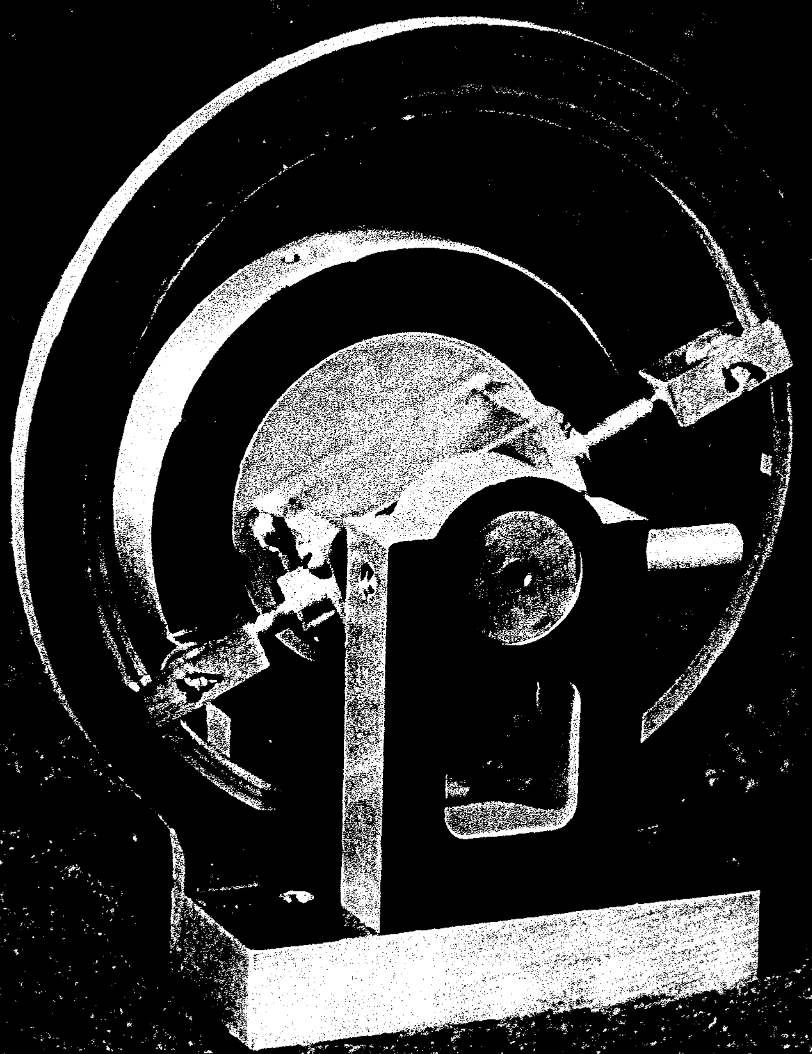
