No. 780,819. PATENTED JAN. 24, 1905.

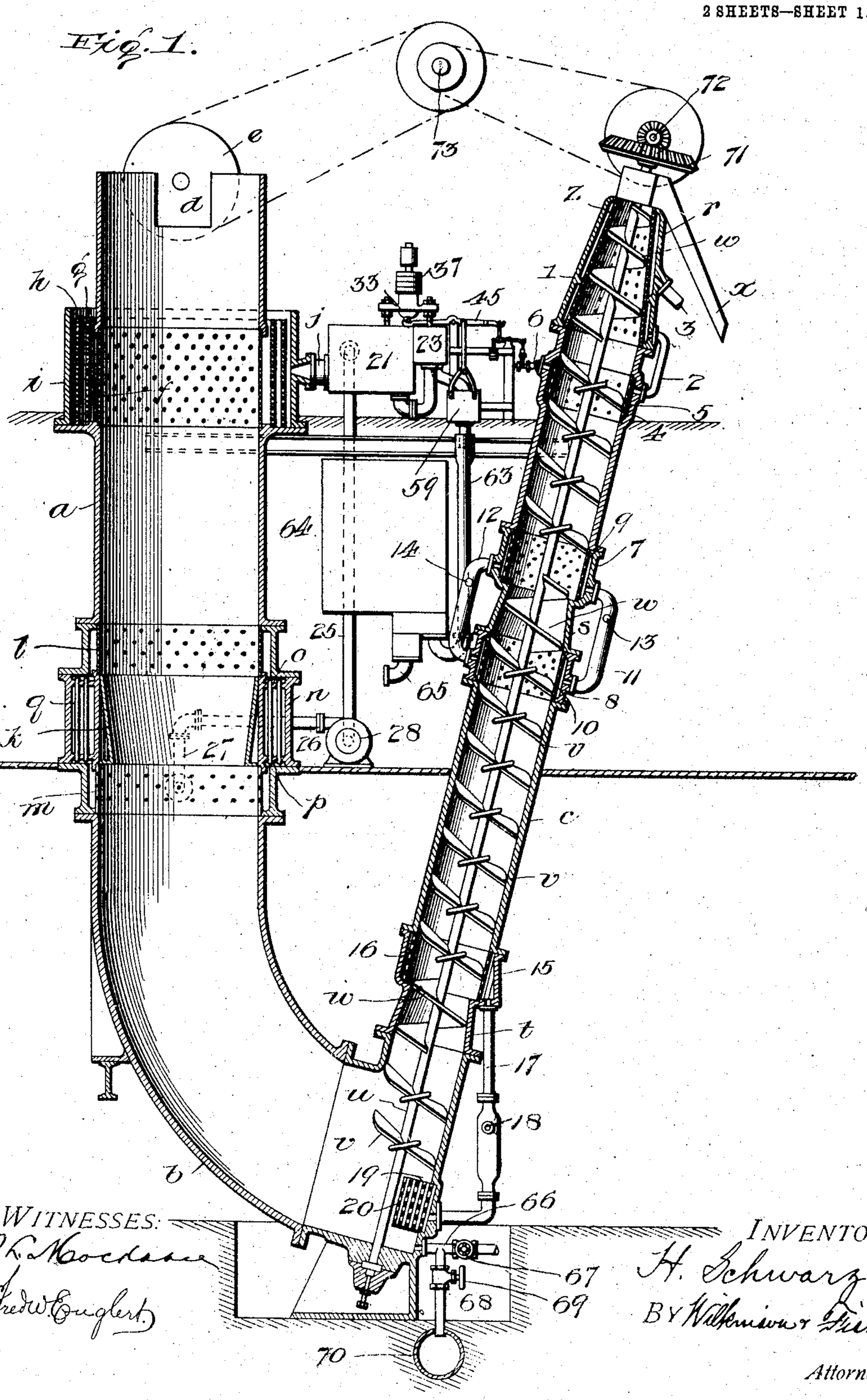
H. SCHWARZ.

DIFFUSION APPARATUS.

APPLICATION FILED MAR. 25, 1904.

2 SHEETS—SHEET 1.

Fig. 1.



WITNESSES:
J. L. Woodward
Fred W. Englert.

