October 18, 1913.

DRAWING

6,219

A careful search has been made this day for the original drawing or a photolithographic copy of the same, for the purpose of reproducing the said drawing to form a part of this book, but at this time nothing can be found from which a reproduction can be made.

Finis D. Morris,

Chief of Division E.

AWK

UNITED STATES PATENT OFFICE.

JNO. SPANGENBERG, OF JEFFERSON PARISH, LOUISIANA.

CLARIFICATION OF CANE-JUICE.

Specification of Letters Patent No. 6,219, dated March 27, 1849; Antedated September 27, 1848.

To all whom it may concern:

Be it known that I, JOHN SPANGENBERG, of the parish of Jefferson and State of Louisiana, have invented a new and useful combination and arrangement of apparatus for applying the waste or other steam of the engine to the clarification of cane-juice, which is described as follows, reference being had to the annexed drawings of the same making part of this specification.

Figure 1, is a plan of the apparatus. Fig. 2, is a longitudinal elevation of the apparatus. Fig. 3, is an elevation of the end of the apparatus.

Similar letters in the different figures refer to like parts.

In the ordinary mode of making sugar on a plantation after the juice is extracted from the cane by the mill it is run into three wooden boxes, or receivers, each containing one "grand" of juice equal to 350 gallons, or thereabout. From these boxes it is run into the grand, which is the term used among planters for the largest kettle in the range; this grand is sometimes also called the clarifying copper. On some sugar estates they have the head of the range and next the grand two or three clarifiers, worked or operated upon by the same fire that is used for the other kettles, or by steam passing through closed pipes, or bottoms, without perforations or holes. The great objection and difficulty in this plan is the imperfect clarification obtained for the following reasons: The small number of juice boxes or clarifiers are insufficient to allow the physical impurities of the juice to precipitate, or subside, on account of the short time it remains in them. The juice from the boxes is passed into the grand in a cold and impure state, often cracking the kettle by the contact, or difference of temperature, and rendering the operation of clarifying the juice very difficult; this difficulty is increased from the inconvenience of arranging the flues under the grands so that they may be brought to the boiling point at the proper time as they generally boil too fast or too slow. In either case the defecation is imperfect, not giving time to skim the kettle, or otherwise retarding the clarification too long for the other kettles which must be supplied from time to time with clarified juice, as otherwise the quality of the sugar will be inferior.

The nature of my invention and the great advantage it has over the old methods is as follows:

In the first place it consists in having a greater number of juice boxes, or otherwise, a number of boxes containing a greater quantity of juice, so that the juice may have more time to deposit its impurities and extraneous matter. Secondly, that by thus having the juice clarified, or its impurities deposited in the several boxes before it is drawn into the grand, the operation of making the sugar is commenced in the kettles with a hot clarified juice which in several respects is a great improvement upon the old plan, first, because the liquid is more pure, and secondly because the granulation of the sugar is advanced and made more easy and perfect. These are advantages and improvements long desired and sought for by sugar makers; thirdly I use the escaped steam for clarifying (although the steam direct from the boiler may be used). In this way there is great economy as to fuel for the steam in the boiler which is used for the grinding of the cane is not at all diminished, that force is kept up untouched and of course no additional fuel is required for the generating of other steam for clarifying and hence the saving.

The escape steam by the peculiar arrangement of my apparatus is amply sufficient and rapid to purify the juice in good time for the boiling kettles, and in no other way by escape steam can this great object be obtained. In my plan by jetting or forcing the whole steam through many perforations in the steam pipes the whole amount of heat is imparted to the juice in the shortest possible time, whereas false bottoms or closed pipes without perforations will not answer the purpose because they can not by the waste steam be made to boil the juice soon enough to supply the kettles.

It is a well known fact among sugar makers that a sufficient pressure can not be obtained from the escape or waste steam operating upon closed pipes or false bottoms, to generate heat enough for the work without producing a reaction, or what is termed backlash of the engine. This retards its working and in a greater or lesser degree effects its power of grinding the cane. The two operations can not go on together effectually; if you resort to the waste steam in the old plan to heat the syrup rapidly enough to supply the kettles with juice then

the cane grinding is diminished in proportion as the escape steam is under pressure, or as the safety valve of the escape is loaded. Besides this much of the latent and other heat from the escape steam is dissipated or lost in its passage through the closed pipes and is let off with the condensed water. Another important advantage in this plan of ejecting the steam into the juice over the ordinary, or any known way, is, that the injecting or perforated clarifiers can be allowed to boil any length of time, the longer the better, my experience having proved that by keeping the steam on them a long time a more perfect purification is obtained and more or less of the coloring matter and mucilaginous impurities of the juice are destroyed. By the old method of clarifying the moment you pass the boiling point of 212 degrees of Fahrenheit the juice begins to concentrate and becomes turbid, boiling the dirt with it and making it impossible properly to purify it in the after process in the kettles.

