THE DONNADIEU RECIPROCATING PUMP.

This pump, which is represented in the accompanying engravings, works in exactly the reverse manner to that of ordinary pumps, the piston being fixed and the barrel movable. From this arrangement result several important advantages, namely, the suppression of the connecting rod and stuffing box, simple and easy erection, and greatly diminished friction.

In ordinary pumps with movable piston, friction is chiefly due to the packing of the piston in the barrel and of the piston rod in the stuffing box, and the working of the rod in its guides, to which must be added that of the water in the rising main. The usual cupped leather, forced against the interior of the barrel by the whole pressure of the water while being impelled upward, is in this pump superseded by

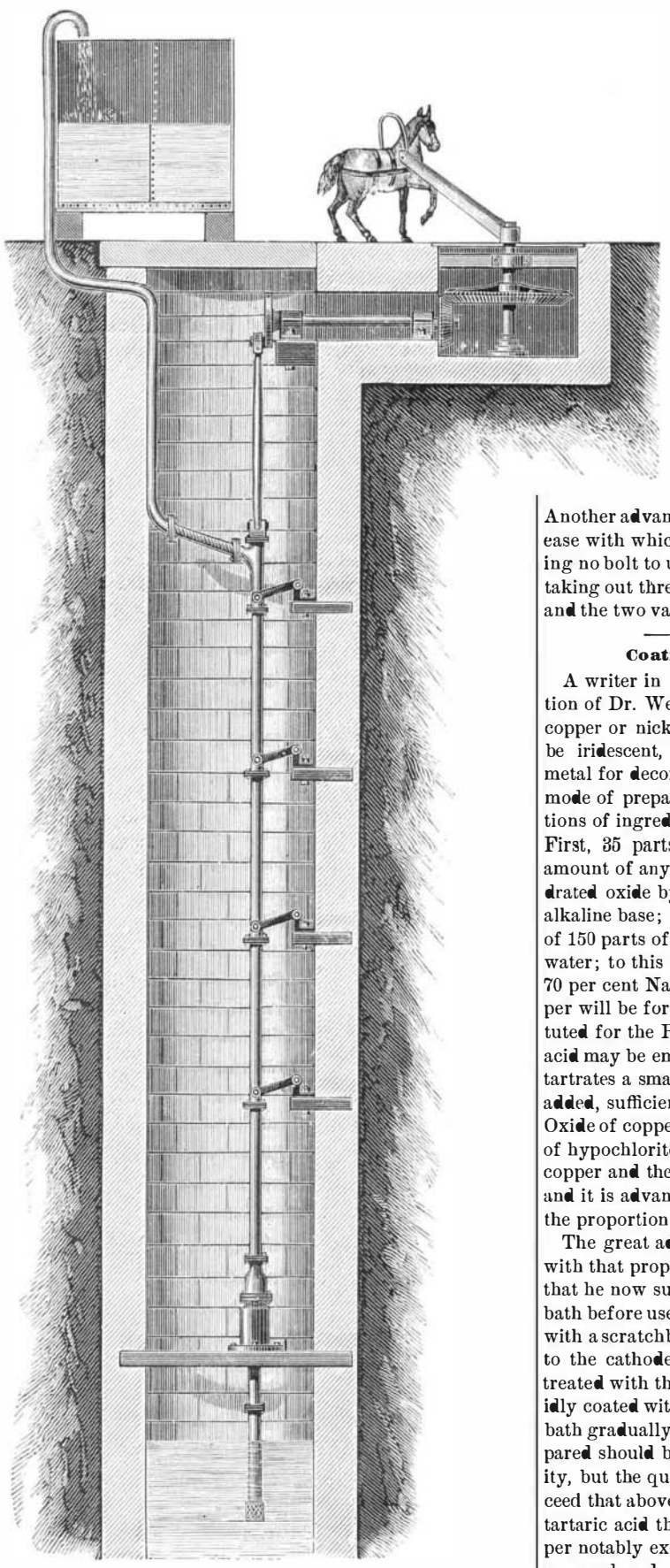


Fig. 1.—THE DONNADIEU PUMP.

superposed segments of leather, breaking joint with one another, clamped between washers, and pressed uniformly against the inside of the barrel by an internal spring. With this packing the influence of the pressure of water while being forced upward is *nil*, so that one great contingent in the total amount of friction is suppressed.

