An earlier version appeared in *American Fireworks News*, No. 242, 2001.

Faversham's Gunpowder Mills

B. J. and K. L. Kosanke

Recently, while in the United Kingdom and between teaching pyro-chemistry short courses, we took a side trip to visit the restored Chart gunpowder mill. This is the only restored mill from what was once a collection of approximately ten powder mills near the town of Faversham in Kent county. When operating at their peak in 1792, these mills produced over 25,000 barrels of powder.

The first of the Faversham powder mills was established near the head of Faversham Creek sometime in the 1500s. The number of mills in Faversham increased over the years because of a combination of favorable factors. Faversham was already an established coastal port, located at the head of its tidal creek. This allowed relatively easy access to the imported components of the powder; sulfur from Italy and Sicily and potassium nitrate from Italy and India. Because Faversham Creek is a tributary of the Thames, this location also provided for the safe delivery of the completed powder, via a water route, to the Royal Arsenals in London. Faversham had an ample supply of water power and the local terrain was reasonably flat to facilitate the construction of the diversion channels, ponds, sluices and their control mechanisms needed to deliver a reliable supply of water to the mills' water wheels. Finally, there was a local forest to provide suitable wood for making charcoal and to provide a level of blast protection to nearby structures.

The general design of the incorporation mills was all somewhat similar. Most commonly, there was a central water wheel, to which water was delivered from below. The water wheel fed power via an arrangement of overhead gears to two edge-runner incorporation mills, one on each side of the central water wheel, thus tending to balance the load and resulting forces. A fairly typical arrangement is illustrated in Figure 1, where the water wheels (W), incorporation mills (I), water flow control structures (C), and blast walls (B)

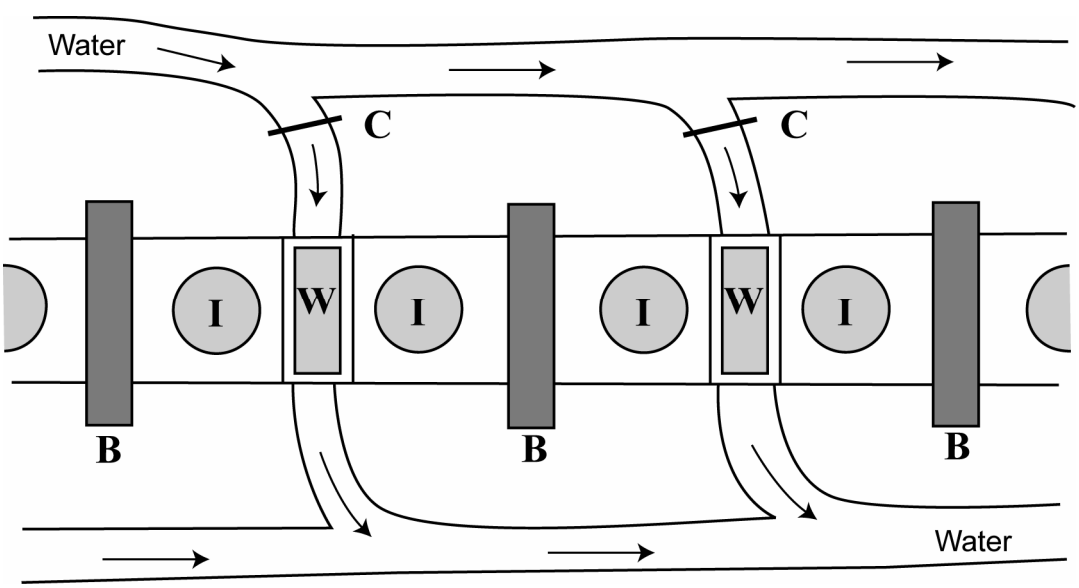

Figure 1. An illustration of a somewhat common layout of incorporation mills, where the W's are the central water wheels (fed from below), the I's are the individual incorporation mills, the B's are heavy stone blast walls, and the C's are water flow control structures.