After repeated trials and experiments I have discovered that by throwing steam into cane juice for the purpose of clarifying it according to my plan and apparatus the juice does not require any extraordinary evaporation in consequence of the condensation of the steam into it as has always heretofore been believed from the theory, that by elevating the temperature from the freezing to the boiling point by the injection of the steam into water it increases the bulk or volume of the liquid by about one sixth of its volume. The reason why an extraordinary evaporation of the juice is not necessary, is that I begin to heat at a temperature of about 60 degrees of Fahrenheit and go up to 212; the great amount of condensation taking place between 32 and 60 degrees but as the juice in my process before the steam is applied is already about 60 degrees in consequence of the heat it acquired while the cane was passing through the mill independent of the climate. The small quantity of "condensed water" thrown into the cane juice by my perforated or jetting or injecting clarifiers, may be accounted for by the fact that the cane in passing through the mill is subjected to an immense pressure which causes the juice to be heated more or less and this elevation of temperature is apparent from the test that it never weighs as much by the saccharometer when first extracted as it does sometime afterwards which may be readily accounted for by the difference in temperature as just stated; as juice or syrup is always heavier by about three degrees in a cold than it is in a heated state.

The temperature of the juice when first expressed by the mill is almost or near sixty degrees Fahrenheit and as I apply the steam the moment the juice is run from the mill into the juice boxes or immediately after the pipes or perforated jets on the bottom of the juice boxes are covered, the condensation of the steam is comparatively little to what it would have been if it had started from a much lower degree of temperature say 32 degrees of Fahrenheit. In a few minutes after the application of the waste or other steam—the temperature of the juice is raised to say 80 degrees Fahrenheit at which point it commences to produce vapor or begins vaporizing and continues to do so as the heat of the liquid increases until it arrives at the boiling point or as long as the steam is thrown into it which evaporation is about equal to the condensation of the steam into the juice, taking into account more or less of the evaporation which is continually going on in the boxes until the juice is drawn off into the "grand." After a box or clarifier of juice has been brought to the boiling point by the jetting of steam into it the volume or quantity of juice is more or less expanded; which expansion has heretofore been attributed to the addition of "condensed water," or "condensed steam," so termed by attendants upon steam engines. This, however, I have discovered to be not so from the following facts and experiments. I have filled a juice box to the depth of twelve inches with syrup or juice at a temperature of 60 degrees of Fahrenheit and brought it to the boiling point by jetting in the steam until it expanded to fourteen inches. I allowed it to cool again to 60 degrees when it contracted or receded to the original depth of twelve inches. Again I have weighed the juice by Baumé's saccharometer at a temperature of sixty degrees of Fahrenheit when its density or weight was eight degrees then brought it to the boiling point by the steam jets—afterwards allowed it to cool down to sixty degrees Fahrenheit, and upon weighing it again found it was of the original density of eight degrees of Baumé's proving thereby that it had not absorbed or taken up any water.

Another great advantage and not the least among the most important to sugar makers is; that by concentrating this clarified juice in the kettles more sugar is made in the same, or any given time, than is made or can be made in the old or any known method. This fact proves that the evaporation is about equal to the condensation.

Another great utility in this invention is that besides the saving of fuel and the other improvements, is the proposed mode of purifying the syrup will enable the sugar maker to dispense in a great degree with the use of lime or any other chemical agent so that the saccharine property will not be diminished by the use of any alkalies or calcareous substances.

Another advantage and improvement in

my invention is that by my perforated or injecting tubes I increase the application of waste steam while I diminish the ordinary number of pipes, one set of my perforated pipes will boil in a given or equal time more juice than a much larger number of closed pipes of the same diameter. Indeed I may say that with one set of my perforated pipes I will heat more juice in twenty minutes than can be heated in the same time by almost any number of closed pipes.

