Fabricating a Fly Press

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Bruce and I live near each other and spend many days blacksmithing together. We have other smith friends that we often get together with for a day of blacksmithing. Our meetings provide opportunities to encourage each other and share our ideas; we are all very unique in our styles. In one of our discussions Bruce stated that he thought a fly press was a machine that matched his idea for a shop press. He liked the attributes of a manually driven, quiet, and powerful machine with good control; compared to his 3-ton arbor press, which was a little lacking in power. So, over a cup of coffee we designed this machine; target cost was to be $700.

Why Make a Press?

The unique ability of the press to provide a controlled amount of energy through fixed tooling makes them very useful for operations that range from stamping and punching to carving. You can setup the same type of tools that are used to drift holes and with complete control push the tool through your part. Instead of using your anvil and a helper for sledgehammer operations you can work solo and put the same material in the press and maintain more control over your work. Many folks use two part dies in their power hammer, the same dies can be used in a press.

Machine Features:

The heart of the machine is a Nook Industries 2-inch diameter Acme screw rated up to 33 ton. The screw is driven by a solid one-inch thick 24-inch diameter flywheel, which weighs 120 pounds. The flywheel has eight attachment points for a handle.

The frame design is an offset H frame. The frame provides six inches of clearance front to back, seven inches of clearance through the machine, ten inches of radius clearance, and eight inches of vertical clearance. The offset H frame idea provides capability to work either crosswise or lengthwise. The frame is mounted on a one inch thick plate that is two feet on a side; providing ample work space.

The ram is 2.5-inches square bar with a simple slip fit tool holder; each tool can be mounted to a ¼ X2.5X2.5-inch bar or a Simpson Strong tie foundation washer. Tools can be quickly constructed and pressed into service (pun intended).

There is a one-inch diameter through hole under the ram to support hole-punching operations. The hole has a shoulder that accepts a plug; the table has a smooth top when the plug is installed. There is a series of tapped holes for fasten-downs or fences. The machine is set at 42 inches above the floor and rides on a purchased machine dolly with brakes. Total machine weight is approximately 550 pounds.

<u>Fabrication Materials:</u>

Base:	1X24X24 plate
Flywheel:	1X24X24 plate
Top flange:	½ X5 bar
Top & weighs:	¾ X8 bar
Frame:	¾ X6 bar
Faceplate:	½ X8 bar
Gussets:	3/8 X8 bar
Ram:	2.5-square bar
Base legs	any size (we used 3X3 tube, 1.5 galvanized pipe)
Nook Industries:	2" acme screw, nut and flange

<u>Specifications:</u>

Acme Screw	2" DIA, 2TPI, 18 inches long
Flywheel power at rim 2'/sec velocity	17280 ft-pounds
Mechanical advantage measured	163:1
Theoretical force via Nook's specs.	29 ton
Measured Force via deflection test	14 ton
Flywheel weight	#120
Clearance front/center/radius	6/7/10"
Vertical clearance	8 inches
Machine weight	#550

<u>Fabrication Description:</u>

To optimize the use of our skills we decided to do our own machining. You may wish to build this machine and hire the fabrication of items such as the flywheel, Acme screw ends, and top plate instead. Our strategy worked well for us. For example: I could be machining a part while Bruce was welding; working together as needed.

Frame:

The frame is welded in such an order to optimize the 'squareness' of the machine. The order is: 1) vertical supports (named frame in the material list) to the faceplate, 2) rear straps are added to make a square box, 3) the weighs are bolted together and welded to the faceplate, 4) the gussets are added to support the top plate (the top plate is not welded, it is welded last), 5) this assembly is then welded to the completed base (base, base legs and dolly); the ram is located directly over the base through hole. The remaining step is to assemble the press with the Acme screw to finalize the location of the top plate, and then weld it.

Flywheel:

The flywheel was flame cut using the center hole as the axis. The torch was mounted on the worktable and operated by one smith while the other rotated the plate (note: a local fabrication shop offered to cut this part for us for $200). There is also a 1.5-inch square center hole, which was also flame cut and filed. Eight handle holes were added around the rim and the four flange holes that hold the Acme screw.

Acme Screw:
We purchased the screw with no machined ends. A lathe was required to produce the turned ends (Nook Industries can do this work). The ram end was machined to enter the one-inch ram hole; a relief was cut to provide space for a roll pin that would keep the ram and screw together. The flywheel end was machined to mate to the 5-inch square flange and also a one-inch long 1.5-inch square tube. The square tube fits tightly into the flywheel square hole, which may be overkill, since the 5-inch flange also serves this purpose (connecting the flywheel to the Acme screw). It is important to note that the flange is necessary. In the future I think I would drop the square hole and go only with the flange (the flange could then be welded to the screw from both sides).

Ram:
The ram has a 1-inch hole in the top end. A 5/16 DIA through hole is drilled to intersect this hole providing the connection to the Acme screw. The tool end has two short pieces of angle welded on the ram sides. This will allow the quick change of the press tools. Tools can be slid under the ram from the front or back.

Adjustments:
The ram is adjusted with .003-inch feeler gauges to set the spacing to the weighs. The weighs bolts are then tightened.

The Acme Screw flange bolts are tightened when the ram is held at the top of its travel with a block. The screw is turned to drive the ram down. The flange bolts are then tightened.

Testing (results listed in the specifications):
True Mechanical Advantage (ME): is determined by static pulling of the flywheel handle and measuring the ratio of pull force to ram push force. The ratio of forces is used to calculate the ME.

Dynamic Energy Delivered: by measuring the deflection of a suspended steel test part; the force delivered by the machine can be calculated using the Modulus of Elasticity of steel and the dimensions of the test part. The distance the part is deflected is directly proportional to the force delivered. The test results are listed in the specifications.