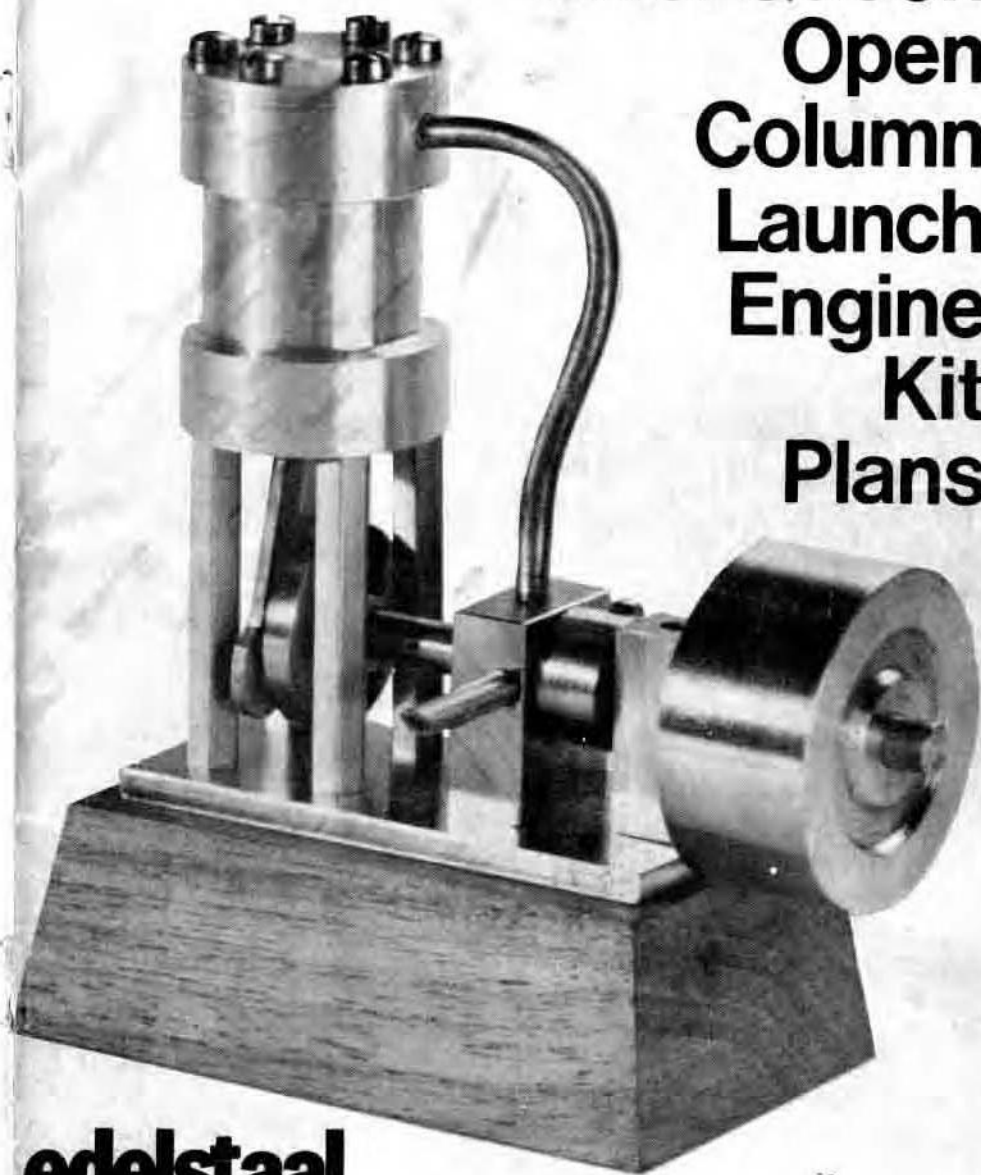


BOOKLET NO. B-100

\$1<sup>00</sup>

# River Queen Open Column Launch Engine Kit Plans



**edelstaal**  
ENGINEERING MODEL SERIES

Published by the EDELSTAAL TECHNICAL INSTITUTE

# BUILDING A WORKING-MODEL OPEN COLUMN LAUNCH ENGINE

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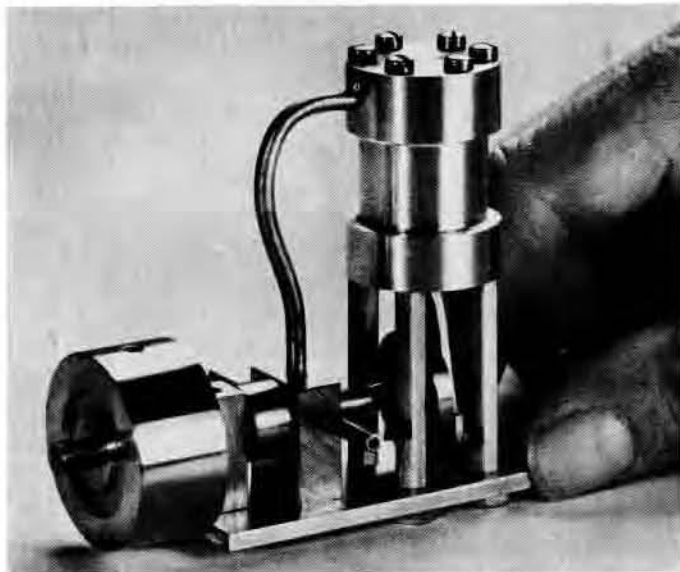
## INTRODUCTION

Working models of old-time steam engines have enduring fascination for anyone interested in mechanics. Building a miniature version of a chugging prime mover of years past is a very satisfying project, and it's a job that even beginning modelmakers can easily accomplish successfully if they work with reasonable care.

