Sheet 1, 4 Sheets.

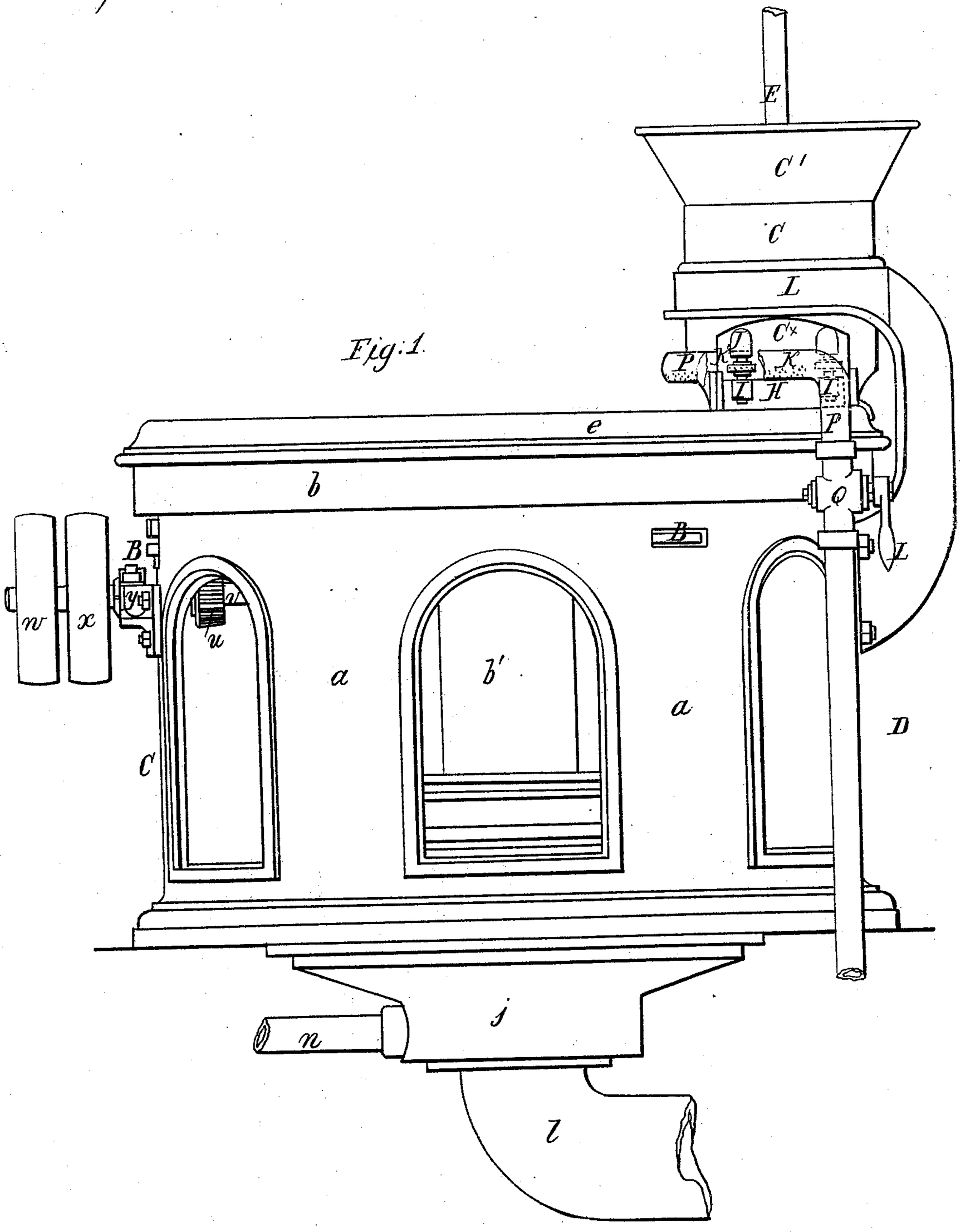
H. Bessimer.

Sugar Mach.

Patented Apr. 20. 1853.

No. 9,081.

Fig: 1.



Sheet 2, 4 Sheets.

H. Bessimer

Sugar Mach.

No. 9,681. Patented Apr. 26, 1853.

Fig. 2.

