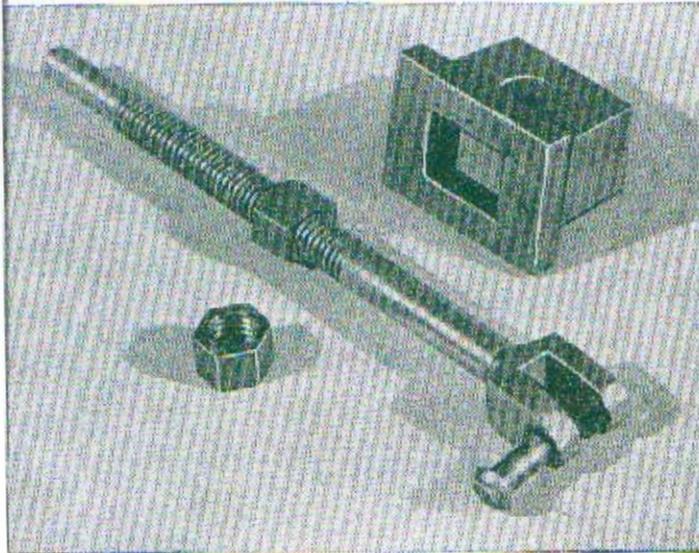
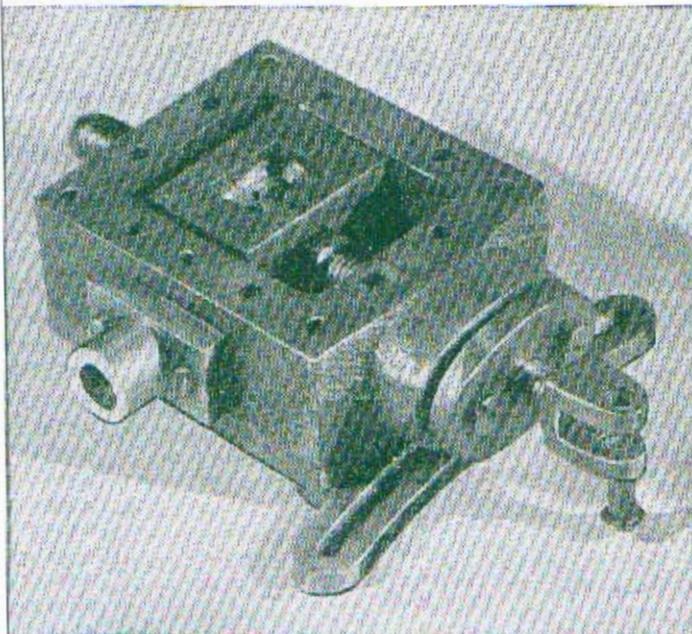


**Vertical  
Steam Engine  
PART FOUR**

Here's the finished job as she'll look when you make the parts described in this last installment



The slide valve is located on the valve rod by a pair of locking nuts that provide travel adjustment. The nuts must be a tight fit on the thread.



Steam chest and valve assembly. The valve is not clamped snugly but floats between the nuts so that steam pressure can hold it against the port face.

# Building the

AT ONCE the most fascinating and the most difficult part of this engine to build, the reverse gear is derived from Stephenson's famous link motion. The valve rod, which moves the slide valve over the ports, is not connected directly to an eccentric at all, but to a small block that slides in a slotted quadrant or link. Two eccentrics, oppositely offset to give the correct advance for both forward and reverse running, are connected to the two ends of this link. A control lever connected through a drag link can shift the slotted quadrant and its connecting eccentric rods one way or the other, bringing the link block and consequently the valve into line with either the forward or the backward eccentric, and so determining which way the engine will run.

When the link block is midway in the slot, no motion is imparted to the valve even if the crankshaft is turning, and the engine will soon stop. Either side of this position, though, the valve will operate with reduced travel. Steam will be cut off during a greater part of the stroke, saving on fuel, a condition analogous to high gear in an automobile transmission and precisely that which obtains in a steam locomotive running at high speed with a moderate load.

The slide valve consists of two pieces of bronze, the face a piece of  $\frac{1}{8}$ " plate in which a rectangle is cut by drilling and filing to form the steam cavity or recess. To this is silver-soldered a bronze block. The hole for the valve rod is filed slightly oval with a needle file so that the valve has some slight play against the port face and may be held on it firmly by steam pressure.