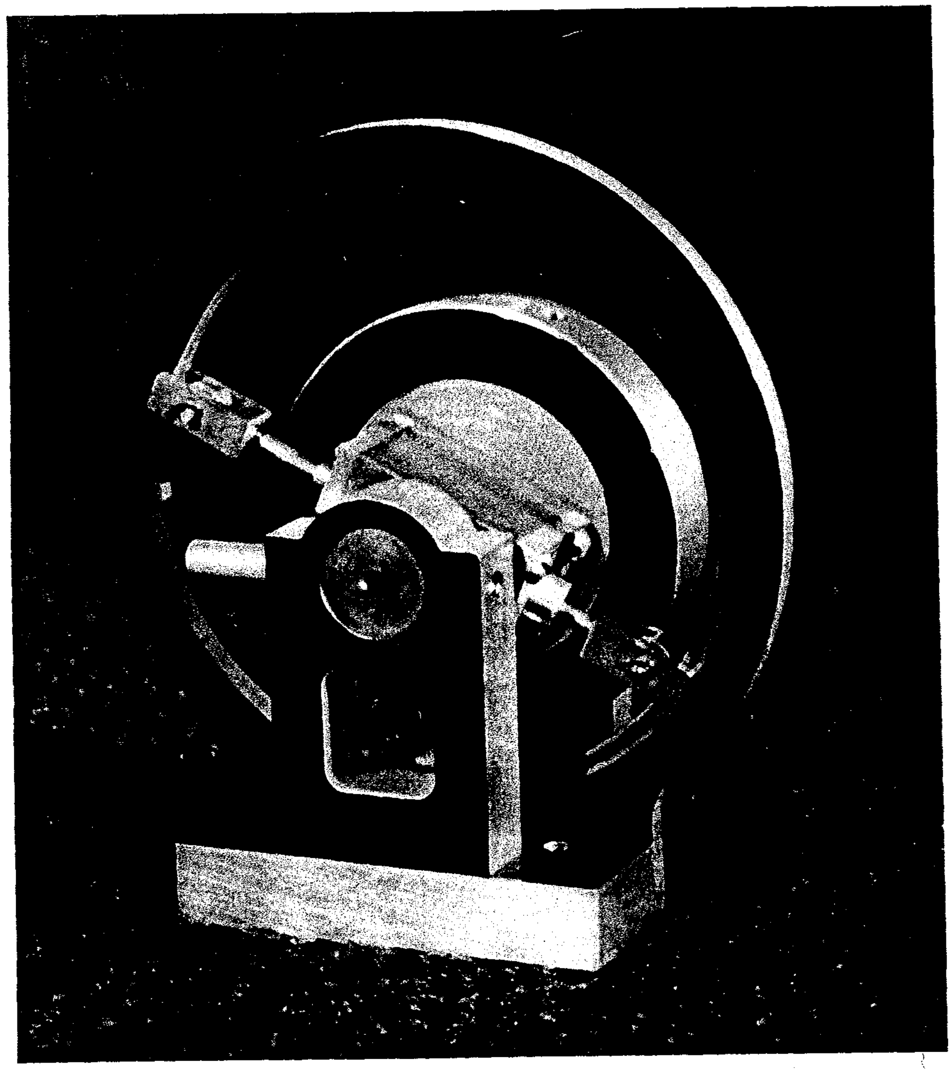
Comber Rotary Engine