Fig. 1 of the accompanying engravings shows the single barrel form of this pump, as applied to wells and arranged for being worked by a horse gear. The piston, fastened to the crossbearer, consists of a hollow rod serving for the suction, which is fitted with the packing above described, and contains in the center a clack valve opening upward. The movable barrel terminates at its upper extremity in a cap, which forms a box for the delivery valve, also opening upward. Both these valves are on the center line of the pump, so that no change of direction is given to the water. The cap is in communication with the rising main, which at the same time forms the pump rod, transmitting the reciprocal motion to the barrel. This combined rod and delivery pipe is guided by stays working on pins at each joint of the pipe. The delivery may take place through a spout inserted in the top of the hollow rod itself, or the hollow rod may be connected to a fixed delivery pipe by a flexible joint, while in large pumps this joint is rigid, working in a cylinder provided with a stuffing box.

It will thus be seen that the friction of the rods in their stuffing boxes, as it exists in ordinary pumps, is entirely suppressed, and that the friction of the guides is greatly diminished, since it is reduced to the simple and very slight oscillation of a pin in its bearing. There is also no friction in the rising main, because the water, instead of being forced by the piston up the delivery pipe, is merely raised with the rod and at the same speed. A still greater saving of friction, and consequently of power, is effected by the adoption of the double pump, as shown by Fig. 2; for the mass in motion may be so perfectly balanced as to reduce resistance to a minimum, and afford a very high delivery in proportion to the power employed. This is due, not merely to the great diminution of friction and the facility for balancing the parts in motion, but also to the position of the valves, which are in the direct line of the action; they occasion no change of direction to the water, which therefore rises naturally. This application of the pump is suitable for great depths, as in mines.

The single Donnadieu pump may be applied with advantage to removing the *débris* and keeping the drill cool in boring operations, as the water is delivered in the very center of the boring, and the pump works equally well above or under water. Another advantage which should not be lost sight of is the ease with which the pump is got at for inspection, there being no bolt to unscrew and no joints to break. By merely taking out three pins without the aid of any tool, the piston and the two valves are freely exposed.

Coating Iron with Iridescent Copper.

A writer in the London *Mining Journal* thinks the invention of Dr. Weil, of Paris, for coating iron and steel with copper or nickel in such a manner that the surfaces shall be iridescent, opens a large field for the employment of metal for decorative purposes. He has found that the best mode of preparing the metalizing bath and the best proportions of ingredients are indicated in the following directions: First, 35 parts of crystallized sulphate, or an equivalent amount of any other salt of copper, are precipitated as hydrated oxide by means of caustic soda or some other suitable alkaline base; this oxide of copper is to be added to a solution of 150 parts of Rochelle salt, and dissolved in 1,000 parts of water; to this 60 parts of best caustic soda, containing about 70 per cent NaO, is to be added, when a clear solution of copper will be formed. Other alkaline tartrates may be substituted for the Rochelle salt above mentioned, or even tartaric acid may be employed, but in the case of tartaric acid or acid tartrates a small additional quantity of caustic alkali must be added, sufficient to saturate the tartaric acid or acid tartrate. Oxide of copper may also be employed precipitated by means of hypochlorite, but in all cases the proportions between the copper and the tartaric acid should be maintained as above, and it is advantageous not to increase to any notable extent the proportion of the caustic soda.

The great advantage of the present process as compared with that proposed by the same inventor a few years ago, is that he now substitutes a Gramme machine for the alkaline bath before used. The object to be coppered is to be cleaned with a scratchbrush in an alkalino-organic bath, and attached to the cathode, and immersed in the coppering bath, and treated with the usual precautions, when it will become rapidly coated with an adherent film of metallic copper. As the bath gradually loses its copper, oxide of copper as above prepared should be added to maintain it in a condition of activity, but the quantity of copper introduced should never exceed that above prescribed as compared with the quantity of tartaric acid the bath may contain. If the quantity of copper notably exceeds this proportion certain metallic irisations are produced on the surface of the object. These effects may be employed for ornamental and artistic purposes. According to the time of the immersion, the strength of the current, and the proportion of copper to the tartaric acid, these iridescences may be produced of different shades and tints, which may be varied or intermingled by shielding certain parts of the object by an impermeable coating of paraffine or varnish, while the iridescent effect is being produced on the parts left exposed. All colors, from that of brass to bronze, scarlet, blue, and green, may be thus produced at will.

