

centerline for the 1/16" Pin. Strike a 7/32" radius from the Shaft centerline and prick punch for the Pin. Return to the lathe, centering for the Shaft bore. Make the 1/4" bore and part off the plain Eccentric about 1/32" full. Reverse in the lathe and do the 1/4" bore and rough out the hub with a narrow tool, leaving 1/64" to 1/32" to clean up. Part off the Eccentric with the hub. Finish both Eccentrics on a close-fitting stub arbor. Drill the pin hole in the plain Eccentric. Mount the Eccentric with hub in a drill vise and make a 1/16" dimple on the pin centerline. While still anchored to the drill press table, run a close-fitting 1/4" pin in the bore and slide the plain Eccentric down over the pin and use it as a jig to complete the 1/16" hole in the Eccentric with hub. Next, spot the 4-40 set screw in the same plane as the 1/16" pin. This will help when timing the Valve. On the plain Eccentric, flow a tiny burr of metal on the rim of the 1/16" hole with a prick punch on the flange side. This will keep the Pin from scoring

the Bearing during operation.

The **CONNECTING ROD** was made of a hard jig-and-fixture grade of aluminum, taking advantage of the lighter weight. Bronze would be more durable.

The **BUSHINGS** in the **BEARINGS** are "Oilite" press fit.

When making the 17/32" **SHOULDER SCREWS** for the Drag Link, try for a condition where the nuts run tight and the parts are just free but not sloppy.

Make sure the **CRANK SCREW** is tight so it won't back out when rotation is reversed.

Try for just a free but not sloppy fit at the **VALVE, VALVE ROD** and **NUT** so the Valve will float free on the Plate held by the steam pressure. Adjust the Valve so it exposes an equal amount of port holes at each end of the stroke. The Valve face and Valve Plate must be lapped flat.

Fine copper wire is used in the #70 holes in the Pivot Pins.

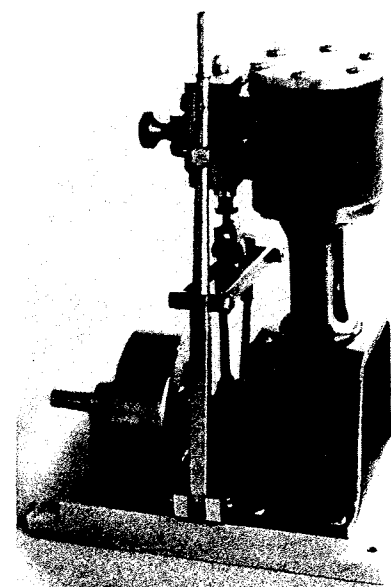
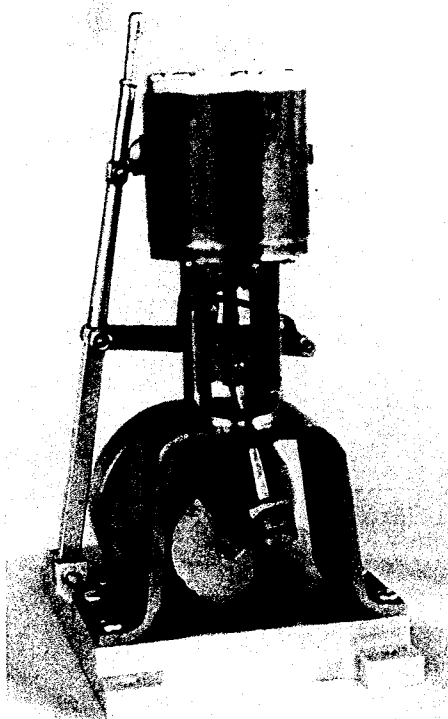
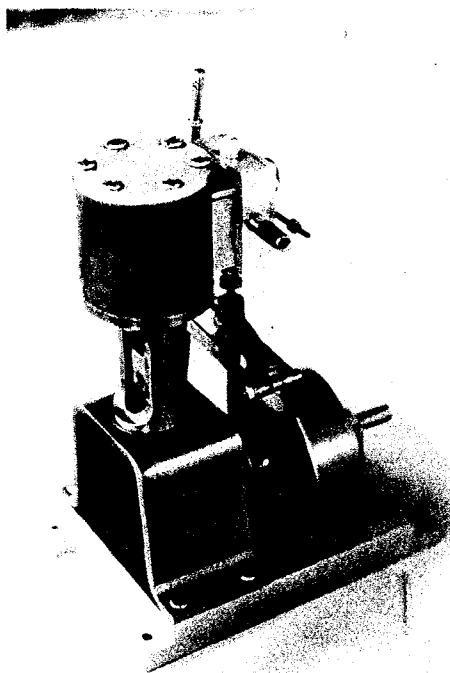
Use some 1/16" strands of unraveled graphited asbestos packing in

the Stuffing Boxes. Snug up the Packnuts only finger tight and take-up as needed as they wear in. Do not over-tighten.

Set the crank throw at its lowest position. Use the hex wrench in the Eccentric Set Screw and aim it also straight down. After some trials, the Eccentric can be rotated a few degrees each way and trials made. When the engine runs its best in both directions, tighten the Set Screw.

Find the best position for the reverse lever and measure so the 1/8" x 3/32" stops can be soldered in place.

This was a first attempt to make a reversing mechanism. It turned out well, though some students of steam engine valving may be able to improve on it. It ran easily on 5 to 10 pounds of air. At about 25 pounds, it was difficult to slow it down by pinching the shaft with the fingers. It is not as compact as the commercial 3/4" models, but it has the Flywheel between the Bearings and not overhung, with the takeoff Shaft beyond that.



# 38 VR 75

This engine is perhaps a bit more practical than some of the past Verburg engines as it can find more use in driving a boat or miniature machine. The bore and general proportions match somewhat the 3/4" engines on the market. This engine does not require castings.

The material is up to the builder.

Only parts that need any comment will be mentioned. All the rest are considered routine machine shop practice.

