R. J. NASH.

CEMENT KILN.

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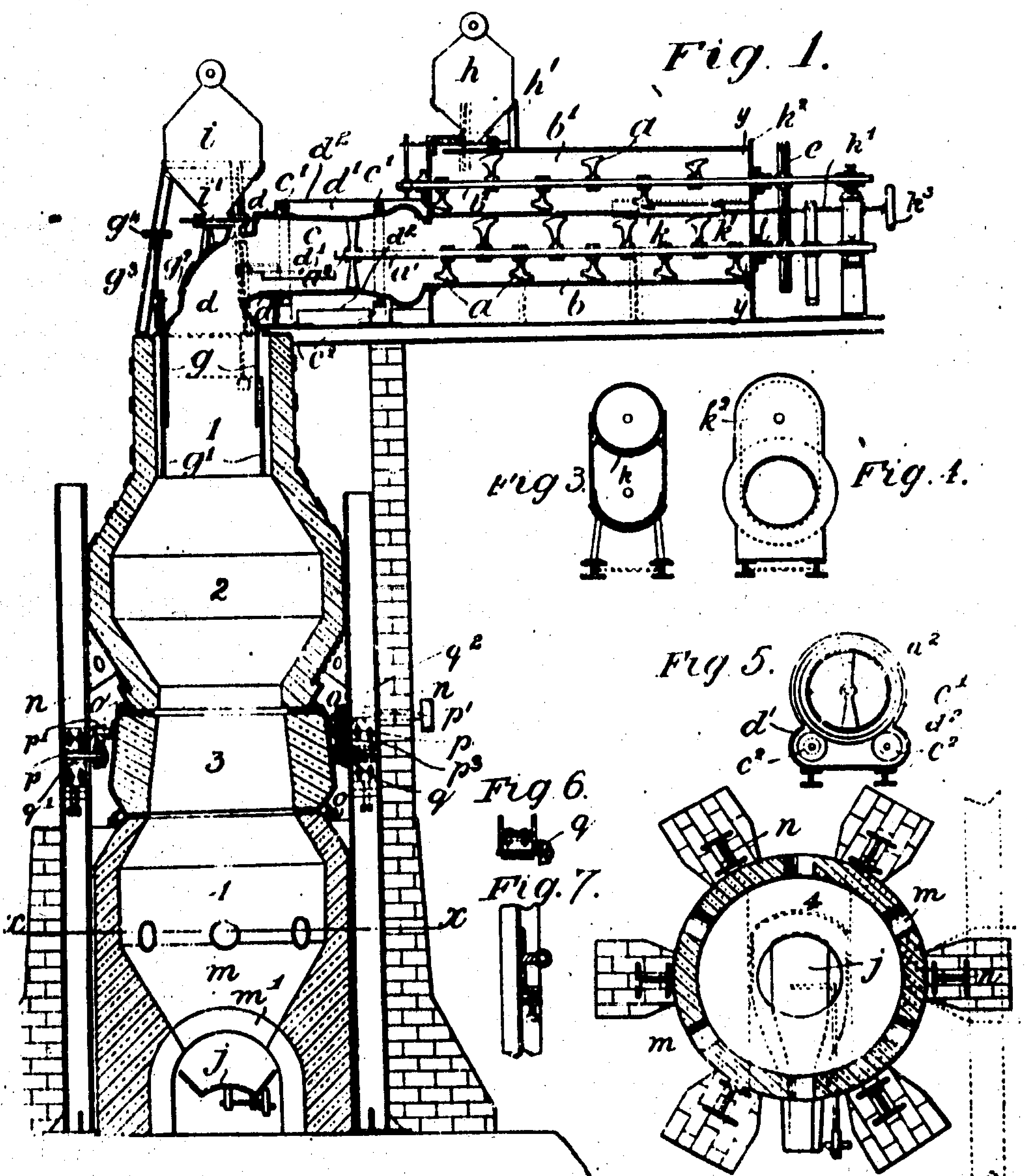
983,563. Patented Feb. 7, 1911.



Witnesses

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CEMENT-KILN.

983,563. Specification of Letters Patent. Patented Feb. 7, 1911.

Application filed August 19, 1910. Serial No. 578,059.

To all whom it may concern:

Be it known that I, ROBERT JOHN NASH, cement-works chemist, residing at Maylawn, Mitcheldean, Gloucestershire, England, have invented certain new and useful Improvements in Cement-Kilns; and I do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same.

