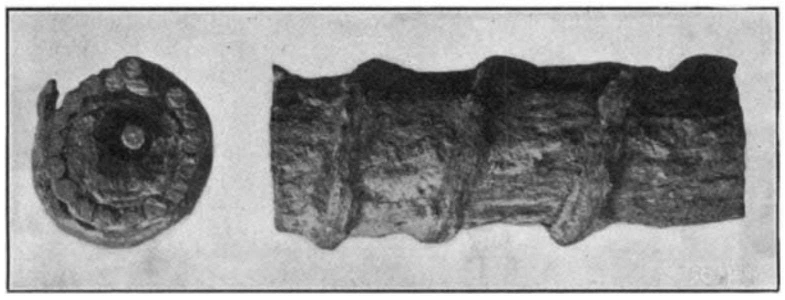
THE FIRST SUBMARINE CABLE.

BY W. F. BRADSHAW, JR.

The first successful application of submarine telegraphy undoubtedly was due to Cyrus W. Field, of New York. But the idea and the first practical application of it, as Mr. Field himself has generously acknowledged, must be credited to John Boyd Sleeth, a Tennessee River steamboat captain.

Captain Sleeth was born at Allegheny, Pa., November 21, 1826, and died at Paducah, Ky., March 12, 1895. For several years he was on one of the old "broadbow" boats that plied on the Mississippi and Ohio Rivers. Then he settled at Paducah, and in 1845 was in the employ of Mr. Tal Shafner, who had charge of the telegraph line at Paducah, which connected St. Louis and Nashville. The Ohio, at Paducah, is something over a mile in width, that being the point of its confluence with the Tennessee. The rivers meet at an acute angle, and the backbone ridge between them breaks opposite the city into two islands. It was by means of one of these islands that Mr. Shafner found it possible to run his line across both rivers. He erected tall staffs, one on the Kentucky shore at Paducah, another on the islands, and a third on the Illinois shore. The wires of the line across the Ohio at Paducah were strung upon lofty poles high above the stacks of passing steamers, which cleared the line in low water seasons, but struck the sagging wires and tore them down when the rivers rose. Great difficulty was experienced in keeping the wires sufficiently high and taut to avoid such accidents. Young Sleeth knew something of the principles of insulation, and the idea of laying an insulated wire across the river bed occurred to him. His idea was received with some skepticism by Mr. Shafner until he proved its feasibility by experiment. About a year later the local management consented to let him make the experiment of running an insulated wire across the river. The work of insulating the wire was slow and uncertain; little was known about insulating materials, and the workmen were "day" laborers, entirely ignorant of the nature of the task, who had to be watched incessantly. One of the eye witnesses, Captain Wes Cooksey, has given the following description of the manufacture of the first submarine cable:

The wire chosen for use as the cable proper, one strand, was stretched along the float and wrapped first with canvas, such as was then used for roofing steamers. The canvas had been soaked thoroughly in hot pine tar pitch. The covering process was continued until the wire was about half an inch in diameter and then it was guarded by a wire of a slightly smaller size, this being placed parallel, as is now the custom. It was then wrapped by loose coil with another wire of the same size. The number of wires laid parallel to the cable outside of the canvas insulation was eighteen. The cable was made in sections, which were joined before being laid. Just how long it took to complete the insulation is not known, but it was several months. The cable was over a mile long, and when laid was reeled off from the end of a large "broadbow" boat in tow of a steam craft. The work of laying was attended with some difficulty and required several days. The first test was very successful, and the wires worked admirably for several weeks; then the pitch insulation of course became water-soaked and the cable began to "stick," as the operators say, and was soon abandoned as worthless. But the idea had proven practicable, provided a better insulation could be found. Some months later Mr. Field sent a representative to Paducah to see Mr. Sleeth. An offer was made him to continue his investigations, and form a partnership. Mr. Sleeth was then in very moderate circumstances and had to decline the offer. The local management went back to the overhead wire, and the unsuccessful cable was soon forgotten. Mr. Sleeth returned to boating, and was soon after made captain of a Tennessee River steamer. He fought through the civil war in the Confederate service under General Roddy, and came out a captain. After the war he went back to the river. Strange to say, he never patented his cable, or made any attempt to do so, but abandoned it entirely after the first failure. Mr. Robert Sleeth, of Pittsburg, Penn., wrote to Mr. Fields in 1891, asking him about the truth of the report of his having sent a representative to see the captain, Mr. Sleeth's brother, and discuss the idea of an insulated cable. Mr. Sleeth has the letter Mr. Fields wrote in reply, acknowledging the facts as stated.