The **CYLINDER** starts out as an accurate 1-3/8" x 1-7/16" x 1-1/8" block. While still square, all holes and outlines are laid out. Notice the four holes at the bottom and six for the top. Drill and tap all holes. Mill and drill all port passages. Center the 4-hole end in the 4-jaw on the bore centerline and turn the flange and bore as in **Step 1**. Take a thin skin cut off the end, only a few thousandths. This face is then square with the bore and the end that mounts on the Crosshead Guide. Reverse in the chuck and turn the second end as in **Step 2**. Make a milling setup and do **Steps 3, 4, 5 and 6**. **Step 7** is optional. It will be hidden if you make the Lagging. Fine-grained cast iron or Meehanite is great for this part.

The **LAGGING** is a cut-and-fit job. Thin black stove pipe steel is ideal for this. Make a thin cardboard pattern and transfer to the metal. The option type is easier to fit. When the fit is satisfactory, roll the piece to a diameter less than the Cylinder flanges and carefully ease it onto the Cylinder so it will cling and not require screws. The corners will catch on the Steam Chest projection and hold it in place.

The **STANDARD U**, **CROSS-HEAD GUIDE V** and **FLANGE W** are steel on the model shown, though brass might be easier to work. The blank for the Standard is laid out on 1/8" x 1-1/4" x 5-5/16" metal and formed using the type of bending jaws developed by Paul C. Haar. The first try came within 1/64" of the required height. Make the four 1/8" anchor holes and mount on the completed

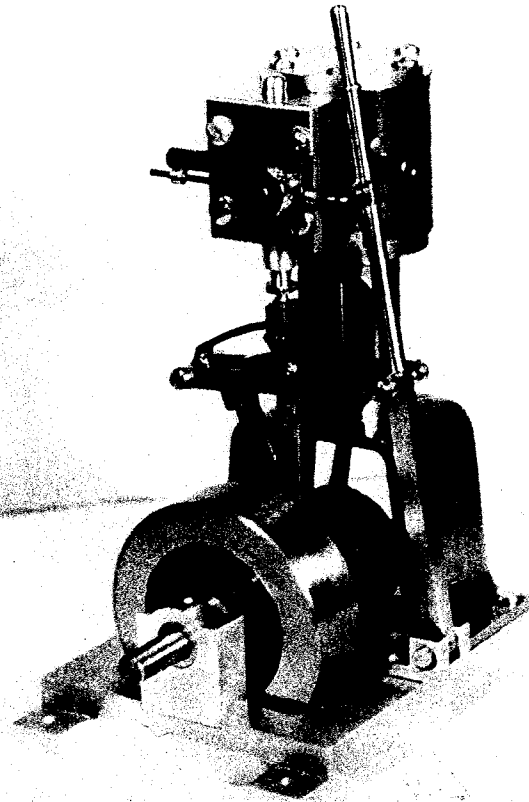
Base. Establish the center for the Crosshead Guide and center-punch. Mount Base and Standard in lathe and bore the 13/16" hole. Make a light cleanup cut on the top, making it parallel with the Base. Make the upper Flange **W**. Turn the Crosshead Guide **V** with shoulder for Flange **W**, and bore 5/8". Measure the sum of the parts to determine where to make the shoulder at the lower end. Mill the flats with a 1/2" cutter. When the total is 3-5/16", solder **U**, **V** and **W** together using at least 430° solder. Keep the 4-bolt-hole pattern in **W** square with the axes of the Base. Squareness and concentricity are important all through these parts to prevent binding at the Piston, Rod and Crosshead.

