

(No Model.)

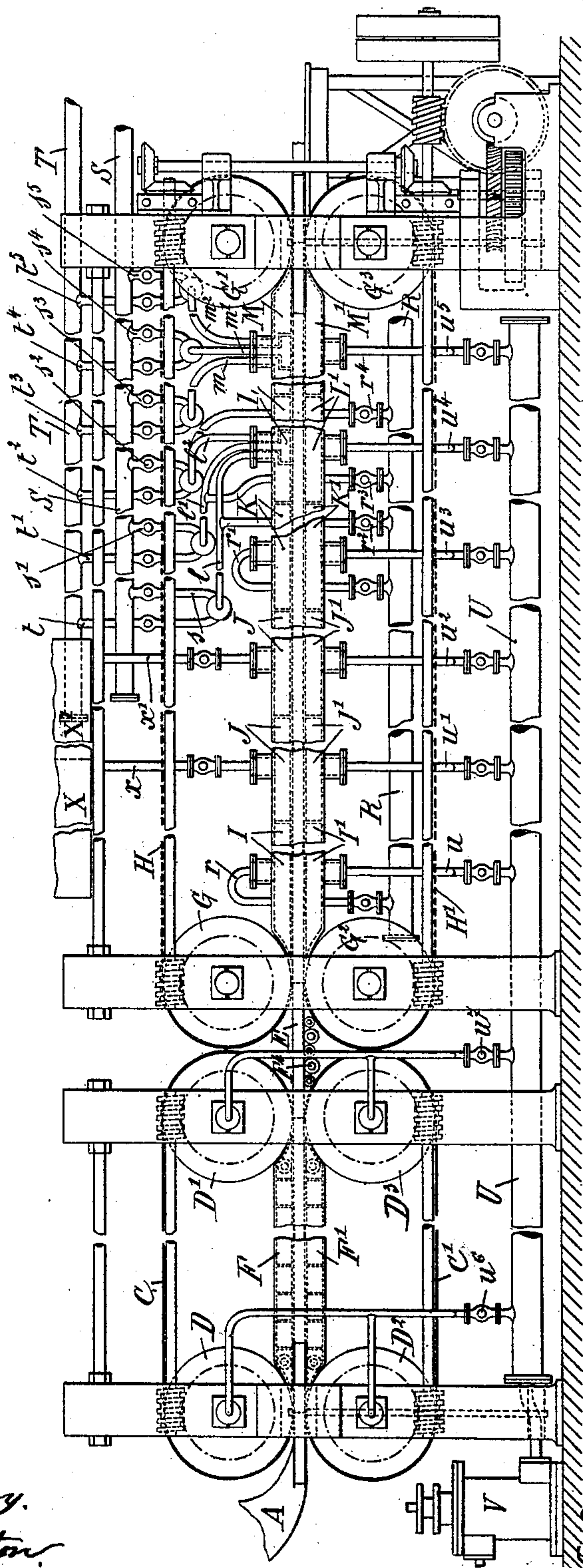
2 Sheets—Sheet 1.

L. E. A. PRANGEY.  
MANUFACTURE OF REFINED SUGAR.

No. 452,063.

Patented May 12, 1891.

Fig. 1



Witnesses:-  
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Inventor:-  
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By Attorney  
R. M. J. Brown

(No Model.)

2 Sheets—Sheet 2.

L. E. A. PRANGEY.  
MANUFACTURE OF REFINED SUGAR.

No. 452,063.

Patented May 12, 1891.

