

OPEN COLUMN LAUNCH ENGINE

CALDWELL INDUSTRIES BOX 170, LULING, TEXAS 78648

A FEW COMMENTS ON MACHINING

Start with the flywheel. Hold it in the 3-jaw chuck, face off both ends & drill. It is large & hard, so it can be machined only a thousandth or two at a pass. This will set the temper of metal work on a Unimat. The piston, cylinder, cylinder head and crank disk are machined without disturbing the way the Unimat is set up.

Turn the jaws of the chuck around and machine the crankshaft rod and the columns. The steam line, steam connection pieces, wrist pin and crank pin are machined in much the same way but are held in the drill chuck rather than the 3-jaw.

Now consider the main bearing and valve housing. The critical point is that the centers of the holes which support the crankshaft be the same height from the base and parallel with it. First smooth the edges by holding in the 4-jaw chuck and facing, then finish by filing. Place the file flat on a table and move the parts on the file. To drill the holes for the crankshaft, a feature unique to the Unimat can be used. Firmly fasten the two pieces to the cross slide in place of the tool holder, and position the part in front of the headstock. Drill the holes, moving the headstock like a horizontal boring mill. This is much more rigid than with the headstock up on its vertical support.

The valve housing is drilled to 5/16". Turn the valve to fit the valve housing. It must be free to turn but without free play. When it gets close to size, remove as little metal as you can on each pass and carefully try the valve housing for fit. When it is the right size, drill the center hole without removing it from the chuck. Face off the other end, and the rough lathe turning is now complete.

Now convert the Unimat to a drill press. Firmly mount the base on the cross slide which is now used like a compound table. The base is moved around using the Unimat's feed handles for measuring. "Dot" the hole positions with a center drill and then drill them to size. Use the holes in the base to mark the locations of the holes in the main bearing, valve housing and bottom of the cylinder. The machine vice is used to hold the flywheel, main bearing, valve housing and piston. The 3-jaw chuck mounted on the arbor holds the crank disk, cylinder and cylinder head for drilling the radial holes. After tapping all necessary holes, assemble the engine (without the steam line) to measure the proper length of the connecting rod and then drill it.

Mill the ends of the base and the connecting rod. Use a 1/16" slitting saw held in the arbor to slot the piston and valve.

CONTINUED ON OTHER SIDE

DIMENSIONS

On these drawings, most parts are dimensioned in inches and fractions. It is generally not necessary to make these dimensions exact to the nearest thousandth, but to consider them as common sense guidelines.

The columns are shown to be 1 1/4". They could be an eighth of an inch either way with no problem. The piston must closely fit the cylinder bore. But it can be at 1/2" or 7/16". The valve must tightly fit the valve housing but the size does not really matter. The holes in the base must fit the holes in the parts that are attached. The main bearing, valve, and valve housing limit the lateral movement of the crankshaft and must fit tightly.

THE DESIGN OF THIS ENGINE

Any design is a compromise of many things in an attempt to meet specified goals. Here are the chief goals we had in mind.

This engine was designed to be the first complex model constructed by the builder, probably on a Unimat, using most of the features. The valve gear eliminates large numbers of small parts common to many other designs. No special castings are necessary. The engine is built entirely from standard stock shapes, and anyone is welcome to get the parts together and build his own. The design was intended from the beginning to be packaged as a kit. All parts, both rough stock and finished can be packaged conveniently. The retail price is lower than the price of individual components for a single engine, since it is difficult to locate small quantities of such materials.

We hope you agree that we have succeeded in providing an enjoyable model.