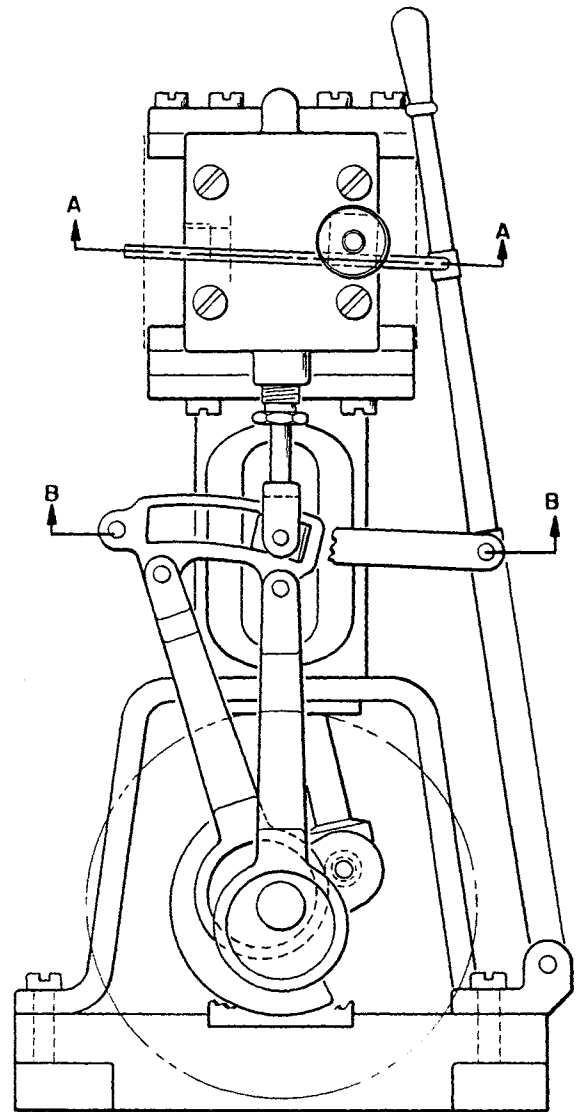
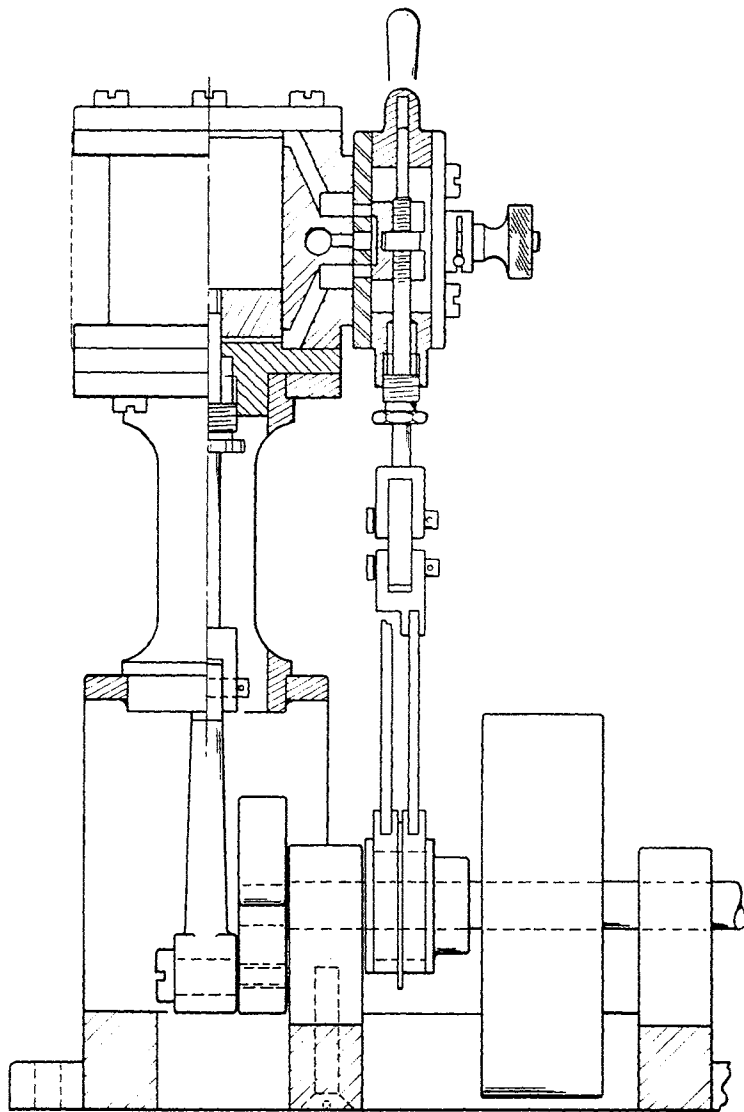
The **STEAM CHEST** starts out as an accurate 5/16" x 1" x 1-9/16" block. Lay out the centers for the Stuffing Box and 3/16" boss and center punch.

Pick up these centers in the lathe and turn each end, doing the Valve Rod and 3/16-40 holes at the same chucking. Drill and mill out the 1/2" x 3/4" center opening.

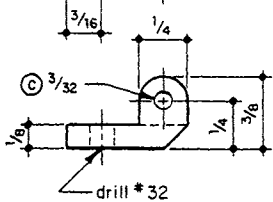
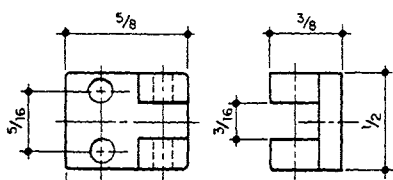
The **LINK** is purely a layout and carving job in steel. Of course, accuracy and close fit on all holes and link part will reduce clanking when the engine is running. A filing machine such as the one developed by Bob Maynard will make a neater and more accurate job.

The **ECCENTRICS** were made of 3/4" diameter free-machining steel. A piece about 2" long is centered in the chuck and each end turned to the final bright 9/16" diameter x 1/8" for the Straps. Remove from the lathe and mount in a V block with clamp. Make the two centerlines at right angles to each other. Scribe the 1/4" bore .080" off-center and prick punch. Set a protractor at 25° and scribe the

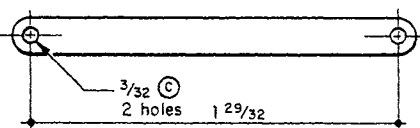




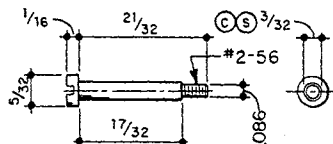
VERTICAL REVERSING  $\frac{3}{4} \times \frac{3}{4}$



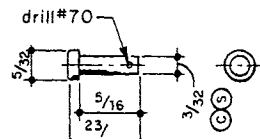
REVERSE LEVER PIVOT



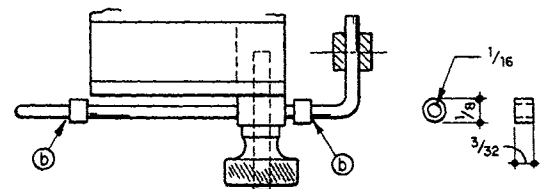
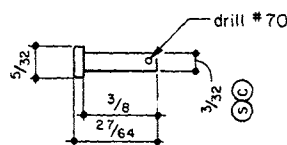
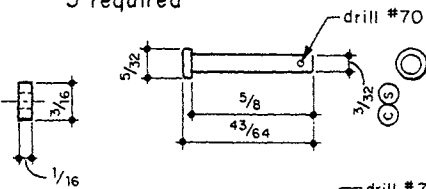
DRAG LINK  
2 required



