(No Model.) 3 Sheets—Sheet 1.

A. MASON.

APPARATUS FOR DRYING BREWERS' GRAINS.

No. 512,673. Patented Jan. 9, 1894.

Fig. 1.

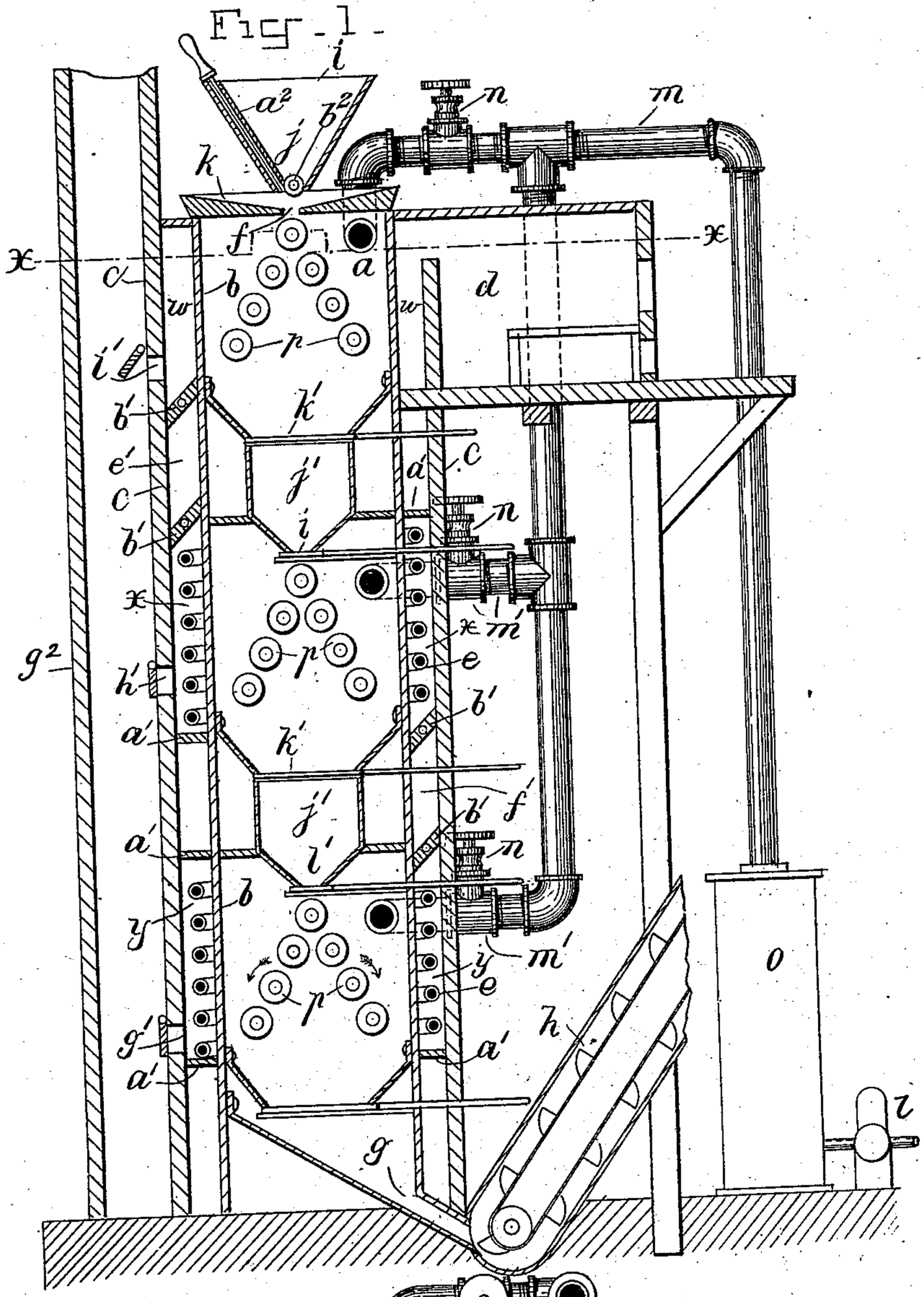

Fig. 2.