Turn the valve rod from  $\frac{5}{16}$ " square steel rod, shouldering the end to a sliding fit in the guide atop the steam chest and threading the stem with some fine thread such as 8-36 or 6-40. Drill the square end for the  $\frac{3}{32}$ " pin that will connect it to the link block, cut the slot, and file to shape.

Eccentrics can be turned from short ends of stock. Chuck a piece  $\frac{3}{32}$ " off center, turn the hub, and drill and ream the  $\frac{1}{8}$ " shaft hole. Then chuck the piece truly in the three jaw to turn the 1" outside diameter and the  $\frac{1}{8}$ " groove, and cut off. Make a second eccentric with no hub. [Turn the page.]



Face both smooth, slip them on a short piece of  $\frac{3}{8}$ " rod, and rivet together at exactly the angle shown in the drawings.

To make the eccentric straps, cut two pieces  $1\frac{1}{2}$ " long from  $3/16$ " by  $\frac{3}{8}$ " cold-rolled steel for each strap. Lay out, drill, and tap the bolt holes for fastening the two halves together. Those in the lower half are drilled out to clear the  $7/64$ " bolts. With the halves bolted together, each blank is chucked and bored to a running fit on its eccentric. The outside is then roughly sawed and brought to final shape by hand filing.

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With dividers, carefully lay out the reverse link on  $\frac{3}{8}$ " steel plate. To make the slot, drill a series of undersized holes, drill between to overlap them, and finally file to the radiuses. Drill for the eccentric-rod pins and finish the outside by filing to shape. Note that the link block has sides of the same curvature as the link slot, in which it should be a perfect sliding fit, without play.

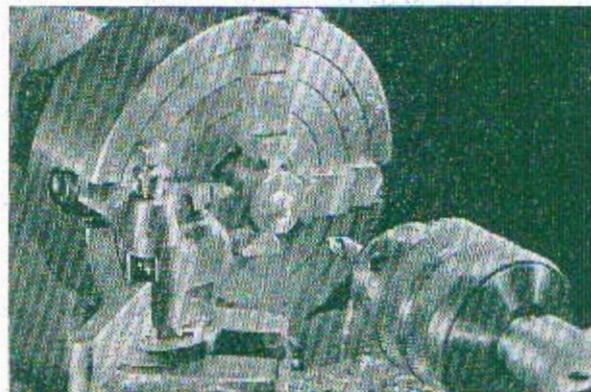
The reverse lever and its quadrant, drag link, and clamping nut offer no special difficulties. With the various short pins and the valve-rod nuts, you are ready to assemble the valve gear. One of the photos shows it in a trial assembly, less the reverse lever.

Assemble the steam chest, valve, valve rod and adjusting nuts, and gland as in the photo on page 174. Be sure the valve rides freely on the rod so that its face may be lifted a trifle above the bolting surface of the chest in the position shown—enough to allow for more than the thickness of a gasket between chest and port face. To allow full contact with the port face, the adjustment nuts should be drawn up only to position the valve, not to clamp it. Either tap the nuts somewhat less than full thread depth for a tight fit on the rod, or make two thin nuts out of each one to provide locking.

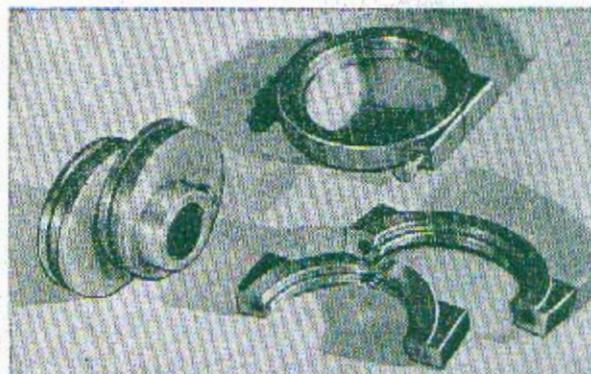
With the cylinder and running gear assembled, mount the steam chest temporarily without the cover and connect the eccentric rods to the link. Set the two eccentrics on the shaft so that the crankpin throw bisects the angle between the eccentrics. You can then observe the valve travel by turning the crankshaft.

