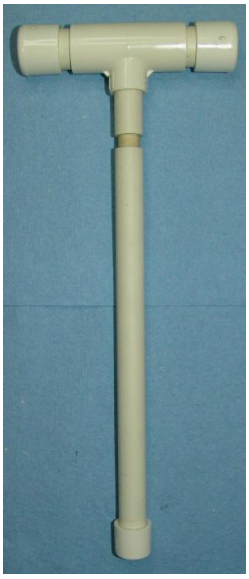
Fire Piston From PVC Pipes

http://www.wildwoodsurvival.com/survival/fire/firepiston/rbmodelt/index.html

Model "T" Fire Piston

*** WARNING ***

(These pages contain instructions on how to make a fire piston using "common" materials. The pressures generated in a fire piston are very high and may be beyond the design limits of some of the component materials. If you try building a fire piston according to these directions, you do so at your own risk. I have not had any catastrophic failures with this design, but that doesn't mean it won't or can't happen. Please take appropriate safety precautions.)



The Wildwood Survival website contains a few articles and references to Fire Pistons. A number of people have emailed me about making or buying Fire Pistons. In some cases, the first emails were about help in building a Fire Piston, and subsequent emails have been about where to buy one. This is indicative of the success rate that people have been having in the construction phase!

(By the way, I don't sell Fire Pistons. If you want a ready-made unit, there are people such as Jeff Wagner and Steve Leung who have been making Fire Pistons for a while and would be happy to sell you one. I have one of Jeff's fire pistons. He makes a beautiful quality product. I met Steve Leung a number of years ago and have seen his fire pistons in action. Check out the web-sites that belong to either of these guys.)

A friend, Ron White, and I have been building various types of fire pistons over the last number of years. I have experimented with styles that more or less required a lathe in the construction process. Ron has played more with what can be done with "common household materials." The result of much of this experience is encapsulated in this web page.

About a hundred years ago, Henry Ford said about the Model T Ford: "I will build a motor car for the great multitude."

Well, the Model T Fire Piston is a design for the masses.
(There must be at least a hundred of us or so, no???)

The idea of the Model T Fire Piston is that for 5 bucks and an afternoon of effort, you can build their own fire piston. No special tools or skill are required. Clearly this PVC based design isn't as elegant as other wood/plastic/bamboo/horn/bone models, but it is a great intro to Fire Pistons and is a great platform for experimenting.

Ok, you've read this far and I know you're asking: "whadda I get for 5 bucks and a few hours of my time?"

Well, I'm glad you asked.

Click on the video to the left at the website and you will see the Model T Fire Piston in action.

Wasn't the video neat? I hear you saying: "yes, yes, I want to build one!"

Building the Model T Fire Piston:

Parts List:

Here is the parts list for the Model T Fire Piston.
All of these items can be bought at your local hardware store.

See below for details and some construction options.

(If you opt for the syringe-style gasket, then you can substitute any 7/16" dowel for the 1/2" dowel in the parts list. Also, you won't need the O-ring Grove Jig parts.)

O-Ring Plunger Parts List	Amount Needed
3/4" CPVC End Cap	2
3/4"-1/2"-3/4" T Fitting	1
1.4" of 3/4" CPVC Pipe	2
1.5" of 1/2" CPVC Pipe	1
#6 Wood Screw 1/2" Long	1
11" of 1/2" Hardwood Dowel	1