CHAPTER

46 Comber Rotary Engine



Chet Sperry, a MODELTECer from Kalamazoo, Michigan, loaned Bill Fitt a book published in 1880 entitled *Appleton's Cyclopædia of Applied Mechanics*, and in it is a sketch and short description of the *Comber Rotary Engine*.

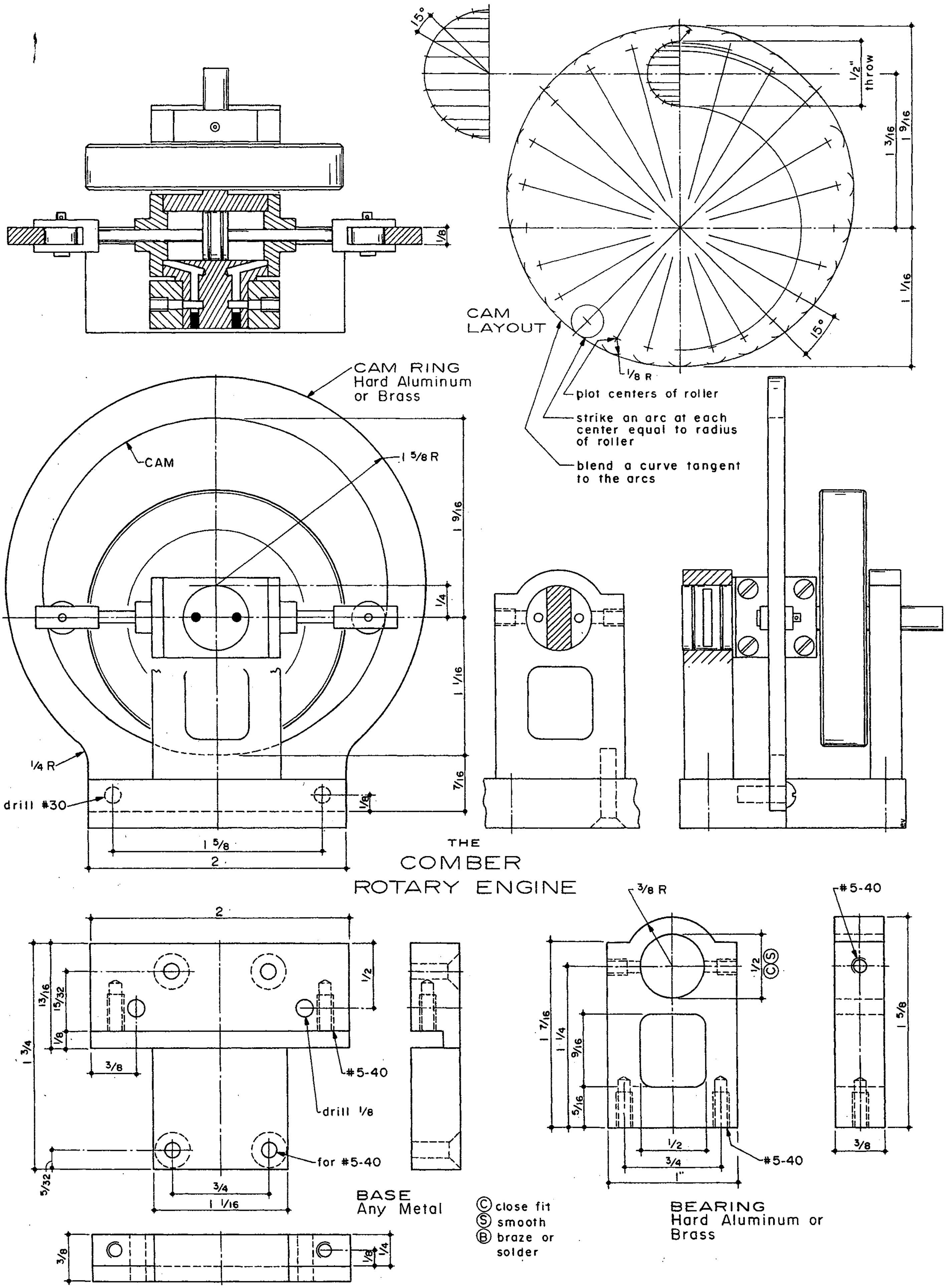
This is an unusual design and an attempt is made here to detail a miniature along those lines. Most of the proportions and design had to be worked from scratch and simplified considerably. The Cam and general accuracy will be a challenge.

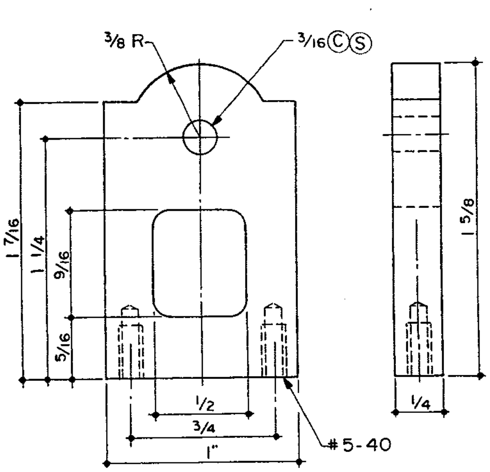
The main feature is a Cam in which the Cylinder rotates with the Shaft. A double-ended Piston Rod with Rollers at each end follows the inside Cam. Valving at one Bearing admits "steam" just as one Roller starts pushing downhill on the Cam, causing the Cylinder and Shaft to rotate. At one half turn, the other Roller is exposed to steam pressure, and it starts down the Cam so it can be considered double acting. Of course, while one is working the other is exhausting. A true circular bore instead of the Cam did not show any promise on some trial layouts.

In general, this engine requires a bit more patience and care in layout and machining. Perhaps some will say it is too small, but we try to have projects within the range of small machine tools. Use your ingenuity and make it 1-1/2 or 2 times larger if you wish. This could be quite an experimental project by using some of your own ideas. The mechanism is a good classroom subject.

