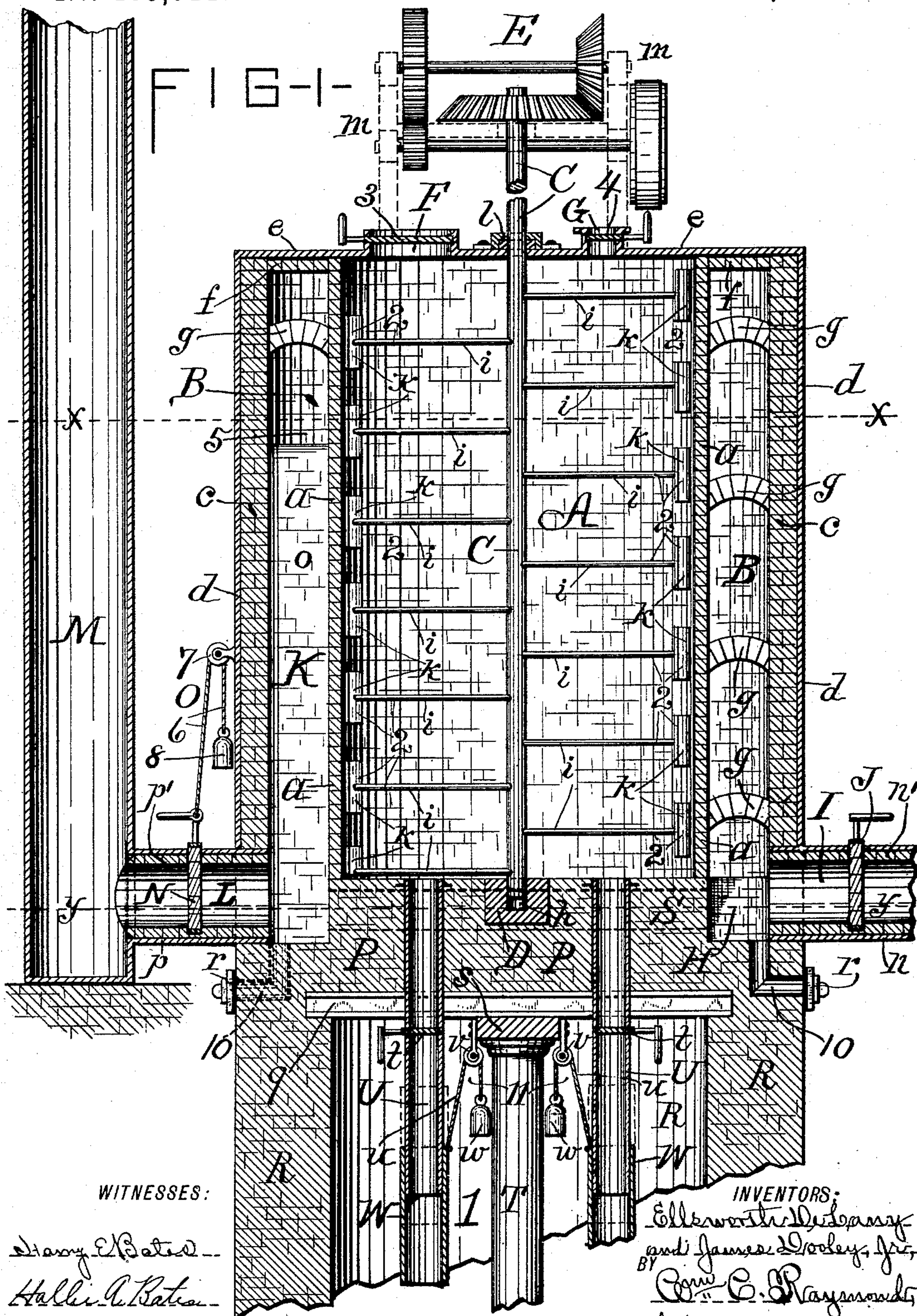


2 Sheets—Sheet 1.

## DRIER.

Patented Nov. 8, 1892.



