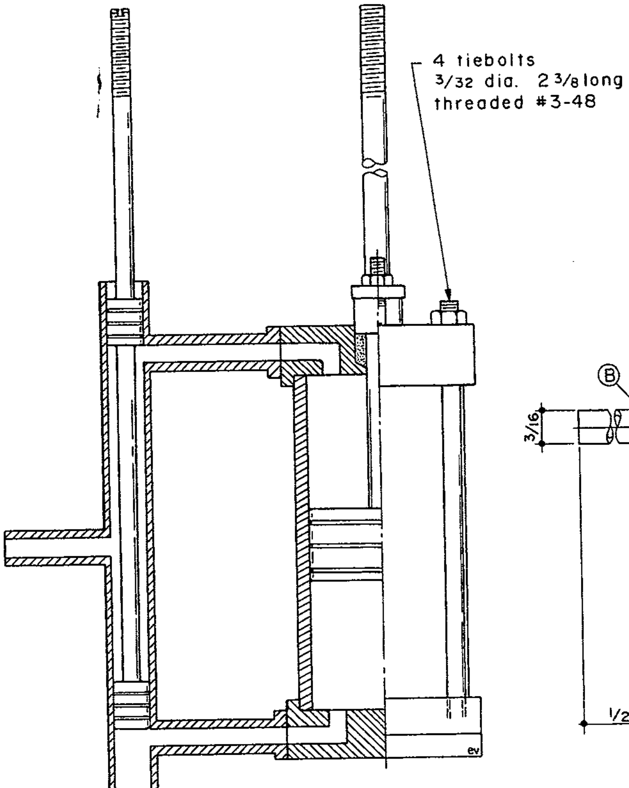
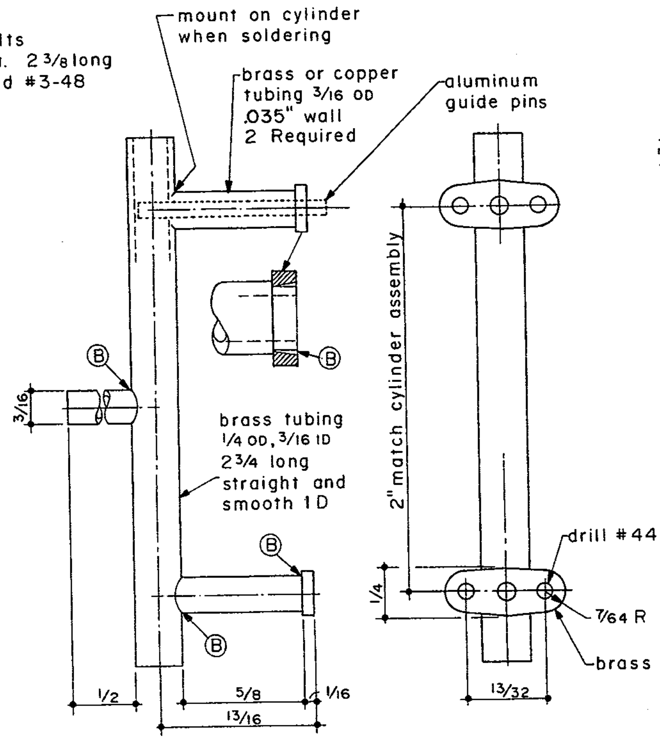
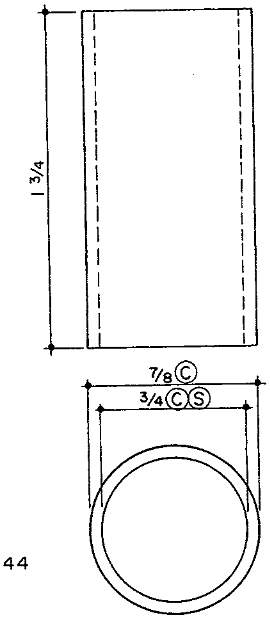