Fig. 3

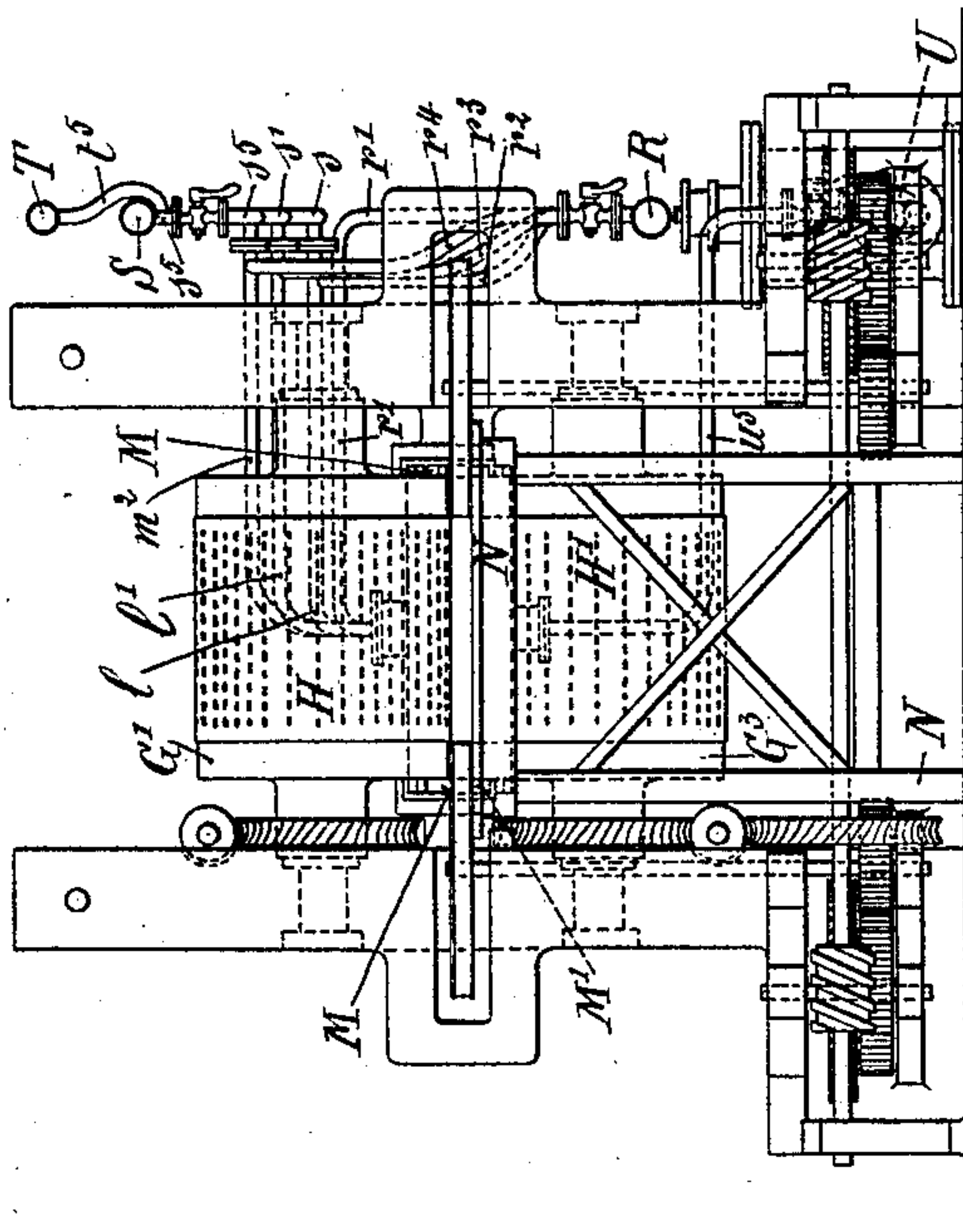
