

# *Simple Free-Energy Devices*

There is nothing magic about free-energy and by “free-energy” I mean something which produces output energy without the need for using a fuel which you have to buy.

## *Chapter 8: The Donnie Watts Generator*

Donnie Watts has designed a simple generator which is capable of providing enough electrical power to meet the needs of a typical household.

The design is based on well known principles and this engine runs cold and is simple enough for many people to be able to build one. The output power increases with rotor diameter and with rate of spin and so in order to stop the device accelerating until it destroys itself, an inflow valve to limit the water entering the rotating cylinder, or other effective means of speed control is an important requirement.

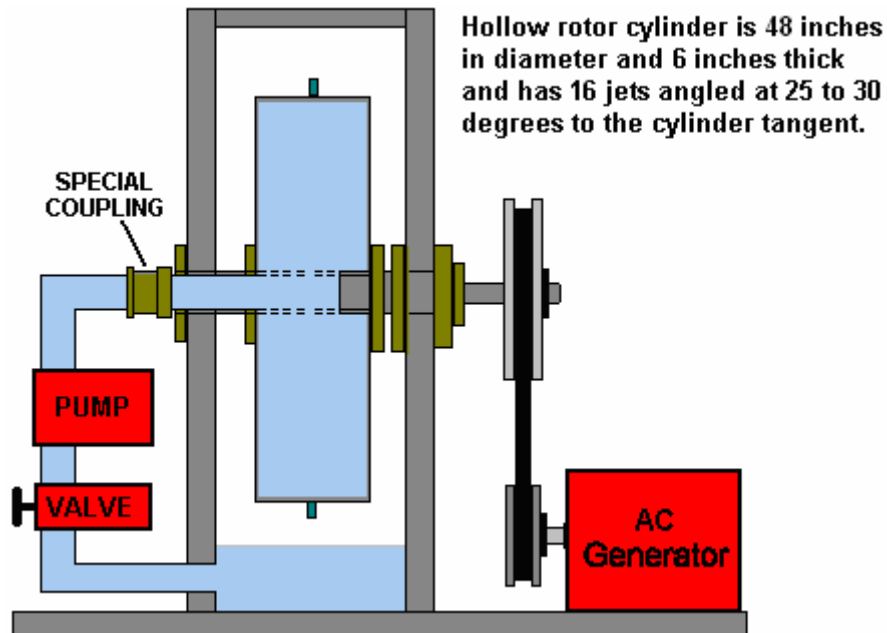
What needs to be understood very clearly is that this is an **exponential** power engine. The output power is proportional to the **square** of the rotation speed, so double the revolution speed and you quadruple the output power. Also, the output power is proportional to the **square** of the rotor diameter, so double the diameter and that quadruples the output power. So, if you double the rotor cylinder diameter and you double the rotation speed, the output power goes up by a factor of sixteen times. The basic Coefficient Of Performance for the design is four. That means that the output power is always at least four times greater than the input power.

This information comes from two separate patents. The first was in 1989 and shows a generator which could be built by most people. The second was three years later and is much more complicated, suggesting mechanical methods of controlling the rotor speed. I suspect that few people would be able to build the later design. Both patents are shown at the end of this document. However, I will concentrate on the simple version so that you have a chance of building it yourself.

Donnie Watts says that initially, it is necessary to start the device with a water pump, but when the rotation reaches 60 rpm the device no longer needs the water pump although it can be left running if desired. At 60 rpm, the pressure inside the rotor drum reaches the point where the suction caused by the water passing through the rotor jets creates sufficient suction to maintain the operation. **But**, remember that this is a positive feedback system, with an increase in speed causing an increase in power, an increase in water flow, an increase in speed of rotation, ..... and consequently, the engine will runaway self-powered and if you are not ready for that with a throttle on the rate of water flow into the cylinder, then the engine is perfectly liable to accelerate to the point where internal pressure damages the engine, probably causing the rotor drum to leak.

However, it occurs to me that an alternative way of starting the generator would be to spin the rotor with an electric motor temporarily attached to the output shaft of the device, or possibly even with a manual starting handle like early cars used.

Anyway, in broad outline, Donnie originally showed the design is like this:

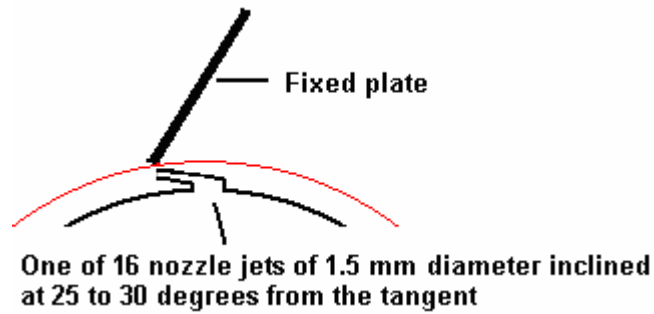


The circular rotor has water (or whatever fluid you decide to use) pumped into it by the pump. The “special coupling” has one side stationary and the other side able to rotate. The water entering the drum squirts out through angled jets on the circumference, causing the drum to rotate. Once the drum gets past one revolution per second, the water squirting out of the jets draws in more water and the system becomes self-powering. The water from the jets collects in the bottom of the sump housing which supports the axle and is then ready to be fed back into the drum again.

Most generators require to be spun at 3000 rpm or slightly faster. That speed can be achieved by the belt gearing between the output shaft and the generator’s input shaft. A generator of that general type could look like this 5 kilowatt alternator costing £325 in 2018:



However, the output power of this design is said to be further increased by the inclusion of thrust baffles on the inside of the housing. The idea is to have the jets of water strike a fixed surface at right angles to the jet and as close to the jet nozzle as possible:



However, the later patent points out that while the jets always apply their thrust to the rotor drum no matter what speed it is rotating at, once the drum gets up to speed, the fluid coming out of the jets is nearly stationary relative to the sump and so these baffle plates would only be helpful when starting from stationary.

Let me stress that this device is effectively a fuel-less engine with a substantial power output. It can be built in various different configurations.



The 1992 patent is shown at the end of this document, but due to the difficulty of constructing that version, I will stay with the original construction which has the axle shaft horizontal and so the axle and drum weight do not apply a sideways load on the bearings.

Donnie Watts shows a 48-inch (1220 mm) diameter rotor drum. Inexperienced constructors almost always decide that instead of constructing what is shown, that they will "improve" the working design by changing it to their own ideas. That almost never works, and what they are testing is their own design and not the design which they are trying to replicate.

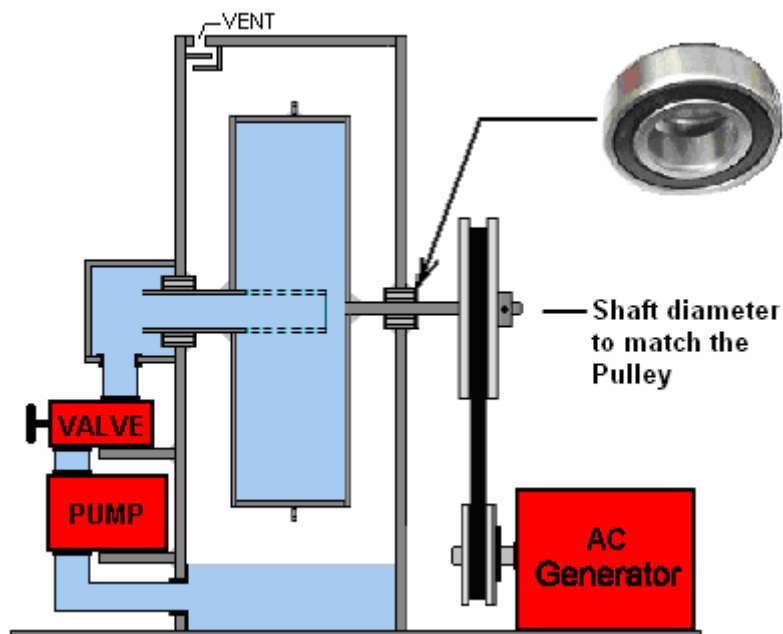
For example, the pipe feeding water to the drum is specified as being 3-inch (75 mm) diameter. An inexperienced constructor chooses to build a smaller diameter drum and so decides to reduce the supply pipe diameter to 1-inch (25 mm). No, no, no! This is a very, very important component which must NOT be changed. Just because you decide to use a smaller drum does not also scale down friction nor the difficulty in pushing water through a pipe.

A 75 mm diameter pipe has a cross-sectional area of 4417 square millimetres. While a 25 mm diameter pipe has a cross sectional area of 490 square millimetres, which is only 11% of the 75 mm diameter pipe. In other words, to match the 75 mm diameter pipe's capability, you would need **ten** 25 mm diameter pipes to carry the same flow. Donnie also stresses that the inlet pipe **MUST** have nearly twice the cross-sectional area that all of the jets have combined. The later patent appears to raise that factor to 8 times the sum of the jet openings.

If you find this hard to believe, then take a one-meter length of ordinary garden hosepipe and try to blow air through it. Although the pipe has a diameter of 12 mm or so, you will see how hard it is to blow air through it. If you build the generator with a 1-inch diameter pipe between the pump and the drum, then you probably will not get the rotor over 300 rpm as that is the equivalent of throttling the pump down to 10% of its input capability.

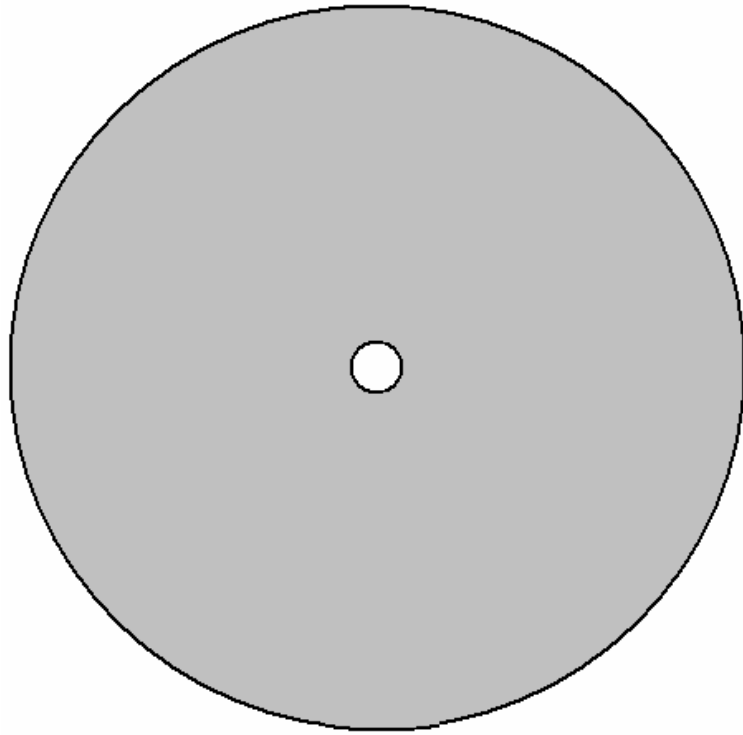
The smaller you make a Donnie Watts generator, the more accurate your construction has to be. For that reason, I strongly recommend that to make the drum at least 1 metre in diameter.

An American developer Rick Evans has come up with a way to avoid the need for a special supply hose coupling and his method looks like this:

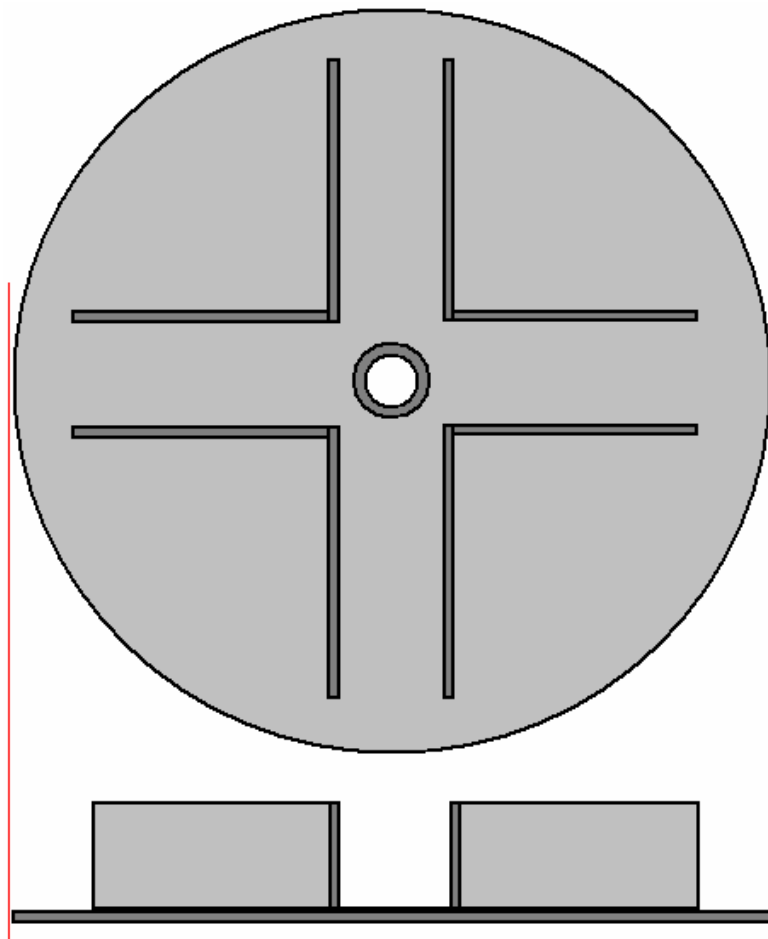


This is a very clever solution with the 3-inch diameter pipe being supported by an ordinary ball or roller bearing. If any liquid were to leak through the bearing, then it ends up in the sump, ready for circulating again.

There are many different ways to construct a Donnie Watts generator. The method shown here is merely a convenient method of construction using 3 mm (1/8 inch) thick mild steel and a welder. The diameter of the rotating drum can be whatever you choose but the output power increases with the square of the diameter, so if you double the diameter the output power becomes four times greater. This example will be based on a 1-metre diameter. You start by cutting out two discs, one with a 3-inch diameter central hole and one with a central hole of the size needed for the axle of your pulley wheel:

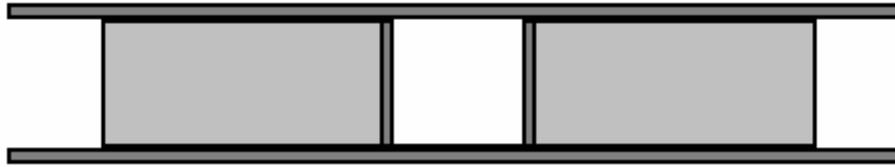


Then you weld on eight rectangles of steel 144 mm wide to the disc which has the smaller hole:



These strips are to channel the water (or other fluid such as transmission fluid) as it passes through the drum when the generator is operating. There must be at least 50 mm (two inches) clear between these plates and the edge of the disc to allow easy flow of water past the plates.

The 144 mm depth of the plates allows clearance for the second disc to be welded in place to form a drum. Seen from the side, it looks like this:



And then the outer rim of the drum is welded in place:



If you have never built anything in steel, let me assure you that it is not a difficult thing to do, and yes, I have built in steel, starting as a total beginner. However, while mild steel is easy to work and weld, stainless steel is much, much more difficult, so avoid stainless steel. Steel pieces are cut and shaped using an angle grinder like this:



And while the picture shows a handle sticking out of the side of the grinder so that you can use two hands, it is generally more convenient to remove the handle and just hold the grinder in just one hand as it is not heavy. When working steel, wear a pair of “rigger” gloves which are strong, reinforced gloves which will protect your hands from sharp steel edges and always wear eye protection.

If you are going to be drilling steel, then a mains powered drill is needed as battery-powered drills are just not up to the job unless it is just a single hole. When drilling steel it is helpful to have an additional hand grip.



With the drill shown above, the hand grip clamps on to the ring just behind the chuck and can be set at any angle. Steel pieces are joined together by welding. Some welders are quite cheap. Most types can be hired for a day or half a day. It is also possible to shape the pieces and have a local steel fabrication workshop weld them together for you and making a good welded joint takes only a second or two. The really vital thing is never look at a weld being made unless you are wearing a welding visor or welding goggles, as you can damage your eyesight looking at a welding arc without protection.

If you decide to buy a welder, then be sure to get one which will run on your house mains supply, otherwise you have to upgrade your house wiring to carry the higher current. This welder would be suitable, and at the start of 2016 it costs only £60 including tax which is about 82 euros or US \$90.



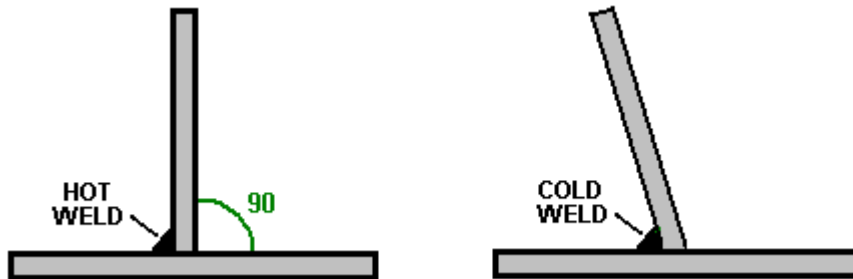
With this “stick welder” the silver clamp on the right is attached to the metal to be welded and a 2.3 mm diameter coated welding rod placed in the black clamp on the left. The stick is then applied to the welding area and the coating on the welding rod becomes a gas cloud, shielding the hot metal from the oxygen in the air. When the weld has cooled down, there may be a layer of oxide on the outside of the joint and so the back of the wire brush is used as a hammer to break up the layer and the wire brush used to scrub the joint clean.

However, the most important item of equipment for anyone doing welding work is a protective helmet. There are many different designs and widely varying costs. Many professional welders choose one of the cheapest types which look like this:



This type has a clear glass screen and a hinged safety filter to allow safe welding. Professionals adjust the hinge tension so that the filter can only just stay in its raised position. The welder then positions the joint pieces in their exactly correct position while looking through the plain glass, and when ready to start the weld he just nods his head which makes the filter drop into place and the weld is started. Never, ever, try welding without proper eye protection.

Welding is easy to learn and it is a brilliant method of construction ... but it has one major problem. When a joint is made the two pieces of steel melt and merge together. This can happen in a tenth of a second. Don't put your finger on the joint to see if it is still hot, if it is, then you will get a painful burn and that should remind you not to do that again. That heat is the problem, because when steel gets hot it expands, and when it cools down it contracts. That means that if you were to set up a piece of steel at exactly a right angles and weld the pieces together then as the joint cools down it contracts and pulls the joint out of alignment:



Please don't imagine that you can just push the vertical piece back into position as that isn't going to happen because the joint is instantly very, very strong. Instead, you use two quick welds of equal size, with the second one being 180 degrees opposite the first one:





Then, as the welds cool down, they pull in opposing directions and while it produces stresses in the metal, the vertical piece stays vertical. Let the welds cool down in their own good time, taking perhaps ten minutes to cool properly. Do **not** apply water to the welds to speed up the cooling as that actually alters the structure of the steel and you really don't want to do that.

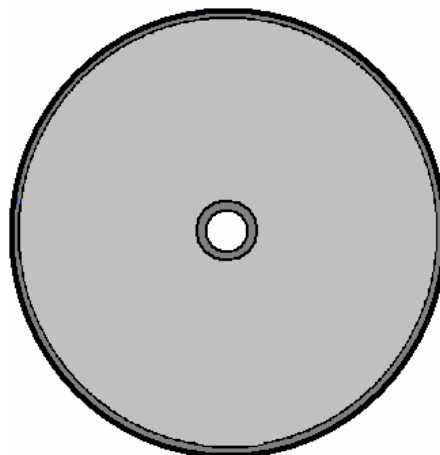
Metal can be cut quite readily using a cutting blade in your angle grinder but be sure to install the blade so that it rotates in the direction shown on the blade. The blade is likely to look something like this:



When cutting or grinding **always** wear protective goggles to make sure that you don't get a metal fragment in your eye – eyes are not readily replaceable !! If you do get a small steel fragment in your eye, remember that steel is highly magnetic and so a magnet may help in getting the fragment out with the minimum of damage, however, it is much, much easier to wear goggles and not have the problem in the first place.

The Donnie Watts drum spins on an axle and so needs a bearing on the axle pipe which supports it. The flow of liquid through the drum will be substantial and so Donnie recommends a 75 mm (3 inch) diameter pipe as the axle. That may sound excessive, but the reality is that it is quite difficult to force liquid through a pipe as there is much greater back-pressure than you would expect. So use a 75 mm pipe.