INVENTOR
H. Schwarz.
BY Wilkinson & Fisher.
Attorneys.

No. 780,819. PATENTED JAN. 24, 1905.

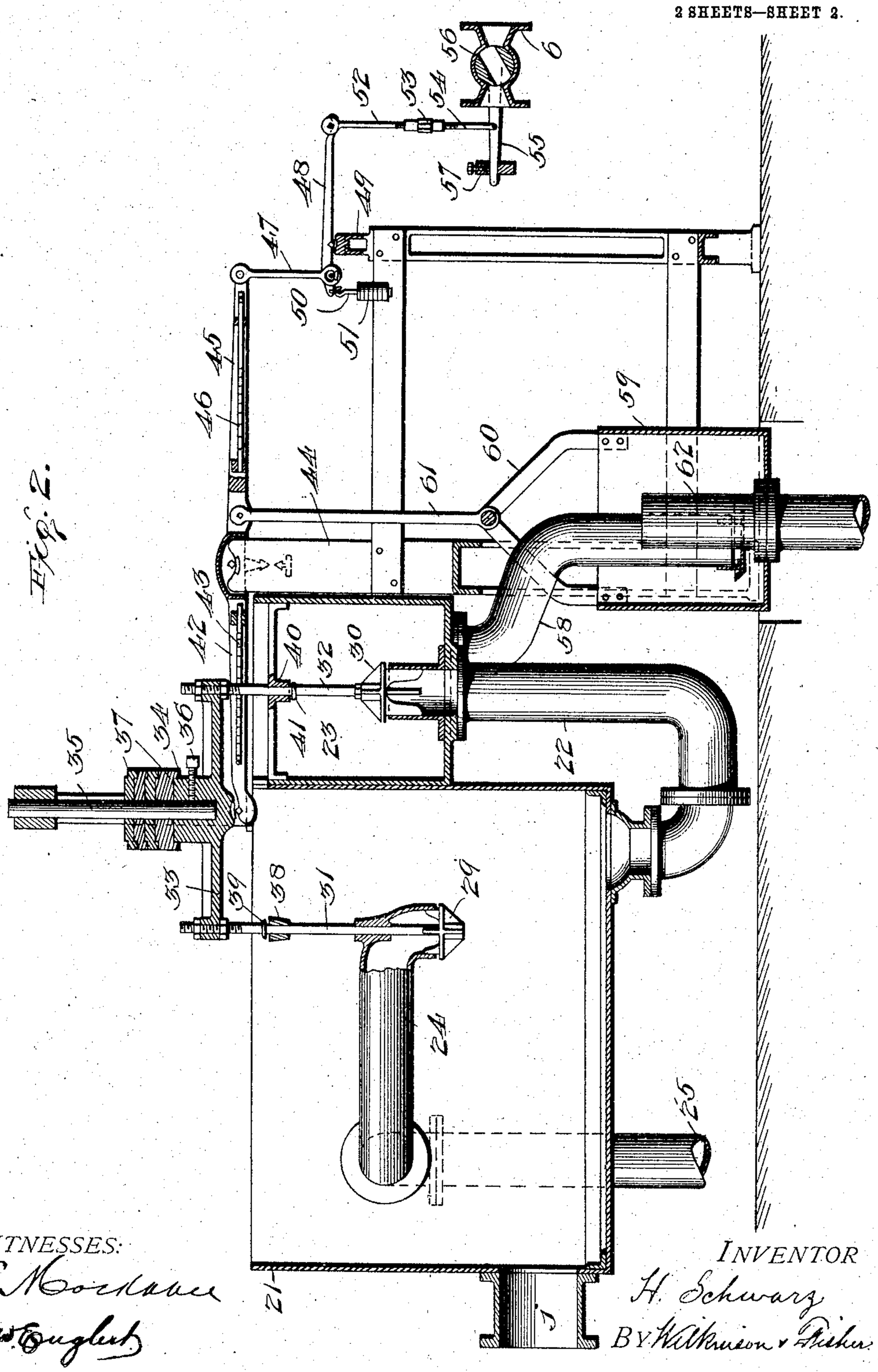
H. SCHWARZ.

DIFFUSION APPARATUS.

APPLICATION FILED MAR. 25, 1904.

2 SHEETS—SHEET 2.

Fig. 2.