**WITNESSES:**

Harry E. Bates  
Hallie A. Bates

**INVENTORS:**

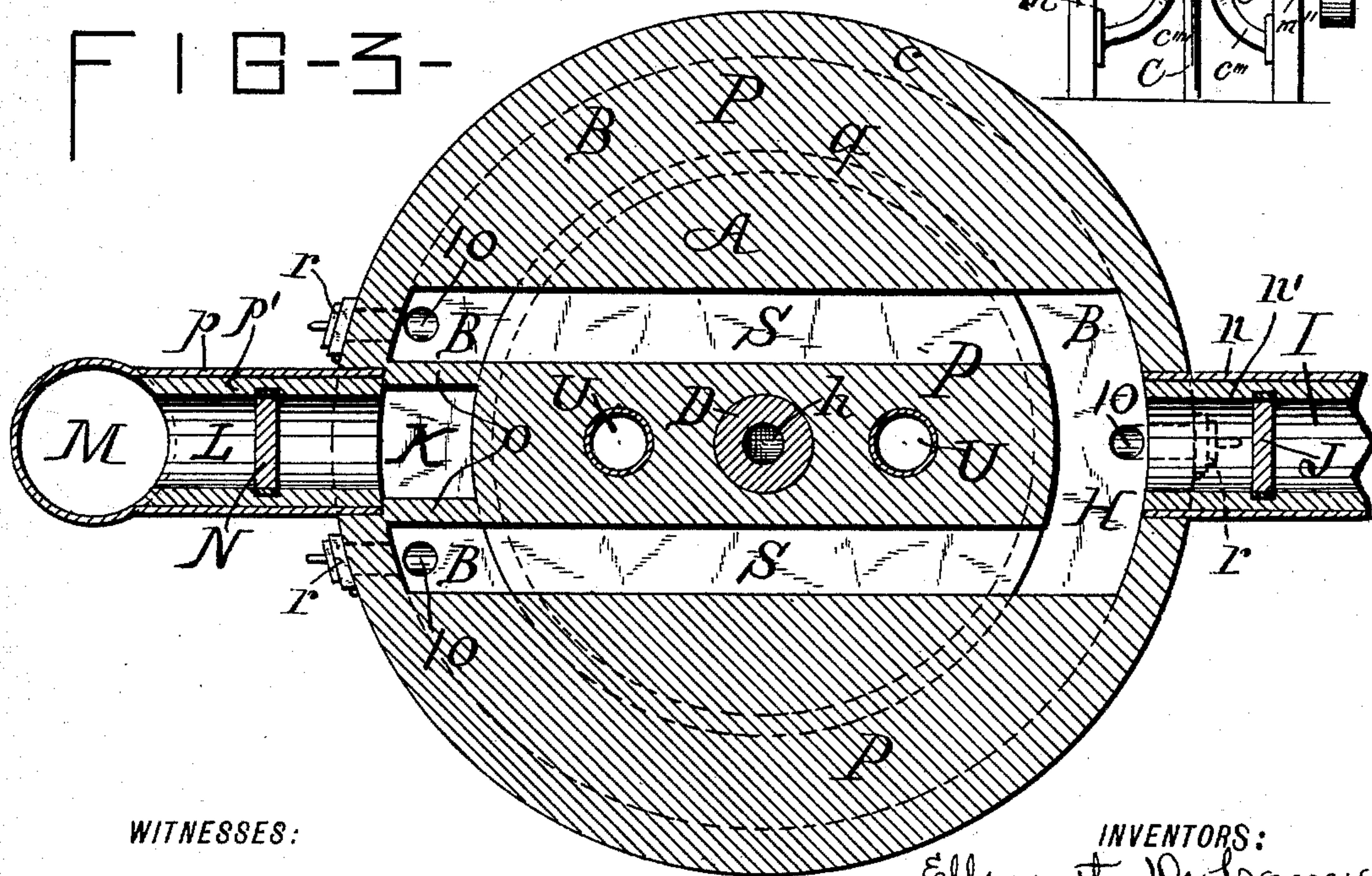
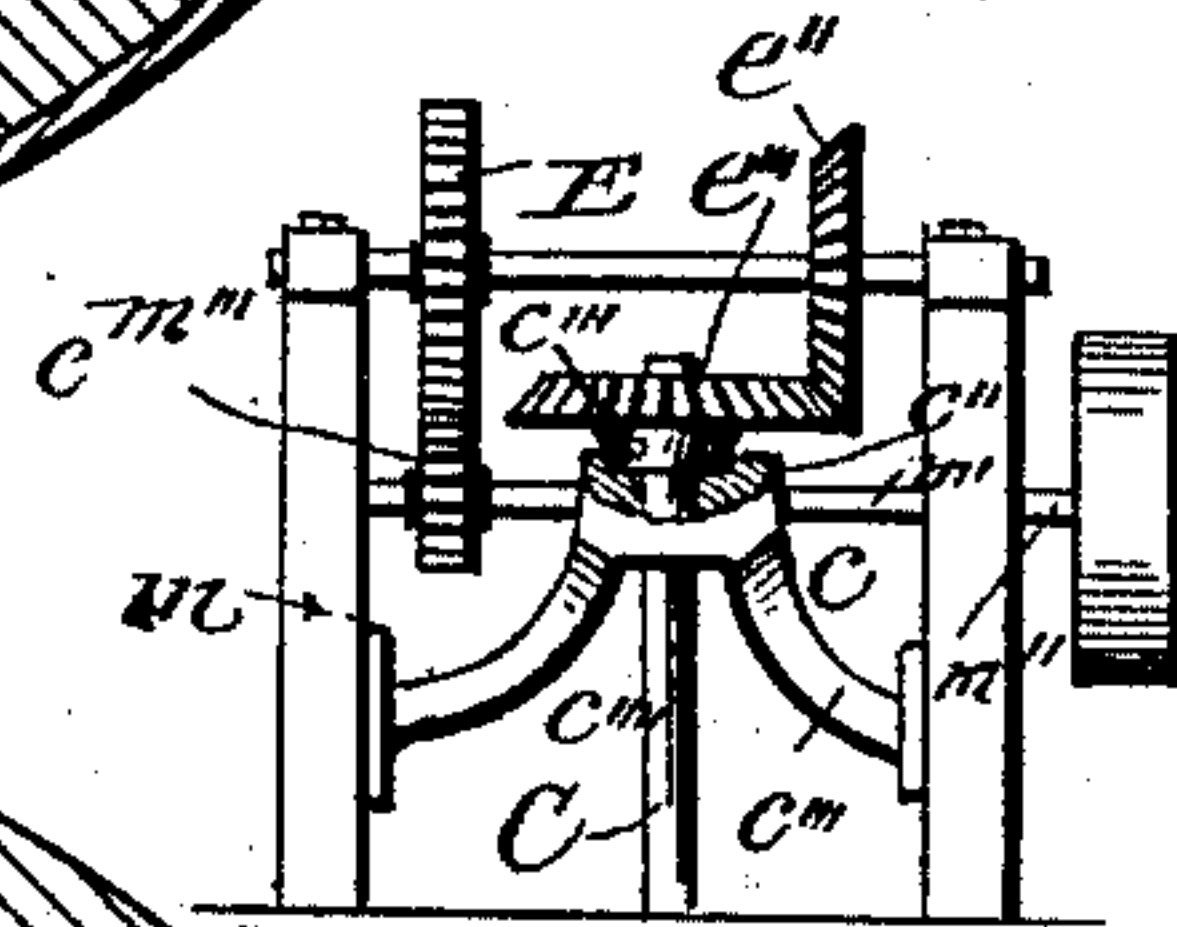
Ellsworth D. Denny  
and James D. Denny, Jr.,  
BY Com<sup>rs</sup> C. P. Raymond,  
their ATTORNEY.



2 Sheets—Sheet 2.

**DRIER.**

Patented Nov. 8, 1892.