Of the many types of engine that utilized steam (beam, oscillating cylinder, slide valve mill engine, etc.), the light open column marine engines wide-

ly used in the late 1800s to power small steam launches are perhaps simplest to model. The 1/2"-bore single-acting engine shown on these pages is an engine of this type.

Launch steam engines ordinarily were built with single vertical cylinders supported on four upright columns, or pillars, with the connecting rod crank-driving a short main shaft fitted with a heavy small-diameter flywheel. This arrangement permitted mounting the engine low in the hull of the launch with the engine shaft



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## EQUIPMENT NEEDED:

Basic Unimat  
3-jaw or 4-jaw spindle chuck  
Machine vise  
Drills, taps and dies  
Hand tools  
Drill chuck



*The materials kit includes cut metal for all parts, screws and drawings*

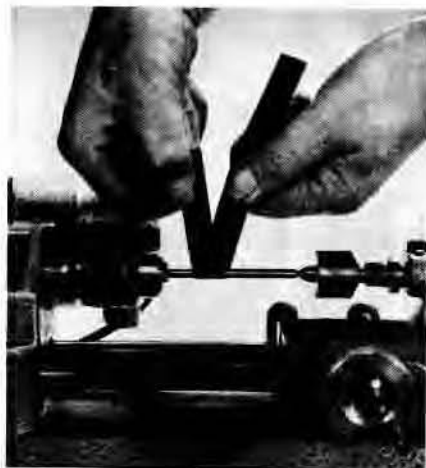
aligned with the craft's propeller shaft. The slow-speed engine then could drive the propeller directly through a flexible coupling. A coal-, cordwood- or oil-fired boiler (burning the fuel most readily available locally) mounted amidships supplied steam to the engine at around 150 lbs. working pressure, with a valve in the steam line serving as a throttle. Probably the most familiar example of a steam launch of this kind is the *River Queen*.

These launch engines were not particularly efficient — their boilers consumed about 1½ lbs. of coal per horsepower per hour — but they were robust and reliable. Engines of this type remained in use until early in this century, when the internal combustion engine made the picturesque steam launch obsolete.

The simplified model launch engine this booklet describes was designed especially for novice machinists to ma-

chine on the Edelstaal Unimat. All parts can be readily machined from metal in stock shapes, and the easy-to-fit rotary valve on the engine's shaft makes the many small parts other types of valve require unnecessary. The materials kit for the engine, which includes rough-cut metal for all parts together with all fastenings, is lower in price than engine kits with ready-machined components.

Although the parts drawings give exact dimensions, it isn't necessary to machine this engine's parts to close dimensional tolerance. Instead, parts can simply be machined to fit. For example, the cylinder bore needn't measure exactly 1/2" in diameter; it can be slightly larger or smaller than nominal size provided the piston fits the bore. Similarly, the exact size of the valve housing's bore isn't important provided the valve is turned to closely fit the housing.



*Polishing the engine's shaft*



*Drilling the flywheel*

#### CONSTRUCTION

Begin with the engine's shaft. The stock supplied is proper diameter and ready for polishing. With the Unimat set up as a lathe, chuck the shaft and centerdrill one end. Then, gripping one end of the stock in the drill chuck and supporting the centerdrilled end with the tailstock center, polish the shaft smooth with very fine 600-grit silicon carbide paper, removing no more metal than necessary.

Next turn the flywheel, which is machined from 1½"-diam. steel. Grip the stock securely in the Unimat's 3-jaw chuck, tapping it as you tighten the chuck's jaws until the outer end runs true, and face the wheel's side. Since steel is a hard-to-cut material, sharpen the lathe's tool bit needle-sharp. Set the tool at a right angle to the work and feed the facing cuts from the center out, using the Unimat's slowest spindle speed and taking very light cuts (about .002" deep, or one mark on the feed handwheel's hub) to avoid chatter. If you have a slow-speed attachment for your Unimat, you can use still slower spindle speed and take deeper cuts. Turning shallow recesses

in the sides of the wheel as shown in the photos improves its appearance.

After finish-turning the wheel's diameter for half its width, reverse the work in the chuck and face the opposite side similarly. Then centerdrill and drill a pilot hole through the wheel with an 1/8" twist drill held in the drill chuck mounted on the Unimat's tailstock, drilling at slowest spindle speed. Withdraw the drill frequently as the hole deepens to clear chips from the flutes and flood the hole with light machine oil. Then enlarge the 1/8" pilot hole with a 3/16" drill, using a new drill to avoid drilling the hole oversize. To drill the hole for the flywheel's setscrew, set the Unimat up as a drill press and grip the wheel in the machine vise.