WITNESSES:

J. K. Mockabee

Fred'k Engelbrecht

INVENTOR

H. Schwarz

BY Wilkinson & Fisher

Attorneys.

No. 780,819. Patented January 24, 1905.

UNITED STATES PATENT OFFICE.

HENRY SCHWARZ, OF LONGMONT, COLORADO.

DIFFUSION APPARATUS.

SPECIFICATION forming part of Letters Patent No. 780,819, dated January 24, 1905.

Application filed March 25, 1904. Serial No. 200,047.

To all whom it may concern:

Be it known that I, HENRY SCHWARZ, a citizen of the United States, residing at Longmont, in the county of Boulder and State of Colorado, have invented certain new and useful Improvements in Diffusion Apparatus; and I do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same.

My invention relates to an improvement in diffusion apparatus, and is designed especially for use in extracting sugar from beets, although it is not confined to such use.

The object of my invention is to quickly and automatically extract the juice from sugar-containing substances and to produce a diffusion apparatus simple in structure and effective in operation and which after being once set will act automatically.

With these objects in view my invention consists in the process and the construction and combinations of parts, as hereinafter described and claimed.

In the accompanying drawings, Figure 1 is a longitudinal vertical section, partly in elevation, of my improved apparatus; and Fig. 2 is a cross-section of a part of the same.

a represents a vertically-arranged cylinder supported in any desired way. The lower end of this cylinder is curved, as shown at *b*, and communicates with the lower end of another smaller cylinder *c*, which is arranged at an angle thereto, as shown. The upper part of the cylinder or tube *a* is open and acts as a hopper, into which the beets are delivered through an opening *d*. *e* represents the pulley which drives the slicer, and one or more slicers may be used for each cylinder.

Near the top of the cylinder *a* are a series of screens *f*, *g* and *h*, varying in mesh for the purpose of thoroughly separating the juice from the solid matter. These are contained within a cylindrical portion *i*, which surrounds the portion *a* and is of larger diameter. The cylinder *i* is communicative by means of a pipe *j* with the juice-tank.

The cylinder *a*, near its center, is provided with an inverted conical portion *k*, which serves to slightly pack the sliced beets together. Above and below the conical portions *k* are screens *l* and *m*, and between these screens and outside the conical portion *k* is a chamber formed by a part of the cylinder *a*, a casing *n*, parallel thereto, and cross-casings *o* and *p* connecting them. Within this chamber steam or other material for heating the fluid may be forced through pipes by connections. (Not shown.) A series of tubes *q* pass through the casings *o* and *p* and serve to conduct the juice mingled with water from the space outside of the screen *m* to the space outside of the screen *l*. This construction affords a means for allowing the circulation of water around the sliced beets when, as said before, they are slightly packed together in the inverted conical portion *k*.

The cylinder *c* is provided at its discharge end with a tapering conical portion *r*. Near the middle is a shorter tapering conical porsion *s*, and a third one, *t*, is located near the bottom. Through the cylinder *c* runs the shaft *u*, which is provided with conveyer-flights *v*. Within the portions *r*, *s*, and *t* instead of the conveyer-flights screw conveyers *w* are mounted for the purpose of positively forcing the sliced beets upward through the cylinder *c*.

x represents a discharge-trough for the sliced beets after they have been subjected to the operation of diffusion, and this trough may either lead to a waste heap or to a press, if desired.

My apparatus is designed to extract practically all of the juice from the sliced beets in a single operation and to deliver them from the top of the cylinder *c* in a substantially dry condition; but if necessary they may be passed through another diffusion apparatus or be subjected to the action of a pulp-press. The conical portion *r* is provided with an internal screen *z* parallel thereto, by means of which as the beets are forced upwardly to the discharge end of the cylinder *c* the juice is allowed to run out through the screen *z* into the space between said screen and the tapering portion *r*. Braces 1 are preferably used between the screen *z* and the tapering portion *r* to prevent the screen from buckling. Nearly all of the juice is expressed from the sliced beets by the

time they are passed through the lower portion of the screen *z*, and a tube 2 is provided to conduct back said juice into the cylinder *c*. An additional tube 3, however, is provided to carry off the few remaining drops that pass through the upper part of the screen *z*, which tube delivers into any suitable receptacle. The tube 2 at its lower end enters an enlargement 4 of the cylinder, which is provided with an internal circular screen 5. The water passes downward through the tube 2, through the screen 5, and down through the cylinder *c*. Water in regulated quantities is admitted through the pipe 6 at one side of the screen, preferably opposite the pipe 2. The water and the juice pass downward through the cylinder *c* and upward through the cylinder *a*, following the line of least resistance. The packing of the sliced beets in the conical portion *r* prevents the water from passing upward, and this downward motion through the cylinder *c* and upward through the cylinder *a* is assisted by the injectors, which will hereinafter be referred to.