The next step is to attach the outside strip to complete the basic drum. If you are great at bending 3 mm thick steel then do that but most constructors will find it much easier to weld, say, 32 strips 150 mm tall, around the outside of the drum (that actually makes it easier to attach the nozzles to complete the drum at a later stage. Here, we will assume that the drum is being built by a professional steel fabrication shop which can bend 3 mm thick steel to the required curvature, that is, to the diameter of the drum:



The outer edge of the drum is welded all along its length. The weld needs to be airtight but please understand that due to heat stress, long welds need to be done in short lengths of say, 25 mm in length or less and allowed to cool before the next weld is made. The technique is to make this series of short welds spread out along the length of the long weld and when those welds have cooled down, then they are each extended for another 25 mm. Slow and careful construction is easily the best method.

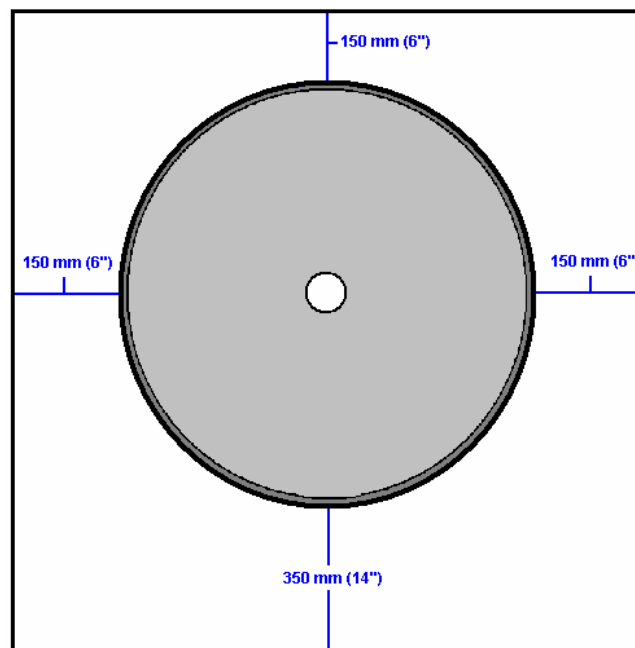
We now need to attach nozzles through the outer wall of the drum. A hole needs to be drilled through the outer wall for each nozzle. As with all holes drilled through steel, the hole is drilled at right angles to the steel, that is perpendicular. I'm not saying that you can't drill a hole at an angle, but it is very, very difficult to do without breaking the drill bit and it is very difficult to hold the drill steady enough to get the hole started.

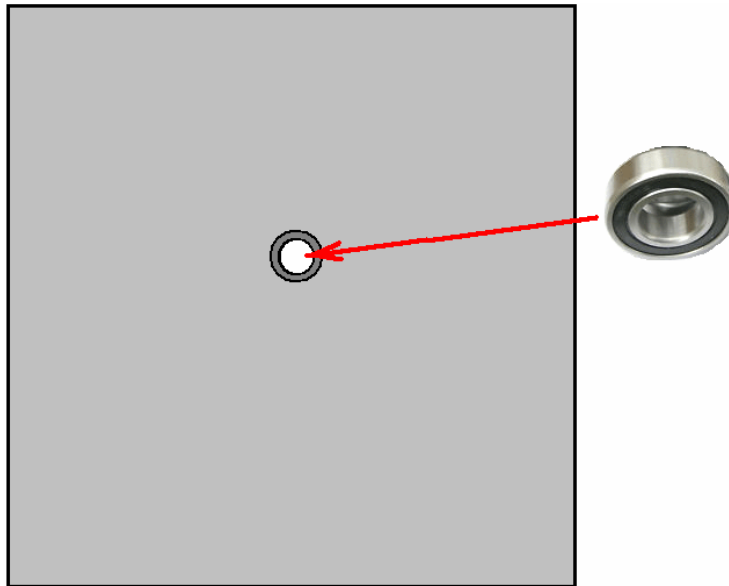
We want to have the jet of liquid leave the nozzle at 25 degrees to the face of the steel. We also want the jet orifice to be 1.5 mm in diameter. So we need to construct jets from steel pipe with that internal diameter, insert them through the outer wall of the drum and weld them in place:



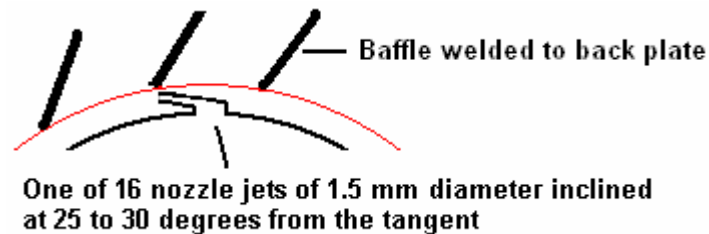
How many jets? I would suggest sixteen, but the number is not critical. It is said that the jets of water are more effective if they strike a nearby surface, so we may choose to attach a series of baffle plates to the outer housing. How many baffle plates? I would suggest sixteen. BUT these baffle plates are only effective when starting a stationary rotor and so can be omitted if you prefer.

The diagram of the sump enclosure drawn by Donnie shows angled top edges, but it is probably easier just to use square plates as there is less cutting and welding if you do that. Donnie suggests that the housing plates need to be 300 mm wider than your drum and have 150 mm clear above it and 150 + 200 = 350 mm clear below it as the bottom of the housing acts as a sump for the liquid which passes through the jets:

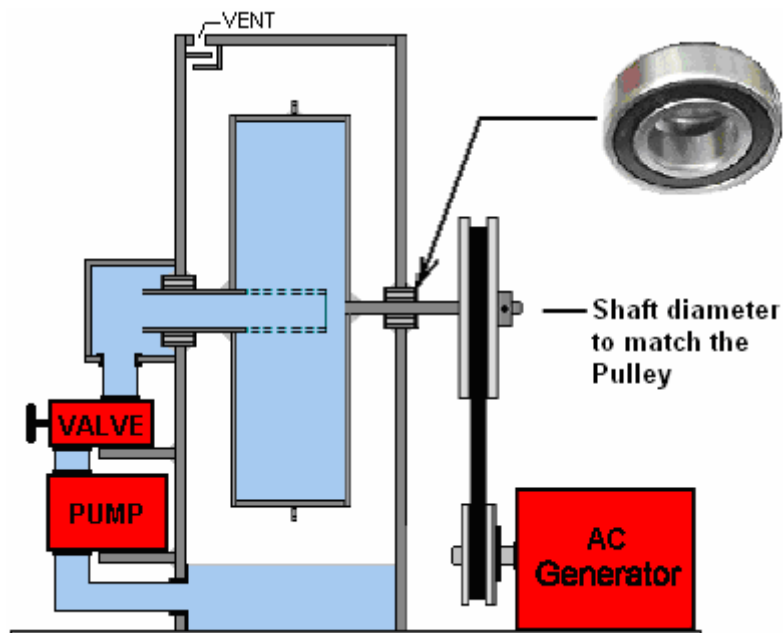




If you want to use baffles then they are welded to the back plate of the sump enclosure which will house the drum, but be sure that they clear all of the nozzles welded to the drum:



There is no need for additional housing. There is a pump needed to get the system started, and that can be mounted on the outside of the drum housing, as can the generator. The slide valve which controls the amount of liquid allowed into the drum is also mounted on the outside of the drum housing. The supporting axle pipe spins with the drum, driving the alternator generator which provides the required mains voltage AC output, and it will be mounted on the outside of the housing. This overall arrangement produces a device which is much taller than it is wide, so a stability plate is welded to the base in order to provide that missing stability. The overall arrangement could be like this:



While the axle shaft can be made of two parts welded together and welded to the drum, I suggest that it is more practical to weld the incoming three-inch diameter pipe to the drum and then, choosing a bar diameter which matches the size needed for your chosen pulley wheel, that bar is welded to the other side of the drum as shown above. The part of the axle on the right of the drum is solid and provides the drive to the generator:

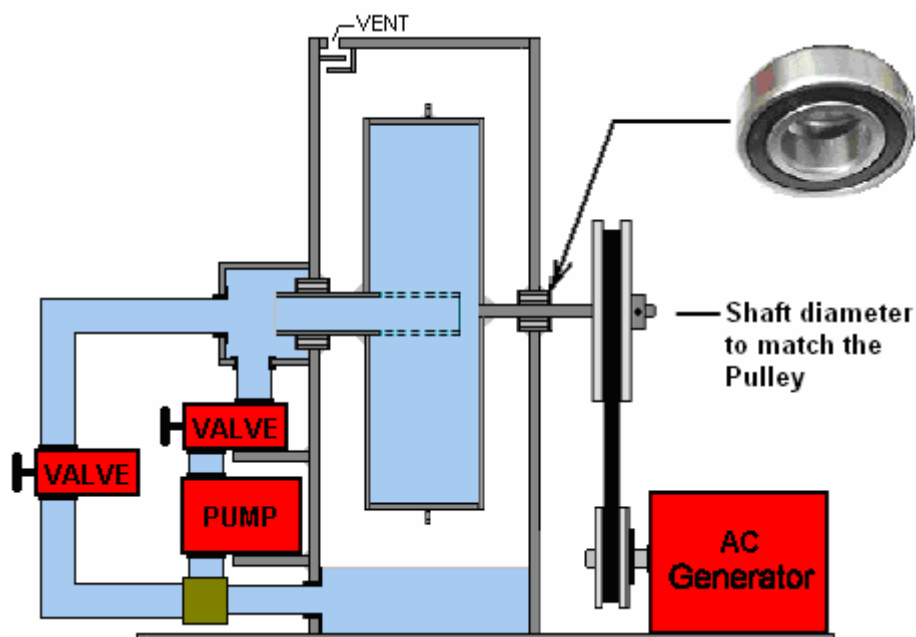


To get the generator operating requires the pump to be operated and so, either access to mains or alternatively access to a battery and inverter is essential. Once the generator is running, the pump can be powered by the generator. It is stated that when the speed of rotation passes one drum revolution per second, that the liquid passing through the jets causes enough vacuum inside the drum that the pump can be powered down, but it is also possible to leave the pump running all the time.

People sometimes have difficulty in understanding the pressures involved. The drum which revolves is the only place that there is pressure when the generator is operating. The outer case has only two main functions, namely to support the drum axle and to act as a sump to return the liquid to the pump which feeds the liquid back to the drum to be used again.

That is, the inside of the sump housing is at atmospheric pressure and if you were to install baffle plates to catch any stray liquid, then it could be open at the top of the case. If the drum is large enough and the drum intake pipe large enough, then the Donnie Watts generator becomes self-sustaining at about one revolution per second, and the liquid exiting through the jets starts sucking liquid in through the intake pipe.

Concerns have been expressed that the pump undergoes unnecessary wear when the generator is running and the pump is no longer needed. So, if desired, the pump can have a bypass which is valve controlled like this:



While this does require some additional piping, a valve and a T-junction for the pipe bypass, it results in a pump which can be switched off when not needed and the new valve used as the drum speed control.

Let me stress again that this is an exponential positive-feedback design which will keep accelerating until the bearings fail or the pressure inside the drum causes some form of rupture which will starve the jets of liquid, or the generator might fail due to excessive speed. While this may seem like irrelevant theory, I assure you that it isn't. You have this generator running and powering your house and the weather is hot. You have an air-conditioning unit keeping your house cool. It draws a lot of current, but then the thermostat switches it off because your house is cool enough. This is a problem. The current draw from the generator goes down by a major amount. This makes the generator shaft much easier to spin, but the drive power from the Donnie Watts unit is now much higher than is needed. This is not helpful, and the system is now unbalanced and the drum will speed up, spinning the generator shaft faster than it should. If you are standing there and adjust the control valve accordingly, then everything goes back to normal. But the point is that a generator of this type is fine for a fixed load, but you need to pay attention to what the electrical load is if it changes. You could build an automatic valve adjustment to make an automatic speed control or install one or more pressure relief valves. The later patent is mainly about automatic speed control of the drum.

As some people find this generator hard to understand, let me explain it in broad outline. The device is essentially a motor. It is a motor which is a spinning drum inside a support housing which acts as a sump. This is a self-powering motor and the faster it goes, the higher the power level which it generates. As that is a positive feedback system, the motor will keep accelerating and gaining power until it exceeds the strength of the materials use to construct it and so it breaks the drum open.

In order to prevent that happening, an adjustable valve (which is the equivalent to a large tap or fire hydrant valve) can be placed in the pipe which feeds the liquid to the spinning drum. That valve acts as a manual speed control for the motor.

In order to produce useful work, this motor design is used to power a separate electricity generator, using two pulley wheels and an AC generator or "alternator", making the design a Motor/Generator. It is not easy to spin the alternator when it is supplying substantial amounts of electricity to washing machines, tumble dryers, air conditioners, heaters, stoves, TVs etc. and so the alternator acts as a brake, slowing the motor down. That doesn't matter as the speed control valve can be opened a bit to get the speed back up to what it should be.

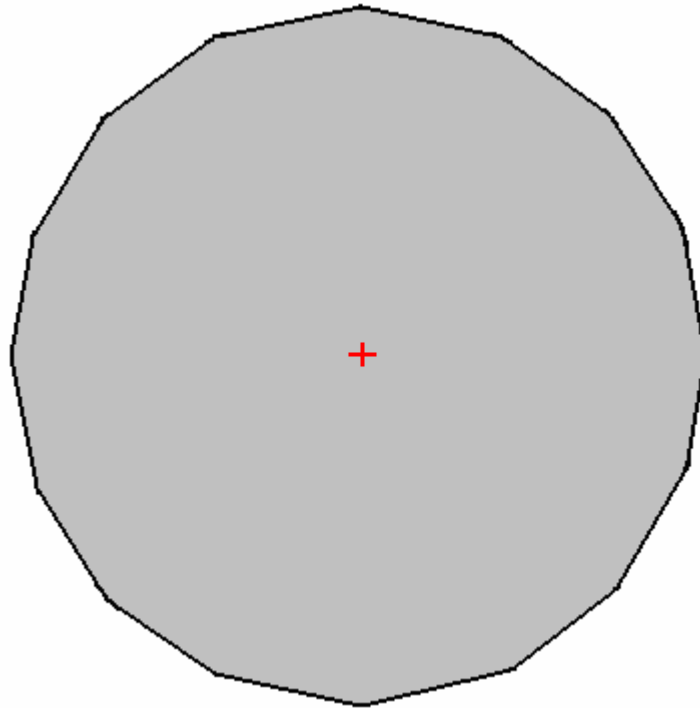
It is important to spin the shaft of the alternator at the speed it is designed for. Spin it too slowly and it will produce a voltage which is less than mains voltage and a frequency which is less than that of the mains. Spin it too fast and the generator will produce a voltage which is higher than mains voltage and a frequency which is greater than the mains frequency.

Typical design speeds for spinning the shaft of an alternator range from 1800 rpm (30 times per second) and 3000 rpm (50 times per second). Alternators are designed to produce either 110 volts at 60 cycles per second for American equipment, or 220 volts at 50 cycles per second for everybody else.

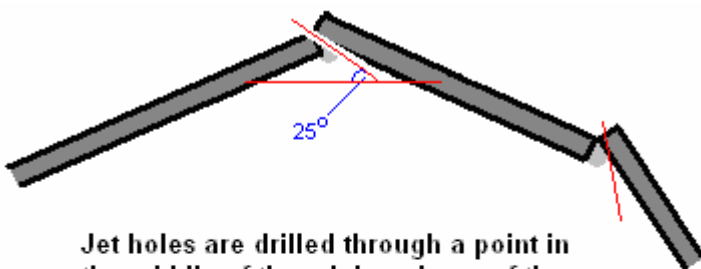
This is fine IF the electrical load is constant and the speed valve is adjusted correctly. BUT we have a problem if the electrical load drops suddenly. Because the electrical current draw has dropped, the shaft of the alternator becomes much easier to spin and so it acts as far less of a brake and because the valve setting is unchanged, the motor speeds up. This is not a problem IF there is a human standing beside the generator ready to adjust the valve setting accordingly. Unfortunately, that is not convenient and worse still, many electrical appliances switch themselves on and off on a very regular basis and the basic Donnie Watts design is not able to cope with that.

So, it would be very convenient if we were to make the Donnie Watts motor adjust it's own control valve when necessary. Let's see if we can come up with a simple system for doing that. Commercial valves are generally not suitable for this as they are either fully ON or fully OFF and are not electrically adjustable to give any intermediate setting. Also, they tend to be far too small a diameter to interest us but we can indeed use them if we wish, but more on that later.

For home builders, it would probably be easier to use a 16-sided shape rather than a circular disc:

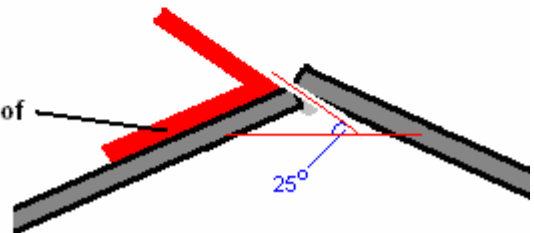


Apart from being all straight-side cuts, there is the advantage that the plates which form the circumference of the drum can become drilling points for a system which is more simple than using pipe nozzles:



**Jet holes are drilled through a point in the middle of the edging pieces of the sides of the drum**

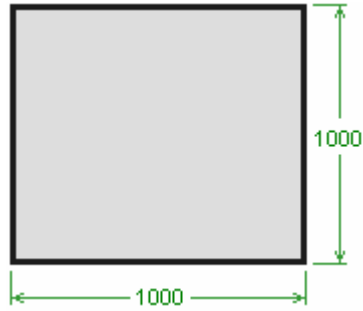
**Drill template clamped to one of the two side pieces.**



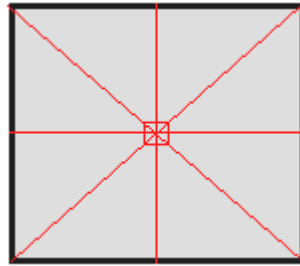
The single drill hole in the middle of the circumference wall of the drum then acts as a jet and using the template to get the drill bit angle the same every time, produces correctly angled water jets.

Some people feel that they would prefer to have some more detailed information, so the following are some very basic details for constructing a generator with a 1000 mm (39 inch) diameter drum using straight edges.

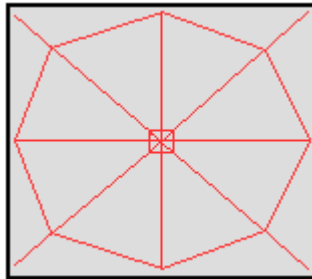
To make the first drum side we start with a square piece of 3 mm thick mild steel 1000 mm x 1000 mm.



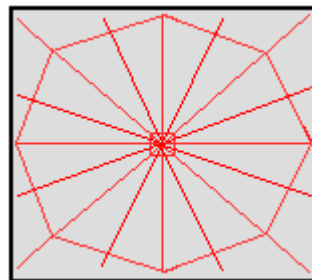
Draw diagonals from the corners to establish where the centre of the square is, then draw vertical and horizontal lines, like this:



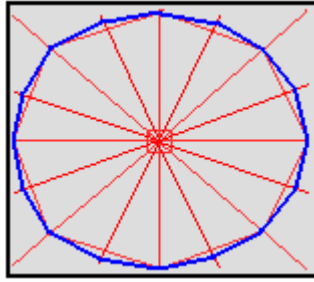
Measure 500 mm from the centre point, out along each diagonal and mark each of those points. Then, connect those points to make an even octagon:



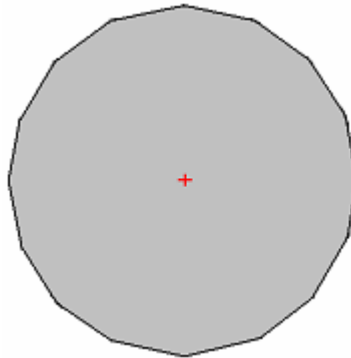
Next, mark the central point of each of the eight sloping lines and draw a line from the central point through each of these new points:



Mark 500 mm from the central point out along each of these new lines and then connect these points to form the 1000 mm diameter 16-sided drum side:



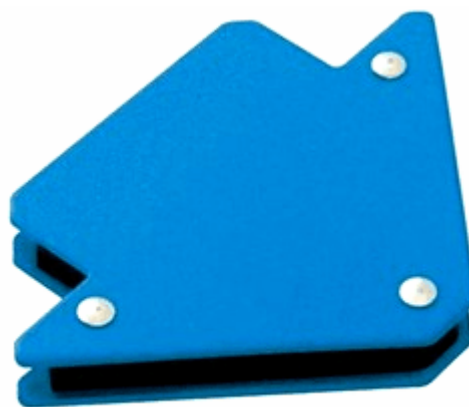
Then cut along these outside lines to form the first side of the drum:



Clamp this side to another piece of 3 mm thick mild steel and mark carefully around it to get the shape and size of the second side of the drum. Cut around this new side and draw some diagonals to establish the centre point.