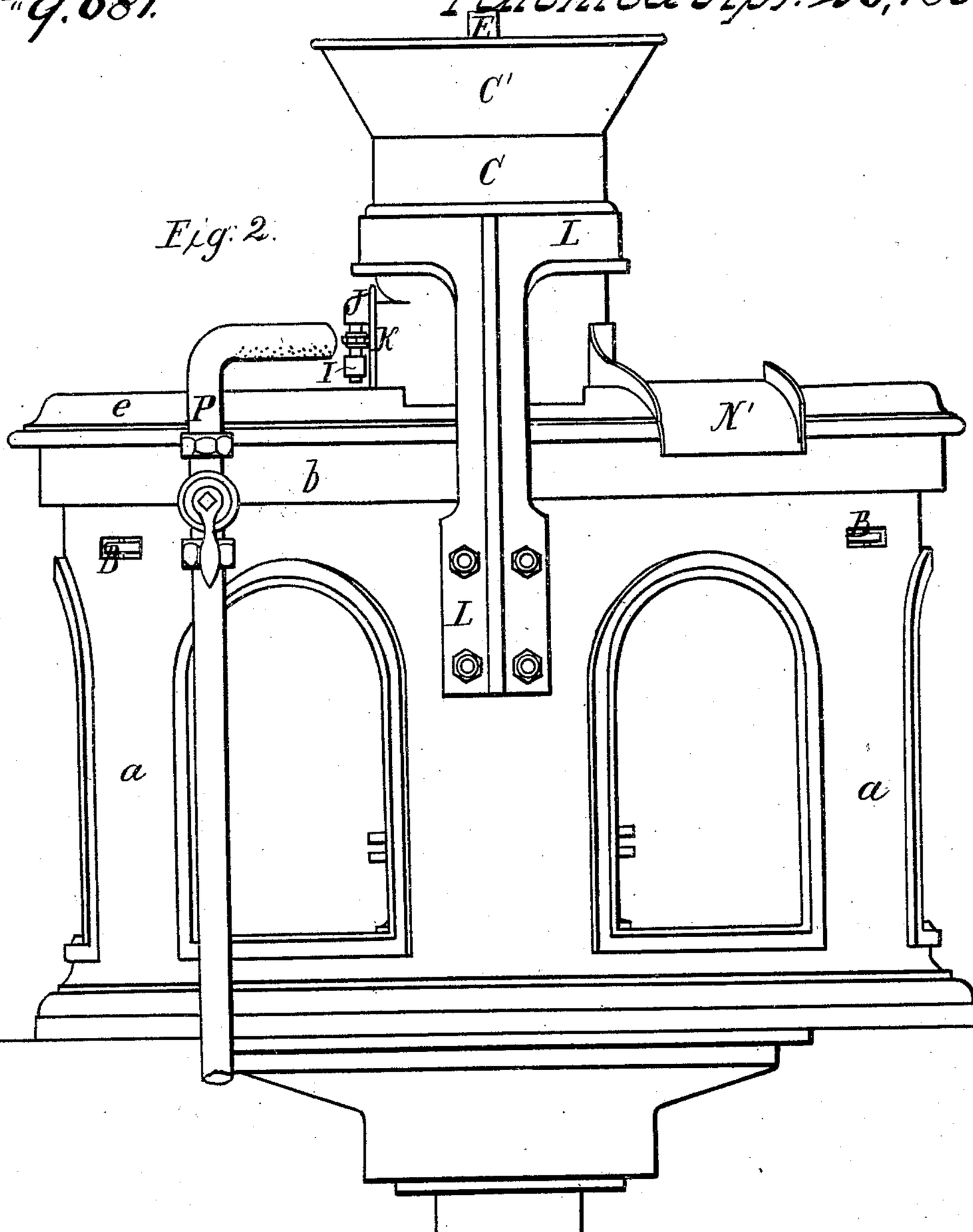
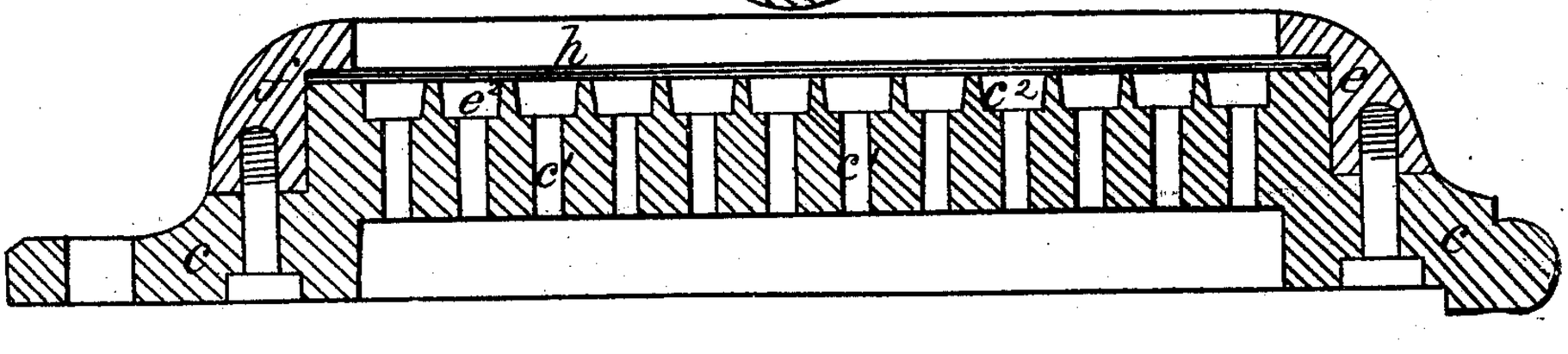


Fig. 7.