PARTS LIST

	NO.	NAME	QTY	DESC.	PRICE
COMPLETE					
PARTS KIT	\$4.95	F 1	FIL HD. BOLT	10	#4-40 X 1/4" \$.05
		F 2	HEX NUT	4	#6-32 .05
INDIVIDUAL		F 3	SET SCREW	1	#4-40 X 1/8" .10
PARTS MIN.	\$1.50	F 4	SET SCREW	1	#6-32 X 3/8" .15
NO.	NAME	QTY	DESC.	LENGTH	PRICE
R 1	FLYWHEEL	1	1 1/4" ROD	3/4" CRS	\$1.25
R 2	CYLINDER	1	1" ROD	1 1/2" AL	1.75
R 3	CYLINDER HEAD	1	1" ROD	1/4" AL	.75
R 4	CRANK DISK	1	3/4" ROD	5/16" CRS	.50
R 5	COLUMN	4	3/16" ROD/HEX	1 7/8" CRS	.10
R 6	PISTON &	1	1/2" ROD	1 1/2" CRS	.60
R 7	VALVE	1	1/2" ROD		R 7
R 8	VALVE HOUSING	1	5/16" X 5/8"	7/8" CRS	.50
R 9	MAIN BEARING	1	5/16" X 1/2"	7/8" CRS	.40
R10	STEAM LINE &	1	1/8" O.D. PIPE	4" BRASS	.40
R11	STEAM CONNECTION	2	1/8" O.D. PIPE		R10
R12	WRIST PIN &	1	1/8" ROD	1 1/8" CRS	.10
R13	CRANK PIN	1	1/8" ROD		R13
R14	CRANKSHAFT ROD	1	3/16" ROD	2 5/8" CRS	.25
R15	CONNECTING ROD	1	1/16" X 5/16"	1 3/4" CRS	.15
R16	BASE	1	1/8" X 1"	2 1/3" AL	.30

SECTIONAL VIEW THROUGH VALVE R 7 AND VALVE HOUSING R 8 AT SLOT B AND HOLE B.

POSITION J
VALVE OPENING
TO ADMIT STEAM
TO CYLINDER

POSITION K
POWER STROKE-
STEAM FLOWING
TO CYLINDER

POSITION L
STEAM VALVE
JUST CLOSED-
NO STEAM FLOW

POSITION M
NO STEAM IN

VALVE FUNCTION
AND ASSEMBLY

SECTIONAL VIEW THROUGH VALVE R 7 AND VALVE HOUSING R 8 AT SLOT A AND HOLE A.

POSITION J
EXHAUST VALVE
JUST CLOSED-
NO STEAM FLOW

POSITION K
NO STEAM
EXHAUST

POSITION L
EXHAUST VALVE
JUST OPENING

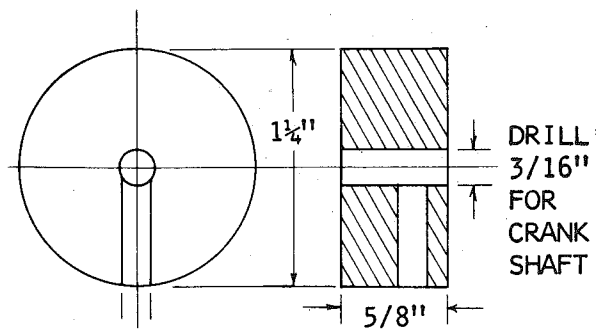
POSITION M
EXHAUST

VIEW OF PISTON, CONNECTING ROD AND CRANKSHAFT SHOWING RELATIVE POSITIONS BETWEEN VALVE AND PISTON.

ALL VIEWS FROM CYLINDER END OF ENGINE LOOKING TOWARD FLYWHEEL

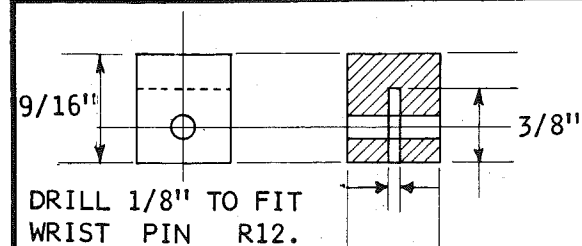
THE TOP OF THE VALVE HOUSING IS CONNECTED TO THE CYLINDER BY THE STEAM LINE R10. THE VALVE IS RIGIDLY CONNECTED TO THE CRANKSHAFT AND ROTATES AS THE ENGINE TURNS.

