normal position. Since the whistles blow in the engineer's cab and in the baggage car every time that the pole is lowered, it is possible for the conductor to know any irregularity that may occur.

Capt. Netter, with the object in view of warning the engineer slightly in advance that he is approaching a danger signal, has provided his system with a third brush, *B*, placed under the center of the engine and rubbing against a third rail placed about 200 yards from the signal and connected by a wire with a commutator situated at the signal itself. According to whether the way is obstructed or clear this commutator connects the wire and rail with the ground or maintains the insulation. In the first case, the current passes and blows the whistles, while in the second nothing occurs.—For the above particulars and the illustrations, we are indebted to La Nature.

ELECTRIC COAL CUTTER.

THE illustration represents an electrically-worked coal-cutting machine manufactured by Mavor & Coulson, Limited, of Glasgow. It is known as the Hurd bar machine. It consists essentially of five parts—namely, the cutter bar, the gear head, the motor, the switch box, and the hauling gear. The cutter bar is tapered—as will be seen from the engraving—and is provided with a spiral groove on its outside, which acts as a worm conveyor, bringing the coal cuttings out from the holing. The cutters are secured in holes drilled in this cutter bar. On the inner end of the bar renewable thrust rings are fitted, and by means of these a reciprocating motion is imparted to the bar. The gear head contains a double bevel wheel, which drives through a 2 to 1 reduction the pinion of the cutter bar, and is itself driven by a pinion fixed on the end of the motor shaft, which is made long enough to project into the gear case. In the lower part of the gear case is a rack which, in conjunction with a pinion, provides for turning the lower part of the gear head, which carries the cutter bar round the vertical axis. The worm and worm wheel above the gear case are for turning the whole of the latter round on its horizontal axis. By means of these two motions it is evident that the cutter bar can be turned in any required direction. The reciprocating motion above referred to is brought about by a worm upon the boss of the bar-driving pinion, which gears with two small worm wheels, each of which actuates a toggle by means of an eccentric pin. The toggles impart a to-and-fro movement of about 2 inches to the thrust block, and with it, of course, the cutter bar. A feather on the bar enables it to pass to and fro within the driving pinion. The combined rotary and reciprocating movement of the bar is said to produce a chipping and shearing action on the coal which greatly reduces the strain and effectually prevents the bar from clogging. The lower part of the gear case is filled with oil or grease. At the outer end of the bar bearing there is a stuffing-box to keep the oil in and the dust out. The motor, so the makers allege, is so inclosed as to be absolutely gas-tight, as well as to be protected from dust and external damage. The pole pieces with their coils are detachable from the sides of the shell. The armature is of the slotted core drum type, the core being built up on a cast iron hub, which also carries the commutator. The starting switch and resistance are inclosed in a case, which is also said to be gas-tight. The switch has a quick double break with renewable contacts. The haulage gear is worked automatically by means of a worm on the armature shaft, which operates a crank and ratchet. The rate of traveling may be quickly adjusted to adapt it to the hardness of the material met with. We understand that this may be done while the machine is at work by varying the throw of a crank. The hauling is effected by means of steel wire rope, and a self-coiling arrangement is fitted to the machine whereby the even coiling of the rope on its drum is insured. These cutting machines are made in three standard sizes. The power required to drive these is 12, 18 and 24 brake horse power respectively. The depth of undercut in the three cases is 2 feet 6 inches to 3 feet 6 inches, 3 feet to 4 feet 6 inches, and 4 feet to 6 feet respectively.

The makers claim a number of advantages of this type of coal cutter. The number of parts, they inform us, is fewer than in any other cutter. There are no bearings or rubbing surfaces under the coal where dust and dirt might subject them to excessive wear, an objection to which some of the machines in use are open. The cutters are capable of being securely fixed to the cutter bar and allow of simultaneous and easy inspection. The cut with this machine can be made either on the pavement or at the roof, or at any intermediate point, and the bar may be tilted to suit the rise or dip of the seam. Moreover, the angle at which the bar works may be altered at will while the apparatus is in operation, thus rendering it possible for the holing to be made in the best position. It is further claimed that it is almost impossible for the bar to be choked or jammed, and there is nearly entire absence of end thrust. The coal it produces is said to be rounder and the waste less than from any other machine, as the loose coal is not dragged out and broken up.

We have had an opportunity of inspecting this machine, and can bear testimony to the strength of its construction, but we have no personal experience of its working in mines, and we are, therefore, able to do no more than enumerate the makers' claims as set out above.—The Engineer.

HOW TO MAKE A DRY BATTERY.

By WILLIAM A. DEL MAR.