One of these two drum plates needs to have the 3-inch (75 mm) intake pipe installed as an axle. You could get a local steel fabrication shop to drill the hole for you. Alternatively, you could mark the exact position and size and drill a ring of small holes around the circumference and with a small cutting blade in the angle grinder, cut between the holes and then using a grinding disc in a power drill, smooth out the unevenness between the holes to give a reasonable quality hole accurately positioned. Remember to use goggles for both cutting and smoothing. Another way would be to rent a plasma cutter and air compressor for a morning and use that to cut an exact hole.

Having got the exactly positioned hole in the drum side plate, it needs to be welded in place. For that, these magnetic angles are enormously helpful:



**100 mm**

This is because they are low cost, grip the plate and pipe very strongly and make a perfect 90-degree angle. Using four of these magnetic clamps holds the pipe securely and accurately.

Remember that the moment a weld is made on one side of the drum plate, the other side of the drum plate needs to be welded immediately and both allowed to cool as slowly as possible to avoid heat shrinkage pulling the pipe out of its alignment with the drum plate. Remember that the drum plate will



be hot enough to burn you even if the weld only took a split second to make, so take care. In other words, if the pipe is vertical, then almost simultaneous welds need to be made on the top of the drum plate and on the underside of the drum plate. The thicker the steel, the easier it is to weld without problems and so welding the pipe is straightforward. It takes a great deal of skill to weld steel sheet of 1 mm thickness without tearing a hole in the sheet, but thankfully, that is not something which you need to do with this design.

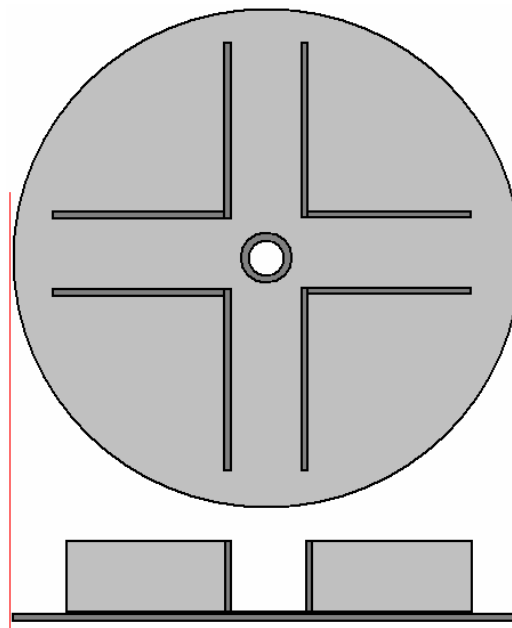
Having tack-welded the pipe carefully and quickly on both sides, using welds only 6 mm or so long, and having waited for those welds to cool down fully, make two additional tack welds at 180 degrees away from the first two, and then two more pairs so as to have a weld every 90 degrees around the pipe. Then the welding all around the pipe is completed welding only very short lengths in opposing pairs and letting the welds to cool before making the next weld.

A cheap workmate like this:



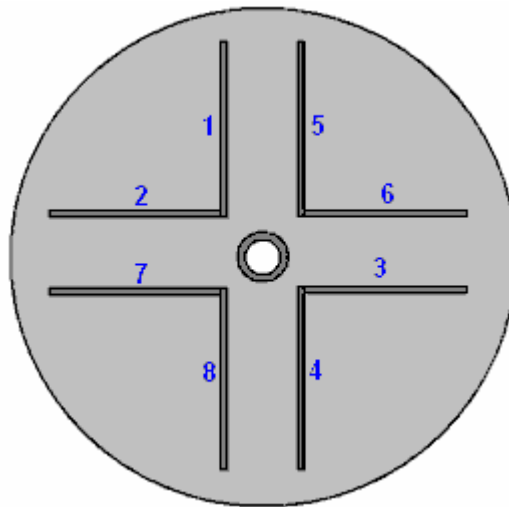
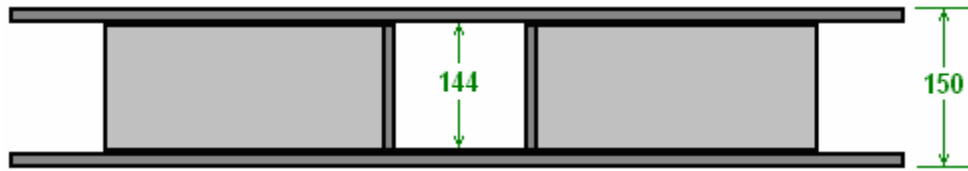
makes a good support for this work and it allows the pipe to be gripped securely while the drum plate is resting horizontally on the bench. If you feel that an open 3-inch (75 mm) diameter pipe is not sufficient to get the liquid into the drum, then make as many openings (drill holes or angle grinder slits) as you consider necessary.

Mild steel 3 mm thick can be supplied in 150 mm wide strips. One of those would reduce the amount of steel cutting needed to complete the drum as it is needed for the internal channels and for the circumference wall of the drum:

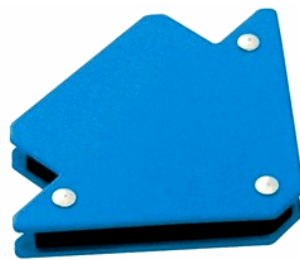


As the drum diameter is 1000 mm and 150 mm is left around the centre and 50 mm is left at each side, the eight internal walls need to be only  $500 - 75 - 50 = 375$  mm (14.76 inches) long. The 150 mm clearance in the centre of the disc does not need to be exact, and so cutting 370 mm from the 150 mm strip will do nicely for all eight walls.

As we want to use the width of the 150 mm strip to make the sixteen circumference strips, measure the exact width of the strip supplied to confirm that it is 150 mm wide. I have never been supplied a strip which was not accurately 150 mm wide, but check carefully to make sure that your strip is exactly 150 mm wide and adjust the measurements slightly if it isn't. Ideally, the strip is exactly 150 mm wide and so the inner walls need to be 144 mm wide and 370 mm long, so 6 mm needs to be removed from each of those eight walls unless you choose to cut them directly from sheet:



Use the magnetic clamps to hold each plate vertical when positioning and tack welding it:

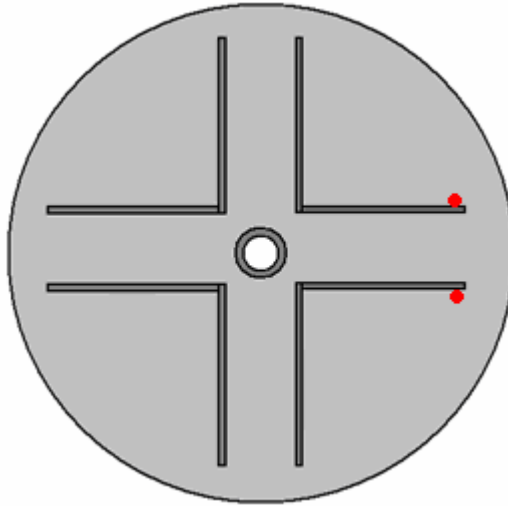


Complete the welding of these eight plates, remembering to take it slowly, remembering to always use simultaneously opposing welds and allowing each weld to cool naturally.

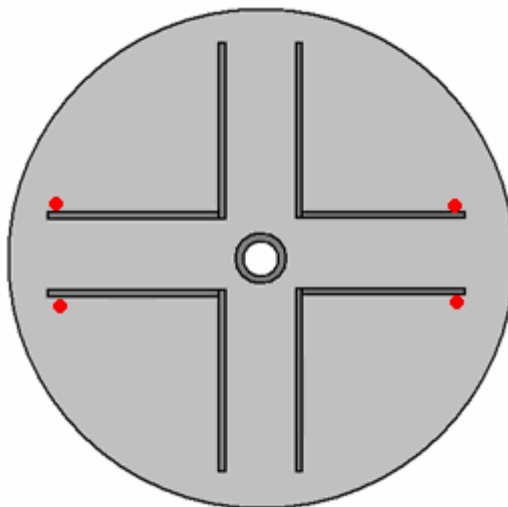
The next step is to attach the second side of the drum. The really important thing here is to align the second side exactly and the magnetic angles are helpful here as well. Measure the straight edges which form the circumference to your drum and cut two 150 mm strips to that exact length. Place the first drum side with its welded partitions, horizontally on the workmate and attach one magnetic brace to it, positioning the magnet exactly at the edge of the disc, half way along one straight edge. Do that 90-degrees away with a second magnet. Attach one of your edging strips to each magnet, standing them straight up vertically, then slide the second side on top, aligning a straight edge with a straight edge on the lower drum side. Use additional magnetic braces to attach the upper drum side to each of the two edging pieces attached to the lower drum side. Make sure that all four magnets are fully touching the drum sides and the edging pieces.

Go around the whole drum, using a setsquare to confirm that the two drum sides match exactly and be very sure that the flat edges match exactly. Remember that once you make the first tack weld on the second drum side, that is it, and you have no realistic chance to change the positioning.

Once you are satisfied that the second drum side is positioned exactly right, make two opposing tack welds on the second (upper) drum side like this:



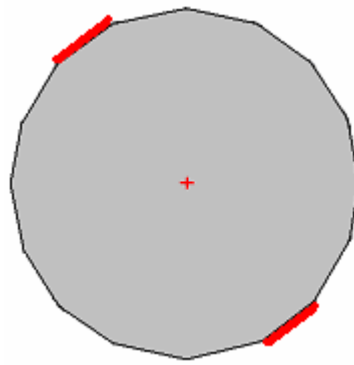
These welds are made upwards, so be sure you are wearing good strong gloves as getting molten metal on bare skin is not a pleasant experience! Then make two more opposing tack welds like this:



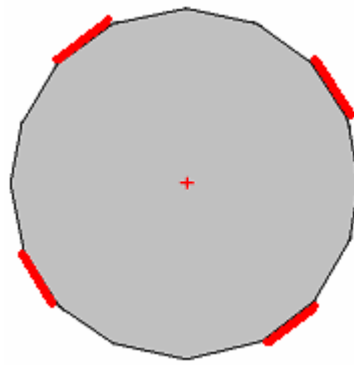
You can then turn the drum over so that all following welding is downwards and you are not liable to get hot metal coming at your hands. There is room to weld inside the drum as the pieces forming the channel walls are only 370 mm long and there is 144 mm of clearance between the drum sides.

These eight short pieces hold the drum sides securely and give the drum major strength. (Strictly speaking, the above diagrams should show 16-sided sides rather than circles). We come now to attaching strips to the sides of the drum to form the outer drum wall. Remove the magnets and alignment side strips and turn the drum sideways and clamp it in the workmate so that the drum edge is facing upwards and so is easy to work with.

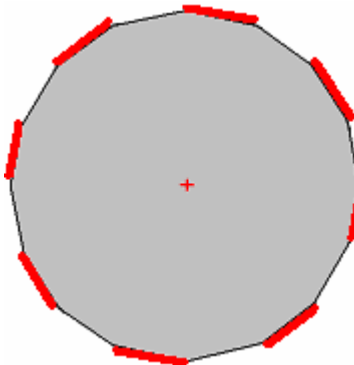
The vertical outer wall of the drum is made up of sixteen strips of steel, each 150 mm wide. Each strip will be about 196 mm long but that length is marked on the strip directly against the straight side of the drum disc. You start by welding these narrower strips as the vertical walls. Take two edging pieces already cut, and weld them to the drum in opposite positions around the drum:



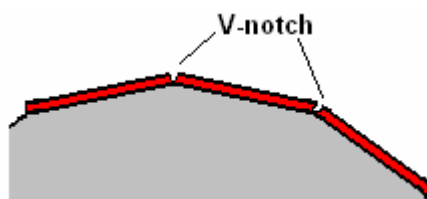
The welds can be made inside the drum if you wish. Two more circumference pieces are then measured carefully, cut and welded like this:



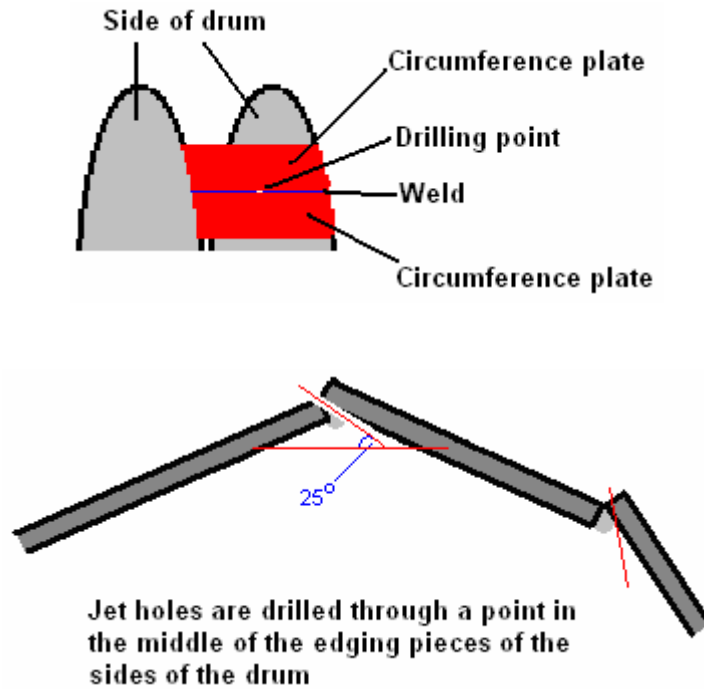
Then four more like this:



This is where it becomes interesting. The final plates need to be measured very accurately and they will be welded in place like this:



The V-notch between the plates is very important as it is where the nozzle jets will be drilled:



It may be necessary to lower the next circumference plate just opposite the jet exit using a grinding tool so that it does not interfere with the jet of liquid leaving the drum:



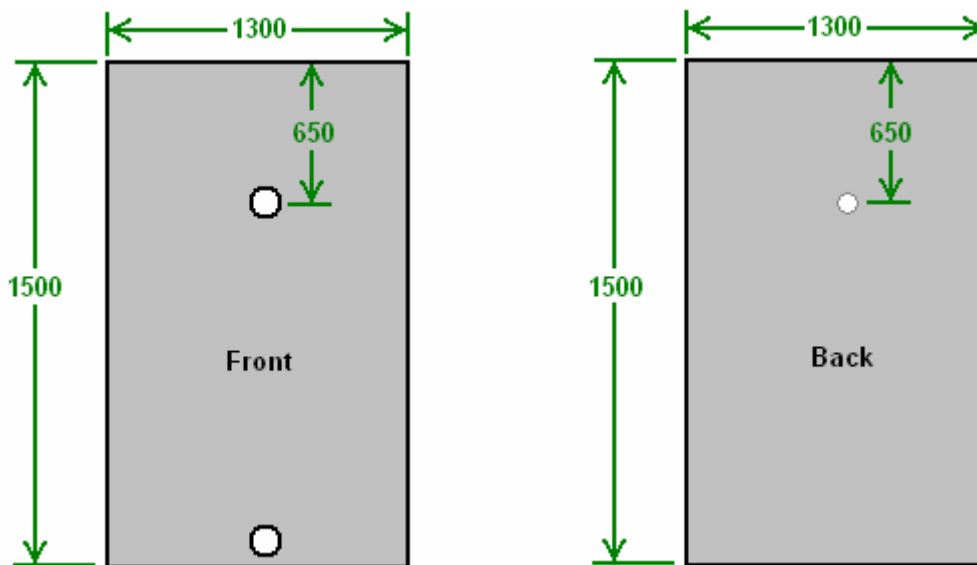
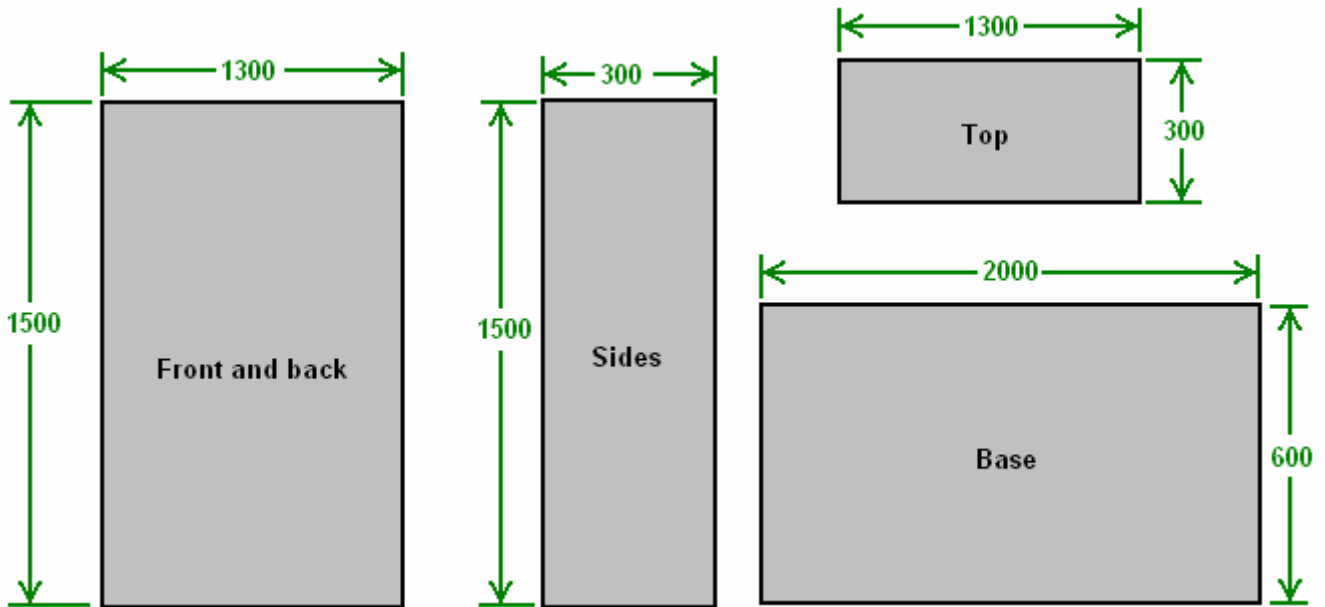
So, after all that effort, you now have a strong and secure drum, but it only has the 3-inch diameter inlet pipe attached and we need the axle support bar on the other side of the drum. What diameter should it be? I don't know, because it needs to have a pulley mounted on it. I would expect it to be about 25 mm (1-inch) in diameter but you need to search suppliers for pulleys and buy two, one for the drum and one to match the drive shaft diameter of your alternator. Obviously, the two pulleys need to work with the same drive belt. Ideally, the drum pulley should be two or three times the diameter of the alternator pulley. In fact, any ratio up to say, five times would be good as the working output of the alternator will be reached at lower drum revolutions and that would give smoother running if the drum construction is not perfect.

So, we have identified what shaft diameter is needed for the drum output and we have purchased a mild steel bar of that diameter. The centre point of the second drum side is marked. If you have cleverly welded it on the inside of the drum, then mark the diagonals to get the centre point. Check it by clamping the 3-inch pipe bearing in the workmate, placing the drum inlet pipe in it and spinning the drum. The centre point should appear stationary when the drum spins. Holding a felt-tipped pen stationary, mark a small circle by touching the drum close to the centre – say about 30 mm in diameter.

That is where the pulley bar needs to be welded. Use the four magnetic clamps to position the bar in the middle of the circle with the clamps at 90-degree angles to each other. Spin the drum again to make sure that the bar does not appear to move. If it does, then correct the position until the bar seems motionless. Then tack weld between the magnets. Unfortunately, heat destroys magnets and so welding so close to the magnets is liable to destroy them – thankfully, they are cheap to replace.

Now that we have completed the drum, we need to make the support housing which also acts as a sump for the liquid which has passed through the drum. In passing, while the Clem engine used cooking oil as the liquid because the Clem engine generates a good deal of heat, some people suggest using transmission fluid in the Donnie Watts design, primarily so that it lubricates everything which it passes through.