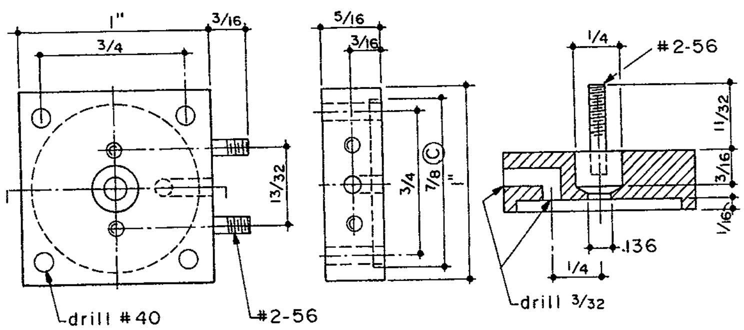
VALVE AND CYLINDER
ASSEMBLY



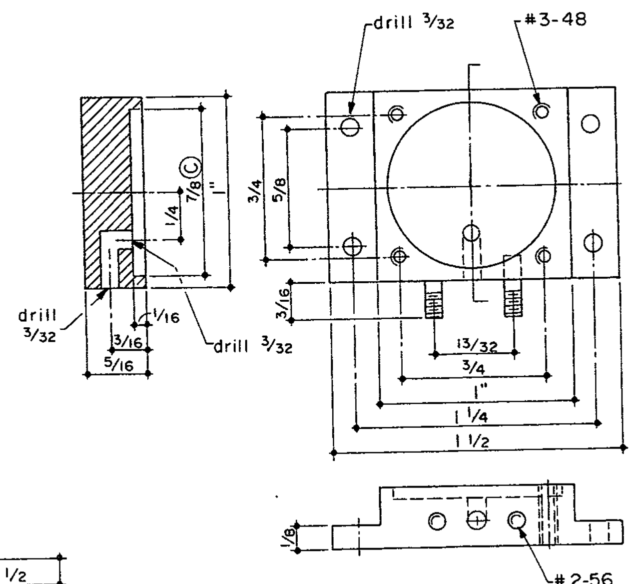
VALVE ASSEMBLY



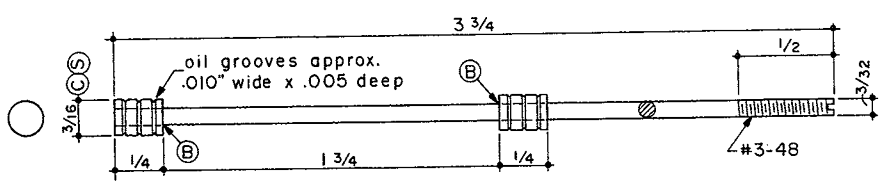
CYLINDER
Brass



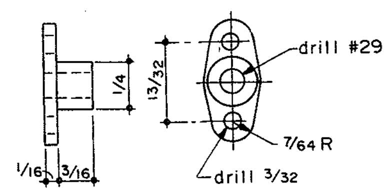
CYLINDER HEAD
Brass



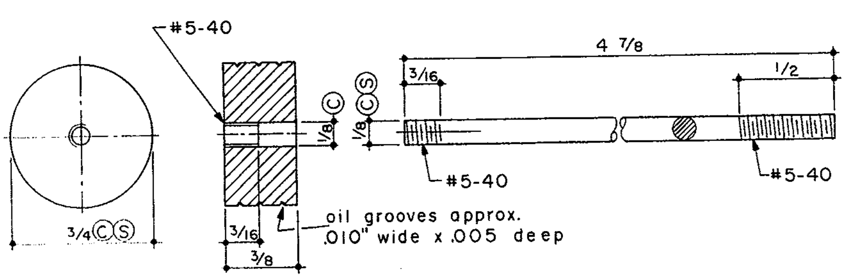
CYLINDER BASE
Brass



VALVE
Brass



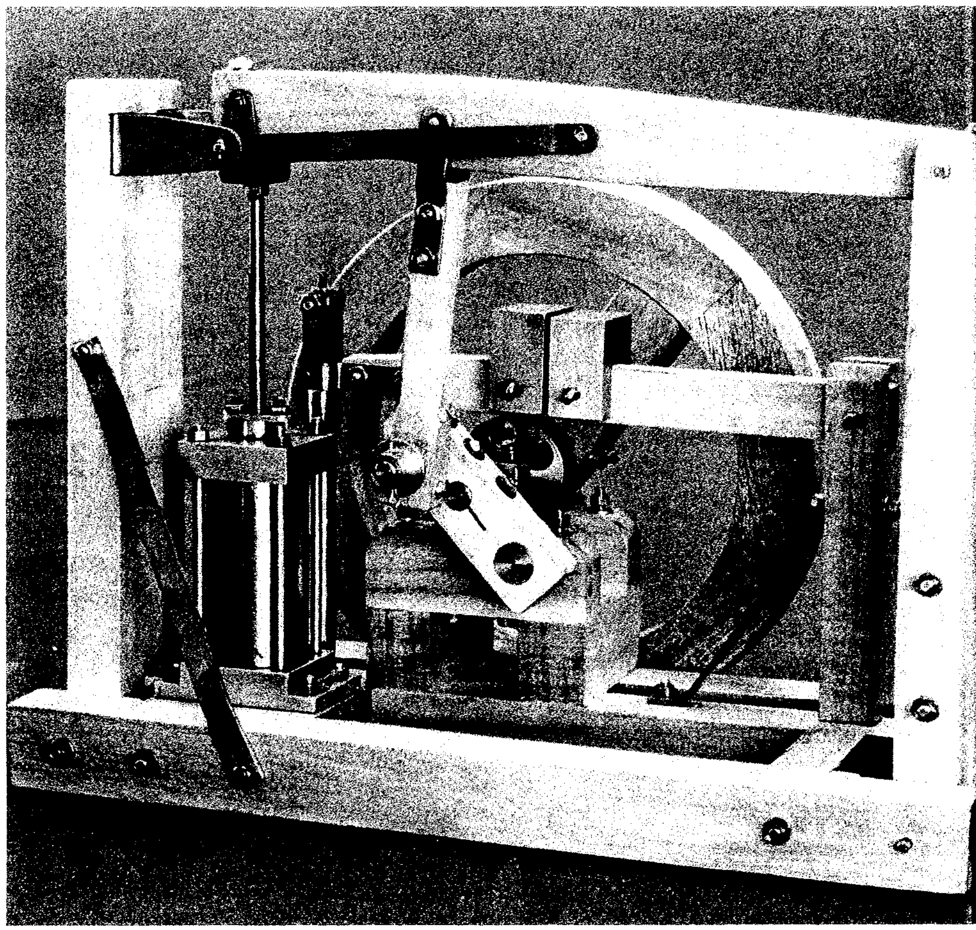
GLAND
Brass



PISTON AND ROD
Brass

CHAPTER

1 Wood Beam Engine



They are called **BEAM** engines so why not make one of wooden beams? There were no pictures on hand of the early engines, only a hazy photograph of a pewter model in a magazine ad. The design here is based on the thinking, materials and skills that might have been used. It runs and is a fine conversation piece. This engine is before Watt's famous parallel motion. However, you will find inconsistencies such as socket setscrews, cotter pins, a setscrew driving a large flywheel, spring pins and hex nuts instead of old square nuts.

Walnut was used for all the wooden parts except hard maple for the Flywheel. All the long bolts were made from finishing nails and brazing rod. A supply of 2" nails was found to be .081" in diameter and some 2-1/2" were .100". When threaded, they served the purpose for #2-56 and #3-48. 3/32 (.094") brazing rod also made #3-48. These smaller-than-nominal diameters produced satisfactory threads in this case.

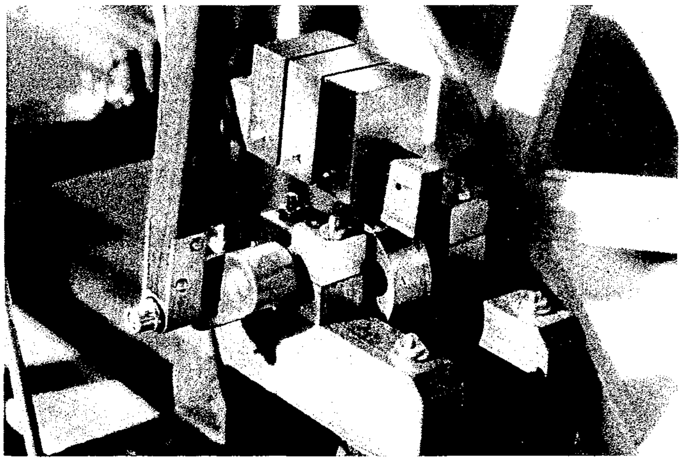
The **CYLINDER** is tubing cut squarely and set in the lower Head with Loctite. The remaining Cylinder parts need no explanation. The **VALVE ASSEMBLY** is mostly tubing. The flanges are silver soldered to the cross tubes and mounted on the Cylinder assembly when soldering the ValveTube. Cut and try until you are satisfied that the Valve Tube is parallel and the right distance from the Cylinder. Make two close-fitting aluminum pins to guide the Valve Tube while soldering. The solder will not stick to the aluminum. The **VALVES** and **VALVE ROD** are a solder job. Make the fit close enough to make the two Valves a close free fit in the ValveTube. There is no attempt to control the exhaust. It just escapes out both ends of the Valve Tube.

