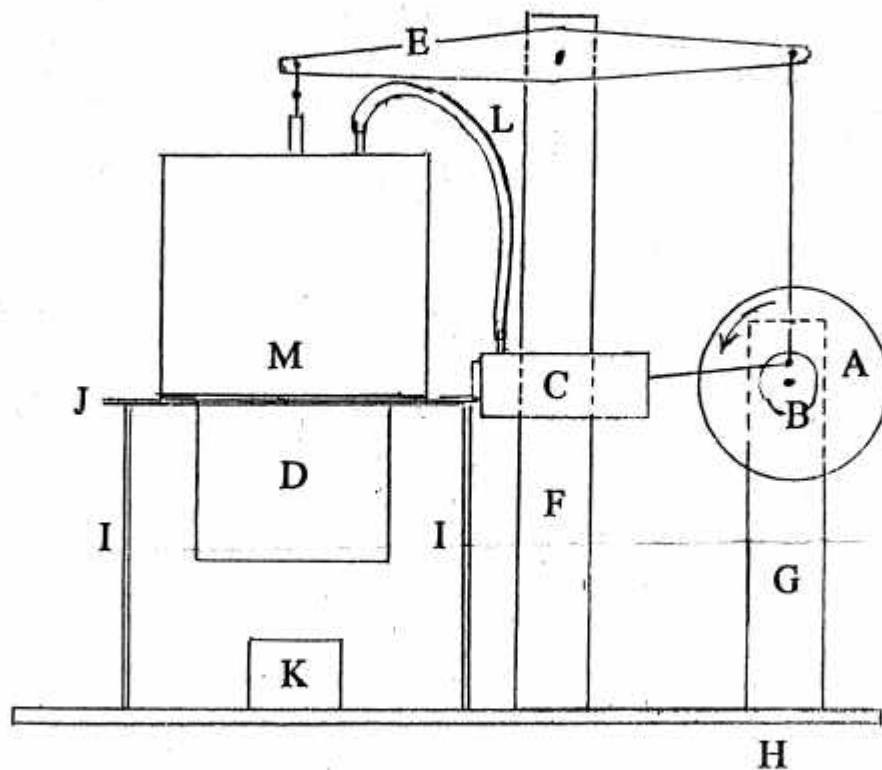


# THE STIRLING CYCLE TIN CAN HEAT ENGINE



THE NORTH AMERICAN MODEL ENGINEERING SOCIETY

## THE STIRLING CYCLE

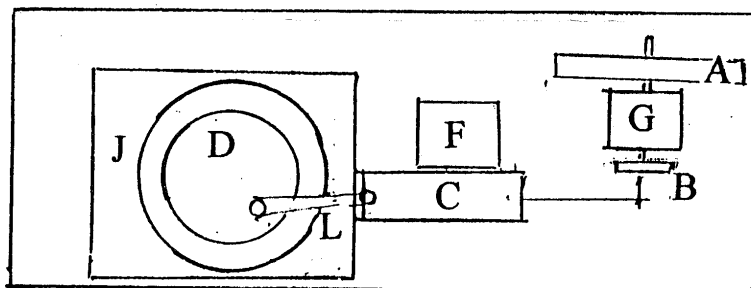
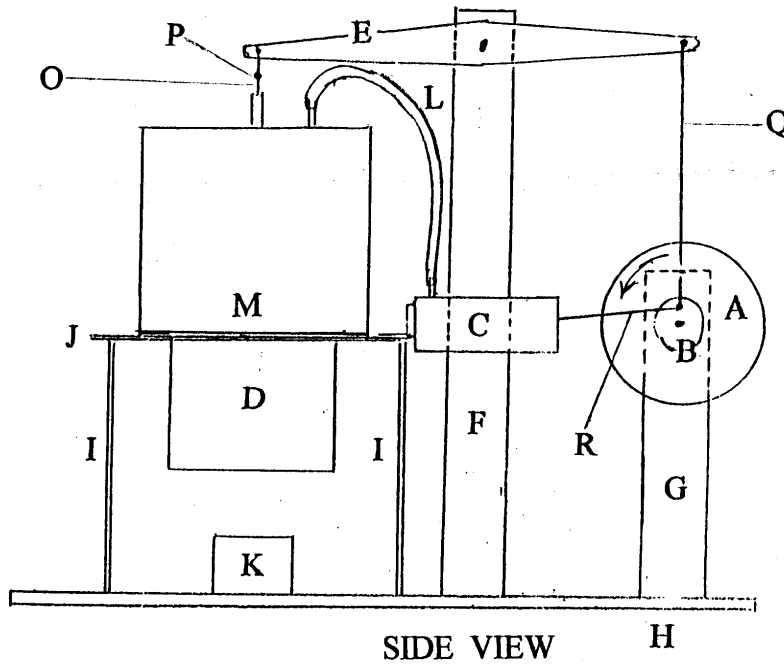
### TIN CAN HEAT ENGINE

THIS PROJECT WILL CHANGE YOUR GROCERY SHOPPING. THE USE OF TIN CANS SIMPLIFY CONSTRUCTION. THE THIN SHEET METAL WALLS PERMITS RAPID TRANSFER OF HEAT. THE CANS ARE READILY MODIFIED, AND IF YOU GO WRONG THROW THE CAN AWAY AND USE ANOTHER.