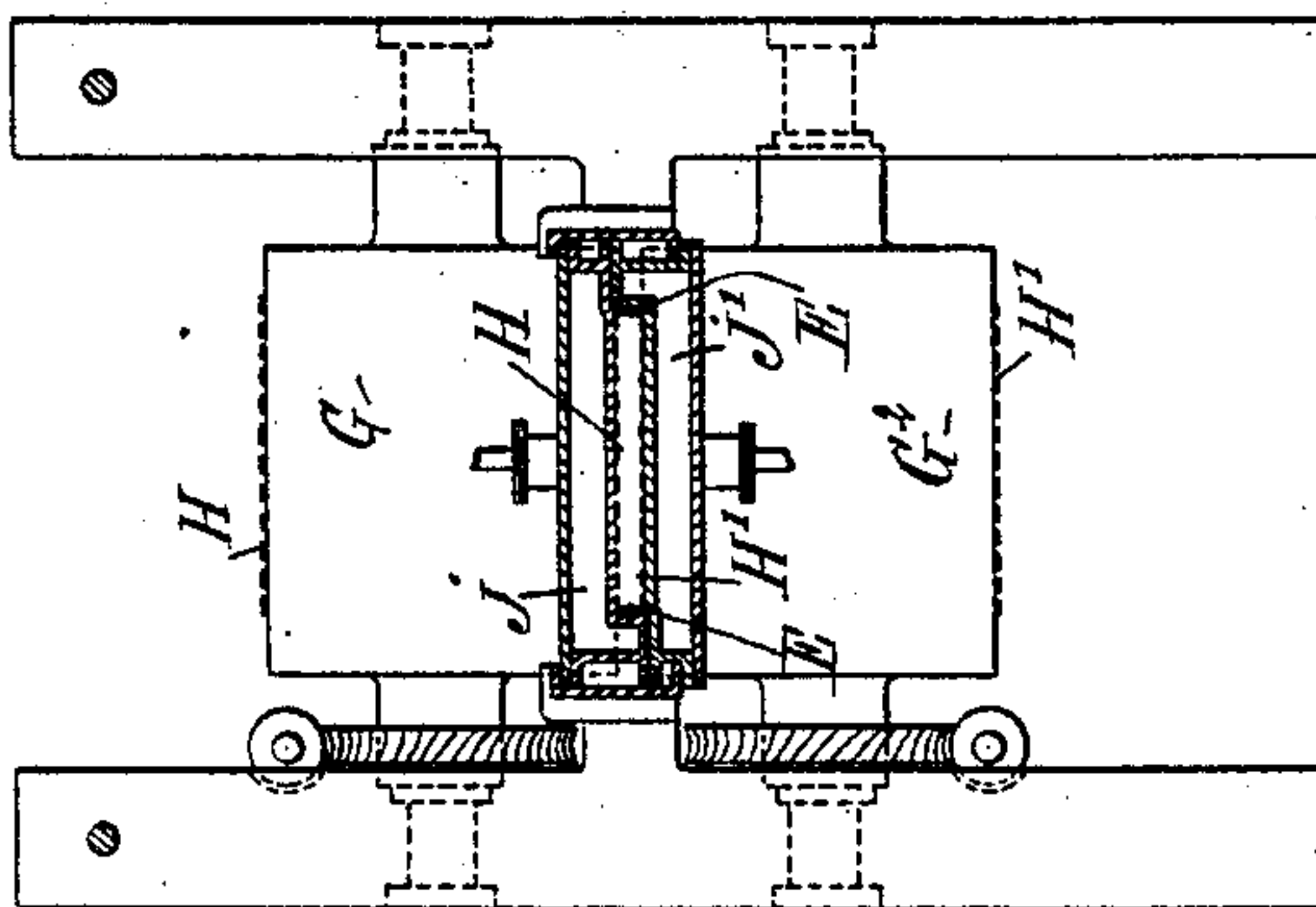