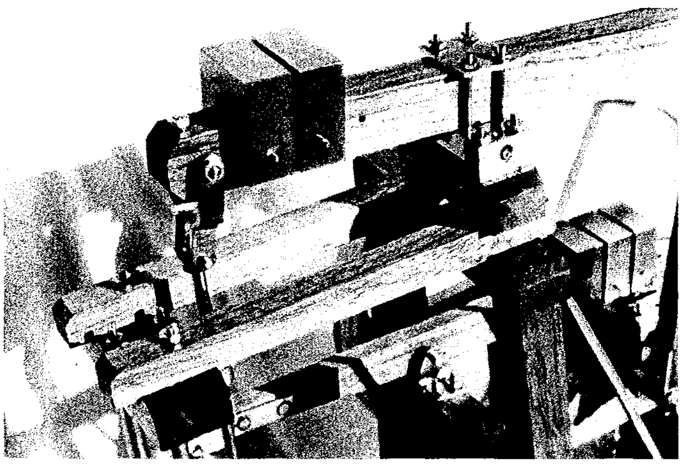
The **BEAM** and fittings are simple. The weights are optional, although they do seem to help. A weight of a sort was shown on the pewter model. The Bushing is set with Epoxy glue. The **ECCENTRIC** is steel. A socket set screw is spotted on the centerline through the offset and Shaft at the greatest throw. When adjusting the Valve, a hex wrench helps locate the Eccentric 90° from the Crank.

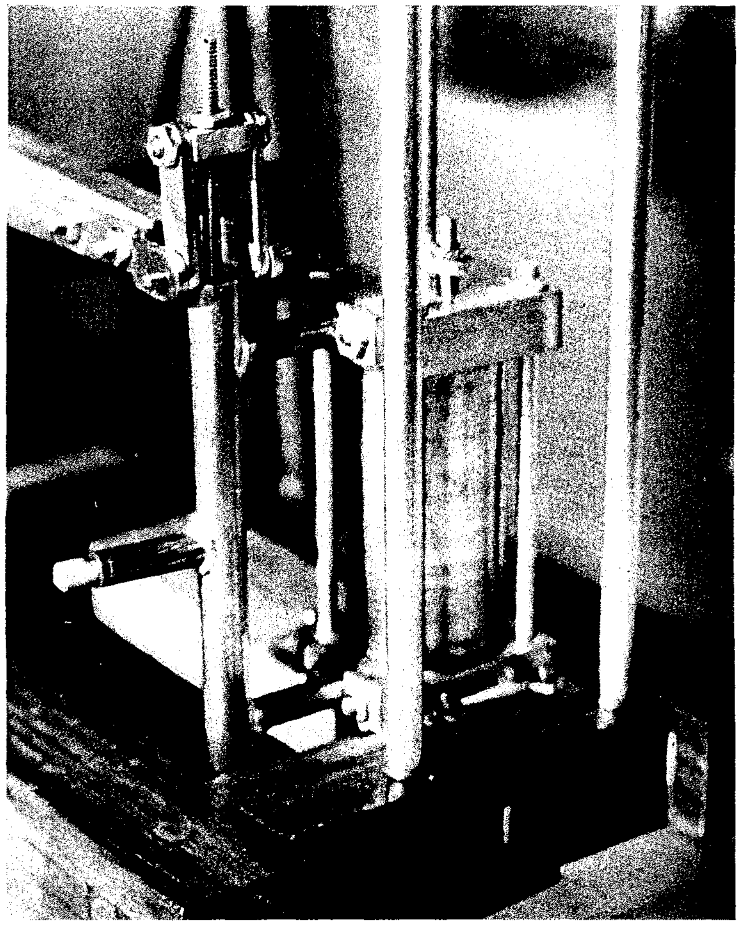
The **VALVE BEAM** needs the weights shown to keep it in contact with the Eccentric. The wear pad, if it was ever a part of such an engine, would probably be rawhide. The wood seems to hold up, so no pad was used. When, at assembly, the Valve Beam location is established the bushing can be set with Epoxy. The screws soldered into the fork can be round-head screws with the slot filed away after soldering.

The **WEIGHTS**, **CRANK COLLAR** and **PIVOT SHAFT** at the upper end of the Connecting Rod use cotter pin retainers. Spread the pins apart then hold together when inserting. Do not bend the ends over; let the springiness hold them in place. The thickness of the two spacers at the Crank Bearing can be determined at a trial assembly. The Bearings are solid blocks. You can make split Bearings to be a bit more authentic.

The **FLYWHEEL** is made of hard maple to gain all the weight possible from common wood. Lay the six segments of a hexagon on a sheet of waxed paper on a **flat** board. Apply fast-setting glue to each joint and press together. Nails can be driven around to help hold the shape while setting. File away the glue ridges and dress flat. Scribe fine accurate lines for the O.D. and I.D. of the rim. Saw and file to these lines. Do the same with the center layer. Assemble the spokes first, holding each in place with a nail. Carefully squeeze the six segments against the spokes. When set, lay out, saw and file to the exact O.D. of the above rings. Saw and file







to the inside line as shown. Opiton: Pierce the center layer in 6 places, add 1/4" x 1/4" x 1-1/2" steel weights to improve Flywheel action. Glue all three pieces together, breaking joints. Bore the 3/8" hole as accurate as you can to prevent wobble and eccentricity. The hub is set with Epoxy and rivets.

