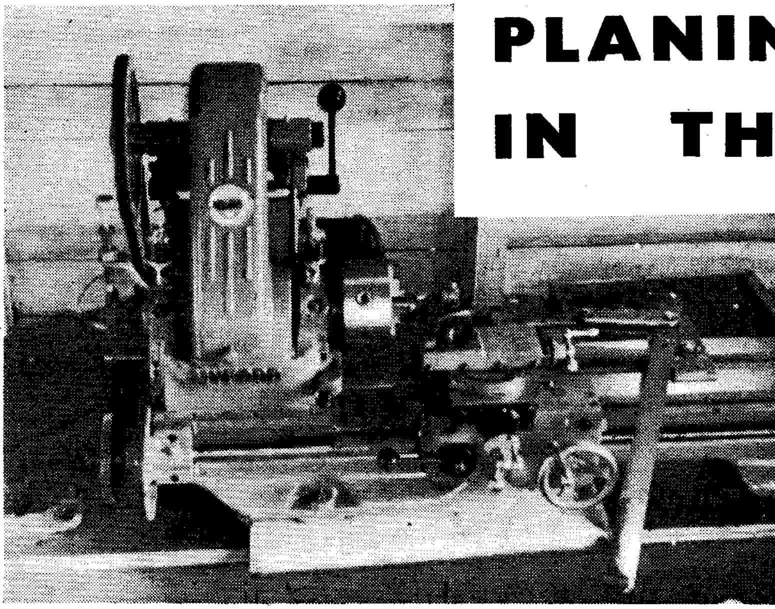


PLANING GEARS IN THE LATHE

Eight shining wheels more than repaid A. E. SMITH for the time and effort which he had spent in making them

WHEN I was considering the cost of building the 1½ in. scale Allchin traction engine? I decided that nothing but castings would have to be bought. They were the only items entirely beyond the scope of my workshop.

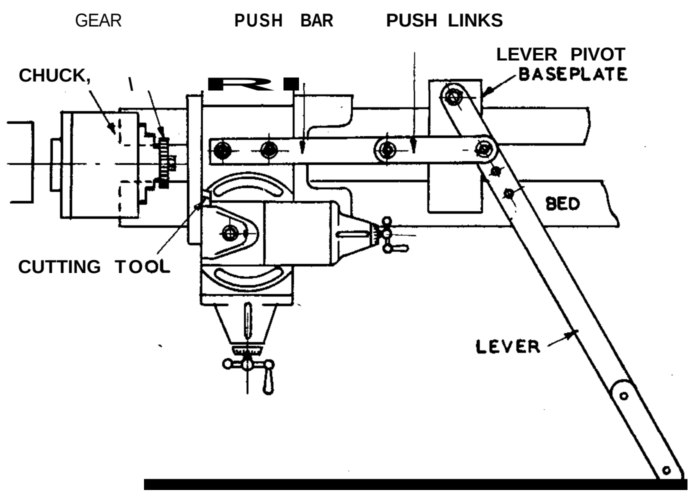
With this in mind, I began on the boiler, which was duly completed and tested. The hornplates were then made and temporarily fitted to the boiler. At this stage I was anxious to tackle something more mechanical that the tender, which was probably the next logical step. The gear wheels were rather expensive to buy and so I resolved to make them. Gear-cutting was entirely outside of my range at that time, as my only equipment was a ML7 lathe with standard equipment and a home-made drilling machine. After toying with various ideas I concluded that planing the teeth with a form tool would involve the least amount of special equipment.

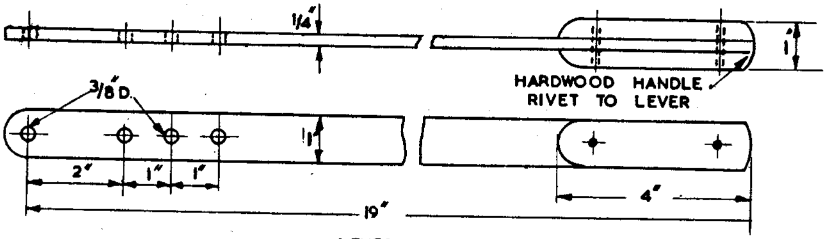
I drew some rough sketches of a planing attachment and dividing device and turned out the scrapbox to find some suitable pieces of metal. A length of 1 in. x 1/4in. flat bar provided a suitable handle. This I drilled to take the pivot pin and push link pins. The push rod was made of the same size material and drilled for bolting to the saddle; links were made from 1 in. x 3/16 in. flat bar and drilled to take the connecting pins. A piece of 2 in. x 1/2 in. flat bar provided a good clamping base for the planing attachment. Confronted with the possibility of long hours planing teeth, I riveted two pieces of hardwood on to the end of the handle and shaped them to form a comfortable hand grip.

