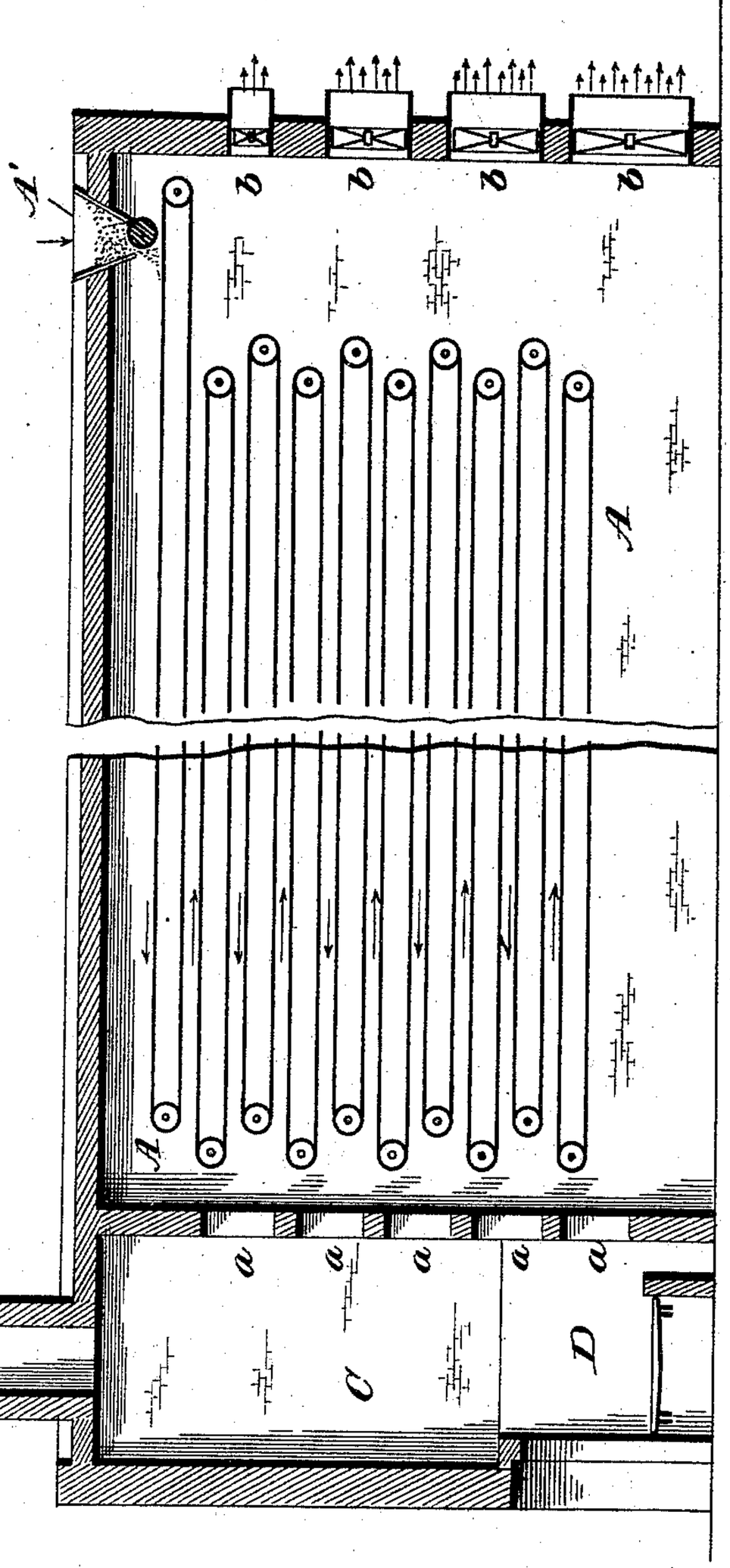
(No Model.)

C. H. KOYL.

APPARATUS FOR DRYING BREWERS' GRAINS.

No. 497,280. Patented May 9, 1893.



Witnesses
L. C. Hills.
Emil A. Dirk

Inventor
Charles Heinckel Koyl
by Marcellus Bailey
his Attorney

UNITED STATES PATENT OFFICE.

CHARLES HERSCHEL KOYL, OF BROOKLYN, NEW YORK, ASSIGNOR TO THE NATIONAL DRYING COMPANY, OF PHILLIPSBURG, NEW JERSEY.

APPARATUS FOR DRYING BREWERS' GRAINS.