THIS ENGINE ISN'T GOING TO BE PRETTY, BUT IT IS REALITIVLY SIMPLE TO BUILD AND YOU WILL COME TO REALIZE THE WHOLE ENGINE DESIGN CAN BE MODIFIED IN MANY WAYS.

# HEAT ENGINE

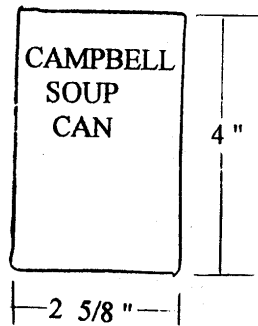
SHOWN HERE IS A SIDE VIEW AND AN OVER HEAD VIEW OF THE COMPLETED ENGINE. YOU CAN REFER TO THESE DRAWINGS AS YOU BUILD YOUR ENGINE.



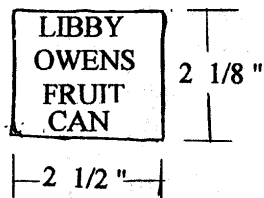
TOP VIEW

(ROCKER ARM NOT SHOWN)

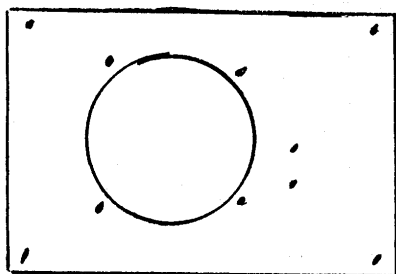
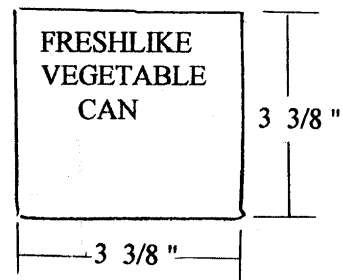
HEAT DISPLACER  
CYLINDER  
"D"



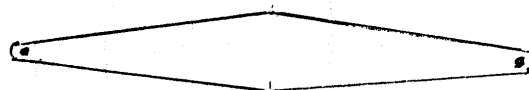
DISPLACER  
PISTON  
"N"



WATER JACKET  
"M"



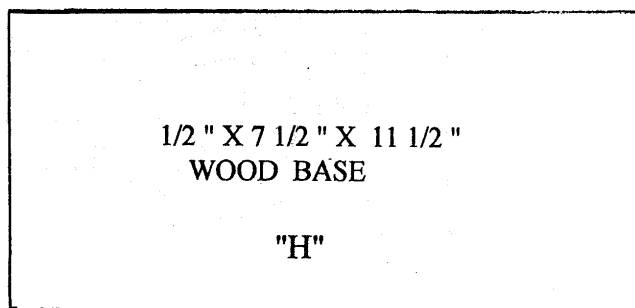
"J"



"E"

ROCKER ARM  
MAY BE CONSTRUCTED  
OF WOOD OR METAL

5" X 6" SHEET METAL  
MOUNTING BASE



"H"

- A FLYWHEEL
- B CRANK
- C POWER CYLINDER
- D DISPLACER CYLINDER
- E ROCKER ARM
- F LONG MAST
- G SHORT MAST
- H BASE
- I SUPPORT LEGS
- J STEEL PLATE
- K BURNER
- L TUBE
- M WATER JACKET
- N DISPLACER PISTON
- O DISPLACER PISTON ROD
- P DISPLACER PISTON CONNECTING ROD
- Q DISPLACER PISTON ROCKER ARM CONNECTING ROD
- R POWER PISTON CONNECTING ROD