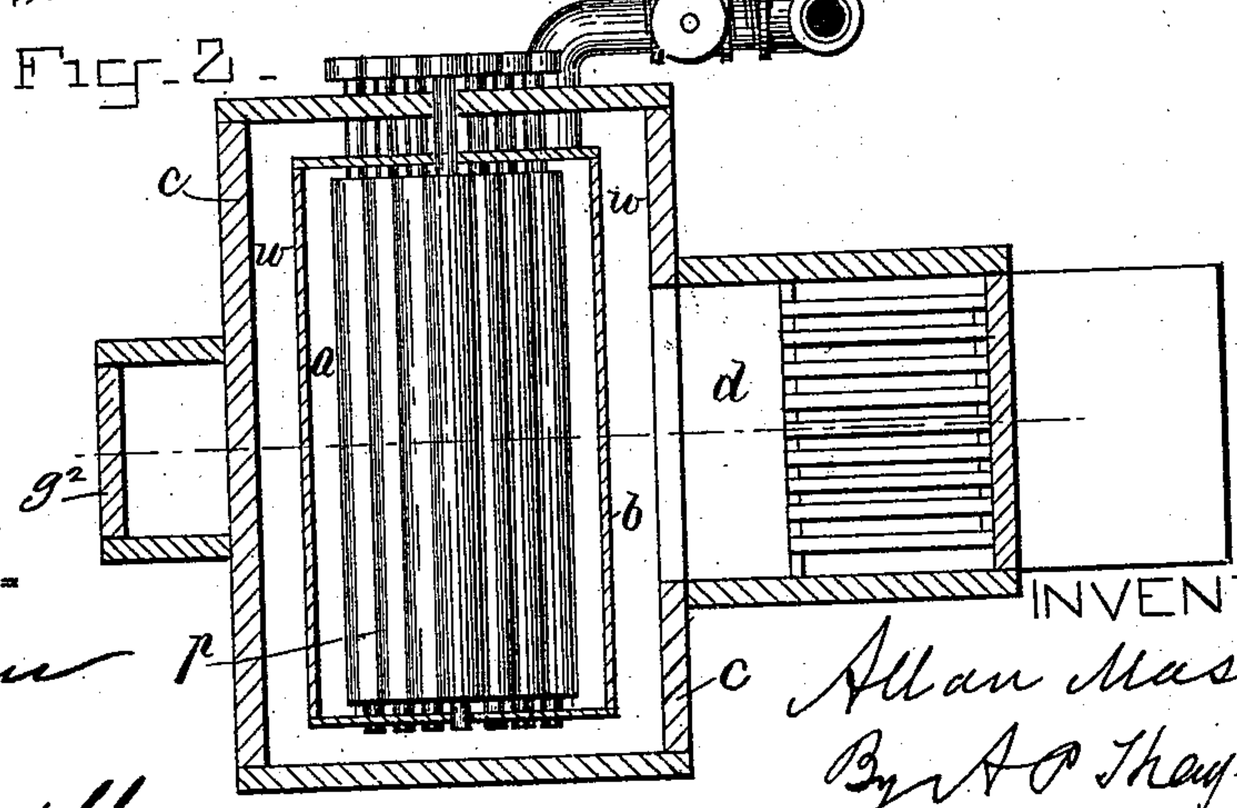

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Fig. 3.

