(No Model.) 3 Sheets—Sheet 1.

S. E. WORRELL.

MACHINE FOR DRYING OFFAL AND OTHER WET PRODUCTS.

No. 363,933. Patented May 31, 1887.

Fig. 4.

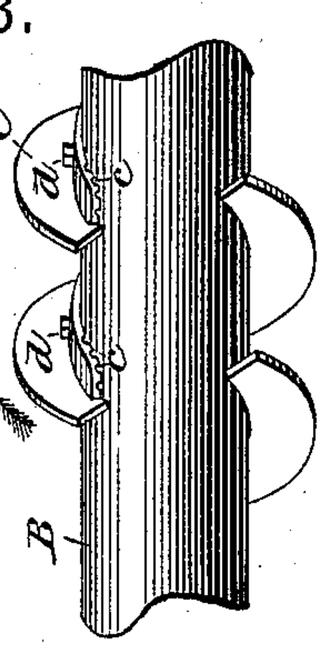


Fig. 2.

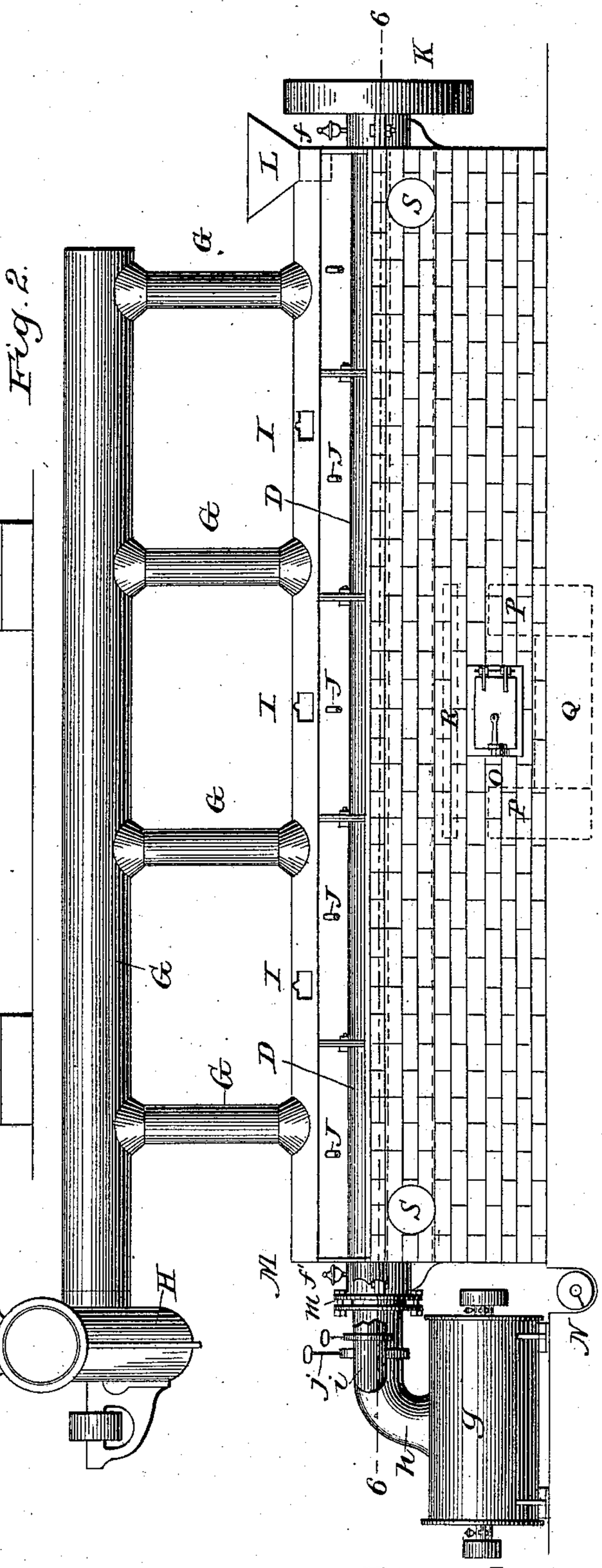
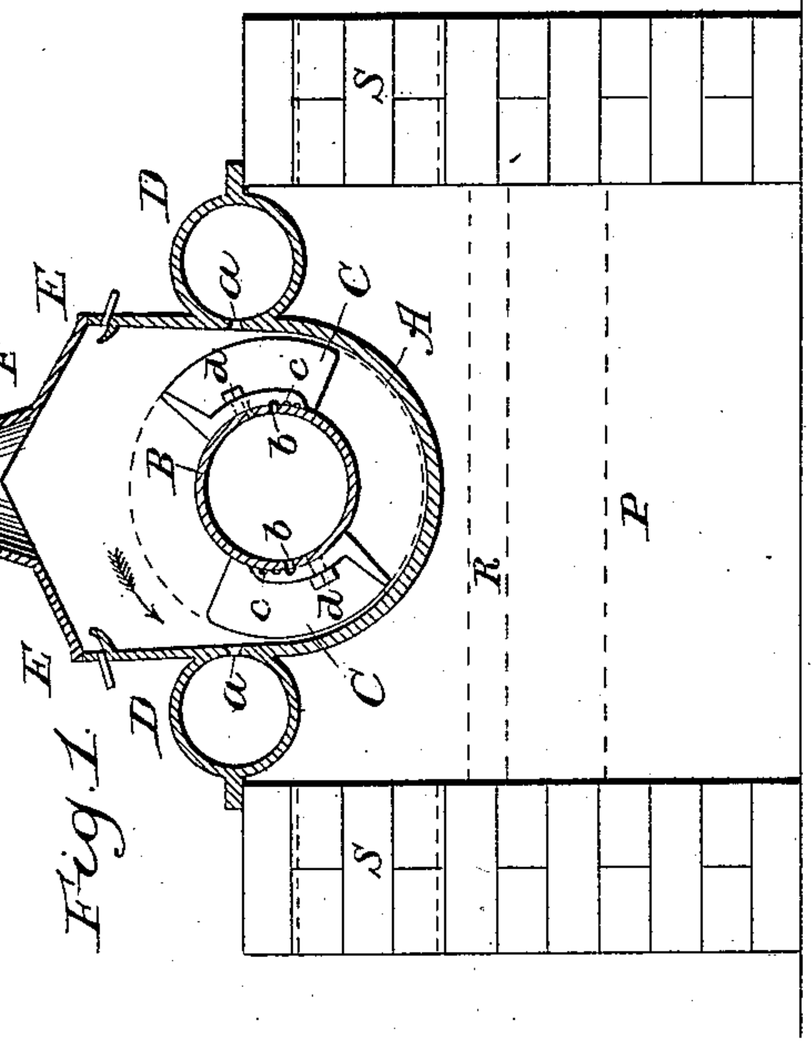