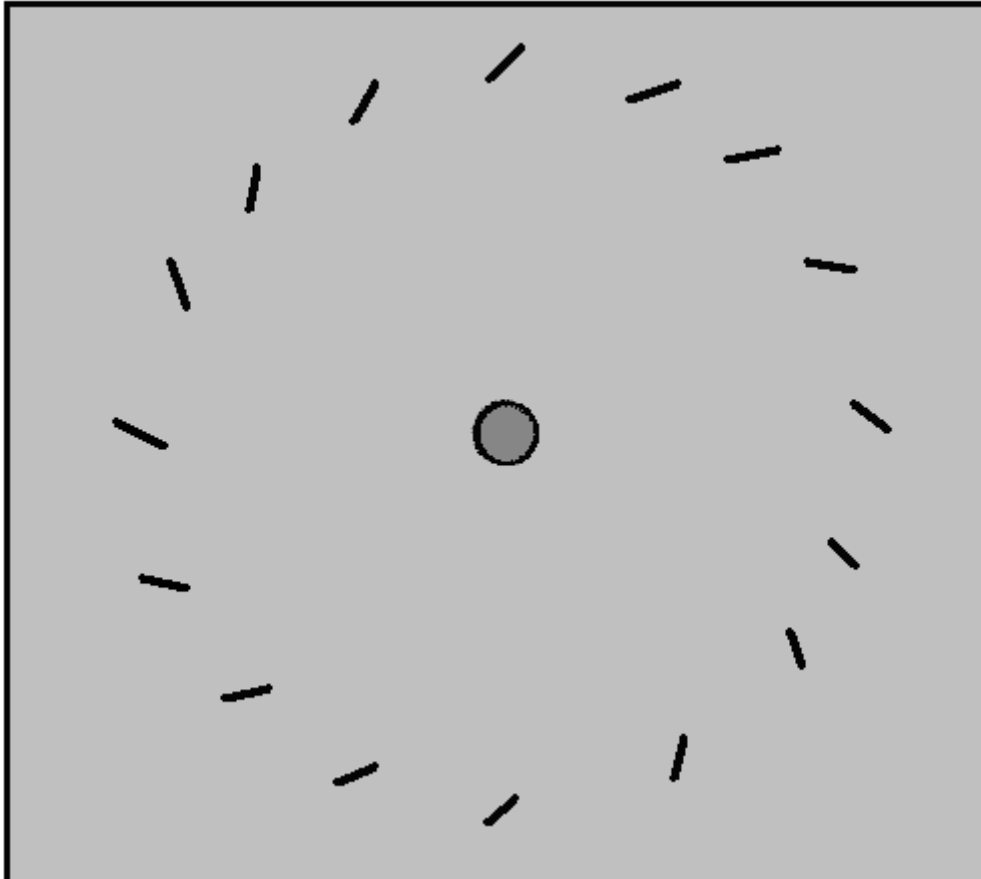
The container which acts as a sump can just be a rectangular box. It is specified that there should be 150 mm clearance on both side of the drum which is  $1000\text{ mm} + 150\text{ mm} + 150\text{ mm} = 1300\text{ mm}$  wide. The sump is to have an additional 200 mm depth and with the 150 mm at the top and the 1000 mm diameter of the drum, makes a front and back panel size of  $1500 \times 1300\text{ mm}$ . The sides would need to be about 300 mm wide:



The next step is to construct the baffle plates to catch the jets of liquid coming out of the nozzles of the drum. First, a hole is created in the front panel and the bearing attached. The bearing will be the best 75 mm diameter bearing which will fit your intake pipe and mount securely to the front panel:



With the bearing fitted, place the front panel on the workmate and feed the drum's intake pipe into the bearing. This gives you a flat, horizontal surface with the drum in it's exact position. Clamp the drum in place so that it can't move. If you want to use baffle plates then use one of the magnet clamps to position, and mark the position of the first baffle. With the drum fixed in place, mark the position of the matching fifteen other baffle plates. Unclamp and remove the drum so that there is a clear unencumbered work area. Using just one magnetic clamp, position each baffle plate and tack weld it in position with a tack weld on the drum side and an immediate matching tack weld on the side away from the drum – remember that we need matching welds to stop the cooling weld pulling the baffle plate away from the vertical.



Next, put the drum back again and give it a spin to make quite sure that the drum clears all of the baffle plates. I seriously doubt the spacing specified for the housing. The liquid squirts through the drum "nozzles" and hits the baffle plates. But then, where does it go? It has lost it's momentum and will just fall under gravity. Some will fall on to the drum which will hurl it off on to the wall where it will fall down into the sump. Part will fall clear of the drum and will fall down the side of the housing. So, why the gap? 75 mm should be easily enough to allow that to happen no matter what the drum diameter is. Five millimeters of space outside the baffles should actually be quite enough.

The physical size and shape of the pump is not important as it is located outside the sump housing. I have been asked what is the minimum pump size, but I don't know, the most I can say is that Donnie Watts specified a 500 watt pump for his four-foot diameter drum, but I feel that a more powerful pump would be helpful. Please understand that I have never built or even seen a Donnie Watts generator. I believe that it will work exactly as specified (especially since the very similar Clem Motor worked well) but I can't guarantee that it will. In passing, if the arrangement where there is a pump bypass pipe and valve, then one pump could be used to start a whole row of Donnie Watts generators by disconnecting the pump from each as soon as it is running properly. Of course, in that case, the pump valve needs to be between the drum and the pump to enclose the sump when the pump is removed.

Purely On and Off valves are not expensive, even in 3-inch diameter:



**1.5" 2.5" 3" 3.5" 0.35Mpa UPVC Fish Pond Gate Valve Filter Outlet Water Gas Oil**

Condition: **New**

Sale ends in: 04d 20h 44m

Size:

Quantity:  7 available / 3 sold

Was: ~~US \$31.99~~ ?

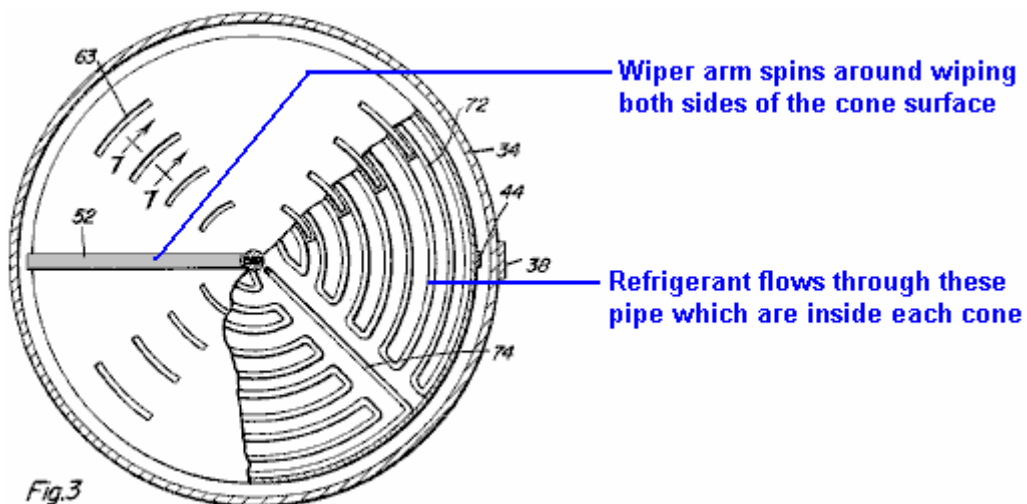
You save: **US \$1.60 (5% off)**

Price: **US \$30.39**

**Buy It Now**

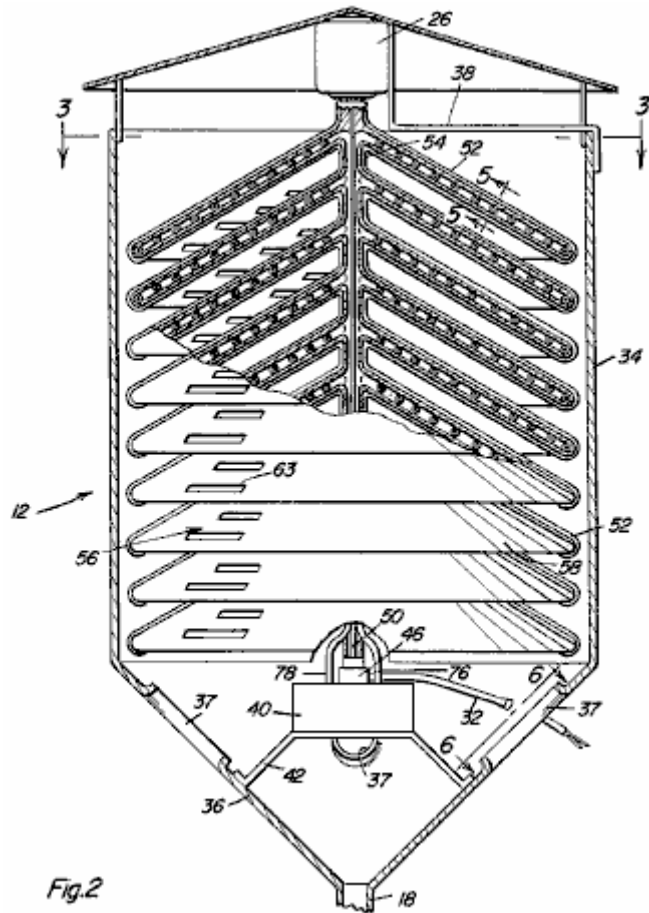
It appears that this valve is either fully On or fully Off. There are valves which claim to be fully adjustable under electronic control but nothing suitable has been found. So, for the moment, assume that the generator will be run under constant load and just construct the box surrounding the drum intake pipe as 300 x 300 x 150 mm in size and with a removable 300 x 300 mm side, sealed with a plastic or rubber gasket.

If you feel that a generator which is restricted to a fixed load output is really not all that useful, then think again. Consider using it to power an Elmer Grimes water supply system. The US patent 2,996,897 (22 Aug 1961) is more than fifty years old and it describes a system which can produce drinking quality pure water. It is effectively an outdoor refrigerator. A series of cone-shaped metal panels are stacked together vertically to save space. Each cone has pipes inside it which pass the cooling fluid through the cones, ensuring that they are always at low temperature. In the same way that a cold drink gets water droplets on the outside of the glass, the cones get water droplets forming on them all the time. A wiper arm like a windscreen wiper on a car then brushes those droplets off, with the wiper arm rotating around the cones continuously, rather than backwards and forwards as a car wiper blade does. This produces a continuous stream of fresh water coming off the cones. Unless there is some good reason why not to, the cones are mounted in a raised position so that gravity can be used to direct the water flow to where it needs to end up. Cones are used as they have a greater surface area than a flat plate of the same diameter would have, and the downward slope of the cone helps the water droplets flow off the cone surfaces. Top view:



Side view:

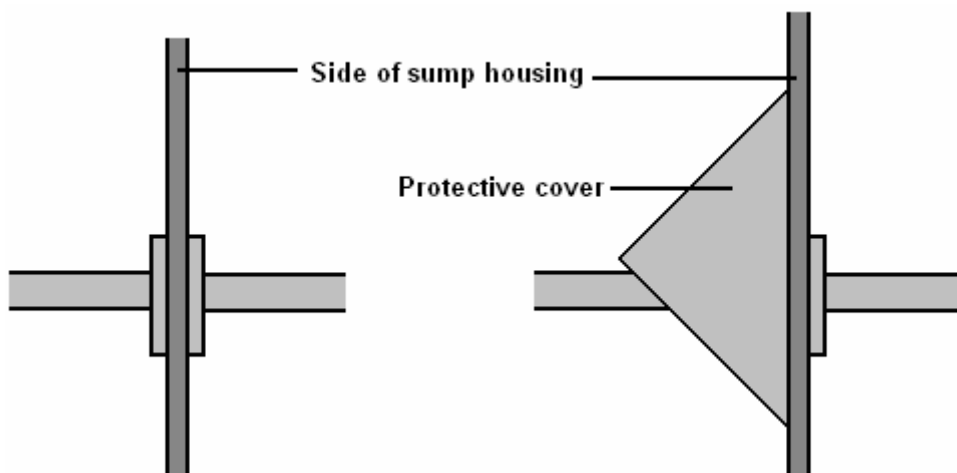




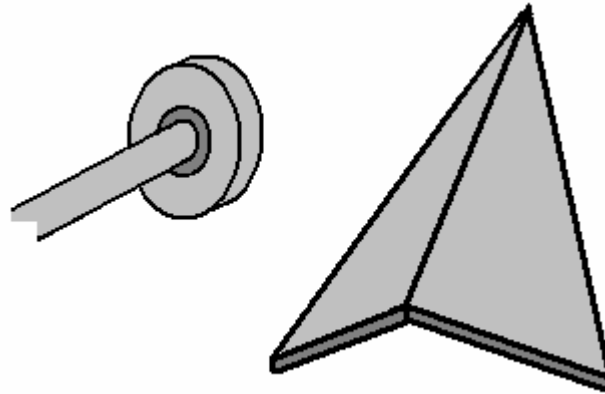
One of these Grimes systems produces enough water to support a ranch in Texas during a drought, and it could be powered indefinitely by a Donnie Watts generator. Think of the effect one would have on a village which has only access to polluted water (especially if you don't know the technology of colloidal silver).

As it is probably not necessary to produce drinking water all the time, the generator could power electrical cooking in area where firewood is getting scarce, charge mobile phones, power TVs, power fans, refrigerators, etc.

The inside of the sump housing is an unpressurised and very wet area. We don't want any oil leaking out through the drive shaft bearing, so providing a steel umbrella would be a good idea:



For this, two triangles of steel are cut and then welded so that most of the oil landing on them will run off without reaching the bearing:

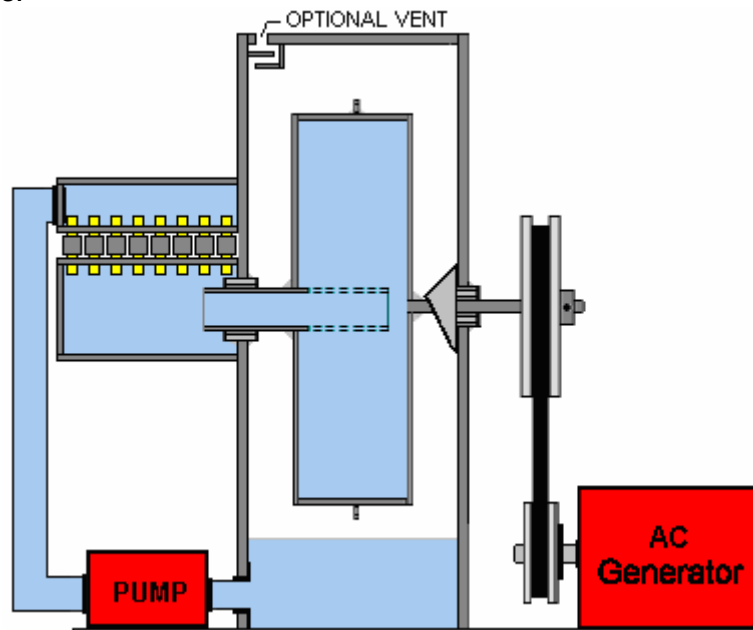


Some people may prefer to use commercially constructed components instead of constructing an adjustable flap for the 3-inch diameter rotating intake pipe to the drum. Well, let's see if we can come up with a different method of low-cost automatic flow control. For the system to be automatic I suggest that we could use electrically operated valves which can then be governed by a control circuit. The vast majority of such low-cost valves are only half-inch diameter made for central heating systems, and they are closed unless fed with power to open them. I would suggest the following valve:

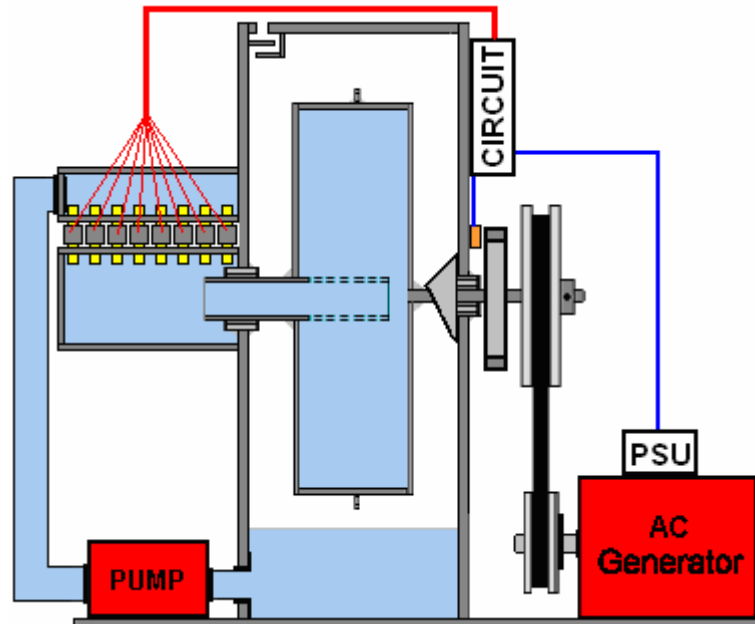
This plastic one-inch diameter valve costs about £8:



We can get variable control by using a row of these valves to restrict flow. For this, we use a second liquid filled box like this:



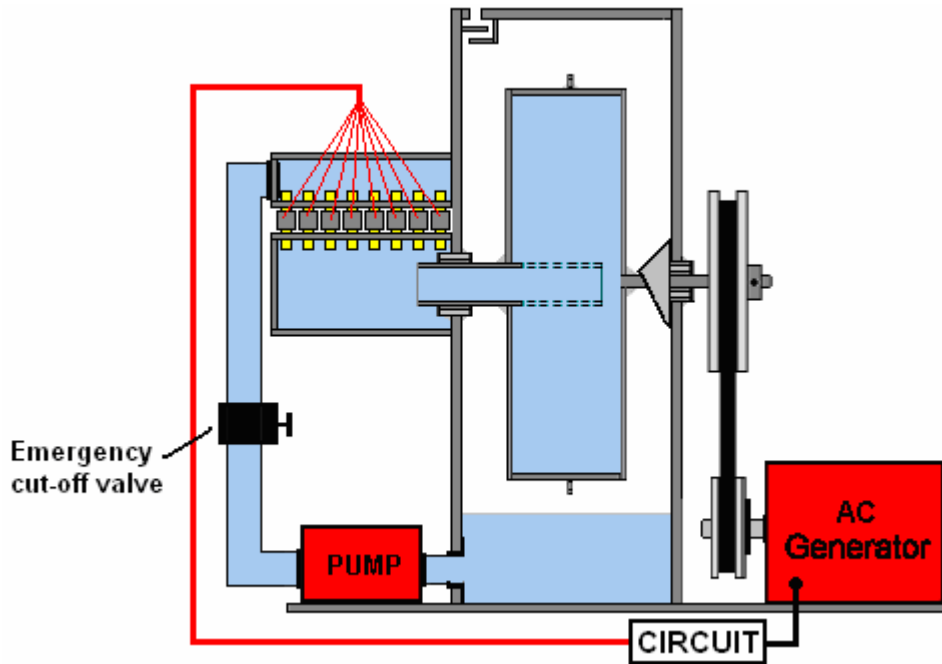
This row of ten valves allows ten different flow settings when the valves are switched on or off by the control circuit and there is the added advantage that if the control circuit is powered via the alternator output and there is a major problem where the drive belt snaps or there is any other major fault which removes the alternator drag from the output shaft, then all valves will automatically shut down and block the flow due to lack of voltage to keep them open. The arrangement could be like this:



The most direct way of determining the speed of the output shaft is to connect a disc to the shaft and use a sensor to detect how often a magnet in the disc passes by. A rev counter circuit then monitors the shaft speed and switches off valves progressively if the shaft starts to rotate too fast.

While the diagram above shows the most secure way to assess the speed of rotation of the generator, for most people it is more convenient to skip as much construction work as possible. So, a way which skips the need for an additional rotor disc and sensor is attractive. For that we can measure the output of the alternator rather than the direct speed of the generator axle.

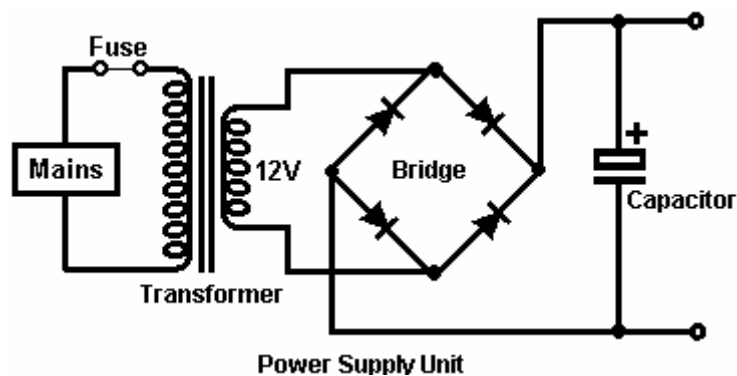
The alternator is an alternating current generator. If you spin the drive shaft of the alternator at its design speed then mains voltage is produced. If the shaft is spun faster than it is supposed to be, then a higher voltage is produced. If the shaft is spun slower than its design speed, then the output voltage is less than the mains voltage. We can therefore use the voltage of the generator's output to control the switching of the row of valves, and the design then becomes this:



With this arrangement, if the drive belt were to break or the alternator were to develop a serious fault, then the circuit voltage would drop off and as a result, the circuit would no longer supply current to the open valves and they all would close, shutting off the generator which is exactly what is needed.

Now, all that is needed is a simple circuit to control the valves. Please understand clearly that I have never been trained in electronics and so I am only self-taught, so feel completely free to consult an expert to provide you with a better circuit.

