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VOLUME XXXI.

Winning and Preparation of Coal.

PART I.

BY MR. JOHN H. ANDERSON (Member).

Tuesday, February 25, 1919, *at* 6.30 *p.m.*

CHAIRMAN: MR. A. BOYLE (Vice-President.)

THE war has taught us many lessons. Among the many, I question if there are any more vital to this country than that of making better use of our coal supplies. Certainly we have never so much appreciated the true value of coal, until it became so scarce. We have had coal absolutely thrown at us, at a comparatively low price, and we have used it, scarcely giving a thought to future generations, as regards conserving a supply for them. There is not the slightest doubt that we hold our wonderful position among the great nations of the world, principally due to the vast store of this material that we possessed. To understand this thoroughly ask yourself the question, "What would Great Britain be like without its coal fields?" I wish you strongly to consider this, as without a doubt we shall be in a similar position in time to come. Long before our coal is wrought out, we shall not be able to compete with foreign countries that possess much larger coal fields than we do.

Just previous to the war, coals were imported from Germany, for the supply of some of our London gas works. If they could send this coal then, when we still have good working seams in this country, what will they be able to do when our easy procured coal is exhausted? leaving us to work the thin seams, at much greater depth, and extraordinarily increased difficulties of temperature rise, and ventilation of the place; when the foreigners still have many seams of easily won coal, much more than we ever had. I have had this warning before this Institution for several years. (See discussion, McArthur's paper, Nov., 1916.) Apart from the many economies advocated at that time, I will just quote one or two striking instances of the folly of neglecting simple precautions, sometimes realised when too late.

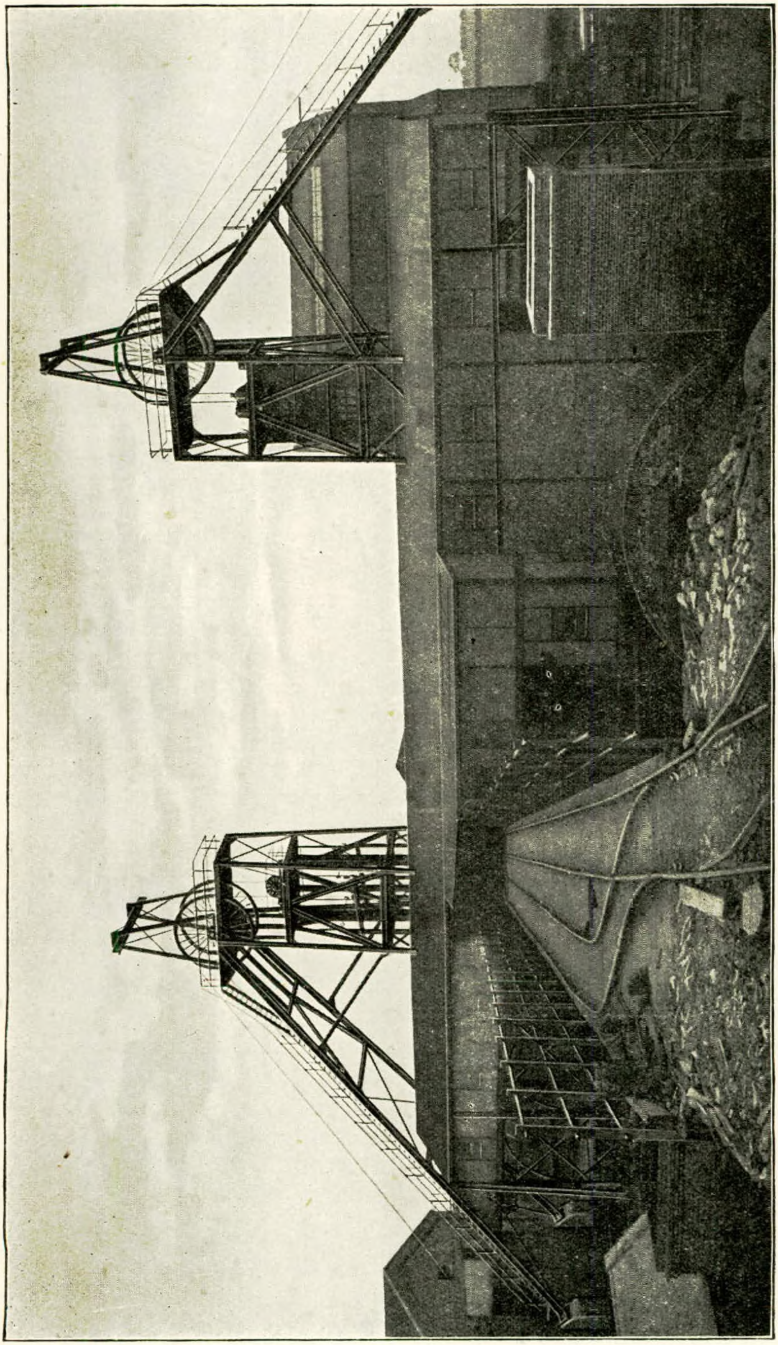
In Lanarkshire—where I gained my first experience of coal mining—the prevailing idea was that their coal was inexhaustible. They possessed an area of about 500 square miles, which contained an average thickness of coal of about 34 feet total of the various seams. One of the standard coals, the "Ell Coal," which I remember was in great demand all over, was 6 ft. thick. Another seam, the "Splint Coal"—also 6 ft. thick—was of such a nature that it could be used direct in the furnaces—without coking—for the smelting of ore. This latter coal so influenced the design of these furnaces that nothing else could be used as fuel. Both of these excellent seams of coal are now entirely finished, and the average thickness of seam now worked is about 36 inches and inferior to that I have just mentioned.

Again look at the various concerns that we have whose principal manufacture is that which is a nuisance to other works to get rid of. I might mention the manufacture of coke for foundry purposes, where the coal is converted into coke and in many instances, the gas and valuable by-products are absolutely lost by escaping to the atmosphere. Probably within a mile or two, there may be a gas works striving to obtain gas from coal and where the resultant coke is a nuisance to get rid of. A little more harmony, together with less prejudice, may result in getting gas and coke to suit both parties. It is only fair to add, that many of our beehive coke ovens are now being scrapped, and by-product recovery ovens are taking their place, but no doubt this was forced on us, due to the necessary material requisite for the manufacture of explosives, and other things that were required during war time.

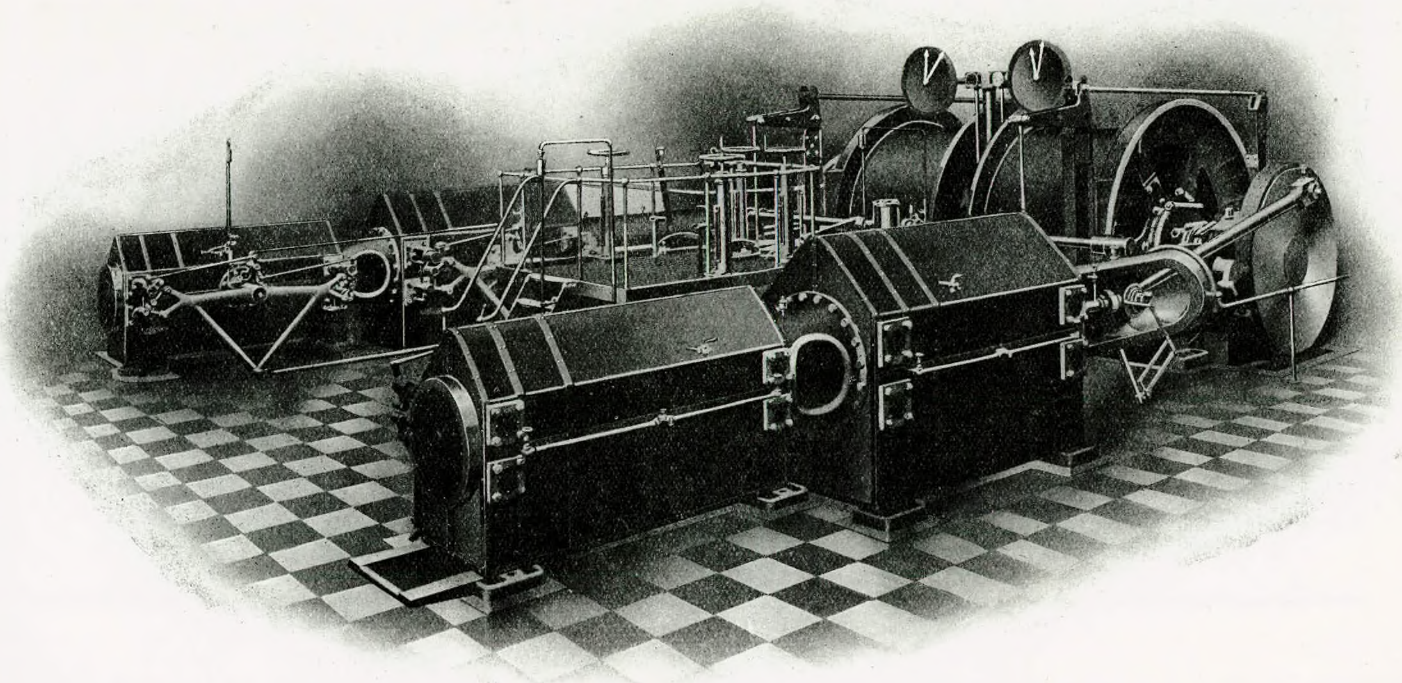
It would be interesting to know where Germany secured the raw material for the enormous quantities of explosives they possessed at the beginning of hostilities, and no doubt if we opened our eyes a little the source could easily be traced to the great amount of tar and other residuals they got from this country in times gone by. When continental people offer to give you something for nothing, fight shy of it, generally it is a case of a sprat to catch a mackerel. They offered to build by-product recovery plants, guarantee more coke per ton of coal and in less time than the older methods, if you let them have the by-products for a few years (I think three years), when they would turn the whole lot over to you free of cost. Surely, this offer was sufficiently glaring to set even our slow brains at work, however, the least said the soonest mended, but I cannot help remarking what foolish people we are to be gulled like this, practically to supply the material with which they tried to destroy us with. Looking into the future the writer can see a great alteration in the more scientific utilization of our valuable asset "Coal." In a great measure this no doubt will be due to the centralization of power generation, either at the coalfields, or distributed sections of the country, perhaps our railways may be the principal means of distribution. We shall then be able to realize the true value of Coal when we extract everything from it at the one operation of handling, and so far as household or factory use of this material is concerned, it will be banished for ever as a relic of bygone days when we made such barbarous use of it. Cheap power—either gas or electricity—will give facilities for many new industries, of which hitherto the foreigner has had the monopoly, at any rate we shall be able to see our country a bit clearer, our lungs will not require to work so hard to obtain the necessary quantity of oxygen for life, neither will they inhale such huge quantities of filth as at present and generally in the aggregate, life will be much sweeter, due to the more scientific use of our coal.

The usual introduction to a lecture on coal mining is to say something in connection with its geological relation, but I wish as much as possible to avoid all technical matters and just to tell you the plain story of how we obtain our coal from the bowels of the earth, showing you various hand and mechanical methods of winning this fuel and its preparation for market, with the multitude of operations of some of the cleaning processes. No matter how, or when, we extract this material it must always remain a dangerous operation, but with the better general education of both miners and officials, the dangers due to past haphazard go as you please methods have been greatly minimised. A great deal of this safety is also due to the application of machinery such as we shall see as we go along. The greater use of mechanical appliances will make it possible to work seams of coal that otherwise could not be worked, and I humbly suggest this as a means of overcoming the restricted output of shorter hours, thus a mutual benefit to employer and employee and probably a part solution of the labour question.

Thrislington Colliery.—Those who have passed through our coal-producing districts, cannot fail to notice the rather prominent erections called pithead frames, together with the various buildings surrounding these structures at the various collieries. Generally speaking, these are more or less alike, with the exception of a few of the details common to each district and also to the method of getting the coal away from the pit. Many small pits win just sufficient coal for their local require-



174.—Thrislington Colliery, general view.

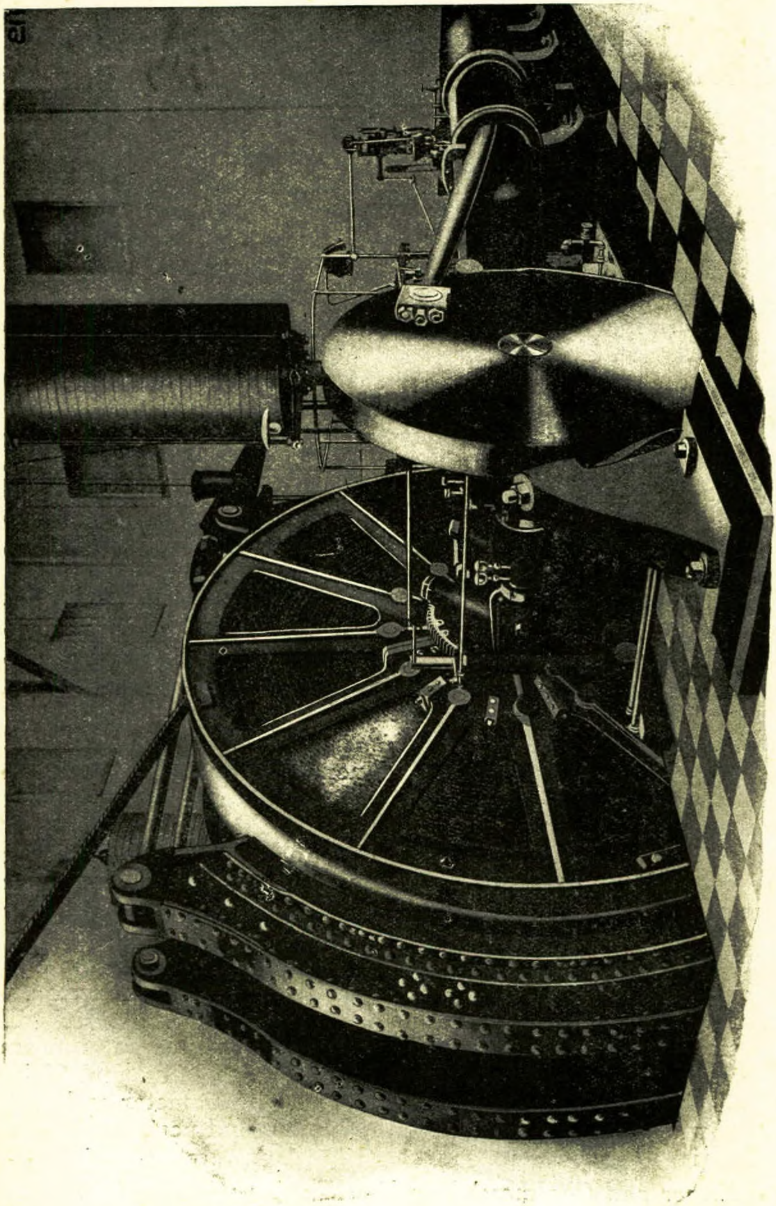


62.—Fraser and Chalmers' Winding Engines, parallel drum.

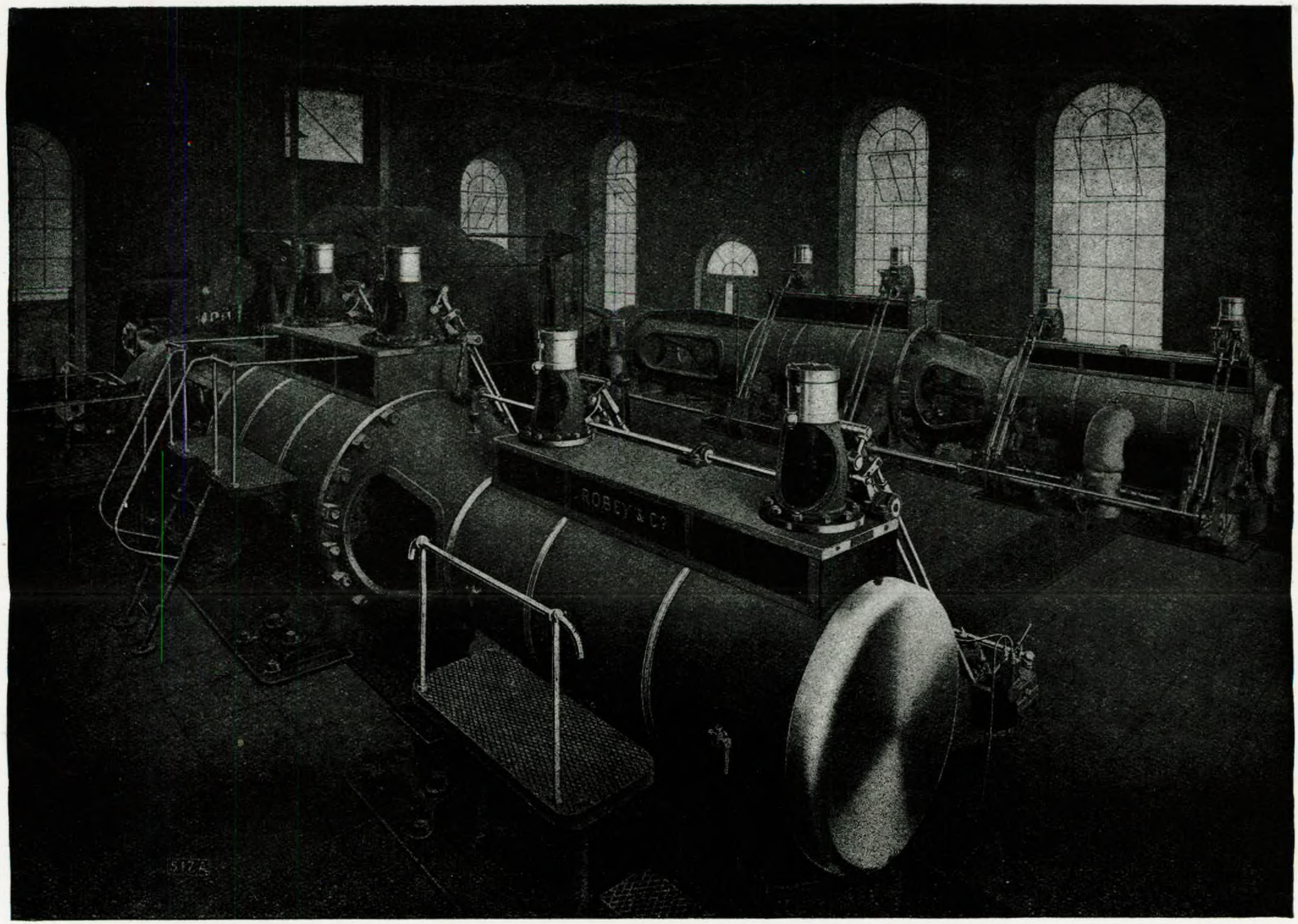
ments and are termed "land sale" collieries, while on the other hand, other collieries win huge daily tonnages, which are exported away from the collieries, by rail or sea. Perhaps the first instance may only require a few horses and carts, while the larger collieries require a huge number or various receptacles for the transport of the material. The most common type of plant for winding coal consists of a pair of engines coupled together with a drum between, on which are fixed the wire ropes, two in number, one reeved over the top of the drum and the other in the opposite way, under the drum, so that when one rope is being wound on the drum, the other rope will be paid out. These ropes are so adjusted that when one cage is at the top of the pit the other cage will be at the bottom. The engines are capable of reversing so that there is a continuity of coal coming out of the pit by each cage coming to the surface, which after taking the loaded hutch off, an empty hutch takes its place, thus a continuous supply of empty hutches are sent down below. In front of the right-hand shaft is seen the fan house for creating a partial vacuum in this shaft, called the upcast shaft. The left-hand headgear is that for the downcast shaft. By means of organisation on the working of the coal and also the closing of various doors of wood or cloth the fresh air going down this shaft is conducted all over the workings of the mine and finally is exhausted to the atmosphere by means of the upcast shaft. Since the Hartley disaster it is compulsory to have a minimum of two shafts or ways to the coal workings, so that such a sad occurrence could scarcely be repeated.

Fraser and Chalmers' Winding Engine with Parallel Drum.—The winding machinery is one of the most important parts of a colliery plant, and to a great extent, the output of coal depends on the efficiency of this operation. For small collieries, where high speed of winding is not essential the engines are usually geared by ordinary spur gearing to the winding drum. For high-speed and larger collieries the usual engine is directly connected to the winding drum as shown on the views before us. The view shows a double drum direct acting Corliss engine, where the drums are parallel, each wire having its independent drum. You will notice that there are high and low pressure cylinders in tandem for each engine, the diameters of which are 16 in. and 28 in. by 60 in. stroke. The drums are 10 ft. in diameter and each 5 ft. wide. They are fitted with clutches and post brakes, and in addition the disc cranks are fitted with steam-operated band brakes.

Fraser and Chalmers' Winding Engine with Reel Drum.—The next view shows a different method of drum, usually called a reel. In this type the rope used is flat, being 6 ins. × $\frac{1}{2}$ in.



62A.—Fraser and Chalmers' Winding Engines, reel drum.



517A.—Robey twin tandem compound drop valve winding engine, Bedwas Nav. Collieries.

thick. The reel is 6 ft. diameter at the centre and on this is wound 3,000 ft. of rope. From this you will gather that there must be a variable diameter of the rope on the drum as it is being wound on. This is of great assistance on starting the engine from rest, particularly if there is no balance arrangement in the shaft. You will also see that the rope can always be in a line with the pithead pulleys, which is not the case with parallel drum ropes. Duplex engines 22 ins. dia. × 60 ins. stroke. This engine will raise a total load of 22,000 lbs. from a depth of 3,000 feet at a speed of 2,000 feet per minute. Both built by Fraser and Chalmers.

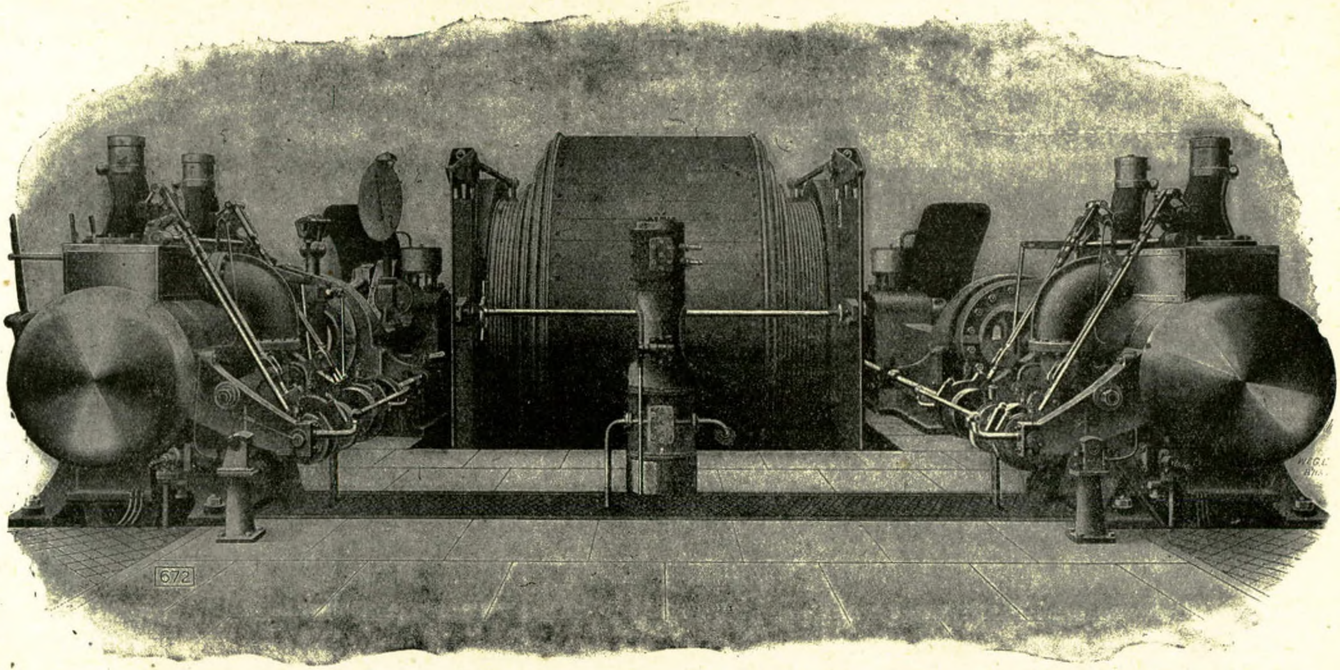
Robey Twin Tandem Compound Drop Valve Winding Engine, Bedwas Navigation Collieries, Bedwas, Monmouthshire.—In view of the great interest being taken at the present time in coal mining matters, the following particulars of capacities and speeds may be appropriate and serve to illustrate some of the work necessary to elevate coal from its bed to the surface. These engines were installed at the Bedwas Navigation Collieries and are of the twin tandem type and operated by the well known and economical drop valve motion of Messrs. Robey and Co., of Lincoln.

High pressure cylinders Dia = 31 ins. Low pressure cylinders Dia = 52 ins. Stroke = six ft. Steam pressure = 140 lbs. per sq. in. Superheat, 600 deg. Fah. Drums semi-conical, largest dia. 22 ft., smallest dia. 14 ft. Depth of shaft, 2,100 ft. Nett load of coal, 6 tons. Number of trucks on cage 4. Weight of each empty truck, $10\frac{1}{2}$ cwts. Weight of cage and chain, $6\frac{1}{2}$ tons. Unbalanced weight of winding rope, $7\frac{1}{4}$ tons. Rope dia., $2\frac{1}{4}$ ins. Maximum hoisting speed, 3,600 ft. per minute. Time of wind, 50 seconds. Time occupied on banking, 10 seconds.

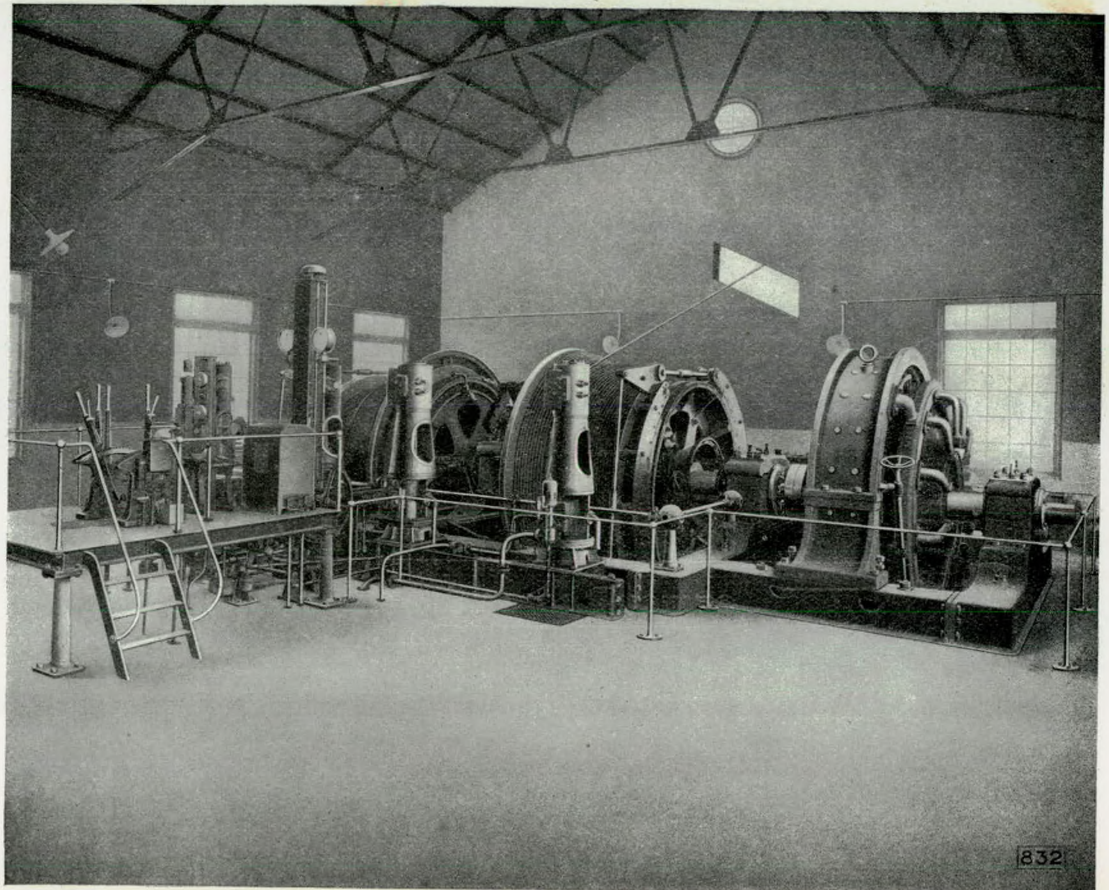
Coupled High Pressure Drop Valve Winding Engine for the Crumlin Valley Collieries, Pontypool.—This view is taken more from the back of the engine and in this instance is a smaller engine than the last one. Built by Robey and Co. for the Crumlin Valley Collieries, Pontypool.

All cylinders are high pressure and are 24 ins. in diameter, with a stroke of four feet. Steam pressure, 150 lbs. per sq. inch. Semi-conical drum, maximum dia. 13 ft., minimum dia. 8 ft. 6 ins. Depth of shaft, 990 ft. Nett coal load, 3 tons. Trucks on cage, two. Weight of each empty truck, 11 cwt. Weight of cage and chain, $78\frac{1}{2}$ cwts. Max. hoisting speed, 2,700 ft. per min. Time of wind, 43 seconds. Size of wire rope, $1\frac{1}{2}$ ins. dia. Weight of rope, 30 cwts.

Robey Electric Winder, Canadian Collieries Co., Vancouver, British Columbia.—In addition to steam engines for winding plant, electricity has, in recent years, been adopted for this



672.—Coupled high-pressure drop valve engine, Crumlin Valley Collieries



832.—Robey electric winder, Canadian Collieries Co.

purpose. This installation was erected for The Canadian Collieries at one of their mines in Vancouver, British Columbia, and is of the Ward-Leonard control system. Referring to the illustration we will see the motor on the right-hand side of the view; this motor is coupled to the main drum shaft, on which are also coupled friction clutches operated by air pressure. The hoisting drums are loose on the shaft and driven by the previous mentioned friction clutches.

At a speed of 83·8 revolutions per minute the B.H.P. of the motor equalled 1,430. The drums are conical. Coal hoisted per hour, 260 tons. Depth of shaft, 1,000 ft. Nett load of coal, 7,800 lbs. Number of trucks, two. Weight of empty truck, 1,600 lbs. Weight of cage, 7,000 lbs. Maximum speed, 3,150 ft. per minute. Time of wind, 33·5 seconds. Time of banking, 15 seconds. Rope diameter, $1\frac{1}{4}$ ins.

In all these engine room views you will notice the substantial brakes fitted. These are easily operated and sometimes this is done automatically. Every thought possible is given for safety of this operation of winding; any obstruction or stoppage of the shaft operations is a serious matter for everyone.

Overwinding and Overspeed Prevention Gear.—The diagram illustrates a much needed appliance in connection with colliery winding operations. The accuracy and reliability of the men placed in charge of this work of winding is unquestionable, yet at the same time the best of human element is not infallible. The main features of the gear under review are for the :—

Prevention of overwind.
,, ,, starting engine in wrong direction.
,, ,, overspeed when cage is near the surface.
,, ,, ,, at any desired point in the shaft.

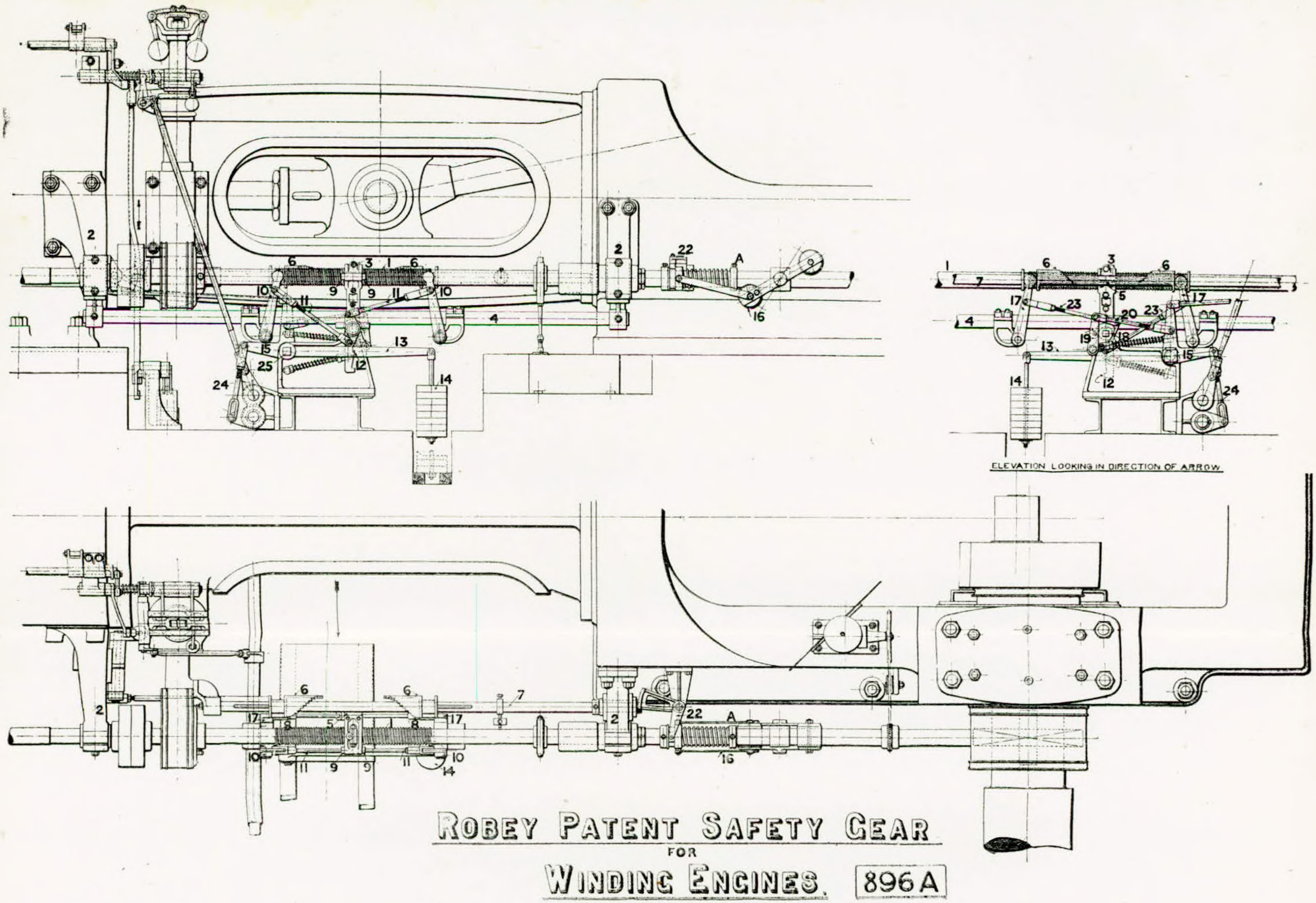
It must be noted that this appliance slows the engine down gradually when the overspeed device is operative; this does not affect the overwinding apparatus, which is entirely independent.

The travelling nut (3) is the main operation of the gear, and works on a screwed portion of the layshaft, thus is always in action as long as the engine is moving, therefore giving a much more reliable security than trains of wheels or belting and sometimes chain driven gear.

Overspeeding.—The length of layshaft (1) has a screw cut upon it, which, when revolving, actuates the traversing nut (3), which corresponds to the position of the cages in the pit shaft, this nut is prevented from revolving by means of the guide shaft (4). At the other end of the shaft is mounted an auxiliary governor (16) which is extremely sensitive, and can readily be adjusted to meet the conditions of working. When the governor weights open out, the auxiliary shaft (7) is rotated by the action of a simple bell-crank lever (22) which is attached to the over-speed governor sleeve; thus the sliding stepped sleeves (6) which are mounted on this auxiliary shaft are brought round so that the catchplate (5) on the traversing nut (3) comes into contact with them before the end of the wind. The fact that the governor weights have opened out proves that the cages were travelling too fast towards the end of the wind. The effect of this traversing nut coming in contact with the sliding sleeve is to carry the sleeve along the auxilliary shaft, and with it, the levers (17) which are connected to the cam plate (18) by means of the rods (23). The movement of this plate actuates the bell crank lever (15) through the lever (19) and coupling rod (20). Thus the engine is slowed down gradually, as the motion of the lever (15) is only a gradual one proportionate to the travel of the nut, while, as will be explained further on, when an overwind takes place, the action of the lever (15) is instantaneous. The top end of the bell-crank lever (15) is connected to the same mechanism as the governor, and pushes up the spindle in the direction of the arrow, and thus lifts the trippers and prevents any steam going to the engine. The other end of the bellcrank lever (15) is connected to the brake engine operating shaft which applies the brake; the connecting rod (24) as shown on the drawing, being slotted so as not to interfere with the ordinary operation of the brake engine. The speed at which it is desired to operate the overspeed gear when coming to bank is regulated by moving the collar marked "A" to compress or release the spring.

Overwinding.—Should, however, the engine have been duly slowed by the driver, the overspeed will not have come into action, but will have withdrawn the stepped sleeve as the nut approached until it reaches the last steps (8) of the sliding sleeve. At the same moment the projection (9) which is on the opposite side of the traversing nut to the catchplate (5) comes in contact with the end of the lever (10) moving it outwards, and by means of the coupling rod (11) releases the catch (12) and so allows the lever (13) to fall suddenly by the action of the weights (14) and thus actuating the bell crank lever (15) which operates the brakes and governor shaft.

It will thus be seen that the cage will be instantly brought to rest, it having been previously slowed down either by the over-speed device or by the engine driver. Should the engine driver



896A.—Overwinding and overspeed prevention gear.

attempt to start the engine in the wrong direction the projection (9) immediately comes in contact with the lever (10), releases the catch (12) and instantly applies the brake and shuts off the steam.

An advantage with this gear is that if the engine driver has an overwind or an overspeed, it is an automatic tell-tale as he cannot re-start his engine without assistance, so that some one gets to know of the case.