Fig. 1.



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(No Model.) 3 Sheets—Sheet 2.

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Fig. 7.

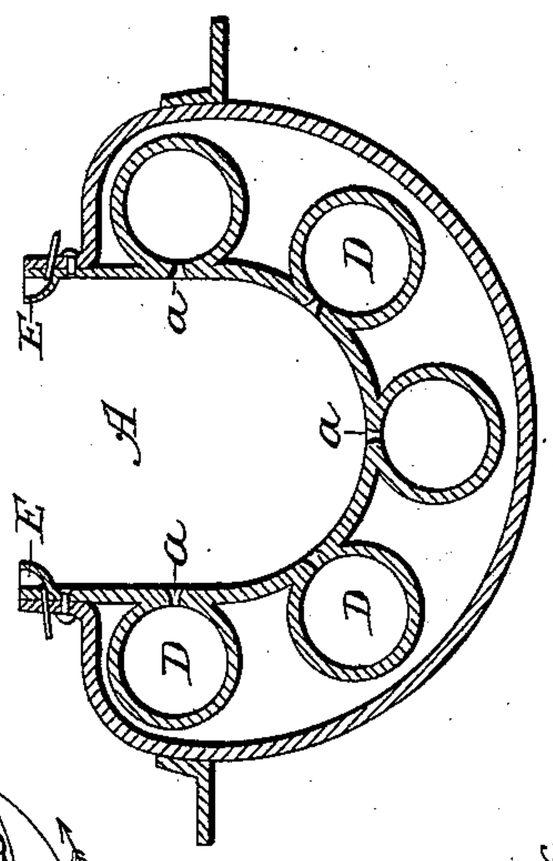


Fig. 5.

