

FIG. 109.—Vertical section of force pump.

Every steam boiler which has to run for long periods and evaporate considerable quantities of water should be in connection with a pump capable of forcing water in against the highest pressure used. In a previous article we have described a force pump driven directly off the crank shaft of an engine. As the action of this is dependent on

the running of the engine, it is advisable, in cases where the boiler may have to work an engine not provided with a pump of its own, to install an independent auxiliary pump operated by hand or by steam, and of considerable capacity, so that in an emergency water may be supplied quickly.

Making a Hand pump

Figure 109 shows the details of a hand pump which is easy to make. The barrel is a length of brass tubing; the plunger a piece of brass or preferably gun-metal rod, which fits the tube closely, but works easily in it. The gland at the top of the barrel, E, is composed of a piece, D, of the same tubing as the barrel, sliding in a collar, C, soldered to E. The bottom of D and top of E are beveled to force the packing against the plunger. The plates A and B, soldered to D and C respectively, are drawn together by three or more screws. A brass door-knob makes a convenient top for the plunger. When the knob touches A, the

bottom of the plunger must not come lower than the top of the delivery pipe, lest the water flow should be impeded and the valve, V, injured. Round off the end of the plunger, so that it may be replaced easily and without disarranging the packing if pulled out of the pump.

The valves are gun-metal balls, for which seats have been prepared by hammering in steel cycle balls of the same size. Be careful to select balls considerably larger than the bore of the pipes on which they rest, to avoid all possibility of jamming. An eighth of an inch or so above the ball, cross wires should be soldered in to prevent the ball rising too far from its seat.

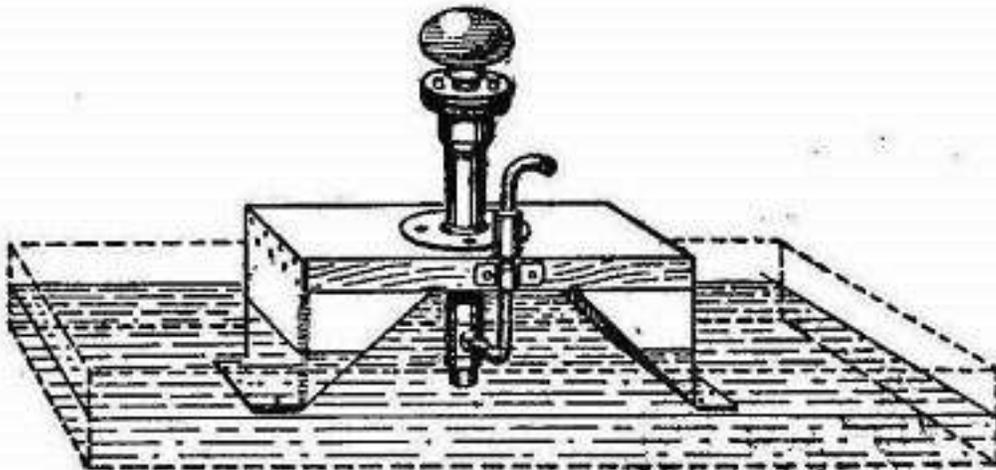


FIG. 110.

A convenient mounting for a hand pump is shown in Figure 110. The plate, F, of the pump is screwed to a wooden base resting on a framework of bent sheet zinc, which is attached to the bottom of a zinc water tray. The delivery pipe, G, will be protected against undue strains if secured by a strap to the side of the wooden base.

The same pump is easily adapted to be worked by a lever, which makes the work of pumping easier. Figure 111 gives details of the top of the plunger and the links, B. A slot must be cut in the plunger for the lever, A, to pass through, and the sides bored for a pivot pin. The links are straddled (see sketch of end view) to prevent the back end of the lever wobbling from side to side.