### SPECIAL TOOLS AND EQUIPMENT NEEDED

METAL LATHE

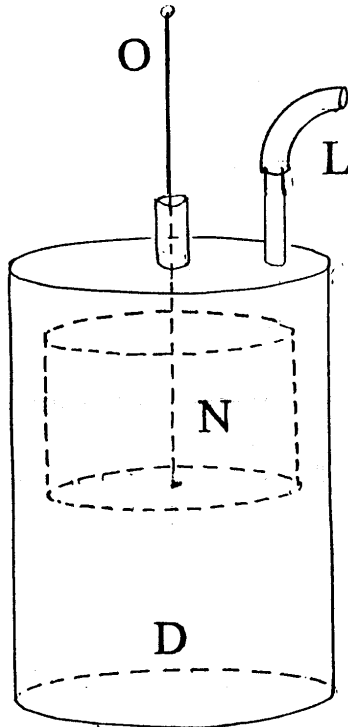
250 WATT ELECTRIC SOLDERING IRON

PROPANE TORCH

50/50 SOLDER

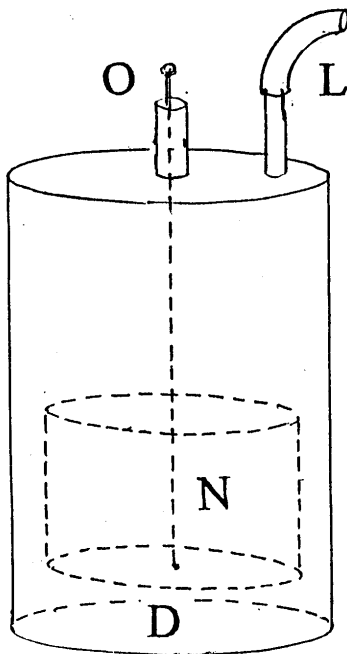
SILVER SOLDER AND STAY-SILV FLUX

## HOW THE HEAT ENGINE OPERATES



HEAT IS APPLIED TO THE BOTTOM OF CYLINDER "D" CAUSING A PRESSURE RISE WITH IN THE CYLINDER.

SHAFT "O" IS ATTACHED TO THE DISPLACER PISTON "N" . AS PISTON "N" IS MOVED UP THIS CAUSES THE PRESSURE TO RISE FURTHER BECAUSE THE COOLER AIR AT THE TOP OF CYLINDER "D" IS NOW FORCED DOWN TO THE HEATED END OF OF CYLINDER "D".



SHAFT "O" IS NOW MOVED DOWN CAUSING THE HEATED AIR IN THE CYLINDER TO RUSH BACK TO THE COOLER END, CAUSING THE PRESSURE TO DROP.

HOSE OR TUBE "L" IS CONNECTED WITH THE POWER PISTON. THE RISE AND FALL OF PRESSURES WITHIN CYLINDER "D" CAUSES THE POWER PISTON TO MOVE.

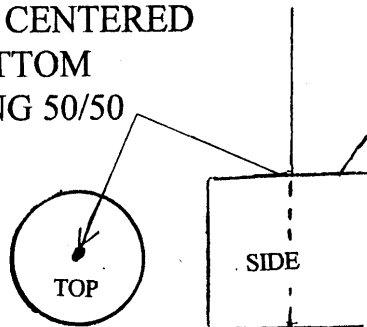
NOTE THAT PISTON "N" IS A LOOSE FIT INSIDE CYLINDER "B".

# CONSTRUCTION OF THE HEAT ENGINE

## STEP 1 DISPLACER PISTON

SOLDER A LID ON THE FRUIT CAN. MAKE SURE IT IS SEALED.  
DRILL A 1/8 INCH HOLE IN THE TOP AND BOTTOM OF THE CAN  
AND SOLDER A 1/8 INCH ROD IN PLACE AS SHOWN.

1/8" X 6" ROD CENTERED  
TOP AND BOTTOM  
SOLDER USING 50/50



TIN COVER CUT TO FIT  
TOP OF CAN

DISPLACER  
PISTON

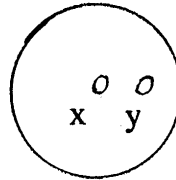
"N"

SOLDER BOTTOM USING  
SILVER SOLDER

**STEP 2          DISPLACER CYLINDER**

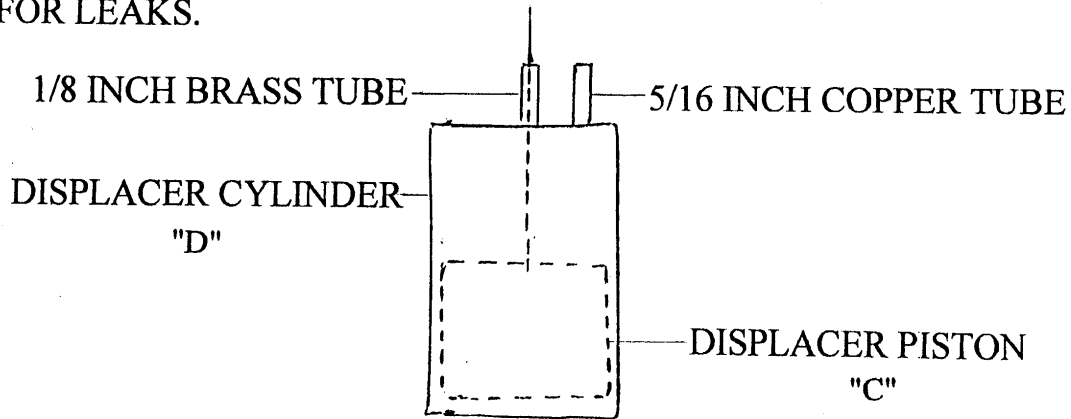
CUT A LID FOR THE SOUP CAN DRILL HOLES AS SHOWN.  
MAKE SURE HOLE "X" IS IN THE CENTER SO THE PISTON  
WILL NOT HIT THE CYLINDER