To make the dividing device, I drilled a 3/8 in. dia. bolt concentrically for the 3/16 in. dia. spring-loaded plunger, mounting it on a piece of 1 in. x 1/4-in. flat bar suitably. bent and tapped. The bar was slotted at the end for fixing under the drip feed lubricator. I made a split collet type of mandrel for mounting the master gears on the rear end of the lathe spindle. The whole operat-ion was completed in one week end. While the items were not a work of art, I considered them quite good enough to do the job.

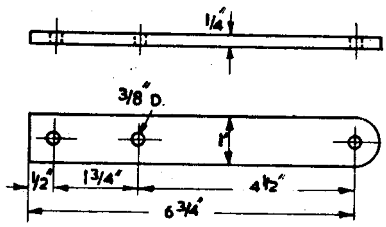
The master gears proved to be a headache, as the standard change wheels of my ML7 did not cover the complete range of the gears I needed; 15, 20, 22, two off 26, 33, 50, and 100 teeth. The 15, 20 and 50 tooth wheels were taken care of by the ML7 change wheels, and as the 55 tooth change wheels gave 11 divisions I cut the 22 and 33 tooth wheels by first cutting 11 teeth in the blank and then rotating the blank one tooth pitch and cutting 11 more, and so on.

I also applied this method to the 100 tooth wheels, using the 50 tooth change wheel as master. This left only the 26 tooth wheel. No answer seemed to be forthcoming, and so I

