J. STEWART.

DIFFUSION APPARATUS.

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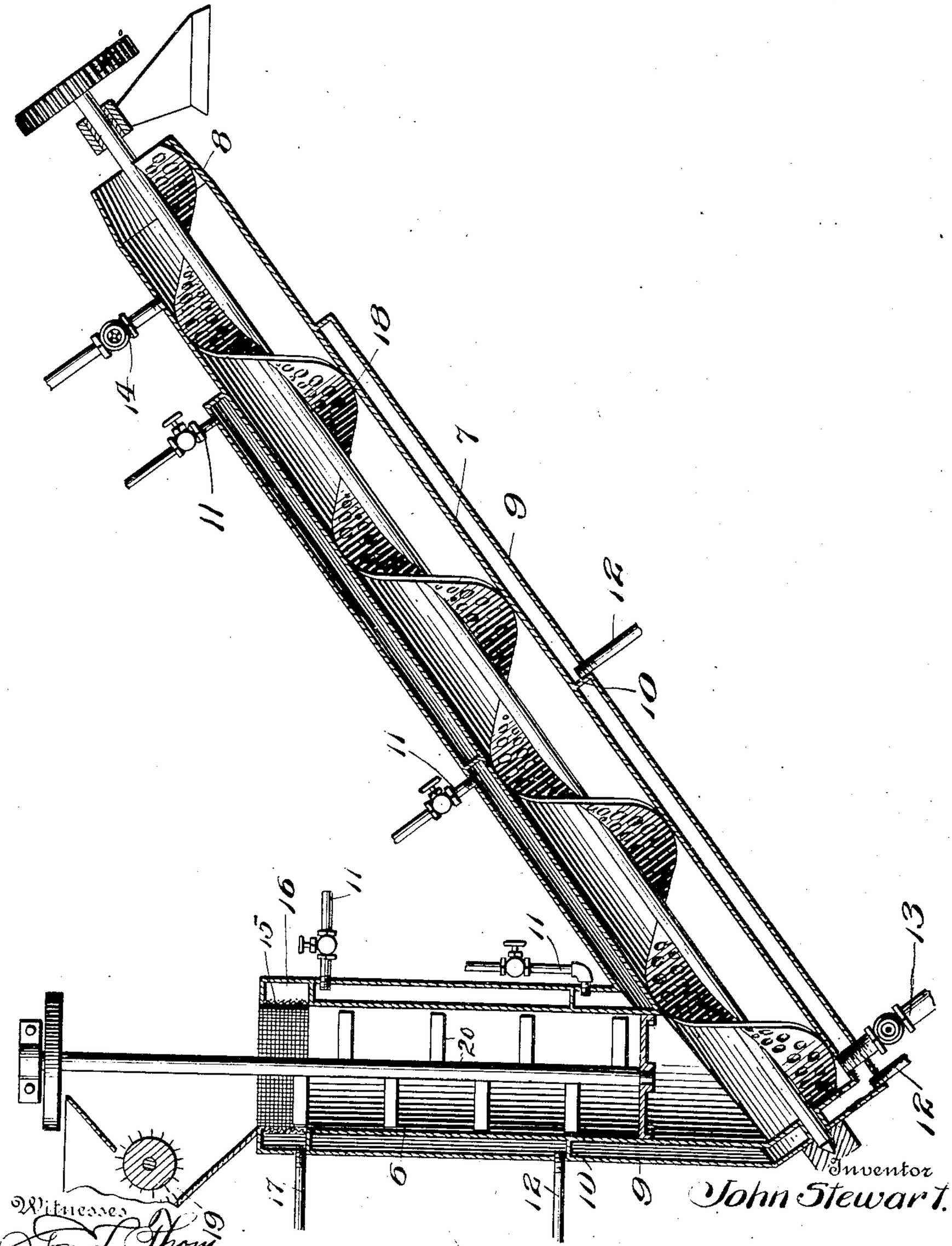

Witnesses
Jean L. Thom
Edith L. Smith

Inventor
John Stewart.

By

Attorney

UNITED STATES PATENT OFFICE.

JOHN STEWART, OF LOGAN, UTAH.

DIFFUSION APPARATUS.

962,725. Specification of Letters Patent. **Patented June 28, 1910.**

Original application filed November 26, 1909, Serial No. 530,018. Divided and this application filed January 28, 1910. Serial No. 540,641.

To all whom it may concern:

Be it known that I, JOHN STEWART, a citizen of the United States, residing at Logan, in the county of Cache and State of Utah, have invented certain new and useful Improvements in Diffusion Apparatus, of which the following is a specification.

The invention forming the subject of the present application is a division of my application No. 530,018 filed Nov. 26, 1909 and relating to a diffusion process for extracting sugar. The present application relates to the apparatus.

A principal object of the invention is to provide an improved apparatus by which the extracting of sugar from beets may be made continuous.