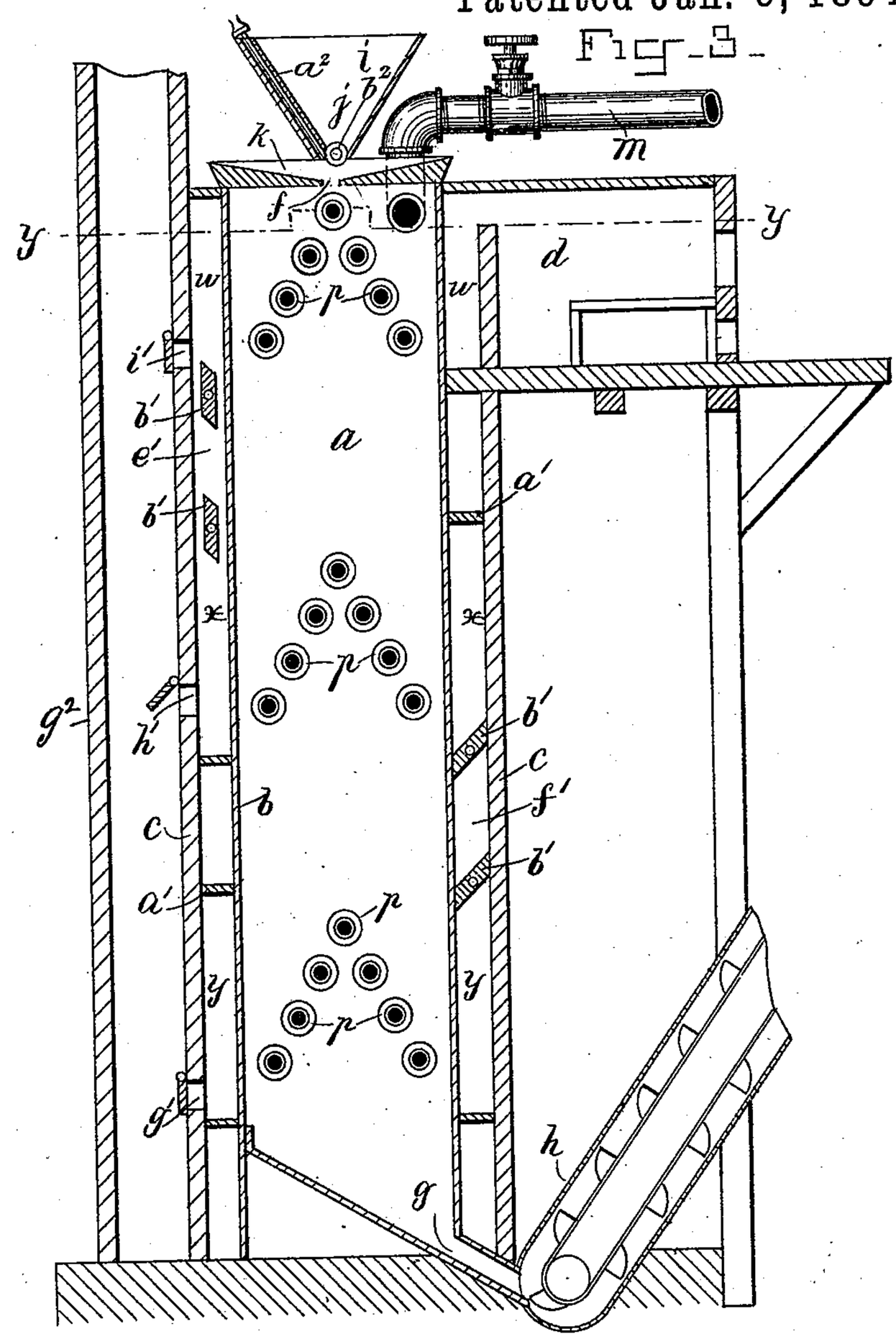

Fig. 4.