As is well known, cement kilns as at present employed are chiefly of two types, viz., the continuous shaft kiln, and the rotary kiln, furthermore, the fuel economy derived from the use of the shaft kiln and the labor saving properties of the rotary kiln are well understood, as are also the attendant disadvantages to either type.

Now the object of the present invention is to provide a kiln which shall combine the advantages derived from both the known types of kiln, and generally to provide a more efficient kiln than hitherto.

In order that this invention may be fully understood, it will now be described with reference to the accompanying drawings in which:—

Figure 1 is a vertical cross section of a kiln constructed according to this invention. Fig. 2 is a cross section on line *w w* (Fig. 1). Figs. 3 to 7 are details hereinafter referred to.

The kiln is essentially of the vertical shaft type connected with a horizontal drying chamber, mechanically operated. The drying chamber consists of one or more conveyers of the paddle blade type, (*a*) working toward the kiln proper and against the hot gases issuing therefrom. The conveyers are arranged one above the other as shown in Fig. 3 which is a cross section on line *y y* (Fig. 1) the hot gases passing through the lower *b*, and under and through the upper chamber *b*', to an outlet or exhaust flue (not shown) the draft being produced by a suction fan arranged in the part of the exhaust flue. The discharge end of the lower conveyer is connected to a slightly converged iron cylinder *c* carried by two tires c^1 on roller bearings c^2, which acts as a bearing for this end of the conveyer (see sectional end elevation Fig. 5). The kiln end of the cylinder is inclosed by a hood *d* fixed upon the kiln proper, and thereby forming a connection with the drying chambers *b*, *b*'. The conveyers are worked by gear wheels *e* and the extended drying drum *c* is revolved by means of its connection with the lower conveyer shaft a^1 through a spider a^2. The size and shape of the conveyer blades vary at intervals along the shaft and are so designed as to best suit the condition of the material at any particular point along the line of conveyance. The duty of the revolving cylinder *c* is to form the half dried slurry or stiff pug into rounded lumps, thereby facilitating the action of burning in the kiln. The kiln is provided with a hopper *i* for the main supply of fuel. This hopper is arranged directly over the vertical portion of the kiln, and it is provided with a slidable door or feeding-device i^1. The vertical portion of the kiln may be divided into four stages or parts, (1) seasoning or smoking, (2) calcining, (3) clinkering, (4) cooling. The seasoning or smoking chamber (1) is for the reception of the green material from the drying chambers *b b*' and is so constructed that by means of a perforated iron cylinder *g* the hot gases are allowed to reach the drier without subjecting the body of green unseasoned slurry to any great heat. The calcining chamber (2) above the clinkering zone is where the expulsion of carbon dioxid is affected, followed by the intense heating previous to clinkering. The clinkering zone (3) which is made to rotate, thereby nullifying the tendency on the part of any semi-molten clinker to adhere to its surface, is where combustion is completed, and vitrification of the material takes place, and the cooling chamber (4) at the base of the structure is where the hot clinker is made to impart its heat to the air passing through it for combustion.

The kiln itself as shown is built of three sections. The bottom section 4 is constructed of brick work and is nominally a clinker hopper with a large mechanically oscillating shaker discharge device *j* (Figs. 1 and 2) at the base. A number of ports *m* consisting of short iron pipes, are built at intervals in the walls. These ports, together with the discharge aperture m^1 form the entrances for the necessary air supply. The discharge is of sufficient size to pass clinker of considerable bulk and is large enough to clear any clinker produced under ordinary conditions. The capacity of this chamber is sufficient to enable the clinker to be discharged in a warm to moderately cool condition. The discharge of the device is regulated by the speed of the raw material feed and drier conveyer, thereby keeping the level of material in the kiln constant.

n n are six perpendicular girder supports upon which the sections 1 and 2 are carried and the sections are built of substantial steel shells lined with fire brick. In order to facilitate the lining with refractory brick, the shells are constructed conically as much as is possible, the whole weight of the brickwork being taken by the conical part of the shell and in the case of the calcining chamber 2 with this further advantage, that the lower ring or rings of fire brick may be replaced without interfering with those above.

From the principle of the kiln, previously set forth, it will be obvious that considerable advantage is gained by working a number of kilns in a battery. It will therefore be necessary in dealing with the construction and working of the kiln to mention certain points common to a battery only.