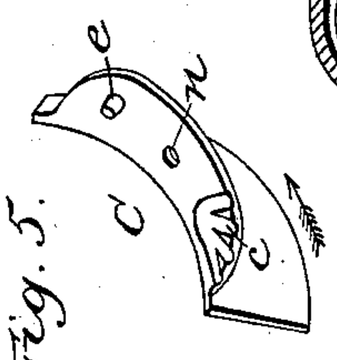


Fig. 3.

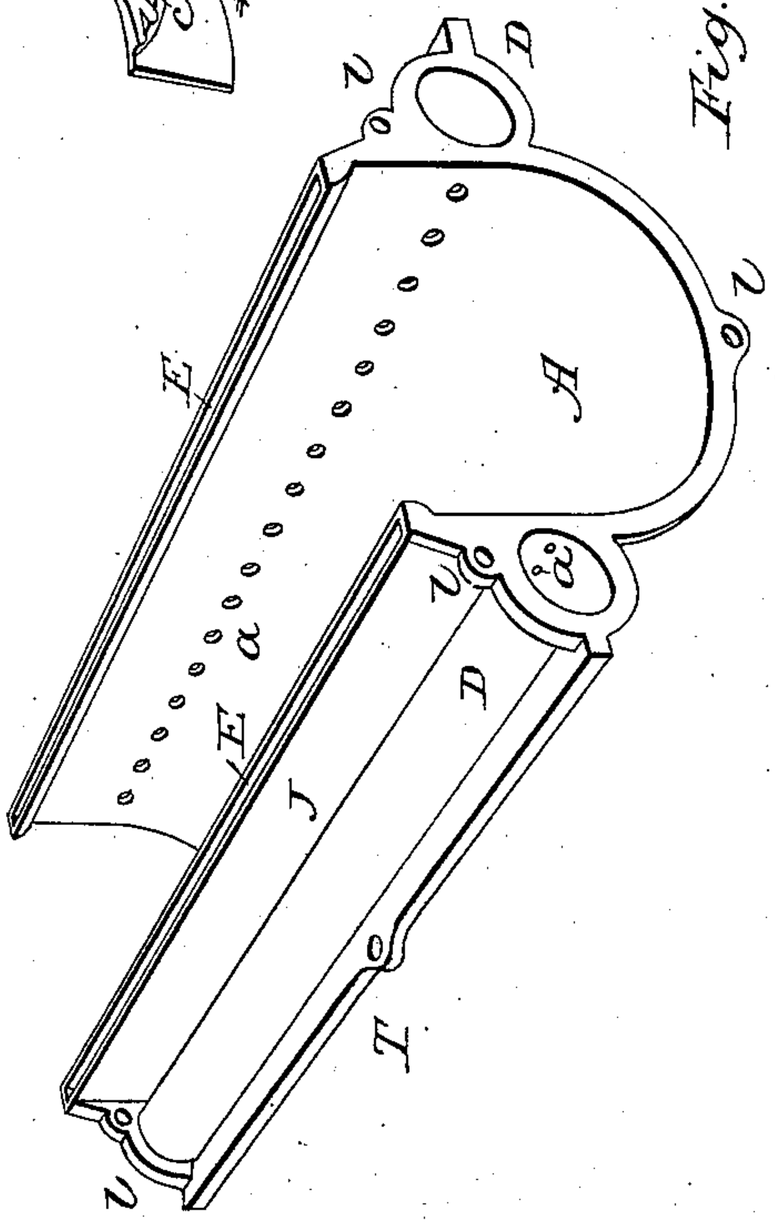
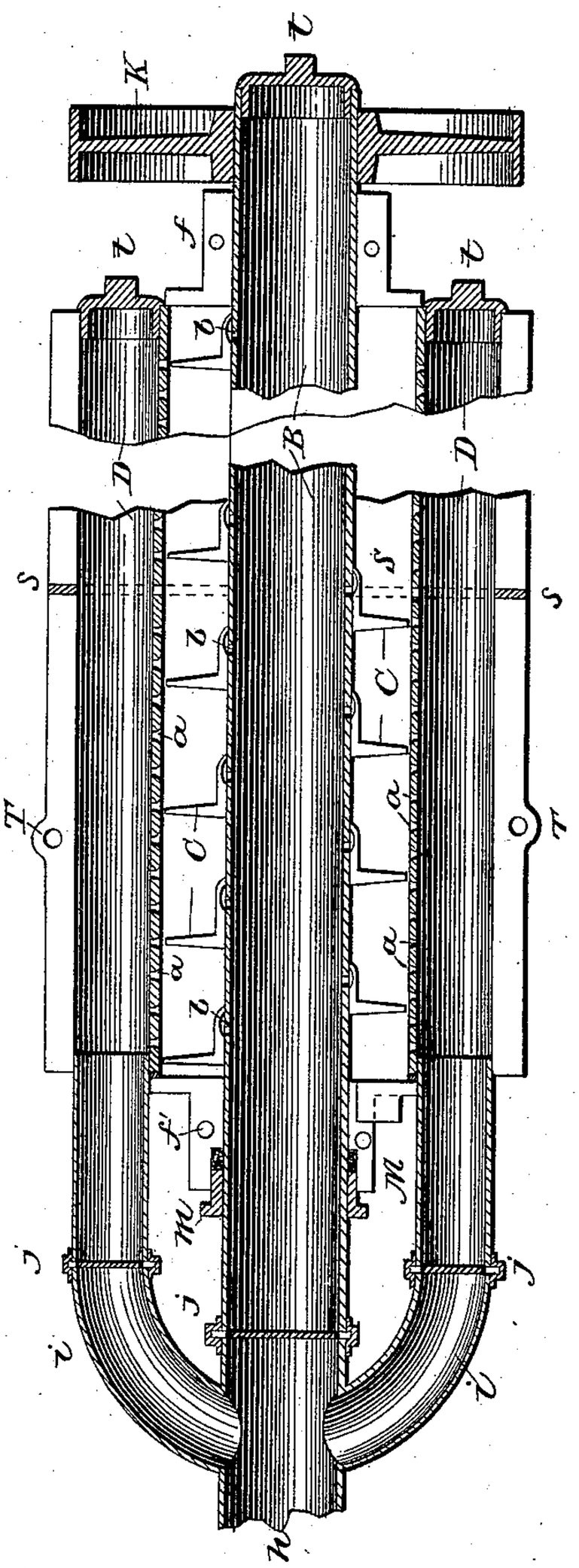