CUT ROUND METAL LID  
DRILL HOLE IN CENTER OF  
LID "Y" TO ACCEPT 1/8"  
INSIDE DIAMETER BRASS TUBE  
1 1/4" LONG.



DRILL HOLE "Y" AT A POINT  
MIDWAY BETWEEN "X" AND  
THE RIM. HOLE SIZE TO ACCEPT  
5/16" COPPER TUBE 1 1/4" IN  
LENGTH.

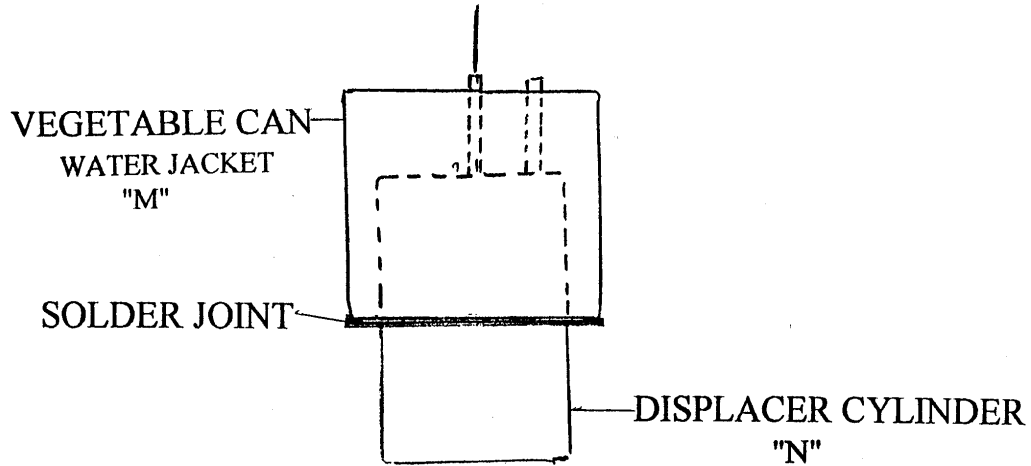
**STEP 3          DISPLACER CYLINDER-PISTON ASSEMBLY**  
PLACE THE DISPLACER PISTON INSIDE THE CYLINDER. SOFT  
SOLDER THE LID ONTO THE CYLINDER USING 50/50 SOLDER.  
THREAD THE 1/8 INCH BRASS TUBE OVER THE DISPLACER  
PISTON ROD AND SOLDER IT TO THE LID. MAKE SURE THE  
DISPLACER PISTON CLEARS THE WALLS OF THE CYLINDER.  
SOLDER THE 5/16 INCH COPPER TUBE INTO THE LID. TEST  
FOR LEAKS.