The raw material, either slurry, or pug, is mixed with a proportion of breeze, which mixture is elevated, if necessary to a conveyer feeding the line of hoppers over the kiln driers. This conveyer has a capacity, greater than that of the united hopper extraction screws, *h* thus insuring a return flow of the mixture to the breeze and slurry mixer. By this arrangement, the hoppers, *h* which are only of comparatively small size, are always kept full and the feed of any particular kiln may be increased or diminished without inconvenience. The extraction screw h^1 is driven from the extended shaft b^2 of the top drier conveyer and its speed is regulated by that of the drier. The drier shafts are driven through the gear wheels *e* from a small motor, or a line of shafting through a variable speed controller. The drying chambers are constructed of substantial iron the design being shown in the sectional diagram (Fig. 3). The top part of the upper chamber is removable, as is also the side of the bottom chamber, thereby giving access to the shafting and conveyer blades for repairs or adjustment. At the discharge end of the top conveyer, the chamber is made with a sliding bottom *k* the adjustment of which alters the distance of conveyance through both chambers. The slide bottom moves upon ledges attached to the vertical sides of the lower chamber, and is adjusted by means of a screw rod k^1 passing through the drier end, and worked by a convenient hand wheel. The ends of the chambers are covered by suitable iron plates or "ends" k^2 bolted to angle iron flanges attached to and surrounding the drier. To these plates are fixed bearings *l* for the conveyer shafts, but the plate k^2 at the kiln end of the drier (Fig. 4) only closes the top chamber, leaving a clear passage from the bottom conveyer to the rotary cylinder *c*. This cylinder *c* is attached to the conveyer shafts as beforesaid by a spider a^2 keyed to the shafts as before use of which the pug is worked forward in uniform pieces previous to being subjected to the rolling action of the cylinder. In this chamber the remaining moisture is further expelled, and the thorough drying of the material completed. Should this process take place too rapidly, the lumps or balls of material will tend to burst asunder and break up into small fragments, which would greatly restrict the draft and regular running of the kiln. In order to prevent this, a clear passage is provided for the hot gases around the material as well as through it by employing an internal cylinder *g* of substantial perforated iron depending from the hood *d*. By this means, the body of material contained by the iron cylinder is not subjected to excessive heat, and by the time it is admitted to the hot chamber below it is in a condition to withstand the effects of a high temperature, without the harmful effect above mentioned. From the hood *d* inclosing the discharge end of the cylinder, a long rod or scraper d^1 is fixed, its position being such, as to detach from the ascending side of the cylinder any plastic material which should tend to adhere to its surface. As the draft within the kiln and drier is induced by suction, it would be detrimental to admit air at any point above the burning zone and as the rotary cylinder *c* is situated with a stationary structure at either end, an air passage at the junctions can not be avoided and in order to exclude outside air from these passages, the cylinder is completely inclosed by a sheet iron casing, d^2 connected at one end to the kiln hood *d* and to the drier end at the other. The bearing wheels c^2 upon which the cylinder *c* revolves are also inclosed by the casing d^2 but it is so arranged that the spindles of these wheels are carried by bearings fixed outside the casing (see Fig. 5). The whole exterior surface of the drier and casing is covered with packing of non-heat conducting properties.

The seasoning or "smoking" chamber (1) which constitutes the upper part of the top section is so designed as to allow of its capacity being varied and for this purpose a second perforated sleeve g^1 is telescopically mounted around the lower end of the cylinder *g*, adapted to be raised or lowered by screwed rods g^2 engaging extensions g^3 and operated by hand wheels g^4. These variations in size are made at the expense of the lower pre-heating chamber and the reason for thus altering the capacity of both chambers will be apparent when the manipulation of the kiln is hereinafter described.