Fig. 6.



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(No Model.) 3 Sheets—Sheet 3.

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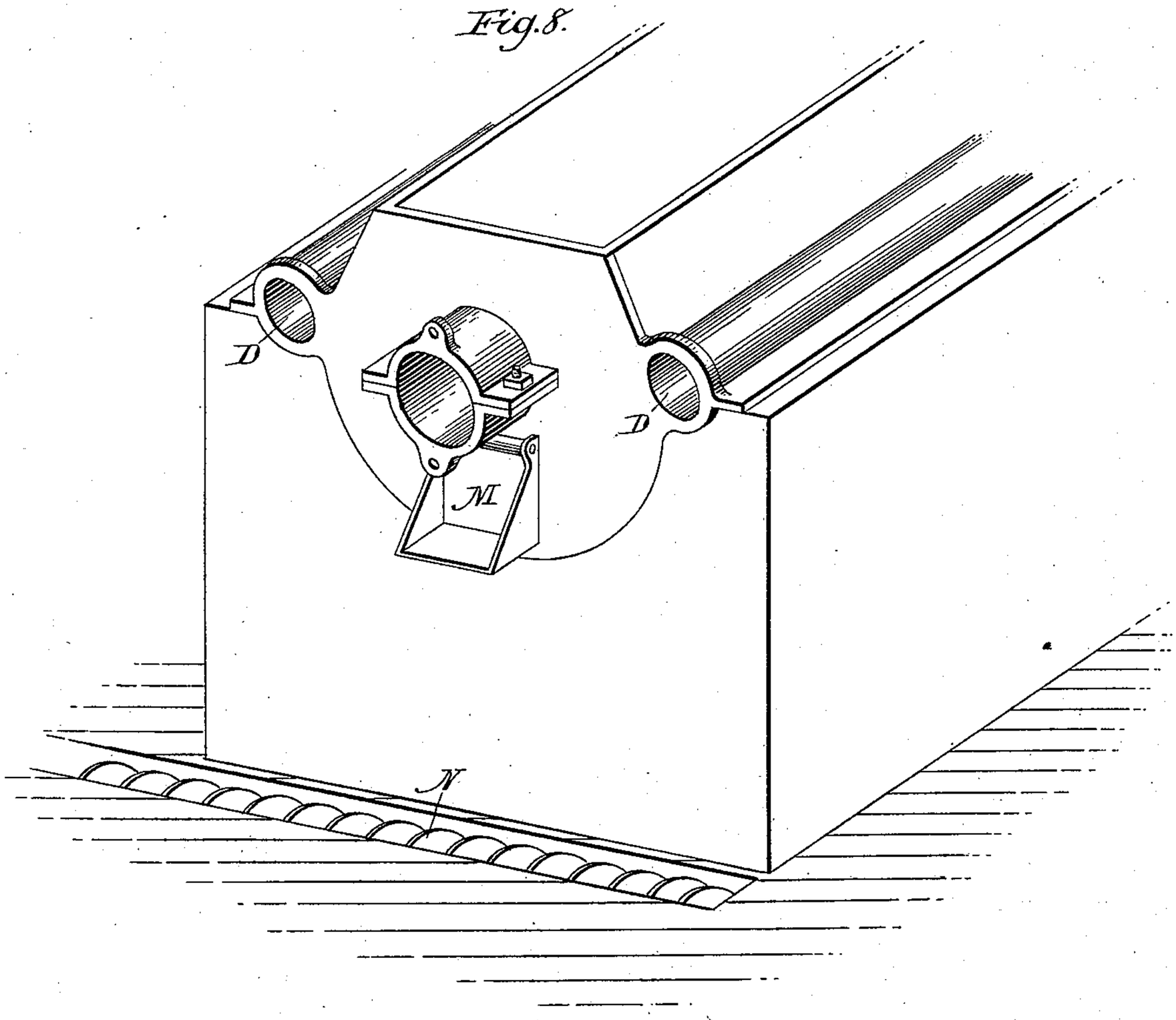
MACHINE FOR DRYING OFFAL AND OTHER WET PRODUCTS.