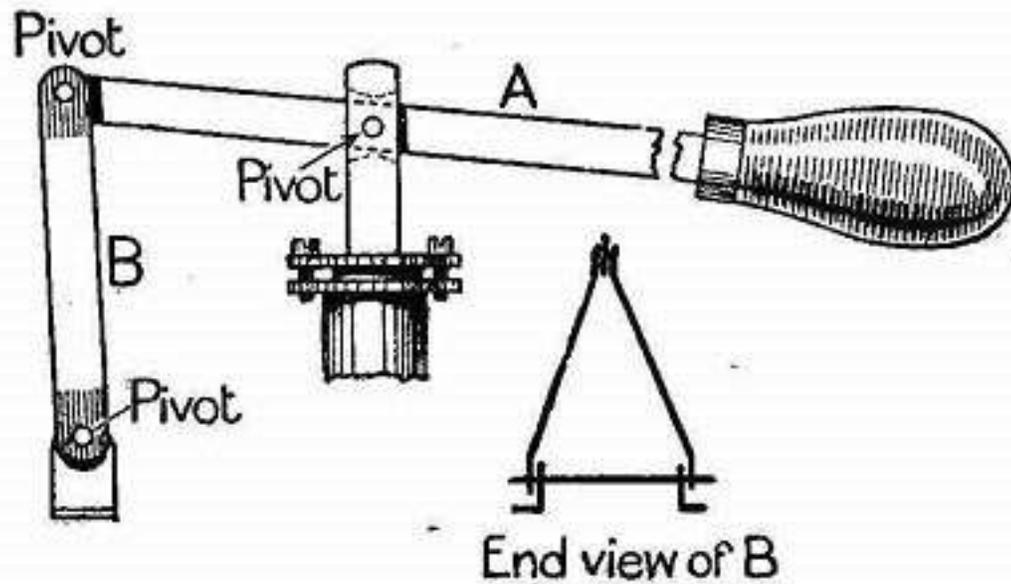


FIG. 111.—Details of lever for force pump.

A Steam Pump

The pump illustrated in Figure 112 belongs to what is probably the simplest self-contained type, as no fly wheel, crank, or eccentric is needed for operating the valve.

The steam cylinder and the pump are set in line with one another (in the case shown, horizontally), and half as far apart again as the stroke of the cylinder. The plunger is either a continuation of the piston rod, or attached to it.

An arm, S, fixed at right angles to the piston rod, has a forked end which moves along the rod. This rod is connected with the slide valve through the rocking arm, R1 and the rod, R2. On it are two adjustable stops, T1 T2, which S strikes alternately towards the end of a stroke, causing the valve to shift

over and expose the other side of the piston to steam pressure. The absence of the momentum of a fly wheel makes it necessary for the thrust exerted by the piston to be considerably greater than the back pressure of the water, so that the moving parts may work with a velocity sufficient to open the valve. If the speed falls below a certain limit, the valve opens only part way, the speed falls, and at the end of the next stroke the valve is not shifted at all.

The diameter of the plunger must be decided by the pressure against which it will have to work. For boiler feeding it should not exceed one-third that of the piston; and in such case the piston rod and plunger may well be one.

A piston valve, being moved more easily than a box valve, is better suited for a pump of this kind, as friction should be reduced as much as possible.

