel position when in the land operating mode to a deployed, adjacent-wheel position when in the water operating mode. An attachable propeller, drive shaft, and gearing means cooperatively engages the pedal-sprocket structure for powered mobility when in water. This type of cycle is used in flood prone zones for transferring foods and other human utilities.

## 1. INTRODUCTION

An amphibious cycle is a human-powered vehicle capable of operation on both land and water. The design which has probably received the most coverage is Saidullah's Bicycle. The bike uses four rectangular air filled floats for buoyancy, and is propelled using two fan blades which have been attached to the spokes. Moraga's Cycle Amphibious uses a simple tricycle frame to support three floaters which provide both the floatation and thrust. The wings on the powered wheels propel the vehicle in a similar way to a paddle wheel. It consists of 2 inflatable floats with straps that allow the carrying of a bicycle with passenger. The ensemble, when deflated, fits in a backpack for carrying by the cyclist. The Amphibious Cycle combines a recumbent frame with separate floats, and is propelled using a paddle wheel. A speed test on water achieved an average speed of 1.12 m/s. The cyclist was able to transition the cycle both into and out of the water unassisted. This prototype has a real application in urban areas of flooding, as well as applications in the leisure industry. An amphibious vehicle was created by five engineering students at Calvin College as a senior design project (May 2010). This vehicle improves upon previous designs by allowing smooth transition from water to land.
Another recent design was made especially for Ebrahim Hemmatnia for his voyage around the world. This velomobile design was called the Ad Infinitum.

## 2. METALS AND FLOATING MATERIALS USED IN FABRICATION

### 2.1.1 MILD STEEL OR PLAIN-CARBON STEEL:

Plain- Carbon steel is steel in which the main interstitial alloying constituent is carbon in the range of 0.12–2.0%. The American Iron and Steel Institute (AISI) defines that:
Steel is considered to be carbon steel when no minimum content is specified or required for chromium, cobalt, molybdenum, nickel, niobium, titanium, tungsten, vanadium or zirconium, or any other element to be added to obtain a desired alloying effect;
When the specified minimum for copper does not exceed 0.40 percent; or when the maximum content specified for any of the following element does not exceed the percentages noted: manganese:-1.65, silicon:-0.60, copper:-0.60
The term "carbon steel" may also be used in reference to steel which is not stainless steel; in this use carbon steel may include alloy steels. As the carbon percentage content rises, steel has the ability to become harder and stronger through heat treating; however it becomes less ductile. Regardless of the heat treatment, higher carbon content reduces weldability. In carbon steels, the higher carbon content lowers the melting point. Carbon steel is broken down into four classes based on carbon content:

**2.1.2Mild and low-carbon steel**

Mild steel, also known as plain-carbon steel, is the most common form of steel because its price is relatively low while it provides material properties that are acceptable for many applications. Low-carbon steel contains approximately 0.05–0.15% carbon making it malleable and ductile. Mild steel has a relatively low tensile strength, but it is cheap and easy to form; surface hardness can be increased through carburizing. It is often used when large quantities of steel are needed, for example as structural steel. The density of mild steel is approximately 7.85 g/cm3 (7850 kg/m3 or 0.284 lb/in3) and the Young's modulus is 210 GPa (30,000,000 psi).

Low-carbon steels suffer from yield-point runout where the material has two yield points. The first yield point (or upper yield point) is higher than the second and the yield drops dramatically after the upper yield point. If a low-carbon steel is only stressed to some point between the upper and lower yield point then the surface may develop Lüder bands. Low-carbon steels contain less carbon than other steels and are easier to cold-form, making them easier to handle.

**2.1.3Higher carbon steels**

Carbon steels which can successfully undergo heat-treatment have a carbon content in the range of 0.30–1.70% by weight. Trace impurities of various other elements can have a significant effect on the quality of the resulting steel. Trace amounts of sulphur in particular make the steel red-short, that is, brittle and crumbly at working temperatures. Low-alloy carbon steel, such as A36 grade, contains about 0.05% sulphur and melts around 1,426–1,538 °C (2,599–2,800 °F). Manganese is often added to improve the hardenability of low-carbon steels. These additions turn the material into a low-alloy steel by some definitions, but AISI's definition of carbon steel allows up to 1.65% manganese by weight.

