No. 664,465. Patented Dec. 25, 1900.

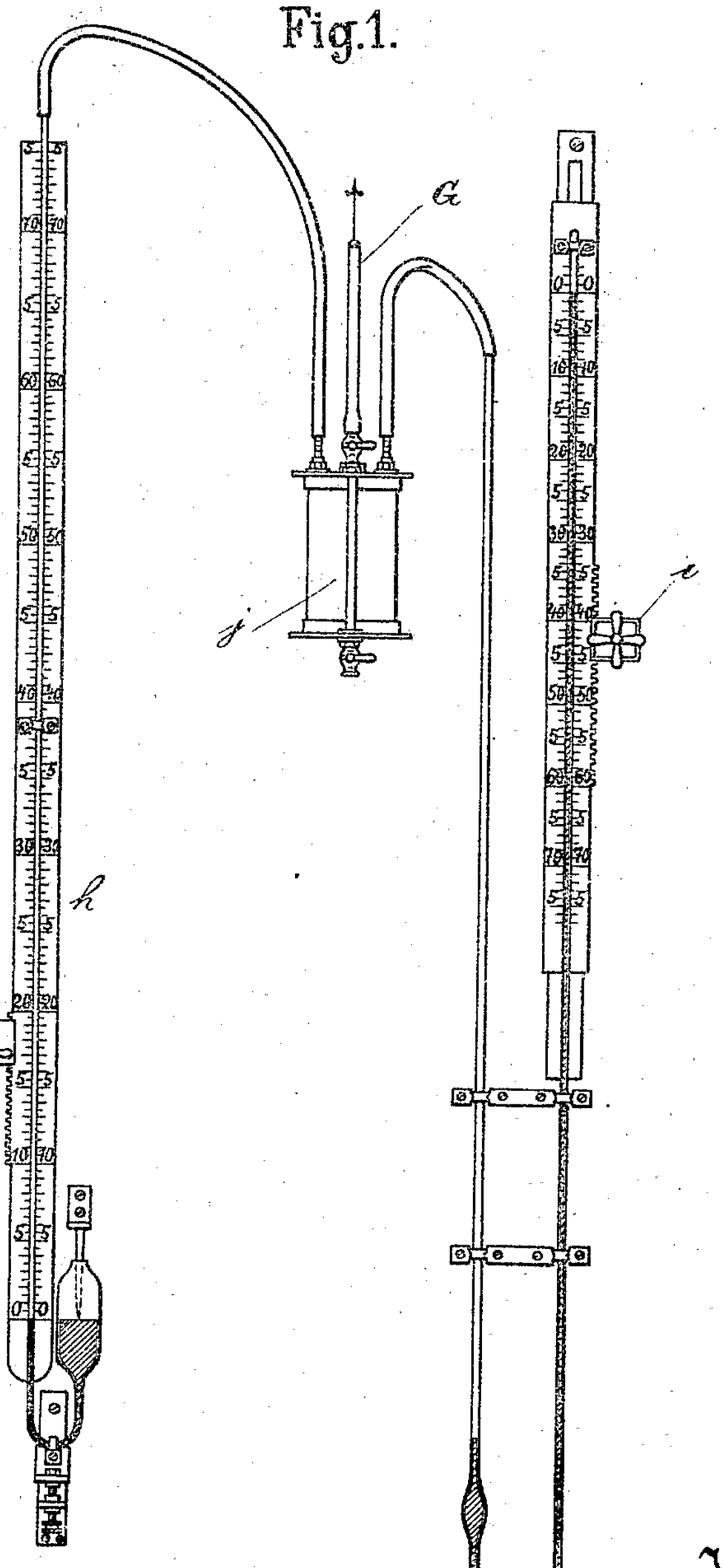
H. CLAASSEN.

PROCESS OF CRYSTALLIZING SUGAR.

(Application filed Jan. 4, 1900.)

(No Model.) 3 Sheets—Sheet 1.

Fig.1.



Witnesses
W. Parker
Chas. W. Parker

Inventor
H. Claassen,
By
Briesen & Knauth
his Attorneys

No. 664,465. Patented Dec. 25, 1900.