Sheet 3. 4 Sheets

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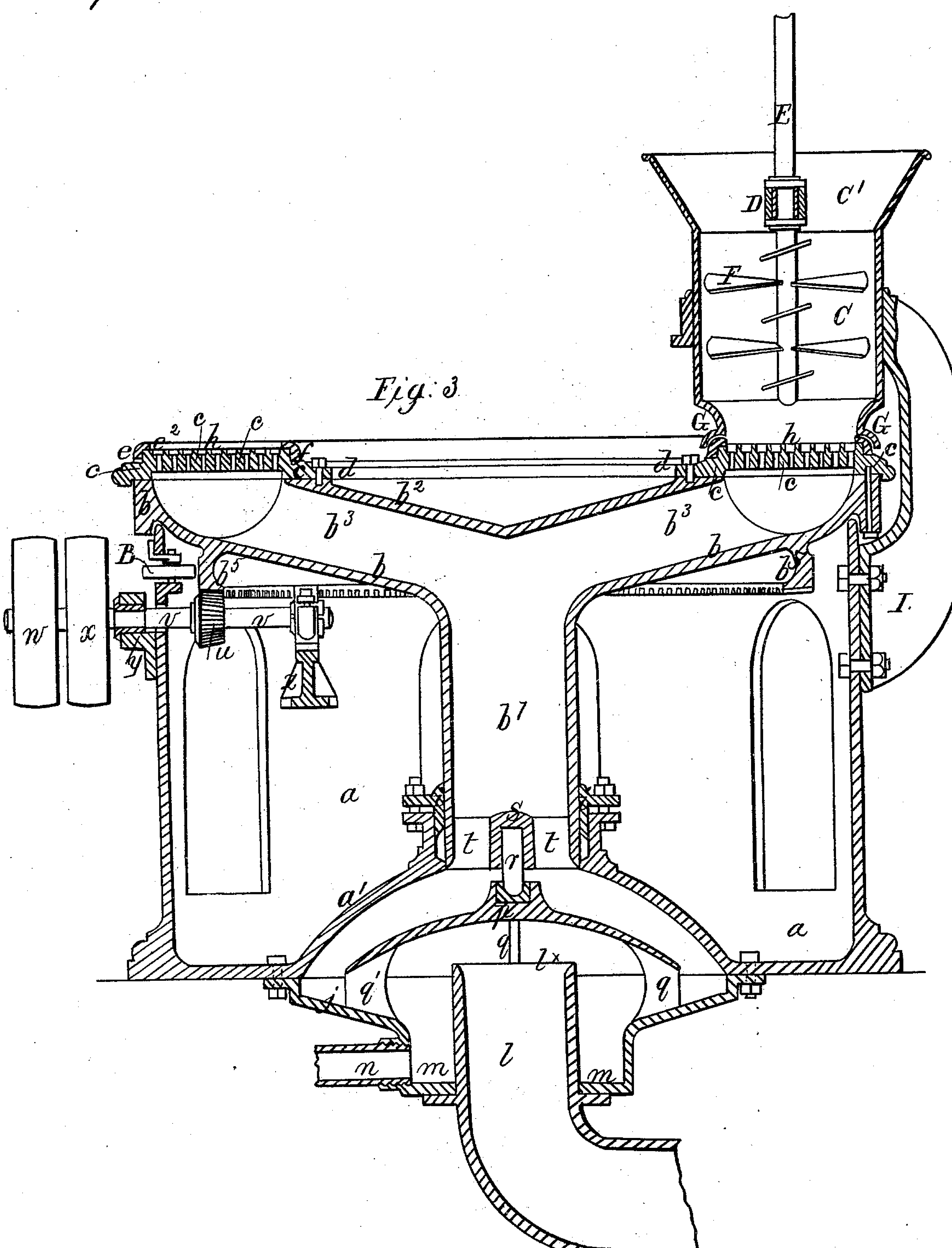
No. 9,681. Patented Apr. 26, 1853



N. PETERS, PHOTO-LITHOGRAPHER, WASHINGTON, D. C.

Sheet 4, 4 Sheets.

H. Bessimer.

Sugar Mach.

No. 9,681. Patented Apr. 26, 1853.

Fig. 5.