With the flywheel fixed on the end of the shaft with its setscrew, chuck the shaft in the lathe and true the flywheel's diameter with a very light finishing cut. Then polish the wheel with fine abrasive cloth.

Next thread the opposite end of the shaft with a 10-32 die for the screwed-on crank disc. (If you lack the 10-32 tap and die, turn the shaft end to a shouldered tenon that can be inserted

through the hole in the crank disc and riveted over.)

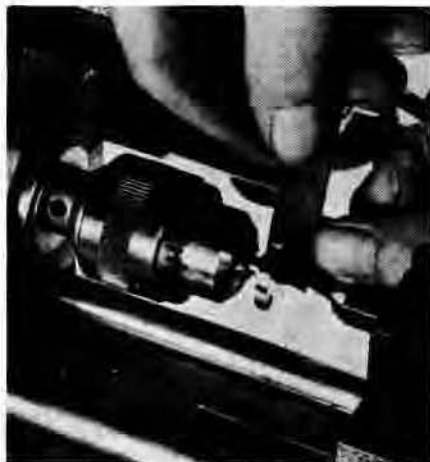
Turn the hubbed crank disc from the piece of mild steel supplied and drill and tap its center hole 10-32. To drill the offset hole for the crankpin, set up the Unimat as a drill press and grip the disc in the machine vise by its hub. Tap the pin hole 6-32. Then screw the crank disc firmly on the shaft, stake the threads (or smear them with filled epoxy cement) to prevent unscrewing, and with the shaft chucked in the drill chuck on the lathe spindle, true the disc with very light finishing cuts and polish it with fine abrasive cloth. Then thread the end of the crank pin and screw it into the disc, staking the pin's threads similarly. Leaving the pin over-length will permit trimming it to exact length when the engine is assembled.

It's important to make sure before machining the engine's cylinder that the Unimat's headstock is precisely aligned with the bed, since it would be impossible to fit the piston satisfactorily in a tapered cylinder bore. Also before turning the cylinder, chuck the length of 1/2"-diam. steel included in the kit (both piston and valve are cut from

this stock) in the Unimat's 3-jaw chuck, face one end, and take a very light truing cut on the stock's diameter the length of the piston, removing no more metal than necessary. Smooth off burrs and polish the turned surface with fine abrasive cloth. This stock now can be used as a plug gauge for boring the cylinder, after which the piston will be slotted and cut off.

The cylinder is turned from free-machining aluminum. First turning a short 3/4"-diam. tenon that can be gripped in the 3-jaw chuck on one end of the aluminum slug and centerdrilling the opposite end for the lathe's dead center will simplify turning the cylinder's outer diameter and central recess.

After turning, bore the cylinder without removing it from the chuck. Drill through the work lengthwise with a 3/16" drill, using slowest spindle speed and withdrawing the drill frequently to clear chips. Then enlarge the hole using successively larger drills to about 3/8" in diameter. Finally, finish-bore the hole accurately to size — until the piston fits with close sliding fit — with a boring tool. (If you lack a boring tool for your Unimat, you can



*Polishing the crank disc*



*Turning piston for use as plug gauge*



*Drilling the engine's aluminum cylinder*



*Boring the cylinder to accept piston*

grind one from a blank tool bit or length broken from an old round or triangular file.) As the bore nears finish size, set the Unimat's carriage movements up snugly and feed the final cuts slowly and continuously to machine the cylinder wall to a perfectly smooth finish. Work patiently, taking extremely light final cuts to fit the piston as carefully as you can, for the piston has no rings and must fit the bore closely. When the cylinder is bored, turn off the chucking tenon.

Next complete the piston, slotting it and cross-drilling for the wrist pin. You can saw the slot for the connecting rod using a slitting saw blade mounted on the Unimat's saw arbor, or you can do the job satisfactorily by hand with a fine-toothed hacksaw blade.

That done, turn the aluminum cylinder head, which has a locating boss that should closely fit the cylinder bore. Having finish-turned the head, lay out centers for six screw holes, spacing them equally on a 3/4"-diam. circle with dividers and centerpunching lightly. Convert the Unimat to a drill press and grip the head by its boss in the machine vise to drill these six 7/64" holes. Then use the drilled head as a template to locate matching No. 43 holes in the top of the cylinder. Drill the holes in the cylinder as deep as possible without breaking through the end shoulder and tap them 4-40, starting the threads with a taper tap and finishing them with a bottoming tap. (Lacking a bottoming tap, you can simply grind off some of the tapered end of the taper tap.)

Next make the engine's steel baseplate. The edges and rough-cut ends of the plate can be nicely finish-ground with a cup wheel on the Unimat's grinding arbor, or you can square them with a file. To smooth up the top and bottom faces, rub the plate on medium-grit abrasive cloth placed on a flat surface. Then lay out and centerpunch the plate's eight screw holes, measuring carefully and using a small square to

scribe accurate centerlines. To drill the holes, set up the Unimat as a drill press and grip the plate in the machine vise with its top face flush with the vise jaws. Drill the holes at the Unimat's slowest spindle speed.