Steam ports should just begin to open as the piston reaches top or bottom dead cen-

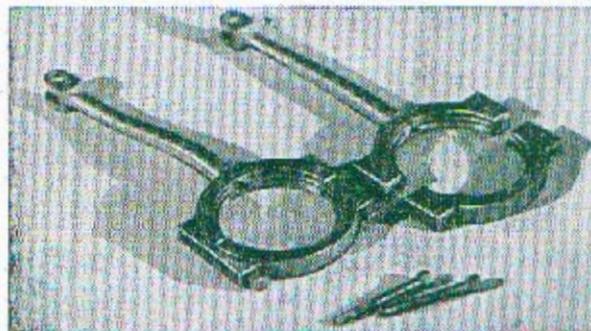
ter. The valve should uncover both ports to an equal degree, and at no point expose the exhaust port. These conditions will best be observed at full forward and full reverse setting, with the link block at the two ends of the slot. At intermediate positions valve travel will be shortened, and cutoff—the closing of the port last admitting steam—will occur earlier in the stroke. If setting the valve nuts does not correct valve travel, it



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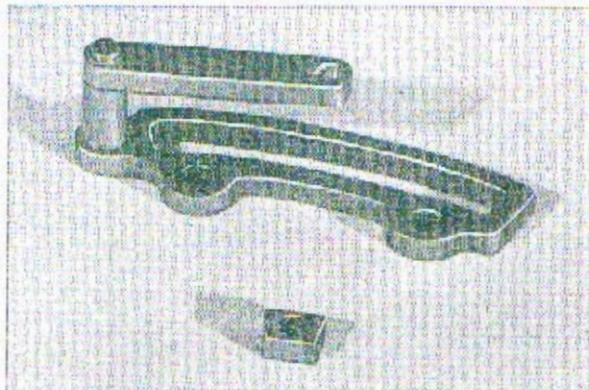
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may be necessary to reset the eccentrics, or even shorten or lengthen their rods.

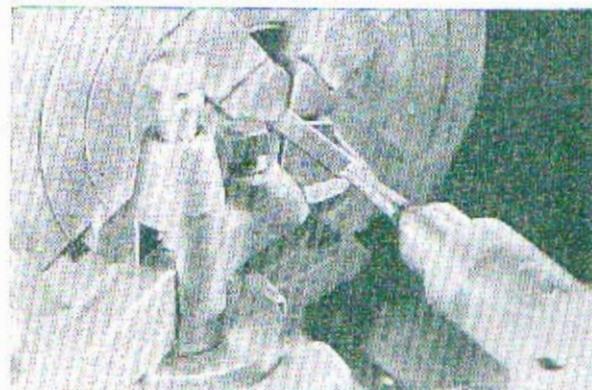
Assemble the engine, using oil freely on all moving parts, with gaskets and graphited gland packing. Run it in at low speed on steam or air, or by outside power, until the parts have worn to a good fit and lost any initial tightness. The steam line should have a lubricator to oil the cylinder.

Beware the temptation to throw over the

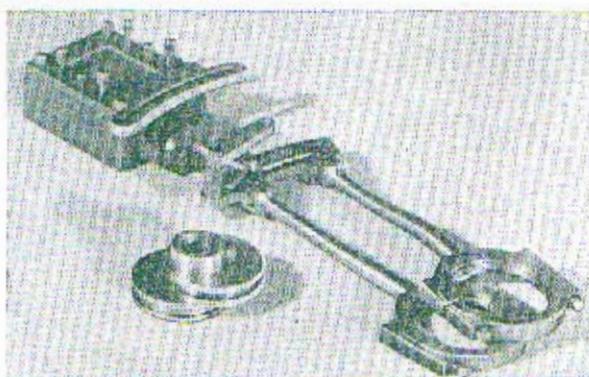
reverse lever at high speed. While the engine should stop at mid-quadrant setting, you'll want a throttle valve for fuller control. It's well to add asbestos lagging and a sheet-metal jacket to the cylinder to minimize condensation, and to start up slowly until the cylinder is hot and any condensate has escaped via the exhaust. Being of cast iron, the engine will safely stand pressures up to 100 lb. END