H. CLAASSEN.

PROCESS OF CRYSTALLIZING SUGAR.

(Application filed Jan. 4, 1900.)

(No Model.) 3 Sheets—Sheet 2.

Fig. 2.

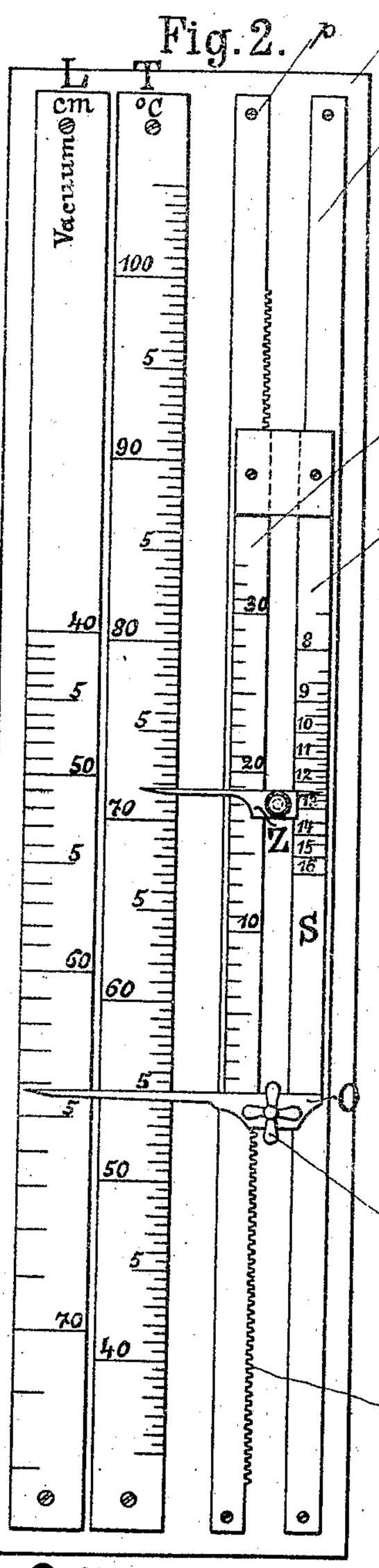


Fig. 3a.

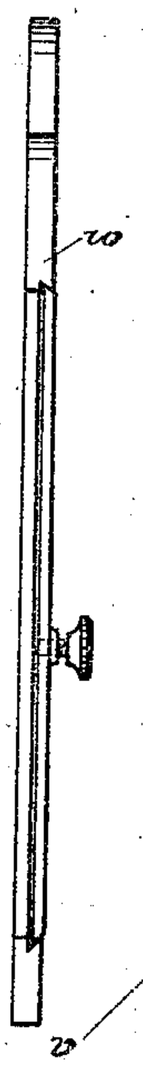
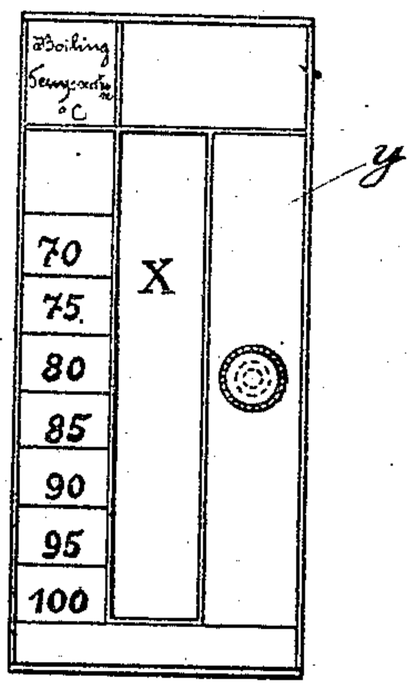


Fig. 3.

Table for boiling the run off syrup to grain. Percentage of Water of the Syrups while boiling.