Having drilled the plate, use it as a template to mark locations of the four tapped holes in the bottom of the cylinder for the four supporting columns. Drill these holes with a No. 36 drill, taking care not to drill through the cylinder's end shoulder, and tap the holes 6-32. Use a bottoming tap or ground-off taper tap to thread these holes full-depth.

The four hexagonal steel columns supporting the engine's cylinder have turned-down ends threaded to shoulders. Threading the column's ends will be quite easy if you have a thread-chasing attachment for your Unimat. Lacking the thread-chasing attachment, you can thread the ends satisfactorily with a 6-32 die if you reverse the die after the threads are well started to cut them close to the shoulder. (If you have difficulty threading the columns, simply turn them off square, drill and tap the ends, and cement in studs cut from 6-32 screws with filled epoxy cement.) Having threaded the top ends, measure and mark the length of the columns from the top shoulder and turn and thread the bottom ends. The four columns must be exactly equal in length, shoulder to shoulder, to support the cylinder squarely.

You can finish-machine the engine's front bearing and valve housing blocks by gripping the rough stock in the lathe's 4-jaw chuck and facing each side, or you can surface-grind the blocks with a cup grinding wheel. The easiest way to bore the holes through the two blocks is to set up the Unimat as a horizontal boring mill, mounting a drill in the drill chuck on the lathe spindle and clamping each block in turn squarely on the carriage with a stud clamp. This will insure that the centerlines of the holes in the two



*Tapping steam port in cylinder*



*Drilling the baseplate's screw holes*



blocks will be at identical height. Use slowest spindle speed when drilling the blocks, first drilling small pilot holes and then enlarging the pilot holes with progressively larger drills. The bearing block has a 3/16" hole. The hole in the valve housing is 5/16" in diameter and must have a smooth finish. Drill this larger hole slightly undersize and then ream it, using either a chucking reamer or a 5/16" end mill run at the Unimat's slowest spindle speed. Squirt on cutting oil liberally when drilling or reaming steel.

When the blocks are bored, set up the Unimat as a drill press and drill the three steam ports in the valve housing block. Locate the top port, which supplies steam to the cylinder, on the block's centerline. The centers of the two side ports, inlet and exhaust, are offset 1/16" from the block's centerline. The inlet port is offset 1/16" towards the cylinder end of the engine, and the exhaust port is offset 1/16" towards the flywheel end. After tapping these three ports 6-32, carefully scrape away burrs left inside the valve housing's bore.

Then turn the valve to an accurate

sliding fit in the valve housing. Finish the working surface of the valve carefully, taking very light cuts with a sharp lathe bit and reducing diameter very gradually until the valve turns freely in the housing but has no play. For satisfactory seal the valve must fit the housing's bore precisely. (If you should cut the valve too small, try again with a new piece of steel.) When the valve fits, face the end and shoulder and drill the 3/16" center hole before removing the part from the chuck. Then reverse the valve and face the opposite end.

With the valve drilled and tapped for its 4-40 setscrew, slide the valve housing, valve and front bearing block on the engine shaft and clamp the assembly temporarily in place on the baseplate, making sure that the shaft aligns with the plate's centerline. Then mark locations for mounting screw holes on the two blocks through the holes in the baseplate. Drill and tap the holes in the blocks 4-40. Always use cutting oil when tapping steel.

Next screw the valve assembly on the plate and mark the valve's two steam passage grooves, rotating the valve in its housing and lightly scribing



*Sawing the piston's slot*

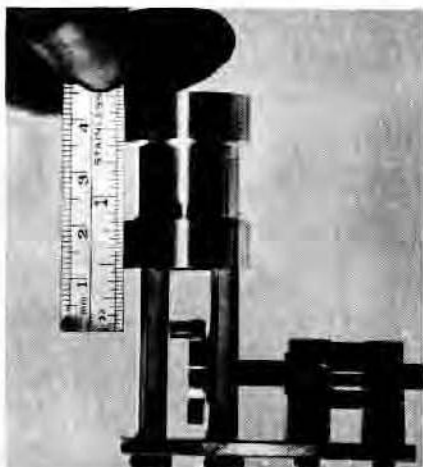


*Reaming hole in the valve housing*





*Scribing centerlines for valve grooves*



*Measuring length for connecting rod*

the centerline for each groove through the top port. Hold the scribe against the cylinder side of the port to scribe the inlet groove's centerline and against the flywheel side of the port to scribe the exhaust groove's centerline. Each groove runs half-way around the valve. Establish beginning and ending points for each groove as shown in the valve operation diagram. The steam inlet groove provides a steam passage that connects the side inlet port with the top cylinder port during the first half of each revolution of the valve. The steam exhaust groove provides a steam passage that connects the top cylinder port with the side exhaust port during the second half of each revolution of the valve.

If you have an indexing and dividing head for your Unimat, you can mill these two grooves with nice precision using a 1/16"-diam. miniature end mill. Lacking the indexing head, you can cut the grooves satisfactorily by hand using a hacksaw blade and knife-edged file. The two grooves should have square rather than V-shaped cross-section. Avoid marring the working surface of the valve as you cut them.