THESE VIEWS SHOW CLOCKWISE ROTATION WITH STEAM ENTERING FROM LEFT AND EXHAUST TO RIGHT. IF STEAM AND EXHAUST WERE REVERSED, THE ENGINE WOULD RUN THE OPPOSITE DIRECTION.



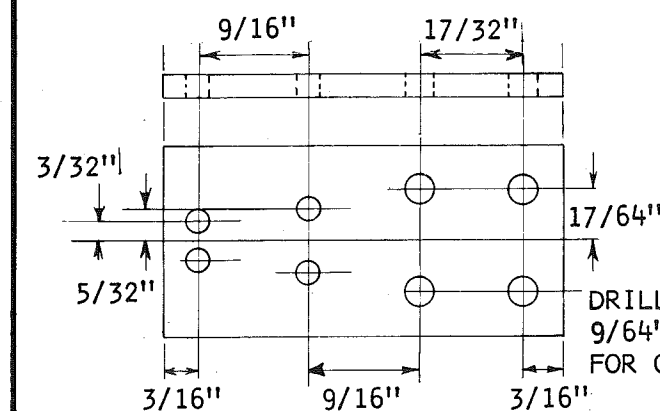
DRILL NO. 36
AND TAP 6-32
FOR SET SCREW
PART NO. F4

R 1 FLYWHEEL



DRILL 1/8" TO FIT
WRIST PIN R12.

R 6 PISTON



DRILL 4 HOLES 7/64"
CLEARANCE FOR F 1
BOLT TO FIT VALVE
HOUSING R 8 AND MAIN
BEARING R 9.

R16 BASE

DRILL HOLES IN BASE BEFORE
DRILLING CYLINDER, VALVE
HOUSING AND MAIN BEARING.
THEN USE THESE HOLES TO
MARK LOCATION OF MATING
HOLES.

COMMENTS ON MACHINING CONTINUED

Now it is time for final fitting and assembly. Convert the Unimat back into a lathe. The crankshaft rod and crank disk are screwed together but the rod will stick out too far. Hold the assembled parts in the drill chuck and cut the rod off flush with the disk, holding it the same way to face off the back of the pin. Use a centerpunch to stake these threads together and make a permanent assembly. Assemble the engine and the crank pin will be

DRILL THROUGH
AND TAP 6-32
TO FIT R10
STEAM LINE.

R 2 CYLINDER

HOLES IN ENDS OF
CYLINDER SHOULD
BE DRILLED AS
DEEP AS POSSIBLE
WITHOUT BREAKING
THROUGH SHOULDER

RADIUS
3/8"

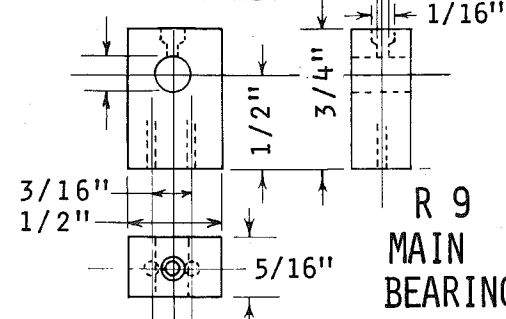
BOTTOM

TOP

DRILL FOUR HOLES NO. 36
EVENLY SPACED FOR COL-
UMNS R5 AND TAP 6-32

DRILL SIX HOLES NO. 43
TO MATCH CYLINDER HEAD
NO. R3 AND TAP 4-40

3/16" HOLE FOR
CRANKSHAFT ROD R14



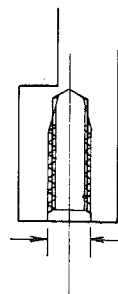
**R 9
MAIN
BEARING**

7/64"
1/8"
3/16"
1/4"
1 1/4"
1/4"
1/8"
THREAD BOTH
ENDS 6/32".