Boiling Temperatur	Coefficient of Purity of the Syrups at grain forming Stage. 80	75	70	Percentage while boiling lowering down to 1st Stage	2d Stage	3d Stage	While boiling to finish.
	a	b	c	d	e	f	g
70	17,3	15,2	13,2	12,5	12,0	11,5	11,0
75	16,4	14,5	12,5	12,0	11,5	11,0	10,5
80	15,6	13,8	11,9	11,5	11,0	10,5	10,0
85	14,7	13,0	11,2	11,0	10,5	10,0	9,3
90	13,8	12,2	10,5	10,3	10,0	9,5	8,7
95	12,9	11,4	9,7	9,5	9,0	8,5	8,1
100	—	—	—	—	—	—	7,7

Fig. 4.



Witnesses
H. C. Fairhall
Chas. W. Parker

Inventor
H. Claassen
By Briesen & Knauth
his Attorneys

No. 664,465. Patented Dec. 25, 1900.

H. CLAASSEN

PROCESS OF CRYSTALLIZING SUGAR.

(Application filed Jan. 4, 1900.)

(No Model.)

3 Sheets—Sheet 3.

Fig.5.

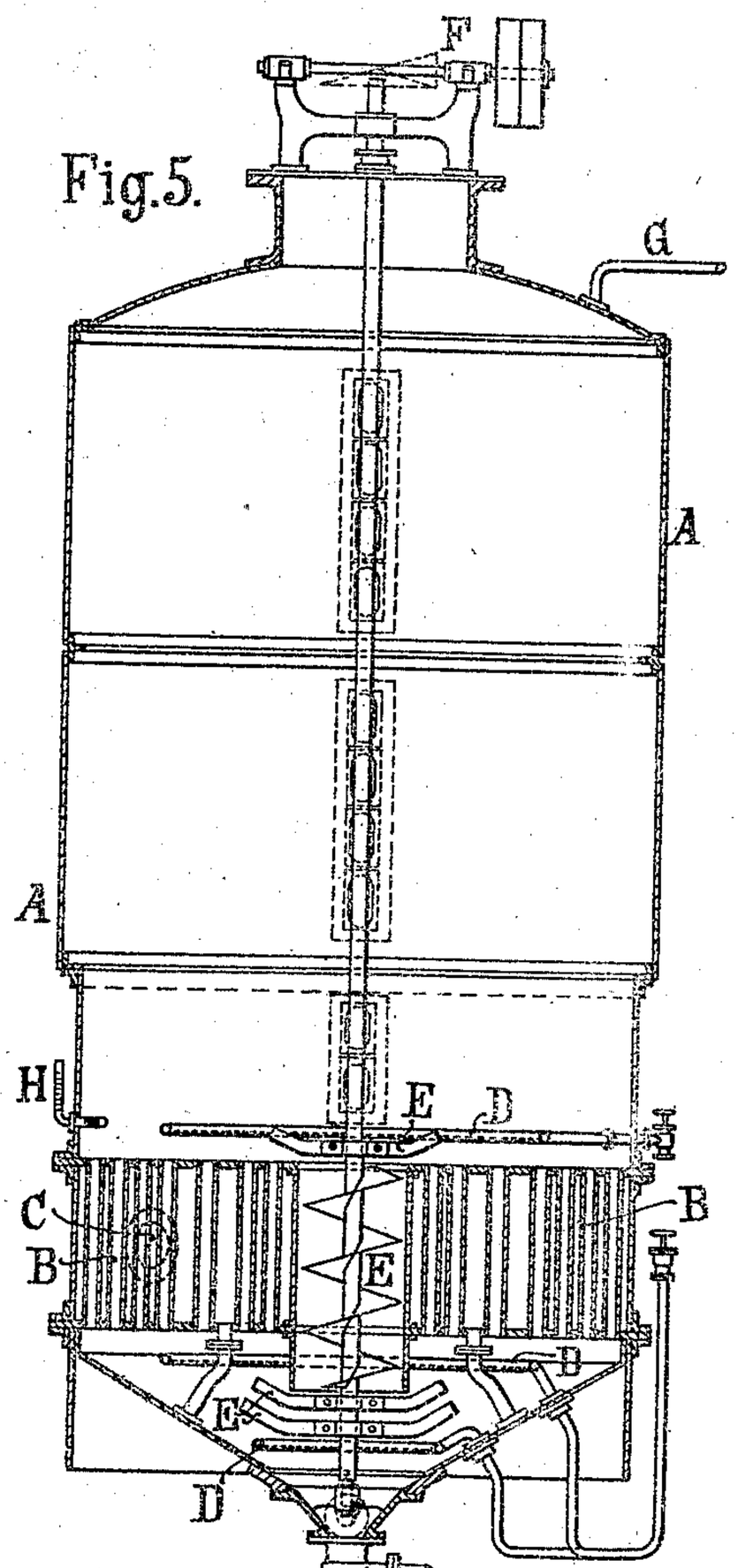
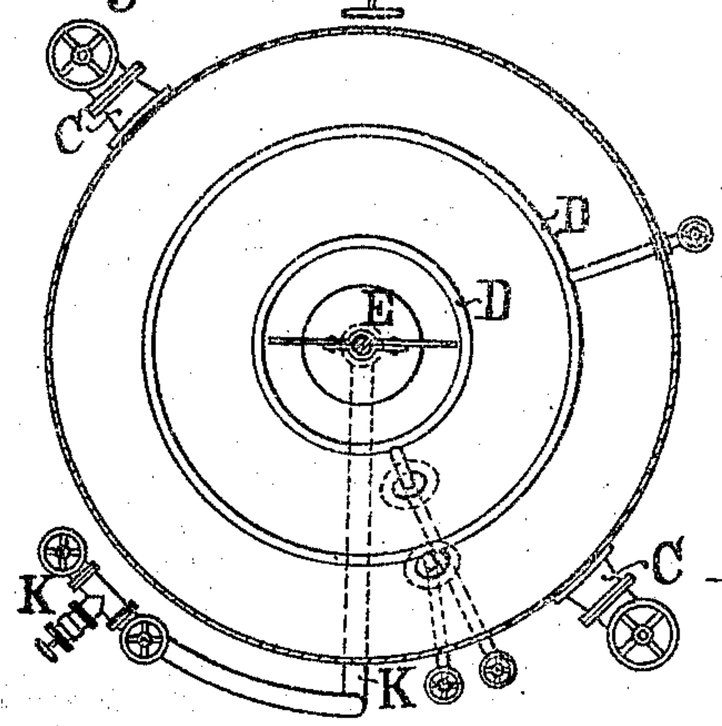