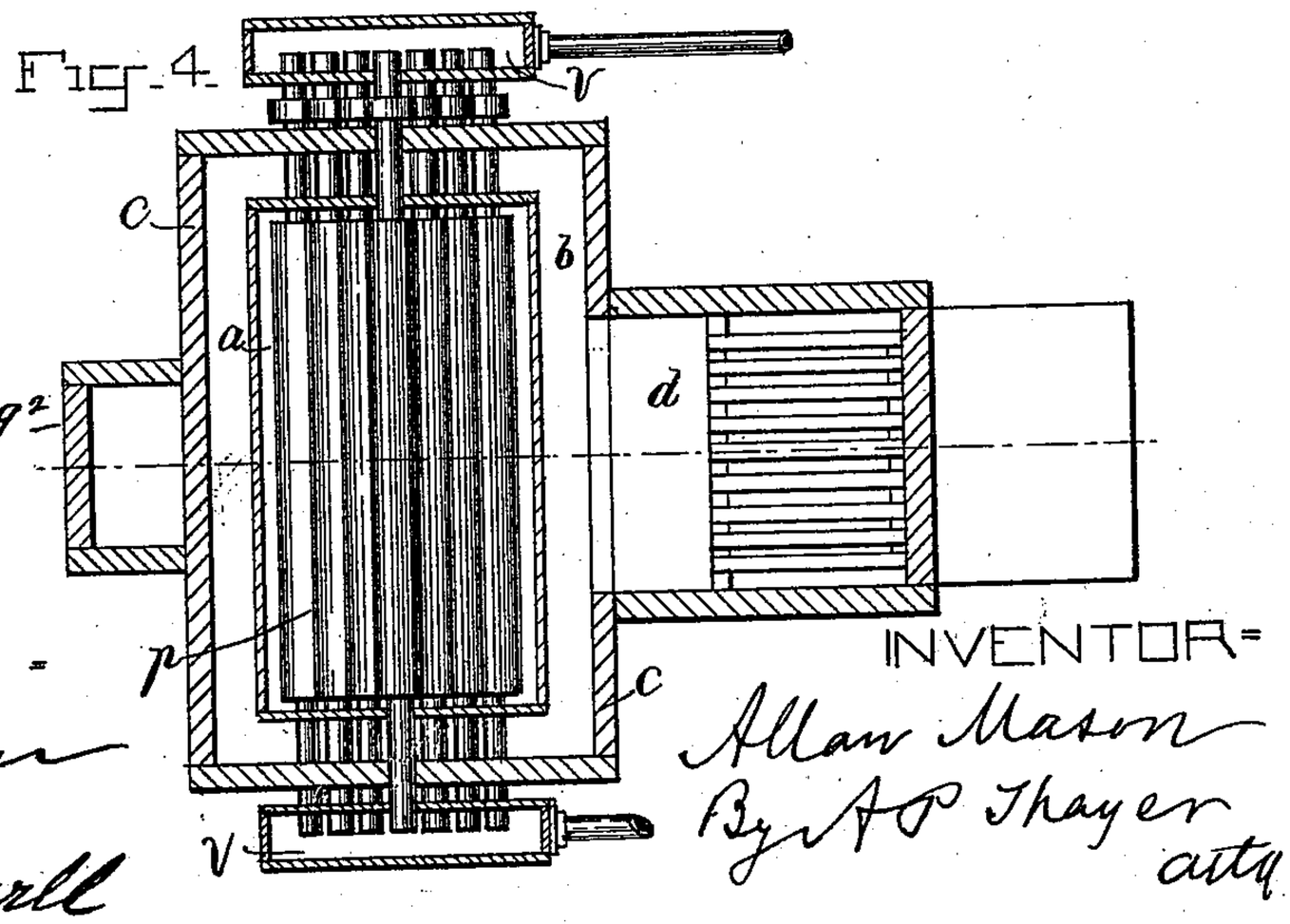

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Fig. 5.