SPECIFICATION forming part of Letters Patent No. 497,280, dated May 9, 1893.

Application filed January 12, 1893. Serial No. 458,150. (No model.)

To all whom it may concern:

Be it known that I, CHARLES HERSCHEL KOYL, at present residing in Brooklyn, Kings county, State of New York, have invented a new and useful Improvement in Apparatus for Drying Brewers' Grain and the Like, of which the following is a specification.

I have previously in patents numbered 453,562, dated June 2, 1891, and 460,051, dated September 22, 1891, respectively, shown from theoretical considerations and stated that I have proved in practice, certain fundamental necessities for the economical drying of large quantities of wet material such as brewers' grains, distillery waste, starch waste, &c.—these necessities being first, that the material should be spread out in thin layers, second, that these layers should be freely subjected to currents of warm air, third, that if these layers are one above the other, each should be supplied with an independent current of air in order that no one layer shall depend for its evaporation upon air which has been partly saturated by passing through or about a previous layer, fourth, that since for economy in operation the material is always introduced at the top of the kiln and dumped from one apron to another in its descent, being always wettest near the top of the kiln and successively drier on each succeeding apron, and the wetter material abstracting heat from the air more rapidly than the drier material, therefore the currents of air admitted to the kiln at different heights should be of highest temperature near the top of the kiln and of successively lower temperatures nearer the bottom, fifth, that an appropriate temperature to be maintained where the air first strikes the uppermost apron is not far from 800° Fahrenheit and at a corresponding point on the lowest apron not far from 300° Fahrenheit.

I have shown and described in my aforesaid Letters Patent appropriate means for accomplishing these ends; and said means are efficient and all that can be desired for driers of relatively small capacity, capable of producing in twenty-four hours say twelve tons of dried brewers' grains. But in late attempts to enlarge the capacity of my driers I have found that in these large kilns the currents of air introduced at one end of the drier do not maintain lines of flow sufficiently near the horizontal, but have too great a tendency to mount to the top of the kiln and therefore to leave the lower part of the drying apparatus unprovided with sufficient heat on the exit end. In driers of this relatively large capacity the aprons are for example from thirty or thirty-five to fifty feet long (I refer now only to their upper or carrying surface), and six feet wide. There are usually from ten to sixteen superposed aprons. The hot air inlets are at one end of the chamber and the outlets are at the other, with a view to cause the air to traverse the chamber lengthwise of the aprons. And the aprons are separated from the inlet wall by a space of say three feet, and from the outlet wall by an even greater interval. Thus I have a kiln, stack or drying chamber, whose internal dimensions are roughly stated from twenty five to forty feet in height, about seven or eight feet in width, and from forty-five to sixty feet in length, and through the length of this chamber, it is requisite, in order to secure the best results, that the hot fresh air should flow in approximately horizontal lines over the grain on the aprons, and at temperatures varying with the varying condition of the grain as it passes from the top to the bottom of the kiln. The natural buoyancy of the hot entering air, and its tendency to rise lead it to seek the exhaust at the other end of the chamber by way of the upper part of the chamber—a tendency which is favored by the interval between the inlet wall and the adjoining ends of the aprons; which provides a flue space or passage up through which the heated air can rise unobstructedly, and in fact does rise under ordinary conditions such as have heretofore existed. The result is that the heat to which the grain on the lower aprons is subjected, practically does not exceed 125°, although theoretically and to secure the best results it ought to be about 300°. I have found that this defect can be remedied and that approximately horizontal lines of flow of the currents of fresh air across the layers of wet material from end to end of the chamber can be insured, by providing at different points in the height of the exit end of the chamber an artificial exhaust, graduated in power from the

lowest to the highest point of exit and being practically sufficient at each point to offset and overcome the tendency of the hot air entering at corresponding points at the inlet end of the chamber to rise. The strongest and most powerful exhaust should be at the lower part of the chamber and those above it should be proportionately less according to the height at which they are placed. For example the lowermost exhaust should be say a forty eight inch exhaust fan; the one next above should be of less capacity and so on. The uppermost exhaust or exhausts indeed may be mere exhaust openings communicating with the discharge flue—the natural draft at this point being sufficient in some cases for the purpose.

The thing which is of prime and vital importance is the provision at the lower part of the exit end of the chamber for securing artificial exhaust or suction sufficient to create at that point the partial vacuum or tendency to vacuum which will neutralize the tendency of the hot air entering the chamber at and near this level to rise and will pull it over in horizontal lines toward the opposite end of chamber in which the exhaust is located.