OPTIONALLY-
3/16" ROUND
STEEL COL-
UMNS MAY BE
USED.

R 5 COLUMN

ENLARGED VIEW OF
THREADS RESULTING WHEN
A TAPER TAP IS USED.
THE TOP OF THE COLUMNS
MUST BE MADE TO FIT
FLUSH. USE OF A BOTTOM
TAP WILL SOLVE THIS
PROBLEM. A SHORT RELIEF
HOLE IS DRILLED 9/64"
GIVING ROOM FOR THE
UNFINISHED LAST THREAD
OF THE TOP OF THE
COLUMN.



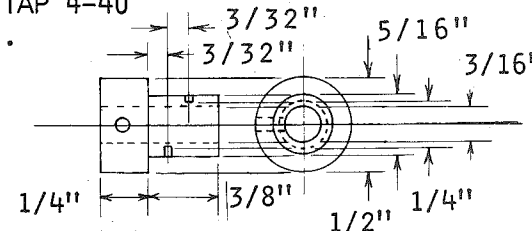
DRILL NO. 43 AND TAP 4-40
FOR SET SCREW F 3.

THE TWO SLOTS SHOWN
ON THE VALVE DO THE
ACTUAL SWITCHING OF
STEAM. THEIR FUNCTION
AND LENGTH ARE SHOWN
ON THE VALVE FUNCTION
AND ASSEMBLY DRAWING.

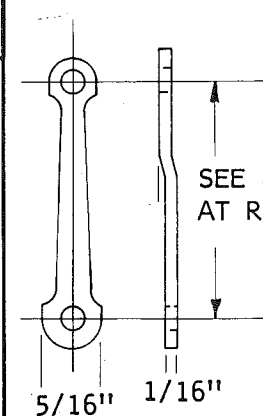
R 7 VALVE

SLOT A

SLOT B

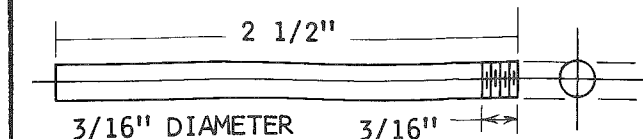


DRILL 1/8" TO FIT WRIST PIN R12
AND CRANK PIN R13. THIS PIECE
SHOULD BE THE LAST ONE MACHINED
AND IT SHOULD BE MACHINED TO FIT
RATHER THAN TO SPECIFIED DIMEN-
SIONS. THUS THE DISTANCE BETWEEN
THE HOLES IS TO BE MADE SUCH
THAT THE PISTON DOES NOT HIT THE
HEAD AND DOES NOT COME OUT OF THE
BOTTOM OF THE CYLINDER. THE
CORNERS AT THE TOP AND BOTTOM
ARE CUT OFF SO THE CONNECTING
ROD DOES NOT HIT THE PISTON OR
THE BASE. THE OFFSET IS SO THE
CONNECTING ROD DOES NOT HIT THE
CRANK DISK. THE RELIEVED SIDES
ARE MILLED OFF FOR APPEARANCE.



**R15
CONNECTING ROD**

SEE NOTE
AT RIGHT



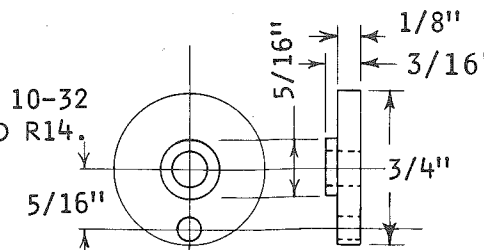
**R14
CRANKSHAFT ROD**

THREAD END 10-32 TO FIT
CRANK DISK R 4. AFTER
ASSEMBLY STAKE WITH
CENTERPUNCH TO PREVENT
UNSCREWING.

