BLASTING BY COMPRESSED AIR.

Extensive experiments are now being made at the Pemberton colliery, near Liverpool, in the Reuss system of blasting with compressed air. The plan consists in boring a hole in the coal, inserting a cast-iron cartridge 16 inches long and 3 inches in diameter, and exploding it by compressing air into it. The cartridge is ½ inch thick, and is connected to the air pumps by weldless steel pipes ½ inch outside diameter, and a bare ⅛ inch bore. The explosion takes place when a pressure of about 8,500 pounds per square inch is reached. The air pumps are mounted on a small trolly which can accommodate its gauge from a minimum of 20 inches upward, the total height of the machine being 33 inches, the width 4 feet 3 inches, and the weight 8 cwt. There are six pumps worked by three cranks on one shaft, and although the enormous pressure required is quickly gained, the pumps are perfectly independent, and the stage process is not used. They are driven by crank handles worked by two colliers and geared three to one on the pumps, which latter made 54 to 60 strokes per minute. The rams are ¾-inch in diameter by 10-inch stroke, and work in the barrels without any packing, which is certainly a most remarkable feat considering the pressure attained. There are no suction valves, the admission of the air taking place through holes in the sides of each barrel, which are uncovered when the plunger is at the top of its stroke. The delivery valves are of lead, and are placed close to the bottoms of the pump barrels, which are all screwed into one block of gun metal, from which the delivery pipes start. The bases of the pumps work in water to keep them cool. A great deal of the success of the operation depends on the truth with which the hole is bored in the coal for the reception of the cast-iron cartridge, and to accomplish this Mr. Reuss uses a small universal hand-drilling machine, the supporting bar for which is made fast to the face of the coal by expanding wedged at its foot let into a hole jumped in the coal for this purpose. The cutter for making the cartridge hole has a diamond-pointed center, and cuts on both sides, and clears itself well at the edges. It makes holes about 40 inches deep, into which the cartridges are placed, and well tamped with sagger clay and the borings from the holes just made. The pipes connecting the pumps and the cartridge are joined together with couplings, having soft copper washers placed between the ends of the pipes to insure tight joints, and the last length of pipe is screwed into the end of the cartridge, which is increased in thickness for this purpose.

A PLASTIC CEMENT.

Amongst the many useful purposes which glycerine has served, there are probably none of greater utility than its combinations with other substances, by which compounds with peculiar properties have been produced. A plastic cement is the latest invention, in which glycerine forms the important ingredient; it is known as Jannin's cement, from the name of the patentee, a resident of Paris. The cement is simply a mixture in suitable proportions of yellow oxide of lead (the quality known as massicot being preferable) with glycerine. Several other metallic oxides and matters may be mixed with the cement, so as to suit the quality or the colour of the cement to the nature of the work to be produced, but the two essential compounds are yellow oxide of lead and glycerine. The proportions of oxide of lead and glycerine vary according to the consistency of the cement it is desired to produce. The proportion of glycerine will of course be larger for a very soft cement than for a stiff cement; it is not necessary, therefore, to specify the exact proportion of each of the two essential compounds. This cement is specially adapted for moulding those objects which require an extreme delicacy in the lines of the cast, such as engraved blocks and plates, forms of printing type, photoglyptic plates, &c. Under the influence of gentle heat it sets in a few minutes, and then resists perfectly both pressure and heat. When set, it is also a very good substitute for natural lithographic stones, and it can replace them for many practical purposes. It can also be used for artistic reproductions, such as facsimiles of terra cotta, whose colour and sonorous quality it possesses. Though setting to great hardness in a few minutes it does not shrink. Massicot it may be observed is an old name for litharge, but the term is more generally applied to the yellow oxide of lead, prepared from the scum of the molten metal by roasting until the colour is fully developed. For purposes in which the colour is of no moment, the scum itself would doubtless answer, provided it is thorougly oxidised.

FIRE-PROOF CONSTRUCTION.

[A paper by F. Schumann, C. E., read at the Eleventh Convention of the American Institute of Architects.]