**INVENTORS:**

Ellsworth DeLoe,  
and James Dooley, Jr.  
BY Comm  
C. B. Raymond  
their ATTORNEY.



# UNITED STATES PATENT OFFICE.

ELLSWORTH DE LANY, OF SYRACUSE, AND JAMES DOOLEY, JR., OF CAMILLUS,  
NEW YORK.

## DRIER.

SPECIFICATION forming part of Letters Patent No. 485,911, dated November 8, 1892.

Application filed September 28, 1891. Serial No. 407,080. (No model.)

*To all whom it may concern:*

Be it known that we, ELLSWORTH DE LANY, residing at Syracuse, and JAMES DOOLEY, Jr., residing at Camillus, in the county of Onondaga, State of New York, citizens of the United States, have invented certain new and useful Improvements in Driers; and we 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, reference being had to the accompanying drawings, in which—

Figure 1 is a sectional elevation taken vertically through the center of our drier; Fig. 2, a horizontal transverse section taken upon dotted lines *x x*, Fig. 1 of the drawings. Fig. 3 is a horizontal transverse section taken on dotted lines *y y*, Fig. 1; and Fig. 4 is a detached view of the upper portion of the shaft and drier and the means for suspending and operating said shaft.

Similar letters and numerals of reference denote corresponding parts throughout the views of the drawings.

Our invention relates, broadly, to driers heated by hot air, ignited gas, or steam, susceptible of utilization for the drying of varied substances, materials, or products; and, primarily, it relates to gas-heated driers or retorts for the drying of soda-ash, aluminum, and analogous substances, and, concurrently, the obtaining and saving of ammoniacal gases or other volatile products generated through the drying of the substances or materials undergoing treatment.

The object of our invention is the production of a drier of the character referred to of large capacity, great utility, comparatively cheap to construct, practically inexpensive of operation, readily operated, and thoroughly durable, efficient, and reliable.

Our invention consists in the novel features of construction and operation herein-after described, and specifically enumerated in the clauses of claims hereunto annexed.

It is constructed as follows: A is a vertical drying-chamber, of cylindrical form, created by the circular wall *a*, formed of fire-brick or other heat-withstanding material permitting the radiation of heat into the chamber A,

said wall preferably being formed of a single course of bricks to permit of the ready indirect egress of heat into the drying-chamber, wherein the substance to be dried is deposited. If deemed preferable or advantageous for the insuring of additional solidity to the wall *a* to withstand the outward pressure of the material in the drying-chamber against the same, we provide the interior surface of said wall with a metallic lining *b* of suitable thickness, as indicated by the dotted circle in Fig. 2 of the drawings.

B denotes the annular-shaped combustion and heating chamber, circumferentially surrounding the drying-chamber A, said combustion and heating chamber being created by the aforementioned circular wall *a* interiorly and outwardly by the circular wall *c*, circumferentially surrounding at a distance therefrom the aforescribed wall *a*, said outer wall *c* also being constructed of fire-brick or analogous material of a thickness preferably at least double that of the interior wall *a* and provided externally and peripherally with a metallic casing or jacket *d*, serving in unison to not only impart great and sufficient stability and solidity to the same, but also on account of the thickness of said outer wall *c* effectually preventing the passage of the heat outwardly from the combustion and heating chamber.

*e* is the disk-shaped metallic top of the drier, disposed horizontally, covering the cylindrical opening of the drying-chamber A and the annular-shaped opening of the heating and combustion chamber B, created by the upward termination of the brickwork and metallic lining and casing, said metallic top being firmly secured in place by any suitable means.

Usually we provide the under side of the metallic top of the drier lying over the combustion and heating chamber B with a lining of fire-brick *f* for the better retention of the heat within said chamber, and *g* represents arches or stays, formed of fire-brick or other fire-resisting material, disposed at intervals within the combustion-chamber B and spanning wall *a* to wall *c*, the design of same being to retain the inner thin wall *a* from lateral or outward displacement through the radial



pressure of the substance within the drying-chamber against the aforesaid wall. These braces *g*, being of comparatively-slight proportions, and thus occupying but a minimum amount of space at stated intervals, are virtually no barriers to the free passage of the ignited gas or products of combustion through or about the combustion and heating chamber B.