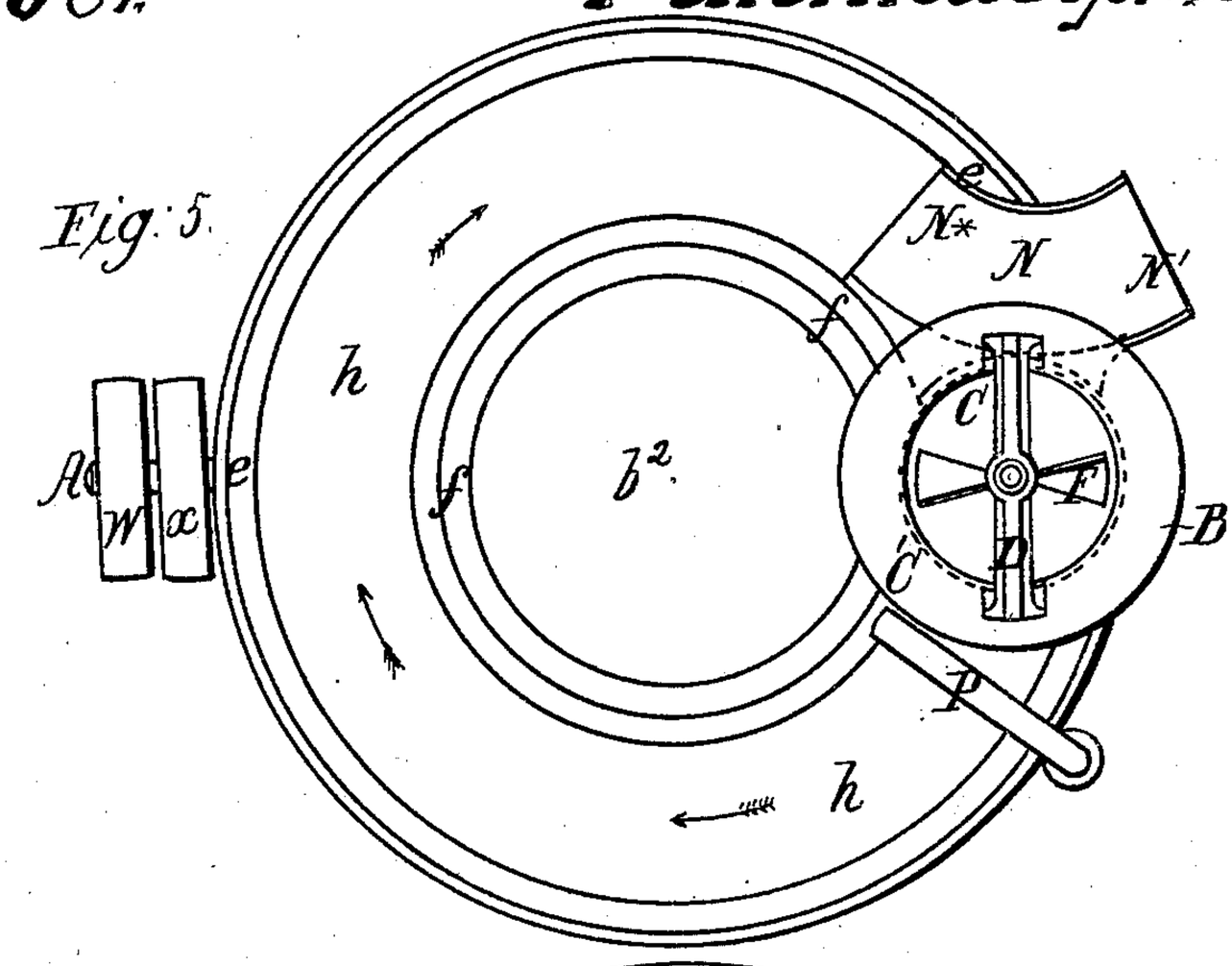


Fig. 4.