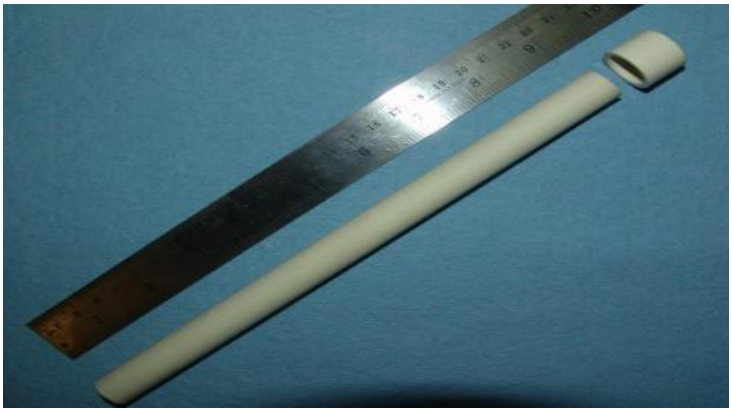
Wine Bottle Cork	1
5/16"x7/16" O-Ring	1

Cylinder Parts List	Amount Needed
1/2" CPVC	9"
1/2" CPVC End Cap	1

O-Ring Grove Jig	Amount Needed
1.5" of 1/2" CPVC Pipe	2
1" of 1/2" CPVC Pipe	1
1" of 1/2" Hardwood Dowel	1
1/2" CPVC End Cap	1
1/2"-1/2"-1/2" T Fitting	1

Miscellaneous	Amount Needed
Glue for CPVC	Dab
Epoxy Glue for O-Ring Groove	Dab
Vaseline	Dab
Tinder	Some

Building the cylinder:



While boring an acceptable hole in a piece of wood or plastic isn't always easy, making the cylinder from CPVC is a trivial exercise.

Cut a 9" piece of 1/2" ID CPVC.

When buying your "end caps," check to see whether the ones at your local store have a "nipple" inside. If the nipple is there, it will press against the plunger, or against the tinder in the end of the plunger. So, either buy end caps such as the one on the left that don't have the nipple, or if you end up with a cap such as the one on the right, it is better to carve it out.

If you have CPVC cement, use it to seal one end cap to the end of the cylinder. If you don't have CPVC cement, you can also use epoxy glue. You will need epoxy glue later in this project, so if you need to buy adhesives, buy the epoxy. It is a waste to buy a whole can of CPVC cement since so little is required.

Using sandpaper, or a knife, smooth out the inside edge of the opening of the cylinder. This will allow the plunger to be inserted more easily.

There, the cylinder is done!

Building the Plunger - The Handle:

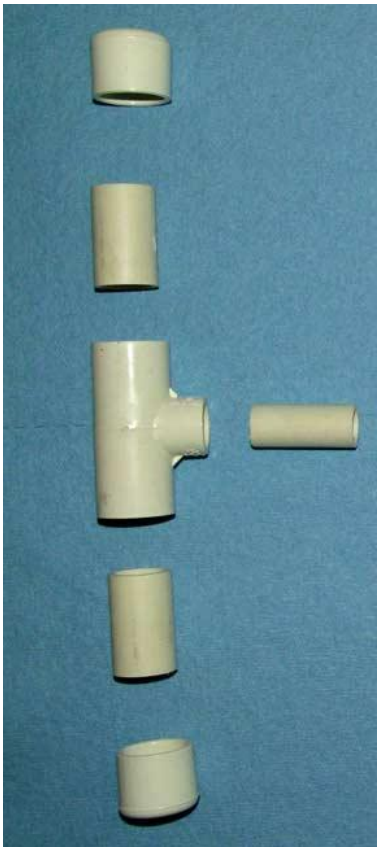
This is what the plunger looks like when it is finished.

The "T" handle is an ergonomic way of holding the plunger.

It also provides storage.

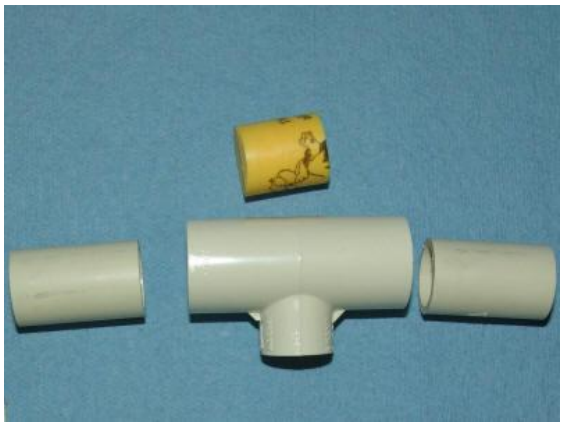
Removing one end-cap from the handle reveals the storage area for tinder.