Fig. 2



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# UNITED STATES PATENT OFFICE.

LOUIS EDME ACHILLE PRANGEY, OF PARIS, FRANCE.

## MANUFACTURE OF REFINED SUGAR.

SPECIFICATION forming part of Letters Patent No. 452,063, dated May 12, 1891.

Application filed July 11, 1888. Serial No. 279,640. (No specimens.) Patented in France August 8, 1887, No. 185,230; in Belgium August 8, 1887, No. 78,501; in Germany August 8, 1887, No. 42,754, and in Italy December 24, 1889, XLIV, 361.

*To all whom it may concern:*

Be it known that I, LOUIS EDME ACHILLE PRANGEY, a citizen of the Republic of France, residing at Paris, in said Republic, have invented a new and useful Improvement in the Manufacture of Refined Sugar, (for which I have obtained patents as follows, viz: in France, dated August 8, 1887, No. 185,230; in Belgium, dated August 8, 1887, No. 78,501; in Italy, dated December 24, 1889, No. XLIV, 361, and in Germany, dated August 8, 1887, No. 42,754,) of which the following is a specification.

My invention consists in an improved method of refining sugar, which permits the operation to be performed in an absolutely continuous and very rapid manner and without the use of molds or centrifugal apparatus.

As is well known, in the present organization of the sugar industry the saccharine juices extracted from sugar-cane, beet-root, or other vegetable substances are treated in a manner to obtain from them crystallized sugar, and the raw sugar thus produced passes afterward, almost always, through a series of operations intended to increase its purity, and which constitute what is commonly called "refining." Now the industry of refining employs to-day a fractional method of work, which has the multiple inconvenience of requiring a considerable and very costly plant. The employment of this method is very burdensome both as to the cost of the establishment and as to the expenses of working, and on the other hand it does not permit the execution and delivery of an order as rapidly as it is desirable from the commercial point of view to be able to do it.

My invention has for its purpose to obviate these inconveniences at once by effecting the refining and purification of sugar in a continuous manner, and, so to say, instantaneously. It permits in effect the successful submission of the raw material in a few moments only to all the operations necessary without having to pour it into molds as at present practiced, and having to let it remain therein for a long time and submitting it to various operations of purging and clarifying and then withdrawing it to submit it to operations of drying and cooling. I have, in effect, con-

ceived a means which permits me to effect upon the raw sugar the operations of refining similar in practice to the ordinary operations, although practiced in a special manner, without the necessity of placing the sugar in permanent recipients, such as molds.

To this end my invention consists, essentially, in conducting the raw sugar between pervious media—such, for example, as perforated or reticulated endless aprons—having left between them a convenient space and having given to them a movement of translation by any means whatever in such manner as to cause it to be presented between them in the form of a comparatively thin layer or sheet to the successive action of different agents which will effect its purification and then its drying. Owing to the disposition of the matter in a thin layer and to the movement of translation which is given to it between the pervious media, the said agents, which act at fixed points, operate successively upon its different parts with facility and rapidity in such manner that when it has passed before them all it arrives at the state of desired purity, and has only to be received to be packed or to be converted into the final shape which it is desired to give it—as, for example, dividing it into pieces if it is required to make broken refined sugar. As the raw sugar, according to my system, only has to be treated during the actual period of the application of the purifying and drying agents, which act one after the other without interval, (contrarily to what takes place in the ordinary method, where for the clarifying, for example, the sugar on which the clarifying-liquid is poured must afterward remain in its mold to permit this liquid to operate to slowly effect its action,) it results that the movable surfaces themselves, which serve to cause the advance of the matter to be treated, retain it for a sufficient time, and in such manner that my process dispenses entirely with all molds or receivers whatever, thus realizing an enormous economy of plant, of maintenance, of hand labor, and of storage, the more so as the stoves ordinarily employed for drying loaves of sugar become useless, as well as the filling apparatus and the granulators.



One of the very advantageous consequences of my method is that if a thin sheet or layer of saccharine matter is solidified, and that is done by taking the matter in a hot and fluid state or after reheating it if it is cold, and then cooling it during the first part of its movement of translation, there is obtained after it has been purified in the course of its movement a slab or sheet of refined sugar purified or whitened, which is compact and of regular form, and may afterward be sawed or broken without the waste which occurs in the case of conical loaves.

It will be understood that my system may be employed to effect the whole of the operations constituting refining or only one part of them, and also that each operation—clarifying, for example—may be repeated a greater or less number of times, according as may be judged expedient.

For completely refining the raw sugar, which is either the cooked mass of the refinery, hot or cold—that is to say, raw sugar having been subjected in the ordinary manner to the preliminary operations of refining up to and including the cooking—the raw sugar in grain is conducted between the movable perforated or reticulated surfaces intended to produce its movement in the form of a thin layer and in its course is subjected successively to the following operations: straining to take out the green sirup, clarifying by means of sugar sirup, exhausting it of the clarifying-sirup remaining in it, and afterward drying and cooling by means of air, of which the temperature is first increased and then decreased as the material moves on.

The operations above mentioned will be recognized as the ordinary operations of refining, but I perform them under new conditions.