Fig.6.



Witnesses
W. Faehol.
Chas. W. Parker.

Inventor
H. Claassen
By
Briesen & Knauth
his Attorneys

UNITED STATES PATENT OFFICE.

HERMANN CLAASSEN, OF DORMAGEN, GERMANY.

PROCESS OF CRYSTALLIZING SUGAR.

SPECIFICATION forming part of Letters Patent No. 664,465, dated December 25, 1900.

Application filed January 4, 1900. Serial No. 301. (No specimens.)

To all whom it may concern:

Be it known that I, HERMANN CLAASSEN, a subject of the King of Prussia, German Emperor, and a resident of Dormagen, Rhenish Prussia, German Empire, have invented a new and useful Improvement in Processes for Producing Sugar in Crystal Form from Syrups, of which the following is a specification.

In crystallizing sugar out of syrups under *vacuo* it is quite difficult to constantly maintain those conditions which are necessary for a good and perfect correct working. These conditions are essentially the following ones: first, maintaining a suitable percentage of water in the mass necessary for an efficient crystallization out of the mass and a predetermined superconcentration of the liquid mass according to the purity of the liquid; second, maintaining a temperature in the liquid mass corresponding to the vacuum and the concentration, and, third, a suitable period of time for treating the liquid masses under distinct temperatures, distinct percentage of water, as well as distinct superconcentration. For keeping up or maintaining these conditions the operator had no other means at his disposal but the empiric string proof or trial by which the percentage of water could be approximately controlled or proved. However, this string proof or trial is seriously influenced by the quality of the non-sugar substances in the mass and by the viscosity of said substances, so that said proof or trial will never render a satisfactory or reliable result. Besides such empiric means there was made use of the thermometer for indicating the temperature and the vacuum-meter for indicating the stand of the *vacuo*. Other means have not been known for ascertaining and maintaining the above-named conditions and to conduct or to carry through the boiling process in a perfect distinct manner, and therefore the operator was not in the position to carry through the treatment of the syrups and the production of the greatest quantity of sugar possible out of such syrup in a correct manner. By the process of the present invention the object in view will be arrived at.