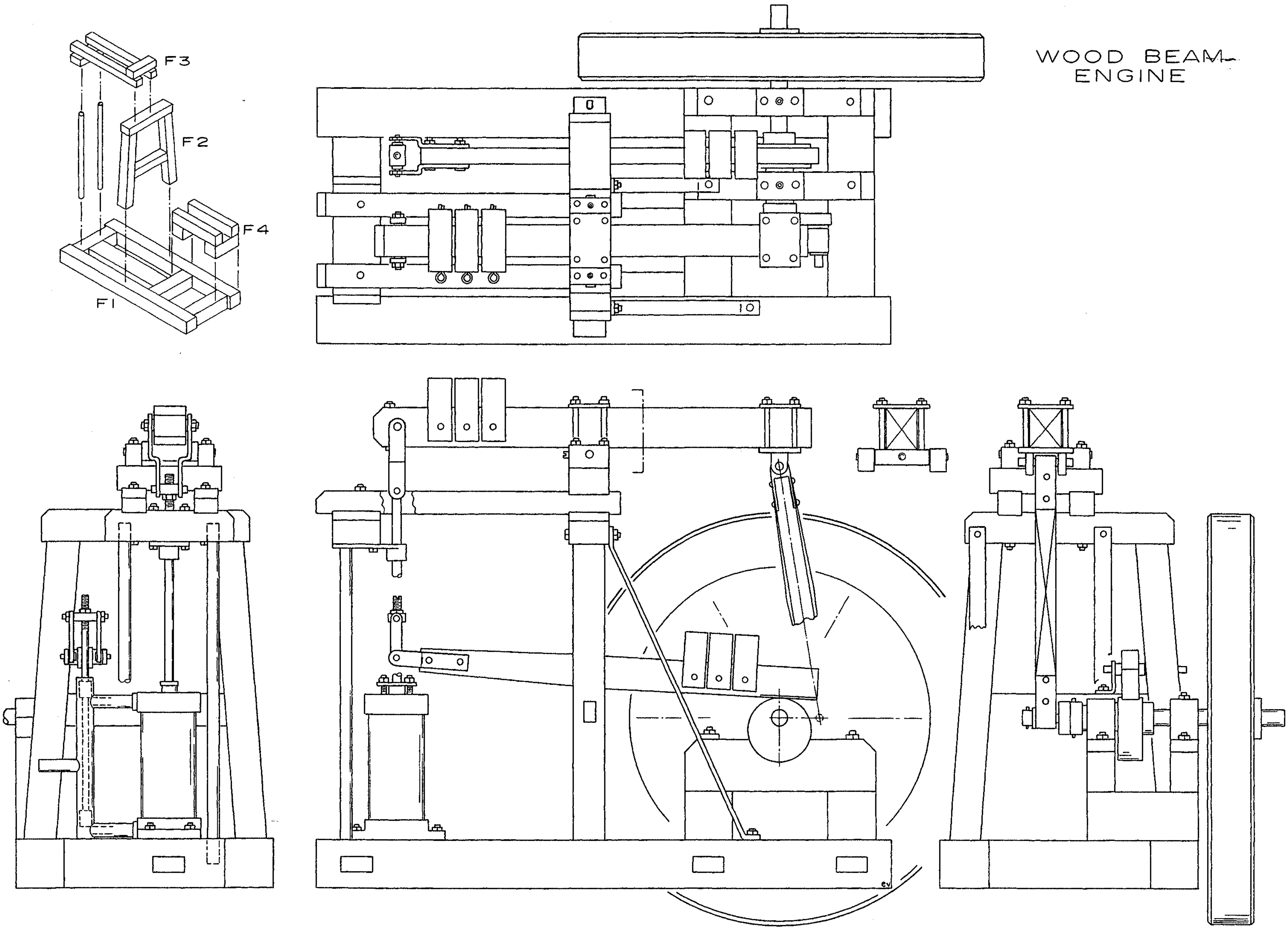
Now, if you made this Wheel and it runs true without wobble, you did a better job than on the one shown. It really calls for some expert woodworking. This is a way that will be tried if another is made: Bore the hub to 7/32" instead of 1/4". Chuck the wheel in a 3-jaw on the rim I.D. and bore 3/8" for the hub. Make a light chalk mark on the rim at the #1 chuck jaw. Remove from the chuck and set the hub with Epoxy and rivets. Re-chuck with the chalk mark at the #1 jaw. Make skin cuts on the wheel O.D. and faces. Use a tiny boring bar and bore the hub to a 1/4" close fit on the Shaft using very light cuts. Filing, rounding corners and sanding will make a fine surface for a transparent coat of lacquer or varnish. There is a chance such a Wheel made in those days would show some signs of wobble or irregularities. Since they ran so slow it would hardly be noticeable. Try to imagine a temporary tool rest and someone on a platform holding a heavy chisel truing up the rim of a big wheel. Maybe someone can tell us how such a wheel would have been made. Also, it is more likely that a large pulley or wheel of this size would have a split hub with tiebolts to clamp onto the Shaft instead of a screw or pin.

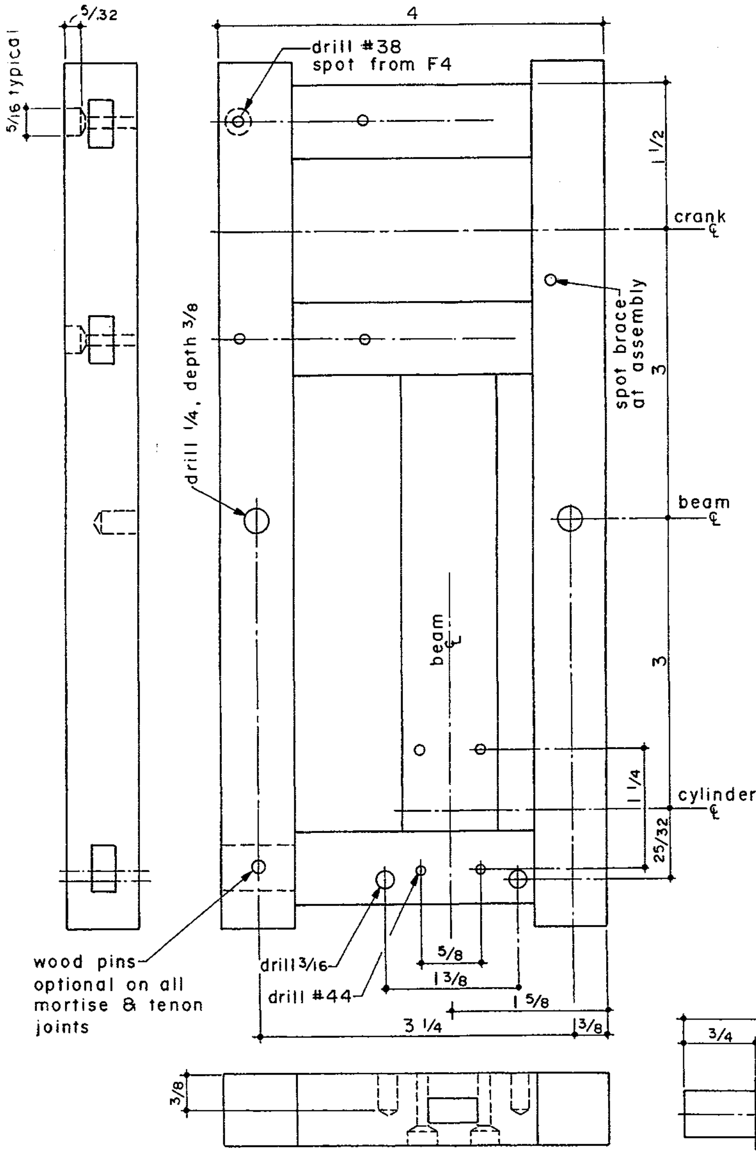
The **CONNECTING ROD** can be a straight piece or tapered as shown. Make the two end pieces of brass. Spread the ends to match the taper. Cement with Epoxy. When set, dress wood and metal even and flush for good appearance. Drive four escutcheon pins or round head nails in to represent rivets in each end. Lay out the two pivot holes, drill and ream.