All the operations hereinabove described must be rapid in my process. I accomplish this by performing them with the aid of pressure or of vacuum, or of both pressure and vacuum at once, which permits the agents employed to act efficaciously upon the thin layer of sugar. Supposing the case of double action—that is to say, with pressure on one side and vacuum on the other side of the layer—the draining is performed by forcing the hot air against one of the faces of the layer and at the same time exercising a suction on the other side. In practice the pressure and vacuum will be produced, by preference, in boxes of any form whatever, against which the movable perforated surfaces against or between which the sugar is held and carried are caused to pass, such boxes having their faces contiguous to the said surfaces perforated for the passage of the air for the purpose of producing the action uniformly all over the layer. For operation by simple action the hot air would be projected through the sugar from one of the faces of the layer without producing a vacuum on the other face. This injection of air, which is not practiced in the ordi-

nary process, permits me to operate very energetically by employing a sufficiently elevated pressure. I might also produce vacuum on one side of the layer of sugar without applying a pressure of air on the other side. For all the following operations, also, (clarifying, &c.,) the vacuum exercised upon one face of the sugar will suffice, as I have above stated, to cause the agent of treatment to pass through it. After it has been drained the sugar, continuing its movement, receives upon one of its faces the clarifying-sirup arriving under pressure, and this clarifying-sirup passing through it drives out before it the molasses, which was mixed with the crystals of the sugar. If it is necessary, a vacuum is at the same time produced on the opposite face to draw from the sugar the clarifying-liquid and the impurities; or the vacuum only may be used. In practice I prefer that the clarifying-liquid should arrive through a perforated box having the full width of the layer of sugar, and that the vacuum should be at the same time produced in a box arranged on the other face of the layer and furnished with a perforated or reticulated wall, in order that the suction should be distributed over the whole width of the layer. The sugar will receive successively the clarifying-liquors, more and more pure, analogously to what is done in the ordinary process of refining. The same clarifying-liquid may be caused to pass several times through the layer of sugar, if judged suitable, in such manner that it shall be the purest clarifying-liquid, which serves to finish the clarifying—that is to say, the clarifying-liquid shall be caused to pass from one box to another by a movement in a reverse direction to that in which the sugar passes in being treated to produce a methodical purification. After having received the desired number of clarifyings the sugar is submitted to suction or forced draining for the purpose of extracting the clarifying-liquor remaining in it. This may be effected either by the means of pressure of air or by means of a suction apparatus or by forcing air against one face of the layer at the same time that suction is applied to the other face. This operation is, like the preceding, analogous to the ordinary process of refining, except as to the different manner of performing it. The sugar being from that time completely purified remains to be dried. Ordinarily for this purpose loaves of sugar are placed in a drying-room, where they are left during the number of hours necessary that there may remain no more humidity in the loaves. In my system I replace this drying in a drying-room by an injection of hot air through the layer of sugar with or without suction. This injection of hot air may be preceded by an injection of superheated steam. In proportion as the layer of sugar is carried forward it is subjected to the action of hotter and hotter air, the temperature of the air being different in each of the perforated



boxes before or over which the layer of sugar passes successively. It may be remarked that this operation is different from the ordinary drying performed in a drying-room for drying sugar. In a drying-room the loaves of sugar are simply surrounded by hot air, which cannot absorb the humidity of the sugar, except while it is at the surface of the loaves. In my process the hot air does not remain around the layer of sugar, but penetrates it by acting upon all the width of the layer at a time, and it takes out almost instantly all the humidity by saturating itself during its passage. After this injection of hot air or improved drying all that remains to be done is to cool the sugar gradually, which is done by causing to pass through it colder and colder air injected against one of the faces of the layer with or without the taking up of the said air by an air-pump on the other side.

As will be understood, according to the degree to purification to which I wish to submit the sugar by my method, I may dispense with any part whatever of the operations hereinabove described. I may also substitute for the clarifying, by means of sirup, a clarifying or cleansing by means of water or by bleaching by the aid of steam, which should preferably be of high pressure and superheated.

As an example of the process of partial purification which may be advantageously effected according to my process, I will mention particularly the operation called "turbineage," because it is habitually practiced by means of a turbine or centrifugal machine, an operation which has for its purpose the expulsion of molasses by the action of centrifugal force from raw sugar delivered to the refineries by the manufacturers of sugar, it being the custom to submit raw sugar to such operation before melting it again to refine it, as well as the low products obtained in the course of refining. It is sufficient for me, in fact, to cause the passage of air, more or less heated and under a sufficient pressure, through the advancing layer of sugar from one side thereof, aiding, if necessary, this action of the air by a vacuum produced on the other side of the layer, or else by employing air at natural pressure on the one side, but producing a vacuum on the other side, to obtain at very slight expense the same result as is effected by the centrifugal machine. It is easy for me to complete this operation by a bleaching with water or steam if I deem it expedient. Moreover, as I have already stated, my method of purification may be just as well employed in the "factories," properly so called, as in refineries, seeing that it does not require the plant and considerable space necessary with the processes of refining heretofore known. Consequently my invention resolves the problem of the production by the manufacturers of white sugar deliverable directly to the consumer. They may content themselves with purging their sugars by the