In order to keep up the temperature of the syrup in the vacuum-pan for a period of some length at the necessary height in accordance with the percentage of water in the liquid and with the vacuum without causing an evaporation of the mass, the direct introduction of steam into the liquid has proved to be the most suitable and best means. As the steam is subjected to the action of the vacuum in the liquid it will again pass as steam out of the syrup and will introduce into the latter that number of calories only which it had at its introduction into the syrup according to the temperature in the vacuum. Therefore while the percentage of water in the syrup is kept up at a certain standard the temperature of the syrup will be kept up at the desired uniform height. If now crystals have been formed out of the syrup, which latter by means of indirect heating-steam and subsequent water evaporation has been superconcentrated, or if sugar in any form whatever has been introduced into the syrup, the operator in further filling up the vacuum-pan with syrup to be crystallized out and in boiling the same has to reduce gradually the percentage of water in accordance with the separating out of sugar, and according to such reduction of the contents of water a change of the temperature in boiling must follow. These two conditions—temperature and contents of water—may be controlled and established with safety by means of the apparatus herein described. With the help of that apparatus the operator is enabled to keep up the suitable temperature and the percentage of water, suitable for the crystallizing process, while using the above-named introduction of direct steam into the liquid and in making use of the crystallization in motion, the latter being necessary. It is a fact that the syrup while the sugar separates out of it decreases in purity. By this decreasing in purity of the syrup its viscosity increases. Means for increasing the temperature is applicable only up to a certain degree, according to the vacuum. Therefore for reducing the viscosity, which prevents crystallization, the superconcentration, highly desirable otherwise, must be reduced, as the latter is of greatest influence upon the viscosity. Therefore it must be observed during the continuing filling up of the vacuum-pan with the syrup to reduce with the decreasing purity, which is a matter of consequence of the working operation, also the superconcentration of the heated syrup. In

working thus the operator is enabled to desaccharize the syrup up to a standard of purity which is a little above that of ordinary molasses. In order to obtain the last particles of sugar capable of gaining, I recommend to subject the heated mass to a subsequent crystallization in motion in special crystallizing apparatuses. Also at this stage with the cooling that takes place the objectionable viscosity takes place, and to reduce the same the only means will be to reduce the superconcentration of the mother-lye out of which crystallization takes place. Notwithstanding having reduced the percentage of water in the syrup during the working operation in the vacuum-pan for crystallizing-out purposes, now, contrary to good sense, as it may appear, an addition of water to the mass out of which crystallization takes place serves as a promoter for separating out the sugar, for the high viscosity will hinder the separation of sugar and its union with present crystals to a greater extent than such separation will be promoted by a strong superconcentration of the mother-syrup. By the addition of water the viscosity is reduced in a much higher degree than in proportion the superconcentration is reduced. It may be proceeded with this addition of water suitably to such a degree that finally in the centrifuging process the overconcentration is nearly done away with.

Instead of adding water a diluted molasses may be employed for the same purpose.

In the accompanying drawings I have shown an apparatus for carrying out my invention.

In the drawings, Figure 1 indicates a double vacuum-gage. Fig. 2 represents the calculating-scale; Fig. 3, a table containing information concerning the percentage of water of the syrups while boiling at different stages. Fig. 3ª is a side view thereof with the indicating-slide thereon. Fig. 4 is a face view of the indicating-slide. Fig. 5 is a vertical section of the vacuum-pan, and Fig. 6 is a horizontal section thereof.