DRILL NO. 21 AND TAP 10-32
TO FIT CRANKSHAFT ROD R14.

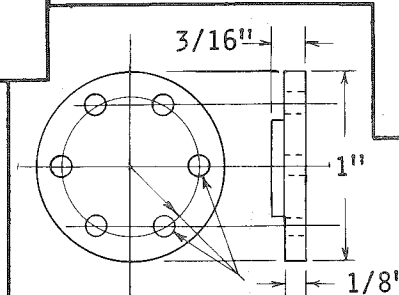
DRILL NO. 36 AND TAP 6-32
TO FIT CRANK PIN R13.

R 4 CRANK DISK



DRILL THREE HOLES NO. 36 AND
TAP 6-32. ONE HOLE TOP CENTER,
AND ONE HOLE ON EACH SIDE OFF-
SET 1/16" FROM CENTER.

DRILL TWO MOUNTING HOLES
NO. 43 AND TAP 4-40 FOR F 1
BOLT. HOLES MUST MATCH
THOSE IN BASE R16.



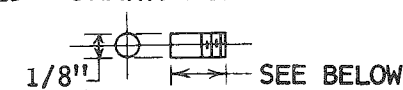
SIX HOLES 7/64"
3/8" RADIUS CLEARANCE
FOR F 1 BOLTS

R 3 CYLINDER HEAD

THESE TUBES ARE CONNECTION
POINTS FOR PRESSURE AND
EXHAUST. A MORE PERMANENT
CONNECTION MAY BE USED
IF DESIRED.

R11 STEAM CONNECTION

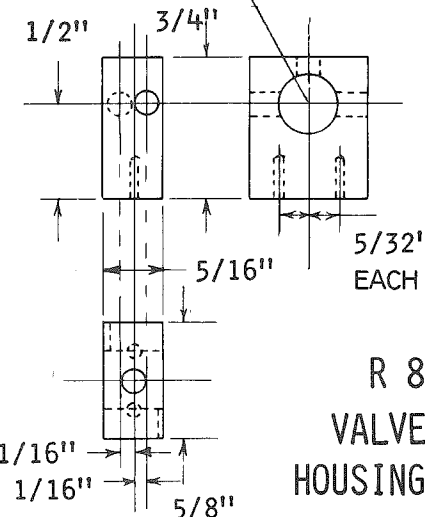
R13 CRANK PIN



THREAD END 6-32 TO FIT CRANK
DISK R 4. AFTER ASSEMBLY
STAKE WITH CENTERPUNCH TO
PREVENT UNSCREWING.

LENGTH TO BE DETERMINED
AT ASSEMBLY. MAKE AS LONG
AS POSSIBLE UNTIL ASSEMBLY
OF ENGINE. THEN SHORTEN SO
PIN JUST CLEARS COLUMNS
WITHOUT ROOM FOR CONNECTING
ROD TO COME OFF. SEE
ASSEMBLY DRAWING.

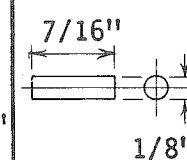
DRILL 5/16" HOLE
FOR VALVE



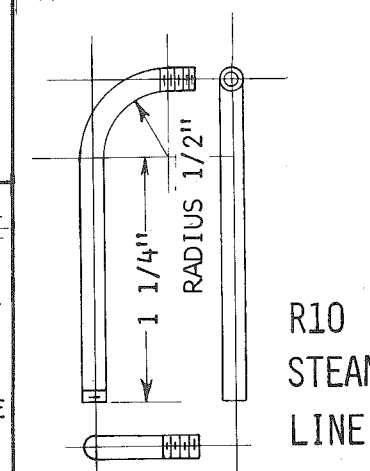
**R 8
VALVE
HOUSING**

HOLE A 1/16"
HOLE B 1/16"

THREAD EACH END 6-32
TO FIT CYLINDER R 2
AND VALVE HOUSING R 8.



**R12
WRIST PIN**



**R10
STEAM
LINE**

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