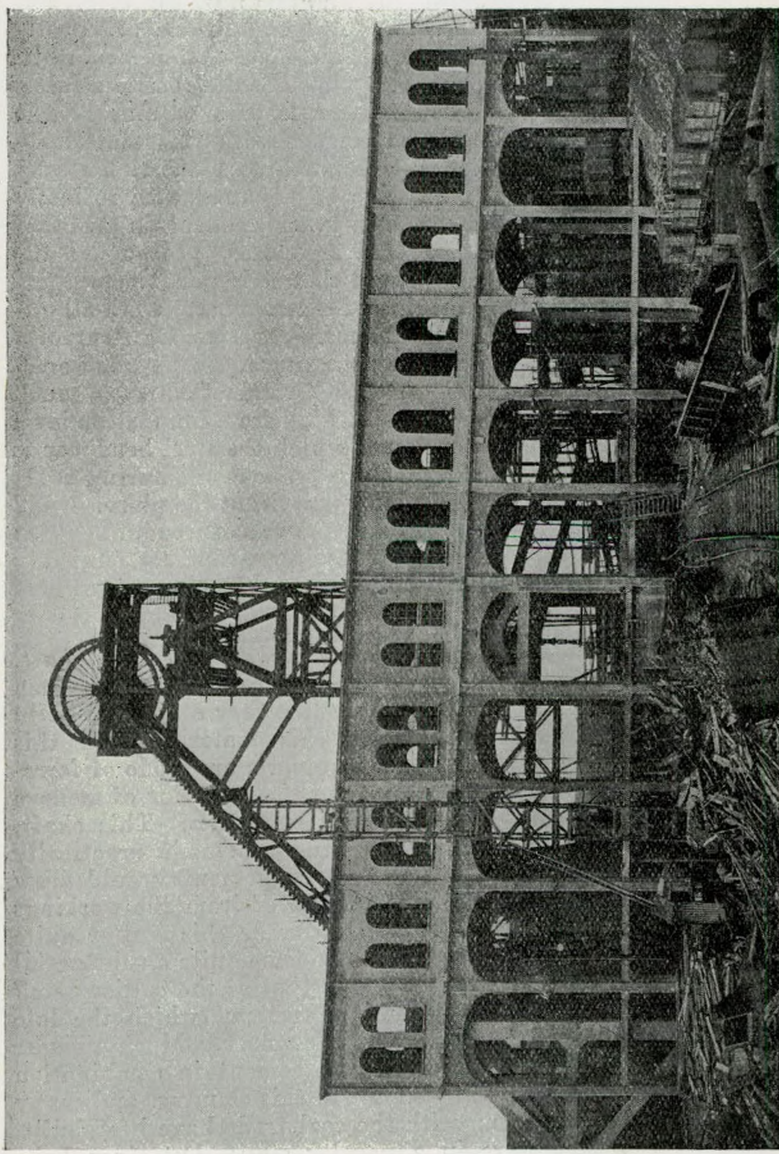
Assuming an overwind has taken place, *i.e.*, the man has started the engine in the wrong direction and the trip (12) has been released, and the lever (13) and the weights (14) drop. It is then necessary for the engine driver to close his throttle and immediately he has to call an assistant to go to the overwinding device, this assistant has to lift the lever (13) while the driver manœuvres his engine by reversing and letting the cage down a few yards, when the lever will again fall into the catch and be ready set again. It will be noticed that the engineman can do nothing whatever with the engine until the lever (13) is lifted, as that, of course, releases the brakes and the trippers, and allows steam again to be admitted to the engine. Supposing now that the overspeed device has come into action. The first thing to be done then is to release whichever of the nuts (6) has been engaged by the travelling nut, which can be done by hand quite easily, the governor should then return to its lowest position, that is the weight close to the shaft if all is free, as it should be. It is then necessary to take a spanner and place it on the square (25) and return the gear to its original position, and it is only when this has been done that the engine is again in charge of the driver.

Messrs. Robey and Co. make an independent safety gear for attaching to existing engines in addition to the device which they fit on their own engines as just reviewed.

Head Wrightson Headgear and Screening Plant, Easington Colliery.—We now show the marks of progress in the construction of headgear, which is entirely of steel in the form of lattice girders. Since the passing of the Coal Mines Act, 1911, the reading of which seems to provide that pithead frames at any new pit must be non-inflammable, unless the mine is a very small one employing less than 30 persons. This is quite an elegant structure and certainly much preferable to wood.

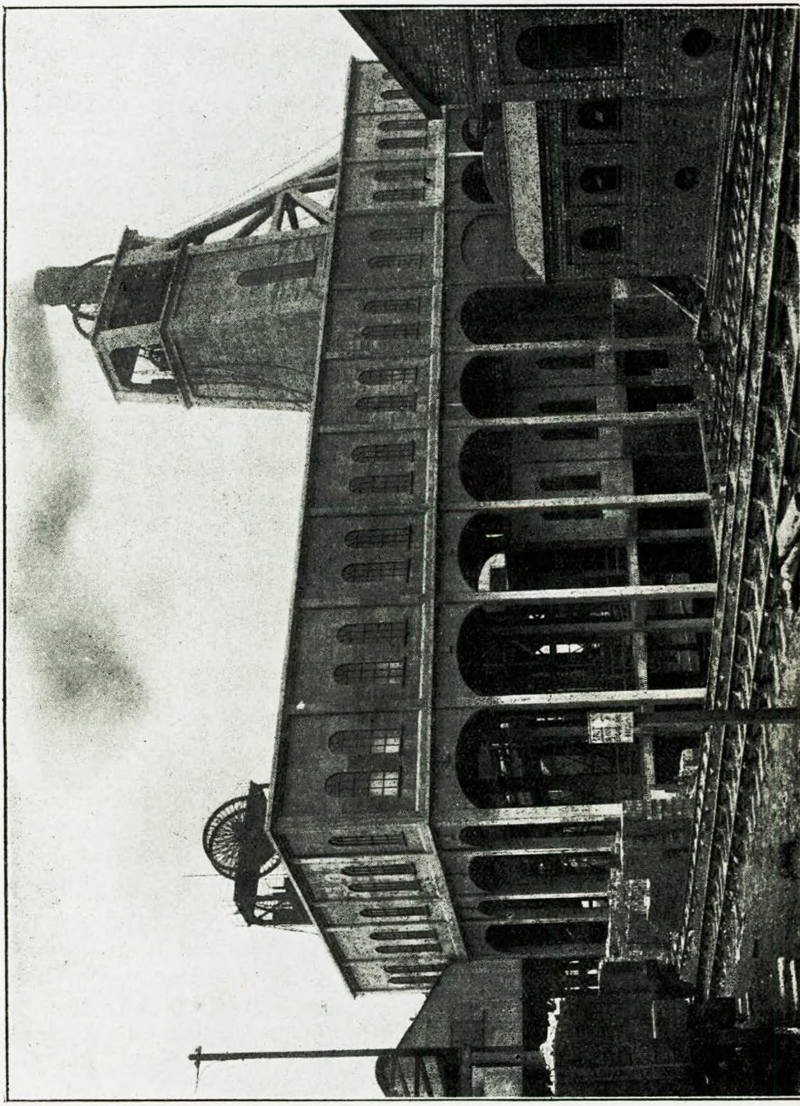
Ferro-Concrete Heapstead, No. 1 Pit, Bentley Colliery.—Another innovation in colliery heapsteads is the adaptation of

478A.—Modern steel headgear and screening plant, Easington Colliery, Co. Durham.
Head Wrightson and Co.



3.—Ferro-concrete heapstead No. 1 Pit, Bentley Colliery, ferro-concrete for this purpose, the first of which was erected at Bentley Colliery, near Doncaster. As you will see, practically all the heapstead is of this material, a composition of steel in its most easy made section principally to take the tensile strains, with concrete to take the compression loads or strains. The author has had considerable experience with this material—probably a unique experience—insomuch as I question if any others have had the opportunity to be favoured with so many heavy collisions to structures, causing various effects in the other members further away, then, having closely probed out the cause of cracks, and finally proved that it is possible to effect repairs and to prevent re-cracking of the member. With all this experience I strongly recommend ferro-concrete for structural work, but wish to emphasise the necessity of treating the erection work as something to be respected, rather than as so much navvy work. This building is 58 ft. high from foundation level to the top of the flat roof, on top of which the steel headgear is situated. We are now looking at this pit as it was during 1911, when some of the contractors' plant was still at the place. No. 2 pithead is close by, and this at that time was of wood. A great field is open for the further use of this ferro-concrete, probably no one has used it for such varied purpose, more than the owners of these mines.

Ferro-Concrete Heapstead with air locks for upcast Shaft, No. 2 Pit, Bentley Colliery.—Ferro-concrete has given such satisfaction to Messrs. Barber Walker that they decided to build their No. 2 Pit Heapstead with this material. In this instance the whole of the headgear supports are made of ferro-concrete, and quite a huge building for the reception of modern screening apparatus is seen in this illustration. This shaft, being the upcast shaft, must have the top made practically air-tight, otherwise the ventilating arrangements would draw the air from the top of the mine instead of from the workings below. The use of ferro-concrete has made this matter quite a simple thing indeed, and at the same time quite a substantial building is the result. The design is that of the colliery staff and is carried out on the Henibique system, which the late L. G. Mouchel introduced into this country. Much pioneer work in the utilisation of gravel and cement in combination with steel bars has been carried out in this country, and many noble works in connection with the coal trade have been built, which at the time were in a novelty stage, but since have proved their worth. In this respect the name of Chas. S. Meik,

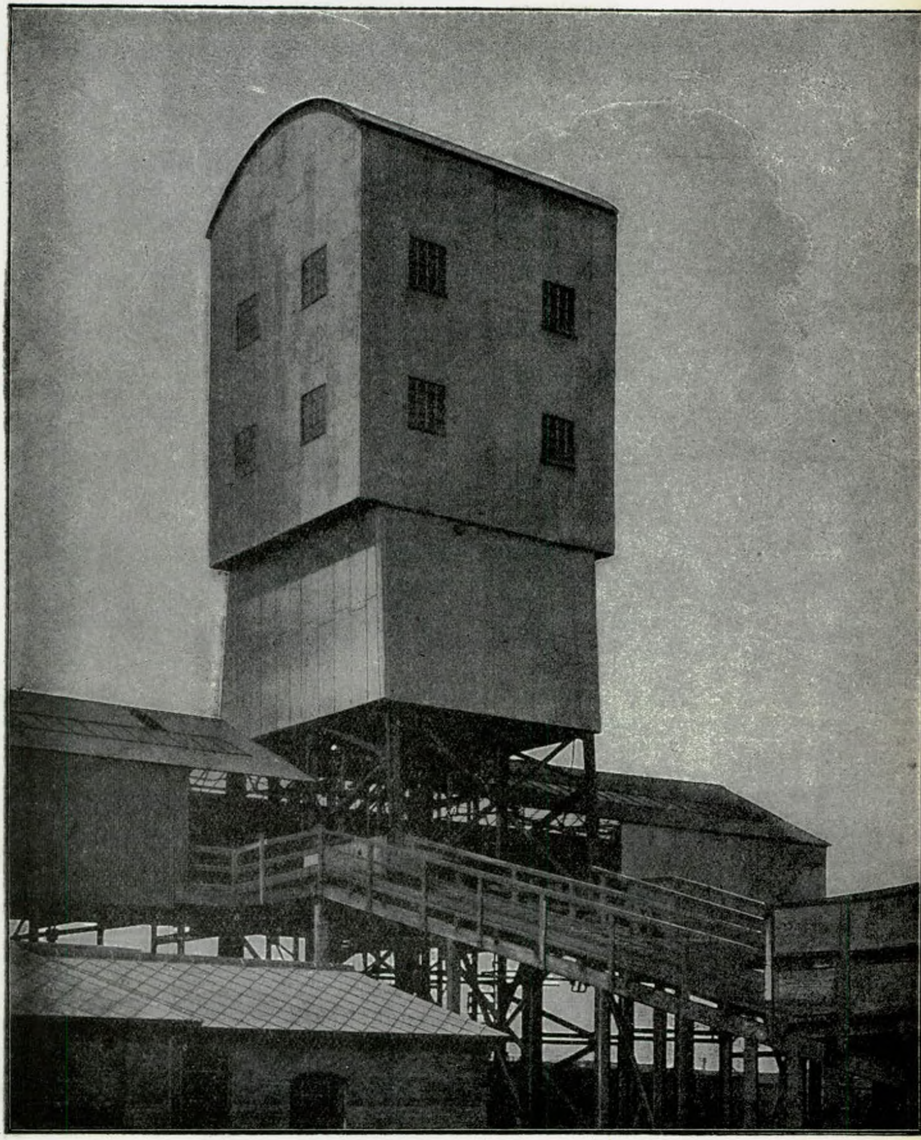


3A.—Ferro-concrete heapstead with air locks for upcast shaft, No. 2 Pit, Bentley.

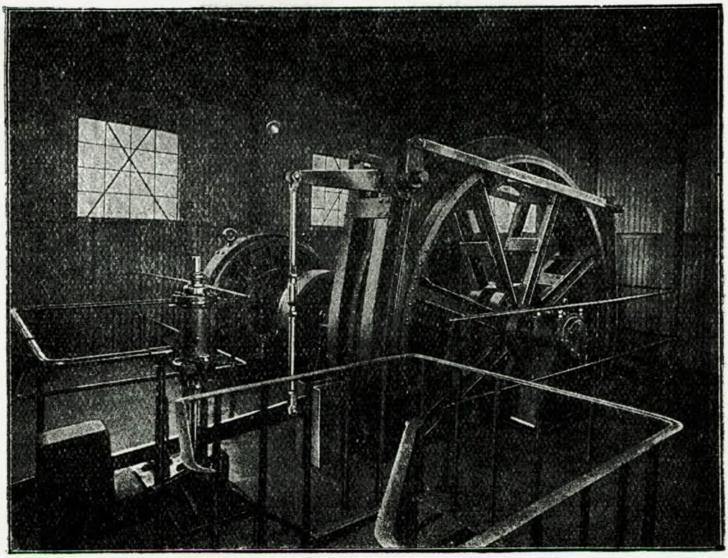
M.I.C.E., will always stand out as one of the first who recognised its merits in this country.

Koepe Winding Plant at Plenmeller Colliery.—It is only recently that the Koepe system of winding has been employed in this country, although it is extensively used on the Continent and also South Africa. This plant now under review was erected during 1916, at Plenmeller Colliery, Haltwhistle, Northumberland, by the British Westinghouse, Co., of Manchester. It is capable of winding a load of 5,040 lbs. at 1,360 feet per minute from a shaft of 800 feet deep. We here see the exterior of the headgear which in place of the usual colliery headgear we see a double floored steel building covered with corrugated sheeting for housing the pulleys and winding gear. In the Koepe system of winding, a single groove rope pulley is used instead of a winding drum, over this pulley the rope is led, the cages being attached to each end. At Plenmeller this pulley is 11 ft. 6 ins. in dia., and is fitted with a steel brake path on each side of the rim. A weighted lever keeps the brakes on while it requires air pressure to hold this brake off. The drive on the winding rope is purely a frictional one, the winding motor at the side shown being of 240 h.p. and connected to winding pulley through single reduction gearing. This motor is controlled so that any speed from "creeping" up to 200 revs. per minute may be obtained. The guide pulley on the lower platform is of similar design as the winding pulley but rather lighter. This pulley is used to bring the ropes vertical with the cage centres, but use is also made of this to drive the depth indicator and operate the accelerating device used with this plant. This accelerating device is controlled in such a manner as to prevent the driver starting up at any other than the determined rate, and similarly when retarding, it gradually reduces the speed of the motor as the cages near the end of the wind, also at bank level, the motor can only be worked at a slow speed.

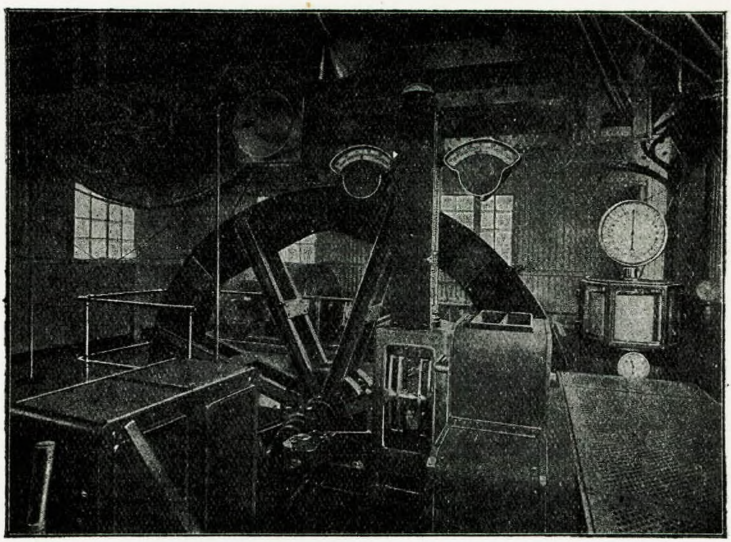
When coal is found at or near the surface the usual method is to drive a sloping mine or drift as it is sometimes called. Tramroads are laid, and these are used to run the hutches on, these being hauled up the incline by means of an endless chain or wire rope. These tramroads are usually double, so that the weight of the empty hutches or tubs as they are sometimes called, help to reduce the power necessary to haul the loaded tubs up. Unfortunately we are not favoured with many shallow seams in this country to-day, those of any value have



60.—Koepe winding plant at Plenmeller Colliery.



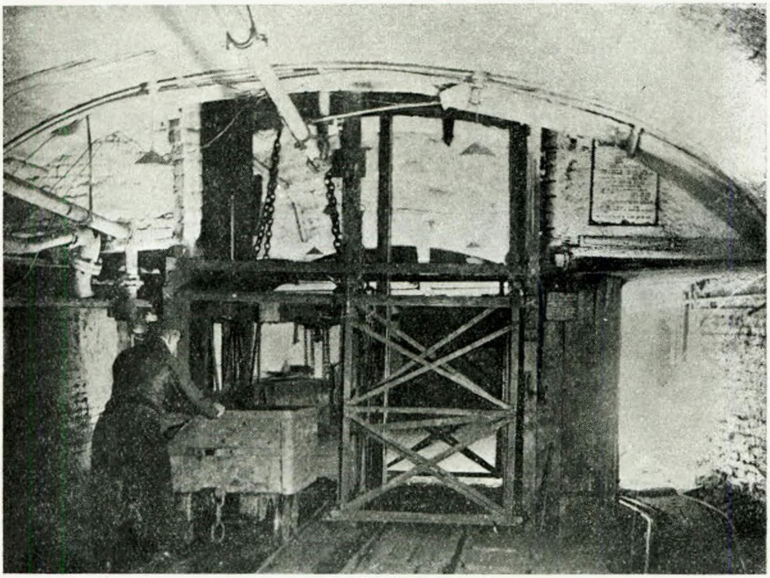
61.—Koepe winding plant at Plenmeller Colliery.



61A.—Koepe winding plant at Plenmeller Colliery.

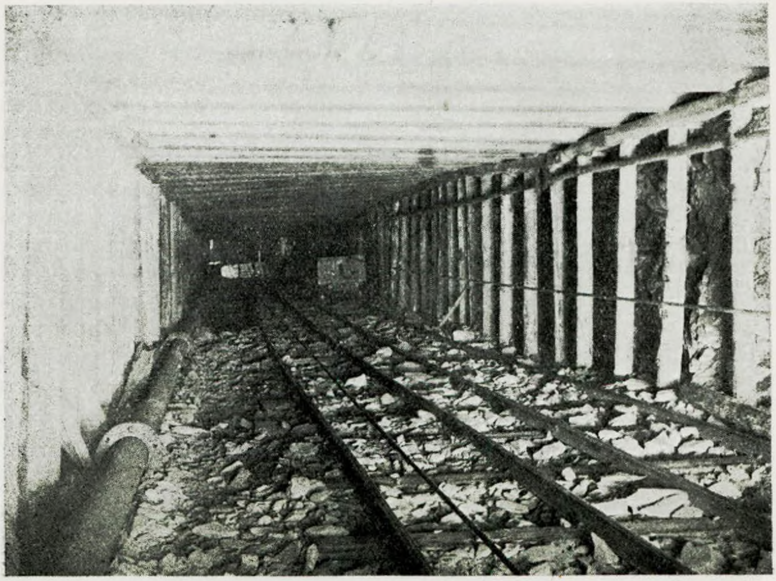
been practically wrought out, and we are compelled to go much deeper for coal, naturally this adds to the difficulties of bringing it to the surface, it increases the difficulties of ventilation, and particularly if there is any dampness about, it makes the workings most difficult for the men owing to the increase of temperature.

In America these slopes are quite common, as a matter of fact many are driven in level with the outside and very often one has to climb up to the coal workings, this of course, is when coal is found in the hills, as such is so in the Western parts of the States and Canada.

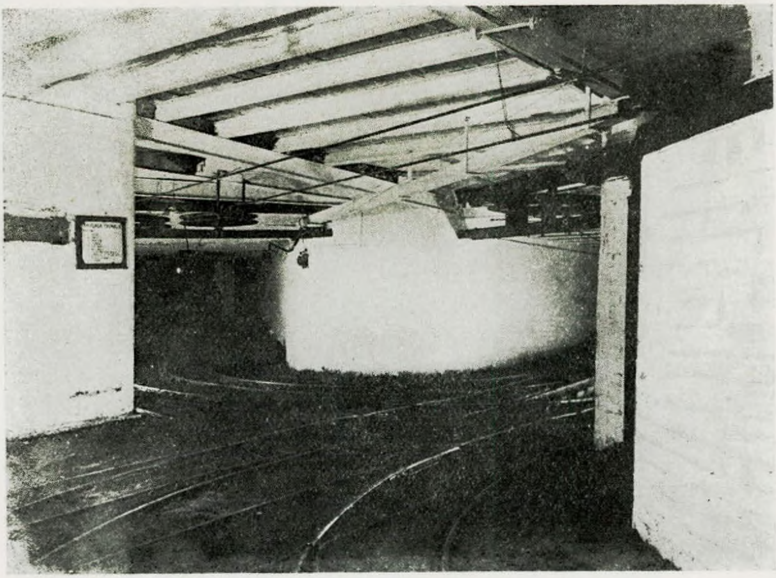


Copyright. With permission of Ashington Coal Co.
7.—Shaft bottom, Ashington Colliery, Northumberland.

Shaft Bottom, Ashington Colliery, Northumberland.—There is much of a muchness at shaft bottoms. This is that of Ashington Colliery, Northumberland, one of the finest collieries in England, and one that is run on ideal lines. On one's first arrival at such a place, where the skill of engineers has triumphed over natures difficulties, one is apt to lose a lot of the sentimental side of the dangers of colliery working, however, as has been said before "coal mining must always be a



7A.—Rolley way timbering, Ashington Colliery, Northumberland.

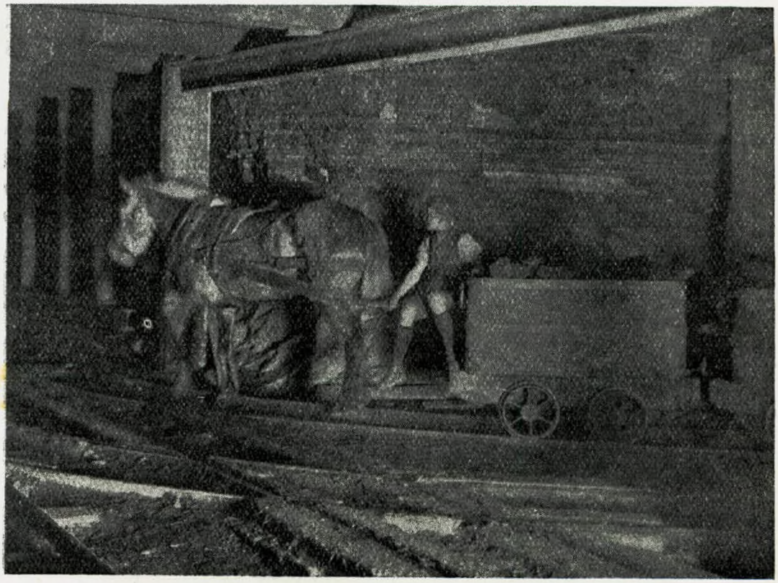


7B.—Haulage junction carl yard seam, Ashington Colliery, Northumberland.

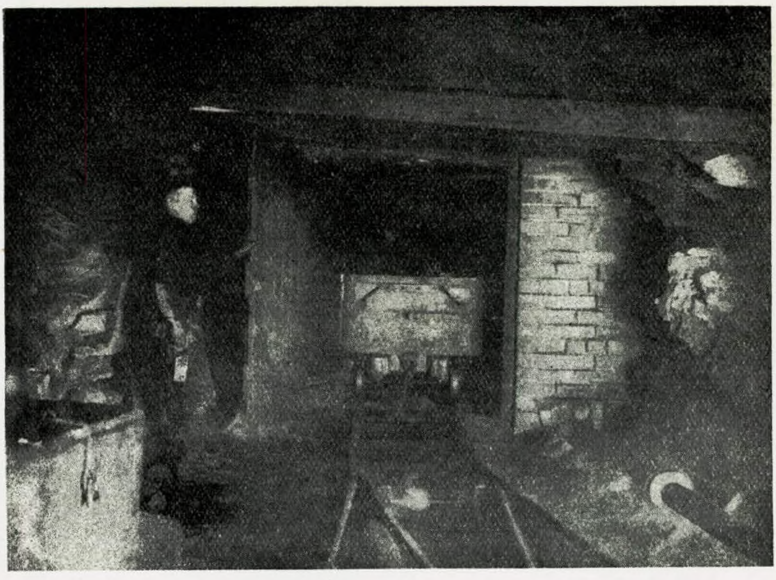
dangerous operation." It is our duty to minimise this danger as much as we can, by making substantial and safe roofs at the vital places such as the shaft bottoms and main roads. When a load is suspended on an ordinary wire rope the tendency is to uncoil the rope and cause the weight to spin; to prevent this and also to guide the cage off the sides of the shaft, some shafts have wooden guides, when on the cage there is a shoe that runs up with the cage. Nowadays, we have extraordinary good ropes, called non-spin ropes, no matter what weight is put on them below the weight they are made for they remain practically as if they were a solid bar of steel so far as twisting is concerned, yet on the other hand they are quite flexible, so far as bending is concerned. You will see the permanent nature of these places and the good lighting arrangement of electric lighting.

13.—Coal hewing, Ashington Colliery, Northumberland.

Coal Hewing.—Holing, or under-cutting the coal by hand is one of the most dangerous operations the miner has to perform. After a considerable amount of back breaking experiences we arrive at a place where the miner is at work, undercutting the coal by means of a miner's pick. Usually this is undercut

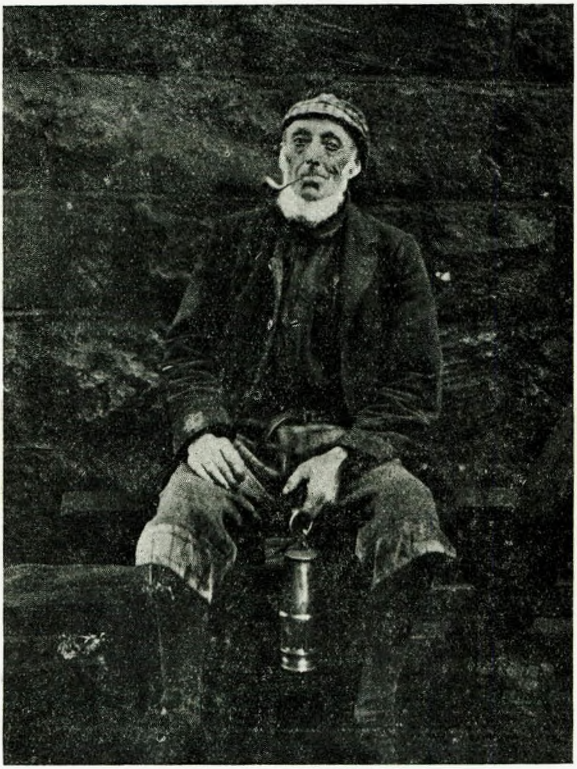


Copyright. With permission of Ashington Coal Co.
13A.—Pony driver, Ashington Colliery, Northumberland.



Copyright. With permission of Ashington Coal Co.
13B.—Trapper boy, Ashington Colliery, Northumberland.

some three to four feet deep, then afterwards a thin groove is made as deep as the miner can reach. Some pits are very hot and moist, and most trying for the men, who at times strip bare to the waist. We are still at Ashington, and here we see a Northumberland miner undercutting by hand. You will see that this man has no necessity to strip, the mine is much cooler and better for working in. The Northumberland miners



Copyright. With permission of Ashington Coal Co.
50.—Typical old Northumbrian pitman, Ashington Colliery, Northumberland.

are quite a class by themselves, and are generally recognised as such; they mostly all work in low shoes—quite substantial made articles—short knicker-trousers made from white or white and blue flannel, long blue stockings, and a blue flannel shirt; the waistcoat and coat is not so particular, but very often a white flannel coat is part of his equipment. Very often they live to a remarkable age, some of them hewing coal practically all their lives; I know of instances of them remaining at this hard work, and even then competing with the younger men, when reaching the age of nearly seventy years. They serve a long apprenticeship, starting as boys either as pony drivers or trapper boys.

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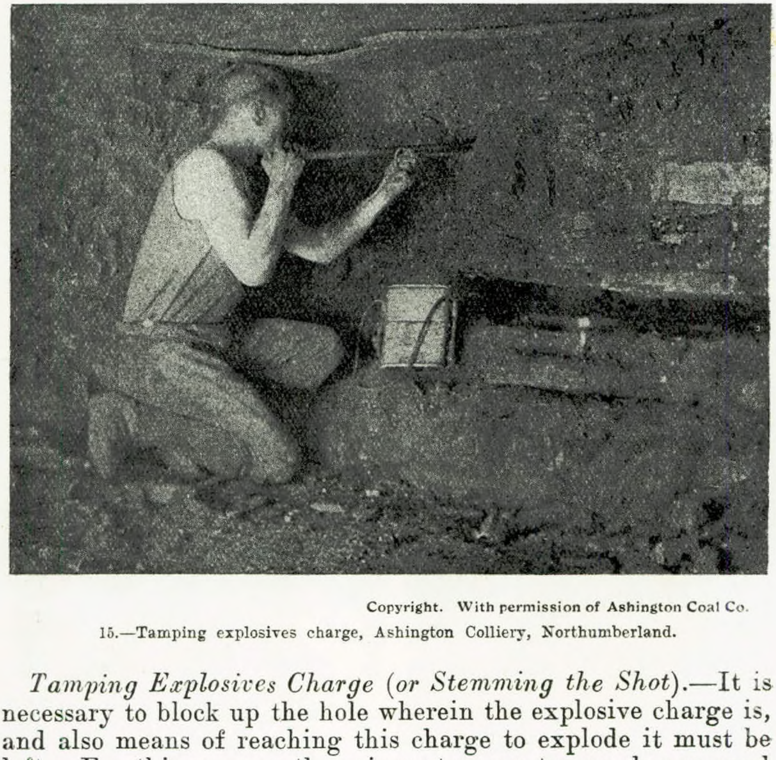
14.—Boring shothole by hand, Ashington Colliery, Northumberland.

Boring Shot-hole by Hand.—After undercutting by hand the collier then starts preparing to secure this block of coal under which he has been labouring. In many mines he is assisted with the weight of the roof above, partly squeezing and breaking the coal down after undercutting. It is very interesting to watch this process, the miner with experience is gifted and can scent danger and knows just how far to go in this matter. However, many coals are too hard and require some other agent to get it down, and for this reason, the collier in front of us is boring a hole for the reception of a charge of powder which eventually will be fired. This hole is usually taken nearly as far as the undercut he previously made under the coal, and may be bored at a rate of from two to eight inches per minute, depending on the material being cut.



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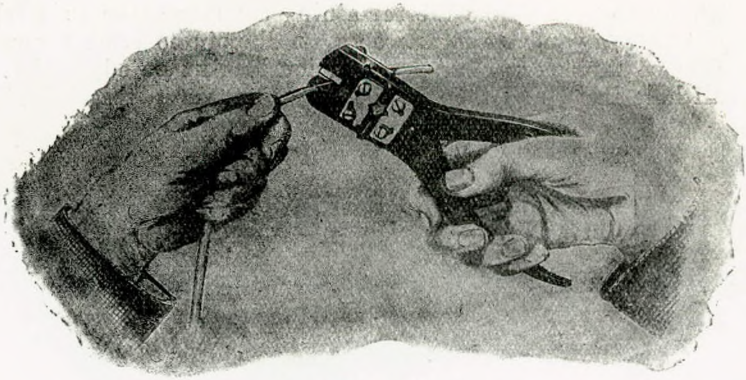
15.—Tamping explosives charge, Ashington Colliery, Northumberland.

Tamping Explosives Charge (*or Stemming the Shot*).—It is necessary to block up the hole wherein the explosive charge is, and also means of reaching this charge to explode it must be left. For this purpose the miner stems or tamps clay or sand into the hole, at the same time a hole is left for the squib or detonator fuse. The author has made many a cartridge when the colliers used to make their own, and this was usually done by rolling a piece of newspaper around a piece of round wood, closing one end, pulling it off the wood and then filling it with black powder. The squibs were made in a somewhat similar way. Several times I have thought of this operation, because many a time the men would be smoking their pipes at the same time they were handling this loose powder. Needless to say, my assistance at that time was voluntary, this work usually being done on the collier's door step at home, many a valuable lesson I learned from these men, particularly the older worthies. The Tamper is in the right-hand, while the pricker or squib hole-former is in the other.

Safety fuses are now used in place of the previously mentioned squibs, and these may be cut to any length, thus giving ample time for the men to get to a place of safety; these fuses and detonators are made by Messrs. Nobel's Explosives Co., Ltd., of Glasgow, and are much safer than the older squibs.

The usual operations for blasting after the bore hole is prepared is:—

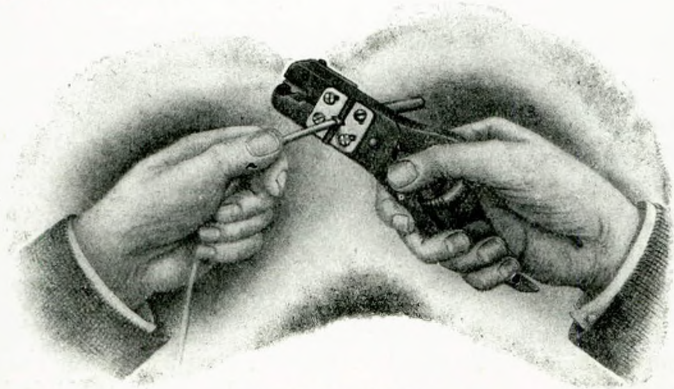
1st Operation.—Insert the quantity of cartridges, excepting one, one by one into the bore hole, and by means of a wooden tamping rod (not pointed) press each home gently, but firmly, so that all are brought closely into contact, while the bottom of the bore hole is solidly filled without an air-space at the back of the cartridges. One cartridge, called the "Primer," is kept out.



15A.—Cutting safety fuse.

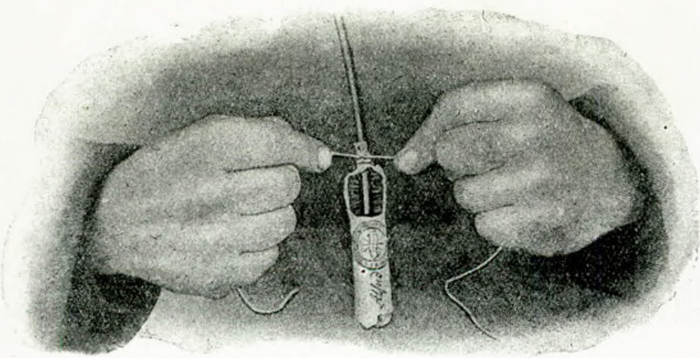
2nd Operation.—Cut the required length of safety fuse square across by means of nippers as per illustration, or with a sharp knife.

3rd Operation.—Insert the safety fuse in the detonator and fix it by means of the nippers. If there is water present or if the bore hole is damp, make the junction of the fuse and detonator watertight by means of tough grease, or similar material of suitable consistency; this is important, as an imperfectly waterproofed junction is the cause or source of many missfires, either from the water or too soft grease finding its way into the detonator or sometimes soft grease is washed away by water.



15B.—Fixing safety fuse.

4th Operation.—Take the remaining cartridge (the Primer), open one end, and by means of a small pointed stick (or the handle of the special nippers previously illustrated) make a small hole in it, and then insert the detonator in this hole, so



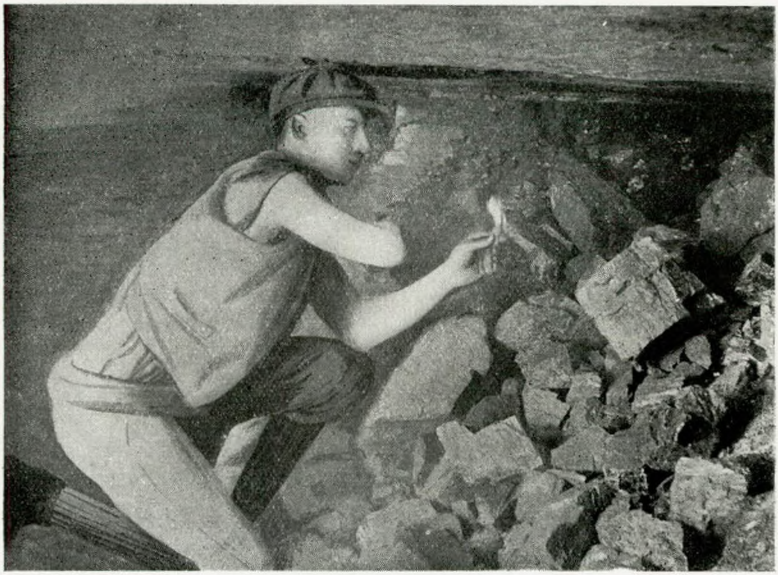
15C.—Inserting and fixing detonator.

that about one-third of the copper tube is left exposed outside of the explosive. The safety fuse, just above the detonator, should be securely tied in position in the cartridge, as shown in the illustration of a Nobel's "Viking"

Cartridge, composed of a powder permitted for coal mining work. If the detonator be pushed too far into the cartridge the safety fuse may set fire to the cartridge before the detonator can act. This circumstance, and the use of defective, inferior, or damp detonators are fruitful causes of unpleasant fumes and frequently lead to only partial detonation of explosives.