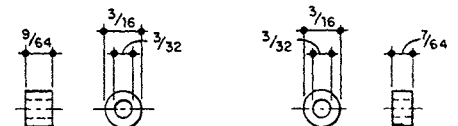
2 required



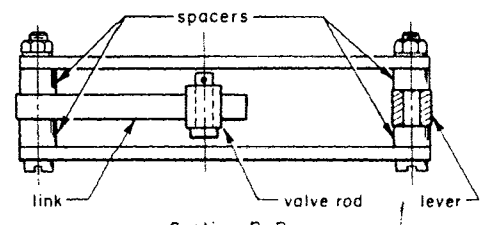
3 required



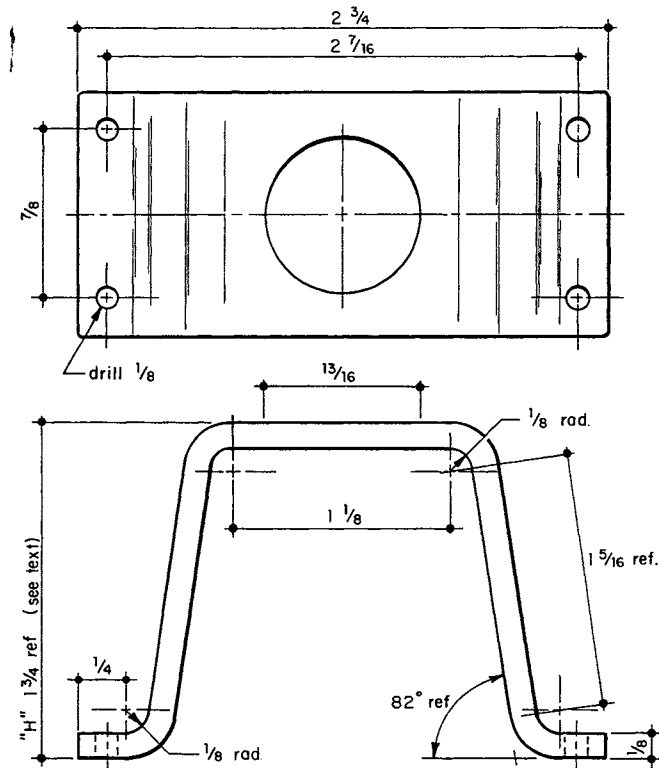
Section A-A



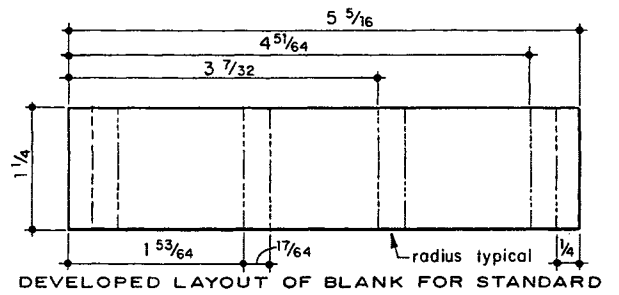
SPACERS



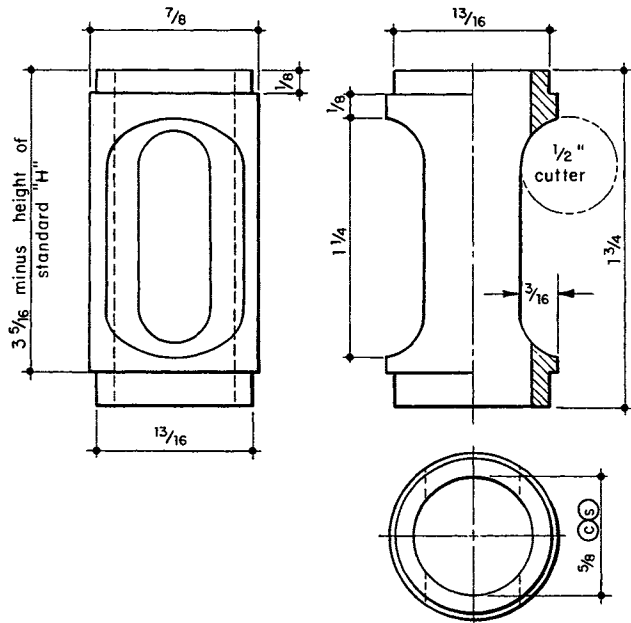
Section B-B



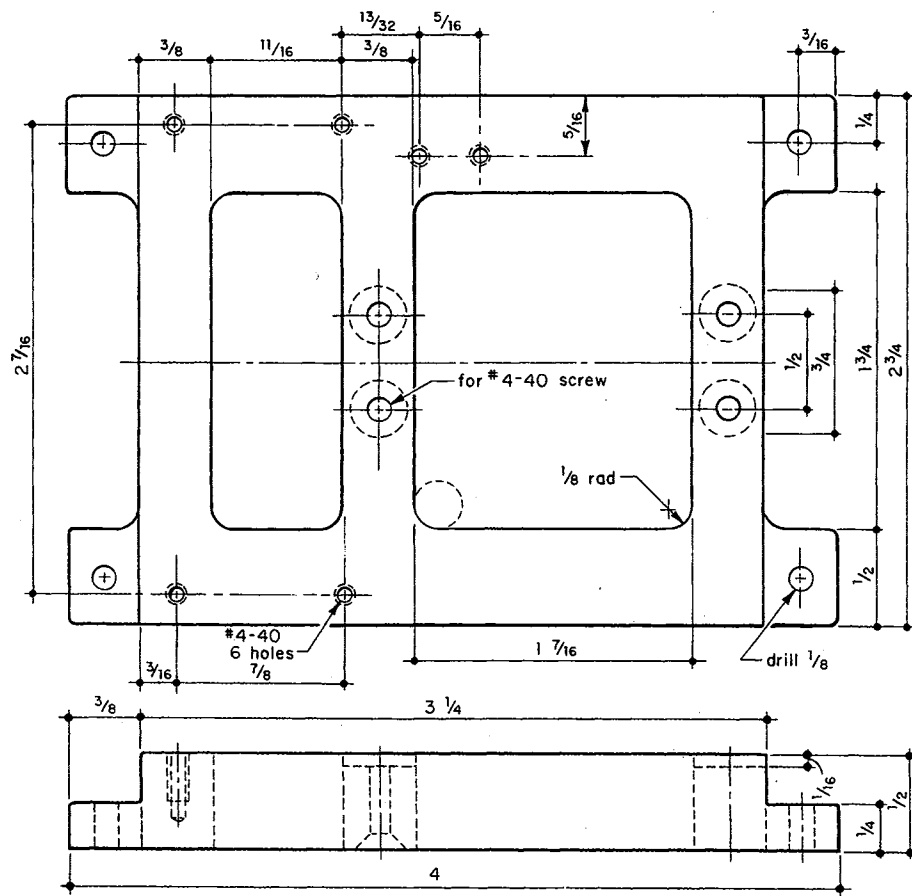
STANDARD U



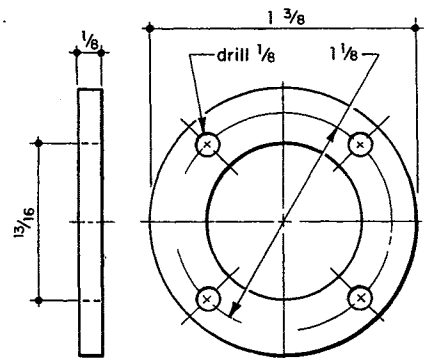