Description.—A the escape pipe of the engine made and arranged in the usual manner. B the heater, also made in the usual manner. C C′ butterfly valves to let the steam on and off the clarifiers. D cock to try the quantity of water in the heater. E main pipe leading transversely from the escape pipe to the cross pipe F. F main cross pipe placed over the ends of the boxes or clarifiers inclining a few degrees toward the discharging cock K to let off the condensed steam. G small perforated steam pipes, with rows of holes on each side, placed in the juice boxes or clarifiers on the bottom thereof to let the steam issue in contact with the cane juice. H are branch pipes connecting the pipes G in the boxes to the cocks I on the cross pipe F. I cocks to let the steam on and off the clarifiers. J flanches for connecting the sections of the pipes. K small cock to let off the condensed steam in the main cross pipes. This cock is inserted into the lower end of the cross pipe F, and may be left partly open. L safety valve arranged at the upper end of the cross pipe F.

The apparatus made sufficiently strong of copper can be used for high steam direct from the boilers.

The blowers or pipes G for jetting the steam directly into the juice or fluid may be used in conjunction with the common worm, false bottom, or other pipes, or pans, using high steam from the boiler or waste steam passing through pipes without holes or false bottoms. These perforated pipes G may be of the form of the letter H, or as represented at G in the several vats, or boxes, 1, 2, 3, 4, 5, 6, 7, 8.

Operation: The operation is described as follows. The vats are filled to within 3 inches of the top with cane juice let on from the mill in the usual manner, and whilst being let on and when the perforated pipes G are covered about one inch in depth, the steam is then let on by opening the butterfly valve C′ in the pipe E and at the same time closing the valve C in pipe A. The steam is continued to be admitted until the juice is sufficiently clarified, when it is again shut off by turning the butterfly valve and the juice allowed to remain in the vats until it shall have precipitated its impurities. It is then let into the "grand" in a clarified and proper state for evaporation. By my method the use of lime in a great degree is rendered unnecessary; still a suitable quantity of it may be added to the juice whilst in the vats—or whilst in the "grand"—to assist in making a more perfect defecation and cleaning of the sirups.

Another most important improvement in my apparatus is the contracting or diminishing in size the pipes H H^2 and G the former to 2 or 3 inches and the latter from one to two inches diameter and the main pipes E and F being from 4 to 6 inches in diameter, or otherwise all the pipes may vary from the above dimensions, but must be made in the proportions above stated the cross pipe H^2 connecting the perforated pipes G in the juice boxes should have no perforations and have a swell *h* in the middle diminished in diameter from the said swell to their union with the perforated pipes which are to be from 1 to 2 inches diameter or otherwise be large enough to admit the volume of steam from the pipe H to the jetting tubes G. The diminishing or contracting of the pipes as above stated is absolutely necessary in order to have a sufficient pressure and heat to force the steam through the juice and speedily bring it to the boiling point: and also to make the apparatus practicable and useful. If the pipes were all large and of equal size the reaction or vacuum or concussion of the steam would cause a vibration; shaking and breaking the apparatus to pieces or otherwise injuring it; or if they were small and of equal sizes and not in proportion to the quantity of escape steam they would not do the work and continually waste the steam by blowing it off at the safety valve L on the end of the main cross pipe F or otherwise cause too great a pressure on the heater, retarding the engine.

The number of holes or jets in the pipes G in the juice boxes should be in proportion to the quantity of steam passing from the cylinder and through the pipes, allowing a free egress for the steam into the juice carrying from 4 to 6 pounds pressure to the square inch on the safety valve on the cross pipe F. The shape or form of the pipes in the juice boxes containing the perforated holes or jets may be made as in the drawing; or any other form to suit the fancy of the constructor.

The inside of the heater of the engine may be arranged in various ways, but having a worm to pass the water from the pumps to the boiler and at the same time heat it by the surrounding steam as it escapes from the cylinder and afterward used for the clarification of the cane juice is I believe the best method.

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

The direct application of steam by injec-

tion to the sugar cane juice, whilst in the vats and before being transferred to the "Grand" for the purpose of speedily heating, clarifying, defecating, purifying and freeing the juice of the feculent and other extraneous, injurious and impure matter, as herein fully set forth.

In testimony whereof I have hereunto signed my name this 13th day of February before two subscribing witnesses.

J. SPANGENBERG.

Witnesses:

A. E. H. JOHNSON,

W. FENWICK.