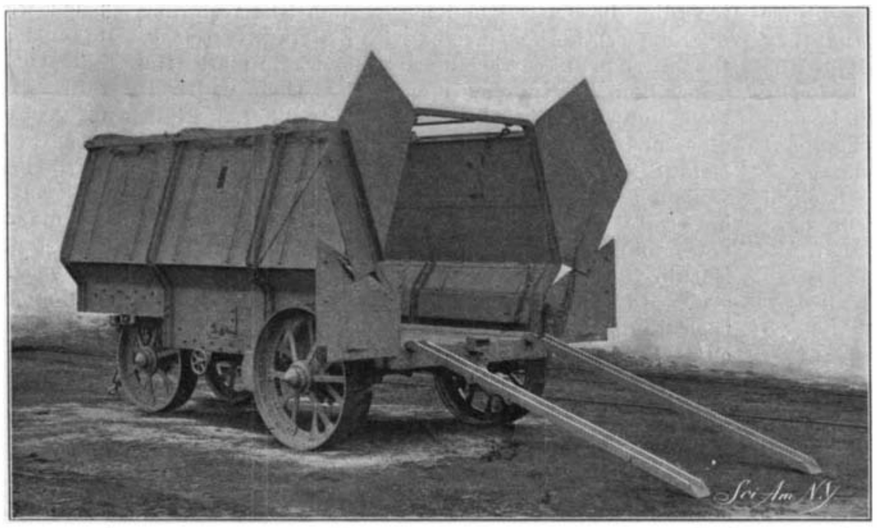
A PORTION OF THE FIRST SUBMARINE CABLE.

About three years ago the end of the cable was found on the Kentucky side of the Ohio River, during the low water in August, and the accompanying illustration is a photographic reproduction of a piece filed off and now in the possession of Mr. James B. Sleeth, of Paducah, son of Captain Sleeth.

◆

ARMORED TRACTION ENGINE AND TRAIN.

The events of the South African war have proved that the problem of transportation has been rendered if anything more difficult than ever by the changed conditions of modern campaigning. The wastage in horses alone in the army under Lord Roberts was estimated at one time to amount to 5,000 a month. It was inevitable that in an age so mechanical as the present, attempts would be made to substitute steam power for the horse and the ox, and the armored traction engine and train, herewith illustrated, represents the most successful design for military traction in the field that has yet appeared.



ARMORED WAGON, OPEN TO RECEIVE A FIELD GUN.

Each train consists of a special road locomotive and three or four wagons, all armored with special steel bullet-proof plates tested to withstand rifle fire at 20 yards range, or splinters from shells. Each vehicle is intended to carry one 5-inch or 6-inch howitzer on its carriage, and a 4·7-inch naval gun arranged for the same carriage as the howitzer. It can also be used, if necessary, to carry ammunition, stores or men. The train is fitted with a special arrangement of winding drum and steel cable, which enables it to cross spruits and other difficult, soft, or steep places, by winding, should the train be unable to travel direct.