In the drawings, Fig. 1 shows a double vacuum-gage consisting of two gages *h i*, communicating with the vessel *j*, which communicates by a tube G with the vacuum-pan. The vacuum-gages are adjustable for calibration by adjusting means *h' i'*, so that the vacuum-gages can be adjusted in accordance with the prevailing atmospheric pressure. As before stated, the double vacuum-gage communicates with the vacuum-pan, which consists of an outer shell A and a heating apparatus B, consisting of a chamber traversed by vertical pipes by which the liquid in the lower and upper part of the pan may circulate. The pipe C is for the purpose of introducing indirect or heating steam into the heating apparatus B. D represents pipes placed, preferably, above and below the heating apparatus B for introducing direct steam into the vacuum-pan. In some cases one pipe D will be sufficient. E is the stirring device, rotated by the gearing F. H indicates the thermometer, and J the pipe for drawing off the finished masse-cuite, and K is the pipe for drawing in the syrup, which pipe for the purpose of clearness of illustration is shown only in Fig. 6 and terminates, preferably, under the heating apparatus B. The process is carried out in the vacuum-pan, as hereinafter described, the structure shown in Fig. 1 being employed to give the air-pressure in the vacuum-pan.

The structures shown in Figs. 2, 3, 3ª, and 4 are employed to aid the sugar-boiler in carrying out the process and enable him to maintain a proper degree of superconcentration at every stage of the process. In Fig. 2 are shown a base *k*, provided with a plurality of scales L T. The scale L indicates centimeter of vacuum, and the scale T indicates temperatures at which water will boil at such vacuum, the two scales being so correlated with each other that a single index may be employed coöperating with both scales, the vacuum indicated by the index corresponding with the temperature indicated thereby, so that by setting the index at any point in the vacuum-scale the boiling-point of water at that vacuum will be indicated on the temperature-scale. I have also shown a double scale S, which slides freely upon rails *o p*, being movable thereon by pinion or handle *q*. The pinion, which is not shown, meshes with the rack *r* on the side of the rail *p*. The double scale S consists of a temperature-scale *t*, which indicates degrees of temperature, the divisions on the scale *t* corresponding in size with the divisions on the scale T, the numerals on the scale *t* indicating temperatures which the boiling syrup has in excess of the boiling-point of water at the same *vacuo*. The other scale *u* of the double sliding scale S shows the percentage of water contained by the syrups if the raising of boiling-point is equal to the exact opposite degrees on scale *t*. The sliding scale S is provided with an indicator O, stationary with respect to the said scale when the apparatus is in use. This indicator coöperates with the vacuum-scale and the temperature-scale T. The sliding scale S is provided with a sliding indicator Z, which coöperates with the scales *t*, *u*, and T. In Figs. 3 and 3ª I have shown a table in which the percentage of water contained in the liquid treated is given at several stages of the operation. In the columns *a b c* the percentage of water of various other stages of the operation are given. This table consists of an undercut or mortised board *w*, in which a slide *y* slides. This slide *y* is provided with a temperature-scale and with an aperture X, so that the said slide may be moved along the table for a convenient reference to avoid the possibility of mistake. In using this calculating device the double scale is moved until the indicator O points to that place on the vacuum-scale which corresponds to the figure indicated by the vacuum-meter. Thereupon

the boiling-table is consulted, and the movable indicator is adjusted to that point on the scale *u* which corresponds to the percentage of water desired, whereupon the boiling is effected at the temperature on the scale T indicated by Z. It will thus be seen that the sugar-boiler has at hand the means for directing the boiling of syrups or juices with the greatest exactness. It will also be observed that this apparatus enables me to calculate the percentage of water of the juice or syrup at any temperature and pressure.