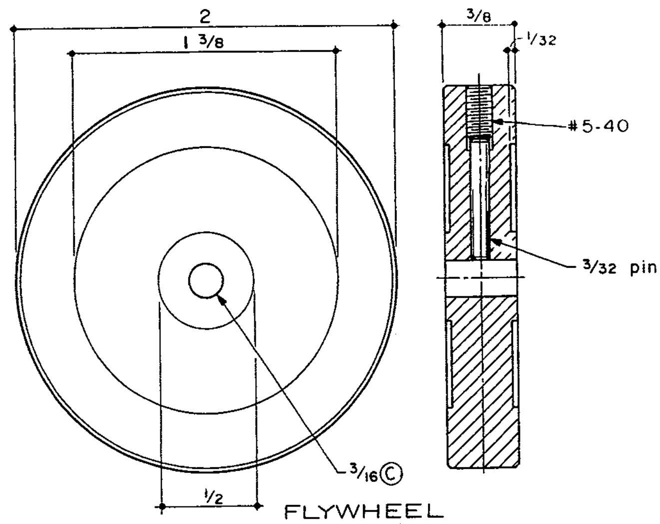
Since the **CAM RING** is the most difficult, we will start with it. Drawing space and the detailed Cam layout led to dimensioning on the assembly drawing (perhaps not good drafting practice, but it helps associate the Cam with the engine principle). It was required that at any time or position in the rotation of the engine that both Rollers touch the inside of the Cam. Now that does not mean extremely close fit. A wide gap between the distance across the Roller and the distance across the Cam could cause poorer performance and perhaps a pounding noise. Try for a gap in the neighborhood of .005 to .010".

Start out with a flat square piece of stock 1/8" x 3-1/4" x 3-3/8". By using a square piece, a protractor or square can be used on any edge. After coating with layout dye, make a centerline 1-1/2" up from the bottom and another at right angles midway on the 3-1/4" width. Scribe a short centerline 1/4" above the horizontal centerline and prick punch. Using this center, scribe the 1-5/8" radius, and lay out the 2" wide lower mounting projection. What is needed is to plot the path of the Roller center. A double-size layout was made on paper. 24 spaces were laid out around the Shaft center and, 1-3/16" from this center, a centerline was made representing the mid-position of the Cam throw. A half circle off this center was divided into 12 equal spaces (24 divided by 2). Horizontal lines were drawn intersecting the vertical centerline, producing narrow spaces increasing in size to the center and then reducing down at the other end. An enlarged view of this method is shown. These intersecting points were the compass settings for radii intersecting the 24 radial lines. Each intersection was the center of the Roller as shown on the layout. Arcs equal to the radius of the Roller were scribed and the Cam