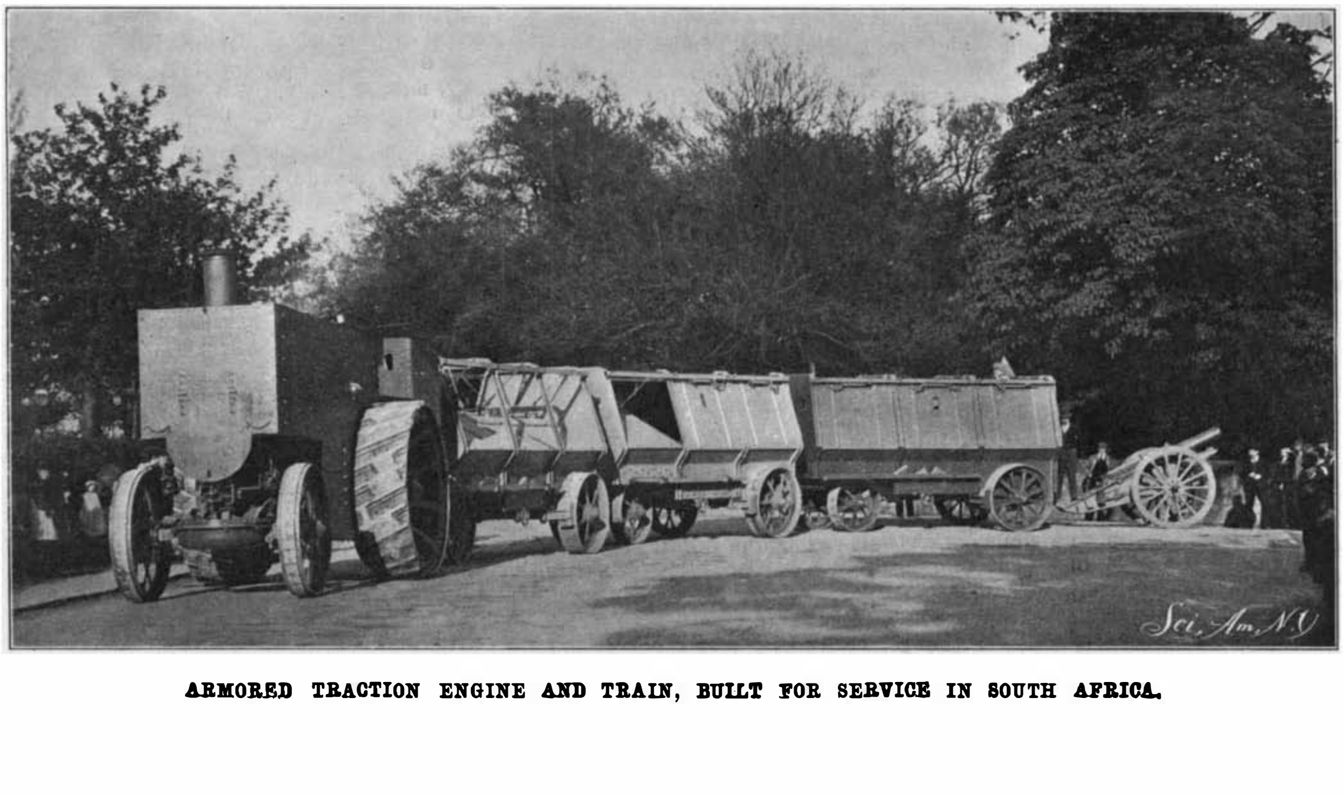
The most perplexing problem that faced the constructors in designing the engine was the effectual and adequate protection of all the vital parts, yet in such a manner as not to interfere in any way with the easy manipulation of the engine by the driver and steersman. Then, again, special attention had to be given to the boiler—blowing off, washing out and cleaning—lubricating the working parts of the engine, the use of the winding forward drum, the proper paying out of the cable, and so forth. These arrangements necessitated a special construction throughout.

