

On Her Majesty's Service

WASC1381

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Royal Institution
20th June 1843.

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Sir,
Having considered the paper you placed in my hands in conjunction with the objects and circumstances which were presented to us in our joint visit to the Waltham Abbey Gunpowder Works, I proceed to give such answers to the enquiries contained in the former as I am able, with my best judgment to make; begging you, however to remember that it is with diffidence I speak as one having only a theoretical acquaintance with these matters, in comparison with that practical knowledge which is possessed and can be gained only by those who are occupied in the continual observance and practice of the Works. With this degree of reservation I shall answer freely to the points in order.

With respect to the Sieves used in granulating (5) and the possibility that the different Metals employed in them combined with the water and Nitre of the Gunpowder, could have produced by any galvanic effect the ignition of the Powder in them, it is my strong opinion that it could not, and that no inflammation of Gunpowder has ever occurred at the Mills from such a cause.

In reference to the incorporating Mills, it appears that they are usually either of Marble or of Iron; and further that when of Marble, Chips and Fragments () have been known to separate and pass on with the Gunpowder

to

Colonel Cockburn R. A.
Director of the Royal Laboratory
Woolwich

to the pressing or granulating Houses. This it appears to me, must be, as is said, a source of serious danger, and in that respect Iron appears to be superior. To this may be added that there never can be an absolute certainty that the Limestone does not contain portions of Grit, which if present, are causes of increased danger. Iron is considered in the paper as a less ignitable substance than Stone () by which I conclude it is intended to say that it is less liable to ignite the Gunpowder, (it is more ignitable itself,) which is probably true, under the circumstances; and it is assumed that in certain cases of ignition some grit () must have been present to cause the effect. I cannot however remove from my mind the impression that either, between iron and iron, or marble and marble, the ignition of Gunpowder is possible, as an extreme case, without Grit: - for if a thin film of well incorporated powder, and a slight irregularity in the surface of the roller or bed, and the grinding twist of the roller, with its great weight, should all, by any rare conjunction of circumstances come into simultaneous effect at one spot, I can easily conceive the Gunpowder might be fired without any Grit. Of course this is generally avoided by the care taken to spread the composition uniformly (); I am only speaking here of a possibility -

It still seems to me that the roller might be Iron and the bed of some hard wood, based upon either Iron or Stone (); and if this were practical, it would relieve my mind from much of the impression of the
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risks of the incorporating houses. I do not see that whilst there is powder between the runner and the bed the wood would suffer much; but I offer it only as a suggestion - How the wooden bed should be laid, or bound together and whether it should be with the grain upwards or lengthways would be matters for practical consideration.

No galvanic effect () need be apprehended from the use of Iron in the incorporating Mills, nor from the Metals in the boxes at the Press House ().

In the Press House the Powder is described as being put into boxes (), and that Gunmetal plates are introduced with the Powder. If these boxes are Metal within, and the edges of the introduced Metal plates are liable to come against the inside of the boxes, then it seems to be very possible, that when great pressure is on, the settlement of the mass under the continued or increased pressure might cause such friction as should at some unfortunate moment inflame the powder between the two surfaces; but I am not aware whether any precaution is taken to keep the plates from ever touching the sides, or whether the box is made of or lined with wood -

I pass to the Granulating Machine; and apprehend no harm from its frame-work being constructed of Gun-metal () and the axis of iron () by any galvanic effect which they can produce (); further if the Cogs of the wheels being well formed are kept, not merely well oiled (), but wet with

with Oil, by a process of lubrication as independent as possible of the care of the Men, like that figured for instance. I think they would be as safe as, or safer than bands or any other means of conveying the power. Where the wheels are large enough to allow of the use of wooden cogs, my impression is in their favor.

In the Granulating roller the intent is, and the arrangement such, that the teeth shall never touch each other, and that nothing but powder shall pass between them (), and these conditions being fulfilled, there is as little danger as possible in the process: I do not know whether the opportunity has yet occurred of observing whether the temperature of these rollers rises in the process by the friction of their teeth against the pressed cake. It is a point worthy of attention and remark in the first instance.

In reference to the question of zinc hoops (), I at first considered them as unexceptionable, and so they are as far as they could act by Galvanic action. But there is an effect which they in common with Copper, Lead, or any metal roof () may by possibility produce, of the following nature which might be dangerous. If we suppose a roof of metal plates, & a Thunder cloud or electric atmosphere over Lead, a discharge of Lightning though at some distance, might
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cause sparks of electricity to pass between the plates, or between them and the Metal Spouts, &c, because of their being under inductive action at the time. The Sparks might be very small, but yet fine Gunpowder Dust might be in the place where they occurred, and though it is perhaps Ten thousand to One that they would fire it, still the possibility remains.

It is true that if all these pieces of Metal were a Bar of Iron in metallic communication with each other, and with a good Lightning rod, the sparks would not occur; but even from the Roof if put in such communication at first, the action of Sun, Air, Heat, cold, &c, might gradually cause separation. The Plates are riveted together and then the circumstances would be as above. Besides this it is not the mere fixing of two sheets together, or nailing them over each other, that makes Electrical contact; for the Oxide upon their surface is quite sufficient to keep them so far apart, as to be electrically separate.

With reference to the Charcoal, I am not able to suggest any thing definite; experience is the only safe guide.

Again begging you to remember that I answer with diffidence on all the practical points.

It seems to me that a safer roof cannot be constructed than that proposed (if galvanised iron) I have the honor to be Sir, Yr. faithful ob. Servt. W. Faraday
It is still 10000 to 1 against the power igniting -
24. Are there not many other combinations that might occur in the various process of making Gunpowder which would be less than 10000 to 1?