B. E. CAMMELL & J. DUFFIELD.
Treating Cast Steel Ingot.

No. 205,351. Patented June 25, 1878.

Fig. 1.

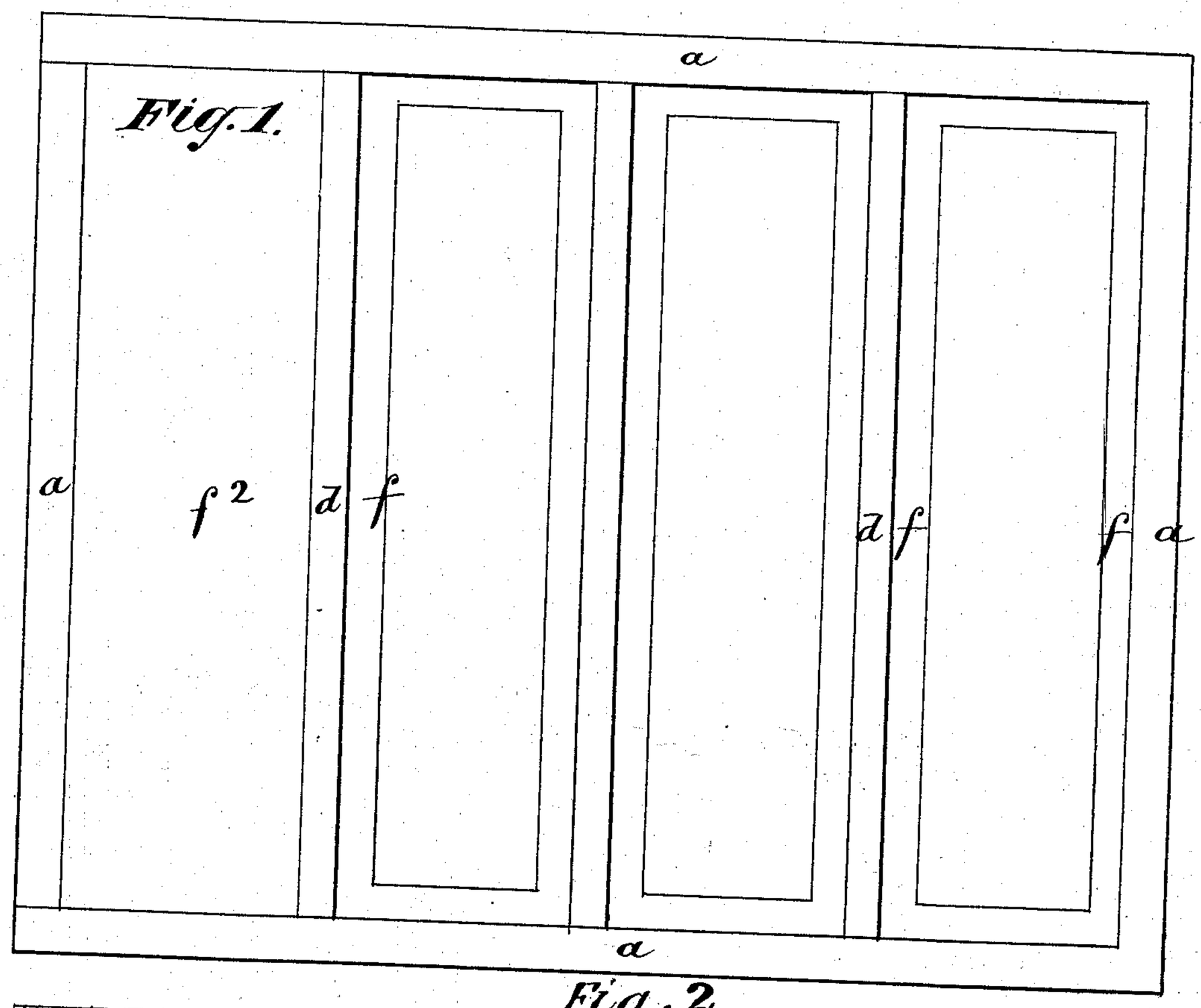
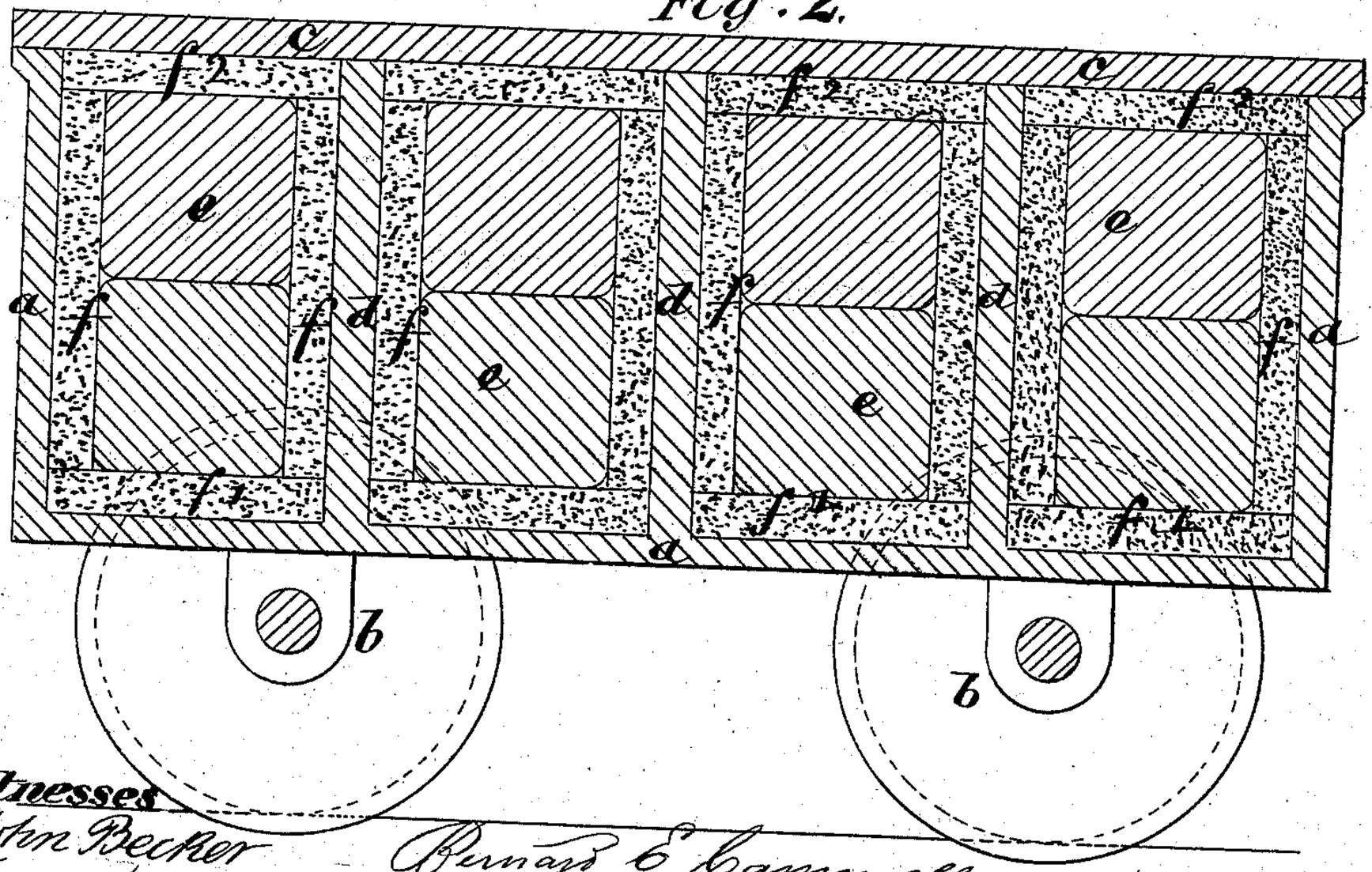