If the temporary assembly runs free and the engine operates satisfactorily on 5 pounds of air, you can go back and complete the final cementing and assembly. The finish is up to you. If the metal is bright and the wood has a fine surface, the entire assembly can be sprayed with a transparent sealer. If there is a trace of oil on all the pivots, bearings, slides, etc., there will be little drag caused by the spray.

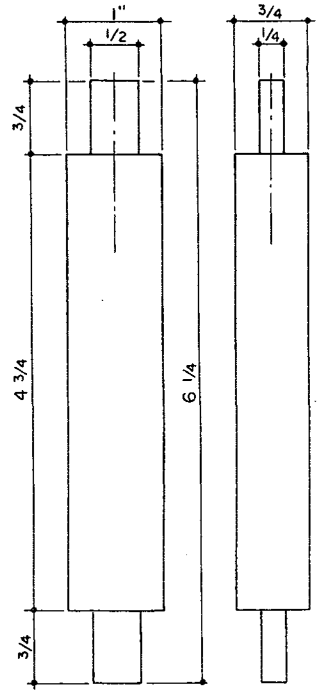
These giant engines ran on less than 100 rpm but you will be lucky to keep this one under 100. The speed is one item that is hard to scale down.

WOOD BEAM ENGINE

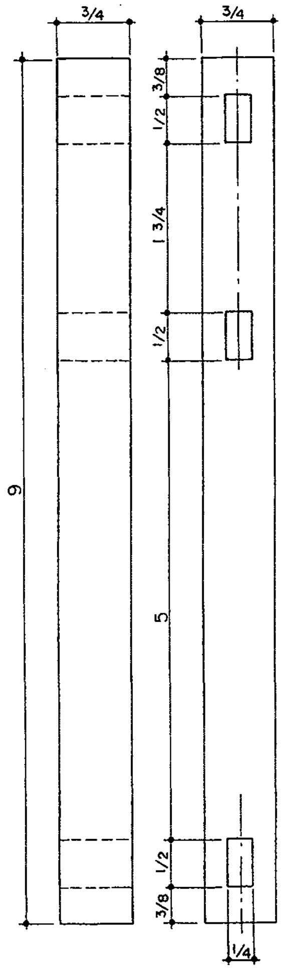




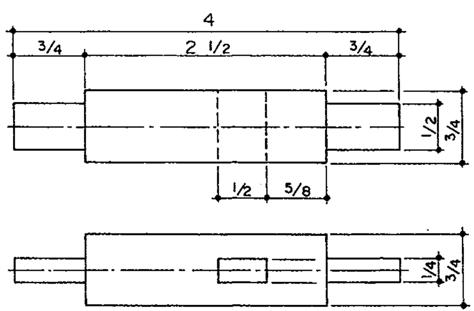
F1 ASSEMBLY (BASE)
Wood

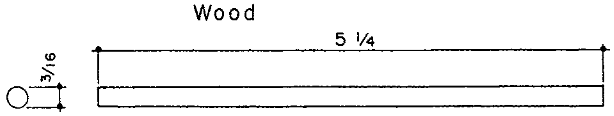


LONGITUDINAL BRACE



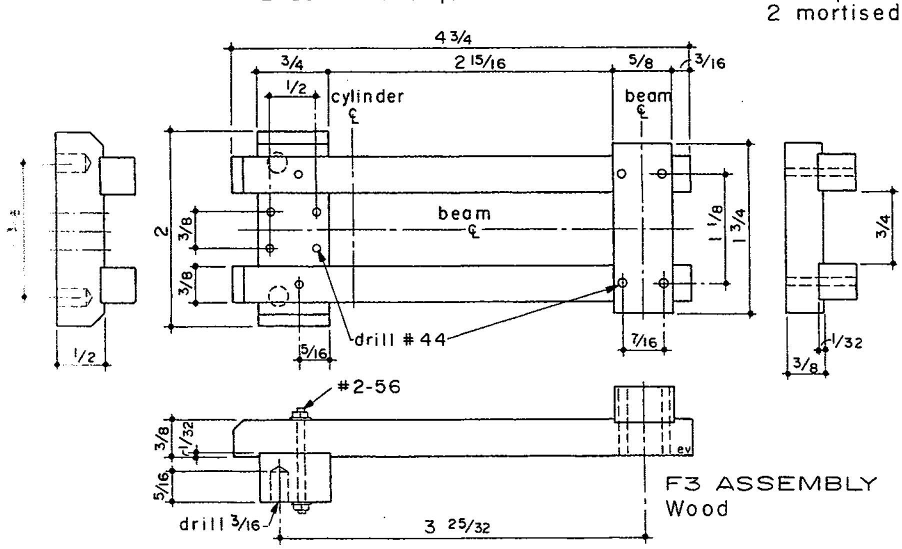
BASE SIDE BEAM
2 Required





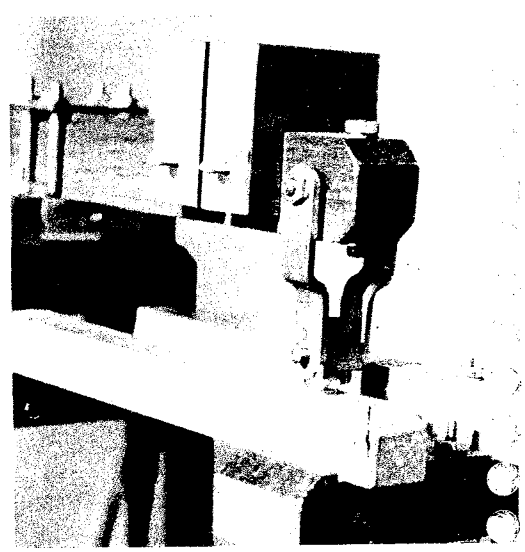
METAL POST
Brass 2 Required

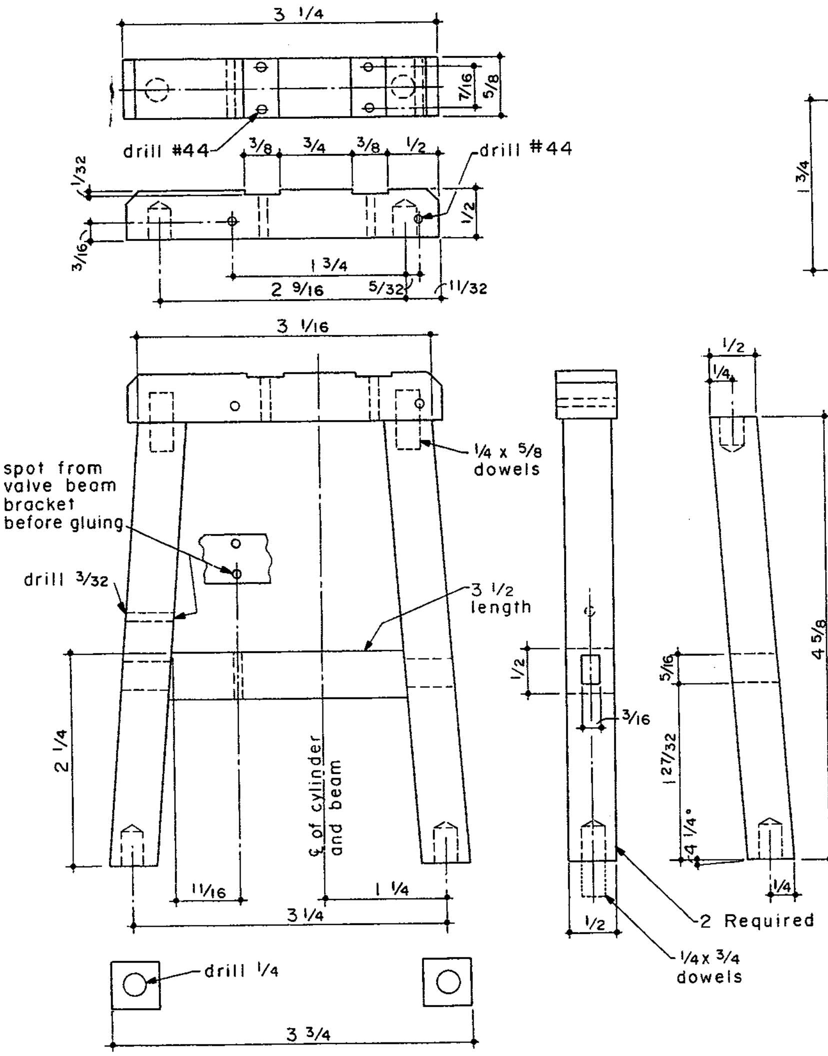
CROSS BRACE
3 Required
2 mortised, 1 plain



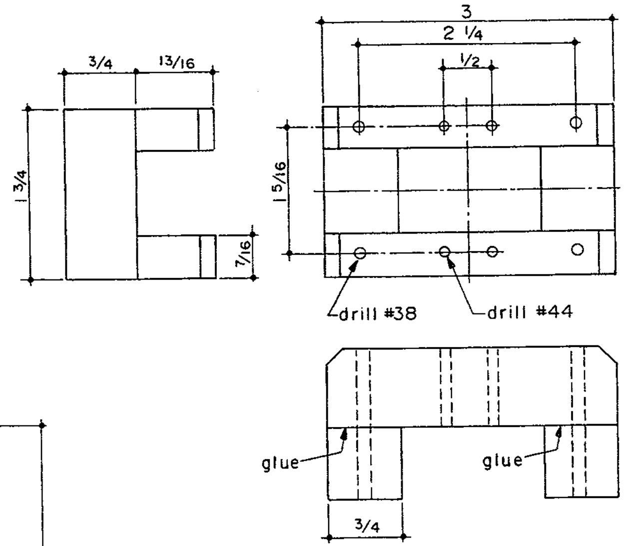
F3 ASSEMBLY
Wood

All joints glued (pinning optional)