5th Operation, Tamping.—A lump of damp clay may be pressed in after the last cartridge and then the usual tamping material should be inserted and rammed in without using force. Care should be taken that a wooden tamping rod alone is used, and that it is not pointed at the end.

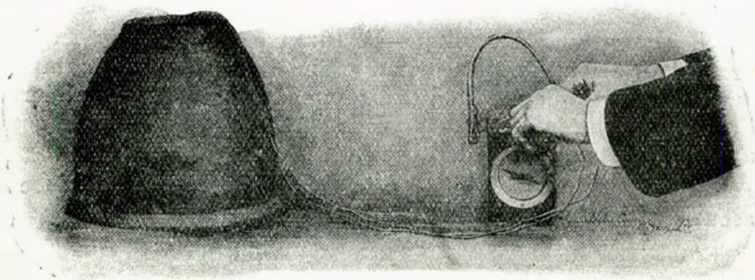
6th Operation.—Light the safety fuse and retire to a place of security.



16.—After the shot, Ashington Colliery, Northumberland.

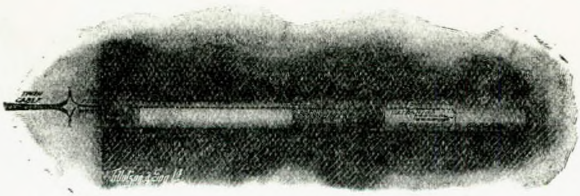
After the Shot.—The charge is now exploded, and on revisiting the place we see an alteration in the aspect. Great care must be exercised in this process of blasting, not only to prevent shattering the coal to a useless size, but also to see that no other danger is set up by ignition of any gas about the place.

Electric Shot Firing.—The firing of explosives by electricity is frequently done, and for this purpose, as the fuses may occasionally get damaged, it is imperative, in order to avoid missfires, that every fuse should be tested before being used. For testing low tension fuses this is usually done by means of a



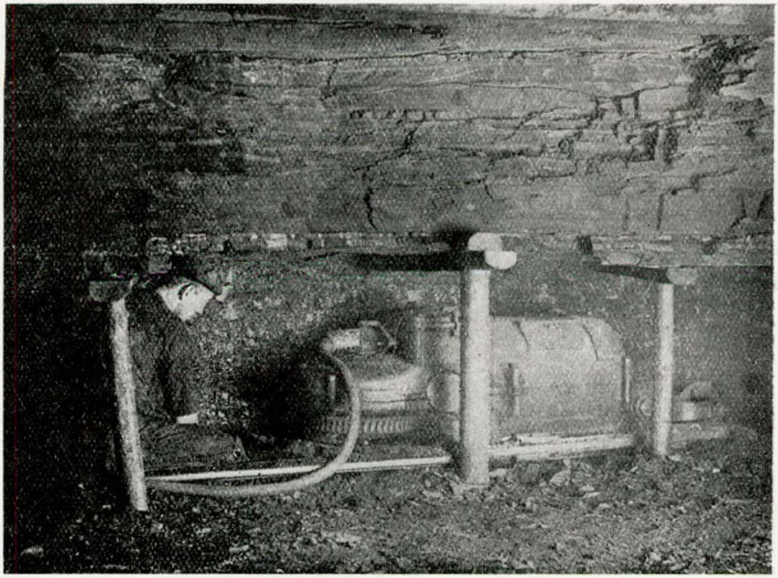
16A.—Electric shot firing.

galvanometer. The electric detonator should be placed in an iron receptacle such as illustrated (for protection in case of accidental explosion) and the bared ends of fuse wires just touching the terminals of the galvanometer, care being taken that the ends of the wires do not touch each other. If the needle moves the fuse is good, otherwise the fuse should be discarded.



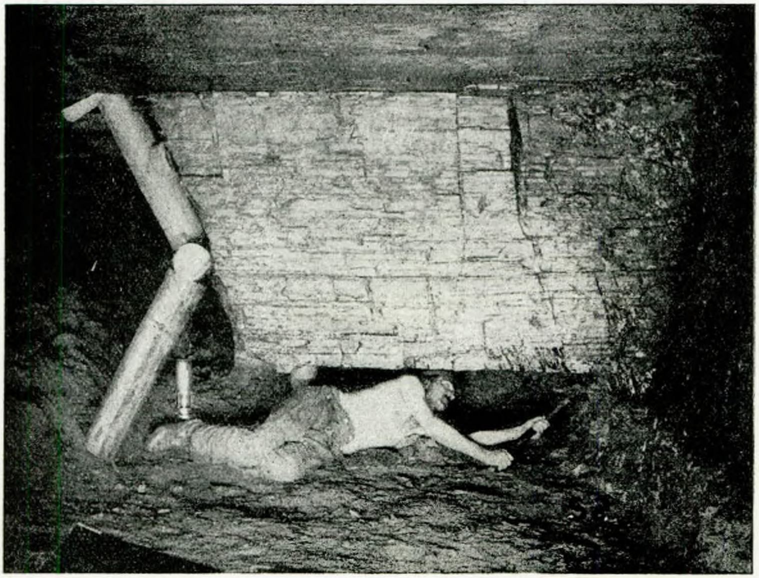
16D.—Charging boreholes for electric firing.

Charging Bore Holes for Electric Blasting.—The firing by electricity resembles in all respects the previously described methods, excepting that in place of safety fuse being lighted by a naked light, thus firing a detonator, a special detonator is used that can be exploded by electricity. Referring to the illustration of bore hole shown in section we can see that two distinct insulated wires are twisted together and lead from the detonator to outside the bore hole. An exploder placed in some safe place, probably a hundred yards away, also has two distinct wires led to, and connected to the detonator wires, thus forming a complete electrical circuit for transmitting current to the detonator when this current is generated by the exploder. This method of firing is much safer than other methods, as better control can be exercised and not only that but several cartridges may be blasted simultaneously, thus getting the combined effects of the various charges at the same moment.



Copyright. With permission of Ashington Coal Co.
19.—Longwall coal cutter, Ashington Colliery.

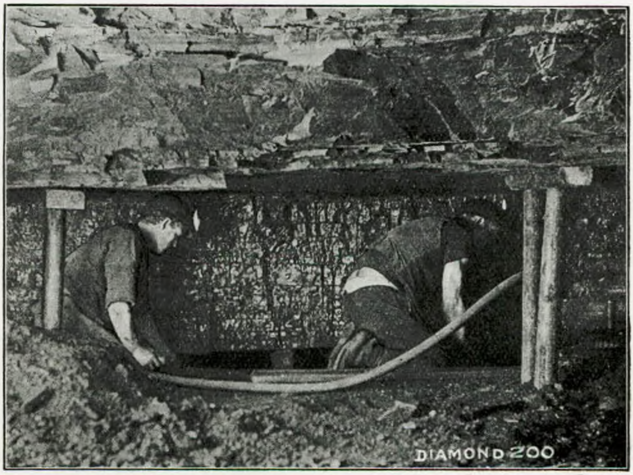
Long Wall Coal Cutter, Ashington.—As we said before, undercutting is one of the most dangerous operations that the miner has to contend with, when done by hand, especially hard is this work in thin seams, or in hard coal. Many a time the miner is completely under the coal he is undercutting, at the same time the overweight may be cracking and creaking in a dangerous state. For this reason alone, you will easily recognise the increased safety to the miner, by the use of cutting machines, as thereby it is not necessary to crawl under and stay there in danger all the time. In addition to that, the fact of the undercutting being done more rapidly, thus reduces the time for the material over the coal, breaking the supporting timbers. Again much deeper cuts can be made without the same waste of coal, as made by hand, as it is only necessary to undercut the thickness of the cutters, instead of sufficient to let a man in laying on his side three or four feet from the outside of the coal. We here see a coal cutter at work cutting any-



52.—Undercutting or holing by hand.

thing to about six feet deep. While for comparison the next view shows the dangers of some hand undercutting, as well as some of the peculiar although very effective methods of supporting the block of coal while the material underneath is extracted so that this block of coal will be won. This system of timbering is called Sprag and Cockering, and is used for supporting the coal when holing or undercutting the coal face in mines where the coal seam is of a steep rise.

Fixing Sprags and Cleaning out Kirvings (by permission of the Ashington Coal Co. and the Diamond Coal Cutter Co.).— As the coal cutter machine is pulled along undercutting the coal, wedges or chocks must immediately be driven in, otherwise in all probability the whole lot would come down in a solid block, thus all the labour would be wasted and the work would have to be re-done, only this time cutting coal instead



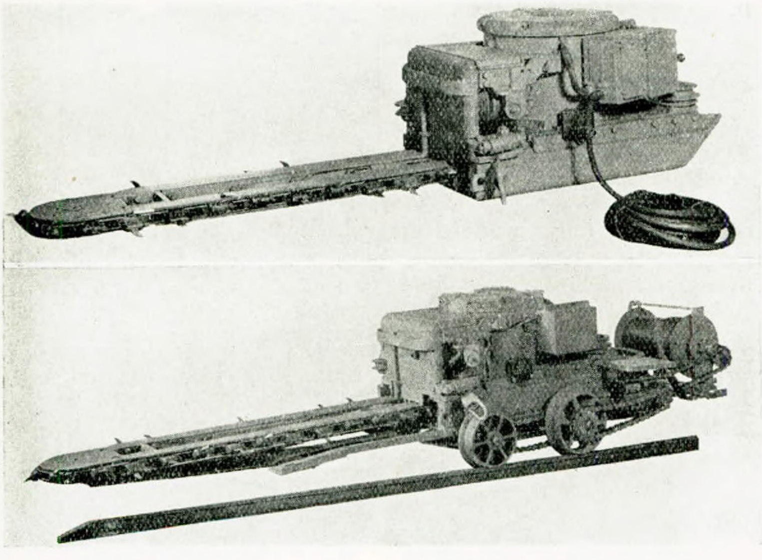
200.—Fixing sprags and cleaning out the kirvings, Ashington Colliery.

of the hard clays underneath, thus being a loss of coal and also harder cutting. The miners here seen, do this propping up and also perform the operation of cleaning out the kirvings

201.—Timbering the face.

as it is called, that is, they clean out the small cuttings left underneath the coal. Kirvings, I suggest, is a corruption of curve, that from the curve made on the extreme end of the cutter or miner's pick.

Timbering the Face (by permission of the Ashington Coal Co. and the Diamond Coal Cutter Co.).—With machine cutting it is necessary to keep the working face followed up by driving in the roof supporting props, which the miner is here doing. Very often these props form a guide to the cutting machine, skids being placed on the machine which rub against the timbers, the timbers thus keeping the machine against the face of the coal. This work is usually undertaken by special men.



21A.—Morgan Gardner shortwall machines, mounted and unmounted.

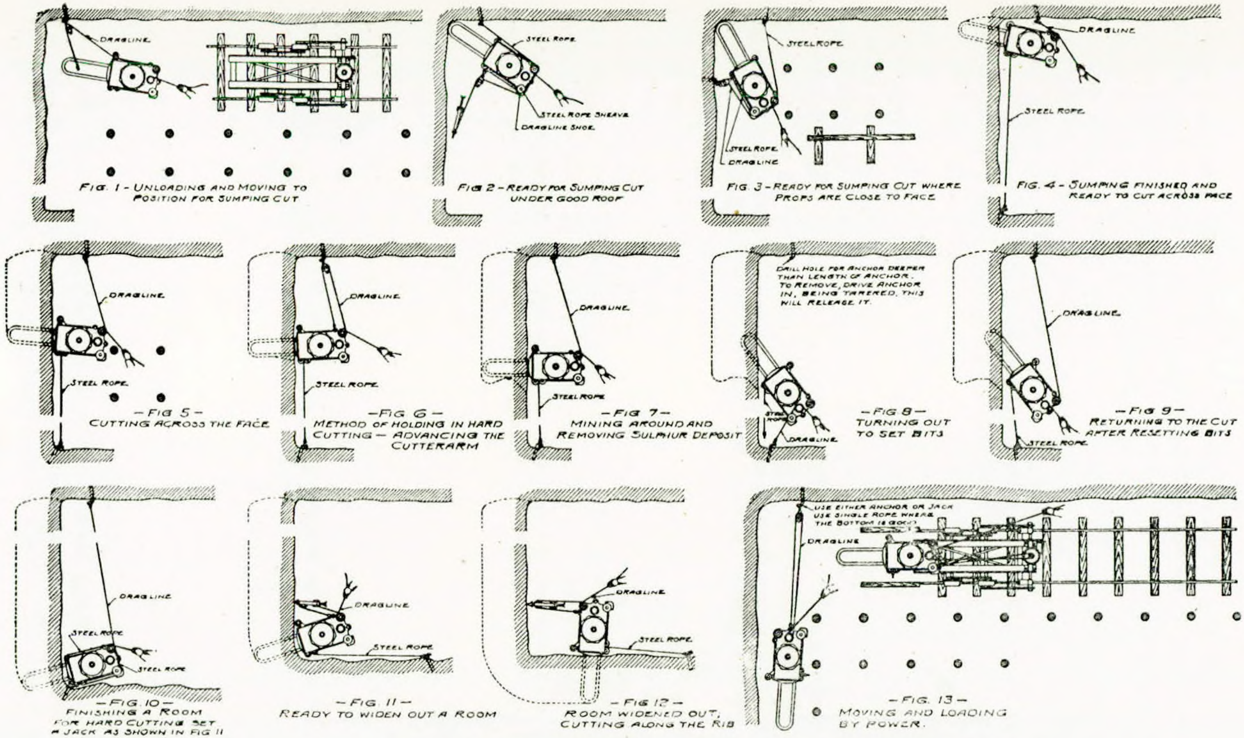
Morgan Gardner S. A. Shortwall Machine.—The "Morgan Gardner Shortwall" machine for undercutting coal is a particular handy type, its size and the manner in which it may be worked makes it useful for working in faces where the timbering needs to be kept pretty close. It is fitted with a vertical motor, thus eliminating bevel gearing and making the drive simple, at the same time its height is not great. The machine can be handled by power in all its movements as will be explained diagrammatically as we go along. Mechanically and electrically it is built to carry severe overloads for considerable periods. Its height as shown unmounted is 27 inches for the standard machine, but special machines may be built as low as $23\frac{1}{2}$ inches in height for working in low seams. Weighing about 32 cwt., it is thus just a handy size for manipulation. As much of the American methods of winning coal is on the pillar and room system of working, many ingenious methods of transporting these machines from one room to another is adopted, such as simple trucks running on rails, special trucks with low wheels. Other trucks are made from where the machine actually does the work of undercutting when mounted on the truck. The illustration before us shows the machine mounted on what is termed a simple self-propelling device, when cutting machine is placed in this position its cutting chain drive gear comes into mesh with the main transmission gear on the truck, thence through a reversable bevel gear to a shaft underneath, on which is a sprocket at each side of the machine. From these a chain makes positive connection to all four wheels of the truck. The truck is fitted with brakes and is thus very suitable for operation on rising or falling roads, grades of 21 degrees have been negociated both climbing by power and braking on going down. Automatic cable reels are fitted to these trucks similar to those on the Morgan Gardner haulage locomotives illustrated in detail further on in our article.

Typical Settings and Operations of the Morgan Gardner Shortwall Machine.—The facility with which this machine handles itself in regular and special operations is one of its strong features, resourceful machine men may do anything with this class of tool, but generally speaking in regular working there is a constant repetition of a cycle of five operations for a machine with a truck mounting for transport.

1st. Unloading and dragging to the face.
2nd. Sumping the cutter arm into the coal.
3rd. Undercutting across the face.
4th. Dragging the machine out and re-loading.
5th. Travelling to the next working place.

Referring to the diagram:—

1st. Unloading from the truck and dragging to the face are done by one simple operation. A jack or anchor is set at the right-hand rib near the face and the drag-line connected as



Figures 1 to 13—Typical settings and operations of the SA Short Wall Machine.

21B.—Typical settings and operations of the Morgan Gardner mach!ne.

shown (Fig. 1) with a few turns around the winch head, the motor started, the machine slides off the truck and is drawn toward the corner of the room where its work has to begin.

2nd. Sumping the Cutter Arm.—Fig 2 shows the more direct sumping where there is plenty of space, while Fig. 3 shows the closer working for a greater swinging action as the arm cuts in, also when timbers are closer to the face. The steel rope is brought around to the right-hand side of the machine and attached to the jack at the rib near the face. The drag line is carried around to the left to another jack at the face, then through a snatch block near the front of the machine over a suitable guide shoe at the corner and on to the mooring post, where a few turns complete the setting for the sumping operation. With this setting the man has complete control of his machine, allowing the rear end to swing around by slackening off the drag-line as the steel rope advances the cutter-arm into the face, all in such a way that the back bits at all times run clear of the cutting and so cannot catch and throw the machine from the face. On finishing the sumping, the machine should be in a similar position as that of Fig. 4.

3rd. On Undercutting Across the Face, the steel rope is carried directly from the feed drum, across the room to a jack at left-hand corner (Fig. 4). The drag-line is attached to the jack in the right-hand rib—lately used for steel rope when sumping—and a few turns taken with this rope around snubbing post as before. This drag-line may be used as a single or double purchase as circumstances warrant. The miner's position is directly behind the machine, where he can see any obstruction, and observe the character of the cutting. All control arrangements are within his reach and also with the drag-line he has absolute control of the cutter, this line is held in the hand and is paid out around the snubbing post as the machine is drawn across the face by means of the steel wire rope (Fig. 5). He can then make the cutter arm swing forward by holding the drag-line tight (Fig. 6) or allow the arm to lag by permitting the drag-line to slip. He may transfer the drag-line from the snubbing post to the winch head, throw out the feed clutch and thereby draw the machine back, so that the cutter arm may advance at a different angle to the cutting. Variation of the cutting angle is a decided advantage when cutting is very hard or where sulphur balls are met (Fig. 7), thus you will see he is able to work around them. When the feed clutch is thrown out this does not loosen the coils of rope on the drum as this is automatically prevented. If it is necessary to change the cutter bits whilst going across the room the drag-line is attached to the jack at the left (Fig. 8) and heaved ahead by winch head. To return the machine after setting new bits the ropes must be put back as before (Fig. 9) and the drag-line taken to the winch head and heaved until the cutter arm is again in position to resume cutting.

Finishing the cut at the left side of the room is often accomplished without changing the ropes, the drag-line being held tight to throw the cutter arm ahead, so as to maintain proper room width. Where it is desired to grip at a wide angle or widen a room, the steel rope may be carried around the machine and back to the jack as in Fig. 10. In hard cutting the drag-line may also be carried to a jack set as in Fig. 11 to give more powerful action. To widen a room by a full cut in the left rib the steel rope may be carried to a newly set jack back along the rib as in Fig. 12.

4th. Re-loading on to Truck when the work in a room is finished, the cutting chain drive lug is removed so that the cutting chain is idle when the motor is working. The drag-line—either single or double purchase—is carried to a jack near the truck (Fig. 13) and then by a few turns around the winch head, the machine is drawn by its power across the floor and swung into position for loading. The truck is rolled forward, its front end passing beneath lugs on the machine frame, passed around a sheave on the truck drive gear, and back to the winch head. Thus the machine is drawn into mesh with the truck gearing and made fast with the windlass chain.

The machine is now ready for the fifth operation of transporting to the next working place.

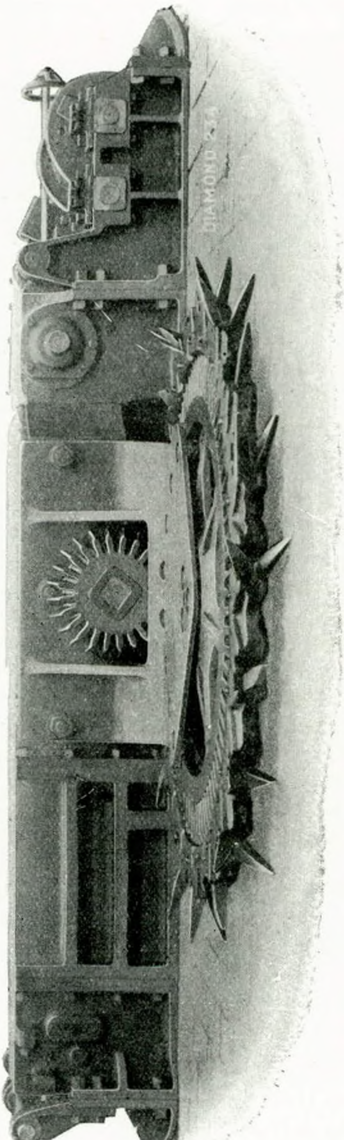
Diamond Coal Cutters.—Great credit is due to the original pioneers of this type of cutting machine. The persistent efforts put forward to bring this machine to its present efficient pitch has taken a great number of years; originally its worth was proved in one of the most difficult seams of coal in the country. Difficult as regards strata and depth, this also brought temperature conditions rather severe for the workers, and possibly this may have been the reason why so much effort was made to make the machines a success at this colliery. This temperature increase, due to greater depth, is one of the problems that will have to be tackled by the mining engineer in the near future, and in this respect there appears to be two ways by which this may be given a trial, that is: 1st, greater ventilation; and 2nd, cooling of the air as put down the mine.

The first brings in rather a complication of circumstances, as no doubt a lot of heat in a coal mine arises from the oxidation of the exposed surfaces, therefore the more air and consequently more oxygen supplied, the greater must this oxidation of the coal take place. Probably such simple things as tarring, whitewashing or cementing the old faces that are not worked might prevent a lot of this absorption of oxygen taking place, at anyrate it would obviate a lot of air friction on the coal, thereby reducing another source of heat.

The second suggestion will be governed by cost of power, but this may be got over when we utilise our coal to better advantage from the point of calorific efficiency. Whichever way is adopted to make a working place comfortable the greater use of mechanical coal cutters will still further benefit everyone.

The four views of the Diamond Disc Cutter show machines made by an English firm, the first two are electrically operated, and the others derive their power by compressed air. The general designs of these machines are very much alike, the difference, principally, being for the nature of the coal seam to be worked, for instance the Diamond Electric Disc Cutter illustrates a standard electrically driven machine which is fitted with a 30-40 h.p. motor to suit either direct or alternating current; they are designed to meet the heavy and rough treatment usually met with down a pit. The gearing is enclosed, but the control arrangements are easily accessible. The motor is of totally enclosed type, watertight and explosion proof and possesses a large reserve of design for overload. The reduction in speed from the motor to the cutter is obtained by spur and bevel gearing made of steel throughout, oiltight and fitted with forced lubrication. The cutter wheel on which the picks are fitted is also made of steel, while the picks as a rule are made of special tool steel; these latter usually fitted by the colliery smiths who have many whims for local work, no doubt the result of long practice.

The Diamond 15 in. Electric Disc Cutter is quite a novel machine, which has been specially designed to suit thin seams; this machine stands only 15 ins. high. This machine also runs in oil, and consequently is extremely silent in working. This is of great advantage to the miner working seams of coal, when



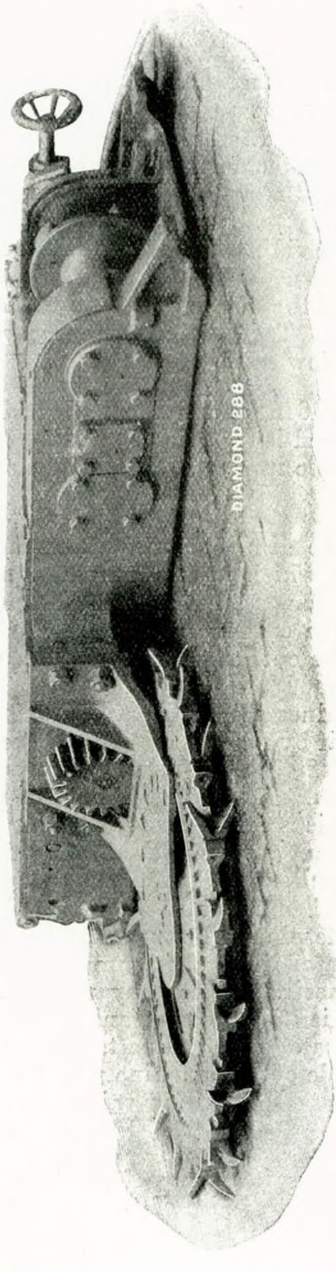
234.—Diamond 16½in. electrically driven enclosed gear disc coal cutter.

it gives him an opportunity to recognise the warnings of falling roofs, etc. These machines are also built for compressed air as well as electricity as a motive power. The Diamond Low Type Compressed Air Cutter is most suitable for undercutting in dirt underlying the coal seam, or where the conditions are very hard and the coal is firm and has no tendency to fall after being undercut. The machine can be raised to any height above the floor by providing it with special sledges. It is fitted with two double acting cylinders 9½ ins by 8 ins. which are bolted to each end of the main gear case. This machine is also run in an oil bath. Total height 19 ins. overall; thus it is capable of working low seams.

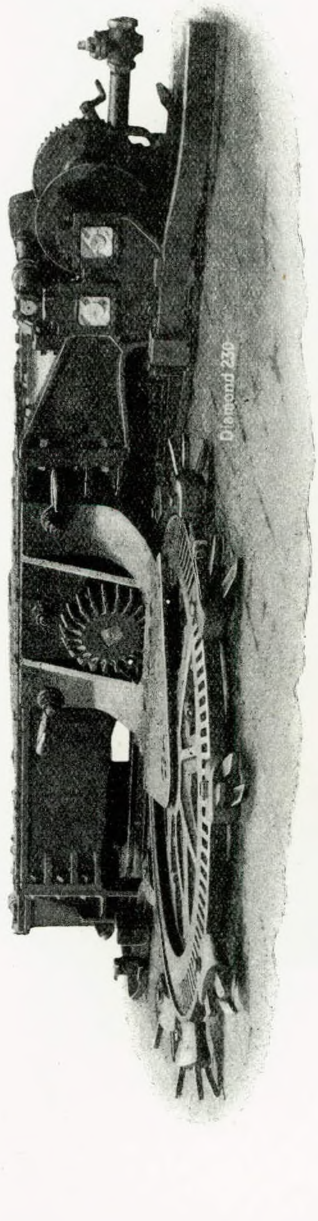
The Diamond 5 ft. 6 in. undercut compressed air disc machine is a powerful tool, and is capable of undercutting to a depth of 5 ft. 6 ins. as its name implies. The height of this machine is 27 inches.

In addition to the disc machines there is also a Diamond Chain Type Cutter which is of recent design, and is a most successful machine for cutting in soft holing or where there is any tendency for the coal to fall as the cuttings are brought clear from under the cut, also with this machine the coal can be packed up (spragged) close up to the cutter if necessary. As with the disc machines this tool may be driven by electricity or compressed air, if by the latter the machine is fitted with an air turbine engine of 40 h.p., quite a novelty as regards English made machines. A special clutch is provided on the sprocket shaft of this machine so that it may be run or drawn along the face without rotating the cutting chain. The jib of the cutter may be pulled into the cut by means of the power of the machine and when right in it is rigidly secured to the machine by a simple pin. The feed may be started or stopped by a clutch, and in addition there are two speeds of feed provided, which are easily operated by means of a lever. The haulage of the tool is effected by means of a strong chain which enables a constant rate of feed to be taken. The chain may be worked on either side of the machine which ensures it hugging the face without a special trailing rail when it is travelling in either direction.

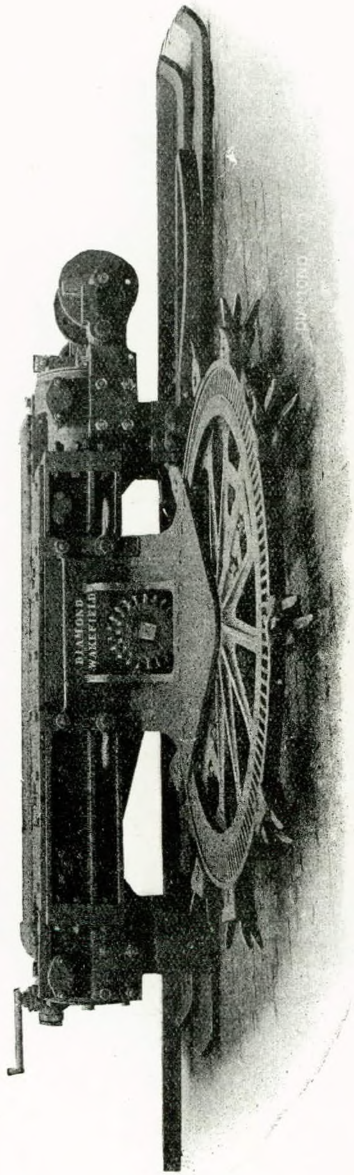
There are advantages in the use of machines for undercutting the coal from the point of size of the material, the next three views clearly show this.



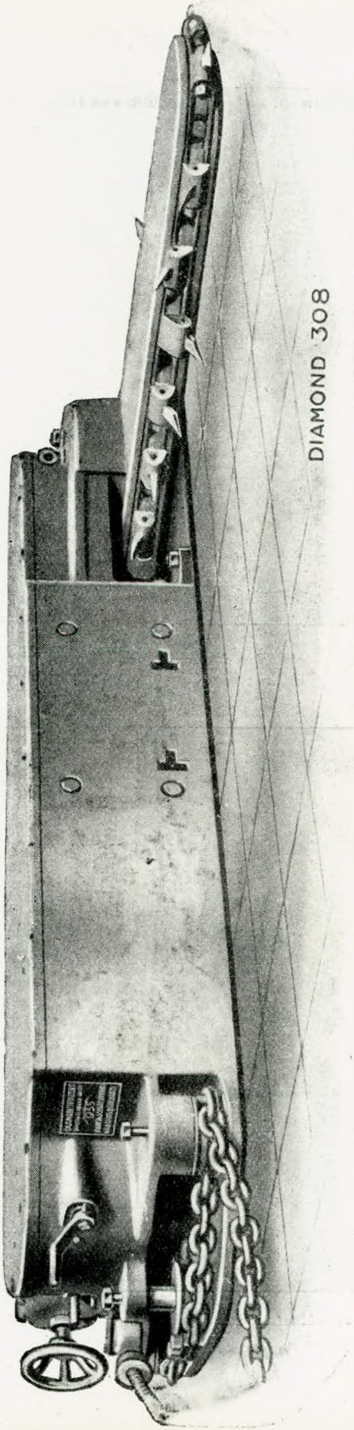
288.—Diamond 15in. electrically driven enclosed gear disc coal cutter.



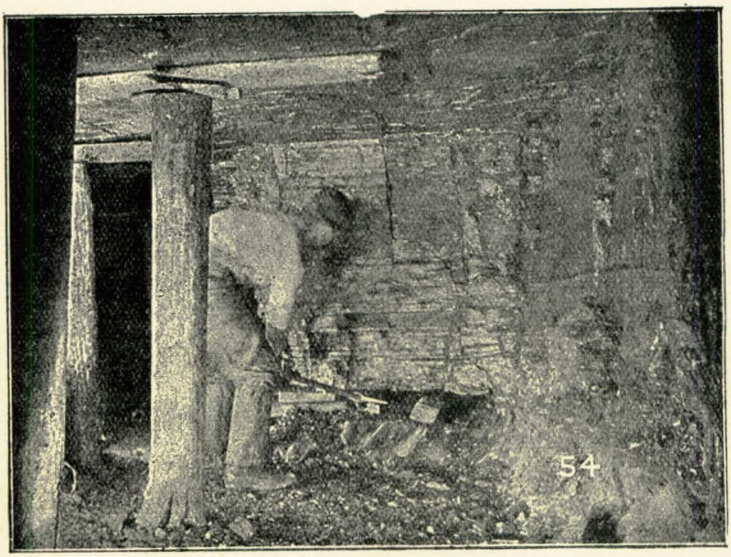
230.—Diamond 19in. compressed air driven enclosed gear disc coal cutter.



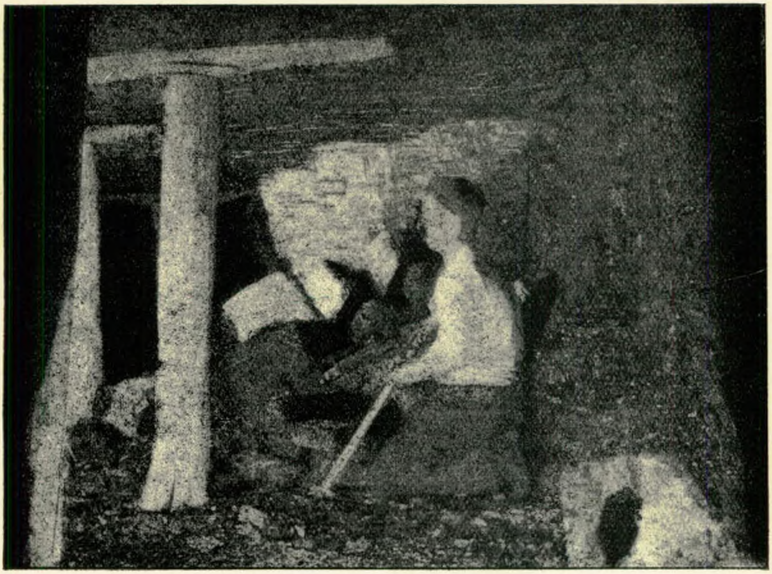
Diamond 5ft. 6in. undercut compressed air driven enclosed gear disc coal cutter.



308.—Diamond chain coal cutter.



54.—Removing the sprags.



63.—Machine-cut coal falling after removal of sprags.

After the coal is undercut the supporting sprags are removed, when in many seams the coal needs no further agent than the weight of the roof to burst and crack the seam as shown where the coal is falling after removing the sprags.

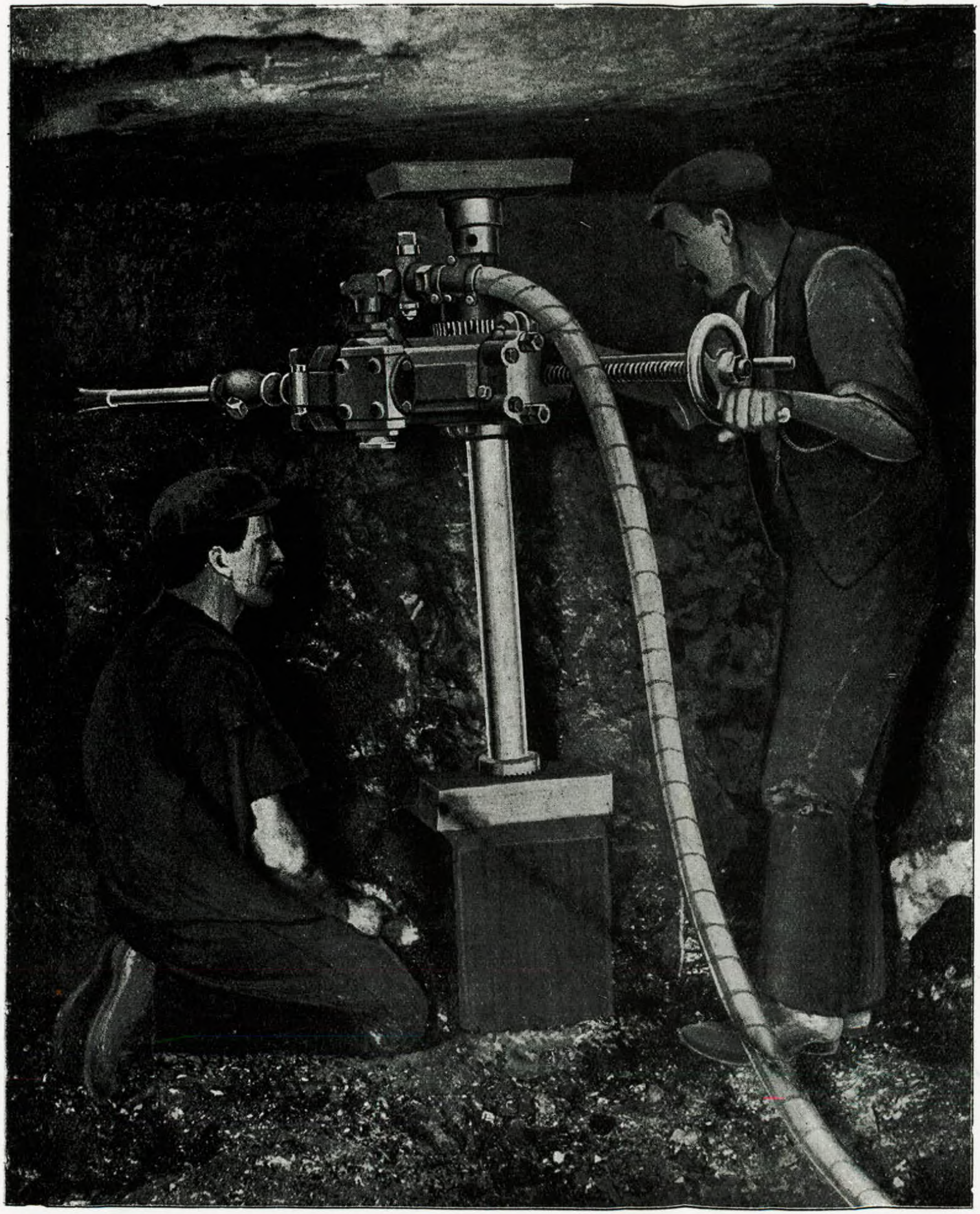
Very often the coal may burst out just as seen, when in these instances the material is practically in large lumps ready for filling. The hutch or tub is close by, being in this instance able to get right up to the working face. This is

56.—Filling the coal.

not always the case, particularly in the thinner seams of coal, where it is necessary to throw or shovel the coal from the face to the place excavated a bit deeper to allow the hutches to run.