Fig. 2.



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UNITED STATES PATENT OFFICE.

BERNARD E. CAMMELL, OF SHEFFIELD, AND JAMES DUFFIELD, OF DRONFIELD, ENGLAND.

IMPROVEMENT IN TREATING CAST-STEEL INGOTS.

Specification forming part of Letters Patent No. **205,351,** dated June 25, 1878; application filed January 22, 1878.

To all whom it may concern:

Be it known that we, BERNARD EDWARD CAMMELL, of Sheffield, in the county of York, and JAMES DUFFIELD, of Dronfield, in the county of Derby, England, have invented an improved method of treating cast-steel or other ingots preparatory to rolling, hammering, or forging them into any desired form, of which the following is a specification:

Steel ingots are usually cast in iron molds, from which, when they are sufficiently solid, they are turned out and allowed to cool down. In doing so it has been found that the outer part of the ingot, by being in contact with the air, will cool very rapidly, while the internal part will still remain in a liquid state, or at any rate at a very high temperature, for some time. The consequence is that, if the ingot be broken when cold, it will be found that the crystallization of the central part of the ingot will present a very different appearance from that of the parts nearer the surface. If, therefore, an ingot, just as it comes from the iron mold, were subjected to either of the operations of rolling, hammering, or forging, for the purpose of converting it into sheets, plates, rails, bars, or other forms, the result would be very unsatisfactory, owing to the want of uniformity in the heat, and crystallization of the metal through the ingot. This is well known to iron and steel manufacturers, and therefore the usual practice is to submit the ingots to a heating-furnace before subjecting them to the operations of rolling, hammering, and forging. By thus reheating the ingot its temperature is rendered uniform, or practically so, throughout the whole mass, and it is ready for the operations of rolling, hammering, or forging. This reheating of the ingots, however, requires a considerable amount of fuel and an increase of plant, thereby adding materially to the manufacturing expenses.