Just above and below the conical portion *s* are enlargements 7 and 8, within and parallel to which are the screens 9 and 10. Pipes 11 and 12 passing around the conical portion *s* connect these enlargements and afford a passage for the juice around the conical portion *s*, where of course the sliced beets are somewhat packed together. Connected with each of these pipes is an injector, and the points where the injectors enter the pipes are shown at 13 and 14, respectively. Just above the conical portion *t* is an enlargement 15, within which is the circular screen 16. Connected with the space between the screen 16 and the enlargement 15 is a pipe 17, which affords a passage for the juice down into the lower part of the cylinder *c*, where it joins the lower part of the cylinder *a*. Connected to this pipe 17 is an injector, the point of entrance of said injector into said pipe being indicated at 18. Surrounding the pipe 17 at the point where it discharges into the lower part of the cylinder *c* is a shield 19, provided with a screen 20, which prevents the sliced beets from clogging up the pipe 17.

The juice passing through the pipe *j* enters the circulating-tank 21 through the pipe *j*, and thence it passes through the overflow-pipe 22 into the overflow-tank 23. In some instances, however, the whole or a part of said juice may pass outwardly from the tank 21 into the pipe 24, and thence through the pipes 25, 26, and 27 back into the central part of the cylinder *a*, this circulation being caused by a centrifugal pump located between the pipes 25 and 26 and indicated in the drawings at 28.

The pipe 24 may be closed by the valve 29 and the overflow-pipe 22 may be closed by the valve 30. These valves are connected by valve-rods 31 and 32 to a cross-piece 33, so that they move simultaneously. In a hollow projection 34, centrally located in the cross-piece 33, is the rod or shaft 35, which is fastened by a screw 36. Weights 37 are adapted to fit over the top of the projection 33 and are kept in place by the rod or shaft 35. Of course the number of weights may be varied as desired. The valves 29 and 30 are so related to each other that when one is fully closed the other is open.

The valve-rod 31 passes through a brace 38, fastened to the sides of the tank 21, and is also provided with a collar 39, which limits the downward movement of said rod. The valve-rod 32 passes through a similar brace 40, attached to the sides of the tank 23, and said rod is provided with a collar 41, which limits its upward movement. As the rods are rigidly connected to the cross-piece 33 at right angles thereto, the upward and downward movement of these valves is limited by the collars 39 and 41.

The cross-piece 33 is centrally mounted on a knife-edge bearing on one arm 42 of a scale-beam, which arm is provided with graduations 43. This scale-beam is mounted on a knife-edge bearing on the upright scale-support 44. The other arm, 45, of this scale-beam is provided with graduations 46 and has attached to its outer end a rod 47, and a lever 48 is suspended on a knife-edge bearing on the lower end of the arm 47, which is mounted on a knife-edge bearing on the outer end of the scale-arm 45. The lever 48 is mounted on a knife-edge bearing on a support 49, and to one end of the lever 48 is attached a hook-support 50, on which weights 51 are removably placed. On the opposite end of the lever 48, on a knife-edge bearing, is pivoted a vertical screw-threaded rod 52, which is connected by a turnbuckle 53 with a screw-rod 54, which is pivotally attached to an arm 55, which operates a valve 56, located in the pipe 6, which delivers water into the cylinder *c*. The upward movement of the arm 55 is limited by the stop 57.