**2.1.4.Low carbon steel** 0.05-0.3% carbon content.

**2.1.5.Medium carbon steel** Approximately 0.250–0.6% carbon content. Balances ductility and strength and has good wear resistance; used for large parts, forging and automotive components.

**2.1.6High-carbon steel (ASTM 304)** Approximately 0.9–2.5% carbon content. Very strong, used for springs and high-strength wires.

**2.1.7Ultra-high-carbon steel** Approximately 2.5–3.0% carbon content. Steels that can be tempered to great hardness. Used for special purposes like (non-industrial-purpose) knives, axles or punches. Most steels with more than 2.5% carbon content are made using powder metallurgy. Note that steel with a carbon content above 2.14% is considered cast iron.

**2.1.8 Float material**

The materials that can be used as floating materials should have a density less than that of the density of water. The commonly used floating materials are foam, thermocol, pipes which have the density less than water density such as HDP.

**3.PROPERTIES OF MILD STEEL**

1. Mild steel is one of the most common of all metals and one of the least expensive steels used. It is to be found in almost every created from metal.
2. It is weldable, very durable (although it rusts), it is relatively hard and is easily annealed.
3. Having less than 2% carbon it will magnetize well and being relatively inexpensive, can be used in most projects requiring a lot of steel.
4. However when it comes to load bearing, its structural strength is not usually sufficient to be used in structural beams and grinders
5. Most everyday items made of steel have some milder steel content. Anything from cookware, motorcycle frames through to motor car chassis, use this metal in their construction.
6. Because of its poor resistance to corrosion it must be protected by painting or otherwise sealed to prevent it from rusting. At worst a coat of oil or grease will help seal it from exposure, and help prevent rusting.
7. Being a softer metal it is easily welded. Its inherent properties allow electrical current to flow easily through it without upsetting its structural integrity. This is in contrast to other high carbon steels like stainless steel which require specialized welding techniques.
8. This mild variant of harder steel is thus far less brittle and can therefore give and flex in its application where a harder more brittle material would simply crack and break.

## 4. MECHANICAL PROCESSES INVOLVED IN FABRICTION

### 4.1 WELDING:

Welding is a fabrication or sculptural process that joins materials, usually metals or thermoplastics, by causing coalescence. This is often done by melting the work pieces and adding a filler material to form a pool of molten material (the weld pool) that cools to become a strong joint, with pressure sometimes used in conjunction with heat, or by itself, to produce the weld. This is in contrast with soldering and brazing, which involve melting a lower-melting-point material between the work pieces to form a bond between them, without melting the work pieces.

Two types of welding process

1) Arc welding
2) Gas welding]

### 4.2 ARC WELDING:

Arc welding is a type of welding that uses a welding power supply to create an electric arc between an electrode and the base material to melt the metals at the welding point. They can use either direct (DC) or alternating (AC) current, and consumable or non-consumable electrodes. The welding region is usually protected by some type of shielding gas, vapour, or slag. Arc welding processes may be manual, semi-automatic, or fully automated. First developed in the late part of the 19th century, arc welding became commercially important in shipbuilding during the Second World War. Today it remains an important process for the fabrication of steel structures and vehicles. One of the most common types of arc welding is shielded metal arc welding (SMAW), which is also known as manual metal arc welding (MMAW) or stick welding. An electric current is used to strike an arc between the base material and a consumable electrode rod or *stick*. The electrode rod is made of a material that is compatible with the base material being welded and is covered with a flux that gives off vapours that serve as a shielding gas and provide a layer of slag, both of which protect the weld area from atmospheric contamination. The electrode core itself acts as filler material,

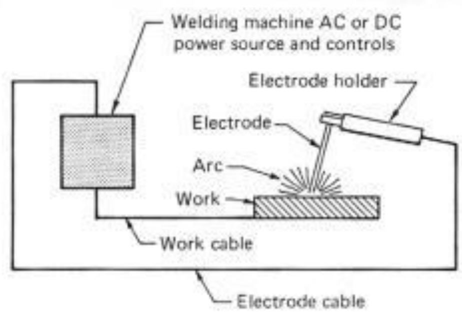



Fig: Arc Welding

making a separate filler unnecessary. The process is very versatile, requiring little operator training and inexpensive equipment. However, weld times are rather slow, since the consumable electrodes must be frequently replaced and because slag, the residue from the flux, must be chipped away after welding. Furthermore, the process is generally limited to welding ferrous materials, though specialty electrodes have made possible the welding of cast iron, nickel, aluminium, copper and other metals. The versatility of the method makes it popular in a number of applications including repair work and construction.