aid of air acting under pressure with or without the aid of vacuum, or they may be able to afterward whiten them by an injection of steam or otherwise, or even to submit them to the action of a clarifying more or less complete by means of sirup. With my process and without the need of employing either centrifugals or molds they may, like refiners, produce solid and compact sugar, either in the form of tablets or ingots or of small lumps, by solidifying the layer of sugar at the commencement of the operation in the manner which I have indicated—that is to say, by working upon the hot mass which is cooled during its movement of translation to form it into a solid sheet before purifying it. This sheet will be afterward broken or sawed without waste by the known means. The matter employed to thus form a compact sheet may be the raw cooked mass of the factory or the cooked mass of the refinery employed hot and fluid soon after the cooking, or even the cooked mass which has been cooled. In the latter case I commence by reheating the matter by the aid of moist steam, in order to unite the crystals of the sugar with one another. The method is applicable also to the more or less complete purification of sugar grains, which will remain in the granular state after purification.

To enable my invention to be completely understood, I have represented in the accompanying drawings a machine which may be employed for the complete process, comprising the molding of the sugar into comparatively thin layers or sheets.

Figure 1 represents a longitudinal elevation of the machine. Fig. 2 represents a transverse section taken in the line  $xx$  of Fig. 1 through the cooling-box. Fig. 3 is a view of the rear end of the machine.

A designates a hopper containing the saccharine matter which is to be refined or purified and molded into thin sheets or slabs. This hopper may be surrounded by a heating-jacket and may be furnished in the center with a rotary shaft carrying agitating-arms and terminating below by a conical screw to push the matter out through a flattened nozzle having the same section as the slab or sheet of sugar which it is desired to form. Two pairs of pulleys  $D D'$  and  $D^2 D^3$  carry the imperforated aprons  $C C'$ , which receive the matter at its exit from the hopper and carry it through the machine. This matter is confined laterally between two endless imperforated ribbons  $E E$ , which move at the same speed as  $C C'$ , and which complete the endless mold. The matter contained between these four aprons or ribbons moves with them the whole length of the box  $F F'$ , which has a transverse section of rectangular form, presenting in the center a rectangular passage for the endless mold and the matter which it carries. Within the hollow walls of this box circulates cold water or other refrigerating agent. When the matter has arrived at the extremity of



the cooling-box, it forms a solid and compact slab of sugar. The aprons C C' may leave it upon a fixed table, an endless movable apron, or, as in the example shown, a series of rollers F<sup>1</sup> serving to support it. Thence the slab is taken between the pervious media consisting of a pair of perforated or reticulated endless aprons H H', carried and put in motion by pulleys G G' and G<sup>2</sup> G<sup>3</sup>, still being confined at its sides by the endless ribbons or belts E E. It is thus led along the central rectangular space of a series of boxes I I' J J' K K' L L' M M', which constitute a box with hollow walls, like the box F F', before mentioned. The upper halves of these boxes have no communication with each other, neither do the lower halves; but the bottoms of the upper halves and the tops of the lower halves, against which the aprons or pervious media H and H' slide, are perforated to permit the liquids or fluids which constitute the treating agents and which arrive from their respective reservoirs in the upper parts of the different boxes to pass through the slab or sheet of sugar and pass out therefrom into the lower parts of the boxes. In passing from the upper to the lower half of the several boxes the said treating agents have to pass through the pervious media constituted by the perforated or reticulated aprons.