If it be desired to deposit nickel, the only modification of the above process requisite is the substitution of precipitated oxide of nickel for the oxide of copper, produced by precipitation as above mentioned. In the above process it will be observed that the introduction of sulphuric acid into the bath is avoided, at least except in such insignificant quantities as may still adhere to the precipitated metallic oxides. Now, I think it will occur to most of your readers that the amount of ornamentation that could be produced with metal work treated by the above process would justify a large outlay for providing the necessary plant. The ornamental iron castings made both in Great Britain and France are really beautiful in form and design, and by the judicious coloration of them with combinations of iridescent brass and scarlet, brass and blue, or brass and green, would produce effects which would insure their general adoption.

Clothing in its Relation to Health.

Approximately, the human body when clothed resembles a steam jacketed pipe; the clothing forms the outer covering, between which and the body there is a layer of steam and heat, and which are constantly ascending. The place where this current of hot air and steam passes out into the atmosphere is the narrow ring between the neck and the shirt collar. This opening plays, therefore, an important

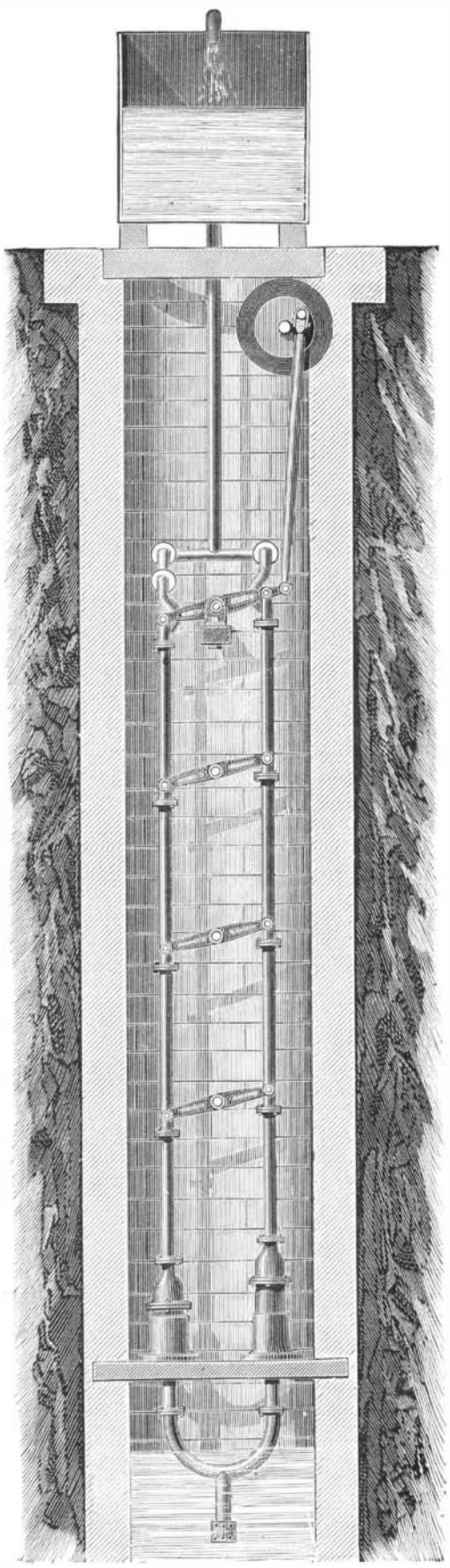


Fig. 2.—THE DONNADIEU PUMP.

part in the maintenance of the temperature of the human body. If it is enlarged, the heat and steam escape more quickly, and the skin is soon cooled; if, on the contrary, it is wholly or partially closed, by being closely buttoned or by a muffler, then the loss of heat is stopped, and the temperature of the skin raised. Thus there is nothing more injudicious than the constant wearing of a muffler or the thick neckerchief of our forefathers, becauses it impedes the evaporation of the matter which ought to pass out of the skin; though, for the same reason, it is of great value in case of a cold.

While the dampness of the atmosphere affects the evaporation through the lungs as well as the skin, clothing, by night as well as by day, regulates that of the latter. All covering which impedes this evaporation acts injuriously. Though no material is quite faultless in this respect, there is still a great difference in their structure. The less they are

impervious the more they are to be avoided. India rubber stands at the bottom of the list, for it does not admit of the passage of any water; leather comes next; less objectionable, but still repellent, is close linen, as an instance of which we may mention the blue linen blouses worn by the Belgians and Dutch, and also the French, over their other garments as a kind of waterproof. Cotton has a great advantage over the foregoing, as it is, to a certain extent, porous; but the best of all percolators is a woolen material. Thus a flannel shirt is more healthy than a cotton one, and a blanket a far better covering for the night than a linen sheet.