**GAS WELDING:**

Oxy-fuel welding (commonly called oxyacetylene welding, oxy welding, or gas welding in the U.S.) and oxy-fuel cutting are processes that use fuel gases and oxygen to weld and cut metals, respectively. French engineers Edmond Fouché and Charles Picard became the first to develop oxygen-acetylene welding in 1903. Pure oxygen, instead of air, is used to increase the flame temperature to allow localized melting of the workpiece material (e.g. steel) in a room environment. A common propane/air flame burns at about 2,000 °C (3,630 °F), a propane/oxygen flame burns at about 2,500 °C (4,530 °F), and an acetylene/oxygen flame burns at about 3,500 °C (6,330 °F).

Oxy-fuel is one of the oldest welding processes, besides forge welding. Still used in industry, in recent decades it has been less widely utilized in industrial applications as other specifically devised technologies have been adopted. It is still widely used for welding pipes and tubes, as well as repair work. It is also frequently well-suited, and favoured, for fabricating some types of metal-based artwork. As well, oxy-fuel has an advantage over electric welding and cutting processes in situations where accessing electricity (e.g., via an extension cord or portable generator) would present difficulties; it is more self-contained, in this sense — hence "more portable". In oxy-fuel welding, a welding torch is used to weld metals. Welding metal results when two pieces are heated to a temperature that produces a shared pool of molten metal. The molten pool is generally supplied with additional metal called filler. Filler material depends upon the metals to be welded. In oxy-fuel cutting, a torch is used to heat metal to its kindling temperature. A stream of oxygen is then trained on the metal, burning it into a metal oxide that flows out of the kerf as slag. Sometimes called a "Gas Axe". Torches that do not mix fuel with oxygen (combining, instead, atmospheric air) are not considered oxy-fuel torches and can typically be identified by a single tank (Oxy-fuel cutting requires two isolated supplies, fuel and oxygen). Most metals cannot be melted with a single-tank torch. As such, single-tank torches are typically used only for soldering and brazing, rather than welding.

**TACK WELDING:**

Tack welding is a vital part of a pressure vessel fabricated by welding. This is why the ASME Boiler and Pressure Vessel Code requires qualification of the welding procedure used for tack welding. The code requires the tack welding procedure to be qualified in accordance with the referencing book section and Section IX the same as for other weldments. Many metals used in code fabrication are very sensitive to rapid quenching including many of the basic P-No. L metals. Very hard, brittle, crack sensitive micro structures, such as martin site and upper binate, are formed in many metals when rapidly quenched from an elevated temperature. The brittle micro structures are likely to crack during the solidification of the weld metal or when highly stressed during operation of the pressure vessel. The cracks are usually an under bead crack not detectable by visual or dye penetrant examination and difficult to detect by radiographic or magnetic particle examination. Yet these small cracks may lead to the product failure, if not at hydro test, at some future time due to cyclic fatigue of the pressure vessel. There are many preventive measures to circumvent this problem such as preheat, high heat input processes, subsequent Post Weld Heat Treated (PWHT), etc. high heat input process may be selected for the welding, but the tack is applied by the shielded metal arc welding process. The tack is a very rapid quench application and a brittle, crack sensitive micro structure results usually at the root of the weld. The tack may be subsequently pulled and stressed during the fit-up operation with a resultant underbid crack in the pressure retaining material at the root of the weld. Subsequent weld passes with the high heat input process do not, generally, remove the cracks. In fact, the cracks may propagate further into the base metal and/or weld metal during the subsequent welding operations.

There is at least one exception to these statements and that is in stud welding. Performance qualification of welders for tack welding must include as essential variables: backing, base metal type, and position, deposited weld metal thickness range . Poorly applied tack welds are frequently the cause of entrapped slag, porosity, lack of full penetration, leaks and cracks. This is why the ASME code requires tack welds to be procedure and performance qualified and incorporated into the controlled manufacturing system of the manufacturer for any code fabrication.

**4.2 GRINDING:**

Surface grinding is the most common of the grinding operations. It is a finishing process that uses a rotating abrasive wheel to smooth the flat surface of metallic or non metallic materials to give them a more refined look or to attain a desired surface for a functional purpose.