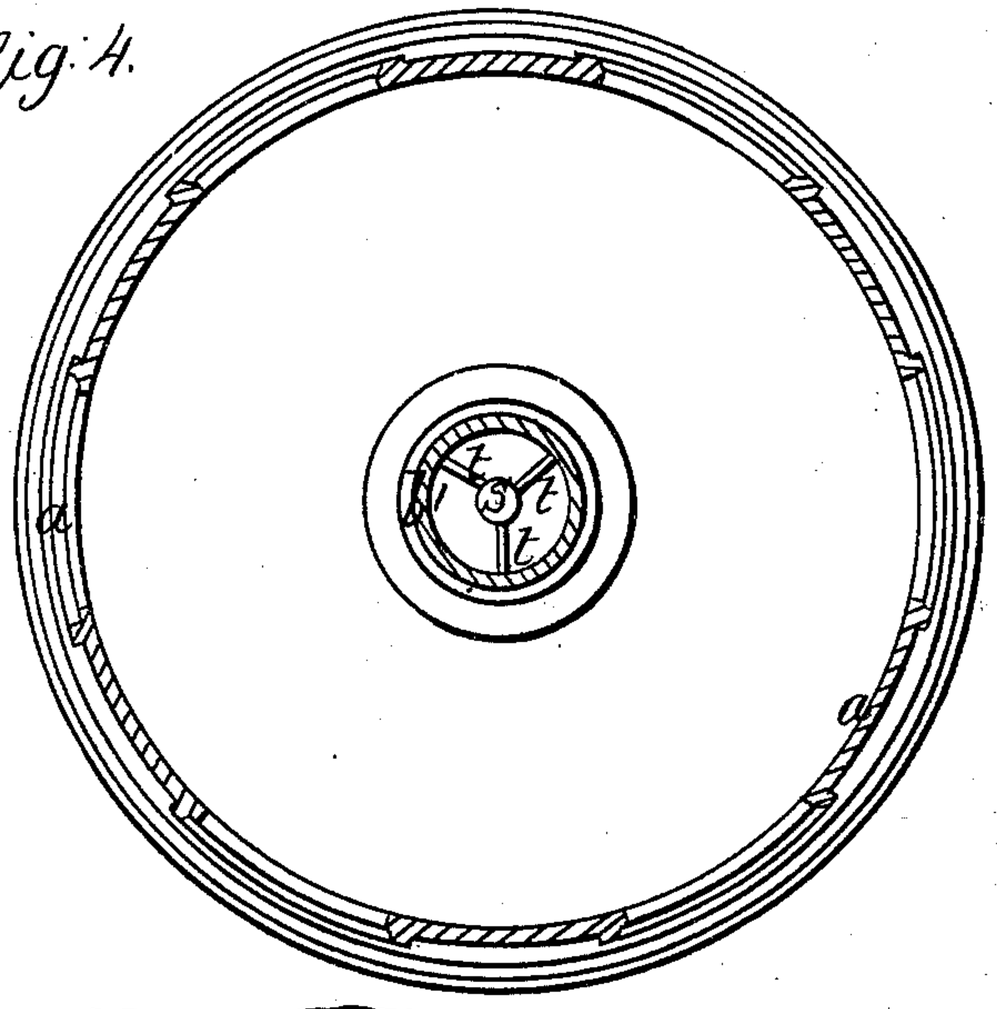
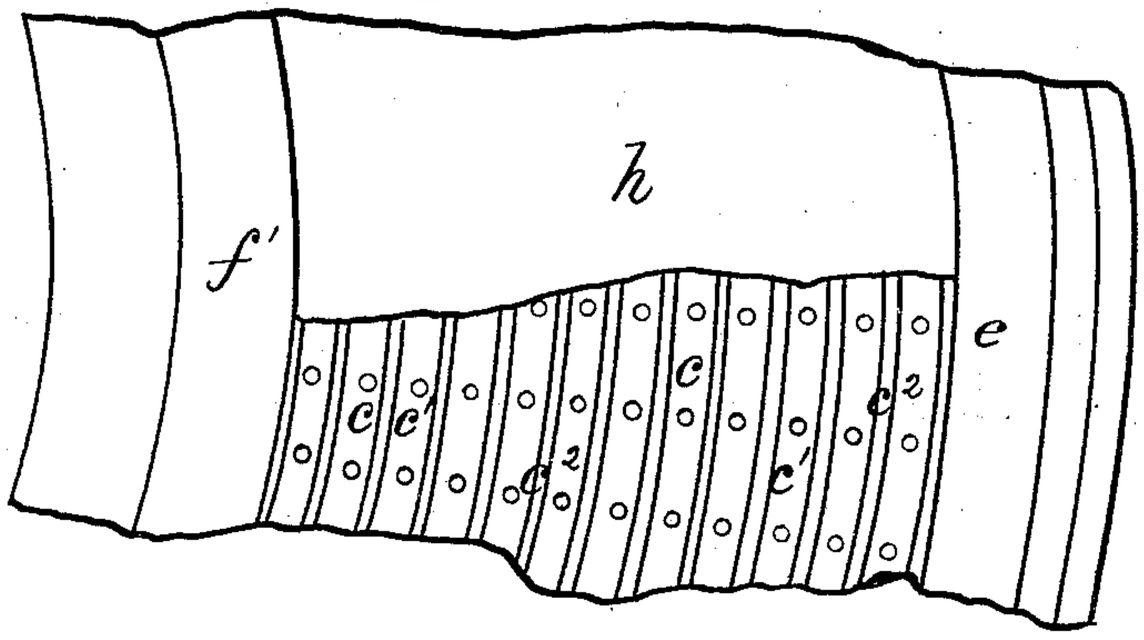


Fig. 6.