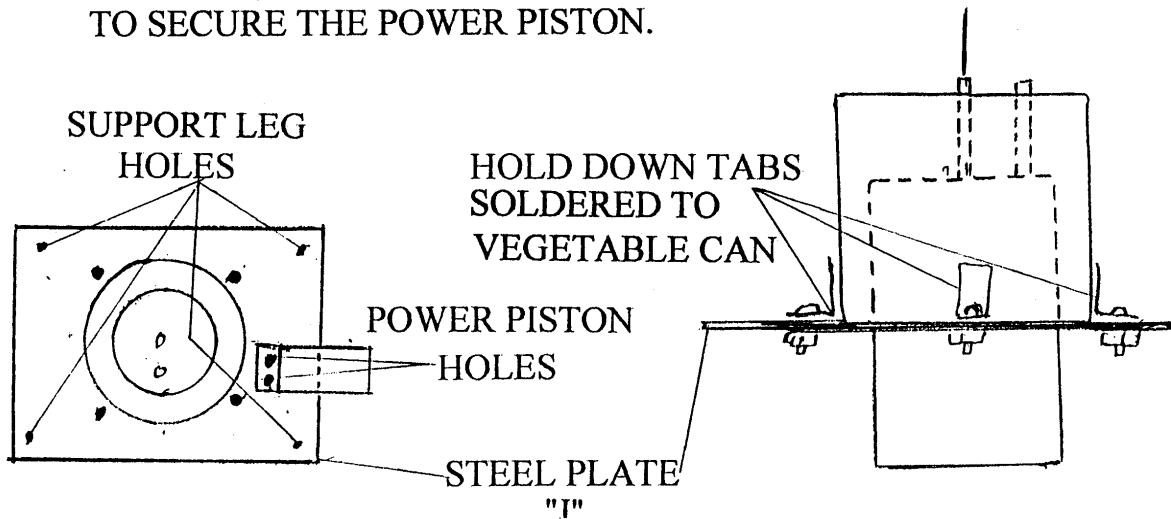
**STEP 4 WATER JACKET**

CUT THE BOTTOM OUT OF THE VEGETABLE CAN TO FIT AROUND THE DISPLACER CYLINDER. PLACE THE VEGETABLE CAN AS SHOWN AND SOLDER IN PLACE. MAKE SURE THE SOLDER JOINT IS WATERTIGHT



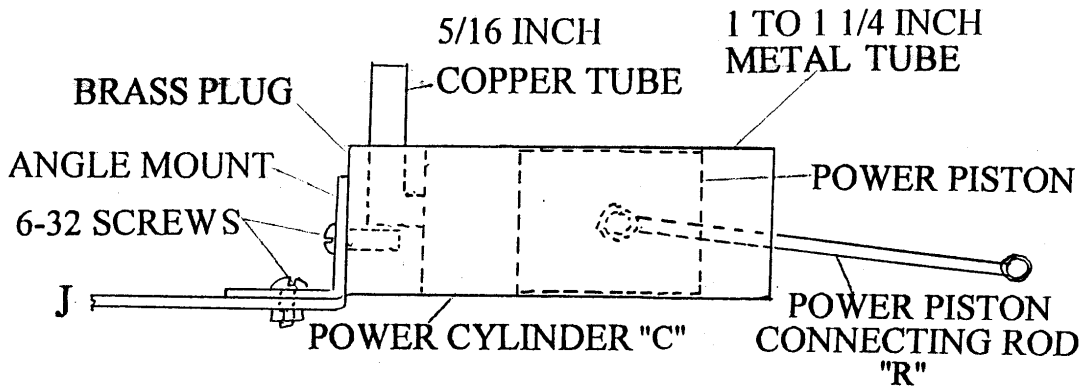
**STEP 5 MOUNTING BASE**

CUT A HOLE IN THE 5 INCH BY 6 INCH STEEL PLATE TO ACCEPT THE DISPLACER CYLINDER AS SHOWN. DRILL 4 HOLES AROUND THE DISPLACER FOR "L" SHAPED HOLD DOWN TABS. SOLDER THE TABS TO THE WATER JACKET. THE STEEL PLATE WILL ALSO HAVE 4 HOLES AT ITS CORNERS FOR SUPPORT LEGS AND 2 HOLES TO SECURE THE POWER PISTON.



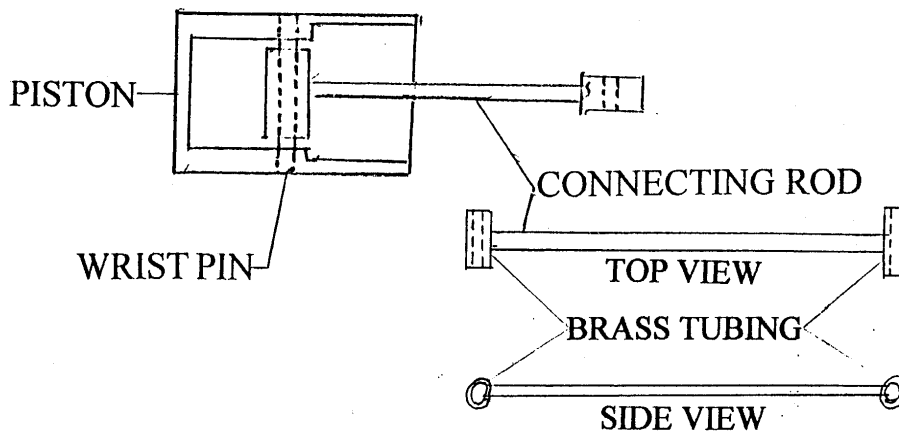
**STEP 6 POWER CYLINDER**

SOLDER A BRASS PLUG INTO ONE END OF THE 1 TO 1 1/4 INCH BRASS TUBE. DRILL A HOLE TO ACCEPT THE 5/16 INCH COPPER TUBE. DRILL AND TAP THE CENTER OF THE PLUG FOR A 6-32 SCREW. DRILL 2 HOLES IN THE ANGLE MOUNT BRACKET TO ATTACH THE POWER CYLINDER TO THE STEEL PLATE, AND 1 HOLE TO ATTACH THE POWER CYLINDER TO THE BRACKET.