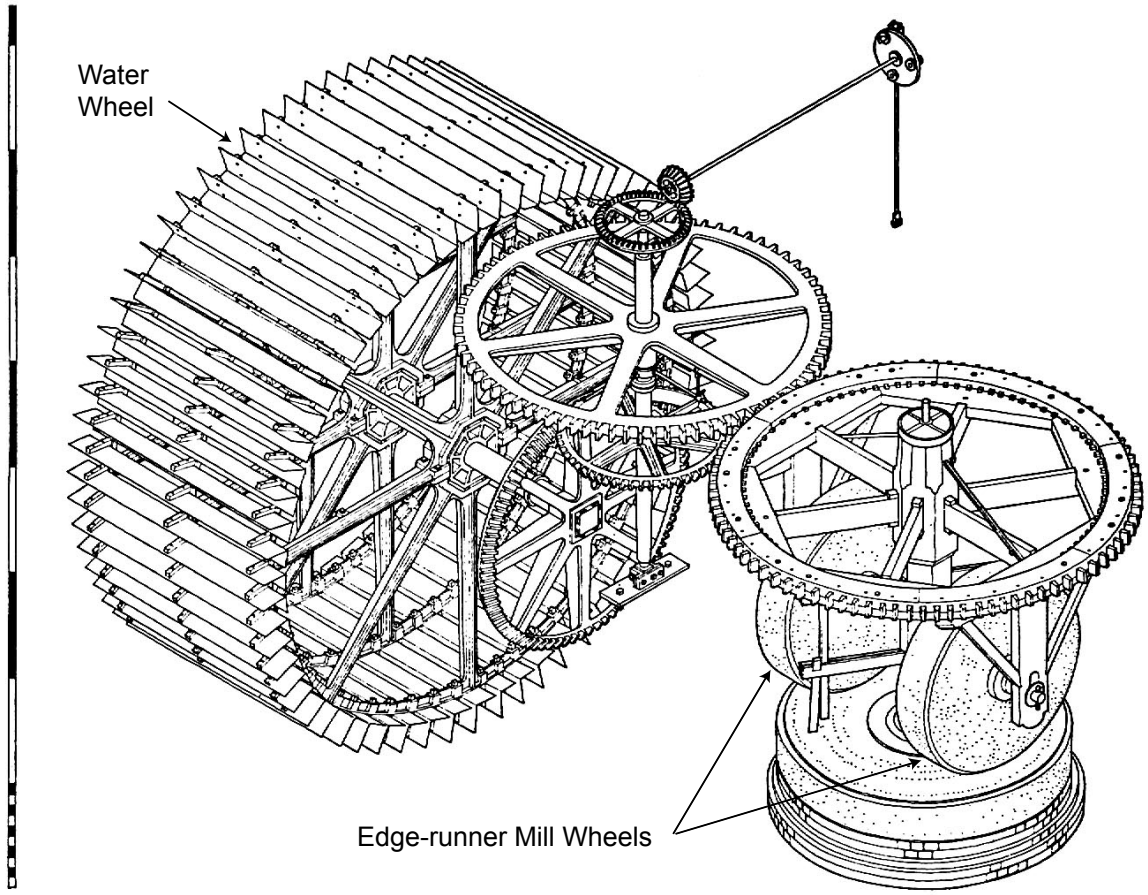

Figure 2. A detailed illustration of the mechanics of the reconstructed Chart incorporation mill in Faversham, England. (Each large scale unit to the left in the drawing is one meter.)

are shown. (Note that in some designs, blast walls were also located on either side of each central water wheel.) The wooden buildings of the mills then extended between the heavy stone blast walls.

A more detailed view of a water wheel, the overhead arrangement of gears and one incorporation mill with its pair of mill wheels is shown in Figure 2. The edge-runner mill wheels are suspended slightly above the lower surface of the mill (a heavy iron pan) with the load of powder caught and worked in the narrow space between the wheels and the pan. The wheels are mounted slightly asymmetric with respect to the angles with which their individual central shafts (horizontal) meet the main vertical shaft of the incorporation mill. This arrangement forces the charge of powder slightly toward the outside edge of the mill with each pass of the wheels. The powder is continually brought back under the mill wheels using wooden plows (not well illustrated in Figure 2). The overall action of the milling is a combination of particle size reduction and intimate mixing (i.e., incorporation) of the dampened powder.