UNITED STATES PATENT OFFICE.

HENRY BESSEMER, OF BAXTER HOUSE, ENGLAND.

IMPROVEMENT IN SUGAR-DRAINERS.

Specification forming part of Letters Patent No. **9,681**, dated April 26, 1853.

To all whom it may concern:

Be it known that I, HENRY BESSEMER, of Baxter House, Old Saint Pancras Road, in the county of Middlesex, England, have invented a new and useful machine for curing sugar or separating the mother-liquor or molasses from the crystals thereof; and I do hereby declare that the same is fully described and represented in the following specification, reference being had to the drawings accompanying and making part of the same.

In the ordinary mode of manufaturing sugar the mother-liquor or molasses in which the crystallized portions of the sugar are contained is imperfectly separated by making an opening in the bottom of the vessel, through which the semi-fluid matters are allowed slowly to drain, leaving the crystals with a small film or coating of the molasses still adhering to them, which darkens the color and adds much to the impurity of the sugar. Several modes intended to prevent the disadvantages arising from this imperfect separation of the molasses have been used; but it had been found that much labor and loss of sugar resulted from their employment. If crystallized sugar containing a small quantity of molasses is brought in contact with water, a union of the water and molasses will rapidly take place. The water will also dissolve the crystallized sugar, if suffered to remain in contact for a sufficient time; but as the molasses is on the exterior surface of the crystal, and exists in a semi-fluid state, there must necessarily be a period of time after the addition of water when the molasses will become united therewith and the solution of the solid crystals not commenced. This being the case, it must therefore follow that if we can bring water in contact with sugar only for the short period of time which is required for it to unite with the molasses, the water being immediately removed, the water so withdrawn will carry away with it the molasses in solution, while the washed crystals of sugar will be left in a clean state. In order to carry into practice this mode of "curing" or cleansing sugar, I construct an apparatus as represented in the annexed drawings, where—

Figure 1 is an elevation of it; Fig. 2, an elevation of it, taken at right angles to the elevation of Fig. 1. Fig. 3 is a vertical section of it, taken near the line A B of Fig. 5. Fig. 4 is a horizontal section of it, taken on the line C D of Fig. 1. Fig. 5 is a plan of it, and Figs. 6 and 7 are details on a larger scale.

In the said drawings, *a* is a circular cast-iron frame, made with arched openings for the purpose of affording access to the interior of it.

b is a circular table, having a hollow axis, *b'*. The upper side of the table has a central covering-plate, b^2, which is united to the part *b* by six vertical ribs, b^3. Around the upper side of the table there is formed a large annular opening, over which is fitted an annular plate of brass, *c*, which is secured to the table by screws and flanges *d*. The upper side of the plate *c* has a number of concentric grooves formed in it, the spaces or ribs between the grooves being very thin and terminating upward with a nearly sharp chamfered edge. Between each of these ribs a row of holes is drilled all around the plate so as to establish a communication at numerous parts between the upper side of the plate *c* and the hollow table *b*.

e and *f* are two rings of brass, which have an annular ring of wire-gauze, *h*, soldered to them. The rings *e* and *f*, with the wire-gauze attached to them, are fitted onto the plate *c*, so that the wire-gauze comes in contact with and is supported by the thin annular ribs formed thereon, the whole being secured by screws passing upward through the plate *c* and screwing into the rings *e* and *f*. This will be better understood on reference to Figs. 6 and 7, which show a portion of the plate *c* in plan and section on an enlarged scale.

c' are the holes and c^2 the ribs which support the wire-gauze covering *h*. The rings *e* and *f* project upward a short distance, and thus form a shallow annular trough or channel having a pervious or porous bottom, which extends all around the upper edge of the table *b*.

The base-plate of the frame *a* is raised in the form of a dome, *a'*, in the center of which there is a gland, *i*, which forms a stuffing-box around the hollow axis *b'* of the table, the same being for the purpose of preventing the external air from entering the dome *a'*.

On the under side of the base-plate of the table there is bolted a cover, *j*, through the center of which the main air suction-pipe *l* passes upward and terminates with an open end or mouth at *l**. The cover *j* has a recess

or annular space, *m*, formed between the lower part of it and the pipe *l*, and leading into this space is an exhaust-liquor pipe, *n*.