The method of working according to the foregoing-described process is a very simple one, and for thorough understanding the following example will be quoted: Let us take the purity of the syrup to be boiled at seventy-five and the vacuum in the boiling-pan to be a standard one of sixty centimeters. The boiling-pan is then filled up to a certain height with syrup, and the latter is boiled down for such a period until it indicates, according to the table of the boiling-control apparatus, a contents of water of thirteen and three-fourths—that is to say, until the thermometer of the boiling apparatus will indicate a temperature of 80° centigrade. Now the valves of the indirect heating apparatus are almost entirely closed, and the valve for the direct steam for regulating the temperature is opened for such a period until the necessary quantity of fine crystals in the samples taken become visible, which usually will be the case within half an hour. Thereupon the valves of the indirect heating are reopened and syrup is slowly and gradually drawn in, while the concentration of the mass is regulated according to the table, so that, for instance, within the first four hours the contents of water will sink down gradually to eleven and one-half per cent., in the next four hours to eleven per cent., and within the last four hours down to ten and one-fourth per cent., which means to say that with a standard vacuum of sixty centimeters the temperature of the boiling mass will raise to $81\frac{1}{2}$° centigrade and to $82\frac{1}{2}$° centigrade and to $83\frac{1}{2}$° centigrade. After twelve hours the vacuum-pan will be almost entirely filled, and now boiling down begins, into which pan molasses or water may be drawn in periodically, the percentage of water sinking down to nine and one-half per cent., the temperature rising consequently to 85° centigrade. If the vacuum is not a constant one—say sixty centimeters—the control is not rendered difficult by it, as in such case the fixed indicator has to be directed only to the vacuum indicated by the vacuum-meter, whereupon the movable indicator of the slide, permanently fixed for the period in question, will immediately indicate the necessary temperature which the boiling mass must have on scale T. During this manipulation in the vacuum the mass is kept in motion by the agitator or stirrer. The masse-cuite thus obtained may be subjected to an after crystallization at rest or more suitably to a crystallization in motion in special apparatuses. With the crystallizing process in motion a longer period of agitation and a suitable high temperature should be kept up corresponding to the higher overconcentration of the mother-syrups. However, with the gradual cooling down and with the increase in impurity the above-named deleterious effect of the viscosity will occur, which, as stated above, is now exclusively or entirely annihilated by the dilution of the mass. Water in such quantity is admitted, either continually or periodically, into the mass in motion that the viscosity becomes reduced. The quantity of addition of water is limited thereby that it can be added only to such an extent that to the highest the entire superconcentration of the mother-syrup is obviated, as with the addition of water a dissolving of the already-separated sugar may take place. Of course instead of pure water diluted molasses may be made use of.

I claim—

1. In the operation of crystallizing out syrups, the process which consists in subjecting the mass alternately at each desired stage of the operation to the action of indirect heating-steam for creating a desired superconcentration of the syrup and of direct steam introduced into the mass for maintaining the mass at a temperature corresponding to the *vacuo* for the time being, maintaining all the while a superconcentration of the syrup.

2. In the operation of the crystallizing out of syrup, the process which consists in alternately acting upon the mass with indirect heating-steam for creating the desired superconcentration of the syrup and with direct steam introduced into the mass for maintaining the temperature corresponding to the *vacuo* for the time being, while maintaining the superconcentration of the syrup and the continued crystallizing out of the so-obtained mass by reducing its viscosity by the addition of a diluent.

3. The process of producing sugar from syrup, consisting in concentrating the first-drawn-in syrup according to the purity of the latter by boiling with indirect steam, stopping the indirect steam when the desired concentration has been obtained and replacing such indirect heating-steam by introducing steam direct into the mass for maintaining the temperature in the latter according to the *vacuo* for the time being while concentration remains unaltered, until formation of grain takes place, stopping the introducing of direct introduced steam, drawing in further syrup and continuing the alternate employment of indirect heating-steam for creating the desired concentration for the stage present and of direct-introduced steam for maintaining the temperature without alteration of the concentration, the mass being all the while stirred by mechanical means and con-

tinuing the treatment of the so-obtained masse-cuite for further crystallization by reducing its viscosity by the addition of a diluent corresponding to the decrease of temperature, and gaining the so-produced sugar by separating the same from the mother-liquid.

In testimony that I claim the foregoing as my invention I have signed my name, in presence of two witnesses, this 19th day of December, 1899.

HERMANN CLAASSEN.

Witnesses:

WILLIAM ESSENWEIN,

EMIL HOETTE.