C designates a vertical rotating shaft suspended in operative position by a suitable bearing or support located over the top of the drier, said shaft passing axially through the drying-chamber A and at its lower termination projecting partly into a circular recess *h* in a guide-plate D, located at the base of the drying-chamber and beneath the level of its floor, said recess and shaft end being of such relative size that the latter will be loose in the former and will not touch the bottom thereof, so that all liability of the shaft becoming bound or tightened in the recess by expansion incident to its becoming heated is obviated, the object of said guide-plate being to retain the shaft C perfectly perpendicular, and thereby prevent lateral swaying thereof from operative position. Upon usually diametrically-opposite sides of the periphery of said shaft C there radially project at stated intervals lateral arms *i*, firmly secured thereto, standing outward in near proximity to the interior face of the wall *a* of the drying-chamber and provided at their extremities with scraper blades or knives *k*, that are just out of contact with the interior of the chamber-wall *a*, said several arms and their attached scraper-blades conjointly forming stirrers 2 for the stirring or agitation of the substance being dried, the vertical and incliningly-disposed blades being particularly adapted to scrape and dislodge from the interior of the wall *a* whatever portion of the substance undergoing drying may happen to adhere thereto, and whereby any material incrustation thereof is effectually prevented. As clearly shown in Fig. 1 of the drawings, the stirrers at one side of the shaft stand alternately as regards position to the stirrers at the opposite side. The shaft C, operating the stirrers, passes through a stuffing-box *l* upon the top surface of the drier and thence upward a suitable height, whereat it is connected with suitable gearing and drive-pulley or other satisfactory shaft-rotating mechanism, said driving-gear being mounted in position by means of any preferred style of standards or hangers that will insure strong and safe supports for the driving mechanism and rotating shaft.

The mechanism adopted by us for suspending and operating said shaft from its top is shown best in Fig. 4, and on reference to said figure it will be seen that such suspending mechanism consists of the vertical standards *m*, erected upon the top of the drier parallel with each other, the braces *c'*, comprising the horizontal portion *c''*, perforated for the passage of said shaft C and having in its top a

recess to receive a collar *c'''*, secured to said shaft, and the diverging arms *c''''*, secured at their lower ends to the standards *m*, and that the operating mechanism consists of a horizontal shaft *m'*, having its bearings in said standards and provided on its outer end with a drive-pulley *m''* and near its inner end with a pinion *m'''*, which meshes with a gear-wheel *e'*, mounted on one end of a shaft E, the opposite end of which shaft carries a bevel-gear *e''*, that intermeshes with a horizontal bevel-gear *e'''*, mounted on the upper end of said shaft C.

F is a charging inlet or opening provided with a slide or shut-off 3 and located at the top of the drying-chamber to one side of the rotating shaft, the purpose of which is to permit of the dumping of the soda-ash or other substance to be dried into the drying-chamber, the slide 3 being kept closed, except when the said chamber is being charged with material, and G indicates a flanged gas and moisture escape or exit located at the top of the drying-chamber and preferably opposite to the charging-inlet and provided with a sliding escape-damper 4, the purpose of said opening G being to allow, as mentioned, of the escape from the drying-chamber into any desired piping secured to the flange of the escape G and communicating with any desired reservoir or other apparatus of the ammonia or other gases or moisture generated and arising from the soda-ash or other substances undergoing drying.

H denotes a receiving-chamber disposed at one side of the combustion and heating chamber B, extending for a distance therewith upon a lower level and having unobstructed communication throughout its length with the above annular heating and combustion chamber, and I is an ingress-flue entering the said receiving-chamber through the side of the drier and preferably communicating at its other end with any suitable gas-generating device. This ingress-flue I preferably comprises a metallic tubular portion *n*, provided interiorly with a cylindrical lining of fire-brick *n'*, whereby it may effectually resist the effects of heat, and J is an upwardly-sliding damper with a suitable handle portion, and by preference formed of fire-brick surrounded edgewise with a metallic band, whereby deleterious effects of heat thereupon are obviated.