DEVELOPED LAYOUT OF BLANK FOR STANDARD



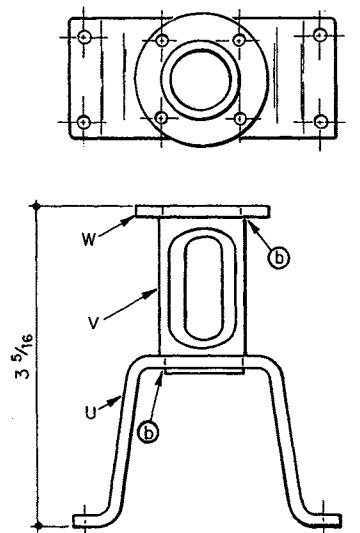
CROSSHEAD GUIDE V

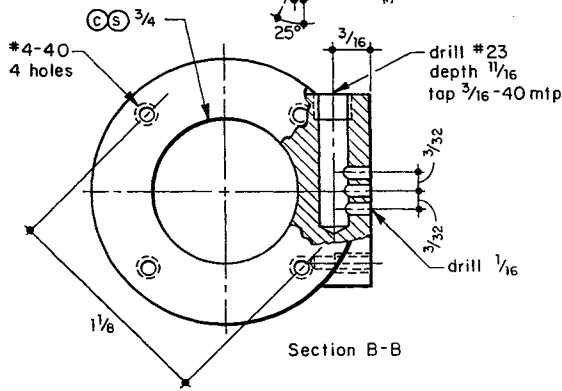
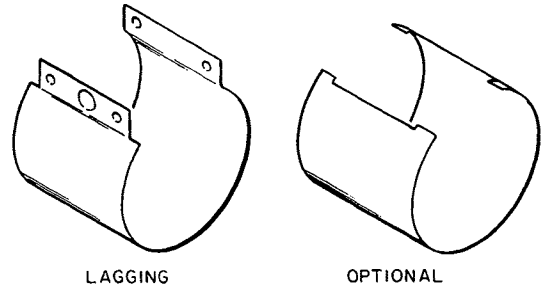
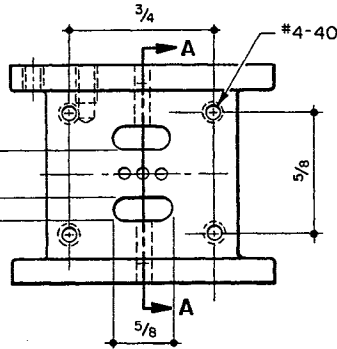
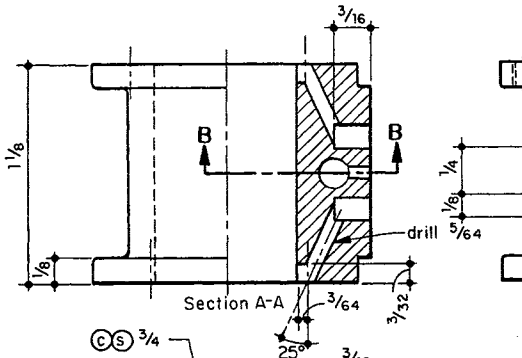
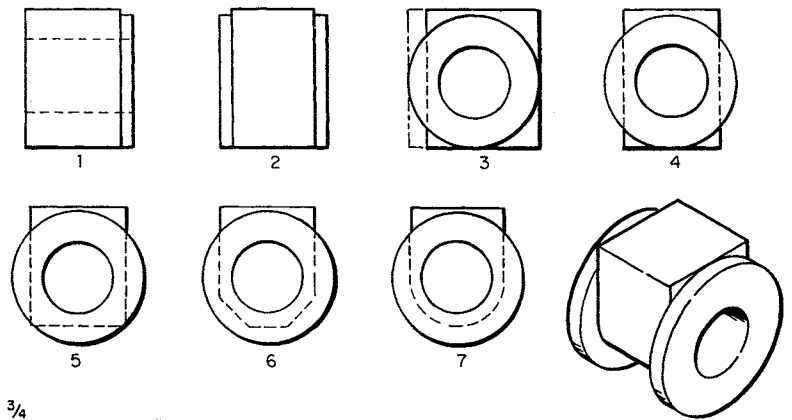
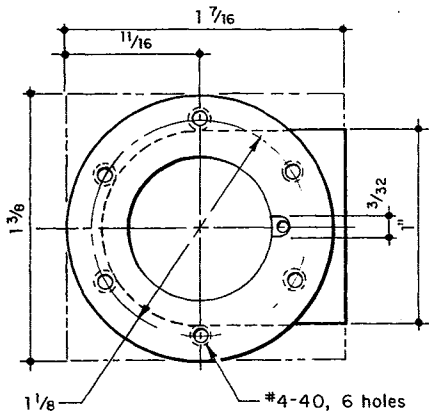