The action of the skin depends also upon the circulation of the blood under its surface, and the latter is promoted by outward friction; a material which induces the latter is therefore also more healthy, and rougher underclothing, such as woolen or coarse cotton, are preferable to the enervating finer linen or silk.

Another point to be observed is the keeping of the skin warm, because warmth keeps the pores open, while cold contracts and closes them; and here again woolen clothing stands first.

Thus it is proved that in point of porousness, friction, and warmth, woolen clothing is to be preferred to all others.

But not only the material of the clothing is of importance, but also its cut. In warm climates, where clothing is more a luxury than a necessity, the loosest garments are the best; but in those latitudes where a certain amount of warmth has to be obtained by clothing the garments must be worn more closely fitting. We have before likened the human body to a steam jacketed pipe, where this steam is constantly in an ascendant motion; the faster this circulation takes place, the more is the skin cooled; it follows, therefore, that the most regular and constant evaporation is maintained by closely fitting garments, and the soldier's uniform is therefore the healthiest of all.

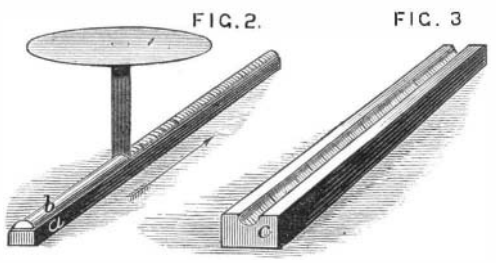
We need not here enlarge upon the very extended use of flannel underclothing, especially as shirts, which has come in vogue since cotton clothing rose to such exorbitant prices during the American war, and which, once appreciated, has not been abandoned since. This has also led to the production of a great many textile fabrics containing more or less wool mixed with cotton or other fibers, in order to counteract the shrinkage of the latter and make the fabrics more adapted for washing, one of the products being the vigogne yarn, to which we have lately drawn attention.—*Textile Manufacturer.*

A SIXPENNY PHONOGRAPH.

When a great scientific discovery or invention is announced to the world, such, for example, as the telephone of Professor Graham Bell, the microphone of Professor Hughes, or the phonograph of Mr. Edison, it is pretty certain in a short time to be followed first by spurious and unauthorized imitations, which, if the invention be protected, are nothing more or less than direct infringements of the patent, and after that by highly interesting modifications of the apparatus either for the extension of the principle, developing further physical facts, or to analyze those already discovered; or else for the reduction of the instrument to its simplest possible form, so as to place in the hands of the teacher as well as in those of the million a scientific toy which can illustrate and render familiar the principle which lies at the base of the more important and typical apparatus.

The sixpenny phonograph, which is represented in Fig. 1, consists, first, of a hollow cone of pasteboard, about one inch and a half in diameter, whose apex is connected to the center of a similar sized pasteboard disk by means of a lead wire about sixteen inches long; and, second, of a small board or tablet, on which is fixed one or a larger number of short lengths of lead wire, each of which bears upon its upper surface a phonographic embossed record corresponding to a certain word or sentence, by which it was originally produced. The method is as follows: The upper surface of a rectangular prism of glass, or other hard and rigid material, is thickly coated with stearine wax, which is then scraped into a convex form, as shown in the diagram, Fig. 2, in which *a* represents the glass bar and *b* the convex coating of stearine. This bar is then fixed into a simple phonographic instrument, which, by means of a screw or other mechanical contrivance, traverses it at a suitable speed below a diaphragm. This diaphragm is rigidly held around its circumference by an annular framework (not shown in the diagram), and is in every respect exactly similar to the diaphragm of an ordinary phonograph. To the center of this diaphragm is attached a thin flat plate, whose lower end is cut out to a concave curve to fit the convex surface of the stearine, *b*. When all is properly adjusted, and the temperature is so arranged as to give to the stearine surface the proper degree of hardness to insure the best results, the handle of the instrument is turned, and at the same time words are spoken against the diaphragm, which immediately set up in it vibrations, which are communicated to the plate or style. While this is moving up and down, following the vibrations of the diaphragm caused by the voice, the stearine coating of the bar, *a b*, is steadily drawn in the direction of the arrow below the vibrating bar, receiving from it a phonogram similar to that produced on the tinfoil of an ordinary phonograph.

