

differences of pressure in the main line, and would affect the other motors to some extent. What advantage it is, but especially in large works, to disconnect or switch out any machine or apparatus at any moment without being obliged to shift belts over loose or friction pulleys, nor being able to stop the humming and buzzing noise of the overhead shafting with its tangle of belts, which are a constant menace to everyone's dear existence, not to speak of the great convenience to convey the power with ease from place to place and from any machine above or below ground to another!

Now, I wish to direct your attention to one of these machines which has, strange to say, found in this country very little or no attention, although it deserves it very fully. It is this, an electric drill of a very ingenious but simple construction and of great efficiency. The reason that we have heard and read but little of it in this country, and even in the States, is that we are too indifferent in acquainting ourselves with what other nations do in the various industries, and this is especially the case in the mining industry. We patronise in many cases the home industry too much to the disadvantage of our miners and mines. To some extent it might also be attributed to the prejudice which seems to exist against electric drills on account of the poor success which the so-called Solenoid machines of Van Depoele and Marvin had. These machines were constructed after Werner Von Siemens's so-called electric hammer principle, but soon abandoned by the latter. The principal fault of these machines were their inefficiency and weak return pull of the bit, although the consumption of energy was large, too large compared with the newer drills of Siemens & Halske. But even that earlier machine is surpassed in waste of power by the air drills so much in vogue at the present time. These earlier machines had the Solenoids the motor - in the drill itself, which was a great disadvantage, considering the shocks which they received with every stroke of the piston; besides, it became soon hot, and lost on account of this a large amount of energy, that is, efficiency. Different is it with the newer percussion drill of Siemens & Halske. The motor is here separated from the drill, and is connected with it by a flexible shaft of about 8 ft. long. This arrangement enabled the inventors to construct a more compact solid machine, but at the same time a more simple mechanism. The axis of the piston could be placed near the one with which it is fastened to the upright or tripod, therefore a more rigid position was secured, and a shaking when in operation was avoided. But to give the drill a still more steady working a fly-wheel was fastened on the crank shaft of the machine, whose inertia would hinder the power-transmitting mechanism, especially the teeth of the cog-wheels, from clattering upon each other. Another good arrangement is connected with the machine the piston rod for the drill steel is hollow throughout, therefore it is not necessary to change the position of the machine when a new bit has to be inserted. It can be done from the hind end by releasing the key with which it is fastened in its place. Further, the feed of the steel is on these machines either by hand or automatic, but always self-regulating according to the hardness of the material to be drilled. A jamming of the bit in the hole, which is with most percussion drills a very common occurrence, happens very rarely, for the return pull of the piston is so strong that on account of this and the powerful concussion the columns or stretcher bars had to be con-

structed especially strong, and instead of the common tripod, a quatripod, if you will permit me to give the four-legged stand that name, had to be provided for this percussion drill.

In regard to the consumption of power, this machine excels in economy every other percussion drill so far invented or in the market. A drill working with full capacity will use from 0.8 to 1.3 kilowatt, or six drills in operation will need ten horse power of a steam or water engine, if the length of the transmission of power is not too great, and 12 horse-power if it is great. It will drill a hole in the hardest rock from  $1\frac{1}{4}$  to  $1\frac{1}{2}$  inch wide, and from 2 ins. to 12 ins. deep in one minute; for instance, in very hard granite 3 ins. to 4 ins. deep per minute. There is not one percussion drill, steam or air driven, which could show such results combined with such economy. To make a comparison, only the largest size of air drill might be able to drill a hole of the same depth and in the same time above mentioned, but would need six to eight times the power of one of the smaller electric drills. The vertical depth drilled with this machine is  $6\frac{1}{2}$  feet, and the depth bored without changing bits is 16 ins., with about 420 strokes per minute. The weight of the machine is about 240 pounds, and to raise and lower it on the stretcher bars with ease a small block and tackle is used.

Besides the percussion drill the firm of Siemens & Halske manufacture also a "rotary drill." This machine, which is used for boring in rocks and fossils of a softer nature, is of simpler construction and lighter weight than the former. No fly-wheel is necessary for this drill, because the drill barrel has only to follow the rotation of the flexible shaft and the forward feed of the inner mechanism, which is automatic and self-regulating according to the hardness of the material to be drilled. The consumption of energy is with this machine as with the former, about 800 watt = to one h.p., and will bore in rock salt a hole 1 6-10 in. wide by 12 to 16 in. deep, or in salt, clay, gypsum, or oolitic iron ore, etc., 8 to 10 in. per minute. With two bit changes the machine can bore a hole of over 6 ft. Its weight is not more than 70 lbs., and breakage or parts showing wear and tear can be easily and quickly replaced by new ones. The construction of the stretcher bar or column can be said to be a very handy apparatus.

I have to say now a few words about the flexible shaft which connects the drill with the motor. This shaft consists of two parts; the outer protecting flexible tube is made of a steel wire spiral and surrounded with leather, while the inner, the real power transmitting part, is a very pliable apparatus made of a number of right and left wound conaxial steel wire spirals, provided on both ends with massive steel pins and couplings, with which they rest smoothly against the outer protecting tube, and connect firmly with the motor and machine. The whole shaft is very solidly made, so that a rough handling in the workings will not injure it very easily.

Now, when we consider with what ease all the different parts connected with these drills can be carried from place to place, and compare it with the work that is necessary and the difficulty which exists in carrying the air or steam along in a mine, we understand readily the saving of time, and also the saving of expenses especially when we compare the much greater efficiency of these electric drills with those of steam or air.