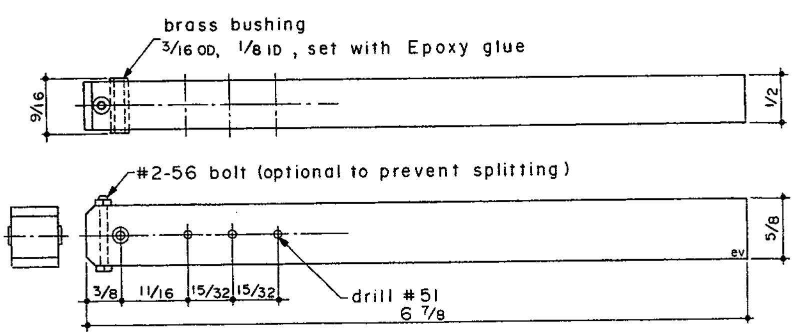




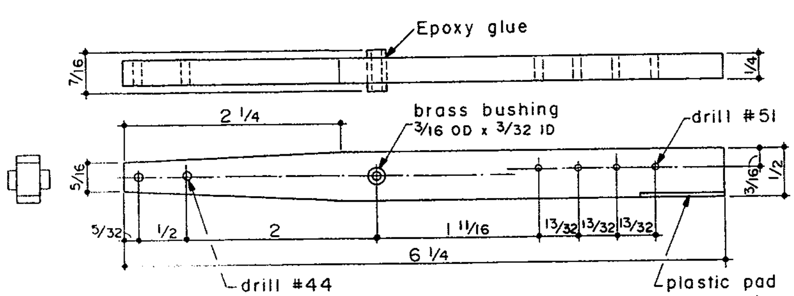
F2 ASSEMBLY
Wood



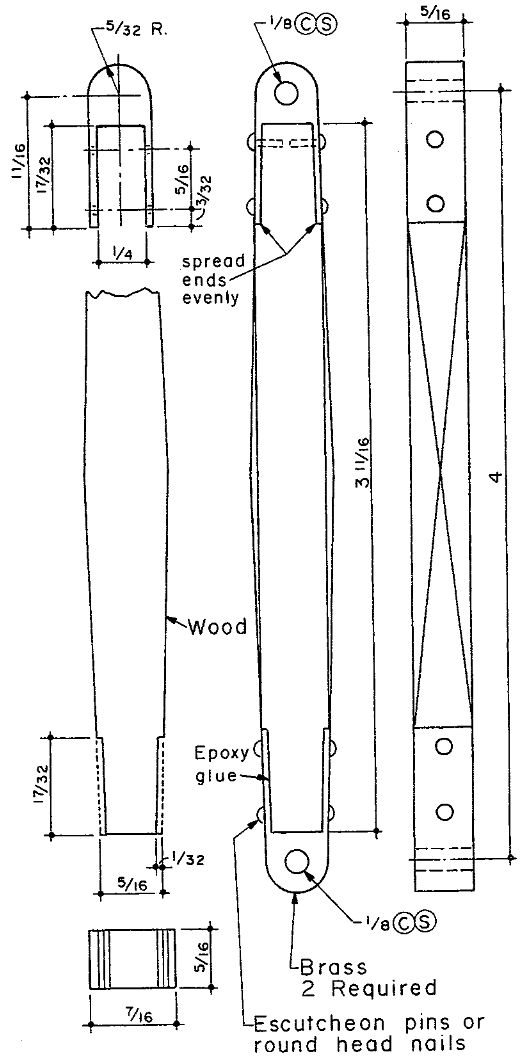
F4 ASSEMBLY
Wood



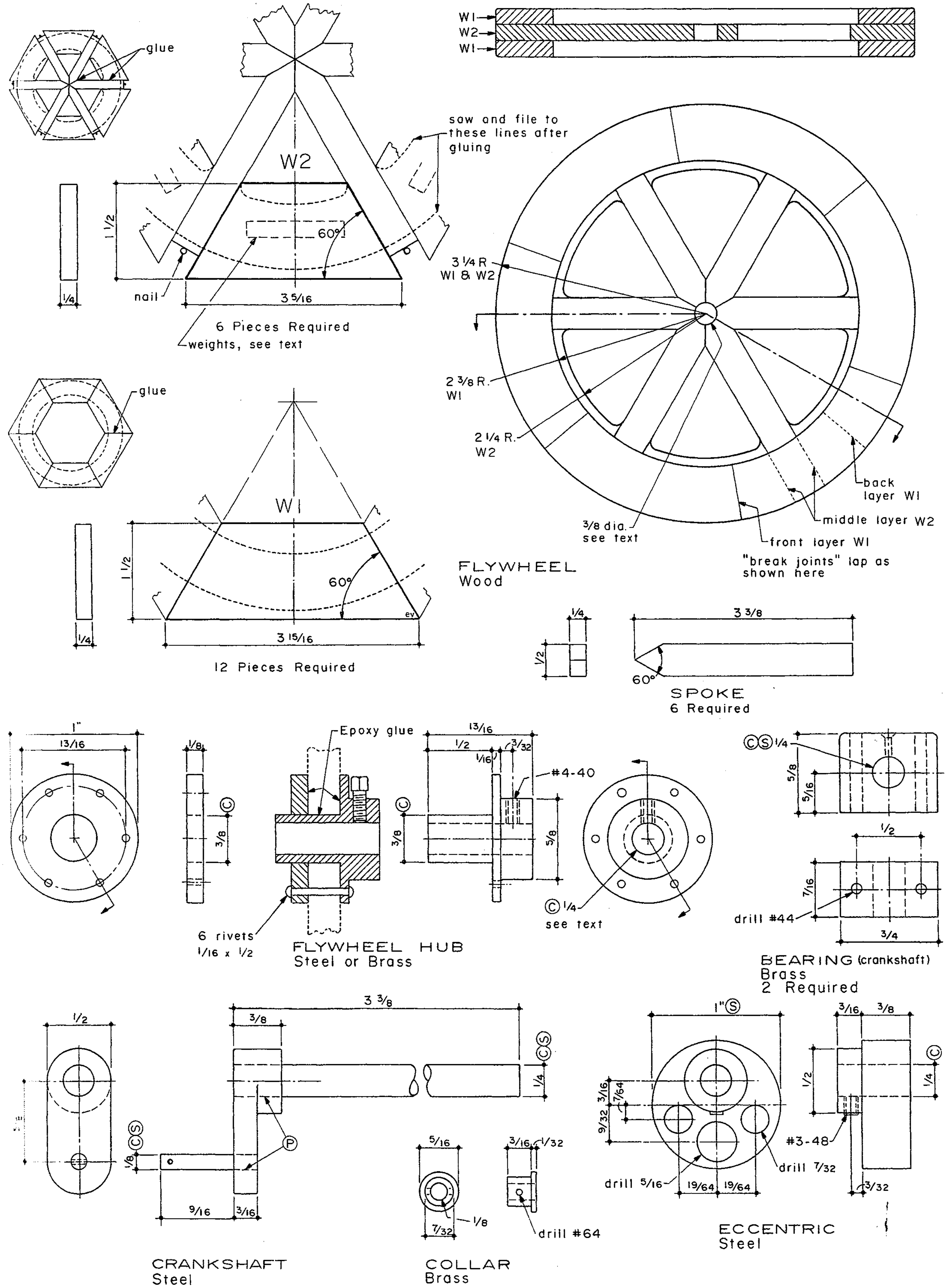
BEAM
Wood



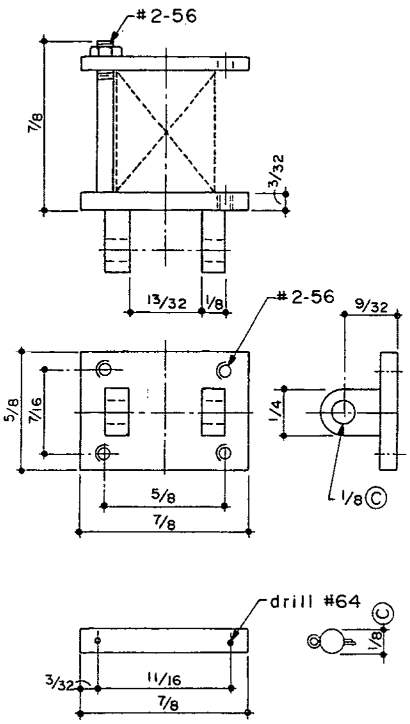
VALVE BEAM
Wood



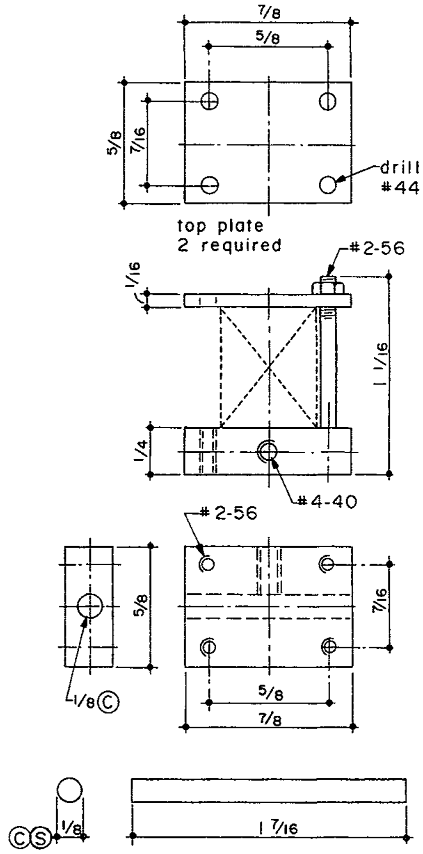
CONNECTING ROD



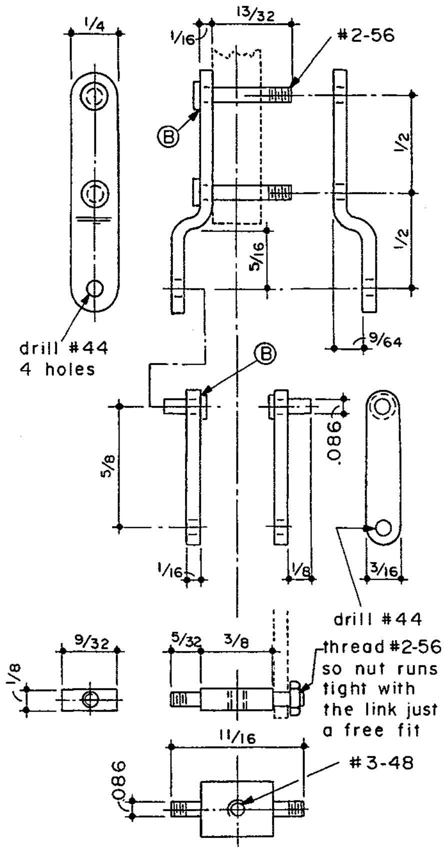
glue
W1
W2
W1
saw and file to these lines after gluing
W2
1 1/2
60°
1/4
nail
3 5/16
6 Pieces Required
weights, see text
3 1/4 R
W1 & W2
2 3/8 R.
W1
2 1/4 R.
W2
3/8 dia.
see text
back layer W1
middle layer W2
front layer W1
"break joints" lap as shown here
FLYWHEEL
Wood
glue
W1
1 1/2
60°
ev
1/4
3 15/16
12 Pieces Required
1/4
1/2
3 3/8
60°
SPOKE
6 Required
1"
13/16
1/8
3/8
Epoxy glue
13/16
1/2
3/32
1/16
#4-40
3/8
5/8
C 1/4
see text
6 rivets
1/16 x 1/2
FLYWHEEL HUB
Steel or Brass
CS 1/4