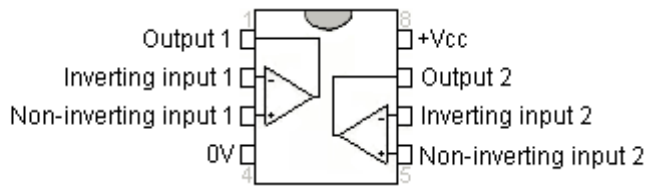
The valve opens if fed 300 milliamps of current at 12 volts. That is 3.6 watts of power for each valve or just 36 watts for all ten valves. The alternator produces mains voltage so we will drop that down to around 12 volts both for safety sake and to make the circuit components cheaper. To drop the voltage down we use a simple power supply comprising of a 3-amp mains transformer to lower the voltage, a diode bridge to convert the output into pulsing DC and a capacitor to smooth out the pulsing:



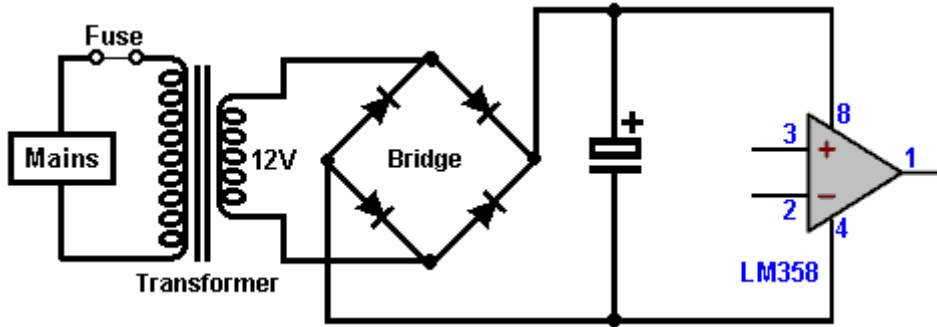
As with all circuits, and especially mains circuits, we install a fuse or circuit breaker as the first component, and we insulate all metal components to make sure that we don't accidentally touch them and get a nasty shock. Once the voltage is down to 12 volts the circuit is no more dangerous than a 12 volt car battery and it is not necessary to insulate everything. The fuse is a 3-amp fuse.

This circuit is deliberately not self-adjusting as we want to use it to detect voltage differences coming in from the alternator which is marked "Mains" in the diagrams. The most important thing is to detect a rise in voltage as that indicates that the generator is starting to rotate too fast and so we want to switch off one or more valves. The circuit for each valve is the same as for all of the others although the adjustment of each circuit is slightly different so that the valves switch off at slightly different voltages.

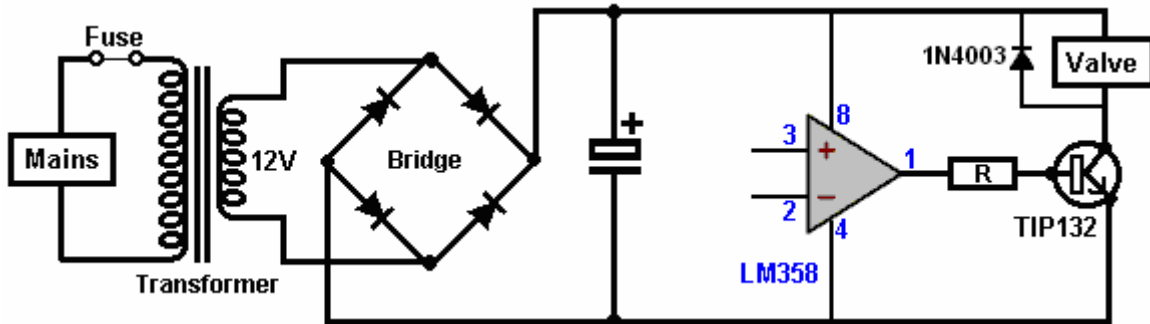
The switching circuit which we will use is called an “operational amplifier” and thankfully that whole circuit comes ready made in a standard chip. For example, the very cheap LM358 chip has two separate “op-amp” circuits in it:



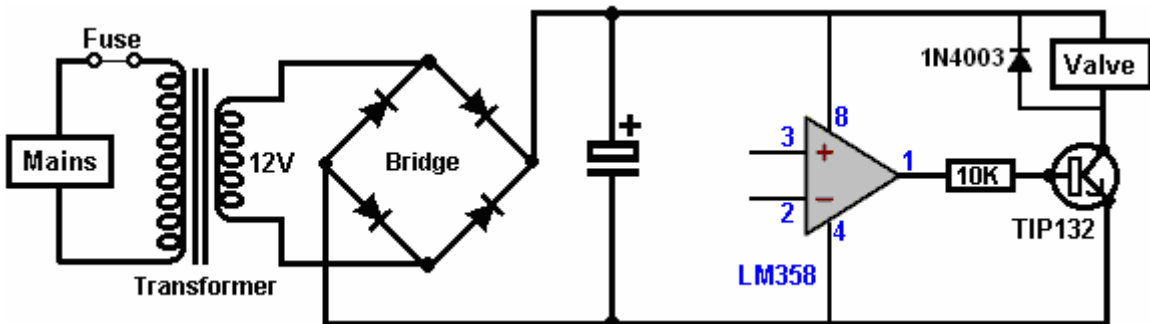
If we connect an LM358 into the circuit we get this:



If the voltage at pin 3 exceeds the voltage at pin 2 then the output on pin 1 will be high (about 10 volts) otherwise the voltage on pin 1 will be low. We will use the high voltage on pin 1 to switch on one of the valves and we will use a high-power high-gain transistor like the TIP132 to do this:



The TIP132 can handle 100 volts, 8 amps and has a gain of 1000, so if it is passing 330 milliamps through the valve winding, then it will need a base current of 0.3 milliamps. That current flows through the resistor “R” which has about 10 volts across it. Resistance = Volts / Amps or 10 / 0.0003 amps which is 33,333 ohms or 33K. However, we will increase the base current by a factor of 3 and use a 10K resistor:

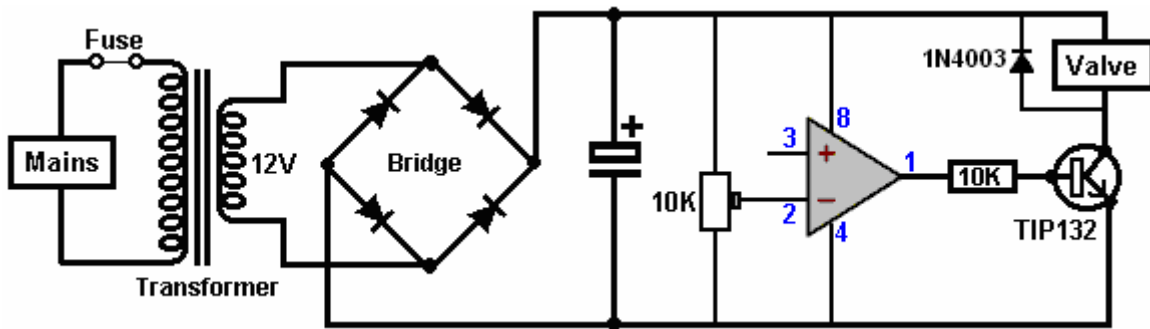


Now we need to get the LM358 to switch off, causing the voltage on pin 1 to drop low, starving the TIP132 of base current and cutting the power to the coil of the valve. For that, we need the voltage on pin 2 to rise above the voltage on pin 3 and we want that to happen if the power supply voltage rises.

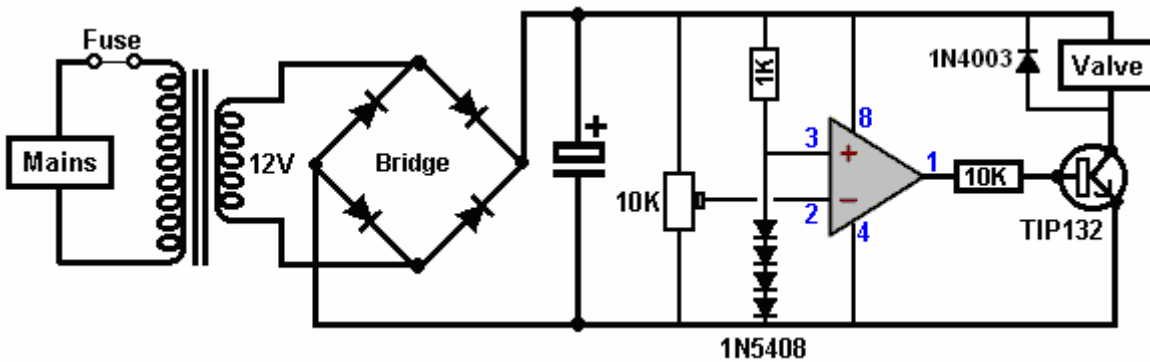
So, if we connect a multi-turn 10K preset resistor across the power supply and feed it to pin 2, then we can set it so that the op-amp triggers with a rise in voltage. A resistor of that type looks like this:



And the circuit becomes:



Now the last step is to provide a reference voltage which does not change if the power supply voltage increases. The approved way is to use a zener diode with a resistor in series with it and in theory, the voltage drop across the zener diode is a reliable reference voltage. I have not found that arrangement to work at all well, so I suggest using ordinary diodes such as the 1N5408 instead, like this:



This arrangement gives about 10 milliamps flowing through the diode chain and some 2.75 volts are generated across the diodes. That voltage does not alter appreciably if the power supply voltage increases.

The second op-amp in the LM5408 chip can be used to control the next valve. Pins 4 and 8 are already connected to the power lines, but what was pin 1 is now pin 7, what was pin 2 is now pin 6 and what was pin 3 is now pin 5.

The circuit is set up using a bench power supply. Measure the voltage of the power supply powered by the Donnie Watts alternator and then disconnect it. Connect the bench supply in place of the alternator supply and set the voltage to exactly the same value. All op-amps are connected to the four diode reference voltage point.

Let's say that we want the valves to drop out at every 5-volt increase of the mains voltage. If it is a 240 volt mains supply, then the transformer drops that down to 12 volts which makes the change 20 times smaller, so the power supply voltage will go up by only  $5 / 20$  volts which is only one quarter of one volt. So you adjust the bench power supply up by a quarter of a volt and adjust the first variable resistor so that the first valve shuts off. Lowering the bench supply voltage by that quarter of a volt should have the valve clicking open again.

This is repeated with all of the valves so that the second valve drops shut at half a volt higher voltage. The third valve drops closed at three quarters of a volt increase over the original voltage, and so on.

When starting the Donnie Watts generator you need the valves open and so a 12V source has to be applied to the valves. Make sure you do that through a press button switch and not a toggle switch because you could easily forget to switch the toggle switch off after the system gets up to speed.

## **The two patents:**

The 25th September 1989 patent application by Donnie C. Watts describes the operation of the device:

### **DESCRIPTION AND WORKING DETAILS OF THE CENTRIFUGAL ENERGY AMPLIFICATION AND CONVERSION UNIT**

#### **Description of Unit**

The unit consists of two circular steel plates one eighth of an inch thick and four feet or larger in diameter, forming the exterior of a wheel. These plates are placed six inches apart on a hollow axle three inches in diameter. Between these two plates are four V-shaped pieces of sheet metal spaced precisely to form six-inch spokes which will direct water from holes in the central axle to the outer rim, while the inside of the V will form air pockets between the spokes. The ends of the V must not be closer than two inches to the outer rim of the wheel. All four V-shaped units must be precisely placed in balance with each other and securely welded to keep the air pockets and the water pockets separated. The outer rim of the wheel is made of a piece of one eighth inch thick sheet metal six inches wide, formed in a perfect circle and welded securely to the edge of the circular plates so that the area inside is completely enclosed. On this outer rim, directly in the centre, are placed between four and fifty water jets about the size of a football needle, slanted sharply to one side to give the wheel a turning motion. (The optimum number of water jets on the outer rim depends on the application, but the volume of water being expelled through the jets must not exceed sixty-six percent of the volume of water which can pass through the openings at the centre axle. The reasons for this are:

1. The water going out of the jets would be going out faster than the water entering the wheel which would result in no pressure near the outer rim, pressure which is essential for the running of the motor.
2. The water entering the wheel must go immediately into a puddle of water. The longer it remains a stream of water instead of a puddle of water, the more energy is wasted.

Because the water being ejected through the exterior jets is always less than the amount of water available to the jets, a pressure build-up will occur near the outer rim. A spring-loaded pressure release jet (not shown) must be built into the exterior rim along with the other jets, but facing in the opposite direction to keep the wheel from over-spinning if the load (generator) is dropped or does not take enough power off to keep the wheel speed constant. There are several other ways to control the speed.

The central axle is designed to have water going into one end of it, and an electrical generator attached to the other end of it. Between the water entry and the generator, very close to the wheel itself, would be very sturdy roller or ball bearings resting on, and attached securely to, a framework which will hold the wheel one foot off the floor. Water is forced into the axle via a high-volume low-power centrifugal force pump, approximately one half horsepower motor, at approximately 20 (US) gallons per minute depending on speed and power requirements. This motor and water pump is primarily to start the wheel and since the power from this is all added to the power output of the big wheel, I prefer to leave the pump running during operation.

The entire unit (depending on application) can be put into a containment shell which can be pressurised or evacuated of air. If the unit is to be operated in an open field, the outer shell can be pressurised and the starting pump removed or turned off once the motor is running by itself. If the unit is to be operated in a garage or near a house, it would be operated at atmospheric pressure or in a vacuum, in which case it is necessary to leave the pump attached and running so that air bubbles do not form near the central axle.

Also, the containment shell must be able to collect about ten inches of fluid in the bottom, waiting to be recycled through the wheel.

Important Notes Regarding this engine:

1. The speed and horsepower curve of a self-energised motor is exactly the opposite of that of a normal motor. A normal motor reaches a power peak and then starts downwards. The power curve starts with a slow upward climb and then accelerates rapidly until the power line curve is almost vertical (just prior to disintegration if speed control is not being used).

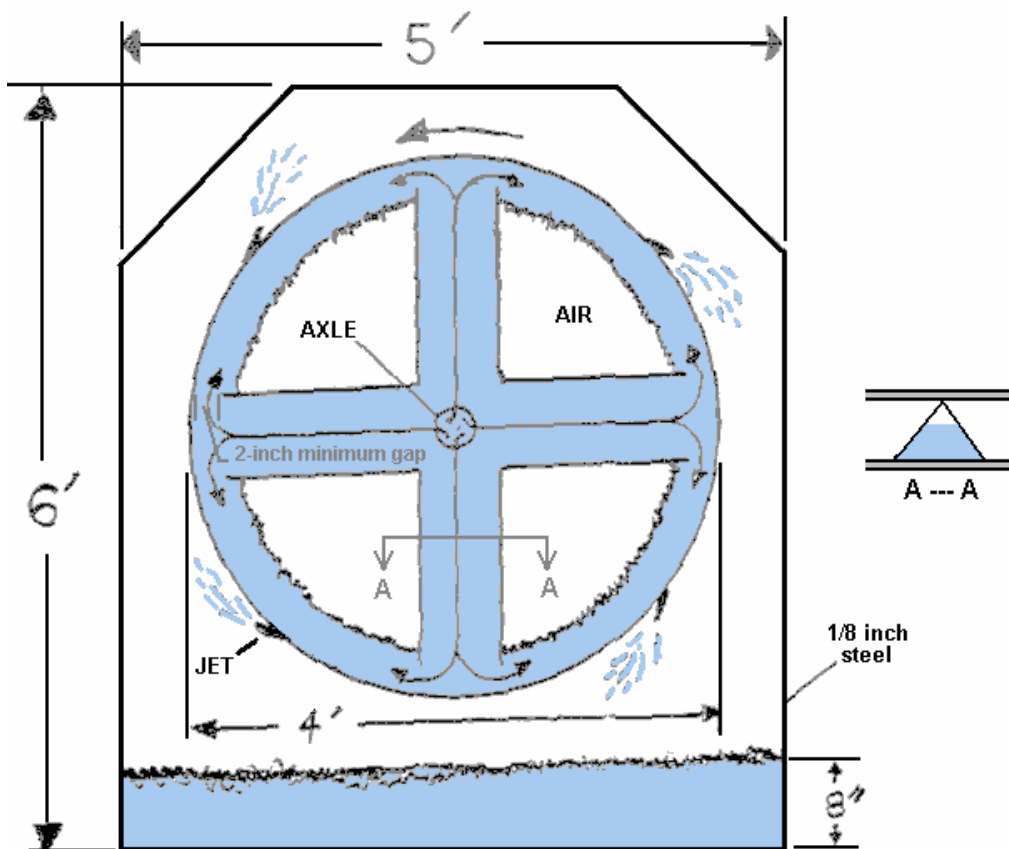
The motor will not generate more energy than is put into it before it reaches 60 to 100 rpm, depending on design and size.

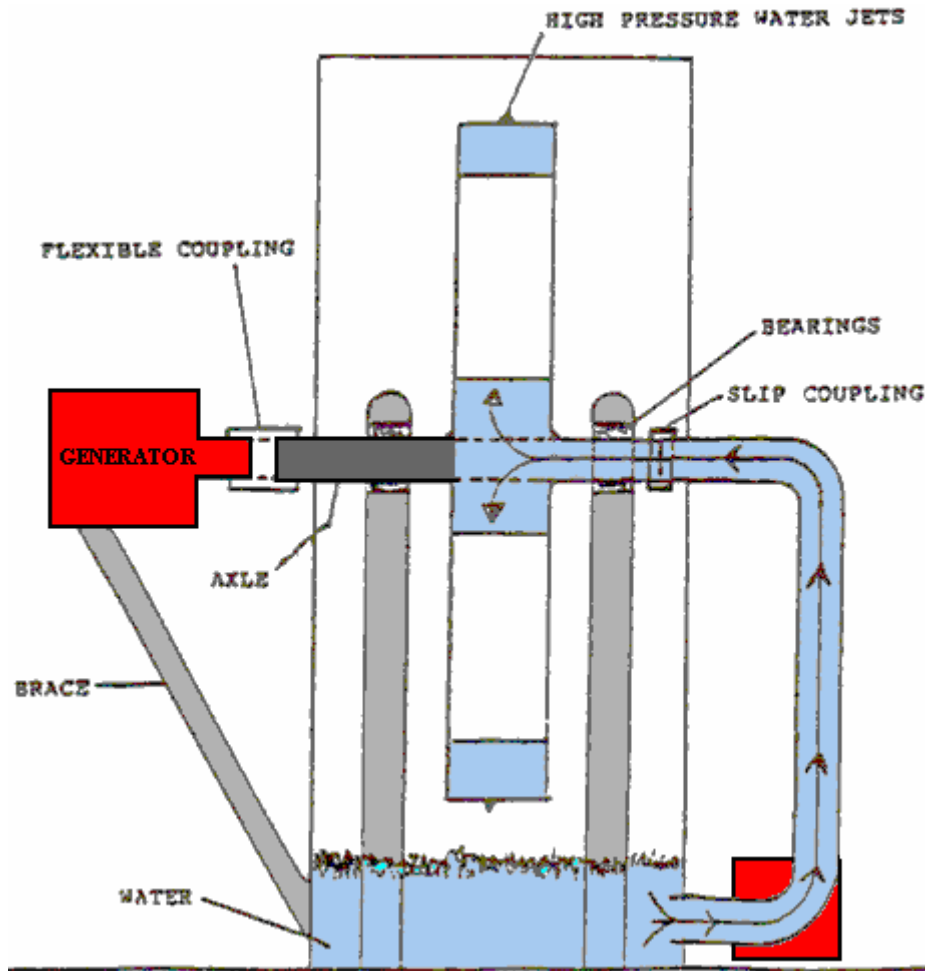
2. As speed increases, air bubbles which occur in the working fluid will accumulate in the air pockets. The air pockets serve only to hold the pressure steady and give a gentle persuasive pressure that is multi-directional instead of just centrifugal, resulting in a steady pressure to the jets. It is not just possible or probable that the unit would blow itself apart by its own power (if the pressure were not released at some point or power taken off); it happens to be a fact. Air pressure will accumulate in the air pockets inside the wheel only after the wheel is going 60 rpm or faster.
3. The pressurised air in the outer rim of the wheel is essential because it pushes in all directions at once, while the water pushes in only one direction. In other words, centrifugally forced water is not interested in finding its way through the jets, it is only interested in pressing directly against the outer rim. The water holds the air in place at the same time that the air is forcing the water through the jets, and the water coming down from the axle keeps replacing the expelled water. This is why I keep saying over and over again, "Make it big enough, make it big enough". Otherwise it would be no more workable than a small dam.
4. In order for this motor to work properly, the water coming down the spokes must not be restricted in any way until it reaches the outer rim. This is why we have six-inch spokes. The water resting against the outer rim cannot be moving about rapidly; we want the water sitting as still as possible under as much pressure as possible.
5. There are two primary factors which must not be altered in the design of this wheel, otherwise it will not work:
  1. The spokes must be very large and free of restrictions, because liquid in general tends to cling to anything it gets near.
  2. The speed of the wheel turning is essential to the centrifugal force required to build up the pressure near the outer rim, and for this reason the jets in the outer rim must be small in diameter and in large numbers so that the concentration is on speed instead of on volume (but not to exceed 66% of the water which can enter at the central axle).