BASE

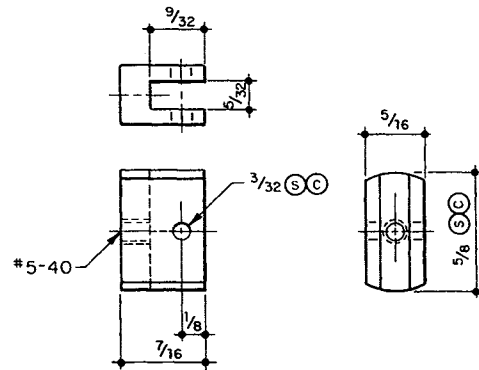


GUIDE FLANGE W



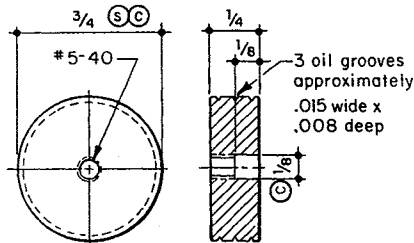


CYLINDER

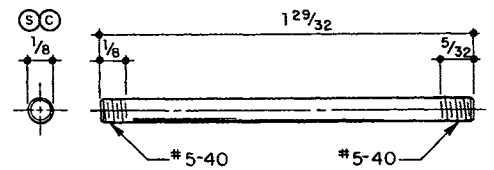


CROSSHEAD

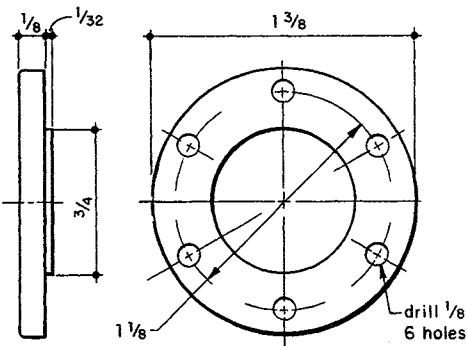
(S) smooth	(b) solder or braze
(C) close	(D) press fit or "loctite"
(f) flat	



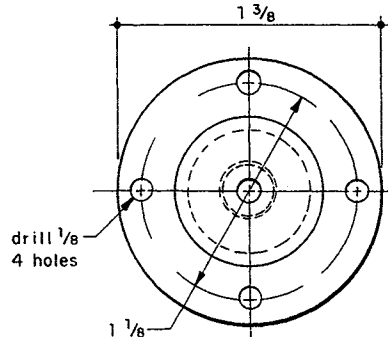
PISTON



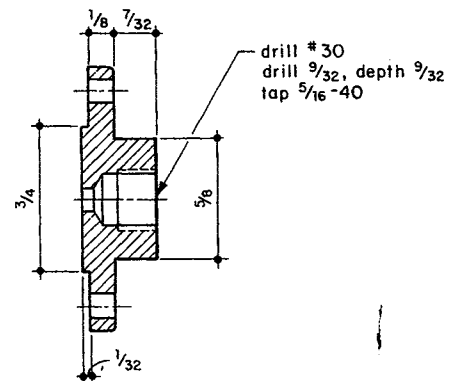
ROD

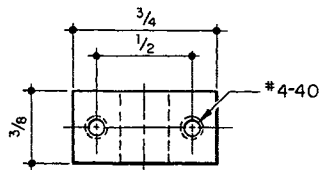
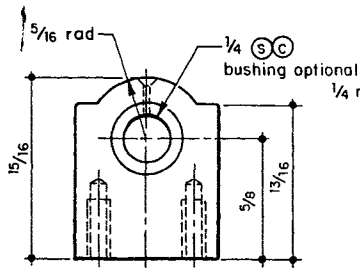


OUTBOARD HEAD

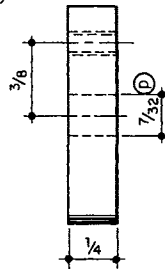
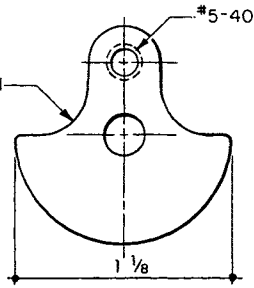


INBOARD HEAD

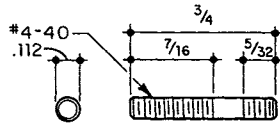
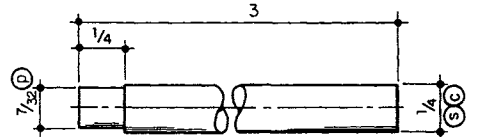