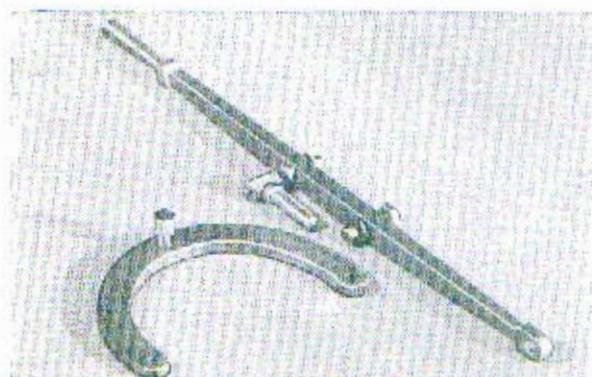
A short pivot stud connects the drag link to the reverse link. Also above is the link block, shaped to match the slot, which fits the valve-rod fork.



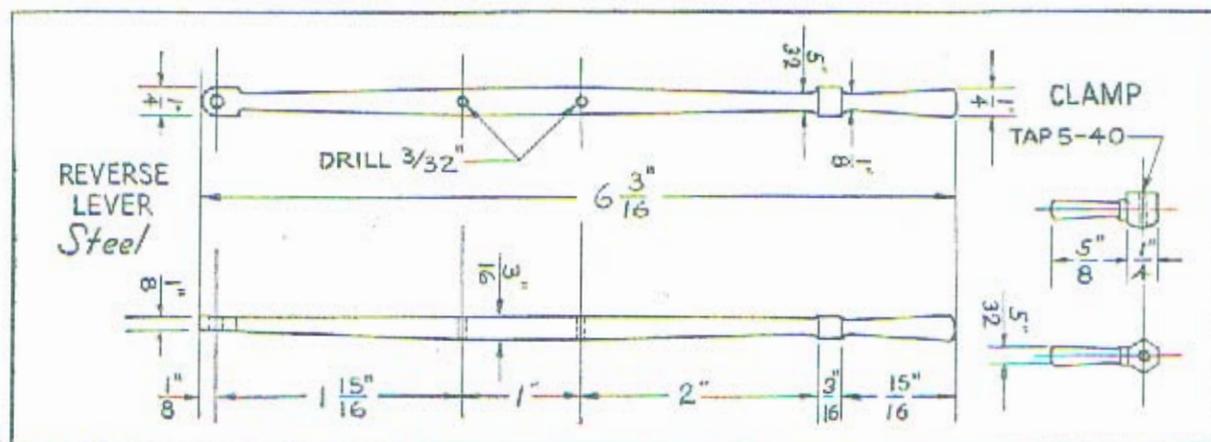
Chucked in the four-jaw, a piece of  $\frac{1}{4}$ " square steel is turned down to form the handle of the reverse lever. Holes must be located as in the drawing.



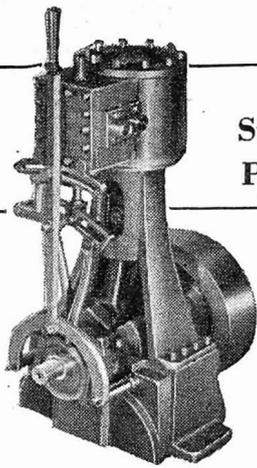
How the reverse gear will be assembled on the engine. The quadrant on the steam chest receives the clamp screw that locks the reverse-lever setting.



At its lower end, the lever pivots on a stud that screws into the ring, which will itself be bolted to the base. The clamp nut is fitted with a handle.



