

impelled, by the considerable electrical pressure exerted, across the small space where the circuit is broken. Going now into somewhat greater detail, we will proceed to examine the high-tension system, starting from the explosive charge.

"The High-tension System."—In the case of blasting agents where detonators are used to secure the full explosion of the charge, the electrical fuse is attached to, and forms part of, the detonator, which, as is well known, consists of a small copper tube closed at one end and filled to about half-way up with the detonating compound; the latter consists mainly of fulminate of mercury. The detonating compound is sealed in place with a thin coating of varnish, so as to protect it, at the same time keeping it in position; the electrical connections are introduced into the open end of the detonator, and there fixed. They consist of two pieces of insulated electric wires of sufficient length to reach from the explosive charge along the borehole into the working-face, with the igniting terminals suitably mounted. This is effected by passing their ends through a piece of vulcanite, guttapercha, or other solid piece of insulating material, about equal in diameter to the internal dimensions of the detonator. This cylinder of insulating material has two holes in it, through which the wires are brought as above; the ends are cut off short and are bent towards one another, so that they are the required distance apart. The junction of the insulating ends of the wire and the back of the insulating block through which they are introduced are then carefully covered with any convenient form of insulating material, which may be put on in a heated condition and left to solidify as it cools. In order to insure that the igniting spark, which is produced between the two exposed ends of the electrical wire, is immediately communicated to the detonating charge, from which it is distant some $\frac{1}{4}$ in., their ends are covered by a suitable chemical composition, which bursts into intense flame immediately the spark is produced. This flame in due course ignites the detonator, which in turn explodes the main charge.

"It is frequently stated, and also proved by means of volt-metres, that the electro-motive force of the current for high-tension blasting need only amount to about 125 volts, or little more than is usually to be found on electric-lighting installations. Those who have practical acquaintance with the subject will realise that the distance which a current of this comparatively small voltage can arc or spark over is far too small to be alone of any practical service for the purposes here mentioned; but the chemical composition, besides possessing the property of bursting into flame when ignited, assists the electric spark in the work required. It is unnecessary here to do more than mention the fact that once a current has been started a pressure much less than that mentioned above is amply capable of maintaining a spark of sufficient intensity to provide the heat for igniting the explosive. We have dwelt somewhat on this point as, from the electrician's point of view, it is a misnomer to apply the term 'high tension' to a system of electricity where no more than 125 volts are in use; though we admit that, by comparison with the amount required for the low-tension system, the use of this term in a specialised sense is in some respects justified. In fact, the terms 'high resistance' and 'low resistance' appear more correctly to define the two classes of fuses from an electrical standpoint. A further reason we have in calling attention to this point is to indicate that in high-tension blasting it is not a case of a spark leaping across a space of infinite electrical resistance, because such a state of affairs would involve the use of really high-tension apparatus, which, as such, would require for its proper working the impossible condition of perfect electrical insulation. High-tension blasting, so called, may therefore be looked upon as a system where a chemical composition which is a fair conductor of electricity is raised to a high temperature by the passage through it of an electric current of medium strength.

"The Low-tension System."—The low-tension system of blasting requires an electro-motive force of but a few volts; for there is no serious interruption in the circuit through which it flows, as the two wires, which are fixed within a short distance of one another, in about the same way as is described above, are connected by a piece of very fine platinum wire, which, in technical parlance, is known as a 'bridge.' The resistance of the circuit is therefore very much less than where the ends of the wire are connected solely by the chemical composition mentioned above, and consequently the amount of force necessary to establish the current is proportionately smaller. Three or four volts can force a current across the platinum bridge of sufficient volume, if we may use the term, to heat it to whiteness. The ends of the wire are, as in the case of the high-tension system, imbedded in the same chemical composition, though in the present case its only property which comes into use is its capacity to burst into flame as soon as the platinum bridge gets hot.

"The main feature of difference between the high-tension and the low-tension system of blasting is that it is possible to test the latter form of fuse before putting it into use, in order to ascertain if the electrical continuity of the circuit is uninterrupted. This is done by passing such a feeble current through it as will be sufficient to produce an indication on a sensitive form of measuring-instrument, known as a galvanometer. This test, however, is not of great importance, except in very particular work; for, given sufficient care in manufacture, the percentage of faulty fuses is so small as to render this precaution needless for practical purposes. Furthermore, the test does not show everything, for it can only indicate those faults which are due to an interruption of the circuit, ignoring those cases where the wires may be in contact otherwise than through the platinum wire—a condition of affairs which would lead to an inadequate amount of current passing through the platinum bridge to render it incandescent. The number of faults of this last-mentioned kind, small as their number may be, would about equal the total number occurring in high-tension fuses. Practically, therefore, this advantage is not of material character. Further, it is important to remember that in firing a number of low-tension fuses the resistance of the wires used for connecting purposes is a very serious factor to be taken into consideration; every additional 100 yards of wire so used will be found to reduce materially the number of fuses that can be fired. When using high-tension fuses this is not nearly so great a difficulty.

"Electrical Connections."—Having dealt separately with the two forms of fuse, we will now consider the question of connecting them up with the source of the electricity. There is, however, not