5/8
5/16
1/2
7/16
drill #44
3/4
BEARING (crankshaft)
Brass
2 Required
1/2
3 3/8
3/8
CS
1/4
CS
1/8
P
9/16
3/16
5/16
3/16
1/32
1/8
7/32
drill #64
1" S
3/16
7/64
9/32
drill 5/16
19/64
19/64
drill 7/32
3/16
3/8
1/2
1/4
#3-48
3/32
CRANKSHAFT
Steel
COLLAR
Brass
ECCENTRIC
Steel



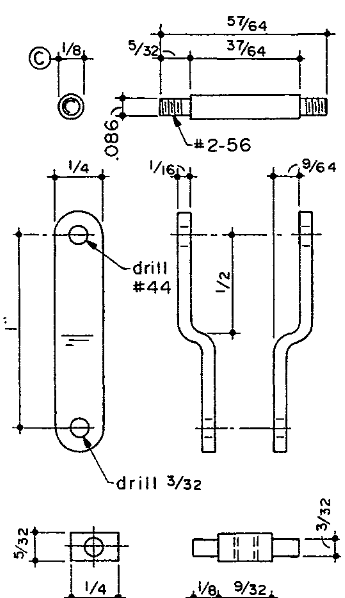
BEAM FITTINGS
at connecting rod
Brass

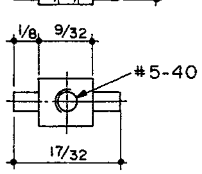


BEAM FITTINGS
at beam pivot
Brass

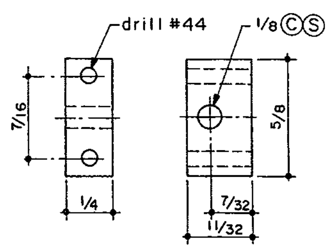


VALVE BEAM FITTINGS
Brass

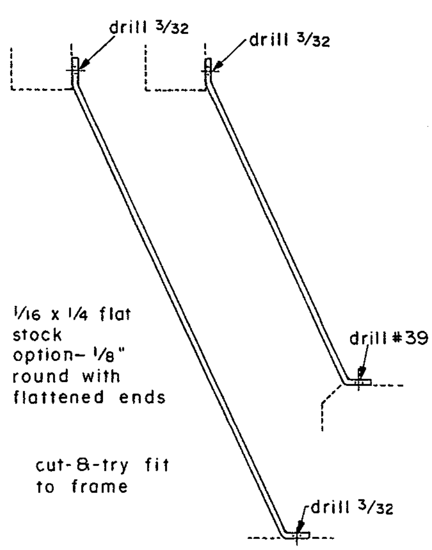




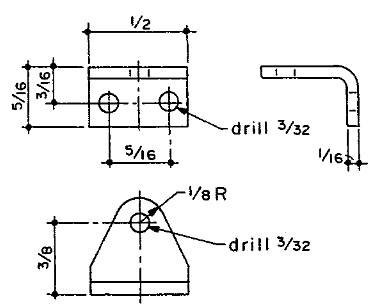
BEAM
FITTINGS
at cylinder
Brass



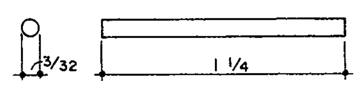
BEARING
Brass, 2 Required



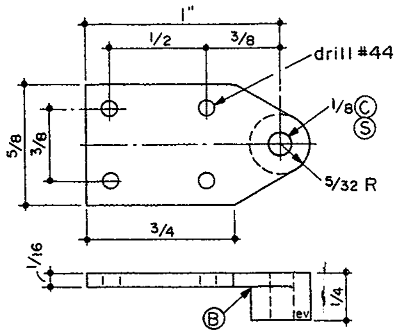
BRACES
Brass



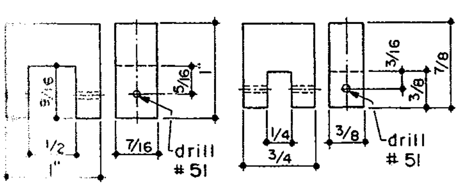
BRACKET
Brass



PIVOT
Brass



GUIDE
Brass



WEIGHTS
Steel or brass, 3ea. req.