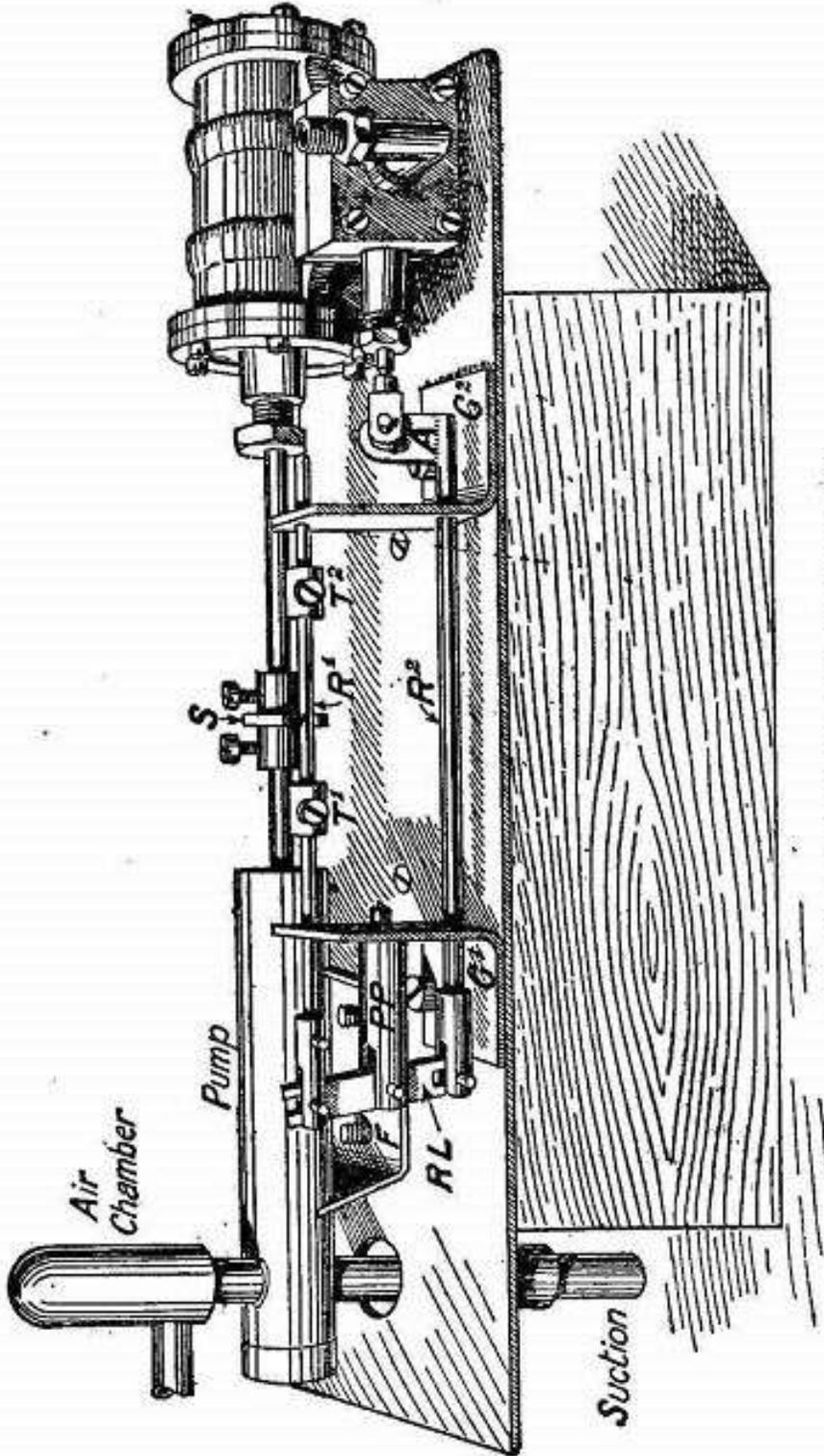


FIG. 112.—View of steam pump, showing details.

CONSTRUCTION

The cylinder will not be described in detail, as hints on making a slide-valve cylinder have been given in another article. The piston rod should be three times as long as the stroke of the cylinder, if it is to serve as pump plunger; and near the pump end an annular groove must be sunk to take a packing.

The pump, if designed to work horizontally, will have the valves arranged like the pump illustrated in Figure 65; if vertically, like the pump shown in Figure 109. Both suction and delivery pipes should be of ample size, as the pump works very fast. The pump is mounted on a foot, F, made by turning up the ends of a piece of brass strip, and filing them to fit the barrel.

The bed can be fashioned out of stout sheet brass or zinc. Let it be of ample size to start with, and do not cut it down until the pump is complete. Rule a center line for cylinder and pump, and mount the cylinder. Pull out

the piston rod plunger as far as it will go, and slip the pump barrel on it. The foot of the pump must then be brought to the correct height by filing and spreading the ends until the plunger works quite easily in the pump, when this is pressed down firmly against the bed. When adjustment is satisfactory, mark the position of the foot on the bed, solder foot to barrel, and drill and tap the foot for the holding-down screws. Don't forget that the distance between pump and cylinder gland must be at least 1-1/3 times the stroke.

The valve motion can then be taken in hand. Cut off for the guides, G1 G2, two pieces of stout brass strip, 2-1/2 inches long and 3/4 inch wide. Lay them together in a vice, and bore the holes (Figure 113) 1-1/4 inches apart, center to center, for the 1/8-inch rods, R1 R2. The feet are then turned over and a third hole bored in G1, midway between those previously made, to take the end of the support, PP, of the rocking lever.

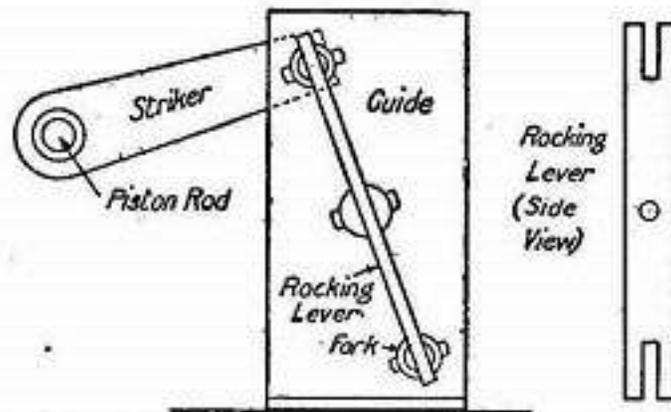


FIG. 113.—End view of striking mechanism of steam pump.