Connected to the bottom of the tank 23 is the pipe 58, which delivers into the scale-tank 59, which is supported by a bail 60, pivotally connected to a rod 61, which is mounted on a knife-edge bearing on the scale-arm 45 and which of course moves up and down with the movement of said scale-arm. The scale-tank 59 has projecting into it and fastened to the bottom thereof an overflow-pipe 62, from which the juice overflowing through the pipe 62 passes into the pipe 63, the pipe 62 telescoping into the upper part of the pipe 63, as shown in Fig. 1. The pipe 63 connects with the lower part of the measuring-tank 64, from whence the juice, after it is measured, passes through the pipe 65 into the carbon filter. Automatic means (not shown) are provided in

the measuring-tank for emptying the same when a certain quantity of juice has accumulated in the measuring-tank.

The parts are so adjusted, and more especially the weights 37 and 51, that the scale-arm 45 will move down only when the juice has reached the desired point of concentration. Until that point has been reached the valve 30 will be practically closed and the valve 29 open and the fluid kept circulating through the tank 21 down through the connecting-pipes and pump and upwardly through the upper part of the cylinder *a*. When, however, the juice becomes heavy enough to depress the scale-tank 59, it will be delivered into the measuring-tanks and thence to the refining apparatus. This part of the apparatus therefore works automatically.

Connected to the lower part of the cylinder *a* are means for cleaning the apparatus, (shown in Fig. 1,) consisting of a pipe 66, which is connected to a pump and is provided with a valve 67 and a pipe 68, provided with a valve 69, which is connected to a sewer or other discharge pipe 70. In cleaning the apparatus the sliced beets are completely discharged from the tube or cylinder *c*, the valve in the water-inlet pipe 6 is closed, the valve 67 opened, and the juice is drawn out through the pipe 66 by the pump. After this the valve 67 is closed and the valve 69 opened, and the whole apparatus is cleansed by passing water therethrough, which runs into the sewer.

The shaft *u* is driven by a bevel gear-wheel 71, which meshes with a similar gear-wheel on the shaft 72, which is driven by a belt running from the driving-shaft 73, which also drives the slicers.

The operation is as follows: The apparatus is filled with water up to the conical portion *k* in the cylinder *a*. This water is heated by means of the injectors connected to the pipes 12, 13, and 17. The sliced beets are then delivered into the cylinder *a* until they have reached the level of the pipe *j*. The shaft *u* is then set in motion, and as soon as the sliced beets reach the cone portion *s* the water is turned on through the pipe 6, the valve-arm 55 being connected to the arm 52 by means of the turnbuckle 53 and rod 54. At the same time the injectors connected to the pipes 11, 12, and 17 are started, and steam or other heating means is delivered into the space around the pipes *q*, and the centrifugal pump 28 is started in operation. After this the operation is continuous and automatic, as has already been described in connection with the several parts.

While I have thus described my invention, I wish it to be distinctly understood that I do not limit myself to the exact means shown and described, as these might be varied greatly and still be within the scope of my invention.

I claim—

1. In a diffusion apparatus, the combination of means for forcing the material under treatment upward against the action of gravity, means for repeatedly and intermittingly subjecting said material pressure during its upward passage, and connections whereby a stream of water is caused to flow through and around said material in the opposite direction to the travel of said material, substantially as described.

2. In a diffusion apparatus, the combination of a substantially cylindrical tube terminating in a conical discharge portion, conveying means in said tube, said conveying means being in the form of a solid conveyer in said discharge portion and having intermediate parts adapted to compress the material under treatment, and connections for supplying water to said cylindrical tube below said tapering discharge portion, whereby the water is caused to move in the opposite direction to the movement of the material under treatment, substantially as described.

3. In a diffusion apparatus, the combination of a substantially cylindrical tube provided with a conical discharge portion and with intermediate conical portions, a conveyer-shaft in said tube, conveying-flights on said shafts, and solid conveyer portions on said shaft inside of said conical portions, means for supplying water to said tube below the tapering discharge portion thereof, and connections whereby said water is caused to flow through and around the material under treatment in a direction opposite to the travel thereof, substantially as described.

4. In a diffusion apparatus, the combination of a substantially cylindrical tube arranged in a nearly upright position, said tube being provided with a conical discharge portion and with intermedite portions, a conveyer-shaft in said tube, conveyer-flights on said shaft, and solid conveyers on said shaft within said conical portions, internal screens in said tube, means for supplying water to said tube behind one of said screens and below the conical discharge portion of said tube, connections running from said tube from above to below the intermediate conical portions, whereby the liquid is permitted to flow around said conical portions in a direction opposite to the travel of the material under treatment, said screens being so located as to prevent the material under treatment from entering said connections, substantially as described.