THE number of instructions to be found in various books on how to make a dry battery is legion, but they are so incomplete and indefinite, that the amateur finds it very difficult to produce a battery which will give as good results as those now on the market. The instructions here given will enable the amateur to make with ease any number of dry cells of the Burnley type. This is effected as follows:

Make one well-planed wooden block 5 x 3 x 2 inches, and one 5 x 2 x 1 inch. At one end of the smaller block screw in a hook as shown in Fig. 1. Now cut from a stout sheet of zinc a piece of 10½ x 6 inches and bend and hammer it round the block, as shown in Fig. 2, soldering the overlapping parts. When the side is soldered, cut along the four corners from the wooden block outwardly and hammer down and solder the projecting inch of zinc at the end of the block, as shown in Fig. 3. Now remove the wooden block and fill the zinc case with strong washing soda solution, which should be left in it for about an hour. Meanwhile, zinc cases for other cells may be prepared. Then remove the soda and rinse *thoroughly* with water.

Place in the bottom of the zinc cells about half an inch of the following mixture:

Plaster of Paris..... 85 per cent by weight.
Flour .... 15 per cent by weight

And on it place the small wooden block centrally with regard to the case and with the hood end up. Then make into a paste some of the above mixture with the following fluid:

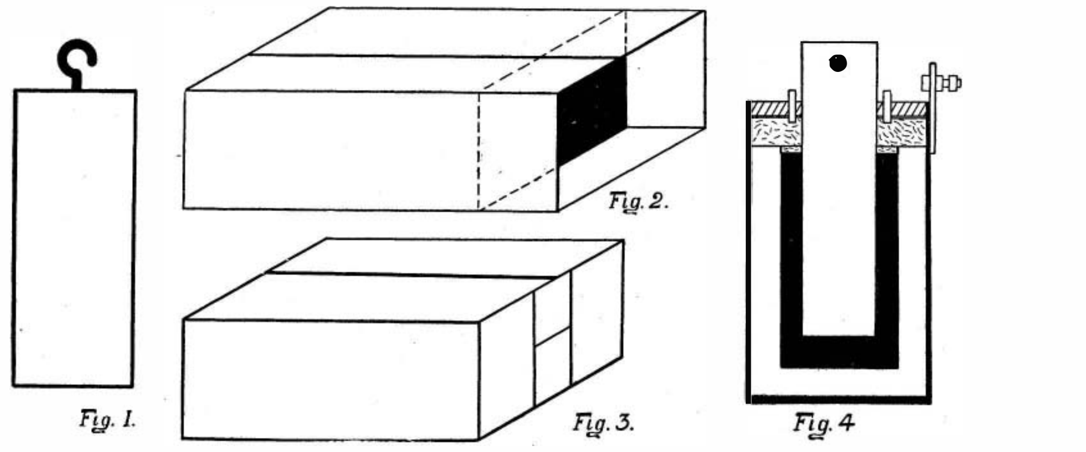
Concentrated solution of sal ammoniac .... 85 per cent.
Concentrated solution of zinc chloride .... 15 per cent.

Make about twenty cubic inches of thick, creamy paste and pour it into the zinc case around the wooden block to within three-quarters of an inch of the top. When the paste has set, pull out the block by means of its hook, and in the bottom of the hollow, put one-half inch of the following mixture:

Manganese peroxide... 60 per cent by weight
Powdered carbon .... 25 per cent by weight
Zinc chloride .... 5 per cent by weight
Sal ammoniac (powder) .... 10 per cent by weight

Then hold a carbon plate about 1¼ x 5 x ¼ inch (having a brass binding screw near the top), in the middle of the hollow but resting on the bottom, and pour around it a thick paste composed of the above mixture and water, to within one-eighth inch of the top of the outer mixture. Fill the zinc case to within one-quarter inch of the top with rasped cork and put in this a couple of glass tubes ½ inch long and of about ⅛ inch bore to project ⅛ inch above the top of the case. Cover all but the tubes with a layer of paper and pour molten sealing wax on this to the top of the case, leaving only the carbon and the two glass tubes projecting. A brass binding screw, soldered onto the zinc case completes the cell, which is shown in section in Fig. 4.