6. Regarding the working fluid: Although it has been referred to here as “water”, the working fluid can be any kind of transmission fluid, oil, hydraulic fluid, etc., keeping in mind that the working fluid must also act as a lubricant for the bearings which are expected to last for ten to twenty years. I recommend regular off-the-shelf transmission fluid, which I have seen used alone in a car engine with lubrication results quite comparable to oil.

The primary functional differences between this motor and damming up a river are: We create our own “gravity” and pre-determine the amount of that gravity by two methods instead of just one. The gravity in a dam can only be increased by building the dam larger; the motor can also increase the working “gravity” by increasing the rpm. This is done by adding more jets, right up to the point where 66% of the incoming water is being ejected. To use more of the available water than this would cause too much turbulence of the water inside the wheel. But keep in mind that there is always plenty of pressure inside the wheel to do the work it is designed for, providing that it is let run at a high enough speed to keep the pressure in the outer rim very high – in exactly the same sense that you don’t try to take off in your car until the engine is going at high enough rpm to handle the load application.





The two drawings above were produced by Donnie Watts and in them 4' means four feet and 8" means eight inches.

This design from Donnie Watts could be built by most people, but on 13th March 1992, Donnie Watts and T. Edwin Orton obtained Canadian patent 2025601 for a much more complicated version of the motor. It looks like this:

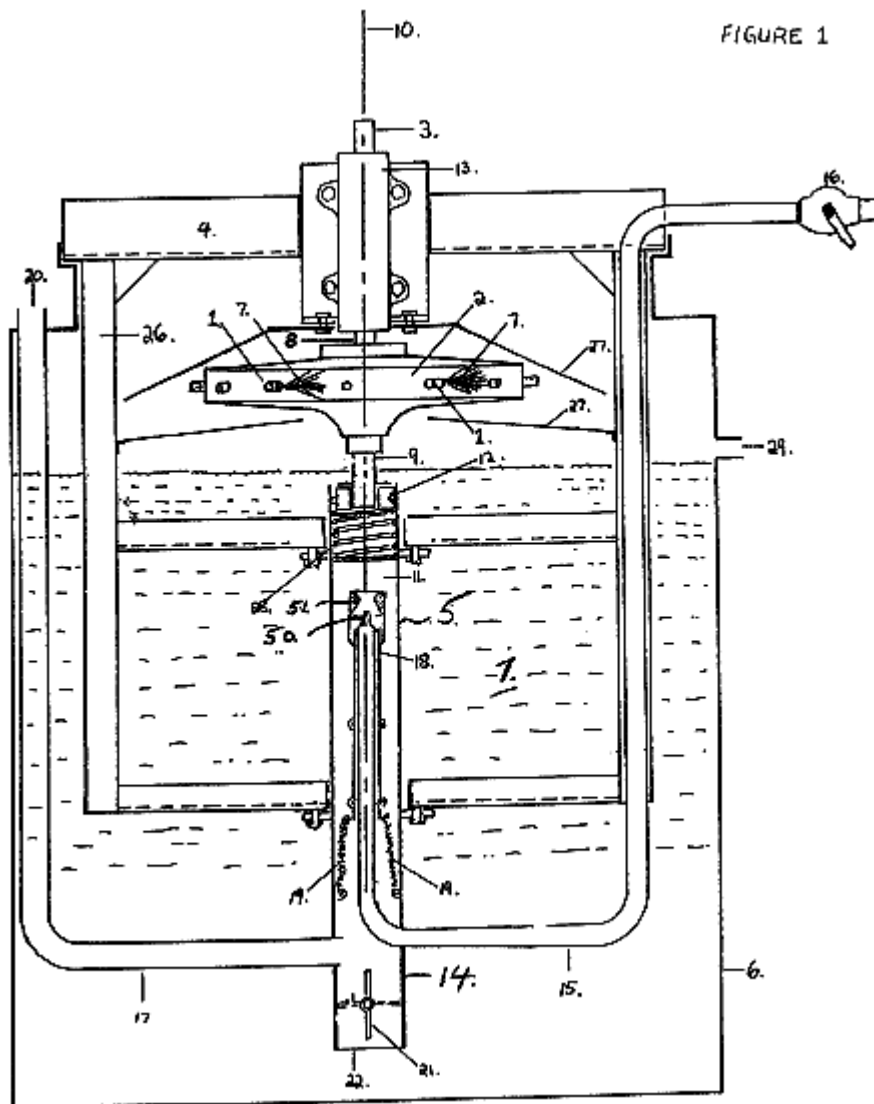


FIGURE 1

This is a much more complicated device with the rotor bearing having to support the full rotor weight as an axial drag, and there is the addition of an extra air intake, an extra valve, springs and a valve seal among other things.

### The Canadian 2025601 Patent

#### ROTOR POWER CONVERSION APPARATUS AND METHOD

##### **Field of the Invention**

This invention relates to the field of mechanical power converters and in particular to the field of mechanical power conversion apparatus which convert the flow of the fluid to rotational mechanical power at high efficiency.

##### **Background of the Invention**

In prior art there are many devices in which rotational mechanical power has been extracted from the kinetic or potential energy of moving fluid. Devices have included the water wheel, the water turbine and "Pelton wheel" and various turbines in which fluid under the influence of external pressure, flows radially outwardly or inwardly past curved vanes to impart its force to the vanes and create torque. The present invention falls into the latter category but the method of power conversion is significantly different from the prior art in order to achieve higher efficiencies.

In conventional power conversion apparatus, moving fluid under the influence of gravity or pressure from an outside source is directed tangentially against vanes or paddles as in the case of the water wheel, "Pelton wheel" or water turbine; or it is directed radially outwardly or inwardly to impact against and escape freely past curved vanes as in the case of various water, air and exhaust turbines. The fluid transfers its energy to the paddles or vanes by impacting against them and, as the paddles or vanes move at increasing velocity away from the point of impact, the force of impact, the force of impact of fluid against them decreases. Thus, as the tangential velocity of the rim of the wheel or rotor increases, the torque on the wheel or rotor decreases as a function of the geometry and angular velocity of the turbine. The moving fluid transfers some of its kinetic energy to the vanes or paddles, losing some of its velocity in the transfer, but escapes past the vanes or paddles, still retaining a considerable proportion of its velocity and kinetic energy. In the present invention, this escaping energy is reduced as will be further described. In the present invention, this escaping energy is reduced as will be further described. In the present invention, the torque on the rotor is caused by jet thrust reaction originating at and acting tangentially to the arc described by the outer periphery of the rotor. Because jet thrust reaction is always relative to its point of origin and undiminished regardless of the movement of that point or origin, being dependent only upon the efficiency of the jet and the pressure which feeds it, the torque on the rotor does not decrease as the rotational speed of the rotor increases.

Secondly, whereas the movement and/or pressure of fluid in conventional devices is supplied from an outside source such as external pressure or gravity, the working pressure of the fluid in the present invention is increased within the hollow rotor itself by the centrifugal force acting upon the fluid like a greatly enhanced artificial gravity acting radially outward as the fluid rotates with the rotor. To accomplish this, the working fluid is freely admitted to the centre of the hollow rotor but allowed only restricted escape at the diametral periphery of the rotor through jets much smaller in aggregate cross-sectional area than the aggregate cross-sectional area of the passages by which fluid enters and travel outward from the centre to the periphery within the rotor. At the same time the fluid is forced to rotate with the rotor by being conducted radially outward in discrete passages as it gradually moves outwardly from the centre to the periphery of the rotor to replace fluid which is expelled from the thrust-jets by the centrifugally-induced pressure.

The jets eject a relatively small volume of fluid compared to that which can freely flow radially outward from the hub, while being forced to rotate with the rotor, so as not to disturb the predominately static (relative to the rotor) pressure head inside the rotor.

By these means, the velocity and kinetic energy of the fluid is first converted to a substantially static pressure head of fluid within the periphery of the rotor and thence to a jet thrust originating at and acting tangentially to the arc described by the periphery of the rotating rotor, such thrust always being always relative to its point of origin and not diminished by the movement of that point of origin. This thrust produces torque on the rotor, relative to a fixed frame of reference, which is extracted as rotational power at the axis in a conventional manner.

An explanation of the mathematical relationships involved will aid in understanding the working principles of this invention. For simplicity, the diametral periphery of the rotor will be called the rim and the hub where the fluid enters will be called the centre. The jets are at the rim and thrust tangentially to it. The fluid enters at the centre and is forced, by radial passages or partitions, to rotate with the rotor as the fluid moves gradually toward the rim where it is constrained except for a portion which can escape via the thrust-jets. Such portion is a small amount in proportion to that which the passages can transfer with minimal friction losses. The fluid within the rotor acts much like a fluid flywheel exerting centrifugally-induced pressure outwardly from the centre toward the rim of the rotor.

Mathematically, excluding friction losses, the pressure of the fluid inside the rim due to the centrifugal force acting on the column of fluid radially disposed between the centre and the rim, is always proportional to the tangential velocity of the rim regardless of the diameter of the rotor; i.e. a 1 foot diameter rotor at 20 revs per second gives the same pressure as a 2 foot diameter rotor at 10 revs per second. Quantitatively, by conventional centrifugal pump design formula, it is shown that the centrifugally-induced pressure within the rim of the rotor is sufficient to eject fluid from the jets at the same velocity, relative to the jet, as the tangential velocity of the jet and rim, relative to a fixed frame of reference. The acceleration of fluid from the jets tangential to the rim of the rotor, causes an equal and opposite reaction thrust to be imposed on the rim of the rotor, such thrust being relative to the jet and

not diminished by the tangential rotational movement and velocity of the jet fixture in the opposite direction. The ejected fluid has very little velocity remaining relative to a fixed frame of reference; having given up almost all of its kinetic energy to the rotor as tangential reaction thrust.

Experimental jet thrust velocities of 0.95 in relation to theoretical values are readily achieved with correct jet design as set forth in various manuals, (Ref.1) as are net thrust values of 0.9 of theoretical values in relation to pressure.

$$\text{Theoretical pressure head } H = V^2 / 2g$$

Where  $V$  = rim velocity and  
 $g$  = acceleration due to gravity

$$\text{Velocity of fluid from jet } V = \text{the square root of } 2gH$$

After allowing for friction losses and inefficiencies just as in conventional machines, a high ratio of output power to input kinetic or potential energy is nevertheless achieved.

### Summary of the Invention

An apparatus for converting fluid pressure into rotational mechanical power has the object of providing a more efficient means for converting input power into output power than is conventionally obtainable.

In its broadest form, the invention provides an apparatus for converting the power of a fluid flow into a mechanical power output, the apparatus comprising a hollow rotor mounted for rotation about a central axis relative to a fixed frame of reference and provided with a thrust-supplying jet on the circumference of the rotor, and fluid supply means for supplying the fluid flow to the interior of the rotor at a point on the axis of the rotor. The apparatus is adapted to provide enforced rotation of the fluid in the interior of the rotor together with the rotor, and constraintment of the fluid within a diametral periphery of the rotor, other than fluid flow through the jet. The fluid pressure is therefore converted into a tangential rotational reaction thrust acting at a point at or near the diametral periphery of the rotor, the magnitude of the thrust acting at the point being dependent only on the fluid pressure within the rotor.

According to one aspect of the invention, the apparatus converts input power to output power at high efficiency by a sustainable rotational reaction thrust originating on a rotor, where the thrust, being relative to the rotor, propels the rotor at high rotational velocity relative to a fixed frame of reference. The apparatus has thrust-jets, a pressure-tight hollow rotor radially disposed around a hollow hub with fluid entrance at one or both sides of the hollow hub and thrust-jets tangentially oriented around the diametral periphery. The hollow rotor has discrete radially-oriented internal passages or partitions extending from the hub to, or nearly to, the internal diametral periphery of the rotor to freely conduct fluid radially outward from the hub while enforcing its rotation together with the rotor. The apparatus has a rotor support shaft and low-friction bearing means, a bearing support, a power take-off and a fluid supply. The thrust-jets extend from the rotor and impart rotational thrust to the rotor by ejecting a pressurised stream of fluid in a direction approximately tangential to the arc described by the rotor's rotational motion, while at the same time, the rotor's rotational motion causes a centrifugally induced increase in the pressure of the fluid which feeds the thrust-jets from within the rotor; the pressure thus generated being additive to external input pressure to the hub of the rotor. The rotor has a rigid axle or axles as hollow intake pipe or pipes attached to the rotor along the axis of rotation, the axle(s) being supported by the bearing means to rotate freely therein. Fluid is admitted to the hollow intake pipe(s) which may also serve as axle(s) and thence through the hollow hub to the radial feed arms or channels within the rotor. The radial feed arms or channels feed fluid through **at least an 8:1 contraction ratio** to the thrust-jets. In the case of liquid being used as the working fluid, fluid is admitted to the intake pipe(s) through a rotating seal in order to exclude air. The axle(s) extend through low-friction bearings on the rotor support to provide a power take-off whereby mechanical power may be transmitted by gears, pulleys and the like. A starting mechanism, rotor speed governors, air purging mechanism in the case of liquid operated units, and shut-off mechanisms are provided.

Brief description of the drawings

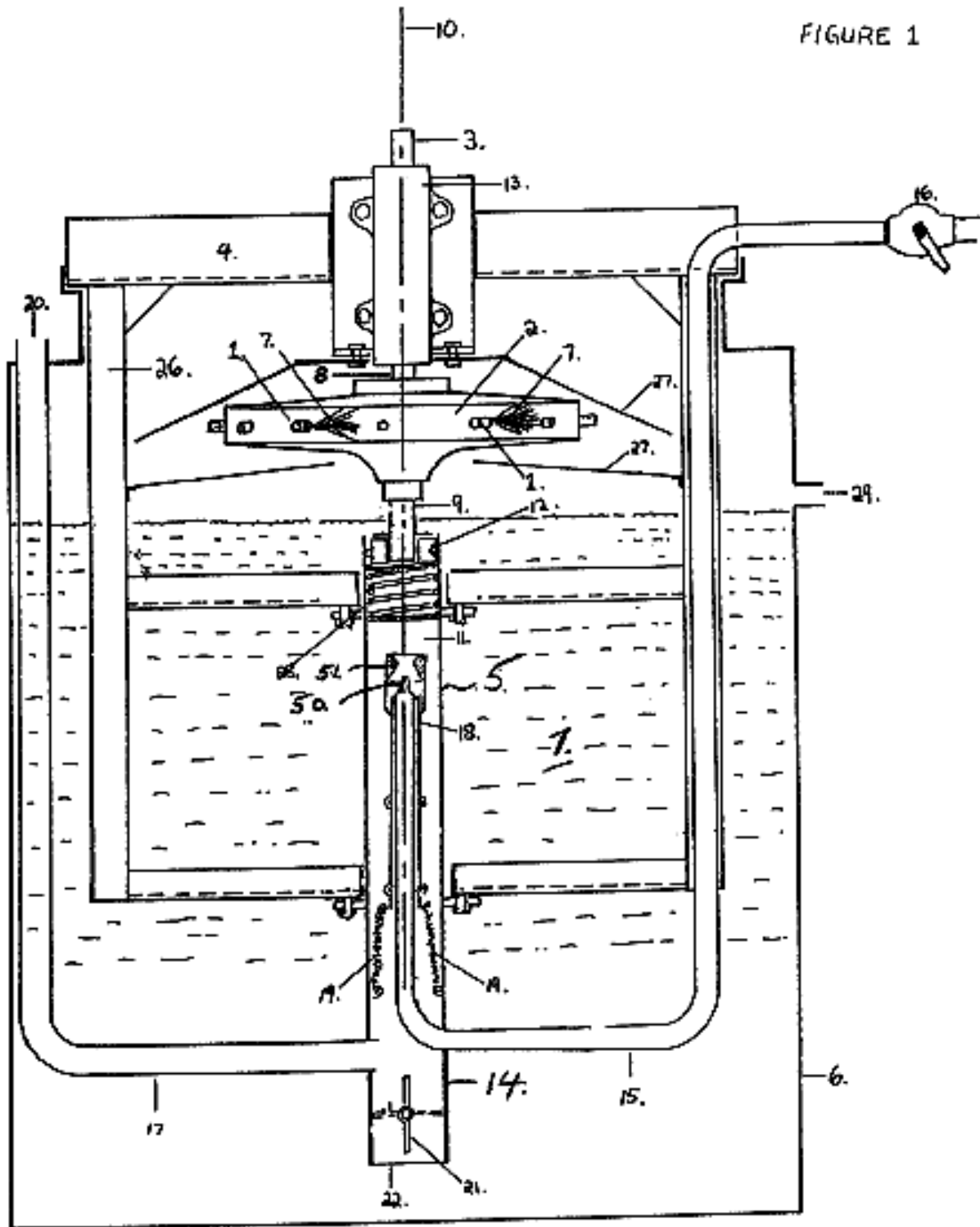


Fig.1 is a front elevation view, partially in cross-section of one embodiment of the apparatus showing the retractable jet-siphon pressure injection nozzle in it's retracted position.

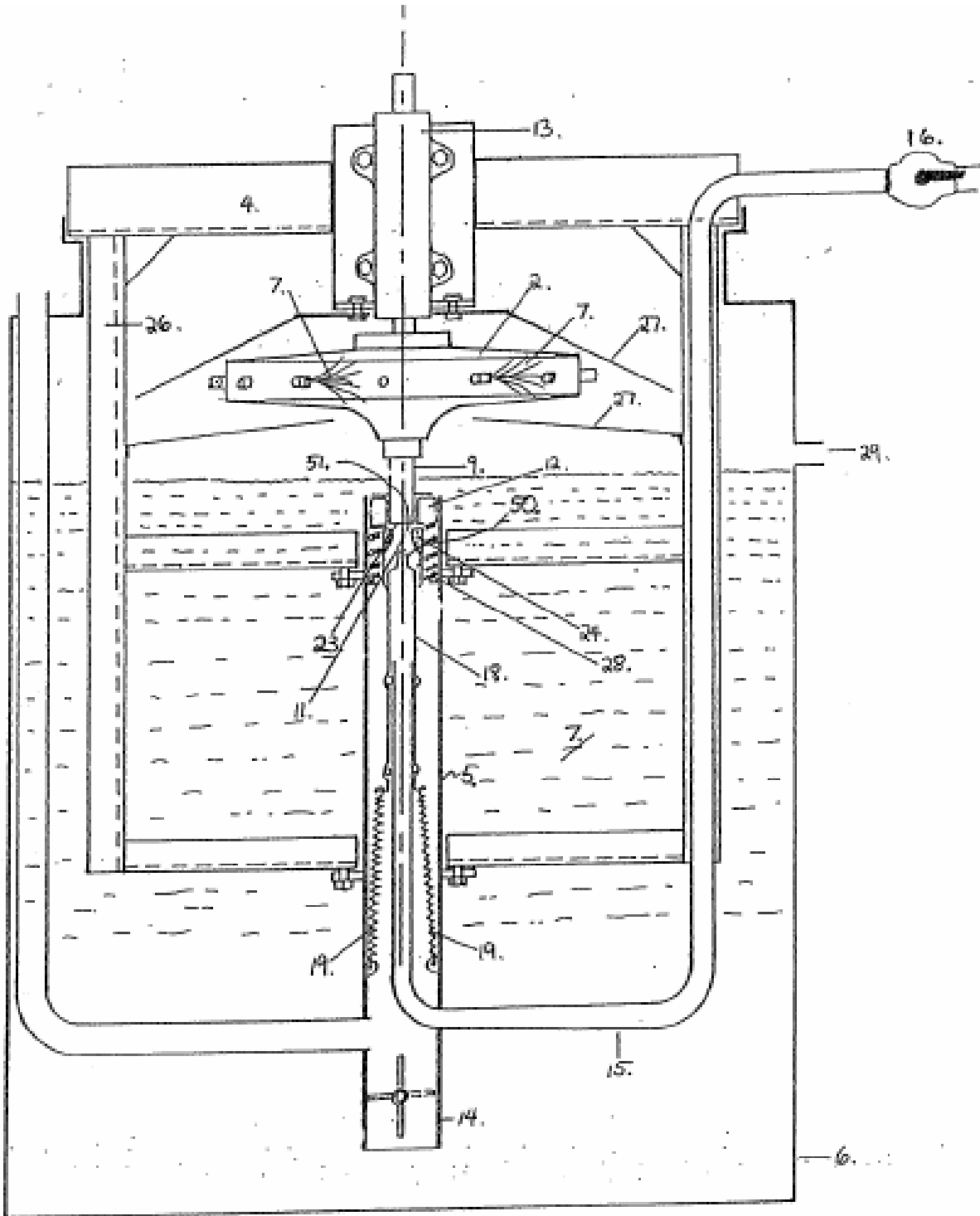


Fig.2 is a front elevation view, partially in cross-section, of one embodiment of the apparatus, showing the retractable, jet-siphon pressure injection nozzle in its pressure injection engaging position.