GENERAL REMARKS.

No material used in building construction, except brick or burnt clay, is practically fire-proof. A building constructed of incombustable material throughout, and stored with only small quantities of combustable and inflammable matter, can be considered fire-proof. Warehouses for the storage of miscellaneous merchandise cannot, with our present knowledge, be constructed absolutely fire-proof; we can only apply devices that diminish the danger by confining and localizing the conflagration. Generally, public places of amusement, churches, schools, offices, or dwellings do not contain so much inflammable matter, such as furniture, etc., as to materially injure or endanger the building when properly constructed. Warehouses, when stored with inflammable matter, even if constructed entirely of brick, but without precautionary subdividing walls, forming compartments, will succumb to the heat, by reason of the great expansion causing a movement of the walls and ultimate collapse of the floor arches.

All constructive iron-work in buildings, except those having small quantities of combustible furniture in them, should be protected from the direct action of a fire by some fire-proof and non-conducting coating, securely fastened to the member it is intended to protect.

The maximum temperature of a vigorous fire, raging in a building fed by combustible and inflammable matter stored therein, may be correctly assumed at 2,000°,—equal to that in brick furnaces. It is found that the strength of iron is diminished about 60% when at a dull red heat, or a temperature of 977°; at this temperature, iron-work proportioned to three times safety, would be at the point of failure. We will compute, approximately, the time required to raising to 977° the temperature of a cast-iron plate one foot square and one inch thick, representing the side of a squared column. The amount of heat required to raise the temperature of the plate to 977° is—the specific heat of cast-iron being 0.13 units, and the weight of the plate 40 pounds—997°x0.13x40 = 50,804 units. The conducting power of the plate, under the existing circumstances, is 233 (2,000—977) = 238,359 units per hour, and as we have only 50,804 units to conduct the time will be $\frac{50804}{238359} = 0.213$ hours = 13 minutes. If the plate be protected by a layer or coating of ordinary plaster, one inch thick, the amount of heat conducted will be only 3.86 (2,000 — 977) = 3,949 units per hour, or $\frac{50804}{3949} = 13$ hours longer; when protected by 4½ inches of brickwork, only $\frac{483(2000-977)}{45} = 1,100$ units per hour will be conducted, or $\frac{50804}{1100} = 46$ hours longer.

Buildings stored with large quantities of inflammable matter may have cast-iron columns of square cross section, of the necessary dimensions to carry the superimposed weight, with skewbacks cast on, for supporting brick arches between the columns that carry the floors; the column is enveloped by 4½ inches of brickwork, as a protecting layer only. This method, shown by Fig. 7, admits a considerable reduction of the size of piers from those built of brick only; for example: The height of a pier is 18 feet, and the weight to be carried 100 tons; a cast iron column 10 inches square, with thickness of metal 1 inch, will carry the weight with eight times safety; 4½ inches of brickwork will increase the size of pier to 19 inches. A solid brick pier, allowing 70 pounds per square inch as its safe resistance to crushing, will carry only $\frac{192\times70}{2000} = 12.7$ tons. To support a weight of 100 tons, the pier would have to be $\sqrt{\frac{100\times2000}{70\times144}} = \sqrt{19.91}$ = 4′ 6″ square.

It is asserted that iron is unsuitable for fire-proof construction, by reason of its failure when exposed to a certain degree of heat. That this is so is of course admitted; but, nevertheless, it is the only material at our disposal suited to modern requirements; and the architect will meet with more satisfactory results in devising means and methods for its protection against the destructive effects of fire, than by discarding it.

Columns or girders of wood resist the destructive effects of fire much longer than if made of iron exposed. The necessary dimensions, however, except for comparatively light structures, are such as to make the use of wood for those purposes impracticable; for example: A column of oak 18 feet high and one foot square will support with safety 25 tons, while a hollow cast-iron column, one foot square and one inch thickness, of metal, will support 119 tons. So, also, will a beam of yellow pine 15 inches