

drills, rhymer, taps, boring cutters, etc., is not increased per ft. run of actual work done, when compared with manual labour.

Thus it is clear that if the additional machinery a factory makes or purchases in trying to use air as a distributor of power is confined to such tools as will be often or fairly continuously used, this outlay is justified, and the cost of compressing relatively to total wages is so small that tools evidently wasteful in the use of air are economical, or rather show a net balance to the good, if the men find them portable, easily adjustable and handy to use, and their simplicity of make and freedom from repairs and break downs, results in but few delays to the steady out-put of work.

ROTARY MOTORS.

It is evident that the use of compressed air has stimulated the use of rotary-motors, and not because it was believed that they were economical converters, but because their light weight and small bulk permitted them to be used by hand. However, the making of a more perfect air engine than the steam rotaries, for which so many designs were made and patents taken out between 1830-50, has been attempted, but it is questionable if any advance has been made. The author has no information as to any attempt to use a reaction or impact turbine as a portable air motor. What has probably discouraged this is that the necessity to gear down the high speed would make the engine weighty and the friction excessive, although, as air at the same pressure is twice as heavy as steam, it looks as if air would do well in such a form of reaction engine.

The most simple form of rotary motor is an eccentric or cam, forming part of the central shaft, whose length is that of the cylinder in which it rotates, and whose outer surface (belly) touches in the course of one revolution the whole internal circumference of the cylinder. A reciprocating plate moved in centrally from the cylinder wall receives the backward thrust of the air. The admission port is in front of this plate, and the exhaust port at its rear. So made, the small sizes to be held by hand, when at work, give an irregular, wobbling motion, as the shaft—or plug as it is called—is unbalanced. This long ago provoked the use of two parallel shafts or cams geared together, but the author must confess to a failure in an attempt to reverse a form of the Root blower, using it as a small motor.

The later attempts make the cylinder in cross-section oval or elliptic, with several inlet and ports in its walls. The shaft, which is as large as the minor diameter of the ellipse, carries two or four movable blades or pistons in its body, whose outer edges are kept in contact with the varying walls of the cylinder, not by steel springs, but by the admission of compressed air to the bottom of the slots of the shaft in which each radial piston blade plays in and out.

Without dispute, the leakage is large, judged by the standard of a reciprocating steam piston, in part due to the several reciprocating blades being subject to wear on their three outer edges as well as looseness in their shaft slots, and also in part due to the fact that with air and steam under exactly similar conditions of surface, of metal, and of pressure, air will get past any packing more readily than steam will pass it. A suggested explanation for this is that the film of water that condensation leaves on the steam walls retards the passage of steam between smooth metal surfaces.

The dynamic efficiency of such motors is low, so low as to apparently discourage any attempt at metering, indicating or brake-testing them, yet many wideawake shop managers use them in direct application to drills and taps, because, communicating a cutting speed from five to twenty times higher than can be given to the same tool by hand, they therefore prove cheap, although lavish in the use of air.

RECIPROCATING ENGINES.

At the sacrifice of perfect portability much is gained by using small reciprocating engines, weighing from 100 to 200 lbs., with two to four cylinders receiving air pressure on one side only of the pistons.