The surface grinder is composed of an abrasive wheel, a work holding device known as a chuck, and a reciprocating or rotary table. The chuck holds the material in place while it is being worked on. It can do this one of two ways: ferromagnetic pieces are held in place by a magnetic chuck, while non-ferromagnetic and non-metallic pieces are held in place by vacuum or mechanical means.

Factors to consider in surface grinding are the material of the grinding wheel and the material of the piece being worked on. Typical work piece materials include cast iron and mild steel. These two materials don't tend to clog the grinding wheel while being processed. Other materials are aluminium, stainless steel, brass and some plastics. When grinding at high temperatures, the material tends to become weakened and is more inclined to corrode. This can also result in a loss of magnetism in materials where this is applicable. The grinding wheel is not limited to a cylindrical shape and can have a myriad of options that are useful in transferring different geometries to the object being worked on. Straight wheels can be dressed by the operator to produce custom geometries. When surface grinding an object, one must keep in mind that the shape of the wheel will be transferred to the material of the object like a mirror image.

Spark out is a term used when precision values are sought and literally means "until the sparks are out (no more)". It involves passing the work piece under the wheel, without resetting the depth of cut, more than once and generally multiple times. This ensures that any inconsistencies in the machine or work piece are eliminated. A surface grinder is a machine tool used to provide precision ground surfaces, either to a critical size or for the surface finish. The typical precision of a surface grinder depends on the type and usage; however ±0.002 mm (±0.0001 in) should be achievable on most surface grinders. The machine consists of a table that traverses both longitudinally and across the face of the wheel. The longitudinal feed is usually powered by hydraulics, as may the cross feed, however any mixture of hand, electrical or hydraulic may be used depending on the ultimate usage of the machine (i.e., production, workshop, cost). The grinding wheel rotates in the spindle head and is also adjustable for height, by any of the methods described previously. Modern surface grinders are semi-automated, depth of cut and spark-out may be present as to the number of passes and, once set up, the machining process requires very little operator intervention. Depending on the work piece material, the work is generally held by the use of a magnetic chuck. This may be either an electromagnetic chuck, or a manually operated, permanent magnet type chuck; both types are shown in the first image. The machine has provision for the application of coolant as well as the extraction of metal dust (metal and grinding particles) periphery (flat edge) of the wheel is in contact with the work piece, producing the flat surface. Peripheral grinding is used in high-precision work on simple flat surfaces; tapers or angled surfaces; slots; flat surfaces next to shoulders; recessed surfaces; and profiles. The face of a wheel (cup, cylinder, disc, or segmental wheel) is used on the flat surface. Wheel-face grinding is often used for fast material removal, but some machines can accomplish high-precision work. The work piece is held on a reciprocating table, which can be varied according to the task, or a rotary-table machine, with continuous or indexed rotation. Indexing allows loading or unloading one station while grinding operations are being performed on another Disc grinding is similar to surface grinding, but with a larger contact area between disc and work piece. Disc grinders are available in both vertical and horizontal spindle types. Double disc grinders work both sides of a work piece simultaneously. Disc grinders are capable of Aluminium oxide; silicon carbide, diamond, and cubic boron nitride (CBN) are four commonly used abrasive materials for the surface of the grinding wheels. Of these materials, aluminium oxide is the most common. Because of cost, diamond and CBN grinding wheels are generally made with a core of less expensive material surrounded by a layer of diamond or CBN. Diamond and CBN wheels are very hard and are capable of economically grinding materials, such as ceramics and carbides that cannot be ground by aluminium oxide or silicon carbide wheels. As with any grinding operation, the condition of the wheel is extremely important. Grinding dressers are used to maintain the condition of the wheel, these may be table mounted or mounted in the wheel head where they can be readily applied. In oxy-fuel cutting, a torch is used to heat metal to its kindling temperature. A stream of oxygen is then trained on the metal, burning it into a metal oxide that flows out of the kerf as slag. Sometimes called a "Gas Axe". Torches that do not mix fuel with oxygen (combining, instead, atmospheric air) are not considered oxy-fuel torches and can typically be identified by a single tank (Oxy-fuel cutting requires two isolated supplies, fuel and oxygen). Most metals cannot be melted with a single-tank torch. As such, single-tank torches are typically used only for soldering and brazing, rather than welding. A cutting torch head is used to cut materials. It is similar to a welding torch, but can be identified by the oxygen blow out trigger or lever. The metal is first heated by the flame until it is cherry red. Once this temperature is attained, oxygen is supplied to the heated parts by pressing the "oxygen-blast trigger". This oxygen reacts with the metal, forming iron oxide and producing heat. It is this heat that continues the cutting process. The cutting torch only heats the metal to start the process; further heat is provided by the burning metal The melting point of the iron oxide is around half that of the metal; as the metal burns, it immediately turns to liquid iron oxide and flows away from the cutting zone.