The locomotive is Fowler's compound, spring-mounted type, specially designed and built to carry armor. The latter is so arranged that if the exigency arose, it could be easily dismounted, and then the engine would be similar to the army service type, which is now being used with great success in South Africa. The boiler is constructed to work at a pressure of 180 pounds to the square inch. The power is transmitted from the crankshaft to the hind axle by a train of cast steel gearing, with a self-acting differential gear on the main axle. The ratio of the gear is such that a speed of 1½ to 3 miles per hour is made in slow gear, about 2½ to 4½ miles per hour in middle gear, and about 6 to 8 miles per hour in the fast gear. These speeds can be increased if desired by simply running the engine faster. The capacity of the water tanks is sufficient for a run of from 10 to 17 miles, according to the weight hauled by the train and the conditions of the road upon which it is traveling.

All parts of the engine, with the exception of the road wheels, are protected from rifle fire, and all levers, rocks, and lubricators are arranged so that they can be adjusted from the footplate. The driving wheels are of special construction and measure 7 feet in diameter by 24 inches in width, with the section strips for giving increased adhesion on the veldts and on sandy ground. The armor is of bullet-proof plates manufactured by Messrs. Cammell & Company, of Sheffield. Every plate was tested by the War Office officials at 20 yards range point blank with Lee-Metford and Mauser bullets, which were found to have no appreciable effect upon the plates. The driver and steersman are inclosed in a large cab, access to which is obtained by a small door in the rear. Lookout holes provided with special shutters, convenient for the engineers in charge of the locomotive, are provided in the cab.

An important advantage possessed by this locomotive is that it is mounted entirely on laminated springs, with an arrangement of suspending levers, etc., which enables the engine to attain a high rate of speed, even upon rough ground, without affecting the true working of the driving gear in the slightest degree, and yet at the same time reducing the oscillation risk of damage to a minimum. In fact, without this spring gear, it would have been impossible to have successfully armored the engine.

The general design of the wagons, and also the details regarding their protection from rifle fire, were prepared by the War Office. The main frame is constructed entire of steel scantlings with an arrangement of springs which yields sufficient elasticity to enable the wagons to ride steadily when traveling over rugged country. The wheels are specially built with hard steel tires



ARMORED TRACTION ENGINE AND TRAIN, BUILT FOR SERVICE IN SOUTH AFRICA.

12 inches wide, and the hind wheels have a wide gage to give the utmost stability to the vehicle. The front wheels are narrower in gage, in order to allow sharp locking for turning corners with precision and safety.

The wagon bodies are built of bullet-proof steel one-quarter of an inch thick and absolutely Mauser-proof. The lower part of the body is made a fixture to the frame. The upper portion is formed of three flaps on each side hinged to the lower part of the body, and made either to fix up when required or to close down in the form of a ridge. The steel of which the flaps are made is impervious to rifle fire at a range of one hundred yards. By forming a ridge, when closed down, very slight damage can be inflicted by rifle fire, since the bullets strike the object at a sharp angle, and simply ricochet.

When the flaps are open, the wagon can be utilized for the accommodation of men, who, if necessary, can maintain a fire upon the enemy through the small loopholes which are provided. As in the case of the locomotive cab, these loopholes are fitted with shutters, which are made readily adjustable, so that any sized opening may be obtained. Our illustration of the complete train comprehensively shows how this idea is successfully carried out. The wagon next to the engine has the flaps closed down, as would be the case if the vehicle were carrying ammunition or stores. The movements of the flaps are actuated from the steel ribs by check ropes. The second vehicle shows one flap let down; while the third wagon shows the flaps open, and also the arrangement of the adjustable shutters.

The brake power, which is powerful and ample, can be applied either from the exterior or the interior of the vehicle, whichever occasion demands. A spring coupling-bar is provided for every wagon, also suitable coupling arrangements at the tail end, either for yoking up to another wagon, or for engaging with the trail end of a howitzer, as shown in our illustration. Each wagon is equipped with a pair of incline ramps or trackways which are intended to facilitate the loading of the vehicle with a howitzer, naval gun, etc.

