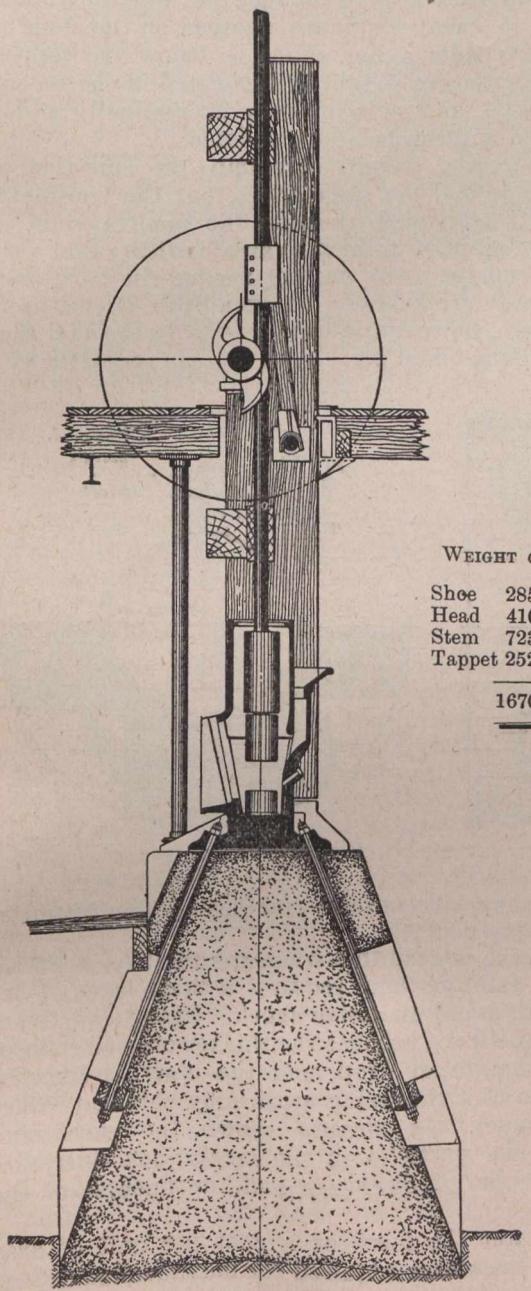
between, has been in use now for three years with no visible sign of cracking or deterioration. This has been so encouraging that at the Simmer Deep and Jupiter mills all the batteries have been erected with the mortar-box resting on the concrete blocks.

Crushing is usually performed either by impact or abrasion, and whilst hard ores are best dealt with by the former method, the latter is applicable to softer material. The relative efficiency of the two methods for hard material is well illustrated by the case of the diamond,



WEIGHT OF STAMP (NEW).

Shoe	285 lb. =	17·066 %
Head	410 ,, =	24·551 %
Stem	723 ,, =	43·293 %
Tappet	252 ,, =	15·090 %
	1670 ,, =	100·000 %

FIG. 1.

which is hardly capable of abrasion at all except by its own dust, whereas, if placed on an anvil, it will be shattered into a thousand fragments by one blow of a hammer.

As has been pointed out by C. de Kalb, the crushing of the larger pieces of ore in stamp milling is done as the result of reaction from the resilient die, the waves of compression transmitted through the ore from the shoe being reflected from the die, until the strains set up from the oncoming and reflected waves exceed the elastic limit of the ore, and rupture results.[10] The stamp is essentially an impact machine, and hence readily pulverizes hard tough ore.

Such ore, if handled in any of the legion of rubbing or shearing appliances, would only be reduced at the expense of serious wear by abrasion of costly steel parts which may have to be discarded when but a fraction of their weight has been worn away. With soft material the case is different, and machines of the latter class may be employed with advantage and without undue abrasion of wearing faces.

It is much to be regretted that no satisfactory machine for testing the capacity of material to resist abrasion, or conversely of testing the abrasive capacity of materials requiring abrasion, yet exists, as this property is of prime importance in all crushing operations.

When gravity stamps are used for very fine crushing they pass beyond the economic range, and operate by abrasion rather than by impact, with consequent reduction of efficiency, as may be seen from the following considerations. Impact is essentially dependent on the pressure exerted by the blow, and depends upon the

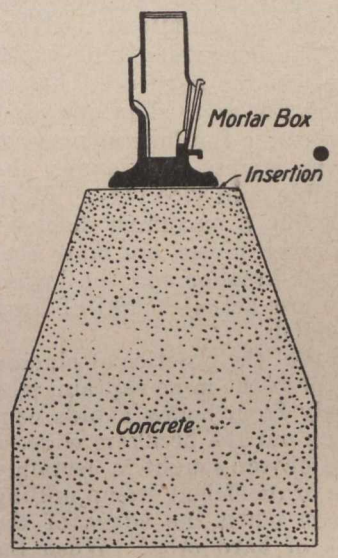


FIG. 2.

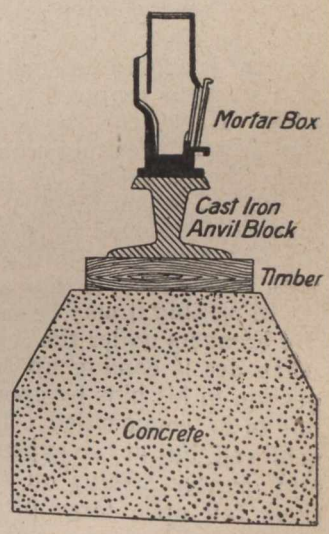


FIG. 3.

weight of the stamp and the height of the drop. Assume that a 1,750-lb. stamp having a 9.5 in. diameter shoe and with a set height of drop of 8 in. strikes a layer of ore 2 in. thick on the die, and comes to rest 0.5 in. from the die. Then having fallen 7.5 in. and having done work for 1.5 in., it has exerted on the ore a mean total pressure of 8,750 lb.[11] The shoe having an area of 71 sq. in., the average unit pressure exerted over the whole of its area is only 123 lb. per sq. in., or less than that exerted by a man of average weight supported upon an area of 1 sq. in.

The crushing effect of such a pressure on hard quartz grains is trivial, and a certain amount of reciprocal abrasion of grains of sand re-arranging themselves under pressure is probably the main effect produced. The case, however, is quite different in the first impact of the stamp on the ore in the box. Assume that only a 2in. cube resting on the die is first struck; having an

[10] See Mines and Minerals, p. 135, Oct., 1906; O. H. Howarth in Mines and Minerals, p. 441, May, 1906; and Journal Chem. Met. and Min. Soc. of S. A., vol. vi. June, 1906, p. 385.

[11] Cf. Hiscox, "Compressed Air," p. 437.