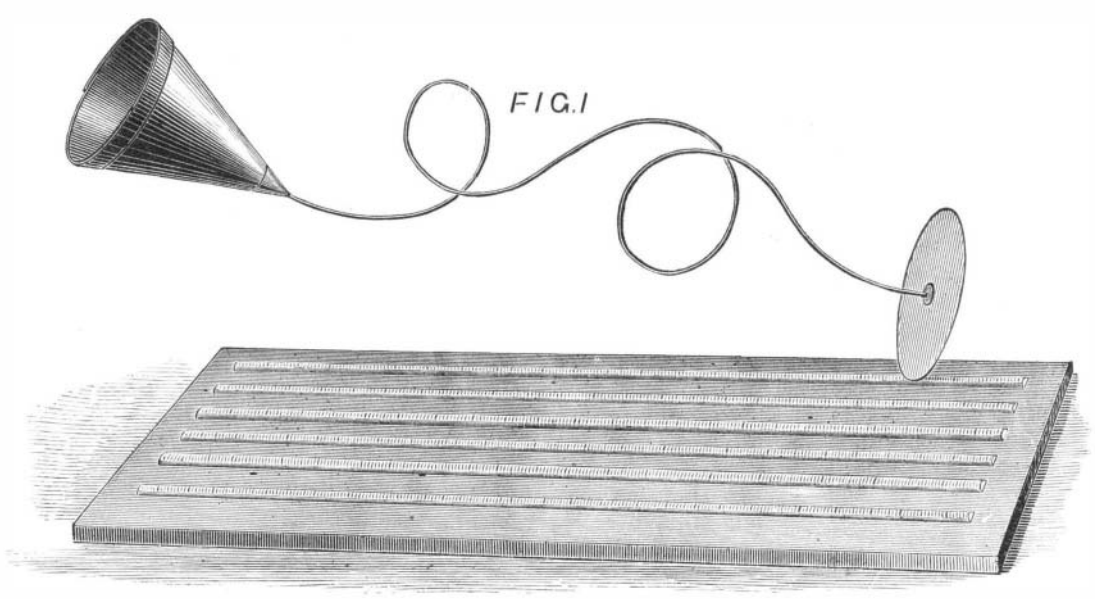
The stearine bar is then coated with a fine surface of plumbago, so as to give to it an electrically conducting surface, and it is then electro-plated with copper by the ordinary process. Out of the copper coating so formed the stearine is removed, and a rigid backing of lead or other metal having been run over the outside convex surface of the copper,



A SIXPENNY PHONOGRAPH.

a firm copper lined matrix or mould is formed, the whole presenting the appearance shown in Fig. 3, and consisting of a rectangular block having along the center of one of its sides a semi-cylindrical groove, *c*, of copper, which bears upon its surface certain raised striations corresponding to the depressions which were made by the diaphragm on the surface of the stearine. Into this groove is laid a piece of lead wire of about three or four millimeters in diameter, and the two being put into a press and squeezed together, the surface of the lead wire receives a permanent impression, which is an exact reproduction of the original impression made upon the stearine bar. From one copper matrix a very large number of lead impressions may be made, and we are told that the whole process can be gone through, and lead wires, each containing the record of a short sentence, can be made and sold with a profit for one halfpenny each.

We have had an opportunity of testing this simple little instrument, and the words come out of it with remarkable distinctness, though of course with but feeble power; and among the following words, all of which we have heard it utter, some were unmistakably clear: "Mon cher ami," "Louis Quatorze," "Victor Hugo," "La République," "Octavie," "Bonjour," "Lambrigot," "Misérable," and "Miracle," and it is a curious fact that while in the phonograph the words "Phonograph," and "How do you do?"



A SIXPENNY PHONOGRAPH.

come out with exceptional distinctness, so in this instrument the words "Bonjour," and the name of the inventor, "Lambrigot," are the clearest of those we have heard.

It is only fair to Mr. Edison, the inventor of the phonograph itself, to point out that the plan of producing a phonogram on a stearine surface, and afterwards reproducing it in copper by the process of electrolysis, was suggested by him long ago, but we do not understand that M. Lambrigot claims any novelty for that portion of the invention, but more especially for having produced a little instrument at the cost of a few pence, which can demonstrate the action of the phonograph and illustrate some of the most beautiful phenomena connected with the science of acoustics.