**4.3 DRILLING:**

Drilling is a cutting process that uses a drill bit to cut or enlarge a hole of circular cross-section in solid materials. The drill bit is a rotary cutting, often multipoint. The bit is pressed against the work piece and rotated at rates from hundreds to thousands of revolutions per minute. This forces the cutting edge against the work piece, cutting off chips (sward) from the hole as it is drilled. Exceptionally, specially-shaped bits can cut holes of non-circular cross-section, a square cross-section is possible. Under normal usage, swarf is carried up and away from the tip of the drill bit by the fluting of the drill bit. The cutting edges produce more chips which continue the movement of the chips outwards from the hole. This is successful until the chips pack too tightly, either because of deeper than normal holes or insufficient backing off (removing the drill slightly or totally from the hole while drilling). Cutting fluid is sometimes used to ease this problem and to prolong the tool's life by cooling and lubricating the tip and chip flow. Coolant may be introduced via holes through the drill shank, which is common when using a drill mostly gun drill. When cutting aluminium in particular, cutting fluid helps ensure a smooth and accurate hole while preventing the metal from grabbing the drill bit in the process of drilling the hole. When cutting brass, and other soft metals that can grab the drill bit and causes "chatter", a face of approx. 1-2 millimetres can be ground on the cutting edge to create an obtuse angle of 91 to 93 degrees. This prevents "chatter" during which the drill tears rather than cuts the metal. However, with that shape of bit cutting edge, the drill is pushing the metal away, rather than grabbing the metal. This creates high friction and very hot scarf. Different drill bits are used to drill metal depending upon hardness, thermal properties of the metal and hole diameter required. Saw, Step, Countersink are some among them. The drill speed is also adjusted depending upon the thermal properties and hardness of metal. For example, when cutting stainless steel slower speed is recommended than steel. Drilling too fast on stainless steel will heat it up easily and make it hard quickly which makes it very difficult to drill. For heavy feeds and comparatively deep holes oil-hole drills are used in the drill bit, with a lubricant pumped to the drill head through a small hole in the bit and flowing out along the fluting. A conventional drill press arrangement can be used in oil-hole drilling, but it is more commonly seen in automatic drilling machinery in which it is the work piece that rotates rather than the drill bit. In computer numerical control (CNC) machine tools a process called peck drilling, or interrupted cut drilling, is used to keep scarf from detrimentally building up when drilling deep holes (approximately when the depth of the hole is three times greater than the drill diameter). Peck drilling involves plunging the drill part way through the work piece, no more than five times the diameter of the drill, and then retracting it to the surface. This is repeated until the hole is finished. A modified form of this process, called high speed peck drilling or chip breaking, only retracts the drill slightly. This process is faster, but is only used in moderately long holes; otherwise it will overheat the drill bit. It is also used when drilling stringy material to break the chips.