To prevent any fluid from falling into the open end *l** of the air-pipe, a large covering-plate, *p*, is placed above it, and is retained in its position by radial ribs *q*, by which it is firmly attached to the cover *j*. The upper side of the covering-plate *p* receives the end of the small axis *r*, which is keyed into the boss *s*. This boss is supported by arms *t* cast in the lower end of the hollow axis *b'* of the table, and thus forms a support for the table *b* and an axis on which it may revolve. On the under side of the table is a ring, b^5, on which beveled cogs are formed and have a beveled pinion, *u*, in gear therewith. This pinion is keyed on the shaft *v*, which receives motion from any first mover by a strap passing over the drum *w*, which is also keyed upon the shaft *v*. *x* is a loose drum running freely on the shaft *v* for the purpose of receiving the driving strap or belt when the machine is required to be stopped. The shaft *v* is supported by a plumber-block, *y*, bolted to the outside of the frame *a*. On the inside of the frame *a* there is a small girder, *z*, passing from one side of the frame to the other for the purpose of supporting a plumber-block or bearing in which the end of the shaft *v* revolves.

It will be observed that the table *b* has only a lower axis. It therefore becomes necessary that the upper part of the table should be guided or supported in some way. For this purpose the vertical outer surface of the ring b^5 is turned truly, and at three equidistant parts of the frame *a* there are friction-rollers B working in bearings in the frame *a* and coming in contact with the ring b^5, whereby the table *b* will be guided and enabled to revolve with a quiet and steady motion. In lieu of three friction-rollers, three brass bearings may be used, with proper screws for tightening them up when required.

Above that part of the revolving table *b* which forms a shallow annular trough is fixed the hopper C, which is a circular vessel with an enlarged mouth, C', across which is a bracket, D, fastened for the purpose of forming a support or bearing for the vertical shaft E to revolve in. The upper part of this shaft is shown broken off, as its support will be fixed to the ceiling of the house in which it works. The mode of driving it, being dependent on local circumstances, is not shown. The lower part of the shaft has arms or blades F fixed upon it like those of a common pug-mill, they being for the purpose of forcing the sugar downward. The hopper is open on the under side, the circular form of it being somewhat altered at G, so as to make it fit against the rings *e* and *f*, as closely as possible. One side of the hopper is flattened at the part C*, where is an opening having a sliding door, H, fitted to it. On this door there are formed two projections, I, and above them there are two similar projections, J, formed on the flattened part of the hopper. K K are screws, which work into the projections I at one end, and the other into the projections J J, the central part of each screw having a capstan-head formed upon it, by which it may be turned around when it is required to raise or lower the sliding door H.

The hopper C is firmly retained in its position by a stout bracket, L, through which it passes, the lower part of the bracket being firmly supported by bolts to the frame *a*. The enlarged part C' at the upper part of the hopper may be continued at the same angle until it rises to the floor above, where a hole may be made equal in size to it, and thus a convenient means will be obtained of putting in large quantities of the matter to be acted on. The upper part of the hopper in that case being also secured to the floor by a flange and bolts.

At the back of the hopper, and secured to it, there is a plow or scraper, N, made of sheet-copper with raised edges. The front edge of this plow inclines downward between the rings *e* and *f*, and has nearly a sharp edge at N*, where it comes in contact with the wire-gauze *h*. The scraper is curved on the side next the hopper, and rises up sufficiently high to pass over the ring *e*, when it again inclines downward, forming a sort of spout, N', down, which the cured sugar slides into any convenient receptacle arranged to receive it. The whole of the space included between the scraper N and the hopper C is covered, so as not to admit air upon the wire-gauze.

In front of the sliding door H, and at a small distance from it, there is a pipe, P, having a cock, Q. This pipe is bent over at right angles, and points in the direction of the center of the table. The under side of this bent part, which is within a few inches of the wire-gauze surface, is perforated with numerous small holes like a syringe, and from which water or other fluid may be projected on the table, which revolves in the direction indicated by arrows in Fig. 5; or instead of the numerous small jets of fluid which issue from the pipe P, I place a small trough or box across the annular ring of wire-gauze, and so near to it as almost to come in contact with the sugar, which is carried round with the table. This box is open at bottom, so that the water or other fluid (that is supplied to it by a pipe) rests on the thin coating of sugar, which passes beneath it, and thus an abundant supply of fluid to wash the sugar is obtained in the short interval of time during which it is subjected to its action.

When using this machine, it is necessary to maintain a partial vacuum in the hollow table *b*, which may be effected by one or more air-pumps, similar to those used for exhausting vacuum-pans, such pump or pumps being connected with the pipe *l* in a manner well understood. There will also be required a

common suction-pump, for the purpose of drawing off fluid by the pipe *n* and discharging it into an elevated cistern, from which it may again flow down through the perforated pipe P or be conveyed to a concentrating-pan. Any fluid matters that pass through the wire-gauze surface *h* will pass down between the ribs b^3 and descend into the hollow axis *b'* of the table, and from it into the space *m*, from which they can be drawn off by the pipe *n*.