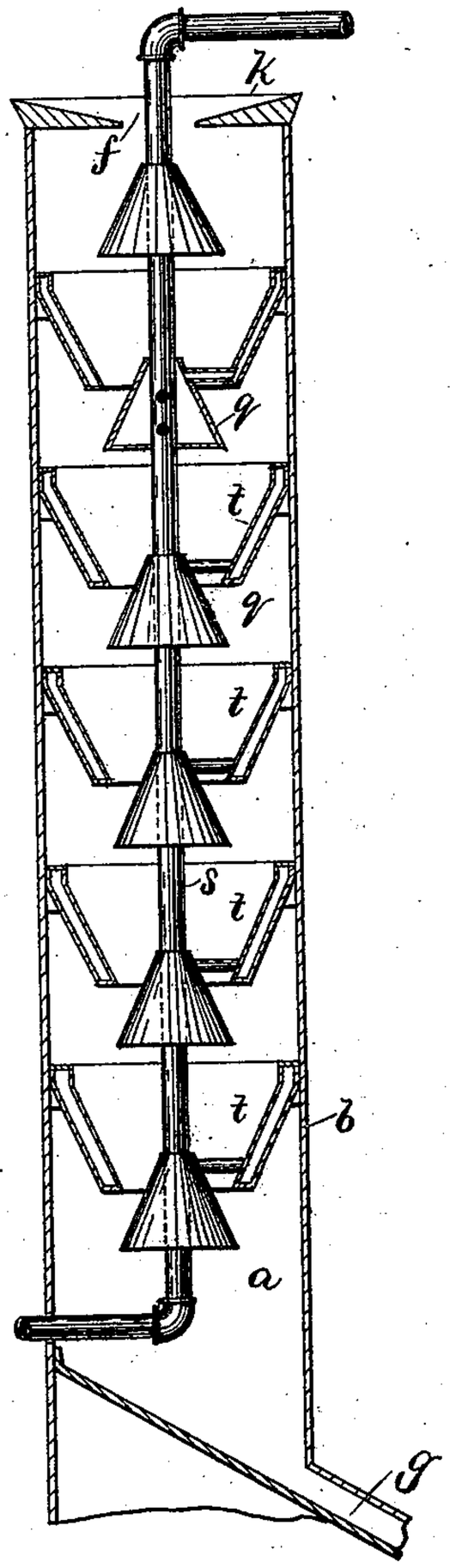
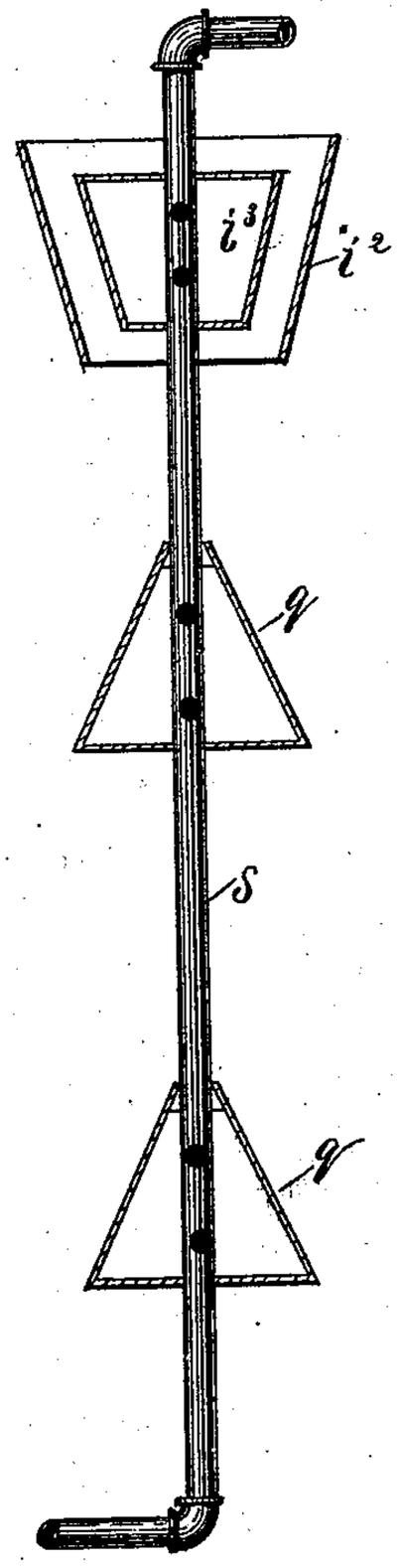


Fig. 6.



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APPARATUS FOR DRYING BREWERS' GRAINS.

SPECIFICATION forming part of Letters Patent No. 512,673, dated January 9, 1894.

Application filed December 10, 1891. Serial No. 414,551. (No model.)

To all whom it may concern:

Be it known that I, ALLAN MASON, a citizen of the United States, and a resident of Brooklyn, in the county of Kings and State of New York, have invented certain new and useful Improvements in Methods of and Apparatus for Evaporating Brewers' Grains, Saccharine Matters, and other Substances, of which the following is a specification.