**4.4 TURNING ON A LATHE:**

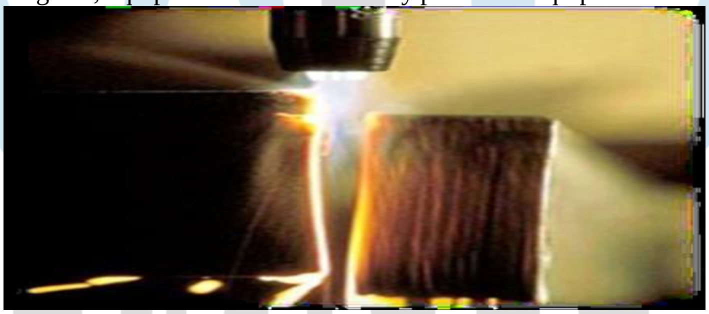
A lathe is a machine tool used principally for shaping pieces of metal, wood, or other materials by causing the work piece to be held and rotated by the lathe while a tool bit is advanced into the work causing the cutting action. Lathes are to be very fine can be divided into three types for easy identification: engine lathe, turret lathe, and special purpose lathes. Some smaller ones are bench mounted and semi-portable. The larger lathes are floor mounted and may require special transportation if they must be moved. Field and maintenance shops generally use a lathe that can be adapted to many operations and that is not too large to be moved from one work site to another. The engine lathe is ideally suited for this purpose. A trained operator can accomplish more machining jobs with the engine lathe than with any other machine tool. Turret lathes and special purpose lathes are usually used in production or job shops for mass production or specialized parts, while basic engine lathes are usually used for any type of lathe work. Mainly used in production for multitask work.Turning is an engineering machining process in which a cutting tool, typically a non-rotary tool bit, describes a helical tool path by moving more or less linearly while the work piece rotates. The tool's axes of movement may be literally a straight line, or they may be along some set of curves or angles, but they are essentially linear (in the nonmathematical sense). Usually the here the variation term "turning" is reserved for the generation of external surfaces by this cutting action, whereas this same essential cutting action when applied to internal surfaces (that is, holes, of one kind or another) is called "boring". Thus the phrase "turning and boring" categorizes the larger family of (essentially similar) processes. The cutting of faces on the work piece (that is, surfaces perpendicular to its rotating axis); whether with a turning or boring tool, is called "facing", and may be lumped into either category as a subset. Turning can be done manually, in a traditional form of lathe, which frequently requires continuous supervision by the operator, or by using an automated lathe which does not. Today the most common type of such automation is computer numerical control, better known as CNC. (CNC is also commonly used with many other types of machining besides turning.)

When turning, a piece of relatively rigid material (such as wood, metal, plastic, or stone) is rotated and a cutting tool is traversed along 1, 2, or 3 axes of motion to produce precise diameters and depths. Turning can be either on the outside of the cylinder or on the inside (also known as boring) to produce tubular components to various geometries.

Although now quite rare, early lathes could even be used to produce complex geometric figures, even the platonic solids; although since the advent of CNC it has become unusual to use non-computerized tool path control for this purpose. In general, turning uses simple single-point cutting tools. Each group of work piece materials has an optimum set of tools angles which have been developed through the years. The bits of waste metal from turning operations are known as chips (North America), or swarf (Britain). In some areas they may be known as turnings.

**4.5 GAS CUTTING:**

Gas, a suitable burner and a steady hand are all that is needed for cutting mild steel. This principle has not changed since the beginning of the twentieth century. Flame cutting is a combustion process. It is not the heating flame itself that does the actual cutting but an oxygen jet, which burns the material during heat formation and transports the combustion products (slag) away from the cut. When cutting, the purity of the oxygen is of huge importance to the cutting speed. The purer the gas, the higher the cutting speed and the better the productivity and cut quality. Before cutting can begin, the steel must be heated to ignition temperature by means of a gas flame. The choice of fuel gas affects cut quality and the time used for preheating. When choosing a fuel gas, the thickness of the material must also be considered. By using (odorized oxygen), you can minimize the risk of fire and explosion which is always associated with fuel gases. The odour provides a timely warning in the event of gas leaks. The most important part of cutting equipment is the cutting nozzle. The higher the outlet speed of the oxygen jet, the better the output of the nozzle. In turn, the speed depends on the shape of the cutting nozzle. Nowadays, nozzles with an expansion channel are often used... The construction of the cutting nozzle and its adjustment to various fuel gases with regard to the size of the gas channels, exact geometry, tolerances and surface finish are of crucial importance to achieving a high quality cut. The cutting speed can be increased by using a curtain nozzle, for example. This type of nozzle has a special oxygen channel which protects the cutting oxygen jet from impurities, making higher cutting speeds. Oxy fuel cutting can be used for cutting mild and low-alloyed steel, up to thicknesses of just over 1,000 mm. The cut quality also depends on the surface of the work piece, and can be affected by different types of shop primer. Use of several burners for straight cutting, phase cutting and joint preparation is an example of the cutting process's versatility The use of fuel gases together with oxygen can give rise to dangerous situations, if the user lacks adequate knowledge of how gases, equipment and the necessary protective equipment must be used.