Percussive Coal Cutter.—This is a different kind of cutter to those we have previously seen with discs or chains on which the cutters are fixed and which are known as rotary or chain machines. This type is called a percussive cutter and is a very useful tool for certain work, such as for driving drifts or working in confined places where there are not the facilities for a long stretch of continuous cutting such as in longwall working, however, it is sometimes used for this class of working. You will see that the machine pillar is packed up with blocks of wood and is kept secure in this position by means of an adjustable jack screw, screwing the whole firmly between the roof and pavement. The depth of undercut is usually between four to six feet but of course this depends on the nature of the seam being wrought. By the addition of longer bars the range of the machine may be increased with each setting. The usual method of operation is to swing the machine right and left, thus forming an arc in the undercut, till he reaches the bottom of the undercut, the advance of the tool is done by screwing the handle in the operator's left-hand while with his right-hand he is turning another handle which has gear in connection with the worm wheel on top, thus controlling the swinging horizontally. When he reaches his depth of undercutting he then works on either side squaring the undercut when he has reached the extreme width required. Various patterns of these machines are in use, some of which can be swung at any angle including a vertical working so that they may be used for shearing the coal vertically as well as undercutting, an operation frequently done in the driving of new places. The rapid blows given by this machine fairly represent the work done by the miner with his pick. The illustration is that of the Hardy Percussive Machine, the photograph was taken in a mine near Sheffield, the top half of this seam is coal and the bottom gannister; machine is holing in coal.

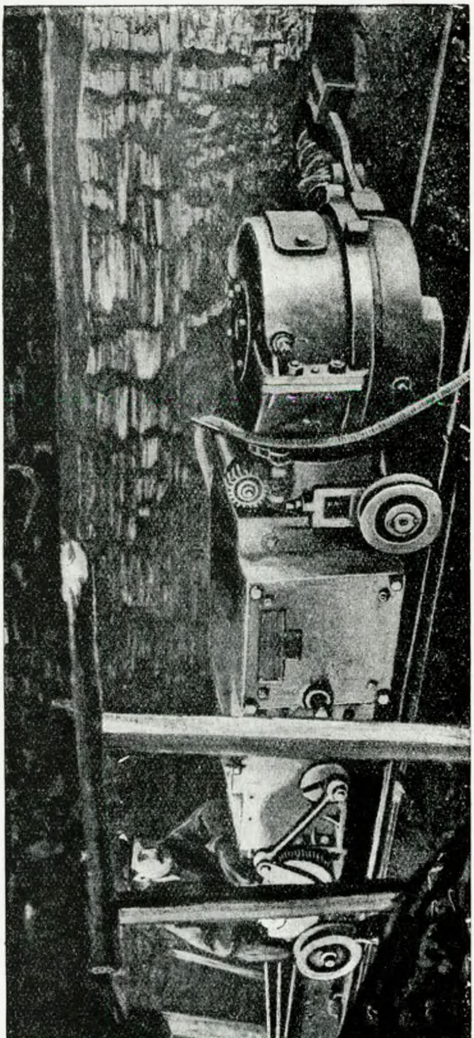
Large Size "Pick Quick" Coal Cutters. Undercutting at Pavement Level.—We now see another type of coal cutter, the Pick Quick, another British made machine, which possesses properties that some of the other machines do not. Some of the other machines occupy quite a considerable space of the undercut made, and no doubt you will have noticed the wedges or chocks put in this undercut to support the coal overhead until the favourable moment for bringing it down. Sometimes this coal presses down on to the machine cutters, and often they have to be dug out owing to this, that is if they cannot overcome the extra friction. With the machines now before us, the coal is cut with a series of revolving picks, secured on a shaft or arm, you will thus see that it is possible to put wedges or chocks right close to the cutter bar which only occupies the



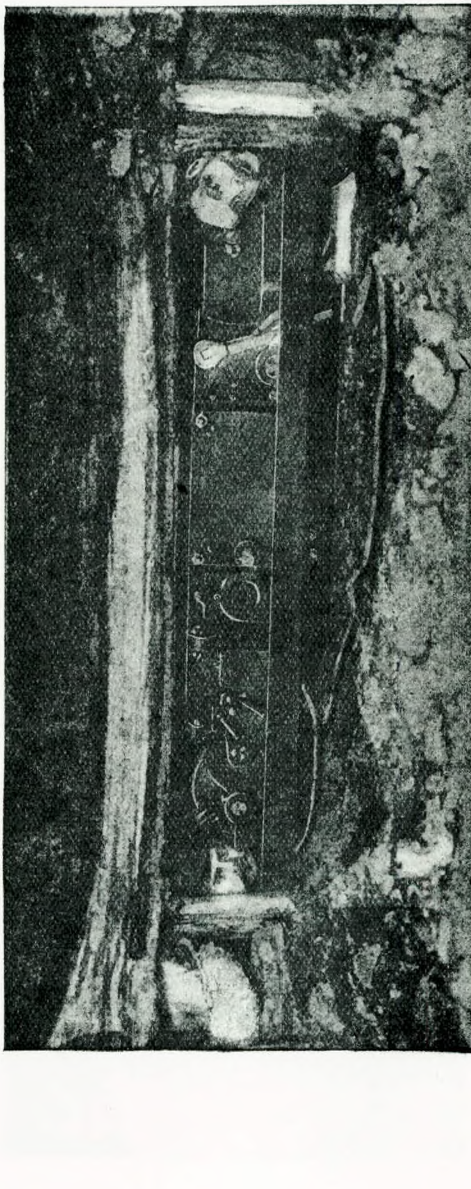
24A.—The Hardy Percussive Coal Cutter.

space in the length of the cut equal to the height of the undercut. The views before us were taken in a Lanarkshire mine.

Small Size "Pick Quick" working in a 16 *in. Seam.*—One machine is undercutting at pavement level, while the other is

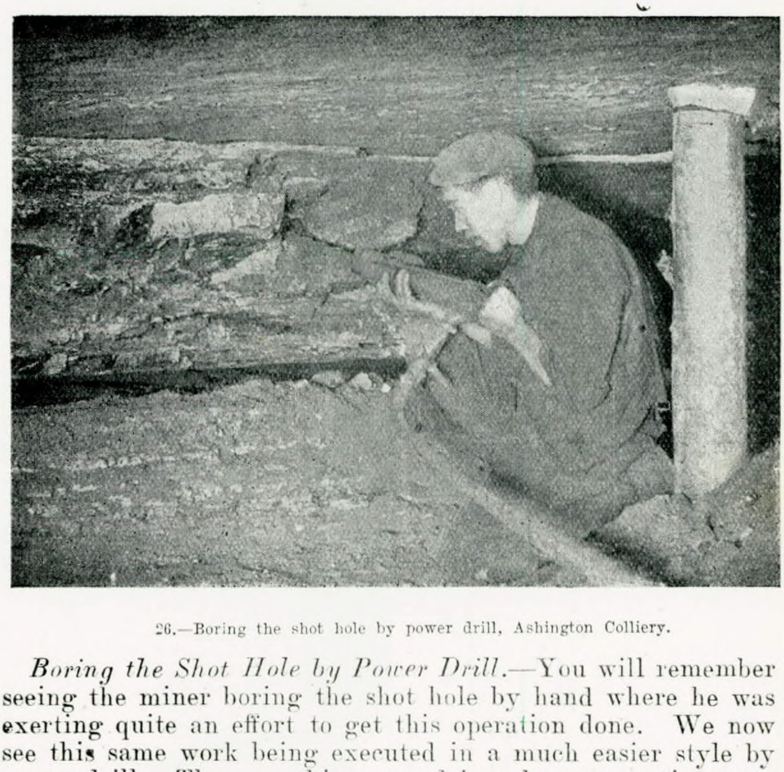


25.—Large size Pick Quick undercutting at pavement level.



25A.—Small size Pick Quick working in a 16in. seam.

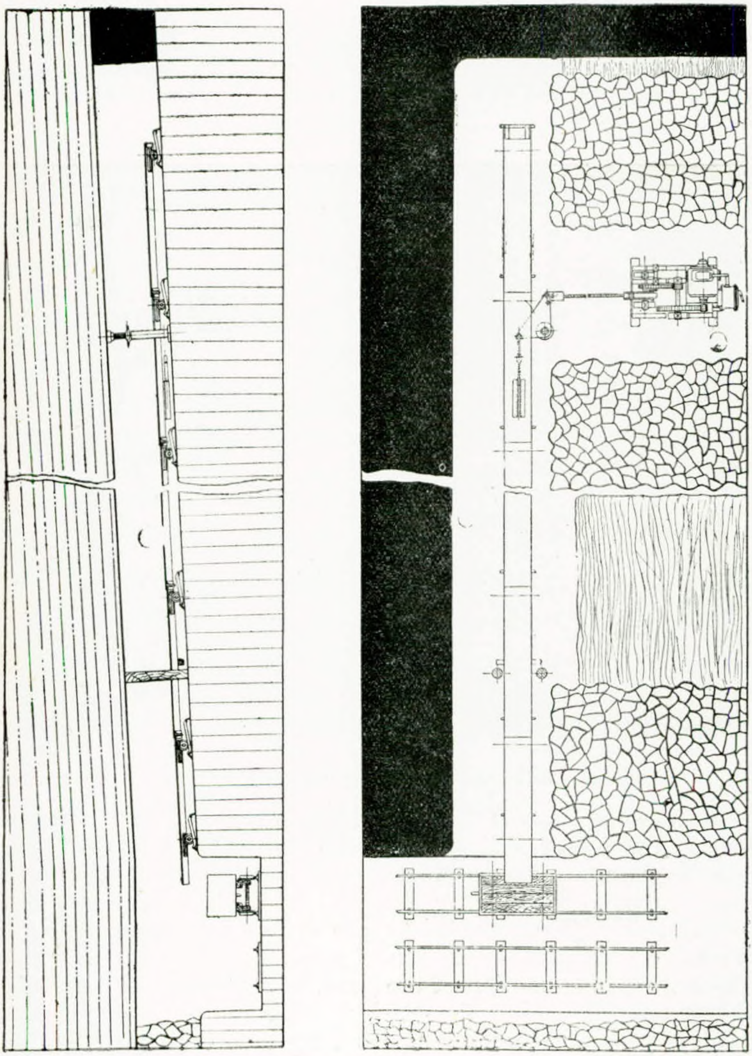
a specially made tool and no doubt it may be interesting to know that it is working in a seam of coal 16 ins. thick. There is a very wide scope for the further introduction of these machines, particularly when we are faced with the problem of working the thinner seams of coal owing to the great reduction of our thicker seams, being worked out in time gone past. I hope you will appreciate the difficulties of working these thin seams, and it behoves us to make the best use of this national asset of ours, to delay the day when we shall not be able to compete with other countries who may have easier procured coal.



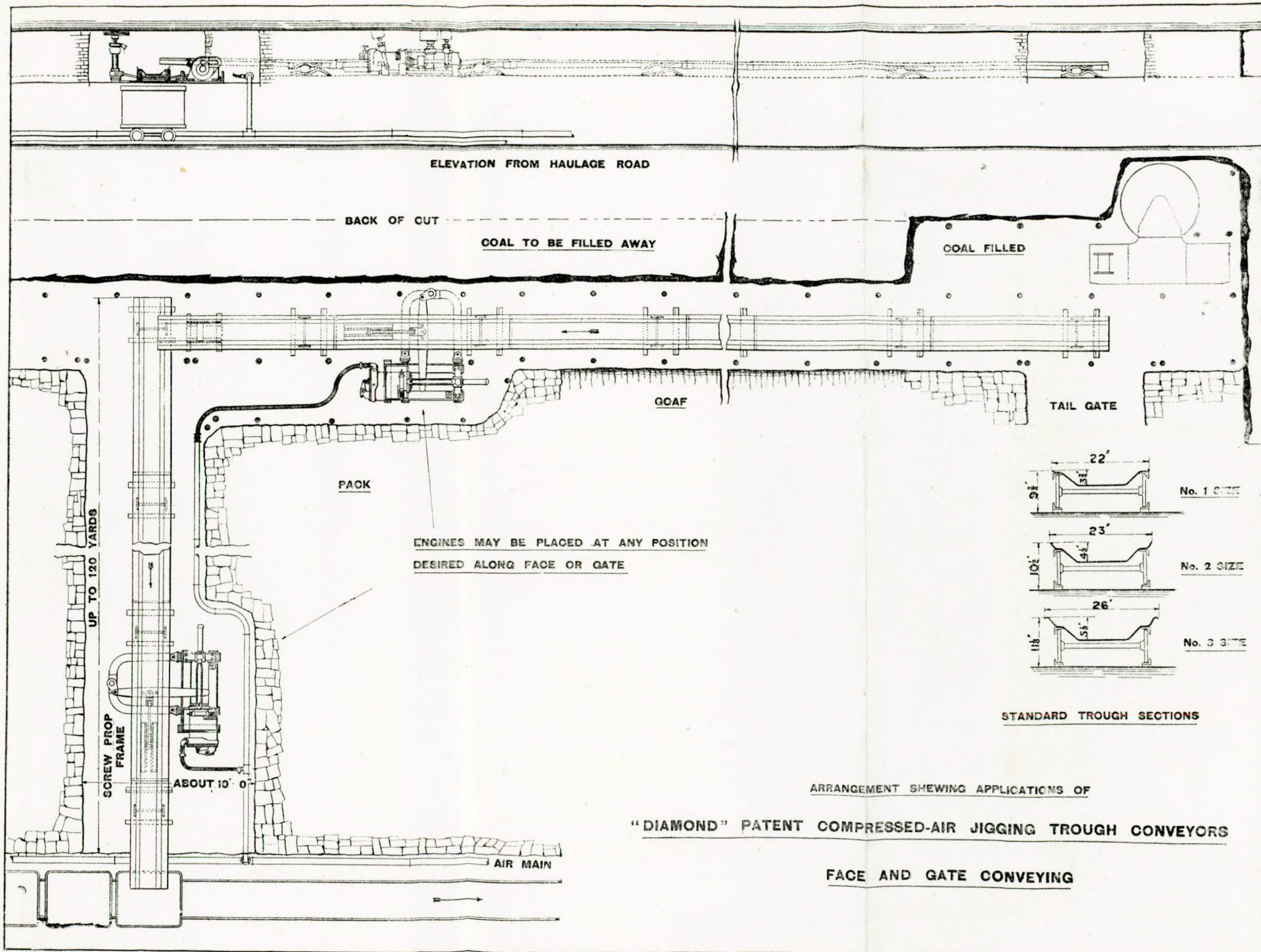
26.—Boring the shot hole by power drill, Ashington Colliery.

Boring the Shot Hole by Power Drill.—You will remember seeing the miner boring the shot hole by hand where he was exerting quite an effort to get this operation done. We now see this same work being executed in a much easier style by power drill. These machines are driven by pneumatic power with a considerable reduction of muscular effort on the part of the miner, in a fraction of the time, occupied by hand methods, consequently making the work much safer on account of the coal not having to hang up so long before it is drilled and eventually blasted down.

Plan and Elevation Longwall Working of Underground conveying with M & C Machine.—There is no doubt that the use of mechanical conveying has been stimulated by the use of coal-cutting machinery particularly for longwall working in

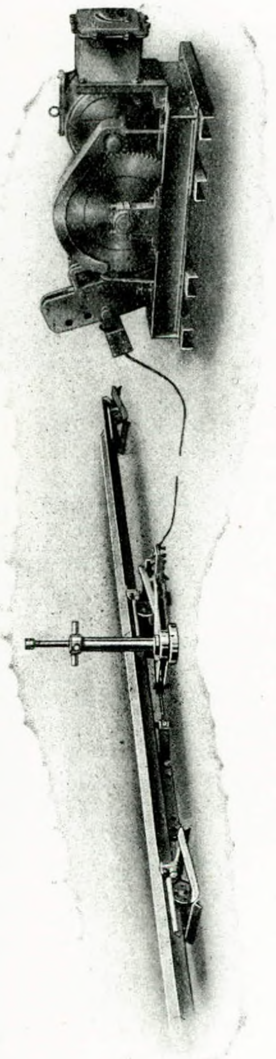


51 & 51.—Plan and elevation of underground conveying with the M and C machine.

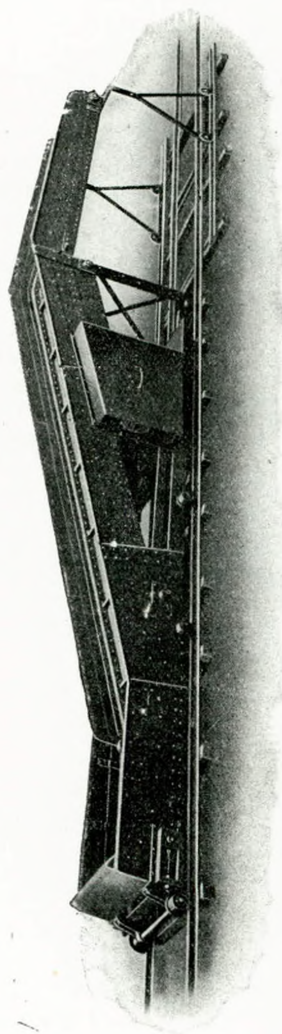


269.—Arrangement showing application of Diamond jigging trough conveyer.

thin seams. There are several kinds of conveyer in use, but before showing some of the actual machines we will examine the two drawings before us which are an elevation and a plan of an M and C shaker conveyer fitted up from the working face to the loading road, where it delivers the coal to the tubs or hutches. The shaker conveyer is admirably suitable for thin seams, working with a slope to the loading road as shown on the elevation. This view gives one quite an intelligent idea of longwall working, and instances are known where certain kinds of conveyer have been working and receiving the coal from the miners, 500 yards from the delivery. On looking at the lower plan the solid black portions represent the coal still to be wrought. With machine worked coal this face is kept practically in a straight line, so that this offers better effect of roof pressure to assist the working of the coal. With hand work this face would be more advanced at places and might represent in plan something of a saw tooth appearance, which would not allow the roof to exert its influence equally all along the face, from this you will see that it must give a better control of the roof, both at the face and also where the coal has been previously wrought from, making it safer for both working the coal and also eventually lowering the roof behind. The coal is shovelled on to this conveyer and by a peculiar motion given to the conveyer by either an electric or air power motor connected by means of a rope to a quadrant on the shaker, which is pulled slowly back away from the delivery end, towards the motor, it is then released, and runs by the weight of the conveyer and the coal on top, rapidly down the tapered chocks as seen on the elevation at the top. Here the conveyer stops, the coal has not yet lost its inertia and is thus shaken along a certain distance at each stroke. It is quite a simple matter to take away or add additional lengths to this type of conveyer, these lengths are standardised at nine feet long. This is one advantage over an endless belt or chain operated conveyer. You will notice at the place where the hutches are filled that it is excavated or ripped as it is called by the miner, below the seam so as to allow for headroom for filling. When this section is wrought out it will be necessary to rip another road similar to this to allow room for working. This will give you an idea of the advantages of the conveyer in thin seams in a mine, because if this coal were loaded up by hand, either a considerable number of loading roads would require to be provided, or the coal would have to be thrown out, with several throws, incidentally breaking the coal at every operation of moving it.



M and C shaker conveyer.



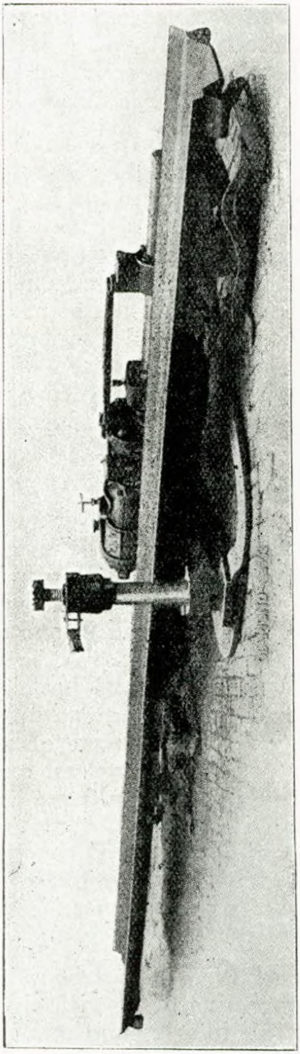
52A.—Gibb gate end conveyer.

M & C Shaker Conveyer and Gibb Gate End Conveyer.—The view now before us is an illustration of the machine we have just been describing, in this instance it is shown with electric driving gear, which can be fixed, and by the simple method of letting out a little more rope at each shift of the conveyer the motor may remain here till the conveyer or working face has advanced anything up to 50 yards away from the motor.

The next machine is the Gibb Gate End Conveyer. Both of these machines are British made. Sometimes it is not possible to rip the floor up as shown in the last view, this floor may just be of sufficient strength to resist the pressure forcing it up, or there may be other difficulties, you will thus see that it will be necessary to elevate the coal higher and this can be accomplished by the lower machine, when at one end it receives the coal from the shaker conveyer and then by means of an endless scraper chain, it drags the coal up the slight incline and delivers it to the hutch or tub under the other end. This machine may also be used to convey the coal from headings driven in advance of the face.

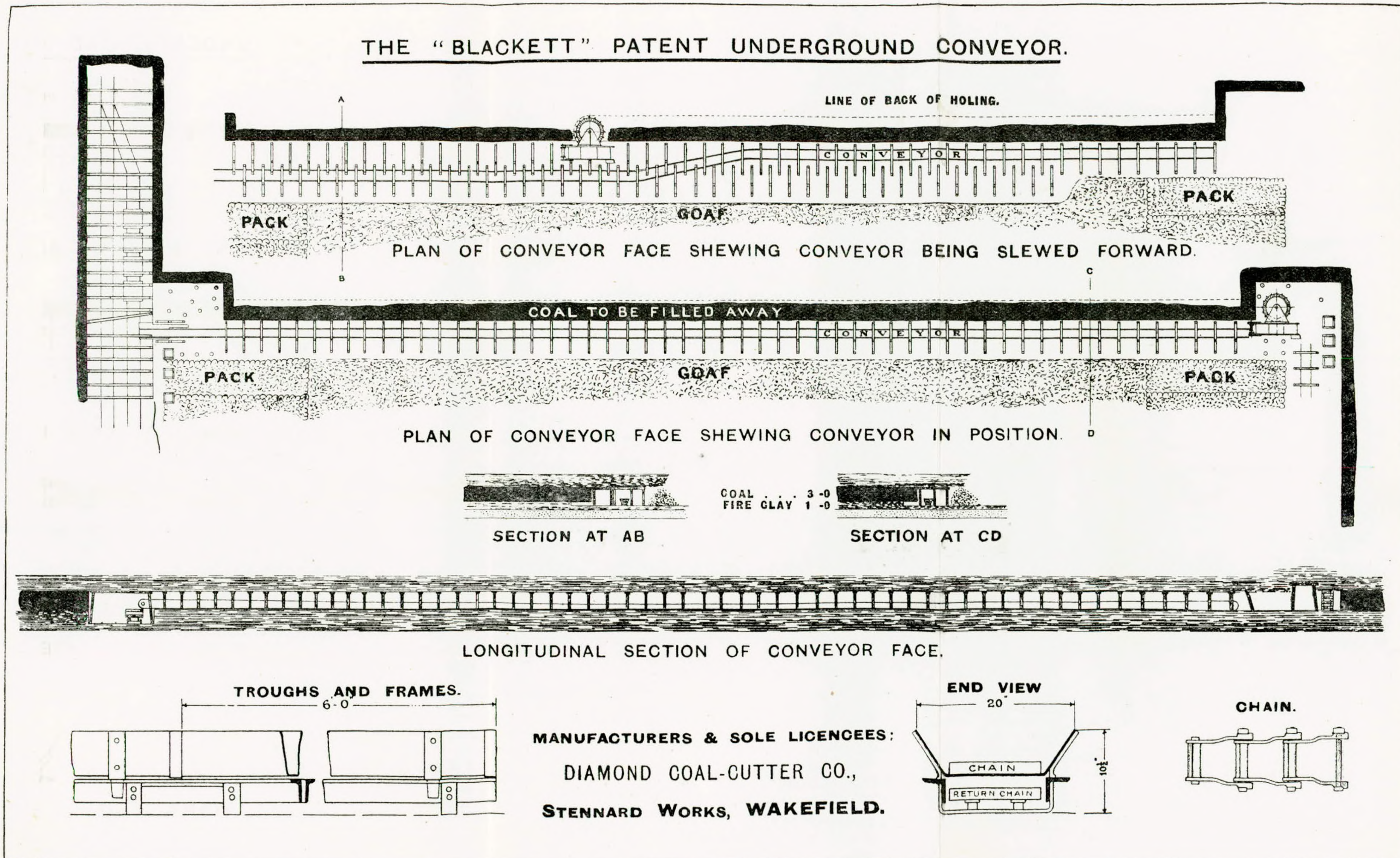
Arrangement Showing Applications of Diamond Jigging Trough Conveyers.—This shows another method of the application of jigging or shaker conveyers, the working face in this instance being parallel with the loading road. The conveyer is seen delivering the coal which has been placed on it by the miner, to a second conveyer placed in one of the gates left in the older workings. This system saves the expense of making, and maintaining numerous gateways, but of course a great deal of the methods employed is due to the nature of the seam of coal being wrought. Jigger conveyers are of a more simple construction than other positive conveyers, and of course in the event of any roof trouble there would not be the labour or loss with getting this machine refitted, that there would be with continuous belt or chain machines, in most cases it would only require the addition of a length or two of troughing. This type of machine is usually worked on a face between 80 and 100 yards long.

Diamond Compressed Air Jigging Conveyer.—This illustration shows a standard engine fitted with single acting cylinder which is very economical in consumption of air, requiring only about 100-120 cubic ft. of free air per minute at 30-40 lbs. per square inch at the coal face. The method of propping the machine by means of the pillar prop may be easily seen from this illustration. Thus the whole machine is kept rigid, by being tightly secured between roof and floor.

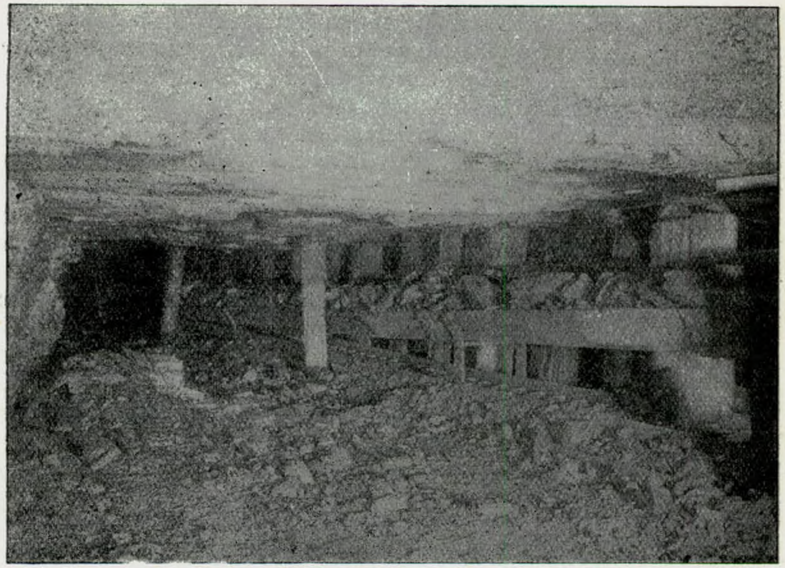


272B.—Diamond compressed air jigging conveyer.

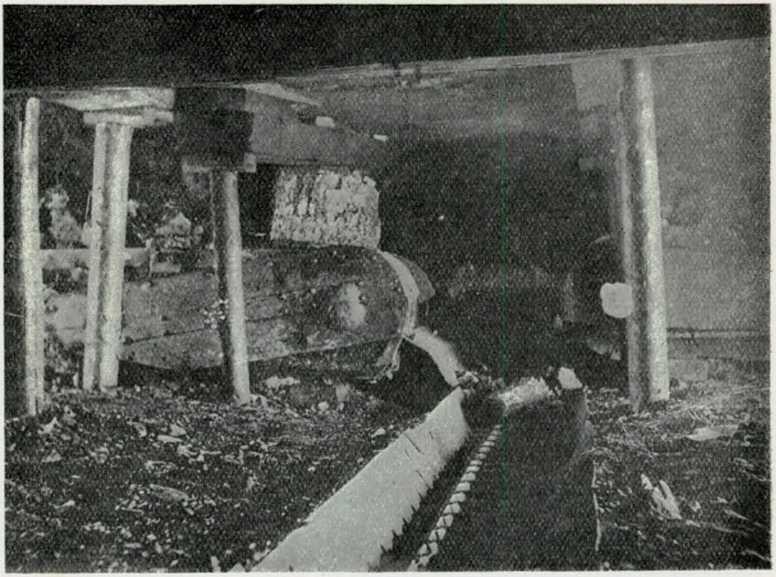
The Blackett Underground Conveyer.—We now see another type of conveyer "The Blackett," which in this instance is



199.—The Blackett underground conveyer.



26.—The Blackett underground conveyer at the working face.



26B.—View of two conveyers delivering coal to a main conveyer, Ashington Colliery.

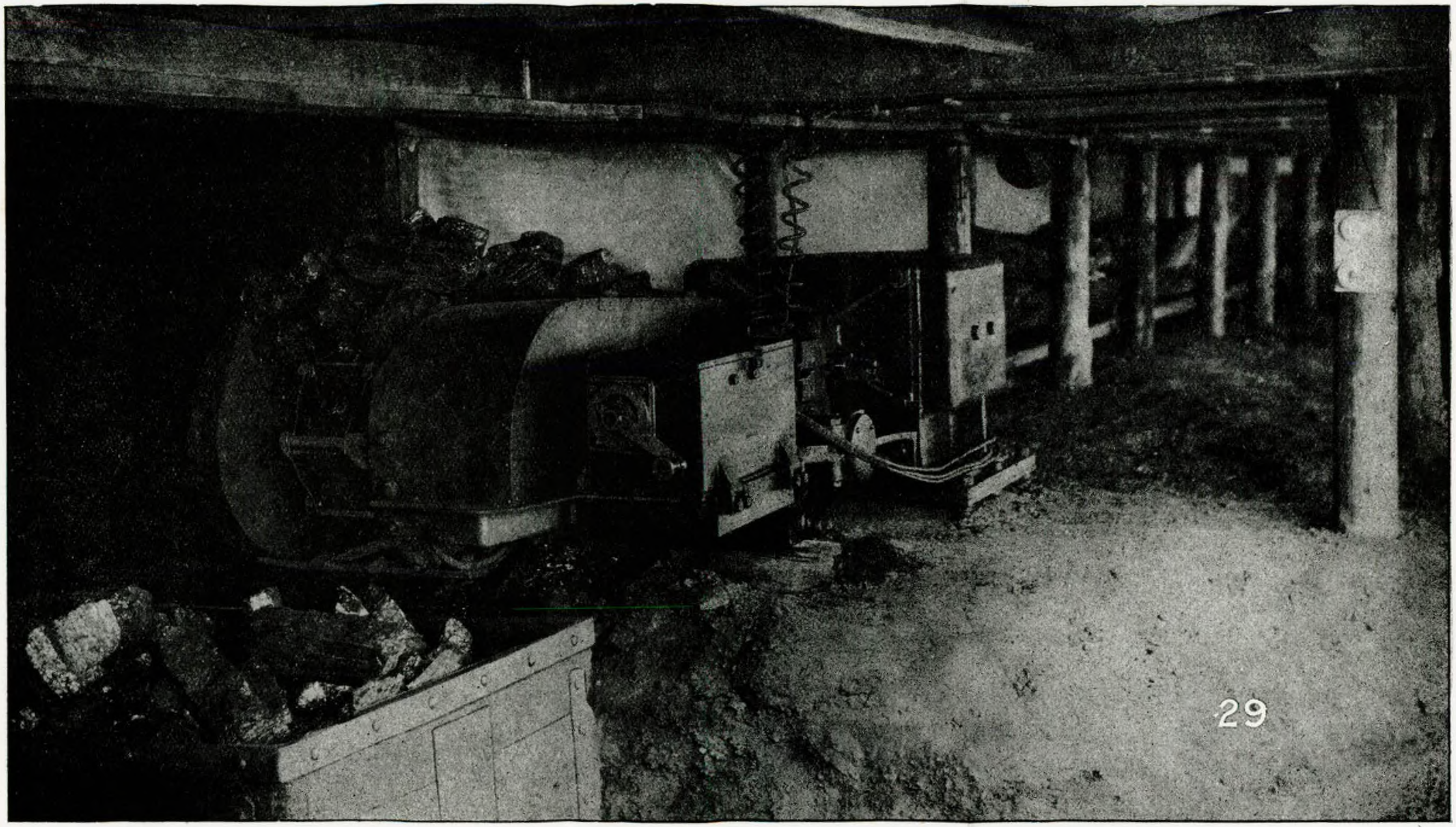
shown with a compressed air motor, but of course, they are frequently driven by electric power. These conveyers are able to deliver as much coal as can be filled on to it, and of course owing to its positive action they will carry the coal against a gradient. The conveyer consists of an endless chain, running in a trough which is made in 6 ft. sections. The chain carries the large coal, the small dropping to the bottom of the trough where it is drawn forward by scrapers fixed on the underneath side of the chain. On the plan underneath you will see a machine cutter undercutting the coal from right to left. The conveyer has been moved over to the coal brought down at the right end, and is in a position for this coal to be shovelled on to the chain when it is straightened out similar to the next lower plan, where in this instance the cutter machine has been working from left to right. The two sections will give you an idea of the working face, with the timbering, but probably this timbering is more prominent in the lower longitudinal section. The advanced workings on the right-hand side of the plans are termed "headings" by the miner.

In this view the Blackett Conveyer is seen along the working coal face.

View of two conveyers delivering coal to a main conveyer, Ashington Colliery.

While in the next picture quite a good underground photograph has been secured, showing the delivery end of one of these same conveyers. As may be seen by the control gear this machine is electrically driven, this view gives one quite an intelligent idea of how the secondary roads have to be ripped up to allow for headroom for tubs passing in to be filled, which of course must be below the delivery point of the machine. At the same time one may grasp the huge amount of hand shovelling that would be necessary without conveyers, so as to get the coal to the tubs. Of course for hand filling many more roads would be necessary to be ripped to let the tubs get nearer to the miner, so that you can see considerable savings with conveyers, not only in laborious work but also in preventing reduction of breakage of coal by being thrown about so much. Again this breakage creates a huge amount of dust, which is carried along by the air current and at times may create a dangerous explosion.

Underground Haulage Junction, Bothal High Main.—The view we now see is at the junction of one of the secondary roads with the main roads, most of the haulage to the main road is

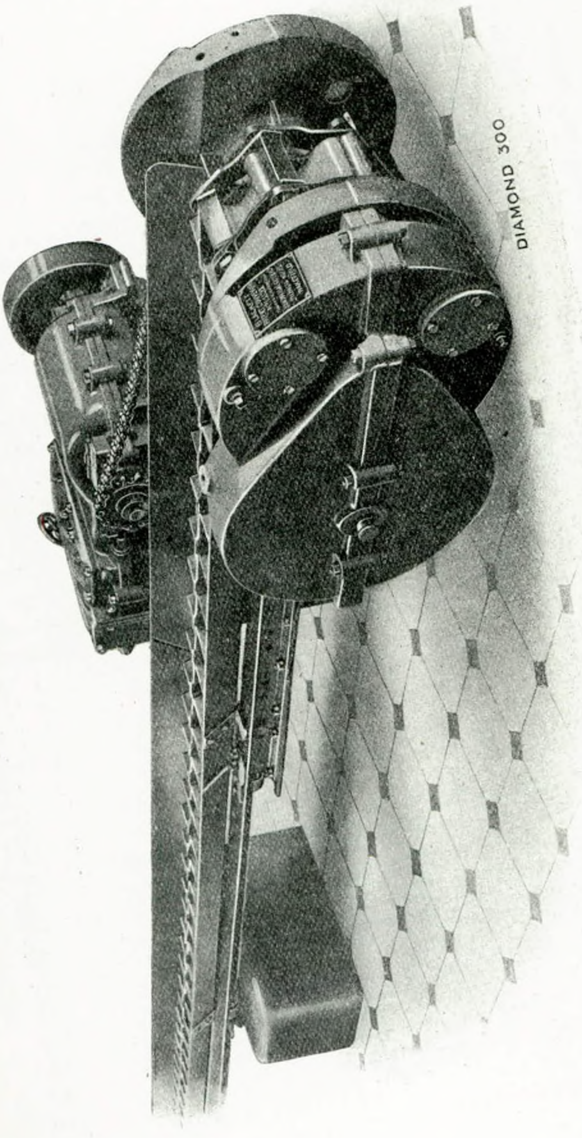


29.—Blacket underground conveyer delivering coal.

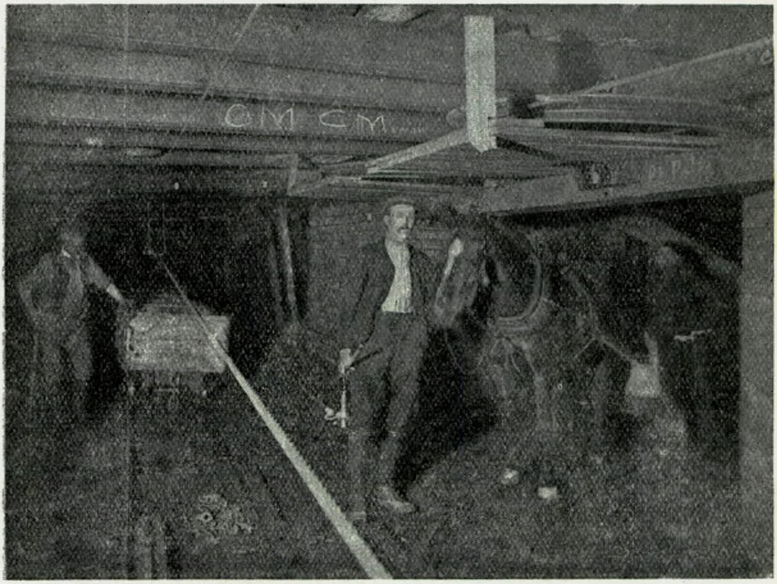
done by ponies when the hutches are then coupled on to the endless wire system and taken to the bottom of the shaft. Great pride is taken by the boys who are in charge of these ponies, to see that their favourites are kept in good condition. You will notice once more the substantial supports holding the roof, the easy curved rails and walls to the secondary road, and generally a feeling of security is given that one would scarcely think they were two or three thousand feet below the surface. One of the mine officials is seen standing at the ponies head, in his right hand he is carrying his safety lamp, together with an apparent walking stick, which in reality is a yard long and principally used for measuring purposes.