Removing the other end-cap show where Vaseline is stored. The Vaseline is used to lubricate the plunger O-ring. It can also applied to cotton balls or other organic material and makes a great fire-starter.



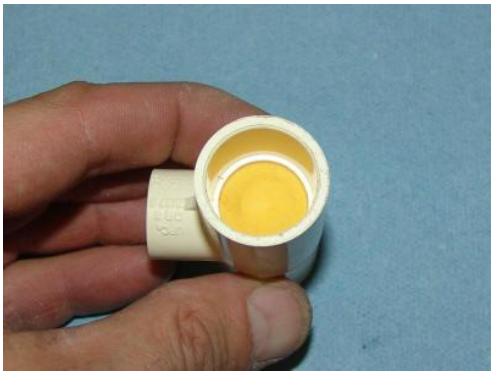
Here is an exploded view of the top portion of the plunger.

Refer to the parts list for the lengths of the CPVC pieces.



The first construction step is to cut the cork in half and press-fit it into the 3/4"-1/2"-3/4" T Fitting.

The purpose of the cork is to separate the tinder and lubricant compartments in an air-tight and water-tight fashion. If you don't want to bother with storage in the handle portion, you can skip this step.



This is what things should look like with the cork inserted.

You can now cement (CPVC glue or epoxy) the two 1.4" of 3/4" CPVC Pipe pieces to the T fitting.

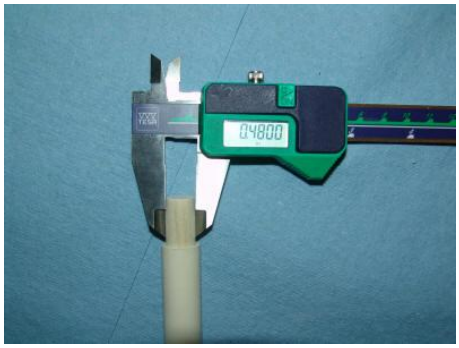
Also, cement the 1.5" of 1/2" CPVC Pipe to the remaining opening on the T fitting.

This is what things should look like at this point.

Building the Plunger - The Piston- "O" Ring Method:

This is the trickiest part of the whole project - the plunger itself. We are going to use an O-ring to provide an air-tight seal to the cylinder.

Don't cut the wooden dowel to length at this point. It might take a try or two to get the O-ring fit just right. If you make a mistake, it is a simple matter to cut off the end of the dowel and you can try again.



Step one is to check whether the dowel fits inside of the 1/2" CPVC pipe.

In theory, the inside diameter of the CPVC pipe is about 1/2" and the outside diameter of the dowel is 1/2" so there is a chance that the dowel might fit.

(We all know that: "In theory, there is no difference between theory and practice, but in practice there is." Source unknown.)

We don't want a tight fit. The O-ring will provide us with an air-tight seal, not the wood. Usually I have had to reduce the diameter of the dowel slightly.

A knife can be used as a scraper to remove material quickly from the dowel.

Try to keep the dowel round during the scraping process.

After scraping, or if the diameter is almost correct, smooth things off with some sand paper.

Remember, the dowel needs to slide freely.

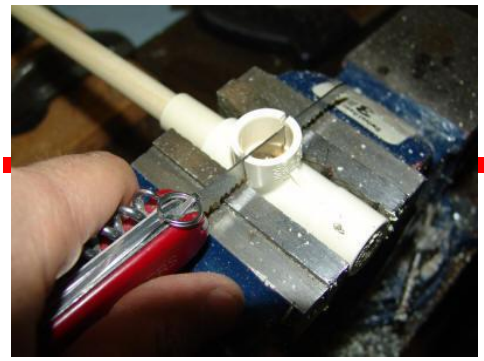
<u>Now for the gasket</u>.