The sixpenny phonograph described as above in *Engineering*, is a novel affair, but we doubt if it is, after all, as simple and effective as one described and illustrated in our columns some eight months since. Page 118, Vol. 29.

Compressed Air for Blasting in Mines.

At a meeting held at Manchester, England, recently, Mr. Joseph Dickinson, H. M. Chief Inspector of Mines, in the chair, a paper "On the Advantages of Compressed Air at High Pressure (8,000 lb. and upward to the square inch) as compared with Blasting by means of Gunpowder or other Explosives," was read by Mr. W. E. Garforth, of Dukinfield. After referring to the various efforts which had been made to dispense with gunpowder for blasting in mines, Mr. Garforth stated that a machine had been invented by Messrs. Garforth, of Dukinfield, for bursting down coal by means of compressed air. The machine was portable, of small dimensions, so as to be suitable even for small mines, and could be worked by two men, and by it air had been compressed to 946 atmospheres, or 14,200 lb. per square inch. The compressed air was conveyed through wrought iron pipes to a cast iron cartridge 12 inches long, placed in a hole drilled in the coal, and the cartridge, when its known breaking strain was reached, burst and broke down the coal.

A machine had recently been made by Messrs. Garforth which was capable of giving 2,000 lb. pressure to the square inch, and by permission of Messrs. Morland, of Hollinwood, a trial was made at the Bower Colliery in the presence of some of the members of the Geological Society under the following conditions: The coal known as the Bower Mine was 5 feet thick and very hard. It was undercut to the depth of 4 feet 6 inches, and by a drilling machine a hole was cut 39½ inches in depth and 7 feet from the cut end of the coal. The cartridge, 11¾ inches long, 3 3-16 inch diameter, and 9-16 inch thick, was put into this hole and stemmed tight. The pipes and machine were then attached, and at 9,553 lb. pressure per square inch, the coal was broken down, the quantity being estimated at between 5 and 6 tons.

After describing the great difficulties which had been experienced in perfecting the machine and the cartridges, Mr. Garforth proceeded to lay before the members his ideas of how this great power, obtained by means of compressed air, could be utilized. He would first state that among other points which had been proved by the experiments which had been made were: (*a*) that 14,200 lb. pressure per square inch could be obtained; (*b*) that a pressure of 9,550 lb. per square inch was sufficient to break down the coal in a hard mine like that of Bower Colliery; and (*c*) that the pressure when obtained could be kept for hours both in the machine, pipes, and cartridges. In the suggestions which he was about to make he felt convinced that a machine to meet the requirements of deep mining should be such as not to require too much manual labor, owing to the high temperature experienced in deep and extensive workings.

What he proposed was to use a vessel or small receiver, made so very strong that the bursting point would be six or seven times the required pressure, proved beyond doubt to be perfectly safe in transit, also of such a capacity as would allow highly compressed air to expand into the pipes and cartridges without reducing the pressure below the known bursting point of the cartridge. The air compressing machine necessary to fill this receiver with highly compressed air might be fixed on the surface, or, if preferred, at the bottom of the shaft, and worked by steam in the ordinary way. These portable receivers should then be charged with air to the required pressure, sent into the various working places, attached by means of a valve and pipes to the cartridges with the coal, and then by simply opening the valve the air in the receiver would rush into the cartridge and explode it, the operations requiring little or no manual labor. Of course, it would be understood that the receiver could be placed at a sufficient distance away to obviate the use of pipes; the receiver could be placed near, and the valve opened by other means.

If the expansion of the air were found to be such as to make the receiver too large, a small hydraulic pump might be connected to it, and by forcing water through the valve opening upward, the water would thus occupy the place of the air, and by this means any pressure which had been lost through expansion could be recovered, or, if necessary, increased to more than the original pressure. As water was, comparatively speaking, incompressible, the time taken to effect this operation would not be long nor the labor very great. In the same way that machines were improved upon the original idea, so he felt convinced that in a short time this great force of ten, fifteen, or twenty thousand pounds pressure per square inch would be so utilized that they would be able to put into the hands of the miner a power that, when gunpowder and other explosives were prohibited, would enable him to get the coal with the same facilities as now, without the risks from blown out shots, explosions, or the production of deleterious gases.

It might appear strange to old miners when it was proposed to place a small machine in the hands of the workmen, but