

Cableway Drag-Line Excavators

Giant Machines for Open Pit Mining

ONE of the chief reasons for the leading position that Great Britain holds in the modern industrial world is that she has under her soil an immense store of hard coal that is an ideal fuel for industrial purposes. Other countries are not so fortunate in this respect, and in many of these the chief natural fuel supplies take the form of lignite, or brown coal, which represents an intermediate stage between wood and coal. This is soft compared with the coal with which we are familiar, and usually is comparatively light, friable and porous. Its heating value is very low, and when lighted in an open grate it smoulders, but it can be burned with little difficulty in specially designed grates using some form of forced draught.

Brown coal is not obtained from deep pits reached by shafts. It is found comparatively near the surface, at depths ranging from only a few feet to perhaps 200 ft., and usually is extracted by stripping off the covering layer of soil, or overburden, and then digging the fuel itself out of the open pit. There are immense deposits of this kind in many parts of the Earth, notably in Germany, where it is largely used in industry, in North America, and at Yalourn, Victoria.

The fuel is only economical when cheap mechanical methods of extracting it are used, and giant machines of many types therefore have been devised for use in the open pit mining by which it is won. These include powerful electric shovels and bucket excavators, for the material is sufficiently soft to be dug up readily by appliances of this kind, but in many ways cableway drag-lines are the most interesting of the machines employed. These are literally land dredgers. The excavating bucket is

suspended from great cables that may be up to a quarter of a mile in length, and is dragged through the coal, which is scooped up in it and hauled to one of the towers supporting the cables. There it is dumped or delivered into wagons, and the bucket is hauled back to dig up another load.

A great area can be swept free of brown coal in this manner, or the covering layer of clay can be removed, as easily as mud can be dredged from the bottom of a lake or estuary. One advantage of the machine is that it not only digs out the coal or soil from the open workings, but also lifts it and carries it away in a single operation.

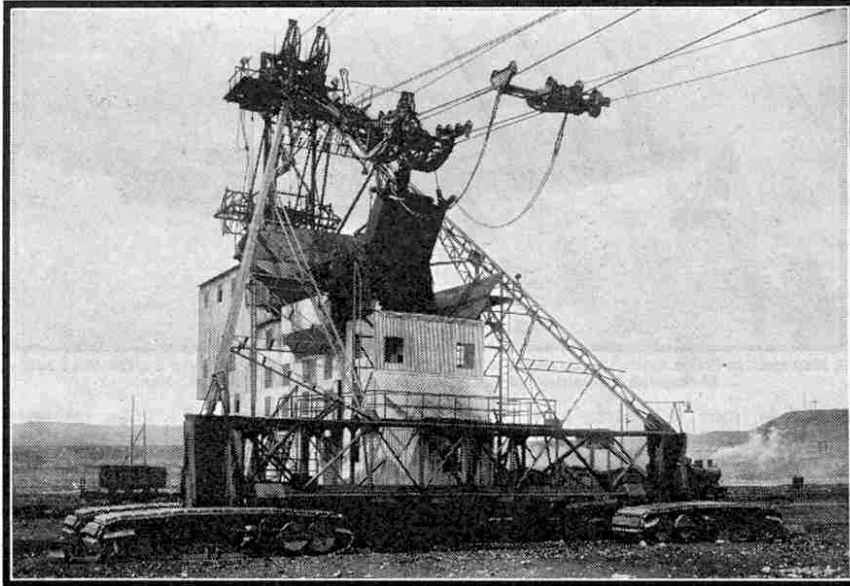
It will be seen that these giant machines

combine the features of drag-line excavators, of the type that have often been described in the "M.M.," with those of cableways. The main cables that stretch across the open pit are supported at their ends by immense towers built of steel. These are known as head and tail towers respectively. The former carries the machinery that operates the bucket and may be as much as 60 ft. to 80 ft. in height, and the latter often is fitted with a bunker in which large pieces of coal are broken up, and a hopper from which the material is fed into the wagons waiting to receive it.

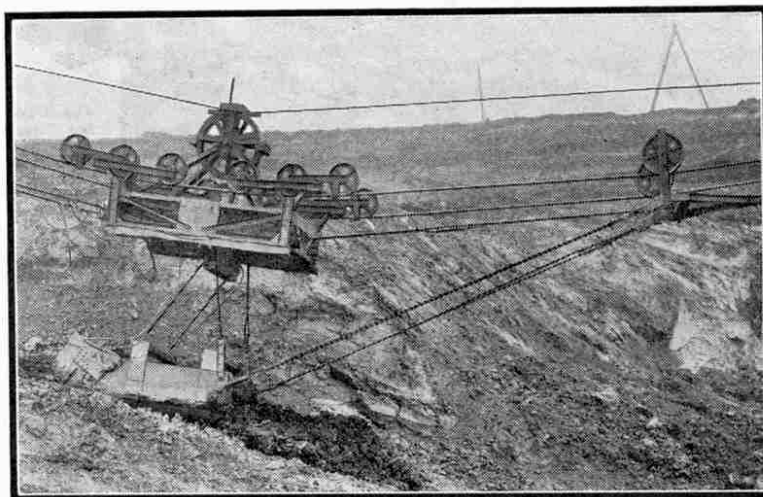
The towers are movable, and are carried on bogies with creeper tracks of large size. The usual plan is to make use of triple tracks for

each tower, and the size of these can be gauged from the upper illustration on this page.

