

Notwithstanding the horse-power required, it pays to use tube mills : of this I am convinced.

[] I find in practice, however, that the question of linings is a very serious one ; the wear of the flints on both the steel and silex linings increases the cost of upkeep to a very considerable degree. I have, however, overcome this difficulty, and at present the Waihi Gold-mining Company (Limited) and Waihi Grand Junction Gold-mining Company (Limited) are using my patent lining in connection with their tube mills throughout their reduction plants, and by this means are saving a considerable amount annually.

This is a patent method of securing any hard rock in tube mills or other grinding-machines without the costly and sometimes impossible preliminary work of dressing the material into rectangular blocks.

[] Many classes of rock have the wearing quality of silex, but cannot be dressed into shape. The system consists of having suitable frames, being segments fitting the grinding-machine, into which any suitable rock is packed with a good cement mortar. When well set the segments are built into the tube mill with cement.

Frames.—Frames are best made of any cheap quality of cast iron. Their size is limited to the opening into the tube mill. A convenient shape for a frame for a tube mill of 5 ft. diameter is one-eighth of its circumference, and as long as the door will admit, preferably dividing up the distance between the doors in equal parts. Fig. 1 shows such a frame divided into four spaces. A few making-up segments of different sizes are required for fitting the old spaces round the doors left by the standard-size frame.

Filling the Frames.—Have a block of wood dressed to fit the outside diameter of frames, and some plates of iron $\frac{1}{2}$ in. thick, 2 in. larger each way than the frame, with $\frac{5}{8}$ in. hole near the edge at each corner, the plates to be bent to fit frame. With four $\frac{1}{2}$ in. hook-bolts and wing-nuts secure the plate to the frame, putting a piece of old canvas or sack between, so that the plate does not stick to the cement. Then, having the frame, with false bottom attached, placed upon the curved block, pack each division tight with rock in as large pieces as possible, well grouted in with cement mortar. There is no objection to portions of the stone standing up, say, 2 in. above the edges of the frames. It is more important to fit the stones well into the base of the frame than to have a smooth, neat outside surface ; the better the base is fitted, the better they hold in when nearly worn out. The mortar can be made of any good Portland cement mixed with equal parts of clean coarse sand. The best sand is obtained by crushing the scrap pieces of worn-out flint pebbles that escape through the outlet of the tube mill.

A light prospecting stamp will crush enough in a few hours through a $\frac{1}{4}$ in. mesh screen to line a tube mill.

After filling, the frames are stacked to harden, wet sacks preferably being put over them. The back plates can be removed the next day if the mortar is firm enough, but the linings will not be ready for use for at least a month, giving, if possible, still more time to harden.

Fitting the Barrel Segments.—In case any difficulty should arise in fitting the barrel segments against the rough faces of the end linings, it is more convenient to have a cast-iron ring in segments cemented into the corner of the mill before starting to put in other linings shown in Fig. 2. If the standard circumferential linings are a fairly neat fit, the last one in each complete ring will be slid into place, but the last one in the last ring must be made a little narrower, so that it can go straight into position, when it is keyed in with any pieces of scrap iron, wooden wedges, or flat stones driven into the mortar.

Casting the Frames.—The patterns are made with sufficient "draw" to leave their own core, and the castings only require fettling on the outside edges and outside diameters. Roughness or lumps left on the inside or slight flaws in the castings are of no account.

Building Linings into Tube Mill.—Clean the interior, and then lay a straight row of linings, starting from one of the doors, bedding them well down in neat cement. This is a point to be carefully attended to, as some tube-mill barrels are very much out of truth, and a segment might bear on its edges only, and have no support under the stone in the divisions.

Five such rows can be laid without moving the mill. The fifth row is then to be supported by a length of wood about 3 in. by 2 in. laid along its centre. This wood is then tightly held with six stretcher bars from the opposite row of linings. The stretcher bars are simply lengths of 1 in. gas-pipe, with a $\frac{7}{8}$ in. bolt in one end, screwed up to head, and an ordinary nut (as shown in Fig. 8). The last row being thus firmly held in position so that it cannot drop down, the mill is turned round so that the last row laid is on top ; the sixth row is then put in, the mill again shifted one-eighth turn, and so on to the last or eighth row. Any opening left at the closing-up can be jammed tight with bits of scrap iron, old flat pieces of stone from worn-out linings, or wooden wedges driven into the mortar.

Repairs.—In case the stone filling should fall out of a division, it can be repaired in five minutes by putting in a spare division-frame, previously filled with stone, and keying it into position with dry soft-wood wedges.

In breaking up large blocks of stone a pneumatic chisel is useful, as by running it round a block it makes a starting-point for breaking ; a smart blow with a spauling-hammer then splits the block along the line made by the pneumatic chisel.

Life of Linings.—Of course, this is dependent upon the quality of stone used and the thickness of lining. With frames 3 in. deep, filled with Waihi quartz, linings have lasted over six months ; but with frames 3½ in. deep, filled with quartzite, a life of over nine months has been obtained.

There are now twelve tube mills running at Waihi lined with "Honeycomb" linings, the average life of the linings being over double that of imported silex blocks.