I have mentioned a fan as the exhaust appliance, and this I in practice prefer to use and do use.

It will be understood however that for it any other suitable device for producing the requisite artificial exhaust or suction can be substituted.

A kiln thus provided with artificial graduated suction at its exit end, may have its heating apparatus and inlets constructed as shown in my patent No. 460,051, or may be provided with a heating apparatus consisting simply of a furnace and a large combustion chamber or flue from which openings are formed through the inlet wall of the kiln as in my patent No. 453,562. This form of heating apparatus which has been embodied in the latest drying kiln built by me or under my instructions is shown in the accompanying drawing which will be presently more particularly referred to. What is essential is that the drying capacity of the air passing over the uppermost apron shall be greater than that which traverses the lower aprons proportionately as the grain above is wetter than that below. The drying capacity of any current of air is a function of its volume multiplied by its absolute temperature. And by the employment of graduated suction in the manner hereinbefore indicated it is feasible to obtain large flow of air currents in horizontal lines or proximately so, and of the volume and temperature required by the varying condition of the grain to be acted on.

To enable those skilled in the art to make and use my invention I now proceed to describe the manner in which it is or may be carried into effect, by reference to the accompanying drawing which represents in longitudinal vertical central section a kiln or drier embodying the invention in its preferred form.

I have not deemed it necessary in this illustration of my invention to show the appliances for driving the aprons and the fans, nor to represent the structural details of the aprons and fans themselves. They may be of any suitable known construction; and can be driven by any of the usual power mechanisms employed for the purpose.

A is the body of the kiln or chamber—a hollow covered brick structure, with a hole in its top for the feed hopper A′ through which the wet grain is fed to the uppermost aprons. In its inlet end it has at different heights arches or inlet passages *a* communicating with the combustion chamber C; these arches or passages *a* can be screened by wire gauze or the like to prevent possibility of sparks from the combustion chamber entering the drier. This precaution however is more a nicety than a necessity. The fuel used in the furnace D is preferably coke, which in itself produces little or no spark or smoke; and as there are wide draft openings over the furnace grate (which preferably extends uninterruptedly the width of the kiln and is about six feet deep) there is not that rush of entering air through and in the immediate neighborhood of the bed of fuel which will occasion sparking.

In the opposite or exit end of the kiln are openings at different heights in which are placed exhaust fans *b* of varying power and capacity. That which has the greatest power is located at the bottom, and they thence decrease in capacity toward the top; and they are so graduated and speeded that when in action the hot fresh air entering through the inlets *a* at the opposite end of the kiln will be pulled through or across the kiln to the other end thereof in horizontal or proximately horizontal lines—these horizontal currents in their passage traversing the aprons B lengthwise, and acting on the wet grain or other material spread thereon. By means of pyrometers, as well as by actual observation of the air currents in the kiln, through windows formed therein for that purpose, it can readily be determined when the exhaust fans are so speeded and graduated in action as to secure the end in view.

The endless aprons B are some ten in number. They are superposed one above the other, and are staggered so that the material discharged from any one apron will fall upon the end of the one next beneath. They are mounted on power driven wheels (usually sprocket wheels which gear with sprocket chains bounding the edges of the aprons) and the direction of their movement is indicated by the arrows. Usually I employ wheels fifteen inches in diameter, and arrange them one above the other so that there shall be twenty-four inches between the centers of

adjoining wheels in vertical series—thus providing a space of nine inches between the upper ply of one apron and the under ply of the apron next above.

The combustion chamber is surmounted by a safety chimney or flue *c* closed by a sheet iron damper or door *d* which normally is closed during the time the drier is in operation. Should however the aprons cease running for any cause, then the damper *d* is opened thus allowing the hot air and products of combustion to pass off without entering the drier; otherwise the grain being motionless would be apt to be overheated and scorched or burned.

Having described my invention and the best way now known to me of carrying the same into effect, what I claim herein as new and of my own invention is—

The combination of the chamber or kiln, the series of superposed staggered endless aprons therein, the hot air inlets *a* and means for supplying heated air or gas therethrough, and the exhaust or suction appliances *b* located at different heights in the exit end or side of the chamber, and of graduated power or capacity, substantially as and for the purposes hereinbefore set forth.

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

CHARLES HERSCHEL KOYL.

Witnesses:

HENRY DISTLER,

CHRIS PISKE.