April 10, 1838.

JOSHUA FIELD, V. P., in the Chair.

On the Application of Bickford's Fuzes to Blasting under Water.

By C. W. Pasley, Col. R. E., Hon. M. Inst. C. E.

The improvement in blasting under water, which forms the subject of the above paper, was first adopted at the Royal Engineer Establishment at Chatham, under the direction of the author, in the autumn of 1834. Blasting
under
Water.

Great advantage in blasting under water is derived from the use of Bickford's fuzes applied to tin powder cases; also from the new system of tamping by means of small stones, and of fixing ring bolts in stones or rocks, introduced by Mr. Howe. But the ordinary Bickford fuze, though superior to every other in shoal water, cannot be altogether depended on in depths of from five to ten fathoms. The general practice has hitherto been to ignite the powder contained in a tin canister, by dropping a piece of red-hot iron down a tin tube, reaching to the surface. The tin tubes being liable to failures, Colonel Pasley had used flexible leaden pipes, and a piece of port-fire instead of red-hot iron for vertical explosions. Several other means of firing—as small rockets, a quick match, and small linen hoses—were tried, but without any great success.

A small fine powder hose, about one-eighth of an inch in diameter, secured so as to burn gradually instead of rushing forward and exploding, was found to succeed very well, but is neither so simple nor so cheap as the Bickford fuzes. These fuzes consist of so minute a thread of fine powder, that they burn rather than explode, and are in no danger of bursting the case, which is made of twisted hemp, coated with pitch, and so performs the double duty both of the hose and the metallic tube. The fuzes having been ignited are thrown on the water, and generate a small column of elastic gas as they burn. Colonel Pasley then details several instances of the successful application of these fuzes, and proceeds to describe the general arrangements which were adopted by him, the fitting up of the tin cases, the mode of firing, the best borers for blasting under water, and a form of plug-bolt peculiarly adapted for mooring and warping up rapids.

The fuze is inserted through the cork of the tin case, upon which is placed an iron cone, having a small groove at the side of the base to admit the fuze, and the hole filled up to the top with small pieces of hard stone of about three quarters of an inch in diameter,

as tamping. The plug-bolt, which is 3 feet long and $1\frac{3}{8}$ of an inch in diameter, having about four inches of the bottom end spread out into a cone or base, has about three inches inserted into a hole cut a little oblique towards the current, and fixed in the same manner by pieces of stone.

From experiments on tamping the holes of blasts with loose sand, it appeared that double the charge of powder was required to produce the same effect when the hole was filled with loose sand, as when filled by ramming in fragments of brick ; but the method above described is far the most efficacious, saves trouble, and is less liable to accidents.

The Bickford fuzes as ordinarily made were found several times to fail in 10 fathom water, and some larger ones burst the envelope, so that Colonel Pasley is of opinion, that in deep water some other means should be resorted to. Also, when a large quantity of powder is to be fired, the time which the fuze is burning, namely about half an hour in 8 fathom water, keeps the experimenter in a great state of uncertainty as to when the fuze has ceased to burn ; the small air bubbles sent up to the surface being generally imperceptible, except at a very small distance. In these cases the small hose and leaden pipe are preferable.

Tamping.

The various kinds of tamping employed having been discussed, Mr. Macneill stated that he considered the tamping with sand to consume more powder, but to effect a great saving in time ; it was also attended with less danger. He had found considerable advantage result from mixing a small portion of roach lime with the powder.

Colonel Pasley found from his experiments, that tamping with small stones produced the same effect as a double charge of powder, when the tamping was sand. He had also tried equal portions of powder and saw-dust, and the effect of a given quantity of powder in throwing a shell was somewhat increased by the presence of the saw-dust ; not however to such an extent as so induce them to trouble themselves with this additional article.

Mr. Rendel considered the best tamping to consist of clay and small stones ; any requisite degree of density might be given to such a mass.

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JOSHUA FIELD, V. P., in the Chair.

William Rickman and Wilson Saunders were elected Associates.