#### FINAL ASSEMBLY

Now begin final fitting. Screw the valve assembly and front bearing to the baseplate. Then screw the four hexagonal supporting columns into the bottom of the cylinder and lower the cylinder assembly over the crank disc. This done, measure the proper length for the connecting rod, which should be cut to fit. With the piston just clearing the cylinder head and the crank disc's pin at top center, measure the distance between the piston's wrist pin and the crank pin, center to center. Drill 1/8" holes spaced this distance apart in the 1/16"-thick stock supplied for the connecting rod and then grind or file the rod to the profile shown. Bending the rod to a slight offset allows it to clear the crank disc. Shorten the crank pin with a file just enough to clear the columns.

Timing the engine is simply a matter of holding the piston at top dead center and rotating the valve on the engine's shaft until the leading end of the valve's steam-inlet groove can be seen through the top cylinder port. Lock the valve in this position with its setscrew.

Finally, cut to length and thread the



*Bend the rod to clear the crank disc*

ends of the soft copper-tube steam line supplied with the kit. Bend the tube to a neat curve with your fingers, taking care not to collapse it, and screw the top end into the cylinder, using pipe-joint compound on the threads. To screw the bottom end into the valve housing, disassemble the engine, screw the valve housing on the end of the tube, and reassemble. Cutting and threading short copper-tube nipples and screwing them into the valve block's inlet and exhaust ports will simplify connecting steam or air lines to the engine. Make sure that the ends of the copper tubes do not bind the valve.

You can run your engine either with steam from a small boiler or with compressed air from a paint-spraying compressor. A well-built engine at first runs stiffly, but its bearing surfaces will soon wear in. Keep the front bearing oiled, oil the valve through its exhaust port and oil the cylinder bore from the bot-

tom. The engine's direction of rotation can be reversed by interchanging inlet and exhaust lines.

If you want to paint your engine, paint the baseplate, valve housing and front bearing block with a spray can, leaving all other parts bright-finished. The color traditionally used on steam engines was flat medium-olive-drab green.

Small steam engines have surprising power for their size, and a 1/2"-bore engine will drive a model boat up to two feet long. To mount the engine on stringers in the hull of a model launch, bolt two lengths of angle stock to the bottom of the baseplate and bolt these mounting fittings through the stringers.

Don't hesitate to modify the design of this engine to suit yourself. If you prefer a more closely-coupled engine, simply shorten the baseplate and shaft. If you prefer brass bearing blocks, substitute brass for the steel supplied in

the kit. A machined copper or brass elbow fitting can be used to make the bend in the steam line.

If you want to mount your engine for display, cut a 3/4"-thick walnut block with 10 degree edge-bevels for a sub-base. Routing recesses in this block for the nuts and screw-heads on the bottom of the engine's baseplate will permit mounting the model flat on the block. After sanding the wood smooth, give the sub-base two coats of flat varnish or

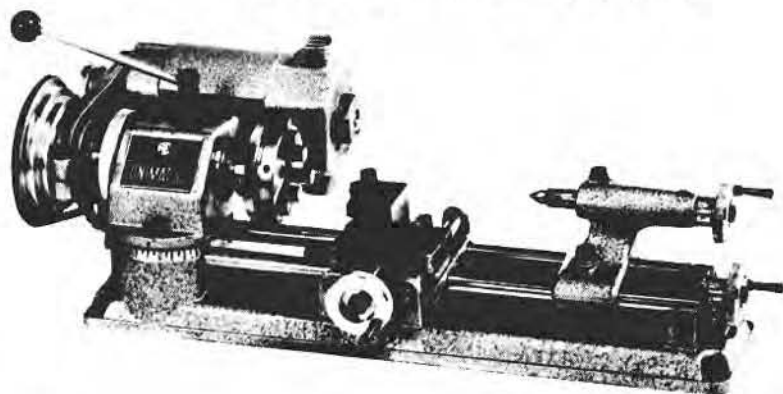
flat black paint and secure the engine on its base with small dabs of epoxy.

Edelstaal material kits for more advanced model steam engines machined from castings are available, and the line also includes model cannon kits and other interesting projects that can be machined on your Unimat. See these new kits at your Edelstaal dealer, or write to American Edelstaal, Inc., 1 Atwood Avenue, Tenafly, New Jersey 07670, for literature. END



*Here's the finished engine*

For Unimat owners.