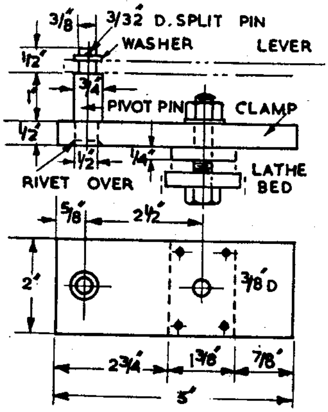




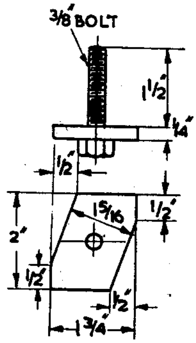
LEVER 1 OFF BMS



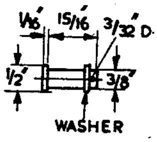
PUSH BAR 1 OFF BMS



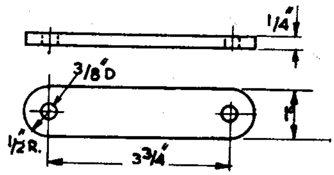
LEVER PIVOT BASEPLATE
1 OFF BMS



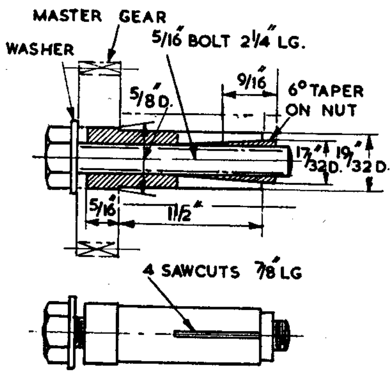
CLAMPING PAD
1 OFF BMS

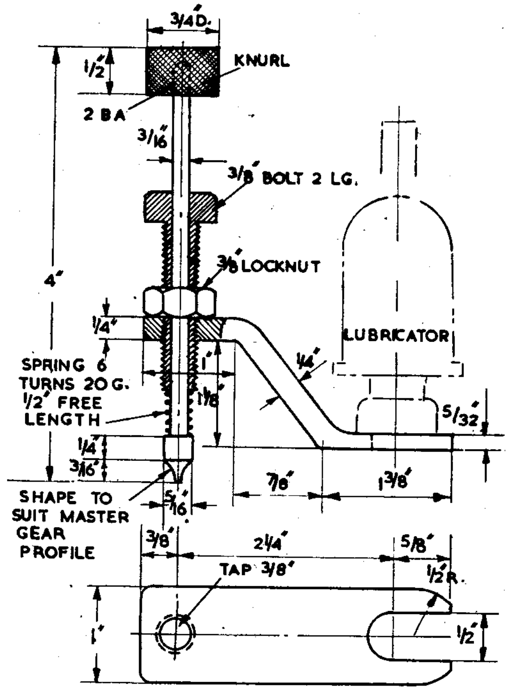


LINK PIN
2 OFF BMS



PUSH LINK
2 OFF BMS





made a special divider by drilling as accurately as possible 3/32 in. dia. holes round the circumference of a brass disc. The disc was large enough to make small errors even smaller on the actual gear.

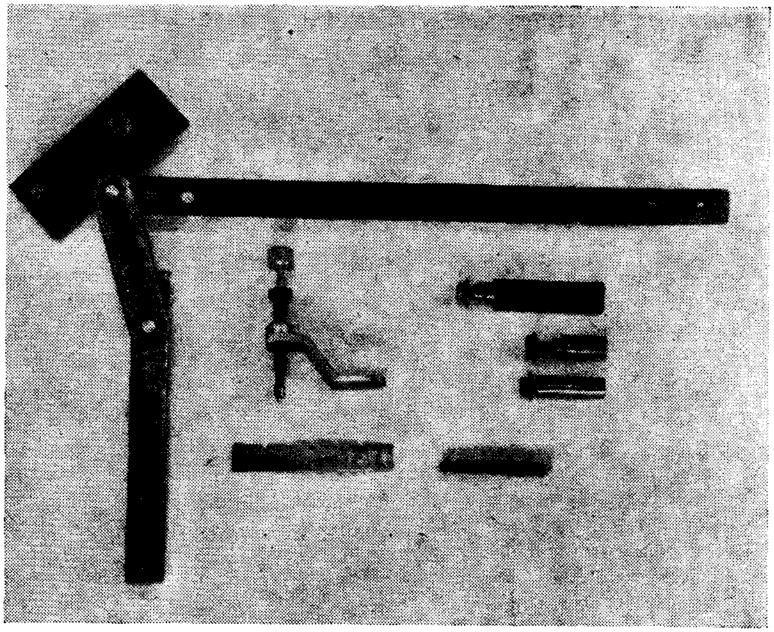
After this I came to the tooth profiles. As the gears had a diametrical pitch of 16, I constructed a complete set of profiles four times full size, on the drawing board. I made a gauge for grinding the form tools to shape, using dimensions taken from the profiles.

Having completed gear-cutting equipment, I began on the gear wheels themselves. The gear blanks were cut from $\frac{3}{8}$ in. thick mild steel plate and were annealed by leaving them in the living room fire overnight. I spent a weekend turning the blanks up. The 50 and 100 tooth wheels were turned and bored to finished size, but the remaining wheels were drilled $\frac{1}{2}$ in. dia. for mounting on a stub mandrel. As the 20 tooth wheel seemed to be a good one to practice on, I gripped the stub mandrel, with the blank mounted on it, in the three-jaw chuck. An old lathe tool was ground to the 20 tooth gauge profile and firmly secured in the toolpost at centre height. The dividing plunger height was adjusted to suit the master gear, locked in position with the plunger inserted in one of the teeth.

With the planing device firmly bolted down to both saddle and lathe bed, I cut the first tooth. A drop of cutting lubricant now and again helped enormously and the finished tooth profile was cleanly cut and bright. I pressed on with the remaining teeth, and about one hour later I finished the gear wheel. The result was better than I expected, but the time taken indicated that I would need plenty of elbow grease to complete the job. Cheered by my initial success, I cut the 22 tooth wheel, using the same tooth profile, reground the tool to the profile gauge, and cut the 26 tooth. By now, having had a good deal of practice, I succeeded in reducing the time taken from three minutes a tooth to about 29 minutes. I cut the remaining gears, using the respective form tool profiles for each gear. After about 12 hours' work, all the teeth had been cut. This worked out at about 21/2 minutes a tooth, including setting up, tool regrinds, and so forth.