This is our goal. An O-ring seated in the dowel a short distance from the end.

In order for the O-ring to seal properly, we need to cut a groove into the dowel.

For this, we are going to make a jig.

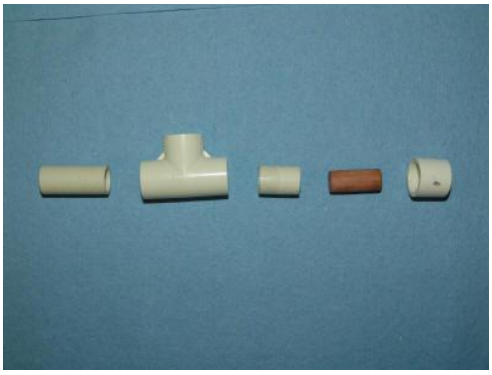
Another view of what we need to achieve.



This is what the jig looks like.

It is an assembly of CPVC pieces that allows us to cut a very controlled slot near the end of the dowel. The knife/saw is held stationary, and the dowel is rotated. This forms the slot.

The width of the saw should be equal to, or slightly less than the thickness of the O-ring.



Here is an exploded view of the jig.

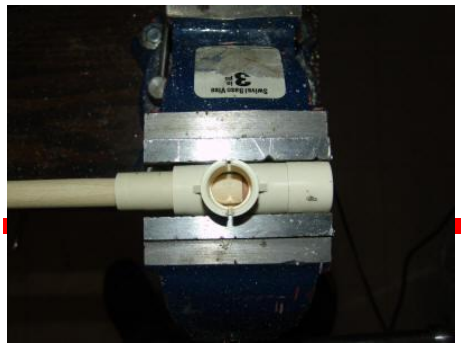
Use the parts list above for dimensions of the pieces.

Here is a partially assembled version of the jig. Note the slot that has been sawn into the T-fitting.

The trick is to cut the slot just deep enough that the knife/saw blade won't cut too deeply into the end of the dowel.

A top view of the jig.

There is no need to glue the pieces together. A press-fit should be good enough.



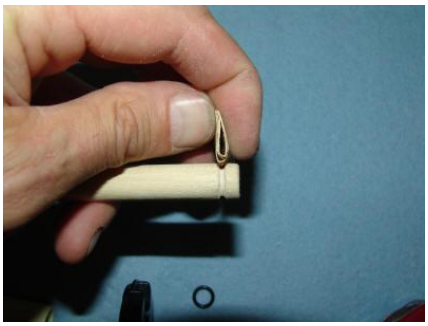
We are now ready to make the cut.

Cut a ways into the dowel, then remove it from the jig and test for a fit into the cylinder.

This is an iterative process. Test, cut a bit, and test again. At this point we are going for a tight fit.

A dental pick is a useful tool for removing the O-ring from the slot.

When dowel with O-ring can be forced in the cylinder, it's time to smooth out the slot with some sandpaper. One technique to do is fold some sandpaper over a piece of string. It is important not to remove too much material during the sanding process.



A folded piece of sandpaper can also be used.

Sand and retry the fit in the cylinder. Keep sanding until the dowel + O-ring starts to slide freely in the cylinder. You should be able to generate a distinctive "pop" sound as you remove the plunger from the cylinder.

Almost done....

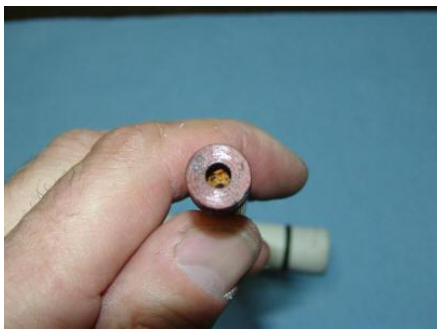
Mix up some 5 minute epoxy and slather it all over the end of the dowel. This will seal the wood. Now roll the O-ring

into its slot and wipe off the all of the exposed, excess epoxy.

Slide the plunger into the cylinder and let the epoxy set.