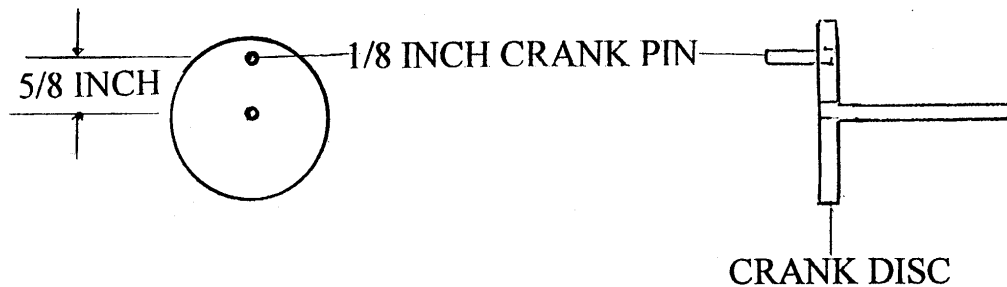
**STEP 7 CONNECTING ROD AND PISTON**

SOLDER BRASS TUBING TO THE END OF THE 1/8 INCH CONNECTING ROD AS SHOWN. USE TWO LENGTHS OF 1/8 INCH ROD IN THE BOSSES TO CHECK ALIGNMENT BEFORE SOLDERING. MACHINE THE PISTON TO FIT THE POWER CYLINDER WITH VERY LITTLE DRAG. DRILL THE WRIST PIN HOLE.



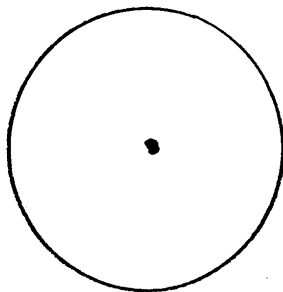
**STEP 8 CRANK AND CRANK PIN**

DRILL A HOLE INTO THE CENTER OF THE 1 1/2 DIAMETER CRANK DISC. THE SIZE OF THE ROD WILL DEPEND ON THE SIZE OF THE MAIN BEARING. DRILL ANOTHER HOLE 5/8 INCH FROM THE CENTER TO ACCEPT A 1/8 INCH CRANK PIN.

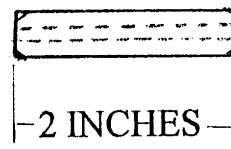


**STEP 9 FLYWHEEL AND MAIN BEARING**

CUT A 4 TO 8 INCH DIAMETER DISC FROM 1/2 OR 3/4 INCH PLYWOOD OR A THINNER PIECE OF METAL. CUT A PIECE OF BRASS TUBING 2 INCHES LONG WITH HOLE TO ACCEPT THE CRANKSHAFT. MAIN BEARING PROJECTS THRU "G" THE SHORT MAST.



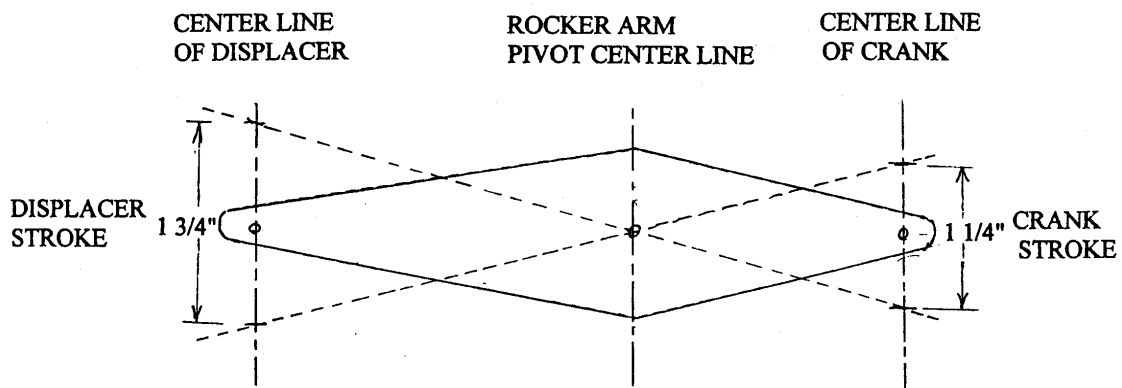
FLYWHEEL "A"