Endless Rope Haulage.—We now see the actual operation of coupling a set of hutches or tubs on to the endless wire which is effected with the addition of a short length of chain, one end coupled to the hutch while the other end, which possesses a clipping arrangement, is clipped to the endless wire. The heavier the pull on this clip the more secure it holds. There are many kinds of fastenings for this purpose of connecting the hutches, some exceedingly simple and most effective.

Mining Locomotive Haulage (Morgan Gardner).—America is far ahead of us in the matter of underground haulage, no doubt this is due in many respects to the geological situation of the coal seams, the thicker seams they have, and the generally better and stronger roofs. As we have said elsewhere in this article a great many of the American mines are shallow, in fact a large proportion are worked into the side of the hills and in many instances the coal seams are high up in the mountain sides. Advantage is taken of this by making quite substantial railways, almost on a par with the weight and gauge of many of our main railways in this country, thus quite heavy trains of coal are brought right away from near the working face, taken out of the mine and then transported to the tipple all in one operation. This is done by what are termed mine locomotives. These weigh from a few tons up to as much as 25 or even 30 tons, so that you may judge the great amount of coal that may be brought out at a time on each journey. Electricity is the motive power and usually this current is picked up from bare wires fixed on the roof as may be seen from several of the illustrations. The larger locomotives are usually built and used as simple haulage machines, the smaller types being used to gather together and get ready a train for the larger ones, by working into the various rooms, taking out the loaded car, and replacing



330.—Blackett underground conveyer, photograph of, taken above ground.



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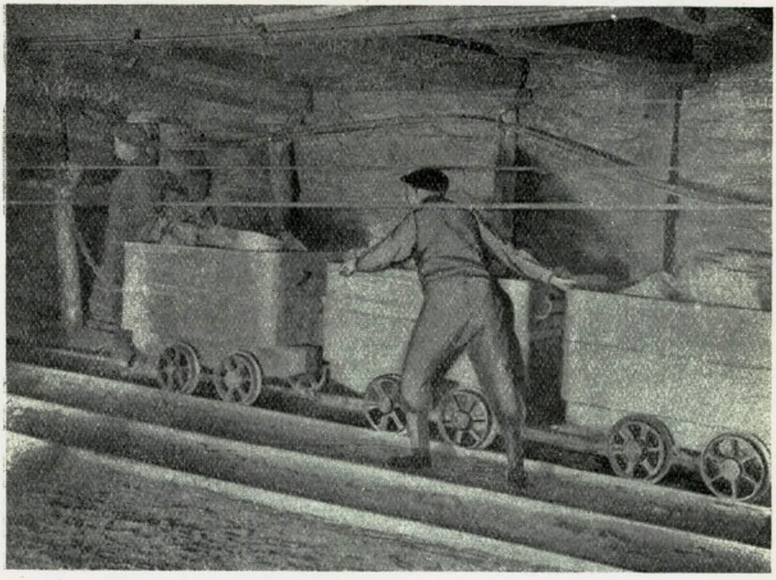
28.—Underground haulage junction, Bothal High Main, Ashington Colliery.



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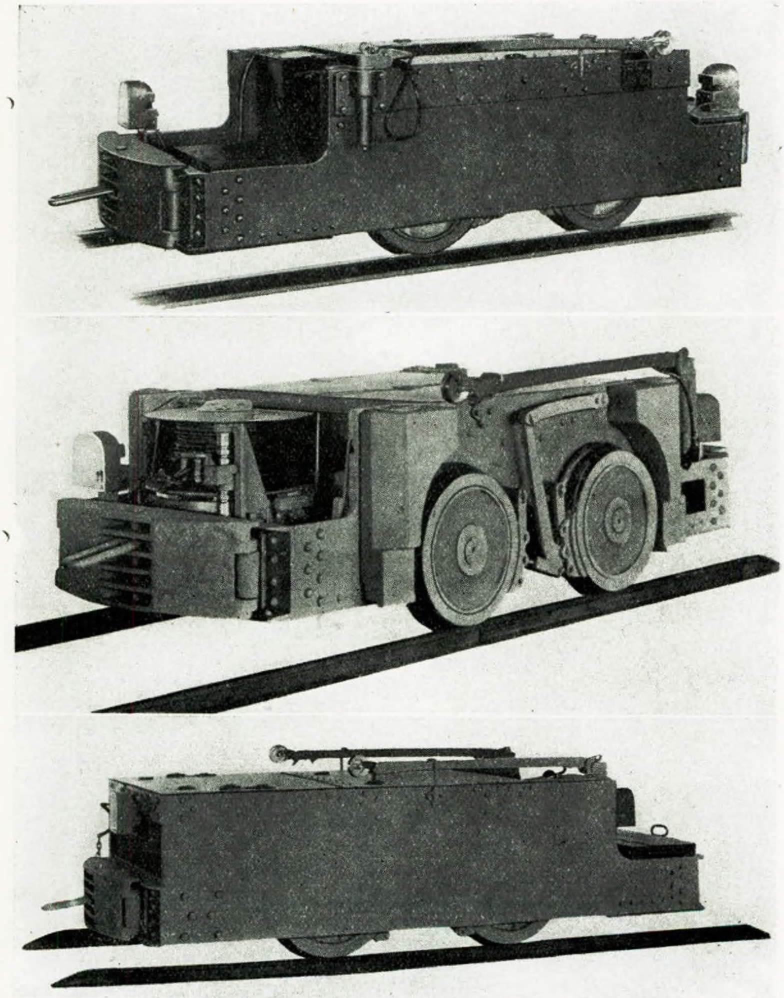
29.—Endless rope haulage.



29A.—Mining locomotive haulage. Morgan Gardner.

Top.—5-ton Morgan Gardner locomotive.

2nd.—5-ton gathering loco., wheels outside of frame.

Bottom.—10-ton haulage loco., 2-motor equipment 6 to 8 miles per hour, loaded.

this with an empty to be filled by the miners. These smaller types called gathering locomotives, are fitted with ingenious methods to overcome the less equipped rooms where the coal is obtained and where there may not be any electrical connection for the trolley poles in this respect, two devices have proved themselves practicable and very necessary for this distribution of cars from and to the working places. First there is the Reel method, for supplying current to the locomotive, this is simply a coil of flexible cable which is connected to the end of bare trolley wire, thus allowing the locomotive to work to the distance beyond the trolley wire equal to the length of the reel wire.

The other method is that of wire rope haulage, and is known as a crab, by this means a steel wire is unwound from a drum on the end of the locomotive, taken into the rooms and fastened to the coal cars. These are then drawn out by setting the crab in motion. This is usually used when it is not desirable or practicable to work the locomotive itself. There is also a combination method embracing as it does simple haulage, electric cable reel and crab wire rope haulage drum, and when fitted like this the machine is capable of universal service. The Morgan Gardner Gathering Reel is quite an automatic device and always ready for use, the only additional thing for the driver to do is to throw in a clutch drive when starting a series of gathering operations. The reel is placed in the front crab as shown in the illustration of one of these machines actually at work, going beyond the trolley wiring; on this view you will notice that the trolley arms are dropped down and held there by means of a bracket keep. The cable pays out freely under a brake control, as the locomotive works away from the point where this cable is connected to the trolley wire. As the locomotive returns the reel automatically winds in the cable, in properly pooled layers, so that there is no crossing or tangling of the cable. The reel carries from 300 to 400 feet of cable with proper terminal fastenings to secure it to the trolley wire. The other arrangement of wire haul requires to operate quite independently of the movement of the locomotive, thus the crab is made a completely self-contained device, driven by its own motor within the frame of the crab. This crab is set at such a height that the rope leads off fairly above the buffers or side frame of the locomotive, and the lead of haul may be in any direction. The weight of the crab complete with $7\frac{1}{2}$ h.p. motor 250-500 volts and drum carrying 300 feet of $\frac{3}{8}$ in rope equals 750 lbs., and this winds in at a speed of 125 to 225 feet per minute, with a pull up to about 1,600 lbs. The weight of this type of locomotive varies from five to six tons, depending essentially on the equipment for the various services, such as for:—

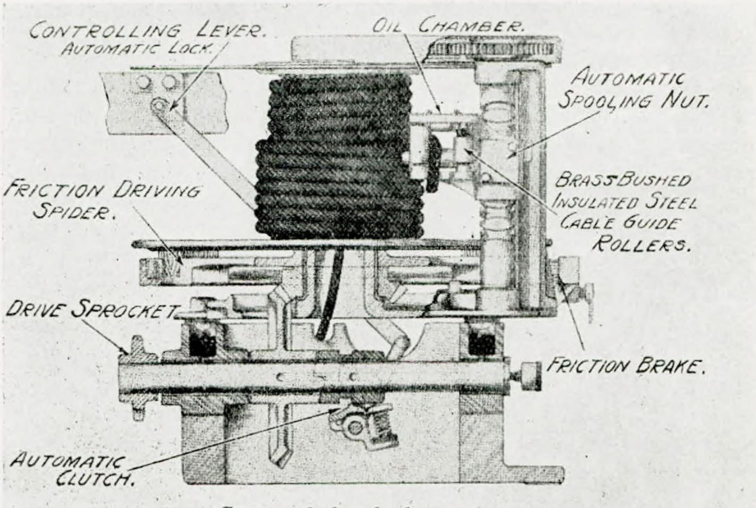
1. Plain haulage.
2. Gathering with reel, and also plain haulage.
3. Gathering with crab, and also plain haulage
4. Gathering with reel and crab, and also plain haulage.

The speed loaded is from four to six miles per hour. A heavier type of machine is also made by the Morgan Gardner Company, and is built in weights of from 9 to 11 tons. This machine embraces many of the working parts as interchangable with the lighter machine, which is a great thing in mining matters. This locomotive has two motors, each driving a separate axle, by gear and chain reductions, and when loaded travels at the rate of from six to eight miles per hour.

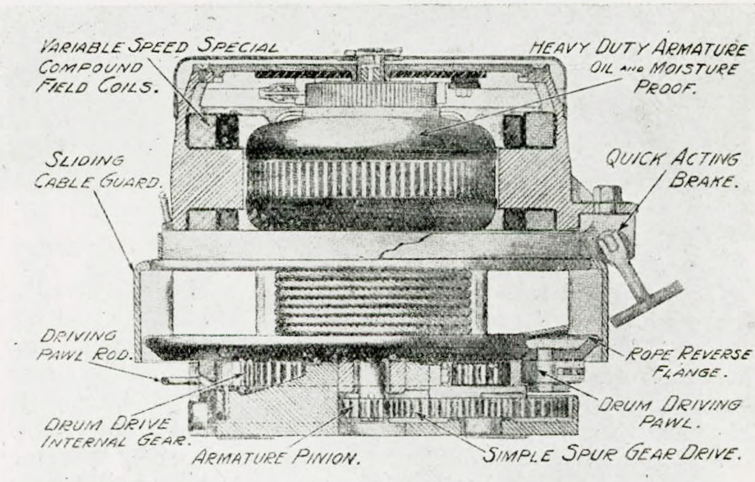
Sectional Sketch showing construction of the Electric Cable Reel.—This section of cable reel shows the construction. The shaft through the base is in chain connection from the sprocket on the left to a driving sprocket on the loco. axle. The cable reel rotates on a vertical axis, driven through bevel gears as shown. One end of the hub of the driving gear forms one half of a spiral jaw clutch, through which, of course, the gear can be driven in only one direction—that for reeling in the cable. On reversal of the direction of the motion for the loco. and horizontal reel shaft the clutch is inoperative, but underspring action is ready to drive the reel immediately the direction for reeling is resumed. This arrangement prevents the cable from slacking and being run over by machine. The reel proper, rests upon and is carried by the circle of wood blocks which form the friction drive. As the cable winds in the weight of the reel increases and the friction thus automatically increases to keep up practically uniform tension on the cable. Connection from the reel to the loco. controller is made by the cable seen leading down out of the interior of the reel.

Sectional Sketch showing Gathering Crab, Motor, Drum, and Gearing.—This sketch explains itself very easily. The motor being seen on the top, and the reduction gearing on the bottom, while the wire rope drum is in between.

TOP VIEW.



Sectional sketch showing construction of the electric cable reel.

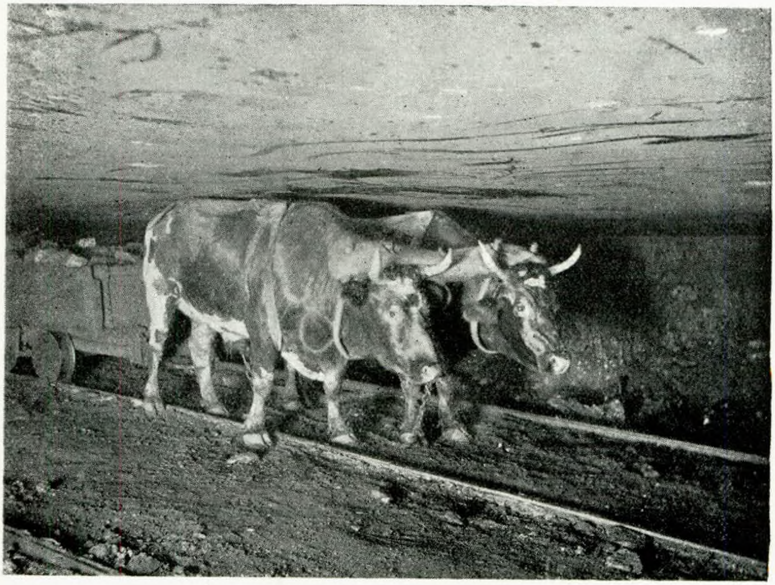


The gathering crab in section, showing motor, drum and drive gearing.

BOTTOM VIEW.

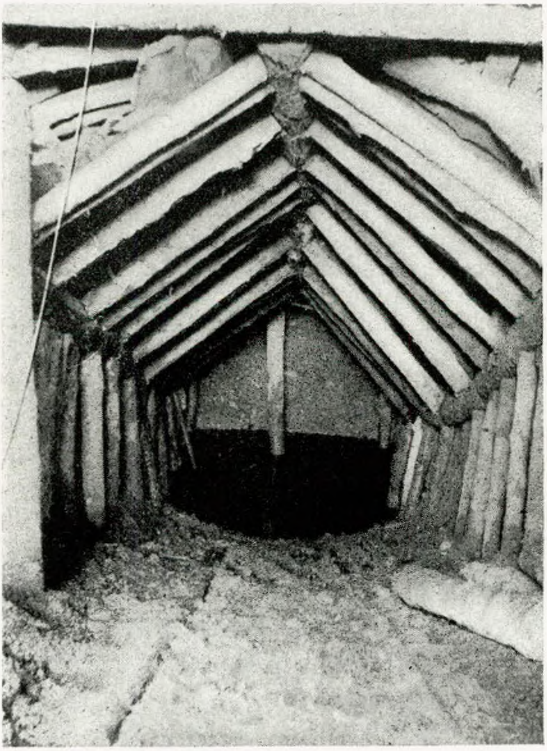
29B.—Sectional sketches showing construction of electric cable reel (top view) and gathering crab motor and gearing (bottom view).

An interesting Early Type Haulage Method.—In comparison with the modern American method of haulage it may be interesting to show an old scheme of getting this coal along underground, you will see even then the spirit of kindness is shown to these animals by protecting their backs with a leather protection which no doubt some of their predecessors provided.



58D.—An interesting early type American haulage.

Cockering Timbering.—It is stated that half of the accidents in or about a coal mine is due to the fall of the material from overhead, crashing down on to the men underneath. These roofs are tested very frequently by the miner, who is often seen tapping a suspicious place with his pick end. He can tell if this roof is secure principally by the sound, but also by touch. The sense of security or danger is very keen with the miner. The sound made by the light blow gives him a similar knowledge as that which the boiler inspector gains when testing a dubious spot in a boiler's thickness of metal. Not only does the roof fall and the sides cave in, but many collieries have bad pavements or floors, which have a great tendency to rise, so that various complications may ensue from these things. This system of timbering called "Cockering or Herringbone Timbering" is a substantial method of securing the safety of very bad places, preventing the falling in of the roof or the sides of the roadways when made in this style of cockering timbering. In the words of a mine manager friend to whom I am indebted for much useful information he says: "I had a roadway which

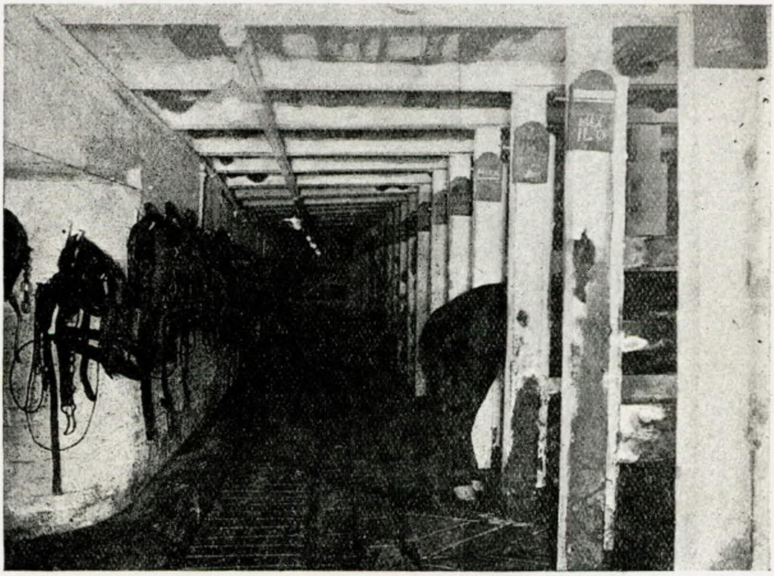


57.—Cockering timbering.

was always causing trouble. Bars of 18 in. dia. being broken in 24 hours after setting. I always had a gang of 30 men to keep this place in repair. Not only that, it was a main haulage road and the loss of winning coal due to the roof and side trouble at this place was enormous. In despair I had a few lengths of the cockering timber put in, and was very agreeably surprised to see the way it stood the strain. It never broke, but one piece dug into the other until it became as one piece of timber. I then had this method of timbering put in the whole length of the roadway (45 chains) and this cured the trouble. It took many months to do the work, but when completed two men kept the place in good order." The view before us shows the driving of a new adit or slope entrance to a mine. The black patch in the distance is water which had accumulated during the week-end.

In a great many of the scenes we have put on the screen you will have noticed the peculiar looking lamps that are used by the miner, these are called safety lamps, of which there are many kinds. These have been gradually improved since the days of Sir Humphrey Davys research work, from which the "Davy" lamp was the ultimate result and from which most of the later types were a development of his original lamp. One of the properties of combustion is that to cause a combustible to burn with flame, it must be heated to its temperature of ignition; so long as a gas is given off this flame will continue while this temperature is kept up. Davy applied this in practice by surrounding the flame of a lamp with fine wire gauze so that this gauze always being of a low temperature it cooled the flame and prevented its penetration beyond the gauze. If by any means this gauze got hot, such as by holding the lamp on its side, or by placing the lamp in a strong current of air, then the flame would penetrate through the gauze and ignite any gas that would be outside. You may easily prove this at your leisure over a gas burner or over a candle with a piece of gauze. I am sure it will open up thoughts as regards the economic use of coal, and explain some of the difficulties one experiences when fires are placed in places which take away the heat too rapidly before the gases have been properly heated, but this is wandering beyond the scope of this lecture. The presence of gas has a decided effect on the burning of the lamp, depending on the gas present; sometimes the flame is reduced in size, other times it is lengthened, again it may be quite smoky and another time it may be put out completely. In practice the miner gets quite adept with the use of this guide, and naturally he takes every care to prevent any risk of an explosion; not only does his life depend on these precautions, but also every soul in the mine may be affected. At some of the working faces the coal is at times actually blown out by the force of some of these gas accumulations, it is recorded that pressures of several hundred pounds per square inch has been measured.

In many mines portable electric lamps are now used and quite elaborate arrangements are made for the storing, repairing and battery charging of these lamps, they cannot be used for gas testing purposes, but quite reliable gas indicators are used for this work, not only that, at the more up-to-date mines samples of gas are periodically gathered, and analysed by chemists who are employed at these progressive places.



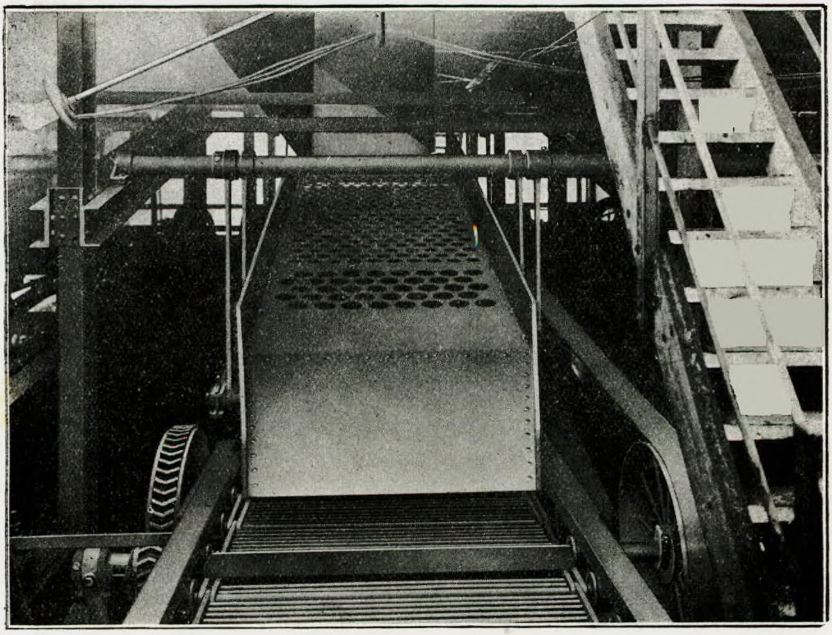
41.—Underground stables, Ashington Colliery.

Underground Stables, Ashington Colliery.—Before returning to the surface we will just give a passing glance at the stables where the ponies spend their time when not at work hauling or gathering the tubs. Here we see a place that would create jealousy with many of the surface animals if they got the chance. The boys in the pit think a great deal of their ponies nowadays. You will see from the illustration that this is quite a sanitary place, and taking into consideration that the temperature of the mine does not vary much, pit pony life is quite good compared with that of the surface ponies.

The Preparation of Coal.—In recent years quite an alteration has been made in the design of pit-head heapsteads, and at

482.—Friction driven tipplers arranged at an angle to their respective screens.

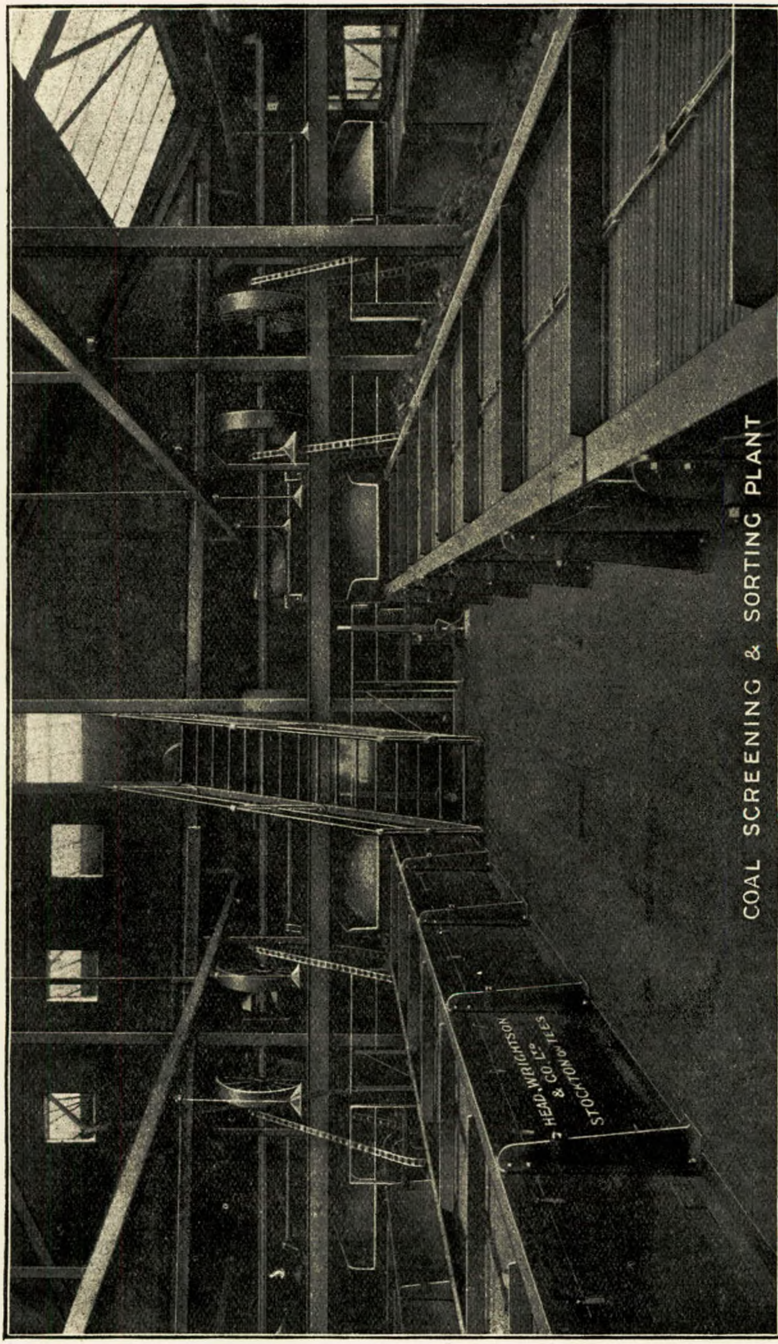
some of the latest pits an extraordinary amount of mechanical means is employed to ensure a cleaner and better fuel, and also to grade this coal to the sizes required for market. There is no doubt that the greater use of mechanical stokers has made a demand for this grading of the coal in its various sizes, and



495.—Suspended jigging screen, note shoot from tippler.

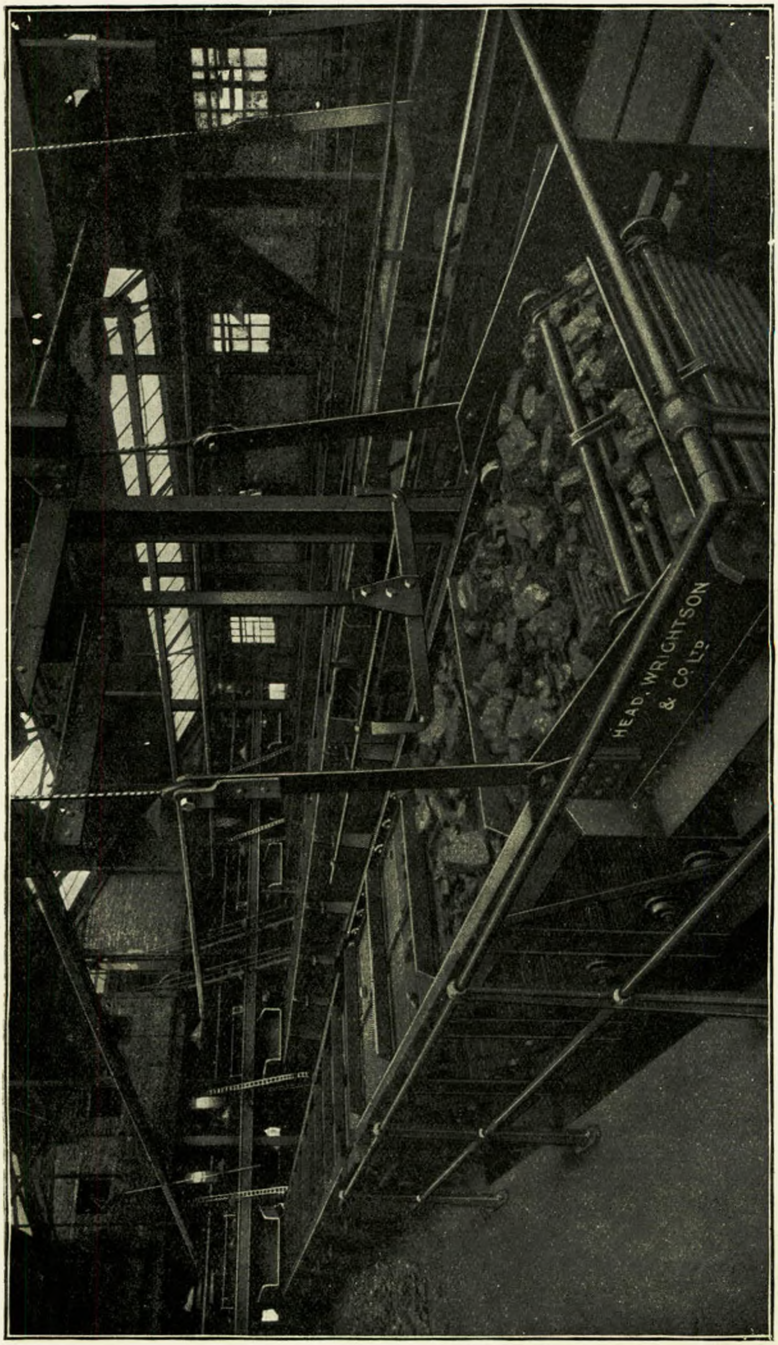
to-day practically everything that comes out from a progressive mine in the way of coal is utilised, by screening the material through different sized screens and other treatment. At many collieries these operations are combined with mechanical washing of the coal, for which there are many systems principally depending on the separation of the rock and other foreign material by its difference of specific gravity in agitated water, the coal passing away with the water, while heavier material escapes at the bottom.

Some collieries wash all the coal, large and small, while others only wash the small. Again some coals are sold in the sizes screened while others are mixed in certain proportions of large with certain properties of the smalls after washing. It is quite a busy place looking at the hand picking of coal, where the coal is travelling along a belt at a slow speed, and numerous



484.—Jigging screens and bar belts.

485.—Overhead gears for raising and lowering the deflecting ends of the belts so that coal is lowered to the bottom of the wagon with the minimum of breakage.



486.—View of deflecting end of bar belts raised up clear of the full wagon below.

490.—View in a picking house showing jigging screens and plate belts, with tipplers in the distance; note small belt for refuse.

men and boys may be seen picking out stones, "brasses," etc., as they come along, probably a certain number of these men at stated intervals may pick out bright pieces of coal as a special coal for certain purposes, this picked coal is usually put on to the next belt alongside, the stones as a rule being thrown into bins or may be into barrows close by.

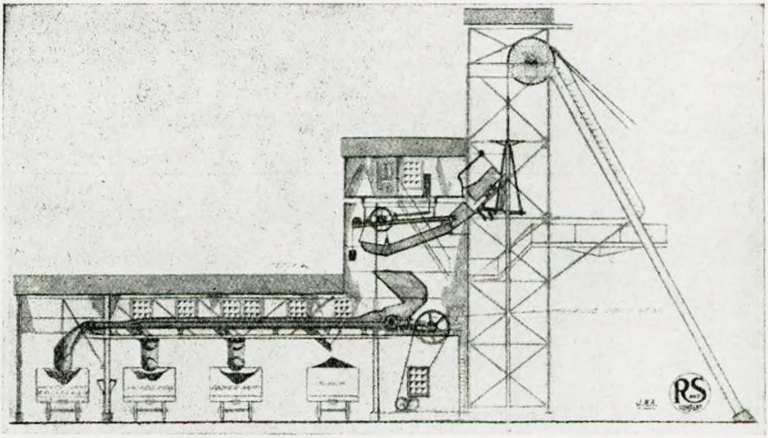
The miner is not supposed to send any stones out of the pit, neither is he supposed to make a lot of small coal, but these are things easier said than done, especially in a mine with bad roofs or floors or in thin seams of coal that may be wrought with something else at the same time. At one time the only preparation done on the surface of the mine, was to tip the hutches down an inclined screen, the coal passing over the screen going direct into wagons for market, the smalls that came through the screen usually consumed at the pit boilers, the surplus being used for anything else to get rid of it. No doubt this has left its mark at many collieries, even to-day so far as economic use of coal is concerned, and probably this is one of the principal reasons why colliery plants are in the average so low in boiler efficiency. The collier at that time did most of the preparation by the simple process of leaving the small coal in the mine, where no doubt it was the cause of many of the fires we have heard about, due to the greater area of the surface of this coal thus offering a huge surface for oxidation effect.

This coal is entirely lost, the prevalent idea being that there was no end to the supply of thick seams of coal, therefore they picked and chose the easiest wrought and only sent the best of this to the surface.

Of all the improvements that have been brought out in recent years in connection with banking machinery there is not one that has more thoroughly revolutionised the whole system than the horizontal screen and conveyer. The principle of the Marcus screen is that a trough with perforated bottom or otherwise, is made to run backwards and forwards on wheels. Unlike most other screening arrangements which run at about 300 revs. per minute, the Marcus only works at from 60 to 80 revs. per minute.

The propulsion gear is so constructed that by means of a connecting link on the crank of two shafts which are out of line, a variable speed is produced, beginning slowly at the commencement of the stroke the trough increases in uniform acceleration up to $\frac{3}{4}$ of the stroke, then slows down during the last quarter, reverses, and the return stroke is inversely the same as the forward; so that instead of uniform acceleration in velocity, there is uniform retardation in velocity. The low speed at each end of the stroke tending to cushion the shock. The material is carried with the trough in its forward stroke and as it increases in speed it gradually imparts sufficient impetus to the material to overcome the frictional contact between the material and the trough in its backward stroke. Many advantages in this system are not recognised at first sight, but the following will show that the features gained are of great importance. As the screen can be horizontal or even rise in the opposite direction to the ordinary screen, it will be seen that the height of the whole construction of the pithead can be materially reduced, and thus comparatively speaking, instead of the huge and high erections that we have grown accustomed to see at collieries quite a low building is all that is needed. The screen and picking trough are combined and at each stroke of the trough every piece of coal changes its position, so that it is impossible for shale or refuse to be covered up under pieces of good coal, and so escape the eyes of the pickers. All small coal made during the process of picking under ordinary conditions excepting on a bar belt, finds its way into the large size, whereas the small made during the process of picking on the Marcus goes through the perforations with the smaller sizes. By those who have never seen this screen at work it has been objected to because it would be trying to the eyes of the pickers, but this has been proved by experience to be quite the reverse. In places where this system is used and pickers are working side by side with ordinary picking belts they much prefer to work on the Marcus because the coal is constantly altering its position in the trough. Under ordinary circumstances where it is required to make a number of different kinds of coal, and to mix them again if desired, a most complicated and expensive arrangement of belts is necessary, whereas by putting a second deck into the Marcus Screen with sliding doors the different sizes can be mixed after they have been picked to meet the various market demands. These are only a few advantages, not to speak of the fact that all mechanism and working parts are at one end, and there is no wear and tear on the links, pins, drums, etc., as in ordinary belts.

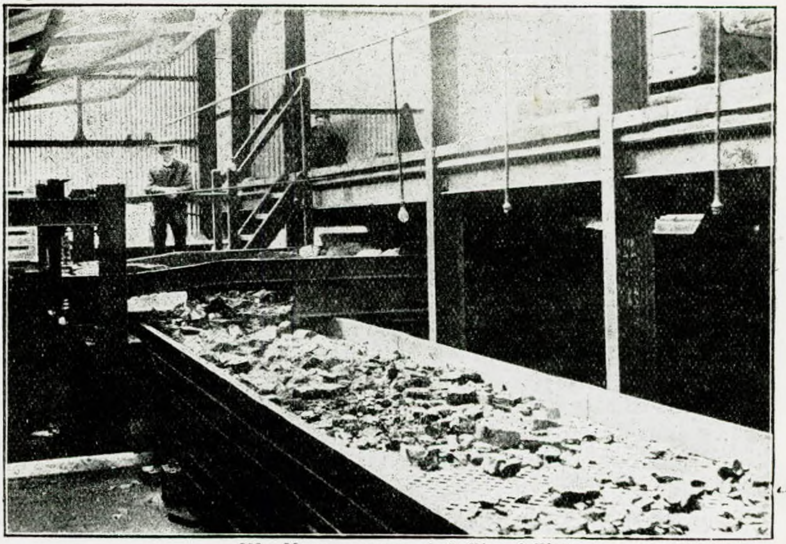
A few weeks work makes the trough bright and smooth and the material travels along gently with very little friction. The power required to drive this type of screen is regulated somewhat by the length and size of the perforations employed, but generally speaking a 50 ft. screen takes from 10 to 12 h.p. While it is possible to convey 325 tons per hour and only absorb 7 h.p. in a plain trough, the introduction of perforated plates retards the progress of the coal, but it is efficiently picked. I do not think it is desirable to attempt to pick, on any type of screen, or belt, more than from 75 to 80 tons per hour; of course the quality of the coal is a controlling factor, for instance, if there are numerous pieces of foreign material to be picked out



591.—Typical American headgear and screens, by Roberts and Shaefer Co.