When the drag-line is at work the towers remain in one position held firmly by means of anchors or hold-fasts, until the long strip beneath the cables has been worked to the required depth. Then one of them is moved so that the



General view of the tail tower of a cableway drag-line, showing the bucket discharging fuel into a crusher. We are indebted to Bleichert-Transportanlagen G.m.b.H., Germany, for the illustrations to this article.



The digger bucket of a cableway drag-line excavator in use at Wolfersheim, Germany.

bucket covers fresh ground, or if necessary both are made to travel sideways. The use of creeper tracks enables this to be done readily, and these have the further advantage that towers mounted on them can travel up gradients as steep as 1 in 15. Very little levelling therefore usually is necessary when a pit is being opened out, or when a change in the scene of operations becomes necessary. Some of the earlier drag-line excavators had their towers mounted on rails. They were not so easily adaptable as those now in use, and could not travel on such severe gradients.

The excavating bucket of one of these giant excavators may hold as much as 15 cu. yds. of coal. It is carried by a travelling cradle that is suspended from the main cables, and can be pulled backward or forward by means of operating ropes. At the head tower the main cables pass over the top of a jib that can be raised or lowered as required. When the machine is working the jib is first lowered, causing the main cable to dip. The bucket is thus brought into engagement with the ground, through which it cuts its way as it is dragged along by the hauling cable. When it is full it is lifted from the ground by raising the jib, and is then pulled to the head tower or the tail tower to deposit its contents.

The movements throughout are controlled from an operating room in the head tower, in which are installed the winches by means of which the cables attached to the jib and to the cradle are hauled in. The work of lifting the jib is made easier by providing it with a counterweight. All the winches are electrically driven, and separate motors are employed for the different motions. In one excavator in which a bucket of 15 cu. yds. capacity is used, the motor that pulls it through the coal is of 345 h.p., while other motors of 380 h.p. and 275 h.p. respectively are employed for pulling the load along the cable and raising the jib. The discharge of the spoil from the bucket also is automatic and is controlled from the head tower; in this case a 25 h.p. motor operates

the mechanism that brings this about.

The speed at which the bucket is dragged through the coal usually is 60 yds. per min., and hoisting and lowering take place at similar speeds. These movements are short in comparison with the distance travelled by the bucket when full, or when returning empty after discharging, and comparatively little time would be saved by speeding them up. The rate at which the bucket travels along the cable has been greatly increased since these excavators were first introduced, and is now from 300 to 400 yds. per min. when full and 500 yds. per min. when empty.

The entire operation of filling the bucket, raising it, and returning it

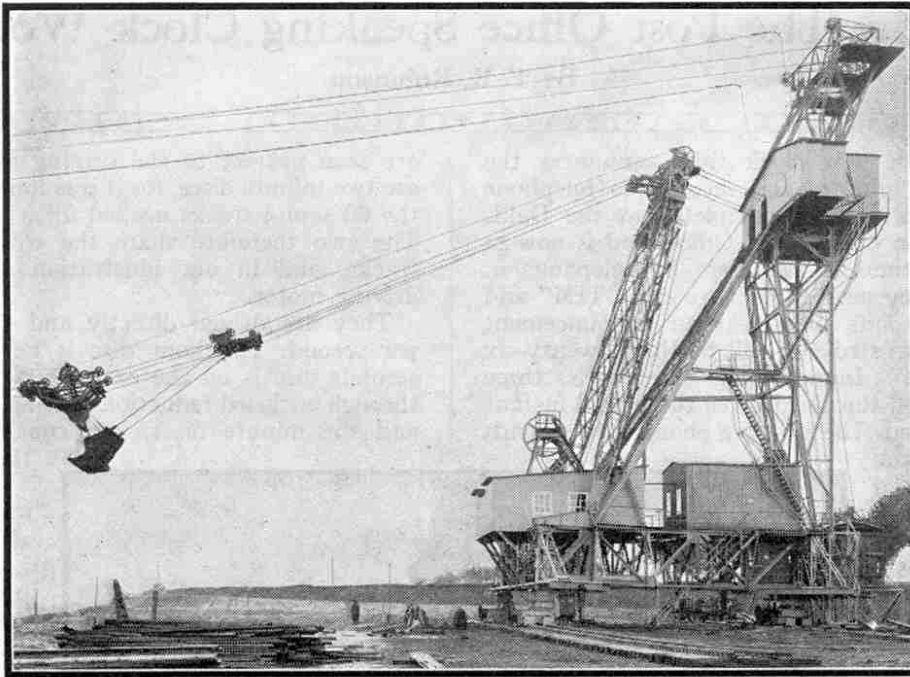
to the ground after emptying its contents where required occupies from two to three minutes, and of this time only 10 sec. are spent in the actual excavation. The output of cableway drag-line excavators usually is very large, however, and is about half as much again as that of mechanical shovels employing the same number of attendants. Normally only three men are

required to a drag-line. These are a driver in the control room of the head tower, a signaller in the pit who communicates with the driver by telephone, and a greaser. Possibly a fourth man may be required to manipulate the tracks on which the tail tower moves.

An interesting feature of the use of cableway drag-lines in open pit mining is the manner in which flooding is dealt with. Surface water is bound to be encountered in open pit working, and this would form a considerable handicap if it were

allowed to spread through the mine. For this reason strips of ground are left intact between successive excavations in which water accumulates. These strips act as bars or dams, and prevent the flow of water from one section to another as the depth of the pit is increased.

These giant excavators also can be used with advantage for digging out deposits of gravel, sand and sandy clay that contain gold, tin and other valuable products.



The head tower of an excavator at the Altenbury workings in Borken, Hessen. The span of the cableway is 355 yds.



A cableway drag-line excavator at work removing debris at the Gornitz Pit, Silesia.