A further object of the invention is to provide simple and comparatively inexpensive means for accomplishing the result indicated, the apparatus being cheaper both with respect to the cost of installation and the cost of operation than apparatus now in use.

In the early stages of beet sugar manufacture, the beets were cut into small pieces and subjected to heavy pressure to obtain the sugar, this process being copied from the ordinary cane sugar process. Later the chopped beets were placed in baskets and subjected to lixiviation by immersion in tanks of water, being lifted from one tank to another for repeated operations. This was followed by running the water from one tank to another instead of moving the beets, which forms the basis of the modern diffusion process. In this process it is attempted to take advantage of the fact that sugar passes through the walls of the plant cells more rapidly than some other constituents, thus giving a purer juice than that obtained by pressure or by lixiviation, and the practice has been to cut the beets into uniform and clear cut slices or cossettes through which the water was flowed to extract the sugar constituent; and in order to obtain such uniform and clear cut slices much expense has been incurred, and is incurred, in beet sugar factories.

The present invention introduces, among other features, that of disintegrating or reducing the beets to a fine pulp, before the diffusion treatment. This enables a complete extracting of the sugar from the beets to be made in a very brief time and in a very short diffusion vessel, and it overcomes some of the most important difficulties heretofore existing with processes and apparatuses designed to operate continually.

I am aware that efforts have been made to provide a continuous diffusion process operating upon cossettes, but they are more or less objectionable and complicated, involving in some instances a repeated passage or flow of the liquor through the same, in order to obtain the required density. With the present process only one passage is necessary, which is conducive to simple and economical operation.

An apparatus embodying the invention is illustrated in the accompanying drawing, which is a vertical sectional view thereof.

Referring specifically to the drawings, I provide a cylindrical diffusion vessel made of boiler plate or similar material, and having a vertical leg 6, and an inclined leg 7 connected to the lower end of the former, and extending upwardly therefrom at an angle of about 45°. The upper end of the inclined cylinder will extend somewhat higher than that of the vertical cylinder, say one or two feet. The size and proportions of the apparatus may be varied, but the diameter of the cylinders will conveniently be about three feet or more depending on the capacity desired, and the height of the vertical cylinder will be about eight or twelve feet. The upper end of the inclined cylinder may be slightly conical or contracted with advantage, as indicated at 8. These cylinders are inclosed throughout substantially their entire length by a cylindrical steam jacket 9 which is divided into sections by annular partitions 10, and each section is provided with a steam inlet 11 and an outlet 12. The cylinder 7 has a water inlet 13 at the bottom, below the vertical cylinder 6, and also a water inlet 14 at the top.

At the upper end the vertical cylinder 6 has a perforated section 15, about one foot long, through which liquid may flow from within the cylinder into the annular space 16 which is provided with an outlet pipe 17 to carry the juice into the receiving vessel for the subsequent treatment. The perforations in the section 15 are quite fine, to prevent escape of the disintegrated mass.

Mounted to rotate within the inclined cylinder 7 is a perforated screw conveyer 18, which extends throughout the entire length of said cylinder. This may be mounted and driven in any suitable manner, and it is perforated for the purpose of allowing the water to flow through the conveyer blades during its passage downwardly from the top to the bottom of the cylinder.

Located directly above the top of the vertical cylinder 6 is a shredder or disintegrating apparatus indicated at 19, and consisting preferably of a cylinder with projections for grating, operating in connection with a concave, although other forms of grater may be substituted. This grater discharges directly into the top of the vertical leg.

In operation the disintegrated mass from the shredder drops directly into the open end of the cylinder and passes downwardly in the same until it reaches the screw conveyer in the inclined cylinder by which it is carried up and forced therefrom through the open upper end into any suitable discharging device. During the same time currents of water are allowed to flow into the apparatus from the water pipes 13 and 14, the direction of flow of the water being in an opposite direction to that in which the beets travel; and the sugar is diffused and extracted by this flow of the water through the mass, the juice overflowing at the top through the perforated metal 15 and thence out through the discharge pipe 17. The cylinders are heated during this operation by means of steam introduced into the jacket 9. Inasmuch as the beets are shredded into very small particles the water has access to all parts thereof and thus makes a very complete extraction, and also a more rapid extraction, than when the mass consists of slices or cossettes.