My invention comprises improved means for exposure of the material to be evaporated to heat preferably in a partial vacuum during its regulated or graduated descent in a heating chamber either divided into two or more sections or not, and surrounded by the heat, the intensity of which is greater at the top where the material enters, and is graduated along the same downward according to the requirements of the case.

Various forms of apparatus may be employed for carrying out the said invention, but what I claim herein consists essentially of a vertical drying chamber either constructed in two or more sections, or not, inclosed in a heat circulating jacket of several sections to which the heat is first applied at the top in greatest intensity from a furnace located thereat to secure high temperature, and is graduated downward along the chamber, with appliances for regulating the same, also with vapor exhausting and condensing apparatus, and also with suitable means of feeding in the material to be dried and removing the dried product, all as hereinafter fully described reference being made to the accompanying drawings in which—

Figure 1, is a sectional elevation of one form of apparatus which I employ for carrying out my invention, the steam heating coil therein represented being shown merely to indicate that it may be used as another way of applying the heat if desired, but it is not essential and is therefore omitted from the other figures. Fig. 2, is a horizontal section of Fig. 1, on line *x x*. Fig. 3, is a sectional elevation of the apparatus in a modified form of construction. Fig. 4, is a horizontal section of Fig. 3, on line *y y*. In this figure I represent steam jackets coupled with the rolls used for regulating the passage of the material to be dried, which may be used in some cases but will not be necessary in other cases, and I therefore omit them in Fig. 2. Figs. 5 and 6, are sectional elevations of parts of the apparatus showing other modifications more particularly adapted for saccharine products and the like substances.

In the drying or evaporating of certain salts, phosphates, grains, fertilizers, saccharine products, &c., it is essential that the greatest heat shall be at the point of first contact or entrance into the evaporator or drier, and only be maintained at that temperature for a certain portion of the space and time of exposure thereto, and that the heat shall decrease as the material gets nearer to crystallization or the perfectly dry state. In the majority of cases it is absolutely injurious for the products of combustion to come in contact with the material being crystallized, evaporated or dried as it has been applied in some cases. In the case of brewers' grains and cereals it renders them unpalatable for animal food and unfit for brewing or milling. It is essential also in many cases that the different temperatures in the so-called drier or evaporator shall be certain and evenly maintained. In many cases it is necessary while retarding as much as possible the progress of the material through the drier to prevent it sticking or adhering to any part or parts of the evaporator or drier. For this purpose I make the retarders hollow and so that steam can be introduced and by its heat, without coming in contact with the material, cause the detachment of the adhering substance.

In the case of grains and cereals the direct application of the air and products of combustion in contact with the material being dried prevents—because of the danger of setting them on fire—the use of the high heat necessary to thoroughly evaporate in a chamber open to such application. By my method there can be no fire or danger thereof in the drying or evaporating chamber, and in addition I do not require so high a temperature, and there would be no danger of fire by my system at any temperature I might require or choose to use.

In the drawings *a*, represents a vertical dry-

ing chamber inclosed in a metallic case, *b*, surrounded by a heat retaining jacket *c*, in which heat from a furnace *d*, or from steam heating coils *e*, is to be applied to the material to be dried which enters at the top through a feed opening *f*, and from which the dried or crystallized material is discharged at the bottom in any approved way, as by the chute *g*, conducting the same into an elevator *h*, or other approved means of removing the same. In this case I represent a hopper *i*, at the top of the drying chamber which may be supposed to receive the material from a spout or other conductor and from which the material escapes through the opening *j*, at the bottom into the shallow pan *k*, below and having the aforesaid passage *f*, admitting the material into the drying chamber. The hopper or pan or both may have any approved form of regulating gate or valve as the sliding plate a^2 for controlling the feed, and a feed roll b^2 or other feeding device may be employed in the opening of the hopper to prevent clogging and to regulate the feed, as may be necessary in the treatment of some substances as brewers' grains, cereals and the like. With such a drying chamber the inlet and discharge passages of which will be practically closed in operation by considerable bodies of the material being treated collecting in advance of the inlet and outlet passages so as to materially obstruct the ingress of air I combine a vacuum process for taking away the vapors rapidly generated within the drying chamber, which greatly facilitates the work, and may also employ a condenser *o*, in the treatment of substances from the vapors of which valuable products may be obtained, and connect said chamber with the condenser by the pipe *n*, with a vacuum pump *l*, connected with the condenser as usual in such cases, and when the chamber is divided into different sections as in Fig. 1, branches *m'*, are connected with each chamber, said pipe and branches having suitable regulating valves *n*, to control the exhaust from the several chambers.