◆

ELECTRICAL COAL-MINING MACHINES.

BY FRANK C. PERKINS.

Because of their compactness and the ease with which they can be manipulated, electrical coal-cutting machines have won their way into extensive use, and have served to greatly increase the output of those mines in which they are employed. The electric motor as applied to chain coal-cutting machines is both economical and safe, and facilitates greatly the rapid placing of the product on the market. It may be of particular interest to look into the actual working conditions of this type of machine as shown in the accompanying illustrations.

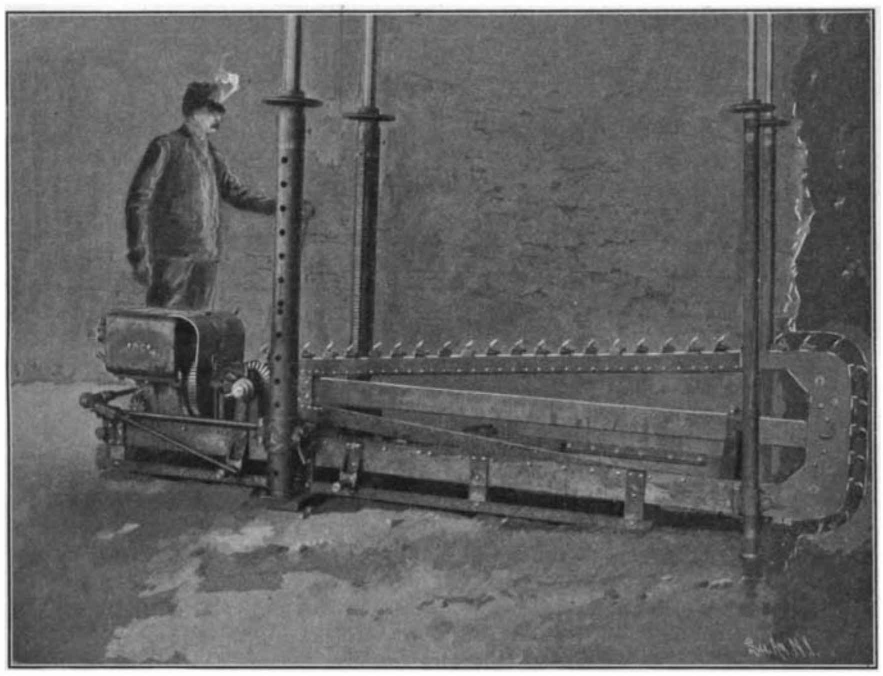


Fig. 1.—ELECTRIC, CHAIN, CUTTING MACHINE MAKING VERTICAL CUT.