When the air and liquor pumps are in action, and motion is given to the shaft *v* and vertical shaft E, the action of the apparatus will be as follows: Crystallized sugar mixed with its mother-liquor is to be thrown into the hopper C. From thence it will be forced down (by the revolving blades F) onto the wire-gauze surface *h*, which should be moving under it at the rate of about eight or ten revolutions per minute, or at such other rate of speed as may be necsssary. If the sliding door H is lifted up about one-quarter or three-eighths of an inch, a coating or stratum of sugar of that thickness will be carried forward on the revolving table, and as soon as one complete revolution is made, the whole of the annular ring of wire-gauze will be covered with sugar. The exhaustion of air from the hollow table will now cause the molasses to be drawn into the table *b*, while the jets of water or solution of sugar under which the thin stratum of sugar passes will be rapidly drawn through it and carry off the adhering film of molasses. While the sugar is moving around in the direction of the plow, the air will pass through it and carry off the moisture, so that it will arrive there sufficiently dried, and by it will be scraped up and led into a hogshead or other receptacle, while fresh portions are being acted upon in a similar manner. Thus the operation is rendered continuous. If the revolving table is four feet in diameter, its outer edge will pass through a space of more than twelve feet in each revolution; and if the table makes ten revolutions per minute, the whole time which the sugar would occupy from the time it left the hopper to the time at which it would be removed by the plow from the machine would be less than five seconds, because it requires only about three-fourths of a revolution of the table to produce this effect; and if each complete revolution of the table, which is twelve feet in circumference, occupies six seconds of time, and the jets of water act upon a breadth of three inches or one-fourth of a foot, it must follow that the time occupied by the sugar in passing under the jets of water will be equal to one-eighth part of a second of time, and when it is considered with what velocity fluids enter a vacuum, it will be fully understood how short a period is allowed in the process for the water to act upon the sugar.

The removal of the coating of molasses from the crystals in so small an interval of time is chiefly owing to the friction against the crystals of sugar caused by this rapid rush of air and water between them, while the small amount of obstruction to the passage of air or water between the crystals, in consequence of the thinness of the stratum of sugar on the wire gauze, enables the water to pass between the crystals before it has time to dissove them.

The time which the sugar is under operation may be regulated to any extent necessary by simply altering the speed at which the table revolves, and if a very perfect cleaning of the sugar is desired other jet-pipes for the supply of water or liquor, similar to the pipe P, may be made to cross the table at different parts. When in lieu of jets a body of water or liquor is brought in contact with the sugar, before described, and sometimes also where the jets are used, I cause a greater amount of exhaustion to be made at those parts of the table over which the said water or liquor is made to act, whereby the fluid is caused to pass through the sugar with great force and rapidity while the air passing through with it will not be sufficient to prevent the requisite amount of exhaustion being obtained with a pump of moderate dimensions, while the other parts of the surface of the table may be exhausted by a fan-blower or other convenient means. In order to effect this separate exhaustion it will be necessary to divide the table *b* into a number of cells at that part where there is an annular opening on its upper side, each of which cells are formed by radial partitions, which extend down the hollow axis *b'*, and at that part where the axis enters the stuffing-box openings should be made on the exterior surface of the axis *b'*, which is at this part fitted in a fixed collar that has two passages formed therein, one of which communicates with the exhaust-pump and the other with the fan or other less powerful exhaustion, or that the axis of the table forms a sort of two-way cock, by means of which the cells under that part where the liquor is supplied are constantly being brought in connection with the air-pump, while the other cells are in like manner caused to communicate with the other exhausting apparatus.

In the refining of sugar the great quantities of glucose or molasses generally contained in Muscovado sugar is a source of much inconvenience in the process. I therefore prefer to remove it by this curing apparatus previous to melting it in what is usually termed a "blow-up" cistern, for which purpose the sugar may be first damped or wetted before putting it into the hopper C of the curing-machine. This apparatus may also be employed for treating sugars that have been manufactured abroad and sent into the United States in an impure state. For this purpose I prefer sugar made in the vacuum-pan, which, when thus deprived of its molasses, may be again sent into the market.

Having thus described the nature of my said invention and the manner in which the same

is to be performed, I would have it understood that what I claim as my invention is—

The combination of the revolving and hollow spreading-table formed with a wire-gauze or perforated top, and connecting with an air-exhausting apparatus, the spreading mechanism, the water-sprinkling pipe or its equivalent, the means of discharging the water and molasses, and that of removing the cured sugar, the whole being substantially as specified.

In testimony whereof I have hereunto set my signature this 30th day of December, A. D. 1852.

HENRY BESSEMER.

Witnesses:

JOSEPH MARQUETTE,

JOHN R. DARKER.