For retarding the descent of the material in the drying chamber to prolong the exposure to heat, various devices may be employed as best suited to the nature of the material being treated. For brewers' grains, cereals and some other substances I will employ rolls as *p*, preferably arranged in clusters of inverted V shape in cross section, with the uppermost roll receiving the material on it and so geared that the material is delivered downward from one roll to another along and outside of the inclined ranges of said rolls.

For saccharine products and other viscous fluid substances I will employ a series of steam heated cone shaped retarders *q*, supported on a center post *s*, one above another within a circular chamber *a*, so that the material will fall from one to another, and be temporarily obstructed, said cones preferably increasing a little in diameter of the base from above downward successively, but I believe they will work well in the case of viscous fluids if all are of the same size, because such fluids naturally stick to and flow inward under the cones before escaping therefrom, but I will also employ the annular inwardly sloping shelves *t*, attached to the inner wall of the drying chamber, alternately with the cones, and projecting at the inner edges to a suitable distance within the circumference of the cones at the base so that the material will fall from one to the other of the cones and the shelves alternately. This form of retarder will also be useful with brewers' grains, cereals and other granular substances. An annular feeding hopper as i^2, may be employed for feeding the material on to the cones, with a steam heated hollow core i^3, forming the inner wall of the hopper. The supporting post for the cones will be a steam pipe and the cones will be hollow, and the pipe will be perforated within the cones for the circulation of steam for heating the plates and causing the escape of any matters adhering to the outer surfaces, and for the same purpose the shelves will be made hollow and have steam connections for the circulation of steam through them, and the rolls *p* likewise will be hollow, and the ends will connect with steam jackets *v*, Fig. 4, when used for drying any substance liable to collect on them. This device probably will not be required in the upper and hotter portions of the drying chamber, where the retarders will be kept so hot by the drying heat as to prevent the material from sticking, but will be needed in the lower cooler portions.

In Figs. 1 and 3, I represent the heat inclosing jacket divided into upper, middle and lower sections *w*, *x* and *y*, by suitable partitions *a'*, and valves *b'*, with the furnace *d* discharging directly into the upper section, said furnace being located in close proximity thereto, for the most direct and economical application of the greatest heat thereat, where the material to be dried enters in the wet condition capable of absorbing the greatest heat.

From the upper section of the heating jacket the heat products considerably cooled therein will be caused to pass down along the passage *e'*, valves *b'*, being opened, into the next section *x*, below, and thence through passage *f'*, to the lower section *y*, when still retaining sufficiently high temperature, and finally will escape through the passage *g'*, into the chimney g^2, but there is also an escape passage *h'*, from section *x*, and a passage *i'*, from section *w*, to discharge the heat products from either of them in case it may be required, and to be used also for regulating the quantity of heat passing into the chamber below by means of the valves controlling said passages. The passages are located at the lower parts of the sections of the heating jacket and the heat products are caused to flow from above down-

ward in said sections and in passing from one section to another which enables much better and more positive control than when they flow upward for the natural tendency being directly upward they pass in the most direct course to the place of escape when it is in that direction, but when the flow is downward they set back and fill all the space laterally before escaping through the passage below.

In case the hot products from the furnace are cooled too much in one or more of the upper sections of the jacket steam heat may be employed in the lower sections, by the coils *e*, as before stated, the coil of each section having a different source of supply for gaging the temperatures according to the requirements in the different sections of the heating jacket.