No. 363,933. Patented May 31. 1887.

Fig. 8.



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UNITED STATES PATENT OFFICE.

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MACHINE FOR DRYING OFFAL AND OTHER WET PRODUCTS.

SPECIFICATION forming part of Letters Patent No. 363,933, dated May 31, 1887.

Application filed May 1, 1886. Serial No. 200,989. (No model.)

To all whom it may concern:

Be it known that I, STANLEY E. WORRELL, a citizen of the United States, residing at Hannibal, in the county of Marion and State of Missouri, have invented a new and useful Machine for Drying Grain and Other Wet Products, of which the following is a specification.

My invention relates to improvements in machines for drying grain and other wet substance of a granular nature in a manner that will simplify and reduce the cost of existing drying processes and produce more perfect results in the dried products. I attain these objects by the mechanism illustrated in the accompanying drawings, in which similar letters refer to similar parts through the several views.

Figure 1 is a vertical transverse section of a drying-machine containing my improvements. Fig. 2 is a reduced side elevation of a complete drier embodying my invention. Fig. 3 is an enlarged perspective view of a section of the conveyer-trough and hot-air conduits. Fig. 4 is a distended side view of a part of the hollow conveyer and agitator as arranged in my device. Fig. 5 is an enlarged perspective of the under side of one of the conveyer-flights. Fig. 6 is a horizontal section on line 6 6, Fig. 2. Fig. 7 is a cross-section of the trough and hot-air ducts, showing a modification. Fig. 8 is a detail showing discharge.

The novel features of my invention are as set forth in the claims.

My entire device is supported by a plain structure of brick containing the furnace and heating arrangements. The conveyer case or trough A and parallel air-tubes D, to prevent injurious warping by unequal heating and for convenience of manufacture and transportation, are made in sections, one of which is shown in Fig. 3. These are flanged at each end and joined together by bolts passing through the holes *l*. The joints are packed with a layer of asbestus or other springy fireproof material, *s*, Fig. 6, which will take up the slight amount of expansion or contraction caused by the unequal degree of heat to which different parts of this case are subject to, thereby at all times securing its perfect alignment. For reasons of economy and strength, these sections are generally cast in one piece, and the bottoms are of an extra thickness of metal, to equalize the distribution of the heat passing through them. The numerous perforations *a* are for the passage of the air from its tubes D into the trough A. They are countersunk on the inner side of the case to prevent the material being dried passing into and closing them.

At the upper edges of the trough are gutters E, which collect the water that condenses on the interior of the cover F and exhaust-pipes G and discharges it through the spouts J. The flanges along the outer sides of the air-ducts D support the case upon the brick walls, and bolts passing through the holes T hold the machine in position.