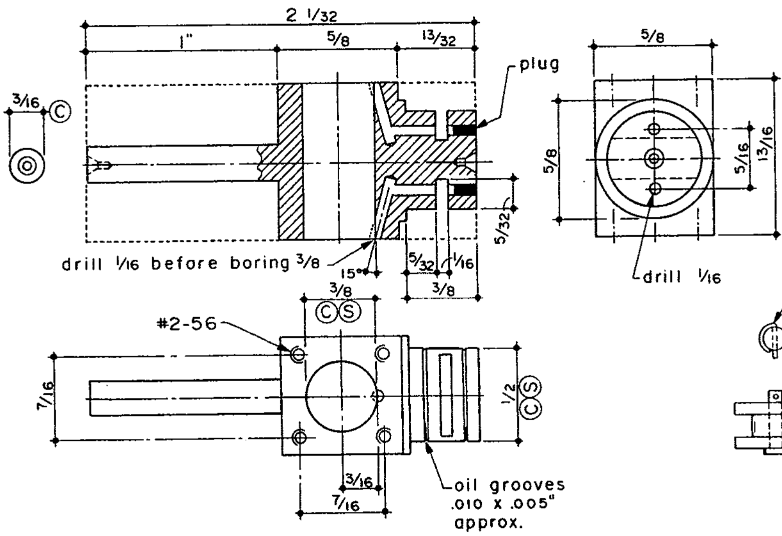

CAM LAYOUT
15°
1/2" throw
1 3/16
1 9/16
1 1/16
1/8 R
plot centers of roller
strike an arc at each center equal to radius of roller
blend a curve tangent to the arcs
CAM RING Hard Aluminum or Brass
CAM
1 5/8 R
1/8
1/4
7/16
1/4 R
drill #30
1 5/8
2
THE COMBER ROTARY ENGINE
BASE Any Metal
13/16
15/32
1/2
1 3/4
3/8
#5-40
drill 1/8
for #5-40
5/32
3/4
1 1/16
3/8
1/8
1/4
Ⓒ close fit
Ⓢ smooth
Ⓑ braze or solder
3/8 R
#5-40
1/2 ⒸⓈ
1 7/16
1 1/4
9/16
5/16
1/2
3/4
1"
1 5/8
BEARING Hard Aluminum or Brass



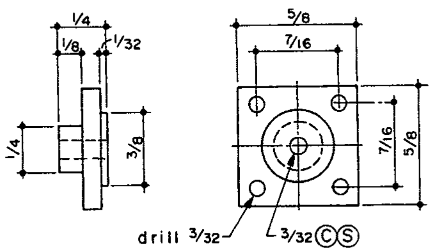
BEARING
Hard Aluminum or Brass



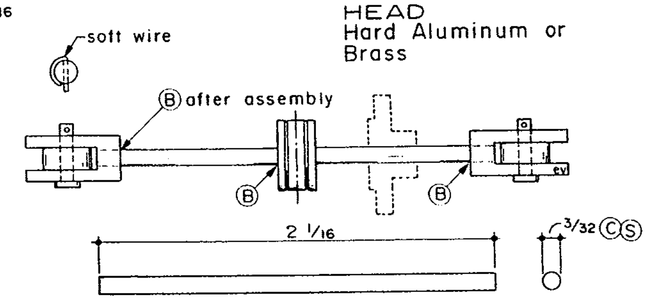
FLYWHEEL
Any Metal



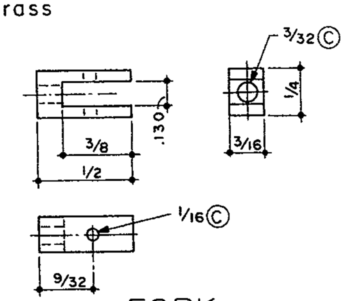
CYLINDER-SHAFT
Brass



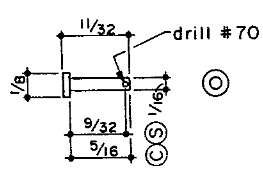
HEAD
Hard Aluminum or Brass



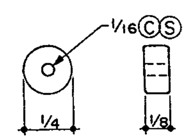
PISTON ROD
Brass



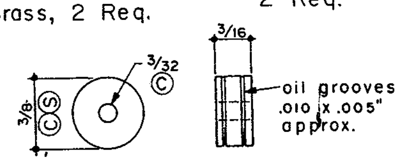
FORK
Brass, 2 Required



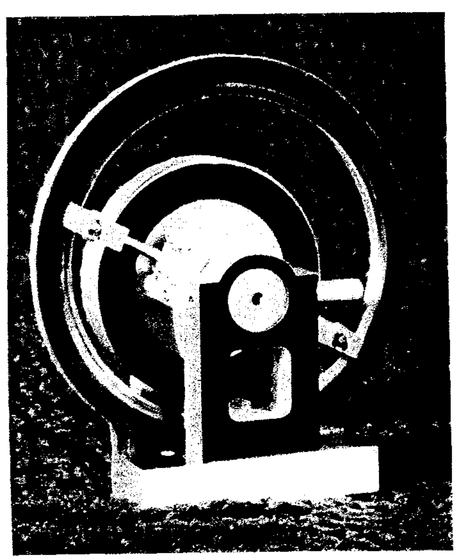
PIN
Brass, 2 Req.



ROLLER
Steel
2 Req.