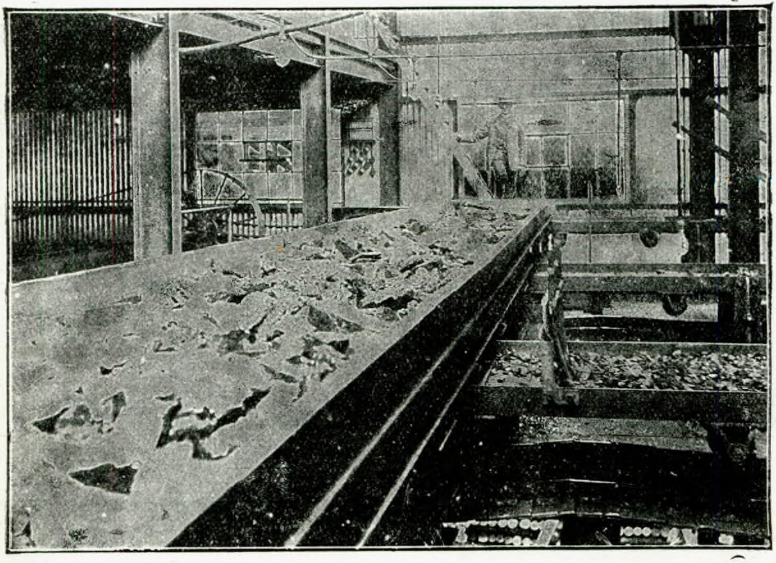
then it would not be advisable to have a capacity greater than that which could be thoroughly examined by the number of pickers employed.

Typical American Headgear, by Roberts and Schaefer Co.— This diagram view showing weighing facilities and the Marcus



288.—Marcus screens at Gedling Colliery.

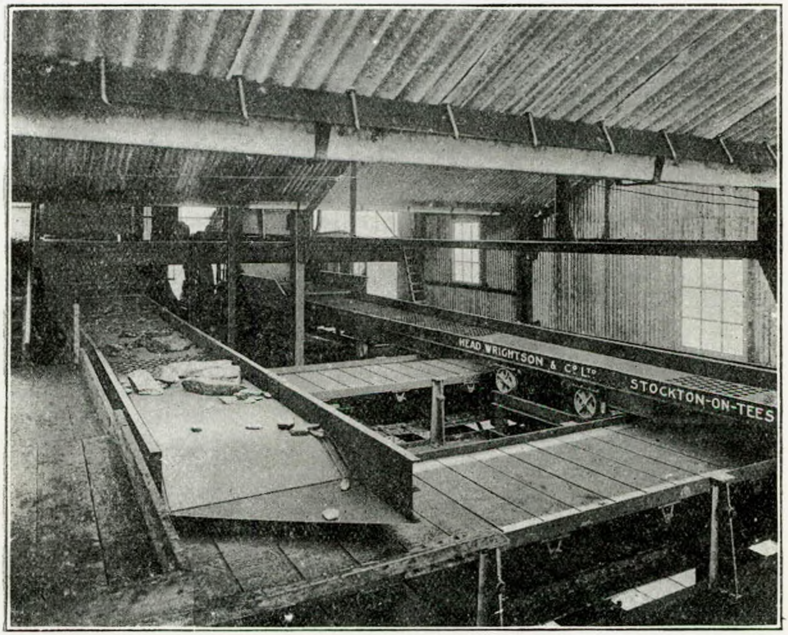
Patent Picking Table Screen, illustrates a method greatly in vogue in the United States, whereby the hutch never leaves the cage on the surface of the mine. It clearly shows the height of the whole screen, and from this, one may judge the saving that is effected between this method and the older gravity screens. I am glad to note at least one thing from which an English firm derives royalties from abroad. The inventors of the Marcus Screen being Messrs. Head, Wrightson and Co., Ltd.



220.—Marcus screens at Gedling Colliery.

Marcus Screens at Gedling Colliery.—At this colliery there are two sets of Marcus Screens, each consisting of two screen conveyers, working at right angles to each other as shown. Each is capable of screening 150 tons per hour respectively. The main screen receives the coal direct from the tippler and is 22 ft. 3 ins. long with a width tapering from 8 ft. 5 ins. to 5 ft., and is used to grade the coal into two sizes (best to a bar belt, and all under cobbles to secondary belt). The main screen supplies the secondary or transverse screen with coal, this screen being 78 ft. long with a width tapering from 5 ft. to 8 ft. 6 ins. and which grades the coal into four sizes. You will notice that there are also other belts travelling at right angles to this screen, these receive the coal from the screening machine, by this material passing through the perforations of the size required as fixed on the bottom of the trough of the

Marcus screens. These belts are used to hand pick the coal from, that is to take off any foreign material. The various belts each take a certain size of coal and deliver this to the wagons on the railway siding.

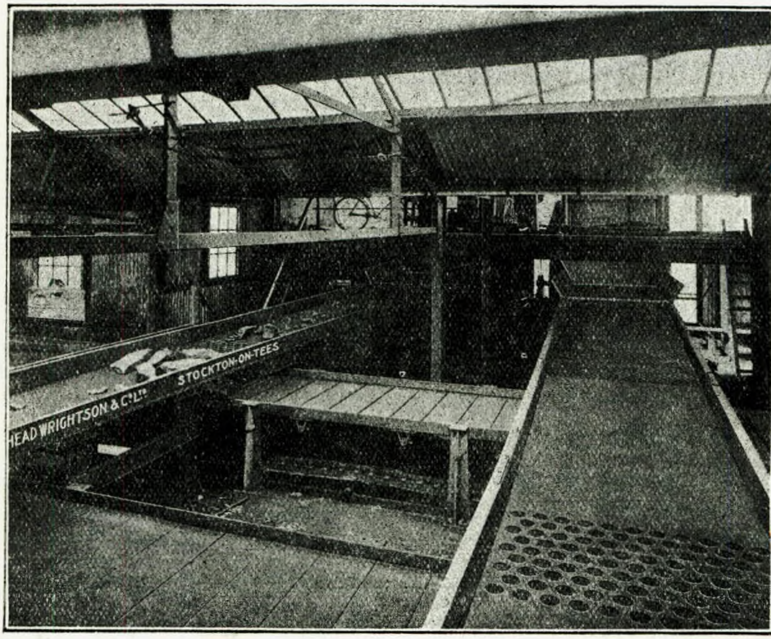


296.—Marcus Screens.

Marcus Screens.—This view shows two Marcus Screens, each of 100 tons per hour capacity, the supporting wheels are seen on the further screen, and in the near screen you will notice the delivery to a plate belt. You will see that the end of the screen is cut diagonally, this is to give a fair distribution of the coal on to the plate belt travelling at right angles to the Marcus Screen.

This is a closer view of the same screens. You will notice the perforations through which the coal to that size passes through. The previous set of holes would be smaller, thus you will see that first the slacks are passed through, then as each picking belt is arrived at, a larger size of coal goes to it, until at the finish only the lumps go over the end as best coal.

Ashington Screening and Hand-picking Coal.—This view gives one an idea of hand-picking from belts. Light plays an important part in this work as will be noticed by the glass roof for day working and electric lighting for night time. Numerous boys start their colliery work here and very often the older men or partly disabled find an occupation at this work.



287.—Marcus Screens.

Loading Wagons, Ashington Colliery.—General view of screening plant, Thrislington Colliery, showing balance weights for deflecting ends of belts, also the wagons loaded ready for shipment.

American Hillside Mine, Pulaski Iron Co., at Eckman, W. Va.—This illustration is of a Marcus Coal Tipple, of timber construction, with modern screening, cleaning and loading facilities, electrically operated throughout. Built for the Pulaski Iron Co., for the preparation of Pocahontas coal, at their mines at Eckman W. Va., by the Roberts and Schaefer

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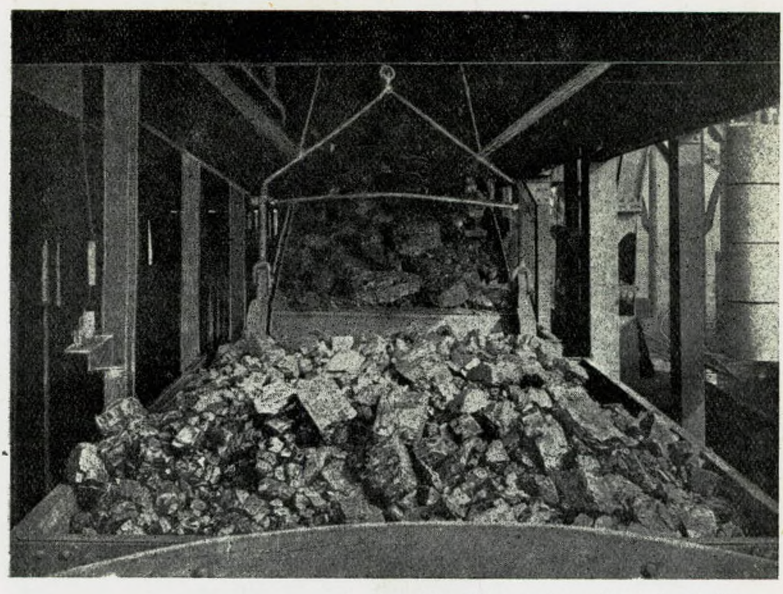
46.—Coal screening and hand picking, Ashington Colliery.



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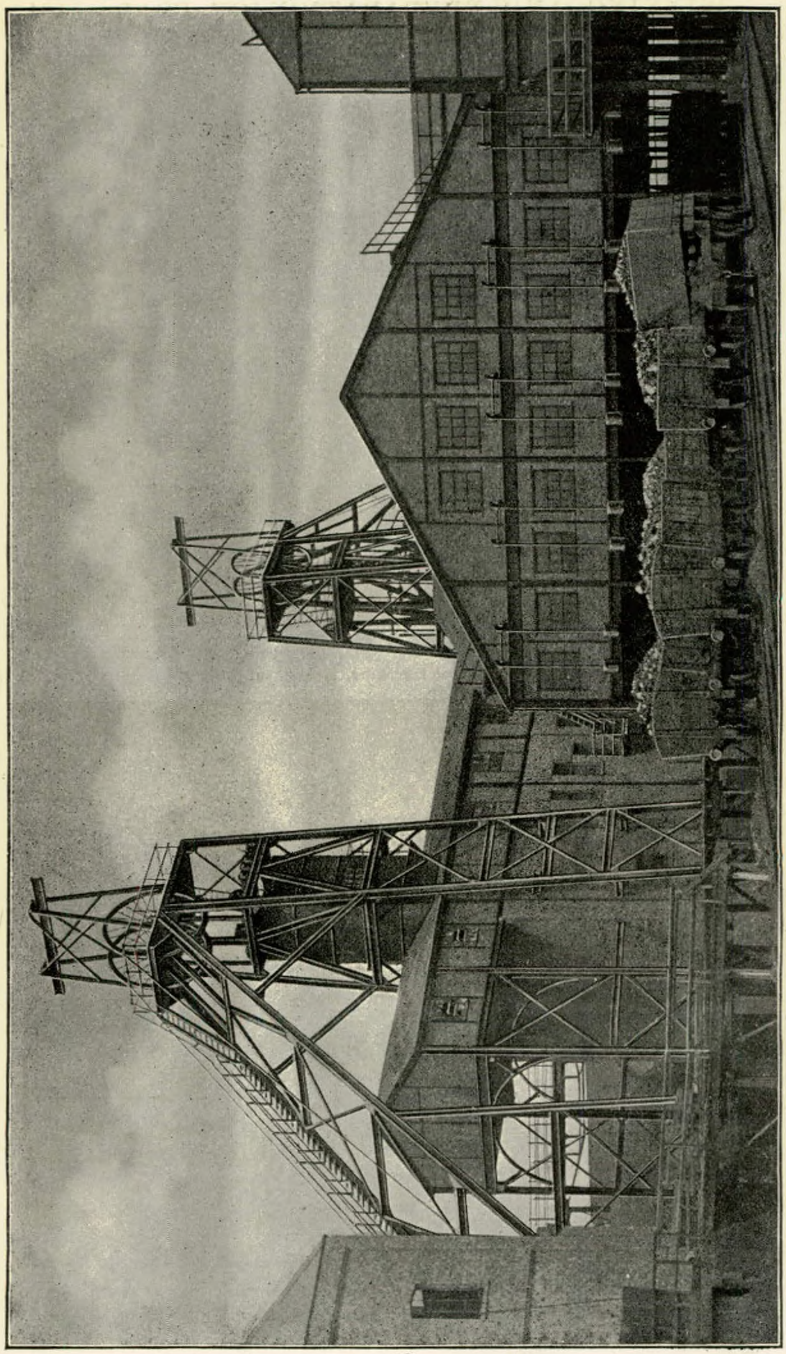
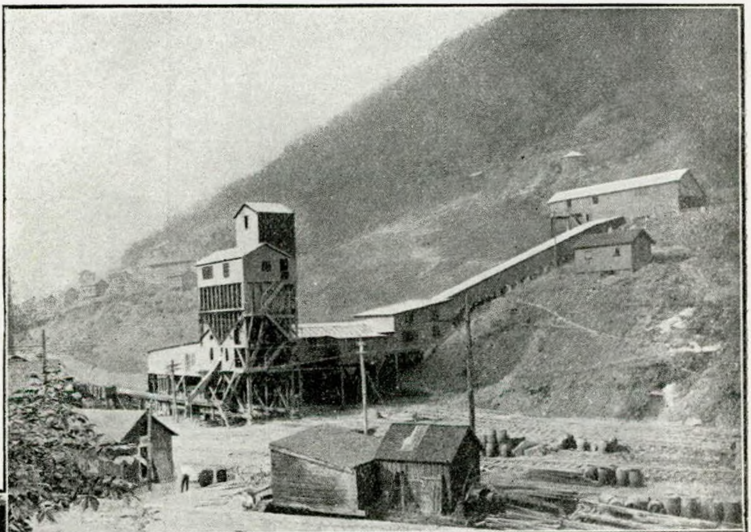
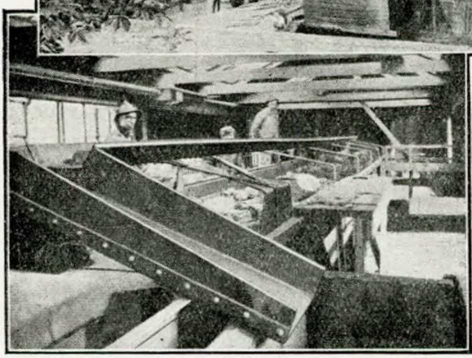
47.—Loaded wagons ready for transport, Ashington Colliery.



479.—General view of screening plant, Thrislington Colliery, showing balance weights for deflecting ends of belts, also the wagons loaded ready for shipment.

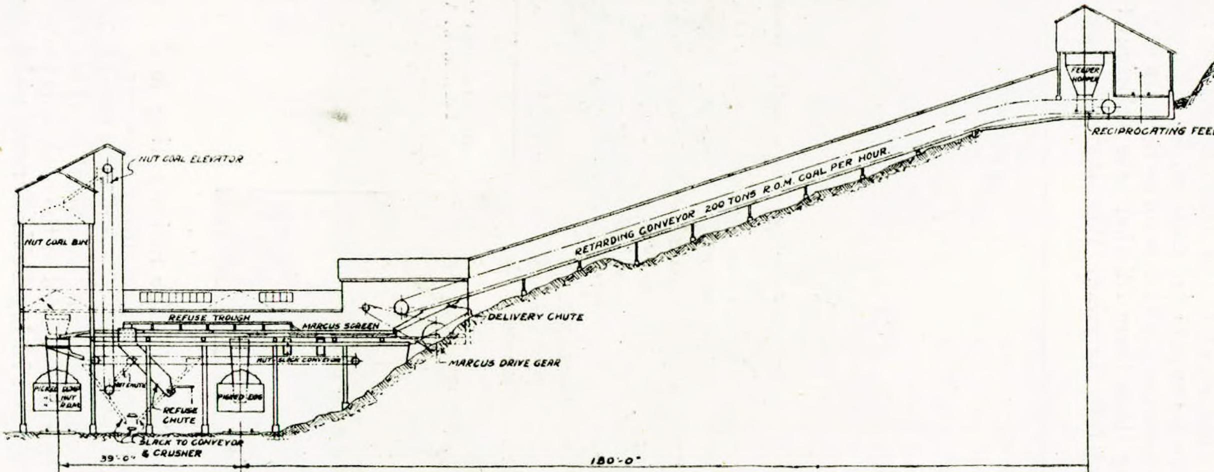
Co. The coal is delivered to the dump house from two mine openings, and the mine cars are dumped by a Phillips' Crossover Dump and Kickback, which returns the cars to the storage yard, assembling them there till there are sufficient to make a suitable trip back into the mine. Working in conjunction with





47B.—American hillside mine at Eckman, W. Virginia.

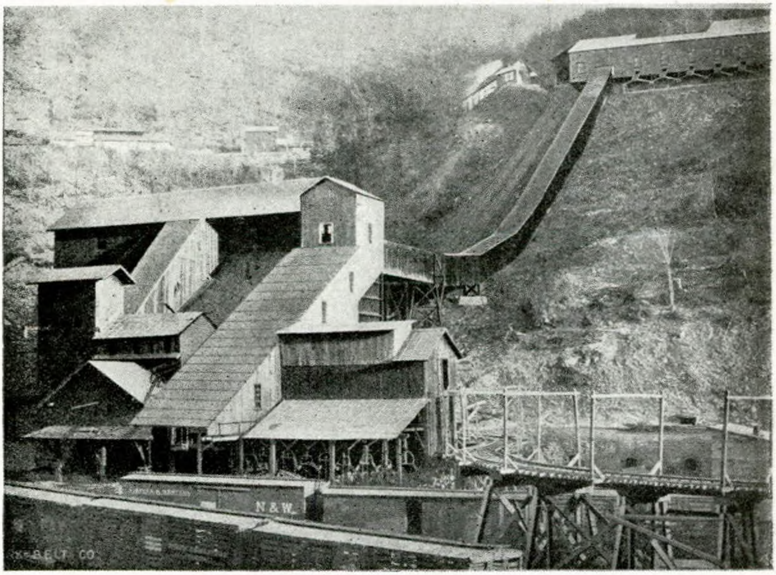
the dump hopper is an incline reciprocating feeder which delivers run of mine coal to the retarding conveyer as seen coming down the hillside, this works at a uniform rate of 200 tons per hour. By means of a steel roller chain, carrying rugged steel flights, which control the travel of the coal, this permits its easy delivery to a Marcus Picking Table Screen, which screens into



SIDE ELEVATION OF TIPPLE of PULASKI Co HILLSIDE MINE

47c.—American hillside mine at Eckman, diagram of.

four sizes and at the same time enables the pickers to remove refuse and dispose of it on to the novel additional trough as seen on the lower part of the view, when it is delivered to a refuse wagon. Egg and lump coal are carefully screened and cleaned and then loaded into railroad cars of large capacity by two Rand's Shaker Loading Booms, on each of which is a rescreener for finally removing any fine coal. These shaker loaders are composed of two reciprocating sections placed in balance and actuated by a drive shaft. The outer or boom section of each is lowered by an electric hoist. This enables the



47D.—"Link belt" chain retarding conveyer and tipple, McDowell Coal Co., Virginia.

operator to load low or high cars near the bottom when starting, and gradually raising as the railroad cars fill. The preparation of nut coal in this plant is accomplished in a very unusual manner. The Marcus delivers it to the nut slack conveyer, which is made with two compartments, one carrying the nut coal and the other the slack. The nut coal elevator receives this coal from one compartment of the nut slack conveyer and delivers it to the bin where it is stored—as the quantity made is comparatively small. When it is desired to ship this coal the nut shoot to shaker loader is opened and the loader on the "lump" track lowers it, without breakage into railway cars. All the slack screened from the r.o.m. (also all re-screenings from the nut, egg, and lump removed by the Rand's Shaker Loaders), is carried by a conveyer parallel to the lump track and reduced in a crusher from $\frac{3}{8}$ in. to 0 for coke making.

Link Belt Chain Retarding Conveyers (McDowell Coal and Coke Co.).—In mountainous districts the entry of the mine is usually at quite an elevation above the level of the railroad tracks, thus involving a problem of conveying the coal from the drift mouth to the loading tracks without undue breakage. This is accomplished by the use of retarding conveyers, which are simply a sort of scraper conveyer to prevent the coal falling away, at the same time these regulate the delivery. The view we are now considering is a typical Virginian colliery, and by a close study of this you will easily see that we are presented with a clear idea of how little labour is necessary for many operations at an American mine. The coal loads are assisted by gravity in all cases. The delivery of refuse from the picking is dumped down the hillside. The mine is automatically drained—note the outlets in the right-hand side, and in addition natural ventilation takes place, all these operations tend to increase the average output per man employed about a colliery. This view is that of the McDowell Colliery W. Va., and this tipple has a capacity of 300 tons per hour. Length of conveyer 320 ft., built by Link Belt Co.

Before showing the methods of loading and delivery of our fuel to the London market, we will examine some of the ways of how coal is washed.

Coppee "Draining Elevator Type" Washing and Crushing Plant. Description of a Washing Plant to treat 2,000 *tons of Coal in* 16 *hours* (125 *tons per hour*), *United National Collieries, "Risca Coll.," Mon.*—It is rather difficult to show the multitude of operations in connection with the washing of coal by modern methods by means of photographic slides, but by carefully following the numbers we shall endeavour to trace the various operations by means of this diagram. First of all the screenings from the colliery up to $\frac{7}{8}$in. is brought in end door tip wagons, and tipped by one of four electric tips (ten h.p. Westinghouse motors) (1) into the pit (2) raised by elevator (3) to a double balanced screen (4) where it is graded into four sizes: nuts, $\frac{7}{8}$in. bars to $\frac{3}{4}$in. sq. holes; beans, $\frac{3}{4}$in. sq. holes. $\frac{1}{2}$in. sq. holes; peas, $\frac{1}{2}$in. sq. holes, $\frac{1}{4}$in. sq. holes; small, $\frac{1}{4}$in. sq. holes to 0.

The nuts, beans and peas are conveyed in troughs (5) by means of water to the washing boxes (6) of which there are five. When washed the nuts and beans are sent along by trough and water (7) to the draining sieves; (8) after draining they pass into their respective hoppers or storage bunkers (9) from where they are loaded by chute (10) into railway trucks. There are four of these hoppers, two for peas and one each for nuts and beans. The small coal $\frac{1}{4}$in. to 0 is taken from the screen (4) by trough and water (13) to the feldspar washing boxes (14) where it is divided into washed small, mixed coal, shale.

The mixed coal and the crushed shale for the nuts, beans and peas are sent by the trough (15) into the basin (16) from where they are raised by the elevator (17) and delivered into the feldspar re-washing box (18) where it is divided into re-washed small shale.

Draining.—The small coal that may have passed through the draining sieves (8). The washed small from the feldspar washer (14) and the re-washed coal from the feldspar re-washer (18) are respectively conveyed by troughs and water (19), (20), (21) and delivered into basin (22). From this basin the mixture is raised by the draining bucket elevator (23) delivering to a scraper conveyer (24) which distributes the material to a series of ten small hoppers (25) of a total capacity of a thousand tons. From these bunkers the small coal is fed on to the scraper conveyer (26) and raised by the elevator (27) and delivered into a "Carr crusher" (28), when crushed the coal is lifted by elevator (29) into the storage hoppers (30) of a capacity of three hundred tons, from the bottom of which the trucks (31) for charging the coke ovens can be loaded. This small coal may also be sent to market as provision is made whereby this fuel can be taken from the scraper conveyer (26) to an elevator which lifts this coal to a 50-ton bunker from which railway wagons may be loaded underneath. In addition the bunkers (25) have loading shoots provided near the bottom of each bunker and extending over the siding, so that if necessary this coal may be loaded up for sale direct into railway trucks.

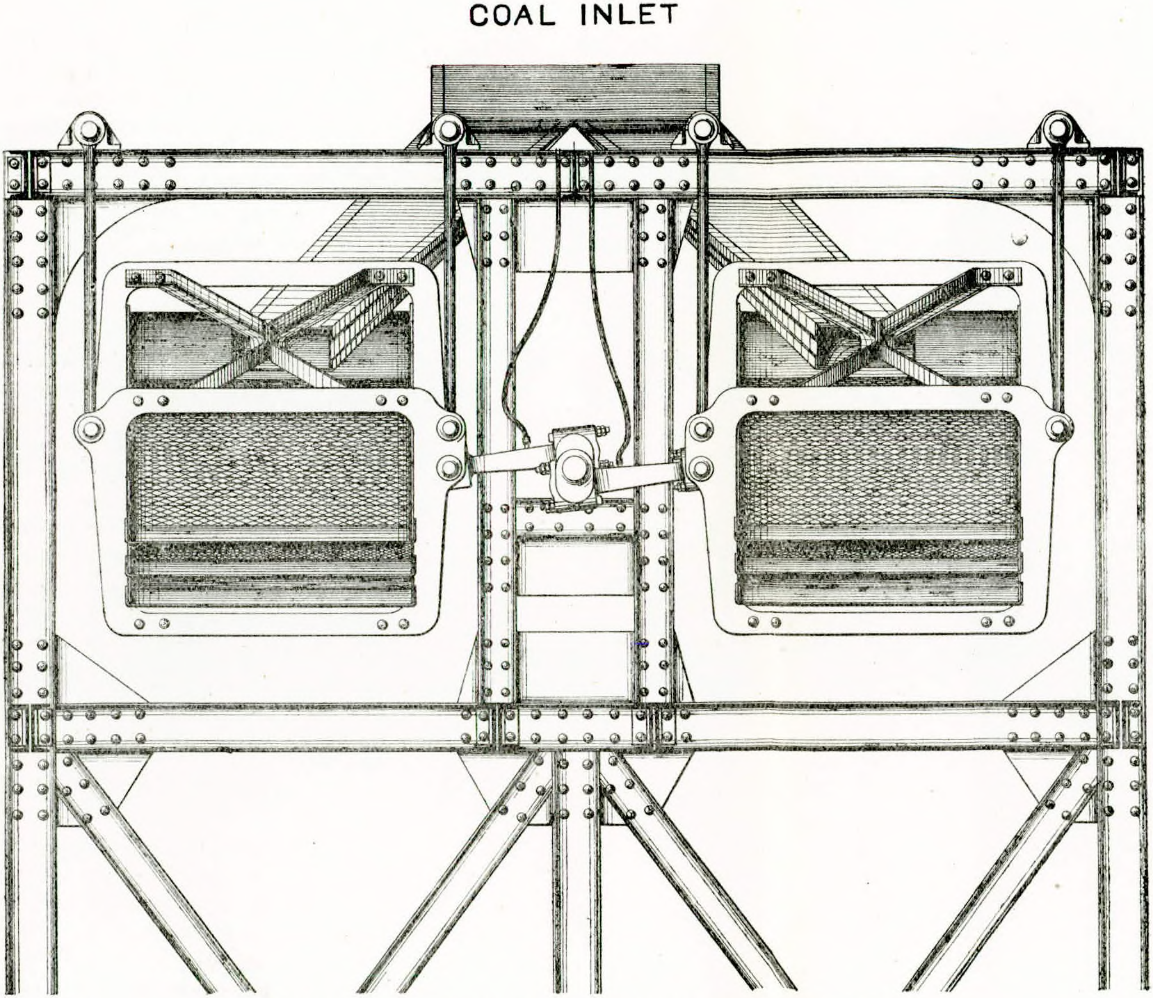
Small Shale.—From the feldspar washers (14) and re-washer (18) the shale is conveyed by means of trough and water (32) into basin (33) elevated by draining elevator (34) into bunker (35) from where it may be loaded into small wagons which may be sent to the tip or into railway wagons direct on the siding.

Water.—The overflow of the basins (16), (22), and (33), is taken by the troughs (36) to the clarifying basins (37). The draining water from the various bunkers is taken to the basin (38) pumped by small centrifugal (39) into clarifying basin (37). The clarified water is forced by centrifugal pump (40) into feed tank (41) from where the water is delivered to the various apparatus by means of the pipes (42). The slurry from the basin (37) is tapped off by valves (43), collected into basins (44), loaded into trams and used at the boiler house. Washery driven by Robey engine 250 h.p and crushers by Robey 160 h.p.

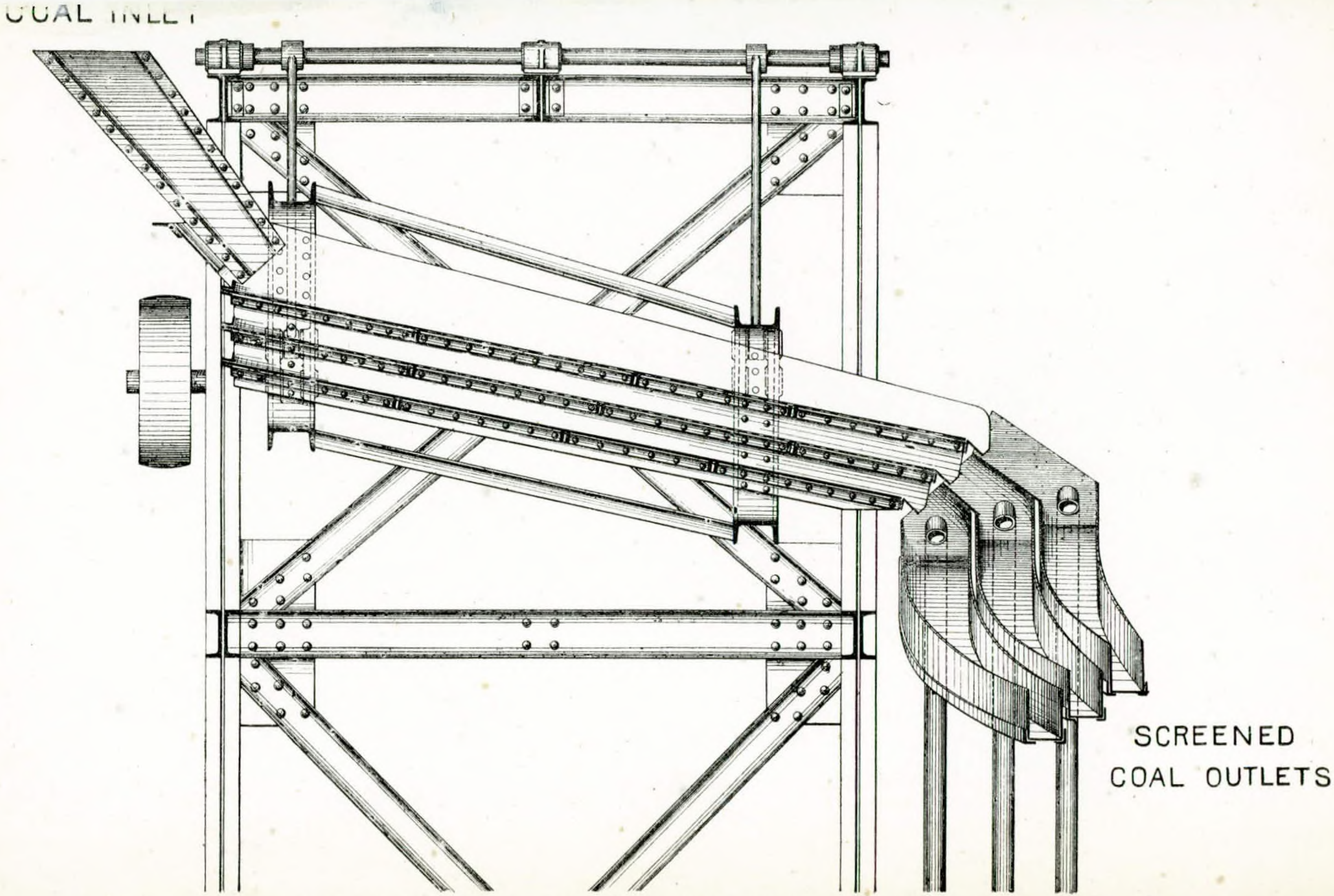
"Coppee" Double Balanced Laternal Shaking Screens for Coal Washery.—Most coal washeries are designed either to screen the coal to the respective sizes before washing, or to wash the whole first and then screen afterwards. Where the coal is classified first, as in this system, the best results are obtained. This is very noticeable with coal containing high ash results, because the specific gravity of the coal and shale is almost alike, therefore, unlike an ore washing plant where the difference between the ore and quartz is great, it is thus found best to have the coal sized first. If the colliery owner desired to keep the small coals within a certain standard quality and also ensure a reputation for his coal, he must put it on the market in its best condition free from dirt, of a fair average size, and a clean bright appearance. We here see the method of initial treatment of classifying the coal into four sizes, each of which is delivered to its respective trough, excepting the smallest coal which is not shown, but which goes to another trough under the lower screen and from there direct to the feldspar washer. You will see that the motion given to coal is by crank and connecting rods to the supported boxes which are thus given a reciprocating motion.

"Coppee" Nut, Bean and Pea Washer.—In these washers the unwashed coal enters at the top as shown, each size is treated in separate boxes. The washing water is kept agitated by mechanical plungers driven from a shaft by means of an eccentric, the stroke of which can be readily adjusted to suit the pulsation volume required. The heavier than coal material gravitates to the bottom and the coal is carried forward with the washing water by trough to the draining sieves. The shale is raised by the elevator shown and delivered into the crusher for further use.

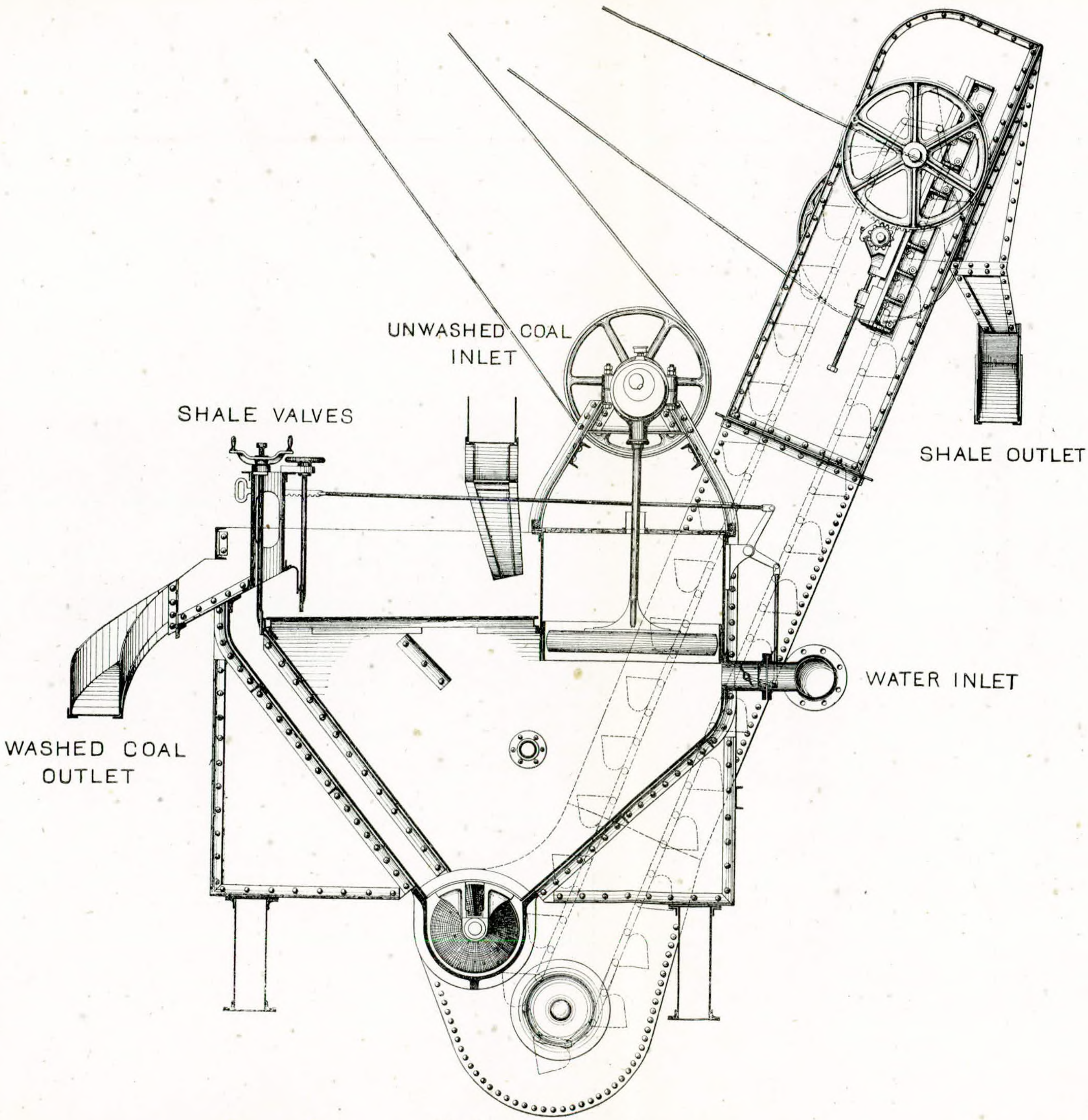
Nut, Bean and Pea Washing Boxes at Risca Colliery.—This view is that of the nut, bean and pea washing boxes at Risca



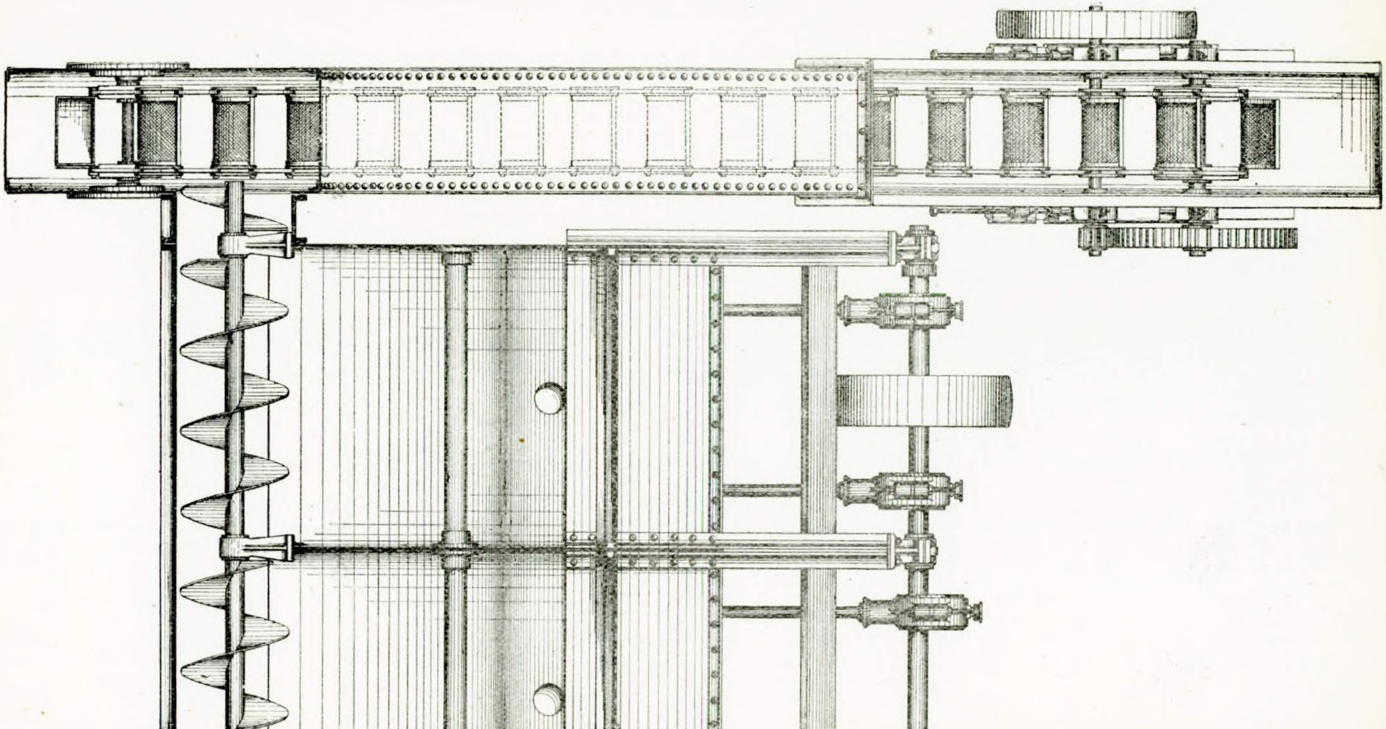
883.—Front view Coppee double balanced laternal shaking screens for coal washing.