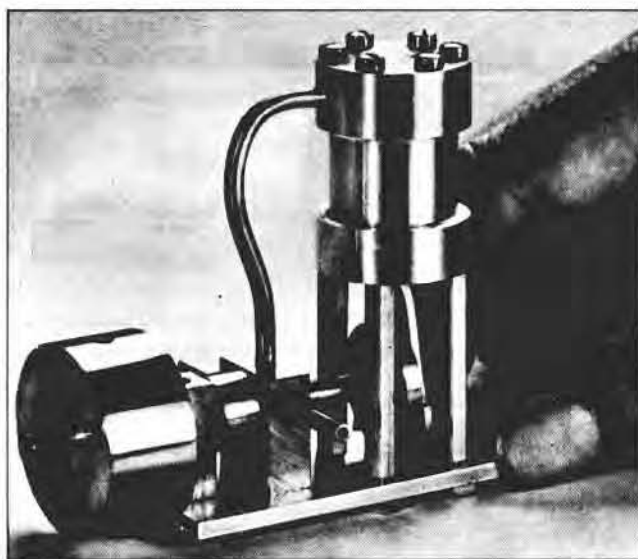


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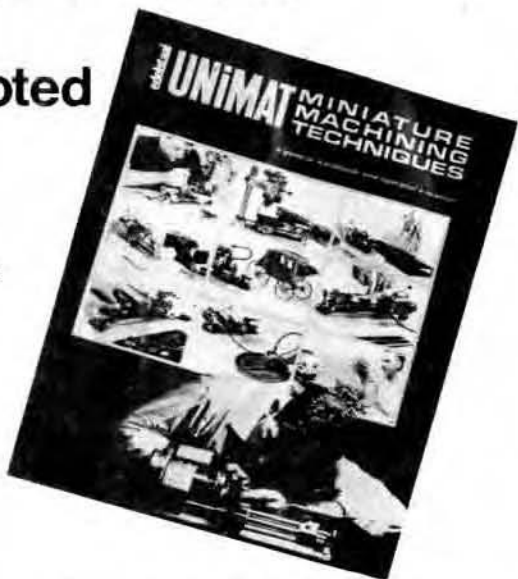
Steam-powered pick-up truck actually operates, is only 4 1/4" long, comes complete with engine, boiler and gear drive.

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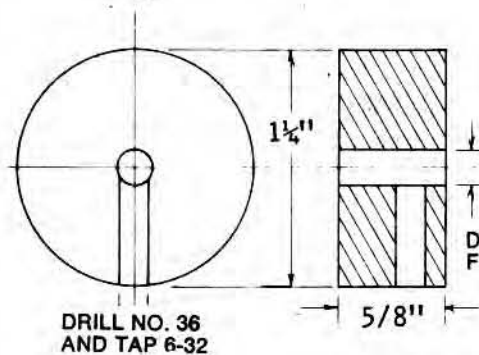
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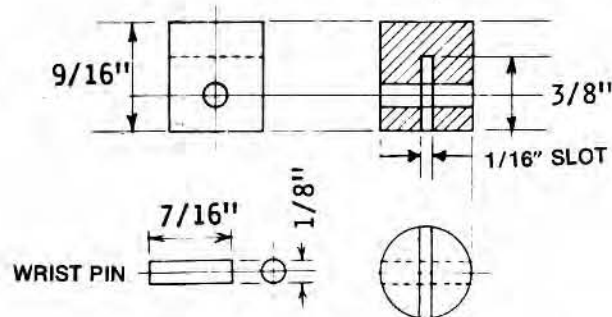
Printed in USA