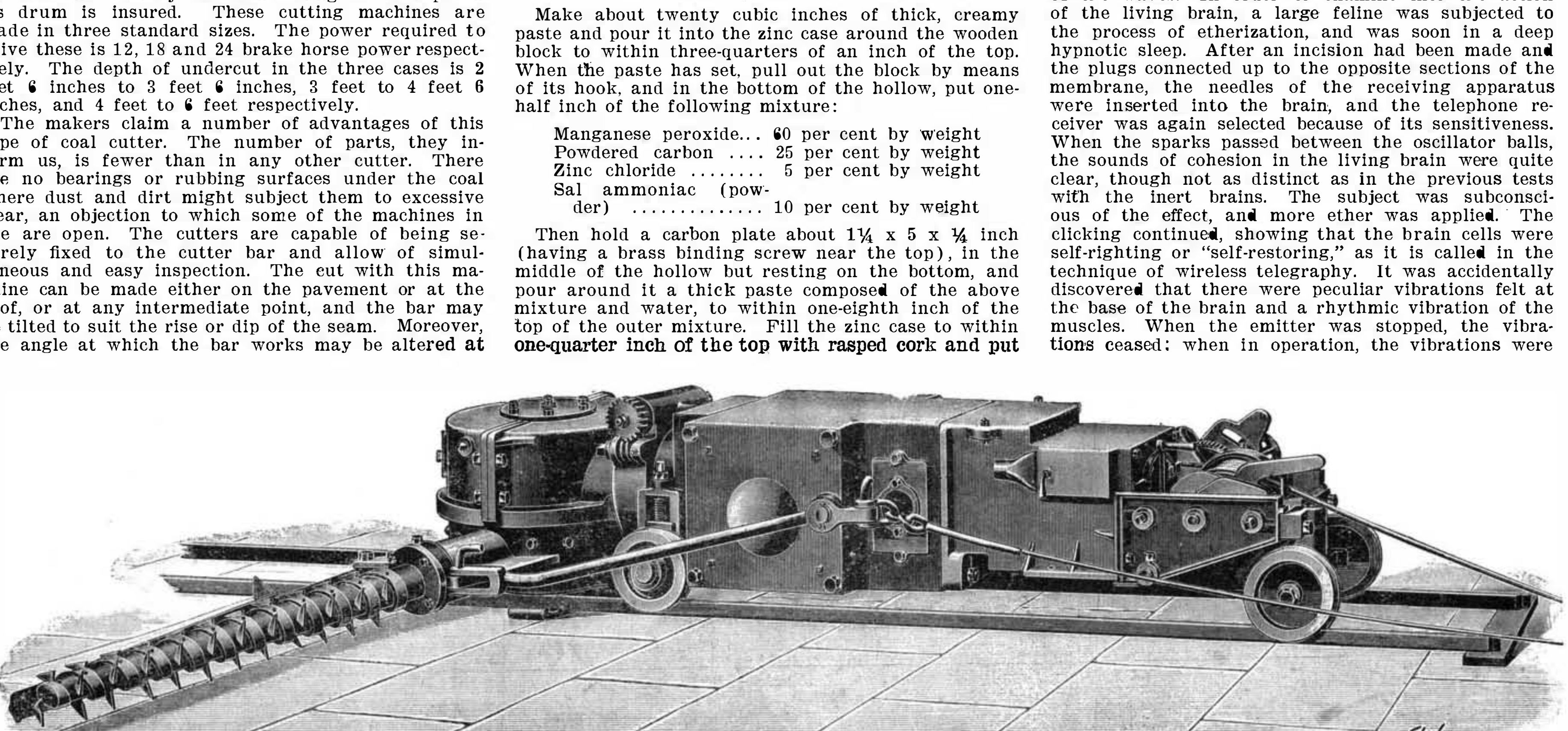
The cell should be inclosed and glued into a cardboard case, which will act as an insulator. This is especially required at the bottom where the battery touches the table. The cells, being thus insulated, and oblong in shape, may be packed together into batteries of any number, without loss of space. The electromotive force of such a cell is 1.45 volts.



DETAILS OF A DRY BATTERY.

ELECTRIC WAVES AND THEIR EFFECT ON THE HUMAN BRAIN.

IN an article by A. Frederick Collins, published in the London Electrical Review, some interesting experiments are described, which were conducted for the purpose of establishing the nature of the relationship existing between electrical storms and persons afflicted with certain forms of nervous diseases. The brain of a freshly-killed animal was procured, and an apparatus for sending out the electric waves of radiations was arranged. It was thought necessary to measure the resistance of the brain, and two needles connected to the testing set were embedded in opposite hemispheres. The high resistance offered by the tissues to the passage of an electric current, especially considering its large cross-section, was surprising. A telephone receiver was introduced in place of the testing set, and two resonator plates connected with two coherer plugs connecting the opposite sides of the brain with the resonator plates, and a dry battery and telephone receiver were bridged in between the two resonator plates. Waves were then sent out by the emitter at a distance of three meters, but there was no sound in the receiver. Had the waves appreciably cohered the brain cells, the telephone would have registered it. It then occurred to the author that the resistance of the brain, like loose metal filings, was too great, and its sensitiveness therefore proportionately decreased. The needles were inserted 1 mm. apart, and the key again pressed. There was a sharp click in the telephone receiver as though a carbon coherer had been employed instead of the brain cells. Time after time the experiment was repeated in all its possible variations, and with many other brains from mammals, but with the same results. The tests proved that cohesion of the brain cells in animals takes place after death under the action of the waves. In order to examine into the action of the living brain, a large feline was subjected to the process of etherization, and was soon in a deep hypnotic sleep. After an incision had been made and the plugs connected up to the opposite sections of the membrane, the needles of the receiving apparatus were inserted into the brain, and the telephone receiver was again selected because of its sensitiveness. When the sparks passed between the oscillator balls, the sounds of cohesion in the living brain were quite clear, though not as distinct as in the previous tests with the inert brains. The subject was subconscious of the effect, and more ether was applied. The clicking continued, showing that the brain cells were self-righting or "self-restoring," as it is called in the technique of wireless telegraphy. It was accidentally discovered that there were peculiar vibrations felt at the base of the brain and a rhythmic vibration of the muscles. When the emitter was stopped, the vibrations ceased; when in operation, the vibrations were



ELECTRICALLY-WORKED COAL-CUTTING MACHINE.