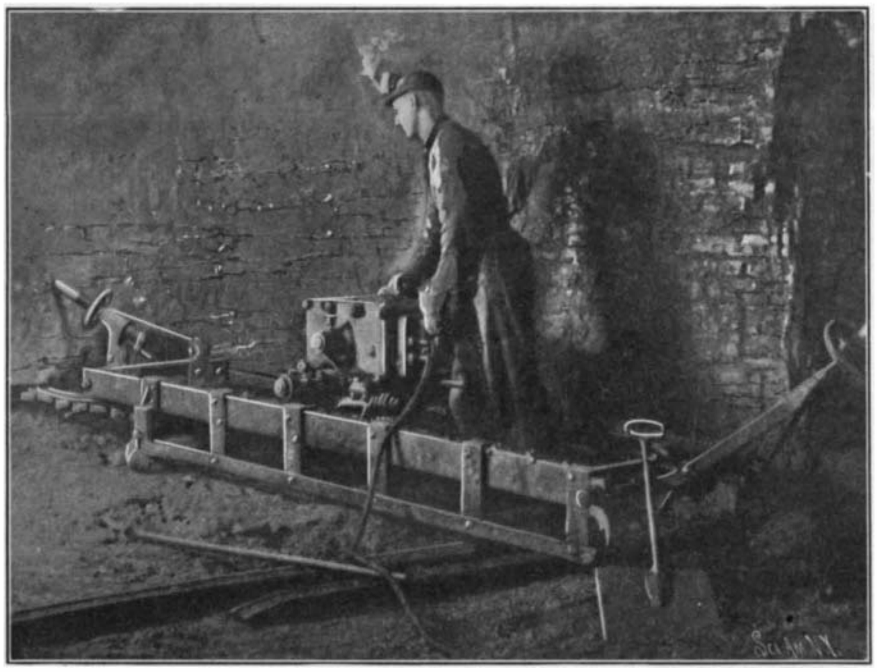


Fig. 2.—ELECTRIC, CHAIN, CUTTING MACHINE UNDERCUTTING THE COAL.

The Longwall coal-mining machine is generally used where the space for operation is limited and there is a call for an especially compact machine. The illustration, Fig. 3, shows a machine whose total height is only 18 inches; its width, without wheel, 3 feet 9 inches; and its length over all, 8 feet 2 inches. The entire machine is built of steel, and the cutting is done by means of cutters inserted in the periphery of a horizontal cutter wheel. This wheel swings on a bearing, so that it is adjustable in a horizontal plane, being so arranged in order to follow the variations in the floor of the mine. As a single rail only is required, it is known as the single-track Longwall machine. The accompanying illustration shows the method of bracing the track on which the machine runs, and also shows the cutter in the wheel and the bevel gears by which it is driven. The wheels will undercut 3, 4, 5 or 6 feet in depth with a kerf or width of cut of about four inches. The electric motor required for a machine of this type is much more powerful than those found necessary in the chain coal-cutting machines described later. The speed of cutting can be varied according to the character of the material in which the cutting is being done, and can be changed without stopping the machine.

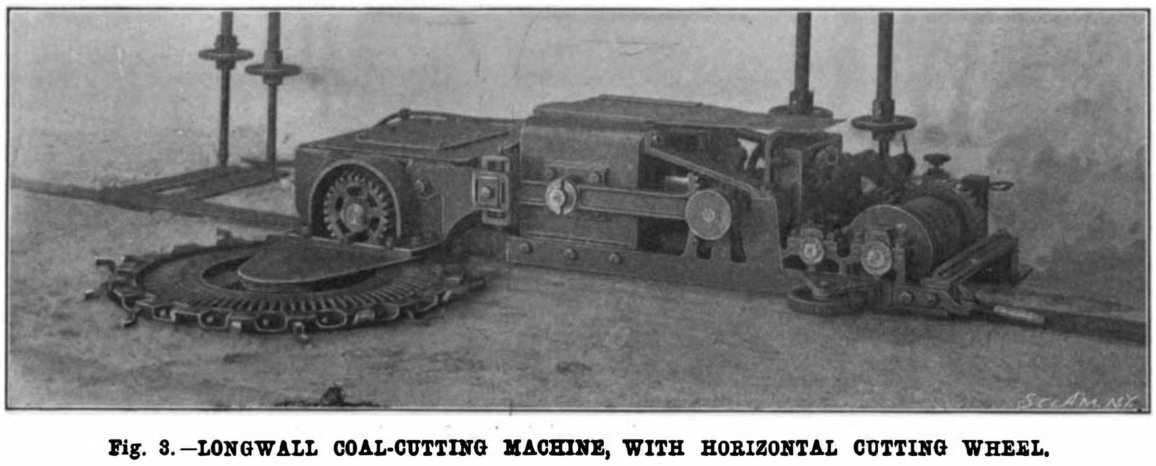


Fig. 3.—LONGWALL COAL-CUTTING MACHINE, WITH HORIZONTAL CUTTING WHEEL.

