

The chain machine is one where the cutters are secured in a desired position on an endless chain, and this machine is being satisfactorily operated. It is claimed that the holings are cleared away very freely with this class of machine. Some of this type are enabled to hole on either side, as the jib carrying the chain can be laterally moved in an arc of 180 degrees. Some are constructed upon wheels, whilst with others the wheels are dispensed with, but these machines are hauled along the working-faces by gearing which is handily under the control of the operator. The height of such machines is about 16 in., which renders them suitable in that respect for winning very low seams. The width varies from 1 ft. 9 in. to 2 ft. 3 in., with lengths from 6 ft. 6 in. to 8 ft. The weights of different sizes range from 22 cwt. to 45 cwt.

The bar machines are so termed from the fact that for holing or undercutting a revolving bar takes the place of the disc at right angles to the framework. In some there is a slight reciprocating motion of the bar, the latter can also be worked in an angle of about 180 degrees, thus enabling it to cut its own entrance into the coal to the necessary depth preparatory to moving forward. As the machine is automatically moved ahead the bar, which is fitted with cutters placed at suitable positions round and along the length of the bar, cuts the coal and thus performs the holing. In addition to the cutters the bar has a spiral arrangement fitted thereon, the purpose of which is to bring the coal-cuttings to the front of the holing, whence they can be readily cleaned away, and the bar is thus allowed freedom of action. The general type of bar used is tapered and it thus forms a cut ranging from about 8 in. at the front to 3 in. or 4 in. at the back of holing. Recently this class of machine has been tried with a bar of uniform diameter, and results are claimed to be equally satisfactory to those obtained with the tapered bar. They are stated to cut from 3 ft. to 6 ft. in depth, and to vary in weight from 1 ton to 2½ tons.

In connection with longwall work, it is proved, practically beyond question, that, generally considered, machine operations at the coal-face have proved advantageous by proportionately increased output, and in the matter of decreased cost per ton, either directly relative to labour charges, or indirectly by a gain in percentage of large coal. These are factors proving that it is but to operate the right type of machine under particular conditions encountered to ultimately insure coal-cutting by machinery becoming practically universal.

The trend being now in the direction of mechanical coal-cutting, and with a strong belief in the skill of the profession, allied with that of machine-designers, as being quite able to surmount each and every difficulty, it should not appear too optimistic to predict such general application.

It is deemed desirable in this paper to refer to what has been done with respect to coal-cutting by machinery in the Southern Hemisphere.

In connection with the coal-mining industry of New South Wales, and up to the year 1903, no positive attempt has ever been made to introduce coal-cutting machines. At one mine a Stanley heading-machine was operated for a time, about the year 1890, but it was finally dispensed with. Two or three trials with other types of machines were made at certain mines, but under conditions which did not by any means admit of justice to the machines under test; naturally the inevitable result took place—viz., failure. During the year 1903, however, determined action has been taken in the matter of installing machines in connection with some of the large and important mines now developing the future extensive coalfield of New South Wales to the south of the town of West Maitland. These mines approximate some thirty miles from the port of shipment at Newcastle. At this the inceptive stage of the establishment of this industrial enterprise, a great antipathy is being exhibited by the hewers to the innovation, which opposition doubtless will cease or be satisfactorily minimised when they realise that their conservatism must reasonably yield to a more up-to-date system of coal-winning, a system not so adverse to their general interests as appears to them at the outset.

With reference to coal-cutting by machinery in this colony of New Zealand, it is safe to assert that a greater proportion of the total output is so won than is the case in any other coal-producing country of the world. In the year 1902 the quantity produced by coal-cutting machines equalled 37 per cent. of the total output of all classes of coal, and, calculated on the output of bituminous and semi-bituminous coal, 49 per cent. of the tonnage may be credited to coal-cutting machinery. The Westport Coal Company (Limited), of New Zealand, whose base of operations is on the west coast of the South Island, has for many years used coal-cutting machinery. During the period various types are tried; with some of these the results were adverse to their adoption. The class of machine which has so far proved most applicable under local conditions is that of the percussive type actuated by compressed air, therefore these machines are in general use with satisfactory results. A Stanley heading-machine was at one time in operation, but owing to very erratic grades the machine proved too cumbersome and unwieldy to be profitably employed. The conditions were unfavourable, and therefore it would be unfair to condemn the header, which under more suitable opportunities would give satisfactory results. The same remarks are applicable to a Jeffrey chain breast machine, actuated by electricity. This machine when in operation fulfilled all the maker's guarantee in the matter of speed, depth of cut, &c., but the varying and heavy grades were adverse to its being "fitted" without an excessive amount of labour, thus nullifying any other gain attached to its actual work. Percussive pick-machines, with electricity as the motive power, were at one time tried exhaustively, but this class of machine was not a success, doubtless attributable to the mechanical action being unsuitable to such a motive power. It might be said that whilst in actual operation good work was performed, but "breakdowns" were the rule instead of the exception, and the loss of time thus occasioned, together with the resultant excessive amount of repairs needed, more than counterbalanced any gain in other directions. These machines have been discarded, and percussive pick machines driven by compressed air have been substituted for some years past. They are practically of one type but by different makers, the one class is called the "Leyner," the other the "Yoch."

There is no difference in the principle of air-driven percussive machines, but in construction makers vary the proportional parts and the mechanism somewhat. The diameter of cylinder is