Although impressive, the incorporation mills are only a small part of the powder manufacturing operation. To begin with the raw materials must be prepared. In the 18th century, the raw potassium nitrate needed refining through recrystalization; however, eventually the purity of the material supplied improved to the point where it could be used just as it came from the refineries. The needed charcoal was manufactured on site, using the normal destructive distillation process. Also, the raw sulfur was refined on site in a distillation process.

The charcoal and refined sulfur were first milled together, and then combined with the refined potassium nitrate. This *green powder* was moistened and charged into the edge runner mills. The process of incorporation took two hours for blasting powder and eight hours for the finer sporting powders, during which time the moisture content was maintained between approximately one and six percent, depending on the stage of the processing and the type of powder being produced. Following this milling, the *mill cake* (more commonly called *wheel cake* in the US) was removed using wooden implements and placed in trays to form layers of powder, which were then pressed to higher density using a mechanical press. The resulting *press cake* was then broken into the near final granulations in a process called *corning,* wherein the powder was passed between a pairs of wooden rollers with a gap between them. Following the corning process the powder was dried in a chamber heated by the backside of an iron fireplace. The next process was *glazing.* Prior to the 1800s, glazing merely consisted of tumbling the powder to remove its sharp edges and to have some of the dust being produced pack into exposed pores in the powder. Later glazing often included the use of graphite to lightly coat the powder grains, making the powder flow more freely and also providing a greater degree of moisture protection for the powder. The final process before packaging was the sieving of the powder into the various granulations. (It might be of interest to note that the largest number of employees in the mills were not used in making powder, but rather they worked in the cooperage, making the barrels into which the powder was loaded for shipment.)


ADVERTISEMENTS. 463

GUNPOWDER.

TRADE MARK.

EACH FLASK THUS LABELLED.

MESSRS. JOHN HALL & SON

BEG respectfully to direct the attention of Sportsmen to the varied and well-known Brands of their manufacture, which, with the traditions and experience of very many years, are yet constantly adapted to the enlarged development of practical science in Guns.

Their familiar SPECIALITIES—the "RIFLE," "GLASS," and "TREBLE STRONG" POWDERS, in all Sizes of Grains (from Nos. 1—8)—will be found worthy of their fame: while the Brand recently introduced with so much success—"FIELD B."—specially prepared for Choke-bore Guns, and giving admirable results in competitive Matches, brings up Black Gunpowder to its highest present excellence, and insures those trustworthy and calculable results which *can be obtained by no other form of explosive.*

Messrs. HALL'S GUNPOWDER may be obtained of all Gunmakers and Dealers; and Sportsmen who do not fill their own Cartridges will do well to insist that the Powder of their choice is used in the cartridges they buy.

N.B.—Sportsmen in India and the Colonies are urgently solicited to see that they are supplied with *the highest class of Sporting Powder*, and not to be satisfied with the lower qualities largely in demand for ordinary commercial purposes, which, while of excellent proportionate quality, differ widely from the ammunition on the use of which a man may safely stake his reputation, and, as has often happened, his life.

All Messrs. HALL'S Best Sporting Powder sent to India now bears this additional Trade Mark.

TRADE MARK.

MILLS:—FAVERSHAM, KENT; LOCHFYNE, ARGYLLSHIRE.

Established by Queen Elizabeth A.D. 1565.

Office: 79, Cannon Street, London, E.C.

Figure 3. An example of an advertisement of Black (gun) Powder from one of the oldest mills at Faversham.

During the period from the construction of the first mill at Faversham in the 1500s until 1759, all of the mills at Faversham were operated by private manufacturers. (See the advertisement included as Figure 3.) In 1759 the British government ceased relying on the private sector for its supply of powder and acquired all of the Faversham mills. In the half century thereafter, the government acquired much of the country's remaining private powder mills. Based on accounts of fatalities in the country's gunpowder industry, this would seem to have been a good thing. During the period of government acquisition, the annual number of fatalities in the

gunpowder industry decreased from approximately 43 to 7 per year. While the greatest number of accidents occurred in the incorporation mills, the most serious accidents and the greatest loss of life occurred in the pressing and corning operations.

The authors gratefully acknowledge the Faversham Society for supplying some of the information for this article and for granting permission to reproduce the figures in this article. In addition, a large amount of the information in the article has come from the booklet, *The Gunpowder Industry*, by Glenys Crocker, Shire Publications, 1991.