# OPEN COLUMN LAUNCH STEAM ENGINE

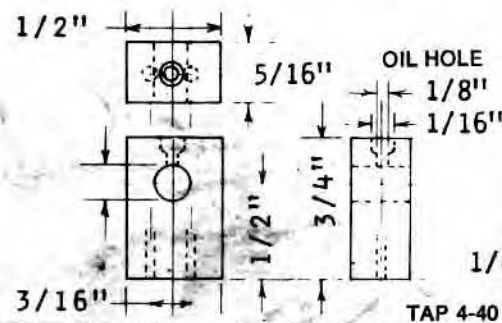
ALL DRAWINGS ACTUAL SIZE



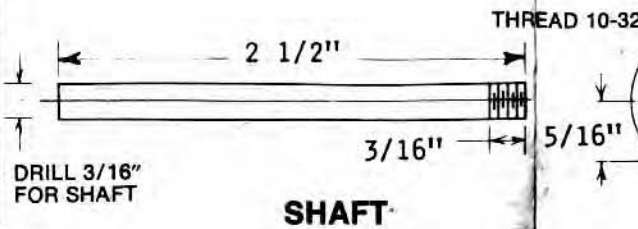
FLYWHEEL



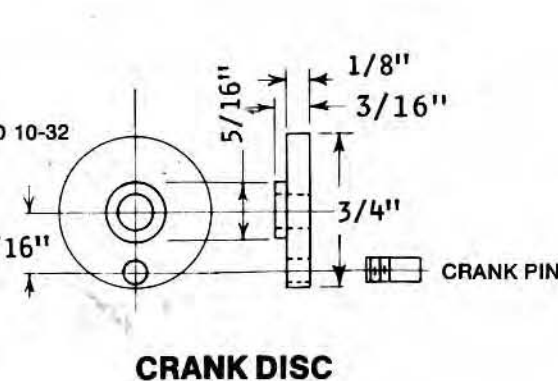
PISTON



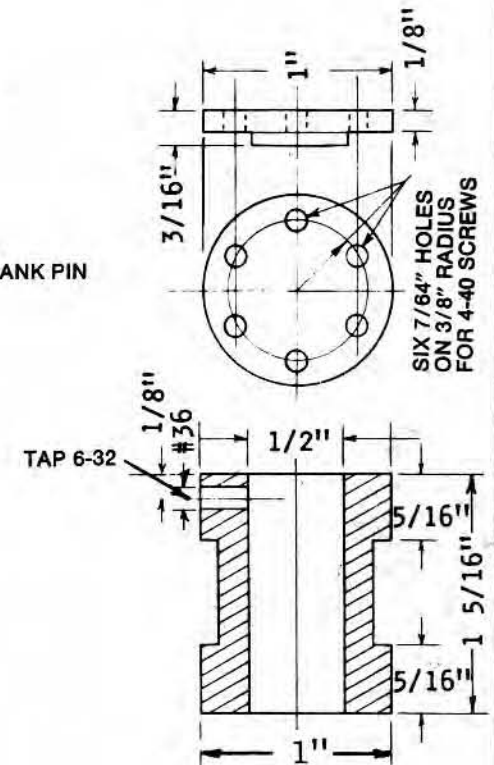
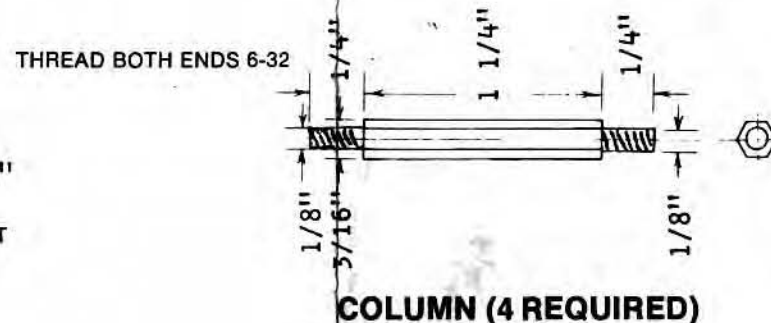
FRONT BEARING



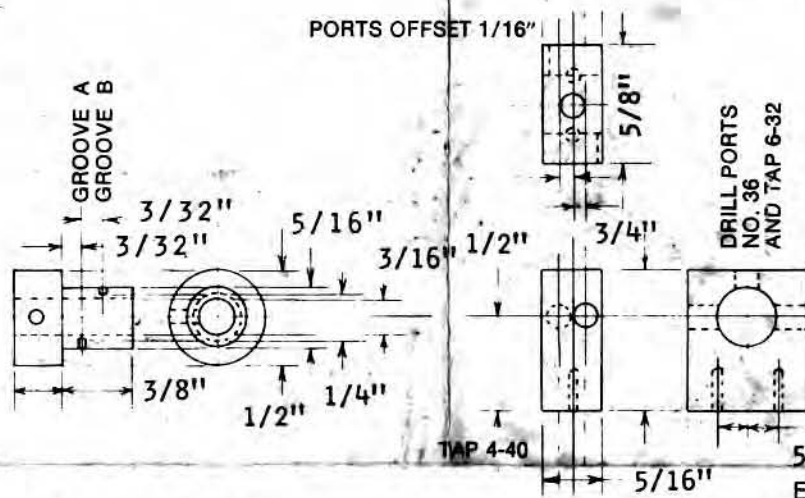
SHAFT



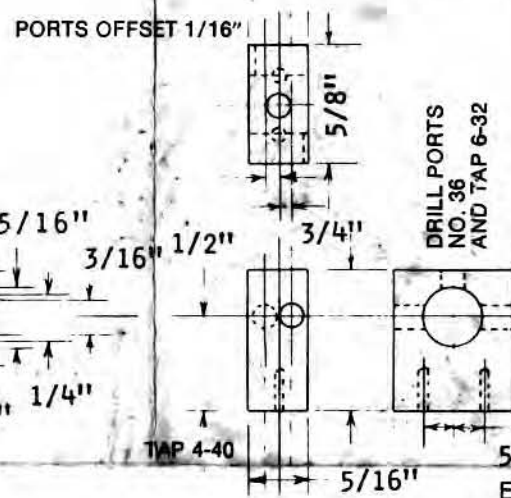
CRANK DISC



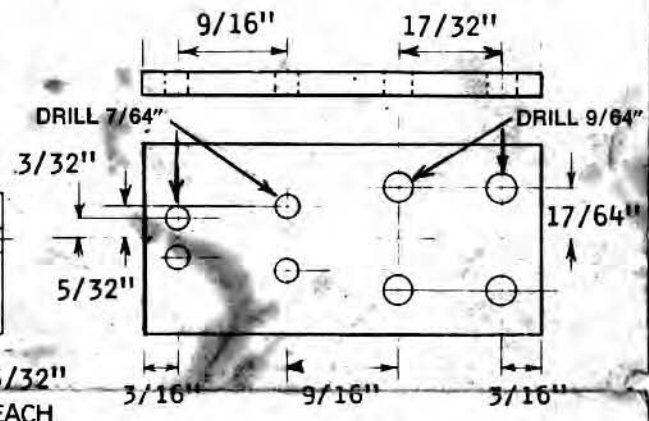
CYLINDER AND HEAD



ROTARY VALVE



VALVE HOUSING



BASEPLATE



## FRONT BEARING

## ROTARY VALVE

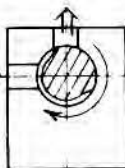
## VALVE HOUSING

## BASEPLATE

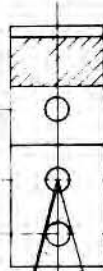
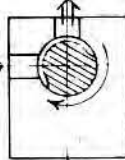
SECTIONS THROUGH VALVE  
AND VALVE HOUSING AT  
GROOVE B and PORT B

