

coal, and where necessary they are built securely up with brick and mortar; but, where openings have to be left to enable the workings of the mine to be carried on, they are all fitted with doors which when closed are almost air-tight.

There are several things to be considered in ventilating a mine, one of the most prominent being the amount of carbonic-acid and carburetted-hydrogen gas that may be generated in a mine; but, in order to produce a free circulation of air, "Callon, on Mining," has laid down the following fundamental principles to be observed:—

First: "To compel a current of air to follow a given course." This is generally done by placing stoppings at the entrance of each of the central galleries which cross those forming the given circuit. These stoppings sometimes consist of thin partitions of brick placed on edge, with mortar joints; sometimes of more or less thick walls of ordinary masonry, or even of dry walls. Wherever there might be a danger of these walls being destroyed by an explosion of fire-damp, they should be made tolerably thick. An ordinary wall of stowing, two or three yards thick, will resist an explosion better than a thin wall of the best masonry, because of the instantaneous shock of the explosion. A true shock is produced, which generates an effort the intensity of which cannot be calculated, but which is greater and more instantaneous in proportion as the obstruction is more unyielding. If this obstacle is quite rigid, it will most certainly be broken; but the inertia of a large and less incompressible mass cannot be overcome in a short interval of time, and this mass does not move much, nor does it acquire an appreciable momentum. If it is necessary, the barrier in the side gallery can be opened at pleasure, and a trap-door placed instead of the stopping. A single door can be made use of, if it can be opened temporarily without interrupting the ventilation; but double or even triple doors must be employed in the contrary case. The interval between any two consecutive doors should be sufficient to hold the longest train of wagons which traverse the galleries. The doors should always open in the direction in which the full wagons are travelling. They should shut of their own accord, and this is effected by placing the hinges in an inclined position. The edges of the doors which fall against the frame, and the edges of the frame against which the doors strike, ought to be lined with strips of cloth if they are required to be very air-tight. The space between the frame and the sides of the gallery should also be filled up, so as to prevent loss of air. The principal doors should be under the control of a "trapper," who should open and shut them as required. The doors which are opened only occasionally (like the doors leading to the furnace) should be under lock and key, and the key should be kept by the person whose business it is to look after the stoker. Lastly, it is sometimes the case that hanging-doors, or safety-doors, are placed at very important points of the workings. They are attached to hinges placed horizontally, and are supported in a suitable excavation in the roof, where they present no impediment to the passage of the air. If an explosion occurs which carries away the ordinary doors, it leaves the safety-doors uninjured; because the violent but instantaneous currents of air like those produced in an explosion are very destructive in the line of their movement, but produce no sensible effect sideways. The safety-doors can therefore be shut as soon as they are reached, after an explosion, in order to restore the air-current to its proper course. They may even be made so that they are shut by the explosion itself, if the support which holds them up is placed in such a position that the blast of the explosion drives it out. By means of these doors it becomes possible to restore the main features of the distribution of air soon after an explosion. It has also been claimed for them that they might be used for insulating faces in the workings into which the men could retreat and escape the deleterious effects of after-damp and thick clouds of dust after an explosion.

Second: "To force air into an advanced gallery which is not in the direct course of the air-current." This question corresponds to a case of very common occurrence in practice. It includes the ventilation of a sinking shaft; that of a cross-measure drift; and, lastly, that of all the galleries which are pushed forward for purposes of exploration. The general solution consists in the establishment of two distinct air-ways in the cul-de-sac which constitutes the working-place, one serving the purpose of conducting the air-current (or part of it) to the face, the other serving to bring it back to the main air-way again. For this purpose an air-compartment is formed, either by means of boards placed horizontally or vertically; or a thin brick brattice is built, or a brick arch; or, if the place is large enough, a mass of stone is built along the middle; or, lastly, if there is plenty of air and no necessity for husbanding it, loose cloth may be hung from the roof to the floor along the line of the galleries. Again, if the gallery is narrow, air-boxes made of wood, or pipes made of sheet-iron or zinc, may be substituted for the brattice. These are joined end to end, and either lie on the floor or are suspended in the angle of the timbering by means of two small pieces of boards. Lastly, one of the methods very often resorted to, more especially in exploring-galleries in coal-seams, is to drive two parallel drifts, having a barrier of several yards in thickness between them, and to make a cross-cut through the pillar every now and then, as it is required. The last cross-cut serves to introduce the air from one drift into the other, and the previous cross-cut is stopped up or stowed up as soon as the new one is completed. All these methods are commonly used in mines. They can always be employed in such a way as to bring a current of air as close to a given point as may be desired. One method or the other can be adopted, according to the degree of difficulty or danger which a particular place may present. In order to produce a current of air in galleries divided in the manner described, the point at which the air enters them requires to be separated from the point at which the air leaves them again on its return back from the face. This is effected by either completely or partially closing the passage which the air would naturally take, and so forcing it to take the way that has been prepared for it. This may be done in some cases by means of a single or double trap-door, or by a fixed brattice, or by a simple cloth stretched across the gallery.

Third: "To cause two or more currents to circulate in the same gallery, and travel either in the same direction or in opposite directions, without allowing them to mix with each other." The solution of this question (of which the preceding one was only a particular case) is obtained by simply dividing the gallery into as many compartments as there are separate air-currents.