5. In a diffusion apparatus, the combination of a substantially cylindrical tube arranged nearly in a vertical plane, said tube being provided with a conical discharge portion and with intermediate conical portions, a screen arranged in said conical discharge portion, screens arranged above and below said intermediate conical portions, said tube being provided with enlargements for the reception of said screens, means for supplying water to said tube just below the conical discharge

portion thereof, connections passing around said intermediate conical portions and located behind said screens, whereby said liquid is caused to travel in a direction opposite to that taken by the material under treatment, a conveyer-shaft in said tube, conveyer-flights on said shaft, and a solid conveyer on said shaft located in each of the conical portions of said tube, substantially as described.

6. In a diffusion apparatus, the combination of a vertically-arranged diffusion-cylinder, into the upper end of which the material under treatment is delivered, a reduced portion in said cylinder for the purpose of causing the material under treatment to pack slightly, said cylinder being enlarged above and below said reduced portion, screens above and below said reduced portion, partitions forming a heating-compartment in proximity to said reduced portions, and conducting-tubes passing through said heating-compartment whereby the liquid is permitted to pass around the packed material through said screens, substantially as described.

7. In a diffusion apparatus, the combination of an open-ended vertically-arranged diffusion-cylinder, provided near its center with means for causing the material under treatment to pack slightly, screens and passages arranged above and below said reduced portion to permit the liquid to pass around said material at the point where it becomes packed, a screen arranged near the top of said cylinder or tube to permit the juice to flow out and be separated from the material under treatment, a casing around said screen, a juice-tank connected with said casing, and means for causing the juice to circulate through the parts mentioned above until it has acquired the required density, substantially as described.

8. In a diffusion apparatus, the combination of a vertically-arranged open-ended cylinder through which the material under treatment is adapted to pass by gravity, means for causing the material under treatment to pack slightly during a portion of its descent, means for allowing the liquid to pass around said packed material, a second tube substantially cylindrical and arranged nearly vertically, said tubes being connected together at their lower ends, means in said second tube for causing the material under treatment to pass upward through said tube and be discharged therefrom and subjecting said material in its passage to pressure, and connections whereby a stream of water is caused to pass down through said second-named tube and up through said first-named tube in a direction opposite to the direction of travel of said material, substantially as described.

9. In a diffusion apparatus, the combination of means for causing the material under treatment to travel in one direction, and means for causing a stream of water to travel in the opposite direction, thereby extracting the juice from said material, connections for drawing off the juice-laden water after it has passed through said apparatus, and means for automatically returning said juice-laden water into said apparatus until it has acquired the required density, substantially as described.

10. In a diffusion apparatus, the combination of means for causing the comminuted material to travel in one direction, means for subjecting said material under pressure at intervals during its travel, means for causing a stream of water to travel through and around said material in the opposite direction, thereby extracting the juice, means for drawing off the juice-laden water, means for automatically returning said juice-laden water into said apparatus until it has acquired the required density, and means for automatically delivering said juice-laden water out of said apparatus as soon as it has acquired the required density, substantially as described.

11. In a diffusion apparatus, the combination of means for causing the material under treatment to travel in one direction, means for causing a stream of water to travel through and around said material in the opposite direction, means for withdrawing the juice-laden water from said apparatus, means for automatically testing said juice-laden water, and for delivering it when up to a certain test to another apparatus for further treatment, substantially as described.

12. In a diffusion apparatus, the combination of means for causing the comminuted material under treatment to travel in one direction, means for causing a stream of water to travel through and around said material in the opposite direction, means for withdrawing said juice-laden water from said apparatus, means for weighing said juice-laden water to see if it has acquired the required density, means for measuring the juice-laden water when it has acquired the required density, and connections for delivering said water out of the apparatus, substantially as described.

13. In a diffusion apparatus, the combination of means for causing the material under treatment to travel in one direction, means for causing a stream of water to pass through and around said material in the opposite direction, thereby extracting the juice, means for heating said water, means for withdrawing said juice-laden water from said apparatus, means for returning said juice-laden water into said apparatus, and means for delivering said juice-laden water out of said diffusion apparatus for further treatment when said water has acquired the required density, said last two means acting alternately, substantially as described.