To get a feel for how much friction there should be on the plunger, watch this video: Bounce Video.

Notice how easy it is to depress the plunger, and how far back it bounces from the air pressure. If there is too much friction, one won't be able to generate enough speed to get a high enough pressure to light the tinder. This is the biggest factor in the success of the fire piston.



Now drill a hole into the end of the plunger. Using a 1/4" bit and going about 3/8" deep is a good starting point. Since this design gives some much volume and compression, the hole isn't all that critical.

Note that this hole already has some tinder fungus loaded into it.

Here are some ideas for non-traditional holes. A hole that goes across the dowel makes for easier removal of the tinder. This particular plunger has a hole in both dimensions. The thought here was that the hole in the end would better expose the tinder to the high pressure/temperature air, and the hole in the side would make it easy to pop out the tinder. This worked out well.

Now we cut the dowel to size, and insert it into the T handle. The length of the dowel should be such that it "just" touches the bottom of the cylinder. Any air-space left over is a bad thing

since it reduces the possible maximum pressure. If the dowel is too long, it will bottom out - which is OK, but puts greater stresses on the whole assembly. A perfect fit isn't all that hard to do.

Building the Plunger - The Piston - Syringe Method:

A hypodermic syringe is "just what the doctor ordered" for making a fire piston!

I was able to get some 6ml syringes from a farmer's supply store. The inside diameter of the syringe is just under 1/2" and the seal on the plunger is almost exactly 1/2"

First, I wouldn't suggest using just the syringe as a fire piston. Doing so might be dangerous as the syringe will likely shatter and you could get hurt.

I tried this. I inserted a screw into the end of the cylinder to seal it off.

I then tried the contraption, and the plunger shattered. Luckily I was wearing gloves - from which I have to extract one of the fragments!

I also tried using the syringe cylinder with a wooden plunger and the cylinder blew apart. Clearly syringes were not designed for the

pressures involved in the function of a fire piston

But... the syringe does have one redeeming quality, the rubber seal is perfect!
Pull the plunger out of the syringe and remove the rubber seal.

The seal conveniently already has a hole in it.

Drive a small screw through the hole in the plunger seal. Make a small pilot hole in the end of the wooden dowel. Assemble the two pieces and you're done. Note - with the syringe gasket as a seal, the diameter of the dowel is less critical. 7/16" dowel will work just fine and will ensure that you don't need to reduce the diameter. This saves an extra step.

I don't know how much variation there is in the sizes of the syringe rubber seals, but with the syringes that I have, the seal is perfect, and requires no fiddling to make it work.

Now you should have a cylinder, and one or two plungers.

(Note that the plunger with the syringe seal also has an O-ring groove. This grove is of course unnecessary. I just happened to attach the syringe seal to a piece of dowel that had previously been used with an O-ring.)
Done!:

This is what you should have ended up with.

Review the two videos above to get a feel for the amount of friction you should have in your assembly.

Also, note the speed and force that is used to power the plunger.

The critical action is to generate as much speed and pressure as quickly as possible. It isn't all that critical how quickly the plunger is removed. Most tinders will stay aglow for many seconds.

You will need some tinder to place into the end of the plunger. My favorite is tinder fungus. This isn't always so easy to come by. Char is a great alternative that is readily made. Have a look at some of the pages on tinder and char on this website.

***** A Word of Caution *****

(Please be careful about the types of materials you put into the fire piston. Any highly flammable or volatile substance can easily cause the fire piston to explode. Be safe.)

Conclusions:

A simple Fire Piston design has been presented. It requires no special tools or materials. The cost is absurdly low - even more so if you can get some scraps from someone doing some plumbing work. The simplicity and modularity of the design makes for a great platform for experimentation. It is a simple matter to substitute a new piece of dowel and try different gaskets. You can try the traditional string gasket, or maybe have a go at the leather cup version. Try longer or shorter cylinders. Try different diameters for the design.

http://www.wildwoodsurvival.com/survival/fire/firepiston/index.html

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