The Jeffrey electric chain-cutting machine, seen in Fig. 2, was photographed as it was making a cut in one of the mines of the Pocahontas District in West Virginia. This shows a very deep vein, where there is plenty of room to work; but where the veins are very low, the cramped condition of the miners renders the operation of the machine more laborious. These electric chain coal-cutting machines are built up of three distinct parts, including the electric motor and carriage, the outside frame, and the inside or cutting frame. The motor is of the multipolar type, having ironclad armature and two field coils. The field frame is of cast steel and surrounds the field coils and armature, protecting them from injury. The bearings are lined with bronze bushings, no babbitt being used. The carriage is made of cast steel, with motor supports made solid with the body. It also contains the main drive-shaft bearings. The outside or bed frame consists of two steel channel bars, firmly fastened together by means of heavy steel braces. A stout steel casting joins the channel bars at the front of the bed frame and forms the guide for the inside frame.

The inside frame, called the cutter frame, consists of a forged steel center rail, a cutter head, and two steel guides in which the cutter chain runs. This chain machine is built to undercut 5 feet deep and 44 inches wide. It can be used in different veins of coal varying in thickness from 2 to 3 feet, as the height of the machine over all is only 18½ inches. The motor is of the multipolar type and is used on circuits of 220 or 500 volts potential.

In using these coal cutters the only preparation necessary is the stringing of the wires. Then the machine, mounted on its truck, is taken into the room where the cutting is to be done and delivered to the face of the coal, the truck running on the wooden rails or temporary track usually used for mine cars. The rear end of the truck is lifted, and the machine slides off into place and is then in position to begin cutting. The cable is connected to the motor and reel terminals, and by means of the starting switch the machine is put in operation. The rooms are seldom more than 25 feet wide. The machine is placed in position at the left hand rib, and the front jack is screwed securely to the face of the coal and the rear jack to the roof, as shown in Fig. 2.

It requires about four minutes to make a cut and about one minute to withdraw the machine, after which the jacks are loosened and the machine is then moved over for another cut, this being repeated until the entire width of the room is undercut 5 or 6 feet deep. After the machine is started, it continues to advance until the full depth of cut is made, when it is automatically thrown out of feed and is ready to reverse and withdraw from the cut.

There are many districts in the coal-mining regions where the formations are such that the coal will be produced in better condition when sheared than when undercut; and in many other cases the formation requires not only shearing but also undercutting. When shearing is found necessary, a machine of the type shown in Fig. 1 is used. The machine is built on the same general plan as the undercutting chain machines, except that the center or cutting frame is located in a position normal to that of the undercutter, the shaft of the armature being parallel to the center rail. A power raising device may be attached to this machine for elevating and lowering it from top to bottom.

When shearing a room or entry with machines of this class, it is necessary to raise the machine to the top of the vein, and the best results are usually obtained by making the first cut at the top and then letting the machine down far enough to make another cut. Illustration Fig. 1 shows this machine in position making a lower cut, and also shows to good advantage the two main columns (located at a point representing the balancing position), to which the frame is clamped tightly in order to hold it in place when cutting. The front end of the machine is also steadied by two auxiliary columns, and it will be noticed that the four columns can be varied in length according to the thickness of the vein in which the machine is working.

It is usually found possible to cut from 50 feet to 100 feet of entry per day of ten hours, the exact figures depending upon the character of the coal and the condition of the mine. A single cut is three feet high, four inches wide and from five to seven feet in depth.

There is no question that the introduction of electrically operated tools in mines has demonstrated the many advantages in utilizing the power of the engines, boilers and dynamos on the surface and transmitting the current by cables to the points in the mines where power is required.

◆

THREE thousand bronze tablets containing the records of Rome from the foundation of the city to the time of Vespasian are known to be buried in the marshes near Ostia. They were saved from the fire which destroyed the Capitol in the year A. D. 69. The Italian archæologist, Signor Maes, wishes the Italian government to drain the marshes and hunt for the tablets.