14. In a diffusion apparatus, means for causing the material under treatment to travel in one direction, means for causing hot water to pass through and around said material in the opposite direction, thereby extracting the

juice, connections for withdrawing the juice-laden water from said apparatus, means for returning said juice-laden water into said apparatus if it is of too low a density, means for testing the density of said juice and simultaneously cutting off the flow of water into said apparatus when the juice-laden water has reached the required density, means for delivering the juice-laden water when it has reached the required density into a measuring-tank, said means operating automatically to cut off the return flow of the juice-laden water into the apparatus, substantially as described.

15. In a diffusion apparatus, the combination of means for causing the material under treatment to travel in one direction, means for causing a stream of water to pass through and around said material in the opposite direction, a juice-tank, an overflow-tank, a scale-tank, a scale-beam to which said scale-tank is attached, connections between said juice-tank and the apparatus, and valves in said juice-tank and overflow-tank, said valves being so connected that when the scale-tank moves the scale when the juice has acquired the requisite density, the flow of juice-laden water from the juice-tank is cut off from the main apparatus and permitted to flow through the scale-tank, substantially as described.

16. In a diffusion apparatus, the combination of means for causing the material under treatment to travel in one direction, means for causing a stream of hot water to travel through and around said material in the opposite direction, thereby extracting the juice, a juice-tank, an overflow-tank, a scale-tank, a scale-arm to which said scale-tank is connected, means for cutting off the flow of water into the apparatus, said means being connected to said scale, connections between said juice-tank and the main part of the apparatus, valves in said juice-tank and said overflow-tank connected in operation and operated by one arm of said scale, said parts being so arranged that the return flow of the juice into the main apparatus is cut off and the juice allowed to flow through the scale-tank as soon as it has acquired the requisite density, and a measuring-tank, substantially as described.

17. In a diffusion apparatus, the combination of a juice-tank, an overflow-tank, a scale, a scale-tank connected to said scale, valves in said juice-tank and overflow-tank, so arranged that when one is open the other is closed, a cross-piece connecting said valves, said cross-piece being mounted directly upon one of the arms of said scale, substantially as described.

18. In a diffusion apparatus, the combination of connections for supplying water to said apparatus, means for admitting or cutting off the water in said connections, a scale which operates said means, a scale-tank connected to said scale, an overflow-tank, a juice-tank, oppositely-arranged connected valves located in said juice-tank and said overflow-tank, said valves being supported by one of the arms of said scales, substantially as described.

19. In a diffusion apparatus, the combination of a driving-shaft, a slicer operated thereby, a vertically-arranged diffusion tube or cylinder into which said slicer delivers, discharge-screens for the juice arranged near the upper end of said cylinder, a casing surrounding said screens, an inverted conical casing located about the center of said diffusion-cylinder to cause the material under treatment to pack slightly, screens arranged above and below said conical portion, thereby allowing the liquid to pass around said conical portion, a second smaller tube arranged in a nearly vertical position connected at its lower end to the lower end of the first-named tube, said second-named tube being provided with a conical discharge portion, a screen in said conical portion, intermediate conical portions, screens arranged above and below said intermediate conical portions, a conveyer-shaft in said second-named tube, conveyer-flights on said shaft, solid conveyers on said shaft located in said conical portions, means for revolving said shaft, a pipe for supplying water to said tube below said conical discharge portion, connections passing around said intermediate conical portions, injectors in said connections, a juice-tank connected with the upper part of said first-named tube or cylinder, connections between said juice-tank and said first-named cylinder below said conical portion, a pump in said connections, an overflow-tank, a scale-tank, a measuring-tank connected with said scale-tank, a scale supporting said scale-tank, oppositely-arranged valves in said juice-tank and said overflow-tank, a weighted cross-piece connecting said valves, said cross-piece being directly mounted on one of said scale-arms, a valve located in the connection which supplies water to the smaller tube, and means for operating said valve connected to said scale-arm on the same side thereof to which said scale-tank is connected, substantially as described.

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

HENRY SCHWARZ.

Witnesses:
JOHNNY GIRARD,
J. F. PFEIFFER.