## STEP 10 ROCKER ARM

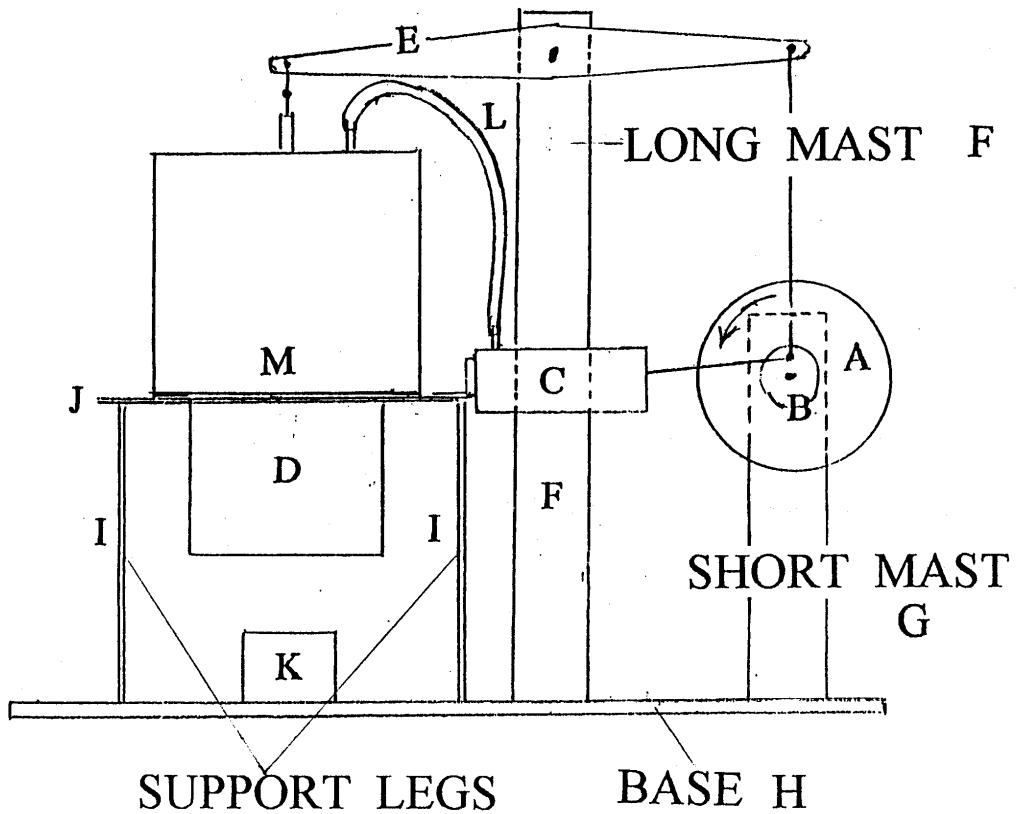
THE LENGTH OF THE ROCKER ARM CAN BE DETERMINED BY KNOWING THE CENTER LINE OF THE CRANK AND OF THE DISPLACER PISTON. THE PIVOT POINT OF THE ROCKER ARM IS NOT THE MID-WAY POINT OF THE ROCKER ARM. THE REASON FOR THIS IS THAT THE POWER PISTON AND DISPLACER HAVE DIFFERENT STROKES. THE POWER PISTON HAS A STROKE OF ABOUT 1 1/4 " AND THE DISPLACER HAS A STROKE OF ABOUT 1 3/4 ".

DETERMINE THE LOCATION OF ROCKER ARM PIVOT POINT

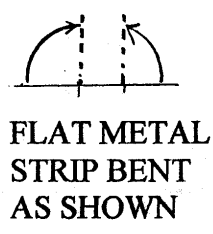
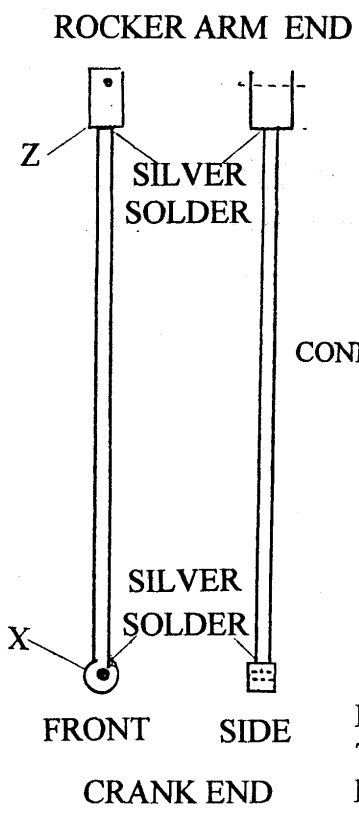


MAKE SURE DISPLACER PISTON DOES NOT STRIKE THE TOP OR BOTTOM OF DISPLACER CYLINDER AS ENGINE IS ROTATED. CRANK STROKE MAY HAVE TO BE SHORTNED TO KEEP DISPLACER PISTON FROM HITTING ENDS OF DISPLACER CYLINDER.