I decided that the gears should be run together in their respective pairs with grinding paste to improve the accuracy of profile. A mandrel was made for fixing in the toolpost, the spigot being turned 1/2-in. dia. to suit the centre bore ,of the gears. One gear in the three-jaw chuck and one on the toolpost mandrel were run together in second backgear speed with a mixture of oil and grinding vaste. A reversing switch is not -fitted to my lathe, and so the gears were reversed and run again. This ironed out any small inaccuracies in gear profile that were present.

After running all the gear pairs in this manner, I washed them in paraffin and again mounted them on the mandrels. After being carefully set to the actual running centre they were lightly oiled and run in second speed. No undue noise or chatter was heard when they were in mesh. All that remained to be done was the boring out for pressing on their centres.The sight of eight shining new gears, made at no cost, more than justified the time and effort.



Components used in the planing of gears

HIELAN' LASSIE . . . ,

Continued from page 368

then turn up two little plugs for the cylinder ends as shown, from $\frac{1}{4}$ in. rod. They should be *a* tight drive fit in the bores; sol&r over the heads for the sake of safety. True up the port faces as you did the engine slide valves, and screw in the trunnions; these are $\frac{11}{16}$ in. lengths of 3/32 in. round rod, screwed both ends, as shown in the illustrations.

The larger ram is a piece of $\frac{1}{8}$ in. round silver steel, or rustless steel, $\frac{7}{8}$ in. long, with a No 48 cross hole drilled at one end, and a flat filed on it to clear the big-end bush of the smaller ram. This is a piece of 3/32 in. steel, one end turned down to 5/64 in. and screwed 9 BA as shown in the little &tail sketch. The bush is a $\frac{1}{8}$ in., slice parted off a 7/32 in. rod held in the three-jaw. Drill a No 48 hole through the middle before parting off, and then drill a No 53 hole in the edge, and tap it 9 BA. The distance from end of ram to the hole is approximately $\frac{13}{16}$ in. Pack the glands with graphited yarn, and round off the cylinders as shown in the plan view.

To make the bearing, chuck a piece of $\frac{5}{16}$ in. hexagon brass rod in the three-jaw with 1 in. projecting. Turn down $\frac{7}{8}$ in. length to $\frac{3}{16}$ in. dia., and screw $\frac{3}{16}$ in. *x 40.* Face, centre, and drill down 1 in. depth with No 41 drill. Part off $\frac{15}{16}$ in. from the end, leaving a $\frac{1}{16}$ in. head. Make a nut to suit, from the same size rod; face, centre, drill 5/32 in. for $\frac{3}{16}$ in. depth, tap $\frac{3}{16}$ in. *x* 40, chamfer the comers, and part off a $\frac{1}{8}$ in. slice.

The spindle is a piece of 3/32 in. silver steel, approximately $1\frac{1}{16}$ in. long, with $\frac{1}{8}$ in. of 3/32 in. or 7 BA thread on each end; it carries a ratchet wheel $\frac{7}{16}$ in. dia., 3/32 in. wide, with about 35 to 40 teeth. The wheel should be drilled No 43 and forced on to the spindle, so that $1\frac{1}{16}$ in. projects from the bearing side. Tip for beginners: press an overlength bit of silver steel through the wheel first; then cut to length and screw the ends afterwards. This saves a lot of trouble, as you do not have to shift the wheel any more, when once it is on. Be careful that it is on the right way; with the long end of the spindle away from you, the vertical side of the teeth should point left, the sloping side right; the lubricator works clockwise, looking at the ratchet end.

The crank is only a few minutes' work. Chuck a bit of $\frac{3}{8}$ in. round rod in three-jaw; face, centre, drill $\frac{3}{16}$ in. deep, with No 48 drill, and tap to match the spindle. Part off a $\frac{1}{8}$ in. slice. At $\frac{1}{8}$ in. from centre, drill and tap a 9 BA hole (53 drill) and screw in a piece of 15 gauge spoke wire, so that $\frac{5}{16}$ in. projects from the crank disc.

★ *To be continued on October 6*