**5.COMPONENTS OF AMPHIBIOUS CYCLE**

1) Frame
2) Axle
3) Wheel
4) Pedal rod
5) Propeller
6) Float material

**FRAME:**

A bicycle frame is the main component of a bicycle, onto which wheels and other components are fitted. The modern and most common frame design for an upright bicycle is based on the safety bicycle, and consists of two triangles, a main triangle and a paired rear triangle. This light, which they do by combining different materials and shapes.

The frame is made of MS bars which are in hollow rectangular shape. The wheels are mounted on the axle on the rear side and a fork is placed in the front side where the wheel is fitted for supporting on the front side. The size of the frame is the front bar has the length of one metre and the V shaped frame has the angle between them to be 90'.The V shaped frame has each member of length 70cm and the holes are made in the V type frame with the gas cutting as the dia of the holes is large such that the axle is placed in the holes.

FORK FRAME AXLE

**AXLE:**
The axle is made of MS metal which is used for supporting the wheels on the rear side. The axle is also used for mounting the freewheels on the rear side for the motion of the wheels on the rear side and also the freewheel is also used to the motion of the propeller mounted behind the rear axle. An axle is a central shaft for a rotating wheel or gear. On wheeled vehicles, the axle may be fixed to the wheels, rotating with them, or fixed to the vehicle, with the wheels rotating around the axle. In the former axle is supported. In the latter case, a bearing or bushing sits inside a central hole in the wheel to allow the wheel or gear to rotate around the axle. Sometimes, especially on bicycles, the latter type axle is referred to as a spindle.

**WHEEL:**
A wheel is a circular component that is intended to rotate on an axial bearing. The wheel is one of the main components of the wheel and axle which is one of the six simple machines. Wheels, in conjunction with axles, allow heavy objects to be moved easily facilitating movement or transportation while supporting a load, or performing labour in machines. Wheels are also used for other purposes, such as a ship's wheel, steering wheel, potter's wheel and flywheel.

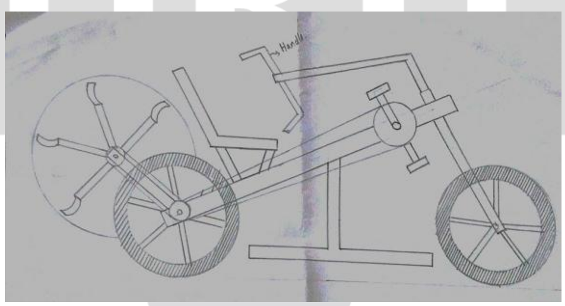
Common examples are found in transport applications. A wheel greatly reduces friction by facilitating motion by rolling together with the use of axles. In order for wheels to rotate, a moment needs to be applied to the wheel about its axis, either by way of gravity, or by the application of another external force or torque. In the amphibious cycle three wheels are used one wheel on the front and two wheels on the rear side.

**PEDAL ROD**:
The pedal rod is place just before the front wheel such that the pedals are mounted on them. The pedals are mounted in such a way that it is easy for the pedalling such that less effort is applied for the forward and backward motion of the cycle.

**PROPELLER:**
An axle is mounted behind the rear axle on which two discs supporting the propeller blades are mounted. The plates made up of fibre glass are fitted to the discs such that when the pedalling is done the wheels along with the propellers rotate and the propeller blades made of fibre push the water and helps for the movement of the cycle in forward direction when the cycle is on the water.

**FLOAT MATERIAL:**
Float materials used in the cycle is used for the supporting the cycle frame on the water such that it floats on water. The float material used here are the polyethylene pipes or the heavy duty pipes which has the density less than that of water. The density of the pipe is 0.9 which is less than that of water i.e., 1.0. The properties of the HDPE are

1. Large strength to density ratio
2. Harder, opaque and high tensile strength.
3. Can withstand temperatures upto $120^{0}$C



**7. TRANSMISSION SYSTEM INVOLVED IN AMPHIBIOUS CYCLE**
The transmission system involved in the amphibious cycle is the chain transmission system. Here the double chain transmission is used where the crank at the pedal rod and the free wheel mounted on the rear axle is connected with a chain such that when the pedalling is done the wheels move and help the cycle to move on the land , along with it another flywheel is mounted on the rear axle where it also rotates along with the axle from this freewheel another transmission is provided such that it links up to the axle on which the propeller blades are mounted such that when the axle rotates the wheels rotates along with them the propeller blades also move.

**7.1 CHAIN TRANSMISSION:**

Chain drive is the way of transmitting the mechanical power from one place to another place. It is often used to convey power to the wheels of a vehicle particularly bicycles and motorcycles. It is used in a wide variety of machines besides vehicles.