The agitator B, a part of which is shown in Fig. 4, is journaled at each end of the trough and acts also as a conveyer for moving the substance operated upon over the entire length of the drier, at the same time constantly stirring and mixing it. The body of this agitator is constructed out of a tube for the purpose of using the interior of it for a cool-air conduit. To the outside of the hollow shaft B are secured the flights or stirrers C. These are placed in broken spiral lines, so as to frequently reverse the drying products and leave no extended openings through it. Perforations *b*, Fig. 1, are made in this tube under the back end of the flange of the flights for air-outlets.

Fig. 5 shows the under side of one of the stirrers C. These are secured firmly to the shaft by the stud *e* and a bolt, *d*, Figs. 1 and 4, passing through the hole *n*. Each of the perforations, *b*, communicates with a number of diverging passages, *c*, made in the inner side of the flange by which the flight is secured to the hollow shaft B. These air-outlets are arranged in this manner so as not to become clogged by the substance being dried, the flanges acting as shields to the perforations *b c*. The pitch-lines of the flights C are varied on different sections of the tubular shaft to correspond with the unequal temperature to which different divisions of the case are subject and the varying amount of moisture contained in the surrounding material being operated upon. The edges of these stirrers move closely to the circular bottom and sides of the trough and scrape off any of the substance

which, from its adhesive nature, tends to stick to the hot interior surface of the cast A.

The cover F, containing the observation-gates I, fits closely upon the top of the case A, but can be easily removed for the purpose of making repairs or examination of the operation. To the top of the cover are connected the air-spouts G leading to the exhaust-fan H.

The discharge-pipe *h* of the pressure-blower *g*, Fig. 2, leads through a stuffing-box at *m* into the hollow shaft B. This main spout is joined on each side by a branch-pipe, *i*, leading to the hot-air ducts D. (See Fig. 6.) Cut-off gates or dampers *j* are placed in all of these tubes for regulating the amount of air passing through them, and for the purpose of directing the whole air-current into any one of these pipes to force out any obstruction that may enter the apertures *a*, *b*, and *c*.

The two end journals are shown at *f f'* in driers of extra length. One or more intermediate hangers are supplied to assist in supporting the tubular shaft B, which is revolved by the pulley, gear, or chain-wheel *k*, secured to the end of it. The ends of the air-ducts D and B, not used as inlets, are closed by caps or plugs, *t*, Fig. 6, that can be easily removed at any time for the purpose of cleaning these passages.

The feeding-hopper is shown at L, and a discharging-gate is placed at the opposite end of the machine at M. The conveyer N is provided for removing the dried product.

In the heating apparatus, O is the fire-box, P are the bridge-walls, Q is the ash-pit, R the deflector, and S the smoke-outlets. The chimneys leading from the latter are each fitted with dampers, not only to regulate the draft of the furnace, but also to draw the heat to that part of the drier where it is most needed. These chimneys are not shown in the drawings, as I make no claim to them.

Having clearly described the construction of my invention, I will now proceed to illustrate the manner of operating the same, and its effects.

Motion being applied to the mechanism and connections, and combustion induced in the furnace, the wet product to be dried is supplied to the hopper L. From thence it drops down into the case A, entirely covering the agitator B. It is now brought to a high temperature by contact with the hot-metal trough; but any injurious degree of heat is prevented by its constant agitation and commingling by the stirrers C and the cool air entering through the tube B. The heat having drawn the dampness to the surface of its particles, it is now in proper condition for the drying process, which is mainly performed by the numerous streams of hot air from the conduits D passing through it. Moving air in this condition having a great affinity and capacity for moisture as it comes in contact with the wet granules, absorbs the water contained in them and carries it away. The inclination of the flights C causes the material being operated upon to gradually pass over the entire length of the machine, during which the action just mentioned is constantly being repeated, until finally it is discharged through a gate at M, Fig. 6, into the conveyer N in a thoroughly-dried condition. During this treatment the air-currents are governed as follows: The discharge *h* of the pressure-blower *g* is divided into three streams. The middle one enters the end of the hollow shaft B, passes through the perforations *b*, and through the channels *c*. It is now distributed by the flights C through the hot damp product, and escapes by the spouts G. This current of air absorbs a portion of the moisture; but its principal object is to equalize the temperature of the material undergoing the operation, so that it will endure a high degree of heat without liability of damage by scorching at exposed positions. Through the two spouts *i* (seen in Fig. 6) joining the main pipe *h* a portion of the current of air is driven into the conduits D. As these are subject to the heat of the furnace, the air during its passage becomes very hot. In this condition it enters the case A through the numerous perforations *a*. It now passes through the interstices in the material being dried, where it loads itself with moisture. Then it unites with the just-mentioned current from the agitator B, and escapes by the spouts G. To assist the action of these streams of air, an exhaust-fan, H, is connected to the pipes G, which creates a suction which greatly expedites the movement of the air through the granular substance, and thereby increases the drying capacity of the machine.