PISTON
Brass



line made tangent to the arcs. This drawing is reduced down to actual size in the drawings presented here. If you choose to lay out the Cam as shown in these drawings, you may make a smooth Cam with only 12 total spaces, using the principle shown here. In any case, the number of spaces on the half circle must be the same as on one half of the Cam. This would be an even number such as 12, 14, 16, etc. The simplest choice is to use the Cam layout on the following page by tracing as accurate as you can on tracing paper. Be sure to draw in the centerlines so you can paste it onto the 1/8" metal matching the centerlines you scribed. Drill, saw and *very carefully* file the Cam to the lines on the tracing paper. File so you don't feel any ripples on the Cam surface.

When the time comes to fit the double-ended Piston Rod, do a little trial fitting and keep the slack to a minimum. If all came out right, it is 2-5/8" across the outside of the Rollers. By setting dividers at this dimension, it should fit across any one of the radial lines and be in contact with the Cam at both ends, with slight allowance for the off-center contact during midstroke.

Now is a good time to mention the importance of squareness and accuracy. If the bore for the Piston is not square with the Shaft, the Roller Forks will rub hard on the Cam ring. By making the Forks lap over onto the Cam ring, a guide is provided to keep the Rollers in position.

The fit of the Valve end of the Cylinder-Shaft should be a close fit in the Bearing to keep leakage to a minimum. This aggravates the binding if the parts are not in good square and parallel condition.

This is a novel engine to run on air pressure, and fun to show off for short runs. It is a good conversation piece. You may have to practice a bit of the old "fussin, fiddlin, filing and fittin" on this assembly.

The original article in the 1880 book mentions built-in adjustments that were impossible to make on such a small engine. The article mentions the Bearings as being mounted in brackets with adjustments in all directions.

The **BASE** is a simple machining job requiring care to insure squareness and fit among the related parts. After making the 1/8" groove, check for flatness since cuts like this relieve stress and the piece may warp. Spot the 5-40 tapped holes from the Cam ring.

The same care must be taken on the **BEARINGS,** the thick one especially, to make a free running engine. The 1/2" bore should be as close and as near air-tight as you can and still rotate free.

The **CYLINDER-SHAFT** combination is a bit complicated. If you can see a simple way, perhaps it can be made in two pieces sweated together. Start out with a piece of brass 5/8" x 13/16" x 2-1/32" and lay out all centers and lines. Lay out and make the lathe center holes. Remember accuracy so the Cylinder doesn't wobble. Drill the 1/16" steam passages. Mount squarely in the 4-jaw and make a fine 3/8" bore for the Piston. Next, mount between centers and do the outside turning. Mill the 1/16" grooves and use the Heads as jigs and spot for the 2-56 bolt holes. The corners can be sawed out to reduce turning time on the 3/16" end.

Not much need be said about the remaining parts. No stuffing boxes are used for simplicity and compactness.

At assembly, leave one Fork free so trials can be made and high spots in the Cam found and dressed down with careful scraping with a three-cornered scraper, until the Rollers run close and free for a full rotation. Place a piece of .005" shim stock between one Roller and the Cam and lightly wedge the Roller against the Cam. Use a tiny pellet of solder and a fine propane flame to solder in place. The construction of this engine is a compromise since it is so small. The solder on one Fork will have to be softened in order to disassemble.

After a break-in run, this engine ran on about 15 pounds of air. It did take a bit of time to free it and it turned out that it should not be fixed too close end-wise on the Shaft. Let it float and find itself where it has the least rubbing action at the Forks. In other words let the Forks center the Cylinder.

An interesting side light in making this engine was the use of some salvage brass plating bars. Turning off the crusty outside surface left a beautiful gold-colored bar that was about 1-1/8" in diameter, large enough to mill and shape into a rectangular piece. It worked up nice but the metal was made for beauty and not toughness. It was easily bent and dented, so a wobble came into the Flywheel. With patience, it was freed up and the engine ran but it will have to be replaced someday. It shows a hazard in using salvage material. Standard half-hard brass is a lot tougher.

SAFETY FIRST

WEAR PROPER CLOTHING — DOUBLE-CHECK SET-UP

USE PROPER LIGHT — KEEP FLOOR CLEAN

DON'T USE DULL TOOLS — USE YOUR GOGGLES

USE PROPER COUNTERBALANCE

USE PROPER SPEED

PURSUE YOUR HOBBY ACTIVITY SAFELY