If it is desired to produce dry refined sugar cooled before leaving the machine, as I have supposed in the example represented, (the hopper contains in this case the masse-cuite of the refinery—that is to say, sugar having been already submitted to the first operations of refining, including the boiling,) the box I, intended to effect the purging of the green sirup contained in the mass, receives in its upper part air saturated with humidity at a temperature of 35° centigrade. The boxes J J' serve for the clarifying-liquids. The box K, which effects the purging of the clarifying-liquid, receives, like I, air saturated with humidity. The box L, employed for the cleansing, receives in its three separate compartments moist air, having a temperature of 50°, of 60°, and of 70° centigrade, respectively. Finally, the box M, which serves for the drying and the cooling, receives in its three compartments, respectively, dry air at 70°, at 60°, and at 50° centigrade. As I have stated, to cause the passage through the layer or slab of sugar of the fluids and liquids admitted upon its upper face I may apply these agents under pressure or else produce a vacuum under the slab or layer, or have recourse to both these means at once. In the example represented I have proposed the combined employment of the two means, and in consequence the lower parts of all the boxes are represented as communicating with the suction-pipe of a vacuum-pump.

R is a pipe for introducing the air saturated with humidity at a temperature of about 35° centigrade.

S is a pipe introducing the dry air at a natural temperature.

T is a pipe for introducing air at about 80° centigrade.

U is a vacuum-pipe.

Two branches *r r'* of the pipe R conduct into the boxes I and K moist air such as the pipe R furnishes. Three other branches *r<sup>2</sup> r<sup>3</sup> r<sup>4</sup>* of the same pipe unite with the branches *s s' s<sup>2</sup>* of the pipe S and two branches *t t'* of the pipe T in such manner as to permit the introduction into each of the three compartments of the boxes I by the pipes *l l' l<sup>2</sup>* air having a considerable degree of temperature and humidity, the supply of which may be regulated by means of cocks, with which all the branches are furnished. The dry-air pipes S and T are furnished with branches *s<sup>3</sup> s<sup>4</sup> s<sup>5</sup> t<sup>3</sup> t<sup>4</sup> t<sup>5</sup>*, connected two and two and furnished with cocks, which permit the entrance into each one of the compartments of the box M, by the pipes *m m' m<sup>2</sup>*, air at the temperature desired.

*u u' u<sup>2</sup> u<sup>3</sup> u<sup>4</sup> u<sup>5</sup>* are the branches by which the suction-pipe U communicates with the pipes of all the boxes. *u<sup>6</sup> u<sup>7</sup>* are two other branches, which may be provided on the suction-pipe U when it is desired to make the aprons C C' adhere to their pulleys by a pneumatic action.

V is the vacuum-pump, which may be of any sort whatever.

X X' are two reservoirs, containing, one common clarified liquid and the other white clarified liquid, which are admitted, respectively, into the boxes J J' by the pipes *x x'*, which are furnished with stop-cocks.

When the sugar is not intended to be delivered from the machine in a state of plates or slabs, but leaves the machine in granular state, those parts of the machine comprising the cooling-box F F' and the aprons C C' are not used. The feeding in of the saccharine matter then takes place immediately in front of the pulleys G G'. After the purification this matter falls into a trough which is placed at the end of the machine and in which an Archimedean screw pushes the granular matter into a box. In cases where the sugar either in slabs or in grains is not required to be subjected to all the operations which are comprised in complete refining I may leave inactive certain of the boxes I I', J J', K K', L L', M M'. On the other hand, a number of the boxes may be employed in treating the sugar with water or steam, as I have hereinbefore mentioned.

The apparatus above described forms no part of the present invention, but is the subject-matter of my application for United States Patent, Serial No. 250,562, filed September 24, 1887.

What I claim as my invention, and desire to secure by Letters Patent, is—

1. The improvement in the refining of sugar in the form of slabs, consisting in causing



the transit of the slabs of sugar between pervious media and simultaneously causing the passage transversely through the said slabs of a liquid or aeriform fluid, substantially as 5 and for the purposes herein set forth.

2. The improvement in the manufacture of refined sugar, consisting in first introducing hot, raw, and moist sugar between parallel moving surfaces, and while it is moving with 10 and between said surfaces subjecting it to the influence of a cooling medium, whereby

it is formed into a solid slab, next causing the transit of the so-formed slab between pervious media, and while so in transit causing the passage transversely through it of liquids 15 and aeriform fluids for the purposes of purification and drying, substantially as herein set forth.

LOUIS EDME ACHILLE PRANGEY.

Witnesses:

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CHRIS. A. JENSEN.