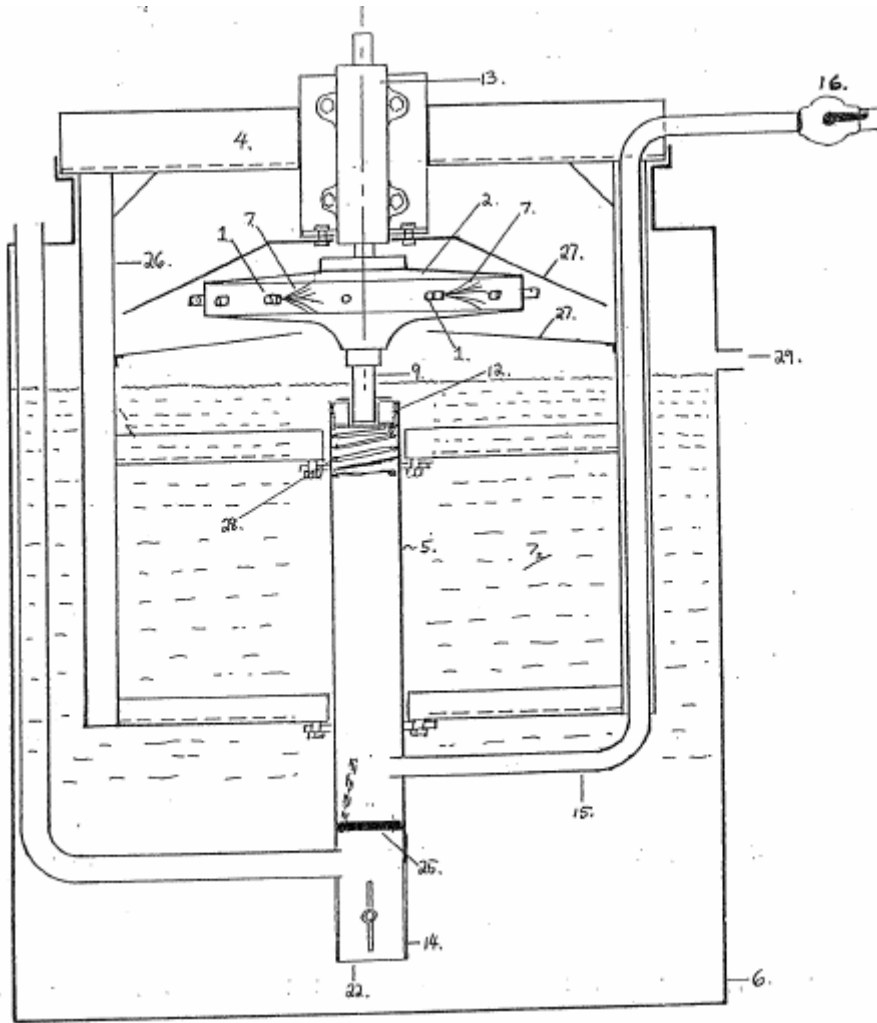


Fig.3 is a front elevation view, partially in cross-section, of a second embodiment of the apparatus showing the one-way valve in the open position.

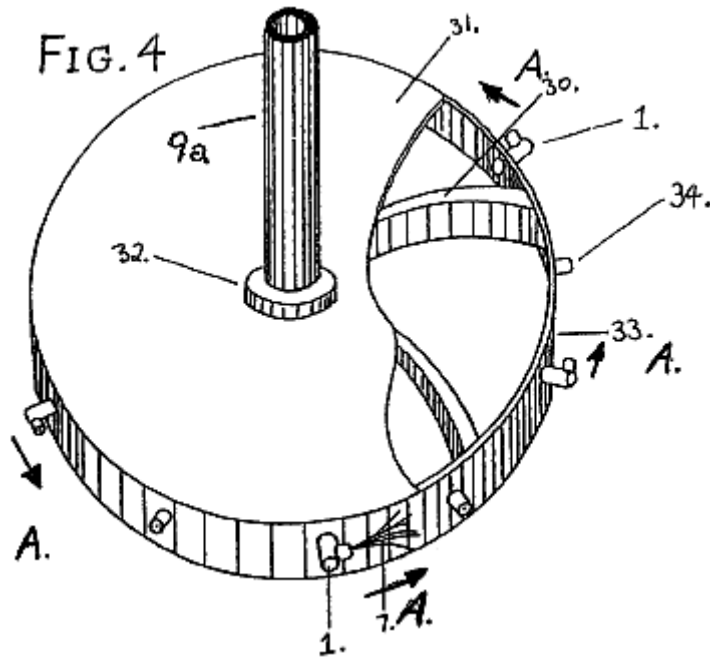


Fig.4 is a top oblique view, partially cut away, of one embodiment of the rotor of the invention.



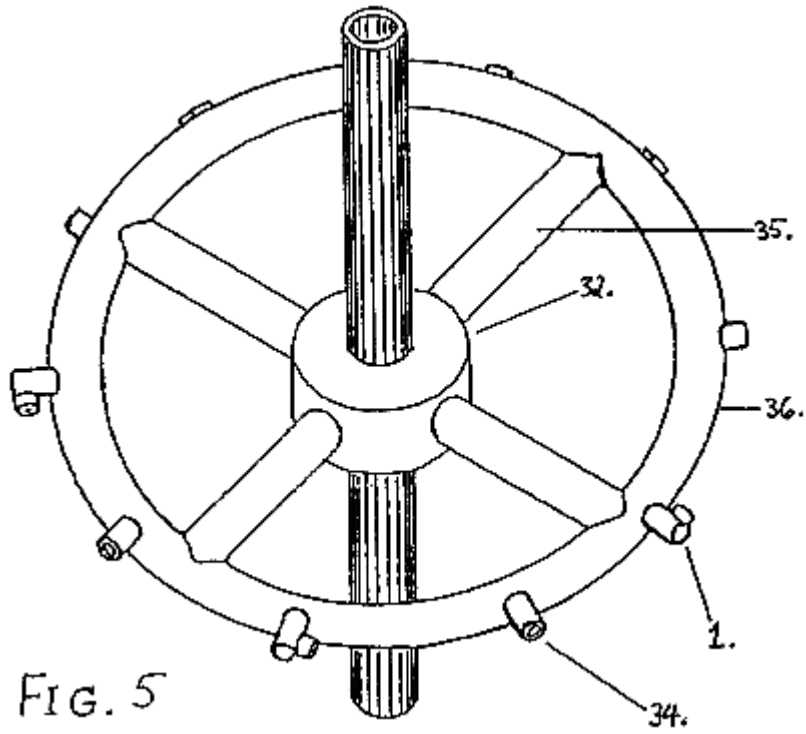


Fig.5 is a top oblique view, partially cut away, of a second embodiment of the rotor of the invention.

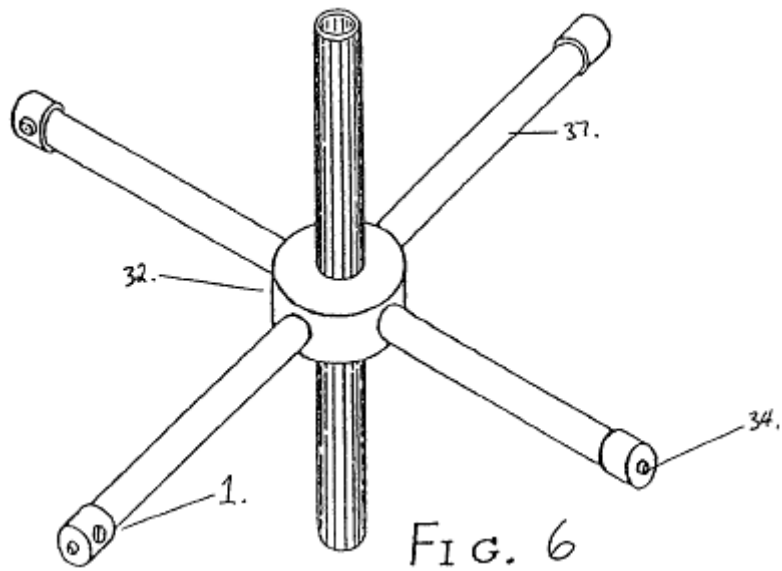


Fig.6 is a top oblique view, partially cut away, of a third embodiment of the rotor of the invention.

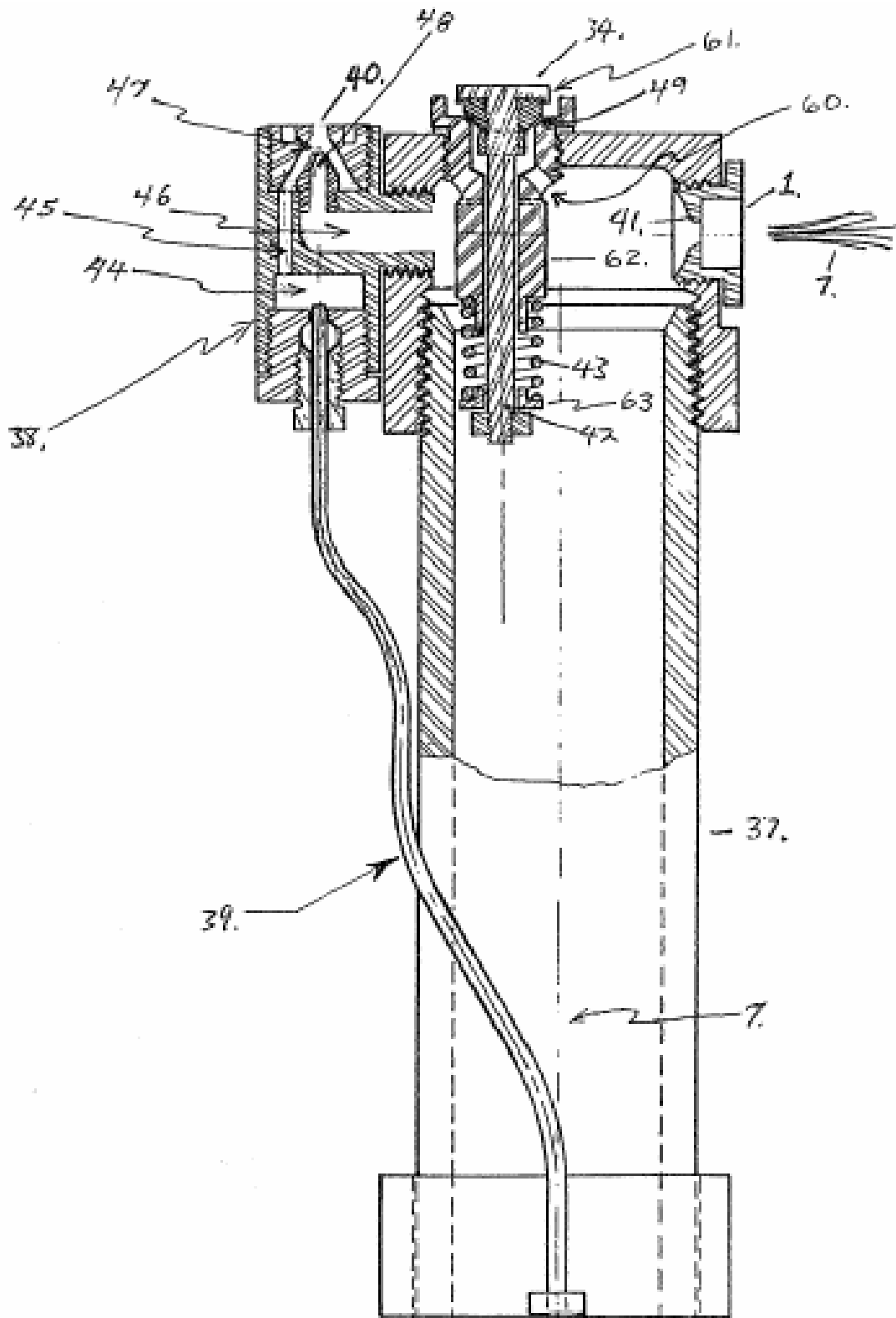


Fig.7 is a top elevation view, partially cut away, of greater detail of the outer end of a radial feed arm of the third embodiment of the rotor of the invention, showing a centrifugal-force operated, poppet type governor release valve, a pressure operated jet-siphon air purging mechanism and a correctly shaped thrust-jet.

## Detailed Description of the Preferred Embodiment

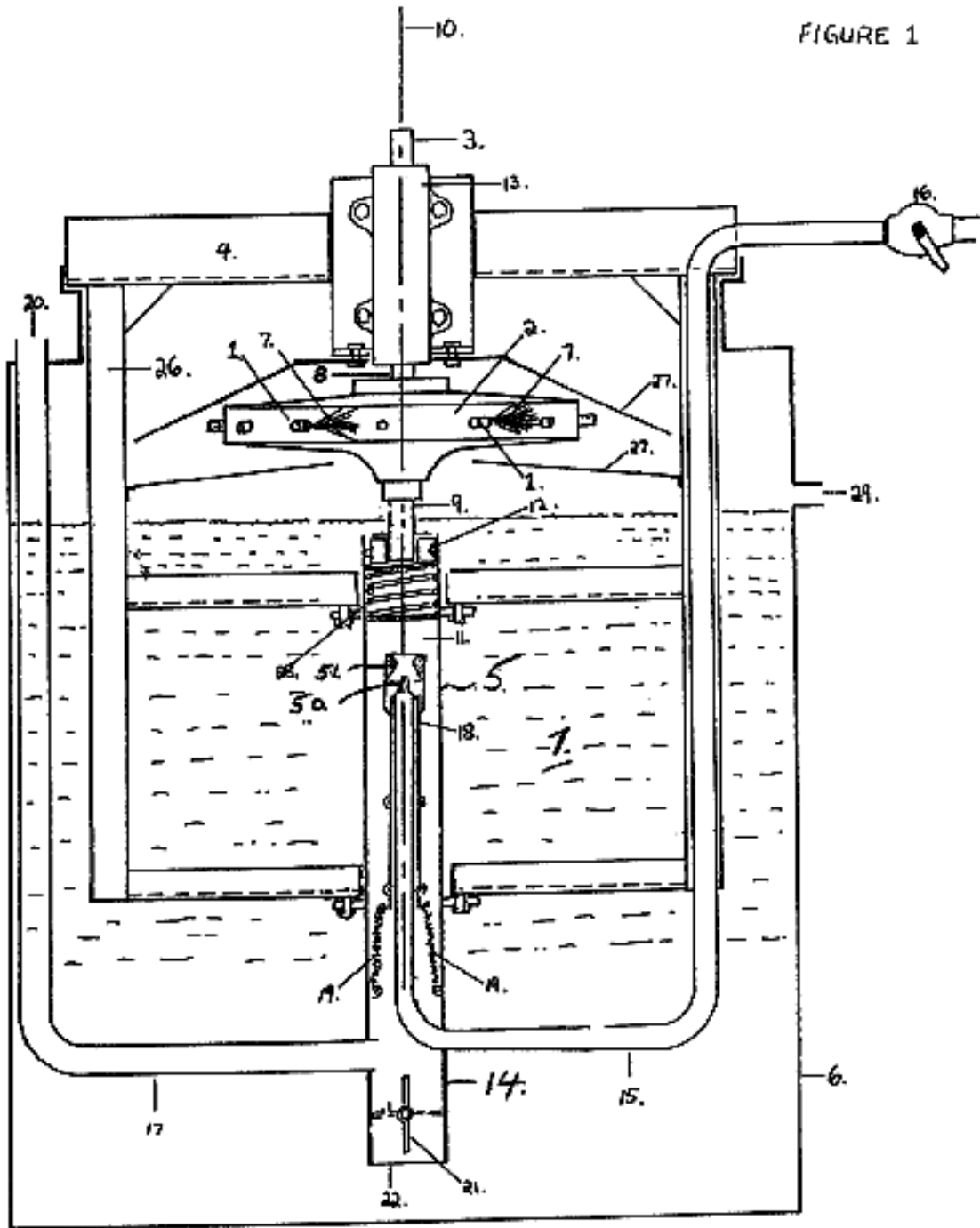


Figure 1 illustrates the invention having thrust-jets 1, rotor 2, power take-off 3, rotor support 4, fluid supply 5, and fluid reservoir 6. Thrust-jets 1 extend from rotor 2 and impart rotational thrust to rotor 2 by ejecting a stream of fluid 7 in a direction indicated by arrow "A" in Figure 4, approximately tangential to the arc described by the rotor's rotational motion.

Fluid 7 (such as water) is supplied to the fluid supply line 5 through the open bottom 22 in order to exclude entrained air bubbles. Rotor 2 has rigid upper axle 8 and rigid lower intake pipe 9 attached to the rotor 2 along the rotor's axis of rotation 10. Rotor 2 is suspended over fluid reservoir 6 on axle 8 by rotor support 4.

Fluid supply line 5 is supported in fluid reservoir 6 on axle 8 by rotor support 4. Fluid supply line 5 is supported in fluid reservoir 6 centrally aligned beneath rotor 2. Intake pipe 9 is hollow and communicates with fluid supply line 5 to channel fluid 11 from fluid supply line 5 to rotor 2. Fluid 7 is

channelled from intake pipe **9** through rotor **2** in one of the manners further illustrated below. Intake pipe **9** is seated in seals **12** mounted in the upper end of supply line **5**, where such seals may be of a conventional ceramic, composite or carbon-graphite wear-ring type. Axle **8** extends through low friction bearings (not shown) in upper bearing housing **13** on rotor support **4** and connects to power take-off **3**. Axle **8** is solid or sealed from rotor **2** and intake pipe **9** such that fluid **7** in rotor **2** and intake pipe **9** is prevented from entering axle **8**. Mechanical power is transmitted from power take-off **3** by attaching suitable gears, pulleys or the like.

Fluid supply line **15** is supplied with fluid under pressure from an outside source through fluid supply line **5** through leak proof connections or welding and its inner end is attached centrally below and in line with intake pipe **9**. Retractable jet-siphon assembly **18** telescopes on to the inward vertical end of fluid supply line **15** and is provided with one or more O-ring seals along its interior diameter to provide a sliding (telescoping) fluid-tight joint. Unless forced upward by internal pressure from the fluid supply line, the jet-siphon assembly is held in the retracted position shown in Figure 1 by retraction springs **19** attached to fluid supply line **5**.

Ventilator pipe **17** communicates with fluid supply line **5** at its lower end with open air at its upper end **20**. Ventilator **17** is provided so that ambient air may be introduced into fluid supply line **5** to interrupt the supply of fluid **7** into rotor **2** from reservoir **6**. While retractable jet-siphon assembly **18** is retracted under the spring force of springs **19**, introduction of ambient air from ventilator **17** into fluid supply line **5** will, if rotor **2** is spinning, cause rotor **2** to decelerate as air is drawn up through the intake pipe **9** and into rotor **2** to replace fluid exhausting through jets **1**.

Ventilator **17** has air intake **20** and communicates with fluid supply line **5** near its lower end but above butterfly valve **21** which is positioned in fluid supply line extension **14** near opening **22** and may be rotated from an open position (shown in solid lines), in which position fluid from reservoir **6** is free to enter fluid supply line **5** through opening **22**; to a closed position (shown in broken lines), in which position, fluid from reservoir **6** is prevented from entering supply line **5** and ambient air from ventilator **17** may be entrained into fluid supply line **5**. Ambient air from ventilator **17** is entrained into fluid supply line **5** if static fluid pressure in fluid supply line **5** is lower than the ambient atmospheric static pressure. A lower than ambient pressure in supply line **5** will exist if valve **21** is closed and rotor **2** is spinning.