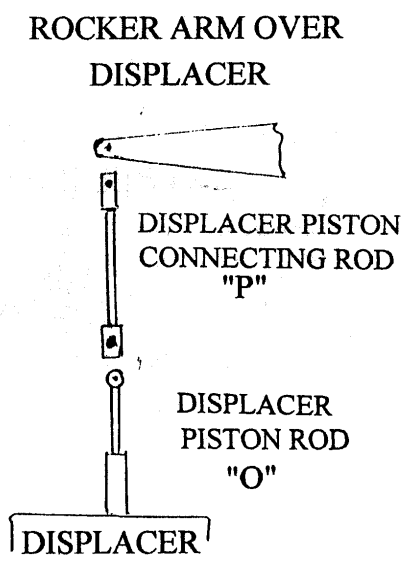
STEP 11 THE SHORT AND LONG MAST  
 DETERMINE THE LENGTHS OF THE LONG MAST "F" AND THE  
 SHORT MAST "G" BY PLACING THE DISPLACER WITH SUPPORT  
 LEGS IN PLACE ON THE BASE. THE POSTION OF THE MASTS ON  
 THE BASE CAN'T BE DETERMINED UNTIL YOU KNOW THE PIVOT  
 POINT OF THE ROCKER ARM "E". THE BASE "H" CAN BE MADE  
 MADE FROM A PIECE OF 1/2 " THICK WOOD. THE SHORT MAST  
 "G" SHOULD PLACE THE CRANK ON THE CENTER LINE OF THE  
 POWER CYLINDER BOTH VERTICALLY AND HORIZONTALLY.



STEP 12 CONNECTING RODS ON THE ROCKER ARM  
TO DETERMINE THE LENGTH OF THE RODS, PUT THE FLY-  
WHEEL CRANK IN THE UP POSITION, THE RODS SHOULD  
PLACE THE DISPLACER PISTON NEAR THE BOTTOM OF THE  
DISPLACER CYLINDER NOW ROTATE THE FLYWHEEL TO PUT  
THE CRANK IN THE DOWN POSITION, THIS SHOULD PLACE  
THE DISPLACER PISTON NEAR THE TOP OF THE DISPLACER  
CYLINDER. TWO CONNECTING RODS ARE NEEDED; ONE TO  
CONNECT THE ROCKER ARM TO THE DISPLACER PISTON AND  
THE OTHER TO CONNECT THE ROCKER ARM TO THE CRANK  
ON THE FLYWHEEL. FIRST THE DISPLACER ROD: SOLDER A  
1/8" INSIDE DIAMETER TUBE ON THE END OF THE DISPLACER  
PISTON ROD "O" SO IT'S HOLE IS AT A RIGHT ANGLE TO THE  
ROD. BEND TWO PIECES OF FLAT METAL INTO A "U" SHAPE  
AS SHOWN AND SOLDER EACH TO THE END OF A 1/8" ROD  
"P". THIS WILL BE THE CONNECTING LINK BETWEEN THE  
ROCKER ARM AND THE DISPLACER PISTON ROD. NOW LETS  
MAKE THE FLYWHEEL TO ROCKER ARM ROD: SOLDER A 1/8"  
INSIDE DIAMETER TUBE TO THE END OF A 1/8" ROD "Q".  
SOLDER THE SECOND "U" SHAPED METAL TO THE OTHER END  
OF THIS ROD. THIS ROD WILL BE USED TO CONNECT THE  
ROCKER ARM AND THE CRANK. THE "U" SHAPED ENDS MUST  
BE SIZED TO FIT THE ROCKER ARM AND THE DISPLACER  
PISTON ROD.



CONNECTING ROD "Q"



DISPLACER END OF ROCKER ARM WILL REQUIRE TWO "Z" ENDS ON CONNECTING ROD. THE DISPLACER PISTON ROD WILL REQUIRE AN "X" END.

**STEP 13 FINAL ADJUSTMENT AND RUNNING**  
MAKE SURE ALL CONNECTING RODS AND LINKAGES ARE FREE TO MOVE. CHECK THE PISTON FIT IN THE CYLINDER; IT MUST BE FREE IN ORDER FOR THE ENGINE TO RUN RIGHT. ADJUST THE BURNER FLAME TO OBTAIN THE BEST RUNNING CONDITIONS FOR THE ENGINE. THE WATER WILL GET HOT ENOUGH TO BOIL! ALWAYS BE CAREFUL AROUND THE DISPLACER AS IT WILL BE VERY HOT. NEVER LEAVE YOUR ENGINE RUNNING UNATTENDED.