During the operation a considerable portion of the moisture held in suspension by the escaping body of air is condensed and precipitated in the form of water upon the interior of the conduits G and cover F. This liquid drains by gravity into the gutters E, and is carried out of the machine by the drain-pipes J. If such provision were not made for disposing of this water, it would return to the damp material and greatly retard the drying process. This is a very important feature of my invention.

Owing to the variable temperature of the furnace and different amount of moisture contained in the material undergoing the operation, it is desirable to provide means for easily changing the relative proportion of air entering the machine through the tubes B and D. This action is quickly accomplished by manipulating the cut-offs *j* in the pipes *h* and *i*, Figs. 2 and 6. These dampers are also used in removing obstructions from the perforations *a*, *b*, and *c*, and the conduits D and B in the following manner: By closing two of these cut-offs and fully opening the remaining one, the whole force of the blower is brought to bear on the outlets of its respective tube, and the obstacles are removed from the small channels by the air-pressure. The cap *t* is then removed from the end of this tube, and any remaining obstruction is quickly blown out of it. This action is repeated on each pipe until all

the air-passages are thoroughly cleaned. These gates *j* are very essential to the easy operation of my device. The drying process is continuous as long as the wet product is supplied and the mechanism continues in motion.

Although I find this a convenient mode of construction, I do not limit myself to the precise details hereinbefore described, as they may be varied without departing from the nature of my invention. If preferable, the number of hot-air ducts D D can be increased by placing additional ones along the bottom of the trough A, as shown in Fig. 7. If so desired, one or all of the blower-pipes *h* and *i* can be attached to the opposite end of the machine; or the tubes D and B may be supplied with air at both ends, or, again, the pressure-blower *g* can be dispensed with by connecting the spouts G to a powerful exhausting device.

In locations where it is impossible to use a furnace, or in machines for drying materials of a delicate nature and substances containing only a small amount of moisture not admitting a high degree of heat, a tight jacket can be placed around the sides and bottom of the case A, including the tubes D, as shown in Fig. 7, and steam applied as the heating agent.

My invention can be adapted for the combined drying and cooling process by extending the end at which the air enters beyond the heating arrangements or by shortening this end of the furnace. It can be utilized for cooling hot materials of a granular nature by simply omitting the heating agent.

I am aware that a number of drying-machines have been patented that somewhat resemble my invention in appearance, but their construction and operation widely differ from mine in many important features that are necessary for the successful application of a device for this purpose.

Although my device is well adapted for damp grain, seeds, green coffee, &c., it is more especially applicable to drying wet products, such as brewers' grains, starch, refuse, distillery-slops, salt, fertilizers, sewage-precipitates, clay, and other matters containing a large percentage of water.

I claim as my invention—

1. The tubular agitator B, having flights and small orifices *b*, with branches *c*, extending beneath the flanges of the flights, substantially as and for the purpose set forth.

2. The combination of a furnace, a trough with side air-ducts set over the furnace, a rotary tubular agitator within the trough, a blast-fan in connection with the side ducts and with the interior of the agitator, and air-orifices extending from the interior of the agitator and the side ducts to the interior of the trough.

3. The combination of the trough, the tubular agitator, the side ducts with orifices leading into the trough, the blast fan or blower having connection with the interior of the tubular agitator and side ducts through branching pipes, and dampers in said branches, by which any of the branches may be partly or wholly closed, as and for the purpose set forth.

4. The tubular agitator having flights disconnected from each other, and having air-passages *b c*, extending from the interior to the rear ends of the flights, substantially as and for the purpose set forth.

5. The combination, in a drier, of a furnace, a trough to contain the material to be dried, and having a rotary tubular agitator therein, a lid to the trough having ducts in connection with an exhaust fan or blower, side ducts heated by the furnace, and having orifices discharging into the trough, orifices in the tubular agitator discharging into the trough, and a pressure-blower discharging air into the agitator and the heated side ducts, for the purpose set forth.

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