The shell of the rotary or clinkering chamber (3) widens downward, parallel with its interior surface, as far as the bottom ring of bricks. At this point the shell narrows inward finishing with a horizontal flange. The bottom course of fire bricks are therefore of more or less the same shape as the last course in the pre-heating chamber and the weight of the refractory lining instead of being taken by the flange alone is taken by the narrowed portion of the shell. As this chamber revolves between stationary bodies, it is necessary to prevent outside air from entering at the junctions. To accomplish this, a metal channel or canal *o* is attached to the top of the chamber 3 within which a flange o^1 depends from the upper stationary chamber 2. This channel or canal *o* contains a low melting alloy or some such suitable fluid, air being thereby effectually excluded. A similar arrangement is used at the lower end of the chamber, but with the flange and canal situated vice versa. Surrounding the shell at a suitable point is a strong horizontal flange *p*, to the top side of which is bolted a bevel spur wheel p^1 while to the other side is bolted a tire p^2. The chamber by means of the tire is supported by bearing wheels *q* carried by brackets q^1 attached to the steel uprights *n* (see details in Figs. 6 and 7). The rotation of the chamber upon these wheels is accomplished by the engagement of suitable bevel wheel a^2 gearing with the spur wheel p^1. The revolution of the chamber is necessarily slow and the best speed can only be ascertained by practice, but it is probable that an internal surface speed of about 4 ft. to 6 ft. per minute would be suitable.

The manipulation of the kiln is extremely simple and straightforward. This is due to the fact that each of the different actions which take place under the process of calcination can be controlled at any stage, independently and as a whole with the greatest ease. As a rough example of the method of working with this kiln, assume the kiln running at its normal capacity but with clinker obtained from the clinkering zone (3) showing an effect of over vitrification due to excessive temperature. The burner would immediately increase the speed of the kiln in accordance with the degree of overburning to be remedied. This would have the effect of discharging the clinker and also feeding the kiln at a greater speed, with the result of a more rapid passage of material through the burning zone. In conjunction with the increased speed the size of the smoking and pre-heating chambers 1 and 2 would by extending the perforated cylinder g^1 in the smoking chamber, be increased and reduced respectively. The capacity of the drying chambers *d*, b^1 may also be reduced by manipulating the slide bottom *k* of the conveyer, with the result of an immediate loss of heat, as by these means the escaping gases would be much hotter owing to the difference in the work they would be called upon to accomplish before their exit. A corresponding effect would be produced in the pre-heating chamber 2 as the material entering from the seasoning chamber (1) would be much less advanced toward the completion of clinkering therefore requiring more heat to bring it to the requisite temperature within a given time. The effect upon the clinkering zone (3) would be found in a very short time and steps could be taken according to the degree of overburning to be rectified, to bring the kiln again to its normal working rate. The reason for taking overburning as an example of kiln manipulation is that it is the least to be desired, for the effects in the ultimate cement from this cause are more often far-reaching and active in character than are the effects of light burning.

Light and under-burning would of course be rectified by reversing the operations given in the foregoing example. It would only be in severe cases of under or over-burning that the coal supply would need to be varied, at least to any extent, and with a kiln of such consistency, variations of any description would only be slight in character and rare in occurrence.

Having now particularly described my said invention what I claim as new and desire to secure by Letters Patent is:—

1. In a kiln, the combination, with a calcining chamber and a cooling chamber arranged one above the other, of a rotary clinkering chamber arranged between the said chambers, and driving mechanism for revolving the said rotary chamber.

2. In a kiln, the combination, with a calcining chamber and a cooling chamber arranged one above the other, of a rotary clinkering chamber arranged between the said chambers, air-tight joint members provided with tongues and grooves and arranged between the rotary chamber and the said chambers, and driving mechanism for revolving the said rotary chamber.

3. In a kiln, the combination, with a calcining chamber, of an inlet hood for receiving the fuel and the material to be calcined, said hood being provided with a telescopic delivery cylinder which projects within the said chamber, and means for adjusting the length of the said telescopic cylinder.

4. The combination, with a kiln provided with an inlet hood for receiving the fuel and the material to be calcined, of a horizontal drying compartment connected to the said hood, a rotary spiral conveyer working in the said compartment and operating to feed the material into the hood, and a revoluble drum interposed between the said compartment and hood and driven by the said conveyer.

5. The combination, with a kiln provided with an inlet hood for receiving the fuel and the material to be calcined, of a horizontal drying compartment connected to the said hood, a rotary spiral conveyer working in the said compartment and operating to feed the material into the hood, a second horizontal drying compartment arranged above the first said compartment, a slidable plate between the said compartments for varying their effective length, and a second rotary spiral conveyer arranged in the second said compartment and feeding the material from it into the first said compartment.

In testimony whereof I, affix my signature, in presence of two witnesses.

ROBERT JOHN NASH.

Witnesses:
ALBERT W. WINBALL,
SYDNEY R. TAYLOR.