In Fig. 1, I represent the drying chamber divided into three sections corresponding with the three sections of the heating jacket, for retaining the material a suitable time in each, with an intermediate trap *j'*, into which the material is to be discharged from the section above and be temporarily retained while feeding into the section below. In this example a sliding gate or valve *k'*, opens and closes the passage into the trap from the section above, and a similar gate *l'*, opens the passage and regulates the feed from the trap into the section below. It will be seen that the gates *k'*, which are always closed except when dumping the material collected above, and the body of material above and in the trap below prevent suction of air from one section of the drying chamber to another which the watery mass like brewers' grains affords against inlet of air at the feed opening *f*, and a body of dried material collected in advance of the discharge spout *g*, largely obstructing ingress of air thereat, the sections of the drying chamber and especially those above the lower one may be subject to partial vacuums of considerable power which facilitate the work both by causing more rapid evaporation, and by the more rapid removal of the vapors generated. In this example I represent the gates *k'*, as arranged to be manipulated by hand for dumping the material collecting on them into the traps *j'*, from time to time, but any approved mechanical means of operating them automatically may be employed if desired.

I am aware that in some driers in which steam is used for applying the heat the steam has been first introduced in the upper part of the heating chamber and conducted downward therein, and I do not broadly claim such application of heat.

I claim—

1. The combination in a drier of the vertical jacketed drying chamber, a furnace connected with the upper portion of the jacket for applying the heat thereat, escape passages to cause the downflow of the heat along said jacket and drying chamber and feed and delivery apparatus to pass the material to be dried from the top downward through the drying chamber substantially as described.

2. The combination in a drier of the vertical jacketed drying chamber, a furnace connected with the upper portion of the jacket for applying the heat thereto, escape passages to cause the downflow of the heat along said jacket and drying chamber, feed and delivery apparatus to pass the material to be dried from the top downward through the drying chamber, and vacuum producing apparatus connected with said drying chamber to exhaust the vapors substantially as described.

3. The combination in a drier of the vertical jacketed drying chamber, a furnace connected with the upper portion of the jacket for applying the heat thereat, escape passages to cause the downflow of the heat along said jacket and drying chamber, feed and delivery apparatus to pass the material to be dried from the top downward through the drying chambers, and partitions and valves dividing said jacket into two or more sections one above another substantially as described.

4. The combination in a drier of the vertical jacketed drying chamber, a furnace connected with the upper portion of the jacket for applying the heat thereat, escape passages to cause the downflow of the heat along said jacket and drying chamber, traps separating said drying chamber into two or more sections one above another, gates controlling the passage of the material into and through the traps, and feed and delivery apparatus to pass the material to be dried from the top downward through the drying chamber substantially as described.

5. The combination in a drier of the vertical jacketed drying chamber, a furnace connected with the upper portion of the jacket for applying the heat thereat, escape passages to cause the downflow of the heat along said jacket and drying chamber, retarders in said chamber for obstructing the downflow of the material to be dried, and feed and delivery apparatus to pass the material to be dried from the top downward through the drying chamber substantially as described.

6. The combination in a drier of the vertical jacketed drying chamber, a furnace connected with the upper portion of the jacket for applying the heat thereat, escape passages causing the downflow of the heat along said jacket and drying chamber, retarders in said drying chamber consisting of rolls arranged under the inlet passage in the inverted **V** shaped order described, and the feed and delivery apparatus to pass the material to be dried from the top downward through the drying chamber substantially as described.

7. The combination in a drier of the vertical jacketed drying chamber, a furnace connected with the upper portion of the jacket for applying the heat thereat, escape passages causing the downflow of the heat along said jacket and drying chamber, traps separating

said drying chamber into two or more sections one above another, gates controlling the passage of the material into and through the traps, retarders in said chamber consisting of a cluster of rolls arranged under the inlet passage in the inverted V shaped order described and feed and delivery apparatus to pass the material to be dried from the top downward through the drying chamber substantially as herein set forth.

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Witnesses:
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