Screw G1 G2 down to the bedplate, 3/4 inch away from the cylinder center line. G1 is abreast of the mouth of the pump, G2 about half an inch forward of the end of the cylinder.

The striker,...

...S, is a piece of brass strip soldered to 1/2 inch of tubing fitting the piston rod. (See Figure 113.) Its length is decided by running a rod through the upper holes in G1 G2, allowance being made for the notch in the

end. The collar is tapped for two screws, which prevent S slipping on the piston rod. The rods for R1 R2 are now provided with forks, made by cutting and filing notches in bits of brass tubing. The notches should be half as deep again as the rocking lever is wide, to give plenty of room for movement. Solder the forks to the rods, and put the rods in place in the guides, with the forks as far away from G1 as the travel of the slide valve. Then measure to get the length of the rocking lever support. One end of this should be filed or turned down to fit the hole drilled for it; the other should be slotted to fit the lever accurately.

The rocking lever, RL, which should be of steel, is slotted at each end to slide on the pins in the forks, and bored for the pivot pin, which, like those in the forks, should be of hardened steel wire. Assemble the rocking lever in its support and the rod forks, and solder on the support.

To the back end of R2 solder a steel plate, A, which must be bored for the pin in the valve fork, after the correct position has been ascertained by careful measurement.

The stops, T1 T2, are small, adjustable collars, kept tightly in place on R1 by screws.

Setting the Striker

Assemble all the parts. Pull out the piston rod as far as it will go, and push the slide valve right back. Loosen the striker and the forward stop, and slide them along in contact until the striker is close to the pump. Tighten up their screws. Then push the piston rod fully in, draw the valve rod fully out, and bring the rear stop up against the striker, and make it fast. Each stop may now be moved 1/16 inch nearer to a point halfway between them to cause "cushioning" of the piston, by admitting steam before the stroke

is quite finished.

A pump made by the author on this principle, having a 1-1/4 inch stroke and a 1/2-inch bore, will deliver water at the rate of half a gallon per minute against a head of a few feet.

Note. -- To steady the flow and prevent "water hammer," a small air-chamber should be attached to the delivery pipe.

An Alternative Arrangement

If the builder prefers a steam pump which will work at slow speeds, and be available, when not pumping, for driving purposes, the design may be modified as shown diagrammatically in Figure 114. The striker becomes a cross head, and is connected by a forked rod passing on each side of the pump with the crank of a fly wheel overhanging the base. The valve is operated in the ordinary manner by an eccentric on the crankshaft. The steadying effect of the fly wheel and the positive action of the valve make it possible to use a larger pump plunger than is advisable with the striking gear. With a pump piston of considerably greater diameter than the piston rod, the pump may be made double-acting, a gland being fitted at the front end for the piston rod to work through, and, of course, a second set of valves added.

A SUGGESTION

For exhibition purposes a small, easily running, double-action pump might be worked by the spindle of a gramophone. A crank of the proper throw and a connecting rod must be provided. Both delivery pipes feed, through an air-chamber, a fountain in the center of a bowl, the water returning through an overflow to the source of supply, so that the same water may be used over and over again.

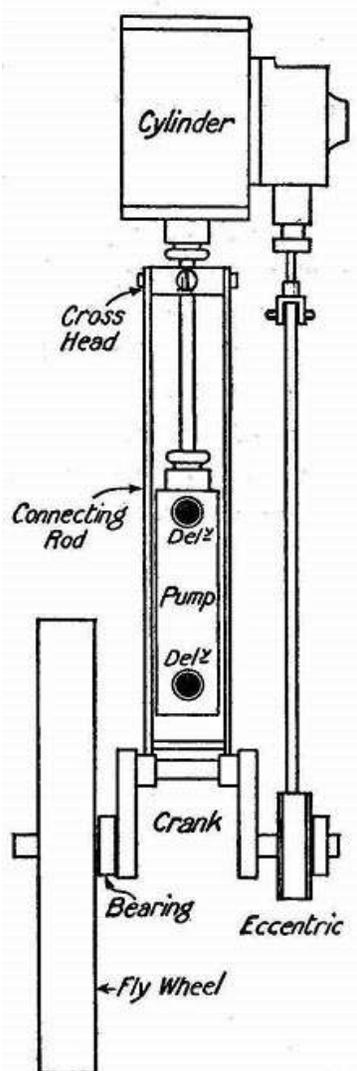


FIG. 114.—Plan of steam pump with fly wheel.

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