At the side of the drier structure opposite to that where the receiving-chamber H is located there is an escape chamber or flue K, created by a semi-division of the heating and combustion chamber B, said escape-chamber K extending downwardly a distance corresponding to the bottom level of the receiving-chamber H and upwardly part way the height of the chamber B, preferably about two-thirds its height, the said escape-chamber K, with its open top, being created by the medium-thick transversely-disposed division-walls *o o*, of fire-brick, rising from the bottom of the chamber and terminating a distance beneath



the top of the drier, and whereby are created upward lateral openings 5, communicating directly with the heating and combustion chamber B, as clearly shown in the drawings. Into the bottom portion of the escape chamber or flue K there horizontally connects therewith through the side of the drier structure an egress-flue L, communicating at its outer end with the vertical stack M, that is erected on a suitable foundation. This egress-flue L comprises, preferably, a metallic pipe *p*, having a cylindrical lining of fire-brick *p'*, similar to the ingress-flue I, and also provided with an egress-damper N, adapted to slide upward, formed of fire-brick and having edgewise a metallic band for the securing of the brick thereof in place. This egress-damper N also has a handle portion, and additionally is preferably provided with a cord or chain 6, attached thereto and passing up over a pulley 7, mounted upon the outside of the drier or other satisfactory support, and at its downwardly-hanging end provided with a weight 8, and thereby conjointly forming a regulating-support O for the retention of the egress-damper at whatever position it may be desired to have it kept for a certain period. Evidently the escape-chamber K and egress-flue L, in conjunction with the main stack M, act as an auxiliary stack portion for the drier, the practically-consumed gases that were in combustion or remaining products thereof being drawn through suction into the practically-auxiliary stack portion and thence upward into the stack proper and out into the atmosphere.

P denotes the base of the drying and the combustion and heating portion of our drier, and R the foundation or support thereof. The base portion P, extending horizontally beneath the drying and heating and combustion chambers of our drier, is of some considerable thickness and constructed of fire-brick or other suitable brick or stone laid in proper courses, the said base portion P being centrally thoroughly supported in place by means of metallic I-beams 9 or other satisfactory girders or supporting medium springing horizontally across from the preferably annular or circular foundation-wall R of the drier, constructed of brick or stone work and seated firmly therein. Yet, as is obvious, the foundation R may, if deemed advantageous, simply comprise piers or abutments of suitable material, with central semicircular arches rising therefrom for the support of the overhead portions of the drier. Circumferentially, as is clearly illustrated, the vertical wall or walls of the foundation R continue uninterruptedly upward to the overlying and virtually-integral portion of the base P thereupon.

S S indicate horizontal heating and combustion flues located but slightly below the floor or bottom of the drying-chamber A of the drier by choice, but a single thickness of fire-brick intervening between said floor-surface of the drying-chamber and the horizon-

tal flues S S, formed beneath, whereby the heat is readily transmitted through said material upwardly into the drying-chamber A, and these flues S S, usually comprising two or more and respectively located at either side of the center of the drier, communicate at their ends, either directly or indirectly, with opposite portions of the annular heating and combustion chamber B, whereof they form an auxiliary portion, and preferably, as illustrated in the drawings, said flues S S extend horizontally through the base of the drier in a direction corresponding to that of the ingress and egress flues; also, the flues S at one end open into that depressed part of the annular chamber B designated as the "receiving-chamber," and open at their opposite end into that depressed portion of the chamber B lying at the outer side of the partition-walls forming the escape chamber or flue K, the said escape-chamber outside whereof they terminate being of somewhat segmental contour transversely, as indicated, and whose area may be greatly enlarged, if deemed advantageous in the constructing of our drier, by starting the partition-walls *o* at points farther along the combustion and heating chamber, so as to occupy a third, a half, or even more of the space preferably reserved by us for said chamber B proper, and in that event it would be necessary to vary the location and direction of the horizontal flues S to agree therewith.