*small end*

POSITION J  
VALVE OPENING  
TO ADMIT STEAM  
TO CYLINDER



POSITION K  
POWER STROKE —  
STEAM FLOW  
TO CYLINDER



POSITION J

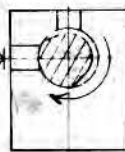
POSITION M

POSITION K

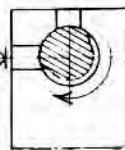
POSITION L

PISTON, CONNECTING ROD  
AND CRANK DISC SHOWING  
RELATIVE POSITIONS OF  
PISTON AND VALVE

POSITION L  
STEAM VALVE  
JUST CLOSED —  
NO STEAM FLOW



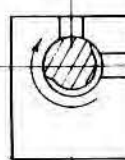
POSITION M  
NO STEAM IN



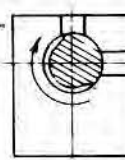
SECTIONS THROUGH VALVE  
AND VALVE HOUSING AT  
GROOVE A AND PORT A

*shoulder side*

POSITION J  
EXHAUST VALVE  
JUST CLOSED —  
NO STEAM FLOW



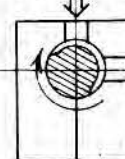
POSITION K  
NO STEAM  
EXHAUST



POSITION L  
EXHAUST VALVE  
JUST OPENING



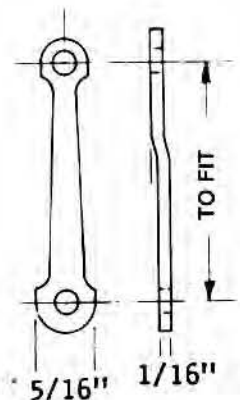
POSITION M  
EXHAUST FLOW



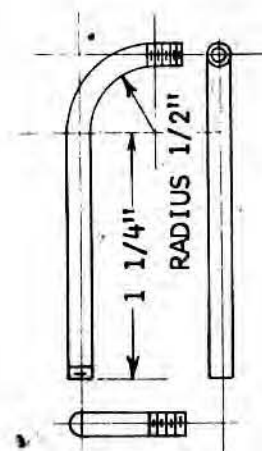
ALL VIEWS FROM CYLINDER END OF EN-  
GINE LOOKING TOWARDS FLYWHEEL. DIA-  
GRAMS SHOW CLOCKWISE ROTATION WITH  
STEAM INLET AT LEFT AND EXHAUST AT

RIGHT. VALVE HOUSING'S TOP PORT IS  
CONNECTED TO THE CYLINDER BY THE  
STEAM LINE. THE VALVE IS FIXED ON THE  
SHAFT AND ROTATES AS THE ENGINE RUNS.

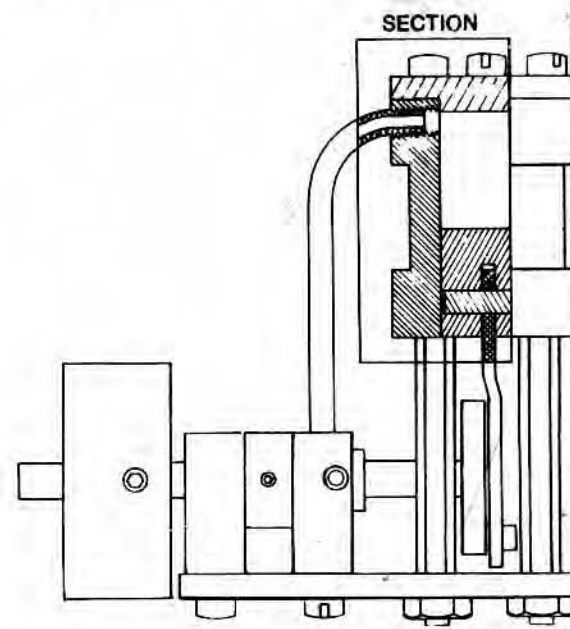
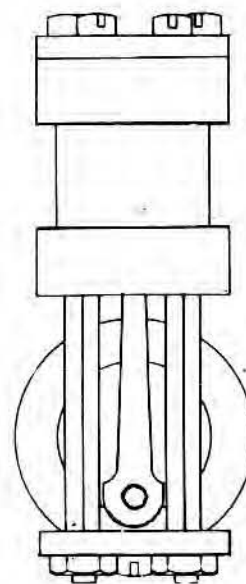
## VALVE OPERATION



## CONNECTING ROD



## STEAM LINE



## ASSEMBLY