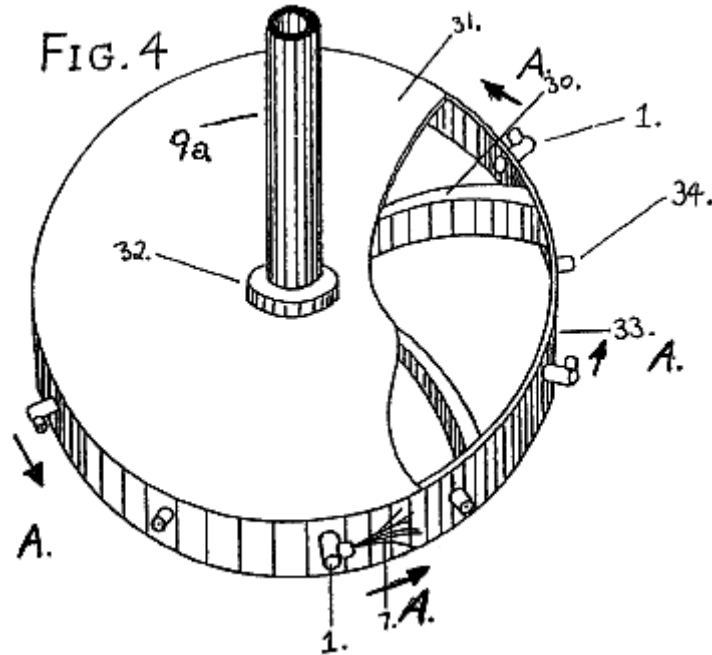
As illustrated in Figure 2, retractable jet-siphon assembly is mounted on the end of supply line **15** supported concentrically within fluid supply line **5**. Retractable jet-siphon assembly **18** has restricted inner nozzle **50** with outer venturi **51** affixed in cooperative relationship to it, forming a jet-siphon. Nozzle **50** has a diameter significantly less than the diameter of pipe **15**. As the force acting to advance retractable jet-siphon assembly **18** increases due to increased fluid pressure from fluid supply line **15** acting on the interior of the retractable assembly **18**, retractable jet-siphon assembly **18** advances toward opening **23** in rotor intake pipe **9**. Conversely, as fluid static pressure from fluid supply line **15** is decreased, assembly **18** retracts away from rotor intake pipe **9** under the force of retraction springs **19**.

When jet-siphon assembly **18** is fully advanced, upper side of venturi ring **24** seals against the underside of seal **12** so that jet-siphon **18** injects fluid from fluid supply **7**, mixed with and assisted by fluid under high pressure from fluid supply line **15**, directly into intake pipe opening **23**. By these means, a high pressure, low volume fluid supply from fluid supply line **15**, is used to provide a higher volume of fluid to the rotor at somewhat lower pressure. Conversely, as fluid static pressure from fluid supply line **15** is decreased, nozzle **18** retracts away from lower rotor axle **9** under the force of retraction springs **19**. Retraction springs **19** are secured to supply line **5**.

Figure 3 illustrates a second embodiment of the invention. A one-way valve **25** is provided in the supply line **5** instead of retractable jet-siphon assembly **18**. One-way valve **25** is biased from a closed position, in which fluid from reservoir **6** is prevented from entering through opening **22**, to an open position (shown in broken lines) in which fluid from fluid reservoir **6** flows into supply line **5** when static fluid pressure in supply line **5** is lower than ambient atmospheric static pressure. Static fluid pressure in supply line **5** is lower than ambient atmospheric static pressure when fluid supply valve **16** is closed and rotor **2** is spinning. Rotor **2** in this embodiment is supplied with fluid under pressure from an outside source by pressurising fluid in supply line **5** from fluid supply line **15**. This pressurisation closes one-way valve **25** and forces pressurised fluid from fluid supply line **15** into rotor **2** and on out through jets **1**

as fluid 7. In this embodiment, fluid supply line 15 enters supply line 5 between intake pipe 9 and one-way valve 25.

As illustrated in Figures 1, 2 and 3, support frame 26 descends from rotor support 7 into fluid reservoir 6. Support frame 26 and bearing housing 13 support fluid deflectors 27 which deflect and diffuse fluid streams from 1 into reservoir 6. Rotor housing 26 extends below rotor 2 into reservoir 6 to rigidly support fluid supply line 5. Coil spring 28 is supported at its lower end in the inner surface of supply line 5 and resiliently supports seals 12 within supply line 5. Reservoir 6 has overflow port 29.



Figures 4, 5 and 6 illustrate three embodiments of rotor 2. Rotor 2 in Figure 4 has straight or curved radially oriented guide partitions 30 within rotor casing 31 and extending from the fluid entrance in hub 32 to, or almost to the inner rim 33 of rotor 2. On the initial acceleration of rotor 2 from rest, pressurised fluid from intake pipe 9a and/or intake pipe 9 (not shown) is forced away from rotor hub 32 between partitions 30 to rotor rim 33 where the pressurised fluid is forced from jets 1 to accelerate rotor 2. Centrifugal force due to the rotational motion of rotor 2 further pressurises the fluid constrained within rotor casing 31 against rotor rim 33. Fluid from open inner end of intake pipe(s) 9 and/or 9a enters casing 31 and is accelerated rotatively as it is impelled, by centrifugal force, radially outward from rotor hub 32, between partitions 30 to rotor rim 33 where it continuously replaces the fluid forced from jets 1 or from governor pressure release valves 34. The rotational velocity of the fluid is great compared to its radial velocity in order to ensure maximum pressure build-up due to centrifugal force, and minimum turbulence and static pressure head loss due to fluid friction within the rotor 2. Governor pressure release valves 34 regulate rotational speed of the rotor 2 by releasing fluid radially from rotor 2 when centrifugal force, plus static fluid pressure head within rotor 2 exceeds a predetermined level exerted against governor pressure release valves 34 limits rotational speed of rotor 2 by increasing the flow of fluid through rotor 2 and thereby increasing the amount of power used to rotationally accelerate fluid without increasing the tangential jet thrust imposed on rotor 2.

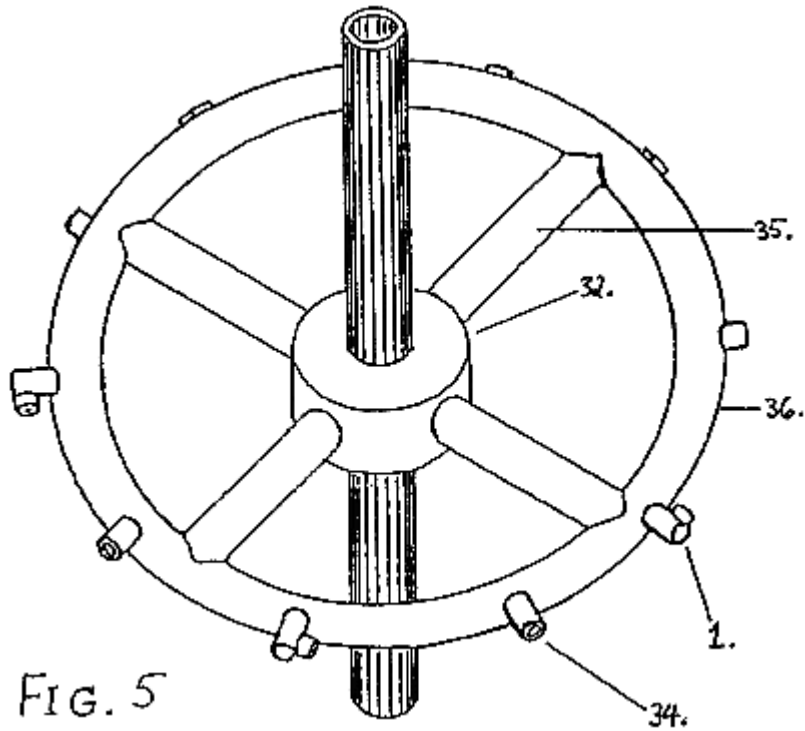


Figure 5 illustrates an embodiment of rotor 2 where hollow spokes 35 and hollow tubular rim 36 are substituted for radial partitions 30 and rotor casing 31.

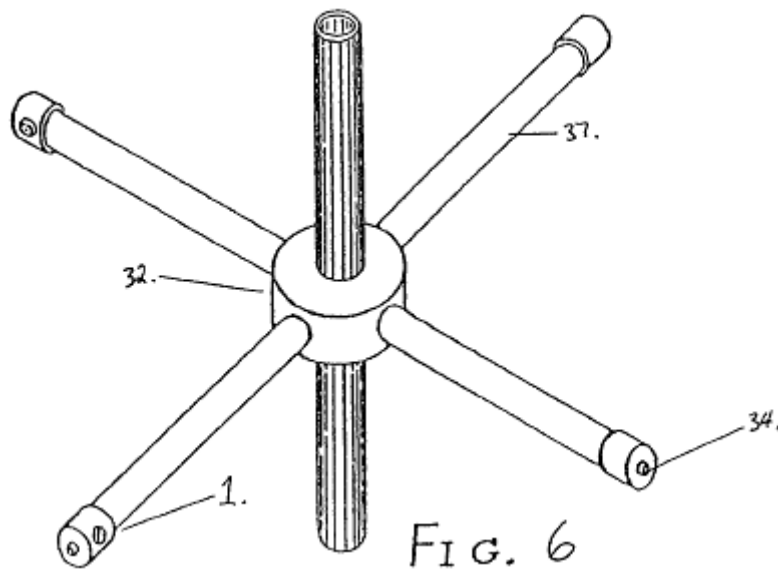


Figure 6 illustrates an embodiment of rotor 2 where hollow arms 37 are substituted for radial partitions 30 and rotor casing 31.

In embodiments illustrated in Figures 4, 5 and 6, **the combined cross-sectional area of intake pipes 9 and/or 9a and the combined cross-sectional areas of spokes 35 and of arms 37, are at least 8 times greater than the combined cross-sectional areas of the nozzle openings in jets 1 in order to reduce pressure losses in rotor 2.**

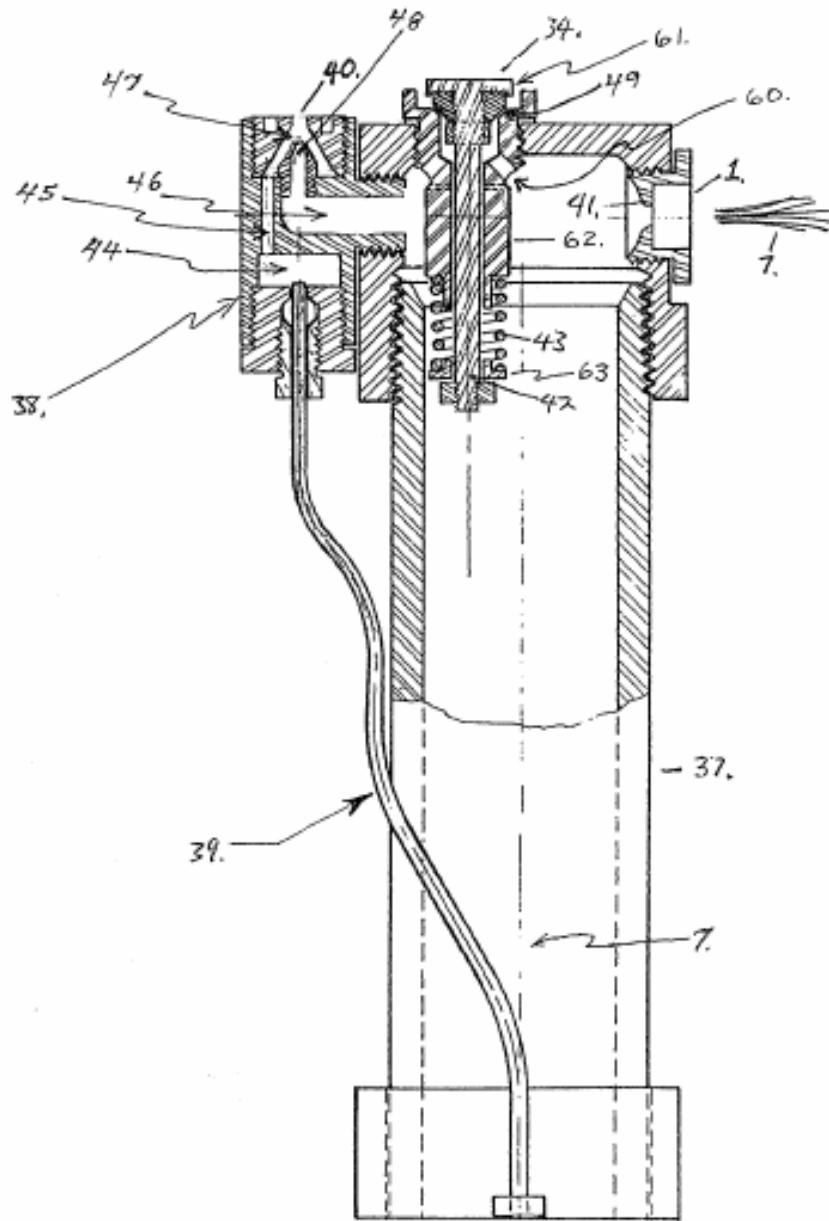


Figure 7 illustrates an embodiment in greater detail of spoke **37** incorporating a jet-siphon air purging mechanism **38** for machines using liquid operating fluid **7**. Air line **39** connects the central interior cavity of rotor hub **32** to intake area **44** of air purging mechanism **38**. When rotor **2** is spinning, a small amount of air inevitably entrained in fluid **7** is centrifuged out of fluid **7** and would otherwise collect in the centre of rotor **2**, thus reducing centrifugally induced pressure build-up in the working fluid **7** within the rotor **2**. Jet-siphon purging mechanism **38** uses a small amount of fluid **7** under high pressure from within rotor **2** and conducts it via passage **46** to high-pressure siphon-jet **48**. The fluid **7** is ejected at high velocity through venturi area **47** and draws air along connecting passages **45**, through intake area **44** and through air line **39**, from the hub **32** of rotor **2**. The air entrained with working fluid **7** in venturi **47**, is exhausted from purging mechanism outlet **40**, either radially or tangentially-assisting jet thrust from thrust-jets **1**.

In a further embodiment, rotor **2** may have air purging means (not shown) consisting of a small diameter tube centrally affixed within feed pipe **5** and extending upward through the centre of intake pipe **9** into the central interior cavity of rotor **2**; the lower end of said tube extending through fluid-tight connectors through the wall of feed pipe **5** and through the outer wall of reservoir **6** to communicate with outside air or with the intake of an external vacuum pump, whereby air may be purged from the central cavity of rotor **2** by incoming fluid pressure into rotor **2** forcing air out of the small diameter purge tube, or air may be drawn out of the purge tube by the vacuum pump and expelled to the outside air.

Figure 7 also illustrates a cross-section, governor pressure release valve assembly **38**. As rotational speed of rotor **2** increases beyond a pre-determined limit, increasing centrifugal force and fluid pressure within arm **37** of rotor **2** presses outward against valve stem **42** and valve head **61**. Valve stem **42** with retainer **63**, is forced against coil spring **43**, allowing valve head **61** to move away from valve seat **49** in valve body **62**.

Pressurised fluid **7** from within arm **37** of rotor **2** is thus allowed to escape through passages **60** in valve body **62** and thence out between valve seat **49** and valve head **61**; then being exhausted radially from arm **37** of rotor **2**.

As previously stated, the release of fluid from governor pressure release valve **34** increases the outward radial movement of fluid **7** within arm **37** of rotor **2** without a corresponding increase in tangential jet thrust; and more fluid per unit of time is caused to be accelerated from its curvilinear velocity at the hub **32** of rotor **2** to its curvilinear velocity at the outer end of arm **37** of rotor **2**, as it moves radially outward within arm **37** of rotor **2**, than that which is ejected to produce jet thrust at the jets **1**. The increased fluid-acceleration demand imposes a drag force upon the rotational movement of rotor **2** without a corresponding increase in propulsive from the jets **1**, thus preventing the rotor from overspeeding. Conversely, when transmission of power from power take-off **3** (in Figure 1) holds the rotational speed of rotor **2** within the predetermined limit, valve spring **43**, reacting against valve spring retainer **63** on valve stem **42**, pulls valve head **61** firmly against valve seat **49**; thus preventing the escape of fluid **7** through governor pressure release valve **34** and allowing rotor **2** to operate at full efficiency. Figure 7 also illustrates a correctly configured thrust-jet **1** having very short, constant diameter jet tube and smoothly rounded approach **41** so as to produce fluid stream **7** from jets **1** with low pressure loss in the nozzle and maximum velocity.

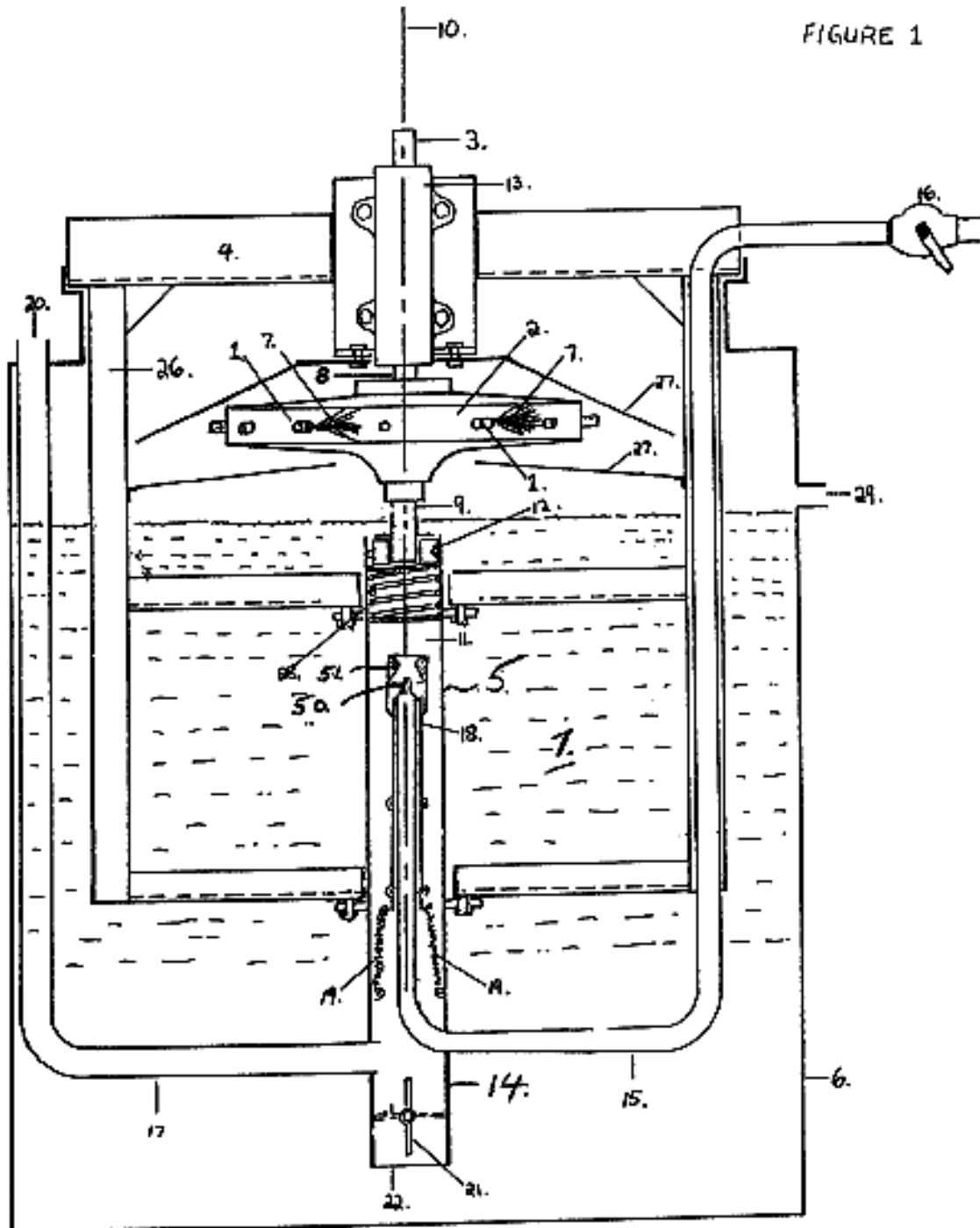
In a further embodiment, rotor **2** may have governor jets (not shown). Whereas jets **1** provide an acceleration thrust to rotor **2**, governor jets act in a direction generally opposite to that of jets **1** to provide a decelerating thrust to rotor **2**. Governor jets are activated when static fluid pressure in rotor **2** exceeds a predetermined level exerted on governor jets. The governor jets may be interspersed between thrust-jets **1**.

Also, in a further embodiment (not shown), rotor **2** may have governor means to limit rotational speed of the rotor by deployment of deflectors against the stream of fluid issuing from the jets, or by rotation of the jets in their mountings.

Referring to Figures 1 and 2, in operation. Rotor **2** is accelerated from rest by opening fluid supply valve **16** and advancing the retractable jet-siphon assembly **18** so that the upper side of venturi ring **24** seals against the underside of seal **12** which communicates with intake pipe **9** of rotor **2**:



FIGURE 1



Pressurised fluid is injected into rotor 2 via intake pipe 9. Rotor 2 fills with pressurised fluid 7 which is forced through jets 1 and the reaction thrust acting tangentially, accelerates the rotor from stationary. Centrifugal force increases as the square of the rotational speed. Once the rotor has been accelerated to its desired operating speed, mechanical power may be transmitted from take-off 3 in accordance with the design capacity of the apparatus. It is necessary that the rotational speed of the rotor be automatically and quickly governed in order to prevent the rotor from overspeeding and quickly destroying itself.

Patrick J Kelly  
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