10 are cold-air flues, one of them leading from the exterior of the drier to the receiving-chamber H and the other two leading, respectively, from the outside of the drier into that depressed portion of the heat and combustion chamber B adjacent to the escape chamber or flue K, said cold-air flues entering into the said chamber B at its bottom, being respectively provided at their outer opening with air-dampers *r*, comprising, usually, suitable doors with slides therein.

At T we indicate a central support or column provided with a girder *s*, whereon the transverse horizontal I-beams centrally rest, said central support T being erected upon any satisfactory foundation within the center of the central apartment 1, (having any suitable entrance,) created by the circular foundation-wall or piers upon a solid foundation and the overhead base portion of the drier, in which apartment 1 is received the dried soda-ash or other material which has been subjected to the effects of heat.

U U represent vertical discharge-ducts for the precipitation and passage through same of the dried soda-ash or other substance and which lead from the bottom of the drying-chamber A through the base of the drier into the apartment I, extending downwardly some distance therein, said discharge-ducts at a point in proximity to the base of the drier being provided with shut-offs or slides *t* for regulating the discharge of the substance through them, and W are extension-sleeves



adapted to slide over the lower portion of the aforesaid ducts and whereby the length or projection of the pipes may be increased or diminished, as desired. To the upper part of the respective sleeves W is secured a rope or chain *u*, passing up to and over a pulley *v*, suspended from any suitable overhead support and having a weight *w* attached to its end, the said parts conjointly forming a sleeve-regulating support 11, whereby the connected sleeve may readily be upheld at any desired height upon the discharge-duct.

In the utilization of our drier for the drying of soda-ash and the like and the employment of coal-gas in a state of combustion as a heating medium our apparatus is operated substantially as follows: The coal-gas, generated by any suitable gas producer or generator and conveyed in the direction of the drier by satisfactory piping connected with the ingress-flue I, passes from said gas-producer through the aforesaid ingress-flue, and thence entering the depressed receiving-chamber H, auxiliary to the heating and combustion chamber B, meets the cold air admitted through the cold-air flue 10, opening into said chamber, whereupon some fire—as, for instance, burning waste—being already inserted within the air-flue 10 and retained there until the brickwork of the receiving-chamber H has become somewhat heated; or, on the other hand, perhaps more properly speaking, the contactor intermingling of the flames ascending from the burning substance with the gas (the necessary dampers being open for the creating of a suction through the combustion and heating chamber) causes immediate igniting and combustion of the flowing coal-gas now circulating in both directions through the heating and combustion chamber B and auxiliary flues toward the stack portion of the drier, and, as is evident, (the proper dampers being opened,) the gas in a state of combustion circulating around and underneath the central drying-chamber A, wherein the soda-ash or other substance is deposited, gradually thoroughly dries the same, causing the moisture and gases therefrom to rise, the shaft C, that is meantime rotating within the chamber, impelling the revolution of the stirrers attached thereto and agitating the substance being dried. Obviously the combustion of the coal-gas ceases, or practically so, through the consuming thereof by the time of its arrival at the top of the escape chamber or flue K, that practically is an extension of the stack M, through which the products of combustion are carried off. Evidently the quantity of the heat-producing gas may be regulated in accordance with the amount thereof requisite to perform the work required. The damper N and also the dampers J *r* are opened at the outset, when the flame is inserted into the cold-air flue for the heating of the above adjacent brickwork and igniting of the gas. While there may at times be a slight degree of gaseous combustion