These objections it has before been proposed to remove in part, and to preserve the heat in the ingot as the latter is taken from the mold, and to utilize said heat for the after manipulation or working of the ingot by inclosing the ingot, as it is taken from the mold, in a chamber or furnace of fire-resisting material, or having a charcoal or other special fire-resisting lining, and thereby to prevent the heat due to the casting of the ingot from radiating from the external part of the ingot, and so preserving the temperature of the ingot until its interior is set and the time has arrived for rolling or otherwise working the ingot. Our invention, however, removes the obections hereinbefore cited in a simpler and more perfect manner, and brings the ingots to a uniform temperature throughout their mass, suitable for rolling, hammering, or forging purposes, without subjecting the ingots to the action of a reheating-furnace. This is effected by embedding or burying the hot ingots, as they are taken from their molds, in some pulverized material which is a bad conductor of heat, thereby completely excluding the air from the ingots, while the heat from the interior of the ingot is allowed to radiate toward the exterior and raise the temperature of the cooler parts of the ingot until the heat throughout the mass is equalized and a proper temperature is obtained for the ingot throughout its whole body to admit of its being rolled, hammered, or forged into bars, rails, plates, or other articles, without the use of a reheating-furnace or specially lined and constructed chambers of fire-resisting material.

In carrying out the invention we proceed as follows: When an ingot has been cast by pouring the molten metal into the iron mold in the usual manner, it is allowed to remain in the mold a short time—that is, until it has become sufficiently solid to handle. It is then released from its mold and immediately placed in an iron box or other receptacle containing charcoal or other suitable non-conducting material in a pulverized state, and covered with this substance so as to completely exclude the air therefrom. The buried ingot is thus left until it is found that the inner part of the ingot has given up so much of its superfluous heat to the exterior as to cause an approximately-uniform distribution of the heat throughout the whole ingot, which latter is then ready to be rolled, hammered, or forged into bars, plates, rails, or other articles without any further preparatory treatment.

In the accompanying drawings, Figure 1 is a sectional plan view, and Fig. 2 is a longi-

tudinal vertical section, of one form of apparatus we employ for carrying our invention into effect.

It consists of a rectangular metal box, *a a*, mounted on wheels *b b*, for the convenience of moving it about either on rails or otherwise. It may also be provided with an air-tight cover, *c*, if desired. The box is subdivided into compartments by the vertical partitions *d d*, each compartment being capable of containing two ingots, *e e*, together with their packing of pulverized charcoal or equivalent material $f f f^1 f^1 f^2 f^2$.

When an ingot has been cast and has become solid enough to admit of handling, it is removed from the molds and placed quickly in one of the compartments of the box *a*, on the bottom of which a layer of pulverized charcoal or any other suitable pulverized non-conducting material, f^1, has been previously placed as a bed to receive it. As quickly as possible another ingot is placed on the first, and, the spaces between the ingots and the sides of the compartments having been filled with the same pulverized non-conducting material as shown at *f f*, the two ingots are covered in with a layer, f^2, of the pulverized material. When all the compartments of the box have thus been filled and the ingots covered up with charcoal, so as to prevent the access of air thereto, the box may be closed, if desired, by means of the cover *c*. The contents are then left a sufficient length of time, as before mentioned, to allow the greater heat of the central part of the ingots to radiate toward the cooler parts and raise their temperature, after which the ingots may be removed, one by one, as required, and subjected to the processes of rolling, hammering, or forging in the usual manner.

It will be seen that we have divided the chamber *a* into compartments by means of the fixed vertical partitions *d*. This is done for the sake of convenience, so that the workman can remove the ingots from one compartment without disturbing or interfering with those in the adjoining one. If desired, however, these partitions may be dispensed with altogether, and the box may be a simple rectangular vessel of suitable size to contain a convenient number of ingots; or a pit may be employed to receive the ingots. This pit, like the box, should be lined with fire-clay, and it may be conveniently situated between the Bessemer converters (or the spot where the ingots are cast) and the rolling mechanism.

The length of time which the cast ingot should remain buried in the pulverized charcoal or bad conductor of heat in order to equalize or approximately equalize the temperature throughout the whole mass will, of course, depend upon the size of the ingot and other conditions of it. From experiment, however, we have found that about fifteen minutes (more or less) is, in a general way, sufficiently long—but it may be longer without detriment—for a cast ingot measuring, say, about twelve inches square at the bottom and eleven inches square at the top, and weighing about thirteen hundredweight, to remain buried in the pulverized charcoal or non-conducting material to approximately equalize the heat throughout it and bring it to the right temperature for rolling, hammering, or forging.

Having now described our invention, and the manner of carrying the same into effect, we claim—

The process of equalizing throughout the mass of the ingot the heat which it contains when discharged from the mold, and thus rendering the ingot fit, without further heating, to undergo the operations of rolling, hammering, or forging into shape, such process consisting in burying the heated ingot for a limited time in pulverized charcoal or other bad conductor of heat reduced to a granular or pulverized state, and thereby protecting the ingot from the action of the air.

Dated the 30th day of November, 1877.

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