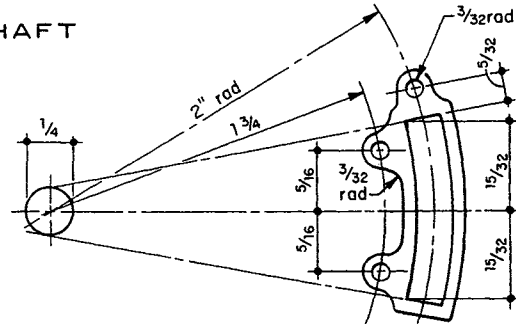
BEARING



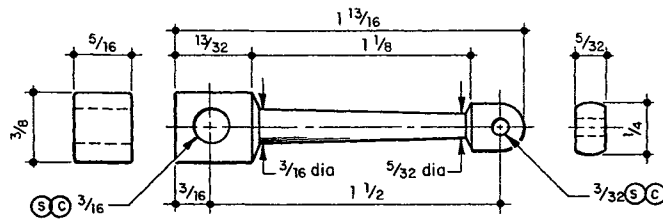
CRANKSHAFT



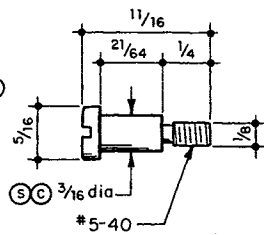
STUD



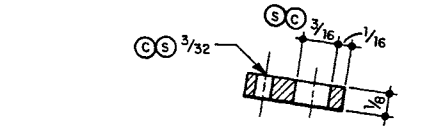
REVERSE LINK



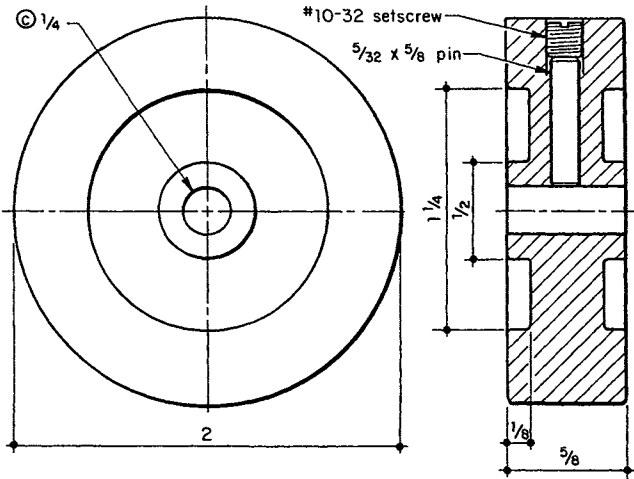
CONNECTING ROD



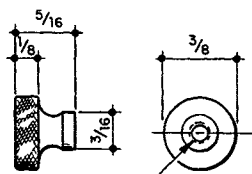
CRANK SCREW



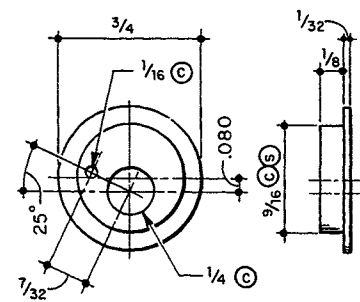
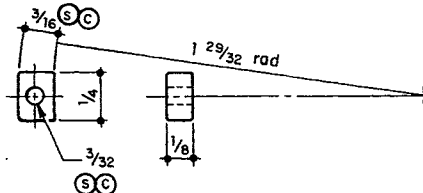
LINK BLOCK



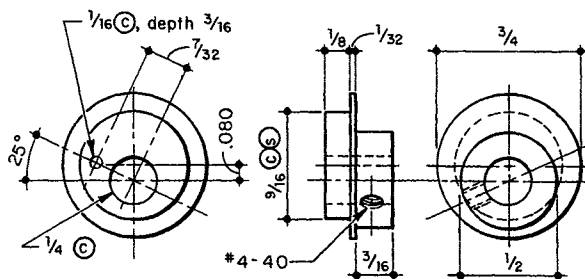
FLYWHEEL



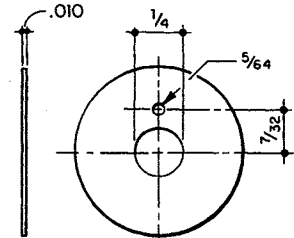
REVERSE LEVER CLAMP NUT



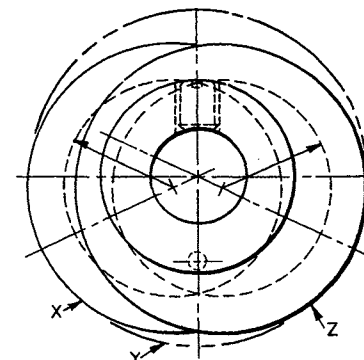
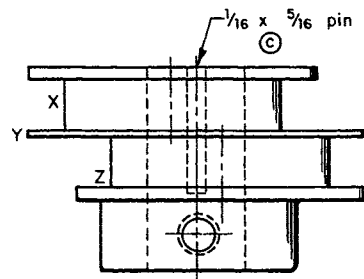
X ECCENTRIC

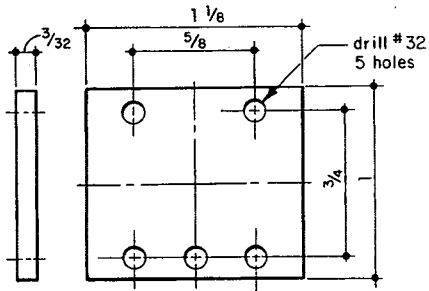


Z ECCENTRIC WITH HUB

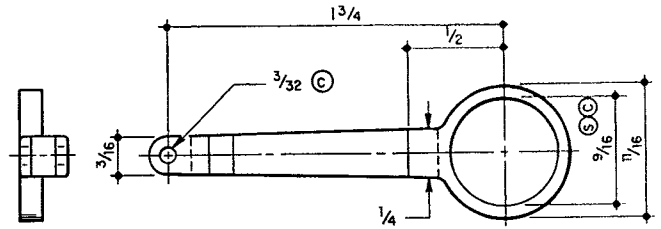


Y SPACER

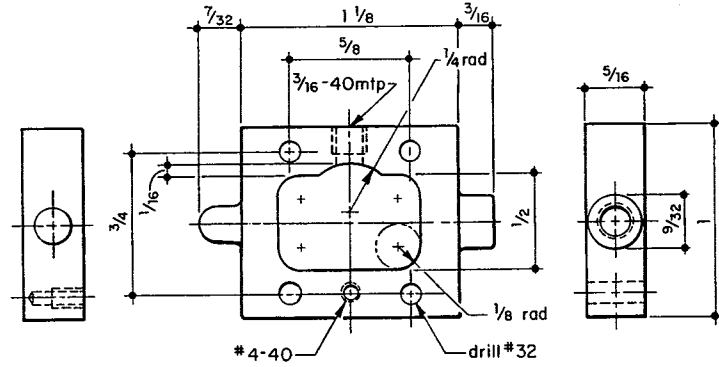




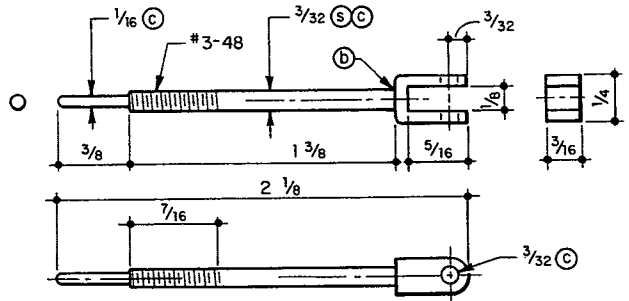
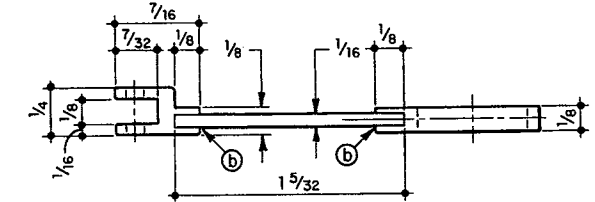
COVER