within the escape chamber or flue K, it will in our opinion be of infrequent occurrence. The soda-ash or analogous substance where- with the drying-chamber A may be charged is deposited therein through the charging-inlet F in a wet state and is discharged through the discharge-ducts U in a fine and thoroughly-dried condition. It is both preferable and advantageous to charge the drying-chamber A gradually until full, and, as deemed expedient, draw out the dried substance gradually or in a body at one time. The purpose of the extension-sleeves W, sliding on the discharge-ducts U, projecting into the apartment 1 of the drier structure, is to obviate the arising of the dust from the dried material when being discharged into wheelbarrows or other movable receptacles, the extensibility of the ducts U by reason of their sleeves W admitting of the carrying downward of the same directly to the receptacles, whereby, there practically being no interval intervening between the said receptacles and the discharge end of the sleeve-provided ducts, no opportunity for the arising and consequent waste of the dust is afforded. As is evident, the sleeves W may be adjusted at any desired height and retained thereat by the regulating-supports 11. If the combustion of the gas is not thoroughly equalized throughout the heating and combustion chamber and auxiliary flues, the damper to the cold-air flue 10 at the stack side, ordinarily closed, is opened and the damper to the opposite cold-air flue 10, entering the receiving-chamber, closed, or partially so, to cause additional combustion at the stack side, and thus effect the proper equalization of the combustion and consequent even heating of the drying-chamber A of the drier. Whatever moisture, ammonia, or other gas or products is generated by the drying of the soda-ash or other substance, the same is allowed to escape through the overhead gas and moisture escape G, wherefrom it is carried by suitable piping to any desired point for further utilization. The proper dampers being opened, it is apparent that the escape-chamber K, in conjunction with the communicating stack M, insures all requisite draft or suction for the proper working of the heating and combustion portion of the drier.

The construction of the stirrers 2 (comprising the lateral arms and attached blades) and their manner of operation serve not only to agitate and pulverize the substance or material being dried, but also to keep the wall of the drying-chamber free from incrustation and concurrently permitting of the access of new moisture-laden material in proximity thereto.

Obviously, so far as the operation of our drying and heating and combustion chamber and auxiliary chambers and flues and stirrers is concerned, our drier would to a greater or less degree be adaptable for effective service were the said parts disposed horizontally instead of



standing vertically and connected with a stock and with suitable discharge-ducts disposed at a proper angle to the aforementioned portions, the whole being properly supported, such possible change or reversal of our construction of a drier being virtually, as is evident, a modification or variation, and thereby coming, broadly, within the scope and purview of our invention.

10 Having described our invention, what we claim as new, and desire to secure by Letters Patent, is—

15 1. The combination, in a drier, of the drying-chamber A, the heating and combustion chamber B, encircling said drying-chamber, a receiving-chamber H at the lower end of said heating and combustion chamber at one side thereof, an ingress-flue leading to the side of said receiving-chamber, an escape-chamber K 20 in the opposite side of said heating and combustion chamber, a stack having communication with said escape-chamber through an egress-flue L, and cold-air flues entering the lower extremities of said receiving and escape 25 chambers, all substantially as shown and described.

30 2. The combination, in a drier, of the drying-chamber A, the heating-chamber B, encircling the same, said heating-chamber having at one side thereof vertical transverse partitions forming a vertical escape-chamber in-

closed within said heating-chamber, said escape-chamber having an open top, an egress-flue entering the side of said escape-chamber at the lower end thereof, and a stack connected to said escape-chamber by said egress-flue, all substantially as described, and for the purpose set forth. 35

3. The combination, in a drier, of the drying-chamber provided with means for the ingress and egress of the material to be dried 40 and also with means for the escape of the gas and moisture with a heating-chamber closed at its top and encircling said drying-chamber, said heating-chamber extending to a lower 45 plane than said drying-chamber, a vertical escape-chamber inclosed within one side of said heating-chamber, a vertical stack having communication with the lower end of said escape-chamber, and horizontal flues connecting 50 together opposite sides of said heating-chamber at the lower end thereof, substantially as shown and described.

In testimony whereof we affix our signatures, in presence of two witnesses, this 7th day of 55 July, 1891.

ELLSWORTH DE LANY. [L. S.]  
JAMES DOOLEY, JR. [L. S.]

Witnesses:

WM. C. RAYMOND,  
HARRY E. BATES.