Different temperatures are maintained in the several sections of the steam jacket, at different stages of the process. The temperature of the exhaust pulp should be as low as practicable, say about 25° C., so as to avoid loss of heat in the waste product, while the temperature at the end where the juice is discharged, that is the top of the vertical cylinder, should be approximately 60° to 80° C. The intermediate portion of the apparatus should be at a temperature intermediate these. The practically continuous steam jacket along the full length of the cylinders is desirable for supplying the requisite heat, but does not require the high temperature which would be necessary if the jacket were used on merely a small part of the diffusion vessel, since there would then be a danger of locally overheating in order to maintain the mass in the whole vessel at the desired temperature. It is expected that the steam jacket as described will furnish sufficient heating surface on account of being supplemented by preheating the water entering at inlet 13. Besides, with the beets in a fine state of division, this process will not require the high temperature of approximately 80° C. now generally used in diffusion batteries, and a lower temperature is in practice much to be preferred. I thus avoid the necessity of removing the juice from the diffusion vessels and passing it through tubular heaters as is now done in all beet sugar factories, and as it is proposed to do in the process described in the Schwartz Patent No. 802,331, and in other known processes, which removal of the juice is objectionable on account of the cost and for other reasons.

The diffusion apparatus now in use requires a greater heating surface and does not admit of heating the water materially before it enters the apparatus because with the slices used it is not practicable to have two inlets for water at different temperatures and at the same time get a complete extraction of the sugar. If with present apparatus the water were heated and introduced into the apparatus at the point where the pulp is discharged there would be much loss of heat, and if introduced cold the apparatus would have to be too long for practical purposes.

By my process I avoid piping to take the juice outside of the cylinder, the process is simplified, and the operation and result are more uniform; and by heating the water introduced at the bottom of the vertical cylinder waste of heat in the discharged pulp is avoided.

The water entering through the pipe 13, at the bottom of the apparatus, is preferably heated before entering the apparatus, thus supplementing the heating effect provided by the jackets. The water entering the upper inlet 14 is cold, and percolates through the pulp as the pulp passes up the inclined cylinder, thus taking up the heat contained in the pulp and at the same time extracting any remaining sugar. The perforated screw conveyer allows this flow, without the necessity for any sieves or by-passes in the inclined cylinder, which are objectionable because of the danger of clogging and for other reasons.

If desired or necessary a stirring device 20 may be located in the vertical cylinder, to assist in accomplishing a uniform extraction.

I am aware that it has been proposed to pulverize and treat the beets or cossettes after extracting nearly all the sugar and not before, but for obvious reasons this is inferior to the process described herein, since the latter avoids the necessity for the costly and unsatisfactory slicing of the beets preliminary to the diffusion.

As the result of disintegrating the beets

and treating the pulp in the manner indicated it is possible to greatly shorten the time required for extracting the sugar, and it is possible to obtain a complete extraction of the sugar in a simpler and shorter diffusion battery, and also enables the treatment to be made continuous instead of intermittent, and also more economical than that in any other apparatus known to me. The apparatus described is simpler and less costly than those heretofore proposed. Furthermore, with a fine pulp, it is unnecessary to heat the mass to as high a temperature as with the coarse slices.

The apparatus may be adjusted, in order to obtain the required density of juice without any automatic circulating devices, by varying the amount of water being delivered to the apparatus, the rate at which the beets are delivered to the apparatus and the rate at which the screw removes the exhausted mass; but when once adjusted to a proper working condition very little modification of the adjustment will be required.

What I claim as new is:—

1. In a diffusion apparatus, the combination of means for disintegrating the material to a condition of pulp, an elongated chamber into which the disintegrated material is delivered, means for forcing the material in one direction through said chamber, means for heating said chamber to different degrees at different portions of substantially its entire length, and means for flowing water through the material in said chamber in the opposite direction.

2. In a diffusion apparatus, the combination of an elongated chamber having a vertical leg and an inclined leg communicating at their lower ends, means in the inclined leg for conveying material through said chamber, an inlet pipe for heated water near the bottom of the vertical leg, another inlet for water near the top of the inclined leg, and an outlet for juice at the top of the vertical leg.

3. In a diffusion apparatus, the combination of an elongated chamber through which the material passes in one direction, a heating jacket surrounding said chamber along substantially its whole length, said jacket being divided into several sections whereby different degrees of heat may be applied to different sections of the chamber, and means for causing a flow of water through said chamber in the opposite direction.

4. In a diffusion apparatus, the combination of an elongated chamber having two legs joined at the bottom and extending upwardly therefrom at an angle to each other, a conveyer in one of said legs for conveying material upwardly therein to a discharge outlet at the top of said leg, a water inlet pipe at the bottom of said chamber, near the junction of the two legs, a water inlet pipe at the top of said leg near the said outlet, and an outlet for juice at the top of the other leg.

5. In a diffusion apparatus, the combination of an elongated chamber having two legs joined at the bottom and extending upwardly therefrom at an angle to each other, one of said legs being of the same diameter throughout, a screw conveyer with a perforated blade fitting closely in said one of said legs, a steam jacket inclosing both of said legs throughout substantially their entire length, a water inlet pipe at the top of the leg having the conveyer therein, and an outlet for juice at the top of the other leg.

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

JOHN STEWART.

Witnesses:
H. L. McCLEERY,
ROBERT STEWART.