Most often the power is conveyed by the roller chain, known as drive chain or transmission chain passing over a sprocket gear, with the teeth of the gear meshing with the holes in the links of a chain. The gear is turned and this pulls the chain putting mechanical force into the system.

Sometimes the power is output by simply rotating the chain, which can be used to lift or drag objects. In other situations a second gear is placed and the power is recovered by attaching shafts or hubs to this gears. Though drive chains are often simple oval loops, they can also go around corners by placing more than two gears along the chain gears that do not put power into system or transmit it out are generally known as idler wheels. By varying the diameter of the input and output gears with respect to each other, the gear ratio can be altered so that for example the pedals of a bicycle all the way around more than once for every rotation of the gear that drives the wheels. A bicycle chain is a roller chain that transfers power from the pedals to the drive wheel of a bicycle thus propelling it. Most bicycle chains are made from plain carbon or alloy steel, but some are nickel-plated to prevent rust, or simply for aesthetics.

A bicycle chain can be very energy efficient one study reported efficiencies as high as 98.6%. A larger sprocket will give a more efficient drive, reducing the movement angle of the links. Higher chain tension was found to be more efficient. The bicycle chain is to be lubricated periodically to decrease its wear and to increase the efficiency.

**7.3 DISADVANTAGES OF CHAIN TRANSMISSION:**

1. Lubrication is critical - unlubricated drives can wear 300 times faster than lubricated drives (difficult to properly re-lube chain).
2. The lubrication attracts dirt which leads to wear problems.
3. Life is usually low since an estimated 90-95% of chain drives are improperly lubricated.
4. Frequent maintenance is required due to wear and stretch.
5. Necessary lubrication is messy (may be a problem in food/beverage industry).
6. Alignment is important as it affects life and stability.
7. Chain drives are noisy (proportional to speed) due to metal-to-metal contact.
8. Linear speed is limited to 3000 ft. /min. for roller chain.
9. Vertical drives may present problems since less slack can be permitted than in a horizontal drive in order to insure proper chain/sprocket engagement.
10. Vertical "shaft" drives are generally discouraged.
11. Equipment damage can result upon chain failure due to steel construction.
12. Available only in full box length increments except in rare cases.

**7.2 ADVANTAGES OF CHAIN TRANSMISSION:**

1. Relatively inexpensive.
2. Virtually any length chain and sprockets can be obtained.
3. Large selection of chain and sprockets, especially for #80 and smaller chain.
4. Positive drive provides synchronization of two shafts (Synchronous belts such as Poly Chain® also possess this characteristic).
5. Bearing loads are generally lower than for belts (no slack side tension).
6. Chain drives are 95-99% efficient (Poly Chain is 98-99% efficient).
7. Tends to be self-cleaning.
8. Simplicity of design and selection of components.
9. Versatile - large variety of attachments can be adapted (a situation difficult to handle with synchronous belts).
10. Breakable - splice capability allows for varying length and installation on drives where endless chain cannot be installed.
11. Due to chain's symmetric design characteristics, serpentine drives are possible (serpentine drives are also possible using twin tooth synchronous belts).

12. Fixed centre drives can be "accommodated" by removing links to take up chain slack (although this is not a recommended practice).
13. Chain tends to be fairly forgiving when misapplied and users are willing to live with poor performance.
14. Chain drives seem to give the appearance that they will do the job - i.e., steel is tough.

## 8. ADVANTAGES OF AMPHIBIOUS CYCLE:

1. Less cost.
2. Ease of maintenance.
3. Can be run on water with less effort.
4. More useful in flood prone zones.
5. Can be used in remote areas and water abundant regions where bridges are not available for crossing rivers and lakes.
6. Can be used both on land and water simultaneously

## 9. CONCLUSION

There are many gadgets designed for moving on water surfaces. Some of them are very efficient but very few have the capacity to move both on water and land. Many of the existing systems require Advanced machinery and fuel to maintain them on water. Our proposed model is a very low cost and efficient system which achieves the same using human energy. The system currently lacks safety systems and hence is suitable only for shallow water lakes and ponds.

The prototype design does not include any safety instruments and hence is suitable for shallow water lakes and ponds only. The effect of strong water waves also could not be estimated in this project. We hope to include these improvements in a later model.

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