884.—Longitudinal section Coppee double balanced lateral shaking screens for coal washing.

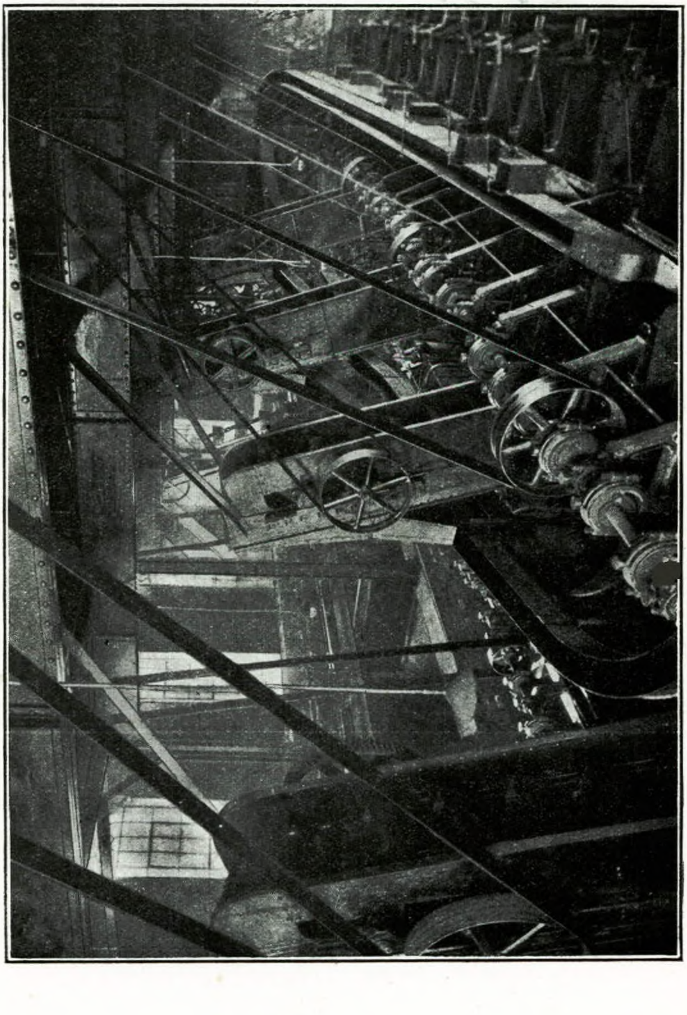


885.—Nut, bean and pea washer



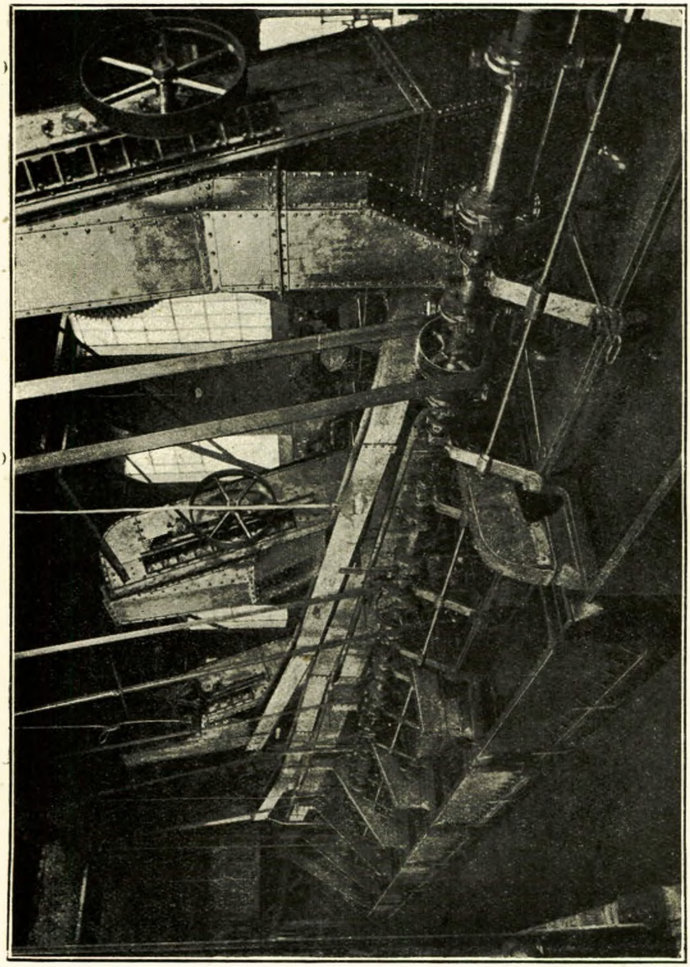
886.—Nut, bean and pea washer.

Colliery washery. Each washing box can be regulated to suit the coal to be washed in five different ways: by adjustment of (1) the coal feed; (2) water feed; (3) eccentric stroke; (4) thickness of shale bed; (5) regulating the shale outflow. Generally it is found that when coal is fed regularly there is no need to alter the adjustments when this has been adjusted to suit the coal being washed.



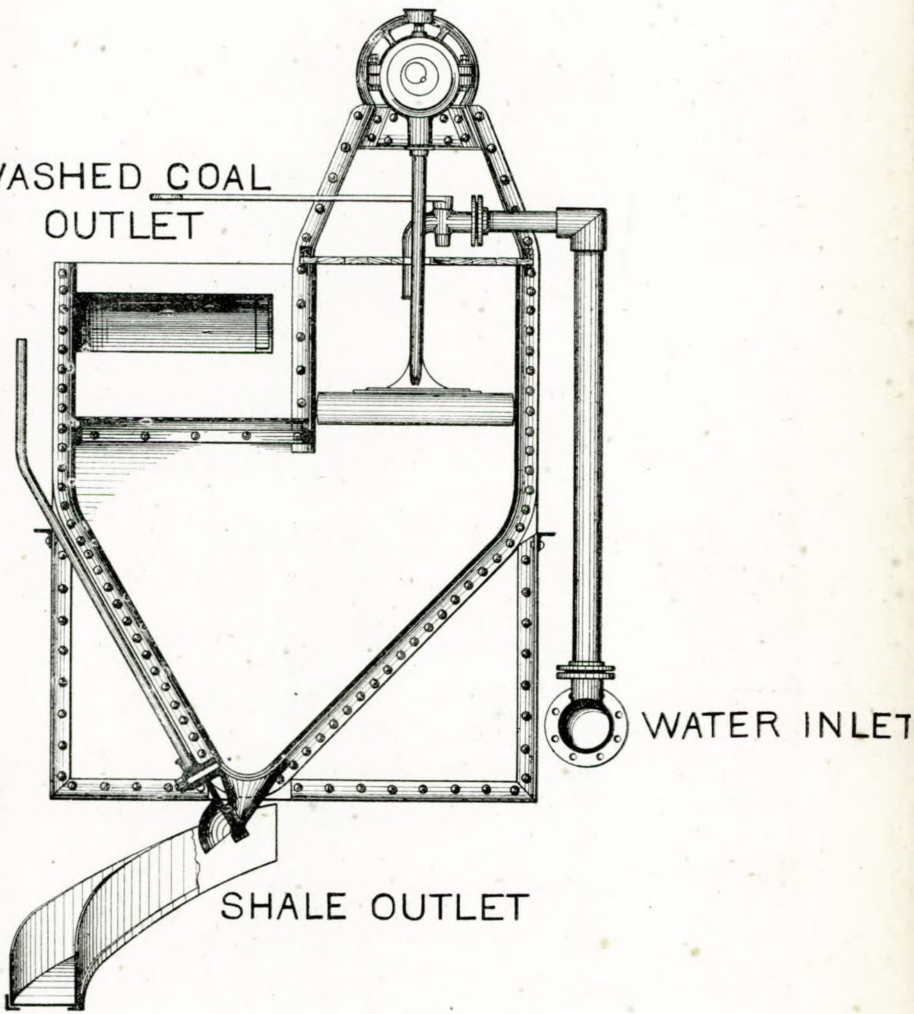
890.—Nut, bean and pea washer at Risca Colliery.

Small Feldspar Washer.—The small coal is treated in the same way as the nuts, beans and peas, except that it is washed in feldspar boxes. Here it is divided into washed small, mixed

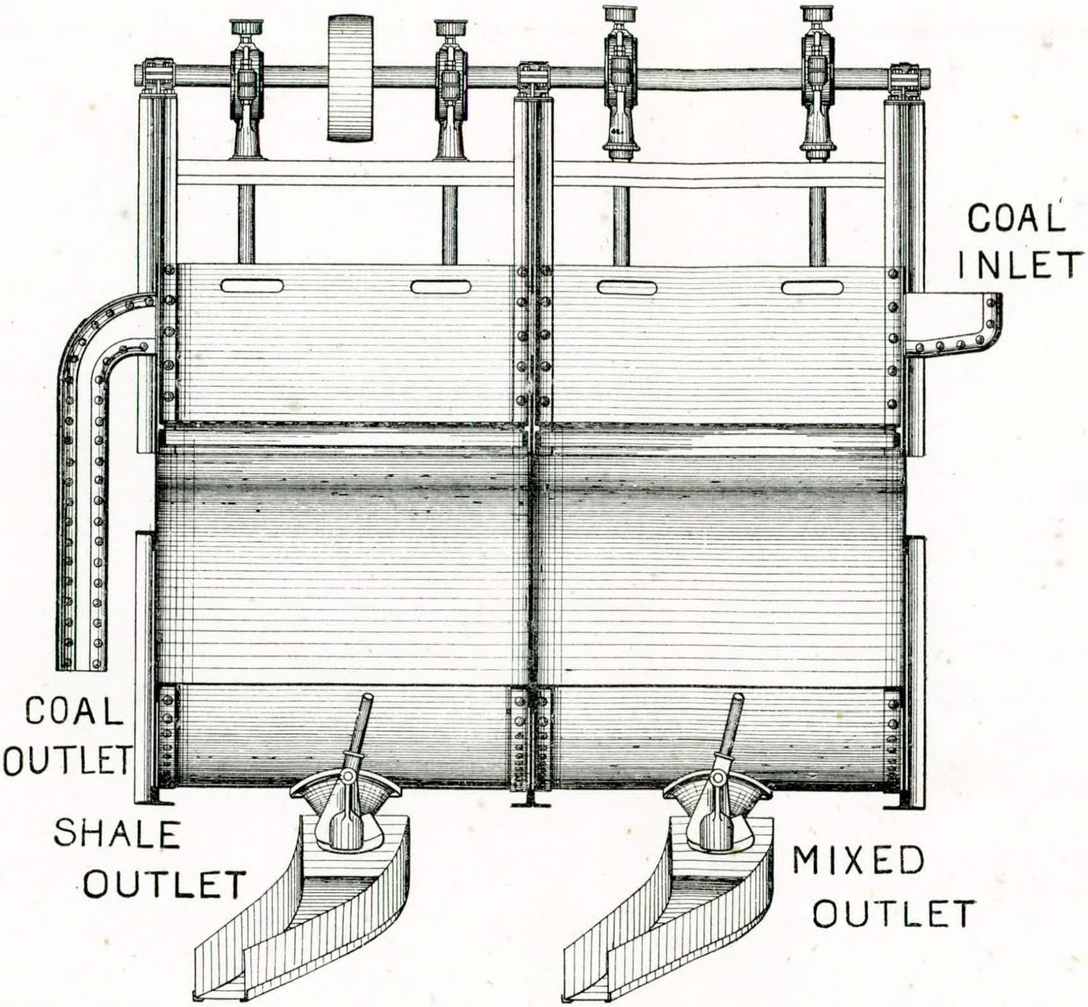


893.—Small feldspar washer at Risca Colliery.

coal and shale. The washed coal passing over the top and sent by trough to a collecting and draining basin. The mixed coal and the shale are sent for re-washing to another feldspar box,



887.—Small Feldspar Washer.

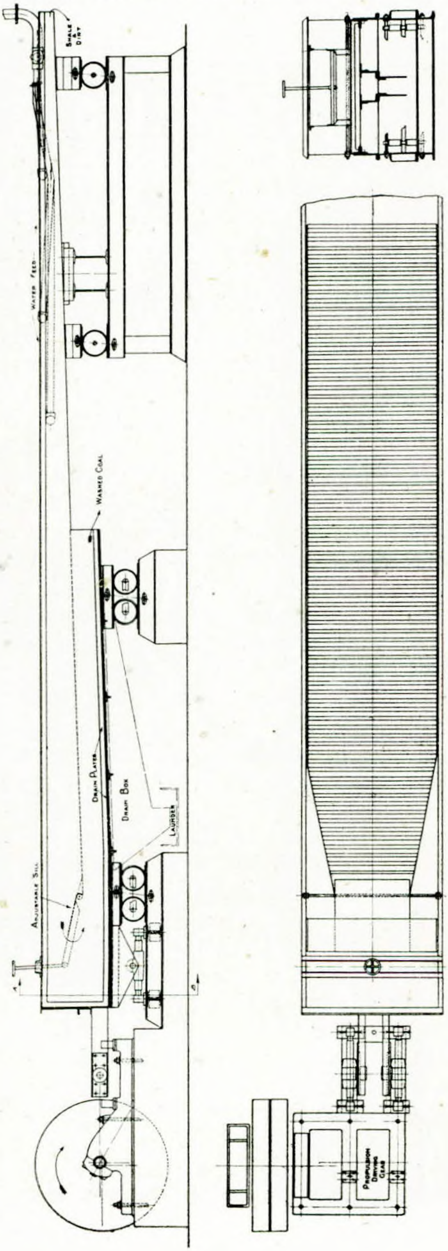


868.—Small Feldspar Washer.

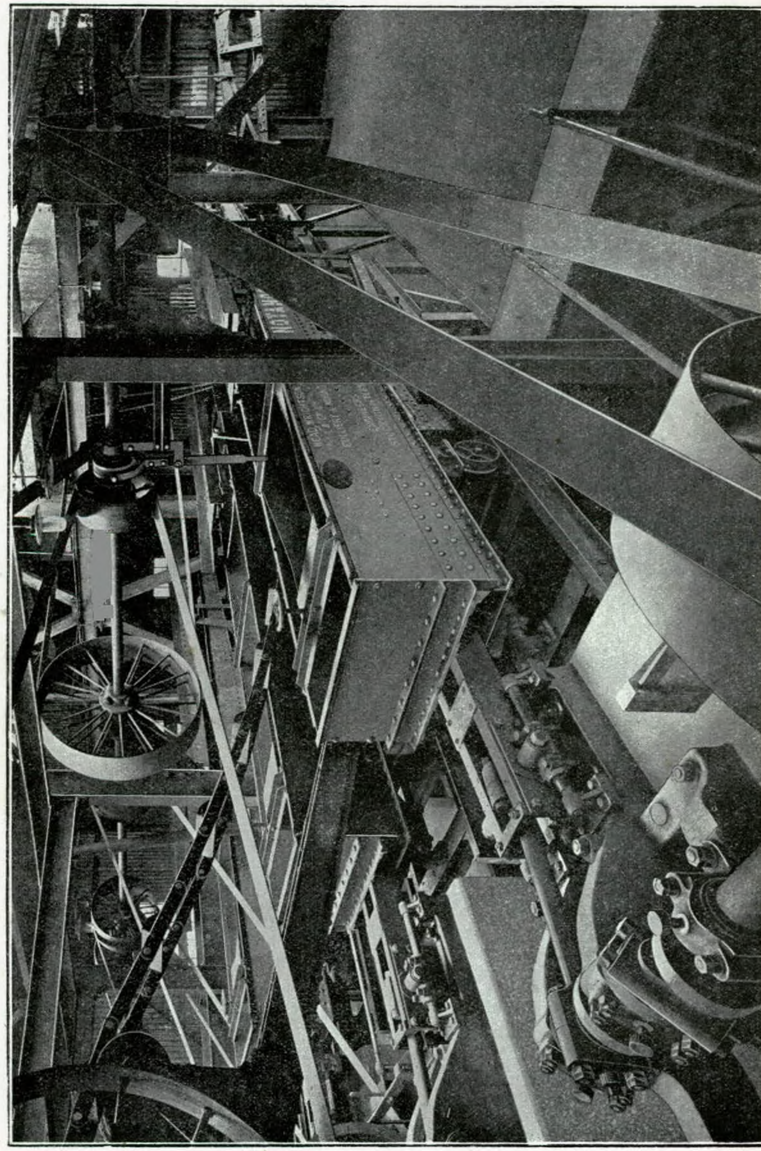
the re-washed coal going from there to the same basin as previously mentioned, while the shale is delivered by trough for further treatment.

Small Feldspar Washer Boxes at Risca Colliery.—This view shows these feldspar boxes, also at Risca Colliery. These feldspar boxes can be regulated to suit the different coal to be washed by adjustment of the feed of the coal; the feed of the water; the stroke of the eccentric; the thickness of feldspar, and by altering the size of the feldspar.

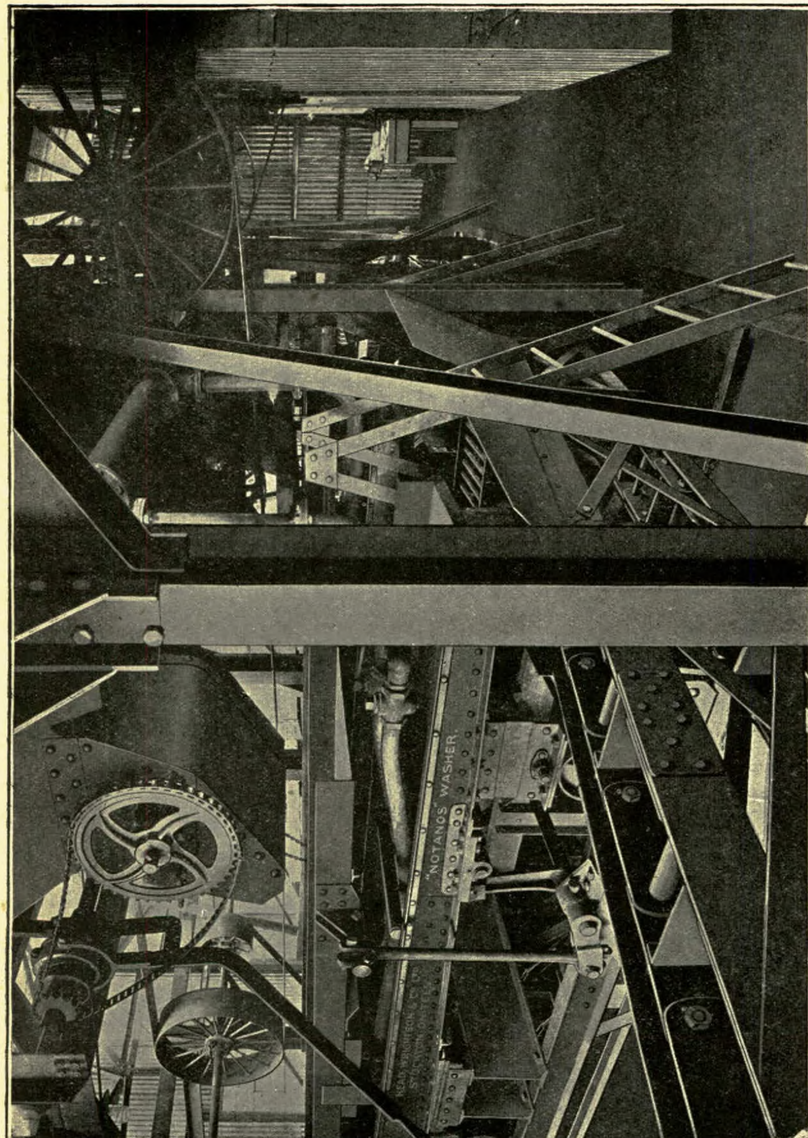
Outline Diagram of Head Wrightson Nota-Nos Coal Washer. The Nota-Nos Washer is a simple and efficient machine, and is built in units which are capable of washing from 10 to 15 tons of coal per unit per hour, depending on the size of the material being washed—the smaller the fuel the less it will wash—or I should say the less it is desirable to wash per hour. The makers of this plant have embraced the results of practical experience gained with a full-size experimental plant erected on their works to treat their fuel supplies. While being unique in many respects, this machine contains the efficient features of the old trough washers combined with those of the later jig or bash machine, in addition this plant may also be utilised to grade the material in size after washing. The method of separating the heavier dirt from the lighter coal is carried out by causing two forces to oppose each other. One force is obtained by the Marcus motion—as previously described during our review of the Marcus screens—this tends to carry all the material in one direction towards the right-hand of the diagram illustrated, while the other force is due to a stream or jets of water which float the lighter parts (coal) in the opposite direction. When the material to be washed has been previously graded to a uniform size, the above idea is all that is required, but when the size varies an upper deck screen is necessary, and jets of water of different size deal with the various sizes of material. It is obvious that a force of water strong enough to wash or float down a large lump of coal would also carry down some fine dirt with it; so also, a large lump of stone would be apt to carry some fine coal with it, hence the necessity for the limitation of sizes being washed together. The adjustable sill at the right-hand side of the machine is a very important feature, as by the adjustment of this a greater or less amount of water is massed, which being in great agitation resembles the action of the ordinary jig washer. The water with the clean coal passes over the top of this sill and falls on to the finely perforated lower



727.—Outline diagram of Head Wrightson's Nota-Nos coal washer.



723.—Nota-Nos. coal washing plant at Glasshoughton Colliery.



725.—Nota-Nos. coal washing plant at Glasshoughton Colliery.

deck where the water is drained free from the coal and passes through drain box to launder and thence to a settling tank where any settlings may be extracted by means of a slow scraper conveyer passing through it, while the water is used over and over again. The washed coal on these drain plates, not being opposed by the water flow, is now carried along by the Marcus motion and deposited over the end to another conveyer if necessary, or to storage bunkers, depending on the requirements of the material whether for wagon loading direct or storing till a certain quantity has accumulated.

If the coal is required to be sized after washing, this may be done on these drain plates, similar to a Marcus screen, or the end of delivery may be extended and the motion of washer given to this extension, and thereon the sizing may take place. Reverting to the adjustment of the sill, this depends on the difference of specific weight between the coal and dirt; when this is nearly equal the sill must be raised, therefore increasing the depth of water, but the lower the sill, the greater the capacity of the machine. The power required to operate an average washery of this type equals about 7 h.p. per ten tons of material washed per hour. Regarding the dirt, this being heavier than the coal, it falls to the bottom of the washing trough and is conveyed by the Marcus motion against the flow of water to the high end, over which it is shot to a refuse conveyer or to a wagon as the case may be. These washing machines are also used for washing and sizing coke at gas works.

TEST SHEET FOR NOTA-NOS. WASHER.

Washer.	No. 1.					No. 2.					No. 3.				
Max. size of Feed Q	Under ½"					½" to ⅞"					⅞" to 1¼"				
	T.	C.	Q	L.		T.	C.	Q.	L.		T.	C.	Q.	L.	
Quantity per washer	5	11	2	7		1	18	2	21		7	1	0		
Product of washers					%					%					%
Washed Coal ..	4	1	1	0	69·3	1	11	1	14	77	5	3	0		76·7
Settlings	1	4	1	0	20·7		4	0	0	9·9		1	14		5
Dirt and Shale ..		11	3	0	10		5	1	14	13·1	1	1	14		18·[illegible]
Total including moisture ..	5	17	1	0	100	2	0	3	0	100	7	2	0		100
Moisture ..		5	2	21	5·1		2	0	7	5 3		1	0		3·45

COMPARATIVE ANALYSIS.

Material.	Washer.	Carbon %	Ash %	Sulphur %
Unwashed Coal ..	No. 1	79·245	18·7	2·055
Washed Coal	No. 1	94·09	5·2	·71
Unwashed Coal	No. 2	90·88	8·4	·72
Washed Coal	No. 2	95·45	3·7	·85
Dirt and Shale after Wash	No. 1	30·88 @ *	65·06	4·06
,, ,, ,,	No. 2	23·69 @ *	73·1	3·31

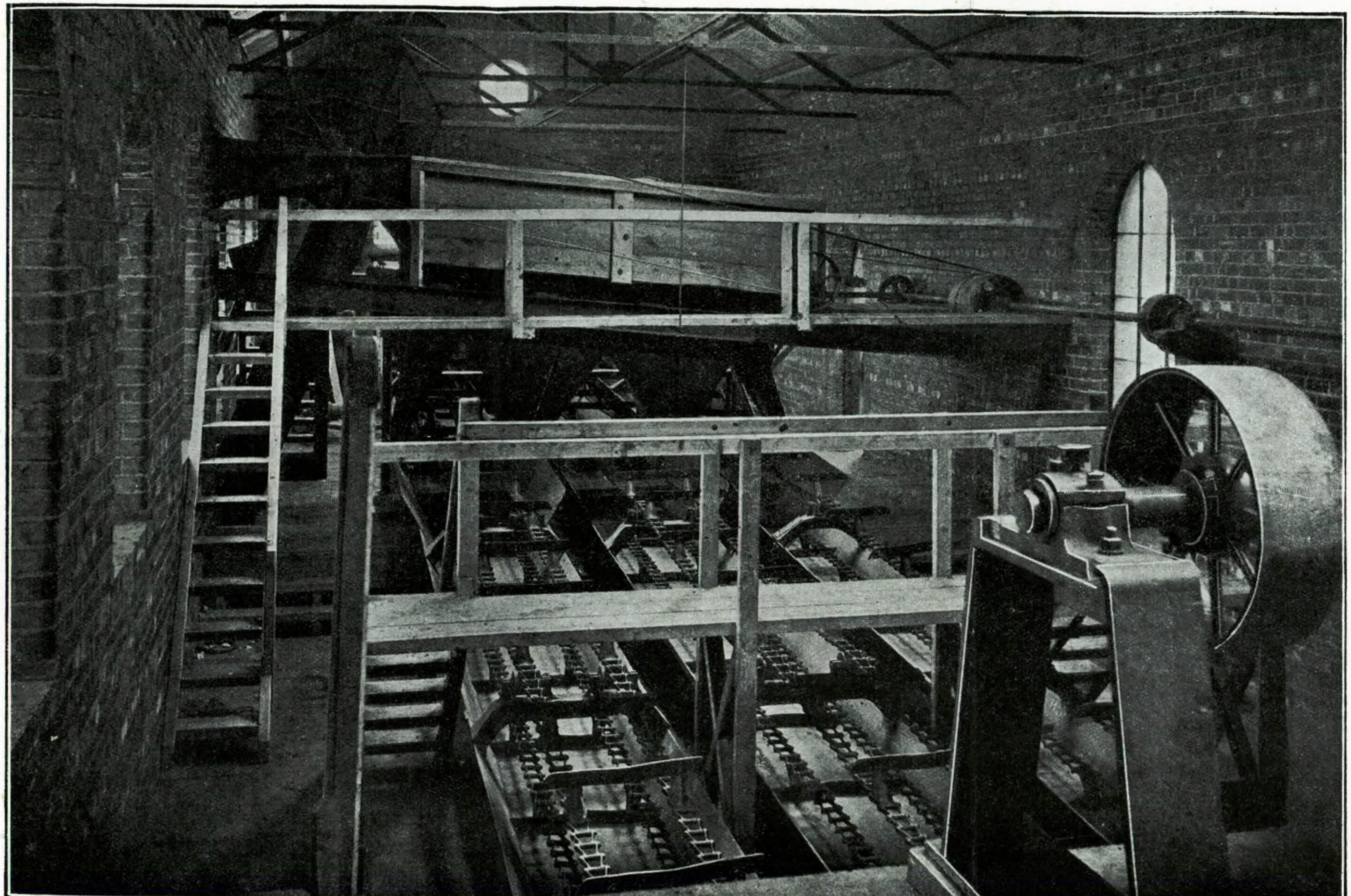
@ * Inseparable Carbonaceous Matter.

The New Elliot Coal Washer.—This type of washer made by the Hardy Patent Pick Co., of Sheffield, and known as "The New Elliott," is of the trough system of washing machines, the theory of washing being the same as other types, that is, coal and shale dirt being of different specific gravities, fall through water at different velocities, the heavier material on falling offers more resistance to a flowing stream of water and thus settles, while the coal is carried away with the flowing water, that is depending on the difference of size between the largest and smallest pieces of coal being washed. The principle of this machine is that of size first then wash, and in this repect it is suggested that for all practical purposes the largest piece of coal being washed should not exceed four times the cubic capacity of the smallest piece of shale, thus to ensure perfect washing and to cover this suggestion, the coal should previously be sized into 1/16in. to 5/16in., 5/16in. to $\frac{5}{8}$in., $\frac{5}{8}$in. to $1\frac{1}{4}$ins., $1\frac{1}{4}$ins. to 2ins. It is also suggested that the only perfect way to wash small coal is to eliminate all dust below 1/16in., although the grains of this size of 1/16in. cubic capacity can be washed, but those under this size if left for washing tend to render the washing water too dense to properly wash the smaller sizes such as peas and small coal. There is a difference of opinion as regards this, but perhaps the solution rests more with the composition of the coal and its impurities than anything else; however, in many of these plants this small under 1/16in. ($1\text{-}1\frac{1}{2}$m/m.) is very efficiently eliminated by a dry dust extractor, also of Messrs. Hardy's make. This dry dust may be utilised by blending with the washed coal for coking plants, or due proportions of it may be added to the washed coal providing it does not increase the ash results above the specification of the clients whom the coal is for. Looking at the inside view of this plant you will notice the elevator (on the left-hand side) which lifts the coal and dirt to the sizing screen, this screens to the various sides, and delivers each size to its respective washing trough underneath. These troughs are made of stamped sheet steel or cast iron, and are a foot wider at the top than at the bottom; in this instance the troughs are for double chain scrapers and are 2ft. 3ins. wide at the bottom, but single chain trough-washers also in use with a bottom width of 1ft. 6ins. On this chain may be seen the scrapers, fixed at suitable distances from each other; these are shaped similar to the section of the trough, and in the newer type of these washers are made of a corrugated or saw-tooth shape, as it was found in the old flat and straight scrapers that the water volume was greatest in the centre and gave imperfect washing. With the new shape the washing process is as effective at the sides as at the centre of the trough, this simple alteration has improved this washer so much that the coal as it leaves the bottom of the trough is entirely free from loose dirt, whilst the dirt which is delivered at the upper end of the scrapers is free from loose coal.

In the sectional elevation of this washer you will see that at each end of the trough is fixed a sprocket wheel, over which the endless scraper chain works into the trough, this trough has a fall of one in 12 in the direction of the water flow towards the washed coal end, the direction of travel of the scrapers is against the water flow. The main washing water enters the trough through the main water box on the right-hand side and is here diverted horizontally along the trough. In addition to this washing, which is simply a mechanical application of the old system of hand-trough washing, a novel and efficient method of primary washing is carried out on a washing table, where the unwashed coal is delivered to near the middle of the trough. On this table the coal and primary washing water are thoroughly mixed, the water being spread all over the surface of this plate, thus spreading and carrying the coal forward with it, this effects such a preliminary separation that practically the larger pieces of shale are immediately separated and fall into the trough to be carried along by the scrapers as shown on diagram, thus the actual work required to be done by the trough is considerably reduced, incidently increasing the capacity and efficiency of the machine, in fact the addition of this primary arrangement has effected a reduction of about 15ft. in the length of the machine in comparison with the older type. There is no moving part in this primary washer, it is merely a plate or series of plates over which the material is passed on its way to the washing trough, the difference of gravity of the material plays an important part whereby the heavy dirt falls in a more direct path of the trough while the lighter coal passes beyond this aperture, over another plate, repeating the process then delivering this coal thoroughly saturated and with the larger and rougher dirt eliminated into the main washing trough. Here the lighter coal is taken forward by the force of water, drained and delivered to place required, while the heavier dirt is taken by scrapers against the flow of the water and put to dirt heap. It is claimed by this type of washer that peas, breeze and nuts can be washed within one per cent. of the natural ash. There is practically no heavy machinery attached to this plant, therefore it may be placed in buildings of very light structure. The various wagon-tips, elevators, conveyers, water schemes, etc., depend on local conditions, but broadly speaking the method of washing is all on the lines explained. An addition to this is made by a fine coal recovery plant, which abstracts practically the whole of the fine coal from the washing water, so that this water is used over and over again. The recovered coal (schlaam) can be mixed with the washed coal, or as in many cases used in the colliery boiler furnaces.

This is done from a large area settling tank, usually placed in the base of the building, into which all the washing water drains. In this tank is fixed a scraper conveyer which moves along the bottom and dredges out the fine coal and deposits it to wherever required, by producing this conveyer to point of delivery, either to wagons or to washed coal conveyer. Owing to the large area of this tank there is little movement of the water, thus plenty of time is given for small coal to settle to the bottom, while at the same time the water is left clear and is used over and over again for washing purposes.

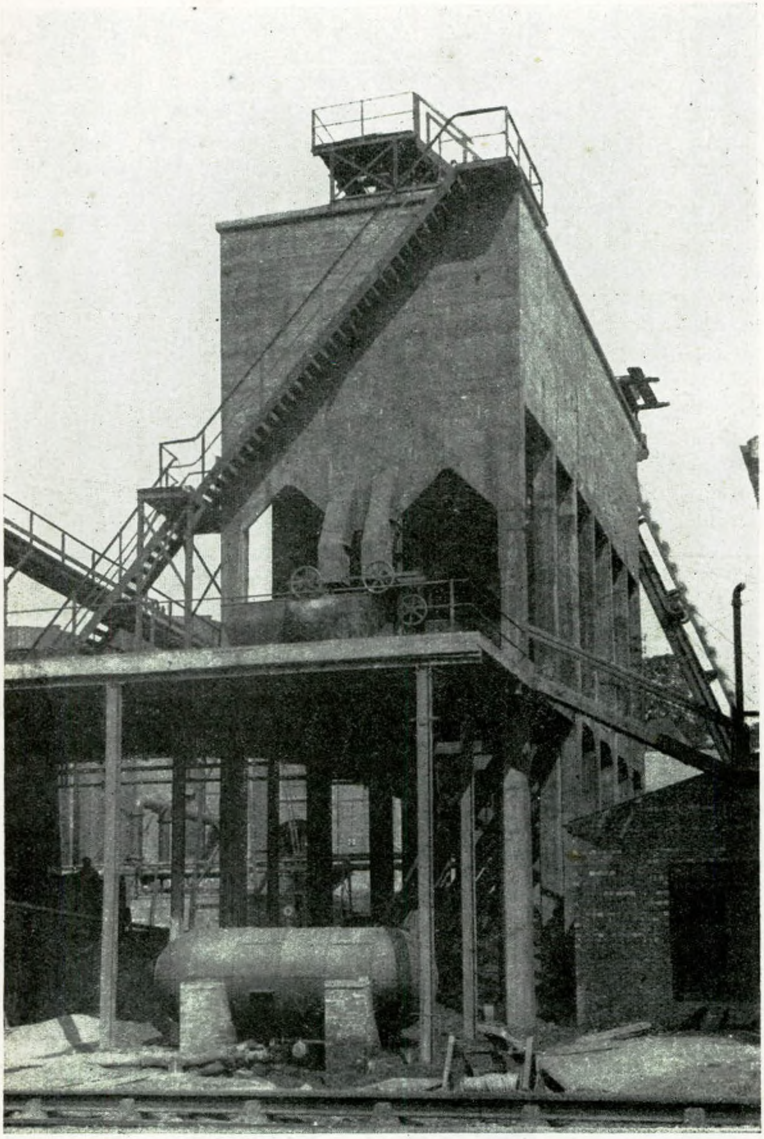
Ferro-concrete Coal Storage Bunkers at Skelmanthorpe, Yorkshire.—These were built for the purpose of storing small coal from the washery plant—we have just reviewed—for the continuous supply of fuel for coke oven installation. The bunkers form a building 53ft. 10in. long × by 19ft. wide by 56ft. high, divided into 12 compartments, each having a capacity of 60 tons, thus totalling 720 tons of storage. The bunkers are situated at the end of a range of coke ovens, and facing a set of rails on which runs a ram for feeding the ovens. Ten of the bunkers discharge from hopper outlets over the ram, and two at the end discharge independently beneath the arched openings shown. At the further end of the building there is a ferro-concrete cantilever projecting sufficiently from the outer wall to permit the working of an elevator raising coal from trucks on a siding below. A conveyer runs along the centre line of the flat roof and receives the coal raised by the elevator. this conveyer delivers into the bunkers. A continuous stream of coal is thus passing from the sidings to the bunkers and from there to the ovens, without any manual labour. The building is carried by 14 ferro-concrete columns. The total load is approximately 1,200 tons, thus each column has to carry about 85 tons. The columns are based on extended footings 6ft. × 4ft., thus distributing the load to about $3\frac{1}{2}$ tons per sq. ft.