**Vertical  
Steam Engine  
PART FOUR**



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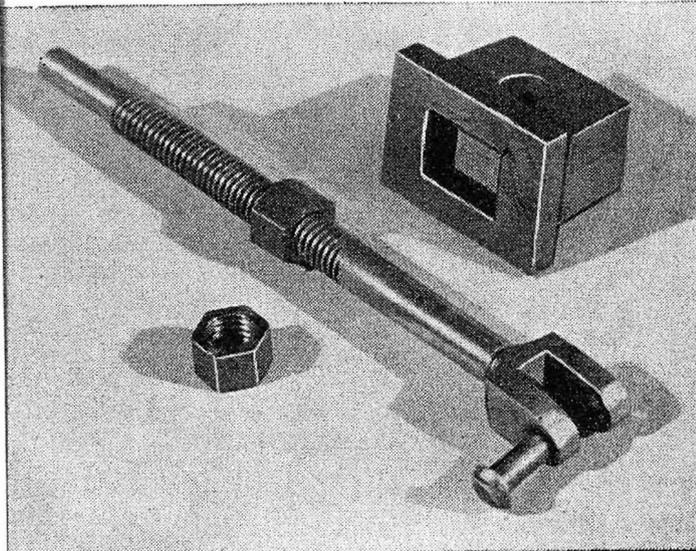
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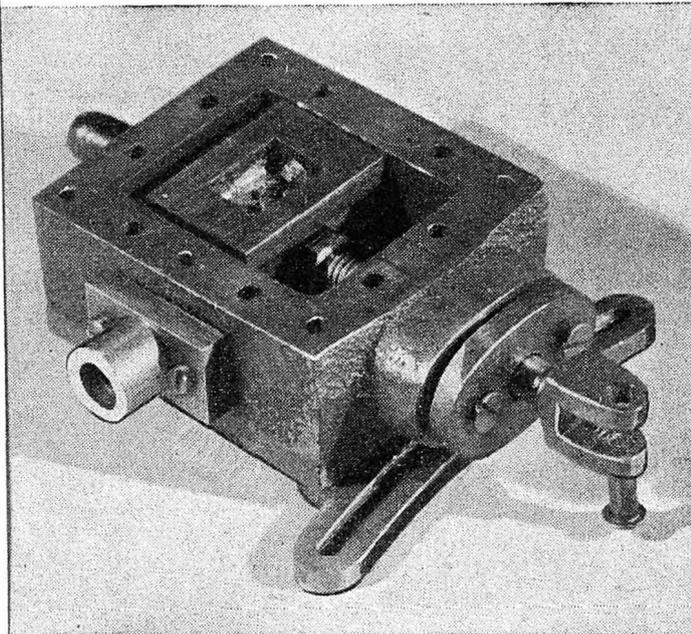
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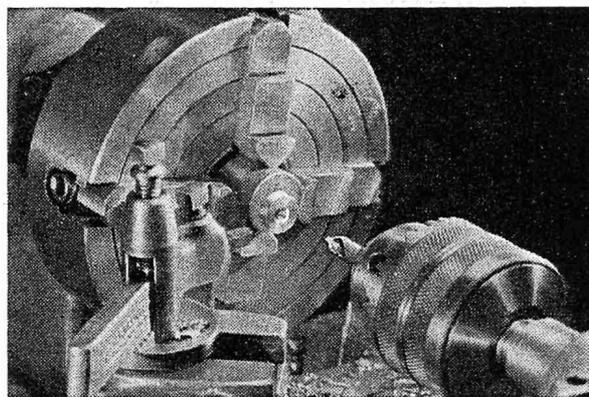
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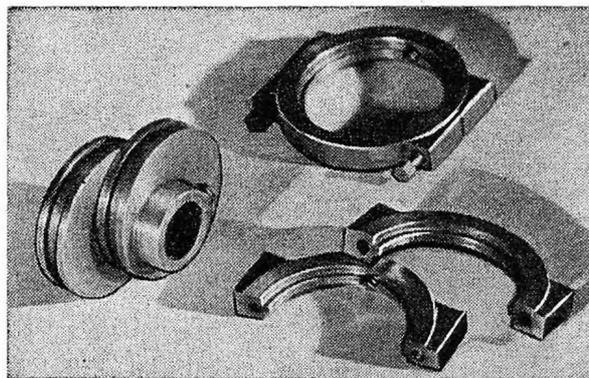
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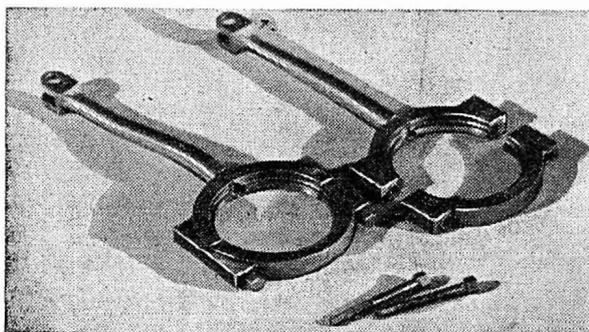
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