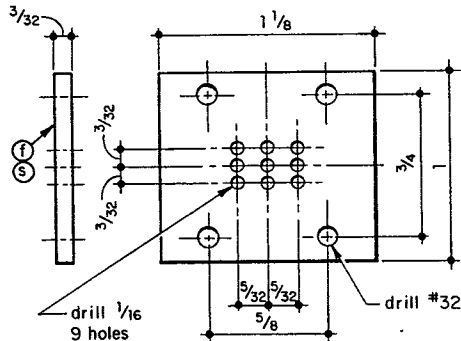
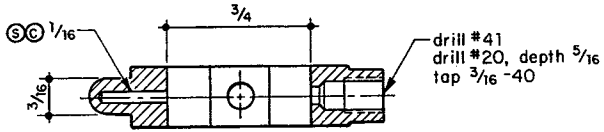
ECCENTRIC STRAP  
2 Required



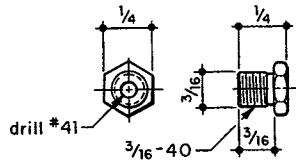
STEAM CHEST



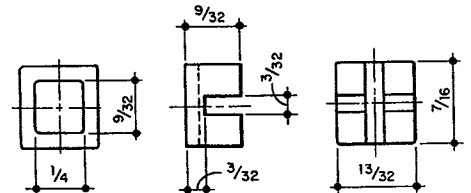
VALVE ROD



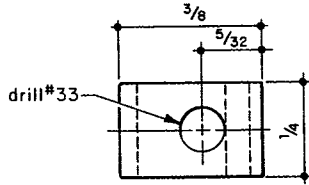
VALVE PLATE



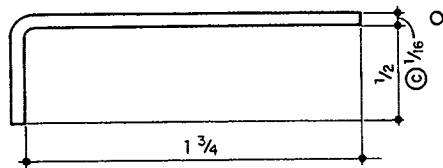
PACKNUT  
(Steam Chest)



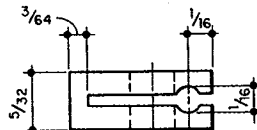
VALVE



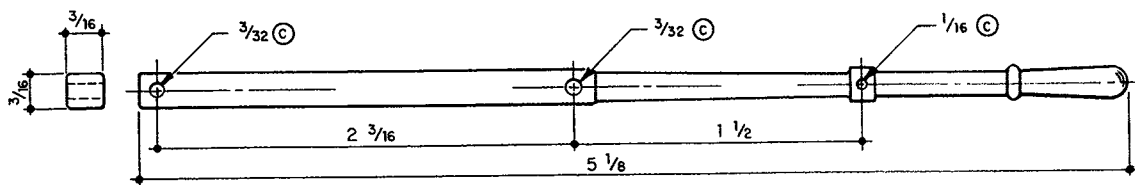
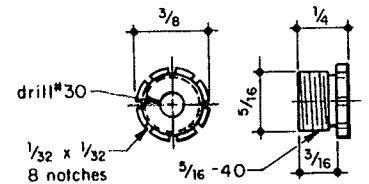
CLAMP  
2 x Size



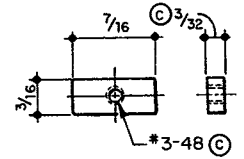
CLAMP ROD



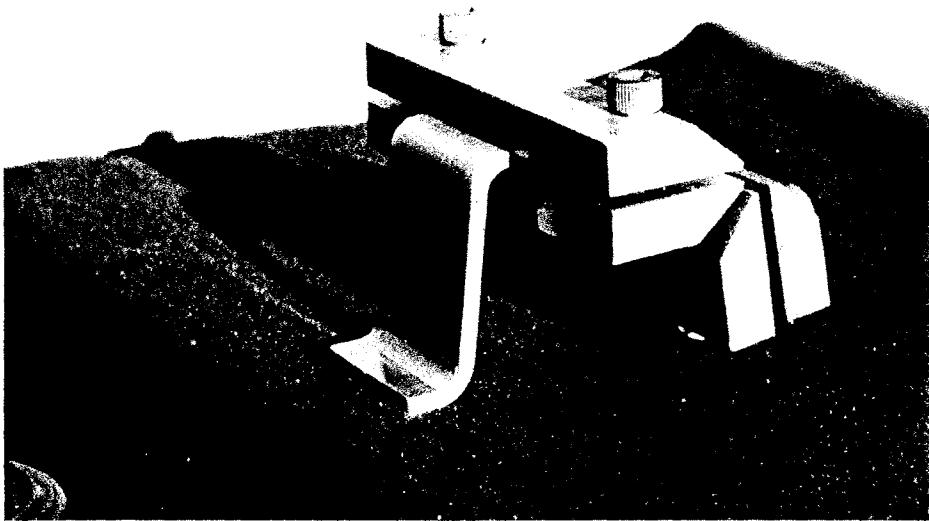
VALVE NUT



REVERSE LEVER



VALVE NUT



**Above:** Forming the Standard

**Center:** Using center test indicator to center Standard prior to boring for Crosshead Guide.

**Below:** Milling the sides of the Crosshead Guide.