70B.—The New Elliot Coal Washer, inside view, Skelmanthorpe.

In order to obviate the risk of lateral movement, the column footings are connected by horizontal ties 9in. square beneath the four sides of the bunkers, and 8in. wide × 12in. deep transversely. As a further precaution the columns are braced horizontally and diagonally, so as to constitute a framed structure of great strength and rigidity. A point of special interest in connection with the columns is that the cross section is only 12ins. square or less than the sectional area of a steel column of equal strength adequately cased in fire resisting material. The division walls are only 5 ins. thick, excepting the transverse partition between the two end bunkers, these two bunkers measure 10ft. × 9ft. in plan for the distance of 15ft. 6ins. below the top, then the sides slope in to form the discharge hopper with an outlet of 26in. square. Two auxilliary discharge shoots are provided on the outer wall. The remaining ten bunkers are of rectangular form four measuring 9ft. × 8ft. $1\frac{1}{2}$ins. and six 9ft. × 8ft. 9ins. in plan, the sides are vertical 12ft. 6ins. below the top, the bottom then slopes at 45° to the outlet in front. And to provide for the discharge of coal at the back, a tunnel 5ft. high × 2ft. 6ins. wide passes through each of the front compartments. The initial outlay compared favourably with estimated cost of ordinary construction, but the advantages due to being able to obviate maintenance charges rather influenced the firm. Built by the Yorkshire Henibique Contracting Co., in 15 weeks in spite of very bad weather.

British "Baum" Coal Washing Plant.—We have already heard that in times gone past the only treatment given to coal was the dry screening to recover the large that passed over the screens, the smalls usually being a nuisance more or less. This large coal could not be hand picked therefore must have contained a high percentage of ash and sulphur. With constantly increasing competition and also from a national point of view it has become imperative to recover every particle of coal, no matter what size. Of course this small coal contains a large amount of sulphur, dirt, shales, and floorclay, which in some instances may create a resultant ash of over 30 per cent., so that all things considered at the time, particularly as regards the difficulty of picking out this refuse from the small screenings in a dry state, and also in respect of the transit of so much useless dirt, which even on arrival at the furnaces requires a certain portion of the pure fuel to consume it; these small dry screenings must be detrimental to the costs of a power plant. The



70c.—Ferro-concrete coal storage bunkers at Skelmanthorpe.

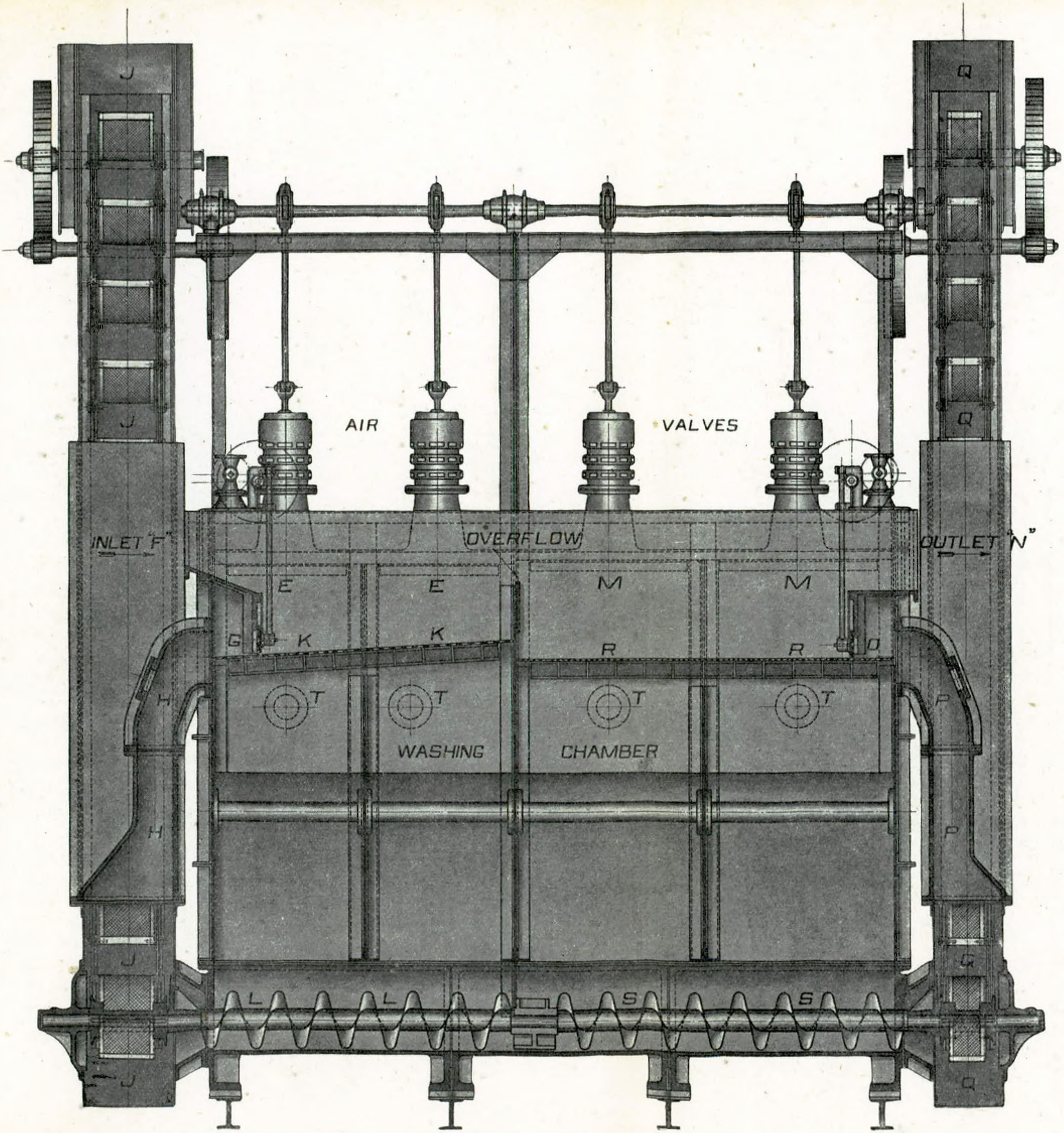
washing of this small coal has now reached a fine art, and the demand for this material, particularly the graded sizes, has exceeded the supply that is recovered by the screens without breaking the larger coal. No doubt modern mechanical appliances in the boiler house has created this demand, together with the designers of modern washery plants, the result is that practically no waste is incurred at a modern colliery where washing operations are carried out with efficient classification of the material.

The system of washing coal, now under review, is to first wash then size. All coal below $3\frac{1}{2}$ins. mesh is washed in a washer box, the heavier product going to the bottom and the lighter (coal) going away with the water; the foreign material is separated due to its difference of specific gravity, for instance soft coal equals 1·25 to 1·35, shale and bottom clay from two to 2·7, while pyrites are as high as five or slightly over. This system allows for the treatment of the washing water, and the automatic recovery of all sediment, so that there is no need for any large settling ponds as in many other cases where they recover this "Slurry," in fact, no water outlet is necessary from the plant, as the washing water is in continuous circulation, being clarified in an elevated settling tank. In combination with a "British Slurry Refiner," which is also used for draining the coal, this system is known as the "British Baum Washery."

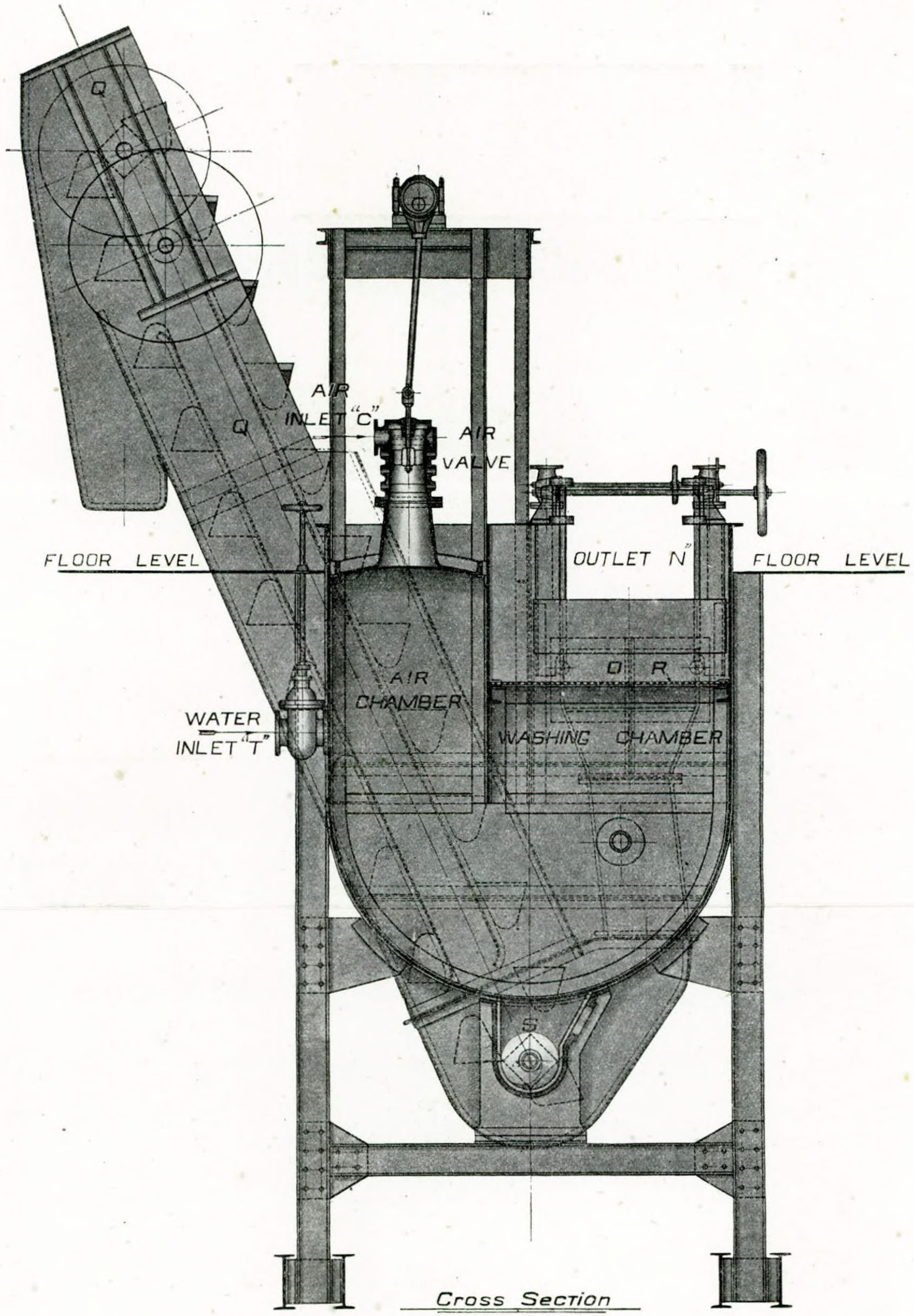
Baum Washer Box.—The diagrams are those of a Baum Washer, with a capacity up to 150 tons per hour. The action of the water is effected by compressed air at about 2 lbs. per square in. pressure, this being obtained by means of a four-blade blower, which supplies air to the air-valve inlet C. This air-valve is provided with a sleeve piston operated by the eccentrics shown on the top shaft. When this piston is at its lower position air passes from the blower direct through the passage C into the air compartment of the washer box, there exerting its full pressure over the whole surface of the water. On the top of this piston's stroke, the passage C is cut off from the washer box, and the compressed air already in the air compartment of the washer box, is now released by passing through the holes on the side of the cylinder, when the piston has cleared these posts inside. The result is a short and energetic upward stroke of the washer bed, and a slow and gentle downward movement giving ample time for the material to classify according to its specific weight, the dirt going to the bottom and the coal remaining on top. Any stones are at once taken out in the first section E, at the inlet end F of same. An escape gate G is fixed at this end, to regulate the quantity of dirt passing away. Any dirt deposited in this box, gradually moves down to the gate G, and goes with the stones down the enclosed passage H, to the dirt elevator J, on which it is elevated and drained previously to its point of delivery to refuse heap or wherever required. Any small dirt passing through the bed-sieves K settles in the bottom of the washer box, and is conveyed by the dirt worm L to the bottom of previously mentioned dirt elevator J, where it joins the dirt from passage H. The coal, along with the middles and light dirt, overflows into the second section of the washer box M, where it undergoes a further treatment, the good material overflowing into a trough N, to be dealt with as required. The bad material passes through the sluice O, into the passage P and then elevated with another dirt elevator Q. The small dirt passing through the perforators in bedplates R is gathered by conveyers and led to dirt elevator Q, similar to first process.

This section of the washer box can be regulated if necessary, so as to send the middles (that is the material of a heavier specific gravity than pure coal, but lighter than the dirt, such as a piece of coal with a thin band of pyrite in it) either with the coal or with the dirt, which latter can be dealt with again before being finally disposed of, such as by crushing the pieces and then re-washing. The washing water enters the washing box, through four regulating valves T, and passes with the washed coal through the outlet N, to be separated from the coal at will. The bulk of the coal washed in this country (after the larger sizes are screened leaving that up to about 3in. mesh or so) contains anything between 15-20 per cent. ash or even more. The amount of dirt washed out varies from 10-18 per cent. leaving the washed coal 4-8 per cent. ash. The amount of the ash in washed coal is not always proportionate to the amount of ash in the unwashed coal, because coal is treated with 25 per cent. ash and reduced to $5\frac{1}{2}$ per cent. Ash in the washed coal really depends on the line of demarcation of what is dirt and what is coal, this adjustment then depends on the specific gravity of the material and whether there is a lot of these middles of say 1·45 to 1·6 specific gravity.

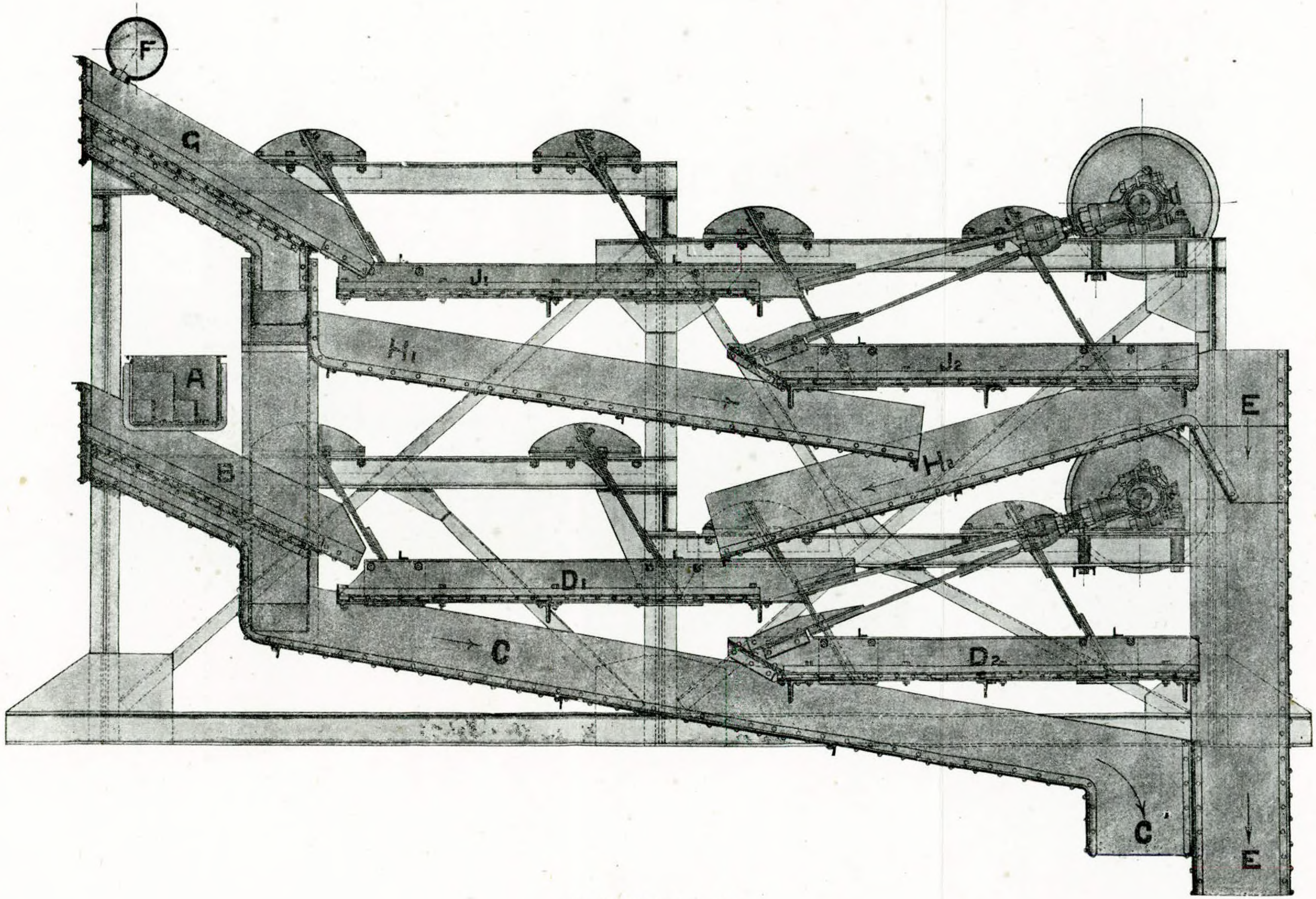
British Slurry Refiner.—This apparatus deals with any coal passing through $\frac{1}{8}$in. or larger mesh, with capacities up to 50 tons per hour per set. The coal, after washing, arrives with



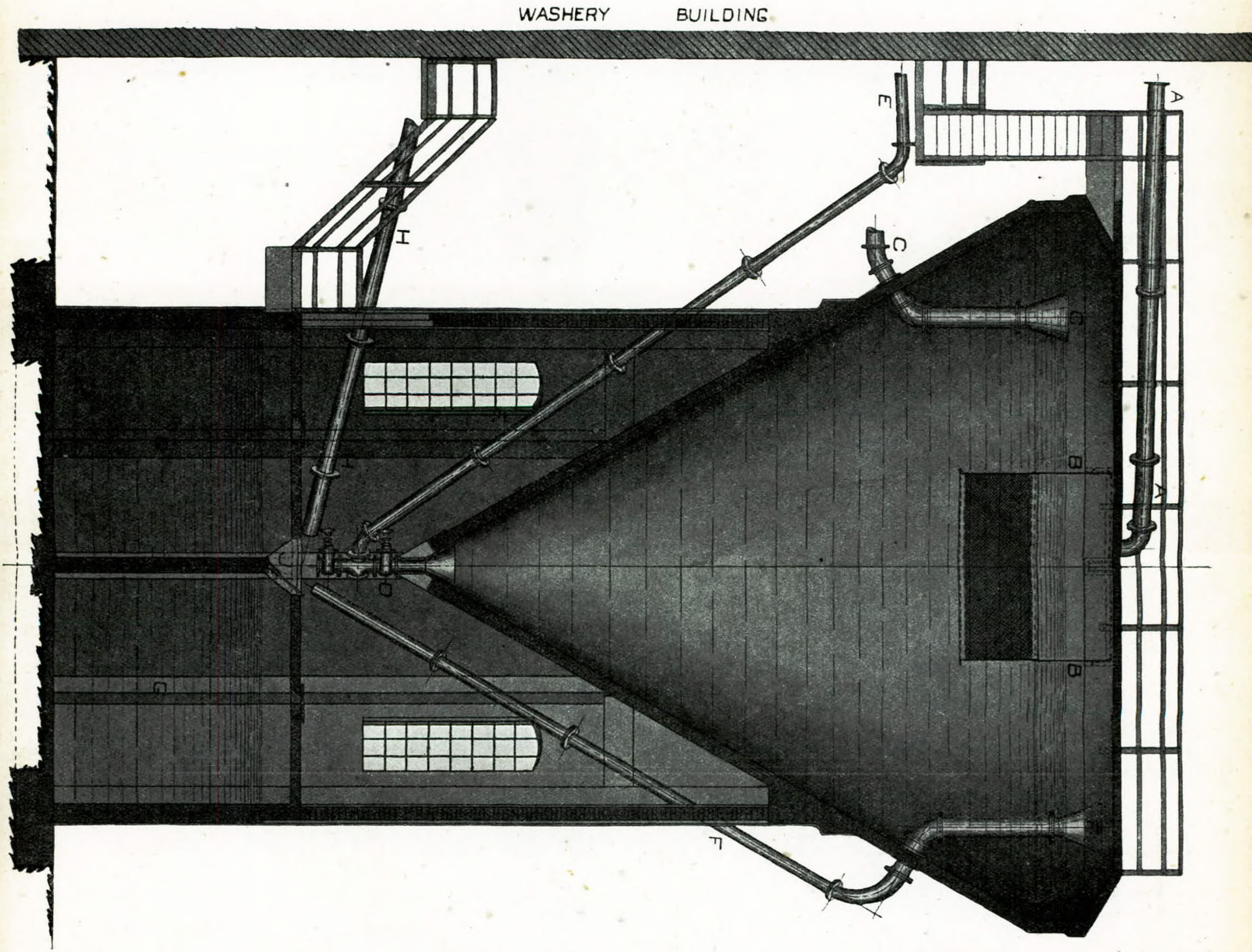
71.—Baum washer box.



71A.—Baum washer box.



72.—British slurry refiner.


WASHERY BUILDING
A
A
B
B
C
E
F
H

the washing water in a trough to the distributor A then on to the drain sieves B where most of the water is separated, the coal sliding down on to the vibrating sieves D1, D2, and thence to shoot E. The separated water and saturated coal dust (slurry) flows down the trough C to the water collecting sump in the washery. The water and slurry is then delivered by a centrifugal pump from this sump into an elevated settling tank —which will be described later—the settlings from which are brought in the slurry pipe F on to the drain sieve G where the water is drained and goes to the sump through C, while the drained slurry drops on to the horizontal vibrating screens J1, J2, the movement of which dislodges the remaining water and moves the slurry gradually forward until it falls in a comparatively dry condition into the shoot E, where it joins the coarser coal from the sieves D, which delivers to the same shoot E. The drainage from the vibrating sieves J1 J2 is evenly distributed on to the coal passing along the sieves D1 D2 immediately under, and this coal acts as a filter bed for the drain water, retaining all coal matter, the clear water passing through and collecting in the sump. Thus all the fine coal down to the smallest particles are mixed together ready for final disposal direct into railway trucks, or into storage bunkers.

Baum Settling Tank.—The purpose of the Baum Settling Tank is to separate the slurry from the washing water, and to clarify this water so that it can be used over and over again. The tank consists of a circular inverted cone, carried on columns at a sufficiently high level to run the water back to the washing boxes at the required pressure for the purpose. This method is the reverse to the usual way, where the settling tank or tanks are arranged in the basement of the washery, and where the clarified water is pumped direct to the washer boxes. In the review of the slurry refiner we saw that all water gravitated to a collecting sump, and was pumped by a centrifugal pump which delivers the water and slurry through pipe A into the central portion of the tank. This portion is screened off from the remainder by means of a sheet-iron curtain B, down which the water has to pass before reaching the outer portion and eventually the return main C to the washery.

This curtain is provided with perforations at the lower end so as to separate the solid matter by friction as well as by gravity. A further advantage is gained by the gradual retardation of the water as it passes down the curtain, part of the water escaping through the perforations and being relieved of the fine solids by the friction in the perforations. The current of water therefore loses itself at the bottom of the curtain and does not stir up the fine particles of slurry which are in suspension, thus these particles have ample time to settle down. The slurry collecting in the bottom of the tank is pressed by the head of water through the regulating tap D and up the pipe E which takes this material to the slurry refiner previously described. To prevent the water running over the sides of the tank an overflow F is arranged, which takes the excess water into the ponds G arranged immediately under the tank. All the safety overflows from the washery are drained through the pipe H into these ponds, a change flap J is provided so that either pond may be in use while the other may be cleaned out when necessary.

British Baum Washery at Frickley Colliery.—This view gives one a general idea of the external appearance of a modern washery. Built for the Carleton Main Colliery Co., at their Frickley Colliery near Barnsley during 1913-14. Ferro-concrete plays a very important part in this structure. On the left is seen the settling tank, and the top part of the building in the centre is the washery, while underneath this is the screening and sizing arrangements for grading this material previous to loading into the empty wagons shown in the foreground.

Mr. Chairman and Gentlemen, we have seen most of the operations of any consequence as regards the winning and preparation of coal and the placing of this into the wagons at the colliery in a manner that you will receive it in its best condition. I wish, on concluding this evening, just to suggest that we all turn our minds to the more efficient use of this material, and in this respect, as many of you come from the North of the Tweed I would like to remind you of our old Scotch saying "Mony pickles mak' a muckle" or in other words in relation to our present subject, the best coal mine we have in this island of ours is the summary of the small savings that can be effected by the thoughtful use made of coal, not only in our power stations, factories and marine boilers, but also in our humble domestic heating and lighting arrangements.

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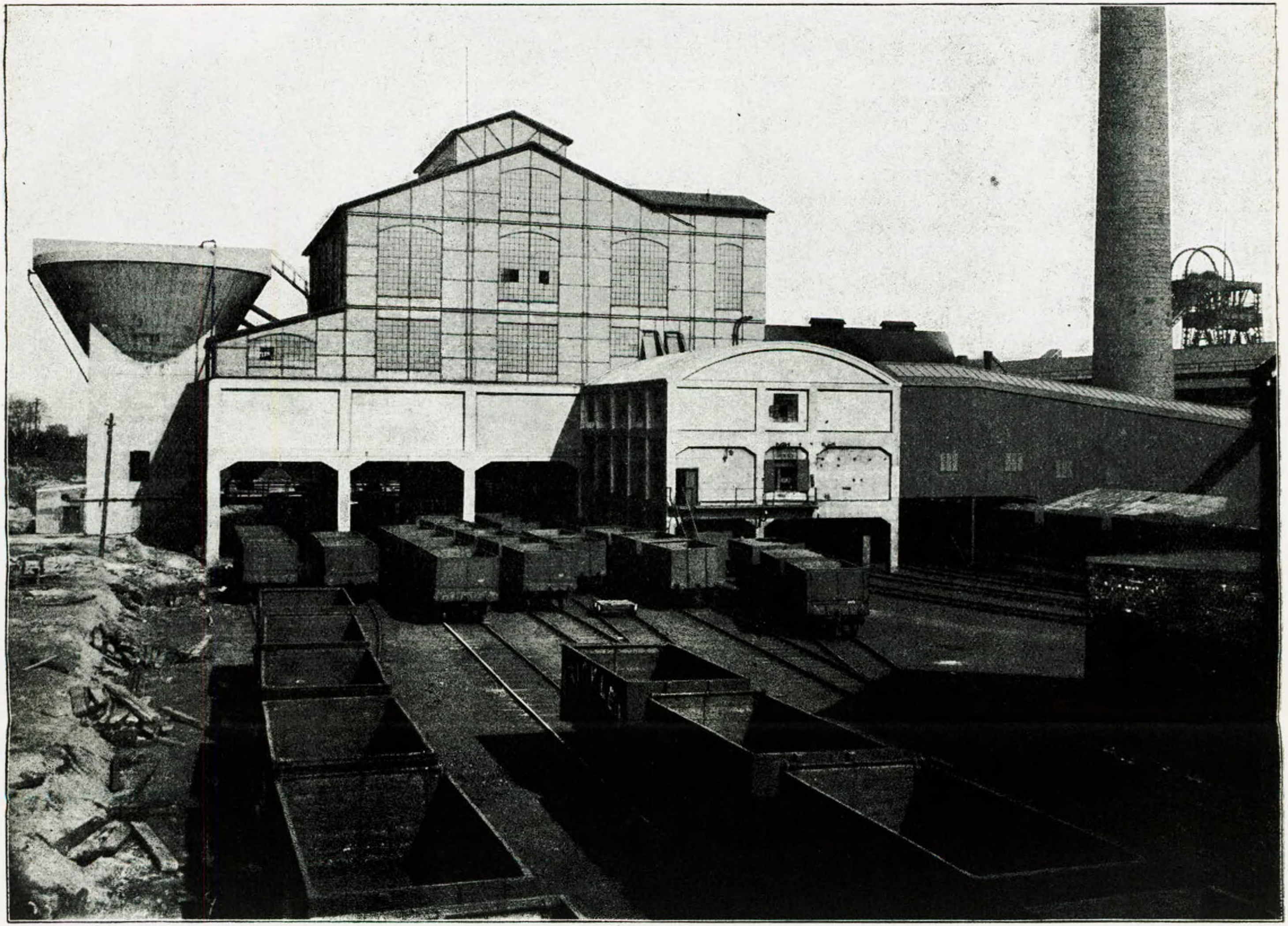

77.—British Baum washery at Frickley Colliery.

Notes

Meeting with the President.—In universal accord and with the high appreciation of the invitation of our President, the Council, the immediate Past President and Vice-Presidents who have been associated with the Institute more or less since its inception, dined with Lord Weir at the Savoy Hotel on May 6th. In the course of the Conference which ensued, the following points were discussed, as one of the objects of the President in thus meeting the Council was to advance the aims of the Institute and find where and how he himself could best aid its progress. He expressed himself as desirous of doing all he could in this direction.

Awards to Marine Engineers for Devotion to Duty and Services rendered under trying conditions during the War.—The President expressed himself in sympathy with the action taken in order to bring before the Admiralty and authorities concerned the awards due and in keeping with those bestowed in other Departments. Copies of correspondence and citations of cases he had received indicated that the Admiralty required to be enlightened on the subject.

The Status of Engineers.—The need for accepted adequate conditions to designate an engineer was discussed and agreed in view of the fact that many made use of the name without justification.

Discussions by the Institute on the subject Vol. V., the contribution by Engr.-Comdr. Malet-Warden, R.N., published in the September issue, 1918, see also *Syren and Shipping* of 20th November, 1918.

Junior Marine Engineers.—The need for more stringent practice *re* the acceptance of junior engineers was considered in order to improve the status of Marine Engineers from the first steps in their career. C.f. Advocacy of a 3rd engineer's certificate by the Institute in May, 1893, but opposed at that time. (See Vol. IV. of Transactions). See also Mr. Fleming's lecture and discussion, April issue, 1919.

Extension of By-Laws.—It was pointed out that owing to their special experience and in recognition of the Government Certificate, many Marine Engineers were appointed to take charge of machinery in land factories and works; hence the desirability of extending the By-laws to embrace engineers in engineering industries, also shipbuilders, and thus widen the scope of the Institute.

Branches at Various Ports.—It was suggested that the Vice-Presidents at various ports might consider the question of having a local room for members to meet in where deemed desirable, thus giving facilities for discussions. Centres were formed in past years on these lines and continued for a time at Bombay, Cardiff and Southampton. C.f. the proposition made by a member at last Annual Meeting.

Chairman at Ordinary Meetings.—It was suggested that if it were convenient for the President to take the Chair at some of the meetings when a paper was to be read, it would be an advantage in securing a larger attendance. Hitherto it had not been the practice to ask the President to attend, to avoid trespassing too much upon his time but if the President could see his way to give a paper himself it would be greatly appreciated. Lord Weir signified his willingness to comply as far as he possibly could with the proposition, and he further signified his willingness to give a paper on a Marine Engineering subject.

Recognition of Engineers.—Comments were made as to the general want of recognition given to engineers, and it was well known, that during the War, civilians without technical knowledge and experience necessary for the duties to which they were appointed, had been delegated to act as Inspectors of Steel or report upon machinery of which they had no knowledge, showing that engineering work was looked upon as of little moment in respect to its intricacies. These comments emphasised the reference to the status of engineers. (See *Shipping Monthly*, July and August, 1918, and *Marine Engineer and Naval Architect*, September, 1918).

Visits to Works.—The advantages to be derived from visits to works received attention, and it was reported that during May visits had been arranged to the Power Plant (May 17th), and the Submersible Motor Works (May 31st), and to add force to the visit to the Power Plant Works a paper was arranged for Tuesday, May 13th on "Gearing as Applied to the Marine Steam Turbine." During July it was hoped that visits would be paid to a vessel fitted with Diesel Engines, and to one of the P. & O. liners. The President remarked that the large German liner now in the hands of the P. & O. was well worth examining as being very finely fitted throughout.

Shipping, Engineering and Machinery Exhibition.—It was reported that the Institute had always taken a deep interest in Exhibitions and encouraged the juniors to attend and study the exhibits, by offering awards for essays on a visit to the Exhibition, besides having papers read in the hall of the Exhibition Building. For the forthcoming Exhibition, to be held at Olympia, September 25th to October 17th, four papers were arranged, so that the Institute was maintaining its former course fully. Sir Archibald Denny, President of the Institute when the Exhibition was arranged for in 1914, was Chairman of the Extended Committee, and the Hon. Secretary of the Institute had been elected and consented to act as Hon. Secretary of the Special Committee. Mr. Kemnal offered to give a prize under the auspices of the Institute in connection with the Exhibition for a paper on Water Tube Boilers.

A very cordial vote of thanks to the President was moved by Mr. Fielden for his kind hospitality and his manifestly great interest in the detail work of the Institute, an interest which betokened a successful year during his Presidency. The vote was applauded unanimously.

Mr. W. J. Lapper (Member) who was awarded a medal under the circumstances recorded in our December issue, was presented with the medal by His Majesty the King at Buckingham Palace on May 29th.

Mr. John Nicol (Member), who was also awarded a medal under circumstances also recorded in our December issue and further referred to in April, 1919, was presented with the medal by His Majesty the King at Buckingham Palace on June 28th.

Mr. Geo. A. Scullard (Member), whose temporary address was given in the May issue, is now returning to *c/o* Messrs. M. H. Bland and Co., Ltd., Gibraltar.

The congratulations of the Council have been tendered to Messrs. Lapper and Nicol.

Jas. Adamson,
Hon. Secretary.

Correspondence.

Awards to and Recognition of Engineers.—The following letters were sent as a result of further communications with the Admiralty on this subject:—

[Copy] *6th May*, 1919.

The Secretary,
The Admiralty, S.W.

Dear Sir,

Rewards to Engineer Officers.

Referring to the correspondence which has taken place on the above subject as per the undernoted dates and references July 31st, 1918, your reply Reference T.W.2 A 80068/116, Nov. 28th (2) and December 3rd, our further letters on the subject January 5th, 1919, your subsequent letters T.N. 2(a) 80068/116, February 11th, 1919, and X.W. 54783/18 conveying the information that the case *re* the explosion and fire at Economia, January 17th, had been referred to the Board of Trade.

The whole question has again been before our Council and carefully considered being also discussed by a specially appointed Committee, the members of which are personally cognisant of the facts placed before you in our communications. I may add that other instances have been brought to our notice where rewards were withheld.

As a result of our deliberations, the following conclusions were arrived at, and these we now place before you that justice may still be done and provision made for a better and more up-to-date recognition of the Engineering Department and its officers. Events have proved the wisdom of our recommendation that a representative engineer ought to be on all Committees appointed to deal with matters where the engineroom department is either directly or indirectly concerned. Had this step been taken in connection with the Committee or Committees selected to consider the evidence in connection with the cases brought to notice, it is manifest to us that the glaring mistakes would not have been made, leading to a travesty of justice. We do not know the composition of the Committees which were appointed to deal with the evidence and report to the Admiralty, so that our conclusions are unbiassed in respect to the personal of the Committees.

The facts as stated in our letter of the 28th *re* the "*Kathlamba*" are correct in detail, and we can only surmise that the Committees or Court of Adjudication appointed were working on false premises and in ignorance of the truth when framing their reports to the Admiralty. The denial of the facts brought to our notice, incidentally, is a very surprising feature, and if you study the case you will come to the same conclusion as we have, and it is not a flattering one. We also conclude that the Admiralty has not been fully informed of the facts, hence the apparent confusion which we so much deplore.

There is a somewhat similar case referred to in the *Marine Engineer and Naval Architect* for March" to which our attention was called, where the Chief Engineer was overlooked in the first instance when awards were bestowed and ultimately awarded the O.B.E.

We have noted that the devotion to duty on the part of the Second Engineer at Economia—overlooked at the inquiry when awards were bestowed—has been remitted to the Board of Trade to inquire into, and we await the result.

It is very disquieting when we review the general aspect of the situation and its bearing upon Marine Engineers as a whole, and we trust that the serious and considered attention of the Admiralty will be brought to bear upon the questions involved with that regard to justice and national harmony which is always necessary and more so now than ever.

Yours faithfully,

JAS. ADAMSON,

Hon. Secretary.

[Copy] *6th May*, 1919.

The Secretary,

Marine Dept.,

Board of Trade,

Whitehall, S.W.

DEAR SIR,

We received a communication from the Admiralty to the effect that it had been remitted to the Board of Trade to consider a case where the Second Engineer had been overlooked in regard to an award for his devotion to duty. The Committee appointed to investigate the case in question and report upon it had apparently not investigated all the facts of the case and awards had been bestowed upon the Captain and Chief Officer only, although from the evidence placed before us the Second Engineer was worthy of greater commendation.

We pointed out to the Admiralty last July that circumstances brought to our notice indicated very grave omissions on the part of the Committee to grasp the evidence in connection with Engineering Department work, and we recommended that a Representative Engineer should be on the Committee when engineering matters were involved, and the more we learn of the way in which the Engineers have been passed by and omitted from due awards, the more are we convinced that our recommendation was a wise one; the Committee seems to have resented this, thus aggravating their want of capacity for fair-play and justice.

I enclose a reprint of our December issue where on pages 277, 255, 285, copies of one of our letters and other notes appear. The case which we understand you have been invited to consider is on page 287.

The courtesy we have received from you in regard to two cases previously reported to you, we appreciate very highly, and we are satisfied that at your hands this one will receive the same consideration.

With warmest respects,

Yours faithfully,

JAS. ADAMSON,

Hon. Secretary.